Air Toxics and Odor Measurement Within Camden, NJ and a Demonstration of Emission Rate Determination Using OP-FTIR and Path-averaged Summa Canisters at the Camden WWTF

FINAL REPORT

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1.0 INTRODUCTION

NJDEP has been interested in wastewater treatment facilities as sources for emissions of air toxic compounds. NJDEP was also interested in further defining the air quality for the southern industrialized areas in the city of Camden. This pilot study was conducted as part of NJDEP efforts to obtain information concerning the sources of air toxic compounds in the Camden general area, to supplement neighborhood "bucket brigade" sampling recently instituted in the area, and to demonstrate the use open-path Fourier transform infrared technology [OP-FTIR] to obtain air toxic emission rates from localized area sources. A major potential source in the project area is the Camden County wastewater treatment facility [WWTF], which includes many area sources requiring specialized sampling to determine emission potential. Use of OP-FTIR for air emissions assessment was suggested from recent results of a former study conducted at the Joint Meeting WWTF. Further evaluation of that technique for air toxics measurement and emission rate assessment was incorporated for the present study. NJDEP and local community issues related to odor control and odorous compound sampling caused the initially designed program to be altered to include some additional air samples for these types of components.

The following were the objectives of this study:

1. Determine WWTF area sources compound identification and relative concentrations by applying point and path averaged coated Summa canister data collection for identified area sources at the facility as well as for upwind backgrounds for this facility in a preliminary sampling.

2. Provide a database identifying and quantifying air toxic compounds for the highest emitting WWTF sources consisting of both OP-FTIR data and Summa canister data.

3. Demonstrate the emission rate determination process for the suspected highest emitting area source using OP-FTIR and supplementary Summa canister data.

4. Assess the feasibility of extending emission rate determination to other WWTF area sources and other area sources that NJDEP may have an interest in.

5. Check community impacts of odorous compounds and attempt to relate them to specific facility operations or areas.

This report addresses these objectives providing findings of a sampling program to gather data on potential sources of air toxics at the Camden Delaware 1 WWTF by collecting data for sources identified within the facility. One neighboring source was also sampled at the facility fence line. Because odor identification and control became an increasing concern for the community efforts carried out by NJDEP, this study was altered to include the collection of odorous compound data. In addition, a demonstration program using OP-FTIR technology in conjunction with some standard sampling methods was carried out at one selected area source to generate air toxic emission rate data for that source. VOC [hydrocarbon, oxygenated compounds, aromatics, and chlorinated compounds] as well as sulfur compounds were sampled for.

This report contains the following remaining sections; Section 2 provides background information, Section 3 provides a discussion of sampling methodologies used and sequence and details of the data collection, Section 4 provides a discussion of the results of the sampling effort, Section 5 discusses project QA/QC and results, Section 6 provides conclusions and recommendations, and Section 7 provides references cited. There are several appendices provided on a CD. Appendix A provides a date-sequenced digital photographic log of the sampling effort, Appendix B provides data collected during this study, Appendix C provides the QA results for the program and QA practices for the laboratory employed for Summa canister supply and analysis. A key is provided for locating the appropriate appendices and topics within the CDs.

2.0 BACKGROUND

The FTIR portion sampling program and emission rate determination demonstration was a follow up to a previous study, " *Evaluation of Hazardous Air Pollutant Emissions from Waste Water Facilities Using FTIR Remote Sensing*" [1]- **NJ DEP Project SR00-046**, conducted for NJDEP in July through December 2001. This study carried out at the Joint Meeting WWTF in Elizabeth, NJ demonstrated the capability of the OP-FTIR to

obtain air toxic concentration information from WWTF sources and indicated what sources within WWTF to target for air toxic emissions. Based on this study and others [2,3,4] the next logical step would be to extend the OP-FTIR capability, along with path-averaged Summa canister data to generate emission rate information for air toxic compound identified at WWTF sources.

Information concerning the potential sources of air toxic compounds in the Camden general area to supplement neighborhood "bucket brigade" sampling recently instituted in the area. A major potential source in the project area is the Camden County WWTF which includes many source areas requiring specialized sampling to determine emission potential. The use of Summa canisters with special coatings allowing for the sampling of aldehydes and reduced sulfur compounds in addition to normal TO-14/ TO-15 compounds was employed to help meet this air sampling need. Table 2-1 provides the designated list of target compounds identified for this study and their associated detection limits.

Table 2-1 VOC and Sulfur Target Compounds and Detection Limits

WWTF Potential Air Toxic Compounds	OP-FTIR WDL Range	Summa Canister MDL
	PPB	PPB
Chloroform	10 to 20	1
Hydrogen Sulfide	3000+	20
Chlorobenzene	10 to 20	1
Carbon Disulfide	40 to 70	20
Benzene	20 to 40	1
Ethylbenzene	40 to 70	1
1,4 Dichlorobenzene	8 to 16	1
Methylene Chloride	10 to 20	1
Methyl tert Butyl Ether	10 to 20	1
Cumene	20 to 30	1
1,1,1 Trichloroethane	1 to 7	1
Carbonyl Sulfide	20 to 40	20
Toluene	15 to 25	1
Carbon Tetrachloride	1 to 7	1
Perchloroethylene	2 to 8	1
Trichloroethylene	5 to 10	1
Ethylene Dichloride	20 to 50	1
Ethene	5 to 10	1
Formaldehyde	6 to 15	15
Isoprene	10 to 20	1
Dimethyldisulfide	30 to 60	20
Dimethylsulfide	30 to 60	20
Methyl mercaptan	70 to 150	20
Benzaldehyde	No reference	20
Acetaldehyde	40 to 70	15
Ammonia	6 to 12	NA
Xylenes	10 to 40	1

The issue of odor impacts in the community arose during the course of the program and modifications were made to the original study scope to address community concerns with odor sources at the WWTF and also other near by sources. The reduced sulfur species were collected and analyzed using techniques [as described in Section 3 of this document] reported to reduce typical detection limits and the tentatively identified compound [TIC] evaluations were enhanced to include more compounds. It was reported as possible to reduce detection limits for reduced sulfur compounds to 1 PPB or less using the reported enhancements.[5] However, odor thresholds are somewhat subjective and do vary by person. The following table 2-2 provides some threshold ranges for some odorous compounds.

Table 2-2 Threshold Odor Concentrations

Compound	Odor Threshold
Hydrogen Sulfide[3]	9.4 ppb
Ethyl butyrate[3]	15 ppb
Diethyl sulfide[3]	0.5 ppb - 100 ppb
Dimethyl sulfide[3]	0.1 - 10 ppb
Diallyl sulfide[2]	0.14 ppb
Dipropyl sulfide[2]	11 ppb
Dibutyl sulfide[2]	15 ppb
Ethyl butyrate[3]	15 ppb
Methyl butyrate[1]	3 ppb
Dimethyldisulfide[5]	0.29-158 ppb
Dimethyltrisulfide[5]	0.28-4.5 ppb
Methyl mercaptan [2]	2.1 ppb
Ethyl mercaptan[1]	0.26 ppb-2ppb
Propyl mercaptan[1,3]	0.7-1.6 ppb
Butyl mercaptan[3]	0.62 ppb

Source Listing for Table 2-2

1. K. Verscheuren, Handbook of Environmental Data on Organic Chemicals
2. U.S. EPA Odors Emitted from Raw and Digested Sewage Sludge (EPA-670/2-73-098)
3. NJ Dept.of Health Toxic and Hazardous Substance Data Sheet Database
4. 3 M Corporation OH & ESD Database
5. J.Zahn, et al. J. Env.Qual. 30: 624-634 (2001)

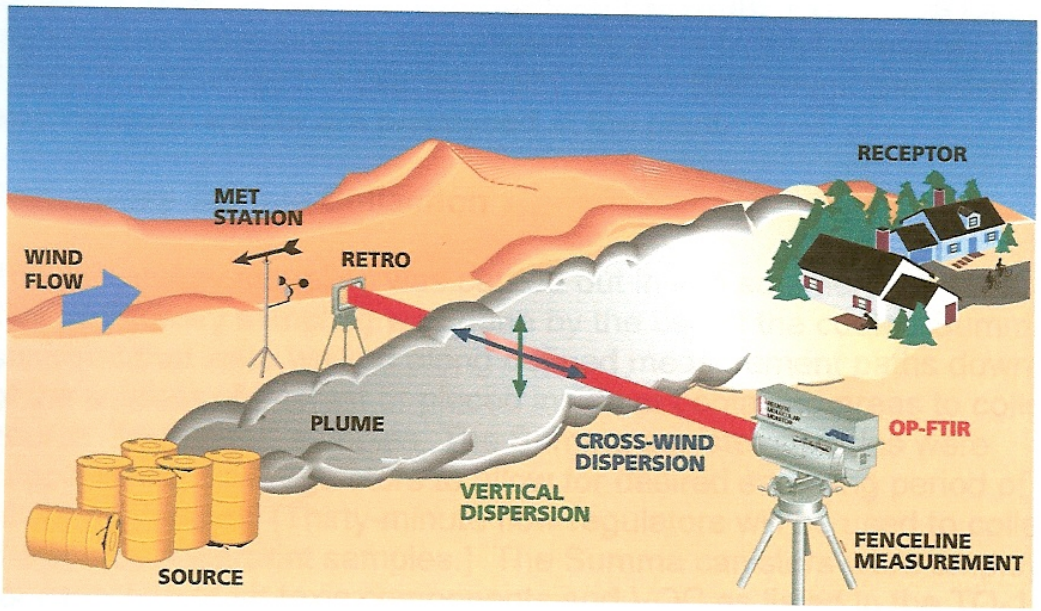
3.0 SAMPLING METHODOLOGIES AND DATA COLLECTION DETAILS

This report section provides descriptions of the technologies employed for the air sampling and for the sequence and details of the air sampling that was carried out.

Two basic technologies were employed for data collection; OP-FTIR and Summa canister. These technologies were supported by some localized meteorological data collection. Most data capture events were documented with digital photographs. These photo-records are found in Appendix A.

The OP-FTIR instrumentation was manufactured by Edo [formerly AIL Instruments]. The RAM 2000™ is a Remote Air Monitor (RAM) that identifies the presence of and measures the concentration of molecules in the atmosphere in real time. The measurement is made by directing a beam of modulated Infrared energy from the monitor's 10-inch telescope at distant targets that can reflect the energy back along the same beam path into the monitor. Molecules of each chemical intercepted in this infrared beam path uniquely absorb energy and from the analysis of the resulting absorption spectrum the monitor identifies and quantifies the molecules present. In the figure 3-1 below the RAM 2000™ is being used in a typical scenario monitoring the air being blown towards the houses in the community. The example shown of leaking drums could also be representative of a chemical plant or any other source of volatile organic compound's (VOC's). The plume is the gaseous phase of these compounds, which are now airborne. The RAM 2000™ projects a harmless IR beam across the plume, which is reflected back into the FTIR by the Retroreflector. As stated above, the beam is divested of energy at specific frequencies as determined by the compounds present in the plume. The OP-FTIR data can be supplemented by the collection of meteorological data that can be automatically stored with the spectral data taken with the FTIR for each sample.

Figure 3-1. Typical OP-FTIR Monitoring Configuration



The actual target compounds measured during the program differed slightly from those listed in Table 2-1 as the maximum compound number for an analysis method is 30 and the total on the list and interferants exceeded that number. Also the preliminary sampling results indicated that a few additional compounds [e.g., acetone and isopropanol] be added on as potential target compounds. Thus the data was not evaluated for a number of the listed target compounds but during validation if unknown peaks were seen then these compounds would be reevaluated.

The Summa canisters supplied for this study were specially coated canisters with Silonite™ coating to enhance capture and desorption of VOC and air toxic species. The canisters were manufactured by Entech and supplied through Centek Laboratories in Syracuse, NY. Centek also carried out all Summa canister sample analyses for the project. Samples collected for analyses for low level reduced sulfur species analysis [methyl mercaptan, ethyl mercaptan, dimethyl disulfide, trimethyl trisulfide, methyl sulfide, and hydrogen sulfide] were cryogenically preconcentrated in a manner different than that used for standard Summa canister samples and scanned over a wider mass spectrometer mass range. Also to achieve the best possible detectability a 200-milliliter aliquot was used for preconcentration instead of the typical 40-milliliter aliquot.

The project sampling was divided into preliminary and main sampling efforts. The results from the preliminary study were reviewed and used to finalize the sample focus and procedures required for the main sampling to be carried out. The Camden Delaware 1 WWTF is located in the south-western section of Camden adjacent to the Delaware River. Figure 3-2 provides the overall facility layout. Both municipal wastewater and industrial waster are processed at the plant.

Preliminary Sample Collection

The preliminary sampling was carried out in late summer 2004. The preliminary sampling was done by the use of the coated Summa canisters that were walked along defined measurement paths down wind of the sources of interest or placed inside of contained areas to collect source "fingerprint" samples. The Summa canister samples were supplied with flow regulators to allow for desired sampling period of about 15 minutes. [Thirty-minute flow regulators will be used to collect the source fingerprint samples.] The Summa canisters were employed for collection of air toxic components and VOC as listed in the TO-14/15 method. Because the Summa canisters were coated to allow for adsorption/desorption of sulfur compounds they also be were analyzed by GC/MS method for selected reduced sulfur compounds and for selected aldehydes.

The targeted area sources were the primary settling tanks, and hypochlorite contact tanks outflow field. Other sources of interest include the preliminary treatment facility [PTF], sludge dewatering and handling, scum processing building [SPB], and the sludge filter cake storage building. Neighborhood samples were collected at several upwind locations during the program including one sample on the eastern side of the Delaware River. Based on a pre-sampling facility tour on July 6, 2004, many improvements were noted in the air pollution and odor control areas by the facility. Consequently some changes in sampling locations were required as the sludge dewatering building and PTF vents [removed with air emissions directed to an alkali scrubber] were eliminated. Trucks with freshly dewatered sludge and trucks delivering septic or grease wastes to the SPB area were added to the sampling list.

Figure 3-2. Camden Delaware 1 WWTF Layout

The predominant winds were off of the Delaware River from the WSW to S. The path-averaged Summa canisters were collected downwind of the selected area and other targeted sources at the WWTF over a fifteen-minute time frame for each measurement. The sampling time frame was determined by expected meteorology based on weather forecasts and onsite activities involving truck transport of waste materials. The preliminary sampling study was carried out at the CCMUA facility on August 11th. Due to the questionable weather forecast for August 12th it was decided to complete the initial sampling study in one lengthy day on-site. The meteorology was generally favorable with generally light SSW to SW winds and partially cloudy skies. Due to more southerly wind flow expected later in the day, it was decided to complete the primary sedimentation tank and secondary tank sampling first. Figure 3-3 provides a depiction of the sampling locations. Several upwind background samples were collected prior and during the tank sampling. One of the upwind background samples involved collection via boat on the Delaware River south and west of the WWTF facility. The sampling of a dewatered sludge truck was next done by collecting a path-averaged canister downwind of a freshly dewatered sludge truck that was parked on the weighing scale for the required 15-minute sampling period. Normal procedure entails that the truck reside on the weighing scale for about 3 minutes so the study provided a worst case sampling.

The next sample collection involved the sampling of a truck delivering grease type waste to the SPB. The sample was collected downwind of the unloading operation for about 20 minutes.

Finally the PTF, SPB, and dried filter cake sludge storage building were sampled. Samples taken to collect source "fingerprint" data were set at one point location for about 30 minutes within the buildings containing the source material to be fingerprinted.

A total of fifteen air samples were collected [10 source, 3 upwind, and 2 QA]. One water sample was also collected from the influent to the primary sedimentation tanks. The project QAPP was followed with regard to the collection, handling and analyses of Summa canisters. Sampling locations were documented with photographs and wind flow was documented with wind streamer use and soup bubble release where applicable.

Figure 3-3: Sampling Locations - Preliminary Sampling August 11,2004

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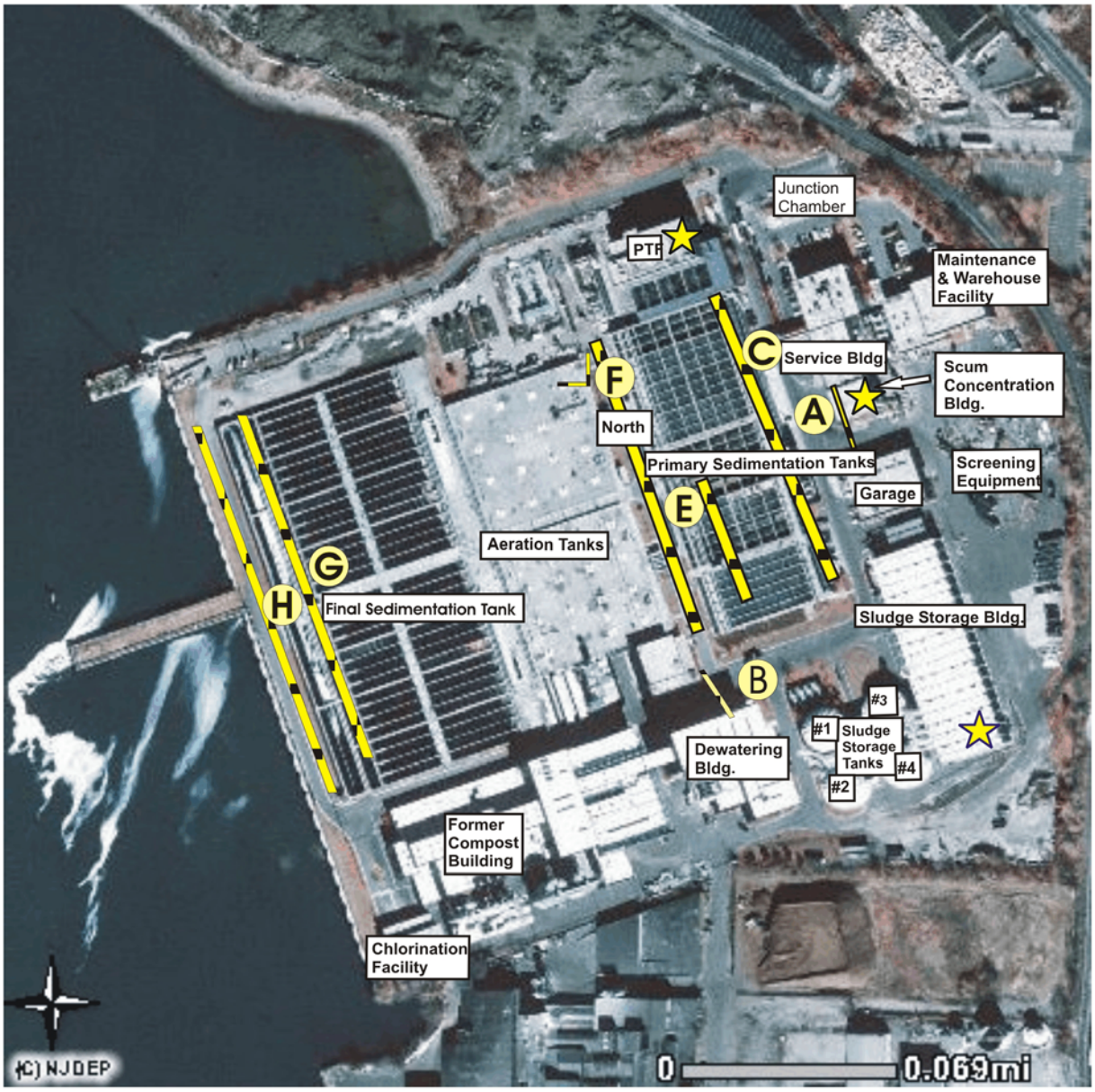

☆= Point CCMUA canister "finger print" sampling
A = Grease truck sampling path
B = Dewatered sludge truck sampling path
C = Influent channel path
D = Scum channel path
E = Effluent channel path
F = North tower aerator tanks
G = Hypochlorite zone path
H = Background 1 and background 3 paths

Main Sampling Program

The main sample collection was carried out in the second half of October 2004. Considerations for the main study included review of target compounds seen in significant concentration, then balancing the air toxic study objectives with NJDEP odor concerns, and finally to focus on a limited number of objectives in a comprehensive manner. The preliminary study also demonstrated the need for frequent background sample collection. The main sampling study was carried out at the CCMUA facility within the period of October 18 through October 29, 2004. Due to the difficulty in getting proper wind sectors for the four study days planned and the unavailability of the plant for sampling due to an equipment performance test, it was decided to complete this sampling study in several parts. The Camden WWTF sources that were focused on in this phase of the study were the primary and secondary settling tanks, sludge filter cake storage area, sludge storage tanks, and the scum processing building. Emissions from the truck transport of freshly dewatered sludge and stored dewatered sludge were further studied with Summa canisters. The MAFCO plant adjacent to the Delaware 1 facility was also sampled at the CCMUA fence line. Finally some near plant neighborhood air samples were collected in conjunction with a NJDEP community bucket brigade sampling round. A total of 26 Summa canister air samples were collected [21 source, 2 upwind background, and 3 QA]. Nine of the canister samples also had low-level sulfur compound analyses done. A water sample was also collected from the primary sedimentation tank influent channel in conjunction with the emission rate demonstration but was invalidated due to an extended holding time caused by delay of sample transport to the analysis laboratory because of the weekend.

The two-day period was selected for which meteorological conditions are forecast to be most favorable for OP-FTIR sampling. This included little or no precipitation during sampling events, and steady light to moderate winds consistently from a single wind sector for several hours or more. The OP-FTIR sampling days were required to be consecutive. The meteorological conditions in October 2004 were not conducive for general W to SW winds and a portion of the sampling was carried out under less than ideal wind conditions with the wind speeds often being quite light. October 28 and October 29 were selected as the sampling days based on forecasted weather conditions and plant availability.

The OP-FTIR was employed for measurement of selected plant sources for about one and one half days and for about one half of a day for emission rate demonstration. The OP-FTIR data was collected for a total of about 8.5

hours on 10/28/04 and 10/29/04 with about 2 hours allotted for surveys of primary tank areas and the chlorination area of the secondary tank, about 1.5 hours for emission rate data collection on primary tank influent channel, 1.5 hours for collecting the required data for TO-16 detection level assessment, 0.5 hours for sampling the MAFCO/CCMUA fence line, 1 hour for SPB area sampling, and about 2 hours for collection of data downwind of the sludge storage and dewatering area. Figure 3-4 shows the OP-FTIR paths used for data collection.

The area source for emission rate demonstration was selected from among the primary tank influent area, the primary tank effluent area and hypochlorite contact zone based on wind sector, logistical considerations and what compounds are measurable by the OP-FTIR for these source areas. These areas were surveyed with the OP-FTIR at a time prior to the emission rate demonstration and analyses of the results suggested that the influent weirs provided the best opportunity to see target compounds.

Other emission sources measured with the OP-FTIR included down wind of the MAFCO plant near the CCMUA fence line, down wind of the sludge storage and handling areas, and downwind of the scum processing building. Sampling duration ranged from 0.5-2.5 hours per location with each sampling event being 5 minutes. The sampling downwind of the dewatered sludge operations was carried out for the longest time interval and was coordinated with neighbor hood sample collection. Upwind sampling was carried out as required. Compendium method TO-16 was followed as applicable for this type of sampling and QA/QC carried out as described in the project QAPP.

Summa canister sampling was carried out over about four days at selected sources at and downwind of the Camden WWTF facility. Canister samples were collected in conjunction with OP-FTIR data collection for the emission rate demonstration. Other sources of interest included the emissions stacks for the sludge storage and dewatered sludge odor control system outlet, and down wind of the sludge filter-cake storage building.

Neighborhood samples were collected at several down wind locations during the time when NJDEP bucket brigade samples were taken. The samples were collected at a time when the wind was from a SW to SSW direction and odors had been detected NE to NNE of the plant. Figure 3-5 indicates community sampling locations.

Figure 3-4: Sampling Locations - Main Sampling October 28 and October 29, 2004

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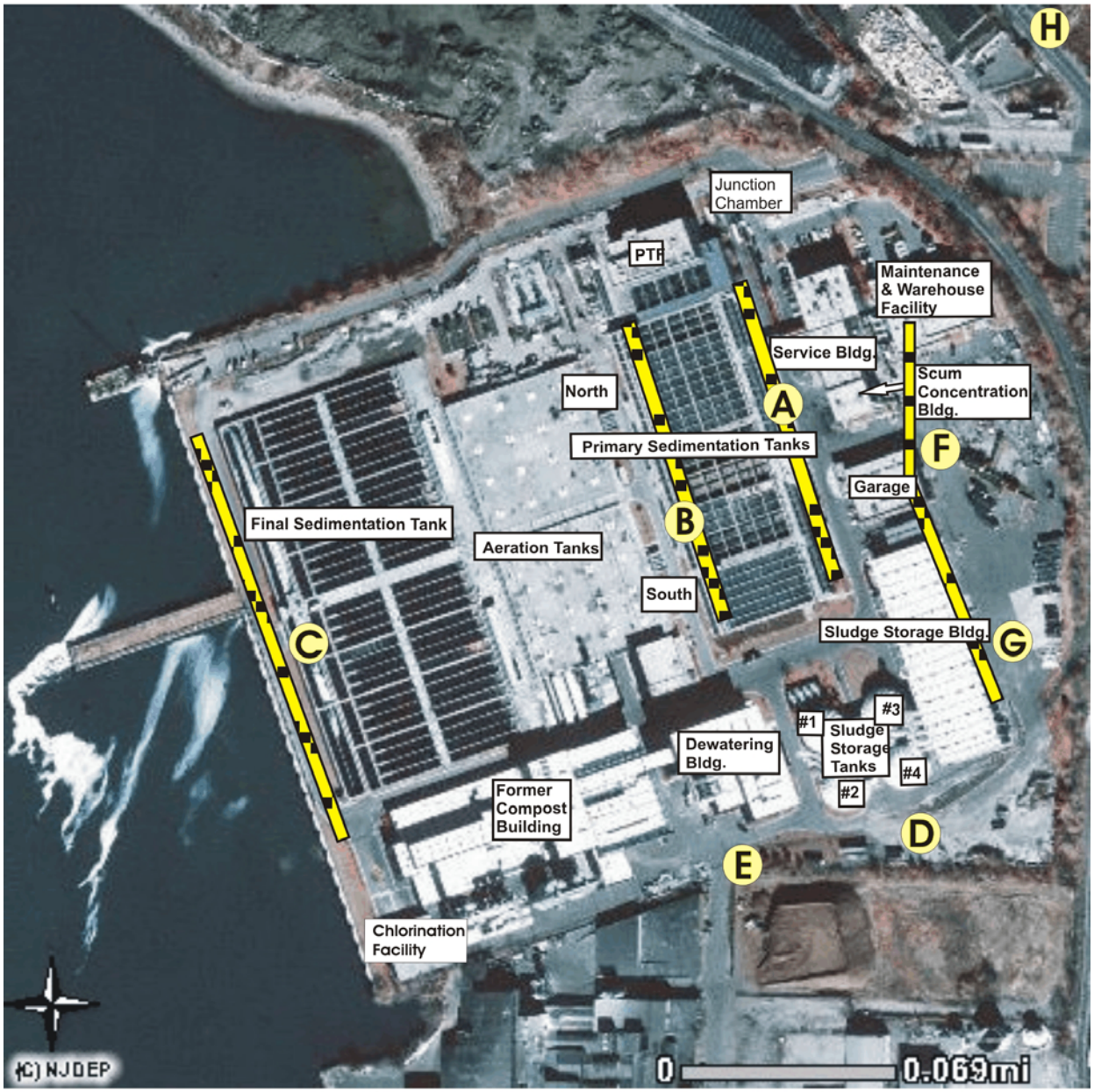

A = OP-FTIR path survey of tanks path & canister path emission rate demonstration
B = OP-FTIR path - effluent channel survey
C = OP-FTIR path - hychlorite addition zone
D = OP-FTIR background data - path T0-16 and upwind 10\29 canister data collection
E = MAFCO/CCMUA fence line OP-FTIR second canister data
F = OP-FTIR data path SPB area path
G = OP-FTIR & canister path downwind sludge area
H = Community monitoring point canister sample

Figure 3.5 Community Sampling Sites

Comm $_1$ = Ferry Ave. at Jackson (SUMMA Collocated with Bucket Brigade Sampling)
Comm $_2$ = Ferry Ave. at Webster (SUMMA only)
Comm $_3$ = Jasper Street (Bucket Brigade Sampling only)
Comm $_4$ = Not on Figure; approx. 1 mile north
Camden Rutgers Library, N. 5th Street (Bucket Brigade Sampling only)

The Summa canister samples were supplied with flow regulators to allow for desired sampling period of about 15 minutes. The Summa canisters were employed for collection of air toxic components and VOC as listed in the TO-14/15 method. Utilization of coated Summa canisters to allow for adsorption/desorption of compounds and these canisters were also analyzed by a GC/MS method for selected reduced sulfur compounds and for selected aldehydes. A subset of samples were collected in Summa canisters equipped for low-level concentration sulfur compound analysis. The method employed was a variation of TO-15 and does not yet have an EPA designation or sanction.

The path-averaged Summa canisters were collected downwind of the selected area source for emissions demonstration assessment over about a fifteen-minute time frame for each measurement. The source selected based on OP-FTIR survey results was the primary tank influent channels. Path-averaged canister samples were collected for background [upwind] assessments, MAFCO fence line sampling, and for downwind sampling of the facility sludge handling area. Point Summa canisters were collected for near plant neighborhood. Figure 3-4 also identifies the canister sampling locations used.

Sampling with Summa canisters was carried out on October 18th for the SPB [both stack after the carbon filter and downwind of the entire building], for the vent stack from the dewatered sludge storage building odor control system, and for the vent stack from the emissions control for the sludge storage tanks. Figure 3-6 provides the sampling locations for this date. The meteorology was generally favorable for SCB measurement using path-average sampling along about a 160-foot [50 meters] path perpendicular to the wind with generally light to moderate WNW to W winds and partially cloudy skies. The meteorology had no impact on the stack sampling. The sampling conducted on October 20, 2004 was for the collection of VOC and low-level sulfur compound emissions from two sludge transport trucks. The sampling time frame for sludge trucks was determined by expected favorable meteorology based on weather forecasts and onsite activities involving truck transport of the sludge. Trucks were held at the scale for an approximate 15-minute period to allow for sample collection. Figure 3-6 also shows the sampling locations for this date. One truck contained about 28 cubic yards of dewatered and dried sludge from the sludge storage building and is typical of the sludge trucked off-site. A second truck contained freshly dewatered sludge filled to about 30 cubic yards and is typical of the sludge transported to the sludge storage building. Both trucks were

Figure 3-6: Sampling Locations - Main Sampling
October 18 and October 20, 2004

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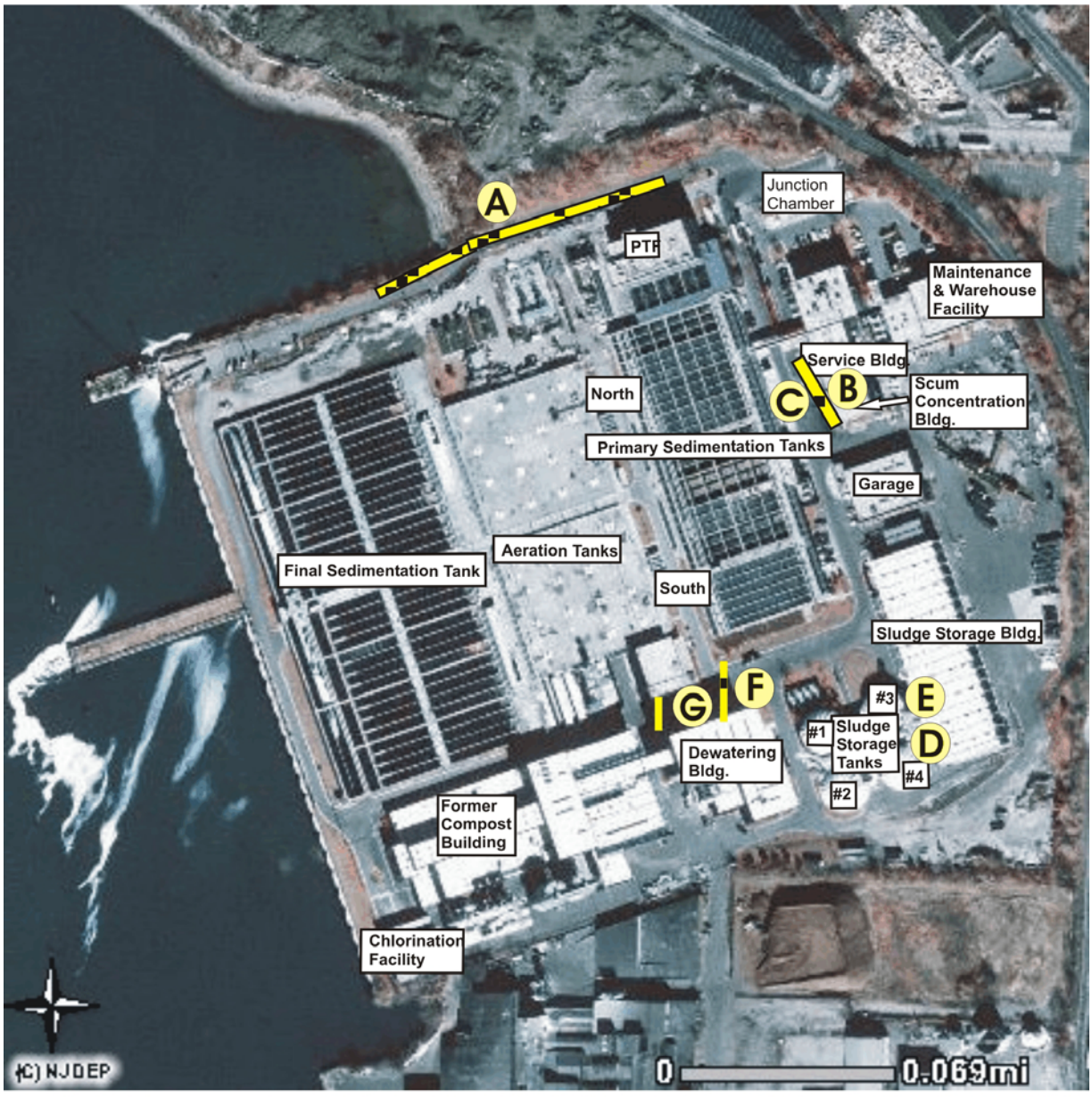

A = Upwind sample path
B = Down wind of SPB path
C = Point sample - SPB carbon filter stack
D = Point sample raw sludge storage tank - vent from scrubber
E = Point sample sludge cake storage air scrubber vent stack
F = Path sample upwind of truck weighing scale
G = Path sample downwind of sludge trucks (dewatered and stored)

measured at the facility truck weighing scale. The downwind samples were collected by walking Summa canisters perpendicular to the truck and roadway about 30 feet from the end of the truck bed. The path was about 50 feet for the stored sludge truck and about 30 feet for the freshly dewatered sludge truck. An upwind [background] sample was taken about 50 feet upwind of the truck scale. The path was parallel to the downwind path and about 66 feet long. The winds were favorable for sampling coming from the ENE to E and being channeled by the building structures directly parallel to the weighing scale and trucks.

4.0 DISCUSSION OF STUDY RESULTS

Review of the results of the laboratory analysis of the Summa samples collected and validated OP-FTIR data collected is broken into six areas of discussion. Results from the open primary/ secondary hypochlorite treatment tanks and PTF measurement, SBP sampling, sludge dewatering and sludge storage areas sampling, dewatered and stored/dewatered sludge transport trucks, results for the downwind sampling of the MAFCO facility, and emission rate assessment demonstration for the primary influent channels are reviewed. Summa canister data was collected in August and October samplings. OP-FTIR data was collected on October 28 and 29 for all of these areas except for the sludge transport trucks and is discussed in conjunction with the Summa canister data. The appropriate summary data reports include the Summa canister laboratory analysis results [EXCEL format], and the OP-FTIR results spreadsheet [EXCEL format] accompany this report as appendix B. The full laboratory analysis [Adobe Acrobat format] results are also provided in the same appendix. Then samplings conducted in August and October provided representative air quality snapshots but did not definitively define average or worst-case effects from the sources studied.

The source "fingerprint" samples of the three CCMUA facility source areas [preliminary treatment building, scum processing building and dewatered sludge storage area] show a somewhat different mix of compounds by source area and will be useful for categorizing community impacts in the future. These fingerprints are additionally discussed in relationship with each of the above areas as appropriate. It was somewhat surprising to see the amounts of acetone, methyl ethyl ketone, toluene, and isopropanol in the dewatered sludge. This implies that

some solvents are selectively retained by the sludge or form in the dewatered sludge during storage in the former compost storage building. H2S was only seen above detection levels in the PTF fingerprint sample but there were considerable sulfides and mercaptans in the Dewatered Sludge Storage Area fingerprint. The fingerprint sample for the Scum Processing Building showed a significant number of detections with acetone, MTBE, isopropanol, methanol, and 2-methyl butane as marker compounds.

Primary and Secondary Treatment Tanks / PTF

Review of the samples collected from the primary and secondary tank locations show that most observed acetone values and minor toluene and hexane values were above background levels. All background samples show some acetone and minor levels of toluene as well as varying levels of octamethyltetrasiloxane [OMTS] and hexamethyltrisiloxane [HMTS]. These are presumed from a source of silicon compounds located south of or across the river from the plant. These compounds are also found in plasticizers, hygiene, and beauty treatment products, as well as a myriad of other commonly used products. Also seen are minor levels of other tentatively identified compounds [TICs] ranging from hydrocarbons to aldehydes. There were no significant indications of BTEX from down river refinery operations. There were also minor amounts of propane puffs seen in one background sample. The primary and secondary tank sampling done during August indicated varying levels of acetone above background, along with low PPB levels of toluene and hexane. There were a few detects at trace levels of m-xylene and one detect of isopropanol. Acetone was seen in all samples [including all background samples] but was seen at higher concentrations in all but one plant sample as shown by the background-corrected sample results. The water sample also shows these same compounds present. There was no chlorinated compounds detected at quantifiable limits in any facility non-fingerprint sample collected. OTMS and HMTS TICs were seen in most samples collected at varying levels. The PTF fingerprint indicated significant amounts of these compounds as input to the plant. Because of the multiple sources of these compounds, it is difficult to determine the amount being contributed by the facility to the air samples collected. Minor levels of higher carbon-number aldehyde TICs were seen mainly in the emissions from the chlorination channel. A propane TIC seen is likely attributable to a source near the primary settling tanks. The

background samples data indicated relatively large puffs of methanol passing through the site, some of which were seen in the data sets collected while sampling on the tanks.

The OP-FTIR data for the primary and secondary tank sampling done on October 28 showed only methane [above normal ambient levels of about 2.0 PPM] and ammonia as constantly emitted target compounds. The survey data for the influent and effluent zones also showed some very low level SF6 [a component at time used for quality assurance assessments] that was likely residual in the OP-FTIR QA cell. Summa canister data was collected in conjunction with the OP-FTIR data on the primary influent channels for emission rate demonstration. The regular TO-15 plus TICs analysis indicated low level toluene in both samples along with acetone and 2-methylbutane as a TIC. One canister also showed isopropanol. All detects were at low PPB levels. The acetone includes background acetone with actual acetone concentrations due to the influent channel apt to be about one half the totals seen based on the previous background results from the preliminary sampling. There were isolated detects of propylene, MTBE, tetrahydrofuran [THF], and acetaldehyde. These detects were below the OP-FTIR detection limits and would not be seen in that data set. The low-level sulfur canister did not show any sulfur compounds above detection levels and showed only a few other TICs. These results were used with the OP-FTIR results to provide emission rates in grams per second, and pounds per hour from the influent channels in the emission rate assessment demonstration.

Scum Processing Building and Associated Activities

The SPB area, including the odor control carbon filter vent stack, have both canister and OP-FTIR data available. The OP-FTIR data indicated no significant target compound detection for this area above detection limits. The canister data was collected about 10 days prior to the OP-FTIR data. The canister data showed acetone estimated at about 7 to 10 PPB above background levels in the downwind and carbon filter vent stack samples. There were trace amounts of toluene and 2-methylbutane for both samplings. There were several low-level TICs seen and the vent stack sample had significant amounts of butane, propane, and isobutane. These components were not seen in the fingerprint sample collected within the building in August. The grease truck unloading sampling results showed very minimal air toxics detects with only some acetone above background and minimal toluene and

isopropanol that was consistent with the fingerprint of this source. There appeared to be a source of propane emissions near the scum processing building and the East end of the primary settling tanks.

Sludge Dewatering and Sludge Storage Areas

The stack samples from the sludge storage area emission control vents and from the raw sludge storage tank odor control vents did not indicate large amounts of VOC or sulfur compound emissions. The sludge storage odor control was more efficient with only traces of acetone, toluene, and dimethyldisulfide seen. The raw sludge vent-stack showed traces of acetone and chloroform with significant toluene and propane. There was some hydrogen sulfide and hydroxyacetaldehyde seen also. The relatively large toluene emission is of interest.

The community sampling effort included canister and bucket brigade data collection along with OP-FTIR data collection down wind of the sludge area of the facility. The OP-FTIR data shows continuous methane and ammonia emissions from these areas. Toward the end of the sampling period a perfume-like odor was noted and speculated to be the odor-masking agent used. The OP-FTIR indicated methanol, propane, and 1,1-dichloroethane during this time frame. The methanol and 1,1-dichloroethane may be associated with the odor-masking agent. The canister sampling data for the community-sampling event on Oct 29th indicated the presence of butanates and also cyclohexanone in the canister collected along the beam path of the OP-FTIR. These compounds were seen in the stored sludge truck sampling. Also this sample shows methanol which was seen in the final few runs of the OP-FTIR data and assumed associated with the odor-masking agent.

The two canister samples collected in the community were decidedly different. The sample collected along Ferry Street between Vanhook and Webster Streets showed components associated with MAFCO or at least the MAFCO direction. [tetrahydrofuran and propylene] The sample taken about 20 meters north of the Jackson and Ferry streets intersection along Ferry Street shows the butanate compounds associated with the plant sludge areas. These detections were consistent with the sampling locations and wind direction [SW-SSW]. There was a lack of detected sulfur containing compounds in all samples, even in those targeted for low-level sulfur detection. Either the detection limits were higher than expected [perhaps 1 to 5 PPB] for the sulfur species or

concentrations were in the high PPT area. The bucket brigade samples collected in conjunction with this effort were somewhat compromised by a FEDEX late delivery to the laboratory problem that caused loss of the sulfur compound samples and some loss of other VOC compounds. The returned results indicated minor levels of dichloromethane, methylethylketone, and toluene in three of the samples with none seen above detection limits in three other samples.

Stored/Dewatered Sludge Transport Truck Emissions

The dewatered sludge truck sampled on August 11, 2004, which was held on the scale for 15 minutes, did not show any sulfur compound or aldehyde above detection level. Toluene, acetone, hexane, and isopropanol are seen at low PPB levels above background. There was a 2-methyl butane TIC also seen. Apparently most of the ketones and aldehydes measured inside the dewatered sludge storage building likely resulted from formation in the sludge in the storage area.

The canister data for the study of the sludge trucks on 10/20/04 showed no detection of any sulfur compounds with the detection limits expected near 1 PPB for most sulfur compounds. The upwind sample for the truck study showed quite a bit of compounds with the hydrazine TIC being the most startling component seen. The wind was blowing from the sludge tanks and processed sludge storage area during the sampling so much of what was seen in this upwind was likely from these areas. The freshly dewatered sludge truck had some toluene and isobutane emissions with acetone just above upwind levels. The methylthioformamide TIC was a new compound that hadn't been identified before in the other sample collections. The stored sludge truck showed acetone and toluene above upwind levels with a multitude of TIC components, some of which were in the background. Curiously there was no indication of hydrazine in either truck sample indicating that this was either a misidentified TIC or the result of a very short duration release. Of note are the butanates, seen in the stored sludge truck and to lesser extent in the upwind sample, that may be significant contributors to the characteristic aged sludge odor.

CCMUA MAFCO Fence Line Sampling Results

The OP-FTIR data survey carried out at the MAFCO / CCMUA facility fence line showed no consistent detection of compounds on the target compound list. There were single detects of propane and ethylbenzene. The ethylbenzene detect proved to be false and it may be an indication of unidentified compounds that absorb in the C-H stretch region of the IR spectrum and were identified as ethylbenzene. It was noted that the winds were very light during this sampling event, but odor and soap bubble checks indicated general air transport from MAFCO. Only a very minor characteristic licorice root odor was apparent. The data summary for the MAFCO canister collected along the OP-FTIR beam path indicated a few minor hits of typical compounds but of interest were the THF and propylene detections. These were seen in a community sample and on the primary tanks. These two compounds may well be marker compounds for the MAFCO source. NJDEP source inventory for MAFCO indicates that propylene glycol is a potential emission from this source and this compound is somewhat similar chemically to THF.

Emission Rate Assessment Demonstration

This section presents results of an emissions characterization in which the ISCST3 Model was utilized to back-calculate emission rates from the preliminary settling tank influent weir channels. This method of back-calculation is referred to the area-source technique and is described in the referenced paper[4].

Application of the area-source technique was refined via the direct estimation of vertical dispersion coefficients based on field measurements. Vertical dispersion coefficients were estimated using the average measured path-integrated tracer concentrations (sulfur hexafluoride or SF_6 and carbon tetrafluoride or CF_4) based on four 5-minute FTIR measurement events or frames. Frames 7, 8, 13, and 17 collected during a 1-hour time period (1214 to 1314) were utilized. Criteria for their selection included having a measured wind direction within 30° of perpendicular to the beam and a measured sigma theta (standard deviation of the horizontal wind direction) less than 35°.

The emission-rate back-calculations were based on the average of the path-integrated measurements for the same events used in the estimation of vertical dispersion coefficients. The compounds for which emissions rates were calculated based on open-path FTIR spectroscopy were methane, ammonia, benzene, and chloroform.

The back-calculation of compound emission rates based on path-averaged Summa canister data involved those samples collected during a time period approximately coincident with the FTIR measurements (between 1208 and 1256). Sampling times ranging from 20 to 22 minutes were achieved using mass-flow control devices and walking the canisters along the FTIR beam-path. All samples were analyzed using USEPA Compendium Methods TO-14A and TO-15. The compounds for which emission rates were calculated based on the Summa canisters were acetone, isopropanol, propylene, toluene, 2-methylbutane, tetrahydrofuran, methyl ter-butyl-ether, and acetaldehyde.

The emission-rate determinations for the preliminary tank influent weir areas based on use of measured vertical dispersion coefficients. Emission rates are calculated by solving the following relationship:

$$Q_c = Q_u / C_u \times C_c$$

where:

- Q_c = calculated compound emission rate (g/s);
- Q_u = unity-based emission rate (g/s);
- C_u = predicted (using ISCST3) unity based path-integrated concentration (mg/m^2); and
- C_c = measured compound path-integrated concentration based FTIR or path averaged Summa Canister samples (mg/m^2).

The ISCST3 Model was run to simulate emissions from the influent weir channels based on measurements of onsite meteorology and onsite estimates of vertical dispersion coefficients. The calculated sigma z coefficients were based on the FTIR path-integrated measurements of the tracer gases CF_4 and SF_6 together with requisite measurement of wind speed using the following equation:

$$\sigma_z = (2\pi)^2 \, Q(\pi C u)^{!1}$$

where:

σ_z	=	vertical dispersion coefficient at a particular downwind distance (m)
Q	=	uniform tracer-gas emission rate (mg/s)
C	=	ground-level crosswind-integrated tracer-gas concentration (mg/m^2)
u	=	mean wind speed (m/s)

Using the CF_4 and SF_6 average upwind distances of 17m and 34m, respectively, the four frames of tracer concentration FTIR measurement data, and coincident wind speed measurements, the sigma σ_z coefficients were calculated. In the ISCST3 modeling to support the back-calculation of compound emission rates, site-specific sigma z curves were developed based on a second degree polynomial ($y = ax^2 + bx + c$) using these calculated sigma z values.

The results from the emission demonstration modeling calculations using the above data collected on October 28 by the OP-FTIR and Summa canisters show the following emission rates calculated for the primary influent channels:

Methane	OP-FTIR	0.127	lbs./hour
Ammonia	OP-FTIR	0.00045	lbs./hour
Acetone	canister	0.00667	lbs./hour
Isopropanol	canister	0.00075	lbs./hour
Propylene	canister	0.00055	lbs./hour
Toluene	canister	0.00114	lbs./hour
MTBE	canister	0.00097	lbs./hour
Acetaldehyde	canister	0.00113	lbs./hour
2-methylbutane	canister	0.00107	lbs./hour
Tetrohydrofuran	canister	0.00104	lbs./hour

In addition the following are the maximum emission rates for two typical target compounds benzene and chloroform based on their TO-16 detection limits:

Benzene	OP-FTIR	0.00574	lbs./hour
Chloroform	OP-FTIR	– 0.00041	lbs./hour

These emission rates would be considered as the highest rates possible based on the detection limits and actual emission rates are likely less than these rates. These emission rates can be used as input to a variety of air quality prediction models to assess source impacts or assess risk.

5.0 PROJECT QA/QC

The QA/QC practices for this study followed those outlined in the project QAPP found in appendix C. Canister sampling and analysis was based on method TO-14a/15 and OP-FTIR sampling was based on method TO-16. All QA/QC details and results are provided in appendix C as well.

Summa Canister QA/QC

For the field sampling appropriate duplicate and blank samples were collected. One blank sample was included and one duplicate sample was collected in each round of sampling. Chain of custody protocol was followed. The contracted testing laboratory followed method TO-14a/15 analysis procedures. A copy of the laboratory SOP is provided in appendix C.

Trip blanks were employed for both the August and October sampling rounds. The results of the analysis [Appendix B] for the trip blanks indicated no detections of any target compounds. A duplicate Summa canister sample was collected in during the preliminary sampling in August for the secondary tank chlorination channel. The review of these results indicate that detected or J value components agreed to within 2 PPB except for acetone which showed a 14.9 PPB variability between sample and duplicate. This is likely due in part to the minor difference in start and end times and the acetone fluctuations seen in the background. The TIC components generally showed wider variations between sample and duplicate indicating less precision for TIC components. OMTS and HMTS were seen in the sample but not seen in the duplicate, and this result was confirmed analysis laboratory. This discrepancy indicates that either the flow regulator, or the canister inlet was contaminated with these compounds for one of the samples. A duplicate sample was collected for the path-averaged canister collected down wind of the sludge areas. The toluene detected in both samples agreed to less than 1 PPB and the acetone showed about a 5.8 PPB difference. The TICs

seen in the sample did not agree with those seen in the duplicate. This causes some uncertainties in the identification and quantitation of TICs. The collection of the sample extended beyond the collection time of the duplicate for several minutes due to differences in the flow regulator rates. This may have contributed to the differences in sample and duplicate TICs for the methanol as this compound was only first detected by the OP-FTIR near the very end of the canister sample collection.

Because measured values were so low, precision could not be assessed for the canister data set. Sample recovery and accuracy for the laboratory were within TO-16 and QAPP requirements

OP-FTIR QA/QC

The QA/QC carried out for the OP-FTIR data included determination of the project minimum detection limits based on the TO-16 procedure, and determination of project data accuracy and precision based on the use of test gases of known concentration. Because the OP-FTIR uses an adaptive background generation program the need for background updating is eliminated. An independent spectroscopist [of the one who prepared the analysis method and collected and analyzed the data set] from RJK Consulting validated the data set.

The data precision was assessed for three data sets of OP-FTIR data. The precision averaged greater than 99% and exceeded the QAPP requirements of greater than 90%. The accuracy was assessed each day by measuring the response to a known certified gas standard while the instrument was set-up on a typical monitoring configuration. The gas chosen was ethylene so accuracy could be assessed in two independent spectral regions. The accuracy assessed averaged about 97% for the 730 to 1200 cm-1 region and about 117% for the 2700 to 3000 cm-1 region. The QAPP requirement for accuracy was a range of 70 to 130%.

The minimum detection limits are shown in the following table. In general the values for the target compounds are below the low end of the range shown for the working detection limits in Table 5-1. This is expected, as the detection limits determined by the TO-16 procedure are lowest achievable detection limits that are rarely observed in actual practice.

Table 5-1 TO-16 MDL for Camden NJ WWTP 10/28 - 10/29/04

Compound	TO-16 MDL[PPB]
Benzene	12.49
Methane	24.57
Trichloroethene	2.63
MTBE	7.09
Propane	17.43
Acetone	9.14
Isoprene	2.39
Methanol	1.56
1,1 Dichloroethane	2.25
m-Xylene	6.94
Ethylene	3.95
p-Xylene	32.27
Ammonia	0.45
Carbonyl Sulfide	1.80
Dichloromethane	3.42
1,1,1 Trichloroethane	0.92
Dimethyl sulfide	16.57
o-Xylene	14.51
Formaldehyde	1.68
Isopropanol	3.28
Benzaldehyde	119.05
Hydrogen Sulfide	1806.65
Chloroform	0.58
Carbon Tetrachloride	0.45
Ethylbenzene	28.07
Carbon Disulfide	33.58
Toluene	14.19
Carbon Tetrafluoride	0.16
Sulfur Hexafluoride	0.03

6.0 CONCLUSIONS AND RECOMMENDATIONS

Conclusions and recommendations are divided into four areas; Summa canister sampling, OP-FTIR sampling, area source emission rate assessment, and findings concerning community air and odor impacts from sources within the Delaware 1 WWTF and other nearby sources.

Summa Canister Sampling

The coated Summa canisters were very effective for sampling TO-15 VOC components with detection limits of 1.0 PPB or better achieved. The canisters were also effective for capturing non-TO-15 reduced sulfur species at minimum concentrations of 5 to 30 PPB dependent on compound. The canisters were not effective in detecting reduced sulfur compounds in the

0.5 to 4PPB range even when enhanced sample pre-concentration and laboratory analysis techniques were employed. Because of the difficulty in capturing samples of this concentration level specialized handling techniques should be employed with regard to the handling of all components of the sampling system including flow controller and any attachments used to obtain the sample. Regarding TIC components, the data shows that the identification of the TIC reported is somewhat questionable and the concentration assigned is very questionable. If a specific class of compounds is to be studied it is recommended that one compound within the class be added to the GC/MS analysis calibration to improve results.

OP-FTIR Sampling

The deployment and use of the OP-FTIR was very successful during this project. It is interesting to note the paucity of target compounds observed above detection levels, but when compounds were present the OP-FTIR did measure them. There were a number of false positives initially reported that were eliminated upon validation of the data. The large number of compounds in the analysis method enhanced the occurrence of false positives. OP-FTIR remains a very powerful and useful tool in measuring fugitive VOC emissions and for emission rate assessments. [See emission rate demonstration conclusions discussion]

Project Findings - Air Toxic and Odor Emissions

The study results suggest that the CCMUA Delaware 1 plant (if operating similar to that during this sampling campaign) is not a significant contributor of VOC and air toxic compounds, but some operations within the facility potentially do contribute odor incidents in the surrounding community.

The PTF should contribute little if any odor and air toxic compounds to the environment as long as the scrubbing system that cleans the air stream from this facility is properly maintained and in service. The primary and secondary settling tanks showed little emissions of air toxic compounds with the largest emissions being ammonia and methane. There were only very minor odor emissions from the tanks. The input burden of odorous compounds and air toxic compounds as seen in the PTF fingerprint sample seems to concentrate in and travel with the sludge and not in the wastewater.

The SPB and associated septic waste and grease waste unloading operations was found to generate little in air toxic compound releases and to only be a very minor contributor to odors observed at the plant. While no septic waste unloading was sampled, a number of septic waste truck unloadings were observed and no large-scale odor impact noted. While fingerprint measurement inside the SPB indicated the potential for some air toxic releases, the measurements downwind of the facility and from the facility carbon filter stack showed almost no air toxic compound emissions above detection levels and minimal odor releases beyond the near vicinity of the source. However, some amount of aliphatic hydrocarbon releases were observed when sampling the carbon filter vent stack.

Based on this study the sludge handling and storage areas have the highest potential for emissions of air toxic compounds and for causing community odor impact and the greatest potential of causing community odor impacts. The components of this processing area are the raw sludge storage tanks and associated scrubbed venting system, the sludge dewatering building, the sludge hauling trucks used for freshly dewatered sludge, the sludge storage building and associated building air scrubbing system vents, and finally, the stored sludge hauling trucks for off-site disposal. The raw sludge storage tank sampling indicated a potential for hydrogen sulfide release and some air toxic releases with toluene being the major compound seen. There is significant odor potential from these tanks. The sludge dewatering building was not directly sampled due to its negative pressure environment and the configuration of the scrubbing system employed for its vent stacks. However due to propensity of the air toxic and odorous compounds to stay with the sludge [as indicated by the fingerprint air sample of the dewatered sludge and plant analysis results for the dewatered sludge], there is some potential for odorous [non-H2S] and air toxic emissions from the scrubber stacks. It should be noted that the current scrubbing process is "geared to" H2S removal. Sampling of the dewatered sludge trucks indicated a significant odor downwind of the trucks and air toxics characteristic of the sludge storage building fingerprint sample. The concentrations of acetone, methyl ethyl ketone, toluene, and isopropanol within the stored sludge cake building were very significant. There were also significant reduced-sulfur compound concentrations observed [but no H2S above detectable levels]. This again indicates that much of the plant inflow of air toxic compounds, and the reduced sulfur compounds formed during treatment, stay with the sludge even through the dewatering process. The air containment and air cleaning system for the sludge cake storage area apparently does a good job of removing air toxic compounds and reduced sulfur compounds as only

dimethyldisulfide at less than 5 PPB levels was seen exiting the scrubber system.

The measurement downwind of a sludge cake hauling truck indicated some of the fingerprint compounds from the sludge cake storage area at low levels and a group of butonate TICs. Butonates are another group of odorous compounds having rancid, garbage-like odors. The perceived odor from the dried sludge-cake truck was significantly stronger than those odors from the freshly dewatered sludge truck. Movement of sludge by truck may cause significant odor and minor air toxic emissions. Also the dried sludge-cake delivered for off-site disposal may have potential for causing air toxic compound emissions at the disposal site.

Other sources to the south of the WWTF were peripherally studied. The on-river background collected sample south of the plant did not indicate any emissions from the refinery complexes down river from the Camden WWTF. Sampling at the MAFCO / WWTF fence line showed minor impacts of air toxic compounds and a characteristic burnt sugar odor from this direction. Marker compounds seen in the canister sample and potentially present in the OP-FTIR data set were propylene and THF.

The samples taken in the community and down wind of the sludge areas of the plant illustrate the use of marker compounds in identifying source impact. The measurement of THF and propylene clearly indicates impact from the MAFCO facility or other facilities south of the WWTF while the measurement of butonates shows impacts from the WWTF sludge areas,

Specific recommendations are:

A. As odor impacts continue to be a community concern, the development of the best sampling approach and techniques to collect low-level concentrations of odorous compounds is suggested. Further studies to enhance analysis and collection procedures for some of the compounds seen in this study [butonates and reduced sulfur compounds] are suggested.

B. Further studies in the spring when the licorice root processing carried out at MAFCO has its maximum impact on odors and compound emissions are recommended. A study involving the characterizing of potential air toxic emissions from the processing of licorice root and a field study involving canister and (or) tube collection of air samples would be useful in better categorizing this emissions source.

C. Process vent testing required by NJDEP for CCMUA should be altered to include target air toxic compounds like toluene, methyl ethyl ketone, and isopropanol and reduced sulfur compounds other than just H_2S. This is recommended for the raw sludge storage tank vent stacks, the sludge dewatering building scrubber outlets, and the outlets from the odor control equipment for the sludge cake storage building.

D. The negative pressure environment within the sludge cake storage building should be increased as the odor potential and air toxic potential is perhaps greater here than for any other plant source. All access doors should be locked to the outside [the door on the SE corner was not]. The ammonia concentration inside the building should be checked to verify that it is not an OSHA concern.

E. While this study indicated that the sludge transport activities do not generate high levels of air toxic compounds there is an odor concern with this activity. It is suggested that all trucks be tarped with some type of odor impermeable covering whenever they are outside the dewatering or sludge-cake storage buildings to prevent odor release. Additionally, some type of washing station should be considered to rinse portions of the trucks soiled when being loaded.

7.0 REFERENCES

1. " Evaluation of Hazardous Air Pollutant Emissions from Waste Water Facilities Using FTIR Remote Sensing", NJ DEP Project SR00-046, R.E. Hague, R.J. Kricks, and C. Weisel, March 2002.
2. "Use of Open-Path FTIR Spectroscopy to Support Development of Refined Estimates of H2S Emissions from a New York City Municipal Wastewater Treatment Plant". Minnich, Timothy R. et al. Proceedings of 95th A&WMA Annual Meeting, Baltimore, MD, June 2002.
3. "Use of OP-FTIR for emission rate assessment of industrial area sources during winter conditions" Kricks, Robert J; Keely, Jerry A.; Spellicy, Robert L.; Perry, Stephen H. Presented at the SPIE meeting for Environmental Monitoring and Remediation Technologies, February 1999
4. "Use of Optical Remote Sensing and Flux Chamber Technologies for Determining Emission Rates from a Pulp Mill Wastewater Treatment Facility" Schmidt, Charles E.; Barton, Douglas A.; Hasegawa, Mark; Minnich, Timothy R.; et al. Proceedings of 87th A&WMA Annual Meeting, Cincinnati, OH, June 1994.

KEY FOR APPENDICES A, B, AND C

Appendices A, B, and C are electronic attachments on a CD. The following are the keys to each appendix to allow the user to locate the referenced files on the CD.

Appendix A

Appendix A contains a photolog for the sampling carried out for the project. The file folder is Pictures. File folders within this folder are for the presampling site visit [Presamplingplantvisit] ,preliminary sampling [Preliminarysampling], and main sample collection [Mainsampling]. The photos contain captions for each digital photo.

Appendix B

Appendix B contains the data for the project for the Summa canisters analysis results, OP-FTIR and meteorological data collection, emission rate demonstration study, and plant support data. The file folder is Appendix B.

The file folder Canister Data contains the folders for Preliminary Sampling and Main Sampling.

The file folder Preliminary Sampling contains the following files:

C0408006ppbv, C0408006ugm3 - Centek Lab analysis results for the preliminary sampling [Adobe format]
RESULTSSUM - preliminary sampling results summary [Excel SS]
BKGDcorresults - preliminary results corrected for background [Excel SS]
FFFPSUM - preliminary results-source fingerprint sampling [Excel SS]

The file folder Main Sampling contains the following files:

C0410019 - Centek Lab analysis results for the 10/18 sampling [Adobe format]
C0410021- Centek Lab analysis results for the 10/20 sampling [Adobe format]
C0411001 - Centek Lab analysis results for the10/28 and 10/29 sampling [Adobe format]

The file folder OP-FTIR Data contains the following files:

Camdenfinalreportsummary - contains all OP-FTIR data and project met data [Excel SS]
Val Camden Report Summary - contains final validated OP-FTIR data for project [Excel SS]
102804-pti-servyrn5 - contains the data set used for emission rate determination [Excel SS]

The file folder Emission Rates contains the following files:

MTABLE ONE ,MTABLE TWO - shows input data and emission determination results [Excel SS]
Table3 - provides support data [Excel SS]
Table4 - provides support data [Excel SS]
Table5 - provides additional support data [Excel SS]

The file folder Plant Data contains the following files:

CCMUA_in - showing plant influent data for 8/04 and 11/04 [Excel SS]
CCMUA_ef - showing plant effluent data for 8/04 and 11/04[Excel SS]
CCCMUA_sl - showing plant sludge data for 8/04 [Excel SS]
noaamo_a - Plant average met data for August04
noaamo_o - Plant average met data for October04

Appendix C

This appendix contains project QA data, the project QAPP, and the analysis laboratory [Centek] QA plan in file folder QA.

File folder OP-FTIR QA in QA contains the following files:

TO-16 MDL analysis	TO-16 MDL assessment [Excel SS]
OPFTIR precisionresults	OP-FTIR data set precision [Excel SS]
C2H4 accuracy results	OP-FTIR data set accuracy [Excel SS]

File folder Canisterdata in QA contains the following files:

CoC04080p1	Chain of custody forms prelim. sampling
CoC04080p2	Chain of custody forms prelim. sampling
CoC04080p3	Chain of custody forms prelim. sampling

File folder QADoc in QA contains the following files:

QAPP Cam denairtoxR_1 Project QAPP [Word file]

File folder L bQA in QA contains the following files:

QC-00-2 - Centek Lab QA/QC plan [Word file]