LOUISVILLE AND JEFFERSON COUNTY METROPOLITAN SEWER DISTRICT

MORRIS FORMAN WQTC

ODOR CONTROL MASTER PLAN

UPDATE 2008

Final Report

December 2008

(Revised February 2009)

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LOUISVILLE AND JEFFERSON COUNTY
METROPOLITAN SEWER DISTRICT
MORRIS FORMAN WQTC
ODOR CONTROL MASTER PLAN – UPDATE 2008

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1.0 INTRODUCTION

1.1 Background

The Louisville and Jefferson County Metropolitan Sewer District (MSD) retained Webster Environmental Associates, Inc. (WEA) and CH_2M Hill to perform an Odor Control Master Plan for the Morris Forman Water Quality Treatment Center (MFWQTC) in 2001. A report was prepared entitled “Odor Control Evaluation for the Morris Forman Wastewater Treatment Plant” and it was dated December 2001. This report included the results of a comprehensive odor sampling and testing plan conducted at the facility as well as the results of air dispersion modeling that predicted the potential impact the odor emissions were having on the surrounding community.

In the fall of 2006 follow-up testing was conducted at the MFWQTC to evaluate the effectiveness of several odor control improvements that had been completed since the 2001 evaluation. The report from this testing was entitled “Odor Control Master Plan Follow-up Testing Report” and was dated January 11, 2007. This report was not a comprehensive comparison of all odor sources at the site since not all potential odor sources at the site were retested. Areas such as the primary clarifiers, headworks area and biotower scrubbers were not retested since there were no odor control improvements made to these areas.

The purpose of this project is to perform follow-up odor and reduced sulfur compound (RSC) testing and investigations to determine the current status of odor emissions. The follow-up testing and investigation will evaluate the effectiveness of new odor control systems and quantify and rank remaining untreated sources. Modeling will be performed to evaluate the odor impacts on the community and these odor contours and odor detection frequencies will be used as a tool to evaluate further odor control measures.

1.2 Project Objectives

The primary objectives of this project are to:

- Quantify current odor and RSC emissions from potentially major sources on the MFWQTC site and rank them in order of priority
- Evaluate the effectiveness and performance of existing odor control systems
- Evaluate the impact of remaining emissions from the plant on nearest residential receptors using air dispersion modeling
- Determine if further odor control improvements are recommended

1.3 Summary of Odor Control Improvements at MFWQTC Since 2001 Master Plan Testing

Several significant changes have been made at the MFWQTC since the 2001 Master Plan testing was conducted. Following is a list of the significant modifications that have been completed and had an impact on odor emissions:

1.3.1 Solids Handling Odor Control (SHOC) – Biorem Biotrickling Scrubbers

The existing fume incinerators were replaced with biotrickling scrubbers (BTS) as part of the Fume Incinerator Replacement Project (FIRP, MSD Contract No. 14955). The biotrickling scrubbers were installed in 2006 (with media from PRD) but never operated as well as intended therefore they were rebuilt in 2008 (with media from Biorem). The rebuilt units are currently in operation, have passed their performance test and are operating as intended. The performance test results are presented later in this report. A picture of the system is shown below and a description of the system follows.

Air from the Solids Receiving Tank (SRT) and the Main Equipment Building (MEB) is treated in the SHOC. Approximately 2,900 cfm comes from the SRT (which holds sludge trucked from Metro plants and from the Guthrie WQTC sludge) and approximately 6,300 cfm comes from the centrifuge conveyors, wet material bins, dewatering wetwell and thickened sludge holding tanks.

Biorem provided the media and controls for the SHOC as a retrofit in the existing vessels. Air enters the bottom of both units which operate in parallel. Each unit has three stages and is designed for a total Empty Bed Residence Time (EBRT) of 30 seconds. Each stage is described as follows:

- First Stage: A 4.5 ft bed of roughing media consisting of polyurethane foam (PUF) provides 9 seconds of EBRT and about 95% removal of H_2S. The PUF media is designed with a high void volume, high surface area and low pressure drop. The system is designed to be operated at a pH of approximately 2.0 *(+/- 0.5)*. Water is recirculated from the sump and the pH is controlled simply by adjusting the bleed rate of the sump water. MFWQTC plant effluent is used as makeup water. No additional nutrients are required.

- Second Stage: A 5 ft. deep bed of Popcorn LWE media is used to remove approximately 90% of the residual H_2S from the second stage. The LWE media has a very high surface area and a void volume that is less than PUF. It is ideal for polishing lower levels of H_2S and has a high surface area that is internal to the granule that is protected from sloughing off of biomass due to high flow. It is operated at the same pH as the First Stage. The recirculating water from the sump is added to the top of Second Stage media. This stage can be operated in Alpha mode (low pH) to remove primarily H_2S or Beta mode (neutral pH) to remove other reduced sulfur compounds (RSC).

  In Alpha mode, both the first and second layer operate at low pH which is optimized to remove and destroy H_2S with thiooxidans bacteria which operate best at pH 1.5-2.5. Biorem stated, "With a total of 20 seconds residence time we will achieve >99% H_2S removal at inlet levels up to the 200 ppm design. There will also be considerable removal of reduced sulfurs, particularly methyl mercaptan which has low pH solubility."

  In Beta mode, the 2^{nd} stage operates at a neutral pH. The media is wetted by water that trickles down from the 3^{rd} stage and no recirculation occurs. MSD and Biorem are currently testing the system in Beta mode to determine if odor removal efficiency exceeds that achieved in Alpha mode.

- Third Stage: A 5 ft bed of combined LWE / BIOSORBENS® XLD low density and high performance biofilter media is used to polish all residual H_2S and to achieve 80% removal of combined RSC through the total system. This stage is irrigated with plant effluent or potable water twice per day for 5-10 minutes, as required.

The system also includes:

- Two (2) 100 gpm Wilfley pumps (on the 1st floor of the SRT Building) to recirculate the bottom two media layers if in Alpha mode and the bottom layer only if in Beta mode.
- A magnetic flow meter and diaphragm valve on the blowdown water line to control the system pH.

The system was first placed into operation in June 2008 and was performance tested on August 14, 2008. Follow-up performance testing was completed in September, 2008. The results are presented later in this report.

Based on an average inlet level of 150 parts per million (ppm) and a peak level of 200 ppm of H_2S and an inlet level of RSC not to exceed 8 ppm, Biorem guarantees the following performance of the media.

1. 99% H_2S removal under all operating conditions
2. 80% RSC removal
3. Media Guarantee:
   - LWE Media 10 year media life
   - Biosorbens® Biofilter media 10 year media life

- PU Foam Media		5 Year media life

1.3.2 Biotower Odor Control (BOC) – Bioway Biotrickling Scrubbers

The chemical scrubbers used to treat emissions from the bioroughing towers were expensive, difficult to operate and provided inconsistent odor and H_2S removal at best. In 2007 one of the chemical scrubbers was removed and replaced with two biotrickling scrubbers. This Biotower Odor Control Improvements Project (BOC, MSD Contract # 15292) was performance tested in August 2008 and the system is currently operating as intended. One of the remaining chemical scrubbers has been left in place and will be used as a backup system to the biotrickling scrubbers.

The units are the Purspring 10000 model manufactured by Bioway and are designed to treat a total of 20,000 cfm of air (10,000 cfm each). Air is blown into the bottom of both units, which operate in parallel. The units are designed for an EBRT of 8 seconds.

Each vessel has three stages of synthetic media, two irrigation spray nozzles and a mist eliminator.

One recirculation sump is provided for both vessels. The system is designed to use recirculation water only during start up.

City water and nutrients are currently being used but MSD is considering installing plant effluent water to the site to eliminate the need for nutrients. Nutrients are "Bioway NutroPlus".

System was first placed into operation in November 2007 and was performance tested on September 3-4, 2008. The performance test results are presented later in this report. The system was required to remove greater than 99% of inlet H_2S, or no more than 0.1 ppm, whichever is greater, when inlet levels are less than 150 ppm. The system is not required to remove a specified percentage of other reduced sulfur compounds.

1.3.3 Truck Unloading Station Odor Control Project

MSD Contract No. 2006-09 was completed in 2007. This project captured all emissions from the truck unloading station and the air is treated in the SHOC biotrickling scrubbers installed under Contract No. 14955. Trucks that bring sludge from metro WQTCs direct connect to a manhole. Air from the manhole is pulled with a fan and discharged to the air space in the SRT. Previously, the air from the truck unloading station was released directly to atmosphere.

1.3.4 MFWQTC Main Equipment Building (MEB) Odor Project

This project was completed in 2006 by MSD using in-house forces. This project included repair and replacement of all damaged or missing screw conveyor covers from the centrifuges to the dryer system and installation of a 1,000 cfm fan and ductwork to collect air from these conveyors, and the wet material bins, and treat it in the SHOC BTS installed under Contract No. 14955. Preventing the release of this air into the MEB building reduced odor emissions from the 6th floor roof fans and potentially the MEB Exhaust Plenum.

1.3.5 Air Release Valve Repairs

Leaking digester air release valves were replaced using MSD forces in 2007.

1.3.6 New Grit Channel Covers

New geomembrane covers were installed over the channels that come from the grit channels and lead to the primary influent channel in 2002 and these were upgraded in 2008.

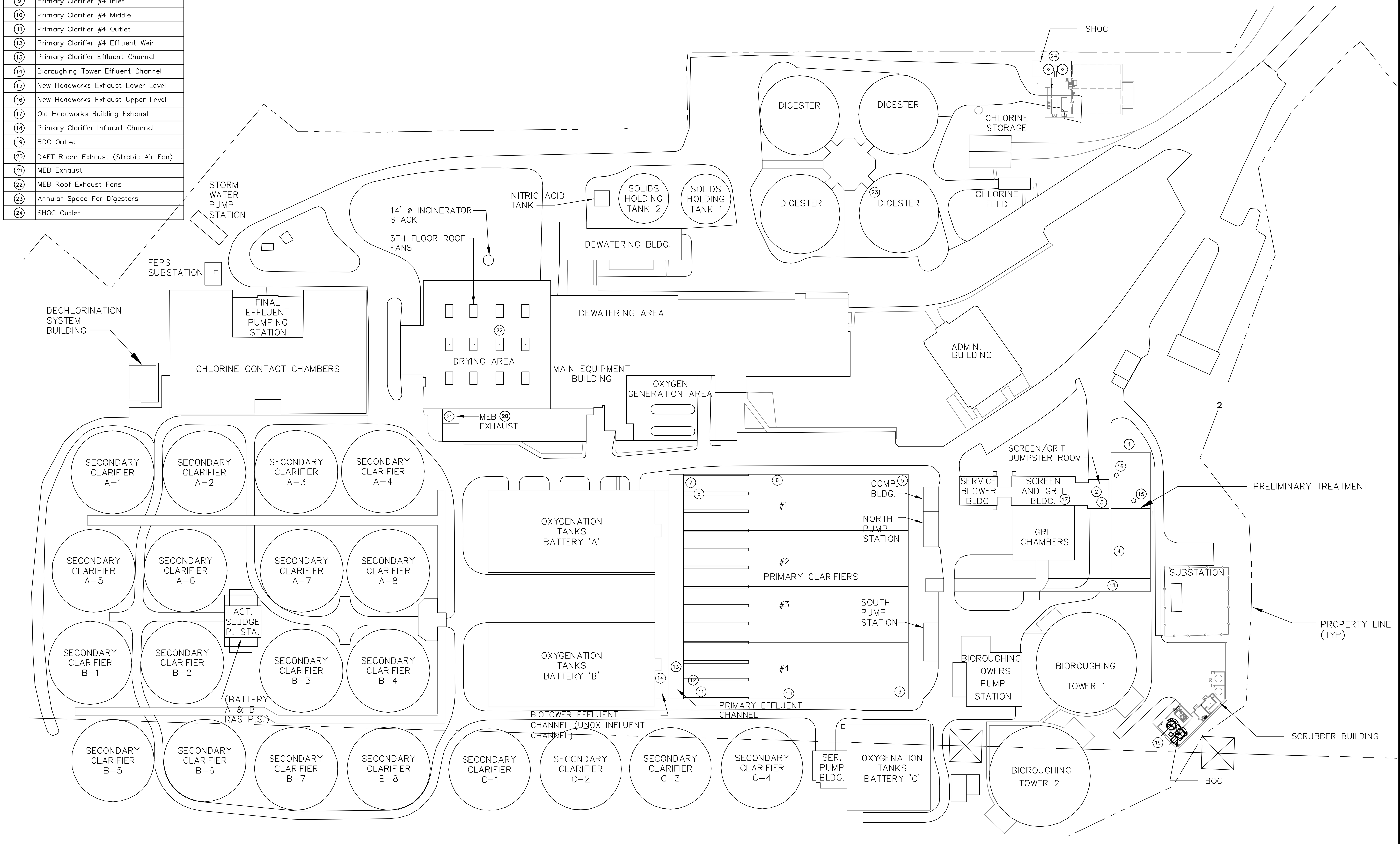
2.0 DESCRIPTION OF ODOR TESTING AND MODELING

2.1 Air Sampling

Two rounds of gas phase (odor) sampling were conducted. The first round was conducted on July 22 and 23, 2008 and the second round was conducted on August 19 and 20, 2008. A total of twenty four (24) air samples were collected during the first round and twenty six (26) samples were collected during the second round. All samples were shipped to the laboratories by overnight express for next day analysis. Sampling locations are shown on **Figure 1** and described in Section 3. Pictures of the sampling locations are included in **Appendix A**.

Air samples for odor panel and RSC analyses were collected in chemically inert Tedlar bags with a polypropylene access valve. Air samples were collected using a vacuum chamber and small battery-operated Teflon pump connected by never-

Location No.	Sample Description
1	Plant Influent Channel & Junc.
2	Grit Loading Building. – Grit Dumpster
3	Grit Loading Bldg. – Screenings Dumpster
4	New Grit Chambers & Channels
5	Primary Clarifier #1 Inlet
6	Primary Clarifier #1 Middle
7	Primary Clarifier #1 Outlet
8	Primary Clarifier #1 Effluent Weir
9	Primary Clarifier #4 Inlet
10	Primary Clarifier #4 Middle
11	Primary Clarifier #4 Outlet
12	Primary Clarifier #4 Effluent Weir
13	Primary Clarifier Effluent Channel
14	Bioroughing Tower Effluent Channel
15	New Headworks Exhaust Lower Level
16	New Headworks Exhaust Upper Level
17	Old Headworks Building Exhaust
18	Primary Clarifier Influent Channel
19	BOC Outlet
20	DAFT Room Exhaust (Strobic Air Fan)
21	MEB Exhaust
22	MEB Roof Exhaust Fans
23	Annular Space For Digesters
24	SHOC Outlet



Engineer's Seal and Signature

Signature

RECORD DWGS:	INITIALS	DATE
CHECKED BY:		
DESIGNED BY:	BEK	
DRAWN BY:	ODS	

FILE NAME:

PLOT DATE: 09/28/06

Consultant's Title

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NO.	REVISION	DATE

SHEET TITLE:
AIR SAMPLE LOCATIONS

PROJECT TITLE:
MORRIS FORMAN WASTEWATER TREATMENT PLANT
ODOR CONTROL MASTERPLAN - UPDATED 2008

GRAPHIC SCALE = 1" ON ORIGINAL

BUDGET I.D.
CONTRACT NO.
RECORD NO.
DRAWING NO:

FIGURE 1

before used Tygon tubing. For area sources such as tank surfaces, a flux chamber was used to collect the air sample.

The sample bag was filled with the sample and then purged to “condition” the container and remove any background container odor prior to collection of the final sample for odor panel analysis.

2.2 Odor Panel Testing Procedures

The odor evaluations were conducted in accordance with ASTM Standard Practice E679-91 (Determination of Odor and Taste Thresholds by a Forced-Choice Ascending Concentration Series of Limits) and E544-99 (Referencing Suprathreshold Odor Intensity). Detection Threshold (DT) and Recognition Threshold (RT) were evaluated in this study. DT values are used as inputs to the odor dispersion modeling, as discussed later in this report. Air samples were collected from each source and shipped to the laboratory at St Croix Sensory in Stillwater, MN where they were analyzed on the following day.

All odor panels involve human panelists who participate in a series of scientifically controlled sensory tests. On this project the collected air samples were analyzed by St. Croix Sensory.

An odor panel consists of six to eight members who are trained and scientifically screened to determine their smelling acuity to butanol. The odor panel testing, although subjective, is conducted under strictly controlled “clean” conditions to produce statistically valid results.

The odor evaluations are conducted in accordance with ASTM Standard Practice E679-91 (Determination of Odor and Taste Thresholds by a Forced-Choice Ascending Concentration Series of Limits) and E544-99 (Referencing Suprathreshold Odor Intensity), using the AC’SCENT Dynamic Dilution Forced-Choice Triangle Olfactometer. The panel is managed in accordance with ASTM STP 758, Guidelines for the Selection and Training of Sensory Panel Members and ANSI/ASQC Q2-1991, Quality Management and Quality System Elements for Laboratories.

The olfactometer is used to determine the minimum number of times an odorous sample must be diluted with clean air before it is no longer detectable by an odor panel. The number of dilutions is known as the dilutions-to-threshold (DT) ratio or the Detection Threshold. Recognition Threshold (RT) is the dilution ratio at which the assessor first recognizes the odor’s character. For example, an odor panel’s response at DT may be “that smells” where the odor panel response at RT may be “that smells like a skunk”. A high DT indicates a strong odor requiring many dilutions to render it undetectable. RT values are always less than DT values because it is easier to detect an odor than identify an odor. The relative magnitude of DT and RT values indicates the relative significance of odors from various odor sources.

The olfactometer presents eight different dilutions of the odorous sample simultaneously for evaluation by a panelist. The panelist is presented with three air flows for each dilution. Two of the air flows are clean air "blanks", and the third is the diluted odorous sample. The air streams are emitted from identical funnel shaped sniffing ports. Clean air is provided by an air compressor, and is filtered with activated carbon. The panelist is required to determine which sniffing port contains the odorous air. The simultaneous presentation of two blanks along with the odor helps to eliminate "false positives" which could occur if only the odor were presented. The statistical nature of the test requires the panelist to make a selection, even if they are unsure of their answer.

The individual panelist registers his/her selection by pressing a button corresponding to the funnel which they think contains the odor. The selection is displayed on an electrical panel on the opposite side of the machine. After making their selection, the panelist proceeds to the next lower dilution level. Panelists may take as much time as they desire to evaluate each sample. All six dilutions are evaluated by each panelist.

Panelists are not given any indication as to "right" or "wrong" answers. This is to eliminate any bias which may influence the panelist's answers. The funnels which emit the odor are changed in a random fashion between odor samples. This prevents a panelist from memorizing which funnel has the odor.

After the panel has completed a sample, the machine is purged with clean air for approximately 5 minutes. The next odor source is connected and allowed to equilibrate for 3-5 minutes before testing resumes.

2.3 Reduced Sulfur Compound (RSC) Test Procedures

Mayfly Odor Laboratory analyzed the samples for the presence of reduced sulfur compounds and other volatile sulfur compounds by direct injection Gas Chromatography / Flame Photometric Detection GC/FPD. The system used for this analysis was a Hewlett Packard 5890 Series II Gas Chromatograph/Hewlett Packard FPD Detector. The column used was a HP-VOC 3um film, 105 Meter x 0.53 mm ID. The sample volume injected was 0.005 to 2.5 ml for air samples depending on sample concentrations. Purchased tank standards were used to calibrate for hydrogen sulfide and to determine other reduced sulfur compound's concentration. When hydrogen sulfide concentrations were too high to allow concentration estimates of other RSC's, or better detection limits were obtained by GC/MS, their concentrations were estimated by the carbon disulfide response factor from the VOC calibration standard from the GC/MS system.

2.4 Hydrogen Sulfide (H_2S) Test Procedures

During this evaluation, H_2S was measured in the field using an Arizona Instruments Jerome 631X H_2S analyzer with a range of 0.003 to 50 parts per million (ppm) and a Detection Instruments Odalog H_2S Analyzer with a range of 0-200 ppm. These measurements are used to identify or confirm odor (and H_2S) sources at the plant.

2.5 Odor Dispersion Modeling

2.5.1 Description of Modeling

Odor dispersion modeling has been used as a reliable and cost-effective approach for predicting off-site odor impacts from odor sources and evaluating odor mitigation alternatives.

The odor dispersion model is essentially a computer program designed to predict what impact an odor source, or group of odor sources, will have on an area based on a number of factors that are input into the program. The primary inputs include:

- Odor emission rates from individual odor sources
- Odor source dimensions and characteristics
- Historic meteorological data

The software used to complete the modeling is Breeze ISC GIS ProVersion 4.0.4 developed by Trinity Consultants Inc. This dispersion model is based on the U.S. Environmental Protection Agency's (USEPA) Industrial Source Complex (ISC) model methodology.

Breeze is a Gaussian plume model that incorporates source-related factors (air flow rate, stack diameter, odor source area, contaminant concentration, and distance from the odor source to particular receptors) and meteorological factors to estimate contaminant concentrations from continuous sources.

The modeling in this study uses actual meteorological data, from the closest and the most recent full year surface and mixing height data available, obtained from the USEPA Support Center for Regulatory Air Models (SCRAM) website. The data includes the actual hourly meteorological data (wind speed, wind direction, temperature, cloud cover, ceiling height, and mixing height) from every hour of the year.

The information input into the model for this study was Odor Emission Rates (OER) for each point source (sources with stacks &/or exhaust fans); Odor Emission Rate per square foot for each area source (open channels and tanks); odor source locations, base elevations, discharge heights and size; and the local meteorological conditions from the Louisville International airport. The OER is the Detection Threshold (DT) at the source multiplied by the air flow rate.

2.5.2 Modeling Output

The model output predicts the highest DT level, estimated at each receptor point on a grid over the area being analyzed. The resulting peak DT levels are shown graphically on odor contour plots. In this study, the hourly average DT levels at particular receptor points were converted to peak DT levels by applying a multiplier to account for short exposure to odors (less than 3 minutes). The peak DT is normally more relevant for odors, since the odor plume meanders and is very transient. Perceived odor complaints are generally related to peak odor levels, as opposed to an hourly average odor level. This peaking factor was selected during the MSD Odor Control Master Plan work and is used on all MSD treatment plant air dispersion models.

Another modeling routine also predicts the frequency of odor events for the areas surrounding the plant. In other words, it predicts the number of times per year odors may be detectable for at least a fifteen second period at any point around the site. For example, a person standing at a point where a frequency of 100 is predicted would be expected to experience an odor that exceeds the selected odor detection threshold 100 times (or during 100 hours) per year. In this study, an odor detection threshold of twenty (20) DT has been selected. An odor with a detection threshold of seven dilutions or less may not be detected because it could be overwhelmed by other natural odors in the area such as grass, trees, soil and flowers, or it may not be detectable at all.

2.5.3 Modeling Protocol

The modeling scenarios were completed with the following modeling protocol settings:

- Peak-to-mean multiplier of:
  (Averaging Period / Peak Duration) $^{0.5}$ = (60 min / 3 min) $^{0.5}$ = **4.47**, based on one hour averaging period, 3 minute average peak duration, and 0.5 power factor. This peaking factor was selected to comply with the modeling protocol set forth in MSD's Odor Control Master Plan (Refer to Final Report – Odor Control Master Plan – Phase 2, dated July 2002)
- Flat terrain option
- 1994 surface and mixing height meteorological data, collected from the Louisville International airport (closest available meteorological data).
- Threshold of 20 DT was used for the odor frequency modeling. This value was selected by MSD based on past experience, values used by other communities and general industrial location of the plant site.

3.0 PRESENTATION OF TESTING RESULTS

3.1 Plant Conditions During Air Testing

3.1.1 Round 1 Plant Conditions

The Round 1 sampling was conducted on July 22 and 23, 2008. On these two days there were mostly sunny skies with high temperatures in the mid-80s. The old headworks facility was out of service, which is normal during dry weather, and all four primary clarifiers were in service. MSD wanted to test a clarifier with a low sludge blanket depth (DOB) and one with a high DOB to determine if that had an impact on odor and H_2S emissions. On the day of testing, clarifier #1 had a DOB of 1 ft. and clarifier #4 had a DOB of 5.5 ft. therefore these two clarifiers were tested.

There were two centrifuges and two dryer trains in service during testing on July 22nd but only one train was in service on the 23rd. All 12 of the MEB 6th floor exhaust fans were in service and all 7 of the fans that feed the MEB Exhaust Plenum were in service. All fans on the roof of the old grit building were in service as were the two exhaust fans on roof of new screen/grit building. The lower level (screen room) air intake duct was covered with grease at time of sampling.

There was foam/sludge on top of all four digesters. The foam was about 11 ft out from the wall on Digester #1, 6 ft on #2 and #3, and 12 ft on #4. Venting was observed coming out of the air release valves on digesters #1 and #2.

Two dissolved air flotation thickeners (DAFT) were in service.

The SHOC seemed to be operating normally during testing with a pH of 1.6 for the tested unit (#1). The recirculation flow rate was 111 gpm and purge rate was 1.68 gpm. The air sample was collected from the outlet of unit #1.

The BOC seemed to be operating normally during this testing. On the day of the test there were no operating alarms. The pH of both upper stages was about 6 and the pH of the lower stages was about 2 during testing which is within the desired normal operating range. The water spray times were 45 seconds (every 10 minutes) for the upper stage and 30 seconds for the lower stage. The nutrient feed times were 26 seconds for upper stage and 17 seconds for lower stage. The outlet air from BOC #1 was sampled.

3.1.2 Round 2 Plant Conditions

The Round 2 sampling was conducted on August 19 and 20, 2008. On these two days there were mostly sunny skies with high temperatures in the low 90s. The old headworks facility was out of service and three of four primary clarifiers were in service. Clarifier #1 had a DOB of 4 ft. on the inlet end and 3.5 ft on the outlet end. Clarifier #4 had a DOB of 5ft. on the inlet end and 6 ft on the outlet end.

There were two centrifuges and dryer trains in service during testing and 11 of the 12 MEB 6^{th} floor exhaust fans were in service. All 7 of the fans that feed the MEB Exhaust Plenum were in service. All fans on the on the roof of the old grit building were in service as were the two exhaust fans on roof of new screen/grit building. The lower level (screen room) air intake duct was covered with grease at time of sampling.

There was foam/sludge on top of all four digesters. The foam was about 12 ft out from the wall on Digester #1 and #4 and 6 ft on #2 and #3.

Two DAFT tanks were in service.

The SHOC seemed to be operating normally during testing with a pH of 1.9 and 1.5 for units #1 and #2, respectively. The recirculation flow rates were 110 and 122 gpm and purge rates were 4.1 and 4.0 gpm. The air sample was collected from the outlet of unit #1.

The BOC seemed to be operating a little inconsistently during this testing. Inlet H_2S concentrations were inconsistent and the BOC was having some difficulty handling the spikes. On the day before the test a high outlet H_2S alarm had been received and there were some low water flow alarms. The pH of both upper stages was about 6 and the pH of the lower stages was about 2 during testing which is the desired normal operating range. The water spray times were 45 seconds (every 10 minutes) for the upper stage and 30 seconds for the lower stage. The nutrient feed times were 26 seconds for upper stage and 17 seconds for lower stage. Within a couple weeks of the test, Bioway increased these times significantly to improve performance. The outlet air from BOC #1 was sampled.

3.2 Air Sampling Test Results

3.2.1 Odor Panel Test Results

Twenty four (24) air samples were collected for odor panel analyses during Round 1 and twenty six (26) samples were collected during Round 2. The odor panel test results are shown in **Table 1,** on the following page. The reports from St Croix Sensory are included in **Appendix B**.

Table 1 – Round 1 and Round 2 Odor Panel Test Results			
Location No.	Sample Description	July 2008 Detection Threshold	August 2008 Detection Threshold
1	Plant Influent Channel & Junc.	1,700	76,000
2	Grit Loading Bldg. - Grit Dumpster	1,800	4,600
3	Grit Loading Bldg. - Screenings Dumpster	1,600	4,100
4	New Grit Chambers + Channels	1,100	10,000
5	Primary Clarifier #1 Inlet	5,000	7,700
6	Primary Clarifier #1 Middle	210	6,200
7	Primary Clarifier #1 Outlet	1,800	4,700
8	Primary Clarifier #1 Effluent Weir	6,500	23,000
9	Primary Clarifier #4 Inlet	4,300	7,200
10	Primary Clarifier #4 Middle	1,100	4,900
11	Primary Clarifier #4 Outlet	2,500	7,200
12	Primary Clarifier #4 Effluent Weir	13,000	96,000
13	Primary Clarifier Effluent Channel	9,300	13,000
14	Bioroughing Tower Effluent Channel	4,300	8,900
15	New Headworks Exhaust Lower Level	470	1,600
16	New Headworks Exhaust Upper Level	1,700	4,700
17	Old Headworks Building Exhaust	4,200	5,300
18	Primary Clarifier Influent Channel	8,000	8,600
19	BOC Outlet	5,100	7,500
20	DAFT Room Exhaust (Strobic Air Fan)	430	900
21	MEB Exhaust Plenum	150	330
22	MEB Dryer Area Roof Exhaust Fans	710	1,100
23	Annular Space For Digesters	160,000	94,000
24	SHOC Outlet	4,100	5,700
25	SWPS Exhaust	Not tested	180
26	Diversion Structure CSO Structure	Not tested	2,700

3.2.2 Odor Emission Rates

Odor emission rates (OER) are calculated by multiplying the detection threshold (DT) of the air source by the air flow rate from that source. OER is a better indicator of how much of a problem a particular source may be than DT because it factors in the air flow rate. A source with a very high DT may not be a problem if the air flow rate is very low. Conversely, a source with a relatively low DT may cause problems if the air flow rate is very high. When multiple samples were collected from a single source, such as the primary clarifier surface, the DT values were averaged and the average value was used in the OER calculation. The OER of the Southwestern Pump Station and Diversion Structure CSO were not calculated since these are not on the MFWQTC site.

Table 2 shows the OER from all tested sources for the Round 1 testing in July 2008 and **Table 3** shows the OER for Round 2 testing in August 2008. **Figure 2** shows the OERs for both rounds of testing in Chart format. The procedures used to calculate the air flow rates from the individual sources are shown in **Appendix C**.

3.2.3 Hydrogen Sulfide Mass Emission Rates

Hydrogen sulfide is the dominant odor compound in most municipal wastewater treatment plant air emissions. H_2S mass emission rates are calculated using the following formula:

$$ME\ (\text{lbs/hr}) = \frac{\text{Air Flow Rate (cfm)} * H_2S\ (\text{ppm}) * 34\ \text{lb/lbmole} * 359\ \text{lbs/ft}^3 * 60\ \text{min/hr}}{1{,}000{,}000}$$

The H_2S mass emission rates for Round 1 and Round 2 are shown on **Tables 4** and **5**, respectively and on **Figure 3**.

3.2.4 Reduced Sulfur Compound Test Results

The RSC test reports provided by Mayfly are included in **Appendix D**. The results show there are six (6) reduced sulfur compounds that appear in significant concentrations. These compounds are:

- Hydrogen Sulfide (Smells like rotten eggs)
- Carbonyl Sulfide (COS)
- Methanethiol (methyl mercaptan)(smells like rotten cabbage)
- Dimethyl Sulfide (Smells like cabbage)
- Carbon Disulfide (Smells like chloroform or rotten eggs)
- Dimethyl Disulfide (Smells like cabbage)

The Round 1 RSC results are summarized on **Table 6** and the Round 2 results are summarized on **Table 7**.

Table 2 – Round 1 (July 2008) Odor Emission Rates				
Sample Description	Air Flow Rate (cfm)	July 2008 Detection Threshold	July 2008 Odor Emission Rate (DT*cfm)	Percentage of Total
MEB Dryer Area Roof Exhaust Fans	360,000	710	255,600,000	39.71%
Annular Space For Digesters	681	160,000	109,018,223	16.94%
BOC Outlet	20,000	5,100	102,000,000	15.85%
MEB Exhaust Plenum	374,000	150	56,100,000	8.72%
SHOC Outlet	9,200	4,100	37,720,000	5.86%
Primary Clarifier Surface (Average using high DOB)	9,227	2,633	24,297,100	3.77%
Old Headworks Building Exhaust	5,000	4,200	21,000,000	3.26%
DAFT Room Exhaust (Strobic Air Fan)	39,400	430	16,942,000	2.63%
New Headworks Exhaust From Upper Level	4,850	1,700	8,245,000	1.28%
Primary Clarifier Effluent Weirs	493	13,000	6,411,726	1.00%
Primary Clarifier Effluent Channel	237	9,300	2,205,300	0.34%
New Headworks Exhaust Lower Level	4,650	470	2,185,500	0.34%
Bioroughing Tower Effluent Channel	237	4,300	1,019,655	0.16%
New Grit Chambers + Channels	425	1,100	467,946	0.07%
Plant Influent Channel & Junc.	200	1,700	340,000	0.05%
Grit Loading Bldg. - Grit Dumpster	33	1,800	59,077	0.01%
Grit Loading Bldg. - Screenings Dumpster	33	1,600	52,513	0.01%
		Total	643,664,041	100%

Note 1 – Detection Threshold is based on the average of 3 samples using the tank with highest depth of sludge blanket.

Table 3 – Round 2 (August 2008) Odor Emission Rates				
Sample Description	Air Flow Rate (cfm)	August 2008 Detection Threshold	August 2008 Odor Emission Rate (DT*cfm)	Percentage of Total
MEB Dryer Area Roof Exhaust Fans	330,000	1,100	363,000,000	37.16%
BOC Outlet	20,000	7,500	150,000,000	15.36%
MEB Exhaust Plenum	374,000	330	123,420,000	12.64%
Annular Space For Digesters	681	94,000	64,048,206	6.56%
Primary Clarifier Surface (See Note 1)	9,227	6,433	59,358,737	6.08%
SHOC Outlet	9,200	5,700	52,440,000	5.37%
Primary Clarifier Effluent Weirs	493	96,000	47,348,131	4.85%
DAFT Room Exhaust (Strobic Air Fan)	39,400	900	35,460,000	3.63%
Old Headworks Building Exhaust	5,000	5,300	26,500,000	2.71%
New Headworks Exhaust From Screen Room	4,850	4,700	22,795,000	2.33%
Plant Influent Channel & Junc.	200	76,000	15,200,000	1.56%
New Headworks Exhaust Lower Level	4,650	1,600	7,440,000	0.76%
New Grit Chambers + Channels	425	10,000	4,254,059	0.44%
Primary Clarifier Effluent Channel	237	13,000	3,082,678	0.32%
Bioroughing Tower Effluent Channel	237	8,900	2,110,449	0.22%
Grit Loading Bldg. - Grit Dumpster	33	4,600	150,975	0.02%
Grit Loading Bldg. - Screenings Dumpster	33	4,100	134,565	0.01%
		Total	976,742,799	100%

Note 1 – Detection Threshold is based on the average of 3 samples using the tank with highest depth of sludge blanket.

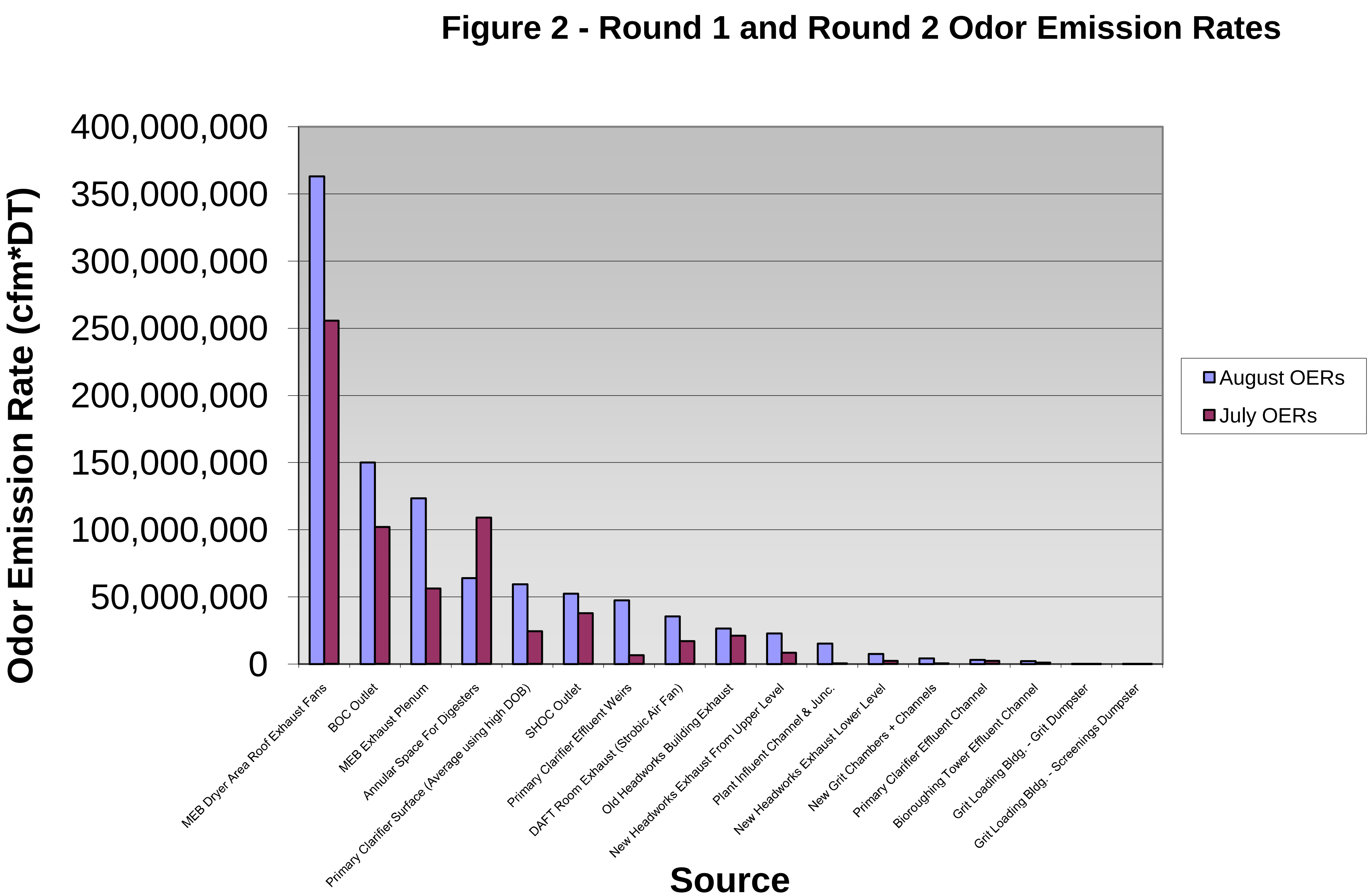


Figure 2 - Round 1 and Round 2 Odor Emission Rates
Odor Emission Rate (cfm*DT)
400,000,000
350,000,000
300,000,000
250,000,000
200,000,000
150,000,000
100,000,000
50,000,000
0
August OERs
July OERs
MEB Dryer Area Roof Exhaust Fans
BOC Outlet
MEB Exhaust Plenum
Annular Space For Digesters
Primary Clarifier Surface (Average using high DOB)
SHOC Outlet
Primary Clarifier Effluent Weirs
DAFT Room Exhaust (Strobic Air Fan)
Old Headworks Building Exhaust
New Headworks Exhaust From Upper Level
Plant Influent Channel & Junc.
New Headworks Exhaust Lower Level
New Grit Chambers + Channels
Primary Clarifier Effluent Channel
Bioroughing Tower Effluent Channel
Grit Loading Bldg. - Grit Dumpster
Grit Loading Bldg. - Screenings Dumpster
Source

Table 4 – Round 1 H_2S Mass Emissions				
Sample Description	Air Flow Rate (cfm)	July 2008 H_2S From Mayfly (ppm)	Mass H_2S Emissions (lbs/day)	Percentage of Total
Annular Space For Digesters	681	175	16.262	52.55%
MEB Dryer Area Roof Exhaust Fans	360,000	0.119	5.842	18.88%
MEB Exhaust Plenum	374,000	0.070	3.570	11.54%
Primary Clarifier Effluent Weirs	493	25	1.682	5.43%
Primary Clarifier Surface (Average Using Low DOB)	9,227	1.102	1.386	4.48%
BOC Outlet	20,000	0.310	0.846	2.73%
Old Headworks Building Exhaust	5,000	0.614	0.419	1.35%
DAFT Room Exhaust (Strobic Air Fan)	39,400	0.071	0.382	1.23%
Primary Clarifier Effluent Channel	237	5.9	0.191	0.62%
New Headworks Exhaust Upper Level	4,850	0.214	0.142	0.46%
SHOC Outlet	9,200	0.062	0.078	0.25%
New Headworks Exhaust Lower Level	4,650	0.101	0.064	0.21%
Bioroughing Tower Effluent Channel	237	1.60	0.052	0.17%
Plant Influent Channel & Junc.	200	0.553	0.015	0.05%
New Grit Chambers + Channels	425	0.204	0.012	0.04%
Grit Loading Bldg. - Grit Dumpster	33	0.365	0.002	0.01%
Grit Loading Bldg. - Screenings Dumpster	33	0.182	0.001	0.00%
		Total	30.943	100%

Note 1 – H_2S is based on the average of 3 samples using the tank with highest depth of sludge blanket.

Table 5 – Round 2 H_2S Mass Emissions				
Sample Description	Air Flow Rate (cfm)	August 2008 H_2S From Mayfly (ppm)	Mass H_2S Emissions (lbs/day)	Percentage of Total
Annular Space For Digesters	681	246	22.859	19.66%
Primary Clarifier Effluent Weirs	493	326	21.928	18.86%
Plant Influent Channel & Junc.	200	581	15.847	13.63%
MEB Dryer Area Roof Exhaust Fans	330,000	0.288	12.961	11.15%
MEB Exhaust Plenum	374,000	0.188	9.589	8.25%
Primary Clarifier Surface (See Note 1)	9,227	4.983	6.271	5.39%
New Grit Chambers + Channels	425	104	6.034	5.19%
Primary Clarifier Effluent Channel	237	114	3.687	3.17%
New Headworks Exhaust Upper Level	4,850	3.5	2.315	1.99%
DAFT Room Exhaust (Strobic Air Fan)	39,400	0.368	1.977	1.70%
Old Headworks Building Exhaust	5,000	2.2	1.500	1.29%
Bioroughing Tower Effluent Channel	237	12.0	0.388	0.33%
New Headworks Exhaust Lower Level	4,650	0.6	0.349	0.30%
BOC Outlet	20,000	0.126	0.344	0.30%
SHOC Outlet	9,200	0.112	0.141	0.12%
Grit Loading Bldg. - Grit Dumpster	33	0.169	0.001	0.00%
Grit Loading Bldg. - Screenings Dumpster	33	0.220	0.001	0.00%
		Total	116.262	100%

Note 1 – H_2S is based on the average of 3 samples using the tank with highest depth of sludge blanket.

Figure 3 - H2S Mass Emissions

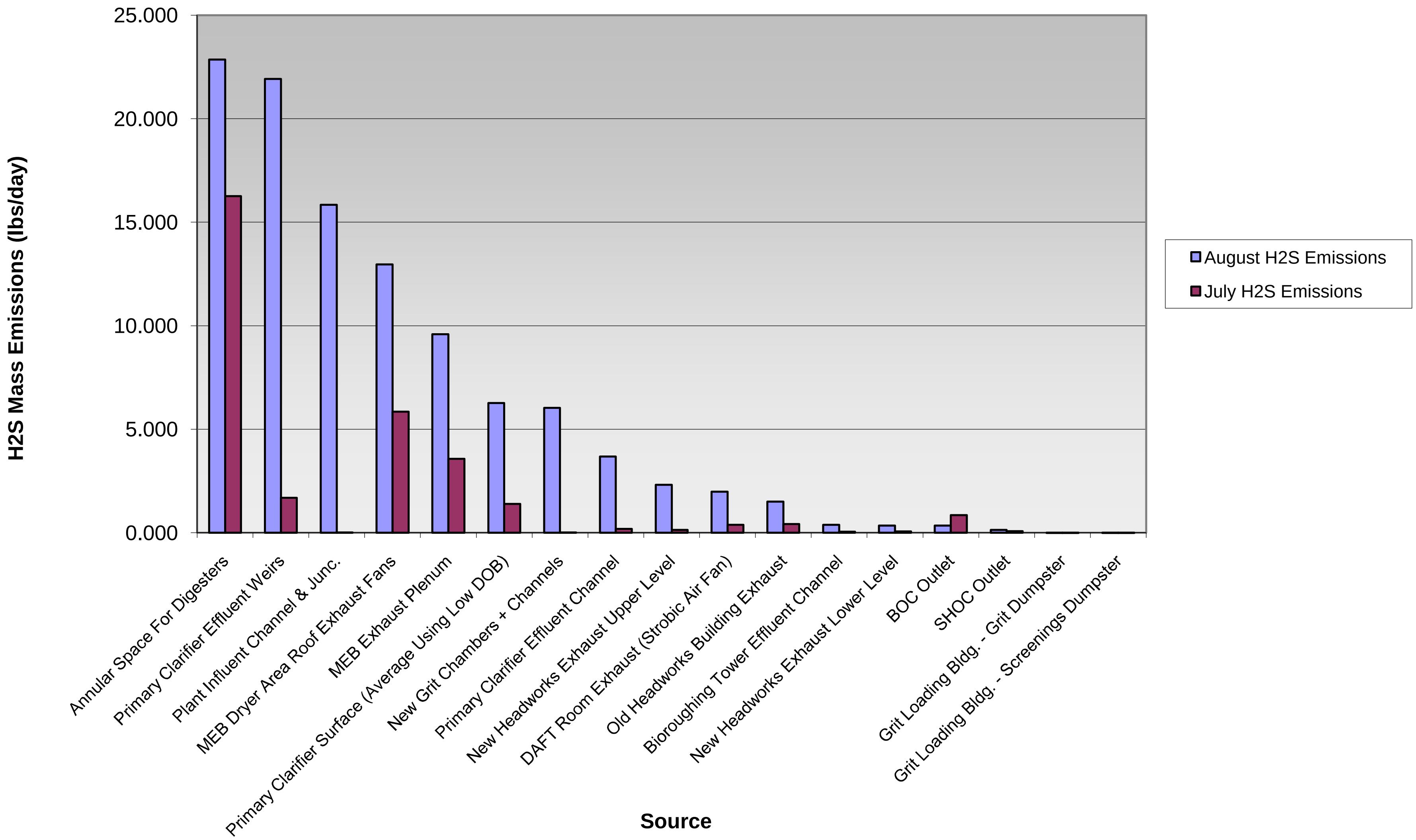


Table 6
Reduced Sulfur Compounds
Round 1 Results

Location	Compound (ppb)					
	H_2S	COS	MM	DS	CD	DD
Plant Influent Channel & Junc.	553	1.5	176	9.4	5.5	2.2
Grit Loading Bldg. - Grit Dumpster	365	2.7	156	29	4.1	1.1
Grit Loading Bldg. - Screenings Dumpster	182	1.1	212	14	5.3	3.3
New Grit Chambers + Channels	204	0.7	126	7.4	2.9	0.5
Primary Clarifier #1 Inlet	2,900	0.9	175	3.2	4.7	0.1
Primary Clarifier #1 Middle	67	0.6	4	3.4	1	<0.1
Primary Clarifier #1 Outlet	338	0.8	4	23	4.8	0.2
Primary Clarifier #1 Effluent Weir	6,800	2.7	454	44	20	1.6
Primary Clarifier #4 Inlet	1,900	2.2	47	5.3	5.2	<0.1
Primary Clarifier #4 Middle	177	0.5	41	4.8	1.2	<0.1
Primary Clarifier #4 Outlet	442	0.6	37	6.4	8.6	<0.1
Primary Clarifier #4 Effluent Weir	25,000	6.6	1970	214	42	13
Primary Clarifier Effluent Channel	5,900	0.1	259	28	2.2	1.6
Bioroughing Tower Effluent Channel	1,600	2	315	26	11	0.3
New Headworks Exhaust Lower Level	101	<1	18	<1	0.6	0.1
New Headworks Exhaust Upper Level	214	<1	42	<1	0.9	<0.1
Old Headworks Building Exhaust	614	0.4	4	<1	0.9	<0.1
Primary Clarifier Influent Channel	2,100	0.7	348	12	3	0.6
BOC Outlet	310	5.1	451	128	59	5.8
DAFT Room Exhaust (Strobic Air Fan)	71	0.2	26	<1	0.5	<0.1
MEB Exhaust Plenum	70	0.6	3.7	<1	2.1	<0.1
MEB Dryer Area Roof Exhaust Fans	119	0.8	3.7	<1	3.5	0.8
Annular Space For Digesters	175,000	0.9	INF	<1	39	0.5
SHOC Outlet	62	0.9	84	65	7.7	3.1

Table 7
Reduced Sulfur Compounds
Round 2 Results

Location	Compound (ppb)					
	H_2S	COS	MM	DS	CD	DD
Plant Influent Channel & Junc.	580,915	167	3,549	38	279	2.0
Grit Loading Bldg. - Grit Dumpster	169	21	207	186	66	2.0
Grit Loading Bldg. - Screenings Dumpster	220	22	180	42	23	11
New Grit Chambers + Channels	104,398	46	1,040	9.8	27	0.3
Primary Clarifier #1 Inlet	4,050	14	84	2.5	4.4	0.1
Primary Clarifier #1 Middle	8,647	14	121	0.3	2.7	0.1
Primary Clarifier #1 Outlet	2,342	13	53	0.2	3.7	<0.1
Primary Clarifier #1 Effluent Weir	11,725	328	480	91	176	10
Primary Clarifier #4 Inlet	5,026	20	96	1.8	12	1.3
Primary Clarifier #4 Middle	1,983	24	96	1.3	132	0.2
Primary Clarifier #4 Outlet	5,968	43	84	5.9	75	0.1
Primary Clarifier #4 Effluent Weir	325,515	178	<5,000	77	222	17
Primary Clarifier Effluent Channel	113,547	67	1,853	23	48	2.3
Bioroughing Tower Effluent Channel	11,950	22	795	42	10	2.9
New Headworks Exhaust Lower Level	551	8.2	9.0	<3	2.2	<1
New Headworks Exhaust Upper Level	3,505	13	52	<3	2.1	<1
Old Headworks Building Exhaust	2,166	19	42	<3	61	<1
Primary Clarifier Influent Channel	49,428	63	1,426	15	79	<0.1
BOC Outlet	126	212	216	89	63	<0.1
DAFT Room Exhaust (Strobic Air Fan)	368	7.5	47	<0.1	2.3	<0.1
MEB Exhaust Plenum	188	11	20	<0.1	4.9	0.3
MEB Dryer Area Roof Exhaust Fans	288	17	26	3	96	1.3
Annular Space For Digesters	245,966	50	<5,000	60	85	0.2
SHOC Outlet	112	14	210	60	4.7	4.9
SWPS Exhaust	112	4.6	3	<1	1	<1
Diversion Structure CSO Structure	999	18	62	1.1	44	<1

3.3 Community Odor Survey Results

Three community odor surveys were conducted on the days that air samples were collected for this project. Eleven (11) locations were monitored during each survey. These locations were the same as those that were monitored during the completion of the MFWQTC Community Odor Survey project that was completed from April 1999 through June 2000. The locations are shown on **Table 8**:

Table 8 – Community Odor Survey Monitoring Stations			
Station #	Location	Direction (Degrees) (a)	Distance from Bioroughing Tower (miles)
1	Southwestern Parkway at Chickasaw Park exit	196	0.62
2	Southwest corner of Fairland and Winrose	208	0.67
3	South of Sunset, east of 43rd St.	213	0.96
4	1309 Cecil Avenue	231	0.81
5	3612 Dumesnil	245	1.12
6	East of 39th St. and Stratton Ave.	277	0.68
7	Intersection of Belquin Road and Belquin Place	307	0.83
8	Campground Road, east of I-64 @ Williams Transicold	333	1.22
9	Campground Road, west of Likens	6	1.11
10	Bells Lane, @ Chevron entrance across from Zeon Chemical	331	0.57
11	Bells Lane, near LG&E Paddy's Run Station	48	0.64

Direction is the compass direction from the Monitoring Station to the Bioroughing Towers at the MFWQTC where 0º is due north. This also then relates to the direction wind is coming from at each station.

During each survey, measurements of the following conditions were made at each station.

- Hydrogen sulfide (H_2S)
- Odor intensity
- Odor character
- Odor source
- Wind speed
- Wind direction
- Ambient temperature
- Weather conditions, time and date are noted

The results of each survey were recorded on the data collection forms included in **Appendix E**.

3.4 Liquid Sampling Test Results

Liquid samples were collected from the inlet and outlet end of the primary clarifiers during each round and tested for total sulfides (TS) using a LaMotte Model P-70 sulfide test kit. The results of this testing are shown on **Table 9**.

Table 9 – Liquid Sampling Test Results

	Round 1		Round 2	
Location	TS(mg/L)	DOB (ft)	TS(mg/L)	DOB (ft)
Primary #1 Inlet	0.3	1	4.0	4
Primary #1 Outlet	0.1	1	1.5	3.5
Primary #4 Inlet	0.3	5.5	4.0	5
Primary #4 Outlet	0.1	5.5	1.5	6

DOB – Depth of Sludge Blanket

3.5 Odalog Monitoring Results

1. MSD and WEA have implemented a thorough Odalog monitoring program for the MFWQTC site to assist them in tracking H_2S emissions, identifying trends and hotspots and studying the relationship between various processes. Although odalog monitoring has been occurring at the MFWQTC for years, this formal odalog monitoring program began in June 2008 and continues as this report is being written.

2. The monitoring program consists of the installation of Odalog H_2S monitors at several key locations around the plant. Some locations have been added or subtracted throughout the monitoring but the following eight locations were monitored throughout most of the monitoring period:

   - Inside the truck unloading station wetwell (Truck Unloading)
   - Inside the solids receiving tank (SRT)
   - Inside the solids holding tank (SHT) – Contains TWAS only
   - Inside the solids blend well just upstream of the centrifuges (Blend Well) – Contains TWAS plus digested primary sludge
   - Discharge of exhaust fan in centrifuge room (MEB Solids)
   - Inlet to Solids Handling Odor Control (SHOC Inlet)
   - Outlet from Solids Handling Odor Control (SHOC Outlet)
   - Inlet to Biotower Odor Control (BOC Inlet)

3. The odalogs are installed and set to log an H_2S reading every five (5) minutes. After six days the odalog is removed and downloaded. After setting out for at least 24 hours to allow the sensor to rest, the odalog is reinstalled for another week.

4. The results of this odalog monitoring are summarized on **Table 10**. The odalog data has been copied into a spreadsheet and charts have been

TABLE 10 - MFWTP Odalog Results Summary

SHOC Inlet				SHOC Outlet				MEB Solids Exhaust				Blend Well			
Session	Length of	Hydrogen Sulfide		Session	Length of	Hydrogen Sulfide		Session	Length of	Hydrogen Sulfide		Session	Length of	Hydrogen Sulfide	
Ending Date	Session (Days)	Peak (ppm)	Average (ppm)	Ending Date	Session (Days)	Peak (ppm)	Average (ppm)	Ending Date	Session (Days)	Peak (ppm)	Average (ppm)	Ending Date	Session (Days)	Peak (ppm)	Average (ppm)
6/10/2008	7	77	14.1	6/9/2008	No Data			6/9/2008	7	137.1	35.86	6/9/2008	No data		
6/16/2008	7	88	42.7	6/16/2008	7	30.7	2.44	6/16/2008	7	233.7	120.58	6/16/2008	No data		
6/23/2008	7	140	40.4	6/23/2008	7	19.2	1.89	6/23/2008	1	105.8	97.7	6/23/2008	No data		
6/30/2008	7	68	29.2	6/30/2008	7	2	1.08	6/30/2008	7	138	66.1	6/30/2008	No data		
7/7/2008	7	271	24.2	7/7/2008	7	54.9	0.52	7/7/2008	7	115	70.2	7/7/2008	No data		
7/14/2008	7	78	14.4	7/14/2008	7	0.6	0.08	7/14/2008	7	93	34.6	7/14/2008	No data		
7/21/2008	7	104	30.7	7/21/2008	7	0.6	0.09	7/21/2008	7	248	91.6	7/21/2008	5	205	91.1
7/28/2008	7	180	81.9	7/28/2008	7	0.6	0.09	7/28/2008	5	486	269.8	7/28/2008	4	285.8	244.41
8/4/2008	7	174	63	8/4/2008	7	0.9	0.07	8/4/2008	7	312	94.8	8/4/2008	7	495	317.6
8/11/2008	7	188	44.1	8/11/2008	7	0.9	0.06	8/11/2008	7	257	140.8	8/11/2008	7	238.1	215.65
8/18/2008	7	253	125	8/18/2008	7	2	0.55	8/18/2008	7	333	195	8/18/2008	7	530.6	515.47
8/25/2008	No Data			9/2/2008	9	0.9	0.22	8/25/2008	7	271	261.47	8/25/2008	7	681	363.3
9/1/2008	14	135	75.2	9/9/2008	7	0.4	0.05	9/2/2008	8	240.9	203.81	9/2/2008	8	361	256.3
9/8/2008	7	216	128.8	9/15/2008	7	0.6	0.15	9/9/2008	6	243	228.85	9/9/2008	6	427	273.3
9/15/2008	7	164	94.4	9/22/2008	7	0.8	0.22	9/15/2008	7	243.4	211.55	9/15/2008	7	410	298.7
9/22/2008	7	577	229.4	9/29/2008	7	1.1	0.17	9/22/2008	7	245.2	232.01	9/22/2008	7	396	289
9/29/2008	7	269	90.5	10/6/2008	7	22.1	0.78	9/29/2008	7	301.8	270.31	9/29/2008	7	655	353.5
10/13/2008	6	60.0	5.5	10/13/2008	7	1.1	0.08	10/13/2008	6	543.0	223.1	10/13/2008	6	636.9	354.03
10/20/2008	7	465.0	110.9	10/20/2008	7	0.0	0	1/20/2008	6	498	292.8	10/20/2008	6	645.9	429.22
1/27/2008	7	116.0	23	10/27/2008	7	3.6	0.13	10/27/2008	6	404	292.8	10/27/2008	6	636.9	354.03
11/3/2008	7	239.0	41.7	11/3/2008	7	3.3	0.07	11/3/2008	6	261	164.7	11/3/2008	6	492.1	332.99
11/10/2008	7	103.0	23.7	11/10/2008	7	1.7	0.15	11/10/2008	6	359	278.2	11/10/2008	6	764.7	457.43
11/17/2008	7	302.0	44	11/17/2008	7	1.5	0.02	11/17/2008	6	339	169	11/17/2008	6	939	419.4
11/24/2008	7	26.0	7.2	11/24/2008	7	1.2	0.09	11/24/2008	7	377	227.4	11/24/2008	7	648.5	371.26
12/1/2008	7	123.0	37.9	12/1/2008	7	0.1	0	12/1/2008	7	285	156.2	12/1/2008	7	285	156.2
12/8/2008	7	63.0	16.7	12/8/2008	7	0.7	0.06	12/8/2008	7	585	138.8	12/8/2008	7	1000	416
12/15/2008	7	293.0	29	12/15/2008	7	5.7	0.04	12/15/2008	7	154	86.3	12/15/2008	7	608	280.5
12/22/2008	7	0.7	0.04	12/22/2008	7	5.7	15.5	12/22/2008	7	162	85.2	12/22/2008	7	315	159.1
12/29/2008	7	7.0	0.5	12/29/2008	7	1.0	0	12/29/2008	7	90	42.1	12/29/2008	7	355	170.2
1/12/2009	7	10.0	2.2	1/12/2009	7	0.0	0	1/12/2009	7	48	20.4	1/12/2009	7	181	97.7
1/19/2009	7	3.0	0.4	1/19/2009	7	0.3	0.01	1/19/2009	No Data			1/19/2009	7	188	121.4
1/26/2009	7	90.0	11.7	1/26/2009	7	1.2	0.02	1/26/2009	7	335	204.5	1/26/2009	7	112	54.8
2/2/2009	7	149.0	23.9	2/2/2009	7	0.9	0.03	2/2/2009	7	127	36.4	2/2/2009	7	283	139.6
Total Days	230	Daily Average	47.07	Total Days	226	Daily Average	0.77	Total Days	217	Daily Average	160.81	Total Days	185	Daily Average	280.15

TABLE 10 - MFWTP Odalog Results Summary

Solids Receiving Tank				Solids Holding Tank				Truck Unloading Station Wetwell				Biotower Odor Control Inlet			
Session	Length of	Hydrogen Sulfide		Session	Length of	Hydrogen Sulfide		Session	Length of	Hydrogen Sulfide		Session	Length of	Hydrogen Sulfide	
Ending Date	Session (Days)	Peak (ppm)	Average (ppm)	Ending Date	Session (Days)	Peak (ppm)	Average (ppm)	Ending Date	Session (Days)	Peak (ppm)	Average (ppm)	Ending Date	Session (Days)	Peak (ppm)	Average (ppm)
6/9/2008	7	63.0	2.58	6/9/2008	No Data			6/9/2008	7	212	7	6/9/2008	7	26.7	7.32
6/16/2008	7	47.0	0.9	6/16/2008	7	114.1	19.48	6/16/2008	7	279	11.2	6/16/2008	7	55.1	12.88
6/23/2008	7	122.6	2.44	6/23/2008	7	12	3.3	6/23/2008	7	277	5.4	6/23/2008	7	25.3	2.98
6/30/2008	7	0.0	0.0	6/30/2008	7	38.1	8.5	6/30/2008	7	234	8.9	6/30/2008	7	26.2	5.2
7/7/2008	7	279.0	2.6	7/7/2008	7	19.9	3.61	7/7/2008	7	217.4	8.66	7/7/2008	7	23	4.5
7/14/2008	7	104.0	0.6	7/14/2008	7	5	1.2	7/14/2008	7	246	11.41	7/21/2008	7	40	6.7
7/21/2008	7	138.2	1.3	7/21/2008	7	84.9	15.5	7/21/2008	7	277	12.8	7/28/2008	5	119.1	22.42
7/28/2008	7	88.8	1.2	7/28/2008	6	530.1	185.77	7/28/2008	5	502	20.4	8/4/2008	7	11.4	1.37
8/4/2008	7	21.7	0.1	8/4/2008	7	63.4	13.03	8/4/2008	7	529.8	29.57	8/11/2008	7	31.6	7.97
8/11/2008	7	264.2	4.6	8/11/2008	7	335.6	45.97	8/11/2008	7	500	22.8	8/18/2008	7	84.6	15.9
8/18/2008	7	0.0	0.0	8/18/2008	7	158.5	45.31	8/18/2008	7	295.4	16.43	9/2/2008	8	131.2	36.44
8/25/2008	7	0.3	0.0	8/25/2008	7	289.8	88.73	8/25/2008	7	502	34.9	9/9/2008	6	133.2	32.3
9/2/2008	1	3.6	2.6	9/2/2008	8	162	63.8	9/2/2008	8	293.8	14.76	9/15/2008	7	63.4	20.13
9/9/2008	6	0.0	0.0	9/9/2008	6	295.6	124.39	9/9/2008	6	273.3	17.72	9/22/2008	7	133.3	40.31
9/15/2008	7	45.0	0.2	9/15/2008	7	270.9	160.39	9/15/2008	7	301	20.46	9/29/2008	7	130.2	37.18
9/22/2008	7	9.0	6.1	9/22/2008	7	296.7	147.34	9/22/2008	7	274.5	20.61	10/6/2008	7	0.8	0.01
9/29/2008	7	22.1	0.3	9/29/2008	7	243.7	188.2					9/29/2008	No Data		
10/13/2008	6	465.0	110.90									10/13/2008	6	45.9	0.058
10/20/2008	6	60.0	5.50									10/2/2008	6	0.7	0.00
10/27/2008	6	130.1	11.54									10/27/2008	6	0.9	0.01
11/3/2008	6	147.2	10.88												
11/17/2008	6	118.3	1.44												
11/24/2008	7	0.1	0.00												
12/1/2008	7	1.0	0.00												
12/8/2008	7	1.5	0.01												
12/22/2008	7	0.0	0.00												
12/29/2008	7	41.9	0.36												
1/19/2009	7	3.4	0.36												
2/2/2009	7	157.6	8.11												
Total Days	191	Daily Average	6.02	Total Days	111	Daily Average	69.66	Total Days	110	Daily Average	16.44	Total Days	128	Daily Average	13.35

created which show the results for each month from July through October. These charts show multiple sources and their relationship to each other. The overlay charts for these months are included in **Appendix F**.

3.6 SHOC and BOC Performance Test Results

3.6.1 Solids Handling Odor Control (SHOC) Performance Test Results

The SHOC system is a 3-stage biotrickling scrubber designed to treat up to 9,200 cfm of air drawn from various solids handling sources. These sources include the truck unloading station, solids receiving tanks, solids holding tanks, centrifuge vents, blend well, dewatered sludge cake conveyors and wet material bins. The system includes two vessels and approximately 50 % of the air is treated in each vessel.

The SHOC system was completely rebuilt in the fall of 2007 and spring of 2008. After a lengthy startup period the system was performance tested by Webster Environmental Associates in August 2008. A summary of the results is shown on **Table 11** and the complete test report is included in **Appendix G**.

On September 23, 2008 air samples were collected from the SHOC inlet and outlet to confirm system was still performing as well as expected. A summary of the results from the follow-up test is shown on **Table 12**.

Table 12 - SHOC Follow-up Testing Results

Compound	September 22 Results Removal Efficiency (%)		August 14 Results Removal Efficiency (%)	
	Unit #1	Unit #2	Unit #1	Unit #2
Hydrogen Sulfide	99.92	99.92	99.97	99.95
Methyl Mercaptan	99.0	98.61	92.18	89.52
Dimethyl Sulfide	52.8	57.4	5.94	-17.82
Carbon Disulfide	93.4	95.1	78.98	98.41
Dimethyl Disulfide	96.1	84.7	33.33	38.1
Total RSC (Not Including H_2S)	91.59	91.57	85.17	83.03

3.6.2 Biotower Odor Control (BOC) Performance Test Results

The BOC is a 2-stage biotrickling scrubber manufactured by Bioway America. It was installed in 2007/2008 to replace one of the existing chemical scrubbers and is designed to treat up to 20,000 cfm of air drawn from the bioroughing towers and includes two vessels that treat 10,000 cfm each.

The BOC system was performance tested on September 3 and 4, 2008 by Bowker and Associates under subcontract to ADM, the contractor on the

TABLE 11
Louisville and Jefferson County MSD - Morris Forman WWTP
SHOC Performance Testing - Reduced Sulfur Compound Test Results

Sampling Date Thursday, August 14, 2008 System Air Flow Rate (cfm) 7,500

Round 1

		Concentration (ppb)			Removal Efficiency (%)		Mass Emissions (lbs/hr)			Mass Emissions Removal Efficiency (%)	
Compound	MW	Inlet	#1 Outlet	#2 Outlet	BTS #1	BTS#2	Inlet	#1 Outlet	#2 Outlet	BTS #1	BTS#2
Hydrogen Sulfide	34	34084	11	16	99.97%	99.95%	1.45	0.0005	0.0007	99.97%	99.95%
COS	60	32	21	20	34.38%	37.50%	0.00	0.0016	0.0015	34.38%	37.50%
Methanethiol (MM)	48	4696	367	492	92.18%	89.52%	0.28	0.0221	0.0296	92.18%	89.52%
Dimethyl Sulfide	62	101	95	119	5.94%	-17.82%	0.01	0.0074	0.0092	5.94%	-17.82%
Carbon Disulfide	76	371	78	5.9	78.98%	98.41%	0.04	0.0074	0.0006	78.98%	98.41%
Dimethyl Disulfide	94	21	14	13	33.33%	38.10%	0.00	0.0016	0.0015	33.33%	38.10%
Dimethyl Trisulfide	126	5.8	3.3	0.1	43.10%	98.28%	0.00	0.0005	0.0000	43.10%	98.28%
					Total Including H_2S		1.78	0.0411	0.0431	97.70%	97.58%
					Total Not Including H_2S		0.33	0.0406	0.0425	87.74%	87.19%

Round 2

		Concentration (ppb)			Removal Efficiency (%)		Mass Emissions (lbs/hr)			Mass Emissions Removal Efficiency (%)	
Compound	MW	Inlet	#1 Outlet	#2 Outlet	BTS #1	BTS#2	Inlet	#1 Outlet	#2 Outlet	BTS #1	BTS#2
Hydrogen Sulfide	34	6,300	49	107	99.22%	98.30%	0.27	0.0021	0.0046	99.22%	98.30%
COS	60	25	10	21	60.00%	16.00%	0.00	0.0008	0.0016	60.00%	16.00%
Methanethiol (MM)	48	1,567	311	483	80.15%	69.18%	0.09	0.0187	0.0291	80.15%	69.18%
Dimethyl Sulfide	62	83	69	90	16.87%	-8.43%	0.01	0.0054	0.0070	16.87%	-8.43%
Carbon Disulfide	76	22	3.1	63	85.91%	-186.36%	0.00	0.0003	0.0060	85.91%	-186.36%
Dimethyl Disulfide	94	15	3.5	7.4	76.67%	50.67%	0.00	0.0004	0.0009	76.67%	50.67%
Dimethyl Trisulfide	126	6	0.1	0.3	98.41%	95.24%	0.00	0.0000	0.0000	98.41%	95.24%
					Total Including H_2S		0.38	0.0276	0.0491	92.65%	86.94%
					Total Not Including H_2S		0.11	0.0255	0.0446	76.23%	58.54%

Round 3

		Concentration (ppb)			Removal Efficiency (%)		Mass Emissions (lbs/hr)			Mass Emissions Removal Efficiency (%)	
Compound	MW	Inlet	#1 Outlet	#2 Outlet	BTS #1	BTS#2	Inlet	#1 Outlet	#2 Outlet	BTS #1	BTS#2
Hydrogen Sulfide	34	40,713	486	521	98.81%	98.72%	1.74	0.0207	0.0222	98.81%	98.72%
COS	60	38	31	20	18.42%	47.37%	0.00	0.0023	0.0015	18.42%	47.37%
Methanethiol (MM)	48	4,749	557	597	88.27%	87.43%	0.29	0.0335	0.0359	88.27%	87.43%
Dimethyl Sulfide	62	133	114	91	14.29%	31.58%	0.01	0.0089	0.0071	14.29%	31.58%
Carbon Disulfide	76	409	47	8.9	88.51%	97.82%	0.04	0.0045	0.0008	88.51%	97.82%
Dimethyl Disulfide	94	65	14	13	78.46%	80.00%	0.01	0.0016	0.0015	78.46%	80.00%
Dimethyl Trisulfide	126	28	0.1	0.2	99.64%	99.29%	0.00	0.0000	0.0000	99.64%	99.29%
					Total Including H_2S		2.09	0.0716	0.0691	96.57%	96.69%
					Total Not Including H_2S		0.35	0.0508	0.0469	85.47%	86.60%

Average of All Three Rounds

		Concentration (ppb)			Removal Efficiency (%)		Mass Emissions (lbs/hr)			Mass Emissions Removal Efficiency (%)	
Compound	MW	Inlet	#1 Outlet	#2 Outlet	BTS #1	BTS#2	Inlet	#1 Outlet	#2 Outlet	BTS #1	BTS#2
Hydrogen Sulfide	34	27,032	182	215	99.33%	99.21%	1.15	0.0078	0.0091	99.33%	99.21%
COS	60	32	21	20	34.74%	35.79%	0.00	0.0016	0.0015	34.74%	35.79%
Methanethiol (MM)	48	3,671	412	524	88.78%	85.72%	0.22	0.0248	0.0315	88.78%	85.72%
Dimethyl Sulfide	62	106	93	100	12.30%	5.36%	0.01	0.0072	0.0078	12.30%	5.36%
Carbon Disulfide	76	267	43	26	84.03%	90.30%	0.03	0.0041	0.0025	84.03%	90.30%
Dimethyl Disulfide	94	34	11	11	68.81%	66.93%	0.00	0.0012	0.0013	68.81%	66.93%
Dimethyl Trisulfide	126	13	1.2	0.2	91.27%	98.50%	0.00	0.0002	0.0000	91.27%	98.50%
					Total Including H_2S		1.42	0.0468	0.0538	96.69%	96.20%
					Total Not Including H_2S		0.26	0.0390	0.0446	85.17%	83.03%

Note: Concentrations taken from Mayfly Laboratory report with Project ID 8075, analyzed on 8/15/08 and reported 8/17/08.

9/22/08 Follow-up Testing

		Concentration (ppb)			Removal Efficiency (%)		Mass Emissions (lbs/hr)			Mass Emissions Removal Efficiency (%)	
Compound	MW	Inlet	#1 Outlet	#2 Outlet	BTS #1	BTS#2	Inlet	#1 Outlet	#2 Outlet	BTS #1	BTS#2
Hydrogen Sulfide	34	152632	116	116	99.92%	99.92%	6.50	0.0049	0.0049	99.92%	99.92%
COS	60	88	161	179	-82.95%	-103.41%	0.01	0.0121	0.0135	-82.95%	-103.41%
Methanethiol (MM)	48	27152	266	376	99.02%	98.62%	1.63	0.0160	0.0226	99.02%	98.62%
Dimethyl Sulfide	62	4090	1932	1742	52.76%	57.41%	0.32	0.1501	0.1354	52.76%	57.41%
Carbon Disulfide	76	3509	231	171	93.42%	95.13%	0.33	0.0220	0.0163	93.42%	95.13%
Dimethyl Disulfide	94	940	37	144	96.06%	84.68%	0.11	0.0044	0.0170	96.06%	84.68%
Dimethyl Trisulfide	126	197	0.1	2.7	99.95%	98.63%	0.03	0.0000	0.0004	99.95%	98.63%
					Total Including H_2S		8.94	0.2096	0.2101	97.66%	97.65%
					Total Not Including H_2S		2.43	0.2046	0.2052	91.59%	91.57%

project. The results of the BOC performance test report is included in **Appendix H** and summarized on **Table 13**. The BOC had some operational issues on the first day of the performance test that affected the September 3 test results. These issues were resolved and the system was retested on September 4th. The September 4th results are reflective of actual normal-operation system performance.

3.6.3 Supplemental Testing on MEB Exhaust Plenum and Dryer Area Roof Exhaust Fans

Because the MEB Dryer Area Roof Exhaust Fan air was shown to be the highest ranked source of odors at the MFWQTC, some follow-up testing was performed on the two exhausts points in the MEB on November 25, 2008. One theory was that negative pressure inside the dryer area created by the 6th floor roof fans was greater than the negative pressure inside the dryer system and foul air was being drawn out of the dryer system and into the room. The supplemental testing was designed to determine if odor emissions would be reduced if the dryer area roof exhaust fans were turned off and to determine the impact it would have on working conditions inside the building.

For this test, all dryer area roof exhaust fans were turned off, except for one which remained on inadvertently, on November 18, 2008 and were left off until the morning of November, 25th. Prior to turning the fans back on, air samples were collected from the MEB Exhaust Plenum and the one dryer area roof exhaust fan that was still running. After collecting the samples at about 8:00 am, the fans were set to operate in Auto mode. Since two dryer trains were in service six dryer area roof exhaust fans came on (plus the one that was already on). These fans ran for about 7 hours and then a second round of air samples were collected. The samples were sent to St Croix Sensory for odor panel analysis. The results are shown on **Table 14**.

Table 14 – MEB Follow-up Test Results

	One 6th Floor Roof Fan Operating			Seven 6th Floor Roof Fans Operating		
Location	Air Flow (cfm)	Detection Threshold (DT)	Odor Emission Rate	Air Flow (cfm)	Detection Threshold (DT)	Odor Emission Rate
MEB Exhaust Plenum	314,000	500	157,000,000	314,000	850	266,900,000
Dryer Area Roof Fans	30,000	1000	30,000,000	210,000	1,200	252,000,000
Total	334,000		187,000,000	514,000		518,900,000

Since the detection thresholds were higher with seven fans running than with one fan running it appears that the dryer area roof exhaust fans may be creating enough negative pressure to draw air out of the dryer system.

TABLE 13

SUMMARY OF ODOR PANEL AND REDUCED SULFUR DATA
BIOWAY BIOSCRUBBER SYSTEMS
MORRIS FORMAN WWTP, LOUISVILLE
September 3-4, 2008

Sample No.	Time	Location	Odor Conc'n D/T	Reduced Sulfur Compounds,[1] ppb									
				H_2S	COS	MM	DMS	CS_2	2-P(t)	2-(Mt)P	MT	DMDS	DMTS
September 3, 2008													
1	3:10 PM	Inlet Bioscrubber #1	62,000	65,561	280	5,109	222	243	1.5	1.9	2.6	21	1.5
2	3:10 PM	Outlet Bioscrubber #1	11,000	383	257	140	180	86	1.2	0.6	<3	22	1.4
3	3:30 PM	Inlet Bioscrubber #2[2]	53,000	61,113	152	5,006	123	95	0.1	0.5	<3	11	1.3
4	3:30 PM	Outlet Bioscrubber #2[2]	50,000	15,464	153	3,592	106	75	<0.1	<0.1	<3	14	5.3
September 4, 2008													
5	10:20 AM	Inlet Bioscrubber #2	13,000	29,347	325	3,526	267	210	<3	<3	<3	5.2	0.4
6	10:20 AM	Outlet Bioscrubber #2	4,600	182	219	541	167	36	<3	<3	<3	14	0.4
7	10:50 AM	Inlet Bioscrubber #1	8,700	31,112	180	3,372	142	56	<3	<3	<3	9.0	0.9
8	10:50 AM	Outlet Bioscrubber #1	6,200	155	142	531	105	47	<3	<3	<3	7.0	1.6

The combined odor emission rate from the MEB Exhaust Plenum and the MEB Dryer Area Roof Exhaust during Round 1 testing was 311,700,000, with a total air flow rate of 734,000 cfm and during Round 2 it was 486,420,000 with a total air flow rate of 704,000 cfm. These OERs indicate total emissions from the MEB could be reduced if the 6th floor fans are turned off. One of the operators commented that the air in the dryer area was "heavy" when the fans were off but the HVAC system for the area, not including the 6th floor roof fans, provides more than 5 air changes per hour of air in the building and H_2S levels were slightly lower when only one fan was running (0.7 ppm for MEB Exhaust Plenum and 0.128 ppm for roof fans) than when seven fans were running (0.13 for MEB Exhaust Plenum and 0.2 ppm for roof fans).

3.7 Dispersion Modeling

3.7.1 Description of Modeling Scenarios

Many models were run throughout this project to show the impact the existing odor emissions are having on the surrounding community and to predict the impact future odor control improvements would have. Many of the preliminary models were used to develop future models that are presented in the body of this report. The preliminary models are briefly described and included in **Appendix I** for reference only.

Following is a description of the Base Condition models and the odor control scenarios that were developed after several discussions and meetings with MSD personnel. All models will use 20 DT as the threshold for frequency modeling and the peaking factor is based on a 3-minute duration.

Peak Detection Threshold (Peak DT) and odor frequency isometric contour maps were developed for all Models. In all cases, the Round 1 test results (average summer conditions) were used to model frequencies and Round 2 test results (peak summer conditions) were used to model Peak DTs. The contour maps for these models are included in the following pages along with a discussion of the results.

Model 1a is the **"Base Conditions Model Using Round 1 Test Results"** scenario simulating <u>all MFWQTC odor sources</u>. This Model represents existing conditions on a "normal summer day" and includes no proposed improvements. Odor panel data obtained from the July 2008 sampling, when odor conditions were fairly typical, were plugged into the model. If a source was not sampled in July 2008 (such as secondary clarifiers) then results from previous testing was used. Some of this previous test data may have come from the original Master Plan testing or from follow-up testing that occurred between the original Master Plan and this update. The modeling input data included in **Appendix J** shows when the testing of each source was conducted.   The Frequency contour for Model 1a is shown on **Figure 4**.

Model 1b is the **"Existing Conditions Model Using Round 2 Test Results"** scenario simulating <u>all MFWQTC odor sources</u>. This Model represents existing conditions on a "peak summer day" and includes no proposed improvements. Odor panel data obtained from the August 2008 sampling, when H_2S and odor levels were unusually high, were plugged into the model. **Figure 5** shows the Peak DT contour for Model 1b.

Model 2 is the "**Existing Conditions with MEB Improvements**" scenario.   Frequencies are shown on **Figure 6** and Peak DT is shown on **Figure 7**. This model is based on the following:

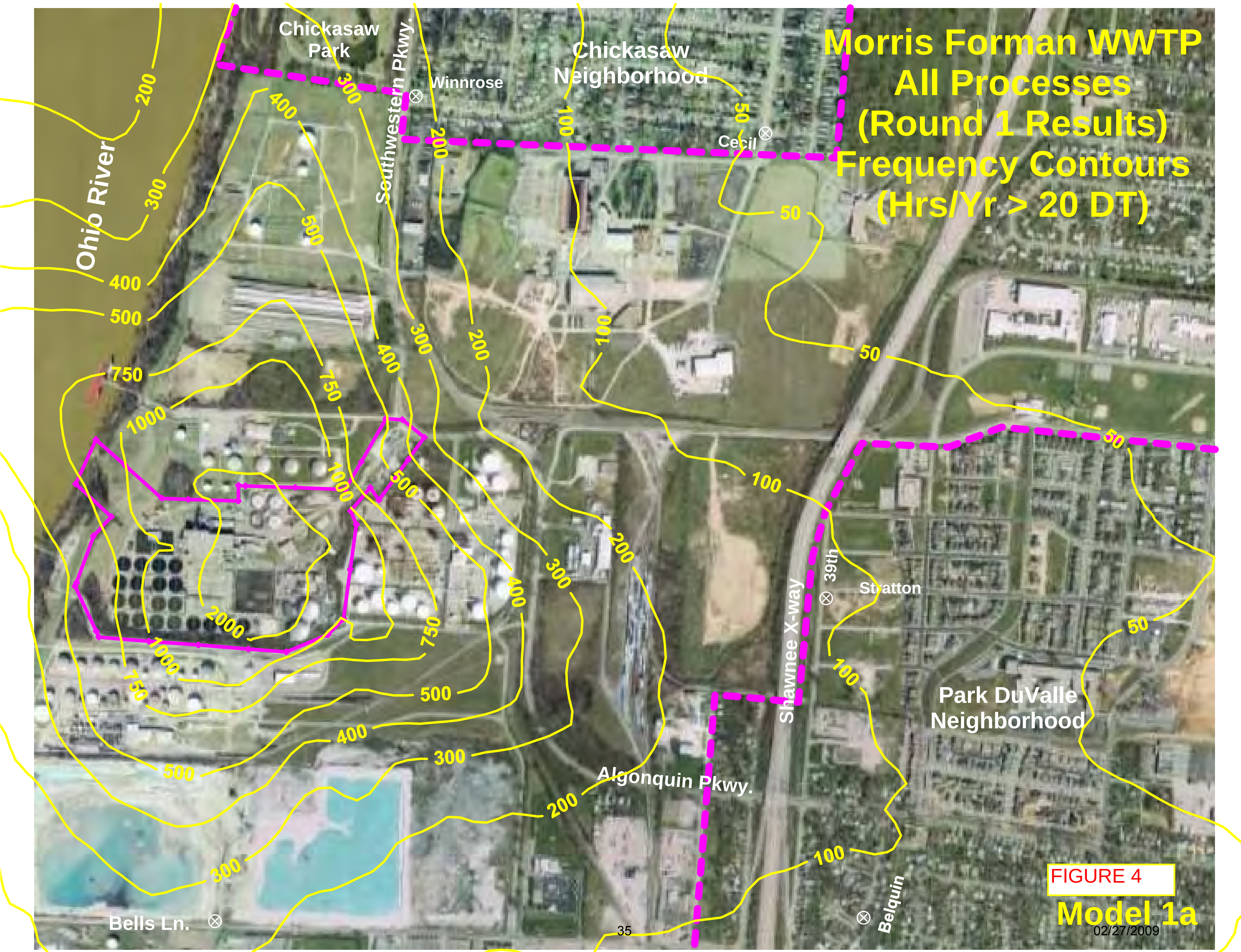
- 6^{th} floor roof fans are turned off and replaced with two 90,000 cfm propeller fans mounted in the wall at the air plenum that discharge to the biosolids incinerator stack. If one dryer train is in service then one propeller fan is in service. If more than one dryer train is in service then both propeller fans would operate. This model assumes two dryer trains are in service and 180,000 cfm is exhausted from the ASP area.
- Assumes air leaks in ASP drying system can be located and repaired and peak DT is 350.
- Peak DT of MEB Exhaust Plenum of 150 to match Round 1 test results.
- Round 1 results used to model frequencies and Round 2 results used to model Peak DTs.
- No other proposed improvements are included.

Model 3 is the same as Model 2 except it includes:

- Chemicals (hydrogen peroxide or ferrous chloride or both) added upstream of headworks. Assume chemical addition will reduce emissions from headworks sources by 50% and from primary clarifier sources by 75%.
- Strobic fans added to screen and grit building and dumpster room.
- The Model 3 contours for Frequency and Peak DT are shown on **Figures 8** and **9,** respectively.

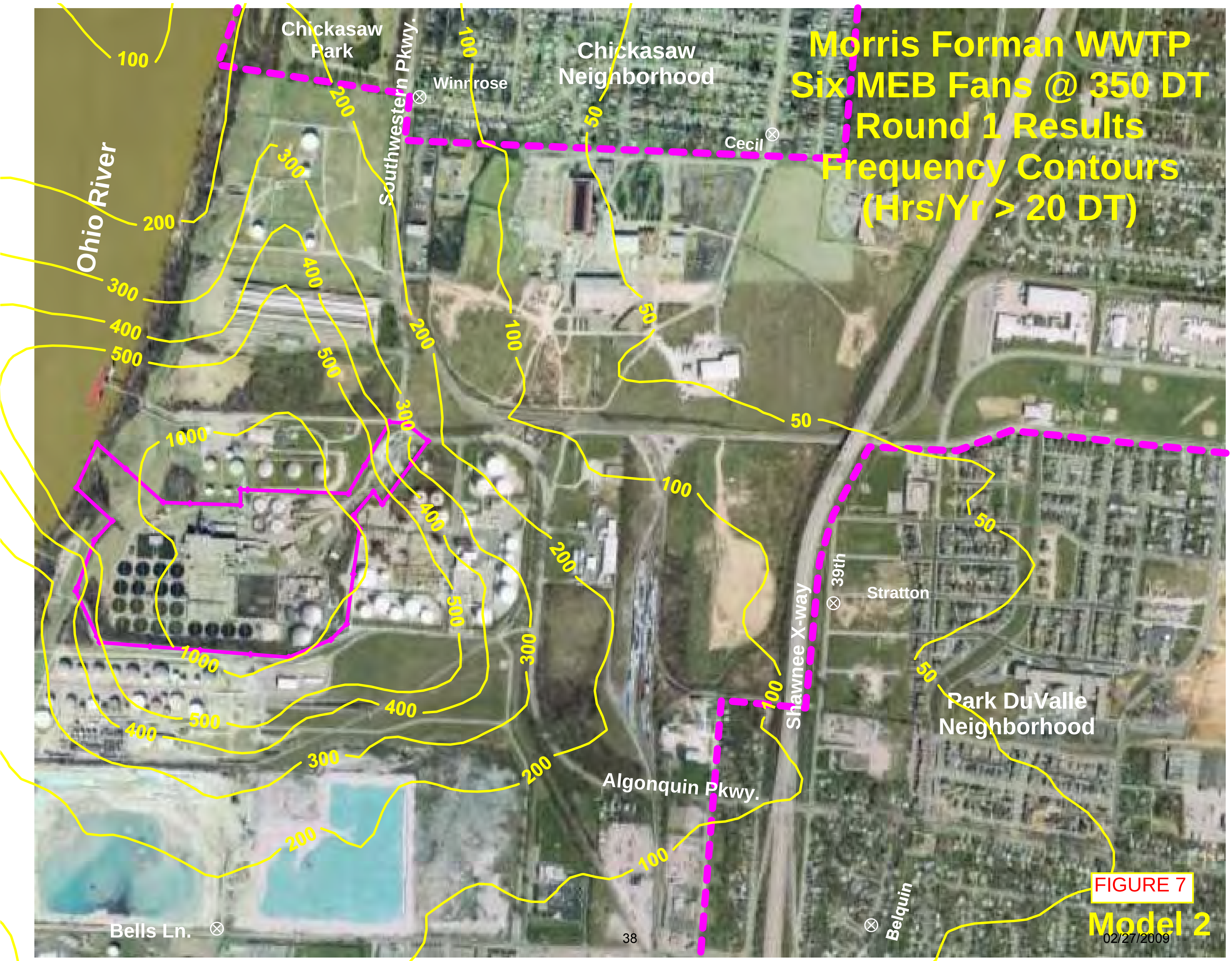
Model 4 is the same as Model 2 except it includes:

- New covers installed over uncovered headworks influent channels and grit tanks. Air collected and discharged to bioroughing towers.
- Primary clarifier effluent weirs are covered and the air is collected and treated in a 10,000 cfm odor control system that provides 90% odor removal efficiency.
- Strobic fans added to screen and grit building and dumpster room.
- No chemical addition at headworks.
- The Model 4 contours are Frequency and Peak DT are shown on **Figures 10** and **11,** respectively.

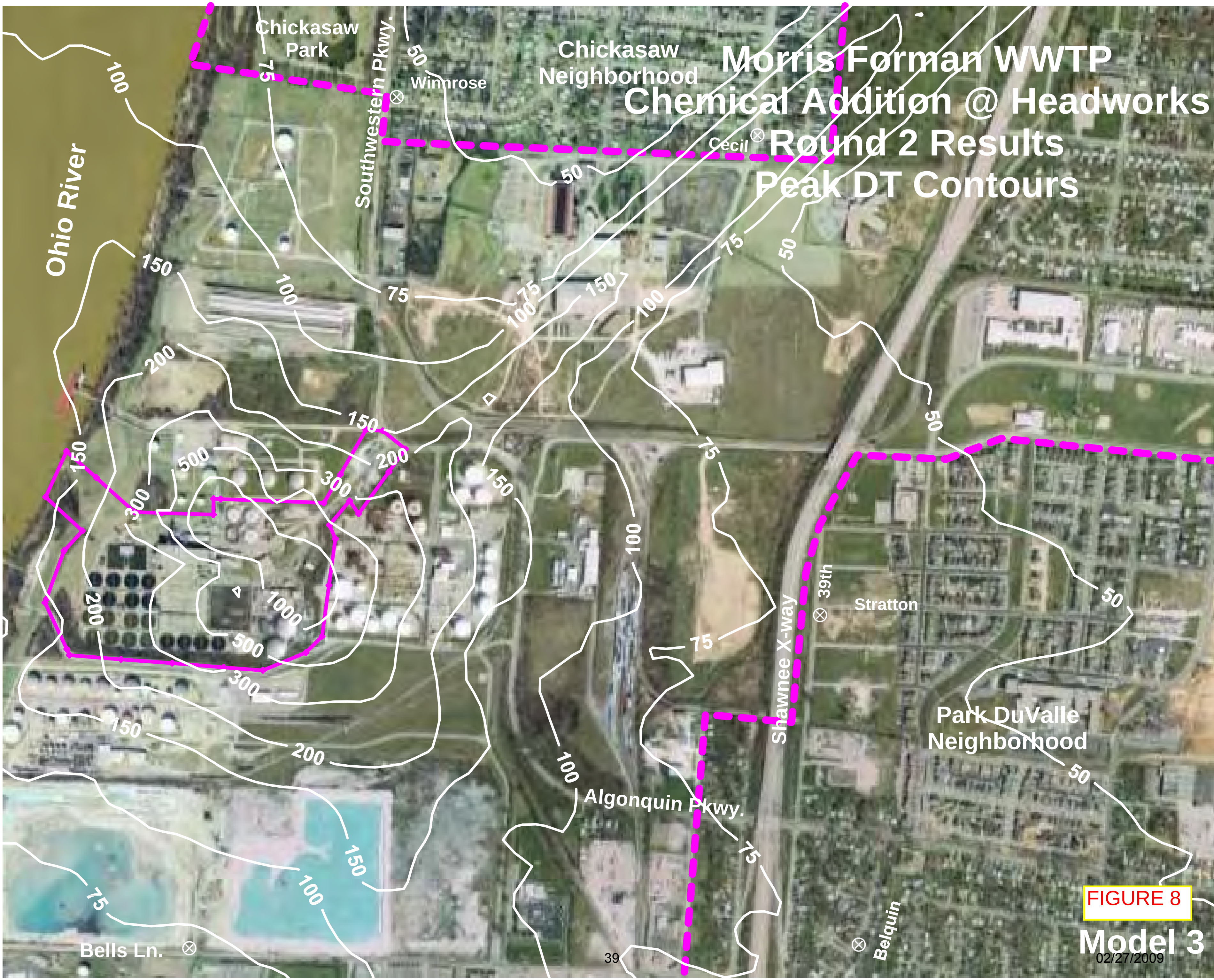

Morris Forman WWTP
All Processes
(Round 1 Results)
Frequency Contours
(Hrs/Yr > 20 DT)
Chickasaw Park
Southwestern Pkwy.
Winnrose
Chickasaw Neighborhood
Cecil
Ohio River
Shawnee X-way
39th
Stratton
Park DuValle Neighborhood
Algonquin Pkwy.
Bells Ln.
Belquin
50
100
200
300
400
500
750
1000
2000
FIGURE 4
Model 1a

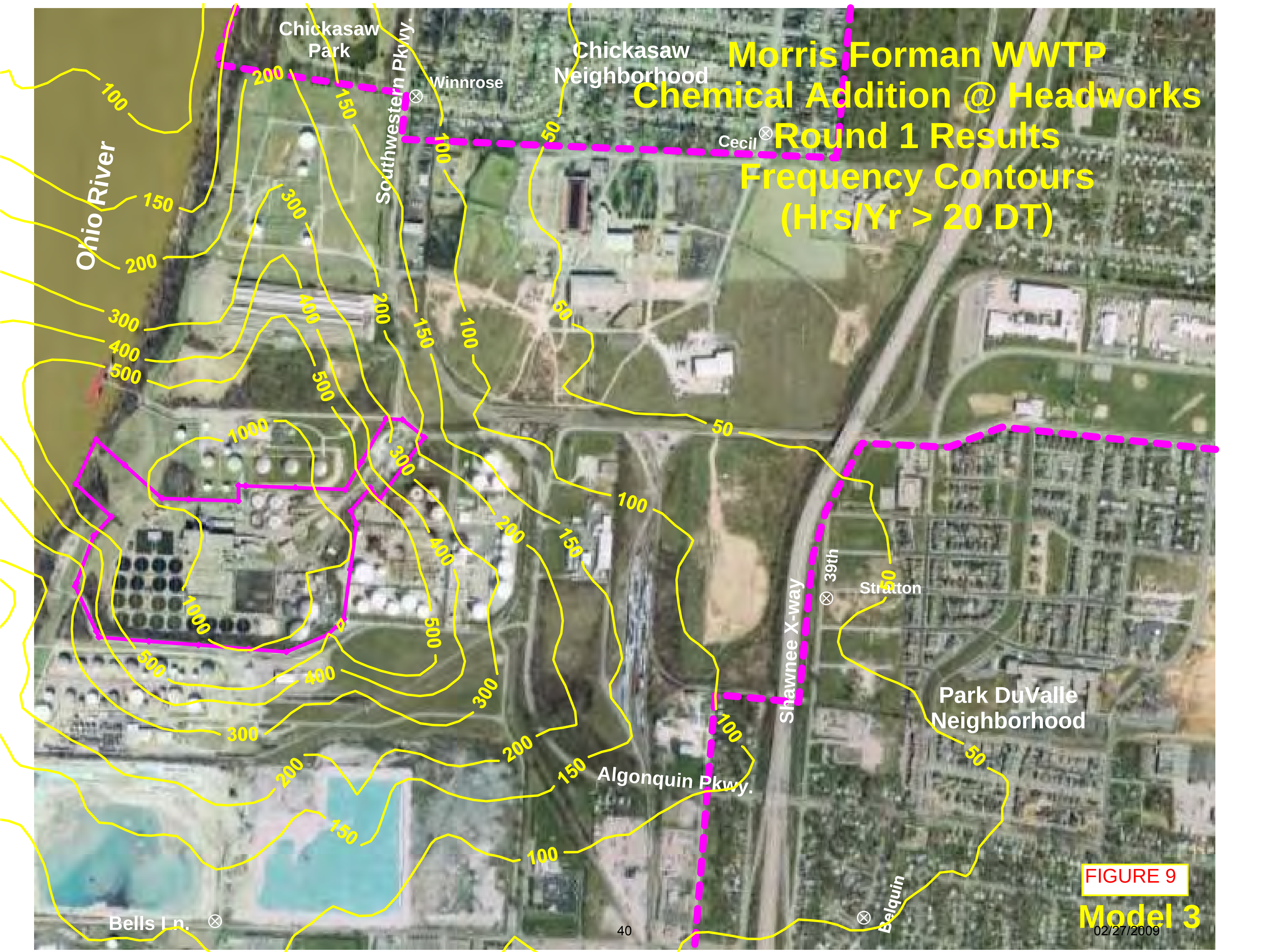

Morris Forman WWTP
All Processes
(Round 2 Results)
Peak DT Contours
Chickasaw Park
Chickasaw Neighborhood
Southwestern Pkwy.
Winnrose
Cecil
Ohio River
Stratton
39th
Shawnee X-way
Algonquin Pkwy.
Park DuValle Neighborhood
Belquin
Bells Ln.
75
100
150
200
300
400
500
1000
2000
FIGURE 5
Model 1b
02/27/2009

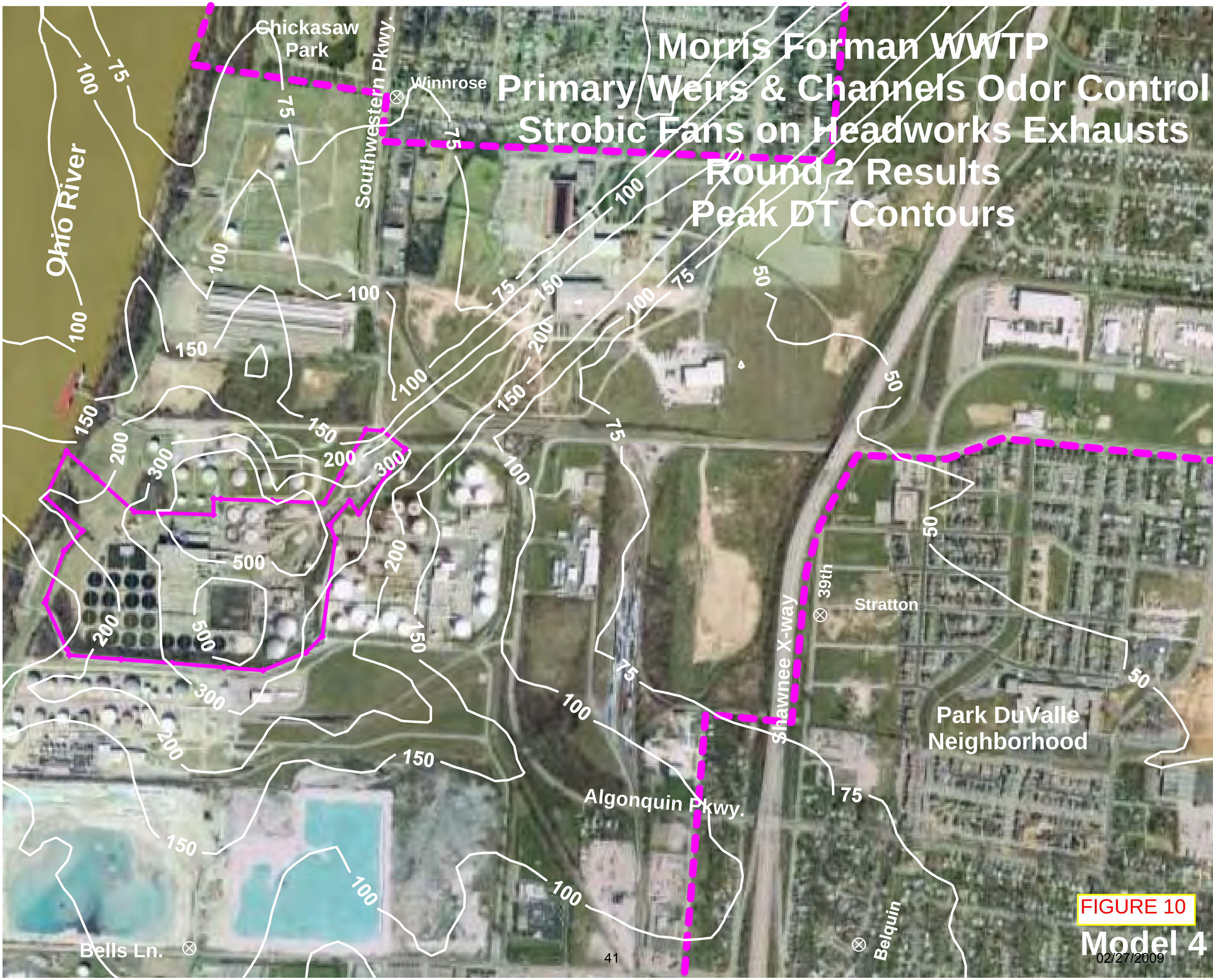

Morris Forman WWTP
Six MEB Fans @ 350 DT
Round 2 Results
Peak DT Contours
Chickasaw Park
Chickasaw Neighborhood
Southwestern Pkwy.
Winnrose
Cecil
Ohio River
Shawnee X-way
39th
Stratton
Park DuValle Neighborhood
Algonquin Pkwy.
Bells Ln.
Belquin
FIGURE 6
Model 2
02/27/2009

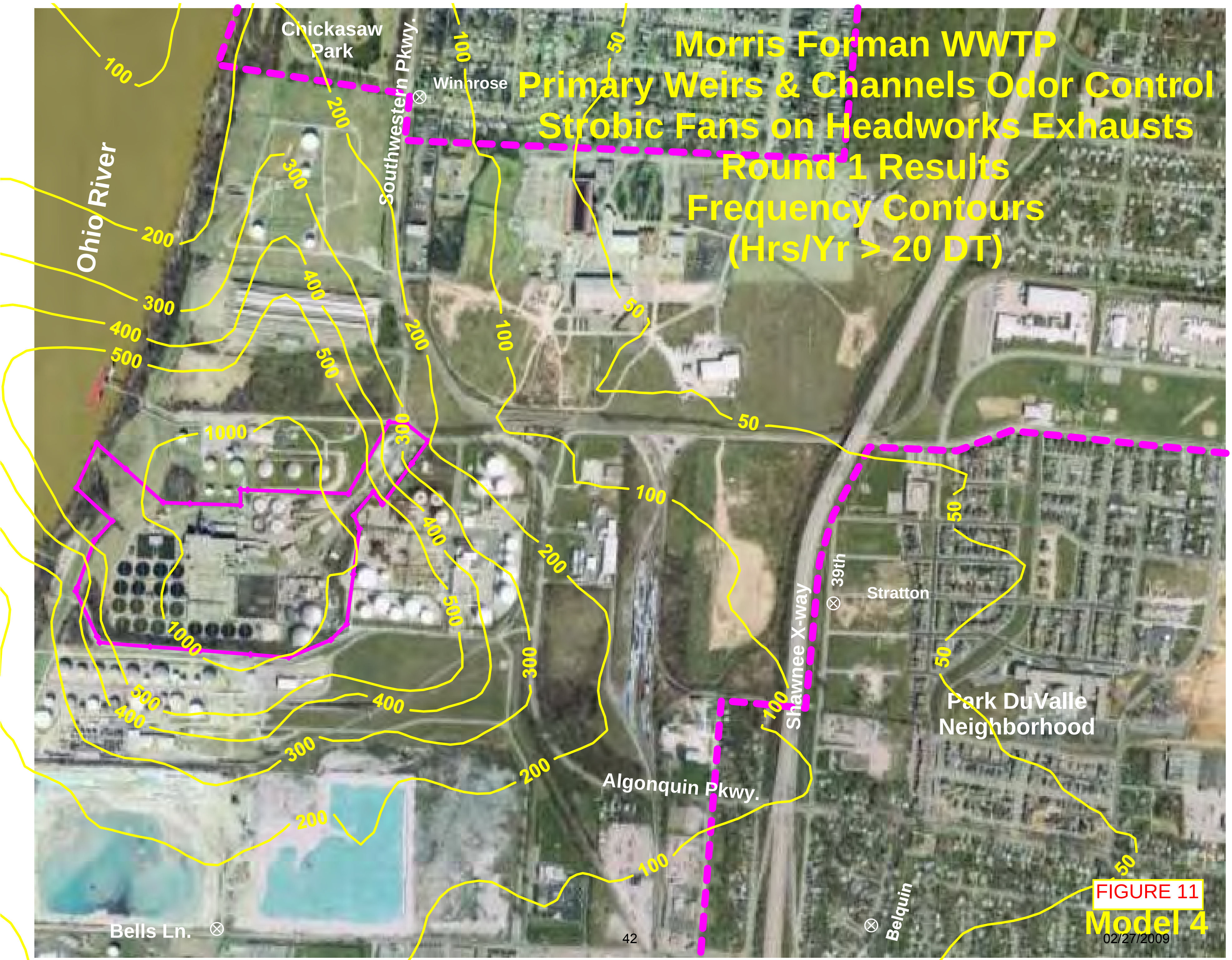


Morris Forman WWTP
Six MEB Fans @ 350 DT
Round 1 Results
Frequency Contours
(Hrs/Yr > 20 DT)
Chickasaw Park
Chickasaw Neighborhood
Southwestern Pkwy.
Winnrose
Cecil
Ohio River
Shawnee X-way
39th
Stratton
Park DuValle Neighborhood
Algonquin Pkwy.
Bells Ln.
Belquin
FIGURE 7
Model 2
02/27/2009


Morris Forman WWTP
Chemical Addition @ Headworks
Round 2 Results
Peak DT Contours
Chickasaw Park
Chickasaw Neighborhood
Southwestern Pkwy.
Winnrose
Cecil
Ohio River
Shawnee X-way
39th
Stratton
Park DuValle Neighborhood
Algonquin Pkwy.
Belquin
Bells Ln.
50
75
100
150
200
300
500
1000
FIGURE 8
Model 3
02/27/2009


Morris Forman WWTP
Chemical Addition @ Headworks
Round 1 Results
Frequency Contours
(Hrs/Yr > 20 DT)
Chickasaw Park
Chickasaw Neighborhood
Southwestern Pkwy.
Winnrose
Cecil
Ohio River
Algonquin Pkwy.
Shawnee X-way
39th
Stratton
Park DuValle Neighborhood
Belguin
Bells Ln.
FIGURE 9
Model 3
02/27/2009


Morris Forman WWTP
Primary Weirs & Channels Odor Control
Strobic Fans on Headworks Exhausts
Round 2 Results
Peak DT Contours
Chickasaw Park
Southwestern Pkwy.
Winnrose
Ohio River
Shawnee X-way
39th
Stratton
Park DuValle Neighborhood
Algonquin Pkwy.
Bells Ln.
Belquin
FIGURE 10
Model 4
02/27/2009


Morris Forman WWTP
Primary Weirs & Channels Odor Control
Strobic Fans on Headworks Exhausts
Round 1 Results
Frequency Contours
(Hrs/Yr > 20 DT)
Chickasaw Park
Southwestern Pkwy.
Winhrose
Ohio River
Shawnee X-way
39th
Stratton
Park DuValle Neighborhood
Algonquin Pkwy.
Bells Ln.
Belquin
1000
500
400
300
200
100
50
FIGURE 11
Model 4
02/27/2009

4.0 DISCUSSION OF TEST RESULTS

4.1 Odor Panel Test Results

The following observations were drawn from the odor panel test results:

1. The Round 2 test results were much higher than Round 1, especially at the headworks and primaries. This was because the incoming wastewater was very high in sulfides during Round 2. The source of these high levels has not been found but catching this peak day was fortunate. It is possible that most off-site odor problems occur on these peak days and if that is the case, then efforts can be made to find the root cause (perhaps an industry) and to control only the peak days. The odor panel results from every source except the digesters were higher during the second round.

2. The Round 1 DT results were similar in magnitude to previous Master Plan test results. The Round 2 odor panel results were significantly higher than have ever been measured at the plant, particularly in the headworks and primary clarifier areas.

3. The DT of the gas bubbling through the annual space of the digesters was extremely high during both rounds of testing and smells like the odor that is frequently detected in front of the administration building.

4. The air from the 6th floor roof fans was 3-4 times worse than the MEB Exhaust Plenum air. Since all of the air being exhausted by the 6^{th} floor roof fans is drawn from the dryer areas it appears there are leaks in dryer process trains.

5. The BOC system had an outlet DT of 5,100 during Round 1 and 7,500 during Round 2. These levels are higher than desired, probably due to reduced sulfur compounds.

6. The SHOC system had an outlet DT of 4,100 during Round 1 and 5,700 during Round 2. Again, these are higher than desired even though the system was operating as well as could be expected. The SHOC handles the most difficult to treat odors on the plant and is the “Work Horse” of the odor control systems on the site. It must be continuously reliable and effective in order for MSD to avoid odor complaints.

7. The odor panel test results show that the primary clarifiers have higher odor DT when the sludge blanket depths are higher, as expected. The results also showed that odor levels from the weirs were much higher than those coming from the surface, also as expected.

8. The supplemental testing performed at the MEB showed that H_2S and OERs from the MEB could be reduced if the 6^{th} floor fans are turned off.

The HVAC system for the area, not including the 6th floor roof fans, provide more than 5 air changes per hour of air in the building which exceeds NFPA 820 requirements.

9. During Round 2 air samples were collected from the Southwestern Pump Station (SWPS) screen room exhaust and from the Diversion Structure CSO and analyzed for odor detection threshold. The SWPS exhaust had a DT of only 180 which would rarely if ever cause off-site odor complaints. The diversion structure CSO sample had a DT of 2,700 which could cause complaints from neighbors. A house near the CSO has complained of odors and this source may be a significant contributor.

4.2 Odor Emission Rates (Refer to Tables 2 and 3)

Odor emission rate observations are:

1. The 6th floor exhaust fans on the roof of the MEB had an OER that was more than double any other source during both rounds of testing.

2. The BOC outlet, MEB Exhaust Plenum and digester annular space had the next three highest OER. These top 4 sources contributed 80% of total odor emissions during Round 1 and about 70% during Round 2.

3. It was assumed that the entire surface area of the foam/sludge on the digester covers had the same odor detection threshold as the bubbling annular space where the air sample was collected. This is a pretty conservative assumption but it is offset by the fact that the pressure relief valves were leaking and emitting odor that was not included in the calculations.

4. The primary clarifier surfaces, weirs and channels combined equal 11.5% of total OER when using Round 2 results and 5.5% in Round 1 results.

5. All headworks sources combined equaled 7.5% of the total odor emissions in Round 2 and 5% in Round 1.

6. Screen and grit dumpsters do not appear to be a significant source of off-site odors based on OERs.

4.3 H_2S Emission Rates (Refer to Tables 4 and 5)

The following observations were made with regard to H_2S emissions:

1. The digesters had the highest H_2S emission rate in each round.

2. The 6th floor roof fans in the MEB contributed 18% of the total H_2S emissions in Round 1 and 11% in Round 2. The total H_2S emissions from

the MEB, including the MEB Exhaust Plenum and the 6th floor fans were 29% in Round 1 and 19% in Round 2.

3. BOC and SHOC are achieving high H_2S removal efficiencies and are not significant H_2S contributors.

4. All headworks sources combined accounted for only about 2% of H_2S in Round 1 but over 22% in Round 2.

5. All primary clarifier sources combined accounted for about 11% of H_2S emissions in Round 1 and over 27% in Round 2.

4.4 RSC Emission Rates (Refer to Tables 6 and 7)

The following observations were made with regard to RSC emissions:

1. The BOC had the highest total RSC emission rate (2.8 lbs/d not including H_2S) during Round 1 while the MEB 6th floor roof fans had the highest RSC emission rate (14.3 lbs/d) during Round 2.

2. The two MEB sources, MEB Exhaust Plenum and 6th floor fans, when combined accounted for 27% of total RSC mass emissions in Round 1 and 75% in Round 2.

3. Total mass RSC emissions were 5.1 lbs/d in Round 1 and nearly 23 lbs/day in Round 2.

4. RSC concentrations were much higher in Round 2 than in Round 1.

5. Methyl mercaptan had the highest RSC concentration, other than H_2S, followed by carbonyl sulfide (COS), dimethyl sulfide (DS) and carbon disulfide (CD). Very little dimethyl disulfide (DD) was detected in either round. MM is relatively easy to remove like H_2S using the same methods as H_2S treatment.

6. No unexpected reduced sulfur compounds were found in significant concentrations.

Table 15 provides a brief summary of odor, H_2S and RSC emission rates from individual sources or groups of sources.

Table 15 – Summary of Emissions by Area	
Source(s)	**Justification**
MEB Dryer Area Roof Exhaust Fans and MEB Exhaust Plenum	These two sources accounted for over 49% of total odor emissions, 19% of H_2S emissions and 75% of RSC mass emissions during 2nd round of testing
Digester Emissions	The digesters were responsible for 12% of total odor emissions, 20% of H_2S emissions and 3% of RSC mass emissions during 2nd round of testing. 1st round percentages were even higher.
BOC Outlet	The BOC is doing a good job of removing H_2S but odor and RSC emissions are still high. During Round 2 it had the 2nd highest OER (15%) and 3rd highest RSC mass emissions (12%). Round 1 results were similar.
Clarifier Effluent Weirs, Effluent Channel and Biotower Effluent Channel	These sources accounted for about 5% of odor emissions, 21% of H_2S emissions and 2% of RSC mass emissions during Round 2. Percentages were lower during Round 1.
Headworks Sources	During Round 2 these sources accounted for 22% of H_2S emissions, 7.5% of odor emissions and about 2.5% of RSC mass emissions. Percentages were lower during Round 1.
SHOC Outlet	Like the BOC, the SHOC is removing almost all of the H_2S but odor and RSC emissions remain higher than desired. The SHOC accounted for nearly 6% of odor emissions and over 6% of RSC mass emissions during Round 1.

4.5 Odalog Monitoring

The odalog monitoring program has provided an immense amount of very valuable data that MSD has been using to identify problem areas and evaluate the relationships between adjacent processes. The analysis of this data is not included in the scope of work for this Master Plan report but the data shown on the overlay charts in **Appendix F** and on **Table 10** shows that there are high H_2S levels in many areas of the plant, and most significantly there are very high peaks of H_2S.

4.6 BOC/SHOC Performance

The SHOC has a better RSC removal efficiency than the BOC, likely because it has a higher EBRT (30 seconds for SHOC and 8 seconds for BOC) and because it was designed for RSC removal, running some stages at a neutral pH. The SHOC is consistently removing more than 99.9% of the inlet H_2S and more than 90% of the other RSC and it appears performance is continuing to improve. Follow-up testing conducted in September 2009 confirmed initial performance test results.

The BOC passed the performance test conducted on September 3-4, 2008 by Bowker and Associates, Inc. MSD accepted the test results on 10/28/08 and the system is under warranty until 3/9/09.

4.7 Dispersion Modeling

The best way to compare models is to pick a couple of random points in the community and identify the Peak DT and Frequency at these points. Two locations have been selected. One is in the Chickasaw Park neighborhood, at the intersection of Cecil and Fortson Ave, and the other is in the Park DuValle neighborhood at the intersection of 39th and Stratton.

Table 16 shows the peak DT and frequency values for each of the proposed improvement alternatives and compares them to the existing conditions for the same two locations in the community as those presented in Table 11.

Table 16 – Proposed Improvements Modeling Comparison

	Cecil and Fortson		**39th and Stratton**	
Model	**Peak DT**	**Frequency**	**Peak DT**	**Frequency**
Model 1a/1b	340	45	140	110
Model 2	340	20	120	75
Model 3	100	15	65	50
Model 4	150	20	60	70

Model 1a/1b – Existing conditions
Model 2 - Improvements to MEB exhaust
Model 3 – Improvements to MEB exhaust and chemical feed to headworks
Model 4 – Improvements to MEB exhaust and cover/treat headworks/primary sources.

These results indicate making the MEB improvements (Model 2) would decrease the frequency of detecting odors greater than 20 DT from 45 times per year to less than 20 times per year at Cecil and Fortson and at 39th and Stratton the frequency would decrease from 110 to 75 times per year. Making the MEB improvements would have little effect on Peak DTs in the community

The models also show that improving MEB emissions and adding chemicals to the headworks (Model 3), or capturing and treating much of the air from headworks and primaries (Model 4) will reduce Peak DTs in the community by

50% or more and that either option will have nearly the same odor impact on the community.

MSD's established goals are to reduce the number of times odor levels exceed 20 DT in the community to less than 100 occurrences or hours per year and to reduce the peak DT from where they are now by more than 50%. The modeling indicates making only the MEB improvements would meet the frequency criterion but making improvements to the headworks/primaries would be required to meet the Peak DT criterion.

5.0 EVALUATION OF CONTROL ALTERNATIVES

5.1 General

The testing and modeling results have shown that the twelve 30,000 cfm (each) exhaust fans on the roof of the MEB building are a consistent daily source of odor emissions from the site. This problem needs to be addressed in order to see an improvement in community odor levels and in the frequency that the MFWQTC odors are detected.

Conversely, many of the remaining odor emissions are intermittent in nature and appear to be related to peak loadings. These peaks are caused by plant influent sulfide spikes at the headworks and primaries and by reduced sulfur compound spikes in the solids handling areas. Therefore, the control alternatives that address these intermittent issues are evaluated on the basis of reducing peak levels that can contribute directly to odor complaints. In addition, because the SHOC is so critical to plant odor control, as it treats "rugged" odor sources with high levels of H_2S and other reduced sulfur compounds, this system will need some added protection in order to enhance and keep performance at a very high reliable level.

5.2 Control of MEB Building Emissions

The MEB building is by far the highest source of odor and RSC emissions on the MFWQTC site with almost 50% of the total odor emissions and 75% of RSC emissions during the 2nd round of testing. The majority of the odors in the MEB building appear to be coming from leaks in the dewatering and drying systems. MSD recently had a company investigate the dewatering and drying systems in search of air leaks. The findings of that report were not made available as this report is written; however, the following improvements are currently underway:

- Measure dryer system pressures and air flows to balance system and determine if the system is operating near design air flow rates
- Replace or repair some leaks in the ductwork
- Replace the existing bucket elevators
- Fire doors to the dryer area should be kept closed to prevent drawing in air from other areas of the MEB building.

The dewatering process is currently serviced by a 3,300 cfm exhaust fan that draws air from the centrifuge vents, several screw conveyors, the centrifuge feed blend well and a couple of other small tanks. It appears that this fan can prevent fugitive emissions from these sources as long as all of the conveyor covers and tank hatches are kept closed and all gaskets remain in place. However, even when this appears to be done, there is normally a distinct sludge odor in the dewatering room indicating leaks are still occurring somewhere in the system. These leaks could be located with a small smoke testing investigation and probably resolved by replacing conveyor cover gaskets, verifying and balancing air flow rates and routine diligence by operators in keeping the system sealed.

The entire drying system is supposed to be kept under negative pressure and all odorous gases are supposed to be captured and treated in one of the four RTOs dedicated to the system. It is apparent that there are leaks in the drying system because of all the dust in the drying area and the high odor levels in the exhausted air. It is possible that the dryer air ducts and fans have accumulated substantial amounts of dust and grease since the system was started about 8 years ago and that the air flow is significantly less than it should be which could decrease the negative pressure in certain parts of the system. It is also possible that the negative pressure inside the dryer portion of the MEB building is higher than the negative pressure inside the dryer system and thereby drawing the foul air into the rooms. This is especially possible when all 12 of the roof fans are operating and most of the makeup air louvers on the lower levels are closed. The results of the supplemental testing performed at the MEB support this theory.

The twelve 30,000 cfm dryer area roof exhaust fans were installed when the biosolids incinerator was installed and were originally intended to remove incinerator heat from the building during the summer time. When the ASP dryer and pelletization system was installed, the roof fans and make-up air louvers were supposed to be programmed to run off of a thermostat, according to the contractor. An operator also indicated that three roof fans were supposed to come on with each dryer train in operation. It appears the roof fans are not operated in either fashion, especially in the summer months when they often run all twelve fans regardless of temperature or how many dryers are operating.

The roof fans are hooded-type fans which means the air is forced down toward the roof and not straight up. This is detrimental to the dilution of the odorous air and makes it more likely to get detected off-site.

The biosolids incinerator stack is located just to the north of the MEB building. It is 14 feet in diameter and is approximately 115 feet tall and has not been used since the incinerator was demolished but is still in good condition and could be used to disperse the air from the drying area of the building and improve dilution. This could be done by installing two 90,000 cfm propeller fans in the north wall of the MEB building at the air plenum that connects the MEB to the stack. The cost of installing these fans is expected to be less than $100,000. The modeling shows if the DT of the air inside the MEB dryer area can be limited to 350 or less (by identifying and repairing leaks in the dryer system), and the air is discharged through the stack, the impact on the frequency of odors in the community is significant. For instance, the frequency of detectable odors at the intersection of Cecil and Fortsen in the Chickasaw Park area would be reduced from 45 times per year to only 20 times per year.

The project currently underway to eliminate air leaks from the dryer system and prevent fugitive dust and odor emissions should lead to lower odor levels inside the building, and subsequently in the surrounding community.

5.3 Control of Headworks Emissions

The modeling shows that the headworks facilities have a moderate impact on off-site odors but it is clearly one of the most significant sources of on-site odors. One of the first things visitors see and smell when they enter the MFWQTC site is the headworks facility. There is nearly always an unpleasant odor when passing by the area that leaves a very bad impression. Odors from this area could be "cleaned-up" in two ways:

- Add chemicals to the influent wastewater **during peak H_2S and odor events** like the one seen during the second round of testing. Chemical addition would reduce emissions at the headworks structures and have the added benefit of reducing emissions throughout the primary clarifiers.

- Cover the influent flow splitter box, screen building influent channel and grit tanks/channels and collect and treat the air by sending it to the bioroughing towers where it will ultimately get treated in the BOC. Strobic Air fans would also be installed on the screen and grit building and the dumpster room to improve ventilation in these areas and improve dilution.

The chemicals that would likely provide the most benefit at the lowest cost would be ferrous chloride and/or hydrogen peroxide. Hydrogen peroxide alone will start reacting immediately with full reaction after 10-20 minutes but would fully react almost instantaneously if a small amount of ferrous chloride is also added as a Fenton's reagent. Iron salts also start reacting immediately with full reaction after a few minutes up to 10 minutes. If peroxide is used with a Fenton's reagent then the chemicals would reduce H_2S and odor at the headworks as well as downstream at the primary clarifiers and potentially the bioroughing towers. A comparison of feeding peroxide versus ferrous chloride is as shown on **Table 17**.

Table 17 – Ferrous Chloride/Peroxide Comparison		
Criteria	**Ferrous Chloride**	**Peroxide w/ Fenton's Reagent**
Reaction Time	0-10 minutes. Some H_2S reduction at headworks	0-20 minutes. More H_2S reduction at headworks
Downstream Impact on Plant	Will reduce H_2S in primaries and biotowers and may have positive impact in biosolids if fed for extended periods	Will reduce H_2S in primaries and biotowers but have no impact on biosolids.
Dosage	2.0 lbs Fe^{++}/lb Sulfide	1.5 lbs H_2O_2/lb Sulfide
Unit Cost	\$0.55/lb of Fe^{++}	\$3.60/gallon
Estimated Daily Cost	\$3,669/day	\$3,600/day
Estimated Capital Cost	\$232,000	\$232,000
Freezing Point	-4°F at 20%	-62°F at 50%
Corrosive to Metals	Very Corrosive	No
Secondary Containment Required	Yes	Yes
Oxidizer	No	Yes
Precipitant	Yes	No
Combustible	No	No
Carcinogenic	No	No
pH	<1	1-3
Pilot Tested	No, but previously used effectively at plant.	Yes. Proven effective.

The existing chemical storage structure just upstream of the headworks could be used to store the chemical(s) since it already has secondary containment. A new 6,000 gallon chemical storage tank would be required along with new chemical metering pumps, piping and instruments. The estimated total capital cost of this system is \$232,000. The estimated daily cost of feeding either chemical if reducing sulfides from 4 mg/L to 0 mg/L is about \$3,600. Assuming chemical is fed 60 days per year the total annual cost would be \$180,000/year plus about \$19,000/year for amortized capital or \$199,000/year total. Refer to **Table 18** for headworks chemical feed system capital and operating costs estimates.

Further improvements to the headworks would include:

1. Installation of aluminum covers over the splitter box and influent channel

2. Installation of inexpensive rubber mats over areas that have existing grating

TABLE 18
Capital and Operating Cost Estimate
Headworks Chemical Feed System

Estimated Operating Cost of Feeding Chemicals at Headworks:

Peroxide O&M Costs

Peroxide Dosage is typically 1.5 lbs of H_2O_2 per pound of sulfide.
Use $3.60/gallon for peroxide per Superoxide telephone quote on 10/22/08.
If we assume 4 mg/L of sulfide on peak days and 100 MGD flow then:
Peroxide solution will be 50% H_2O_2 with density of 10 lbs/gallon. Therefore, 5 lbs H_2O_2/gallon.

4mg/L *100 mgd*8.34 lbs/gal = 3,336 lbs sulfide per day

3336 lb S/d *1.5 lbsH_2O_2/lb S *1 gal H_2O_2/5 lbsH_2O_2*$3.60/gal = **$3,600/day**

Ferrous Chloride O&M Costs

3336 lbs S/d *2.0 lbs Fe++/lb S * $0.55/lb Fe++ = **$3,669.60/day**

Estimated Capital Cost of Feeding Chemicals at Headworks:

	Estimated Capital Cost ($)		
Item Description	**Quantity**	**Unit Cost ($)**	**Total Cost ($)**
6,000 gal. Insulated Chemical Storage Tank	1	30,000	30,000
Miscellaneous Piping	1	20,000	20,000
Pipe Insulation and Heat Tracing	1	6,000	6,000
Chemical Feed Manifold w/ pumps	1	10,000	10,000
Installation (40%)	1	26,400	26,400
Electrical and Instrumentation	1	20,000	20,000
Contractor Overhead and Profit (25%)	1	28,100	28,100
Contingencies (15%)	1	21,075	21,075
Total Estimated Construction Cost			**$161,575**
Estimated Design Fees (10%)			$16,158
Estimated Services During Construction Fees (5%)			$8,079
MSD Force Account (25%)			$46,453
Total Capital Costs			**$232,264**
Amortized Cost at 5% interest for 20 years			$18,637

3. Drawing about 5,400 cfm of air from these areas and feed it into the bottom of the bioroughing towers. The air would pass through the towers and ultimately end up in the BOC.

4. Installing Strobic Air fans on the roofs of the screen and grit building and the screen/grit dumpster room to improve ventilation within these buildings and bring them up to NFPA 820 ventilation standards. The Strobic fans would dilute the air and throw it into the air much like a stack to reduce the chances of off-site detection. The improved ventilation inside the buildings would allow the operators to keep all the doors closed and make the area less offensive to the eye and nose.

The estimated capital cost of these additional improvements is $771,000 and the annual cost for amortized capital is about $62,000, as shown on **Table 19**.

5.4 Control of Primary Clarifier Emissions

About half of the total odor emissions from the primary clarifiers come from the quiescent surfaces and about half come from the effluent weirs and channels. Covering and treating the quiescent surfaces would basically require the installation of a 275' x 280' building over the entire bank of clarifiers and providing a 200,000 cfm odor control system. This is not a reasonable option from an economic standpoint.

Another more feasible option is to cover only the effluent weirs and effluent channels. Normally, the effluent weirs and channels are where most of the turbulence occurs and often account for the majority of the odor emissions from primary clarifiers. As a result, these areas are commonly covered without covering the quiescent surfaces. The higher than normal odor and H_2S emissions from the quiescent surfaces of the MFWQTC clarifiers can likely be attributed to the relatively high sludge blanket depths that were present during testing. An estimate of the capital cost to cover and treat the air from the effluent weir and channel areas only is shown on **Table 20**. It would cost about $2,491,000, $200,000/year when amortized at 5% for 20 years, to cover all of the effluent weirs and channels with aluminum covers and to install a 10,000 cfm 2-stage odor control system consisting of a biotrickling scrubber followed by a carbon adsorber. The two stages would act in series when temperatures were above freezing but during cold weather the BTS would be bypassed and all air would be treated in the carbon adsorber only. A potential location for this system is shown on **Figure 12**.

If chemicals are fed upstream of the headworks facility there will be a residual positive effect at the primary clarifiers. It is estimated that headworks chemical addition would reduce H_2S and odor emissions from the primary clarifiers by about 75%.

TABLE 19
Capital Cost Estimate
Cover Headworks Channels, Install Strobic Air Fans

Location	Dimensions (ft)		Surface Area (sf)
Aluminum Covers			
Influent Junction Box	15	25	375
Influent Channel to New Headworks	50	10	500
Aerated Influent Box	25.33	33	835.89
Total area to be covered with aluminum covers			**1710.89**
Rubber Mat Covers			
Grit Tanks	4 tanks	529 sf	2116
Grit Channels	1	144	
	2	232	
	3	180	
	4	320	
	5	664	1540
Total Area to be covered with rubber matting			**3656**

Calculate Air Flow Rates
Use 1 cfm per square foot of surface area

Air Flow Rate (cfm) **5366.89**
All air from channels and grit tanks gets treated in the bioroughing towers.
Air from new screen and grit building and dumpster room gets exhausted through Strobic Air fans on roofs of buildings.

	Estimated Capital Cost ($)		
Item Description	**Quantity**	**Unit Cost ($)**	**Total Cost ($)**
Aluminum covers (Installed)	1,711	50	85,545
Rubber Matting (Installed)	3,656	5	18,280
Exhaust Fan (Installed)	1	15,000	15,000
Strobic Fans (Installed)	3	35,000	105,000
Ductwork (Installed)	1	100,000	100,000
Crane	1	5,000	5,000
Demolition	1	5,000	5,000
Electrical and Instrumentation	1	25,000	25,000
Contractor Overhead and Profit (15%)	1	53,824	53,824
Contingencies (30%)	1	123,794	123,794
Total Estimated Construction Cost			**$536,443**
Estimated Design Fees (10%)			$53,644
Estimated Services During Construction Fees (5%)			$26,822
MSD Force Account (25%)			$154,227
Total Capital Costs			**$771,136**
Amortized Cost at 5% interest for 20 years			$61,878

TABLE 20

Capital Cost Estimate

Cover and Treat Air from Primary Effluent Weirs and Channels

Each of the four clarifiers has four finger weirs. Each weir/trough is 4.5' wide by 87.66 ' long.

Weir Surface Area = 4.5' x 87.66' x 4/clarifier x 4 clarifiers = 6,315 sf

Primary Effluent Channel Surface Area = 6.5' x 289' = 1,880 sf

Biotower Effluent Channel Surface Area = 6.5' x 289' = 1,880 sf

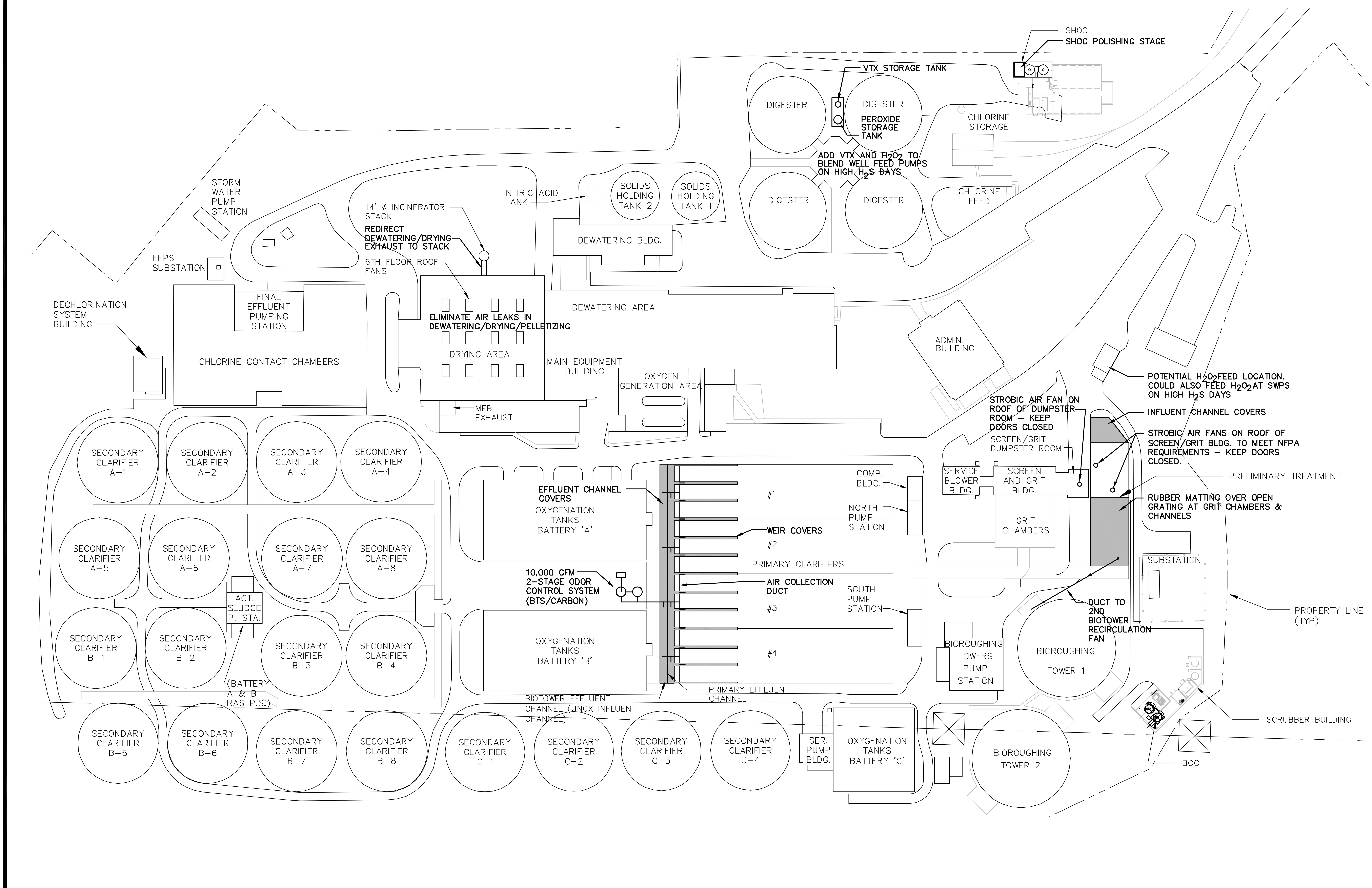
Total Surface Area to be Covered = 6,315 + 1,880 + 1,880 = 10,075 sf

Use 1 cfm/sf of cover surface area.

Design Air Flow Rate = 10,075 cfm

Air Treatment System Description: The air treatment system will consist of a 10,000 cfm biotrickling scrubber (similar to SHOC) followed by a 2nd stage carbon adsorber. The system will
be ducted to allow the BTS to be shut down in cold weather but still allow treatment in the adsorber.

Item Description	Estimated Capital Cost ($)
10,000 cfm Biotrickling Scrubber	300,000
10,000 cfm Carbon Adsorber	175,000
Exhaust Fan	10,000
Equipment installation (30%)	145,500
Concrete pad construction ($500/cyd)	12,500
Aluminum covers (Installed, $50/sf)	503,750
Ductwork (installed)	100,000
Site work	4,000
Electrical and Instrumentation	60,000
Contractor Overhead and Profit (15%)	196,613
Contingencies (15%)	226,104
Total Estimated Construction Cost	**$1,733,467**
Estimated Design Fees (10%)	$173,347
Estimated Services During Construction Fees (5%)	$86,673
MSD Force Account (25%)	$498,372
Total Capital Costs	**$2,491,859**
Amortized Cost at 5% interest for 20 years	$199,953



Engineer's Seal and Signature

Signature

RECORD DWGS:	INITIALS	DATE
CHECKED BY:		
DESIGNED BY:	BEK	
DRAWN BY:	ODS	
FILE NAME:		
PLOT DATE:	09/28/06	

Consultant's Title

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NO.	REVISION	DATE

SHEET TITLE:
ODOR CONTROL IMPROVEMENTS – SITE PLAN

PROJECT TITLE:
MORRIS FORMAN WASTEWATER TREATMENT PLANT
ODOR CONTROL MASTERPLAN - UPDATED 2008

GRAPHIC SCALE = 1" ON ORIGINAL

BUDGET I.D.
CONTRACT NO.
RECORD NO.
DRAWING NO:

FIGURE 12

The modeling shows that feeding chemicals to the headworks (Model 3) would have about the same impact on the community as capturing and treating the air from most of the headworks sources and primary effluent weirs (Model 4). The total estimated annual cost of installing feed equipment and feeding ferrous chloride to the headworks is $216,000/year, if chemicals are fed 60 days per year. The total estimated annual cost of covering and treating headworks sources ($62,000/yr) and the primary effluent weirs ($200,000 for amortized capital and $20,000/yr operating) is $282,000/year.

5.5 BOC Improvements

The biotower odor control system was designed to remove greater than 99% of the inlet H_2S, which it is achieving, but was not specifically designed to remove other reduced sulfur compounds and is struggling to remove these other compounds under current conditions. Bioway America, the manufacturer of the system has been consulted to determine if there are any modifications that can be made to their system to improve RSC and odor removal efficiency and they have offered the following possibilities:

1. Start feeding plant effluent (process) water instead of City water and nutrients. Feeding process water will provide a steadier flow of nutrients to the system and performance is nearly always better with process water than potable water with nutrients, according to Bioway. Plant effluent water is currently not available at the BOC site; therefore, a 2" buried process water line will have to be run from the headworks facility or the biotower pumping facility to the site. MSD is currently using 3 five gallon buckets of nutrients per month and each bucket cost $1,400 therefore the annual cost of nutrients is running about $50,000/year. The BTS are also using about 36,000 gallons/day of potable water. Assuming a cost of $3.30/1000 gallons, the annual cost of potable water is $43,362. It should cost less than $50,000 to run the process water line to the BOC therefore the payback period would be less than one year.

2. Provide a steady source of H_2S to the system, potentially from the headworks area, to give the biomass a steady food supply and keep them hungry so when the spikes come in they can handle them. In order to do this it would be necessary to reduce the amount of air drawn from the bioroughing towers and that is not a reasonable option because fugitive emissions from beneath the domes could occur and the BRT could be starved of oxygen.

3. Decrease air flow rate to BOC to increase empty bed residence time inside the BOC vessels. Again, decreasing air flow from the bioroughing towers (BRT) is not a reasonable option.

4. Recirculate water to the top layer of both vessels all the time. The system was designed to remove most of the H_2S in the 1st stage using low pH autotrophic bacteria and to provide odor and RSC polishing in the top stage using neutral

pH heterotrophic bacteria. If the top stage is recirculated then it would also operate at a low pH and H_2S (and probably methyl mercaptan) removal efficiency would likely increase, particularly during the spikes. The system is getting almost no removal of RSC's, other than H_2S and mercaptans, now due to low EBRTs therefore overall benefits of converting top stage to low pH operation would likely outweigh the costs.

5. Bioway suggested they could have a problem with their first stage spray nozzles not getting full coverage due to interference with the 2nd stage drain water collection system. Bioway modified the nozzles on February 9, 2009 therefore this issue should be resolved.

The best thing to do at this point is to run the process water line to the BOC as soon as possible. The system should then be retested to determine how much impact the process water and nozzle modifications have made on total H_2S, RSC and odor removal efficiency. If further improvements are deemed necessary then recirculation of the top stage should be considered.

5.6 SHOC Improvements

The SHOC receives and treats the worst odors produced on the site. It is performing very well but is still emitting some reduced sulfur compounds that MSD believes could be detected off-site. It is a reliable system but as important as it is in treating the worst of the worst odors and in preventing complaints, consideration needs to be given to supporting and improving its performance. There are four options available that could potentially reduce RSC emissions from the SHOC and these include:

1. Operate the system in the Beta configuration. The system is designed and constructed to operate in two modes. In the Alpha mode the 2nd stage receives continuous recirculation, operates at a low pH and primarily provides H_2S removal. In the Beta mode, the 2nd stage receives only intermittent flow that trickles down from the top layer, operates at a neutral pH and provides RSC removal. The system has been operated in the Alpha mode since startup but a testing program is currently underway to determine if total odor and RSC removal efficiencies increase when operating in the Beta mode. This testing will be completed in the spring of 2009. If effective, there would be no capital costs associated with operating the system in the Beta mode.

2. If operating the system in Beta mode does not provide enough improvement then a polishing stage could be added to the system. Biorem has a new media that is specifically designed for RSC removal. This media could be installed in a concrete enclosure with an integral air plenum. The air would be ducted from the top of the existing vessels to the air distribution panels in the bottom of the polishing stage and then flow through the new media. The system would provide about 15 seconds of empty bed residence time. The estimated capital cost of this option is $788,000 as shown on **Table 21**. The proposal

TABLE 21
Sizing and Cost Estimate for Providing Polishing Stage to SHOC

Air flow rate is 9,200 cfm
15 second EBRT
Construct Concrete walls with plastic air distribution panels in bottom.
Box is 32' x 12' x 9' tall with concrete cover.
Water piping and nozzles will be mounted on underside of top cover.
Media depth is 6'.
Ductwork is 30" diameter.

	Estimated Capital Cost ($)		
Item Description	**Quantity**	**Unit Cost ($)**	**Total Cost ($)**
Biorem Proposal	1	208,000	208,000
Miscellaneous Piping	1	10,000	10,000
Concrete	70	600	42,000
30 FRP Duct/Fittings/Supports	1	40,000	40,000
Installation (25%)	1	75,000	75,000
Electrical and Instrumentation	1	40,000	40,000
Contractor Overhead and Profit (15%)	1	62,250	62,250
Contingencies (15%)	1	71,588	71,588
Total Estimated Construction Cost			**$548,838**
Estimated Design Fees (10%)			$54,884
Estimated Services During Construction Fees (5%)			$27,442
MSD Force Account (25%)			$157,791
Total Capital Costs			**$788,954**
Amortized Cost at 5% interest for 20 years			$63,308

provided by Biorem is included in **Appendix K**. This would provide a robust, biological system that can treat peak transient loads as well as provide polishing to for normal operating conditions.

3. Feed chemicals, such as hydrogen peroxide and VTX, to the sludge upstream of the centrifuge blending well. These chemicals would shave the peaks off of the H_2S, and presumably some of the RSCs, in the air that is drawn from the MEB solids handling sources and the decrease loadings to the SHOC. The chemical feed system would be located in the existing secondary containment area between digesters 2 and 3 and would consist of one 6,000 gallon peroxide storage tank and one 2,500 gallon VTX storage tank. The estimated capital cost of the chemical storage and feed system is $280,000 as shown on **Table 22** and the estimated daily operating cost of feeding the chemicals is $812/day based on estimates provided by Source Technologies.

4. The last option is to turn off the SHOC when inlet loadings exceed design conditions or when off-site odor complaints are received and start the existing fume incinerators. The cost of operating the fume incinerators is nearly $2,200/day as shown on **Table 22** but there are no capital costs associated with this option.

5.7 Digester Gas Leaks

There are three potential sources of odor coming from the digesters. The digesters have a tendency to leak foam onto the covers through the approximately 4 inch wide annular space between the cover and wall. This foam stays on top of the cover and is a source of odor emissions until it is sprayed off.

There is also some off-gassing that occurs from the annular space that is extremely odorous. The volume of this off-gassing is pretty small but with such high odor and H_2S levels it doesn't take much to cause a problem.

The third potential sources of odor from the digesters are the pressure/vacuum relief valves (PRV) located in the center of each cover. These PRVs are designed to release digester gas if the pressure inside the tank exceeds the setpoint but otherwise be airtight. These valves, however, have had a history of not sealing properly and allowing the gas to leak directly to atmosphere even when pressures are not too high.

MSD has tried on numerous occasions to prevent the foaming, off-gassing and leaking and although it is better than it used to be, a problem remains. WEA is not aware of any other steps to be taken to minimize emissions from the digesters, so MSD, it seems, must continue on a program to maintain PRVs and prevent foaming as much as possible.

TABLE 22
Operating Cost Estimate
Compare Costs of Turning on RTO vs. Feeding Peroxide and VTX to Blend well

Natural Gas Cost was \$9.67/dekatherm (dkt) plus \$0.43/1000 cubic feet (mcf) in August 2008 per 10/8/08 Email from Robert Bates. We will use those values.

The PTO uses 8,750 ft3/hr of natural gas.

1 therm = 100,000 btu
1 dkt = mcf *1.0250
mcf = 1000 cubic feet
Gas Cost = \$ 9.67/dkt + \$0.43/mcf

Cost to Operate PTO for one day is:

ft3/hr	hrs/day	ft3/day	mcf/day	dkt/day	$/day
8750	24	210000	210	215.25	**\$ 2,171.77**

Per 10/13/08 email from Stewart North, the cost to feed peroxide and VTX is \$663.50/day.

Includes 110 gpd of 50% H_2O_2 at \$2.25/gallon and 26 gpd of VTX at \$16/gallon.

I spoke to Superoxide and they gave me a cost of \$3.60/gallon for H_2O_2. Using this instead of \$2.25/gallon changes daily cost of chemical addition to **\$812/day.**

In 2007 Odalogs show SHOC inlet exceeded 200 ppm on 21 days between August and November 2007.
In 2008 odalogs show SHOC inlet exceeded 200 ppm on 15 days between July and October.
If Chemicals are fed, or PTO turned on, each day SHOC inlet exceeds 200 ppm the annual cost of each option is:
Assume 20 days/year SHOC inlet exceeds 200 ppm.

PTO Annual Costs	**\$43,435**	
H_2O_2/VTX Annual Costs	**\$16,240**	**/yr +cap costs**

Estimate Capital Costs of Installing Chemical Feed Systems for H_2O_2 and VTX

Robert Bates indicated there are chemical storage tanks and secondary containment between digesters 2 and 3.
He suggests using this area and feeding chemicals to sludge pumps in the digester complex that feed the blend well. Per Stewart North, H_2O_2 will be delivered in 4500 gallon tankers so we need at least 6,000 gallon tank.
VTX will be delivered in 1,500 -2,000 gallon tankers so need 2,000-3,000 storage tank for it.
VTX will freeze at 20F so it needs freeze protection but does not need secondary containment.
H_2O_2 does not need freeze protection (-40F) and does need secondary containment.

Item Description	Estimated Capital Cost ($)		
	Quantity	**Unit Cost ($)**	**Total Cost ($)**
6,000 gal. Peroxide Storage Tank	1	30,000	30,000
2,500 gal VTX Storage Tank	1	15,000	15,000
Miscellaneous Piping	1	25,000	25,000
Pipe Insulation and Heat Tracing	1	6,000	6,000
Chemical Feed Manifold w/ pumps	1	15,000	15,000
Installation (40%)	1	36,400	36,400
Electrical and Instrumentation	1	20,000	20,000
Contractor Overhead and Profit (15%)	1	22,110	22,110
Contingencies (15%)	1	25,427	25,427
		Total Estimated Construction Cost	**\$194,937**
		Estimated Design Fees (10%)	\$19,494
		Estimated Services During Construction Fees (5%)	\$9,747
		MSD Force Account (25%)	\$56,044
		Total Capital Costs	**\$280,221**
Amortized Cost at 5% interest for 20 years			\$22,486

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

The following is a summary of the primary conclusions from the odor evaluation and odor dispersion modeling study:

1. The two primary exhaust areas from the MEB building, the MEB Exhaust Plenum and the dryer area roof exhaust fans, accounted for 49% of the total odor emissions and 75% of the RSC mass emissions during the 2nd round of testing making it the highest priority source on the site. Most of the odor from the MEB comes from the dewatering and drying areas. The existing air collection system for the dewatering area seems to capture most of the dewatering off-gases but this system should be investigated further by measuring air flow rates and smoke testing. The current project underway to identify and repair air leaks in the dryer system should reduce odor emissions from the MEB and reduce the frequency of off-site odor detection. MSD's Process Hazards Analysis team is also looking at some parts of the system and will come out with recommendations in the near future and these may address potential leakage areas in the dryer system. After these improvements are made then further testing may be needed to determine the impact the improvements had on odor emissions. If odor levels are still too high then discharging the dryer area air through the incinerator stack may be required.

2. It was fortunate that the 2nd round of testing occurred on a peak odor day when H_2S levels in the plant influent and through the primary clarifiers were nearly ten times higher than previous testing had shown. The cause for these high H_2S concentrations is unknown at this point but an investigation is underway to try to identify the source(s) of the sulfides. Identifying and eliminating the source(s) may not be easy therefore controlling them at the MFWQTC may be the only option. This can be done using chemical addition or by covering, capturing and treating the air from the headworks sources or by some combination of the two.

3. The modeling indicates reducing emissions from the MEB building will greatly reduce the frequency of detectable odors in the community but will have little effect on peak levels. The only way to reduce peak odor levels in the community is to control emissions at the headworks and primaries when there are high sulfide levels in the influent wastewater. This can be accomplished through chemical addition to plant influent, or by covering and treating some headworks and primary sources, or by doing both.

4. The MFWQTC is a complicated plant with many odor sources and controlling odor emissions will always be a difficult task, especially in the solids handling areas. In addition to the recommended capital improvements, on-going Odalog monitoring should be continued and daily diligence by operators is required to minimize emissions.

5. The SHOC is operating very well, passed the performance test and appears to have little impact on community odors but it may be detected on-site and improved RSC removal efficiency is desired. Four improvement options were presented in this report. The first of these, operate it in Beta mode, is currently being tested. If this is effective then no further improvements may be required, if it does not provide the desired results then the options are to add a polishing stage at a cost of $789,000 with minimal operating costs, feed chemicals to blend well and reduce peaks at a capital cost of $280,000 and operating cost of about $800/day, or turn on the fume incinerator (PTO) at a cost of about $2,200/day. It is recommended after Beta mode testing (spring and summer 2009), that MSD perform a small pilot test or column test of Biorem XLD media with 15 seconds detention time, treating exhaust air from the current SHOC outlet. The estimated cost of the pilot test is $50,000. This polishing step would be the lowest long term cost of the biological, chemical or thermal treatment alternatives. Chemical addition would be difficult to control and is expensive. The PTO is very expensive to operate. If necessary, operate the PTO this summer (2009) and if the pilot test is successful budget the necessary funds in FY10 for the polishing stage. MSD has invested significant money on biological treatment at the SHOC and this further investment is recommended for reliability purposes and as a safety requirement because the SHOC is the first line of defense against odor complaints. Improvements to the SHOC should be seen as an important part of the evolution toward reliable, continuous control of odors at the MFWQTC and toward the goal of reducing odor complaints, not because the SHOC is not effective. We know the SHOC works very well, but we also know it has a most difficult assignment.

6. The BOC is removing greater than 99% of the inlet H_2S as it was designed to do except when unusually high H_2S peaks are received. The system currently operates with potable water and nutrient addition. Changing this to process water should improve performance according to the manufacturer and save MSD nearly $100,000 per year in potable water and nutrient costs. This change should be made as soon as possible. If the system still has trouble handling some of the peaks when operating with process water then the 2^{nd} stage can be recirculated and operated at a low pH to provide improved removal efficiency of H_2S and methyl mercaptan.

6.2 Recommendations

Based on the findings in this report, a program of phased-in odor control improvements (Odor Control Master Plan – Update 2008) is recommended over the next three (3) years. This program will address immediate needs to improve off site odor detection and the frequency of detection and it will provide a greater degree of reliability and protection for existing systems, like the SHOC and the BOC to be able to perform at a high level in treating the most difficult sources of odors at the MFWQTC.

One of the major findings of this report is that in addition to baseline odors, the MFWQTC receives peak influent loadings of sulfides and that the solids handling areas experience very high peaks of hydrogen sulfide and other reduced sulfur compounds, therefore the odor control improvement program will address the need to peak shave and respond to bad odor days in order to prevent off site odor complaints. A three year plan is presented that allows MSD to budget funds to complete the tasks in some order of priority that provides for the largest result for the least expenditures in the first years.

Improvements to the SHOC can be made gradually as tests are completed on the Beta mode of operation and on pilot testing a third stage of polishing, because the PTO can be operated on peak hours or days in the summer months, next summer at the least.

Evaluations on the optimization efforts on the BOC should be accomplished with MSD forces together with Bioway and WEA, except for running a process water line to the BOC system, which should be designed and installed by a contractor. Using process water serves a dual purpose of saving money on nutrients and potable water with a one year payback in costs and it also can improve reliability and performance by providing a constant supply of nutrients to the biological odor control media. If further improvements are required after the system is operated on process water, then recirculating the top stage and operating it in a low pH mode is recommended.

The control of emissions from the MEB is very important to reduce the frequency of odor detection because it is a constant source of background odors in the community. This would be accomplished as follows:

1) Repair the makeup air louvers on the 3rd floor such that they open and close automatically as the dryer area roof fans turn on and off. The roof fans should be programmed to start and stop using a thermostat. As the temperature in the room increases more fans should start. This was the design intent when the ASP project was constructed but the system is not currently operated in this way.

2) Fix the dryer air handling system leaks including:

- Continue with the Process Hazards Analysis
- Measure dryer system pressures and air flows to balance system
- Replace or repair some leaks in the ductwork
- Replace the existing bucket elevators that are full of holes and leaking air
- The fire doors to the dryer area should be kept closed to prevent drawing in air from other areas of the MEB building.
- Repair dryer area exhaust fan makeup air louvers on the 3rd floor and operate the louvers and exhaust fans off of a thermostat. Running only those fans needed to keep building at a comfortable working temperature.

- The air inside the dryer area of the MEB should be monitored when the fans are off to assure safe working conditions and the primary HVAC system for the area must be in proper operating condition.

After these efforts are completed the dryer area roof exhaust fans and the MEB exhaust plenum should be retested and remodeled. If further improvements are required then the air from the dryer area should be exhausted to the incinerator stack with new propeller fans

Controlling odors from the primary clarifier tanks and weirs is best accomplished with chemical addition at the headworks because it can be used only on days of peak H_2S and odor emissions and does not require a large capital cost but it does provide a high degree of protection and the ability to respond rapidly to high influent loadings and or community odor complaints. Chemical addition of iron or hydrogen peroxide in the plant headworks will significantly reduce peak odor levels (by 50% or more) and provides for a large bang for the buck, in terms of investment versus odor reduction in the neighborhoods. MSD will have the ability to add chemicals, as needed but MSD will also need to develop some criteria for dosing chemicals. Hydrogen peroxide with a Fenton's reagent is recommended over ferrous chloride because of the corrosion potential associated with ferrous chloride.

The final recommended investment in Year 3 is to cover the New Headworks Influent Junction Box and Influent Channel, cover the grit tank grating with rubber mats and collect the air under the covers and route the foul air to the bottom of the Biotowers for ultimate treatment in the BOC. In addition, Strobic exhaust fans should be installed on the New Headworks Screening Building and the Screen and Grit Dumpster Building. These improvements will provide a tremendous benefit in reducing on-site odors at a relatively low cost. This area is perceived by plant visitors as a major source of odors due to the location and due to the turbulence of the wastewater in these areas.

MSD will have to continue to repair and maintain Pressure Relief Valves (PRVs) on the digesters and must continue minimizing the foaming on top of the tanks. PRV's should be checked for leaks every 6 months and the foam should be checked every shift. The three-year Odor Control Master Plan – Update 2008 is summarized in **Table 23**.

Table 23 – Recommended Improvements and Budget Costs Over a Three Year Period	
Recommended Odor Control Improvement	**Budget Cost ($)**
YEAR 1- FY 09	
1. Install Chemical Feed System for the MFWQTC Influent	232,000
2. Construct Process Waterline to BOC and Install Filter	50,000
3. Repair Dryer Area Louvers and Exhaust Fan Controls	30,000
Total Cost of Year 1 Improvements	**$312,000**
YEAR 2 – FY 10	
1. Retest and Remodel MEB Exhaust and BOC Exhaust	20,000
2. Pilot Test Polishing Media on SHOC (See Note 1)	50,000
3. Install SHOC Polishing Stage with Biological Media	789,000
Total Cost of Year 2 Improvements	**$869,000**
YEAR 3 – FY 11	
1. Install Covers, Ducts and Fans for Influent Channels and Strobic Fans for Headworks Buildings	771,000
2. Exhaust Dryer Area Air to Incinerator Stack and Shut-down the Dryer Area Roof Exhaust Fans (if necessary)	100,000
Total Cost of Year 3 Improvements	**$871,000**
TOTAL ODOR CONTROL IMPROVEMENTS BUDGET	**$2,052,000**

Notes:

1. Pilot test cost includes $10,000 for Biorem to supply pilot unit and provide assistance during testing, $20,000 for contractor to install pilot unit, $10,000 for demobilization and $10,000 for WEA monitoring of pilot unit. This would be done only if alpha/beta testing on SHOC shows further improvement is required.

Appendix A

Sampling Location Pictures

ODOR CONTROL MASTER PLAN – SAMPLING LOCATIONS

WEBSTER ENVIRONMENTAL ASSOCIATES, INC.

BACKGROUND

- Odor control measures have been implemented over the past 5 years
- MSD contracted WEA to perform follow up odor testing and investigations at MFWWTP
- Follow-up will evaluate effectiveness of new odor control systems and quantify and rank remaining untreated sources

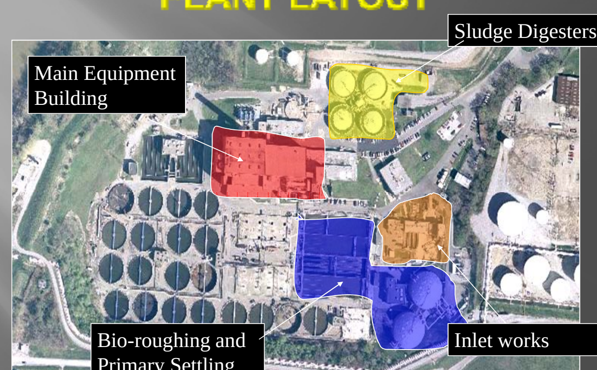
ODOR CONTROL MASTERPLAN – UPDATE 2008
MORRIS FORMAN WWTP

SCOPE OF WORK

- 24 sample locations identified,
- Testing, sampling methods and analytical techniques established for each sample
- Two samples from each location, one for sensory odor testing and one for reduced sulfur compounds

ODOR CONTROL MASTERPLAN – UPDATE 2008
MORRIS FORMAN WWTP

PLANT LAYOUT



ODOR CONTROL MASTERPLAN – UPDATE 2008
MORRIS FORMAN WWTP

Location # 1: Plant influent channel and junction box

Test Type
- Flux Test (without air addition)

Additional Information
- Aeration rates
- Open water surface area (incl. Under bridge)
- Uncovered surface area

ODOR CONTROL MASTERPLAN – UPDATE 2008
MORRIS FORMAN WWTP

Location # 2: Grit loading building – Grit dumpster

No exhaust fans
Work in this area

Test Type
- Flux Chamber over grit dumpster

Additional Information
- Open area of dumpsters
- Dimensions of room
- Size of room openings
- Supply air fan capacity to room

ODOR CONTROL MASTERPLAN – UPDATE 2008
MORRIS FORMAN WWTP

Location # 3: Grit loading building – Screenings dumpster

No exhaust fans
Work in this area

Test Type
- Flux Chamber over screenings dumpster

Additional Information
- Open area of dumpsters
- Dimensions of room
- Size of room openings
- Supply air fan capacity to room

ODOR CONTROL MASTERPLAN – UPDATE 2008
MORRIS FORMAN WWTP

Location # 4: New grit collection chambers – area represents inlet and outlet channels and tanks

Test Type
- Flux chamber over most turbulent spot

Additional Information
- Surface area of open water
- Area of openings

ODOR CONTROL MASTERPLAN – UPDATE 2008
MORRIS FORMAN WWTP

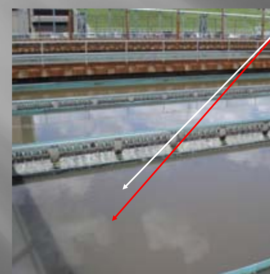
Location # 5 and #6: Primary Clarifier #1 Surface – Inlet and Middle

Test Type
- Flux Chamber one with low blanket levels and one with high blanket levels

Additional Information
- Area of primary settling tanks
- Sludge blanket levels at each sample point
- Sulfides at inlet and outlet

ODOR CONTROL MASTERPLAN – UPDATE 2008
MORRIS FORMAN WWTP

Location # 7 : Primary Clarifier #1 Surface – Near Outlet



Test Type
- Flux Chamber one with low blankets and one with high blanket levels

Additional Information
- Area of primary settling tanks
- Sludge blanket levels at each sample point
- Sulfides at inlet and outlet

ODOR CONTROL MASTERPLAN – UPDATE 2008
MORRIS FORMAN WWTP

Location # 8: Primary Clarifier #1Effluent Weirs

Test Type
- Flux Test in modified chamber

Additional Information
- Dimensions of effluent weir boxes
- Area of weirs

ODOR CONTROL MASTERPLAN – UPDATE 2008
MORRIS FORMAN WWTP

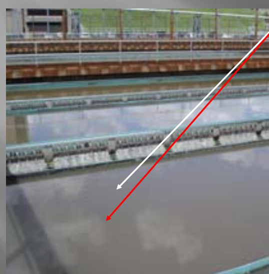
Location # 9 and #10: Primary Clarifier #4 Surface – Inlet and Middle

Test Type
- Flux Chamber one with low blanket levels and one with high blanket levels

Additional Information
- Area of primary settling tanks
- Sludge blanket levels at each sample point
- Sulfides at inlet and outlet

ODOR CONTROL MASTERPLAN – UPDATE 2008
MORRIS FORMAN WWTP

Location # 11 : Primary Clarifier #4 Surface – Near Outlet



Test Type
- Flux Chamber one with low blankets and one with high blanket levels

Additional Information
- Area of primary settling tanks
- Sludge blanket levels at each sample point
- Sulfides at inlet and outlet

ODOR CONTROL MASTERPLAN – UPDATE 2008
MORRIS FORMAN WWTP

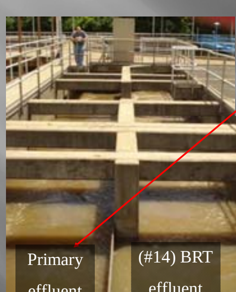
Location # 12: Primary Clarifier #4 Effluent Weirs

Test Type
- Flux Test in modified chamber

Additional Information
- Dimensions of effluent weir boxes
- Area of weirs

ODOR CONTROL MASTERPLAN – UPDATE 2008
MORRIS FORMAN WWTP

Location # 13: Primary Clarifier Effluent Channel



Test Type
- Flux Chamber at most turbulent point

Additional Information
- Area of channels

ODOR CONTROL MASTERPLAN – UPDATE 2008
MORRIS FORMAN WWTP

Location # 14: Bio-roughing Tower Effluent Channel

Test Type
- Flux Chamber at most turbulent point

Additional Information
- Area of channels

ODOR CONTROL MASTERPLAN – UPDATE 2008
MORRIS FORMAN WWTP

Location # 15: New headworks - exhaust from lower screen room

Roof of New Headworks Building

Test Type

- Point source from exhaust fan

Additional Information

- Close doors to screening room
- Obtain extraction rate of exhaust fan
- Get HVAC drawings

Location # 16: New headworks - exhaust from upper screen room

Roof of New Headworks Building

Test Type

- Point source from exhaust fan

Additional Information

- Close doors to screening room
- Obtain extraction rate of exhaust fan
- View HVAC drawings

Location # 17: Old headworks building exhaust

Test Type

- Composite point source of operating exhaust fans

Additional Information

- Exhaust fan capacities

Location # 18: Covered Primary clarifier influent channel

Test Type

- Point source from duct at sample point

Additional Information

- Air flows from fans

Location # 19: BOC Outlet

Test Type
- Point source

Location # 20: DAFT room exhaust -

Test Type
- Point source

Additional Information
- Air flow rates through exhaust fan

Location # 21: MEB exhaust plenum

Test Type
- Point source

Additional Information
- Dimensions of outlet
- Air flows from outlet from fan curves-measure rpm and delta p

Location # 22: MEB Dryer Area Roof Exhaust Fans

Test Type
- Composite point source of operating exhaust fans

Additional Information
- Exhaust fan capacities

Location # 23: Annular space of digesters

Test Type
- Flux chamber over the exposed area, represents the entire area covered by sludge

Additional Information
- Check PRVs while here

Location # 24: SHOC outlet

Test Type
- Point source

Additional Information
- Air flows through towers

Location # 25: Southwestern PS Screen Room Exhaust

Location #26: Diversion Structure CSO Structure

Appendix B

St. Croix Sensory, Inc. Reports

St. Croix Sensory, Inc.

Webster Environmental

MFWTP Master Plan

Odor Evaluation Report

Report No. 820502

07/23/08

Data Release Authorization:	Reviewed and Approved:
Melissa McGinley	Charles M. McGinley
Melissa McGinley	Charles M. McGinley, P.E.
Laboratory Associate	Technical Director

St. Croix Sensory is a laboratory dedicated to practicing state-of-the-art sensory evaluation and to advancing the science of sensory perception.

We are a family owned and operated business providing our clients with personal customer service, flexible scheduling, timely results.

Our focus is to provide the best professional services available to help make your project or product a success.

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St. Croix Sensory, Inc.

Odor Evaluation Report

Client: Webster Environmental

Project: MFWTP Master Plan

Report No.: **820502**

Evaluation Date: 07/23/08

#	Field No.	Sample Description	ASTM E679 & EN13725 Detection Threshold	ASTM E679 & EN13725 Recognition Threshold	ASTM E544 Intensity	PERSISTENCY Dose-Response Slope	CHARACTERIZATION Hedonic Tone	CHARACTERIZATION Principal Odor Descriptors	**Comments**
1	1	Plant Influent Channel & Junc.	1,700	920					
2	2	Grit Loading Bldg. - Grit Dumpster	1,800	1,100					
3	3	Grit Loading Bldg. - Screenings Pump	1,600	920					
4	4	New Grit Chambers + Channels	1,100	650					
5	6	Primary Clarifier #1 Inlet	5,000	3,300					
6	7	Primary Clarifier #4 Inlet	4,300	2,700					
7	8	Primary Clarifier #1 Middle	210	110					
8	9	Primary Clarifier #4 Middle	1,100	590					
9	10	Primary Clarifier #4 Outlet	2,500	1,400					
10	11	Primary Clarifier #1 Outlet	1,800	900					

Client: Webster Environmental

Project: MFWTP Master Plan

Report No.: **820502**

Evaluation Date: 07/23/08

			ASTM E679 & EN13725		ASTM E544	PERSISTENCY	CHARACTERIZATION		
#	Field No.	Sample Description	Detection Threshold	Recognition Threshold	Intensity	Dose-Response Slope	Hedonic Tone	Principal Odor Descriptors	**Comments**
11	12	Primary Clarifier Effluent Channel	9,300	5,700					
12	13	Bioroughing Tower Effluent Channel	4,300	2,100					
13	14	Primary Clarifier #4 Effluent Weir	13,000	8,100					
14	15	Primary Clarifier #1 Effluent Weir	6,500	4,300					
15									
16									
17									
18									
19									
20									

St. Croix Sensory, Inc.

CHAIN OF CUSTODY RECORD FOR ODOR SAMPLES

Page 1 of 2

Client: Webster Env.	Sampled By: Bruce Koetter
Project Name: MFWTP Master Plan	Sampling Date: 7/22/08

Comments: Samples 1-8 in this box. 9-15 in 2nd box.

Line No.	Field No.	Sample Description	Sample Time	Field H_2S (ppm)	Odor Concentration (DT, RT)	Odor Intensity (PPM)	Odor Characterization (Hedonic Tone & Descriptors)	Odor Persistency ("Dose-Response")	Laboratory Sample No. LN	Laboratory Sample No. FN
1	1	Plant Influent Channel + Junc.	7:55a	0.61	X					
2	2	Grit Loading Bldg. - Grit Dumpster	1:25p	0.45	X					
3	3	" " " - Screenings Dump	1:10p	0.27	X					
4	4	New Grit Chambers + Channels	8:30a	0.15	X					
5	6	Primary Clarifier #1 Inlet	10:25a	2.2	X					
6	7	" " #4 Inlet	9:15a	1.3	X					
7	8	" " #1 Middle	11:05a	0.027	X					
8	9	" " #4 Middle	9:35a	0.101	X					
9	10	" " #4 Outlet	10:05a	0.6	X					
10	11	" " #1 Outlet	10:45a	0.4	X					

For Laboratory use Only

Odor Evaluation Report No.

Transfer & Shipping Information

Number of "Air-Pacs"/ Shipping Boxes 2

Relinquished By	Date	Time	Accepted By	Date	Time	Comments & Exceptions Noted
Bruce Koetter	7/22/08	3:45p				
Received at St. Croix Sensory Laboratory			Natasha Koland	7/23/08	9:35	

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St. Croix Sensory, Inc.

CHAIN OF CUSTODY RECORD FOR ODOR SAMPLES

Page 2 of 2

Client: Webster Env.	Sampled By: Bruce Koether	Odor Evaluations Requested: (X)	
Project Name: MFWTP. Master Plan	Sampling Date: 7/22/08		

Comments:
Samples 9-15 in this box. 1-8 in other box

Line No.	Field No.	Sample Description	Sample Time	Field H_2S (ppm)	Odor Concentration (DT, RT)	Odor Intensity (PPM)	Odor Characterization (Hedonic Tone & Descriptors)	Odor Persistency ("Dose-Response")	For Laboratory use Only: Odor Evaluation Report No. / Laboratory Sample No. LN	FN
1	12	Primary Clarifier Effluent Channel	11:30a	7.4	X					
2	13	Bioroughing Tower Effluent Channel	11:45a	1.4	X					
3	14	Primary Clarifier #4 Effluent W.	2:00p	16.0	X					
4	15	" " #1 Effluent Weir	1:45p	6.9	X					
5										
6										
7										
8										
9										
10										

Transfer & Shipping Information

Number of "Air-Pacs"/ Shipping Boxes 2

Relinquished By	Date	Time	Accepted By	Date	Time	Comments & Exceptions Noted
Bruce Koether	7/22/08	3:45P				
Received at St. Croix Sensory Laboratory			Natasha Kelant	7/23/08	9:35	

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Webster Environmental Associates, Inc.

MFWTP - Masterplan

Odor Evaluation Report

Report No. 820601

07/24/08

Data Release Authorization:

Natasha Kaslow

Natasha Kaslow
Laboratory Associate

Reviewed and Approved:

Charles M. McGinley

Charles M. McGinley, P.E.
Technical Director

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St. Croix Sensory, Inc.

Odor Evaluation Report

Client: Webster Environmental Associates, Inc.

Project: MFWTP - Masterplan

Report No.: **820601**

Evaluation Date: 07/24/08

			ASTM E679 & EN13725		ASTM E544	PERSISTENCY	CHARACTERIZATION		
#	Field No.	Sample Description	Detection Threshold	Recognition Threshold	Intensity	Dose-Response Slope	Hedonic Tone	Principal Odor Descriptors	**Comments**
1	16	New Headworks Exhaust Lower Level	470	310					
2	17	New Headworks Exhaust From Screen Room	1,700	1,200					
3	18	Old Headworks Building Exhaust	4,200	2,400					
4	19	Primary Clarifier Influent Channel	8,000	5,000					
5	20	BOC Outlet	5,100	3,400					
6	21	DAFT Room Exhaust (Strobic Air Fan)	430	300					
7	22	MEB Exhaust	150	85					
8	23	MEB Roof Exhaust Fans	710	450					
9	24	Annular Space For Digesters	160,000	100,000					**Field sample diluted 10:1 for threshold evaluation.**
10	25	SHOC Outlet	4,100	2,800					

St. Croix Sensory, Inc.

CHAIN OF CUSTODY RECORD FOR ODOR SAMPLES

Page 1 of 1

Client: Webster | Sampled By: Bruce Koetter

Project Name: MFWTP - Masterplan | Sampling Date: 7/23/08

Comments:

Odor Evaluations Requested: (X)

Line No.	Field No.	Sample Description	Sample Time	Field H_2S (ppm)	Odor Concentration (DT, RT)	Odor Intensity (PPM)	Odor Characterization (Hedonic Tone & Descriptors)	Odor Persistency ("Dose-Response")	Laboratory Sample No. LN	FN
1	16	New headworks exhaust lower level	7:50A	0.046	X					
2	17	New headworks exhaust from screen room	8:00A	0.14	X					
3	18	Old headworks building exhaust	8:45A	0.85	X					
4	19	Primary clarifier influent channel	8:25A	2.1	X					
5	20	BOC outlet	9:00A	0.49	X					
6	21	DAFT room exhaust (Strobic air fan)	10:05A	0.038	X					
7	22	MEB Exhaust	9:30A	0.017	X					
8	23	MEB roof exhaust fans	9:40A	0.067	X					
9	24	Annular space for digesters	11:15A	~~7~~50	X					
10	25	SHOC Outlet	10:30A	0.059	X					

For Laboratory use Only: Odor Evaluation Report No.

Transfer & Shipping Information

Number of "Air-Pacs"/ Shipping Boxes 1

Relinquished By	Date	Time	Accepted By	Date	Time	Comments & Exceptions Noted
Bruce Koetter	7/23/08	4:00P				
Received at St. Croix Sensory Laboratory			Natasha Sehe	7.24.08	9:40	#21 very low air

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St. Croix Sensory, Inc.

Webster Environmental Associates, Inc.

MFWTP Masterplan

Odor Evaluation Report

Report No. 823302
08/20/08

Data Release Authorization:

Natasha Kaslow

Natasha Kaslow
Laboratory Associate

Reviewed and Approved:

Charles M. McGinley

Charles M. McGinley, P.E.
Technical Director

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St. Croix Sensory, Inc.

Odor Evaluation Report

Client: Webster Environmental Associates, Inc.

Project: MFWTP Masterplan

Report No.: **823302**

Evaluation Date: 08/20/08

			ASTM E679 & EN13725		ASTM E544	PERSISTENCY	CHARACTERIZATION		
#	Field No.	Sample Description	Detection Threshold	Recognition Threshold	Intensity	Dose-Response Slope	Hedonic Tone	Principal Odor Descriptors	**Comments**
1	1	Plant Influent Channel	76,000	50,000					Field sample diluted 10:1 for threshold evaluation.
2	2	Grit Dumpster	4,600	2,900					
3	3	Screenings Dumpster	4,100	2,100					
4	4	New Grit Chambers	10,000	5,000					
5	6	Primary #1 Inlet	7,700	3,800					
6	7	Primary #1 Middle	6,200	3,100					
7	8	Primary #1 Outlet	4,700	2,400					
8	9	Primary #4 Inlet	7,200	4,100					
9	10	Primary #4 Middle	4,900	2,500					
10	11	Primary #4 Outlet	7,200	4,400					

St. Croix Sensory, Inc.

Odor Evaluation Report

Client: Webster Environmental Associates, Inc.

Report No.: **823302**

Project: MFWTP Masterplan

Evaluation Date: 08/20/08

			ASTM E679 & EN13725		ASTM E544	PERSISTENCY	CHARACTERIZATION		
#	Field No.	Sample Description	Detection Threshold	Recognition Threshold	Intensity	Dose-Response Slope	Hedonic Tone	Principal Odor Descriptors	**Comments**
11	12	Primary Effluent Channel	13,000	6,700					
12	13	Biotower Effluent Channel	8,900	4,300					
13	14	Primary #1 Eff. Weirs	23,000	11,000					
14	15	Primary #4 Eff. Weirs	96,000	50,000					**Field sample diluted 10:1 for threshold evaluation.**
15	16	Annular Space of Digester #4	94,000	66,000					**Field sample diluted 10:1 for threshold evaluation.**
16									
17									
18									
19									
20									

St. Croix Sensory, Inc.

CHAIN OF CUSTODY RECORD FOR ODOR SAMPLES

Page 1 of 2

Client: Webster

Sampled By: Bruce Koetter

Project Name: MFWTP Masterplan

Sampling Date: 8/19/08

Comments:

Odor Evaluations Requested: (X)

For Laboratory use Only

Odor Evaluation Report No.

Line No.	Field No.	Sample Description	Sample Time	Field H_2S (ppm)	Odor Concentration (DT, RT)	Odor Intensity (PPM)	Odor Characterization (Hedonic Tone & Descriptors)	Odor Persistency ("Dose-Response")	Laboratory Sample No. LN	Laboratory Sample No. FN
1	1	Plant Influent Channel	8:30a	Instrument Malfunction	X					
2	2	Grit Dumpster	9:10a		X					
3	3	Screenings Dumpster	9:25a		X					
4	4	New Grit Chambers	9:45a		X					
5	6	Primary #1 Inlet	10:55		X					
6	7	Primary #1 Middle	10:10		X					
7	8	Primary #1 Outlet	10:35		X					
8	9	Primary #4 Inlet	11:20		X					
9	10	Primary #4 Middle	11:35		X					
10	11	Primary #4 Outlet	11:55		X					

Transfer & Shipping Information

Number of "Air-Pacs"/ Shipping Boxes 2

Relinquished By	Date	Time	Accepted By	Date	Time	Comments & Exceptions Noted
Bruce Koetter	8/19/08	3:30p				
Received at St. Croix Sensory Laboratory			Natasha Sofie	8/20/08	10:00	

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CHAIN OF CUSTODY RECORD FOR ODOR SAMPLES

Page___ of___

Client: Webster

Sampled By: Bruce Koetter

Project Name: MFWTP Masterplan

Sampling Date:

Comments:

Odor Evaluations Requested: (X)

For Laboratory use Only

Odor Evaluation Report No.

Line No.	Field No.	Sample Description	Sample Time	Field H_2S (ppm)	Odor Concentration (DT, RT)	Odor Intensity (PPM)	Odor Characterization (Hedonic Tone & Descriptors)	Odor Persistency ("Dose-Response")	Laboratory Sample No. LN	Laboratory Sample No. FN
1	12	Primary Effluent Channel	1:05p	Instrument Malfunction	X					
2	13	Biotower Effluent Channel	1:20p		X					
3	14	Primary #1 Eff. Weirs	1:55p		X					
4	15	Primary #4 Eff. Weirs	1:35p		X					
5	16	Annular Space of Digester #4	2:15p	"	X					
6										
7										
8										
9										
10										

Transfer & Shipping Information

Number of "Air-Pacs"/ Shipping Boxes______

Relinquished By	Date	Time	Accepted By	Date	Time	Comments & Exceptions Noted
Received at St. Croix Sensory Laboratory			[illegible]	8/20.08	10.50	

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Webster Environmental Associates, Inc.

MFWTP Masterplan

Odor Evaluation Report

Report No. 823402

08/21/08

Data Release Authorization:

Natasha Kaslow

Natasha Kaslow
Laboratory Associate

Reviewed and Approved:

Charles M. McGinley

Charles M. McGinley, P.E.
Technical Director

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St. Croix Sensory, Inc.

Odor Evaluation Report

Client: Webster Environmental Associates, Inc.

Project: MFWTP Masterplan

Report No.: **823402**

Evaluation Date: 08/21/08

			ASTM E679 & EN13725		ASTM E544	PERSISTENCY	CHARACTERIZATION		
#	Field No.	Sample Description	Detection Threshold	Recognition Threshold	Intensity	Dose-Response Slope	Hedonic Tone	Principal Odor Descriptors	**Comments**
1	17	Headworks Exhaust - Lower Level	1,600	900					
2	18	Headworks Exhaust Screen Room	4,700	2,400					
3	19	Old Headworks Bldg Exhaust	5,300	2,700					
4	20	Primary Clar. Influent Channel	8,600	4,400					
5	21	BOC Outlet	7,500	4,100					
6	22	DAFT Room Exhaust	900	480					
7	23	MEB Exhaust	330	180					
8	24	MEB Roof Exhaust Fans	1,100	680					
9	25	SHOC Outlet	5,700	3,100					
10	26	SWPS Exhaust	180	95					

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St. Croix Sensory, Inc.

Odor Evaluation Report

Client: Webster Environmental Associates, Inc.

Report No.: **823402**

Project: MFWTP Masterplan

Evaluation Date: 08/21/08

			ASTM E679 & EN13725		ASTM E544	PERSISTENCY	CHARACTERIZATION		
#	Field No.	Sample Description	Detection Threshold	Recognition Threshold	Intensity	Dose-Response Slope	Hedonic Tone	Principal Odor Descriptors	**Comments**
11	27	Diversion Structure	2,700	1,500					
12									
13									
14									
15									
16									
17									
18									
19									
20									

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St. Croix Sensory, Inc.

CHAIN OF CUSTODY RECORD FOR ODOR SAMPLES

Page 1 of 1

Client: Webster

Sampled By: Bruce Koetter

Project Name: MFWTP Masterplan

Sampling Date:

Comments:

Odor Evaluations Requested: (X)

For Laboratory use Only

Odor Evaluation Report No.

Line No.	Field No.	Sample Description	Sample Time	Field H_2S (ppm)	Odor Concentration (DT, RT)	Odor Intensity (PPM)	Odor Characterization (Hedonic Tone & Descriptors)	Odor Persistency ("Dose-Response")	Laboratory Sample No. LN	Laboratory Sample No. FN
1	17	Headworks Exhaust - Lower Level	8:20a	Instrument Malfunction	X					
2	18	Headworks Exhaust Screen Room	8:30		X					
3	19	Old headworks Bldg Exhaust	8:45		X					
4	20	Primary Clar. Influent Channel	9:00		X					
5	21	Boc outlet	9:15		X					
6	22	DAFT Room Exhaust	10:00		X					
7	23	MEB Exhaust	10:20		X					
8	24	MEB Roof Exhaust fans	10:35		X					
9	25	SHOC outlet	10:55		X					
10	26 27	SW PS Exhaust Diversion Structure	12:00 11:35		X					

Transfer & Shipping Information

Number of "Air-Pacs"/ Shipping Boxes 1

Relinquished By	Date	Time	Accepted By	Date	Time	Comments & Exceptions Noted
Bruce Koetter	8/20/08	3:00p				
Received at St. Croix Sensory Laboratory			Natasha Safre	8.21.08	10:05	

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St. Croix Sensory, Inc.

Webster Environmental Associates, Inc.

Louisville MSD

Odor Evaluation Report

Report No. 833102
11/26/08

Data Release Authorization:

Natasha Kaslow

Natasha Kaslow
Laboratory Associate

Reviewed and Approved:

Michael A. McGinley, P.E.
Laboratory Director

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St. Croix Sensory, Inc.

Odor Evaluation Report

Client: Webster Environmental Associates, Inc.

Project: Louisville MSD

Report No.: **833102**

Evaluation Date: 11/26/08

			ASTM E679 & EN13725		ASTM E544	PERSISTENCY	CHARACTERIZATION		
#	Field No.	Sample Description	Detection Threshold	Recognition Threshold	Intensity	Dose-Response Slope	Hedonic Tone	Principal Odor Descriptors	**Comments**
1	1	MEB Exhaust #1	500	300					
2	2	6th Floor Exhaust Fan #2A	1,000	570					
3	3	MEB Exhaust #2	850	420					
4	4	6th Floor Exhaust Fan #2B	1,200	700					
5									
6									
7									
8									
9									
10									

St. Croix Sensory, Inc.

CHAIN OF CUSTODY RECORD FOR ODOR SAMPLES

Page 1 of 1

Client: Webster Environmental | Sampled By: Bruce Koether

Project Name: Louisville MSD | Sampling Date: 11/25/08

Comments:

Odor Evaluations Requested: (X)

Line No.	Field No.	Sample Description	Sample Time	Field H_2S (ppm)	Odor Concentration* (Detection & Recognition Threshold)	Odor Intensity* (PPM 1-Butanol)	Odor Characterization (Hedonic Tone & Descriptors)	Odor Persistency ("Dose-Response")	For Laboratory use Only: Odor Evaluation Report No. / Laboratory Sample No. EN / EN
1	1	MEB Exhaust #1	7:00a	0.070	X				
2	2	6th Floor Exhaust Fan #2A	7:20a	0.128	X				
3	3	MEB Exhaust #2	3:40p	0.13	X				
4	4	6th Floor Exhaust Fan #2B	3:55p	0.20	X				
5									
6									
7									
8									
9									
10									
11									
12									

Transmittal

Number of Shipping Boxes 1

Relinquished By	Date	Time	Accepted By	Date	Time	Comments & Exceptions Noted
Bruce Koether	11/25/08	4:00p				
Received at St. Croix Sensory Laboratory			Katrina Sattre	11 26 08	10:00	

*Odor Concentration: ASTM E679-04 and EN13725:2003 and Odor Intensity: ASTM E544-99(2004)

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Appendix C

Air Flow Rate Calculations

APPENDIX C
AIR FLOW RATE CALCULATIONS

Plant Influent Channel (Aerated)

Blower supplies air to old aerated grit chambers as well as the plant influent channel. There is no way to tell how much air from the blowers go to each location. In previous masterplan work we used 47 cfm from influent junction box, 63 cfm from plant influent channel and 506 cfm from aerated influent box. We will use same values this time with new DT values.

Quiescent Surfaces Using Flux Chamber

Surface Area of Flux Chamber (m2)	0.13	
Surface Area of Flux Chamber (ft2)	1.40	(A)
Supply air flow rate to flux chamber (L/min)	5	
Supply air flow rate to flux chamber (ft3/min)	0.177	(B)

Source Air Flow Rate = ((B) *Tank Surface Area in SF)/(A)
Source Air Flow Rate = 0.126233 * tank surface area

Quiescent Surface Areas

Location	X	Y	# of Tanks	Total Surface Area (ft2)	Tank Air Flow Rate (cfm)
Grit Dumpster	6.5	20	2	260	32.82
Screenings Dumpster	6.5	20	2	260	32.82
New grit chambers		See Messier calculations		3370	425.41
Primary Clarifiers	275	70	4	77000	9719.96
Primary Clarifiers less the weirs					9226.75
Primary effluent Weirs	4.5	87.66	16	6311.52	493.21
Primary effluent channel	6.5	289	1	1878.5	237.13
Biotower effluent channel	6.5	289	1	1878.5	237.13
Digester annular space					
Digester Diameter	100				
Average sludge distance from wall(ft)	9				
Digester surface area (ft2)	7850				
Surface area with no sludge (ft2)	6500.6				
Area with sludge (ft2)	1349.4		4	5397.66	681.3639

Primary Effluent Weir Flux Chamber

Surface Area of Flux Chamber (m2)	0.21	
Surface Area of Flux Chamber (ft2)	2.26	(A)
Supply air flow rate to flux chamber (L/min)	5	
Supply air flow rate to flux chamber (ft3/min)	0.177	(B)

Source Air Flow Rate = ((B) *Tank Surface Area in SF)/(A)
Source Air Flow Rate = 0.078144 * tank surface area

<u>Appendix D</u>

Mayfly Reduced Sulfur Compound Results

MAYFLY ODOR LABORATORY
450 Flanders Road
Mystic, CT 06355
(860) 536-7431
FAX (860) 536-2212

Client: **Webster Environmental** Received: **7/23-24/08** Reported: **8/2/08** Analysis: **7/23-25/08**
Project ID: **8061** Sample ID: **Air** Sample Type: **Tedlar Bag** Sample Vol: **0.05-2.5 ml**

MFWTP- Master Plan 404-2 **Volatile Sulfur Compounds**

	OT*	Mol. Wt.	#1 7:55 PPB	#2 13:25 PPB	#3 13:10 PPB	#4 8:30 PPB	#6 10:25 PPB	#7 9:15 PPB
Hydrogen Sulfide	0.4	34	553	365	182	204	2,900	1,900
COS	55	60	1.5	2.7	1.1	0.7	0.9	2.2
Methanethiol (MM)	0.01	48	176	156	212	126	175	47
Ethanethiol (t)	0.01	62	<3	<3	<3	<3	<3	<3
Dimethyl Sulfide	1	62	9.4	29	14	7.4	3.2	5.3
Carbon Disulfide	10	76	5.5	4.1	5.3	2.9	4.7	5.2
2-Propanethiol (t)		76	<3	<3	<3	<3	<3	<3
2-Methyl-2-propanethiol		90	<3	<3	<3	<3	<3	<3
2-(Methyl thio) propane (t)		90	<3	<3	<3	<3	<3	<3
Allyl Methyl Sulfide	0.1	88	0.3	0.3	<1	0.1	<1	<1
Diethyl Sulfide	0.03	90	<3	<3	<3	<3	<3	<3
Methylthioacetate		90	<3	<3	<3	<3	<3	<3
1-(Methyl thio) propane (t)		90	<3	<3	<3	<3	<3	<3
2-(ethylthio) Propane (t)		104	<3	<3	<3	<3	<3	<3
Dimethyl Disulfide	2.2	94	2.2	1.1	3.3	0.5	0.1	<0.1
2-M-1-(Methylthio) Propane (t)		104	<3	<3	<3	<3	<3	<3
Diisoproyl Disulfide (t)		118	<3	<3	<3	<3	<3	<3
2-(Methylthio) Butane (t)		104	<3	<3	<3	<3	<3	<3
Methyl Ethyl Disulfide		108	<3	<3	<3	<3	<3	<3
Methyl Thiophene		98	<3	<3	<3	<3	<3	<3
Sec-Butyl isopropyl Sulfide (t)		132	<3	<3	<3	<3	<3	<3
1-(Ethylthio) Butane (t)		118	<3	<3	<3	<3	<3	<3
Methyl Propyl Disulfide (t)		122	<3	<3	<3	<3	<3	<3
Diethyl Disulfide (t)	2	122	<3	<3	<3	<3	<3	<3
2,2-bis(ethylthio) Propane (t)		164	<3	<3	<3	<3	<3	<3
Dimethyl Trisulfide	0.01	126	0.34	<0.1	<0.1	0.53	3.2	<0.1
Methyl Isopropyl Disulfide (t)		122	<3	<3	<3	<3	<3	<3
Methyl 2-propenyl Disulfide		120	<3	<3	<3	<3	<3	<3
M-1-M-1-(Mthio)ethyl Disulfide (t)		168	<3	<3	<3	<3	<3	<3
Allyl disulfide (t)		146	<3	<3	<3	<3	<3	<3
Diisobutyl Disulfide (t)		178	<3	<3	<3	<3	<3	<3

OT*= Odor Thresholds - odor threshold are always reported in a range to reflect inherent human variability, the values reported in this column are the lowest we took from the literature

MAYFLY ODOR LABORATORY
450 Flanders Road
Mystic, CT 06355
(860) 536-7431
FAX (860) 536-2212

Client: **Webster Environmental** Received: **7/23-24/08** Reported: **8/2/08** Analysis: **7/23-25/08**
Project ID: **8061** Sample ID: **Air** Sample Type: **Tedlar Bag** Sample Vol: **0.05-2.5 ml**

MFWTP- Master Plan 404-2 **Volatile Sulfur Compounds**

	OT*	Mol. Wt.	#8 11;05 PPB	#9 9:35 PPB	#10 10:05 PPB	#11 10:45 PPB	#12 11:30 PPB	#13 11:45 PPB
Hydrogen Sulfide	0.4	34	67	177	442	338	5,900	1,600
COS	55	60	0.6	0.5	0.6	0.8	0.1	2.0
Methanethiol (MM)	0.01	48	4	41	37	4	259	315
Ethanethiol (t)	0.01	62	<3	<3	<3	<3	<3	<3
Dimethyl Sulfide	1	62	3.4	4.8	6.4	23	28	26
Carbon Disulfide	10	76	1.0	1.2	8.6	4.8	2.2	11
2-Propanethiol (t)		76	<3	<3	<3	<3	<3	<3
2-Methyl-2-propanethiol		90	<3	<3	<3	<3	<3	<3
2-(Methyl thio) propane (t)		90	<3	<3	<3	<3	<3	<3
Allyl Methyl Sulfide	0.1	88	0.3	0.3	<1	0.1	<1	<1
Diethyl Sulfide	0.03	90	<3	<3	<3	<3	<3	<3
Methylthioacetate		90	<3	<3	<3	<3	<3	<3
1-(Methyl thio) propane (t)		90	<3	<3	<3	<3	<3	<3
2-(ethylthio) Propane (t)		104	<3	<3	<3	<3	<3	<3
Dimethyl Disulfide	2.2	94	<0.1	<0.1	<0.1	0.2	1.6	0.3
2-M-1-(Methylthio) Propane (t)		104	<3	<3	<3	<3	<3	<3
Diisoproyl Disulfide (t)		118	<3	<3	<3	<3	<3	<3
2-(Methylthio) Butane (t)		104	<3	<3	<3	<3	<3	<3
Methyl Ethyl Disulfide		108	<3	<3	<3	<3	<3	<3
Methyl Thiophene		98	<3	<3	<3	<3	<3	<3
Sec-Butyl isopropyl Sulfide (t)		132	<3	<3	<3	<3	<3	<3
1-(Ethylthio) Butane (t)		118	<3	<3	<3	<3	<3	<3
Methyl Propyl Disulfide (t)		122	<3	<3	<3	<3	<3	<3
Diethyl Disulfide (t)	2	122	<3	<3	<3	<3	<3	<3
2,2-bis(ethylthio) Propane (t)		164	<3	<3	<3	<3	<3	<3
Dimethyl Trisulfide	0.01	126	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Methyl Isopropyl Disulfide (t)		122	<3	<3	<3	<3	<3	<3
Methyl 2-propenyl Disulfide		120	<3	<3	<3	<3	<3	<3
M-1-M-1-(Mthio)ethyl Disulfide (t)		168	<3	<3	<3	<3	<3	<3
Allyl disulfide (t)		146	<3	<3	<3	<3	<3	<3
Diisobutyl Disulfide (t)		178	<3	<3	<3	<3	<3	<3

OT*= Odor Thresholds - odor threshold are always reported in a range to reflect inherent human variability, the values reported in this column are the lowest we took from the literature

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Client: **Webster Environmental** Received: **7/23-24/08** Reported: **8/2/08** Analysis: **7/23-25/08**
Project ID: **8061** Sample ID: **Air** Sample Type: **Tedlar Bag** Sample Vol: **0.05-2.5 ml**

MFWTP- Master Plan 404-2 **Volatile Sulfur Compounds**

	OT*	Mol. Wt.	#14 14:00 PPB	#15 13:45 PPB	#16 7:50 PPB	#17 8:00 PPB	#18 8:45 PPB	#19 8:25 PPB
Hydrogen Sulfide	0.4	34	25,000	6,800	101	214	614	2,100
COS	55	60	6.6	2.7	<1	<1	0.4	0.7
Methanethiol (MM)	0.01	48	1,970	454	18	42	4	348
Ethanethiol (t)	0.01	62	<3	<3	<3	<3	<3	<3
Dimethyl Sulfide	1	62	214	44	<1	<1	<1	12
Carbon Disulfide	10	76	42	20	0.6	0.9	0.9	3.0
2-Propanethiol (t)		76	<3	<3	<3	<3	<3	<3
2-Methyl-2-propanethiol		90	<3	<3	<3	<3	<3	<3
2-(Methyl thio) propane (t)		90	<3	<3	<3	<3	<3	<3
Allyl Methyl Sulfide	0.1	88	0.3	0.3	<1	0.1	<1	<1
Diethyl Sulfide	0.03	90	<3	<3	<3	<3	<3	<3
Methylthioacetate		90	<3	<3	<3	<3	<3	<3
1-(Methyl thio) propane (t)		90	<3	<3	<3	<3	<3	<3
2-(ethylthio) Propane (t)		104	<3	<3	<3	<3	<3	<3
Dimethyl Disulfide	2.2	94	13	1.6	0.1	<0.1	<0.1	0.6
2-M-1-(Methylthio) Propane (t)		104	<3	<3	<3	<3	<3	<3
Diisoproyl Disulfide (t)		118	<3	<3	<3	<3	<3	<3
2-(Methylthio) Butane (t)		104	<3	<3	<3	<3	<3	<3
Methyl Ethyl Disulfide		108	<3	<3	<3	<3	<3	<3
Methyl Thiophene		98	<3	<3	<3	<3	<3	<3
Sec-Butyl isopropyl Sulfide (t)		132	<3	<3	<3	<3	<3	<3
1-(Ethylthio) Butane (t)		118	<3	<3	<3	<3	<3	<3
Methyl Propyl Disulfide (t)		122	<3	<3	<3	<3	<3	<3
Diethyl Disulfide (t)	2	122	<3	<3	<3	<3	<3	<3
2,2-bis(ethylthio) Propane (t)		164	<3	<3	<3	<3	<3	<3
Dimethyl Trisulfide	0.01	126	1.2	<0.1	<0.1	<0.1	<0.1	<0.1
Methyl Isopropyl Disulfide (t)		122	<3	<3	<3	<3	<3	<3
Methyl 2-propenyl Disulfide		120	<3	<3	<3	<3	<3	<3
M-1-M-1-(Mthio)ethyl Disulfide (t)		168	<3	<3	<3	<3	<3	<3
Allyl disulfide (t)		146	<3	<3	<3	<3	<3	<3
Diisobutyl Disulfide (t)		178	<3	<3	<3	<3	<3	<3

OT*= Odor Thresholds - odor threshold are always reported in a range to reflect inherent human variability, the values reported in this column are the lowest we took from the literature

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Client: **Webster Environmental** Received: **7/23-24/08** Reported: **8/2/08** Analysis: **7/23-25/08**
Project ID: **8061** Sample ID: **Air** Sample Type: **Tedlar Bag** Sample Vol: **0.05-2.5 ml**

MFWTP- Master Plan 404-2 **Volatile Sulfur Compounds**

	OT*	Mol. Wt.	#20 9:00 PPB	#21 10:05 PPB	#22 9:30 PPB	#23 9:40 PPB	#24 11:15 PPB	#25 10:30 PPB
Hydrogen Sulfide	0.4	34	310	71	70	119	175,000	62
COS	55	60	5.1	0.2	0.6	0.8	0.9	0.9
Methanethiol (MM)	0.01	48	451	26	3.7	3.7	INF	84
Ethanethiol (t)	0.01	62	<3	<3	<3	<3	<3	<3
Dimethyl Sulfide	1	62	128	<1	<1	<1	<1	65
Carbon Disulfide	10	76	59	0.5	2.1	3.5	39	7.7
2-Propanethiol (t)		76	<3	<3	<3	<3	0.7	<3
2-Methyl-2-propanethiol		90	<3	<3	<3	<3	<3	<3
2-(Methyl thio) propane (t)		90	<3	<3	<3	<3	<3	<3
Allyl Methyl Sulfide	0.1	88	<1	<1	<1	<1	<1	<1
Diethyl Sulfide	0.03	90	<3	<3	<3	<3	<3	<3
Methylthioacetate		90	<3	<3	<3	<3	<3	<3
1-(Methyl thio) propane (t)		90	<3	<3	<3	<3	<3	<3
2-(ethylthio) Propane (t)		104	<3	<3	<3	<3	<3	<3
Dimethyl Disulfide	2.2	94	5.8	<0.1	<0.1	0.8	0.5	3.1
2-M-1-(Methylthio) Propane (t)		104	<3	<3	<3	<3	<3	<3
Diisoproyl Disulfide (t)		118	<3	<3	<3	<3	<3	<3
2-(Methylthio) Butane (t)		104	<3	<3	<3	<3	<3	<3
Methyl Ethyl Disulfide		108	<3	<3	<3	<3	<3	<3
Methyl Thiophene		98	<3	<3	<3	<3	<3	<3
Sec-Butyl isopropyl Sulfide (t)		132	<3	<3	<3	<3	<3	<3
1-(Ethylthio) Butane (t)		118	<3	<3	<3	<3	<3	<3
Methyl Propyl Disulfide (t)		122	<3	<3	<3	<3	<3	<3
Diethyl Disulfide (t)	2	122	<3	<3	<3	<3	<3	<3
2,2-bis(ethylthio) Propane (t)		164	<3	<3	<3	<3	<3	<3
Dimethyl Trisulfide	0.01	126	<0.1	<0.1	<0.1	<0.1	0.3	<0.1
Methyl Isopropyl Disulfide (t)		122	<3	<3	<3	<3	<3	<3
Methyl 2-propenyl Disulfide		120	<3	<3	<3	<3	<3	<3
M-1-M-1-(Mthio)ethyl Disulfide (t)		168	<3	<3	<3	<3	<3	<3
Allyl disulfide (t)		146	<3	<3	<3	<3	<3	<3
Diisobutyl Disulfide (t)		178	<3	<3	<3	<3	<3	<3

INF - Sulfur Dioxide interfered with the MM detection

OT*= Odor Thresholds - odor threshold are always reported in a range to reflect inherent human variability, the values reported in this column are the lowest we took from the literature

Client: **Webster Environmental** Received: **7/23-24/08** Reported: **8/2/08** Analysis: **7/23-25/08**
Project ID: **8061** Sample ID: **Air** Sample Type: **Tedlar Bag** Sample Vol: **0.05-2.5 ml**

MFWTP- Master Plan Update 2008

Volatile Sulfur Compounds

	OT*	Mol. Wt.	#1 Plant Influent Channel 7:55 PPB	#2 Grit Dumpster 13:25 PPB	#3 Screenings Dumpster 13:10 PPB	#4 Grit Chamber Channels 8:30 PPB	#6 Primary Clarifier #1 Inlet 10:25 PPB	#7 Primary Clarifier #4 Inlet 9:15 PPB
Hydrogen Sulfide	**0.4**	34	**553**	**365**	**182**	**204**	**2,900**	**1,900**
COS	**55**	60	**1.5**	**2.7**	**1.1**	**0.7**	**0.9**	**2.2**
Methanethiol (MM)	**0.01**	48	**176**	**156**	**212**	**126**	**175**	**47**
Ethanethiol (t)	**0.01**	62	<3	<3	<3	<3	<3	<3
Dimethyl Sulfide	**1**	62	**9.4**	**29**	**14**	**7.4**	**3.2**	**5.3**
Carbon Disulfide	**10**	76	**5.5**	**4.1**	**5.3**	**2.9**	**4.7**	**5.2**
2-Propanethiol (t)		76	<3	<3	<3	<3	<3	<3
2-Methyl-2-propanethiol		90	<3	<3	<3	<3	<3	<3
2-(Methyl thio) propane (t)		90	<3	<3	<3	<3	<3	<3
Allyl Methyl Sulfide	**0.1**	88	**0.3**	**0.3**	<1	**0.1**	<1	<1
Diethyl Sulfide	**0.03**	90	<3	<3	<3	<3	<3	<3
Methylthioacetate		90	<3	<3	<3	<3	<3	<3
1-(Methyl thio) propane (t)		90	<3	<3	<3	<3	<3	<3
2-(ethylthio) Propane (t)		104	<3	<3	<3	<3	<3	<3
Dimethyl Disulfide	**2.2**	94	**2.2**	**1.1**	**3.3**	**0.5**	**0.1**	<0.1
2-M-1-(Methylthio) Propane (t)		104	<3	<3	<3	<3	<3	<3
Diisoproyl Disulfide (t)		118	<3	<3	<3	<3	<3	<3
2-(Methylthio) Butane (t)		104	<3	<3	<3	<3	<3	<3
Methyl Ethyl Disulfide		108	<3	<3	<3	<3	<3	<3
Methyl Thiophene		98	<3	<3	<3	<3	<3	<3
Sec-Butyl isopropyl Sulfide (t)		132	<3	<3	<3	<3	<3	<3
1-(Ethylthio) Butane (t)		118	<3	<3	<3	<3	<3	<3
Methyl Propyl Disulfide (t)		122	<3	<3	<3	<3	<3	<3
Diethyl Disulfide (t)	**2**	122	<3	<3	<3	<3	<3	<3
2,2-bis(ethylthio) Propane (t)		164	<3	<3	<3	<3	<3	<3
Dimethyl Trisulfide	**0.01**	126	**0.34**	<0.1	<0.1	**0.53**	**3.2**	<0.1
Methyl Isopropyl Disulfide (t)		122	<3	<3	<3	<3	<3	<3
Methyl 2-propenyl Disulfide		120	<3	<3	<3	<3	<3	<3
M-1-M-1-(Mthio)ethyl Disulfide (t)		168	<3	<3	<3	<3	<3	<3
Allyl disulfide (t)		146	<3	<3	<3	<3	<3	<3
Diisobutyl Disulfide (t)		178	<3	<3	<3	<3	<3	<3

OT*= Odor Thresholds - odor threshold are always reported in a range to reflect inherent human variability, the values reported in this column are the lowest we took from the literature

Client: **Webster Environmental** Received: **7/23-24/08** Reported: **8/2/08** Analysis: **7/23-25/08**
Project ID: **8061** Sample ID: **Air** Sample Type: **Tedlar Bag** Sample Vol: **0.05-2.5 ml**

MFWTP- Master Plan Update 2008

Volatile Sulfur Compounds

Page 2 of 4

	OT*	Mol. Wt.	#8 Primary Clarifier #1 Middle 11;05 PPB	#9 Primary Clarifier #4 Middle 9:35 PPB	#10 Primary Clarifier #4 Outlet 10:05 PPB	#11 Primary Clarifier #1 Outlet 10:45 PPB	#12 Primary Effluent Channel 11:30 PPB	#13 Biotower Effluent Channel 11:45 PPB
Hydrogen Sulfide	0.4	34	67	177	442	338	5,900	1,600
COS	55	60	0.6	0.5	0.6	0.8	0.1	2.0
Methanethiol (MM)	0.01	48	4	41	37	4	259	315
Ethanethiol (t)	0.01	62	<3	<3	<3	<3	<3	<3
Dimethyl Sulfide	1	62	3.4	4.8	6.4	23	28	26
Carbon Disulfide	10	76	1.0	1.2	8.6	4.8	2.2	11
2-Propanethiol (t)		76	<3	<3	<3	<3	<3	<3
2-Methyl-2-propanethiol		90	<3	<3	<3	<3	<3	<3
2-(Methyl thio) propane (t)		90	<3	<3	<3	<3	<3	<3
Allyl Methyl Sulfide	0.1	88	0.3	0.3	<1	0.1	<1	<1
Diethyl Sulfide	0.03	90	<3	<3	<3	<3	<3	<3
Methylthioacetate		90	<3	<3	<3	<3	<3	<3
1-(Methyl thio) propane (t)		90	<3	<3	<3	<3	<3	<3
2-(ethylthio) Propane (t)		104	<3	<3	<3	<3	<3	<3
Dimethyl Disulfide	2.2	94	<0.1	<0.1	<0.1	0.2	1.6	0.3
2-M-1-(Methylthio) Propane (t)		104	<3	<3	<3	<3	<3	<3
Diisoproyl Disulfide (t)		118	<3	<3	<3	<3	<3	<3
2-(Methylthio) Butane (t)		104	<3	<3	<3	<3	<3	<3
Methyl Ethyl Disulfide		108	<3	<3	<3	<3	<3	<3
Methyl Thiophene		98	<3	<3	<3	<3	<3	<3
Sec-Butyl isopropyl Sulfide (t)		132	<3	<3	<3	<3	<3	<3
1-(Ethylthio) Butane (t)		118	<3	<3	<3	<3	<3	<3
Methyl Propyl Disulfide (t)		122	<3	<3	<3	<3	<3	<3
Diethyl Disulfide (t)	2	122	<3	<3	<3	<3	<3	<3
2,2-bis(ethylthio) Propane (t)		164	<3	<3	<3	<3	<3	<3
Dimethyl Trisulfide	0.01	126	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Methyl Isopropyl Disulfide (t)		122	<3	<3	<3	<3	<3	<3
Methyl 2-propenyl Disulfide		120	<3	<3	<3	<3	<3	<3
M-1-M-1-(Mthio)ethyl Disulfide (t)		168	<3	<3	<3	<3	<3	<3
Allyl disulfide (t)		146	<3	<3	<3	<3	<3	<3
Diisobutyl Disulfide (t)		178	<3	<3	<3	<3	<3	<3

OT*= Odor Thresholds - odor threshold are always reported in a range to reflect inherent human variability, the values reported in this column are the lowest we took from the literature

Client: **Webster Environmental** Received: **7/23-24/08** Reported: **8/2/08** Analysis: **7/23-25/08**
Project ID: **8061** Sample ID: **Air** Sample Type: **Tedlar Bag** Sample Vol: **0.05-2.5 ml**

MFWTP- Master Plan Update 2008

Volatile Sulfur Compounds

Page 3 of 4

			#14	#15	#16	#17	#18	#19
			Primary	Primary	New HW	New HW	Old HW	Primary
			Clarifier	Clarifier	Lower	Upper	Building	Influent
			#4 Eff Weir	#1 Eff Weir	Level	Level	Exhaust	Channel
		Mol.	14:00	13:45	7:50	8:00	8:45	8:25
	OT*	Wt.	PPB	PPB	PPB	PPB	PPB	PPB
Hydrogen Sulfide	0.4	34	25,000	6,800	101	214	614	2,100
COS	55	60	6.6	2.7	<1	<1	0.4	0.7
Methanethiol (MM)	0.01	48	1,970	454	18	42	4	348
Ethanethiol (t)	0.01	62	<3	<3	<3	<3	<3	<3
Dimethyl Sulfide	1	62	214	44	<1	<1	<1	12
Carbon Disulfide	10	76	42	20	0.6	0.9	0.9	3.0
2-Propanethiol (t)		76	<3	<3	<3	<3	<3	<3
2-Methyl-2-propanethiol		90	<3	<3	<3	<3	<3	<3
2-(Methyl thio) propane (t)		90	<3	<3	<3	<3	<3	<3
Allyl Methyl Sulfide	0.1	88	0.3	0.3	<1	0.1	<1	<1
Diethyl Sulfide	0.03	90	<3	<3	<3	<3	<3	<3
Methylthioacetate		90	<3	<3	<3	<3	<3	<3
1-(Methyl thio) propane (t)		90	<3	<3	<3	<3	<3	<3
2-(ethylthio) Propane (t)		104	<3	<3	<3	<3	<3	<3
Dimethyl Disulfide	2.2	94	13	1.6	0.1	<0.1	<0.1	0.6
2-M-1-(Methylthio) Propane (t)		104	<3	<3	<3	<3	<3	<3
Diisoproyl Disulfide (t)		118	<3	<3	<3	<3	<3	<3
2-(Methylthio) Butane (t)		104	<3	<3	<3	<3	<3	<3
Methyl Ethyl Disulfide		108	<3	<3	<3	<3	<3	<3
Methyl Thiophene		98	<3	<3	<3	<3	<3	<3
Sec-Butyl isopropyl Sulfide (t)		132	<3	<3	<3	<3	<3	<3
1-(Ethylthio) Butane (t)		118	<3	<3	<3	<3	<3	<3
Methyl Propyl Disulfide (t)		122	<3	<3	<3	<3	<3	<3
Diethyl Disulfide (t)	2	122	<3	<3	<3	<3	<3	<3
2,2-bis(ethylthio) Propane (t)		164	<3	<3	<3	<3	<3	<3
Dimethyl Trisulfide	0.01	126	1.2	<0.1	<0.1	<0.1	<0.1	<0.1
Methyl Isopropyl Disulfide (t)		122	<3	<3	<3	<3	<3	<3
Methyl 2-propenyl Disulfide		120	<3	<3	<3	<3	<3	<3
M-1-M-1-(Mthio)ethyl Disulfide (t)		168	<3	<3	<3	<3	<3	<3
Allyl disulfide (t)		146	<3	<3	<3	<3	<3	<3
Diisobutyl Disulfide (t)		178	<3	<3	<3	<3	<3	<3

OT*= Odor Thresholds - odor threshold are always reported in a range to reflect inherent human variability, the values reported in this column are the lowest we took from the literature

Client: **Webster Environmental** Received: **7/23-24/08** Reported: **8/2/08** Analysis: **7/23-25/08**
Project ID: **8061** Sample ID: **Air** Sample Type: **Tedlar Bag** Sample Vol: **0.05-2.5 ml**

MFWTP- Master Plan Update 2008

Volatile Sulfur Compounds

	OT*	Mol. Wt.	#20 BOC Outlet 9:00 PPB	#21 DAFT Room Exhaust 10:05 PPB	#22 MEB Exhaust 9:30 PPB	#23 MEB 6th Floor Roof Fans 9:40 PPB	#24 Digester #1 Annular Space 11:15 PPB	#25 SHOC Outlet 10:30 PPB
Hydrogen Sulfide	0.4	34	310	71	70	119	175,000	62
COS	55	60	5.1	0.2	0.6	0.8	0.9	0.9
Methanethiol (MM)	0.01	48	451	26	3.7	3.7	INF	84
Ethanethiol (t)	0.01	62	<3	<3	<3	<3	<3	<3
Dimethyl Sulfide	1	62	128	<1	<1	<1	<1	65
Carbon Disulfide	10	76	59	0.5	2.1	3.5	39	7.7
2-Propanethiol (t)		76	<3	<3	<3	<3	0.7	<3
2-Methyl-2-propanethiol		90	<3	<3	<3	<3	<3	<3
2-(Methyl thio) propane (t)		90	<3	<3	<3	<3	<3	<3
Allyl Methyl Sulfide	0.1	88	<1	<1	<1	<1	<1	<1
Diethyl Sulfide	0.03	90	<3	<3	<3	<3	<3	<3
Methylthioacetate		90	<3	<3	<3	<3	<3	<3
1-(Methyl thio) propane (t)		90	<3	<3	<3	<3	<3	<3
2-(ethylthio) Propane (t)		104	<3	<3	<3	<3	<3	<3
Dimethyl Disulfide	2.2	94	5.8	<0.1	<0.1	0.8	0.5	3.1
2-M-1-(Methylthio) Propane (t)		104	<3	<3	<3	<3	<3	<3
Diisoproyl Disulfide (t)		118	<3	<3	<3	<3	<3	<3
2-(Methylthio) Butane (t)		104	<3	<3	<3	<3	<3	<3
Methyl Ethyl Disulfide		108	<3	<3	<3	<3	<3	<3
Methyl Thiophene		98	<3	<3	<3	<3	<3	<3
Sec-Butyl isopropyl Sulfide (t)		132	<3	<3	<3	<3	<3	<3
1-(Ethylthio) Butane (t)		118	<3	<3	<3	<3	<3	<3
Methyl Propyl Disulfide (t)		122	<3	<3	<3	<3	<3	<3
Diethyl Disulfide (t)	2	122	<3	<3	<3	<3	<3	<3
2,2-bis(ethylthio) Propane (t)		164	<3	<3	<3	<3	<3	<3
Dimethyl Trisulfide	0.01	126	<0.1	<0.1	<0.1	<0.1	0.3	<0.1
Methyl Isopropyl Disulfide (t)		122	<3	<3	<3	<3	<3	<3
Methyl 2-propenyl Disulfide		120	<3	<3	<3	<3	<3	<3
M-1-M-1-(Mthio)ethyl Disulfide (t)		168	<3	<3	<3	<3	<3	<3
Allyl disulfide (t)		146	<3	<3	<3	<3	<3	<3
Diisobutyl Disulfide (t)		178	<3	<3	<3	<3	<3	<3

INF - Sulfur Dioxide interfered with the MM detection

OT*= Odor Thresholds - odor threshold are always reported in a range to reflect inherent human variability, the values reported in this column are the lowest we took from the literature

Client: **Webster Environmental** Received: **8/20, 21/08** Reported: **8/26/08** Analysis: **8/21-24/08**
Project ID: **8066** Sample ID: **Air** Sample Type: **Tedlar Bag** Sample Vol: **0.05-2.5 ml**

MFWTP- Master Plan 404-2 Set

Volatile Sulfur Compounds

Page 1 of 5

			#1	#2	#3	#4	#6	#7
			Plant Influent Channel	Grit Dumpster	Screenings Dumpster	Grit Chambers Channels	Primary Clarifier #1 Inlet	Primary Clarifier #1 Middle
		Mol.	8:30	9:10	9:25	9:45	10:55	10:10
	OT*	Wt.	PPB	PPB	PPB	PPB	PPB	PPB
Hydrogen Sulfide (H2S)	0.4	34	580,915	169	220	104,398	4,050	8,647
Carbonyl Sulfide (COS)	55	60	167	21	22	46	14	14
Methanethiol (MM)	0.01	48	3,549	207	180	1,040	84	121
Ethanethiol (t)	0.01	62	<3	<3	<3	<3	<3	<3
Dimethyl Sulfide	1	62	38	186	42	9.8	2.5	0.3
Carbon Disulfide	10	76	279	66	23	27	4.4	2.7
2-Propanethiol (t)		76	<3	<3	<3	<3	<3	<3
2-Methyl-2-propanethiol		90	<3	<3	<3	<3	<3	<3
2-(Methyl thio) propane (t)		90	<3	<3	<3	<3	<3	<3
Allyl Methyl Sulfide	0.1	88	<1	<1	<1	<1	<1	<1
Diethyl Sulfide	0.03	90	<3	<3	<3	<3	<3	<3
Methylthioacetate		90	<3	<3	<3	<3	<3	<3
1-(Methyl thio) propane (t)		90	<3	<3	<3	<3	<3	<3
2-(ethylthio) Propane (t)		104	<3	<3	<3	<3	<3	<3
Dimethyl Disulfide	2.2	94	2.0	2.0	11	0.3	0.1	0.1
2-M-1-(Methylthio) Propane (t)		104	<3	<3	<3	<3	<3	<3
Diisoproyl Disulfide (t)		118	<3	<3	<3	<3	<3	<3
2-(Methylthio) Butane (t)		104	<3	<3	<3	<3	<3	<3
Methyl Ethyl Disulfide		108	<3	<3	<3	<3	<3	<3
Methyl Thiophene		98	<3	<3	<3	<3	<3	<3
Sec-Butyl isopropyl Sulfide (t)		132	<3	<3	<3	<3	<3	<3
1-(Ethylthio) Butane (t)		118	<3	<3	<3	<3	<3	<3
Methyl Propyl Disulfide (t)		122	<3	<3	<3	<3	<3	<3
Diethyl Disulfide (t)	2	122	<3	<3	<3	<3	<3	<3
2,2-bis(ethylthio) Propane (t)		164	<3	<3	<3	<3	<3	<3
Dimethyl Trisulfide	0.01	126	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Methyl Isopropyl Disulfide (t)		122	<3	<3	<3	<3	<3	<3
Methyl 2-propenyl Disulfide		120	<3	<3	<3	<3	<3	<3
M-1-M-1-(Mthio)ethyl Disulfide (t)		168	<3	<3	<3	<3	<3	<3
Allyl disulfide (t)		146	<3	<3	<3	<3	<3	<3
Diisobutyl Disulfide (t)		178	<3	<3	<3	<3	<3	<3

OT*= Odor Thresholds - (ppb) odor threshold are always reported in a range to reflect inherent human variability, the values reported in this column are the lowest we took from the literature

Client: **Webster Environmental** Received: **8/20, 21/08** Reported: **8/26/08** Analysis: **8/21-24/08**
Project ID: **8066** Sample ID: **Air** Sample Type: **Tedlar Bag** Sample Vol: **0.05-2.5 ml**

MFWTP- Master Plan 404-2 Set

Volatile Sulfur Compounds

			#8	#9	#10	#11	#12	#13
			Primary	Primary	Primary	Primary	Primary	Biotower
			Clarifier	Clarifier	Clarifier	Clarifier	Effluent	Effluent
			#1 Outlet	#4 Inlet	#4 Middle	#4 Outlet	Channel	Channel
		Mol.	10:35	11:20	11:35	11:55	13:05	13:20
	OT*	Wt.	PPB	PPB	PPB	PPB	PPB	PPB
Hydrogen Sulfide (H2S)	0.4	34	2,342	5,026	1,983	5,968	113,547	11,950
Carbonyl Sulfide (COS)	55	60	13	20	24	43	67	22
Methanethiol (MM)	0.01	48	53	96	96	84	1,853	795
Ethanethiol (t)	0.01	62	<3	<3	<3	<3	<3	<3
Dimethyl Sulfide	1	62	0.2	1.8	1.3	5.9	23	42
Carbon Disulfide	10	76	3.7	12	132	75	48	10
2-Propanethiol (t)		76	<3	<3	<3	<3	<3	<3
2-Methyl-2-propanethiol		90	<3	<3	<3	<3	<3	<3
2-(Methyl thio) propane (t)		90	<3	<3	<3	<3	<3	<3
Allyl Methyl Sulfide	0.1	88	<1	<1	<1	<1	<1	<1
Diethyl Sulfide	0.03	90	<3	<3	<3	<3	<3	<3
Methylthioacetate		90	<3	<3	<3	<3	<3	<3
1-(Methyl thio) propane (t)		90	<3	<3	<3	<3	<3	<3
2-(ethylthio) Propane (t)		104	<3	<3	<3	<3	<3	<3
Dimethyl Disulfide	2.2	94	<0.1	1.3	0.2	0.1	2.3	2.9
2-M-1-(Methylthio) Propane (t)		104	<3	<3	<3	<3	<3	<3
Diisoproyl Disulfide (t)		118	<3	<3	<3	<3	<3	<3
2-(Methylthio) Butane (t)		104	<3	<3	<3	<3	<3	<3
Methyl Ethyl Disulfide		108	<3	<3	<3	<3	<3	<3
Methyl Thiophene		98	<3	<3	<3	<3	<3	<3
Sec-Butyl isopropyl Sulfide (t)		132	<3	<3	<3	<3	<3	<3
1-(Ethylthio) Butane (t)		118	<3	<3	<3	<3	<3	<3
Methyl Propyl Disulfide (t)		122	<3	<3	<3	<3	<3	<3
Diethyl Disulfide (t)	2	122	<3	<3	<3	<3	<3	<3
2,2-bis(ethylthio) Propane (t)		164	<3	<3	<3	<3	<3	<3
Dimethyl Trisulfide	0.01	126	<0.1	<0.1	<0.1	<0.1	0.14	<0.1
Methyl Isopropyl Disulfide (t)		122	<3	<3	<3	<3	<3	<3
Methyl 2-propenyl Disulfide		120	<3	<3	<3	<3	<3	<3
M-1-M-1-(Mthio)ethyl Disulfide (t)		168	<3	<3	<3	<3	<3	<3
Allyl disulfide (t)		146	<3	<3	<3	<3	<3	<3
Diisobutyl Disulfide (t)		178	<3	<3	<3	<3	<3	<3

OT*= Odor Thresholds - (ppb) odor threshold are always reported in a range to reflect inherent human variability, the values reported in this column are the lowest we took from the literature

Client: **Webster Environmental** Received: **8/20, 21/08** Reported: **8/26/08** Analysis: **8/21-24/08**
Project ID: **8066** Sample ID: **Air** Sample Type: **Tedlar Bag** Sample Vol: **0.05-2.5 ml**

MFWTP- Master Plan 404-2 Set

Volatile Sulfur Compounds

			#14	#15	#16	#17	#18	#19
						New	New	
			Primary	Primary	Digester	Headworks	Headworks	Old
			Clarifier	Clarifier	Annular	Lower	Upper	Headworks
			#1 Eff.Weir	#4 Eff.Weir	Space	Level	Level	Exhaust
		Mol.	13:55	13:35	14:15	8:20	8:30	8:45
	OT*	Wt.	PPB	PPB	PPB	PPB	PPB	PPB
Hydrogen Sulfide (H2S)	0.4	34	11,725	325,515	245,966	551	3,505	2,166
Carbonyl Sulfide (COS)	55	60	328	178	50	8.2	13	19
Methanethiol (MM)	0.01	48	480	<5000	<5000	9.0	52	42
Ethanethiol (t)	0.01	62	<3	<3	<3	<3	<3	<3
Dimethyl Sulfide	1	62	91	77	60	<3	<3	<3
Carbon Disulfide	10	76	176	222	85	2.2	2.1	61
2-Propanethiol (t)		76	<3	<3	<3	<3	<3	<3
2-Methyl-2-propanethiol		90	<3	<3	<3	<3	<3	<3
2-(Methyl thio) propane (t)		90	<3	<3	<3	<3	<3	<3
Allyl Methyl Sulfide	0.1	88	<1	<1	<1	<1	<1	<1
Diethyl Sulfide	0.03	90	<3	<3	<3	<3	<3	<3
Methylthioacetate		90	<3	<3	<3	<3	<3	<3
1-(Methyl thio) propane (t)		90	<3	<3	<3	<3	<3	<3
2-(ethylthio) Propane (t)		104	<3	<3	<3	<3	<3	<3
Dimethyl Disulfide	2.2	94	10	17	0.2	<1	<1	<1
2-M-1-(Methylthio) Propane (t)		104	<3	<3	<3	<3	<3	<3
Diisoproyl Disulfide (t)		118	<3	<3	<3	<3	<3	<3
2-(Methylthio) Butane (t)		104	<3	<3	<3	<3	<3	<3
Methyl Ethyl Disulfide		108	<3	<3	<3	<3	<3	<3
Methyl Thiophene		98	<3	<3	<3	<3	<3	<3
Sec-Butyl isopropyl Sulfide (t)		132	<3	<3	<3	<3	<3	<3
1-(Ethylthio) Butane (t)		118	<3	<3	<3	<3	<3	<3
Methyl Propyl Disulfide (t)		122	<3	<3	<3	<3	<3	<3
Diethyl Disulfide (t)	2	122	<3	<3	<3	<3	<3	<3
2,2-bis(ethylthio) Propane (t)		164	<3	<3	<3	<3	<3	<3
Dimethyl Trisulfide	0.01	126	2.9	6.2	3.0	<0.1	<0.1	<0.1
Methyl Isopropyl Disulfide (t)		122	<3	<3	<3	<3	<3	<3
Methyl 2-propenyl Disulfide		120	<3	<3	<3	<3	<3	<3
M-1-M-1-(Mthio)ethyl Disulfide (t)		168	<3	<3	<3	<3	<3	<3
Allyl disulfide (t)		146	<3	<3	<3	<3	<3	<3
Diisobutyl Disulfide (t)		178	<3	<3	<3	<3	<3	<3

OT*= Odor Thresholds - (ppb) odor threshold are always reported in a range to reflect inherent human variability, the values reported in this column are the lowest we took from the literature

Client: **Webster Environmental** Received: **8/20, 21/08** Reported: **8/26/08** Analysis: **8/21-24/08**
Project ID: **8066** Sample ID: **Air** Sample Type: **Tedlar Bag** Sample Vol: **0.05-2.5 ml**

MFWTP- Master Plan 404-2 Set

Volatile Sulfur Compounds

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			#20	#21	#22	#23	#24	#25
			Primary		DAFT		MEB	
			Influent	BOC	Room	MEB	6th Floor	SHOC
			Channel	Outlet	Exhaust	Exhaust	Roof Fans	Outlet
		Mol.	9:00	9:15	10:00	10:20	10:35	10:55
	OT*	Wt.	PPB	PPB	PPB	PPB	PPB	PPB
Hydrogen Sulfide (H2S)	0.4	34	49,428	126	368	188	288	112
Carbonyl Sulfide (COS)	55	60	63	212	7.5	11	17	14
Methanethiol (MM)	0.01	48	1,426	216	47	20	26	210
Ethanethiol (t)	0.01	62	<3	<3	<3	<3	<3	<3
Dimethyl Sulfide	1	62	15	89	<0.1	<0.1	0.3	60
Carbon Disulfide	10	76	79	63	2.3	4.9	96	4.7
2-Propanethiol (t)		76	<3	<3	<3	<3	0.7	<3
2-Methyl-2-propanethiol		90	<3	<3	<3	<3	<3	<3
2-(Methyl thio) propane (t)		90	<3	<3	<3	<3	<3	<3
Allyl Methyl Sulfide	0.1	88	<1	<1	<1	<1	<1	<1
Diethyl Sulfide	0.03	90	<3	<3	<3	<3	<3	<3
Methylthioacetate		90	<3	<3	<3	<3	<3	<3
1-(Methyl thio) propane (t)		90	<3	<3	<3	<3	<3	<3
2-(ethylthio) Propane (t)		104	<3	<3	<3	<3	<3	<3
Dimethyl Disulfide	2.2	94	<0.1	<0.1	<0.1	0.3	1.3	4.9
2-M-1-(Methylthio) Propane (t)		104	<3	<3	<3	<3	<3	<3
Diisoproyl Disulfide (t)		118	<3	<3	<3	<3	<3	<3
2-(Methylthio) Butane (t)		104	<3	<3	<3	<3	<3	<3
Methyl Ethyl Disulfide		108	<3	<3	<3	<3	<3	<3
Methyl Thiophene		98	<3	<3	<3	<3	<3	<3
Sec-Butyl isopropyl Sulfide (t)		132	<3	<3	<3	<3	<3	<3
1-(Ethylthio) Butane (t)		118	<3	<3	<3	<3	<3	<3
Methyl Propyl Disulfide (t)		122	<3	<3	<3	<3	<3	<3
Diethyl Disulfide (t)	2	122	<3	<3	<3	<3	<3	<3
2,2-bis(ethylthio) Propane (t)		164	<3	<3	<3	<3	<3	<3
Dimethyl Trisulfide	0.01	126	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Methyl Isopropyl Disulfide (t)		122	<3	<3	<3	<3	<3	<3
Methyl 2-propenyl Disulfide		120	<3	<3	<3	<3	<3	<3
M-1-M-1-(Mthio)ethyl Disulfide (t)		168	<3	<3	<3	<3	<3	<3
Allyl disulfide (t)		146	<3	<3	<3	<3	<3	<3
Diisobutyl Disulfide (t)		178	<3	<3	<3	<3	<3	<3

OT*= Odor Thresholds - (ppb) odor threshold are always reported in a range to reflect inherent human variability, the values reported in this column are the lowest we took from the literature

Client: **Webster Environmental** Received: **8/20, 21/08** Reported: **8/26/08** Analysis: **8/21-24/08**
Project ID: **8066** Sample ID: **Air** Sample Type: **Tedlar Bag** Sample Vol: **0.05-2.5 ml**

MFWTP- Master Plan 404-2 Set

Volatile Sulfur Compounds

Page 5 of 5

			#26	#27
			SWPS Exhaust	Diversion Structure
		Mol.	12:00	11:35
	OT*	Wt.	PPB	PPB
Hydrogen Sulfide (H2S)	**0.4**	34	**112**	**999**
Carbonyl Sulfide (COS)	**55**	60	**4.6**	**18**
Methanethiol (MM)	**0.01**	48	**3**	**62**
Ethanethiol (t)	**0.01**	62	<3	<3
Dimethyl Sulfide	**1**	62	**<1**	**1.1**
Carbon Disulfide	**10**	76	**1.0**	**44**
2-Propanethiol (t)		76	<3	<3
2-Methyl-2-propanethiol		90	<3	<3
2-(Methyl thio) propane (t)		90	<3	<3
Allyl Methyl Sulfide	**0.1**	88	**<1**	**<1**
Diethyl Sulfide	**0.03**	90	<3	<3
Methylthioacetate		90	<3	<3
1-(Methyl thio) propane (t)		90	<3	<3
2-(ethylthio) Propane (t)		104	<3	<3
Dimethyl Disulfide	**2.2**	94	**<1**	**<1**
2-M-1-(Methylthio) Propane (t)		104	<3	<3
Diisoproyl Disulfide (t)		118	<3	<3
2-(Methylthio) Butane (t)		104	<3	<3
Methyl Ethyl Disulfide		108	<3	<3
Methyl Thiophene		98	<3	<3
Sec-Butyl isopropyl Sulfide (t)		132	<3	<3
1-(Ethylthio) Butane (t)		118	<3	<3
Methyl Propyl Disulfide (t)		122	<3	<3
Diethyl Disulfide (t)	**2**	122	<3	<3
2,2-bis(ethylthio) Propane (t)		164	<3	<3
Dimethyl Trisulfide	**0.01**	126	**<0.1**	**<0.1**
Methyl Isopropyl Disulfide (t)		122	<3	<3
Methyl 2-propenyl Disulfide		120	<3	<3
M-1-M-1-(Mthio)ethyl Disulfide (t)		168	<3	<3
Allyl disulfide (t)		146	<3	<3
Diisobutyl Disulfide (t)		178	<3	<3

OT*= Odor Thresholds - (ppb) odor threshold are always reported in a range to reflect inherent human variability, the values reported in this column are the lowest we took from the literature

Appendix E

Completed Community Odor Survey Forms

LOUISVILLE MSD - MFWTP MASTERPLAN UPDATE 2008
MFWTP COMMUNITY ODOR SURVEY

Partly Cloudy

Job # 404-02 Survey No: 1 Observer: BK Date: 7/22/08

STATION	TIME	H_2S (ppb)	~~INTENSITY~~ D/T ~~(1-5)~~	ODOR DESCRIPTION	TEMP. (°F)	WIND DIRECTION	WIND SPEED (mph)	OBSERVER/COMMENTS
1	6:32	5,5	<2	Foliage	74	–	0	
2	6:40	3,4	0	No Odor		–	0	
3	6:45	3,2	0	No Odor		–	0	
4	6:50	3,4	0	No Odor		180	4	
5	6:55	2,3	4	Fried Food		180	2	
6	7:02	3,3	0	No Odor		180	3	
7	7:07	3,3	4	Trees/Foliage		–	0	
8	7:14	3,4	0	No Odor		180	1	
9	7:17	3,4	4	Grass/Foliage		200	3	
10	7:24	4,3	7	Chemical/Sharp		160	3	
11	7:28	4,4	4	Chemical/Sour		160	2	
12								

Summary: Mostly Sunny

LOUISVILLE MSD - MFWTP MASTERPLAN UPDATE 2008
MFWTP COMMUNITY ODOR SURVEY

Job # 404-02 Survey No: 2 Observer: BK Date: 7/23/08

STATION	TIME	H_2S (ppb)	INTENSITY (1-5)	ODOR DESCRIPTION	TEMP. (°F)	~~WIND DIRECTION~~ SPEED	WIND ~~SPEED (mph)~~ DIRECTION	OBSERVER/COMMENTS
1	6:33a	2,2	0	No Odor	70	2	10	
2	6:36a	1,2	0	No Odor		3	20	
3	6:40a	2,1	0	No Odor		-	0	
4	6:44a	1,1	0	No Odor		5	340	
5	6:48	2,3	0	No Odor		2	30	
6	6:54	2,2	0	No Odor		4	20	
7	6:58	2,2	4	Grass/Trees		1	340	
8	7:03	2,2	<2	Chemical		3	280	
9	7:06	1,2	4	Grass		3	50	Smelled Zeon between station 8&9.
10	7:15	1,2	0	No Odor		2	20	
11	7:20	2,4	~~3~~ <2	~~No Odor~~ Sludge Odor		3	350	Detected MFWTP odor while driving between sta 10&11. D/T = 4
12								

Summary: Mostly cloudy at beginning of survey. Mostly sunny at end.

LOUISVILLE MSD - MFWTP MASTERPLAN UPDATE 2008
MFWTP COMMUNITY ODOR SURVEY

Clear, Calm

Job # 404-02 Survey No: 3 Observer: BK Date: 8/19/08

STATION	TIME	H_2S (ppb)	INTENSITY (1-5)	ODOR DESCRIPTION	TEMP. (°F)	WIND DIRECTION	WIND SPEED (mph)	OBSERVER/COMMENTS
1	6:52a	4,6	0	No Odor	64	–	0	
2	6:55	6,6	0	No Odor		–	0	
3	6:58	5,5	0	No Odor		–	0	
4	7:02	4,4	0	No Odor		–	0	
5	7:06	5,5	1	Exhaust		–	0	
6	7:13	5,5	0	No Odor		–	0	
7	7:17	5,5	0	No Odor		–	0	
8	7:23	8,7	0	No Odor		–	0	
9	7:28	6,6	0	No Odor		–	0	
10	7:37	6,11	1	Sludge		–	0	
11	7:41	3,7	1	Gravel Dust		–	0	
12								

Summary: Had sinus congestion today. Nose not working too well.

MFWTP COMMUNITY ODOR SURVEY
FINAL REPORT
(October, 2000)

I. Introduction

The purpose of this odor survey of the community surrounding the Morris Forman Wastewater Treatment Plant (MFWTP) is to determine the impact on community odors when the bioroughing towers at the MFWTP are brought on line. Eleven (11) odor monitoring stations were selected in the community surrounding the MFWTP and seven (7) more stations were chosen on the MFWTP site. The atmosphere at each station was monitored at least once per week over a fifteen (15) month period to determine what the odor levels were before and after the bioroughing towers were placed in service. The surveys were performed for an eleven (11) month period (April, 1999 – February, 2000) prior to the bioroughing towers being brought on line to establish the background (before) conditions. The surveys were performed for a four (4) month period (March through June 30, 2000) to determine the impact (if any) on community odors after the bioroughing towers were brought on line.

The odor monitoring stations in the community are listed below and shown on **Figure 1**.

Station #	Location	Direction (Degrees) (a)	Distance from Bioroughing Tower (miles)
1	Southwestern Parkway at Chickasaw Park exit	196	0.62
2	Southwest corner of Fairland and Winrose	208	0.67
3	South of Sunset, east of 43rd St.	213	0.96
4	1309 Cecil Avenue	231	0.81
5	3612 Dumesnil	245	1.12
6	East of 39th St. and Stratton Ave.	277	0.68
7	Intersection of Belquin Road and Belquin Place	307	0.83
8	Campground Road, east of I-64 @ Williams Transicold	333	1.22
9	Campground Road, west of Likens	6	1.11
10	Bells Lane, @ Chevron entrance across from Zeon Chemical	331	0.57
11	Bells Lane, near LG&E Paddy's Run Station	48	0.64

(a) Direction is the compass direction from the Monitoring Station to the Bioroughing Towers at the MFWTP where 0° is due north. This also then relates to the direction wind is coming from at each station.

<u>Appendix F</u>

Odalog Overlay Charts

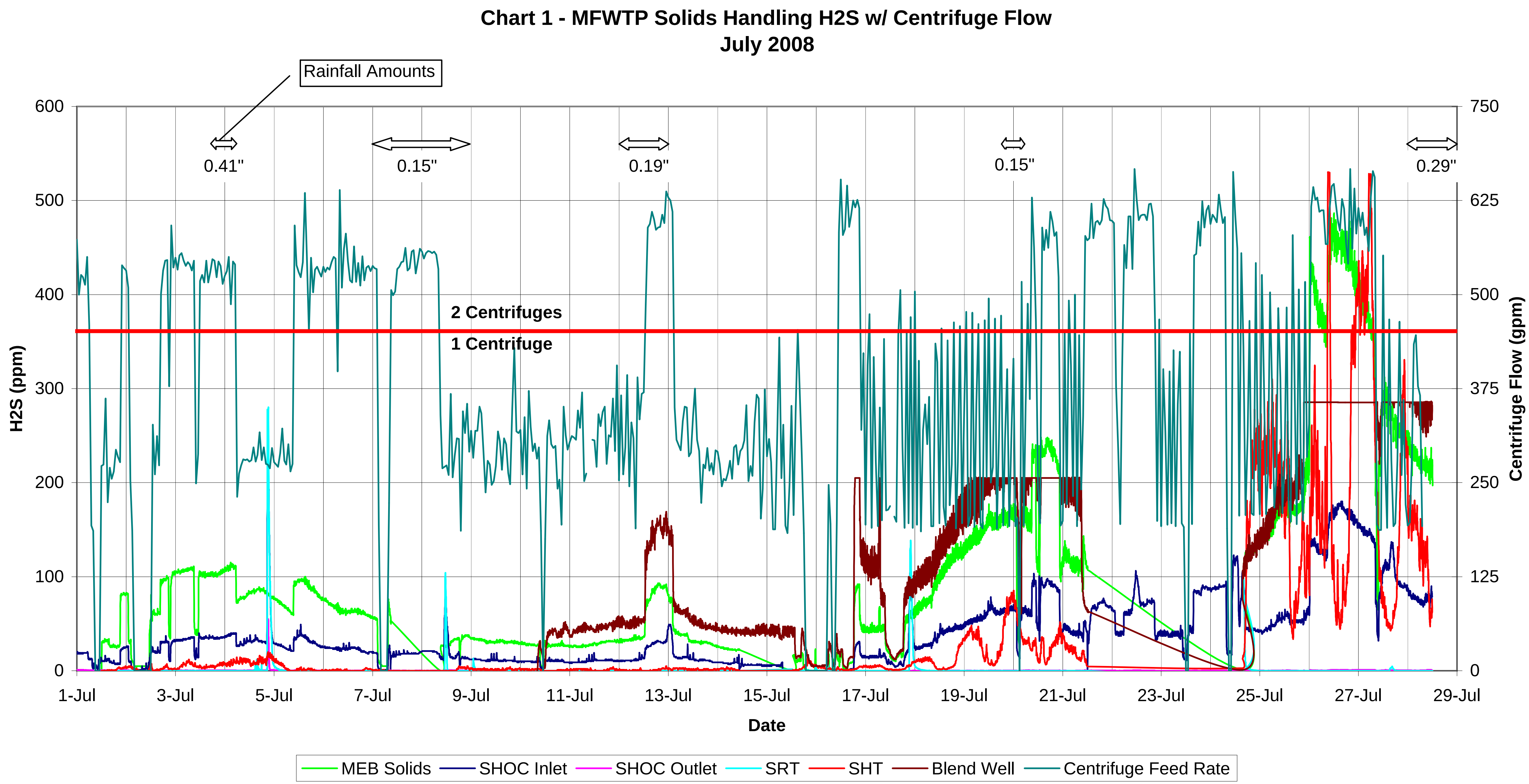


Chart 1 - MFWTP Solids Handling H2S w/ Centrifuge Flow
July 2008
Rainfall Amounts
0.41"
0.15"
0.19"
0.15"
0.29"
2 Centrifuges
1 Centrifuge
H2S (ppm)
Centrifuge Flow (gpm)
Date
600
500
400
300
200
100
0
750
625
500
375
250
125
0
1-Jul
3-Jul
5-Jul
7-Jul
9-Jul
11-Jul
13-Jul
15-Jul
17-Jul
19-Jul
21-Jul
23-Jul
25-Jul
27-Jul
29-Jul
MEB Solids
SHOC Inlet
SHOC Outlet
SRT
SHT
Blend Well
Centrifuge Feed Rate

Chart 1 - MEB Solids, SRT, SHT, Blend Well, SHOC Inlet and SHOC Outlet
August 2008

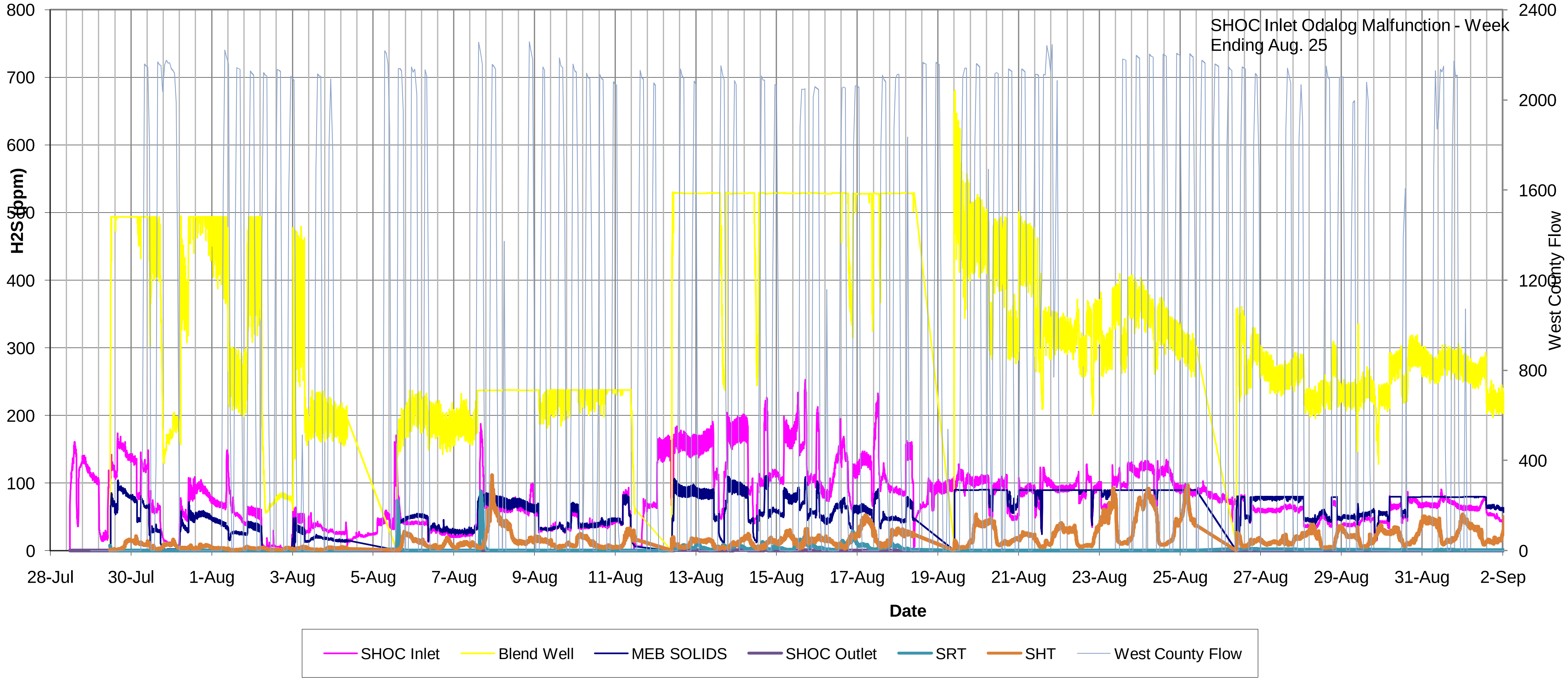
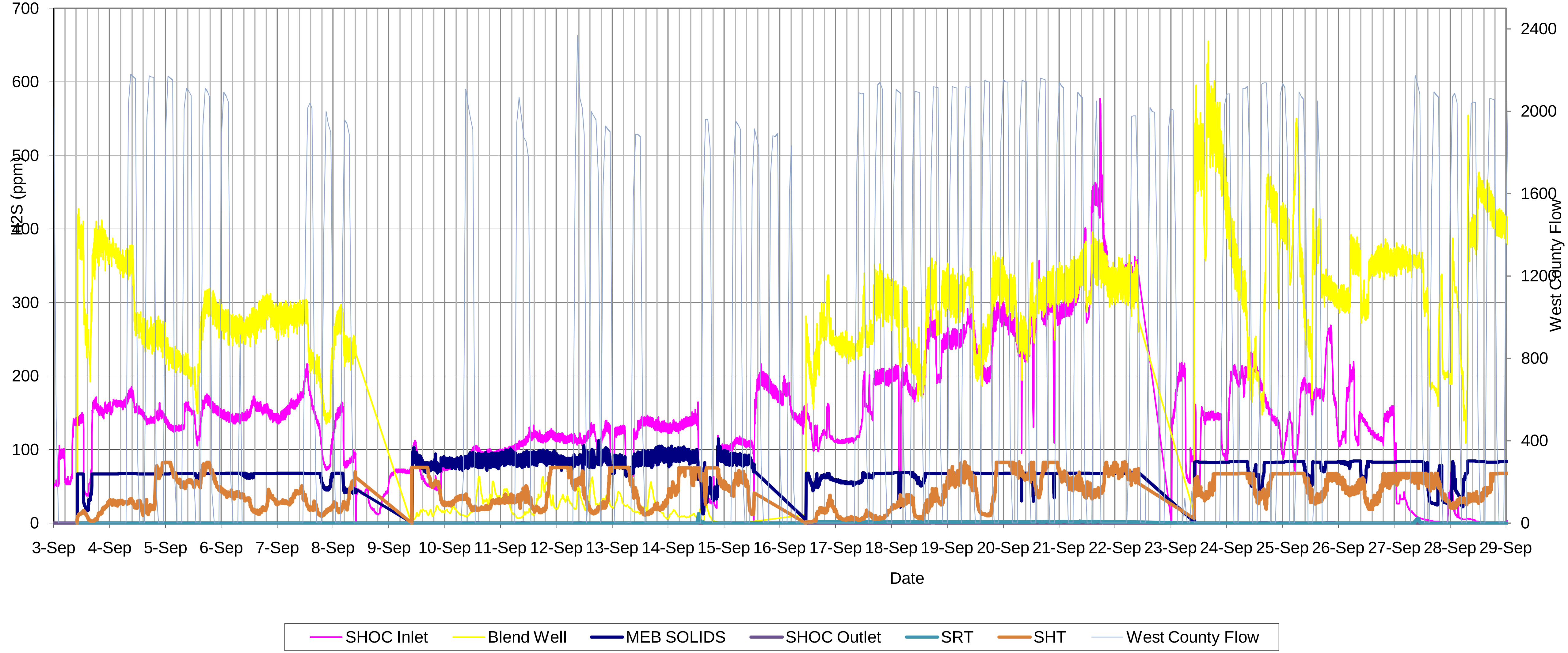


Chart 1 - MEB Solids, SRT, SHT, Blend Well, SHOC Inlet and SHOC Outlet
September 2008



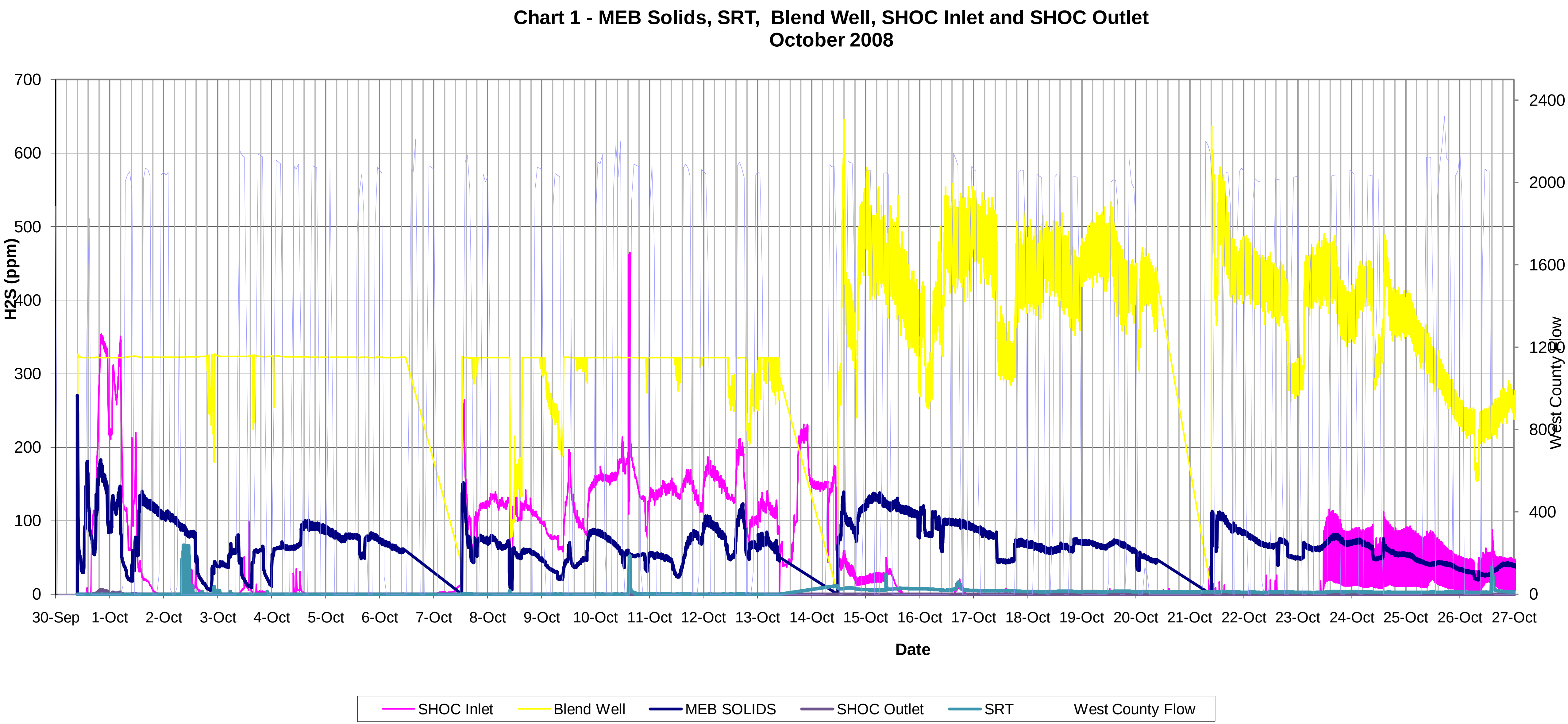


Chart 1 - MEB Solids, SRT, Blend Well, SHOC Inlet and SHOC Outlet
October 2008
H2S (ppm)
0
100
200
300
400
500
600
700
West County Flow
0
400
800
1200
1600
2000
2400
30-Sep
1-Oct
2-Oct
3-Oct
4-Oct
5-Oct
6-Oct
7-Oct
8-Oct
9-Oct
10-Oct
11-Oct
12-Oct
13-Oct
14-Oct
15-Oct
16-Oct
17-Oct
18-Oct
19-Oct
20-Oct
21-Oct
22-Oct
23-Oct
24-Oct
25-Oct
26-Oct
27-Oct
Date
SHOC Inlet
Blend Well
MEB SOLIDS
SHOC Outlet
SRT
West County Flow

Chart 1 - MEB Solids, SRT, Blend Well, SHOC Inlet and SHOC Outlet
November 2008

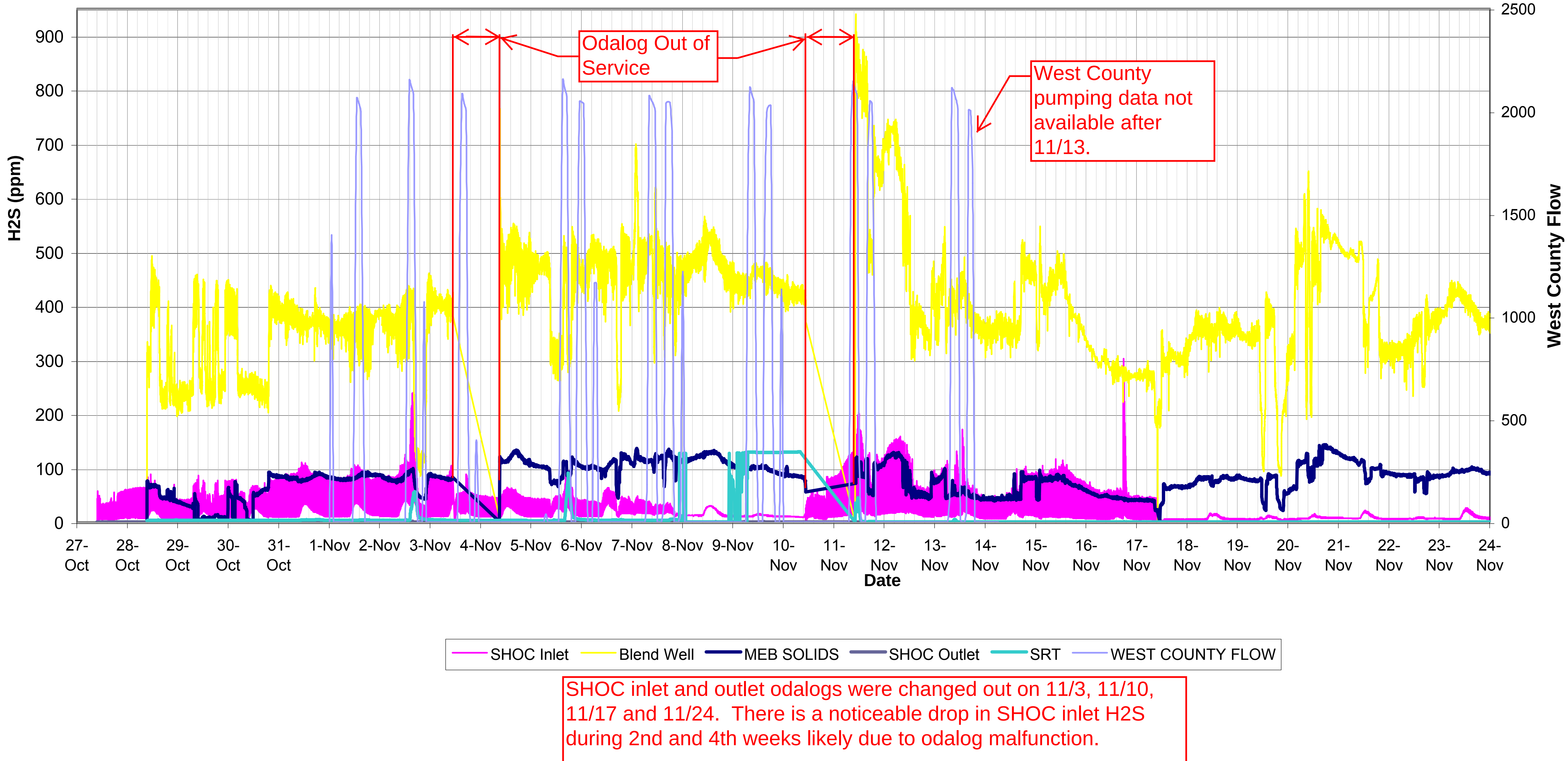
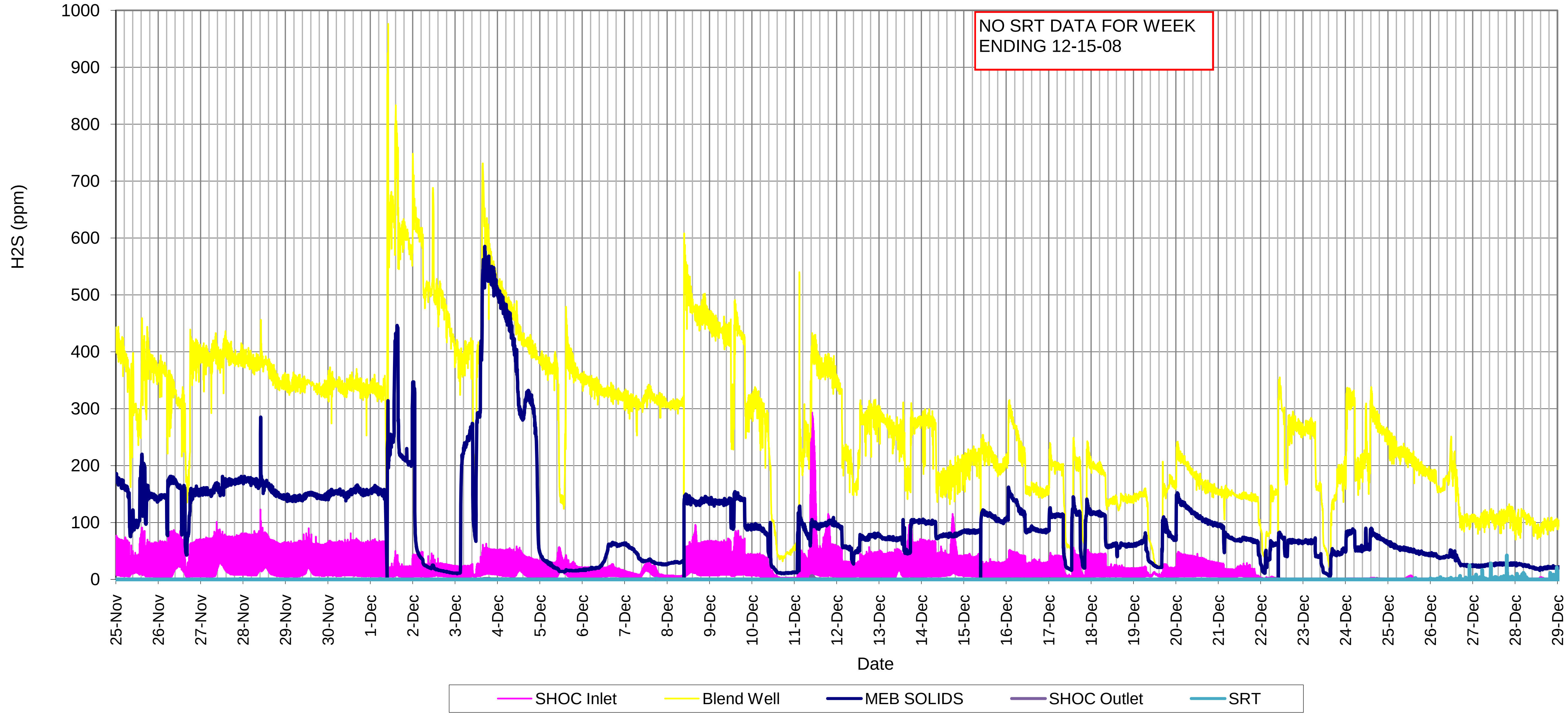


Chart 1 - MEB Solids, SRT, Blend Well, SHOC Inlet and SHOC Outlet
December 2008



02/27/2009

Chart 1 - MEB Solids, SRT, Blend Well, SHOC Inlet and SHOC Outlet
January, 2009

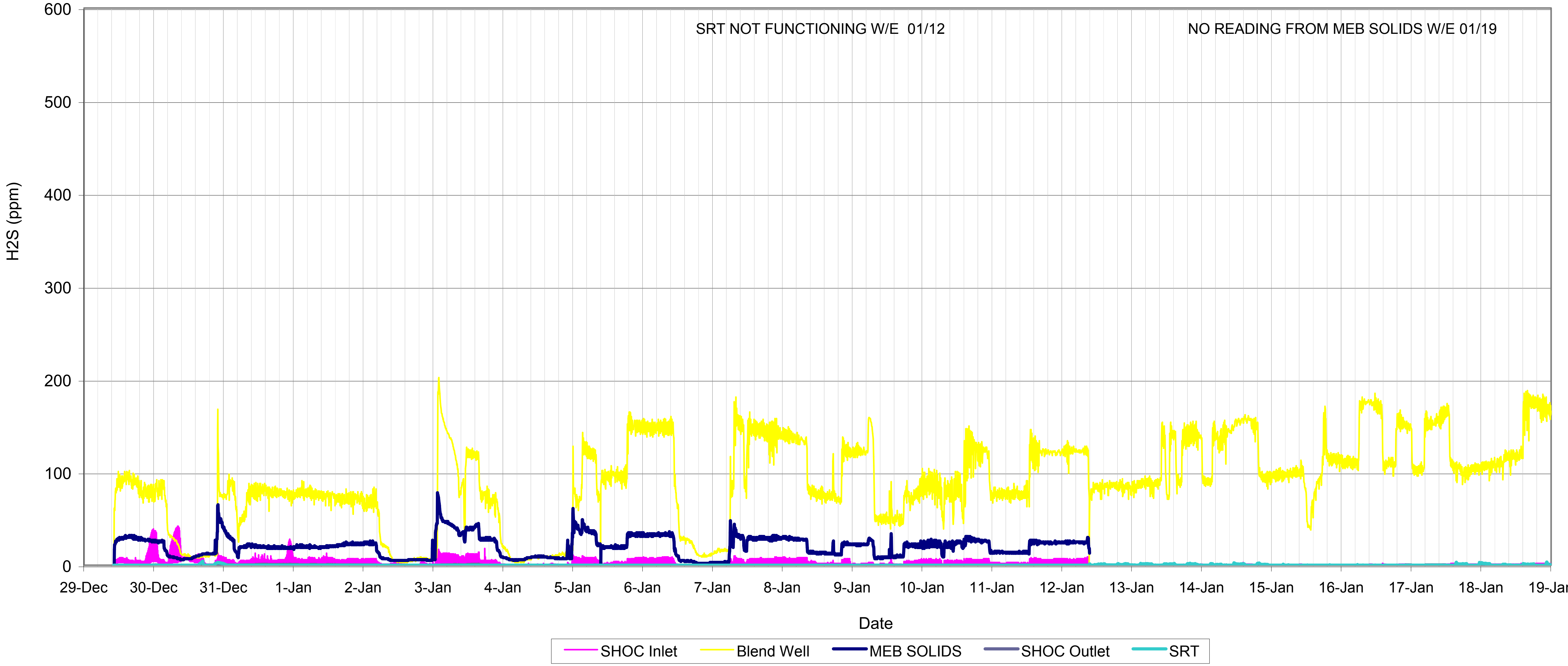
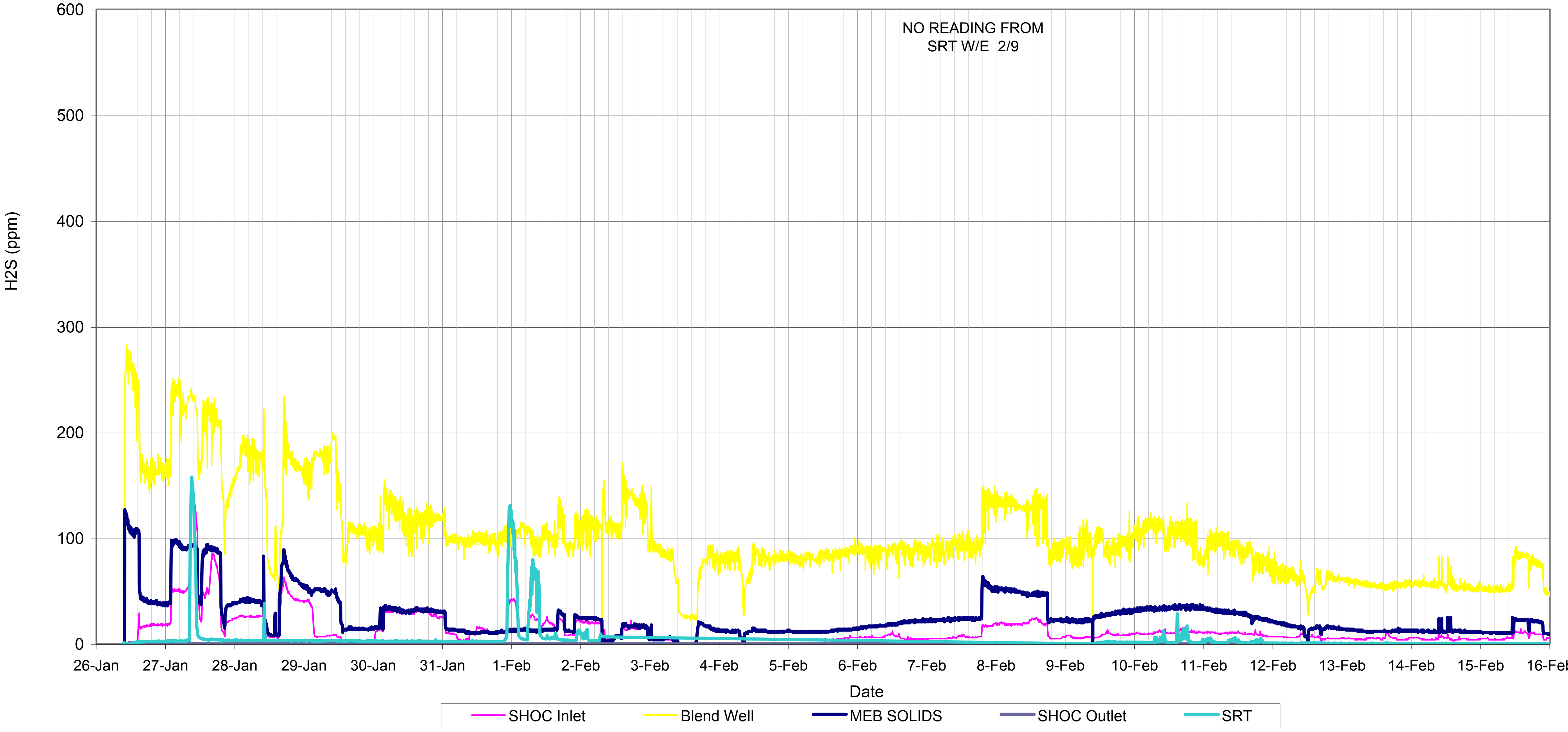


Chart 1 - MEB Solids, SRT, Blend Well, SHOC Inlet and SHOC Outlet
February, 2009



Appendix G

SHOC Performance Test Report

Bruce Koetter

From: Bruce Koetter [bruce.koetter@odor.net]
Sent: Monday, September 29, 2008 7:37 AM
To: 'Sharon Worley'; 'Norman Robinson'; 'Alex Novak'; 'Robert Bates'
Cc: 'Neil Webster'; 'Brian Herner'; 'Daryl Letto'; 'Teodor Kochmar'
Subject: FW: MF 8089
Attachments: 8089-NW-3 samples.PDF

Attached are RSC test results for SHOC. We collected one inlet and an outlet sample for each vessel on 9/22/08. The system seems to be working very well as shown below. The results of the performance test that was conducted in mid-August are also shown below. These results indicate system is performing even better now than in August. Biorem indicated they expected removal efficiencies of dimethyl sulfide to increase as bacterial colonies developed and it appears to be so. Hopefully they will continue to rise.

Compound	September 22 Results Removal efficiency(%)		August 14 Results Removal efficiency(%)	
	Unit #1	Unit #2	Unit #1	Unit #2
Hydrogen Sulfide	99.92	99.92	99.97	99.95
Methyl Mercaptan	99.0	98.61	92.18	89.52
Dimethyl Sulfide	52.8	57.4	5.94	-17.82
Carbon Disulfide	93.4	95.1	78.98	98.41
Dimethyl Disulfide	96.1	84.7	33.33	38.1

Thanks

Bruce Koetter, P.E.
Webster Environmental Associates, Inc.
(502)253-3443

From: REMcCullen@aol.com [mailto:REMcCullen@aol.com]
Sent: Sunday, September 28, 2008 6:44 PM
To: Bruce.Koetter@odor.net
Subject: MF 8089

Bruce,

Attached are the results and invoice for your samples. If you have any questions please call.

Ron Mc Cullen, MS, Lab Director
Mayfly Odor Laboratory
Mystic, CT 06355
email ron@mayflylab.com
phone (860) 536-7431
Cell (860) 235-6306
Fax (860) 536-2212

WEBSTER ENVIRONMENTAL ASSOCIATES, INC.
13121 Eastpoint Park Blvd., Suite E
Louisville, KY 40223-4164

Tel: (502) 253-3443
Fax: (502) 253-3442
Web Site: http://www.odor.net

NEIL A. WEBSTER, P.E.
President

J. W. (BUZ) RUSH III P.E.
Vice President

BRUCE KOETTER, P.E.
Vice President

ENVIRONMENTAL AND ODOR CONTROL ENGINEERING

August 22, 2008

Teodor Kochmar
Biorem Technologies, Inc.
7496 Wellington Road 34
RR #3
Guelph, Ontario, N1H 6H9

Re: Louisville MSD Solids Handling Odor Control Performance Test
WEA Job # 406

Dear Mr. Kochmar,

Webster Environmental Associates, Inc. completed the performance tests on the Morris Forman Wastewater Treatment Plant (MFWTP) Solids Handling Odor Control system on August 14, 2008. The results of these tests are presented in this letter.

Prior to testing a Performance Test Protocol was submitted to MSD for review. MSD approved the protocol on August 13, 2008. The approved protocol is attached to this letter.

On the day of testing it was mostly sunny and warm with an afternoon high temperature of about 85°F. There was no rain throughout the day.

The test consisted of measuring inlet and outlet hydrogen sulfide (H_2S) using handheld instruments and collecting three rounds of inlet and outlet air samples for reduced sulfur compound (RSC) analyses by Mayfly Laboratories in Mystic, Connecticut. The first round of samples was collected at 9:00 am, the second round at noon and the third round at 3:00 pm.

Hydrogen sulfide was measured using a Jerome 631X H_2S analyzer on the outlet air samples and an odalog was used to measure the inlet H_2S concentrations.

Each round of sampling included a sample of the air feeding the two biotrickling scrubbers (BTS) and a sample of the outlet air from each of the two BTS. The air samples were collected in 3 liter tedlar bags using Tygon tubing, a sample pump and a vacuum chamber.

Both systems appeared to be operating normally on the day of testing. The operating parameters for each system during each round of testing are shown on **Table 1**.

TABLE 1

Round 1	**BTS #1**	**BTS #2**
Inlet H_2S (ppm)(Using Odalog)	86	86
Outlet H_2S (ppm) (Using Jerome)	0.53	0.62
pH	1.9	1.6
Recirculation Flow (gpm)	111	124
Purge Rate (gpm)	3.6	3.4
Round 2		
Inlet H_2S (ppm)(Using Odalog)	47.5	47.5
Outlet H_2S (ppm) (Using Jerome)	0.17	0.28
pH	1.9	1.5
Recirculation Flow (gpm)	112	123
Purge Rate (gpm)	3.6	3.4
Round 3		
Inlet H_2S (ppm)(Using Odalog)	106	106
Outlet H_2S (ppm) (Using Jerome)	0.52	0.55
pH	1.9	1.6
Recirculation Flow (gpm)	111	122
Purge Rate (gpm)	3.5	3.3

The RSC results are shown on the attached summary from Mayfly Laboratories. **Table 2** shows the reduced sulfur compounds that were in significant concentrations as well as the removal efficiency of each BTS on each compound for each round and the average for all three rounds. The average results show that both BTS are removing greater than 99.2% of the inlet H_2S and more than 83% of total reduced sulfur compounds (H_2S excluded) on a mass emissions basis. The design specifications required H_2S removal to exceed 99% and RSC removal to exceed 80% therefore both systems have passed the performance test.

If you have any questions about this report or the test please let me know.

Sincerely,

Bruce Koetter

Bruce Koetter, P.E.
Vice President

TABLE 2
Louisville and Jefferson County MSD - Morris Forman WWTP
SHOC Performance Testing - Reduced Sulfur Compound Test Results

Sampling Date Thursday, August 14, 2008 System Air Flow Rate (cfm) 7,500

Round 1

Compound	MW	Concentration (ppb) Inlet	#1 Outlet	#2 Outlet	Removal Efficiency (%) BTS #1	BTS#2	Mass Emissions (lbs/hr) Inlet	#1 Outlet	#2 Outlet	Mass Emissions Removal Efficiency (%) BTS #1	BTS#2
Hydrogen Sulfide	34	34084	11	16	99.97%	99.95%	1.45	0.0005	0.0007	99.97%	99.95%
COS	60	32	21	20	34.38%	37.50%	0.00	0.0016	0.0015	34.38%	37.50%
Methanethiol (MM)	48	4696	367	492	92.18%	89.52%	0.28	0.0221	0.0296	92.18%	89.52%
Dimethyl Sulfide	62	101	95	119	5.94%	-17.82%	0.01	0.0074	0.0092	5.94%	-17.82%
Carbon Disulfide	76	371	78	5.9	78.98%	98.41%	0.04	0.0074	0.0006	78.98%	98.41%
Dimethyl Disulfide	94	21	14	13	33.33%	38.10%	0.00	0.0016	0.0015	33.33%	38.10%
Dimethyl Trisulfide	126	5.8	3.3	0.1	43.10%	98.28%	0.00	0.0005	0.0000	43.10%	98.28%
					Total Including H_2S		1.78	0.0411	0.0431	97.70%	97.58%
					Total Not Including H_2S		0.33	0.0406	0.0425	87.74%	87.19%

Round 2

Compound	MW	Concentration (ppb) Inlet	#1 Outlet	#2 Outlet	Removal Efficiency (%) BTS #1	BTS#2	Mass Emissions (lbs/hr) Inlet	#1 Outlet	#2 Outlet	Mass Emissions Removal Efficiency (%) BTS #1	BTS#2
Hydrogen Sulfide	34	6,300	49	107	99.22%	98.30%	0.27	0.0021	0.0046	99.22%	98.30%
COS	60	25	10	21	60.00%	16.00%	0.00	0.0008	0.0016	60.00%	16.00%
Methanethiol (MM)	48	1,567	311	483	80.15%	69.18%	0.09	0.0187	0.0291	80.15%	69.18%
Dimethyl Sulfide	62	83	69	90	16.87%	-8.43%	0.01	0.0054	0.0070	16.87%	-8.43%
Carbon Disulfide	76	22	3.1	63	85.91%	-186.36%	0.00	0.0003	0.0060	85.91%	-186.36%
Dimethyl Disulfide	94	15	3.5	7.4	76.67%	50.67%	0.00	0.0004	0.0009	76.67%	50.67%
Dimethyl Trisulfide	126	6	0.1	0.3	98.41%	95.24%	0.00	0.0000	0.0000	98.41%	95.24%
					Total Including H_2S		0.38	0.0276	0.0491	92.65%	86.94%
					Total Not Including H_2S		0.11	0.0255	0.0446	76.23%	58.54%

Round 3

Compound	MW	Concentration (ppb) Inlet	#1 Outlet	#2 Outlet	Removal Efficiency (%) BTS #1	BTS#2	Mass Emissions (lbs/hr) Inlet	#1 Outlet	#2 Outlet	Mass Emissions Removal Efficiency (%) BTS #1	BTS#2
Hydrogen Sulfide	34	40,713	486	521	98.81%	98.72%	1.74	0.0207	0.0222	98.81%	98.72%
COS	60	38	31	20	18.42%	47.37%	0.00	0.0023	0.0015	18.42%	47.37%
Methanethiol (MM)	48	4,749	557	597	88.27%	87.43%	0.29	0.0335	0.0359	88.27%	87.43%
Dimethyl Sulfide	62	133	114	91	14.29%	31.58%	0.01	0.0089	0.0071	14.29%	31.58%
Carbon Disulfide	76	409	47	8.9	88.51%	97.82%	0.04	0.0045	0.0008	88.51%	97.82%
Dimethyl Disulfide	94	65	14	13	78.46%	80.00%	0.01	0.0016	0.0015	78.46%	80.00%
Dimethyl Trisulfide	126	28	0.1	0.2	99.64%	99.29%	0.00	0.0000	0.0000	99.64%	99.29%
					Total Including H_2S		2.09	0.0716	0.0691	96.57%	96.69%
					Total Not Including H_2S		0.35	0.0508	0.0469	85.47%	86.60%

Average of All Three Rounds

Compound	MW	Concentration (ppb) Inlet	#1 Outlet	#2 Outlet	Removal Efficiency (%) BTS #1	BTS#2	Mass Emissions (lbs/hr) Inlet	#1 Outlet	#2 Outlet	Mass Emissions Removal Efficiency (%) BTS #1	BTS#2
Hydrogen Sulfide	34	27,032	182	215	99.33%	99.21%	1.15	0.0078	0.0091	99.33%	99.21%
COS	60	32	21	20	34.74%	35.79%	0.00	0.0016	0.0015	34.74%	35.79%
Methanethiol (MM)	48	3,671	412	524	88.78%	85.72%	0.22	0.0248	0.0315	88.78%	85.72%
Dimethyl Sulfide	62	106	93	100	12.30%	5.36%	0.01	0.0072	0.0078	12.30%	5.36%
Carbon Disulfide	76	267	43	26	84.03%	90.30%	0.03	0.0041	0.0025	84.03%	90.30%
Dimethyl Disulfide	94	34	11	11	68.81%	66.93%	0.00	0.0012	0.0013	68.81%	66.93%
Dimethyl Trisulfide	126	13	1.2	0.2	91.27%	98.50%	0.00	0.0002	0.0000	91.27%	98.50%
					Total Including H_2S		1.42	0.0468	0.0538	96.69%	96.20%
					Total Not Including H_2S		0.26	0.0390	0.0446	85.17%	83.03%

Note: Concentrations taken from Mayfly Laboratory report with Project ID 8075, analyzed on 8/15/08 and reported 8/17/08.

MAYFLY ODOR LABORATORY
450 Flanders Road
Mystic, CT 06355
(860) 536-7431
FAX (860) 536-2212

Client: **Webster Environmental** Received: **8/15/08** Reported: **8/17/08** Analysis: **8/15/08**
Project ID: **8075** Sample ID: **Air** Sample Type: **Tedlar Bag** Sample Vol: **0.1-2.5 ml**

406 BioRem SHOC Testing — **Volatile Sulfur Compounds**

			#1	#2	#3	#4	#5	#6	#7	#8	#9
			9:00	9:00	9:00	12:00	12:00	12:00	15:00	15:00	15:00
		Mol.	I-#1	O-1#1	O-2#1	I-#2	O-1#2	O-2#2	I-#3	O-1#3	O-2#3
	OT*	Wt.	PPB	PPB	PPB	PPB	PPB	PPB	PPB	PPB	PPB
Hydrogen Sulfide	0.4	34	34,084	11	16	6,300	49	107	40,713	486	521
COS	55	60	32	21	20	25	10	21	38	31	20
Methanethiol (MM)	0	48	4,696	367	492	1,567	311	483	4,749	557	597
Ethanethiol (t)	0	62	<3	<3	<3	<3	<3	<3	<3	6.4	<3
Dimethyl Sulfide	1	62	101	95	119	83	69	90	133	114	91
Carbon Disulfide	10	76	371	78	5.9	22	3.1	63	409	47	8.9
2-Propanethiol (t)		76	<3	<3	<3	<3	<3	<3	<3	<3	<3
2-Methyl-2-propanethiol		90	<3	<3	<3	<3	<3	<3	<3	<3	<3
2-(Methyl thio) propane (t)		90	<3	<3	<3	<3	<3	<3	<3	<3	<3
Allyl Methyl Sulfide	0.1	88	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	0.2	<0.1
Diethyl Sulfide	0	90	<3	<3	<3	<3	<3	<3	<3	<3	<3
Methylthioacetate		90	<3	<3	<3	<3	<3	<3	<3	<3	<3
1-(Methyl thio) propane (t)		90	<3	<3	<3	<3	<3	<3	<3	<3	<3
2-(ethylthio) Propane (t)		104	<3	6.7	<3	<3	<3	<3	<3	<3	<3
Dimethyl Disulfide	2.2	94	21	14	13	15	3.5	7.4	65	14	13
2-M-1-(Methylthio) Propane (t)		104	<3	<3	<3	<3	<3	<3	<3	<3	<3
Diisoproyl Disulfide (t)		118	<3	<3	<3	<3	<3	<3	<3	<3	<3
2-(Methylthio) Butane (t)		104	<3	<3	<3	<3	<3	<3	<3	<3	<3
Methyl Ethyl Disulfide		108	<3	<3	<3	<3	<3	<3	<3	<3	<3
Methyl Thiophene		98	<3	<3	<3	<3	<3	<3	<3	<3	<3
Sec-Butyl isopropyl Sulfide (t)		132	<3	<3	<3	<3	<3	<3	<3	<3	<3
1-(Ethylthio) Butane (t)		118	<3	<3	<3	<3	<3	<3	<3	<3	<3
Methyl Propyl Disulfide (t)		122	<3	<3	<3	<3	<3	<3	<3	<3	<3
Diethyl Disulfide (t)	2	122	<3	<3	<3	<3	<3	<3	<3	<3	<3
2,2-bis(ethylthio) Propane (t)		164	<3	<3	<3	<3	<3	<3	<3	<3	<3
Dimethyl Trisulfide		126	5.8	3.3	<0.1	6.3	<0.1	0.3	28	<0.1	0.2
Methyl Isopropyl Disulfide (t)		122	<3	<3	<3	<3	<3	<3	<3	<3	<3
Methyl 2-propenyl Disulfide		120	<3	<3	<3	<3	<3	<3	<3	<3	<3
M-1-M-1-(Mthio)ethyl Disulfide (t)		168	<3	<3	<3	<3	<3	<3	<3	<3	<3
Allyl disulfide (t)		146	<3	<3	<3	<3	<3	<3	<3	<3	<3
Diisobutyl Disulfide (t)		178	<3	<3	<3	<3	<3	<3	<3	<3	<3

OT*= Odor Thresholds - odor threshold are always reported in a range to reflect inherent human variability, the values reported in this column are the lowest we took from the literature

PROPOSED PERFORMANCE TEST PROTOCOL
(Submitted August 13, 2008)

Project: **Solids Handling Odor Control Improvements**
Two (2) Biotrickling Scrubbers

APCD Construction Permit #: 139-05-C

Location and Owner: **Morris Forman Wastewater Treatment Plant (MFWTP)**
4522 Algonquin Pkwy, Louisville, KY 40211

Louisville & Jefferson County Metropolitan Sewer District

Prepared by: **Bruce Koetter, P.E., Webster Environmental Associates, Inc. for Biorem Technologies, Inc.**

1.0 Introduction

There are two (2) biotrickling scrubbers (BTS) operating in parallel treating about 4,600 cfm of air each from the solids handling areas of the MFWTP. Several modifications were made to the BTS during the fall of 2007 and spring of 2008 to improve their performance and reliability. The improvements included replacement of the BTS media in each stage, installation of new recirculation pumps and miscellaneous valve and instrumentation changes. MSD signed a contract with Biorem Technologies, Inc. who assisted with the redesign and committed to meeting prescribed hydrogen sulfide (H_2S) and other reduced sulfur compounds (RSC) removal efficiencies. The purpose of this testing is to determine the H_2S and RSC removal efficiencies of the system and whether those meet the specified performance criteria. The testing will be conducted for Biorem Technologies by Mr. Bruce Koetter, P.E., Webster Environmental Associates, Inc. on August 14, 2008.

2.0 Sampling Site Description and Sampling Plan

Each 14 ft diameter vessel has a 30-inch diameter inlet duct and a 36-inch diameter exhaust stack from which air samples will be taken.

Three rounds of sampling will be conducted. Each round of sampling will consist of the following:

1. 3 liter air samples will be collected from the inlet duct and each vessel outlet and sent to Mayfly Laboratories for RSC analyses.
2. H_2S will be measured on-site as each sample is collected using a Jerome H_2S analyzer.
3. System operating conditions will be recorded as each air sample is collected.
4. The first round of sampling will occur at about 9:00 am, 2nd round at about 12 noon and the 3rd round at about 3:00 pm.
5. All samples for inlet and outlet will be taken with a thirty second delay from inlet to outlet to allow for the detention time in the BTS.

3.0 Sampling and Analytical Procedures

3.1 Grab Air Samples for RSC and H_2S (collection in Tedlar bags as in EPA Method 15)

- Air samples collected at 3 L/min. in purged Tedlar bags
- Use a decompression device (vacuum chamber) so that sample bags can be filled without passing the sample through a pump
- New, unused Tygon tubing will be used to collect all air samples
- Samples stored in light-shielded cardboard containers and shipped to laboratory via overnight express mail
- Hold time will be less than 24 hours and analyses complete in less than 48 hours
- Sampling trains on the outlet will be leak checked before and after the sampling day

3.2 Hydrogen Sulfide Analyses (EPA Method 16B)

Mayfly Odor Laboratory will analyze the samples for the presence of 31 reduced sulfur compounds and other volatile sulfur compounds by direct injection Gas Chromatography / Flame Photometric Detection GC/FPD. The system used for this analysis will be a Hewlett Packard 5890 Series II Gas Chromatograph/Hewlett Packard FPD Detector. The column is a HP-VOC 3um film, 105 Meter x 0.53 mm ID. The sample volume injected will be 0.005 to 2.5 ml for air samples depending on sample concentrations. Purchased tank standards will be used to calibrate for hydrogen sulfide and to determine other reduced sulfur compound’s concentration. If hydrogen sulfide concentrations are too high to allow concentration estimates of other RSC's, or better detection limits can be obtained by GC/MS, their concentrations are estimated by the carbon disulfide response factor from the VOC calibration standard from the GC/MS system.

4.0 Monitoring During Compliance Test

The following operating parameters were monitored during the compliance test for the BTS units:

- System pH (desired operating range is 1.5 – 2.5)
- Recirculation water flow (desired range is 110 – 125 gpm)
- Purge water (blowdown) rate
- Exhaust fan speed (rpm)
- Air flow rate to system in cfm

Chain of Custody forms will be prepared for the air samples.

5.0 Results

Results will be presented within two weeks of sampling.

Appendix H

BOC Performance Test Report

PERFORMANCE TESTING OF BIOTRICKLING FILTER ODOR CONTROL SYSTEM SERVING BIOROUGHING TOWERS; MORRIS FORMAN WWTP

Prepared for:

ARNOLD, DUGAN & MEYERS
2712 River Green Circle
Louisville, KY 40206

Prepared by:

BOWKER & ASSOCIATES, INC.
CONSULTING ENGINEERS
477 Congress Street, Suite 1004
Portland, ME 04101

October 16, 2008

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1. INTRODUCTION

A performance test was conducted on two, 10,000 cfm Bioway Purspring™ 10000 biotrickling filters (bioscrubbers) treating odorous air from the bioroughing towers (tricking filters) at the Morris Forman Wastewater Treatment Plant in Louisville, KY. The two bioscrubber towers each contain two zones of media with separate irrigation systems: the lower zone is designed for H_2S removal using autotrophic Thiobacillus bacteria at low pH, while the upper zone is intended to remove other odorous sulfur compounds using heterotrophic bacteria at neutral pH. The system is designed for an average hydrogen sulfide (H_2S) concentration of 60 ppm and a peak H_2S concentration of 150 ppm. The testing was conducted by Bowker & Associates following the approved test protocol prepared by Bioway America.

2. TEST PROTOCOL

The test protocol was developed by Bioway America and approved by MSD. The test protocol consisted of the following elements:

1. Measuring air flow through the two vessels
2. Continuous datalogging of inlet and outlet H_2S levels using a 0–200 ppm OdaLog™ on the inlet and a 0–2 ppm OdaLog™on each of the two outlets, for a minimum of 12 hours.
3. Collection of two inlet and two outlet air samples from each vessel at two different time periods for laboratory measurement of odor concentration (dilutions to threshold) in accordance with ASTM E-679.
4. Collection of two inlet and two outlet air samples from each vessel at two different time periods for laboratory quantification of reduced sulfur compounds.

The contract specifications call for the systems to achieve 99 percent H_2S removal; reduced sulfur compound and odor test results are for informational purposes only.

A single 0–200 ppm OdaLog™ H_2S datalogger was used to record inlet H_2S to the nearest 1 ppm. Odorous air is split evenly between the two vessels. Low-range (0–2 ppm) OdaLog™ dataloggers were used to record outlet H_2S to the nearest 0.01 ppm.

All air samples were shipped via overnight carrier to the respective laboratories. A total of 8 air samples in 10L Tedlar bags were sent to St. Croix Sensory in Lake Elmo, MN for determination of odor concentration, and 8 air samples in 3L Tedlar bags were sent to Mayfly Environmental Laboratory in Mystic, CT for quantification of reduced sulfur compounds. Inlet and outlet samples were collected simultaneously using SKC vacuum chambers with SKC air sample pumps providing the vacuum. This technique allowed sample air to pass through Teflon tubing directly into the sample bag, eliminating the potential for contamination by a sample pump.

3. RESULTS

Mr. Robert Bowker of Bowker & Associates arrived at the site at approximately 11 AM on September 3, 2008. Mr. Rob Duffy, a service technician for Bioway was also at the site for the duration of the testing. The 0–200 ppm OdaLog was installed on the inlet and the two 0–2 ppm OdaLogs were installed on the outlets of the two units. It was soon observed that the inlet H_2S was very high (approximately 130 ppm) and, while the outlet of Bioscrubber #1 showed an H_2S concentration less than 1 ppm, Bioscrubber #2 exhibited an outlet H_2S greater than 2 ppm (off-scale). The Low-Range OdaLog on Bioscrubber #2 was removed and replaced with a 0–200 ppm unit to allow observation of the outlet level, but the actual test monitoring was not started in order to allow troubleshooting of the unit. During the high inlet loading, outlet H_2S concentrations were 10 to 15 ppm.

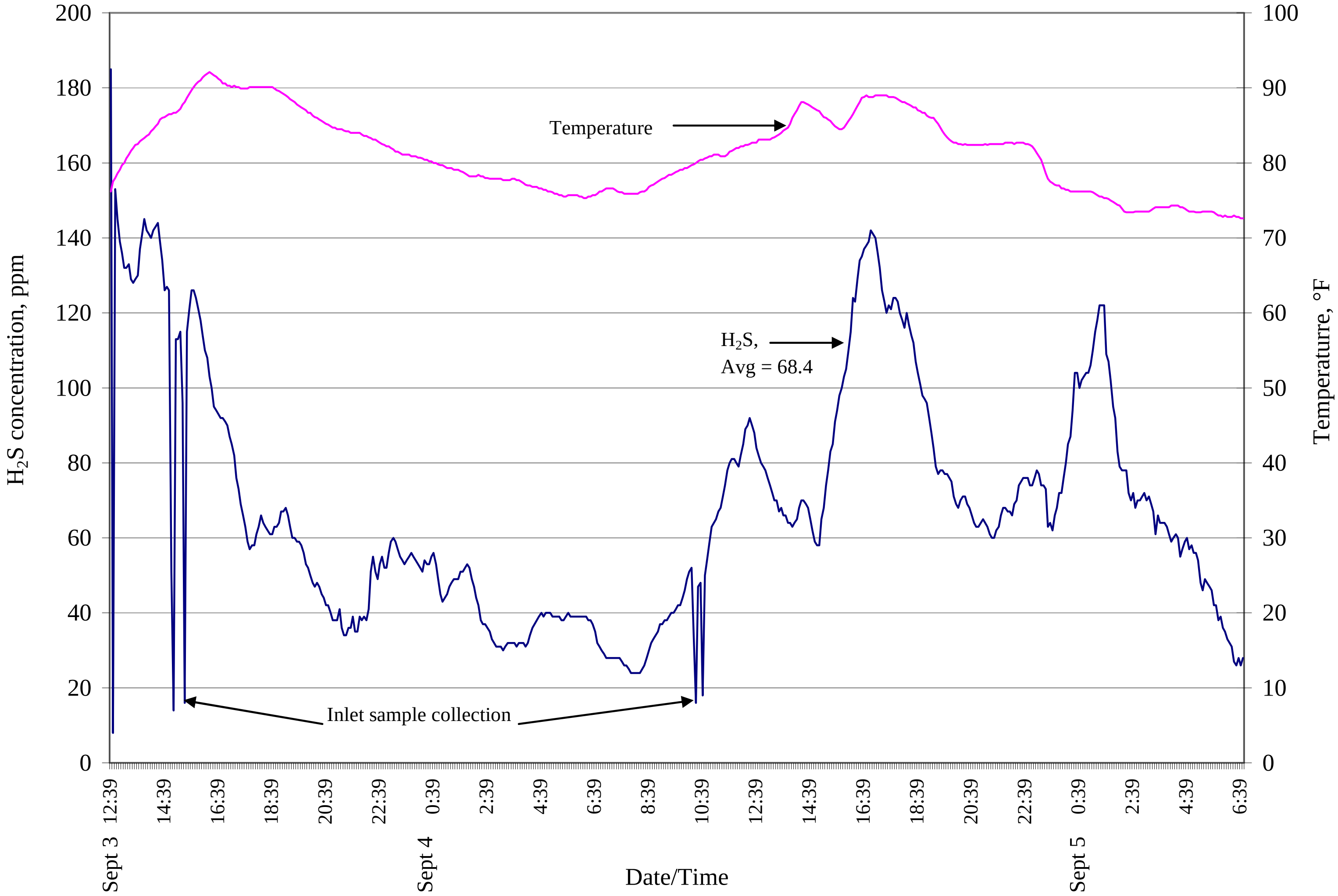
The Bioway service technician determined that MSD had been receiving frequent alarms associated with the nutrient pump for Bioscrubber #2, and that nutrient feed had been interrupted on many occasions. Nutrient feed was restarted. Later, a cracked fitting was found at the discharge of the chemical pump that allowed air to enter the line and cause gas-locking. Despite the poor performance of Bioscrubber #2, air samples were collected in accordance with the protocol on the afternoon of September 3.

By the following morning (September 4), Bioscrubber #2 was achieving a low outlet H_2S concentration, and both reactors appeared to provide consistently low outlet H_2S concentrations of less than 0.5 ppm. With the nutrient feed problem corrected, it was decided to begin the H_2S testing on the morning of September 4, and continue the monitoring until the morning of September 5. The second set of inlet and outlet air samples was collected on the morning of September 4, 2008.

3.1 H_2S Monitoring

Figure 1 shows inlet H_2S concentrations during the period from September 3 at 12:39 PM through September 5 at 6:39 AM. Inlet H_2S ranged from about 25 ppm to 150 ppm, and averaged

FIGURE 1
H_2S CONCENTRATION VS. TIME
INLET TO BIOSCRUBBERS 1 & 2
Morris Forman WWTP
September 3-5, 2008



68 ppm. Figure 2 shows the outlet H_2S for Bioscrubber #1 over a similar time frame. While the outlet H_2S concentrations were reasonably low until the afternoon of September 4, increasing inlet concentrations of up to 140 ppm apparently caused outlet levels to exceed the range of the instrument. The outlet H_2S remained at >2 ppm until the test was ended on the following morning.

Figure 3 shows the outlet H_2S concentration from Bioscrubber #2 from 9 AM September 4 until 6:30 AM on September 5. This was the reactor that had experienced problems with the nutrient feed pump. At several times during the monitoring, the 0 to 2 ppm maximum H_2S range of the instrument was exceeded, and the data exceeding 2.0 ppm was not recorded. Based on the maximum H_2S value on Figure 3 of 2 ppm, the average outlet H_2S concentration was 1.0 ppm for Bioscrubber #2. Similarly, if the average outlet H_2S of Bioscrubber #1 is calculated assuming a maximum value of 2 ppm, the average outlet H_2S is 1.2 ppm. Using an average inlet H_2S concentration of 68.4 ppm, the removal efficiencies are about 98.2% for Bioscrubber #1 and 98.5% for Bioscrubber #2. Again, the average assumes a maximum H_2S outlet of 2 ppm (the upper range of the instrument), which is not a correct assumption. The extent to which the actual outlet H_2S concentration exceeded the 2 ppm is not known.

3.2 Air Sampling

Table 1 summarizes the results of the laboratory testing of the air samples collected from the inlet and outlet of the two biotrickling filters. Reports from the laboratories are included in Appendix A. During the first set of samples on the afternoon of September 3, both reactors were sampled with the knowledge that Bioscrubber No. 2 was performing poorly. H_2S removal efficiency based on laboratory testing was as follows:

	9/3/08	9/4/08
Bioscrubber No. 1	99.4%	99.5%
Bioscrubber No. 2	74.7%	99.4%

FIGURE 2
H_2S CONCENTRATION VS. TIME
OUTLET OF BIOSCRUBBER NO. 1
Morris Forman WWTP
September 3-5, 2008

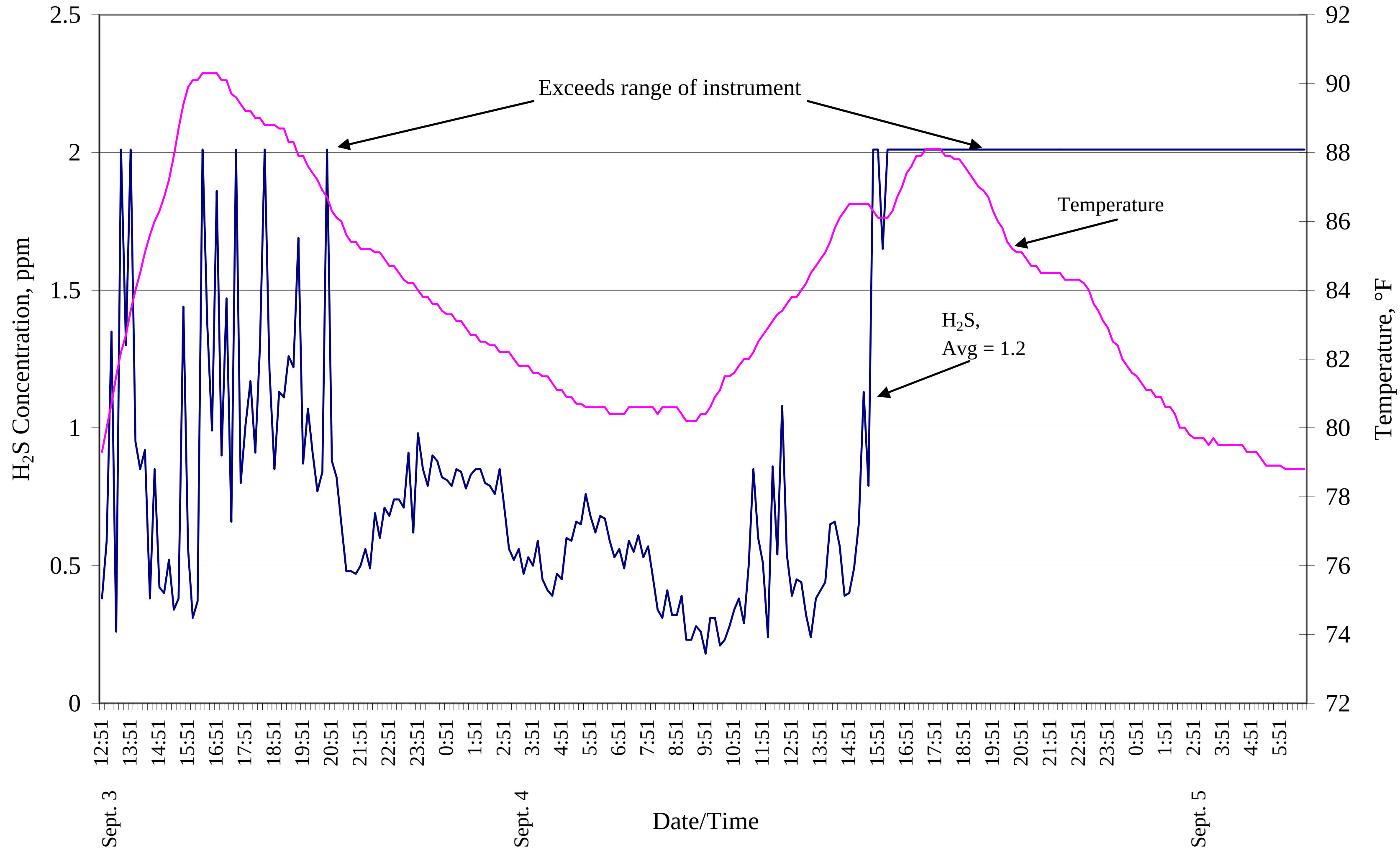


FIGURE 3
H_2S CONCENTRATION VS. TIME
OUTLET OF BIOSCRUBBER NO. 2
Morris Forman WWTP
September 4-5, 2008

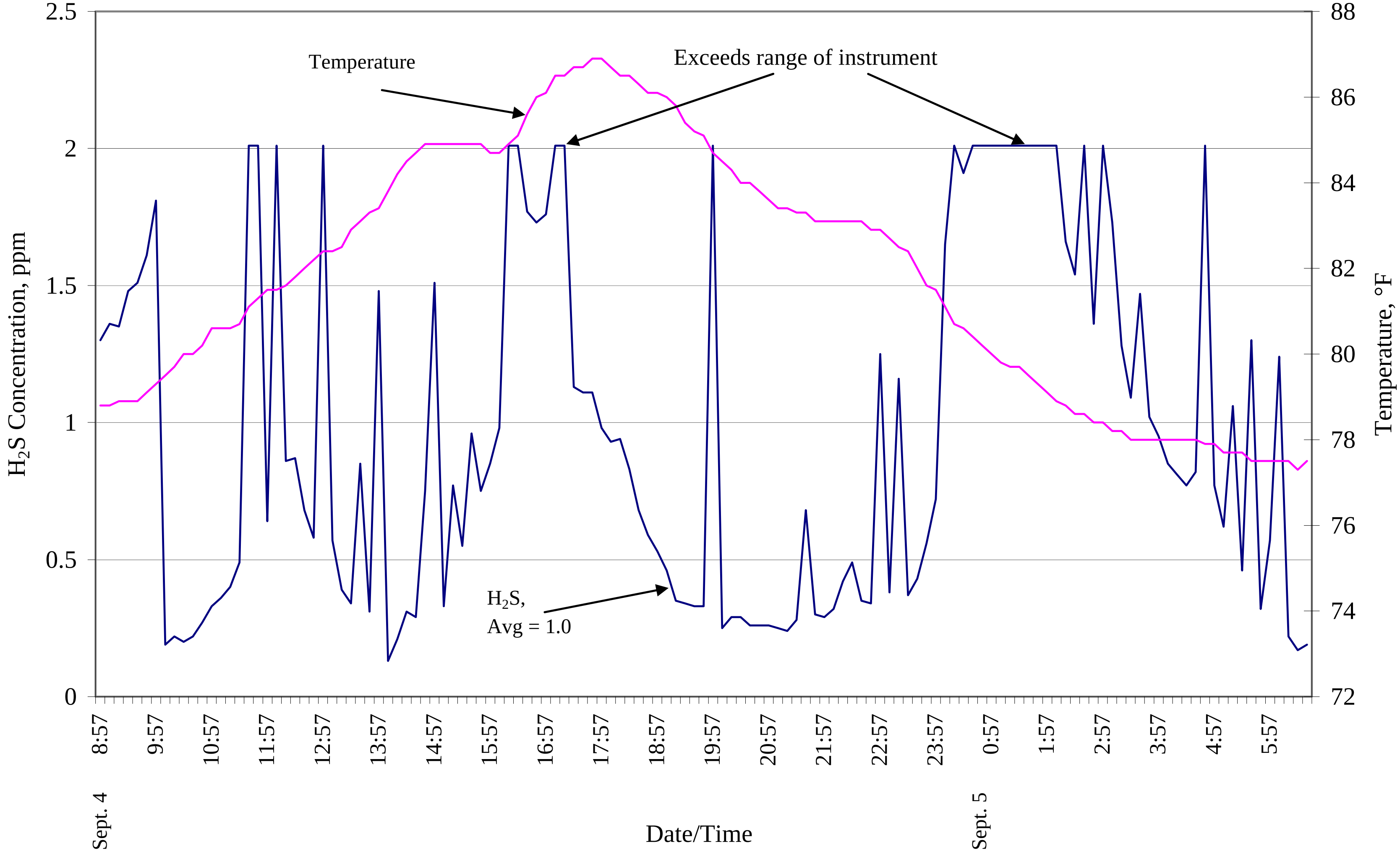


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TABLE 1

SUMMARY OF ODOR PANEL AND REDUCED SULFUR DATA
BIOWAY BIOSCRUBBER SYSTEMS
MORRIS FORMAN WWTP, LOUISVILLE
September 3-4, 2008

Sample No.	Time	Location	Odor Conc'n D/T	Reduced Sulfur Compounds,[1] ppb									
				H_2S	COS	MM	DMS	CS_2	2-P(t)	2-(Mt)P	MT	DMDS	DMTS
September 3, 2008													
1	3:10 PM	Inlet Bioscrubber #1	62,000	65,561	280	5,109	222	243	1.5	1.9	2.6	21	1.5
2	3:10 PM	Outlet Bioscrubber #1	11,000	383	257	140	180	86	1.2	0.6	<3	22	1.4
3	3:30 PM	Inlet Bioscrubber #2[2]	53,000	61,113	152	5,006	123	95	0.1	0.5	<3	11	1.3
4	3:30 PM	Outlet Bioscrubber #2[2]	50,000	15,464	153	3,592	106	75	<0.1	<0.1	<3	14	5.3
September 4, 2008													
5	10:20 AM	Inlet Bioscrubber #2	13,000	29,347	325	3,526	267	210	<3	<3	<3	5.2	0.4
6	10:20 AM	Outlet Bioscrubber #2	4,600	182	219	541	167	36	<3	<3	<3	14	0.4
7	10:50 AM	Inlet Bioscrubber #1	8,700	31,112	180	3,372	142	56	<3	<3	<3	9.0	0.9
8	10:50 AM	Outlet Bioscrubber #1	6,200	155	142	531	105	47	<3	<3	<3	7.0	1.6

1 H_2S hydrogen sulfide; COS carbonyl sulfide; MM methyl mercaptan; DMS dimethyl sulfide; CS_2 carbon disulfide; 2-P(t) 2-propanethiol (t); 2-(Mt)P 2-(methyl thio) propane (t); MT methyl thiirane (t); DMDS dimethyl disulfide; TMDS trimethyl disulfide

2 Samples collected during period of nutrient feed system malfunction

Methyl mercaptan was present in the inlet at high concentrations of 3 to 5 ppm. Except for the sample from Bioscrubber No. 2 when it was performing poorly, methyl mercaptan removal efficiency ranged from 85 to 97 percent. Dimethyl sulfide removal was 25 to 40 percent, but inlet concentrations were less than 0.3 ppm.

Odor removal efficiency was typically 65 to 80 percent. The data from the second sampling of Bioscrubber No. 1 is suspect due to the low reported inlet odor concentration of 8,700 D/T. These data show relatively poor odor removal, even though H_2S and methyl mercaptan removal was high.

3.3 Air Flow Measurements

Bowker & Associates was not able to measure air flowrates through each reactor. Ductwork runs were too short to achieve the recommended separation distance from fittings and bends. We attempted to measure velocity of the exhaust, but it exceeded the maximum range (4,000 ft/min) of the hot-wire anemometer. Previous air flow estimates by Webster Environmental Associates showed the system to be properly balanced and the air flowrates within 10 percent of design values.

4. CONCLUSIONS

1. The two biotrickling filters serving the bioroughing towers at the Morris Forman WWTP are generally performing well; although under peak loading conditions, outlet H_2S excursions apparently occur.
2. The H_2S removal efficiency of the reactors was approximately 99 percent when the inlet H_2S was below 100 ppm. During peak loading conditions of up to 150 ppm, outlet H_2S exceeded the maximum range of the instrument (2 ppm) used to monitor exhaust H_2S levels.
3. Problems with the nutrient feed pump likely caused reduced performance of Bioscrubber No. 2 on September 3, but the unit recovered quickly when the problems were corrected. The cause of the high outlet H_2S in Bioscrubber No. 1 during the last 14 hours of monitoring on September 5 is not known.

APPENDIX A

LABORATORY RESULTS

St. Croix Sensory, Inc.

Odor Evaluation Report

Client: Bowker & Associates, Inc.

Project: 0820 - Louisville Test

Report No.: **824803**

Evaluation Date: 09/04/08

			ASTM E679 & EN13725		ASTM E544	PERSISTENCY	CHARACTERIZATION		
#	Field No.	Sample Description	Detection Threshold	Recognition Threshold	Intensity	Dose-Response Slope	Hedonic Tone	Principal Odor Descriptors	Comments
1	0820-1	Inlet to Bioscrubber #1	62,000	43,000					Field sample diluted 10:1 for threshold evaluation.
2	0820-2	Outlet of Bioscrubber #1	11,000	6,600					
3	0820-3	Inlet to Bioscrubber #2	53,000	30,000					Field sample diluted 10:1 for threshold evaluation.
4	0820-4	Outlet of Bioscrubber #2	50,000	33,000					Field sample diluted 10:1 for threshold evaluation.
5									
6									
7									
8									
9									
10									

P.O. Box 313, 3549 Lake Elmo Ave. N., Lake Elmo, MN 55042 U.S.A. Tel:800-879-9231 Fax:651-439-1065 E-mail:stcroix@fivesenses.com Web:www.fivesenses.com

St. Croix Sensory, Inc. | **Odor Evaluation Report**

Client: Bowker & Associates, Inc.

Project: Louisville Test 0820

Report No.: **824903**

Evaluation Date: 09/05/08

			ASTM E679 & EN13725		ASTM E544	PERSISTENCY	CHARACTERIZATION		
#	Field No.	Sample Description	Detection Threshold	Recognition Threshold	Intensity	Dose-Response Slope	Hedonic Tone	Principal Odor Descriptors	**Comments**
1	0820-5	Inlet to Bioscrubber #2	13,000	7,600					
2	0820-6	Outlet of Bioscrubber #2	4,600	2,800					
3	0820-7	Inlet to Bioscrubber #1	8,700	5,400					
4	0820-8	Outlet of Bioscrubber #1	6,200	4,300					
5									
6									
7									
8									
9									
10									

P.O. Box 313, 3549 Lake Elmo Ave. N., Lake Elmo, MN 55042 U.S.A. Tel:800-879-9231 Fax:651-439-1065 E-mail:stcroix@fivesenses.com Web:www.fivesenses.com

MAYFLY ODOR LABORATORY
450 Flanders Road
Mystic, CT 06355
(860) 536-7431
FAX (860) 536-2212

Client: **Bowker & Associates** Received: **9/4/08** Reported: **9/7/08** Analysis: **9/4-5/08**
Project ID: **8081** Sample ID: **Air** Sample Type: **Tedlar Bag** Sample Vol: **2.5 ml**

Louisville - Test 0820 **Volatile Sulfur Compounds**

	OT*	Mol. Wt.	0820-1 #1 PPB	0820-2 #2 PPB	0820-3 #3 PPB	0820-4 #4 PPB
Hydrogen Sulfide	0.4	34	65,561	383	61,113	15,464
Carbonyl Sulfide (COS)	55	60	280	257	152	153
Methanethiol (MM)	0.01	48	5,109	140	5,006	3,592
Ethanethiol (t)	0.01	62	<3	<3	<3	<3
Dimethyl Sulfide	1	62	222	180	123	106
Carbon Disulfide	10	76	243	86	95	75
2-Propanethiol (t)		76	1.5	1.2	0.1	<0.1
(Methylthio) ethane (t)		76	<3	<3	<3	<3
2-(Methyl thio) propane (t)		90	1.9	0.6	0.5	<0.1
Methyl Thiirane (t)		90	2.6	<3	<3	<3
Diethyl Sulfide	0.03	90	<3	<3	<3	<3
Methylthioacetate		90	<3	<3	<3	<3
1-(Methyl thio) propane (t)		90	<3	<3	<3	<3
2-(ethylthio) Propane (t)		104	<3	<3	<3	<3
Dimethyl Disulfide	2.2	94	21	22	11	14
2-M-1-(Methylthio) Propane (t)		104	<3	<3	<3	<3
Diisoproyl Disulfide (t)		118	<3	<3	<3	<3
2-(Methylthio) Butane (t)		104	<3	<3	<3	<3
Methyl Ethyl Disulfide		108	<3	<3	<3	<3
Methyl Thiophene		98	<3	<3	<3	<3
Sec-Butyl isopropyl Sulfide (t)		132	<3	<3	<3	<3
1-(Ethylthio) Butane (t)		118	<3	<3	<3	<3
Methyl Propyl Disulfide (t)		122	<3	<3	<3	<3
Diethyl Disulfide (t)	2	122	<3	<3	<3	<3
2,2-bis(ethylthio) Propane (t)		164	<3	<3	<3	<3
Dimethyl Trisulfide	0.01	126	1.5	1.4	1.3	5.3
Methyl Isopropyl Disulfide (t)		122	<3	<3	<3	<3
Methyl 2-propenyl Disulfide		120	<3	<3	<3	<3
M-1-M-1-(Mthio)ethyl Disulfide (t)		168	<3	<3	<3	<3
Allyl disulfide (t)		146	<3	<3	<3	<3
Diisobutyl Disulfide (t)		178	<3	<3	<3	<3

OT*= Odor Thresholds (pbb) - odor threshold are always reported in a range to reflect inherent human variability, the values reported in this column are the lowest we took from the literature

MAYFLY ODOR LABORATORY
450 Flanders Road
Mystic, CT 06355
(860) 536-7431
FAX (860) 536-2212

Client: **Bowker & Associates** Received: **9/4/08** Reported: **9/7/08** Analysis: **9/4-5/08**
Project ID: **8081** Sample ID: **Air** Sample Type: **Tedlar Bag** Sample Vol: **2.5 ml**

Louisville - Test 0820

Volatile Sulfur Compounds

	OT*	Mol. Wt.	Inlet BioScub #2 0820-5 PPB	Outlet BioScub #2 0820-6 PPB	Inlet BioScub #1 0820-7 PPB	Outlet BioScub #1 0820-8 PPB
Hydrogen Sulfide	0.4	34	29,347	182	31,112	155
Carbonyl Sulfide (COS)	55	60	325	219	180	142
Methanethiol (MM)	0.01	48	3,526	541	3,372	531
Ethanethiol (t)	0.01	62	<3	<3	<3	<3
Dimethyl Sulfide	1	62	267	167	142	105
Carbon Disulfide	10	76	210	36	56	47
2-Propanethiol (t)		76	<3	<3	<3	<3
(Methylthio) ethane (t)		76	<3	<3	<3	<3
2-(Methyl thio) propane (t)		90	<3	<3	<3	<3
Methyl Thiirane (t)	0.1	88	<3	<3	<3	<3
Diethyl Sulfide	0.03	90	<3	<3	<3	<3
Methylthioacetate		90	<3	<3	<3	<3
1-(Methyl thio) propane (t)		90	<3	<3	<3	<3
2-(ethylthio) Propane (t)		104	<3	<3	<3	<3
Dimethyl Disulfide	2.2	94	5.2	14	9.0	7.0
2-M-1-(Methylthio) Propane (t)		104	<3	<3	<3	<3
Diisoproyl Disulfide (t)		118	<3	<3	<3	<3
2-(Methylthio) Butane (t)		104	<3	<3	<3	<3
Methyl Ethyl Disulfide		108	<3	<3	<3	<3
Methyl Thiophene		98	<3	<3	<3	<3
Sec-Butyl isopropyl Sulfide (t)		132	<3	<3	<3	<3
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Methyl Propyl Disulfide (t)		122	<3	<3	<3	<3
Diethyl Disulfide (t)	2	122	<3	<3	<3	<3
2,2-bis(ethylthio) Propane (t)		164	<3	<3	<3	<3
Dimethyl Trisulfide	0.01	126	0.4	0.4	0.9	1.6
Methyl Isopropyl Disulfide (t)		122	<3	<3	<3	<3
Methyl 2-propenyl Disulfide		120	<3	<3	<3	<3
M-1-M-1-(Mthio)ethyl Disulfide (t)		168	<3	<3	<3	<3
Allyl disulfide (t)		146	<3	<3	<3	<3
Diisobutyl Disulfide (t)		178	<3	<3	<3	<3

OT*= Odor Thresholds (pbb) - odor threshold are always reported in a range to reflect inherent human variability, the values reported in this column are the lowest we took from the literature

Appendix I

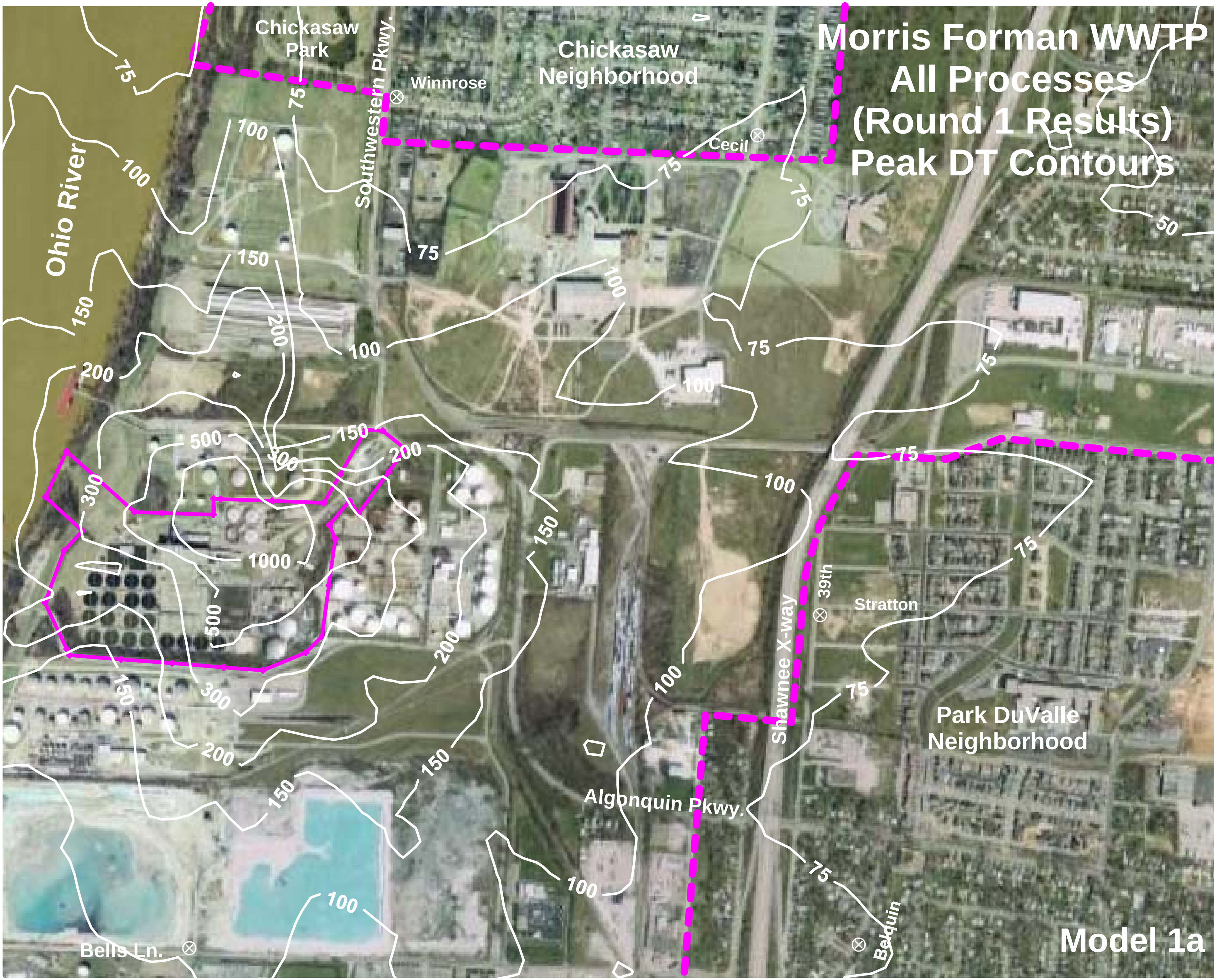
Preliminary Models

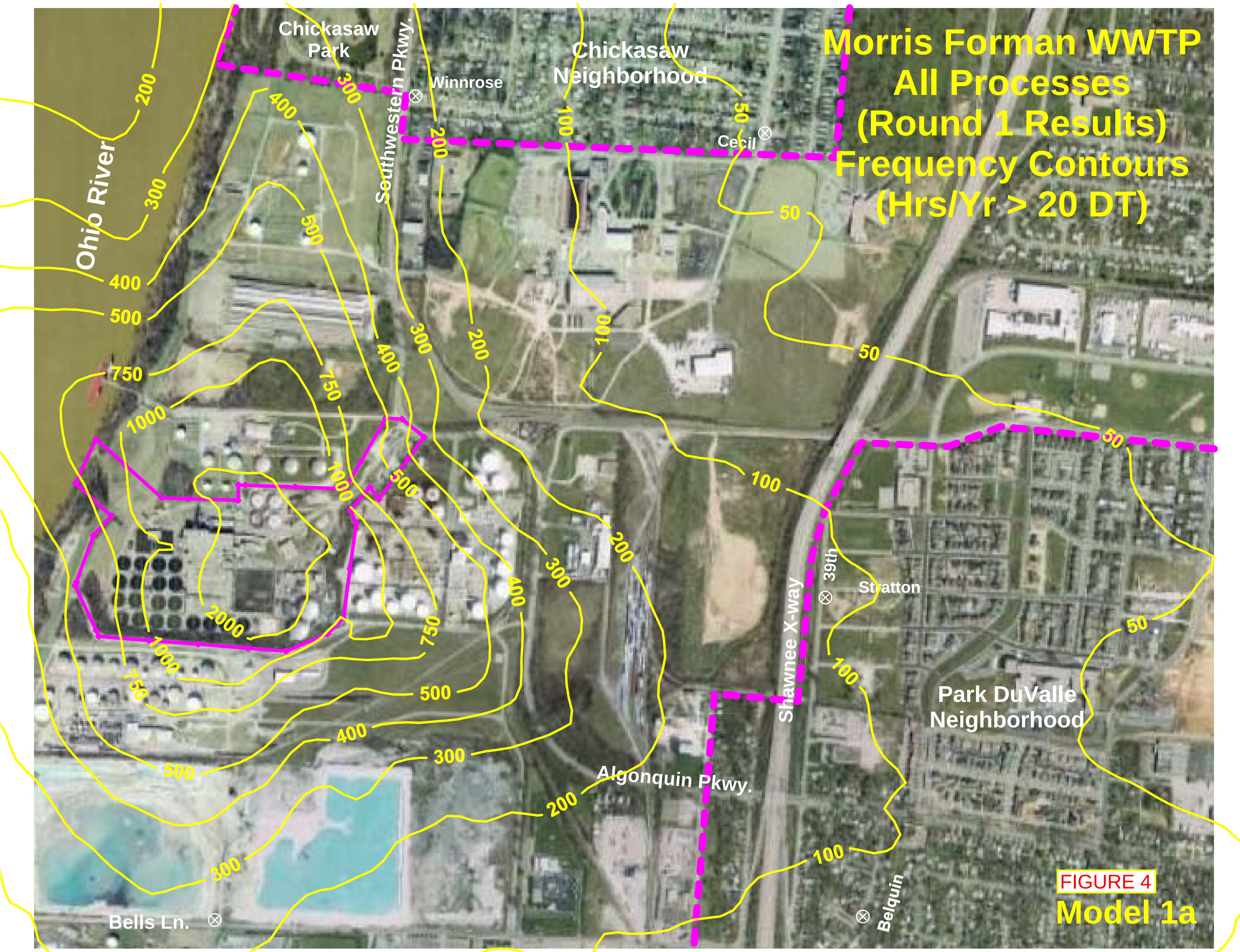
Morris Forman WWTP
Master Plan Update 2008
Modeling Scenarios
Revised 11/18/2008

Model #	Name	Description
1		**All Sources**
		All significant plant odor sources with Round 1 sampling results
		All significant plant odor sources with Round 2 sampling results
2		**All Sources, with MEB roof exhaust fans routed to incinerator stack using 350 D/T.**
		Use Round 1 sampling results for frequency and Round 2 results for Peak D/T
		Existing AHU provide 6 AC/hr with all roof fans off. Should we run models with roof fans off?
		Reduce peak DT of MEB exhaust to 150?
3		**Model 2, with chemical (FeCl2/H2O2) addition to headworks, headworks covers and treatment and Strobic fans**
		Reduce primary emissions by 75% due to chemical addition
		Use Round 1 sampling results for frequency and Round 2 results for Peak D/T
		50% improvement at BOC
4		**Model 3, with primary clarifier weirs and channels covered, air exhausted to new odor control system, no chemical addition a**
		Use Round 1 sampling results for frequency and Round 2 results for Peak D/T
5		**Model 4, with polishing stage added to BOC**
		Use Round 1 sampling results for frequency and Round 2 results for Peak D/T
		Reduce emissions by 80%.
6		**Model 3, with polishing stage added to SHOC**
		Use Round 1 sampling results for frequency and Round 2 results for Peak D/T
		Reduce emissions by 80%.
7		**SHOC only. Round 2 DT vs four times Round 2 DT vs four times Round 2 DT less 80% all on one figure**
		Reduce emissions by 80% with polishing stage.

Notes:

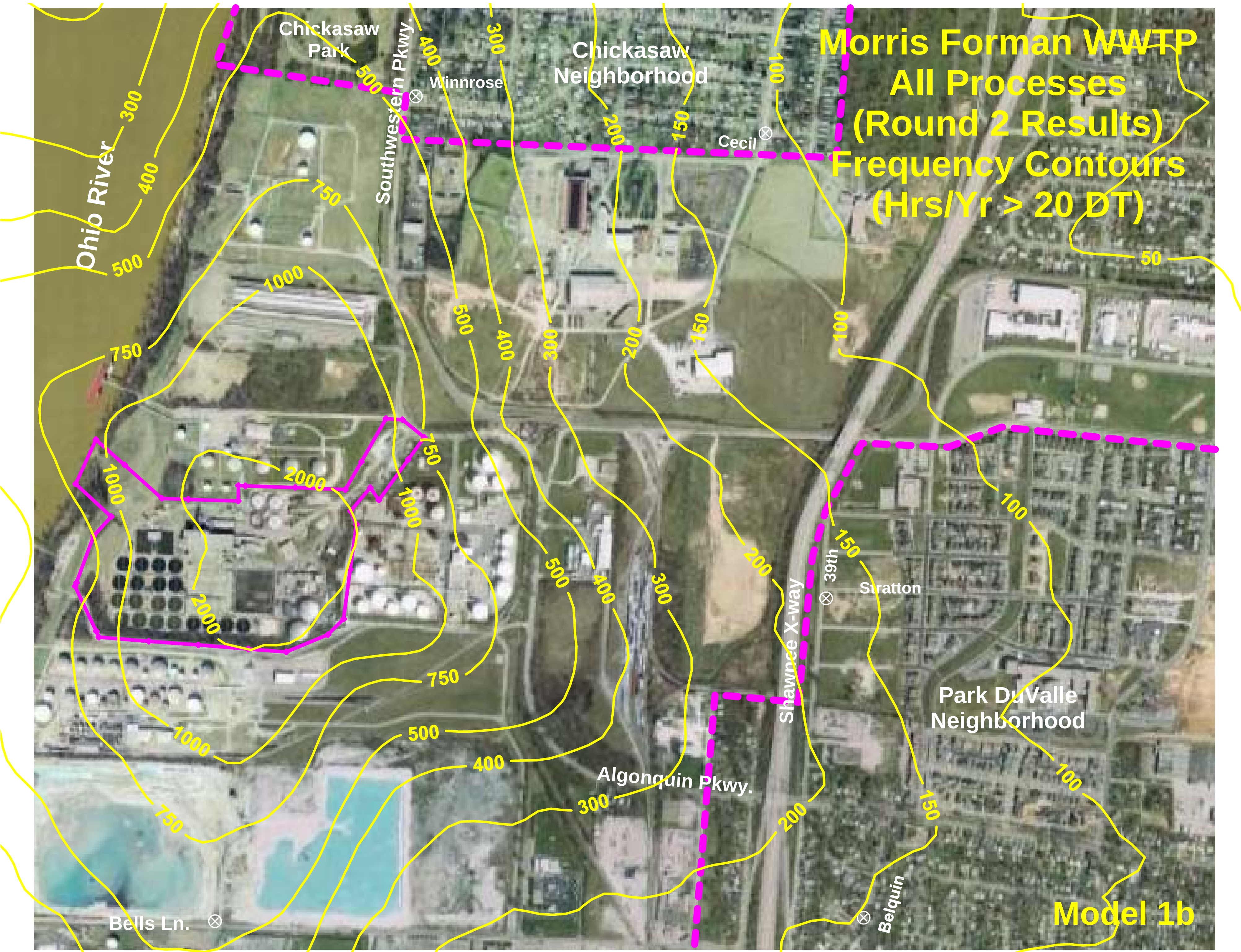
1	All models will use 20 DT as the threshold for frequency modeling
2	Master plan goals are to reduce frequencies to less than 100 occurances/year using 20 D/T and to reduce peak D/Ts by >50%


Morris Forman WWTP
All Processes
(Round 1 Results)
Peak DT Contours
Model 1a
Chickasaw Park
Chickasaw Neighborhood
Southwestern Pkwy.
Winnrose
Cecil
Ohio River
Stratton
39th
Shawnee X-way
Park DuValle Neighborhood
Algonquin Pkwy.
Belquin
Bells Ln.
50
75
100
150
200
300
500
1000

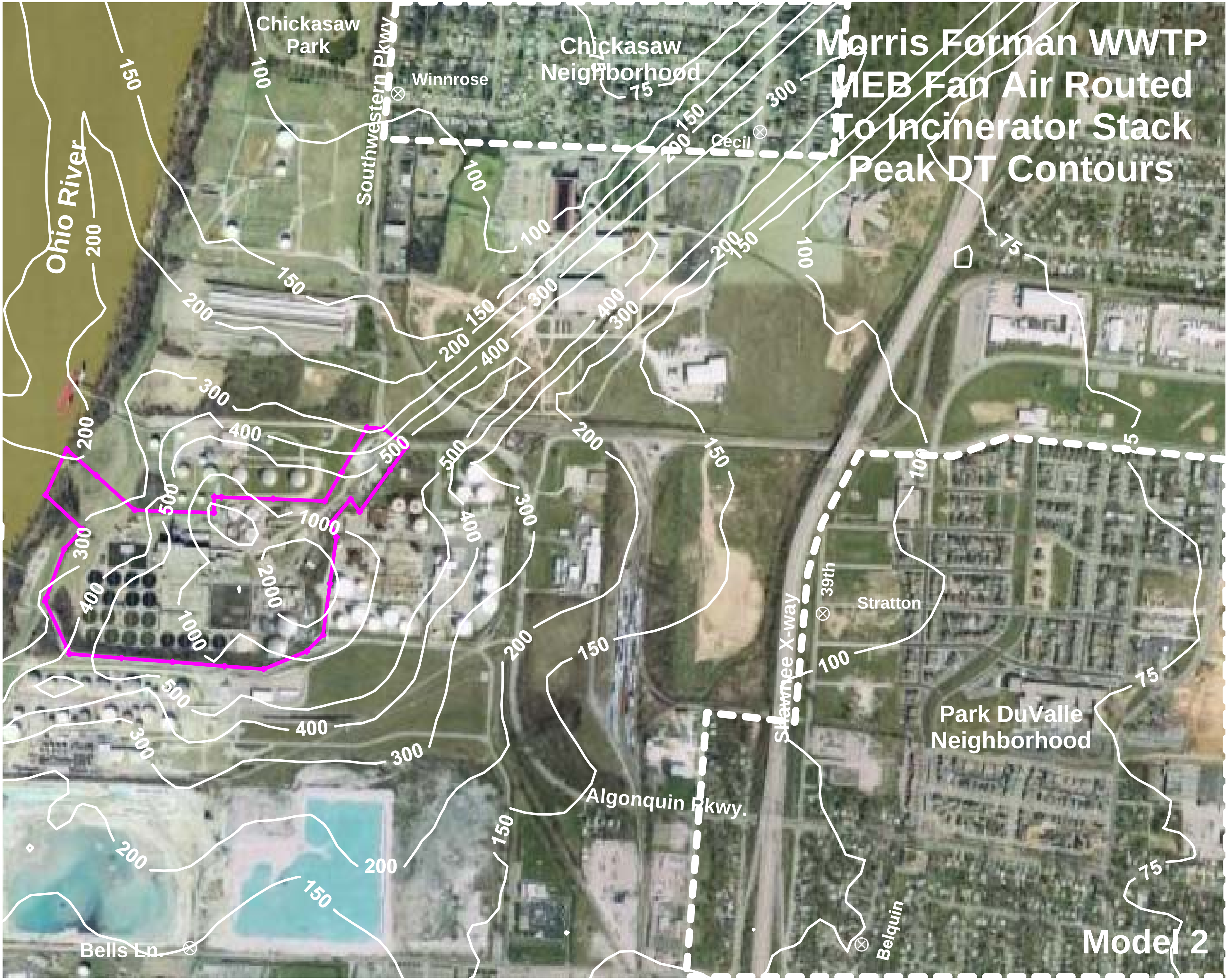


Morris Forman WWTP
All Processes
(Round 1 Results)
Frequency Contours
(Hrs/Yr > 20 DT)
Chickasaw Park
Chickasaw Neighborhood
Southwestern Pkwy.
Winnrose
Cecil
Ohio River
Shawnee X-way
39th
Stratton
Park DuValle Neighborhood
Algonquin Pkwy.
Bells Ln.
Belquin
50
100
200
300
400
500
750
1000
2000
FIGURE 4
Model 1a

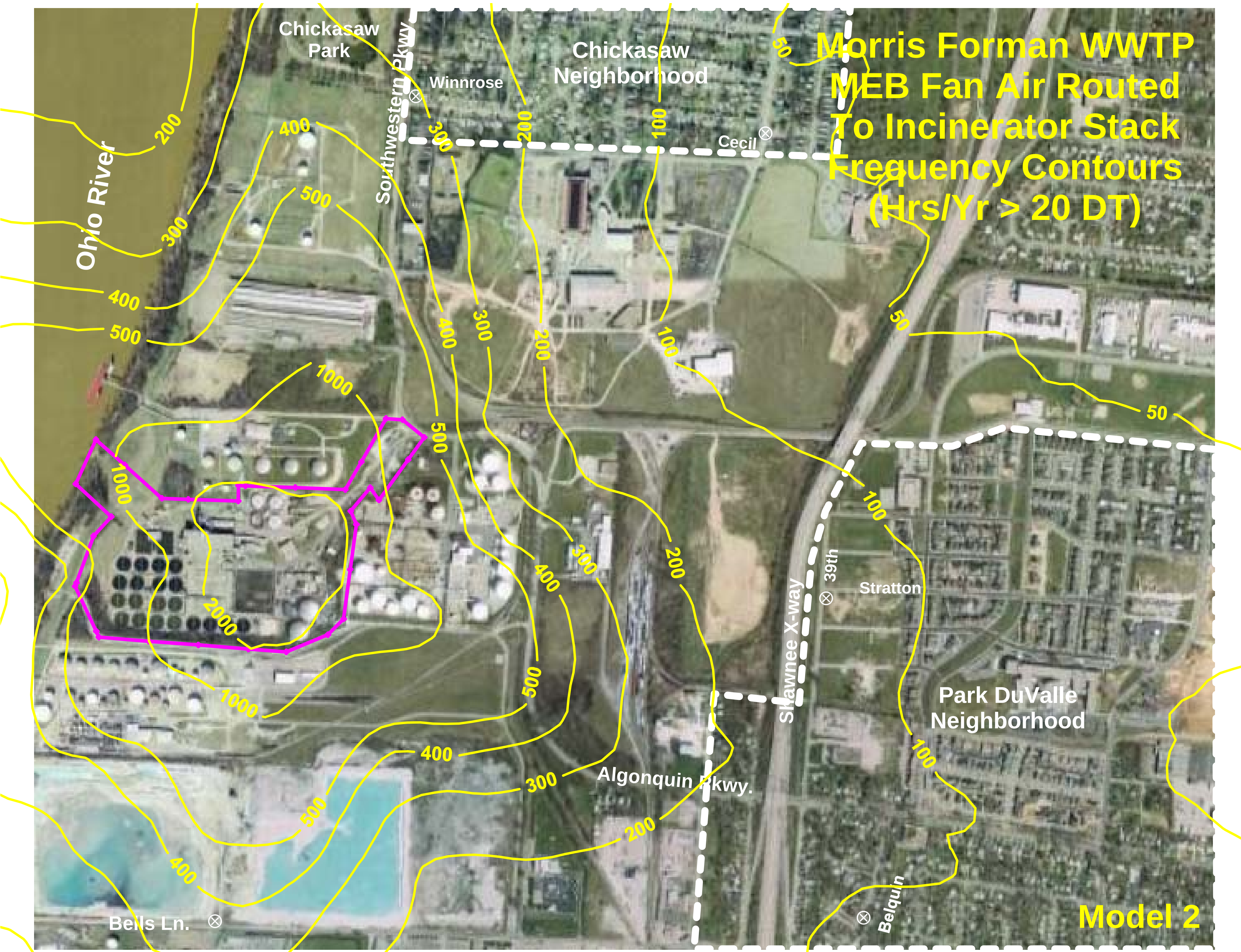

Morris Forman WWTP
All Processes
(Round 2 Results)
Peak DT Contours
Chickasaw Park
Chickasaw Neighborhood
Southwestern Pkwy.
Winnrose
Cecil
Ohio River
Stratton
39th
Shawnee X-way
Park DuValle Neighborhood
Algonquin Pkwy.
Bells Ln.
Belquin
FIGURE 5
Model 1b



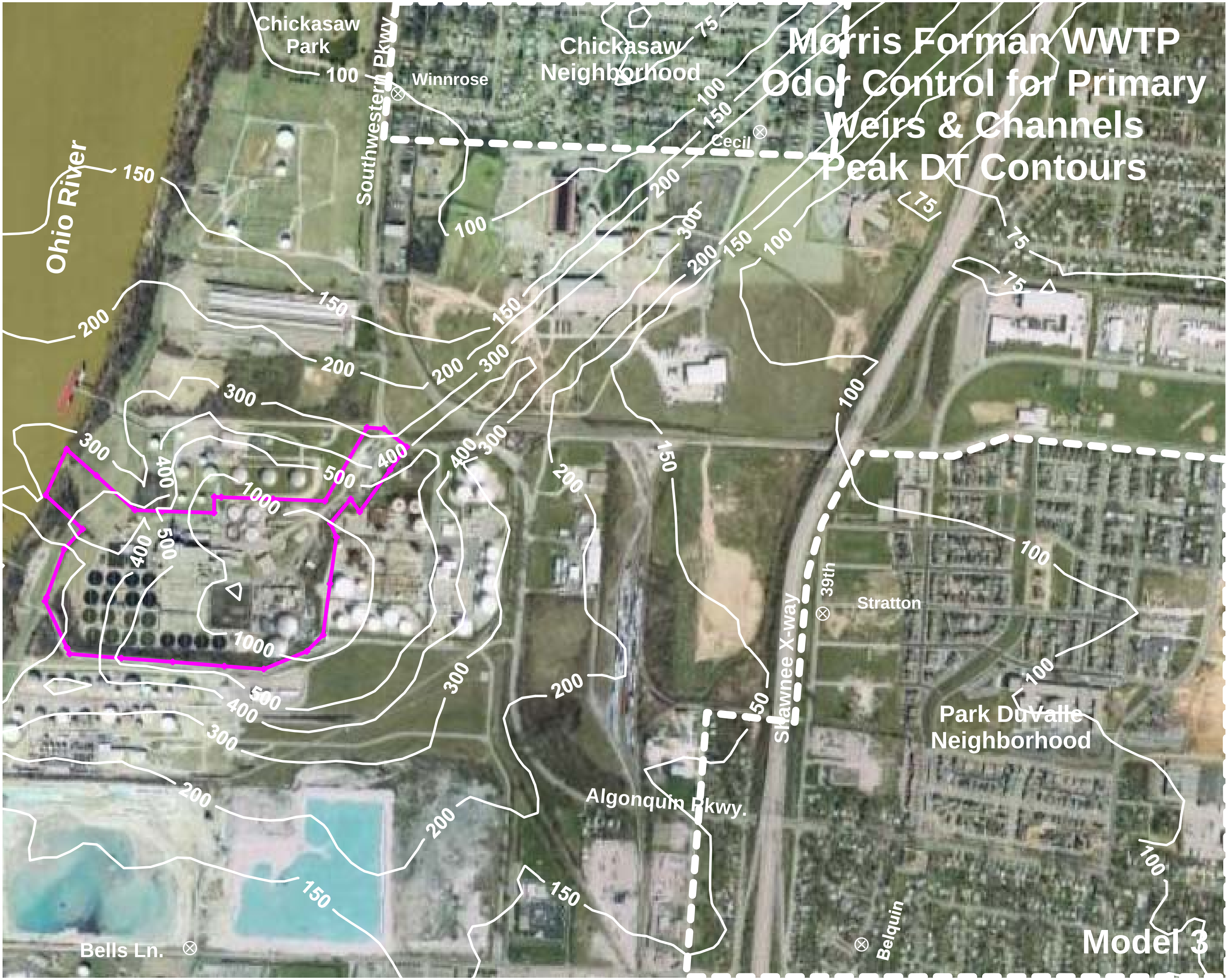
Morris Forman WWTP
All Processes
(Round 2 Results)
Frequency Contours
(Hrs/Yr > 20 DT)
Model 1b
Chickasaw Park
Chickasaw Neighborhood
Park DuValle Neighborhood
Ohio River
Southwestern Pkwy.
Shawnee X-way
Algonquin Pkwy.
Winnrose
Cecil
39th
Stratton
Belquin
Bells Ln.
2000
1000
750
500
400
300
200
150
100
50

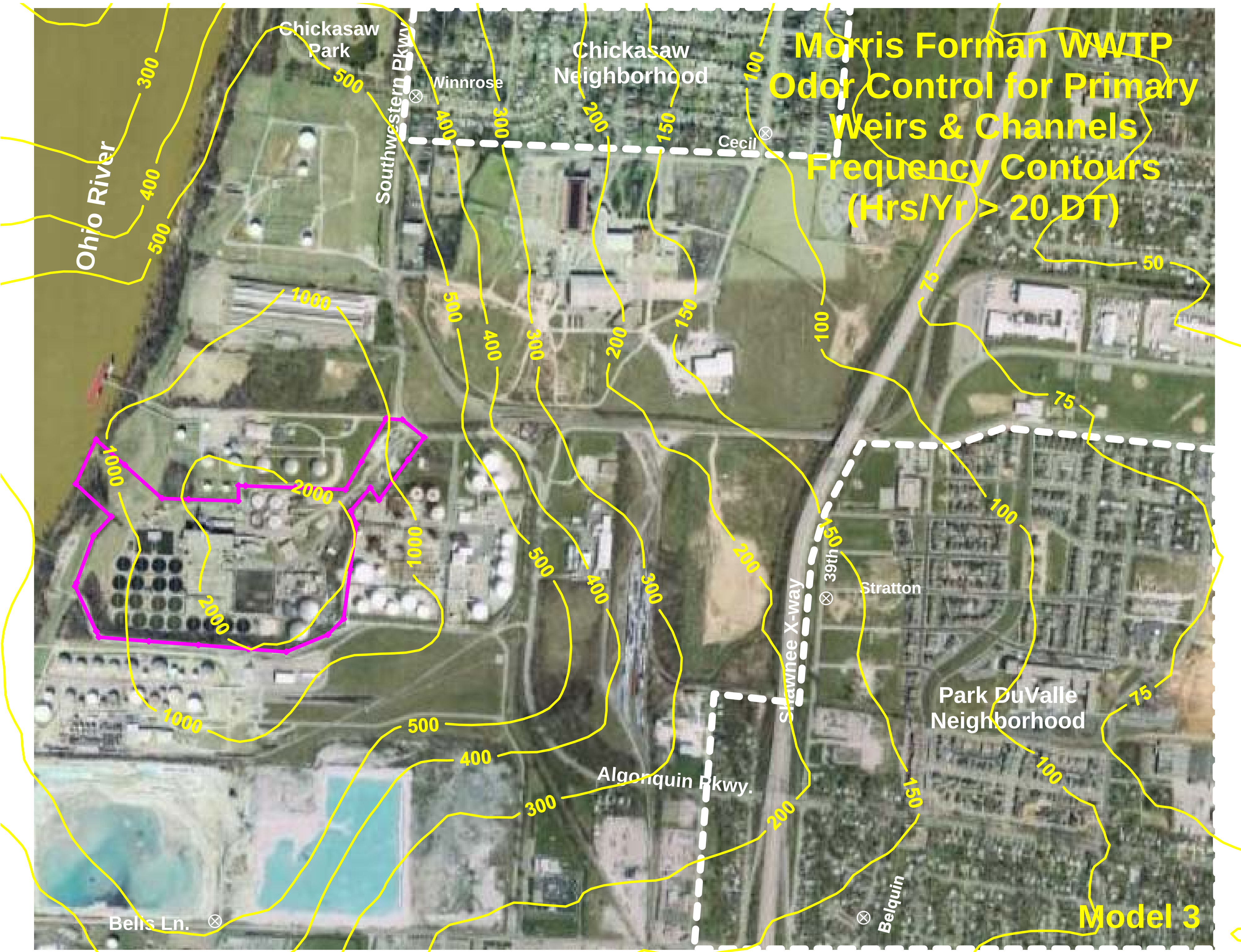


Morris Forman WWTP
MEB Fan Air Routed
To Incinerator Stack
Peak DT Contours
Chickasaw Park
Chickasaw Neighborhood
Southwestern Pkwy
Winnrose
Cecil
Ohio River
Stratton
39th
Shawnee X-way
Park DuValle Neighborhood
Algonquin Pkwy.
Bells Ln.
Belquin
Model 2

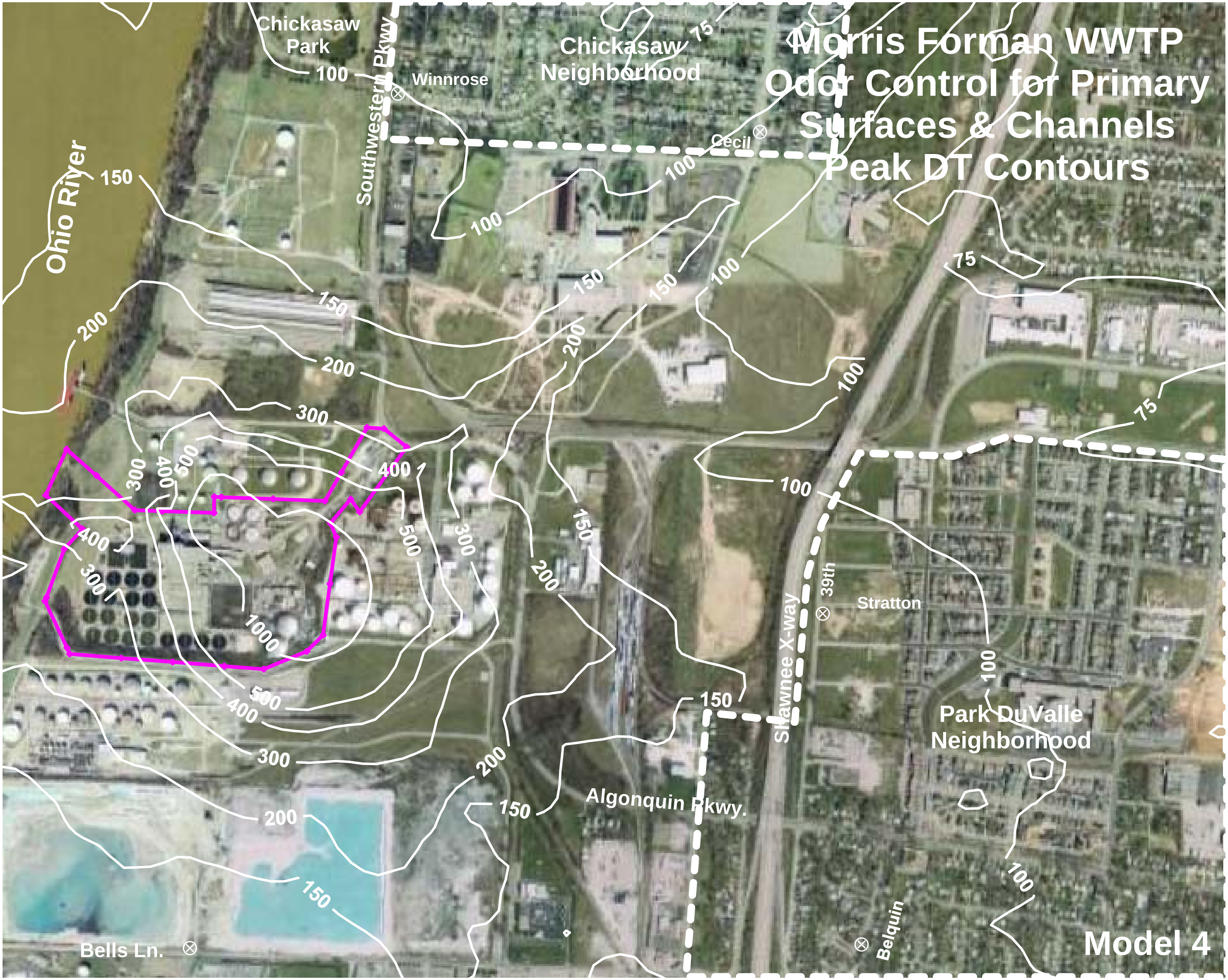


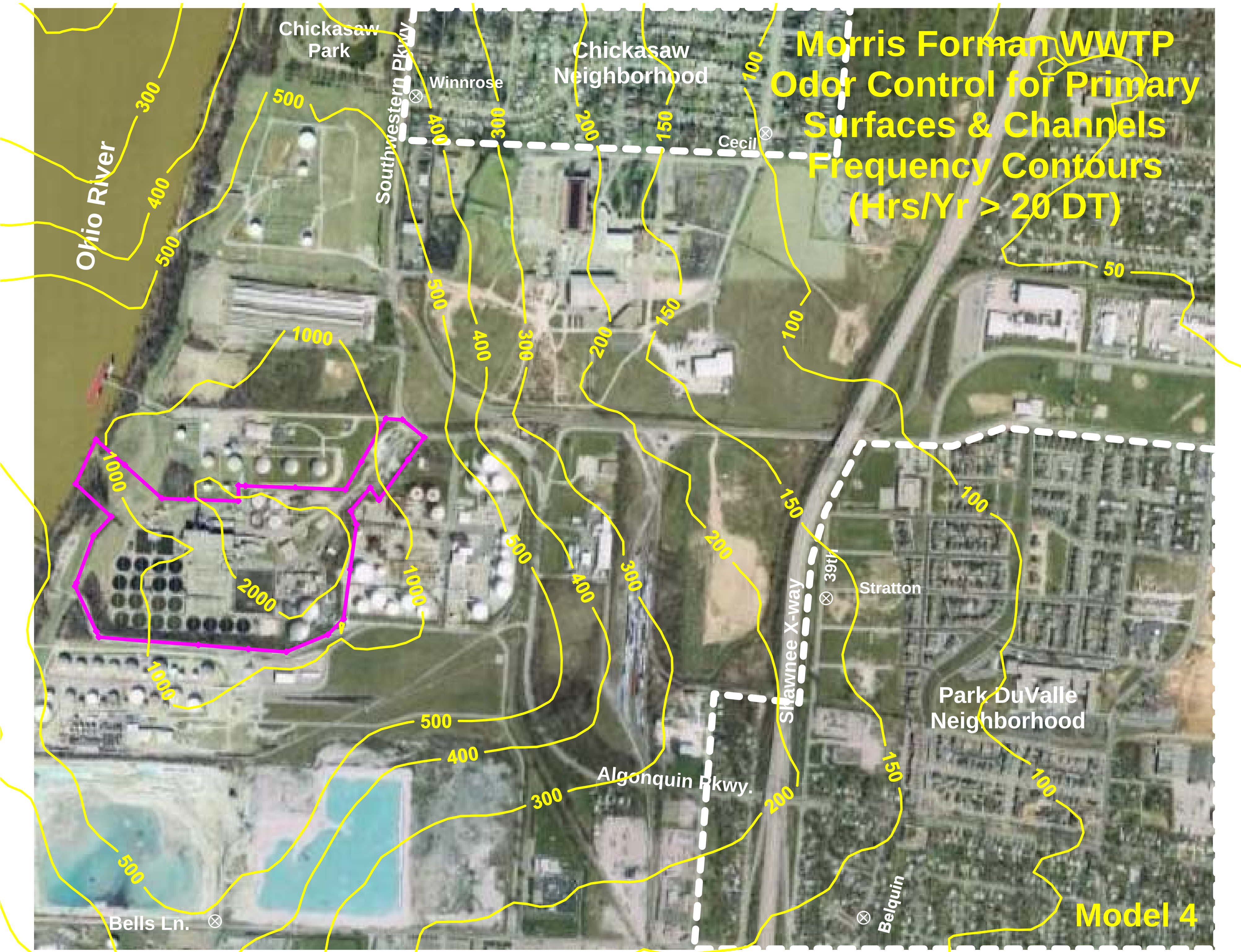
Morris Forman WWTP
MEB Fan Air Routed
To Incinerator Stack
Frequency Contours
(Hrs/Yr > 20 DT)
Model 2
Chickasaw Park
Chickasaw Neighborhood
Winnrose
Cecil
Southwestern Pkwy.
Ohio River
Stratton
39th
Shawnee X-way
Park DuValle Neighborhood
Algonquin Pkwy.
Bells Ln.
Belquin
50
100
200
300
400
500
1000
2000


Morris Forman WWTP
Odor Control for Primary
Weirs & Channels
Peak DT Contours
Model 3
Chickasaw Park
Chickasaw Neighborhood
Southwestern Pkwy
Winnrose
Cecil
Ohio River
Stratton
39th
Shawnee X-way
Park DuValle Neighborhood
Algonquin Pkwy.
Bells Ln.
Belquin
75
100
150
200
300
400
500
1000

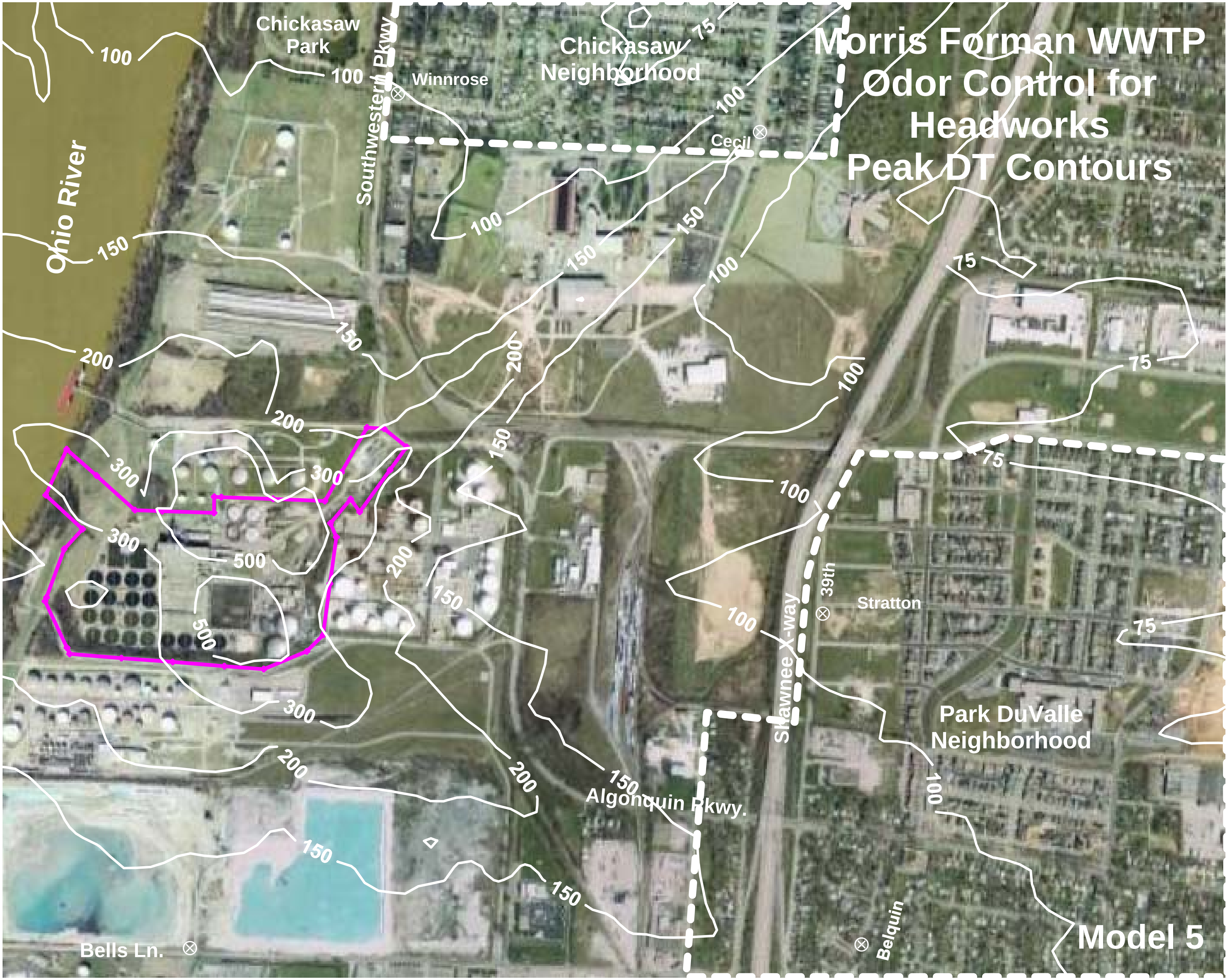


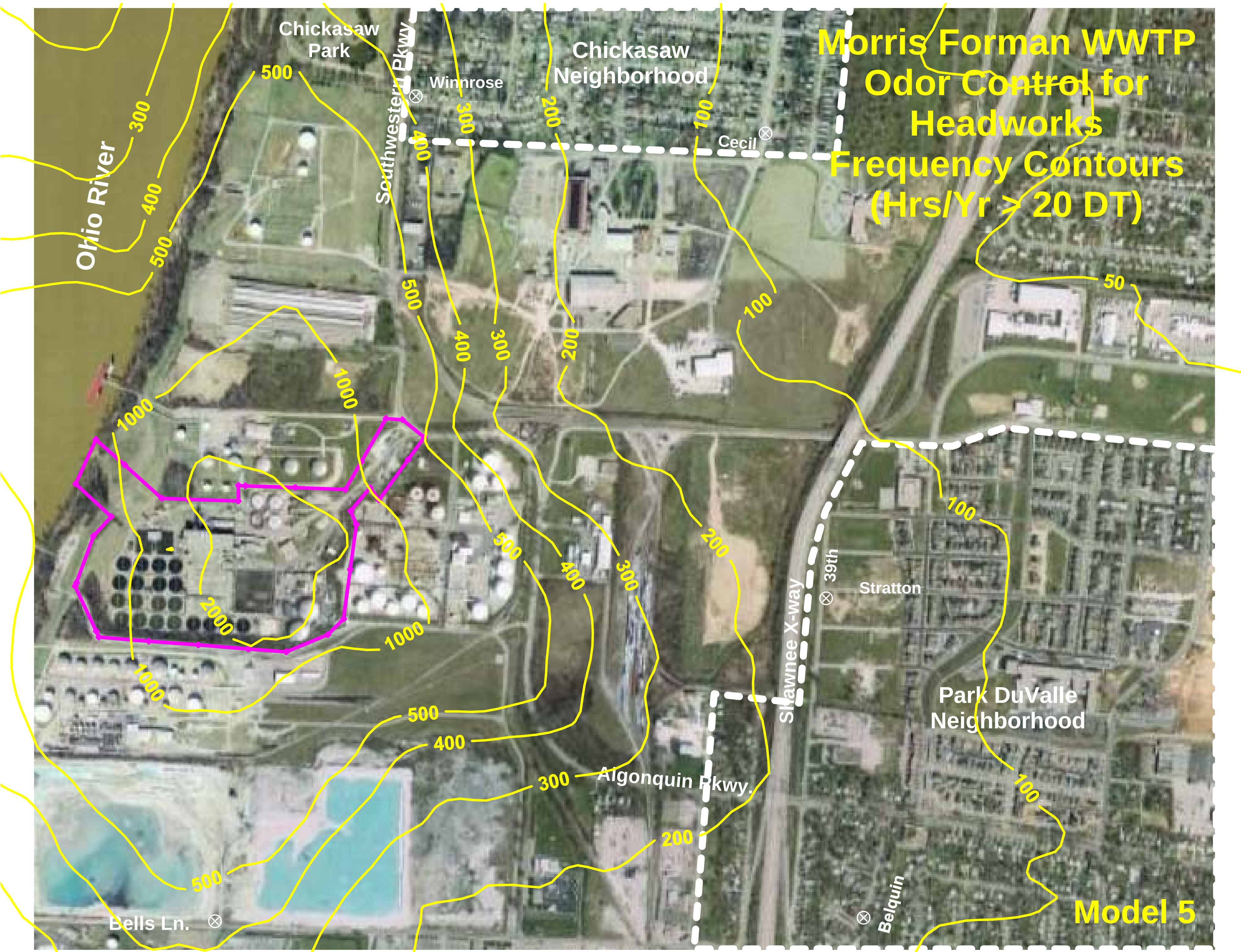
Morris Forman WWTP
Odor Control for Primary
Weirs & Channels
Frequency Contours
(Hrs/Yr > 20 DT)
Chickasaw Park
Chickasaw Neighborhood
Winnrose
Cecil
Southwestern Pkwy.
Ohio River
Stratton
39th
Shawnee X-way
Park DuValle Neighborhood
Algonquin Pkwy.
Bells Ln.
Belquin
Model 3
50
75
100
150
200
300
400
500
1000
2000


Morris Forman WWTP
Odor Control for Primary
Surfaces & Channels
Peak DT Contours
Chickasaw Park
Chickasaw Neighborhood
Winnrose
Southwestern Pkwy
Ohio River
Cecil
39th
Stratton
Shawnee X-way
Park DuValle Neighborhood
Algonquin Pkwy.
Belquin
Bells Ln.
Model 4
75
100
150
200
300
400
500
1000

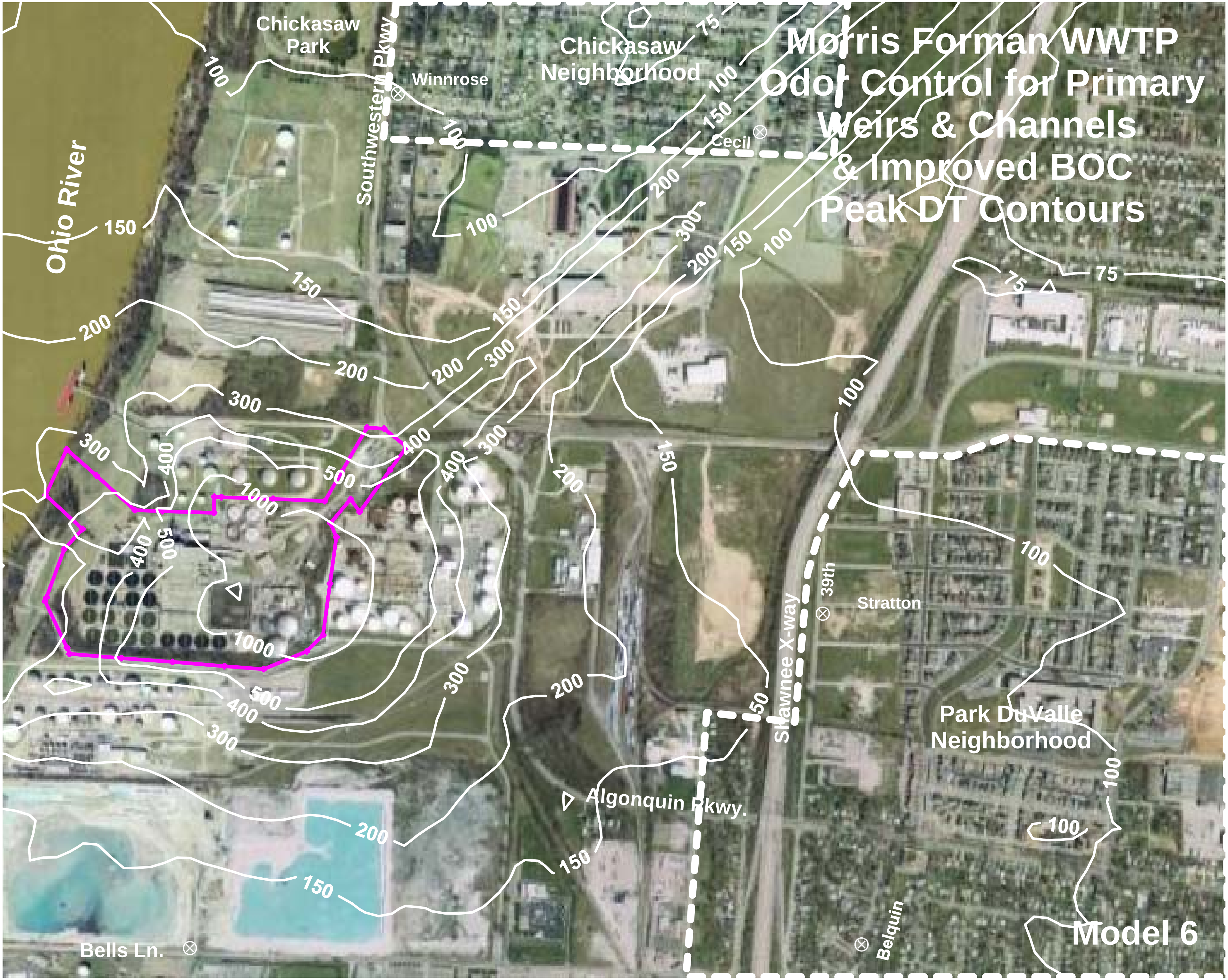


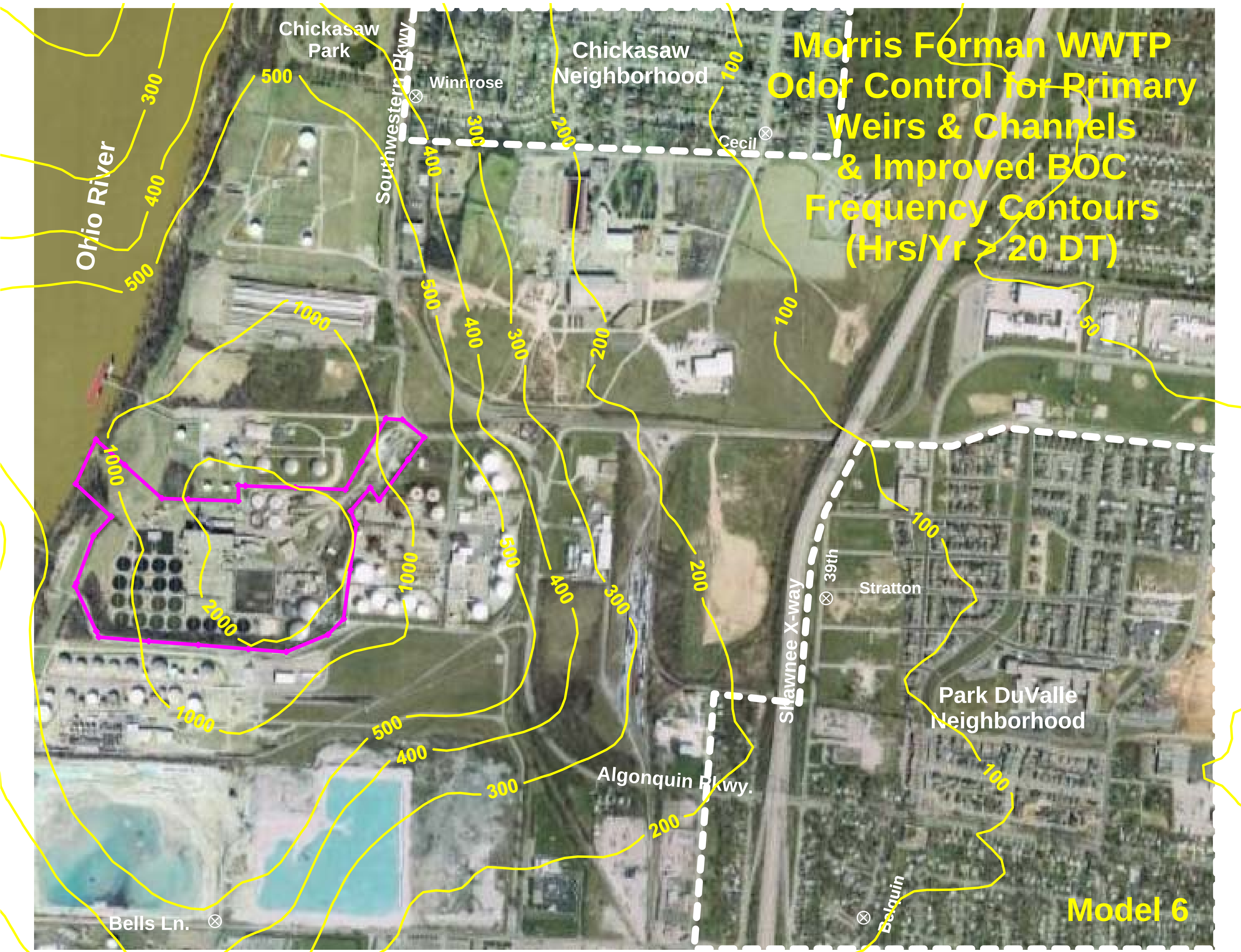
Morris Forman WWTP
Odor Control for Primary
Surfaces & Channels
Frequency Contours
(Hrs/Yr > 20 DT)
Chickasaw Park
Chickasaw Neighborhood
Winnrose
Cecil
Southwestern Pkwy
Ohio River
Stratton
39th
Shawnee X-way
Park DuValle Neighborhood
Algonquin Pkwy.
Bells Ln.
Belquin
Model 4
50
100
150
200
300
400
500
1000
2000

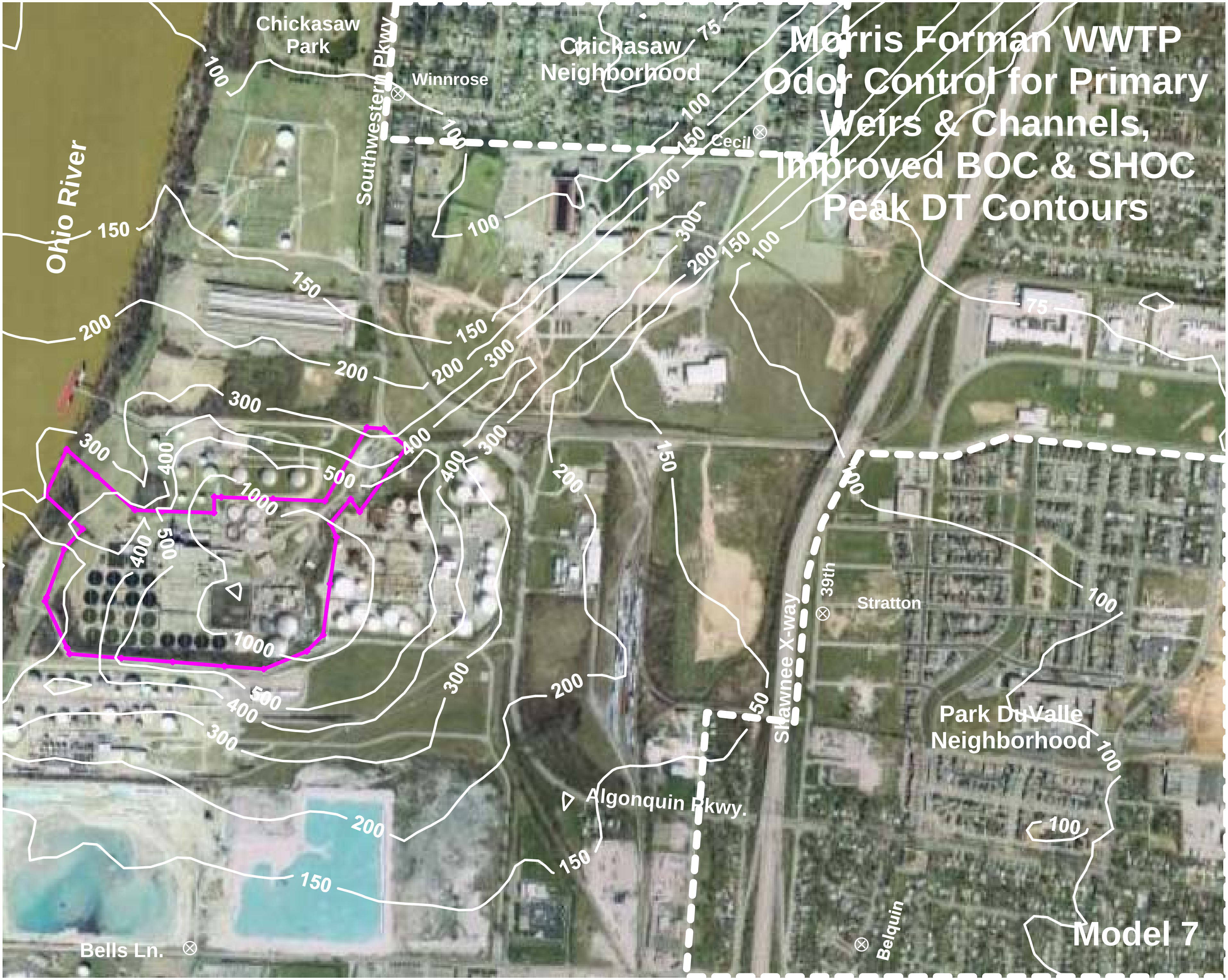

Morris Forman WWTP
Odor Control for
Headworks
Peak DT Contours
Model 5
Chickasaw Park
Chickasaw Neighborhood
Winnrose
Cecil
Southwestern Pkwy
Ohio River
Stratton
39th
Shawnee X-way
Park DuValle Neighborhood
Algonquin Pkwy.
Belquin
Bells Ln.
75
100
150
200
300
500



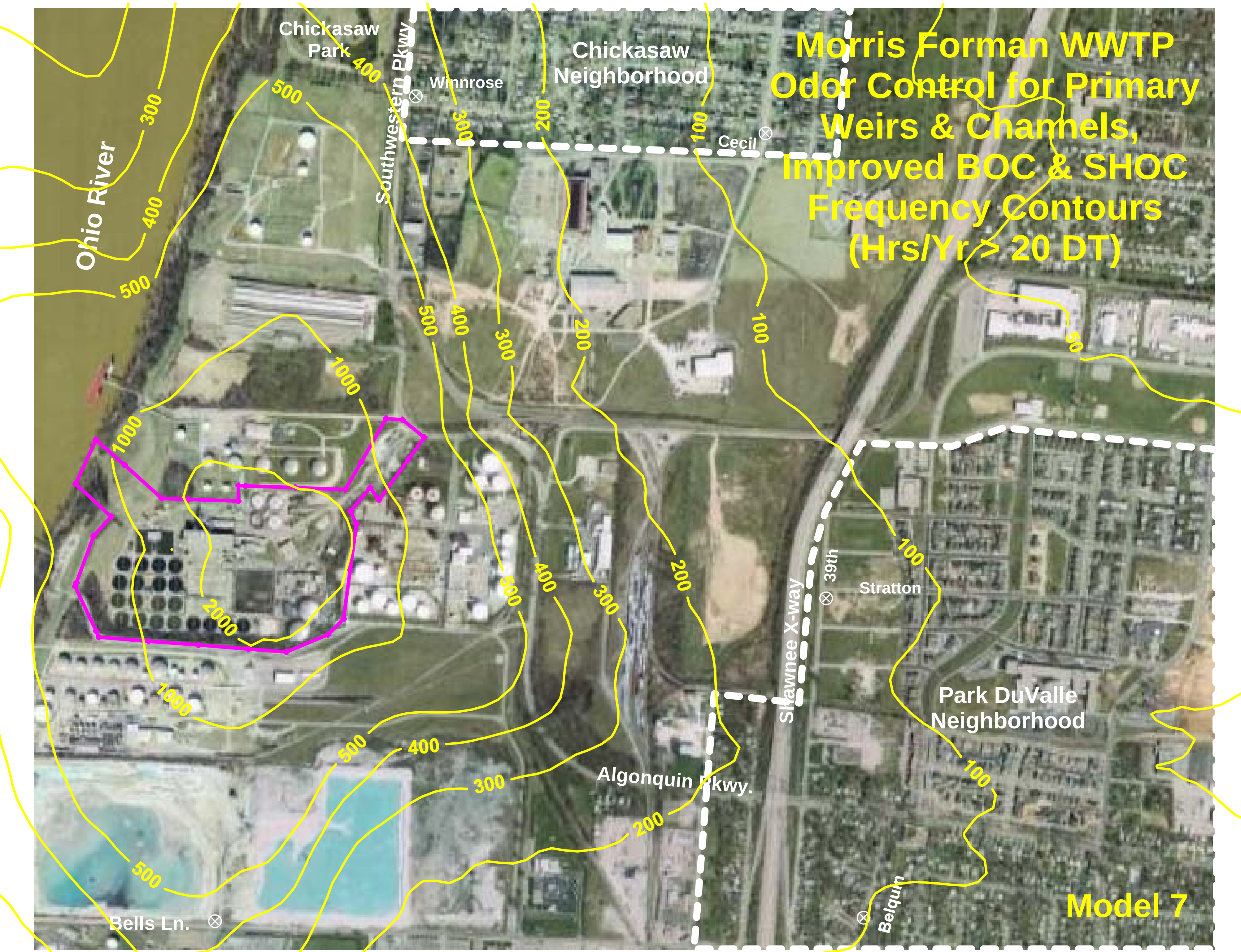
Morris Forman WWTP
Odor Control for
Headworks
Frequency Contours
(Hrs/Yr > 20 DT)
Model 5
Chickasaw Park
Chickasaw Neighborhood
Winnrose
Cecil
Southwestern Pkwy
Ohio River
Shawnee X-way
39th
Stratton
Park DuValle Neighborhood
Algonquin Pkwy.
Bells Ln.
Belquin
50
100
200
300
400
500
1000
2000


Morris Forman WWTP
Odor Control for Primary
Weirs & Channels
& Improved BOC
Peak DT Contours
Model 6
Chickasaw
Park
Chickasaw
Neighborhood
Winnrose
Cecil
Southwestern Pkwy
Ohio River
Stratton
39th
Shawnee X-way
Park DuValle
Neighborhood
Algonquin Pkwy.
Bells Ln.
Belquin
75
100
150
200
300
400
500
1000


Morris Forman WWTP
Odor Control for Primary
Weirs & Channels
& Improved BOC
Frequency Contours
(Hrs/Yr > 20 DT)
Model 6
Chickasaw Park
Chickasaw Neighborhood
Winnrose
Cecil
Southwestern Pkwy
Ohio River
Stratton
39th
Shawnee X-way
Park DuValle Neighborhood
Algonquin Pkwy.
Bells Ln.
Bolguin
2000
1000
500
400
300
200
100
50



Morris Forman WWTP
Odor Control for Primary
Weirs & Channels,
Improved BOC & SHOC
Peak DT Contours
Model 7
Chickasaw
Park
Chickasaw
Neighborhood
Winnrose
Cecil
Southwestern Pkwy
Ohio River
Shawnee X-way
39th
Stratton
Park DuValle
Neighborhood
Algonquin Pkwy.
Belquin
Bells Ln.
75
100
150
200
300
400
500
1000



Morris Forman WWTP
Odor Control for Primary
Weirs & Channels,
Improved BOC & SHOC
Frequency Contours
(Hrs/Yr > 20 DT)
Model 7
Chickasaw Park
Chickasaw Neighborhood
Southwestern Pkwy
Winnrose
Cecil
Ohio River
Stratton
39th
Shawnee X-way
Park DuValle Neighborhood
Algonquin Pkwy.
Bells Ln.
Belquin
2000
1000
500
400
300
200
100
50

Appendix J

Final Modeling Input Data

Morris Forman WWTP
Master Plan Update 2008
Modeling Scenarios
Revised 12/8/2008

Description

Model 1 - Existing Conditions

Model 1a - All significant plant odor sources with Round 1 sampling results representing average conditions
Model 1b - All significant plant odor sources with Round 2 sampling resultsrepresenting peak conditions

Model 2 - Existing Conditions with MEB Improvements

6th floor roof fans replaced with 2 propeller fans that discharge air to incinerator stack. Each propeller fan is 90,000 cfm to equal 3 roof fans.
Assume two dryer trains in service so both propeller fans in service (180,000 cfm) with Peak DT = 350.
Assume peak DT of MEB exhaust is 150 to match Round 1 test results.
No other changes made to any other system.
Round 1 results used to model frequencies and Round 2 results used to model Peak DTs.

Model 3 - Model 2 With Chemical Addition to Headworks

6th floor roof fans replaced with 2 propeller fans that discharge air to incinerator stack. Each propeller fan is 90,000 cfm to equal 3 roof fans.
Assume two dryer trains in service so both propeller fans in service (180,000 cfm) with Peak DT = 350.
Assume peak DT of MEB exhaust is 150 to match Round 1 test results.
Chemical addition to headworks which will reduce emissions from headworks by 50% and primaries by 75%.
Round 1 results used to model frequencies and Round 2 results used to model Peak DTs.

Model 4 - Model 2 with Headworks Covers (treatment in BRT) and Primary Weir and Channel Covers (new air treatr

6th floor roof fans operated in automatic mode. 3 fans will run for each dryer train in service
Assume two dryer trains in service so six 6th floor fans in service with Peak DT = 350.
New headworks covers, air collected and treated in bioroughing towers. Strobic air fans on new headworks building and on dumpster room
New covers for primary clarifier weirs and new 10,000 cfm odor control system that provides 90% reduction in odors.
No Chemical addition to headworks.
Round 1 results used to model frequencies and Round 2 results used to model Peak DTs.

Notes:
1 - All models will use 20 DT as the threshold for frequency modeling
2 - Master plan goals are to reduce frequencies to less than 100 occurances/year using 20 D/T and to reduce peak D/Ts by >50%

Morris Forman WWTP
Rectangular Area Sources

MODEL 1a - 2008 Existing Conditions - Round 1 Sampling Results
12/8/2008

ID #	Description	X Coord (ft)	X Coord (m)	Y Coord (ft)	Y Coord (m)	Base Elev (ft)	Air Flow (cfm)	Air Flow (m^3/s)	D/T (g/m^3)	OER (g/s)	OER (lb/hr)	OER/ft^2	Release Height (ft)	X Length (ft)	Y Length (ft)	Area (sf)	D/T Source
	Influent Junction Box	1,693	516	466	142	0.0	47	0.02	1,700	38	300.9	0.80	3	15	25	375	7/22-23/08 Sampling
	Influent Channel to New HW	1,706	520	466	142	0.0	63	0.03	1,700	51	401.2	0.80	3	50	10	500	7/22-23/08 Sampling
	Aerated Influent Box	1,752	534	420	128	0.0	506	0.24	1,700	406	3,222.0	3.85	3	25.33	33	836	7/22-23/08 Sampling
	Screen & Grit Dumpsters	1,723	525	400	122	0.0	66	0.03	1,700	53	420.3	1.59	6	12	22	264	7/22-23/08 Sampling
	Grit Tank #1	1,755	535	315	96	0.0	67	0.03	1,100	35	274.6	0.52	2	23	23	529	7/22-23/08 Sampling
	Grit Tank #2	1,729	527	328	100	0.0	67	0.03	1,100	35	274.6	0.52	2	23	23	529	7/22-23/08 Sampling
	Grit Tank #3	1,726	526	302	92	0.0	67	0.03	1,100	35	274.6	0.52	2	23	23	529	7/22-23/08 Sampling
	Grit Tank #4	1,749	533	292	89	0.0	67	0.03	1,100	35	274.6	0.52	2	23	23	529	7/22-23/08 Sampling
	New Grit Channel 1	1,755	535	361	110	0.0	18	0.01	1,100	9	74.8	0.52	2	24	6	144	7/22-23/08 Sampling
	New Grit Channel 2	1,716	523	282	86	0.0	29	0.01	1,100	15	120.4	0.52	2	4	58	232	7/22-23/08 Sampling
	New Grit Channel 3	1,716	523	341	104	0.0	23	0.01	1,100	12	93.4	0.52	2	4	45	180	7/22-23/08 Sampling
	New Grit Channel 4	1,775	541	282	86	0.0	40	0.02	1,100	21	166.1	0.52	2	4	80	320	7/22-23/08 Sampling
	New Grit Channel 5	1,736	529	282	86	0.0	84	0.04	1,100	43	344.7	0.52	2	8	83	664	7/22-23/08 Sampling
	Old Grit Chambers	1,621	494	331	101	0.0	-	-	1,100	-	-	0.00	2	56	55	3,080	not in use
	Old Grit Effluent Channel	1,650	503	289	88	0.0	-	-	1,100	-	-	0.00	2	14	30	420	covered
	Combined Grit Effluent Channel	1,499	457	285	87	0.0	-	-	8,000	-	-	0.00	2	280	10	2,800	covered
	Primary Influent Channel	1,463	446	148	45	0.0	-	-	8,000	-	-	0.00	2	6.5	275	1,788	covered
	Primary Clarifiers Surface	1,200	366	161	49	0.0	9,226	4.35	2,485	10,820	85,874.2	1.18	2	260	280	72,800	7/22-23/08 Sampling
	Primary Clarifier Weirs (total of 16)	1,217	371	436	133	0.0	31	0.01	9,750	142	1,125.3	2.92	2	77	5	385	7/22-23/08 Sampling
	Primary Effluent Channel	1,188	362	164	50	0.0	237	0.11	9,300	1,040	8,255.7	3.25	2	9	282	2,538	7/22-23/08 Sampling
	Unox Influent Channel	1,178	359	164	50	0.0	237	0.11	4,300	481	3,817.2	1.59	2	9	267	2,403	7/22-23/08 Sampling
	Unox Effluent Channel A	879	268	295	90	0.0	587	0.28	370	103	813.5	0.54	2	10	150	1,500	5/14/02 sampling
	Unox Effluent Channel B	873	266	151	46	0.0	490	0.23	370	86	679.1	0.54	2	10	125	1,250	5/14/02 sampling
	Secondary Clarifier Influent Channel A	492	150	430	131	0.0	1,539	0.73	370	269	2,132.9	0.54	2	393	10	3,930	5/14/02 sampling
	Secondary Clarifier Influent Channel B	466	142	187	57	0.0	1,590	0.75	370	278	2,203.5	0.54	2	406	10	4,060	5/14/02 sampling
	Secondary Clarifier Influent Channel C	980	299	15	5	0.0	1,567	0.74	370	274	2,171.7	0.54	2	400	10	4,000	5/14/02 sampling

Flux Chamber air flow rate = **0.126** **cfm/f^2**
Peak Factor: Use 3 minute peaks, -0.5 power law factor = **4.47**

Morris Forman WWTP
Point Sources

MODEL 1a - 2008 Existing Conditions - Round 1 Sampling Results

ID #	Description	X Coord (ft)	X Coord (m)	Y Coord (ft)	Y Coord (m)	Base Elev (ft)	Air Flow (cfm)	Air Flow (m^3/s)	D/T (g/m^3)	OER (g/s)	OER (lb/hr)	Stack Height (ft)	Diameter (ft)	Temp (F)	D/T Source	
	New Screen Room Exhaust	1,763	537	372	113	43.0	4,650	2.19	470	1,031	8,186	3	3.00	75	7/22-23/08 Sampling	
	New Grit Classifier Room Exhaust	1,750	533	404	123	43.0	4,850	2.29	1,700	3,891	30,883	3	3.00	75	7/22-23/08 Sampling	
	Old HW Bldg Vent 1	1,632	497	407	124	24.0	1,000	0.47	4,200	1,982	15,732	3	2.92	75	7/22-23/08 Sampling	
	Old HW Bldg Vent 2	1,651	503	407	124	24.0	1,000	0.47	4,200	1,982	15,732	3	2.92	75	7/22-23/08 Sampling	
	Old HW Bldg Vent 3	1,671	509	404	123	24.0	1,000	0.47	4,200	1,982	15,732	3	2.92	75	7/22-23/08 Sampling	
	Old HW Bldg Vent 4	1,693	516	404	123	24.0	1,000	0.47	4,200	1,982	15,732	3	2.92	75	7/22-23/08 Sampling	
	BOC Stack 1	1,801	549	30	9	20.5	10,000	4.72	5,100	24,069	191,026	18	3.50	75	7/22-23/08 Sampling	
	BOC Stack 2	1,818	554	46	14	20.5	10,000	4.72	5,100	24,069	191,026	18	3.50	75	7/22-23/08 Sampling	
	Unox Tank A Vent	957	292	397	121	4.0	50	0.02	250	6	47	10	0.33	75	assumed	
	Unox Tank B Vent	948	289	227	69	4.0	50	0.02	250	6	47	10	0.33	75	assumed	
	Unox Tank C Vent	1,390	424	65	20	4.0	50	0.02	250	6	47	10	0.33	75	assumed	
	Fume Incinerator (PTO) Stack	1,191	363	860	262	42.0	-	-	390	-	-	25.5	2.50	250	not in use	
	Fume Incinerator (New) Stack	1,211	369	840	256	42.0	-	-	800	-	-	25	2.50	250	not in use	
	SHOC 1		502		293	42.0	4,600	2.17	4,100	8,901	70,642	43	3.00	75	7/22-23/08 Sampling	
	SHOC 2		496		293	42.0	4,600	2.17	4,100	8,901	70,642	43	3.00	75	7/22-23/08 Sampling	
	RTO 1 Stack	956	291	817	249	41.0	15,195	7.17	335	2,402	19,066	30	2.00	250	2/17/04 sampling	
	RTO 2 Stack	975	297	817	249	41.0	15,195	7.17	335	2,402	19,066	30	2.00	250	2/17/04 sampling	
	RTO 3 Stack	993	303	817	249	41.0	-	-	335	-	-	30	2.00	250	not in use	
	RTO 4 Stack	1,012	308	817	249	41.0	-	-	335	-	-	30	2.00	250	not in use	
	DAFT Room Exhaust	961	293	541	165	22.0	39,400	18.59	430	7,996	63,458	12	4.50	75	7/22-23/08 Sampling	
	MEB Exhaust		265		154	0.0	374,000	176.51	150	26,476	210,129	65	17.00	75	7/22-23/08 Sampling	15' x 15'
	MEB Roof Exhaust Fan 1	928	283	733	223	0.0	30,000	14.16	710	10,052	79,782	76	7.00	75	7/22-23/08 Sampling	6' x 6.5'
	MEB Roof Exhaust Fan 2	953	290	733	223	0.0	30,000	14.16	710	10,052	79,782	76	7.00	75	7/22-23/08 Sampling	6' x 6.5'
	MEB Roof Exhaust Fan 3	978	298	733	223	0.0	30,000	14.16	710	10,052	79,782	76	7.00	75	7/22-23/08 Sampling	6' x 6.5'
	MEB Roof Exhaust Fan 4	1,003	306	733	223	0.0	30,000	14.16	710	10,052	79,782	76	7.00	75	7/22-23/08 Sampling	6' x 6.5'
	MEB Roof Exhaust Fan 5	928	283	698	213	0.0	30,000	14.16	710	10,052	79,782	76	7.00	75	7/22-23/08 Sampling	6' x 6.5'
	MEB Roof Exhaust Fan 6	953	290	698	213	0.0	30,000	14.16	710	10,052	79,782	76	7.00	75	7/22-23/08 Sampling	6' x 6.5'
	MEB Roof Exhaust Fan 7	978	298	698	213	0.0	30,000	14.16	710	10,052	79,782	76	7.00	75	7/22-23/08 Sampling	6' x 6.5'
	MEB Roof Exhaust Fan 8	1,003	306	698	213	0.0	30,000	14.16	710	10,052	79,782	76	7.00	75	7/22-23/08 Sampling	6' x 6.5'
	MEB Roof Exhaust Fan 9	928	283	663	202	0.0	30,000	14.16	710	10,052	79,782	76	7.00	75	7/22-23/08 Sampling	6' x 6.5'
	MEB Roof Exhaust Fan 10	953	290	663	202	0.0	30,000	14.16	710	10,052	79,782	76	7.00	75	7/22-23/08 Sampling	6' x 6.5'
	MEB Roof Exhaust Fan 11	978	298	663	202	0.0	30,000	14.16	710	10,052	79,782	76	7.00	75	7/22-23/08 Sampling	6' x 6.5'
	MEB Roof Exhaust Fan 12	1,003	306	663	202	0.0	30,000	14.16	710	10,052	79,782	76	7.00	75	7/22-23/08 Sampling	6' x 6.5'
	Pellet Silo Baghouse Exhaust		254		179	0.0	500	0.24	530	125	993	10	0.50	75	9/16/03 sampling	
	Digester 1 NW		416		276	42.0	170	0.080	160,000	12,837	101,881	25	9.50	75	7/22-23/08 Sampling	
	Digester 2 NE		456		276	42.0	170	0.080	160,000	12,837	101,881	25	9.50	75	7/22-23/08 Sampling	
	Digester 3 SW		416		236	42.0	170	0.080	160,000	12,837	101,881	25	9.50	75	7/22-23/08 Sampling	
	Digester 4 SE		456		236	42.0	170	0.080	160,000	12,837	101,881	25	9.50	75	7/22-23/08 Sampling	
	Truck Unloading MH		640		335	19.0	-	-	760,000	-	-	1	2.00	75	Bruce 10/10/06?	

Morris Forman WWTP
Rectangular Area Sources

MODEL 1b - 2008 Existing Conditions - Round 2 Sampling Results

12/8/2008

ID #	Description	X Coord (ft)	X Coord (m)	Y Coord (ft)	Y Coord (m)	Base Elev (ft)	Air Flow (cfm)	Air Flow (m^3/s)	D/T (g/m^3)	OER (g/s)	OER (lb/hr)	OER/ft^2	Release Height (ft)	X Length (ft)	Y Length (ft)	Area (sf)	D/T Source
	Influent Junction Box	1,693	516	466	142	0.0	47	0.02	76,000	1,695	13,450.5	35.87	3	15	25	375	8/19-20/08 Sampling
	Influent Channel to New HW	1,706	520	466	142	0.0	63	0.03	76,000	2,260	17,934.0	35.87	3	50	10	500	8/19-20/08 Sampling
	Aerated Influent Box	1,752	534	420	128	0.0	506	0.24	76,000	18,149	144,041.4	172.32	3	25.33	33	836	8/19-20/08 Sampling
	Screen & Grit Dumpsters	1,723	525	400	122	0.0	66	0.03	4,350	135	1,075.4	4.07	6	12	22	264	8/19-20/08 Sampling
	Grit Tank #1	1,755	535	315	96	0.0	67	0.03	10,000	315	2,496.6	4.72	2	23	23	529	8/19-20/08 Sampling
	Grit Tank #2	1,729	527	328	100	0.0	67	0.03	10,000	315	2,496.6	4.72	2	23	23	529	8/19-20/08 Sampling
	Grit Tank #3	1,726	526	302	92	0.0	67	0.03	10,000	315	2,496.6	4.72	2	23	23	529	8/19-20/08 Sampling
	Grit Tank #4	1,749	533	292	89	0.0	67	0.03	10,000	315	2,496.6	4.72	2	23	23	529	8/19-20/08 Sampling
	New Grit Channel 1	1,755	535	361	110	0.0	18	0.01	10,000	86	679.6	4.72	2	24	6	144	8/19-20/08 Sampling
	New Grit Channel 2	1,716	523	282	86	0.0	29	0.01	10,000	138	1,094.9	4.72	2	4	58	232	8/19-20/08 Sampling
	New Grit Channel 3	1,716	523	341	104	0.0	23	0.01	10,000	107	849.5	4.72	2	4	45	180	8/19-20/08 Sampling
	New Grit Channel 4	1,775	541	282	86	0.0	40	0.02	10,000	190	1,510.2	4.72	2	4	80	320	8/19-20/08 Sampling
	New Grit Channel 5	1,736	529	282	86	0.0	84	0.04	10,000	395	3,133.7	4.72	2	8	83	664	8/19-20/08 Sampling
	Old Grit Chambers	1,621	494	331	101	0.0	-	-	1,100	-	-	0.00	2	56	55	3,080	not in use
	Old Grit Effluent Channel	1,650	503	289	88	0.0	-	-	1,100	-	-	0.00	2	14	30	420	covered
	Combined Grit Effluent Channel	1,499	457	285	87	0.0	-	-	8,000	-	-	0.00	2	280	10	2,800	covered
	Primary Influent Channel	1,463	446	148	45	0.0	-	-	8,000	-	-	0.00	2	6.5	275	1,788	covered
	Primary Clarifiers Surface	1,200	366	161	49	0.0	9,226	4.35	6,316	27,501	218,262.3	3.00	2	260	280	72,800	8/19-20/08 Sampling
	Primary Clarifier Weirs (total of 16)	1,217	371	436	133	0.0	31	0.01	59,500	865	6,867.0	17.84	2	77	5	385	8/19-20/08 Sampling
	Primary Effluent Channel	1,188	362	164	50	0.0	237	0.11	13,000	1,454	11,540.2	4.55	2	9	282	2,538	8/19-20/08 Sampling
	Unox Influent Channel	1,178	359	164	50	0.0	237	0.11	8,900	995	7,900.6	3.29	2	9	267	2,403	8/19-20/08 Sampling
	Unox Effluent Channel A	879	268	295	90	0.0	587	0.28	370	103	813.5	0.54	2	10	150	1,500	5/14/02 sampling
	Unox Effluent Channel B	873	266	151	46	0.0	490	0.23	370	86	679.1	0.54	2	10	125	1,250	5/14/02 sampling
	Secondary Clarifier Influent Channel A	492	150	430	131	0.0	1,539	0.73	370	269	2,132.9	0.54	2	393	10	3,930	5/14/02 sampling
	Secondary Clarifier Influent Channel B	466	142	187	57	0.0	1,590	0.75	370	278	2,203.5	0.54	2	406	10	4,060	5/14/02 sampling
	Secondary Clarifier Influent Channel C	980	299	15	5	0.0	1,567	0.74	370	274	2,171.7	0.54	2	400	10	4,000	5/14/02 sampling

Flux Chamber air flow rate = **0.126** **cfm/f^2**
Peak Factor: Use 3 minute peaks, -0.5 power law factor = **4.47**

Morris Forman WWTP
Point Sources

MODEL 1b - 2008 Existing Conditions - Round 2 Sampling Results

ID #	Description	X Coord (ft)	X Coord (m)	Y Coord (ft)	Y Coord (m)	Base Elev (ft)	Air Flow (cfm)	Air Flow (m^3/s)	D/T (g/m^3)	OER (g/s)	OER (lb/hr)	Stack Height (ft)	Diameter (ft)	Temp (F)	D/T Source	
	New Screen Room Exhaust	1,763	537	372	113	43.0	4,650	2.19	1,600	3,511	27,867	3	3.00	75	8/19-20/08 Sampling	
	New Grit Classifier Room Exhaust	1,750	533	404	123	43.0	4,850	2.29	4,700	10,758	85,381	3	3.00	75	8/19-20/08 Sampling	
	Old HW Bldg Vent 1	1,632	497	407	124	24.0	1,000	0.47	5,300	2,501	19,852	3	2.92	75	8/19-20/08 Sampling	
	Old HW Bldg Vent 2	1,651	503	407	124	24.0	1,000	0.47	5,300	2,501	19,852	3	2.92	75	8/19-20/08 Sampling	
	Old HW Bldg Vent 3	1,671	509	404	123	24.0	1,000	0.47	5,300	2,501	19,852	3	2.92	75	8/19-20/08 Sampling	
	Old HW Bldg Vent 4	1,693	516	404	123	24.0	1,000	0.47	5,300	2,501	19,852	3	2.92	75	8/19-20/08 Sampling	
	BOC Stack 1	1,801	549	30	9	20.5	10,000	4.72	7,500	35,396	280,921	18	3.50	75	8/19-20/08 Sampling	
	BOC Stack 2	1,818	554	46	14	20.5	10,000	4.72	7,500	35,396	280,921	18	3.50	75	8/19-20/08 Sampling	
	Unox Tank A Vent	957	292	397	121	4.0	50	0.02	250	6	47	10	0.33	75	assumed	
	Unox Tank B Vent	948	289	227	69	4.0	50	0.02	250	6	47	10	0.33	75	assumed	
	Unox Tank C Vent	1,390	424	65	20	4.0	50	0.02	250	6	47	10	0.33	75	assumed	
	Fume Incinerator (PTO) Stack	1,191	363	860	262	42.0	-	-	390	-	-	25.5	2.50	250	not in use	
	Fume Incinerator (New) Stack	1,211	369	840	256	42.0	-	-	800	-	-	25	2.50	250	not in use	
	SHOC 1		502		293	42.0	4,600	2.17	5,700	12,374	98,210	43	3.00	75		
	SHOC 2		496		293	42.0	4,600	2.17	5,700	12,374	98,210	43	3.00	75		
	RTO 1 Stack	956	291	817	249	41.0	15,195	7.17	335	2,402	19,066	30	2.00	250	2/17/04 sampling	
	RTO 2 Stack	975	297	817	249	41.0	15,195	7.17	335	2,402	19,066	30	2.00	250	2/17/04 sampling	
	RTO 3 Stack	993	303	817	249	41.0	-	-	335	-	-	30	2.00	250	not in use	
	RTO 4 Stack	1,012	308	817	249	41.0	-	-	335	-	-	30	2.00	250	not in use	
	DAFT Room Exhaust	961	293	541	165	22.0	39,400	18.59	900	16,735	132,819	12	4.50	75	8/19-20/08 Sampling	
	MEB Exhaust		265		154	0.0	374,000	176.51	330	58,248	462,284	65	17.00	75	8/19-20/08 Sampling	15' x 15'
	MEB Roof Exhaust Fan 1	928	283	733	223	0.0	30,000	14.16	1,100	15,574	123,605	76	7.00	75	8/19-20/08 Sampling	6' x 6.5'
	MEB Roof Exhaust Fan 2	953	290	733	223	0.0	30,000	14.16	1,100	15,574	123,605	76	7.00	75	8/19-20/08 Sampling	6' x 6.5'
	MEB Roof Exhaust Fan 3	978	298	733	223	0.0	30,000	14.16	1,100	15,574	123,605	76	7.00	75	not in use	6' x 6.5'
	MEB Roof Exhaust Fan 4	1,003	306	733	223	0.0	30,000	14.16	1,100	15,574	123,605	76	7.00	75	8/19-20/08 Sampling	6' x 6.5'
	MEB Roof Exhaust Fan 5	928	283	698	213	0.0	30,000	14.16	1,100	15,574	123,605	76	7.00	75	8/19-20/08 Sampling	6' x 6.5'
	MEB Roof Exhaust Fan 6	953	290	698	213	0.0	30,000	14.16	1,100	15,574	123,605	76	7.00	75	8/19-20/08 Sampling	6' x 6.5'
	MEB Roof Exhaust Fan 7	978	298	698	213	0.0	30,000	14.16	1,100	15,574	123,605	76	7.00	75	8/19-20/08 Sampling	6' x 6.5'
	MEB Roof Exhaust Fan 8	1,003	306	698	213	0.0	30,000	14.16	1,100	15,574	123,605	76	7.00	75	8/19-20/08 Sampling	6' x 6.5'
	MEB Roof Exhaust Fan 9	928	283	663	202	0.0	30,000	14.16	1,100	15,574	123,605	76	7.00	75	8/19-20/08 Sampling	6' x 6.5'
	MEB Roof Exhaust Fan 10	953	290	663	202	0.0	30,000	14.16	1,100	15,574	123,605	76	7.00	75	8/19-20/08 Sampling	6' x 6.5'
	MEB Roof Exhaust Fan 11	978	298	663	202	0.0	30,000	14.16	1,100	15,574	123,605	76	7.00	75	8/19-20/08 Sampling	6' x 6.5'
	MEB Roof Exhaust Fan 12	1,003	306	663	202	0.0	30,000	14.16	1,100	15,574	123,605	76	7.00	75	8/19-20/08 Sampling	6' x 6.5'
	Pellet Silo Baghouse Exhaust		254		179	0.0	500	0.24	530	125	993	10	0.50	75	9/16/03 sampling	
	Digester 1 NW		416		276	42.0	170	0.080	94,000	7,542	59,855	25	9.50	75	8/19-20/08 Sampling	
	Digester 2 NE		456		276	42.0	170	0.080	94,000	7,542	59,855	25	9.50	75	8/19-20/08 Sampling	
	Digester 3 SW		416		236	42.0	170	0.080	94,000	7,542	59,855	25	9.50	75	8/19-20/08 Sampling	
	Digester 4 SE		456		236	42.0	170	0.080	94,000	7,542	59,855	25	9.50	75	8/19-20/08 Sampling	
	Truck Unloading MH		640		335	19.0	-	-	760,000	-	-	1	2.00	75	Bruce 10/10/06?	

Morris Forman WWTP

Model 2 Frequency- Existing Conditions with MEB Improvements

6th floor roof fans replaced with 2 propeller fans that discharge air to incinerator stack. Each propeller fan is 90,000 cfm to equal 3 roof fans.

Assume two dryer trains in service so both propeller fans in service (180,000 cfm) with Peak DT = 350.

Assume peak DT of MEB exhaust is 150 to match Round 1 test results.

No other changes made to any other system.

Round 1 results used to model frequencies and Round 2 results used to model Peak DTs.

Rectangular Area Sources 12/8/2008

ID #	Description	X Coord (ft)	X Coord (m)	Y Coord (ft)	Y Coord (m)	Base Elev (ft)	Air Flow (cfm)	Air Flow (m^3/s)	D/T (g/m^3)	OER (g/s)	OER (lb/hr)	OER/ft^2	Release Height (ft)	X Length (ft)	Y Length (ft)	Area (sf)	D/T Source
	Influent Junction Box	1,693	516	466	142	0.0	47	0.02	1,700	38	300.9	0.80	3	15	25	375	7/22-23/08 Sampling
	Influent Channel to New HW	1,706	520	466	142	0.0	63	0.03	1,700	51	401.2	0.80	3	50	10	500	7/22-23/08 Sampling
	Aerated Influent Box	1,752	534	420	128	0.0	506	0.24	1,700	406	3,222.0	3.85	3	25.33	33	836	7/22-23/08 Sampling
	Screen & Grit Dumpsters	1,723	525	400	122	0.0	66	0.03	1,700	53	420.3	1.59	6	12	22	264	7/22-23/08 Sampling
	Grit Tank #1	1,755	535	315	96	0.0	67	0.03	1,100	35	274.6	0.52	2	23	23	529	7/22-23/08 Sampling
	Grit Tank #2	1,729	527	328	100	0.0	67	0.03	1,100	35	274.6	0.52	2	23	23	529	7/22-23/08 Sampling
	Grit Tank #3	1,726	526	302	92	0.0	67	0.03	1,100	35	274.6	0.52	2	23	23	529	7/22-23/08 Sampling
	Grit Tank #4	1,749	533	292	89	0.0	67	0.03	1,100	35	274.6	0.52	2	23	23	529	7/22-23/08 Sampling
	New Grit Channel 1	1,755	535	361	110	0.0	18	0.01	1,100	9	74.8	0.52	2	24	6	144	7/22-23/08 Sampling
	New Grit Channel 2	1,716	523	282	86	0.0	29	0.01	1,100	15	120.4	0.52	2	4	58	232	7/22-23/08 Sampling
	New Grit Channel 3	1,716	523	341	104	0.0	23	0.01	1,100	12	93.4	0.52	2	4	45	180	7/22-23/08 Sampling
	New Grit Channel 4	1,775	541	282	86	0.0	40	0.02	1,100	21	166.1	0.52	2	4	80	320	7/22-23/08 Sampling
	New Grit Channel 5	1,736	529	282	86	0.0	84	0.04	1,100	43	344.7	0.52	2	8	83	664	7/22-23/08 Sampling
	Old Grit Chambers	1,621	494	331	101	0.0	-	-	1,100	-	-	0.00	2	56	55	3,080	not in use
	Old Grit Effluent Channel	1,650	503	289	88	0.0	-	-	1,100	-	-	0.00	2	14	30	420	covered
	Combined Grit Effluent Channel	1,499	457	285	87	0.0	-	-	8,000	-	-	0.00	2	280	10	2,800	covered
	Primary Influent Channel	1,463	446	148	45	0.0	-	-	8,000	-	-	0.00	2	6.5	275	1,788	covered
	Primary Clarifiers Surface	1,200	366	161	49	0.0	9,226	4.35	2,485	10,820	85,874.2	1.18	2	260	280	72,800	7/22-23/08 Sampling
	Primary Clarifier Weirs (total of 16)	1,217	371	436	133	0.0	31	0.01	9,750	142	1,125.3	2.92	2	77	5	385	7/22-23/08 Sampling
	Primary Effluent Channel	1,188	362	164	50	0.0	237	0.11	9,300	1,040	8,255.7	3.25	2	9	282	2,538	7/22-23/08 Sampling
	Unox Influent Channel	1,178	359	164	50	0.0	237	0.11	4,300	481	3,817.2	1.59	2	9	267	2,403	7/22-23/08 Sampling
	Unox Effluent Channel A	879	268	295	90	0.0	587	0.28	370	103	813.5	0.54	2	10	150	1,500	5/14/02 sampling
	Unox Effluent Channel B	873	266	151	46	0.0	490	0.23	370	86	679.1	0.54	2	10	125	1,250	5/14/02 sampling
	Secondary Clarifier Influent Channel A	492	150	430	131	0.0	1,539	0.73	370	269	2,132.9	0.54	2	393	10	3,930	5/14/02 sampling
	Secondary Clarifier Influent Channel B	466	142	187	57	0.0	1,590	0.75	370	278	2,203.5	0.54	2	406	10	4,060	5/14/02 sampling
	Secondary Clarifier Influent Channel C	980	299	15	5	0.0	1,567	0.74	370	274	2,171.7	0.54	2	400	10	4,000	5/14/02 sampling

Flux Chamber air flow rate = **0.126** **cfm/f^2**

Peak Factor: Use 3 minute peaks, -0.5 power law factor = **4.47**

Morris Forman WWTP **Model 2 Frequency- Existing Conditions with MEB Improvements**

Point Sources

ID #	Description	X Coord (ft)	X Coord (m)	Y Coord (ft)	Y Coord (m)	Base Elev (ft)	Air Flow (cfm)	Air Flow (m^3/s)	D/T (g/m^3)	OER (g/s)	OER (lb/hr)	Stack Height (ft)	Diameter (ft)	Temp (F)	D/T Source	
	New Screen Room Exhaust	1,763	537	372	113	43.0	4,650	2.19	470	1,031	8,186	3	3.00	75	7/22-23/08 Sampling	
	New Grit Classifier Room Exhaust	1,750	533	404	123	43.0	4,850	2.29	1,700	3,891	30,883	3	3.00	75	7/22-23/08 Sampling	
	Screen & Grit Dumpster Room Exhaust	1,723	525	400	122	27.0	66	0.03	1,700	53	420	3	2.92	75	7/22-23/08 Sampling	
	Old HW Bldg Vent 1	1,632	497	407	124	24.0	1,000	0.47	4,200	1,982	15,732	3	2.92	75	7/22-23/08 Sampling	
	Old HW Bldg Vent 2	1,651	503	407	124	24.0	1,000	0.47	4,200	1,982	15,732	3	2.92	75	7/22-23/08 Sampling	
	Old HW Bldg Vent 3	1,671	509	404	123	24.0	1,000	0.47	4,200	1,982	15,732	3	2.92	75	7/22-23/08 Sampling	
	Old HW Bldg Vent 4	1,693	516	404	123	24.0	1,000	0.47	4,200	1,982	15,732	3	2.92	75	7/22-23/08 Sampling	
	BOC Stack 1	1,801	549	30	9	20.5	10,000	4.72	5,100	24,069	191,026	18	3.50	75	7/22-23/08 Sampling	
	BOC Stack 2	1,818	554	46	14	20.5	10,000	4.72	5,100	24,069	191,026	18	3.50	75	7/22-23/08 Sampling	
	Unox Tank A Vent	957	292	397	121	4.0	50	0.02	250	6	47	10	0.33	75	assumed	
	Unox Tank B Vent	948	289	227	69	4.0	50	0.02	250	6	47	10	0.33	75	assumed	
	Unox Tank C Vent	1,390	424	65	20	4.0	50	0.02	250	6	47	10	0.33	75	assumed	
	Fume Incinerator (PTO) Stack	1,191	363	860	262	42.0	-	-	390	-	-	25.5	2.50	250	not in use	
	Fume Incinerator (New) Stack	1,211	369	840	256	42.0	-	-	800	-	-	25	2.50	250	not in use	
	SHOC 1		502		293	42.0	4,600	2.17	4,100	8,901	70,642	43	3.00	75	7/22-23/08 Sampling	
	SHOC 2		496		293	42.0	4,600	2.17	4,100	8,901	70,642	43	3.00	75	7/22-23/08 Sampling	
	RTO 1 Stack	956	291	817	249	41.0	15,195	7.17	335	2,402	19,066	30	2.00	250	2/17/04 sampling	
	RTO 2 Stack	975	297	817	249	41.0	15,195	7.17	335	2,402	19,066	30	2.00	250	2/17/04 sampling	
	RTO 3 Stack	993	303	817	249	41.0	-	-	335	-	-	30	2.00	250	not in use	
	RTO 4 Stack	1,012	308	817	249	41.0	-	-	335	-	-	30	2.00	250	not in use	
	DAFT Room Exhaust	961	293	541	165	22.0	39,400	18.59	430	7,996	63,458	12	4.50	75	7/22-23/08 Sampling	
	MEB Exhaust		265		154	0.0	374,000	176.51	150	26,476	210,129	65	17.00	75	7/22-23/08 Sampling	15' x 15'
	MEB Roof Exhaust Fan 1	928	283	733	223	0.0	-	-	350	-	-	76	7.00	75	Fan Out of Service	6' x 6.5'
	MEB Roof Exhaust Fan 2	953	290	733	223	0.0	-	-	350	-	-	76	7.00	75	Fan Out of Service	6' x 6.5'
	MEB Roof Exhaust Fan 3	978	298	733	223	0.0	-	-	350	-	-	76	7.00	75	Fan Out of Service	6' x 6.5'
	MEB Roof Exhaust Fan 4	1,003	306	733	223	0.0	-	-	350	-	-	76	7.00	75	Fan Out of Service	6' x 6.5'
	MEB Roof Exhaust Fan 5	928	283	698	213	0.0	-	-	350	-	-	76	7.00	75	Fan Out of Service	6' x 6.5'
	MEB Roof Exhaust Fan 6	953	290	698	213	0.0	-	-	350	-	-	76	7.00	75	Fan Out of Service	6' x 6.5'
	MEB Roof Exhaust Fan 7	978	298	698	213	0.0	-	-	710	-	-	76	7.00	75	Fan Out of Service	6' x 6.5'
	MEB Roof Exhaust Fan 8	1,003	306	698	213	0.0	-	-	710	-	-	76	7.00	75	Fan Out of Service	6' x 6.5'
	MEB Roof Exhaust Fan 9	928	283	663	202	0.0	-	-	710	-	-	76	7.00	75	Fan Out of Service	6' x 6.5'
	MEB Roof Exhaust Fan 10	953	290	663	202	0.0	-	-	710	-	-	76	7.00	75	Fan Out of Service	6' x 6.5'
	MEB Roof Exhaust Fan 11	978	298	663	202	0.0	-	-	710	-	-	76	7.00	75	Fan Out of Service	6' x 6.5'
	MEB Roof Exhaust Fan 12	1,003	306	663	202	0.0	-	-	710	-	-	76	7.00	75	Fan Out of Service	6' x 6.5'
	Biosolids Incinerator Stack	948	289	748	228	42.0	180,000	84.95	350	29,733	235,974	156	14.00	250		
	Pellet Silo Baghouse Exhaust		254		179	0.0	500	0.24	530	125	993	10	0.50	75	9/16/03 sampling	
	Digester 1 NW		416		276	42.0	170	0.080	160,000	12,837	101,881	25	9.50	75	7/22-23/08 Sampling	
	Digester 2 NE		456		276	42.0	170	0.080	160,000	12,837	101,881	25	9.50	75	7/22-23/08 Sampling	
	Digester 3 SW		416		236	42.0	170	0.080	160,000	12,837	101,881	25	9.50	75	7/22-23/08 Sampling	
	Digester 4 SE		456		236	42.0	170	0.080	160,000	12,837	101,881	25	9.50	75	7/22-23/08 Sampling	
	Truck Unloading MH		640		335	19.0	-	-	760,000	-	-	1	2.00	75	Bruce 10/10/06?	

Morris Forman WWTP

Model 2 Peak DT- Existing Conditions with MEB Improvements

6th floor roof fans replaced with 2 propeller fans that discharge air to incinerator stack. Each propeller fan is 90,000 cfm to equal 3 roof fans.

Assume two dryer trains in service so both propeller fans in service (180,000 cfm) with Peak DT = 350.

Assume peak DT of MEB exhaust is 150 to match Round 1 test results.

No other changes made to any other system.

Round 1 results used to model frequencies and Round 2 results used to model Peak DTs.

Rectangular Area Sources **12/8/2008**

ID #	Description	X Coord (ft)	X Coord (m)	Y Coord (ft)	Y Coord (m)	Base Elev (ft)	Air Flow (cfm)	Air Flow (m^3/s)	D/T (g/m^3)	OER (g/s)	OER (lb/hr)	OER/ft^2	Release Height (ft)	X Length (ft)	Y Length (ft)	Area (sf)	D/T Source
	Influent Junction Box	1,693	**516**	466	**142**	**0.0**	47	0.02	**76,000**	1,695	13,450.5	**35.87**	**3**	**15**	**25**	**375**	8/19-20/08
	Influent Channel to New HW	1,706	**520**	466	**142**	**0.0**	63	0.03	**76,000**	2,260	17,934.0	**35.87**	**3**	**50**	**10**	**500**	8/19-20/08
	Aerated Influent Box	1,752	**534**	420	**128**	**0.0**	506	0.24	**76,000**	18,149	144,041.4	**172.32**	**3**	**25.33**	**33**	**836**	8/19-20/08
	Screen & Grit Dumpsters	1,723	**525**	400	**122**	**0.0**	66	0.03	**4,350**	135	1,075.4	**4.07**	**6**	**12**	**22**	**264**	8/19-20/08
	Grit Tank #1	1,755	**535**	315	**96**	**0.0**	67	0.03	**10,000**	315	2,496.6	**4.72**	**2**	**23**	**23**	**529**	8/19-20/08
	Grit Tank #2	1,729	**527**	328	**100**	**0.0**	67	0.03	**10,000**	315	2,496.6	**4.72**	**2**	**23**	**23**	**529**	8/19-20/08
	Grit Tank #3	1,726	**526**	302	**92**	**0.0**	67	0.03	**10,000**	315	2,496.6	**4.72**	**2**	**23**	**23**	**529**	8/19-20/08
	Grit Tank #4	1,749	**533**	292	**89**	**0.0**	67	0.03	**10,000**	315	2,496.6	**4.72**	**2**	**23**	**23**	**529**	8/19-20/08
	New Grit Channel 1	1,755	**535**	361	**110**	**0.0**	18	0.01	**10,000**	86	679.6	**4.72**	**2**	**24**	**6**	**144**	8/19-20/08
	New Grit Channel 2	1,716	**523**	282	**86**	**0.0**	29	0.01	**10,000**	138	1,094.9	**4.72**	**2**	**4**	**58**	**232**	8/19-20/08
	New Grit Channel 3	1,716	**523**	341	**104**	**0.0**	23	0.01	**10,000**	107	849.5	**4.72**	**2**	**4**	**45**	**180**	8/19-20/08
	New Grit Channel 4	1,775	**541**	282	**86**	**0.0**	40	0.02	**10,000**	190	1,510.2	**4.72**	**2**	**4**	**80**	**320**	8/19-20/08
	New Grit Channel 5	1,736	**529**	282	**86**	**0.0**	84	0.04	**10,000**	395	3,133.7	**4.72**	**2**	**8**	**83**	**664**	8/19-20/08
	Old Grit Chambers	1,621	**494**	331	**101**	**0.0**	-	-	**1,100**	-	-	**0.00**	**2**	**56**	**55**	**3,080**	not in use
	Old Grit Effluent Channel	1,650	**503**	289	**88**	**0.0**	-	-	**1,100**	-	-	**0.00**	**2**	**14**	**30**	**420**	covered
	Combined Grit Effluent Channel	1,499	**457**	285	**87**	**0.0**	-	-	**8,000**	-	-	**0.00**	**2**	**280**	**10**	**2,800**	covered
	Primary Influent Channel	1,463	**446**	148	**45**	**0.0**	-	-	**8,000**	-	-	**0.00**	**2**	**6.5**	**275**	**1,788**	covered
	Primary Clarifiers Surface	1,200	**366**	161	**49**	**0.0**	9,226	4.35	**6,316**	27,501	218,262.3	**3.00**	**2**	**260**	**280**	**72,800**	8/19-20/08
	Primary Clarifier Weirs (total of 16)	1,217	**371**	436	**133**	**0.0**	31	0.01	**59,500**	865	6,867.0	**17.84**	**2**	**77**	**5**	**385**	8/19-20/08
	Primary Effluent Channel	1,188	**362**	164	**50**	**0.0**	237	0.11	**13,000**	1,454	11,540.2	**4.55**	**2**	**9**	**282**	**2,538**	8/19-20/08
	Unox Influent Channel	1,178	**359**	164	**50**	**0.0**	237	0.11	**8,900**	995	7,900.6	**3.29**	**2**	**9**	**267**	**2,403**	8/19-20/08
	Unox Effluent Channel A	879	**268**	295	**90**	**0.0**	587	0.28	**370**	103	813.5	**0.54**	**2**	**10**	**150**	**1,500**	5/14/02 sam
	Unox Effluent Channel B	873	**266**	151	**46**	**0.0**	490	0.23	**370**	86	679.1	**0.54**	**2**	**10**	**125**	**1,250**	5/14/02 sam
	Secondary Clarifier Influent Channel A	492	**150**	430	**131**	**0.0**	1,539	0.73	**370**	269	2,132.9	**0.54**	**2**	**393**	**10**	**3,930**	5/14/02 sam
	Secondary Clarifier Influent Channel B	466	**142**	187	**57**	**0.0**	1,590	0.75	**370**	278	2,203.5	**0.54**	**2**	**406**	**10**	**4,060**	5/14/02 sam
	Secondary Clarifier Influent Channel C	980	**299**	15	**5**	**0.0**	1,567	0.74	**370**	274	2,171.7	**0.54**	**2**	**400**	**10**	**4,000**	5/14/02 sam

Flux Chamber air flow rate = **0.126** **cfm/f^2**

Peak Factor: Use 3 minute peaks, -0.5 power law factor = **4.47**

Morris Forman WWTP
Point Sources

Model 2 Peak DT- Existing Conditions with MEB Improvements

ID #	Description	X Coord (ft)	X Coord (m)	Y Coord (ft)	Y Coord (m)	Base Elev (ft)	Air Flow (cfm)	Air Flow (m^3/s)	D/T (g/m^3)	OER (g/s)	OER (lb/hr)	Stack Height (ft)	Diameter (ft)	Temp (F)	D/T Source	
	New Screen Room Exhaust	1,763	537	372	113	43.0	4,650	2.19	1,600	3,511	27,867	3	3.00	75	8/19-20/08 Sampling	
	New Grit Classifier Room Exhaust	1,750	533	404	123	43.0	4,850	2.29	4,700	10,758	85,381	3	3.00	75	8/19-20/08 Sampling	
	Screen & Grit Dumpster Room Exhaust	1,723	525	400	122	27.0	66	0.03	1,700	53	420	3	2.92	75	8/19-20/08 Sampling	
	Old HW Bldg Vent 1	1,632	497	407	124	24.0	1,000	0.47	5,300	2,501	19,852	3	2.92	75	8/19-20/08 Sampling	
	Old HW Bldg Vent 2	1,651	503	407	124	24.0	1,000	0.47	5,300	2,501	19,852	3	2.92	75	8/19-20/08 Sampling	
	Old HW Bldg Vent 3	1,671	509	404	123	24.0	1,000	0.47	5,300	2,501	19,852	3	2.92	75	8/19-20/08 Sampling	
	Old HW Bldg Vent 4	1,693	516	404	123	24.0	1,000	0.47	5,300	2,501	19,852	3	2.92	75	8/19-20/08 Sampling	
	BOC Stack 1	1,801	549	30	9	20.5	10,000	4.72	7,500	35,396	280,921	18	3.50	75	8/19-20/08 Sampling	
	BOC Stack 2	1,818	554	46	14	20.5	10,000	4.72	7,500	35,396	280,921	18	3.50	75	8/19-20/08 Sampling	
	Unox Tank A Vent	957	292	397	121	4.0	50	0.02	250	6	47	10	0.33	75	assumed	
	Unox Tank B Vent	948	289	227	69	4.0	50	0.02	250	6	47	10	0.33	75	assumed	
	Unox Tank C Vent	1,390	424	65	20	4.0	50	0.02	250	6	47	10	0.33	75	assumed	
	Fume Incinerator (PTO) Stack	1,191	363	860	262	42.0	-	-	390	-	-	25.5	2.50	250	not in use	
	Fume Incinerator (New) Stack	1,211	369	840	256	42.0	-	-	800	-	-	25	2.50	250	not in use	
	SHOC 1		502		293	42.0	4,600	2.17	5,700	12,374	98,210	43	3.00	75		
	SHOC 2		496		293	42.0	4,600	2.17	5,700	12,374	98,210	43	3.00	75		
	RTO 1 Stack	956	291	817	249	41.0	15,195	7.17	335	2,402	19,066	30	2.00	250	2/17/04 sampling	
	RTO 2 Stack	975	297	817	249	41.0	15,195	7.17	335	2,402	19,066	30	2.00	250	2/17/04 sampling	
	RTO 3 Stack	993	303	817	249	41.0	-	-	335	-	-	30	2.00	250	not in use	
	RTO 4 Stack	1,012	308	817	249	41.0	-	-	335	-	-	30	2.00	250	not in use	
	DAFT Room Exhaust	961	293	541	165	22.0	39,400	18.59	900	16,735	132,819	12	4.50	75	8/19-20/08 Sampling	
	MEB Exhaust		265		154	0.0	374,000	176.51	150	26,476	210,129	65	17.00	75	8/19-20/08 Sampling	15' x 15'
	MEB Roof Exhaust Fan 1	928	283	733	223	0.0	-	-	350	-	-	76	7.00	75	Fan out of service	6' x 6.5'
	MEB Roof Exhaust Fan 2	953	290	733	223	0.0	-	-	350	-	-	76	7.00	75	Fan out of service	6' x 6.5'
	MEB Roof Exhaust Fan 3	978	298	733	223	0.0	-	-	350	-	-	76	7.00	75	Fan out of service	6' x 6.5'
	MEB Roof Exhaust Fan 4	1,003	306	733	223	0.0	-	-	350	-	-	76	7.00	75	Fan out of service	6' x 6.5'
	MEB Roof Exhaust Fan 5	928	283	698	213	0.0	-	-	350	-	-	76	7.00	75	Fan out of service	6' x 6.5'
	MEB Roof Exhaust Fan 6	953	290	698	213	0.0	-	-	350	-	-	76	7.00	75	Fan out of service	6' x 6.5'
	MEB Roof Exhaust Fan 7	978	298	698	213	0.0	-	-	1,100	-	-	76	7.00	75	Fan out of service	6' x 6.5'
	MEB Roof Exhaust Fan 8	1,003	306	698	213	0.0	-	-	1,100	-	-	76	7.00	75	Fan out of service	6' x 6.5'
	MEB Roof Exhaust Fan 9	928	283	663	202	0.0	-	-	1,100	-	-	76	7.00	75	Fan out of service	6' x 6.5'
	MEB Roof Exhaust Fan 10	953	290	663	202	0.0	-	-	1,100	-	-	76	7.00	75	Fan out of service	6' x 6.5'
	MEB Roof Exhaust Fan 11	978	298	663	202	0.0	-	-	1,100	-	-	76	7.00	75	Fan out of service	6' x 6.5'
	MEB Roof Exhaust Fan 12	1,003	306	663	202	0.0	-	-	1,100	-	-	76	7.00	75	Fan out of service	6' x 6.5'
	Biosolids Incinerator Stack	948	289	748	228	42.0	180,000	84.95	350	29,733	235,974	156	14.00	250		
	Pellet Silo Baghouse Exhaust		254		179	0.0	500	0.24	530	125	993	10	0.50	75	9/16/03 sampling	
	Digester 1 NW		416		276	42.0	170	0.080	94,000	7,542	59,855	25	9.50	75	8/19-20/08 Sampling	
	Digester 2 NE		456		276	42.0	170	0.080	94,000	7,542	59,855	25	9.50	75	8/19-20/08 Sampling	
	Digester 3 SW		416		236	42.0	170	0.080	94,000	7,542	59,855	25	9.50	75	8/19-20/08 Sampling	
	Digester 4 SE		456		236	42.0	170	0.080	94,000	7,542	59,855	25	9.50	75	8/19-20/08 Sampling	
	Truck Unloading MH		640		335	19.0	-	-	760,000	-	-	1	2.00	75	Bruce 10/10/06?	

Morris Forman WWTP

MODEL 3 Frequency - Model 2 with chemical addition to headworks

6th floor roof fans replaced with 2 propeller fans that discharge air to incinerator stack. Each propeller fan is 90,000 cfm to equal 3 roof fans.

Assume two dryer trains in service so both propeller fans in service (180,000 cfm) with Peak DT = 350.

Assume peak DT of MEB exhaust is 150 to match Round 1 test results.

Chemical addition to headworks which will reduce emissions from headworks by 50% and primaries by 75%.

Round 1 results used to model frequencies and Round 2 results used to model Peak DTs.

Rectangular Area Sources 12/8/2008

ID #	Description	X Coord (ft)	X Coord (m)	Y Coord (ft)	Y Coord (m)	Base Elev (ft)	Air Flow (cfm)	Air Flow (m^3/s)	D/T (g/m^3)	OER (g/s)	OER (lb/hr)	OER/ft^2	Release Height (ft)	X Length (ft)	Y Length (ft)	Area (sf)	D/T Source
	Influent Junction Box	1,693	516	466	142	0.0	47	0.02	850	19	150.4	0.40	3	15	25	375	7/22-23/08 s
	Influent Channel to New HW	1,706	520	466	142	0.0	63	0.03	850	25	200.6	0.40	3	50	10	500	7/22-23/08 s
	Aerated Influent Box	1,752	534	420	128	0.0	506	0.24	850	203	1,611.0	1.93	3	25.33	33	836	7/22-23/08 s
	Screen & Grit Dumpsters	1,723	525	400	122	0.0	66	0.03	1,700	53	420.3	1.59	6	12	22	264	7/22-23/08 s
	Grit Tank #1	1,755	535	315	96	0.0	67	0.03	550	17	137.3	0.26	2	23	23	529	7/22-23/08 s
	Grit Tank #2	1,729	527	328	100	0.0	67	0.03	550	17	137.3	0.26	2	23	23	529	7/22-23/08 s
	Grit Tank #3	1,726	526	302	92	0.0	67	0.03	550	17	137.3	0.26	2	23	23	529	7/22-23/08 s
	Grit Tank #4	1,749	533	292	89	0.0	67	0.03	550	17	137.3	0.26	2	23	23	529	7/22-23/08 s
	New Grit Channel 1	1,755	535	361	110	0.0	18	0.01	550	5	37.4	0.26	2	24	6	144	7/22-23/08 s
	New Grit Channel 2	1,716	523	282	86	0.0	29	0.01	550	8	60.2	0.26	2	4	58	232	7/22-23/08 s
	New Grit Channel 3	1,716	523	341	104	0.0	23	0.01	550	6	46.7	0.26	2	4	45	180	7/22-23/08 s
	New Grit Channel 4	1,775	541	282	86	0.0	40	0.02	550	10	83.1	0.26	2	4	80	320	7/22-23/08 s
	New Grit Channel 5	1,736	529	282	86	0.0	84	0.04	550	22	172.4	0.26	2	8	83	664	7/22-23/08 s
	Old Grit Chambers	1,621	494	331	101	0.0	-	-	1,100	-	-	0.00	2	56	55	3,080	not in use
	Old Grit Effluent Channel	1,650	503	289	88	0.0	-	-	1,100	-	-	0.00	2	14	30	420	covered
	Combined Grit Effluent Channel	1,499	457	285	87	0.0	-	-	8,000	-	-	0.00	2	280	10	2,800	covered
	Primary Influent Channel	1,463	446	148	45	0.0	-	-	8,000	-	-	0.00	2	6.5	275	1,788	covered
	Primary Clarifiers Surface	1,200	366	161	49	0.0	9,226	4.35	620	2,701	21,434.0	0.29	2	260	280	72,800	7/22-23/08 s
	Primary Clarifier Weirs (total of 16)	1,217	371	436	133	0.0	31	0.01	2,438	35	281.3	0.73	2	77	5	385	7/22-23/08 s
	Primary Effluent Channel	1,188	362	164	50	0.0	237	0.11	2,325	260	2,063.9	0.81	2	9	282	2,538	7/22-23/08 s
	Unox Influent Channel	1,178	359	164	50	0.0	237	0.11	1,075	120	954.3	0.40	2	9	267	2,403	7/22-23/08 s
	Unox Effluent Channel A	879	268	295	90	0.0	587	0.28	370	103	813.5	0.54	2	10	150	1,500	5/14/02 sam
	Unox Effluent Channel B	873	266	151	46	0.0	490	0.23	370	86	679.1	0.54	2	10	125	1,250	5/14/02 sam
	Secondary Clarifier Influent Channel	492	150	430	131	0.0	1,539	0.73	370	269	2,132.9	0.54	2	393	10	3,930	5/14/02 sam
	Secondary Clarifier Influent Channel	466	142	187	57	0.0	1,590	0.75	370	278	2,203.5	0.54	2	406	10	4,060	5/14/02 sam
	Secondary Clarifier Influent Channel	980	299	15	5	0.0	1,567	0.74	370	274	2,171.7	0.54	2	400	10	4,000	5/14/02 sam

Flux Chamber air flow rate = **0.126** **cfm/f^2**

Peak Factor: Use 3 minute peaks, -0.5 power law factor = **4.47**

Morris Forman WWTP **MODEL 3 Frequency - Model 2 with chemical addition to headworks**

Point Sources

ID #	Description	X Coord (ft)	X Coord (m)	Y Coord (ft)	Y Coord (m)	Base Elev (ft)	Air Flow (cfm)	Air Flow (m^3/s)	D/T (g/m^3)	OER (g/s)	OER (lb/hr)	Stack Height (ft)	Diameter (ft)	Temp (F)	D/T Source	
	New Screen Room Exhaust	1,763	537	372	113	43.0	4,650	2.19	470	1,031	8,186	3	3.00	75	7/22-23/08 Sampling	
	New Grit Classifier Room Exhaust	1,750	533	404	123	43.0	4,850	2.29	1,700	3,891	30,883	3	3.00	75	7/22-23/08 Sampling	
	Screen & Grit Dumpster Room Exhau	1,723	525	400	122	27.0	66	0.03	1,700	53	420	3	2.92	75	7/22-23/08 Sampling	
	Old HW Bldg Vent 1	1,632	497	407	124	24.0	1,000	0.47	4,200	1,982	15,732	3	2.92	75	7/22-23/08 Sampling	
	Old HW Bldg Vent 2	1,651	503	407	124	24.0	1,000	0.47	4,200	1,982	15,732	3	2.92	75	7/22-23/08 Sampling	
	Old HW Bldg Vent 3	1,671	509	404	123	24.0	1,000	0.47	4,200	1,982	15,732	3	2.92	75	7/22-23/08 Sampling	
	Old HW Bldg Vent 4	1,693	516	404	123	24.0	1,000	0.47	4,200	1,982	15,732	3	2.92	75	7/22-23/08 Sampling	
	BOC Stack 1	1,801	549	30	9	20.5	10,000	4.72	5,100	24,069	191,026	18	3.50	75	7/22-23/08 Sampling	
	BOC Stack 2	1,818	554	46	14	20.5	10,000	4.72	5,100	24,069	191,026	18	3.50	75	7/22-23/08 Sampling	
	Unox Tank A Vent	957	292	397	121	4.0	50	0.02	250	6	47	10	0.33	75	assumed	
	Unox Tank B Vent	948	289	227	69	4.0	50	0.02	250	6	47	10	0.33	75	assumed	
	Unox Tank C Vent	1,390	424	65	20	4.0	50	0.02	250	6	47	10	0.33	75	assumed	
	Fume Incinerator (PTO) Stack	1,191	363	860	262	42.0	-	-	390	-	-	25.5	2.50	250	not in use	
	Fume Incinerator (New) Stack	1,211	369	840	256	42.0	-	-	800	-	-	25	2.50	250	not in use	
	SHOC 1		502		293	42.0	4,600	2.17	4,100	8,901	70,642	43	3.00	75	7/22-23/08 Sampling	
	SHOC 2		496		293	42.0	4,600	2.17	4,100	8,901	70,642	43	3.00	75	7/22-23/08 Sampling	
	RTO 1 Stack	956	291	817	249	41.0	15,195	7.17	335	2,402	19,066	30	2.00	250	2/17/04 sampling	
	RTO 2 Stack	975	297	817	249	41.0	15,195	7.17	335	2,402	19,066	30	2.00	250	2/17/04 sampling	
	RTO 3 Stack	993	303	817	249	41.0	-	-	335	-	-	30	2.00	250	not in use	
	RTO 4 Stack	1,012	308	817	249	41.0	-	-	335	-	-	30	2.00	250	not in use	
	DAFT Room Exhaust	961	293	541	165	22.0	39,400	18.59	430	7,996	63,458	12	4.50	75	7/22-23/08 Sampling	
	MEB Exhaust		265		154	0.0	374,000	176.51	150	26,476	210,129	65	17.00	75	7/22-23/08 Sampling	15' x 15'
	MEB Roof Exhaust Fan 1	928	283	733	223	0.0	-	-	350	-	-	76	7.00	75	Fan Out of Service	6' x 6.5'
	MEB Roof Exhaust Fan 2	953	290	733	223	0.0	-	-	350	-	-	76	7.00	75	Fan Out of Service	6' x 6.5'
	MEB Roof Exhaust Fan 3	978	298	733	223	0.0	-	-	350	-	-	76	7.00	75	Fan Out of Service	6' x 6.5'
	MEB Roof Exhaust Fan 4	1,003	306	733	223	0.0	-	-	350	-	-	76	7.00	75	Fan Out of Service	6' x 6.5'
	MEB Roof Exhaust Fan 5	928	283	698	213	0.0	-	-	350	-	-	76	7.00	75	Fan Out of Service	6' x 6.5'
	MEB Roof Exhaust Fan 6	953	290	698	213	0.0	-	-	350	-	-	76	7.00	75	Fan Out of Service	6' x 6.5'
	MEB Roof Exhaust Fan 7	978	298	698	213	0.0	-	-	710	-	-	76	7.00	75	Fan Out of Service	6' x 6.5'
	MEB Roof Exhaust Fan 8	1,003	306	698	213	0.0	-	-	710	-	-	76	7.00	75	Fan Out of Service	6' x 6.5'
	MEB Roof Exhaust Fan 9	928	283	663	202	0.0	-	-	710	-	-	76	7.00	75	Fan Out of Service	6' x 6.5'
	MEB Roof Exhaust Fan 10	953	290	663	202	0.0	-	-	710	-	-	76	7.00	75	Fan Out of Service	6' x 6.5'
	MEB Roof Exhaust Fan 11	978	298	663	202	0.0	-	-	710	-	-	76	7.00	75	Fan Out of Service	6' x 6.5'
	MEB Roof Exhaust Fan 12	1,003	306	663	202	0.0	-	-	710	-	-	76	7.00	75	Fan Out of Service	6' x 6.5'
	Biosolids Incinerator Stack	948	289	748	228	42.0	180,000	84.95	350	29,733	235,974	156	14.00	250		
	Pellet Silo Baghouse Exhaust		254		179	0.0	500	0.24	530	125	993	10	0.50	75	9/16/03 sampling	
	Digester 1 NW		416		276	42.0	170	0.080	160,000	12,837	101,881	25	9.50	75	7/22-23/08 Sampling	
	Digester 2 NE		456		276	42.0	170	0.080	160,000	12,837	101,881	25	9.50	75	7/22-23/08 Sampling	
	Digester 3 SW		416		236	42.0	170	0.080	160,000	12,837	101,881	25	9.50	75	7/22-23/08 Sampling	
	Digester 4 SE		456		236	42.0	170	0.080	160,000	12,837	101,881	25	9.50	75	7/22-23/08 Sampling	
	Truck Unloading MH		640		335	19.0	-	-	760,000	-	-	1	2.00	75	Bruce 10/10/06?	

Morris Forman WWTP

MODEL 3 Peak DT - Model 2 with chemical addition to headworks

6th floor roof fans replaced with 2 propeller fans that discharge air to incinerator stack. Each propeller fan is 90,000 cfm to equal 3 roof fans.

Assume two dryer trains in service so both propeller fans in service (180,000 cfm) with Peak DT = 350.

Assume peak DT of MEB exhaust is 150 to match Round 1 test results.

Chemical addition to headworks which will reduce emissions from headworks by 50% and primaries by 75%.

Round 1 results used to model frequencies and Round 2 results used to model Peak DTs.

Rectangular Area Sources

12/8/2008

ID #	Description	X Coord (ft)	X Coord (m)	Y Coord (ft)	Y Coord (m)	Base Elev (ft)	Air Flow (cfm)	Air Flow (m^3/s)	D/T (g/m^3)	OER (g/s)	OER (lb/hr)	OER/ft^2	Release Height (ft)	X Length (ft)	Y Length (ft)	Area (sf)	D/T Source
	Influent Junction Box	1,693	516	466	142	0.0	47	0.02	38,000	847	6,725.3	17.93	3	15	25	375	8/19-20/08 Sampling
	Influent Channel to New HW	1,706	520	466	142	0.0	63	0.03	38,000	1,130	8,967.0	17.93	3	50	10	500	8/19-20/08 Sampling
	Aerated Influent Box	1,752	534	420	128	0.0	506	0.24	38,000	9,075	72,020.7	86.16	3	25.33	33	836	8/19-20/08 Sampling
	Screen & Grit Dumpsters	1,723	525	400	122	0.0	66	0.03	4,350	135	1,075.4	4.07	6	12	22	264	8/19-20/08 Sampling
	Grit Tank #1	1,755	535	315	96	0.0	67	0.03	5,000	157	1,248.3	2.36	2	23	23	529	8/19-20/08 Sampling
	Grit Tank #2	1,729	527	328	100	0.0	67	0.03	5,000	157	1,248.3	2.36	2	23	23	529	8/19-20/08 Sampling
	Grit Tank #3	1,726	526	302	92	0.0	67	0.03	5,000	157	1,248.3	2.36	2	23	23	529	8/19-20/08 Sampling
	Grit Tank #4	1,749	533	292	89	0.0	67	0.03	5,000	157	1,248.3	2.36	2	23	23	529	8/19-20/08 Sampling
	New Grit Channel 1	1,755	535	361	110	0.0	18	0.01	5,000	43	339.8	2.36	2	24	6	144	8/19-20/08 Sampling
	New Grit Channel 2	1,716	523	282	86	0.0	29	0.01	5,000	69	547.5	2.36	2	4	58	232	8/19-20/08 Sampling
	New Grit Channel 3	1,716	523	341	104	0.0	23	0.01	5,000	54	424.8	2.36	2	4	45	180	8/19-20/08 Sampling
	New Grit Channel 4	1,775	541	282	86	0.0	40	0.02	5,000	95	755.1	2.36	2	4	80	320	8/19-20/08 Sampling
	New Grit Channel 5	1,736	529	282	86	0.0	84	0.04	5,000	197	1,566.9	2.36	2	8	83	664	8/19-20/08 Sampling
	Old Grit Chambers	1,621	494	331	101	0.0	-	-	1,100	-	-	0.00	2	56	55	3,080	not in use
	Old Grit Effluent Channel	1,650	503	289	88	0.0	-	-	1,100	-	-	0.00	2	14	30	420	covered
	Combined Grit Effluent Channel	1,499	457	285	87	0.0	-	-	8,000	-	-	0.00	2	280	10	2,800	covered
	Primary Influent Channel	1,463	446	148	45	0.0	-	-	8,000	-	-	0.00	2	6.5	275	1,788	covered
	Primary Clarifiers Surface	1,200	366	161	49	0.0	9,226	4.35	1,579	6,875	54,565.6	0.75	2	260	280	72,800	8/19-20/08 Sampling
	Primary Clarifier Weirs (total of 16)	1,217	371	436	133	0.0	31	0.01	14,875	216	1,716.7	4.46	2	77	5	385	8/19-20/08 Sampling
	Primary Effluent Channel	1,188	362	164	50	0.0	237	0.11	3,250	364	2,885.1	1.14	2	9	282	2,538	8/19-20/08 Sampling
	Unox Influent Channel	1,178	359	164	50	0.0	237	0.11	2,225	249	1,975.2	0.82	2	9	267	2,403	8/19-20/08 Sampling
	Unox Effluent Channel A	879	268	295	90	0.0	587	0.28	370	103	813.5	0.54	2	10	150	1,500	5/14/02 sampling
	Unox Effluent Channel B	873	266	151	46	0.0	490	0.23	370	86	679.1	0.54	2	10	125	1,250	5/14/02 sampling
	Secondary Clarifier Influent Channel A	492	150	430	131	0.0	1,539	0.73	370	269	2,132.9	0.54	2	393	10	3,930	5/14/02 sampling
	Secondary Clarifier Influent Channel B	466	142	187	57	0.0	1,590	0.75	370	278	2,203.5	0.54	2	406	10	4,060	5/14/02 sampling
	Secondary Clarifier Influent Channel C	980	299	15	5	0.0	1,567	0.74	370	274	2,171.7	0.54	2	400	10	4,000	5/14/02 sampling

Flux Chamber air flow rate = **0.126** **cfm/f^2**

Peak Factor: Use 3 minute peaks, -0.5 power law factor = **4.47**

Morris Forman WWTP
Point Sources

MODEL 3 Peak DT - Model 2 with chemical addition to headworks

ID #	Description	X Coord (ft)	X Coord (m)	Y Coord (ft)	Y Coord (m)	Base Elev (ft)	Air Flow (cfm)	Air Flow (m^3/s)	D/T (g/m^3)	OER (g/s)	OER (lb/hr)	Stack Height (ft)	Diameter (ft)	Temp (F)	D/T Source	
	New Screen Room Exhaust	1,763	537	372	113	43.0	4,650	2.19	1,600	3,511	27,867	3	3.00	75	8/19-20/08 Sampling	
	New Grit Classifier Room Exhaust	1,750	533	404	123	43.0	4,850	2.29	4,700	10,758	85,381	3	3.00	75	8/19-20/08 Sampling	
	Screen & Grit Dumpster Room Exhaust	1,723	525	400	122	27.0	66	0.03	1,700	53	420	3	2.92	75	8/19-20/08 Sampling	
	Old HW Bldg Vent 1	1,632	497	407	124	24.0	1,000	0.47	5,300	2,501	19,852	3	2.92	75	8/19-20/08 Sampling	
	Old HW Bldg Vent 2	1,651	503	407	124	24.0	1,000	0.47	5,300	2,501	19,852	3	2.92	75	8/19-20/08 Sampling	
	Old HW Bldg Vent 3	1,671	509	404	123	24.0	1,000	0.47	5,300	2,501	19,852	3	2.92	75	8/19-20/08 Sampling	
	Old HW Bldg Vent 4	1,693	516	404	123	24.0	1,000	0.47	5,300	2,501	19,852	3	2.92	75	8/19-20/08 Sampling	
	BOC Stack 1	1,801	549	30	9	20.5	10,000	4.72	7,500	35,396	280,921	18	3.50	75	8/19-20/08 Sampling	
	BOC Stack 2	1,818	554	46	14	20.5	10,000	4.72	7,500	35,396	280,921	18	3.50	75	8/19-20/08 Sampling	
	Unox Tank A Vent	957	292	397	121	4.0	50	0.02	250	6	47	10	0.33	75	assumed	
	Unox Tank B Vent	948	289	227	69	4.0	50	0.02	250	6	47	10	0.33	75	assumed	
	Unox Tank C Vent	1,390	424	65	20	4.0	50	0.02	250	6	47	10	0.33	75	assumed	
	Fume Incinerator (PTO) Stack	1,191	363	860	262	42.0	-	-	390	-	-	25.5	2.50	250	not in use	
	Fume Incinerator (New) Stack	1,211	369	840	256	42.0	-	-	800	-	-	25	2.50	250	not in use	
	SHOC 1		502		293	42.0	4,600	2.17	5,700	12,374	98,210	43	3.00	75		
	SHOC 2		496		293	42.0	4,600	2.17	5,700	12,374	98,210	43	3.00	75		
	RTO 1 Stack	956	291	817	249	41.0	15,195	7.17	335	2,402	19,066	30	2.00	250	2/17/04 sampling	
	RTO 2 Stack	975	297	817	249	41.0	15,195	7.17	335	2,402	19,066	30	2.00	250	2/17/04 sampling	
	RTO 3 Stack	993	303	817	249	41.0	-	-	335	-	-	30	2.00	250	not in use	
	RTO 4 Stack	1,012	308	817	249	41.0	-	-	335	-	-	30	2.00	250	not in use	
	DAFT Room Exhaust	961	293	541	165	22.0	39,400	18.59	900	16,735	132,819	12	4.50	75	8/19-20/08 Sampling	
	MEB Exhaust		265		154	0.0	374,000	176.51	150	26,476	210,129	65	17.00	75	8/19-20/08 Sampling	15' x 15'
	MEB Roof Exhaust Fan 1	928	283	733	223	0.0	-	-	350	-	-	76	7.00	75	Fan out of service	6' x 6.5'
	MEB Roof Exhaust Fan 2	953	290	733	223	0.0	-	-	350	-	-	76	7.00	75	Fan out of service	6' x 6.5'
	MEB Roof Exhaust Fan 3	978	298	733	223	0.0	-	-	350	-	-	76	7.00	75	Fan out of service	6' x 6.5'
	MEB Roof Exhaust Fan 4	1,003	306	733	223	0.0	-	-	350	-	-	76	7.00	75	Fan out of service	6' x 6.5'
	MEB Roof Exhaust Fan 5	928	283	698	213	0.0	-	-	350	-	-	76	7.00	75	Fan out of service	6' x 6.5'
	MEB Roof Exhaust Fan 6	953	290	698	213	0.0	-	-	350	-	-	76	7.00	75	Fan out of service	6' x 6.5'
	MEB Roof Exhaust Fan 7	978	298	698	213	0.0	-	-	1,100	-	-	76	7.00	75	Fan out of service	6' x 6.5'
	MEB Roof Exhaust Fan 8	1,003	306	698	213	0.0	-	-	1,100	-	-	76	7.00	75	Fan out of service	6' x 6.5'
	MEB Roof Exhaust Fan 9	928	283	663	202	0.0	-	-	1,100	-	-	76	7.00	75	Fan out of service	6' x 6.5'
	MEB Roof Exhaust Fan 10	953	290	663	202	0.0	-	-	1,100	-	-	76	7.00	75	Fan out of service	6' x 6.5'
	MEB Roof Exhaust Fan 11	978	298	663	202	0.0	-	-	1,100	-	-	76	7.00	75	Fan out of service	6' x 6.5'
	MEB Roof Exhaust Fan 12	1,003	306	663	202	0.0	-	-	1,100	-	-	76	7.00	75	Fan out of service	6' x 6.5'
	Biosolids Incinerator Stack	948	289	748	228	42.0	180,000	84.95	350	29,733	235,974	156	14.00	250		
	Pellet Silo Baghouse Exhaust		254		179	0.0	500	0.24	530	125	993	10	0.50	75	9/16/03 sampling	
	Digester 1 NW		416		276	42.0	170	0.080	94,000	7,542	59,855	25	9.50	75	8/19-20/08 Sampling	
	Digester 2 NE		456		276	42.0	170	0.080	94,000	7,542	59,855	25	9.50	75	8/19-20/08 Sampling	
	Digester 3 SW		416		236	42.0	170	0.080	94,000	7,542	59,855	25	9.50	75	8/19-20/08 Sampling	
	Digester 4 SE		456		236	42.0	170	0.080	94,000	7,542	59,855	25	9.50	75	8/19-20/08 Sampling	
	Truck Unloading MH		640		335	19.0	-	-	760,000	-	-	1	2.00	75	Bruce 10/10/06?	

Morris Forman WWTP

MODEL 4 Frequency- Model 2 with Headworks Covers (treatment in BRT) and Primary Weir and channel covers (new air treatment system)

6th floor roof fans replaced with 2 propeller fans that discharge air to incinerator stack. Each propeller fan is 90,000 cfm to equal 3 roof fans.

Assume two dryer trains in service so both propeller fans in service (180,000 cfm) with Peak DT = 350.

New headworks covers, air collected and treated in bioroughing towers. Strobic air fans on new headworks building and on dumpster room

New covers for primary clarifier weirs and new 10,000 cfm odor control system that provides 90% reduction in odors.

No Chemical addition to headworks.

Round 1 results used to model frequencies and Round 2 results used to model Peak DTs.

Rectangular Area Sources 12/8/2008

ID #	Description	X Coord (ft)	X Coord (m)	Y Coord (ft)	Y Coord (m)	Base Elev (ft)	Air Flow (cfm)	Air Flow (m^3/s)	D/T (g/m^3)	OER (g/s)	OER (lb/hr)	OER/ft^2	Release Height (ft)	X Length (ft)	Y Length (ft)	Area (sf)	D/T Source
	Influent Junction Box	1,693	516	466	142	0.0	47	0.02	-	-	-	0.00	3	15	25	375	7/22-23/08 Sampling
	Influent Channel to New HW	1,706	520	466	142	0.0	63	0.03	-	-	-	0.00	3	50	10	500	7/22-23/08 Sampling
	Aerated Influent Box	1,752	534	420	128	0.0	506	0.24	-	-	-	0.00	3	25.33	33	836	7/22-23/08 Sampling
	Screen & Grit Dumpsters	1,723	525	400	122	0.0	66	0.03	-	-	-	0.00	3	12	22	264	7/22-23/08 Sampling
	Grit Tank #1	1,755	535	315	96	0.0	67	0.03	-	-	-	0.00	2	23	23	529	7/22-23/08 Sampling
	Grit Tank #2	1,729	527	328	100	0.0	67	0.03	-	-	-	0.00	2	23	23	529	7/22-23/08 Sampling
	Grit Tank #3	1,726	526	302	92	0.0	67	0.03	-	-	-	0.00	2	23	23	529	7/22-23/08 Sampling
	Grit Tank #4	1,749	533	292	89	0.0	67	0.03	-	-	-	0.00	2	23	23	529	7/22-23/08 Sampling
	New Grit Channel 1	1,755	535	361	110	0.0	18	0.01	-	-	-	0.00	2	24	6	144	7/22-23/08 Sampling
	New Grit Channel 2	1,716	523	282	86	0.0	29	0.01	-	-	-	0.00	2	4	58	232	7/22-23/08 Sampling
	New Grit Channel 3	1,716	523	341	104	0.0	23	0.01	-	-	-	0.00	2	4	45	180	7/22-23/08 Sampling
	New Grit Channel 4	1,775	541	282	86	0.0	40	0.02	-	-	-	0.00	2	4	80	320	7/22-23/08 Sampling
	New Grit Channel 5	1,736	529	282	86	0.0	84	0.04	-	-	-	0.00	2	8	83	664	7/22-23/08 Sampling
	Old Grit Chambers	1,621	494	331	101	0.0	-	-	1,100	-	-	0.00	2	56	55	3,080	not in use
	Old Grit Effluent Channel	1,650	503	289	88	0.0	-	-	1,100	-	-	0.00	2	14	30	420	covered
	Combined Grit Effluent Channel	1,499	457	285	87	0.0	-	-	8,000	-	-	0.00	2	280	10	2,800	covered
	Primary Influent Channel	1,463	446	148	45	0.0	-	-	8,000	-	-	0.00	2	6.5	275	1,788	covered
	Primary Clarifiers Surface	1,200	366	161	49	0.0	9,226	4.35	2,485	10,820	85,874.2	1.18	2	260	280	72,800	7/22-23/08 Sampling
	Primary Clarifier Weirs (total of 16)	1,217	371	436	133	0.0	31	0.01	-	-	-	0.00	2	77	5	385	7/22-23/08 Sampling
	Primary Effluent Channel	1,188	362	164	50	0.0	237	0.11	-	-	-	0.00	2	9	282	2,538	7/22-23/08 Sampling
	Unox Influent Channel	1,178	359	164	50	0.0	237	0.11	-	-	-	0.00	2	9	267	2,403	7/22-23/08 Sampling
	Unox Effluent Channel A	879	268	295	90	0.0	587	0.28	370	103	813.5	0.54	2	10	150	1,500	5/14/02 sampling
	Unox Effluent Channel B	873	266	151	46	0.0	490	0.23	370	86	679.1	0.54	2	10	125	1,250	5/14/02 sampling
	Secondary Clarifier Influent Channel A	492	150	430	131	0.0	1,539	0.73	370	269	2,132.9	0.54	2	393	10	3,930	5/14/02 sampling
	Secondary Clarifier Influent Channel B	466	142	187	57	0.0	1,590	0.75	370	278	2,203.5	0.54	2	406	10	4,060	5/14/02 sampling
	Secondary Clarifier Influent Channel C	980	299	15	5	0.0	1,567	0.74	370	274	2,171.7	0.54	2	400	10	4,000	5/14/02 sampling

Flux Chamber air flow rate = **0.126** **cfm/f^2**

Peak Factor: Use 3 minute peaks, -0.5 power law factor = **4.47**

Morris Forman WWTP
Point Sources

MODEL 4 Frequency- Model 2 with Headworks Covers (treatment in BRT) and Primary Weir and channel covers (new air treatment system)

ID #	Description	X Coord (ft)	X Coord (m)	Y Coord (ft)	Y Coord (m)	Base Elev (ft)	Air Flow (cfm)	Air Flow (m^3/s)	D/T (g/m^3)	OER (g/s)	OER (lb/hr)	Stack Height (ft)	Diameter (ft)	Temp (F)	D/T Source	
	New Screen Room Exhaust	1,763	537	372	113	43.0	20,000	9.44	186	1,756	13,934	35	2.50	75	7/22-23/08 Sampling	
	New Grit Classifier Room Exhaust	1,750	533	404	123	43.0	28,000	13.21	377	4,982	39,539	35	2.50	75	7/22-23/08 Sampling	
	Screen & Grit Dumpster Room Exhaust	1,723	525	400	122	27.0	39,000	18.41	100	1,841	14,608	25	3.00	75	7/22-23/08 Sampling	
	Old HW Bldg Vent 1	1,632	497	407	124	24.0	1,000	0.47	4,200	1,982	15,732	3	2.92	75	7/22-23/08 Sampling	
	Old HW Bldg Vent 2	1,651	503	407	124	24.0	1,000	0.47	4,200	1,982	15,732	3	2.92	75	7/22-23/08 Sampling	
	Old HW Bldg Vent 3	1,671	509	404	123	24.0	1,000	0.47	4,200	1,982	15,732	3	2.92	75	7/22-23/08 Sampling	
	Old HW Bldg Vent 4	1,693	516	404	123	24.0	1,000	0.47	4,200	1,982	15,732	3	2.92	75	7/22-23/08 Sampling	
	BOC Stack 1	1,801	549	30	9	20.5	10,000	4.72	5,100	24,069	191,026	18	3.50	75	7/22-23/08 Sampling	
	BOC Stack 2	1,818	554	46	14	20.5	10,000	4.72	5,100	24,069	191,026	18	3.50	75	7/22-23/08 Sampling	
	Primary Clarifier Weir/Channel Odor Control	1,214	370	433	132	0.0	10,000	4.72	975	4,601	36,516	30	2	75	7/22-23/08 Sampling	
	Unox Tank A Vent	957	292	397	121	4.0	50	0.02	250	6	47	10	0.33	75	assumed	
	Unox Tank B Vent	948	289	227	69	4.0	50	0.02	250	6	47	10	0.33	75	assumed	
	Unox Tank C Vent	1,390	424	65	20	4.0	50	0.02	250	6	47	10	0.33	75	assumed	
	Fume Incinerator (PTO) Stack	1,191	363	860	262	42.0	-	-	390	-	-	25.5	2.50	250	not in use	
	Fume Incinerator (New) Stack	1,211	369	840	256	42.0	-	-	800	-	-	25	2.50	250	not in use	
	SHOC 1		502		293	42.0	4,600	2.17	4,100	8,901	70,642	43	3.00	75	7/22-23/08 Sampling	
	SHOC 2		496		293	42.0	4,600	2.17	4,100	8,901	70,642	43	3.00	75	7/22-23/08 Sampling	
	RTO 1 Stack	956	291	817	249	41.0	15,195	7.17	335	2,402	19,066	30	2.00	250	2/17/04 sampling	
	RTO 2 Stack	975	297	817	249	41.0	15,195	7.17	335	2,402	19,066	30	2.00	250	2/17/04 sampling	
	RTO 3 Stack	993	303	817	249	41.0	-	-	335	-	-	30	2.00	250	not in use	
	RTO 4 Stack	1,012	308	817	249	41.0	-	-	335	-	-	30	2.00	250	not in use	
	DAFT Room Exhaust	961	293	541	165	22.0	39,400	18.59	430	7,996	63,458	12	4.50	75	7/22-23/08 Sampling	
	MEB Exhaust		265		154	0.0	374,000	176.51	150	26,476	210,129	65	17.00	75	7/22-23/08 Sampling	15' x 15'
	MEB Roof Exhaust Fan 1	928	283	733	223	0.0	-	-	350	-	-	76	7.00	75	Fan Out of Service	6' x 6.5'
	MEB Roof Exhaust Fan 2	953	290	733	223	0.0	-	-	350	-	-	76	7.00	75	Fan Out of Service	6' x 6.5'
	MEB Roof Exhaust Fan 3	978	298	733	223	0.0	-	-	350	-	-	76	7.00	75	Fan Out of Service	6' x 6.5'
	MEB Roof Exhaust Fan 4	1,003	306	733	223	0.0	-	-	350	-	-	76	7.00	75	Fan Out of Service	6' x 6.5'
	MEB Roof Exhaust Fan 5	928	283	698	213	0.0	-	-	350	-	-	76	7.00	75	Fan Out of Service	6' x 6.5'
	MEB Roof Exhaust Fan 6	953	290	698	213	0.0	-	-	350	-	-	76	7.00	75	Fan Out of Service	6' x 6.5'
	MEB Roof Exhaust Fan 7	978	298	698	213	0.0	-	-	710	-	-	76	7.00	75	Fan Out of Service	6' x 6.5'
	MEB Roof Exhaust Fan 8	1,003	306	698	213	0.0	-	-	710	-	-	76	7.00	75	Fan Out of Service	6' x 6.5'
	MEB Roof Exhaust Fan 9	928	283	663	202	0.0	-	-	710	-	-	76	7.00	75	Fan Out of Service	6' x 6.5'
	MEB Roof Exhaust Fan 10	953	290	663	202	0.0	-	-	710	-	-	76	7.00	75	Fan Out of Service	6' x 6.5'
	MEB Roof Exhaust Fan 11	978	298	663	202	0.0	-	-	710	-	-	76	7.00	75	Fan Out of Service	6' x 6.5'
	MEB Roof Exhaust Fan 12	1,003	306	663	202	0.0	-	-	710	-	-	76	7.00	75	Fan Out of Service	6' x 6.5'
	Biosolids Incinerator Stack	948	289	748	228	42.0	180,000	84.95	350	29,733	235,974	156	14.00	250		
	Pellet Silo Baghouse Exhaust		254		179	0.0	500	0.24	530	125	993	10	0.50	75	9/16/03 sampling	
	Digester 1 NW		416		276	42.0	170	0.080	160,000	12,837	101,881	25	9.50	75	7/22-23/08 Sampling	
	Digester 2 NE		456		276	42.0	170	0.080	160,000	12,837	101,881	25	9.50	75	7/22-23/08 Sampling	
	Digester 3 SW		416		236	42.0	170	0.080	160,000	12,837	101,881	25	9.50	75	7/22-23/08 Sampling	
	Digester 4 SE		456		236	42.0	170	0.080	160,000	12,837	101,881	25	9.50	75	7/22-23/08 Sampling	
	Truck Unloading MH		640		335	19.0	-	-	760,000	-	-	1	2.00	75	Bruce 10/10/06?	

Morris Forman WWTP

MODEL 4 Peak DT- Model 2 with Headworks Covers (treatment in BRT) and Primary Weir and channel covers (new air treatment system)

6th floor roof fans replaced with 2 propeller fans that discharge air to incinerator stack. Each propeller fan is 90,000 cfm to equal 3 roof fans.

Assume two dryer trains in service so both propeller fans in service (180,000 cfm) with Peak DT = 350.

New headworks covers, air collected and treated in bioroughing towers. Strobic air fans on new headworks building and on dumpster room

New covers for primary clarifier weirs and new 10,000 cfm odor control system that provides 90% reduction in odors.

No Chemical addition to headworks.

Round 1 results used to model frequencies and Round 2 results used to model Peak DTs.

Rectangular Area Sources 12/8/2008

ID #	Description	X Coord (ft)	X Coord (m)	Y Coord (ft)	Y Coord (m)	Base Elev (ft)	Air Flow (cfm)	Air Flow (m^3/s)	D/T (g/m^3)	OER (g/s)	OER (lb/hr)	OER/ft^2	Release Height (ft)	X Length (ft)	Y Length (ft)	Area (sf)	D/T Source
	Influent Junction Box	1,693	516	466	142	0.0	47	0.02	-	-	-	0.00	3	15	25	375	8/19-20/08
	Influent Channel to New HW	1,706	520	466	142	0.0	63	0.03	-	-	-	0.00	3	50	10	500	8/19-20/08
	Aerated Influent Box	1,752	534	420	128	0.0	506	0.24	-	-	-	0.00	3	25.33	33	836	8/19-20/08
	Screen & Grit Dumpsters	1,723	525	400	122	0.0	66	0.03	-	-	-	0.00	3	12	22	264	8/19-20/08
	Grit Tank #1	1,755	535	315	96	0.0	67	0.03	-	-	-	0.00	2	23	23	529	8/19-20/08
	Grit Tank #2	1,729	527	328	100	0.0	67	0.03	-	-	-	0.00	2	23	23	529	8/19-20/08
	Grit Tank #3	1,726	526	302	92	0.0	67	0.03	-	-	-	0.00	2	23	23	529	8/19-20/08
	Grit Tank #4	1,749	533	292	89	0.0	67	0.03	-	-	-	0.00	2	23	23	529	8/19-20/08
	New Grit Channel 1	1,755	535	361	110	0.0	18	0.01	-	-	-	0.00	2	24	6	144	8/19-20/08
	New Grit Channel 2	1,716	523	282	86	0.0	29	0.01	-	-	-	0.00	2	4	58	232	8/19-20/08
	New Grit Channel 3	1,716	523	341	104	0.0	23	0.01	-	-	-	0.00	2	4	45	180	8/19-20/08
	New Grit Channel 4	1,775	541	282	86	0.0	40	0.02	-	-	-	0.00	2	4	80	320	8/19-20/08
	New Grit Channel 5	1,736	529	282	86	0.0	84	0.04	-	-	-	0.00	2	8	83	664	8/19-20/08
	Old Grit Chambers	1,621	494	331	101	0.0	-	-	1,100	-	-	0.00	2	56	55	3,080	not in use
	Old Grit Effluent Channel	1,650	503	289	88	0.0	-	-	1,100	-	-	0.00	2	14	30	420	covered
	Combined Grit Effluent Channel	1,499	457	285	87	0.0	-	-	8,000	-	-	0.00	2	280	10	2,800	covered
	Primary Influent Channel	1,463	446	148	45	0.0	-	-	8,000	-	-	0.00	2	6.5	275	1,788	covered
	Primary Clarifiers Surface	1,200	366	161	49	0.0	9,226	4.35	6,316	27,501	218,262.3	3.00	2	260	280	72,800	8/19-20/08
	Primary Clarifier Weirs (total of 16)	1,217	371	436	133	0.0	31	0.01	-	-	-	0.00	2	77	5	385	8/19-20/08
	Primary Effluent Channel	1,188	362	164	50	0.0	237	0.11	-	-	-	0.00	2	9	282	2,538	8/19-20/08
	Unox Influent Channel	1,178	359	164	50	0.0	237	0.11	-	-	-	0.00	2	9	267	2,403	8/19-20/08
	Unox Effluent Channel A	879	268	295	90	0.0	587	0.28	370	103	813.5	0.54	2	10	150	1,500	5/14/02 sam
	Unox Effluent Channel B	873	266	151	46	0.0	490	0.23	370	86	679.1	0.54	2	10	125	1,250	5/14/02 sam
	Secondary Clarifier Influent Channel A	492	150	430	131	0.0	1,539	0.73	370	269	2,132.9	0.54	2	393	10	3,930	5/14/02 sam
	Secondary Clarifier Influent Channel B	466	142	187	57	0.0	1,590	0.75	370	278	2,203.5	0.54	2	406	10	4,060	5/14/02 sam
	Secondary Clarifier Influent Channel C	980	299	15	5	0.0	1,567	0.74	370	274	2,171.7	0.54	2	400	10	4,000	5/14/02 sam

Flux Chamber air flow rate = **0.126** **cfm/f^2**

Peak Factor: Use 3 minute peaks, -0.5 power law factor = **4.47**

Morris Forman WWTP
Point Sources

MODEL 4 Peak DT- Model 2 with Headworks Covers (treatment in BRT) and Primary Weir and channel covers (new air treatment system)

ID #	Description	X Coord (ft)	X Coord (m)	Y Coord (ft)	Y Coord (m)	Base Elev (ft)	Air Flow (cfm)	Air Flow (m^3/s)	D/T (g/m^3)	OER (g/s)	OER (lb/hr)	Stack Height (ft)	Diameter (ft)	Temp (F)	D/T Source	
	New Screen Room Exhaust	1,763	537	372	113	43.0	20,000	9.44	450	4,248	33,711	35	2.50	75	8/19-20/08 Sampling	
	New Grit Classifier Room Exhaust	1,750	533	404	123	43.0	28,000	13.21	900	11,893	94,389	35	2.50	75	8/19-20/08 Sampling	
	Screen & Grit Dumpster Room Exhaust	1,723	525	400	122	27.0	39,000	18.41	107	1,969	15,630	25	3.00	75	8/19-20/08 Sampling	
	Old HW Bldg Vent 1	1,632	497	407	124	24.0	1,000	0.47	5,300	2,501	19,852	3	2.92	75	8/19-20/08 Sampling	
	Old HW Bldg Vent 2	1,651	503	407	124	24.0	1,000	0.47	5,300	2,501	19,852	3	2.92	75	8/19-20/08 Sampling	
	Old HW Bldg Vent 3	1,671	509	404	123	24.0	1,000	0.47	5,300	2,501	19,852	3	2.92	75	8/19-20/08 Sampling	
	Old HW Bldg Vent 4	1,693	516	404	123	24.0	1,000	0.47	5,300	2,501	19,852	3	2.92	75	8/19-20/08 Sampling	
	BOC Stack 1	1,801	549	30	9	20.5	10,000	4.72	7,500	35,396	280,921	18	3.50	75	8/19-20/08 Sampling	
	BOC Stack 2	1,818	554	46	14	20.5	10,000	4.72	7,500	35,396	280,921	18	3.50	75	8/19-20/08 Sampling	
	Primary Clarifier Weir/Channel Odor Control	1,214	370	433	132	0.0	10,000	4.72	975	4,601	36,516	30	2	75	7/22-23/08 Sampling	
	Unox Tank A Vent	957	292	397	121	4.0	50	0.02	250	6	47	10	0.33	75	assumed	
	Unox Tank B Vent	948	289	227	69	4.0	50	0.02	250	6	47	10	0.33	75	assumed	
	Unox Tank C Vent	1,390	424	65	20	4.0	50	0.02	250	6	47	10	0.33	75	assumed	
	Fume Incinerator (PTO) Stack	1,191	363	860	262	42.0	-	-	390	-	-	25.5	2.50	250	not in use	
	Fume Incinerator (New) Stack	1,211	369	840	256	42.0	-	-	800	-	-	25	2.50	250	not in use	
	SHOC 1		502		293	42.0	4,600	2.17	5,700	12,374	98,210	43	3.00	75		
	SHOC 2		496		293	42.0	4,600	2.17	5,700	12,374	98,210	43	3.00	75		
	RTO 1 Stack	956	291	817	249	41.0	15,195	7.17	335	2,402	19,066	30	2.00	250	2/17/04 sampling	
	RTO 2 Stack	975	297	817	249	41.0	15,195	7.17	335	2,402	19,066	30	2.00	250	2/17/04 sampling	
	RTO 3 Stack	993	303	817	249	41.0	-	-	335	-	-	30	2.00	250	not in use	
	RTO 4 Stack	1,012	308	817	249	41.0	-	-	335	-	-	30	2.00	250	not in use	
	DAFT Room Exhaust	961	293	541	165	22.0	39,400	18.59	900	16,735	132,819	12	4.50	75	8/19-20/08 Sampling	
	MEB Exhaust		265		154	0.0	374,000	176.51	150	26,476	210,129	65	17.00	75	8/19-20/08 Sampling	15' x 15'
	MEB Roof Exhaust Fan 1	928	283	733	223	0.0	-	-	350	-	-	76	7.00	75	Fan out of service	6' x 6.5'
	MEB Roof Exhaust Fan 2	953	290	733	223	0.0	-	-	350	-	-	76	7.00	75	Fan out of service	6' x 6.5'
	MEB Roof Exhaust Fan 3	978	298	733	223	0.0	-	-	350	-	-	76	7.00	75	Fan out of service	6' x 6.5'
	MEB Roof Exhaust Fan 4	1,003	306	733	223	0.0	-	-	350	-	-	76	7.00	75	Fan out of service	6' x 6.5'
	MEB Roof Exhaust Fan 5	928	283	698	213	0.0	-	-	350	-	-	76	7.00	75	Fan out of service	6' x 6.5'
	MEB Roof Exhaust Fan 6	953	290	698	213	0.0	-	-	350	-	-	76	7.00	75	Fan out of service	6' x 6.5'
	MEB Roof Exhaust Fan 7	978	298	698	213	0.0	-	-	1,100	-	-	76	7.00	75	Fan out of service	6' x 6.5'
	MEB Roof Exhaust Fan 8	1,003	306	698	213	0.0	-	-	1,100	-	-	76	7.00	75	Fan out of service	6' x 6.5'
	MEB Roof Exhaust Fan 9	928	283	663	202	0.0	-	-	1,100	-	-	76	7.00	75	Fan out of service	6' x 6.5'
	MEB Roof Exhaust Fan 10	953	290	663	202	0.0	-	-	1,100	-	-	76	7.00	75	Fan out of service	6' x 6.5'
	MEB Roof Exhaust Fan 11	978	298	663	202	0.0	-	-	1,100	-	-	76	7.00	75	Fan out of service	6' x 6.5'
	MEB Roof Exhaust Fan 12	1,003	306	663	202	0.0	-	-	1,100	-	-	76	7.00	75	Fan out of service	6' x 6.5'
	Biosolids Incinerator Stack	948	289	748	228	42.0	180,000	84.95	350	29,733	235,974	156	14.00	250		
	Pellet Silo Baghouse Exhaust		254		179	0.0	500	0.24	530	125	993	10	0.50	75	9/16/03 sampling	
	Digester 1 NW		416		276	42.0	170	0.080	94,000	7,542	59,855	25	9.50	75	8/19-20/08 Sampling	
	Digester 2 NE		456		276	42.0	170	0.080	94,000	7,542	59,855	25	9.50	75	8/19-20/08 Sampling	
	Digester 3 SW		416		236	42.0	170	0.080	94,000	7,542	59,855	25	9.50	75	8/19-20/08 Sampling	
	Digester 4 SE		456		236	42.0	170	0.080	94,000	7,542	59,855	25	9.50	75	8/19-20/08 Sampling	
	Truck Unloading MH		640		335	19.0	-	-	760,000	-	-	1	2.00	75	Bruce 10/10/06?	

<u>Appendix L</u>

Biorem Proposal

BUDGET PROPOSAL

October 29, 2008

Neil Webster
Webster Environmental & Assoc.
13121 Eastpoint Park Blvd.
Suite E
Louisville, KY 40223

RE: BUDGET PROPOSAL, Quote # 08-5072

Dear Neil,

Thank you for giving BIOREM Technologies Inc. the opportunity to submit a budgetary quotation for a BIOFILTAIR™ biofilter system required for the Louisville MSD. The following proposal will utilize our new XLD media and be used as a polisher for the existing odor control at the facility.

For this application, BIOREM® is proposing a BIOFILTAIR™ system to treat a flow rate of 9200 CFM.

Neil, as discussed at WEFTEC last week, XLD is a new, smaller particle engineered media similar to Biosorbens. The change in the base material is what allows us to capture and destruct more of the reduced sulfur compounds and offer up to 95% total odor removal. We can do this at lower EBRT and give the customer a smaller footprint, less concrete costs and better removal. We estimate the concrete to be approximately 69.7 yards at a cost of $1000/yd. The scope for this proposal includes a cover and stack. We assumed a 6 foot stack height until we can identify just what performance requirements will be needed. I would also suggest that an assessment of pressure drop throughout whole system be done and then verify that the existing fans are adequate.

Please feel free to contact me directly should you require further details or clarification.

Sincerely,

DParker

Dean Parker
Regional Sales Manager
BIOREM Environmental, Inc.

BUDGET PROPOSAL

1.0 Product Description

The Biofiltair system extracts foul air for subsequent preconditioning in the humidification stage and oxidation through the XLD media bed prior to atmospheric discharge.

Odorous compounds in the air entering the biofilter are solubilized into the moisture layer surrounding the individual media particles or are adsorbed directly to their surface. Bacteria present within this moisture film utilize the compounds as substrate. The compounds are biologically oxidized to CO_2, H_2O and inorganic salts and clean air is discharged to atmosphere. It is critical that the filter creates an optimal environment to enhance microbial development. Maintaining proper air temperature, pH, moisture and nutrient levels are essential for favorable biofilter performance and removal efficiency.

2.0 Project Details

The biofilter system shall be designed to remove odorous constituents from a process air stream under the following operating conditions:

Process Parameter	**Value**	
Flow Rate:	9,200 CFM	
EBRT:	15 seconds	
Inlet Air Temperature:	50 - 110 ^{o}F	(Assumed)
Average Inlet RH:	≥ 30%	(Assumed)
Average Inlet Particulate Conc.:	None	(Assumed)
Type of Contaminant:	**Average / Peak Concentration Levels (Assumed)**	
H2S (ppm):	<1	1
DMS (ppm):	2	4
Organic Sulfides:	<1	1
Odor (Odor Units):	<6,000	15,000

The biofilter system will conform to the following specified parameters:

Design Parameter	**Value**
Media Depth:	5 ft
Media Volume:	2,300 ft^3
Media Pressure Drop (at start-up)	2.5“ W.C.
Water Consumption (Irrigation):	172 GPD
Water Supply Connection:	1 inch diameter
Drain Piping Connection:	2 inch diameter
Electrical:	120V, 24VDC
Wall Height:	13 ft

BIOREM

BUDGET PROPOSAL

Footprint Dimensions (L:W):	36 ft : 14 ft
*Concrete Volume Walls:	1570 ft^3 Estimated Value
*Concrete Volume Floor and Footings:	311 ft^3 Estimated Value

***By contractor – not included in BIOREM® scope.**

3.0 System Performance

A. When loaded under average and peak conditions the biofilter system shall provide at least 99 percent removal of H2S when operated at a maximum, equal to the design air flow rate.

B. When loaded under average conditions the biofilter system shall provide at least 80 percent removal of Organic Sulphide compounds when operated at a maximum, equal to the design air flow rate.

C. Odor Removal Requirements: The biofilter system shall provide 95 percent removal for average inlet concentration levels of less than 15,000 and greater than or equal to 6,000 OU. For inlet concentration levels less than 6,000 OU, the outlet concentration levels shall be less than or equal to 300 D/T. (Odor D/T concentrations to be determined using ASTM-E679 with a 20 liter/minute odor panel presentation rate).

D. The system shall be operated under positive pressure.

4.0 Warranties

A. The Manufacturer warrants that the biofilter media will not compact, degrade or decompose for a period of 10 years from the date of Substantial Completion, provided that the system is operated in accordance with the Manufacturer’s printed Operation and Maintenance Manuals.

B. All mechanical components shall be warranted free of manufacturing defects for a period of 12 months from substantial completion.

5.0 Scope of Supply

The following components are provided as part of this budgetary estimate:

A. 2,300 ft^3 XLD media. Media is shipped separately in bulk bags, and stored on site for installation by CONTRACTOR.

B. 460 ft^2 of concrete hollow core roof panels. Hangers and hardware for installation supplied by CONTRACTOR.

C. (1) 6 ft stack, FRP, flanged one end (final size and length to be determined).

D. 460 ft^2 of Concrete Media Support Flooring slats.

E. (1) Media irrigation system with timer to be installed in existing panel.

F. Instrumentation
   i. (1) Differential pressure gauge – local (media pressure drop).
   ii. (1) Media temperature gauge – local.
   iii. (1) Irrigation N/C solenoid valve.
   iv. (1) Flow Totalizer – irrigation feed line.
   v. (1) Water pressure gauge – local

I. 5 Submittal packages.

J. Operations and Maintenance Manuals as specified.

K. The following Field and Engineering Services shall be provided:
   1. A 1-year Bioserve media monitoring and service support package unique to BIOREM®
   2. Operator training and commissioning services on site supplied in 1 trip.

The following items listed are to be supplied by the Contractor and are not in the Manufacturer's Scope of Supply.

A. All equipment offloading, temporary storage and placement.
B. Installation and assembly of all equipment and instrumentation components required for a complete system including labor, equipment and materials. Equipment and instrumentation may or may not be as shown in specified drawings. Equipment installation to include any modifications to existing associated equipment such as vessel(s), fan(s), control panel(s) and all associated instrumentation and components, where applicable.
C. Installation site including site preparation and clearing of materials.
D. Design and installation of concrete basin as per the design criteria, which may or may not be limited to site soil conditions, inlet concentration levels, and associated operating weights.
E. Supply and install all required protective coatings.
F. Supply and install hangers and hardware used for hanging concrete hollow core roof panels.
G. Supply and install all external water piping and drain piping to and from the associated vessel(s) and concrete basin including heat tracing, insulation, piping supports, drainage traps where necessary and / or UV protective paint.
H. Supply and install air ductwork to and from the associated vessel(s) and concrete basin including manual or actuated dampers, exhaust stack(s), interconnecting ductwork, filters, insulation and piping supports.
I. Supply and install all hardware, supports, guide wires, duct gaskets, expansion joints and connectors needed for a complete and operational system.

J. Media onsite storage and installation. Media to be shipped in bulk bags with bottom chute. Installation can be done using a crane or fork lift. Media is not to be dropped more than 5 feet.
K. Utility requirements including main electrical service and system field wiring outside the main biofilter control panel, water supply at minimum pressure of 40psi. All electrical requirements for heat tracing and equipment not specifically provided by BIOREM® to be provided by others.
L. Duct balancing, and system functional, hydrostatic, vibration and performance testing to be conducted by OTHERS as specified.

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BUDGET PROPOSAL

6.0 Budget Quotation

October 29, 2008

	QUOTATION #: 08-5072-00	Budget Price(US$)
01	**Biofiltair Biofilter** **(Please refer to Section 5.0 for Scope of Supply)**	***$208,000***
	Freight	***INCLUDED***
01	*Commissioning and Training.*	***INCLUDED***
01	*Bioserve*	***INCLUDED***

NOTES:

1. Payment Terms: 90% upon equipment delivery, 10% upon system commissioning.
2. Applicable taxes are extra.
3. Prices are guaranteed for 90 days, from date of quotation.
4. Submittals will be provided in 4-6 weeks after receipt of order. Shipment is 12-14 weeks after approved submittals.

TERMS & CONDITIONS

PRICING

Unless otherwise specified in writing by BIOREM Technologies Inc, (BIOREM®) price does not include any taxes, excises, duties, tariffs or other governmental charges which BIOREM® may be required to pay or collect under existing or future law with respect to the sale, transportation, delivery, storage, installation or use of any of the equipment sold by BIOREM®.

CANCELLATION

Unless otherwise agreed in writing by the parties, the Buyer may not cancel the Order, except upon written notice and payment to Seller of an amount covering all costs incurred under the Order, all costs which arose out of the cancellation, and a cancellation fee of 50% of the Order Price. Materials received and Goods manufactured in part or whole under the Order prior to the time of cancellation shall be retained by and shall be property of the seller. When calculating the cancellation related costs, payments made by buyer to seller prior to cancellation shall be taken into account.

LIMITATION OF LIABILITY –SELLER'S LIABILITY TO THE PRICE ALLOCABLE TO THE GOODS DETERMINED DEFECTIVE, AND IN NO EVENT WILL SELLER'S CUMULATIVE LIABILITY BE IN EXCESS OF THE TOTAL SALES ORDER PRICE, WHETHER ARISING UNDER WARRANTY, CONTRACT, NEGLIGENCE, STRICT LIABILITY, INDEMNIFICATION, OR ANY OTHER CAUSE OR COMBINATION OF CAUSES WHATSOEVER. SELLER WILL NOT BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL, OR CONSEQUENTIAL DAMAGES OR INDEMNIFICATION, OR ANY OTHER CAUSE OR COMBINATION OF CAUSES WHATSOEVER. THIS LIMITATION SHALL APPLY NOTWITHSTANDING ANY FAILURE OF ESSENTIAL PURPOSE OF ANY LIMITED REMEDY. BUYER'S REMEDIES ARE SPECIFICALLY LIMITED TO THE REPAIR OR REPLACEMENT OF THE GOODS AND IS EXCLUSIVE OF ALL OTHER REMEDIES. SHOULD THESE REMEDIES BE FOUND INADEQUATE OR TO HAVE FAILED THEIR ESSENTIAL PURPOSE FOR ANY REASON WHATSOEVER, BUYER AGREES THAT RETURN OF THE FULL SALES ORDER PRICE TO IT BY SELLER SHALL PREVENT REMEDIES FROM FAILING THEIR ESSENTIAL PURPOSE AND SHALL BE CONSIDERED BY BUYER AS A FAIR AND ADEQUATE REMEDY.