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Project name:
MSD Odor Control Master Plan

Project ref:
60644274

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Date:
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Memo

Subject: Technical Memorandum #2- Collection System Background Document Review

Encl: Attachment 1- Bioxide Safety Data Sheet

1. Introduction

1.1 MFWQTC Collection System Overview

The Louisville Metropolitan Sewer District (MSD) wastewater collection system serves approximately 332 square miles spanning across Jefferson County and Oldham County, Kentucky. The Phase I project area, which takes up approximately 134 square miles, is defined by the Morris Forman Service Area boundary shown in **Figure 1-1**. Wastewater flow from the project area is collected and conveyed by approximately 1,910 miles of sewer to the Morris Forman Water Quality Treatment Center (MFWQTC) for subsequent treatment.

There are currently thirteen (13) main gravity trunk sewers, (2) major force mains, and 139 pump stations in the MFWQTC service area. **Figure 1-1** shows an overview of the MFWQTC collection system including service area boundaries, major gravity trunk sewers and force mains, and the location of MFWQTC in relation to the collection system.

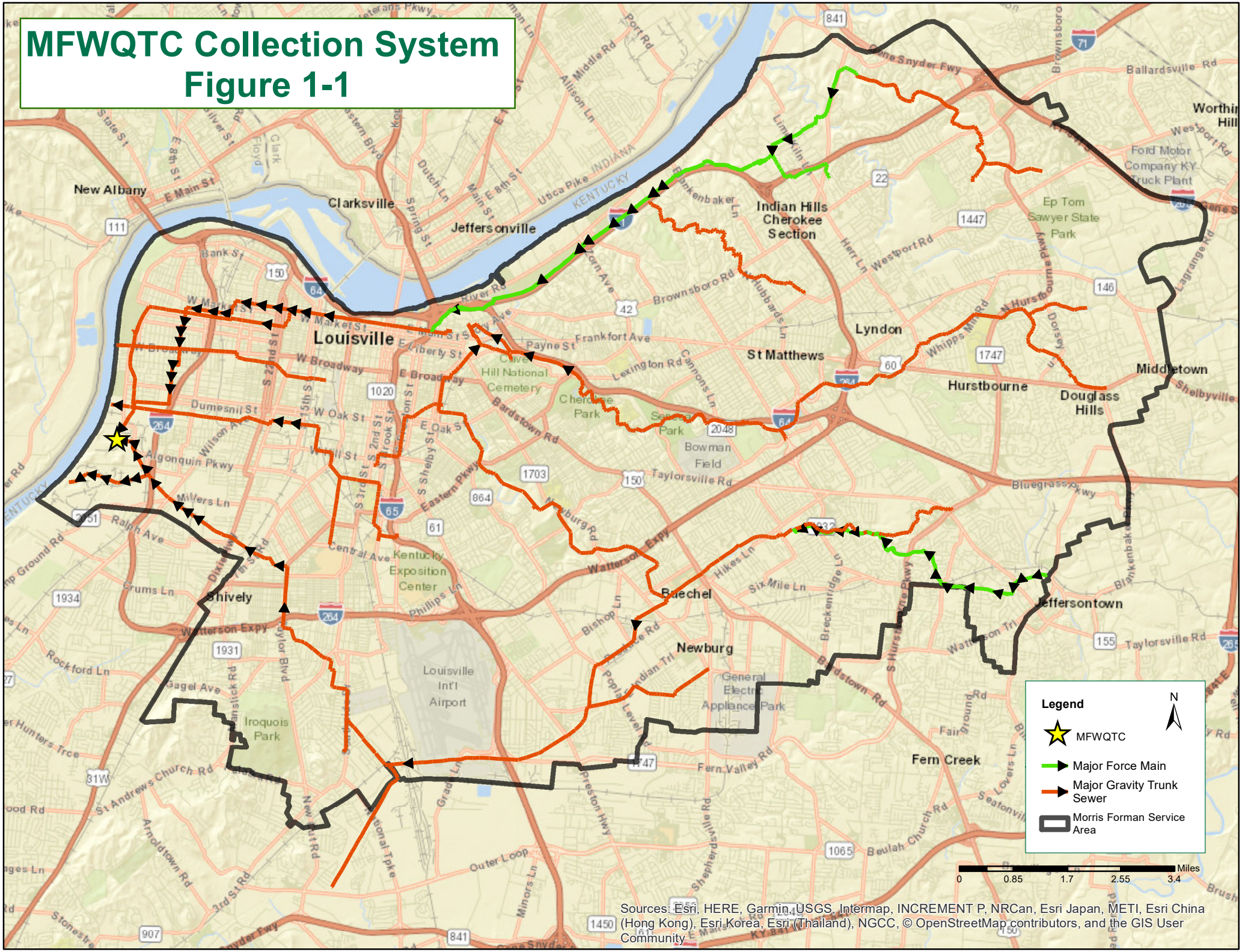
1.2 Background and Purpose

In recent years, MSD has made several odor control improvements within the collection system. Beginning in April 2014, MSD contracted a company to perform routine chemical dosing at various locations. Available reports and data, including chemical dosing and monitoring efforts, were reviewed and are discussed in **Section 2.1**. In March 2018, MSD contracted with a consultant to perform an odor evaluation on the Ohio River Force Main (ORFM) valve locations. The details of this study are outlined in **Section 2.1** of this report. MSD also plans on the continuation of chemical dosing and monitoring within the collection system as outlined in the MSD Collection System Calcium Nitrate Solution Supply and Odor Control Service Bid which is summarized in **Section 2.3.1** of this report.

Despite recent and ongoing odor control efforts in the MFWQTC collection system, MSD has received frequent odor complaints from customers across the project area in recent years. A detailed evaluation of customer complaint data from the period 2019 and 2020 was conducted as part of this study and is discussed in **Section 2.3.2**.

As part of the initial phases of the MSD Odor Control Master Plan (OCMP) Update, AECOM performed a detailed review and evaluation of documentation related to odor control and sampling within the MFWQTC collection system. Detailed maps were generated using available GIS data and used to evaluate the impacts of current odor control procedures. This TM summarizes each background document available and provides conclusions and preliminary recommendations to mitigate odor emissions within the MFWQTC collection system.

MFWQTC Collection System
Figure 1-1



2. Summary of Documents Reviewed

Available data and reports related to odor control in the MFWQTC wastewater collection system were reviewed and evaluated. These documents are summarized and presented chronologically in this Section of the report.

2.1 Chemical Dosing and H_2S Monitoring Service Reports (2014-2020)

Beginning in April 2014, MSD contracted a company to perform routine chemical dosing and H_2S monitoring at target locations in the wastewater collection system, with the overarching goal of improving system-wide odor emissions. According to the July 2020 Invitation to Bid (ITB), a total of nine (9) chemical feed systems were installed within the Morris Forman service area. However, only (5) of these locations have been active during the evaluation timeframe April 2014 through December 2020 based on available service reports. A continuous feed of the odor control chemical Bioxide, commonly known calcium nitrate, was applied to the collection system at each active site. Bioxide is a non-hazardous chemical. The safety data sheet for Bioxide is included as Attachment 1.

Most of the Bioxide feed and sampling locations are located outside of the Morris Forman service area, therefore outside of the study area for this TM. Within the study area, the majority of Bioxide feed and sampling sites are located towards the northeast.

Service reports were submitted to MSD which included the following information at each active Bioxide dosing and H_2S monitoring site, where applicable:

- Bioxide dosing rate adjustments
- Liquid and Vapor monitoring data summary including H_2S levels, humidity, and temperature over monitoring period
- Liquid phase goals for H_2S, disulfide, and nitrate concentrations
- Invoice summary of Bioxide quantities delivered
- Maintenance activities

These service reports were reviewed to assess the performance of recent chemical dosing efforts in the MFWQTC collection system. Data analyses were performed using available service reports from January 2018 through December 2020 and are discussed in this section.

2.1.1 *Chemical Dosing, 2018-2020*

Dosing rates for each individual Bioxide dosing site were provided to MSD quarterly – in March, May, July, and October of each calendar year. Based on the Bioxide volumes included in each service report, it was reasonable to assume that the Bioxide dosing systems were operated at a continuous dosing rate during the quarterly reporting period.

2.1.2 *H_2S Monitoring. 2018-2020*

Monitoring locations were selected to assess the H_2S reduction efficiency of Bioxide dosing at feed sites. Each of these H_2S monitoring sites were related to the associated upstream chemical dosing site(s) based on flow path.

H_2S monitoring results were provided each month during the calendar year with the exception of one site, which was provided quarterly, or in March, May, July, and October. Temperature, humidity, and H_2S tracking was conducted continuously for the respective monitoring month.

These results suggest a low H_2S reduction efficiency of chemical dosing at existing feed locations.

2.2 Ohio River Force Main Odor Study Final Report (2018)

The ORFM, shown in **Figure 1-1**, runs along the south edge of the Ohio River beginning at a PS near US 42 West and SR 841 and discharges to the Ohio River Interceptor (ORI) at the corner of Hancock and Main Street. There are six (6) cross connections along the ORFM which are controlled by either an Air Release Valve (ARV) or a plug valve. After discharging into the ORI via gravity, wastewater flow is conveyed southeast towards the MFWQTC for treatment.

In response to increased odor complaints in the vicinity of the ORFM, particularly at ARV locations, a consultant was contracted to perform an evaluation of potential odor sources at the ORFM and its receiving interceptor, the ORI. The study assumed that H_2S was the dominant source of odors in the ORFM, therefore the proposed odor control system was selected to remove H_2S only and not other reduced sulfur compounds.

2.2.1 *ORFM/ ORI Liquid Sampling*

Liquid phase sampling was performed at (19) locations along the ORFM and the ORI. Two liquid grab samples were collected on two different days at each sampling location; the first round of sampling was conducted in late April 2017 and the second round was conducted in early June 2017.

Based on the sampling results the study concluded that the primary source of sulfides is the ORFM, and not tributary wastewater. The results showed a pH ranging from 5.7 to 8.2 across the sampling locations. Average temperature was 67.5 degrees F on the April 2017 sampling day and 66.0 degrees F on the June 2017 sampling day. The highest temperature reading of 79.5 degrees F was observed at the sampling location along the ORI, about 16,000 feet downstream of the ORFM discharge.

In addition to liquid phase sampling, H_2S monitoring results were used to evaluate the performance of a biofilter pilot test at an ARV site. An Odalog tracking instrument was utilized in the field test installed at the ARV location.

2.2.2 *ORFM/ ORI H_2S Monitoring*

H_2S and vapor phase trends were monitored at nine (9) locations. Four (4) of the locations were installed at ARVs and the remaining five (5) were located at critical manholes or connection points. The monitoring period was continuous from April 26, 2017 through May 9, 2017.

The Odalog data showed that vapor phase H_2S concentrations exceeded the maximum acceptable H_2S threshold at three ARV locations, and the ORFM Discharge Manhole. It was also noted that the liquid sulfide concentration and odor and corrosion potential was likely reduced within the ORI downstream of the ORFM discharge location due to dilution caused by additional wastewater streams.

H_2S monitoring results were used to evaluate the performance of a biofilter pilot-test ARV site. The biofilter system consisted of two stages; the first stage involved a 4-ft by 8-ft precast tank with 3 feet of biofilter media, and the second stage included a 4-ft by 8-ft precast tank with 3 feet of activated carbon media. This field test was initiated to evaluate the H_2S reduction efficiency of the proposed ARV biofilter system and potential implementation across the ORFM. The biofilter system was monitored for inlet and outlet H_2S concentrations from August to October 2017**.**

On average the biofilter H_2S removal efficiency was considered acceptable with a minimum of 79.5% during acclimation phases and a maximum removal efficiency of 99.9% during the final monitoring phase. However, the biofilter performance was less efficient for peak inlet H_2S loadings, with peak H_2S removal efficiency ranging from 63.6% to 95.5%. Based on the average H_2S removal efficiency results, the Consultant concluded that the biofilter system was an effective tool in this application and therefore included the ARV biofilter systems as part of the future ORFM odor control alternatives However, it was noted that H_2S peak loadings should be kept below 100 ppm via oxygen injection for more effective biofiltration.

Based on the observed inlet and outlet loadings from the pilot-test, this particular biofilter technology may not be the appropriate technology for this application.

2.2.3 *ORFM Odor Control Alternative Evaluation*

Based on dispersion modelling efforts, hydraulic modelling, preliminary cost comparisons, and ARV biofilter test findings, five (5) ORFM odor control scenarios were assessed to reduce odor emissions along the ORFM, specifically at the existing ARV locations:

> **Alternative 1**: Close all the FM barrels, or a segment of one FM barrel to decrease detention time and sulfide formation.
>
> **Alternative 2**: Treat the ARV discharges with biofilters equipped with dispersion stacks. Treat the ORFM discharge into the ORI with vapor phase controls (i.e. biofilter).
>
> **Alternative 3**: Add chemical to the ORFM at high doses. Based on life cycle cost analysis, oxygen injection was recommended for implementation.
>
> **Alternative 3A**: Alternative 3 plus additional odor control (biofilter, carbon adsorption or dispersion stack) at ARV discharges.
>
> **Alternative 4:** Add chemicals to the ORFM at lower doses and install dispersion stacks on the ARV discharge.

Using WATS software, dispersion modelling was performed to further refine Alternative 1 and Alternative 2. Modelling scenarios involved various levels of H_2S loadings, dispersion stack sizing and FM barrel closure. The desired peak odor level criteria was a peak Dilutions to Threshold (D/T) value of 7 D/T. Alternative 1, which involved closing one of the two FM barrels, or a portion of one (1) barrel, showed an average predicted H_2S reduction ranging between 71% and 75%, based on existing average peak H_2S conditions at the biofilter pilot test site collected in August –October 2017. Alternative 2 was not considered a viable control option due to site accessibility constraints and aesthetic concerns. Oxygen was the recommended chemical option (in lieu of Bioxide or ferric chloride) included in Alternative 3 and 3A based on lifecycle cost comparison. Alternative 3A was the recommended future ORFM odor control alternative due to the following:

- Significantly reduces odors, corrosion and H_2S exposure limits within the ORFM through oxygen injection, including at the ARV locations and the ORFM discharge manhole
- Provides redundancy at the biofilter pilot ARV site in the instance that the oxygen system is inoperable and the existing biofilter should be utilized as the primary odor control method at this location. It was also noted that additional control measures should be further evaluated at this location, including the installation of a dispersion stack or carbon adsorption vessel.
- Offers the lowest lifecycle cost

The 20-year Present Worth Value for Alternative 3A was estimated at approximately $5.5M, which does not include biofilter or carbon adsorption system costs for the biofilter pilot site. It is also important to note that the study assumed that H_2S was the dominant source of odors in the ORFM, therefore the proposed odor control system was designed to remove H_2S specifically, and no additional reduced sulfur compounds.

Based on the ORFM odor control recommendations, MSD has implemented Alternative 1 by closing one of the two FM barrels. In addition, MSD continues to operate the pilot biofilter system. Details and project status of Alternative 3A is discussed in the next section of this report.

2.2.4 *ORFM Oxygen System*

The second portion of the study involved the system and site layout planning for the proposed oxygen injection system recommended as Alternative 3A. The Super Oxygenation oxygen transfer device was utilized during system concept design which has a design oxygen transfer efficiency of 90% to 95%.

The report outlines potential oxygen supply and storage options, as well as the pros and cons of liquid oxygen versus oxygen generation systems. The Consultant recommends liquid oxygen over oxygen generation based on the following parameters:

- Lower Capital and Operation and Maintenance (O&M) costs
- Easier to operate and maintain
- Easier delivery access to site

Two (2) oxygen dosing stations were recommended to prevent sulfide formation throughout the length of the ORFM, with the intention that one station be located in the upstream portion of the ORFM, and one station in the downstream portion. Screening evaluation was performed and detailed for a total of six (6) MSD-owned locations. Site considerations included liquid oxygen delivery accessibility, system aesthetics for the adjacent community, easement acquisition limitations, permitting, floodplain proximity, potential utility crossings or relocation. MSD-owned facilities were also preferred. The method of liquid oxygen delivery was also considered and recommended for each potential oxygen station site.

Based on the screening evaluation findings, the Consultant selected two pump stations as the two oxygen injection stations.

MSD is currently moving forward with the installation of the proposed oxygen system at the upstream portion of the ORFM. The downstream location for oxygen injection was not selected for construction at this time.

2.3 Ongoing Odor Control Improvements

2.3.1 *Calcium Nitrate Supply and Odor Control Service Bid, 2020*

MSD plans on the continuation of calcium nitrate (Bioxide) dosing and subsequent monitoring within the collection system. On July 21, 2020, MSD released their Invitation to Bid (ITB) for the MSD Collection System Calcium Nitrate Solution Supply and Odor Control Service Bid. This contract was developed to provide odor control via routine chemical injection throughout the MSD wastewater collection system following completion of the ongoing chemical dosing and H2S monitoring contract which was extended by (3) additional years.

The bid documents specify the following services:

- Supply of liquid calcium nitrate
- Operation and maintenance of chemical feed equipment and equipment consisting of tanks, chemical feed systems, modems, and tank monitoring devices.

The ITB documents also outline specific parameters for the calcium nitrate solution including specific gravity requirements, H_2S reduction standards, and the inclusion of quality control measures.

The contractor was also tasked with providing and maintaining equipment at all active sites. In the instance that an inactive site is placed into service, the contractor is required to ensure that the equipment functions correctly prior to chemical dosing. The bidder is required to utilize OdaLog hydrogen sulfide gas monitors, or approved equal, to perform monthly H_2S monitoring at the specified monitoring locations for each active site. A maximum number of (10) H_2S monitoring devices are permitted. As these monitoring devices are replaced, the contractor is also required to perform liquid sampling (nitrates, sulfides and pH).

Similar to the previous monthly service reports (refer to **Section 2.1**), MSD required that the contractor prepare and submit monthly service reports, which summarize the chemical dosing and associated H_2S monitoring results for each active dosing location. The ITB also included provisions to require the contractor to respond to all odor complaints.

2.3.2 *Customer Odor Complaint Data Evaluation, 2018-2020*

Recent customer service complaint data was used to identify existing 'hot spots,' or areas with a high number of customer nuisance complaints, within the project area. Using customer service odor complaint call data from January 2019 through December 2020, detailed maps were generated and evaluated**.** These maps were used to assess the potential impact of collection system infrastructure on odor hot spots, as well as to identify areas where additional odor control improvements are required. Existing catch basin symbology was shown to distinguish between un-trapped and trapped catch basins. A number of un-trapped catch basins were observed near odor hot spots, suggesting that future entrapment of odor emissions may significantly reduce the number of customer complaints.

In addition, an evaluation was performed to evaluate the customer service complaint density across the MFWQTC tributary area for the evaluation period January 2019 through November 2020. The ESRI Kernel Density Spatial Analyst Tool was used to depict the number of calls associated with each complaint location. Based on the call density evaluation, three (3) major hot spot areas were identified which are centralized at the following locations:

1. West Burnette Avenue and Cypress Street
2. South 43rd Street and River Park Drive
3. Central Avenue and Taylor Boulevard

It should be noted that there were relatively few customer odor complaints within the ORFM area, suggesting that recent Bioxide dosing has been effective in minimizing odor emissions within the adjacent community. It is reasonable to assume that odor emissions will be reduced even further following the completion of the ORFM Oxygen System project (refer to **Section 2.2**).

3. Conclusions and Recommendations

3.1 Conclusions

Available data and reports were evaluated to understand existing and future odor control methods within the MFWQTC wastewater collection system, and to identify target areas for further evaluation as part of the OCMP Update.

MSD has made significant efforts to reduce odor emissions and mitigate customer nuisance complaints across the MFWQTC collection system. Beginning in March 2014, MSD contracted with a company to perform Bioxide chemical injections at specific locations in the collection system. Routine operation and maintenance of Bioxide feed systems were performed and documented in monthly service reports. Based on monthly H_2S monitoring data, Bioxide dosing rates were adjusted quarterly, as needed. In July 2020, MSD extended the calcium nitrate (Bioxide) dosing and monitoring services by an additional three (3) years which is documented in the Invitation to Bid (ITB). Nine (9) fall within the MFWQTC collection system, five (5) of which are actively performing Bioxide injection as of December 2020. Following completion of the oxygen dosing system improvements at one of the pump station sites, Bioxide injection will no longer be performed at this location.

In response to increased odor complaints along the ORFM, specifically at ARV locations, MSD contracted with a consultant in 2018 to develop short-term and long-term odor control recommendations for the ORFM region. A liquid oxygen injection system was proposed (and is currently under construction) at one pump station. In addition, MSD closed one of the two barrels in the ORFM based on recommendations from this study, and also continues to operate the biofilter system installed at the ARV as part of the 2018 study.

3.2 Recommendations

A large portion of the OCMP Update will be dedicated to odor control improvements in the MFWQTC collection system. Detailed field sampling will be performed at 'hot spot' locations where existing liquid and/or vapor sampling data is limited. Although MSD has made significant efforts to control and monitor odor-causing emissions in the northeast portion of the collection system and the southeast portion near one pump station, there is a lack of existing or future odor systems in the central downtown areas, towards the northwest and southwest portions of the MFWQTC collection system. Subsequently, high quantities of customer odor complaints have been filed for these locations, particularly between 2019 and 2020.

Based on the odor complaint density evaluation, several locations were identified as target areas for inclusion into the OCMP Update. Available GIS data was also used to determine the total number of untrapped catch basins located within 10-feet of large-diameter gravity sewers (greater than 36-inches in diameter) within each target area.

Table 3-1 summarizes each of the potential OCMP areas evaluated. Priority ranking was based on number of residences affected within each area and discussions with MSD staff. Number of affected residences were determined by summing the number of addresses linked to customer odor complaints during the 2019-2020 evaluation period. The table also identifies main sewers and total number of untrapped catch basins along major sewers as well as within each target area. **Table 3-1** also shows the target area boundaries, 2019 and 2020 customer service odor complaints, major sewers and force mains, and pump stations.

Table 3-1 OCMP Update Target Areas Summary

Priority Rank	Target Area Name	Major Sewer(s) in Target Area	Total # of Residences Affected, 2019-2020[1]	Total # of Untrapped Catch Basins along Major Sewer[2]	Total # of Untrapped Catch Basins in Target Area
1	Chickasaw	Ohio River Interceptor, Western Interceptor	65	6	221
2	Shawnee	Northwestern Interceptor, Ohio River Interceptor	50	27	232
3	California	Southern Outfall, Western Outfall	18	48	326
4	Park DuValle	Southern Outfall, Algonquin Interceptor, Young Ave Trunk	27	12	109
5	Taylor Berry	Larchmont Ave Sewer, Montana Ave Sewer	51	5	155
6	Downtown	Ohio River Interceptor	34	70	998
7	Old Louisville	Central Relief Drain	30	34	402
8	Clifton	Brownsboro Rd Trunk	27	0	213
9	Smoketown Jack/Shelby Pk	Beargrass Interceptor, Dry Run Sewer	25	3	194
10	Germantown	Beargrass Interceptor	23	29	197
11	Deer Park	Castlewood Sewer	21	16	107
12	Wyandotte/Beechmont	Mill Creek Trunk	21	26	300

[1] Total number of addresses linked to customer odor complaints from January 2019 through December 2020

[2] Value represents number of untrapped catch basins located within 10-feet of large diameter sewer centerline (greater than 36-in diameter)

It is recommended that the top (5) areas listed in **Table 3-1** be included in the OCMP Update sampling program for further investigation. The sampling program will include liquid phase sampling and vapor phase monitoring at target areas, as well as system headspace pressure to identify specific odor emission release areas. Ranking of sampling locations will also be performed and provided in future reports.

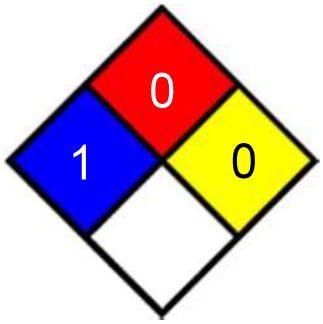
In addition, the contractor selected for the ongoing ORFM oxygen system project shall perform follow-up testing on the future odor system serving the ORFM area. Performance testing results should be provided by the contractor for inclusion into the OCMP Update.

Attachment 1 – Bioxide Safety Data Sheet

SAFETY DATA SHEET

SECTION 1: PRODUCT AND COMPANY INFORMATION			
PRODUCT TYPE:	Inorganic Salt Solution		
PRODUCT NAME:	**Bioxide®**		
COMPANY ID:	Evoqua Water Technologies LLC 181 Thorne Hill Drive, Warrendale, PA 15086		
TELEPHONE NUMBER:	**INFORMATION:**	**CORPORATE**	866.926.8420
	MEDICAL EMERGENCY:	**CHEMTREC**	800.424.9300
	TRANSPORTATION EMERGENCY:	**CHEMTREC**	800.424.9300
DATE PREPARED:	15 May 2015	**REVISION: 0**	

SECTION 2: HAZARD(S) IDENTIFICATION

HMIS RATINGS		NFPA RATINGS	GUIDE
HEALTH	**1**		4 – EXTREME/SEVERE 3 – HIGH/SERIOUS 2 – MODERATE 1 - SLIGHT 0 – MINIMUM ~~W~~ – WATER REACTIVE OX - OXIDIZER
FLAMMABILITY	**0**		
PHYSICAL HAZARD	**0**		
PERSONAL PROTECTION	**D**		

PICTOGRAM	SIGNAL WORD	HAZARD STATEMENT
	WARNING	H302: Harmful if swallowed. H315: Causes skin irritation. H320: Causes eye irritation. H335: May cause respiratory irritation.

PRECAUTIONARY STATEMENT(S)	
PREVENTION	P264: Wash…..thoroughly after handling. P270: Do not eat, drink or smoke when using this product. P280: Wear protective gloves/protective clothing. P261: Avoid breathing dust/fume/gas/mist/vapors/spray. P271: Use only outdoors or in a well-ventilated area.
RESPONSE	P301+P312: IF SWALLOWED: Call a POISON CENTER/doctor/….if you feel unwell. P330: Rinse Mouth. P302+P352: IF ON SKIN: Wash with plenty of water. P332+P313: If skin irritation occurs: Get medical advice/attention. P362+P364: Take off contaminated clothing and wash it before reuse. P305+P351+P338: IF IN EYES: Rinse cautiously with water for 15 - 20 minutes. Remove contact lenses, if present and easy to do. Continue

	rinsing. P337+P313: If eye irritation persists: Get medical advice/attention. P304+P340: Remove person to fresh air and keep comfortable for breathing. P312: Call a POISON CENTER/doctor/….if you feel unwell.
STORAGE	P402: Store in a dry place. P403+P233: Store in a well-ventilated place. Keep container tightly closed. P404: Store in a closed container. P405: Store locked up.
OTHER HAZARDS	
NONE	

SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

PERCENT BY WEIGHT	COMMON NAME (Ingredient / Component)	CAS NO.	IMPURITIES
50-60	Ammonium Calcium Nitrate Double Salt	15245-12-2	none
Balance	Water	7732-18-5	none

SECTION 4: FIRST-AID MEASURES

NECESSARY FIRST AID INSTRUCTIONS	
INHALATION FIRST AID	Remove affected person from area to fresh air. Give artificial respiration ONLY if breathing has stopped. Obtain medical attention if individual shows symptoms of exposure.
SKIN CONTACT FIRST AID	Immediately remove clothing from affected area and wash skin with flowing water and soap. Clothing must be washed before reuse. DO NOT instruct person to neutralize affected skin area. Obtain medical attention if irritation occurs.
EYE CONTACT FIRST AID	Immediately irrigate eyes with flowing water 15-20 minutes while holding eyes open. Contacts should be removed before or during flushing. DO NOT instruct person to neutralize. Obtain medical attention if irritation occurs.
INGESTION FIRST AID:	If victim is alert and not convulsing rinse mouth with water and give water to drink. Do not induce vomiting. If spontaneous vomiting occurs, have affected person lean forward with head down to maintain breathing passage. Obtain medical attention.
DESCRIPTION OF MOST IMPORTANT SYMPTOMS	
No Additional Information Available	
RECOMMENDATIONS FOR IMMEDIATE MEDICAL CARE	
Treat Symptomatically.	

SECTION 5: FIRE-FIGHTING MEASURES

SUITABLE EXTINGUISHING MEDIA	**Use an extinguishing media suitable for the surrounding fire.**
UNSUITABLE EXTINGUISHING MEDIA	**None**
SPECIFIC HAZARDS	**May support combustion at high temperature.**
PERSONAL PROTECTIVE EQUIPMENT	**In the event of fire, wear full protective clothing and NIOSH approved self-contained breathing apparatus with full face piece, operated in positive pressure mode.**

SECTION 6: ACCIDENTAL RELEASE MEASURES

PERSONAL PRECAUTIONS, PROTECTIVE EQUIPMENT AND EMERGENCY PROCEDURES

PERSONAL PRECAUTIONS	Handle in accordance with good industrial hygiene and safety practices. These practices include avoiding unnecessary exposure and removal of material from eyes, skin, and clothing.
ENVIRONMENTAL PRECAUTIONS	DO NOT DUMP ON THE GROUND OR INTO ANY BODY OF WATER.
CONTAINMENT AND CLEAN-UP	Mop up and containerize for subsequent recycling or disposal. Triple rinse empty containers with water prior to reconditioning.
OTHER INFORMATION	All disposal methods must be in compliance with all Federal, State, Local and Provincial laws, and regulations. Regulations may vary in different locations. Waste characterizations and compliance with applicable laws are the responsibility solely of the waste generator.

SECTION 7: HANDLING AND STORAGE	
PRECAUTIONS FOR SAFE HANDLING	Wash thoroughly after handling, immediately remove and dispose of any spillage. Immediately rinse contaminated clothing thoroughly with water. Rinse containers with water only.
CONDITIONS FOR SAFE STORAGE	Store in dry place at ambient temperatures apart from combustible and other readily oxidizable materials, food, beverage, and excessive heat. Rinse empty containers with water only.

SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION			
ENGINEERING CONTROLS	Adequate general and mechanical exhaust ventilation.		
RESPIRATORY PROTECTION	None required under normal use conditions. If use conditions generate mists, wear a respirator with acid gas cartridges.		
SKIN PROTECTION	Wear protective gloves and other protective clothing as appropriate to prevent skin contact.		
EYE/FACE PROTECTION	Wear safety glasses with side shields. Wear chemical goggles if splashing is likely.		
EXPOSURE LIMITS/GUIDELINES	No occupational exposure limits have been established for this material.		
	RESULT	**OSHA 8 HR** mg/m^3	**ACGIH TLV 8 HR** mg/m^3
PARTICULATES NOT OTHERWISE REGULATED (PNOR)			
PARTICULATES NOT OTHERWISE CLASSIFIED (PNOC)			

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES			
COLOR	Clear, colorless to slightly turbid tan	**MOLECULAR WEIGHT**	NA
ODOR	None	**ODOR THERSHOLD**	None
pH VALUE	5-8	**VAPOR PRESSURE**	NA
MELTING POINT	NA	**VAPOR DENSITY**	Liquid
FREEZING POINT	≤ -10 F (-23 C)	**RELATIVE DENSITY**	1.39 – 1.48 @ 20 C
INITIAL BOILING POINT	218 F – 221 F	**SOLUBILITY**	Complete
FLASHPOINT	NA	**PARTITION COEFFICEINT**	NA
EVAPORATION RATE	NA	**AUTO IGNITION TEMP.**	None
FLAMMABILITY	NA	**DECOMP. TEMP.**	NA
UEL	NA	**VISCOSITY**	NA
LEL	NA		

SECTION 10: STABILITY AND REACTIVITY	
REACTIVIVITY	NA
CHEMICAL STABILITY	Stable

POSSIBILITY OF HAZARDOUS REACTIONS	This product is incompatible with organic materials, reducing agents, chlorine or hypochlorite products, and caustic products.
CONDITIONS TO AVOID	Avoid evaporation to dryness. If allowed to dry, product residue is incompatible with flammable organic materials, reducing agents, and chlorine or hypochlorite products. This product is incompatible with caustic materials.
HAZAROUS DECOMPOSITION PRODUCTS	Nitrogen oxides, ammonia

SECTION 11: TOXICOLOGICAL INFORMATION		
INHALATION	ACUTE	Spray or mist may irritate respiratory tract.
	CHRONIC	There are no known chronic inhalation effects.
SKIN	ACUTE	May irritate the skin.
	CHRONIC	There are no known chronic dermal effects.
EYE	ACUTE	May irritate the eyes.
INGESTION	ACUTE	Ingestion of large amounts may cause violent gastroenteritis.
	CHRONIC	There are no known chronic ingestion effects.
LD50		>2000 mg/kg, oral (rat)
LC50		Not applicable
Acute Toxicity Estimate		>3900 mg/kg
CARCINOGENICITY/MUTAGENICITY		There are no known carcinogenic or mutagenic properties
REPRODUCTIVE EFFECTS		There are no known reproductive effects
NEUROTOXICITY		There are no known neurotoxic effects
OTHER EFFECTS		No other effects are known
TARGET ORGANS		Target organs include skin and eyes

SECTION 12: ECOLOGICAL INFORMATION

California Title 22 Acute Toxicity Screening Protocol:

Fish bioassay (96 hr):

Test concentration, ppm	Survival, %
0	100
250	95
750	100

The products of biodegradation are non-toxic. This product does not show any bioaccumulation phenomena.

SECTION 13: DISPOSAL CONSIDERATIONS

SPILL/LEAK PROCEDURES	Only properly protected personnel should remain in the spill area; dike and contain spill; absorb or scrape up excess into suitable container for disposal; wash area with water. Stop or reduce discharge if it can be done safely.
CLEANUP	Mop up and containerize for subsequent recycling or disposal. Triple rinse empty containers with water prior to reconditioning.
REGULATORY REQUIREMENTS	Generators of waste material are required to evaluate all waste for compliance with RCRA and any local disposal procedures and regulations. NOTE: State and local regulations may be more stringent than federal regulations.
DISPOSAL	Material that cannot be used, or reprocessed for use, and empty containers should be disposed of in accordance with all applicable regulations. Product containers should be thoroughly emptied before disposal.

SECTION 14: TRANSPORT INFORMATION		
LAND – DOT	**UN/NA IDENTIFICATION NUMBER:**	Not Applicable to unused finished product
	UN-PROPER SHIPPING NAME:	Not Applicable to unused finished product
	TRANSPORT HAZARD CLASS:	Not Applicable to unused finished product
	PACKING GROUP:	Not Applicable to unused finished product
	MARINE POLLUTANT:	Not Applicable to unused finished product
	HAZARD CLASS:	Not Applicable to unused finished product
WATER – IMO/IMDG	**UN/NA IDENTIFICATION NUMBER:**	Not Applicable to unused finished product
	UN-PROPER SHIPPING NAME:	Not Applicable to unused finished product
	TRANSPORT HAZARD CLASS:	Not Applicable to unused finished product
	PACKING GROUP:	Not Applicable to unused finished product
	MARINE POLLUTANT:	Not Applicable to unused finished product
AIR – ICAO/IATA *For product quantities less than 0.5 Kg*	**UN/NA IDENTIFICATION NUMBER:**	Not Applicable to unused finished product
	UN-PROPER SHIPPING NAME:	Not Applicable to unused finished product
	TRANSPORT HAZARD CLASS:	Not Applicable to unused finished product
	PACKING GROUP:	Not Applicable to unused finished product
	MARINE POLLUTANT:	Not Applicable to unused finished product

SECTION 15: REGULATORY INFORMATION	
OSHA	Hazard Communication Standard: Not regulated.
OSHA	Process Safety Standard: No
CAA	Section 112r: No
CERCLA	Section 103: No RQ: None
SARA	Section 302: No; SARA Section 304: No; SARA Section 313: No
SARA HAZARD CATEGORIES 311/312	Not listed.
TSCA	The ingredients of this product are on the TSCA Inventory List.

SECTION 16: OTHER INFORMATION	
DISCLAIMER:	The information contained herein is based on data considered accurate. However, no warranty is expressed or implied regarding the accuracy of these data or the results to be obtained from the user thereof. It is the buyer's responsibility to ensure that its activities comply with federal, state, provincial and local laws.
REVISION INDICATOR:	Revision 0: (This SDS replaces the former MSDS for this product pursuant to OSHA 1910.1200(g) Appendix D. The MSDS for this product should be considered obsolete).