Example Odour Control Report for a Facility with a Wastewater Treatment Process

**Sample Wastewater Company**

**Anytown, ON**

# Introduction and Scope of Odour Control Reports

## Purpose of the Example Odour Control Report

A person engaging in an activity prescribed for the purposes of the Environmental Activity and Sector Registry (EASR) by Ontario Regulation 1/17 (Air Emission EASR regulation) is required to have available at all times an Odour Control Report (OCR) if any of the circumstances set out in paragraph 5 of Section 24 of the regulation exists at the facility. If an OCR is required, the facility must prepare a facility-specific OCR that includes all the administrative and technical requirements set out in Section 27 of the Air Emissions EASR Regulation. In order to provide appropriate guidance materials and tools for facilities tasked with preparing an OCR, a total of six example OCRs have been developed by the Ministry of Environment and Climate Change (MOECC). One OCR is available for each activity with NAICS Codes listed in Table 3 – Odour – Processes and Setback Distances of the EASR publication, and for each specific process listed in Table 4 – Odour – Processes and Setback Distances, as follows:

* Dog and Cat Food Manufacturing NAICS 311111 and Cooking or Drying Animal Products
* Sugar Manufacturing NAICS 311310
* Breweries NAICS 312120
* Spraying Operation (≥ 10 L/hr) and Printing (> 400 kg/hr ink usage)
* Wastewater Treatment – Lagoons, Uncovered Clarifiers, Sludge Management
* Food Frying

The Dog and Cat Food Manufacturing and Cooking or Drying Animal Products OCR was prepared such that it is applicable to NAICS 311111 listed in Table 3 and Cooking or Drying Animal Products, a Table 4 process. One combined OCR for Spraying Operations (Painting) and Printing was prepared. Where appropriate, the wastewater treatment OCR may be combined with the other OCRs.

The purpose of the example OCRs is to simplify the level of effort required by facilities when developing an OCR. These example OCRs contain useable information and are presented in a recommended OCR format.

Some sections in the example OCRs can be used as a draft for facilities, particularly with respect to the jurisdictional review and odour control options provided in Section 4. This information can be incorporated by facilities into their site-specific OCR. It is imperative, however, that the information be reviewed and validated as it reflects information available at the time this example OCR was prepared (January 2017). There may be advancements in control technologies or other changes to the sector or process that would need to be considered. It is the responsibility of the person preparing an OCR for a facility to ensure that the information, including the jurisdictional review and odour control options is complete.

As well, a number of sections of the OCR will require site-specific inputs and considerations, in particular, Section 2 where unique attributes at a specific facility should be detailed, Section 5 which presents the assessment of control option technical feasibility, and Section 6 which summarizes the status of current odour control measures at the facility.

These example OCRs include narrative guidance text boxes throughout for instructional purposes, as well as Appendices with further guidance materials and resources.

As the unit operations and processes may differ between facilities, this report should not be considered comprehensive for all facilities that require an OCR. A facility-specific OCR must be prepared to include all odorous sources at a facility and all different types of equipment as well as the materials being used. All reasonable effort must be made to identify odour reduction measures and procedures that are available from publicly accessible resources.

# Table of Contents

[Statements of Certification 1](#_Toc486499039)

[Licensed Engineering Practitioner 1](#_Toc486499040)

[Facility Representative 1](#_Toc486499041)

[1. Introduction 2](#_Toc486499042)

[1.1 Odour Control Report for Wastewater Treatment 2](#_Toc486499043)

[1.2 Sector Description 3](#_Toc486499044)

[1.3 Odour Control Report for Sample Wastewater Company 3](#_Toc486499045)

[1.4 Odour Control Report Content 4](#_Toc486499046)

[2. Facility Description 5](#_Toc486499047)

[2.1 Site Location and Location of Points of Odour Reception 5](#_Toc486499048)

[2.2 Facility Owner Legal Name and Contact Information 5](#_Toc486499049)

[2.3 Facility Operator Legal Name and Contact Information 5](#_Toc486499050)

[2.4 Production Rate and Operating Hours 5](#_Toc486499051)

[2.5 Facility Complaint History 5](#_Toc486499052)

[2.6 Unique Facility or Process Attributes 6](#_Toc486499053)

[3. Process Description 7](#_Toc486499054)

[3.1 General Wastewater Process Description 7](#_Toc486499055)

[3.2 Identification of Odorous Contaminants 9](#_Toc486499056)

[3.3 Identification of Odour Sources and Source Groupings 10](#_Toc486499057)

[4. Sector Odour Control Measures 15](#_Toc486499058)

[4.1 Current Practices at Wastewater Facilities 15](#_Toc486499059)

[4.2 Control Measures for Primary Odour Sources at Sample Wastewater Co. 21](#_Toc486499060)

[4.3 Control Measures for Secondary Sources at Sample Wastewater Co. 25](#_Toc486499061)

[5. Feasibility Assessment 28](#_Toc486499062)

[Table 5 – Summary of Feasibility Assessment for Sample Wastewater Co. 31](#_Toc486499063)

[6. Adequacy of Current Odour Control Measures and BMPP 36](#_Toc486499064)

[6.1 Control Measures or Procedures to be Evaluated for Implementation 37](#_Toc486499065)

# List of Tables

Table 1A – Odour Source Identification Table for Sample Wastewater Co. (Primary Sources)

Table **1**B – Odour Source Identification Table for Sample Wastewater Co. (Secondary Sources)

Table 2 – Potential Alternative Odour Control Measures for Sample Wastewater Co.

Table 3 – Potential Odour Control Measures for Sample Wastewater Co. Primary Sources

Table 4 – Potential Odour Control Measures for Sample Wastewater Co. Secondary Sources

Table 5 – Summary of Feasibility Assessment for Sample Wastewater Co.

Table 6 – Control Measures or Procedures to be Evaluated for Implementation

# Appendices

Appendix A – Supplemental Guidance for Developing a Facility Specific OCR

Appendix B – Control Equipment Descriptions

Appendix C – References

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# Statements of Certification

## Licensed Engineering Practitioner

I confirm that based on the information provided to me, the information in the report is accurate as of the date it is signed and sealed.

Signature:

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Name of Licensed Engineering Practitioner:

PEO License Number:

Date:

## Facility Representative

I confirm that all information provided to the Licensed Engineering Practitioner in order to prepare this report was complete and accurate, and I have the authority to bind the company.

Signature:

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Name of Facility Representative:

Position in the Company:

Date:

# Introduction

## Odour Control Report for Wastewater Treatment

This Odour Control Report for the Sample Wastewater Company (the ‘OCR’), a facility with a wastewater treatment process and facility where wastewater treatment is not the primary processing or manufacturing focus of the operations, was prepared to comply with the odour requirements of Ontario Regulation 1/17 – Activities Requiring Assessment of Air Emissions (the ‘Air Emissions EASR Regulation’) for facilities that meet the following criteria:

* The facility is required to register their activities under the Air Emissions EASR Regulation;
* The facility has completed an odour screening report in accordance with Section 25 of the Air Emissions EASR Regulation;
* The facility includes a wastewater treatment process with an uncovered clarifier, lagoon and sludge management at the facility, which are processes set out in Table 4 of Chapter 4 of the “Environmental Activity and Sector Registry – Limits and Other Requirements” (EASR Publication) published by the Ministry of Environment and Climate Change (MOECC), and available on a government website; and,
* The distance between the facility and the closest point of odour reception is less than the distance set out opposite the process in Table 4 (Chapter 4 of the EASR publication explains what a point of odour reception is and how the distance between a point of odour reception and the facility must be measured).

A facility is required to prepare an OCR if any of the circumstances set out in paragraph 5 of Section 24 of the Air Emissions EASR Regulation exist at the facility. If an OCR is required, the facility must prepare a site-specific OCR that includes all the administrative and technical requirements set out in Section 27 of the Air Emissions EASR Regulation.

While this example OCR report pertains to industrial wastewater treatment processes, it can also be used to assist facilities outside of this sector that have similar sources and emissions of odour in preparing their OCRs.

A facility is required to prepare a Best Management Practices Plan for Odour (BMPP) if any of the circumstances set out in paragraph 3 of Section 24 of the Air Emissions EASR Regulation exist at the facility at the time the most recent odour screening report is prepared. BMPPs must be prepared on a facility-basis. In this example, the Sample Wastewater Company must, in addition to this OCR, develop and implement a BMPP. Best Management Practices (BMPs) are practices or procedures to prevent or minimize odorous effects. These may be general in nature and applicable to a wide range of facilities, or they may be facility-specific and intended to help reduce odorous releases from process operations or activities at an individual site. These practices are most easily implemented and most effective if they are incorporated into Standard Operating Procedures (SOPs) and training programs and workers are assigned responsibility and accountability. BMPs in general would not require additional engineering or significant process modifications or the installation of pollution control equipment.

Senior management at the facility must participate in the development of the OCR, and support the Licensed Engineering Practitioner by providing comprehensive and accurate information regarding site processes, activities, and emissions. The accuracy and completeness of the information provided for the preparation of the OCR must be certified by a representative of the facility.

## Sector Description

Ontario has an economy based on manufacturing and processing operations and many facilities have some form of process water treatment at their facility prior to discharge into a municipal sewer system or prior to direct discharge into the natural environment. There is no consideration within this OCR for the treatment of odour control of human wastewater treatment as sewage treatment facilities with NAICS Code 22132 are not subject to the Air Emissions EASR Regulation.

It is not a mandatory requirement of the OCRs to include a sector description. However, it is recommended that a facility demonstrates that the activities and operations carried out at their site are consistent with other facilities in their sector (Section 1.4), and to highlight the differences or aspects of operations that are unique to their operation (Section 2.6).

The receiving bodies are the determining factor in the treatment processes and effluent quality required by the facility. Simple treatment can consist of wastewater collection and equalization with discharge to a municipal wastewater system where the effluent will be further treated with all collected municipal wastewater. A complex system can include tertiary treatment systems having multiple stages of bio-reactors, aerobic, anaerobic systems, and inorganic removal systems as discharges into biologically sensitive receptor wetlands require effluent that meets provincial standards for the direct discharge.

The odours typical to a wastewater treatment process that is designed to treat organic matter are often result of anaerobic or septic conditions that lead to the production of H2S and other reduced sulphur compounds. There are other organic odours that are common, such as mercaptans and amines, but the H2S is the most prevalent.

## Odour Control Report for Sample Wastewater Company

An OCR is required for the Sample Wastewater Co., a facility with a wastewater treatment process handling up to 2,500 litres per day of process wastewater from meat and bakery production and discharging directly to a natural watercourse. The on-site primary and secondary aerobic treatment are activities that trigger the requirement for an OCR. The closest point of odour reception is less than 750 metres from the nearest source of odour at the facility.

Chapter 4 of the EASR publication explains what a point of odour reception is and how the distance between a point of odour reception and the facility must be measured. The required setback distance for Wastewater Treatment is 1000 metres as listed in Table 4 of the EASR Publication.

If an OCR is triggered for both the wastewater treatment process as well as for the facility generating the wastewater, it is not a mandatory requirement of the OCRs to prepare separate OCR for the different activities; one OCR may be prepared that includes all odorous sources.

## Odour Control Report Content

This OCR for the Sample Wastewater Co. has been prepared in accordance with the Air Emissions EASR Regulation, and therefore includes the following required elements:

* Legal name of each facility owner and name under which the owner carries on business, if different from the legal name;
* If the facility operator is not an owner of the facility, the legal name of each facility operator and name under which each operator carries on business, if different from the legal name;
* Facility address;
* A facility description and a detailed process description;
* Measures and procedures used by facilities in this sector, or at facilities with similar sources of odour or activities, to prevent or minimize the discharge of odour, including control equipment, engineering controls, process optimization, pollution prevention, or other associated measures. In many cases, these measures were intended to abate specific contaminants but have the net effect of reducing odour emissions. For example, wet particulate matter control units such as scrubbers or rotoclones could serve to control odours;
* An analysis of the technical feasibility of implementing the measures and procedures identified, or potential combinations thereof at the facility;
* For the control measures identified as technically feasible but not implemented, rationale for why the control measures are not implemented at the facility to prevent or minimize odour;
* A discussion of the adequacy of measures and procedures currently implemented and set out in the BMPP, to prevent or minimize odour effects from the facility;
* A statement by the Licensed Engineering Practitioner confirming that based on the information provided to the practitioner, the information in the report is accurate as of the date it is signed and sealed; and,
* A statement signed by the person engaging in the prescribed activity confirming that all information the person gave to the Licensed Engineering Practitioner in order to prepare the report was complete and accurate.

# Facility Description

## Site Location and Location of Points of Odour Reception

The facility is located at 100 Sample Drive, in Anytown, Ontario.

The UTM co-ordinates for the facility are:

* Zone – 17
* UTM Easting - 723000 m
* UTM Northing - 4840000 m

The Sample Wastewater Co. is located in an industrial area that lies adjacent to a residential development. The closest point of odour reception is a residence located 500 metres from the fenceline of the facility and 750 metres from the nearest odour source at the facility, which is less than the required setback distance of 1000 metres from Table 4 of the EASR Publication. There are other residences as well as a public sports field within 1000 metres of the facility and 1500 metres from the odour source.

## Facility Owner Legal Name and Contact Information

Legal name of the owner: Mr. Bob Weir

Contact Information: 519-123-4567; [bob.weir@samplewastewaterco.com](mailto:bob.weir@samplewastewaterco.com)

## Facility Operator Legal Name and Contact Information

The facility is operated by the owner.

The Air Emissions EASR Regulation requires that the OCR sets out the legal name of each owner of the facility, and the name under which each owner carries on business, if it is not the owner’s legal name. Further, if the person who operates the facility is not an owner, the report must set out the legal name of each person who operates the facility and the name under which each operator carries on business, if it is not the operator’s legal name.

## Production Rate and Operating Hours

The wastewater process treats up to 2,500 litres of process wastewater daily.

The wastewater plant maintains continuous operations 24 hours per day, 7 days per week, with no complete system shut-downs. The facility generating the process wastewater operates 24 hours per day, 7 days per week.

## Facility Complaint History

The facility maintains accurate records of all complaints received and the measures taken to investigate and respond to each complaint following the process outlined in the facility BMPP. This includes complaints made to the facility directly, as well as those made to the local MOECC office. There have been no complaints received over the last 5 years.

It may be beneficial for a facility to document all complaints received and their resolution in the OCR. Some complaints may have been resolved or were the result of a process upset. Resolved complaints could lead to changes or improvements in the facility’s BMPP for odour. However, documenting complaints in an OCR is not a legal requirement.

## Unique Facility or Process Attributes

At the Sample Wastewater Co. there is both a meat product manufacturing line and a bakery product manufacturing line.

The following processes, activities, or sources may be considered unique when compared to other wastewater treatment facilities:

* Treating effluent containing both meat processing by-products and wastewater from baked goods manufacturing; and,
* The sludge generated is shipped off-site for use as Non-Agricultural Source Material (NASM) on nearby farmland.

Each manufacturing and wastewater treatment process is unique and source to source variations in the process, collection and handling practices, source configurations or location at the facility can significantly affect emissions and off-property impacts. The emission variations result from differences in the raw materials, the type and age of equipment used, total production, etc. All of these factors and production details need to be clearly described in a facility’s OCR.

# Process Description

## General Wastewater Process Description

At the Sample Wastewater Co., treatment process includes the following stages:

* Primary Treatment;
  + Coarse Solids Removal - Rotating Drum
  + Fine Solids Removal - Dissolved Air Flotation
  + Equalization Basin
* Secondary Treatment;
  + Aerobic Digester - Aeration Basin
* Tertiary Treatment;
  + Uncovered Clarifier
* Return Activated Sludge;
* Lagoon;
* Waste Activated Sludge - Sludge Thickening;
* Discharge; and,
* Auxiliary Services Equipment.

The wastewater is collected throughout the facility and conveyed to the wastewater treatment system for processing. There are a series of floor drains, sumps and drain lines that convey the process wastewater and sanitation water generated at each stage of production to the wastewater treatment system area located at the rear of the plant.

### Primary Treatment - Rotating Drum

The solids laden wastewater stream, such as the meat processing wastewater, is conveyed in a water flume to the rotating drum. The liquid-waste stream is delivered to the rotating drum where the solids are mechanically separated from the liquids for further processing/disposal and the liquid stream is directed to the Equalization Basin. Depending on the materials being processed, there could be fugitive emissions associated with this process.

### Primary Treatment - Equalization Basin

Liquid waste streams generated in the plant as well as the discharge from the Rotating Drum are conveyed to the Equalization Basin (EQ). This allows for all the individual sources of wastewater generated at the facility to be mixed. This provides a buffer for temperature and pH prior to the chemical and biological treatment. There is negligible odour emissions associated with EQ basin operations.

### Primary Treatment - Dissolved Air Flotation

The wastewater leaves the EQ basin and enters the Dissolved Air Flotation system (DAF). This system utilizes chemical coagulants or flocculants that when mixed with the wastewater cause small particles to conglomerate into bigger clusters. A portion of the treated wastewater is pressurized and introduced into the DAF to create fine bubbles. The combination of the bubbles and the coagulated solids creates a DAF ‘float’ on the surface of the water, and heavier solids form a sludge on the bottom of the tank. There is a continuous removal mechanism for both the float and the sludge. The creation and handling of the DAF float and sludge have the potential to have odour emissions associated with them.

There is further processing of the DAF float through a series of centrifuges. The centrifuges are used to capture oils and other usable substances from the float materials. The use of the centrifuges results in an increase in the wastewater temperature and may potentially increase odour emissions.

### Secondary Treatment - Aerobic Digester – Aeration Basin

Following the DAF, the wastewater is directed to the Aeration Basins where microorganisms consume the organic content of the wastewater through aerobic digestion. Aerators, dissolved oxygen monitors and automated controls maintain a healthy aeration basis and aerobic system which does not have an odour issue associated with its operation.

### Tertiary Treatment - Uncovered Clarifier

The digested wastewater is directed to the clarifier for final settling prior to storage and holding in the lagoon system. The clarifier allows for any solids/sludge to separate out and float to the top for removal. The open clarifier odour emissions and off-property impact depend on weather conditions and siting on the facility with respect to other building, operations, and proximity to the property line.

### Waste Activated Sludge - Return Activated Sludge - Sludge Thickening

The secondary wastewater treatment system creates sludge as a by-product for the aerobic digestion of the organic material in the wastewater stream. The sludge handling includes removing excess sludge (sludge waste) from the system to remove excess microorganisms for proper control of the process and to prevent the secondary clarifier from filling up with solids or getting to a level where solids may go anaerobic. However, a portion of the activated sludge needs to be retained within the system to maintain the health of the aerobic digesters and continue the treatment of the wastewater. Maintaining a healthy sludge balance will minimize odour emissions. The facility utilizes lime stabilization of the sludge waste during storage prior to shipping it off-site to be used as part of a NASM program.

### Lagoon Storage

The clarified wastewater is discharged to the lagoon for final storage prior to its discharge to the natural environment. The lagoon has no odour controls as it is similar to a natural open water body. It is open to interactions with local animal, bird and reptile species as well as full exposure to elements of the weather and seasonal changes. The facility monitors dissolved oxygen content at multiple locations throughout the lagoon as an operational control. Maintaining an optimum oxygen content, pH, and temperature ensures a healthy aerobic system and significantly reduces the odour potential of the lagoon.

### Discharge

The discharge area is a wetland course that enters a recreational area at the north end of the property. The wetland path is designed as a natural growth area with plants that withstand seasonal weather fluctuations in conjunction with the continuous discharge characteristics of the wastewater to provide a buffer to the recreational area. There are no odour emissions associated with the discharge of the wastewater to the watercourse due to the high final quality of the effluent following treatment.

### Auxiliary Services Equipment

The auxiliary equipment and processes are those of any large manufacturing facility, and include:

* Blowers;
* Small unit heaters, radiant heaters, make-up air units, or other HVAC;
* Quality assurance / quality control laboratory; and,
* General (non-process) building exhausts (office space, cafeteria, and washrooms).

## Identification of Odorous Contaminants

In this wastewater facility the expected odorous contaminants are ammonia, hydrogen sulphide and various Volatile Organic Compounds (VOCs). These are all products of degradation and aerobic consumption of organic matter.

It should be noted that odours from wastewater treatment are generally very distinct from the typical production odours for the meat and bakery production that the wastewater plant is servicing. Other controls such as particulate matter (no particulate based odours are emitted from wastewater treatment) or emissions specific to the production facility are not identified or discussed in this OCR as they do not pertain specifically to wastewater treatment operations. The meat processing and bakery associated with the wastewater treatment plant have their own OCRs to deal with odours from their operations.

For the Sample Wastewater Co., ammonia, hydrogen sulphide and VOCs are the predominant sources of odour. Odours may also occur from the use of bleach, chlorine or sanitizing chemicals.

Ammonia (NH4) is produced from the natural degradation of meat products. The ammonia generation within the Aeration Basin – Sludge – Lagoon system will vary with temperature, weather conditions, and water composition.

Hydrogen sulphide (H2S) is a natural by-product in the anaerobic biodegradation of organic material. The ingredients used to make the products at the meat processing and bakery facilities contain organics that have the potential to create H2S. As well, the normal operation of the aerobic wastewater treatment plant can result in anaerobic processes under certain conditions.

VOCs are also released during wastewater treatment, and generally include propanol, toluene, benzene and aldehydes.

The intention of the OCR is to focus efforts on odour emissions that are associated with facilities that have these activities. The speciation of odour in the exhaust gases by specific contaminant is not required.

However, a better understanding of the nature of the odour and the expected chemical composition of odorous emissions may be useful, if available, in determining which control options have been proven effective on similar processes. For example, control options for VOC odours may not be effective or technically feasible on odours from sulphur-containing emissions. This detail also allows for discussion of the offensiveness of the odour and the identification of potential contaminants with low odour detection thresholds.

## Identification of Odour Sources and Source Groupings

Each odour source at the Sample Wastewater Co. facility has been classified as a primary odour source, secondary source, or a negligible odour source based upon the source’s odour emission rate and the relative contribution to potential off-site odour effects. For each odour source, a general description of the associated process, unit operation, equipment, or activity, expected contaminants in the exhaust gas, typical odour loadings, factors which may affect the odour loading, and potential constraints were provided, where applicable. The key parameters are presented in tabular format.

For this sector, ammonia and H2S emissions are considered the predominant source of odours, and to a lesser extent VOCs.

Individual sources identified as primary or secondary sources are presented, or, where possible, sources are grouped where it is reasonable to do so. Grouping is useful when sources are associated with the same process stage, same production area, or have similar odour and exhaust characteristics. These sources may be combined and directed to individual pollution control equipment or dealt with as an aggregate.

Dispersion modelling is not a requirement of the OCR. If no previous odour assessment with dispersion modelling has been completed for the facility, other methods of assessing the relative significance of odour sources may be employed to identify odour sources.

If dispersion modelling for odour has previously been completed, the model output should be reviewed as it may be useful in assessing odour effects and classifying sources as primary, secondary, or negligible. Even if accurate emission data are not available, dispersion modelling for odour and the use of a dilution factor is an effective tool in ranking odour sources by considering the dispersion (i.e. dilution) characteristics of different sources such as tall stacks and wall mounted vents. A dilution or dispersion factor is the modelled odour strength or concentration at a receptor (OU/m³) divided by the source strength as an emission rate (odour units per second, OU/s) that can be used for screening purposes to evaluate the effects of odour emissions from one individual odour source at an odour receptor.

**Estimating Odour Loading (Concentration OU/m³ and Emission Rates OU/s)**

Estimating the odour loading from sources may be done using emission factors, data from similar processes at other facilities, or source measurement. In many cases the only available emission factors are for VOCs as little data on odour loadings is publicly available and difficult to apply on a generalized basis. The odour and VOC emissions may not be directly proportional; however, these values will also assist in site-specific determination of the VOC concentration and emission rate for individual sources to allow for comparisons, ranking of sources, and discussion of the suitability of control measures.

Odour measurement at the source may be conducted on-site to determine the odour concentration and emission rate in OU/m³ and OU/s, respectively. Odour sampling methodology is published in the MOECC Source Testing Code, and odour concentrations are frequently measured using an olfactometer. An odour unit (OU) is a measure of the intensity or strength of an odour. One odour unit is the level at which half the population would detect or respond to an odour, and the odour concentration, in OU/m³, refers to the number of times the sample must be diluted to reach 1 OU.

### Primary Sources of Odour

The primary odour sources from the Sample Wastewater Co. were identified based upon a thorough understanding of the wastewater treatment process and a previous odour survey conducted to rank the sources by potential for off-site effects. The previous odour survey is up to date and reflects current operations.

The following are considered to be the major odour sources from wastewater treatment and are the primary odour sources for Sample Wastewater Co.:

#### Dissolved Air Flotation and Centrifuges;

#### Uncovered Clarifier; and,

#### Sludge Handling and Storage.

These sources are described in Table 1A.

### Secondary Sources of Odour

The secondary odour sources are presented in Table 1B and have the potential to contribute to odour effects, but not to the same extent as those deemed primary sources of odour.

The secondary sources of odour at the Sample Wastewater Co. include:

* Lagoon storage;
* Pre-treatment (Rotary Screen; Equalization Basin); and,
* Secondary Treatment (Aerobic Digestion – Aeration Basin).

Where needed, these sources are considered in the BMPP for the facility.

### Sources Not Considered Odorous

The following air emissions sources are not considered as significant odour sources at most wastewater treatment operations, including the Sample Wastewater Co.:

* Effluent discharge point;
* Chemical storage;
* Blowers;
* HVAC equipment (comfort heating and cooling);
* Cafeteria exhausts and other employee comfort areas; and,
* Office Areas.

All potentially odorous sources have been included in the BMPP for the facility.

All potentially odorous sources should be included in the BMPP for the facility, if applicable. For the Sample Wastewater Co., the chemical storage was included in their BMPP to ensure proper management of all chemicals. There is no odour associated with the other insignificant sources.

**Table 1A - Sample Odour Source Identification Table for Sample Wastewater Co. (Primary Odour Sources)**

| **Source Description** | **Odorous Contaminants** | **Odour Loading** | **Exhaust**  **Characteristics** | **Flow Rate** | **Continuous or Intermittent Discharge** | **Current Odour Control Measures** |
| --- | --- | --- | --- | --- | --- | --- |
| Dissolved Air Flotation (DAF) | H2S  Ammonia | High | Open tank | Low | Passive | Stack Optimization  BMPP |
| Clarifier | H2S | Moderate | Outdoor Open tank | Low | Passive | BMPP |
| Sludge Handling and Storage | H2S  Ammonia | High | Silo Storage - Passive  Handling - Fugitive | Low | Intermittent | Lime Stabilization |

**Table 1B - Sample Odour Source Identification Table for Sample Wastewater Co. (Secondary Odour Sources)**

| **Source Description** | **Odorous Contaminants** | **Odour Loading** | **Exhaust**  **Characteristics** | **Flow Rate** | **Continuous or Intermittent Discharge** | **Current Odour Control Measures** |
| --- | --- | --- | --- | --- | --- | --- |
| Rotary Screen | VOCs, Ammonia | Low | Passive | Low | Intermittent | BMPP |
| Aeration Basin | VOCs  H2S | Low | Open surface | High | Continuous | Oxygen concentration controlled to ensure greater than 4%  BMPP |
| Lagoon Storage | H2S  Ammonia | Low | Open surface | Passive | Continuous | Monitoring of oxygen content, pH, and temperature |

**Site-specific Source Description**

General indicators of the odour loading, stack parameters, and exhaust gas flow rate are provided in Tables 1A and 1B. Facilities should ensure that all available source and stack data, available through their Emission Summary and Dispersion Modelling (ESDM) report, is used to describe the odour sources as accurately as possible.

# Sector Odour Control Measures

This section of the OCR is provided as a summary of general industry practices and BMPs for wastewater treatment that are considered when dealing with uncontrolled or problematic odour sources, where appropriate.

In Ontario, the need to implement odour control measures depends upon many factors, including the presence of odour receptors, a history of odour complaints, or siting in an area with multiple industrial sources. In the absence of off-site odour impacts, there is typically no reason for additional control equipment, engineering controls, or abatement measures specific to odour.

A review of publicly available information was completed to identify what measures and procedures are in use to control air emissions. Sources included Environmental Compliance Approvals (ECAs) for Ontario facilities, European Union BAT reference documents (BREFs) and associated guidance materials, US EPA Title V Permits and Reasonably Available Control Technology (RACT) Analysis documents, among others. In many cases, the control measures were implemented to reduce total VOC discharges, which had the added benefit of reducing odour emissions. A review of measures that can be used on similar sources was also completed to identify any that are potentially transferrable to wastewater treatment.

The odour control measures identified in this section have been demonstrated to be effective at wastewater treatment facilities. Current practices for odour controls range from the implementation of BMPs for smaller processes to control equipment on all odorous sources at larger operations or those that have nearby odour receptors.

A review of a number of facilities or organizations within Ontario, the US, the EU, and Australia was conducted to identify what measures, if any, have been implemented.

## Current Practices at Wastewater Facilities

The odour control measures and procedures identified are currently in use at processes similar to each odour source or source grouping identified at the Sample Wastewater Co. and are presented in Table 3 for the primary sources and Table 4 for the secondary sources.

### Ontario

Facilities that have wastewater treatment activities at their facility cannot be identified by a specific NAICS code. As such, it was difficult to obtain a group of similar business ECAs through the MOECC Access Environment database of historical and current approvals that would be representative of all the potential types of wastewater treatment operations in Ontario. A number of ECAs were reviewed for small, medium and large facilities in Ontario that have potentially odorous activities and have on-site wastewater treatment. There was no data obtained on how many manufacturing facilities in Ontario have wastewater treatment or that may require an OCR.

Information on six facilities in Ontario with MOECC ECAs that included wastewater treatment was obtained through the MOECC Access Environment database of historical and current approvals. Approvals for both industrial sewage works and air were reviewed, where available. In many cases, facilities with an ECA for industrial sewage works did not have an ECA for air and noise.

The data available for the following facilities details control measures, where employed for wastewater treatment, as well as operational production limits and a description of the surrounding area and identification of potential odour receptors:

* One food manufacturing facility collects, treats, and disposes of up to 307,700 m³/year of process wastewater, complete with wastewater pre-treatment via screening, equalization, and dissolved air flotation (DAF) with flocculation, followed by treatment in aerated lagoons. There are no details of control measures specific to air emissions other than the approved treatment system specifications and operational measures, and the required discharge monitoring, that ensures effective wastewater treatment that would prevent odours. The facility is located in a rural setting with agricultural activities and rural residential properties as adjacent neighbours that may be within 500 metres.
* One food manufacturing facility collects, treats, and disposes of up to 5,900 m³/day of process wastewater, complete with primary treatment via screening and DAF, secondary treatment in an activated sludge aeration basin, a clarifier, a polishing aerated lagoon, and a settling lagoon, tertiary treatment involving equalization, chemical dosing, and sand filtration, and lastly UV disinfection prior to discharge. There are no details of control measures specific to air emissions other than the operational measures required for the effective wastewater treatment that would prevent odours. The facility is located in a rural setting with agricultural activities and rural residential properties as adjacent neighbours that may be within 500 metres.
* One pet food manufacturing facility operates with an activated carbon adsorption system to control odours from the wastewater treatment building. There are no details on the volume of wastewater treated. The facility is located on the perimeter of an industrial area with one potential odour receptor noted within 500 metres.
* One food manufacturing facility collects, treats, and discharges up to 60,000 L/hour of process wastewater, complete with treatment via screening, DAF, aeration tanks, clarifiers, and sand filtration, and UV disinfection prior to discharge. There are no details of control measures specific to air emissions other than the operational measures required for the effective wastewater treatment that would prevent odours. The facility is located in a rural setting with agricultural activities, greenspace, and rural residential properties as adjacent neighbours that may be within 500 metres.
* One food manufacturing facility collects, treats, and discharges up to 1,300 m³/day of process wastewater, complete with treatment using anoxic and aeration tanks, a membrane bioreactor, DAF, clarifiers, polishing treatment/lagoon, and UV disinfection prior to discharge. There are no details of control measures specific to air emissions other than the operational measures and discharge monitoring required to ensure effective wastewater treatment that would prevent odours. The facility is located in a rural setting with agricultural activities, and rural residential properties as adjacent neighbours that may be within 500 metres.
* One food manufacturing facility that collects, treats, and discharges up to 300 m³/day of process wastewater, complete with aerated tanks (activated sludge), a secondary clarifier, sand filtration, and UV disinfection prior to discharge. There are no details of control measures specific to air emissions other than the approved treatment system specifications and operational measures, and the required discharge monitoring, that ensures effective wastewater treatment that would prevent odours. The facility is located in a rural setting with agricultural activities, and rural residential properties as adjacent neighbours that may be within 500 metres.

The Sample Wastewater Co. is considered to be a moderately sized facility. It can be inferred that the more stringent emission controls in Ontario and other jurisdictions are a result of either significantly larger scale operations or where site-specific issues have warranted more extensive controls. However, facilities developing an OCR should consider all relevant controls for facilities of various sizes and specific locations.

### Other Provinces

Industrial wastewater treatment activities support other industrial processes and manufacturing; therefore, it is difficult to identify facilities across Canada that would have similar permitting and approvals from publicly available resources. There were no specific guidance, regulatory requirements, or odour emission inventories for facilities in other provinces that provide details on odour control measures utilized by facilities with wastewater treatment operations.

### United States

It is important to note that “odour” is not a regulated emission in the US. The following discussions consider controls required for volatile organic emissions (VOCs). Some of these control systems and requirements will also reduce odour emissions.

In the US, Title V operating permits are federally mandated for major stationary sources of air pollution with actual or potential emissions at or above the major source threshold for specified air pollutants defined by regulation (the major source threshold list can be found at the [Air Toxics Web Site](https://www3.epa.gov/airtoxics/pollsour.html)). The permitting is administered by state or district agencies. A limited number of smaller sources also require Title V permitting.

In addition to the requirement for operating permits, New Source Review (NSR) is a Clean Air Act program that requires industrial facilities to install modern pollution control equipment when they are built or when making a change that increases emissions significantly. The NSR permitting varies depending upon the attainment status of the district in which the facility is located. For major sources, Best Available Control Technology (BACT) would be required in attainment areas under the Prevention of Significant Deterioration program, Lowest Achievable Emission Rate (LAER) in non-attainment areas, there are no specified controls for minor sources or minor modifications to major sources. No documentation is available for facilities that do not trigger Title V permit or NSR requirements.

Similar to Ontario operations, US facilities commonly have wastewater treatment to support their manufacturing processes.

Well-known brands that may require wastewater treatment were searched to determine if any odour control requirements were included in their Part V Permits. The control measures detailed in the following examples are not intended to suggest that control measures are required on all wastewater treatment processes.

The data available for the following five facilities details control measures, where employed for wastewater treatment, as well as operational production limits and a description of the surrounding area and identification of potential odour receptors:

* Two large breweries operate Bio-Energy Recovery Systems (BERS) which uses anaerobic bacteria to reduce organic material in the brewery wastewater. The methane created is used to supplement the boiler fuels. The reactor headspace gases are routed to an off-gas filter to remove the H2S and odour, and a flare is used as a safety device to thermally oxidize methane and H2S that cannot otherwise be burned in the boilers during start-up, shutdown, or malfunction. The volume of wastewater treated is not provided on one permit, the second has a limit of 788 million gallons per 12 month period. One facility is located in a developed area next to a theme park and residential development; the second facility is located adjacent to farmland, other industrial facilities, a medical facility, and a major roadway interchange.
* One large brewery operates an odour control system complete with a biofilter with activated carbon vessels; the odour control system treats headspace vapours from wastewater treatment tanks and fugitive gases from the digester. The facility is located in an industrial area with notable separation from residential developments.
* One facility discharges up to 6.5 million gallons per day of treated process and sanitary wastewater from food manufacturing. The wastewater treatment includes screening, a covered anaerobic lagoon with biogas handling system, an activated sludge system with aeration tank, and a secondary clarifier. The biogas is collected and thermally treated by a propane flare or is directed to a facility boiler. The facility is located in a rural setting adjacent to agricultural activities and rural residential properties.
* One facility pre-treats wastewater from food manufacturing prior to discharge to the municipal water treatment system. The wastewater treatment includes lime injection, with no mention of odour control measures in the permit. The facility is located in a developed area adjacent to other industrial facilities and residential neighbourhoods.

The information on control measures provided in the publicly accessible Title V permits from state or district environmental agencies are for facilities identified as major sources. Small and medium sized facilities are unlikely to reach the release-based thresholds that would trigger requirement of a Title V permit. The odour control measures required, if any, depend upon production levels at the facility. Caution should be used when comparing controls from large facilities as the control measures identified may not be appropriate for smaller facilities.

### European Union

There are Best Available Techniques (BAT) for wastewater treatment odour control published in the European Commission Best Reference Document on Best Available Techniques (BREF) for Common Wastewater and Waste Gas Treatment/Management Systems in the Chemical Sector (CWW) (EC 2016). The BAT for the meat and bakery production lines have been considered in a separate OCR specific to the production area and are not detailed in this sample OCR for the wastewater treatment.

There are two BAT specific to odour control from wastewater collection, treatment and sludge treatment:

BAT20: In order to prevent or, where that is not practicable, to reduce odour emissions, BAT is to set up, implement and regularly review an odour management plan, as part of the environmental management system (see BAT 1), that includes all of the following elements:

1. a protocol containing appropriate actions and timelines;
2. a protocol for conducting odour monitoring;
3. a protocol for response to identified odour incidents; and,
4. an odour prevention and reduction programme designed to identify the source(s), to measure/estimate odour exposure, to characterise the contributions of the sources, and to implement prevention and/or reduction measures.

Note that the elements of the odour management plan recommended as BAT 20 are already found in the Sample Wastewater Co. BMPP for Odour.

BAT21: In order to prevent or, where that is not practicable, to reduce odour emissions from wastewater collection and treatment and from sludge treatment, BAT is to use one or a combination of the techniques given below:

Minimize Residence Times: Minimize the residence time of wastewater and sludge in collection and storage systems, in particular under anaerobic conditions. The applicability may be restricted in the case of existing collection and storage systems.

Chemical Treatment: Use chemicals to destroy or to reduce the formation of odorous compounds (e.g. oxidation or precipitation of hydrogen sulphide). This technique is generally applicable to most wastewater processes.

Optimize Aerobic Treatment: This can include controlling the oxygen content, frequent maintenance of the aeration system, use of pure oxygen, and removal of scum in tanks. This technique is generally applicable to most wastewater processes.

Enclosure: Cover or enclose facilities for collecting and treating wastewater and sludge to collect the odorous waste gas for further treatment. This technique is generally applicable to most wastewater processes.

End-of-Pipe Treatment: This can include biological or thermal treatment. Biological treatment is only applicable to compounds that are easily soluble in water and readily bioeliminable.

### Australia and New Zealand

Environment Australia publishes guidance materials for the purpose of supporting emission estimation for the federal reporting program. The document states that air emission control technologies, such as dispersion, scrubbing, incineration, adsorption on to a solid and biofiltration are commonly considered on point sources from process industries in general. This guidance does not provide details of air emissions control technologies commonly installed on wastewater treatment operations.

The individual Australian territories have also published technical handbooks to guide the management of odours; however, there are no specifics on control measures or abatement techniques that are identified for wastewater treatment facilities. The installation of control equipment, increasing of stack heights, or other measures to reduce odour effects is determined on a case-by-case basis that depends on whether a source is new, modified, or existing, and the proximity of nearby residents (sensitive receptors).

There was no research data available on the number of wastewater facilities currently operating in Australia. There is no publicly available facility-specific information on emission or odour controls for the identified operations.

### Additional Control Measures Suitable for Wastewater Treatment Activities

In addition to the most common approaches to controlling odour emissions from wastewater treatment, other alternative control measures that may be effective but are not as widely used have been identified in Table 2.

**Table 2 – Potential Alternative Odour Control Measures for Sample Wastewater Co.**

| **Control Measure** | **Applicability and Limitations** |
| --- | --- |
| Stack Optimization | Effective stack design will improve dispersion to reduce off-site effects with vertical, unimpeded discharge at optimal stack height and velocity, as well as potentially combining individual exhausts to common tall stacks. |
| Engineering Controls:  Emission Capture | Improved emission capture from specific process units and operations to reduce the fugitive emissions and increase emission capture for directing to appropriate odour control measures. |
| Thermal Treatment | Exhaust stream is directed to an oxidizer or the site boiler combustion chamber for incineration. |
| Ozonation | Concentrated ozone injected to oxidize odorous compounds. |
| Non-Thermal Plasma | Activated oxygen injected into waste gas stream to oxidize VOCs. |
| Biological treatment in Aeration Basin (Bioscrubber) | Odorous emissions are directed to the aeration basins which act as a bioscrubber. |
| Process Optimization: Reduce wastewater production from facility | Enhance water recycling opportunities, minimize wastewater production and volume requiring treatment. A water audit may be useful to identify opportunities for reduction or recirculation. |
| Process Optimization: Enhance automation | Reduce leaks, spills, manual transfers and other potential sources of odour. |

* 1. **Control Measures for Primary Odour Sources at Sample Wastewater Co.**

The primary sources of odour at the wastewater facility are the DAF, the Clarifier and the Sludge Storage and Handling systems. These sources are typically controlled with specific control equipment or technologies combined with BMPs and process optimization to minimize odorous emissions.

Table 3 provides the methodology, equipment and techniques implemented at other facilities to control the odours from these primary sources.

The control measures considered include the following:

* Installation of control equipment;
* Process optimization;
* Stack or discharge optimization;
* Engineering controls (odour capture, combined exhausts, recirculation, as examples);
* Pollution prevention; and,
* BMPs.

Where appropriate, measures from other industrial sectors are considered if the technology or measure may be transferrable to this sector.

Even though odour control measures are designed for specific applications, not all implementations are successful.  This section of the OCR is provided as guidance on general industry practices for the sector. It is possible that some measures may not be effective at odour control due to site-specific process or exhaust conditions. The selection of odour control measures requires engineering, and possibly pilot testing, to ensure odour reduction is achieved.

The measures presented in Tables 3 and 4 are examples that reflected the information available at the time the sample OCR was prepared. It is the responsibility of the facility to ensure that the odour control measures presented in the OCR are reviewed and updated as needed to reflect current information on control measures and best practices.

Further information on the control equipment is provided as an Appendix to this OCR.

The measures presented have been demonstrated as reasonable and effective to prevent or minimize the discharge of odour, and will be carried forward to assess technical feasibility at the Sample Wastewater Co.

**Table 3 – Potential Odour Control Measures for Sample Wastewater Co. Primary Sources**

| **Odour Source** | **Control Measure** | **Applicability** |
| --- | --- | --- |
| All Primary Sources | Stack Optimization | Effective stack design will improve dispersion to reduce off-site effects with vertical, unimpeded discharge at optimal stack height and velocity, as well as potentially combining individual exhausts to common tall stacks. |
| All Primary Sources | Wet Scrubber (including Rotoclones) | Effective particulate matter removal, but limited VOC or odour removal. |
| All Primary Sources | Oxidizing Scrubber | Wet scrubbers that use an oxidizing agent such as hydrogen peroxide, bleach, or others, as the scrubbing solution. Oxidizing agents may be problematic for the existing wastewater treatment systems. |
| All Primary Sources | Thermal Treatment | Thermal oxidation is highly effective at removing odorous VOCs and H2S. Odorous exhaust flow may be directed to the site boiler combustion chamber for incineration, or to a thermal oxidizer. |
| All Primary Sources | Biofilter / Biological Treatment | Process exhausts are directed to a conditioning system and biofilter where microorganisms biologically degrade the organic compounds.  Trickling filters or use of aeration basin as a bioscrubber are alternatives to conventional biofilters. |
| All Primary Sources | Carbon Adsorption | Activated carbon effective on low VOC concentration streams. |
| All Primary Sources | Ozonation | Concentrated ozone injected into exhaust gases to oxidize VOCs. |
| All Primary Sources | Non-Thermal Plasma (NTP) | Activated plasmas gas is injected into waste gas stream to oxidize VOCs. |
| DAF | Process Optimization:  Optimize Bubble Size | Optimizing the bubble size assists the flocculation/ coagulation process to remove more of the organic solids in the wastewater. Removing the organic solids reduces the associated emissions. |
| DAF | Process Optimization:  Optimize Flocculation/ Coagulation Chemistry | Balancing the chemistry of the flocculation/ coagulation optimizes the removal of organic content of the wastewater stream. Having captured the organics in solid form there is less to be volatilized in the latter processes. |
| All Primary Sources | Process Optimization:  Reduce Wastewater Production from Facility | Enhance water recycling opportunities, minimize wastewater production and volume requiring treatment. A water audit may be useful to identify opportunities for reduction or recirculation. |
| All Primary Sources | Engineering Controls:  Emission Capture | Improve emission capture with an engineered enclosure or cover for specific unit operations (e.g. clarifiers) or processes. Provides a more concentrated exhaust stream and eliminates the need to treat large volumes of general ventilation air. |
| Sludge Handling | Anaerobic Digestion | Install an anaerobic digestion system. Methane may be recovered. Solid waste stream generated (digestate). |
| Sludge Handling | Sludge Dewatering | Dewatering by centrifuge and filtration reduces the volume of sludge to be stored and disposed of. The collected effluent is returned to the treatment system. |
| All Primary Sources | Process Optimization:  Enhanced Automation | Use of tank volume monitoring, transfer flow monitoring in conjunction with automated shut-off to avoid overfills or spills. Reduced ingredient/product wastage and less potential for human error result in potential of reduced fugitive odour emission sources. |
| All Primary Sources | Best Management Practices | Develop SOPs and train employees on BMPs for process and control equipment maintenance and operation, good housekeeping, spill prevention and response, reducing chemical and cleaner usage, and managing wastes beyond what is described in the current BMPP.  Specific to sludge handling, increasing the frequency of sludge removal from site decreases the potential that material will become anaerobic which could result in increased odour emissions. |

* 1. **Control Measures for Secondary Sources at Sample Wastewater Co.**

The secondary sources identified at the Sample Wastewater Co. are the rotary screen and the aeration basin. Table 4 lists control measures that are currently in use or have been developed to mitigate this type of odour source.

The odour sources or source groups and the associated control measures, as well as potential alternative control measures, are provided in Table 4.

**Table 4 – Potential Odour Control Measures for Sample Wastewater Co. Secondary Sources**

| **Odour Source** | **Control Measure** | **Applicability** |
| --- | --- | --- |
| All Secondary Sources | Engineering Controls:  Emission Capture | Improve emission capture with an engineered enclosure or cover for specific process units or operational areas. |
| All Secondary Sources | Stack Optimization | Effective stack design will improve dispersion to reduce off-site effects with vertical, unimpeded discharge at optimal stack height and velocity.  Combining multiple exhausts to one common stack possible to allow for stack optimization or to implement one odour treatment system for the combined exhaust flows. |
| All Secondary Sources | Oxidizing Scrubber | Wet scrubbers that use an oxidizing agent such as hydrogen peroxide, bleach, or others, as the scrubbing solution. Oxidizing agents may be problematic for wastewater treatment. |
| All Secondary Sources | Thermal Treatment | Thermal oxidation is highly effective at removing odorous VOCs and H2S. Odorous exhaust flow may be directed to the site boiler combustion chamber for incineration, or to a thermal oxidizer. |
| All Secondary Sources | Biofilter / Biological Treatment | Process exhausts are directed to a conditioning system and biofilter where microorganisms biologically degrade the organic compounds.  Trickling filter or use of aeration basin as a bioscrubber are alternatives to conventional biofilters. |
| All Secondary Sources | Carbon Adsorption | Activated carbon effective on low VOC concentration streams. |
| All Secondary Sources | Ozonation | Concentrated ozone injected into exhaust gases to oxidize VOCs. |
| All Secondary Sources | Non-Thermal Plasma (NTP) | Activated plasmas gas is injected into waste gas stream to oxidize VOCs. |
| Aeration Basin  Lagoon | Process Optimization:  Oxygen Monitoring and Control | The use of coarse aeration and fine aeration, a variable speed aerator and process automation can reduce odour emissions by maintaining an optimal oxygen concentration in the aeration basin.  Monitoring of the oxygen concentration in the lagoon is an indicator of the potential for H2S emissions if aerobic conditions are not maintained. |
| Aeration Basin  Lagoon | Process Optimization:  Temperature Control | Controlling the temperature of the wastewater can improve oxygen transfer in the aeration basin. The overall system should be evaluated to identify opportunities to remove excess heat. |
| Rotary Screen | Process Optimization:  Water Pressure and Temperature | Decreasing the temperature of the water can reduce the volatilization of the VOC from the wastewater stream. Increasing the water pressure can improve screen cleaning. |
| Rotary Screen | BREF BAT Specific to Wastewater: Temperature | Decreasing the temperature of influent wastewater decreases the volatilization of any associated VOCs. |
| All Secondary Sources | Process Optimization:  Reduce Wastewater Requiring Treatment | Enhance water recycling opportunities, minimize wastewater production and volume requiring treatment. A water audit may be useful to identify opportunities for reduction or recycling of water. |
| All Secondary Sources | Process Optimization:  Enhanced Automation | Use of process monitoring and flow monitoring in conjunction with automated shut-off to avoid overfills or spills. Reduced ingredient/product wastage and less potential for human error result in potential of reduced fugitive odour emission sources. |
| All Secondary Sources | Best Management Practices | Develop SOPs and train employees on BMPs for process and control equipment maintenance and operation, good housekeeping, spill prevention and response, reducing chemical and cleaner usage, and managing wastes beyond what is described in the current BMPP.  Frequent maintenance of aeration systems and scum removal are BREF BAT specific to odour control for wastewater installations. |

# Feasibility Assessment

The control measures identified in Section 4 have been shown to be effective in preventing or reducing odour effects at wastewater operations with similar sources and/or other similar operations/processes. There are, however, site-specific limitations that would affect the ability of a facility to implement particular measures or procedures.

The results of the facility technical evaluation for the feasibility of implementation of the potential measures and procedures are summarized below in the form of a table (Table 5). Those justified as not technically feasible are not considered further in the OCR. Those measures deemed technically feasible are discussed in Section 6 (Discussion of Feasible Measures and Procedures). It should be noted that most of the technically feasible control measures described in Table 5 may be used in combination to achieve greater odour reduction. An example of this is the use of both control equipment and stack optimization. In general, any BMPP, process optimization, engineering control or stack optimization can be used in combination. In some cases, combinations of control equipment may also be feasible (e.g. using a carbon filter as a polishing step in combination with another type of control equipment). However, multiple end-of-pipe control equipment is uncommon for these types of sources.

It is a requirement of the Air Emissions EASR Regulation to provide an analysis of the odour control measures and procedures, and potential combinations of them, to determine which would be technically feasible to implement at the facility in order to prevent or minimize the discharge of odour. Table 5 summarizes the individual control measures and the findings of the feasibility assessment for the Sample Wastewater Co. The feasibility assessment must consider potential combinations of the control measures identified.

The technical feasibility of a control measure is a factor of the effectiveness of the mitigation, safety considerations, physical implementation as well as consideration of the impact of the other processes at the facility that could be detrimentally impacted. Although a control measure could be implemented on one specific odour source, the treatment could generate a new waste stream that contains a difficult substance to handle or cause a synergistic effect that results in a new odour source associated with a solid or liquid carrier.

The Sample Wastewater Co. has previously implemented a significant number of control measures at its operations. Combinations of stack optimization, BMPPs, process optimizations and engineering controls are utilized throughout the operations. A well maintained and balanced aerobic wastewater system should not have significant odour issues associated with it. The best method of odour control is to monitor and maintain optimum operating parameters at each stage and operations of the treatment process in conjunction with having BMP to correct and adjust any changes in parameters as identified.

The ability to isolate an odour source and direct the exhaust gases to an optimized stack, process optimization, and/or the implementation of BMPs for odour are the preferred approaches for odour control for the Sample Wastewater Co. Where possible, maintaining a negative pressure in a specific process area will allow for isolation of an odour source that can be discharged from an optimized stack or, if need be, controlled; this will help to prevent or minimize poorly dispersing fugitive odour releases.

It may be possible and beneficial to combine exhaust streams to one common exhaust; however, this must be evaluated as there are potential synergistic effects (e.g. back pressure on some ventilation areas, increased flows causing increased pressure drop through the system that cannot be handled by the fan and stack design). If there is no net negative impact to the operations resulting from the combining of individual sources to one common stack, this may allow for the design of one unimpeded vertical discharge at an optimized height and exhaust velocity to enhance odour dispersion, or the future installation of odour control equipment on one combined exhaust stream.

Wet scrubbers for odour control are technically not feasible due to the limited control efficiency of H2S and ammonia.

Non-thermal plasma and ozonation are both energy intensive, and considered to be emerging technology and there is limited documentation on demonstrated control efficiency or applicability on VOC and odour destruction. There are limitations to both of these technologies as the control medium must come into direct contact with the odorous substance or contaminant to complete the reaction. If there is moisture or particulate matter in the air flow to be treated, the odorous compounds may not have the contact residence time or sufficient exposure to the ozone to completely react. The majority of sources have high moisture content so additional pre-treatment systems would be necessary.

The use of an oxidizing scrubber produces a chemical waste stream that, if added to the existing wastewater system, will affect the microorganism population in the aeration basin.  Should an oxidizing scrubber be installed, it would require a completely separate wastewater system with separate piping to avoid any risk of affecting the aerobic digestion and the stabilization of the existing system. Oxidation scrubbers also require careful monitoring and control of the scrubber solution chemistry, pH or oxidation potential to ensure new odours are not created by the scrubbing solutions itself and the desired odour compounds are effectively scrubbed.  For example, chlorine gas may be released from caustic solutions, or insufficient peroxide concentration may result in discharge of untreated odorous compounds.

The installation of an anaerobic digestion system to treat the sludge was found to be technically not feasible due to the quantity of sludge being created on-site and its solids content. The potential anaerobic output would not sustain the system.

**Technical Feasibility Assessment**

The feasibility assessment requires an analysis of the measures and procedures identified, as well as potential combinations thereof. This assessment should be undertaken in conjunction with facility management to determine which would be technically feasible to implement. This discussion would take process or site-specific constraints into account. Technical feasibility can consider commercial viability of the control for the specific source, experience and use in the industry or for similar sources, other environmental considerations (wastewater impacts), availability of materials (e.g. if natural gas is not available, RTOs are not technically feasible), and site-specific considerations (e.g. space).

**Economic Feasibility**

The intention of the OCR is to establish technical feasibility of odour control measures and procedures. The discussion of economic feasibility is important; however, a complete economic assessment is not required as part of the OCR.

The MOECC provides guidance on undertaking an economic feasibility study in the “Guide to Requesting a Site Specific Standard, Version 2.0”. The US EPA also provides site-specific guidance for consideration of economic hardship and cost-effectiveness of pollution abatement in the Economic Impact Analysis and Industry Profiles by Sector Resource Documents published by the US EPA Office of Air Quality Planning and Standards (2016). These references can be used as a basis for developing an economic feasibility assessment, if needed.

**Table 5 – Summary of Feasibility Assessment for Sample Wastewater Co.**

| **Odour Source** | **Description of Control Measure** | **Technically Feasible?** | **Notes** |
| --- | --- | --- | --- |
| All Primary and Secondary Sources | Stack Optimization | Technically Feasible – previously implemented | The stack discharge on the DAF has been optimized. Further height extension for the main stack could be assessed.  Further improvements to other stacks associated with other sources would be evaluated should additional measures be needed to control off-site odour impacts. |
| All Primary and Secondary Sources | Engineering Controls:  Emission Capture | Technically Feasible | The facility will review the system with the objective of identifying opportunities for improved odour capture to prevent fugitive odour emissions.  The clarifier is an uncovered unit, and installing a cover to capture odours for treatment would be effective and would be evaluated should additional measures be needed to control odours. There may, however, be substantial operating constraints that would result in the installation of a cover on the clarifier to be Not Feasible, such as high ventilation requirements. There are also potential issues related to accessing the top of the clarifier for routine maintenance and operations. |
| All Primary and Secondary Sources | Wet Scrubber (including Rotoclones) | Technically Not Feasible | The use of wet scrubbers can control particulate matter emission, but have limited control efficiency for odours that are associated with VOCs, ammonia, or H2S. |
| All Primary and Secondary Sources | Oxidizing Scrubber | Technically Not Feasible | The use of an oxidizing scrubber may be effective in controlling the odorous gases captured from various stages of wastewater treatment. However, the oxidizing agents may affect the performance of the aerobic treatment systems and their use must be avoided as the risk is substantial. A separate treatment of waste stream management system may be required. |
| All Primary and Secondary Sources | Thermal Treatment | Technically Feasible | Thermal treatment options will be evaluated should additional measures be needed to control odours and may include the installation of a flare or redirecting exhaust gases to a site boiler for incineration. Improved capture and collection would be required that odours from open sources may be incinerated. An oxidizer may be feasible but would likely require concentrating exhaust gases in a pre‑treatment stage, the use of substantial supplemental fuel, and there may be operating issues due to the moisture and range of contaminants present in the exhaust gas. |
| All Primary and Secondary Sources | Biofilter / Biological Treatment | Technically Feasible | Biological treatment options will be evaluated should additional measures be needed to control odours, particularly the potential for redirection of exhaust gases to the aeration basin for bioscrubbing or the installation of a trickling biofilter. |
| All Primary and Secondary Sources | Carbon Adsorption | Technically Feasible | The installation of a carbon adsorption unit will be evaluated should additional measures be needed to control odours. Carbon adsorption would only be useful for smaller, unsaturated flows. |
| All Primary and Secondary Sources | Ozonation | Technically Not Feasible | Ozonation is an emerging technology and there is limited documentation on demonstrated control efficiency or applicability on VOC and odour destruction. |
| All Primary and Secondary Sources | Non-Thermal Plasma (NTP) | Technically Not Feasible | NTP is an emerging technology and there is limited documentation on demonstrated control efficiency or applicability on VOC and odour destruction. It is also not suitable for exhaust gases with high moisture content. |
| DAF | Process Optimization:  Optimize Bubble Size | Technically Feasible – previously implemented | The DAF system has been optimized, and monitoring is conducted to identify changes in operating parameters that may require adjustments to maintain bubble size. |
| DAF | Process Optimization:  Optimize Flocculation/Coagulation Chemistry | Technically Feasible – previously implemented | The flocculation and coagulation chemical addition to the DAF system has been optimized and is automated. |
| Rotary Screen | BREF BAT Specific to Wastewater Treatment:  Temperature | Technically Feasible | The facility would conduct a review of the processes to identify opportunities to remove heat and thereby reduce the temperature of the wastewater requiring treatment. |
| Rotary Screen | Process Optimization:  Water Pressure and Temperature | Technically Feasible | Should additional odour control measures be needed, the rotary screen cleaning procedures would be reviewed. |
| Sludge Handling | Anaerobic Digestion | Technically Not Feasible | Installing an anaerobic digester to this site is not technically feasible due to the limited land space available at the site for the digester and the associated gas and material handling equipment. |
| Sludge Handling | Sludge Dewatering | Technically Feasible | The installation of a centrifuge or belt press for further dewatering is technically feasible and will be evaluated should additional measures be needed to control odours. |
| Aeration Basin  Lagoon | Process Optimization:  Oxygen Monitoring and Control | Technically Feasible – previously implemented | These monitoring and automated control systems are part of the Supervisory Control and Data Acquisition (SCADA) system of the WWTP and site SOPs. |
| Aeration Basin | Process Optimization:  Temperature Control | Technically Feasible – previously implemented | Temperature is currently monitored and adjusted where possible on-site, with heat transfer (wastewater cooling) achieved by the use of extended piping to allow for some cooling. |
| All Primary and Secondary Sources | Process Optimization:  Reduce Wastewater Production from Facility | Technically Feasible – previously implemented | The facility conducts routine water audits in an effort to identify opportunities for water conservation. Water recycling within the production areas is carried where possible. |
| All Primary and Secondary Sources | Process Optimization:  Enhanced Automation | Technically Feasible – previously implemented | Automated controls and monitoring have been installed on a number of the wastewater treatment stages. Should additional odour control measures be needed, the system would be reviewed to identify opportunities for added or improved automation. |
| All Primary and Secondary Sources | Best Management Practices | Technically Feasible - previously implemented | SOPs have been developed and employees trained in BMPs for process and control equipment maintenance and operation, good housekeeping, spill prevention and response, reducing chemical and cleaner usage, and managing wastes.  Of specific note, sludge handling, storage, and removal is effectively managed with BMPs. Lime stabilization of sludge is used, which serves to prevent odours. |

Many of the technically feasible control measures described in Table 5 may be used in combination to achieve greater odour reduction. An example of this is the use of both control equipment and stack optimization. In some cases, combinations of control equipment may also be feasible.

# Adequacy of Current Odour Control Measures and BMPP

This section of the OCR provides the rationale for why the technically feasible measures identified are required or not necessary at this time, to adequately prevent or minimize the discharge of odour from the facility.

The Sample Wastewater Co. Best Management Practices Plan (BMPP) for Odours was prepared in 2010, and most recently updated in 2017 to be compliant with the Air Emissions EASR. The odour BMPP was signed, dated and sealed by Ms. J. Engineer on Feb 2, 2017 (PEO License 1234-9999). The BMPP documents all feasible measures that have been implemented to prevent or minimize odours from process stages, activities, or material storage. In addition to BMPs, control measures that are in place to mitigate odours are detailed in the BMPP.

In 2010, a site-wide odour assessment was prepared as part of an ECA application process. This assessment identified, quantified, and ranked all odorous sources for the potential to cause an off-site odour effect. It was determined that with the control measures and BMPs there were no appreciable odour effects off-site based upon the existing operations, control measures, and the effective implementation of the BMPP.

The Sample Wastewater Co. implemented a Good Neighbour Policy in 2005, which includes measures to prevent off-site odour effects. There have been no odour complaints in the past 5 years that were directly related to the operation of the facility under normal operational conditions and site parameters. Any excursions in normal operations (e.g. spills, emergency situations) or specific operational issues that were successfully addressed with an odour strategy (i.e. BMPP updates) and/or control technology within the last 5 years were not considered.

In the absence of odour complaints, and based upon quarterly odour surveys conducted in the residential areas and at other odour receptors (adjacent sports fields), additional measures to control odours are not warranted at this time, since the following key measures are already in place and are considered to be effective:

* For the primary sources identified, the Sample Wastewater Co. has previously implemented at least one of the technically feasible control measures described in Section 4. The DAF unit is operated within a closed building that has powered, positive ventilation that discharges through an optimized stack, lime stabilization is used for sludge stabilization, and BMPs and process controls are used to control odours from the clarifier;
* For the secondary sources, the prevention of fugitive emissions and the implementation of a BMPP are effective in preventing off-site odour effects. The frequency of the sludge removal from the site to the NASM permitted site has been increased from every other week to weekly which substantially reduced storage requirements and the potential for generating odour; and,
* The Sample Wastewater Co. completed a water conservation program and utilizes the tracking of water savings as a key indicator of production performance. This minimizes the volume of wastewater produced on-site and has resulted in BMPs for dry cleaning at the meat processing and bakery operations which removes a significant portion of organic material from the wastewater stream. Having this organic material removed from the wastewater stream results in the removal of any associated odour emissions that would have been associated with its treatment.

The intention of odour management and control is to prevent or minimize odour effects at odour receptors off-site. The absence of off-site odour effects, supported by five years without an odour complaint, demonstrates that the current odour control measures and BMPs are effective.

**Historical Odour Management**

A facility’s success with BMPP, good community relations, and no complaint history, or a history where the facility responds quickly and mitigates the situation with respect to odours, can be considered a reasonable rationale for not implementing additional odour control measures.

It is recommended that the facility contact the MOECC District Office to confirm that no odour complaints have been registered, and incorporate any feedback provided into this section of the OCR.

However when a facility is facing on-going challenges with its surrounding community, there are upset conditions that result in complaints and the BMPP is not meeting expectations, the facility needs to consider implementing other options. An initial review should be done of the site operations to identify the major odour source(s) and evaluate the current BMPs and/or control actions being taken. Consideration of alternative BMPs as well as re-evaluating current activities can assist in identifying the root cause of the odour issue. If the revised BMP does not mitigate the odour situation, further consideration of control optimization, technologies and equipment should be completed.

## Control Measures or Procedures to be Evaluated for Implementation

At this time, there are no additional emission controls or procedures that are scheduled to be implemented. However, the facility has committed to assessing the feasibility of the technically feasible control measures should odour complaints be received in the future that are the result of the wastewater treatment processes.

Should the facility determine that an odour source is developing into a potential off-site issue, the BREF-BAT (BMPs) would be reviewed to determine whether additional BMPs may be incorporated into the facility’s SOP policy with appropriate employee training, monitoring, maintenance and reporting. Control technologies to manage the odour source issues would also be evaluated should further complaints be encountered and BATs, BMPs, optimization, controls and SOP are not successful.

This site also has several control technologies in operation for specific production equipment and/or emission streams. It would be beneficial to utilize the existing control technology by connecting more of the uncontrolled odour sources.

The next phase of evaluations would include the BMPs, Process Optimization, Engineering Controls, and then control technologies to manage the odour source issues.

Table 6 provides control measures that will be evaluated for implementation at the Sample Wastewater Co. should odour emissions become an issue for the operations and facility.

This section presents the control measures that were found to be technically feasible and could be further considered by the Sample Wastewater Co. should additional odour control measures be needed in the future. Table 6 also presents those measures that are under consideration to be implemented, even though there have been no odour complaints.

**Table 6 – Potential Control Measures or Procedures to be Evaluated for Implementation**

| **Odour Source** | **Control Measure** | **Applicability** |
| --- | --- | --- |
| Primary or Secondary Sources | Thermal Treatment | Thermal treatment of odour emissions will be evaluated should additional measures be needed to control fugitive odours. |
| Primary or Secondary Sources | Biological Treatment | Treatment of odour emissions by biological means such as a biofilter, trickling filter, or bioscrubber will be evaluated should additional measures be needed to control fugitive odours. |
| Primary or Secondary Sources | Carbon Adsorption | The use of carbon filtration as a control measure will be evaluated should additional measures be needed to control fugitive odours. |
| Primary or Secondary Sources | Emission Capture, Stack Optimization and Process Optimization | Should additional measures be needed to control odours, the facility ventilation system and odour sources would be evaluated with the objective of identifying further opportunities for emission capture, stack optimization, and process optimization. |
| Rotary Screen | BREF BAT Specific to CWW:  Temperature | The facility would conduct a review of the processes to identify opportunities to remove heat and thereby reduce the temperature of the wastewater requiring treatment. |
| Sludge Handling | Sludge Dewatering | The installation of a centrifuge or belt press for further sludge dewatering is technically feasible and will be evaluated should additional measures be needed to control odours. |

# Appendix A – Supplemental Guidance for Developing a Facility‑Specific OCR

## A.1 Identification of Odour Sources and Source Groupings

Once a complete inventory of air emissions sources has been prepared, it is necessary to identify which of these sources should be classified as primary odour sources, secondary or minor sources, and negligible odour sources based upon their relative contribution to potential odour effects. This can be done in a number of ways, and often involves some level of judgment based upon process knowledge and experience.

It must be emphasized that the identification of odorous air emissions sources is very specific to each facility. What may be a potentially odorous source at one facility may not have any potential for odour at another. As an example within the brewing and food manufacturing industries, the operation of a jacketed kettle with pressure relief valve is an odour source if it is used for wort boiling or food processing, but may not be odorous if it is used for boiling other liquids in other industries.

For each odour source, a general description of the associated process, unit operation, equipment or activity, expected contaminants in the exhaust gas, typical odour loadings, factors which may affect the odour loading, and potential constraints should be identified, where available. These details are necessary in order to properly assess any potential control or BMP for its technical feasibility. An odour source summary table is an effective way to summarize the odorous emission sources for further assessment, and will be useful should odour dispersion modelling be required.

Published emission factors are useful in quantifying odour loadings from common sources; however, when evaluating site potential emissions or impacts, these factors should be used by someone with technical experience. In many cases the only available emission factors are for VOCs as little data on odour loadings is publicly available. The odour and VOC emissions may not be directly proportional; however, these values will also assist in site-specific determination of the VOC concentration and emission rate for individual sources to allow for comparisons, ranking of sources, and discussion of the suitability of control measures.

Site-specific details of why the facility is unique or different from other wastewater treatment operations should be provided in order to help in identifying sources and determining their relative contribution to facility odour classifying sources.

The location and characteristics of the discharge point must also be considered when determining which sources are major sources of odour at the facility, which are minor, and which are negligible.

The odour source inventory is another tool to consider sources that may become odorous under upset or unexpected conditions; however, these situations are more commonly addressed by BMPs. For example, the discharge from a scrubber may not be odorous when the scrubber is operating effectively; however, scrubber malfunction, insufficient liquid flow rate or insufficient makeup rate may result in odorous discharges.

It may be effective to group sources for the purposes of the OCR if they are associated with the same process stage, same production area, and have similar odour and exhaust characteristics. These sources may be combined and directed to individual control equipment or dealt with as an aggregate.

## A.2 Quantifying Odour Loadings and Odour Source Ranking

There are a number of reference documents that may provide expected odour emissions, emission factors for odour or VOCs, or other data that may reasonably be used to describe sources at the facility.

A few examples are provided:

* [Australian Government. 2011. Emission Estimation Technique Manual for Sewage and Wastewater, version 2.1](http://www.npi.gov.au/resource/emission-estimation-technique-manual-sewage-and-wastewater-treatment)
* [US EPA. 1991. AP-42 Fifth Edition Compilation of Emission Factors Chapter 4.3 Waste Water Collection, Treatment And Storage](https://www3.epa.gov/ttnchie1/ap42/ch04/final/c4s03.pdf)
* [European Environment Agency EMEP/EEA. 2016. Air Pollutant Emission Inventory Guidebook](http://www.eea.europa.eu/publications/emep-eea-guidebook-2016)
* Capelli, Laura et.al. 2014. Odour Emission Factors: Fundamental Tools for Air Quality Management. Chemical Engineering Transactions vol. 40.

## A.3 Identifying Primary or Secondary Odour Sources

In order to classify the sources as primary or secondary, it would be helpful to rank the sources in terms of their potential to cause off-site odour impacts and prioritize accordingly. The ranking could be done on the basis of potential odour emissions (strength of odour), offensiveness of odour, frequency of occurrence and source configuration. The source ranking may be supported by screening level dispersion modelling for each significant source to determine the amount of dilution (i.e. dispersion) for each source. For example a tall stack source would provide much greater odour dilution at off-site locations than a horizontal exhaust at the property boundary.

## A.4 Sources Not Considered Odorous

There are a number of sources at facilities that are not identified as odour sources for the purposes of the OCR. These sources either:

* Do not emit odorous contaminants, such as heating and cooling equipment and process boilers; or,
* Discharge odours that are not of the same characteristic that is generally attributed to the sector and have no appreciable off-site impacts.

Examples of such sources may include trash compaction, cafeteria exhausts, parts washers, product label gluing, laser / ink printing, or ammonia leaks from refrigeration equipment.

## A.5 Indoor Fugitive Emissions

BMPs are generally more appropriate for the prevention or mitigation of odours from general building exhausts and indoor fugitive sources. At specific facilities, BMPs may prove inadequate for some sources, and the installation of capture hoods or fume collection may be necessary. Once the odours are captured, they may then be directed to control equipment, or other measures may be implemented to reduce the potential off-site odour effects.

## A.6 Excess Emissions Due to an Upset or Abnormal Condition

An upset or abnormal condition may arise due to sudden and reasonably unforeseeable events beyond the control of the facility. These situations require immediate corrective action to restore normal operation. The identification of all possible odour sources during upset or emergency conditions is beyond the scope of the OCR. It is expected that the facility will include the preventive maintenance, accident prevention, spill containment, and effective response to upset conditions in the BMPP.

## A.7 Control Measures and Procedures

### Pollution Control Equipment

Often referred to as end-of-pipe or add-on controls, exhaust gases are directed to pollution control equipment to capture or destroy the odorous contaminants. Equipment that captures the contaminants often results in the generation of a new waste stream that could be either solid, liquid, or gas that may still be odorous. An example of a gaseous waste stream is air discharged during the regeneration cycle of an activated carbon bed or tower. These activities may also reduce odours or change the character of the odours making them less intense or offensive.

Destruction of VOCs in the waste stream may be achieved by thermal oxidation, catalytic oxidation, chemical oxidation, or other chemical reaction. This type of pollution control unit may result in the permanent removal of airborne contaminants that are odorous.

### Engineering Controls or Process Changes for Pollution Prevention

Although there may be some redundancy between these measures and those outlined as BMPs in the facility BMPP, the measures detailed here are differentiated from BMPs as they require actual modifications or engineering changes. In contrast, BMPs are by definition, practices or procedures would not require additional engineering or significant process modifications, or the installation of additional control equipment.

The following are examples of measures that have been shown effective in odour mitigation:

* Optimized stack design to improve dispersion;
* Process or building fugitive odour capture to prevent fugitive odours from roof exhausts or building doors, windows, louvers, or vents;
* Process optimization and control, including adjustments to pressure and temperature on pressure vessels, monitoring aeration of waste stream or improving aeration/agitation, or others; and,
* Reducing cooling water temperature of condensers to improve odour control efficiency.

### Masking Agents or Odour Modification

Although the applicability to an individual sector may be limited, there are chemical additives, masking agents, deodorants, and odour neutralizers that may be employed to either theoretically reduce the odour loading or alter the nature of the odour to change its character or hedonic tone.

Masking agents, also called deodorizers, contain perfumes to superimpose a pleasant odour upon an unpleasant one. Although this approach can be considered an alternative for managing odour complaints, it should be considered on a site-specific case and potentially bench tested as it has been found in some cases that the deodorant or making agent may itself become an odour nuisance or the impact on odour receptors has not changed.

Neutralizers differ from masking agents as they are able to react with the odour molecules and are generally dispersed as a fine aerosol into the odorous gas.

### Best Management Practices

BMPs are practices or procedures that in this context are intended to prevent or minimize odorous effects. These may be general in nature and applicable to a wide range of facilities, or they may be facility-specific and intended to help reduce odorous releases from process operations or activities at an individual site.

The facility is required to prepare a BMPP which will outline operational practices and other measures that will be carried out in order to reduce odour emissions or odour effects.

The intention of the OCR is to identify process controls, engineering controls, or add-on control measures. Specific BMPs for the odorous sources identified should be presented if they are currently implemented at similar facilities or recommended in applicable Codes of Practice.

# Appendix B – Control Equipment Factsheets

Appendix B provides general information on the control measures identified in this example OCR. Details such as whether the control measure is considered to be in the developmental stage, where it may be applicable, and what limitations may exist, are given. Facilities may also consider contacting equipment suppliers for further information to determine whether a particular control measure may be technically feasible at their site.

This information is provided in order to show what information may be considered when assessing the feasibility of a control measure.

Including this level of detail on potentially feasible control measures is not a requirement of the OCR and is provided as reference material only.

## B.1 Thermal Treatment

### B1.1 Technologies

* Flaring
* Thermal Incineration in Boiler or other combustion unit
* Regenerative Thermal Oxidizer (RTO)
* Recuperative Thermal Oxidizer
* Catalytic Oxidation

### B1.2 Emission Characteristics

* Gaseous Pollutants (Odour, VOCs)

### B1.3 Air Emission Sources

Common Applications:

* Petroleum and Coal Products
* Lumber
* Printing
* Food Processing
* Surface Coating
* Paint Manufacturing

### B1.4 Description

Thermal treatment uses high temperatures to oxidize VOCs, as well as some particulate matter. The conventional type of thermal oxidizers have a direct flame in contact with the airflow. RTOs use ceramic packed beds to preheat and partially oxidize VOCs prior to incineration to increase efficiency, and catalytic oxidizers use a catalyst material rather than ceramic in the packed beds. Recuperative units incorporate a heat exchanger to recover heat for the purpose of preheating the incoming air.

### B1.5 Applicability and Performance

A properly designed and operated thermal oxidizer or flare can achieve a destruction efficiency of 95-100%, with most achieving more than 99% VOC control. Thermal oxidation is generally used for the treatment of low gas flowrates, with notable cost increases associated with heating greater volumetric flowrates. It may be suitable for malodorous streams with variable contaminant concentrations and some variability in flowrate. Some form of heat recovery is nearly always warranted to reduce operating costs and fuel consumption. Flaring may be appropriate if gas flowrate fluctuates significantly. A concentrator may be used prior to an RTO or other oxidizer for large air flows of low VOC concentration to minimize supplemental fuel requirements.

It may be possible to direct malodorous gases to an existing on-site boiler for thermal treatment, particularly if the volume of waste gas is notably less than the combustion air requirements.

### B1.6 Limitations

Supplemental fuel may be needed if the heating value of the gas is insufficient to sustain the incinerator temperature, and may be significant if the exhaust gas stream is variable or VOC concentrations are low. Water vapour present in the airstream may quench the flame, resulting in poor combustion. For safety reasons, organics present in the waste gas must be well below the respective lower explosive limit (LEL); if the organic concentration is above the relevant explosive limits, a flameless type of system may be appropriate. Pre‑treatment for particulate material removal may be required. By-products, including NOx, SO2, GHGs, acid gases and other pollutants may be generated depending upon the composition of the waste gas to be treated. When halogenated VOCs are present, the potential for dioxins formation exists.

### B1.7 References

European Commission. 2006. Integrated Pollution Prevention and Control Reference Document on Best Available Techniques in the Food, Drink and Milk Industries (EU BREF) Section 4.4.3.11 Thermal Treatment of Waste Gases

US EPA. Air Pollution Control Technology Fact Sheets: Flares EPA-452/F-03-019, Thermal Incinerators EPA-452/F-03-022, and Catalytic Incinerators EPA-452/F-03-018.

## B.2 Absorption

### B2.1 Technologies

* Wet Scrubbers (packed bed absorber, plate absorber, and spray scrubber)

### B2.2 Emission Characteristics

* Wet scrubbers are most effective on exhaust gases with high concentrations of VOCs or water soluble compounds, and to a lesser degree particulate matter.

### B2.3 Air Emission Sources

Common Applications:

* Food manufacturing and cooking
* Mineral processing
* Fertilizer plants
* Asphalt plants

### B2.4 Description

The process involves a mass transfer between a soluble gas and a liquid solvent such as water. The addition of an oxidizing agent to the scrubbing solution may increase odour removal efficiency by reacting with the odorous compounds. Sodium hypochlorite, hydrogen peroxide, ozone, potassium permanganate, acids, and caustics are frequently used as the scrubbing medium.

### B2.5 Applicability and Performance

Primarily used for inorganic fumes and gases, VOCs, and particulate matter. The control efficiency for VOCs varies depending upon the type of scrubber, and a range of 70 to 90% control is expected. Wet scrubbers have relatively low capital and operating costs compared with other treatment technologies, as well as relatively small space requirements. Absorption units can handle gases with high temperature and high moisture contents.

### B2.6 Limitations

The requirements for the scrubber outlet concentrations affect the scrubber design (liquid flowrate, scrubber dimensions), and may result in unreasonably tall towers or long liquid-gas contact times and excessive liquid volumes. A liquid waste stream is generated. Spray chambers are not generally suitable for odour or VOC control.

### B2.7 References

Air & Waste Management Association. 1992. Air Pollution Engineering Manual.

European Commission. 2006. Integrated Pollution Prevention and Control Reference

Document on Best Available Techniques in the Food, Drink and Milk Industries (EU BREF) Section 4.4.3.8 Absorption.

US EPA. Air Pollution Control Technology Fact Sheets: Packed Bed / Packed Tower Wet Scrubber EPA-452/F-03-015, Spray Tower Wet Scrubber EPA-452/F-03-016.

## B.3 Biofiltration

### B3.1 Technologies

* Biological Treatment (beds, trickling filters, bioreactors)

### B3.2 Emission Characteristics

* Gaseous air pollutants (odour, VOCs, H2S) of consistent air flow rate and limited fluctuation in loading.

### B3.3 Air Emission Sources

Common Applications:

* Meat and Fish
* Coffee processing
* WWTP
* Beer yeast drying
* Oil mills
* Cocoa production
* Pump stations
* Animal feed production
* Organic processing

### B3.4 Description

The most common type of biological treatment is the biofilter where pollutants are absorbed onto a filter and degraded by microorganisms living on the filter media.

There are a variety of biofilter styles: in-ground, in-vessel, open-bed, or up-flow systems.

The filter medium may be a blend of wood chips, compost, bark nuggets or inert materials designed to maintain porosity with high surface area to provide good contact between the contaminants and the biologically active micro-organisms.

### B3.5 Applicability and Performance

Properly designed and maintained biofilters can remove most organic contaminants, H2S and reduced sulfur compounds but can produce a slight residual “earthy” odour. An operational and balanced biofilter can achieve relatively high odour removal efficiency at relatively low operating cost compared with other treatment techniques, with odour removal efficiencies greater than 90% reported. The operation and efficiency of a bioreactor is affected by temperature, pH, moisture, gas composition and pollutant concentration, macronutrient feeding, residence time, compacted bed media, and gas channeling. A biofilter may be designed to treat a wide range of air flowrates that ensure appropriate residence time, typically 20 to 30 seconds. Moisture may be added to the gas by pre-humidification.

### B3.6 Limitations

* Particulate matter and oils may need to be removed upstream of the filter to avoid clogging that may result in a large pressure drop and reduction in operational efficiency.
* Significant fluctuations in contaminant concentrations may be problematic.
* Biofilters generally have large space requirements compared to other control technologies.
* There may be a significant energy demand, particularly if preheating or humidification is required.
* Channeling through the biofilter may result in reduced control efficiency.
* Biofilters require temperature regulation, as temperatures over 40 °C may be problematic as the micro-organisms may become sterilised and the filter bed would require re-seeding, and biological degradation decreases notably below 10 °C.
* The pH of the filter material must be maintained, typically between 6.5 and 7.5, which may require alkali addition.
* A typical lifetime of an organic based filter bed is 3 to 5 years for most filter materials.

### B3.7 References

European Commission. 2006. Integrated Pollution Prevention and Control Reference Document on Best Available Techniques in the Food, Drink and Milk Industries (EU BREF) Section 4.4.3.10.1 Biofilter.

Water Environment Research Foundation WERF. 2007. Minimization of Odours and Corrosion in Collection Systems, Section 8.5 Biofilters.

US EPA. 2003. Using Bioreactors to Control Air Pollution EPA-456/R-03-003.

## B.4 Carbon Adsorption

### B4.1 Technologies

* Packed beds, fluidized beds, filter cartridges

### B4.2 Emission Characteristics

* Gaseous Pollutants (Odour, VOCs, H2S)

### B4.3 Air Emission Sources

Common Applications:

* Paint Spraying
* Printing
* Plastic film coating
* Dry cleaning
* Degreasing
* Pharmaceuticals
* Wastewater treatment
* Food manufacturing
* Asphalt processing
* Chemical manufacturing
* Transfer systems

### B4.4 Description

Adsorption is a unit process involving the capture of substances (primarily VOCs), from relatively low concentrations in air/water streams, onto a fine particulate active surface, with resins and activated carbon being the most common materials used. The adsorbed material is physically contained within the filter. Once saturated, the physical content of the filter will require regeneration. Reactivating the carbon requires the substances to be desorbed and this can be done by heat or vacuum. Generally, the maintenance of most carbon adsorption systems are done by a third-party or would require an additional control system to capture, contain and dispose of the absorbed substances. Carbon adsorbers are used for the cleaning of ventilated air and the treatment of malodourous process emissions.

### B4.5 Applicability and Performance

Carbon adsorption is suitable for a range of air flow rates and temperatures; however, high moisture content will significantly impact the maintenance requirements of the carbon. The control of VOC emissions and typically associated odours by carbon adsorption can achieve removal efficiencies of 80 – 99 %.

### B4.6 Limitations

Carbon adsorption is not considered applicable where dust or condensable material is present as it can seriously interfere with the efficiency of a carbon bed and will increase the operating pressure drop. It is also not applicable at a temperature above 40 °C due to the risk of fire. The efficiency of activated carbon is reduced at a relative humidity above 74 % as the moisture will be adsorbed as well as the contaminants, except for water soluble compounds such as the lower amines and hydrogen sulphide. This preferential absorbance of water can lead to condensation within the bed, thus making the carbon inactive.

The components for a carbon adsorption system consists of the filter or filter column and the fan or blower system. On-site regeneration is not normally economical, so the carbon is typically replaced when its adsorption efficiency begins to decrease, but prior to breakthrough. In addition to capital costs, operating and maintenance costs are notable due to requirement to recharge carbon and the energy requirements.

### B4.7 References

European Commission. 2007. Integrated Pollution Prevention and Control Reference Document on Best Available Techniques on Surface Treatment using Organic Solvents (EU STS BREF) Section 20.11.6.1 Adsorption Using Activated Carbon or Zeolites.

US EPA. 1999. CATC Technical Bulletin: Choosing an Adsorption System, EPA-456/F-99-004.

## B.5 Non-Thermal Plasma (NTP)

### B5.1 Technologies

* Corona or Photocatalytic Reactors

### B5.2 Emission Characteristics

* Cold plasma reactors and photocatalytic reactors are considered an emerging technology. There is limited performance data available, and the economics of the processes are unknown at this time.

### B5.3 Air Emission Sources

Common Applications:

* Food and Drink Manufacturing
* Extruders
* Dryers
* Coolers
* Hammer mills

### B5.4 Description

Non-thermal plasma treatment is an odour abatement technique that plasma to create a highly reactive treatment zone that the waste gas passes through. The plasma contains a collection of ions, electrons, charge-neutral gas molecules and other species in varying degrees of excitation. These radicals in the NTP react with the pollutants in the malodorous air stream, producing less malodorous compounds. The most active radicals in this process are nitrogen, oxygen, and hydroxyl based compounds which originate from nitrogen, oxygen and water in the waste gas. Industrial treatment systems are based on electrical discharge, where high voltages (up to 40 kV) are used to create NTP.

### B5.5 Applicability and Performance

The technique has been proven to reduce the odour emissions by 75 – 96%, with higher control efficiencies for VOCs. This technique performs better when treating high VOC. The NTP equipment requires little space when compared to other control measures. Multiple NTP modules can be installed in parallel for higher gas volumes. There is a low pressure drop associated with the NTP, and it can be installed either on either the side of the air extraction fan.

### B5.6 Limitations

Temperature affects the performance of the plasma, with an operating range up to 70°C reported as optimal. Above 80 °C, the performance of the technique may drop significantly. Significant amounts of water condensing on the equipment may be problematic, as well as high particulate matter concentrations. Since high voltages are required to sustain the plasma, there are high operating costs from the power requirements.

### B5.7 References

European Commission. 2006. Integrated Pollution Prevention and Control Reference Document on Best Available Techniques in the Food, Drink and Milk Industries (EU BREF) Section 4.4.3.12 Non-thermal Plasma Treatment.

Water Environment Research Foundation WERF. 2007. Minimization of Odours and Corrosion in Collection Systems, Section 8.10 - Cold Plasma & Photocatalytic Reactors.

## B.6 Ozonation

### B6.1 Technologies

* This technology is considered an emerging technique.

### B6.2 Emission Characteristics

* Odorous exhaust gases.

### B6.3 Air Emission Sources

* Reported installations to treat HVAC return air in smoking rooms.

### B6.4 Description

Ozone is injected to exhaust gas dust or stack in order to react with, and break down, odorous compounds.

### B6.5 Applicability and Performance

There is limited performance data available, and the economics of the processes are unknown at this time.

### B6.6 Limitations

Ozone is less reactive in the gas phase than in liquid phase. Applications of ozone use for water treatment are more common. Hot, humid airflows may not be suitable for ozone treatment systems. Insufficient VOC-ozone contact time may result in incomplete VOC reactions and emissions may still be odorous. Excess ozone may be harmful.

### B6.7 References

European Commission. 2006. Integrated Pollution Prevention and Control Reference Document on Best Available Techniques in the Food, Drink and Milk Industries (EU BREF) Section 4.4.3.8 Absorption.

**Appendix C – References**

[European Commission. 2006. Best Available Techniques Reference Document for Common Waste water and Waste Gas Treatment/Management Systems in the Chemical Sector.](http://eippcb.jrc.ec.europa.eu/reference/cww.html)

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*Miscellaneous Technical Specification Sheets from Equipment Manufacturers and Service Providers*.