Lenz Enterprises
Comprehensive Progressive
Odor Management Plan

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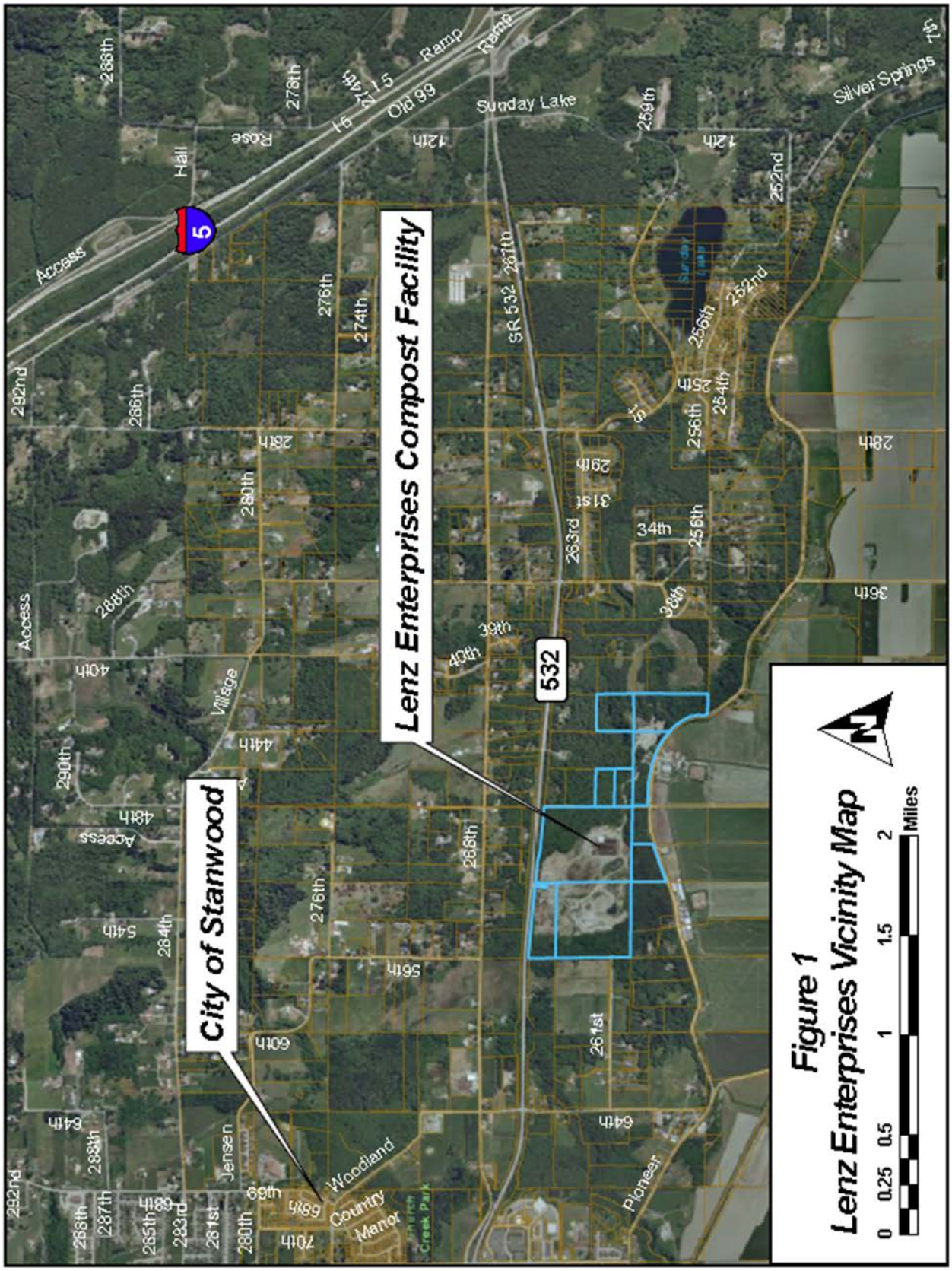

Figure 1. Lenz Compost Facility Vicinity Map

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1) Introduction

All living systems create odorous molecules that, in sufficient concentrations, may be detected by the human nose. Because an "odor" is a sensation the human brain generates in response to chemicals in the air, breathed in through the nose (Dalton, 2003b), odor detection and perception is unique to an individual. Humans can detect and identify many odors even at relatively low concentrations of the chemicals. However, each person's ability to detect odors, and how they perceive them, is different and unique to the individual and the odor being perceived.

Composting is a natural physical and biological process that decomposes organic materials. This processed has occurred on earth since the first plants began to propagate millions of years ago. Commercial compost facilities use technology to optimize and control the environment for composting to occur. Because composting of organics is based on the activity of microorganisms, optimizing the environment for those organisms can enhance and speed up this process. The composting of organic material can create a wide array of odorous molecules, some that may be perceived as pleasant, and some that may be perceived as unpleasant. Nuisance odor management can be an operational challenge at compost facilities due to the numerous and complex odors that can occur. Examples of chemicals that can translate to odors at composting facilities include dimetheyl disulfide, ammonia, dimethyl sulfide, butyric acid, putrascene, terpenese, and hydrogen sulfide to name a few.

Washington State law, WAC 173-400-040 states that "*(5) Odors. Any person who shall cause or allow the generation of any odor from any source or activity which may unreasonably interfere with any other property owner's use and enjoyment of her or his property must use recognized good practice and procedures to reduce these odors to a reasonable minimum.; and (6) No person shall cause or allow the emission of any air contaminant from any source if it is detrimental to the health, safety, or welfare of any person, or causes damage to property or business.*

This Comprehensive Progressive Odor Management Plan (CPOMP) has been prepared to document the processes and procedures to mitigate potential nuisance odors (Odor Prevention), progressive steps to be taken if nuisance odor prevention is not effective (Response Plan), and the responsibilities associated with response to nuisance odor issues should they arise at the Lenz Compost Facility (LCF).

Odor Generation and Propagation Factors

The act of composting generates carbon dioxide, water, heat, and both odors and emissions. The amount, concentration, or distribution of odors or emissions from a particular composting process or type of feedstock in a particular environmental and process setting can vary greatly due to a multitude of factors. Many studies have been conducted, both in-situ and in laboratory, to further characterize odors from composting facilities, but results vary due to each site's unique composting process, the character of feedstocks composted, environmental and other conditions.

In addition to the multitude of odor types that may occur at a compost facility, there are many more factors that can contribute to whether or not these odors become a nuisance. Some of the factors that may affect the generation of odors at the LCF include:

Environmental Factors

- Ambient temperatures
- Precipitation rates and frequency
- Seasonal temperature variations
- Solar radiation
- Wind direction, intensity and modulation.

Process Factors

1. Active compost pile geometry and surface area
2. Air direction through compost
3. Air flow rate through compost
4. Biologically available content and forms of carbon and nitrogen
5. Bulking agent composition
6. Compost C:N ratio
7. Compost homogeneity
8. Compost moisture
9. Compost pH
10. Compost temperature
11. Compost temperature stability
12. Control technology design and effectiveness
13. Feedstock and compost composition (biosolids, green-waste, food-waste, etc)
14. Frequency of compost tuning
15. Microbial respiration levels and stability
16. Oxygen levels and stability

If an odor is generated, a number of additional factors may influence how the odor travels and is diluted in the air and how it might be perceived at a particular receiving location. These factors may include:

- Location of the originating odor
- Structures near the originating odor source
- Quality (type and complexity) of the odor
- Intensity of the odor
- Duration of the odor
- Frequency of the odor
- Local topography
- Local vegetation
- Humidity
- Precipitation
- Local wind direction, intensity, gusting, etc.
- The person detecting the odor

Variability and Management Approach

Given the variability in different people's ability to sense odors and their perception of odor quality, the number of different odors that may be generated at a compost facility, the number of factors that may affect odor generation, and the number of factors that may affect odor propagation, odor control and management can be a difficult task. To ensure success, LCF management takes a comprehensive, progressive and detailed approach to odor management. The LCF facility uses best available odor control technologies, best operating practices and highly skilled technicians to achieve a high quality compost that generates little odor. Only one odor issue has occurred since the site began operations in 2008 and it was promptly remedied. It is the intent of LCF management to ensure that this trend continues; and, if a potential nuisance odor is identified, act immediately and decisively to mitigate the issue and ensure it does not reoccur.

2) Definitions

Odor detection and perception is a uniquely individual experience. Defining and consistently using a common nomenclature to discuss potential odors is imperative to a constructive and useful conversation. This CPOMP uses the following definitions:

Active Composting

Material that is in the process of being rapidly decomposed and contains a high concentration of biological volatile solids. Active compost temperatures of at least 55 degrees Celsius during decomposition are typical.

Composting

The process in which solid organic waste materials are decomposed in the presence of oxygen through the action of bacteria and other microorganisms.

Compost Overs

The oversized woody materials that do not decompose completely in a typical composting cycle and are screened out of finished product at the end of composting. Compost overs have been through the pathogen reduction process.

Curing Phase

The phase of the composting process that begins immediately after the end of the active phase of composting.

Facility

All contiguous land (including buffers and setbacks) and structures, other appurtenances, and improvements on the land used for solid waste handling.

Finished Compost

The biologically stable, humus-like material, and compost overs, that result from the controlled biological decomposition of organic waste materials.

Foodwaste
Pre- or post-consumer food scraps collected from the food service industry, grocery stores, or residential food scrap collection. Foodwaste also includes food scraps that are chipped and ground.

Greenwaste
Organic waste material generated from gardening, agriculture, or landscaping activities including, but not limited to, grass clippings, leaves, tree and shrub trimmings, and plant remains.

Hedonic Tone
Hedonic tone refers to the pleasantness or unpleasantness of an odor. The typical method of determining the Hedonic Tone of an odor is to compare the odor to a number of odorants that range from a commonly perceived pleasant odor to a commonly perceived unpleasant odor.

Nuisance odor
An odor which is found offensive or may unreasonably interfere with a property owner's use and enjoyment of his or her property.

Odor Concentration—Dilutions to Threshold
An odor concentration is determined by a panel of human subjects that smell samples of the odor at various levels of dilution with fresh air. The concentration is expressed in terms of the number of dilutions required for the panel members to no longer detect the odor. This value is called the dilutions-to-threshold (D/T).

Odor Compliant
An odor compliant occurs when an individual perceives an odor to be a nuisance and complains to the suspected responsible party generating the odor.

Odor Event
An odor event occurs when odors released from the compost facility are easily recognized by the average person. These odors may be pleasant or unpleasant in quality.

Odor Intensity
Odor intensity relates to the strength of an odor. This is a sensation, not a concentration, and uniquely individual for each human receptor. Research has shown that the annoyance potential of an odor is directly related to the perceived odor intensity and the character of the odor (Dravniek and Jarke, 1979).

Odor Quality
The quality of an odor is a measure of the character of the odor. This is an important aspect of odor mitigation as odor quality helps to determine the source of an odor. Attempts have been made by some to create a system for identifying odor quality. For example, the American Society for Testing and Materials (ASTM) present character profiles for many chemicals using a descriptor scale. These types of tools can be useful but may not provide all of the information required to fully assess some complex odors from composting facilities.

Odor Thresholds

The Odor Threshold is the minimum concentration of odorant that will arouse a sensation in most humans. Other thresholds have been defined and include:

- Detection Threshold – An odor can be detected but the character cannot be identified
- Recognition Threshold – An odor can be detected and the character identified. The recognition threshold is typically 1.5-10 times greater than the detection threshold for most odors
- Objectionable Threshold – The concentration when the odor is objectionable to the receiver

Due to the variability of human receptors, odors thresholds are typically averaged statistically over a number of samples, using a specified methodology (e.g. Use of an Odor Panel).

Odor Units

The strength of an odor is sometimes quantified in terms of "odor units" (OU). An Odor Unit is the non-dimensional quantity of an odorous contaminant or mixture of contaminants that must be added to one cubic meter of air to produce a threshold concentration of odor in the air..

Organic Feedstocks

Source separated organic materials including bulking agents suitable for vermicomposting, composting, anaerobic digestion, and other processes that transform organic materials into usable materials.

Organic Waste

Includes (typically) foodwaste, greenwaste, woodwaste, and manure, or a mixture thereof.

Solids Residence Time

The single pass mean residence time of the mixed materials including recycle, within a specific process.

3) Inventory of Potential Odor Sources and Existing Control

Introduction

Different types of emissions and odors can potentially occur at different stages of the LCF process. Odors generated from these sources will differ in intensity, frequency, duration, and quality. Due to these differences, different prevention and response is necessary to ensure potential odors are controlled.

In general there are seven potential sources of different types of odors at the LCF:

1. Organics receiving and processing
2. Aerated Static Pile (ASP) Composting
3. Phase 2 Mass Bed Composting
4. Compost Curing
5. Leachate collection and treatment
6. Leachate storage
7. General site conditions

Each of these potential odor sources may require the implementation of different best management practices (BMP) or mitigation strategies. A description of each source, source specific best practices, and source specific best available control technology used at the LCF is provided.

Organics receiving and processing

Organic residual feedstocks are delivered in the receiving building equipped with an air handling system. The evacuated air is treated through a biofilter. Organic material is evaluated as it is delivered to assess the necessary bulking agents that will be required to prepare a mix that is most conducive to an odor-free composting process. Once assessed, the material may be picked for contaminants, or be mixed and ground with an appropriate bulking agent and delivered to the ASP either immediately, or within a few hours of delivery. This on-demand management of organics reduces the potential for nuisance odors to occur.

If processing of organic feedstocks cannot be accomplished the same day as delivery, the feedstocks are pushed to the back of the tipping building and covered with a biofilter.

Best practices used at the LCF for odor control of commercial organics receiving and temporary storage include:

- Containment and biofiltration - Commercial and municipal collected yard debris and putrescible feedstocks are tipped in the receiving building southeast corner equipped with an air handling system. The evacuated air is treated through a biofilter
- On demand processing - Grass clippings and other nitrogen rich materials are incorporated into a compost pile immediately (e.g., mixed with a bulking agent and placed in an ASP) to minimize odor generation
- Covering of organics - If processing cannot be accomplished the same day as delivery, the yard waste or putrescible feedstocks are covered with a biofilter.
- Surveillance monitoring equipment is used to ensure proper content and character of received materials

Best practices used at the LCF for odor control of feedstock mixing and grinding include:

- Containment and biofiltration – Mixing and grinding occurs in the receiving building with an air handling system. The evacuated air is treated through a biofilter
- On demand processing – Immediately after mixing, the material is delivered to the ASP where it is aerated and begins the composting process

Phase I ASP Composting

An efficient composting process starts with a proper mix of materials. Proper compost mix ratio development and characteristics are critical to successful composting. Mix ratio refers to the ratio or portion of each feedstock in the initial mix. The initial mix impacts a number of processing parameters including: processing time, aeration requirements, odor generation, leachate production and final product quality.

LCF targets for initial compost mix include:

- Carbon to Nitrogen Ratio (Target range 20:1 – 40:1)
- Volatile solids (Target range is dependent upon material composition)
- Moisture Content of Mix (Target range 40-60 Percent)
- Particle Size and Exposed Surface Area on Feedstocks (Dependent upon feedstock character and use for compost)
- Interstitial Space (Target 30%)
- Bulk Density (Target range 800 – 1,000 lbs/yd3)

Once the material is delivered to the ASP, a computerized system is used to ensure that the proper environment is created for composting. This results in a more consistent process with fewer operational perturbations. LCF technicians cover each active ASP compost zone with a minimum six-inch layer of biofilter. Compost overs have been shown to significantly reduce odors (R. Horowitz, 2008). This cover filters and biologically reduces potential odors when the ASP system in a positive air mode. The LCF ASP system is also designed to operate in a negative air mode (pulling ambient air down through the compost zone) a significant portion of the time. When this condition occurs, air from the compost pile is directed and filtered through an engineered four to six-foot deep biofilter. Biofiltration is an air pollution control technology that uses a biologically active, solid media bed to absorb/adsorb compounds from the air stream and retain them for subsequent biological oxidation. Biofilters have been shown to be one of the most effective methods to reduce odors.

Best practices used at the LCF for odor control of ASP composting include:

- Compost is mixed to specific design parameters (C:N, solids, moisture, bulk density, etc.) to reduce potential odors
- The operating environment of the ASP is carefully monitored and controlled to minimize temperature fluctuations and maintain moisture.
- ASP compost is covered with a minimum six-inch layer of biofiltration material.
- When the ASP compost is in a negative aeration mode (ambient air is drawn down through the ASP), the evacuated air is directed through a biofilter
- The moisture content of the ASP compost is monitored to ensure proper levels. Moisture levels that are too high can cause pockets where air is not evenly distributed and can create potentially odiferous conditions. Moisture levels that are too low can cause bacterial population reductions and different types of potentially odiferous conditions

Phase II Composting

During Phase II windrow or massbed composting, the bed is turned a minimum of every seven to ensure that proper environmental conditions are maintained including; proper oxygen levels, moisture and porosity. During Phase II composting, both temperature and moisture of the compost pile are monitored to minimize nuisance odors.

Best practices used at the LCF for odor control of Phase II Composting include:

- Compost is mixed to specific design parameters (C:N, solids, moisture, bulk density, etc.)

- The operating environment of Phase II composting is carefully controlled to minimize temperature fluctuations and maintain moisture. Environmental conditions are controlled by physically turning the composting material.
- The moisture content of the composting material is monitored to ensure proper levels. Moisture levels that are too high can cause locations in the pile where air is not evenly distributed and can create potentially odiferous conditions. Moisture levels that are too low can cause bacterial population reductions and different types of potentially odiferous conditions

Phase III Compost Curing

During Phase III Compost Curing, the configuration and size of the bed are controlled to ensure that the potential for odors is minimized. The length of time that compost is allowed to cure is also carefully monitored and controlled.

Best practices used at the LCF for odor control of curing compost include:

- Compost is mixed to specific design parameters (C:N, solids, moisture, bulk density, etc.)
- Moisture is managed to ensure proper conditions
- Curing and finished compost is stored in appropriately sized stockpiles to minimize odors and fire risk

Leachate collection and treatment

The LCF uses an advance technology leachate treatment system to ensure that the potential for odors from collected and stored leachate is minimized. The treatment system consists of the following equipment and processes:

- Collected leachate drains through conveyance piping to deliver leachate to the treatment system in a timely manner
- A leachate collection tank with coarse bubble diffusion is used to ensure that aerobic conditions persist in the collection tank
- A chopper pump is used to transfer water from the leachate collection tank to minimize downtime and ensure proper solids sizing for treatment
- A rotary drum screen (RDS), with a 0.02-inch wedgewire screen is used to separate the majority of solids collected with the leachate.
- A fully-programmable, automatically controlled Modified Sequential Batch Reactor (MSBR), with fine bubble diffusion is used to reduce Biological Oxygen Demand (BOD), and Total Suspended Solids (TSS). The treatment of this water significantly reduces the potential of odors from collection of leachate.

Best practices used at the LCF for odor control of leachate collection and treatment include:

- Leachate collection and conveyance that does not allow stagnant water to accumulate
- Aeration of collected water to mitigate odors
- Advanced treatment of leachate to significantly reduce odor potential
- Computer controlled treatment and processing for consistent treatment results

Leachate storage

Excess leachate that is collected and treated with the leachate treatment system may be stored in the on-site leachate storage lagoon. The quality of water entering this lagoon, due to the advance treatment that is receives, is the main technique in mitigating nuisance odors from the lagoon.

Best practices used at the LCF for odor control of stored leachate include:

- Storing only treated water
- Monitoring quality to ensure stored treated water is odor free

General Site Conditions

The compost site is inspected, and debris removed, multiple times each day. This good-housekeeping technique is the primary practice used to mitigate potential general of site odors. It is essential to clean up the feedstock receiving and mixing areas and eliminate small piles and spills. A daily walk-through of the compost facility is also conducted and important to identify potential sources of odor. Equipment used to mix and process feedstock materials are routinely cleaned to minimize exposure of raw materials to the open air. A sweeper truck is used for cleaning receiving pads after piles are turned or materials are spilled. This vehicle uses an air jet to lift fine particles out of surface crevices. Using these methods, dust and runoff are significantly reduced.

A checklist for daily walk-through inspections and monthly detailed site inspections is used to ensure site checks occur regularly.

Best practices used at the LCF for odor control related to general site conditions include:

- Continual assessment and housekeeping to cleanup and dispose of waste in a timely manner
- Regular compost technician walk-through inspections and cleanings of the facility
- Regular site management inspections
- Timely spill and debris clean up action
- Regular use of a sweeper truck to clean surfaces

4) Likelihood of Odors

Introduction

The LCF was designed and installed using a state-of-the-art engineered compost system; employs best available control technology for potential odor generation, and employs a highly skilled workforce. However, as described previously, the potential for odor to occur is inherent to all living systems. The stabilization of organic material (controlled composting in this case and its by-products) can potentially generate a wide-array of different odors. Odor may occur during normal operations, due to sub-optimal operations, or due to process or equipment breakdown. Whether odors are generated from typical or atypical operating conditions, the potential for odor generation is directly related to the material composition and reactivity; and the environmental and process conditions to which the materials are exposed.

Potential Nuisance Odor Evaluation

Nuisance odors that may be generated from the LCF are of concern, from a legal perspective, because of the potential for the generation of an odor that may unreasonably interfere with another property owner's use and enjoyment of that property. If this situation occurs, the LCF must use recognized good practice and procedures to reduce these odors to a reasonable minimum. Additionally, nuisance odors are of concern, from a practical perspective, because Lenz Enterprises strives to maintain; a good working environment for all employees, a pleasant environment for customers, good community relations, and reduce the association between compost and nuisance odors.

Odors are caused by one or more volatilized chemical compounds that are distributed into the surrounding air. These volatilized chemical compounds cannot become a nuisance odor until the receptor (a human in this case) breaths in the compound through their nose and their brain assesses the quality of the compound. It is up to each individual to determine if an odor is a nuisance. The average human inhales about 10 $m^3$of air per day. During this process the human nose and brain are continually assessing the air and if an odor is of sufficient intensity, quality, frequency or duration (or some combination of these factors), the person may perceive it as a nuisance. The frequency, intensity, duration, and quality that an odor may exhibit are different at different stages of the LCF process due to the relative reactivity of the material, the ambient and process environment which it is exposed, control technologies employed, and the amount of materials and surface area of that material that are exposed to the air.

Factors that can cause an odor event to lead to an odor complaint typically include those shown in Figure 2 (St. Croix Sensory, Inc., 2005). The four factors that make up the model include; character, intensity, duration, and frequency. This methodology assumes an odor event exists when an odorant is present above the human detection threshold. The “Character” of the odor is the actual description of what the odor smells like. This document refers to character as the “quality” of the odor. More offense odors will be more annoying. “Intensity” of the odor refers to the overall strength or power of the odor. The more intense the odor, the more likely a person is to be annoyed. Even very pleasant odors such as perfumes can be very annoying at high intensities. “Duration” is the elapsed time of each individual odor event. Longer duration odor episodes can lead to more drastic changes in a person’s activity at home or in the community. Events of very short duration may be over before a person even thinks about adjusting his or her plans. Finally, “frequency” refers to how often the person experiences odor episodes. The more frequent the intrusion into the person’s life, the more annoying each experience may become.

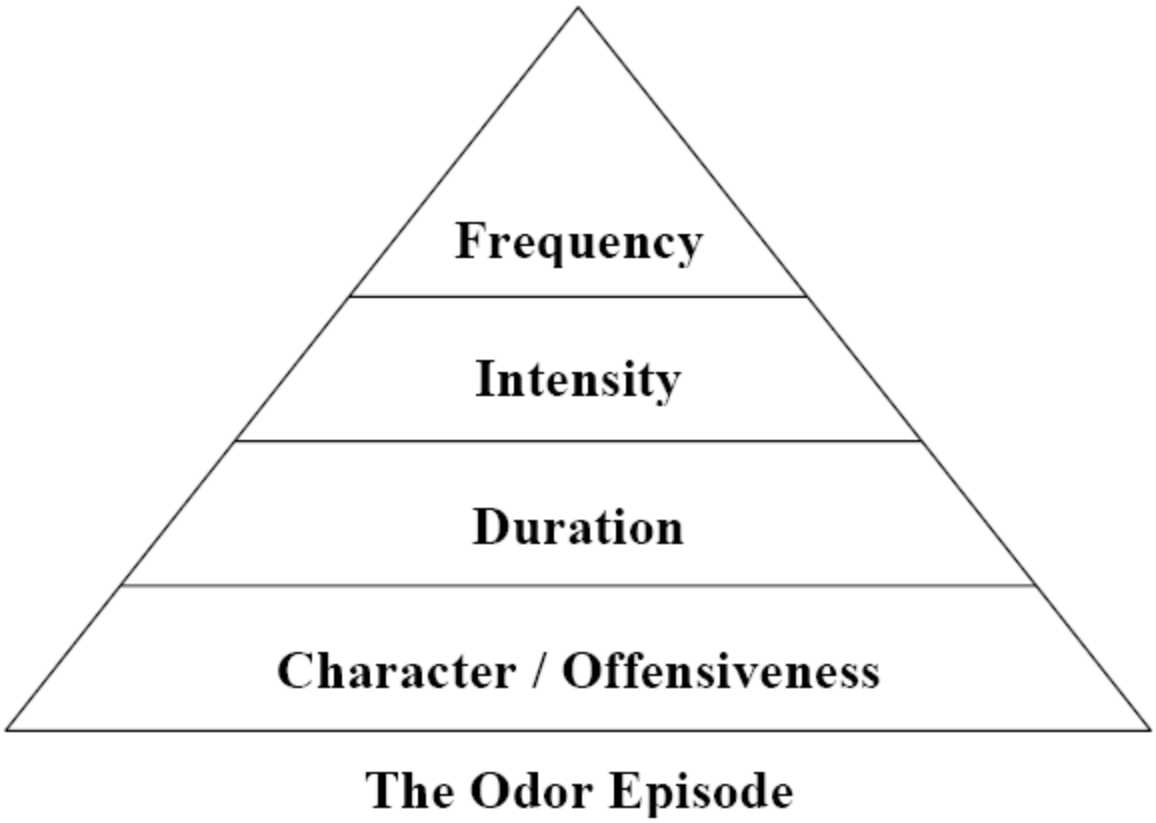

Figure 2. Factors that may lead to a nuisance odor complaint.

The lack or insignificance of any one of these factors may disrupt the sensory event and result in little or no annoyance to the person experiencing the odor. Although each of these factors may also be the single "tipping" factor with regard to whether or not the odor is considered a nuisance odor. To better understand the types of odors that may occur at a compost facility, the concept of the "Odor Wheel" is used (Figure 3). Odor wheels are helpful tools to characterize odors and provide for a standard vocabulary for discussions.

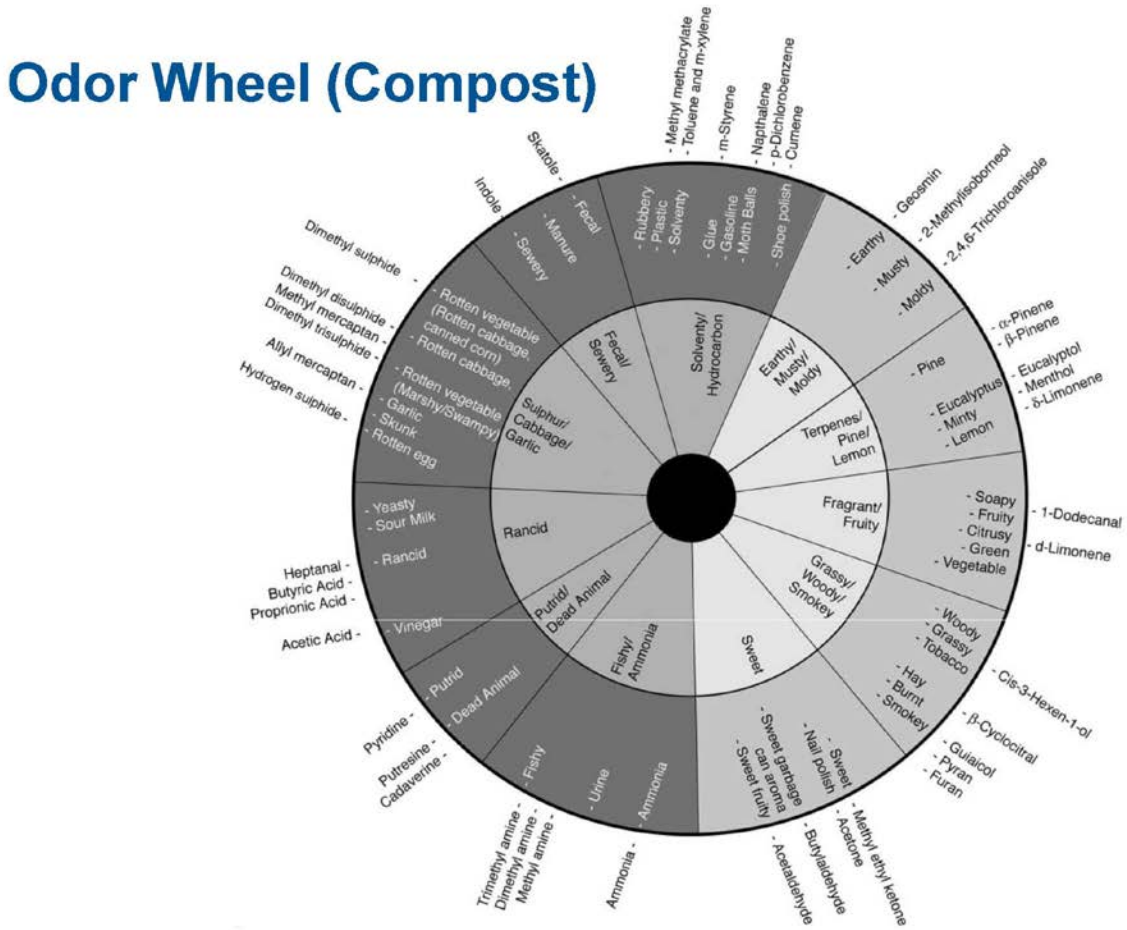

Figure 3. Odor Wheel (Developed by St. Croix Sensory)

Odor Potential at the LCF

Due to the complex nature of odors and atmospheric conditions, it is not always an easy task to identify the source of a specific odor. It is helpful to have a good understanding of the likelihood of potential odors at a facility to facilitate potential odor source identification if required.

Each of the potential sources of odors at the LCF have been assessed and rated as to their likelihood to create nuisance odors. This rating is qualitative, but provides a relative scale to use when investigation of a nuisance odor has been initiated.

A rating scale of 1-5, with 1 being the least potential to generate odors and 5 being the highest potential to generate odors, is used to provide a priority for odor prevention, investigation and mitigation should a potential odor issue occur. A general discussion of how the term “reactivity” is used in this analysis is provided to help the reader understand the assessed values.

- Relative reactivity of the material – This rating values how volatile the material is, which is directly related to the potential for odor generation. For example, incoming organics from commercial sources are typically the most diverse and reactive due to the high level and complexity of biological volatile solids content.
- Relative reactivity of the process – This rating values the impact the particular composting system process could have on the material. For example, the ASP process creates an environment where high volatile biological solids reduction occurs creating a high potential for odor generation due to this active biological breakdown of organics.
- Average volume of material – The more material in process the more odor potential exists, this is a direct relationship
- Average surface area of material in process - The more surface area of material in process the more odor potential exists, this is a direct relationship.
- Control Technology – This rating is contrary to the other ratings and indicates the relative effectiveness of the control technology used at any particular point in the process.

A relative rating of odor potential is provided in Table 2.

Table 2. Relative Odor Potential of Specific LCF Processes

Source/Activity	**Relative Reactivity of Material**	**Relative Reactivity of Process**	**Average Volume of Material in Process/Time**	**Average Surface Area of Material in Process/Time**	**Control Technology Used**	**Overall rating**
Organics receiving and processing	4	1	3	2	-3	1.4
Phase 1 ASP Composting	4	4	4	3	-4	2.2
Phase 2 Composting	3	3	5	5	-3	2.6
Compost Curing	2	1	3	3	-1	1.6
Leachate collection and treatment	3	4	1	1	-4	1
Leachate storage	1	1	4	4	-3	1.4
General site conditions	1	1	2	2	-2	0.8

This analysis indicates the following relative potential for odor generation at the LCF:

Table 3. Relative Odor Potential Generation at the LCF.

Source/Activity	Overall rating
Phase 2 Mass Bed Composting	2.6
Phase 1 ASP Composting	2.2
Feedstock mixing and grinding	1.8
Compost Curing	1.6
Organics receiving and temporary storage - Residential	1.4
Leachate storage	1.4
Organics receiving and temporary storage - Residential	1
Leachate collection and treatment	1
General site conditions	0.8

If an odor were to occur from a LCF process it must be detected by someone as interfering with use and enjoyment of their property before it can be determined to be a nuisance odor. This requires the odor be transported through the air, off the LCF site and to another location. This complex process can be modeled, once an odor emission estimate has been measured or estimated, but it cannot be calculated due to various factors. The following discussion describes the local qualitative potential for odor in the community surrounding the LCF.

Offsite Odor Potential in the Community

The potential for an odor to be generated at the LCF and become a nuisance is very low because:

- the low potential for nuisance odors due to proper design, operation and management;
- site vegetative buffers;
- mixing and dilution that occurs due to topography and meteorological conditions;
- prevailing wind patterns;
- distance to potential receptors in the area; and,
- the low number of receptors in the community.

Prevailing wind direction, speed and gusts are important to assess when developing a plan for potential nuisance odor investigation and mitigation. The National Oceanic and Atmospheric Administration (NOAA) have published data for the region. Information from the Everett NOAA weather station is provided in below. In the table, prevailing wind directions (DIR) are given in compass points; mean wind

speeds (SPD) and peak gust (PGU) are in miles per hour (mph). The Stanwood area is also often home to atmospheric convergence zone activity. A convergence zone is created when two currents of wind collide at a low elevation, pushing air higher in the atmosphere. This atmospheric phenomenon can significantly change local wind patterns.

Table 4. Regional Climatic Wind Data

Parameter	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Ann
DIR	SE	SSE	SSE	SSE	N	N	N	N	N	SE	SE	SE	SSE
SPD	8	8	8	8	7	7	7	7	7	7	7	8	7
PGU	52	62	46	55	46	40	35	30	39	81	51	46	81

The Everett data indicates that from October through April, the prevailing wind direction is primarily southeast or south-southeast and that from May through September the prevailing wind direction is primarily north. A vicinity map showing prevailing wind direction and potential local residential receiving areas within one mile of the LCF is provided in Figure 4.

Figure 4. Potential Residential Receiving Areas within one mile of LCF.

Based on minimal frequency, intensity and duration of odors generated at the LCF; the non-offensive character of odors generated, vegetative buffers, and the atmospheric mixing and dilution that typically occurs, the likelihood of an offsite nuisance odor occurrence is low.

5) Nuisance Odor Management Response

Response Protocol

A critical piece of an odor management plan is the odor complaint response protocol. This protocol is critical from three primary perspectives. First, it is sometimes difficult to separate serious odor complaints from odor complaints made due to other non-odor issues or off-site issues. Second, it is difficult to determine the appropriate level of action required based on the number of valid complaints and the perceived impact, which is subjective. Third, evaluating the effectiveness of the technology or a management response can be subjective.

The following LCF complaint response protocol sets guidelines to respond to potential odor events. In each case LCF management will inform agencies of the situation within 24 hours.

Table 5. LCF Odor Response Nexus

No. of Odor Complaints	Type of Odor Complaint	Conditions	Initial Response	Secondary Response	Follow Up
1	First complaint	No other complaints in vicinity (<1,000 ft)	Contact complainant and gather information	Evaluate site operations	Respond to deficiencies in operations. Inform complainant of action and request new evaluation of odor
>1	First complaint from each	All complaints from a different location or time	Contact complainants and gather information	Evaluate site operations	Respond to deficiencies in operations. Inform complainants of action and request new evaluation of odor
>1	First complaint from each	All complaints from same location and time	Contact complainants and request a group meeting and site tour	Implement full CPOMP	Implement full CPOMP
1	Follow up complaint	No other complaints in vicinity (<1,000 ft)	Request meeting with complainant to tour the facility and identify specific odor issue	Respond to complainant issues	Inform complainant of action and request new evaluation of odor
>1	Follow up complaint	All complaints from a different location or time	Request meeting with complainant to tour the facility and identify specific odor	Respond to complainant issues	Inform complainants of action and request new evaluation of odor

			issue		
>1	Follow up complaint from each	All complaints from same location and time	Contact complainants and request a group meeting and site tour	Implement full CPOMP	Implement full CPOMP
=/>1	Continual	NA	Contact complainant(s) and agency to request a group meeting	Implement CPOMP	Implement CPOMP

Nuisance odors may or may not be from a single source and may or may not require source specific action. Therefore, planned management response to potential nuisance odors at the LCF is both general and source specific. Due to the unknown nature of a potential nuisance odor, LCF management is aware and prepared to alter any part of this management plan to adapt to field conditions or to the specific nature of the event.

General Management Response to Nuisance Odor Generated from the LCF

Level One – Repair, Replacement of Enhancement of Equipment, Infrastructure or Operations

If an appropriate LCF odor response nexus has been met, LCF management will begin the following investigation process immediately. This includes several actions:

- Gathering of additional information from the complainant. This will include a face-to-face discussion if possible; if not a telephone conversation will occur. The LCF will use a standard complaint form (Appendix A) to gather additional information.
- Interview with the facility technician to identify if any abnormal conditions may have occurred in the past 24 hours including; equipment malfunction, process malfunction, unusual character or volumes of received organics, changes to bulking agents used in the process, changes to the typical makeup of compost, or other situations that could have accounted for a nuisance odor.
- Review of both onsite and local weather data to determine prevailing winds around the time the potential nuisance odor was identification.

If the information gathering process reveals that the nuisance odor originated from the LCF, each aspect of operation that could potentially generate a nuisance odor will be evaluated. If a cause and source of the nuisance odor can be identified, and it is operational in nature, the issue will be rectified as soon as possible. The majority of these corrections, such as lowering pile heights, re-blending materials, increasing oxygen levels or adjusting temperatures, can occur within 24 hours. Corrections to equipment or infrastructure may take longer if major repair or replacement is required. If materials or parts need to be ordered this may delay repairs. These corrections will take priority over other operations. Corrections that take longer than 24 hours will be analyzed to determine if actions can be taken to reduce the time

of future corrections, should they occur. This may be in the form of additional spare parts being stored on site, or establishing emergency relationships with service providers.

Examples of this type of action may include:

- Repair or replacement of equipment
- Repair or replacement of infrastructure
- Adjustments to ASP air flow rates or regimes
- Change in frequency to mass bed turning
- Adjustment to leachate treatment control system

Level Two – Change to LCF Plan of Operation

If Level One responses are not responsible for, or do not solve the identified nuisance odor issue, the issue prevails, and LCF processes are working per the Plan of Operation; LCF management will review all aspects of the Plan of Operation to determine if changes to the plan and subsequent implementation may mitigate the identified issue. If a potential change to operations is identified LCF management will implement this change as soon as possible. The range of potential changes that may be needed cannot be identified until such time that a nuisance odor and its cause(s) is identified. Therefore it is impossible to estimate the time required for implementation. However, it is in the best interest of the LCF management to implement the change as soon as possible and LCF management and staff will assign this action the highest priority.

Examples of this type of action may include the following types of changes:

- Organics receiving rates per time
- Feedstock acceptance criteria
- Solids Retention Times (SRT)
- Product Storage Management

Level Three – Agency Coordination and Development of an Action Plan

If Level One and Level Two responses are not responsible for, or do not solve the identified nuisance odor issue, the identified nuisance odor prevails, and LCF processes are working per the Plan of Operation; LCF management will request assistance from the Snohomish County Health District and the Puget Sound Clean Air Agency. This requested assistance will be in the form of a nuisance odor investigation and evaluation to determine appropriate mitigation of the specific potential nuisance odor. Once agreement is reached on appropriate mitigation for the identified nuisance odor between the agencies, the complainant and LCF management; an action plan will be developed by LCF management, in coordination with the agencies, and implemented as soon as possible. Identified changes that can be reasonably implemented will be made as quickly as possible.

Examples of this type of action may include the following:

- Changes to site operation schedules or processes
- Permit condition enhancements

Level Four – Major Facility Infrastructure/Equipment /Process Design Change

If Level One, Level Two, and Level Three responses are not responsible for, or do not solve the identified nuisance odor issue and the identified nuisance odor prevails; design changes may be required to the facility. LCF management will contact a professional engineering company, which specializes in compost facility design, and work to find a solution to the identified nuisance odor issue. This level of change may take several months if permitting is required or significant construction must occur. The nature of this type of change will depend upon the nature and source of the identified nuisance odor. Examples of this type of action may include:

- Enhanced air handling and treatment systems
- Larger or redesigned biofiltration systems
- Enhanced ASP Floor Space
- Enhanced Mass Bed turning equipment or retention times
- Enhanced leachate treatment equipment or processes

During any period of significant upgrade, LCF management will take steps necessary to reduce the nuisance odor using recognized good practice and procedures to reduce these odors to a reasonable minimum.

Source Specific Management Action

Due to the different character of material on site at different locations, and the different processes and source control techniques used at those locations, source specific management actions have been prepared to timely and effectively act upon a nuisance odor should one develop.

Using the previously identified potential source of odors, potential source specific management actions have been identified for use in the case of a nuisance odor complaint.

Organics receiving and processing

If nuisance odors occur, and they are identified as originating from the commercial organics receiving and temporary storage area, the following steps will typically be taken in order:

1. Ensure operations are occurring per the Plan of Operation – Resolve any issues.
2. Ensure that process equipment is operating per design specifications or manufacturers recommendations – Resolve any issues.
3. Ensure that Best Available Control Technology (BACT) is operating correctly – Resolve any issues.
4. Identify inadequacies in the Plan of Operation that may mitigate the issue – Implement identified changes. Examples may include more frequent processing.
5. Review organics receiving material character and Solids Residence Time (SRT) – Make adjustments to types or volumes. Examples include: reducing daily or weekly organic receiving rates, rejecting odiferous materials.
6. Evaluate efficiency of BACT for odor mitigation – Design and implement new systems if identified to mitigate the issue. Examples include: enhanced or additional air handling systems.

7. Evaluate efficiency of receiving building dimension and design, with regard to incoming organics rates – Upgrade or enhance based on identified mitigation strategies. Examples include: door re-design or building dimension changes, air curtain systems.

Phase 1 ASP Composting

If nuisance odors occur, and they are identified as originating from the ASP composting process, the following steps will typically be taken in order:

1. Ensure operations are occurring per the LCF Plan of Operation – Resolve any issues.
2. Ensure that process equipment is operating per design specifications or manufacturers recommendations – Resolve any issues.
3. Identify inadequacies in the Plan of Operation that may mitigate the issue – Implement identified changes. Examples include: changes to time and temperature regimes, changes to feedstock mixing recipes.
4. Review organics receiving material character and SRT – Make adjustments to types or volumes. Examples include: reducing daily or weekly organic receiving rates, rejecting odiferous materials
5. Evaluate efficiency of BACT for odor mitigation – Design and implement new systems if identified to mitigate the issue. Examples include: a greater depth of cover for biofiltration of positive air flow through the pile, more time in negative air flow directed to biofilter system.
6. Evaluate efficiency of the ASP compost system dimension and design, with regard to incoming organics rates – Upgrade or enhance based on identified mitigation strategies.

Phase 2 Composting

If nuisance odors occur, and they are identified as originating from the Mass Bed Composting Area, the following steps will typically be taken in order:

1. Ensure operations are occurring per the LCF Plan of Operation – Resolve any issues.
2. Ensure that process equipment is operating per design specifications or manufacturers recommendations – Resolve any issues.
3. Identify inadequacies in the Plan of Operation that may mitigate the issue – Implement identified changes. Examples include: changes to time and temperature regimes, changes to feedstock mixing recipes.
4. Review organics receiving material character and SRT – Make adjustments to types or volumes.
5. Evaluate efficiency of the Mass Bed compost system SRT– Upgrade or enhance based on identified mitigation strategies. Examples include changes to pile geometry or size.
6. Evaluate efficiency of BACT for odor mitigation – Design and implement new systems if identified to mitigate the issue. Examples include: changes to turning frequency, using biofiltration or emission inhibiting covers to treat or reduce odors at point of odor generation.

Compost Curing

If nuisance odors occur, and they are identified as originating from the compost curing area, the following steps will typically be taken in order:

1. Ensure operations are occurring per the LCF Plan of Operation – Resolve any issues.

2. Ensure that process equipment is operating per design specifications or manufacturers recommendations – Resolve any issues.
3. Identify inadequacies in the Plan of Operation that may mitigate the issue – Implement identified changes.
4. Review receiving material character and SRT – Make adjustments to types or volumes. Examples include: adjust SRT in previous processes to further stabilize materials.
5. Evaluate efficiency of the compost curing system dimension and design, with regard to incoming compost rates – Upgrade or enhance based on identified mitigation strategies. Examples include change to pile geometry or size.
6. Evaluate location – Move location if identified to mitigation the issue.

Leachate collection and treatment

If nuisance odors occur, and they are identified as originating from the leachate collection and treatment system, the following steps will typically be taken in order:

1. Ensure operations are occurring per the LCF Plan of Operation – Resolve any issues.
2. Ensure that process equipment is operating per design specifications or manufacturers recommendations – Resolve any issues.
3. Identify inadequacies in the Plan of Operation that may mitigate the issue – Implement identified changes.
4. Evaluate the need for odor mitigation BACT – Design and implement new systems if identified to mitigate the issue. Examples include: source specific air handling and treatment.
5. Evaluate efficiency of collection and treatment tanks dimension and design, with regard to incoming leachate flow – Upgrade or enhance system based on identified mitigation strategies.

Leachate storage

If nuisance odors occur, and they are identified as originating from the leachate storage lagoon, the following steps will typically be taken in order:

1. Ensure operations are occurring per the LCF Plan of Operation – Resolve any issues.
2. Ensure that process equipment is operating per design specifications or manufacturers recommendations – Resolve any issues.
3. Identify inadequacies in the Plan of Operation that may mitigate the issue – Implement identified changes.
4. Evaluate the need for odor mitigation BACT – Design and implement new systems if identified to mitigate the issue. Examples include: surface aeration and mixing.
5. Evaluate efficiency of leachate lagoon dimension and design, with regard to incoming leachate flow and detention time – Upgrade or enhance system based on identified mitigation strategies.

General site conditions

If nuisance odors occur, and general site conditions are identified as the source, the following steps will typically be taken in order:

1. Ensure operations are occurring per the LCF Plan of Operation – Resolve any issues.

2. Ensure that process equipment is operating per design specifications or manufacturers recommendations – Resolve any issues.
3. Identify inadequacies in the Plan of Operation that may mitigate the issue – Implement identified changes.
4. Evaluate the need for additional odor mitigation – Design and implement new systems if identified to mitigate the issue. Examples include: more frequent cleanup of high traffic areas, dedicated personnel.

Unresolved Nuisance Odor Issues

Potential nuisance odors may go unresolved for several reasons after an initial response. These reasons may include:

- General or source specific management responses did not solve an identified issue;
- The odor perceived by the complainant is not recognized by all stakeholders as a nuisance odor;
- The source of the odor cannot be found.

Management Response Does not solve an Issue

If general or source-specific management responses do not solve an identified nuisance odor issue; and LCF management believes that all reasonable, recognized good practices and procedures have been implemented, agency intervention is required. Washington State law provides general guidelines which require generators of odors to use recognized good practices and procedures to reduce odors to a reasonable minimum if the odors unreasonably interfere with other property owner's use and enjoyment of their property. Because the detection and evaluation of odors is an individual assessment, and many of the terms in Washington State law have not been well defined (i.e. “use and enjoyment of property”, “reasonable minimum”, etc.), agencies with regulatory authority must make impact determinations. LCF management will work diligently with the agency to resolve the issue.

Stakeholders Differ in Odor Assessment

If the odor perceived by the complainant is not recognized by all stakeholders as a nuisance and is an identified LCF issue, a process must be initiated to evaluate the odor issue subjectively. Depending upon the nature and source of the potential nuisance odor, odor measurements may be used to compare the potential nuisance odor with background levels in the area, the source or similar situations. This measurement may occur by sampling and analyzing air constituents in a laboratory, or by human measurement. Human measurement typically employs a panel of people, usually with some specific odor training, to sniff odor samples and then rate, describe or react to them. Because individuals sense and perceive odors differently, odor panels contain several members, preferably 5 to 10 (Haug, 1993). Their collective response is expressed statistically. For example, odor thresholds are usually defined by the point at which 50% of the panel no longer detects the odor (e.g. D/T50). Standard techniques are used to prepare the odor samples, present them to the panel and to register the responses of the panel members. A number of standard methodologies exist for olfactometry, including at least two ASTM standards (Haug, 1993). A standardized method will be used if necessary.

Candidate odors for consideration as nuisances include those which cause obvious and active changes in receptor behavior, such as avoiding use of the garden, closing windows, and making complaints. The determination of a nuisance also must take account of the frequency and duration of odor events, as well as the characteristics of the odor and the numbers of people affected. The opinion and judgment of the regulating agencies are important factors in deciding if, or when, an odor constitutes a nuisance. The opinions and evidence of the regulator will also constitute important evidence in any court proceedings involving nuisance, so it is crucial that regulators are appropriately objective, competent and thorough in their investigations of an alleged nuisance odor. In assessing the odor in a particular area a regulator might well look at the proportion of the population who complain. He/ she could be justifiably less influenced by a small number of complaints from a large or high density residential area where one would expect a high level of reports or complaints to be made. Regulators must also review environmental and other data, such as wind direction at the time of the odor event, to evaluate whether the nuisance odor issue is potentially valid.

The characteristics of the odor are very important. At one extreme, almost all receptors could be expected to find a strong odor arising from the composting of green waste under anaerobic conditions to be both objectionable and offensive with fairly regular exposure for short periods. The concentrations at which these odors become a nuisance could be relatively low if they are persistent and frequent. However, short term exposure to these offensive odors on an irregular basis would be less likely to be considered a justified nuisance.

Source of the Odor Cannot be identified

If the source of the perceived nuisance odor cannot be found through a process of elimination, LCF management will continue to assist in the identification of the source of the potential nuisance odor as necessary.

6) Summary

This Comprehensive Progressive Odor Management Plan (CPOMP) was developed for the Lenz Compost Facility (LFC) located near Stanwood Washington. The goal of this plan is to provide guidance to site management should nuisance odors occur as a result of site activities.

This plan provides general background on nuisance odor science and detection, Washington State regulations concerning required responses to nuisance odors, potential sources of odors at the LCF and their relative potential to become a nuisance odor, general management responses to potential nuisance odors, source-specific management responses to potential nuisance odors, and concepts to be used should a nuisance odor issue go unresolved.

LCF Management is dedicated to the avoidance of nuisance odors and has invested in the best available composting technology, best available odor control technology and highly qualified technicians to ensure that nuisance odors do not occur. If nuisance odors do occur, LCF management is dedicated to their timely identification and remediation.

7) References

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8) Appendix

LENZ

ENTERPRISES

POTENTIAL ODOR COMPLAINT FORM

A – Name

_____ Name

_____ Telephone Number

_____ Address

_____ E-mail address

_____ Signature

_____ Date

B - General Where were you when you smelled the odor?

_____ Location

_____ am/pm Time

_____ hours _____ minutes Duration

C – Intensity Rating
Check the appropriate boxes

Intensity Scale
Choose one

1 2 3 4 5 6 7 8

□ □ □ □ □ □ □ □

Very Faint Light Moderate Strong

D – Odor Description
Check the appropriate boxes

□ Ammonia
□ Decaying Grass
□ Earthy/Moldy/Musty
□ Cabbage-like
□ Turpentine
□ Sewer/Sewage-like
□ Woody

□ Chemical/Solvent
□ Burnt/Smoky
□ Rotten Egg
□ Fishy
□ Turpentine
□ Manure
□ Other __

E – Weather Conditions
Check the appropriate boxes

□ Sunny
□ Overcast
□ Temperature _____F

□ Calm
□ Light Breeze (1-5 mph)*
□ Moderate Wind (5-15 mph)*
*If you checked this box, please provide wind direction in check boxes below:

□ Strong Wind (15+ mph)
□ Humid

Wind Direction
Note direction wind is blowing from

□North □Northeast □ East □Southwest
□South □Southeast □West □Northwest

F – Miscellaneous Notes

_____

_____

This form is not actionable without a complainant signature.

WITNESS: _____

COMPLAINANT _____

LENZ ENTERPRSES POTENTIAL ODOR
COMPLAINT FORM INSTRUCTIONS

There are a couple of important issues to keep in mind as you complete the form.

1. **This record of events may be reviewed by regulatory agency personnel who may contact you for additional information.**
2. **You could be subpoenaed by a court of law to testify as to the details and validity of this complaint.**

Instructions:

A – Name: Print your name, address, e-mail address and telephone number and also sign it when you are finished.

B – General: The "Location" refers to where you were when you smelled the potential nuisance odor. That location is generally noted by the name of the nearest intersection, landmark or home address if you are at your house at the time.

C – Intensity:

1.	Very Faint:	barely perceptible
2.	Very Light:	may not be distinguishable
3.	Light:	distinguished but not objectionable
4.	Light-to-Moderate:	distinguishable and at times objectionable
5.	Moderate:	objectionable/irritating
6.	Moderate-to-Strong:	very distinct, pungent
7.	Strong:	objectionable
8.	Very Strong:	overpowering and intolerable

E – Weather Conditions:

Wind speed can be defined by referring to the following description:

Calm:	Smoke rises vertically
1-5 mph:	Wind is felt on face; leaves rustle; ordinary wind vane is moved by wind
5-15 mph:	Leaves and twigs in constant motion; wind extends light flag; dust, loose paper, and small branches are moved
15+ mph:	Small leaf trees begin to swale; large branches in motion; whistling in phone/electrical wires

Return the completed form to: LENZ ENTERPRISES
5210 SR 532
STANWOOD, WA. 98292