SEWPCC Upgrading/Expansion
Conceptual Design Report

SECTION 16 - Odor Control

Table of Contents

16.0 Odor Control

16.1 INTRODUCTION

As part of the upgrade to the SEWPCC, odor control systems are proposed for the process sources requiring control. This will protect against objectionable odors being detected in neighborhoods beyond the property line of the facility.

16.2 EXISTING ODOR CONTROL SYSTEMS

The SEWPCC currently relies largely on dilution and dispersion of odors through a 47 m tall stack. The plant also utilizes a small thermal oxidation system to treat highly odorous air from the sludge holding tanks.

In the experience of the project team, dispersion cannot always be relied upon to prevent objectionable odors from being detected downwind. Despite use of odor dispersion models that predict little or no downwind impact, plumes of odorous air can sometimes “touch down” and cause odor complaints. There are many examples of wastewater treatment facilities that relied on stack dispersion have had to install systems to treat odorous air. One such example is the Ashbridges Bay WWTP in Toronto.

16.3 SAMPLING OF EXISTING ODOR SOURCES

16.3.1 Description of Sampling Program

A sampling program was conducted in September of 2007 to characterize the odorous air from existing processes at the SEWPCC. This involved collection of odorous air samples and analyzing them for odor concentration and the levels of reduced sulfur compounds, and use of H_2S dataloggers to record fluctuations in H_2S levels. The following odor sources were sampled:

- influent wet well
- screen room
- grit chamber room
- primary settling tank (PST) room
- primary effluent launder
- final clarifier room
- sludge holding tank

- septage receiving

Air samples were collected in 10L and 3L Tedlar™ bags using a vacuum chamber and sampling pump. This allowed sample air to be drawn through Teflon™ tubing directly into the sample bag without potential contamination from the sump. The 3L bags were sent by overnight courier to Alberta Research Council for measurement of reduced sulfur compounds using a gas chromatograph with flame photometric detector (GC-FPD). The air samples were analyzed within 24 hours of sample collection in accordance with standard protocol.

Reduced sulfur compounds are most often the cause of odor at wastewater treatment facilities. In addition to common hydrogen sulfide gas (H_2S), which has a "rotten egg" odor, other odorous compounds include methyl mercaptan, dimethyl sulfide, dimethyl disulfide, and others. These other compounds are often described as having a "rotten cabbage" or "rotten vegetable" character. All of these reduced sulfur compounds can be detected by the human nose at very low concentrations (approximately 1 part per billion).

The 10L bags were delivered to the University of Manitoba, Department of Biosystems Engineering for determination of odor concentration. Odor concentration refers to the number of times an odorous air sample must be diluted with odor-free air until it is no longer detected by 50% of a six-member odor panel. The test uses an instrument called an olfactometer, which simply prepares known dilutions of the sample air and presents it to the panelist. The panelists are first presented with a very dilute version of the odor and two blanks, and are asked to select the sniffing port with the odor. Next, a less dilute sample of the odor is presented, and the panelists are again asked to select the sniffing port containing the odor. Results of the test are statistically analyzed to generate the odor concentration, or "dilutions to threshold." High numbers (e.g., >1,000) represent strong odors that must be diluted many times to render them undetectable. Low numbers (<100) indicate dilute odors that can often be released to the atmosphere without treatment.

Datalogging H_2S analyzers (OdaLog™) with a range of 0 to 200 ppm H_2S were hung in the wet well and grit chamber rooms for two days to record hydrogen sulfide levels. The devices sample for hydrogen sulfide every five minutes and store the data, which can be downloaded to a computer.

16.4 RESULTS

Table 16.1 presents the results of the air sampling program. Results are discussed by process, beginning at the wet well.

16.4.1 Wet Well

Odor concentration in the wet well (Samples 3 and 10) was relatively high, in excess of 1,000 dilutions to threshold (D/T). Reduced sulfur compounds were primarily hydrogen sulfide (H_2S) with some methyl mercaptan and other sulfur compounds. Figure 16.1 shows a wide fluctuation in H_2S levels (from 0 to 65 ppm), with significant spikes occurring in the afternoon and early evening. Average H_2S concentration was only 1.5 ppm.

16.4.2 Grit Chamber Room

Samples from the grit chamber room (Samples 2 and 9) showed moderately high odor levels (600 to 1,100 D/T). Again the dominant sulfur compound was H_2S. Figure 16.2 shows the presence of several spikes in H_2S occurring around midnight. Interestingly, the H_2S spikes observed at the wet well did not show up at the grit chamber. However, the spikes observed in the grit chamber room were more sustained than those recorded in the wet well.

16.4.3 Screen Room

These samples (1 and 8) showed odor concentrations of 300 to 700 D/T. H_2S and other reduced sulfur compounds were generally low. Air exhausted from areas processing raw sewage would normally be treated before discharge. Our understanding is that air from the screen room is used as make-up air for the grit chamber room.

16.4.4 Primary Settling Tanks

Samples were collected of room air as well as the headspace of the covered effluent launders. Samples of room air were collected at the effluent ends of the clarifiers. PST No. 3 showed significantly higher odor concentrations than PST Nos. 1 and 2 (2,100 vs. 60 D/T). Field H_2S measurements in the room air confirmed the higher concentrations in PST No. 3 (0.7 to 2 ppm vs. 0.1 to 0.2 ppm). It is not clear why the odor levels would be so different unless there was a significant difference in ventilation rates or air mixing conditions at the time of sampling.

The high odor level in PST No. 3 would suggest that air from all PSTs be directed to an odor control system.

The headspace of the primary effluent launders showed consistently high odor concentrations of over 5,000 D/T and H_2S levels from 20 to 30 ppm. Methyl mercaptan was also detected in significant quantities.

16.4.5 Final Clarifiers

The sample from the final clarifier room exhibited a low odor level of 40 D/T, with only trace amounts of odorous compounds. Normally, this air is released to the atmosphere without treatment.

16.4.6 Sludge Holding Tank

Samples 7 and 13 from the sludge holding tank showed extremely high levels of odor (20,000 D/T) and reduced sulfur compounds. Hydrogen sulfide levels of over 600 ppm were measured, as well as methyl mercaptan concentrations of 100 ppm and ethyl mercaptan, dimethyl sulfide and dimethyl disulfide levels of 1 to 2 ppm. These are very high levels, and efficient capture

Table 16.1 - Summary of Odor Panel and Reduced Sulfur Data Winnipeg South End WWTP - September 26, 2007

Sample No.	Time	Location	Odor Conc'n D/T	Field H_2S ppm	Reduced Sulfur Compounds,[1] ppb							
					H_2S (lab)	CS	MM	EM	DMS	CS_2	DMDS	DMTS
1	9:00 AM	Screen room	245	0.1	75	7	4	ND	ND	2	ND	ND
2	9:15 AM	Grit chamber room	663	0.6	396	45	64	ND	8	4	1	1
3	9:40 AM	Wet well	1,040	1.1	350	56	60	ND	16	6	4	1
4	10:10 AM	Primary clarifier 1 & 2 room	64	0.1	15	5	2	ND	ND	2	ND	ND
5	10:25 AM	Primary clarifier #2 effluent launder	5,269	31.5	35,650	ND	1,325	ND	36	11	26	ND
6	10:50 AM	Final clarifier #3 room	40	0.0	16	5	2	ND	1	2	ND	ND
7	11:15 AM	Sludge holding tank	18,981	>200	635,000		109,000	788	1,620	110	2,140	232

1 H_2S hydrogen sulphide; CS carbonyl sulphide; MM methyl mercaptan; EM ethyl mercaptan
DMS dimethyl sulphide; CS_2 carbon disulphide; DMDS dimethyl disulphide; TMDS trimethyl disulphide

ND = not detected

Table 16.1 (con't) - Summary of Odor Panel and Reduced Sulfur Data Winnipeg South End WWTP - September 26, 2007

Sample No.	Time	Location	Odor Conc'n D/T	Field H_2S ppm	Reduced Sulfur Compounds,[1] ppb							
					H_2S (lab)	CS	MM	EM	DMS	CS_2	DMDS	DMTS
8	8:25 AM	Screen room	696	0.1	20	ND	ND	ND	ND	2	ND	ND
9	8:40 AM	Grit chamber room	1,094	0.2	234	ND	32	ND	ND	ND	ND	ND
10	8:55 AM	Wet well	4,156	3.2	1,050	ND	143	ND	24	5	ND	ND
11	9:25 AM	Primary clarifier #3 room	2,131	1.7	689	ND	51	ND	ND	ND	ND	ND
12	9:50 AM	Primary clarifier #3 effluent launder	5,235	19.0	5,320	ND	453	ND	ND	ND	ND	ND
13	10:15 AM	Sludge holding tank	26,894	>200	268,000	ND	68,000	ND	ND	ND	ND	ND
14	11:00 AM	Septage receiving	1,706	0.2	3	6	ND	ND	ND	ND	ND	ND

1 H_2S hydrogen sulphide; DMS dimethyl sulphide; CS carbonyl sulphide; CS_2 carbon disulphide; MM methyl mercaptan; DMDS dimethyl disulphide; EM ethyl mercaptan; TMDS trimethyl disulphide

ND = not detected

FIGURE 16.1
WINNIPEG SOUTH END WPCC WET WELL
Hydrogen Sulfide Levels
25-27 September, 2007
Average = 1.5 ppm

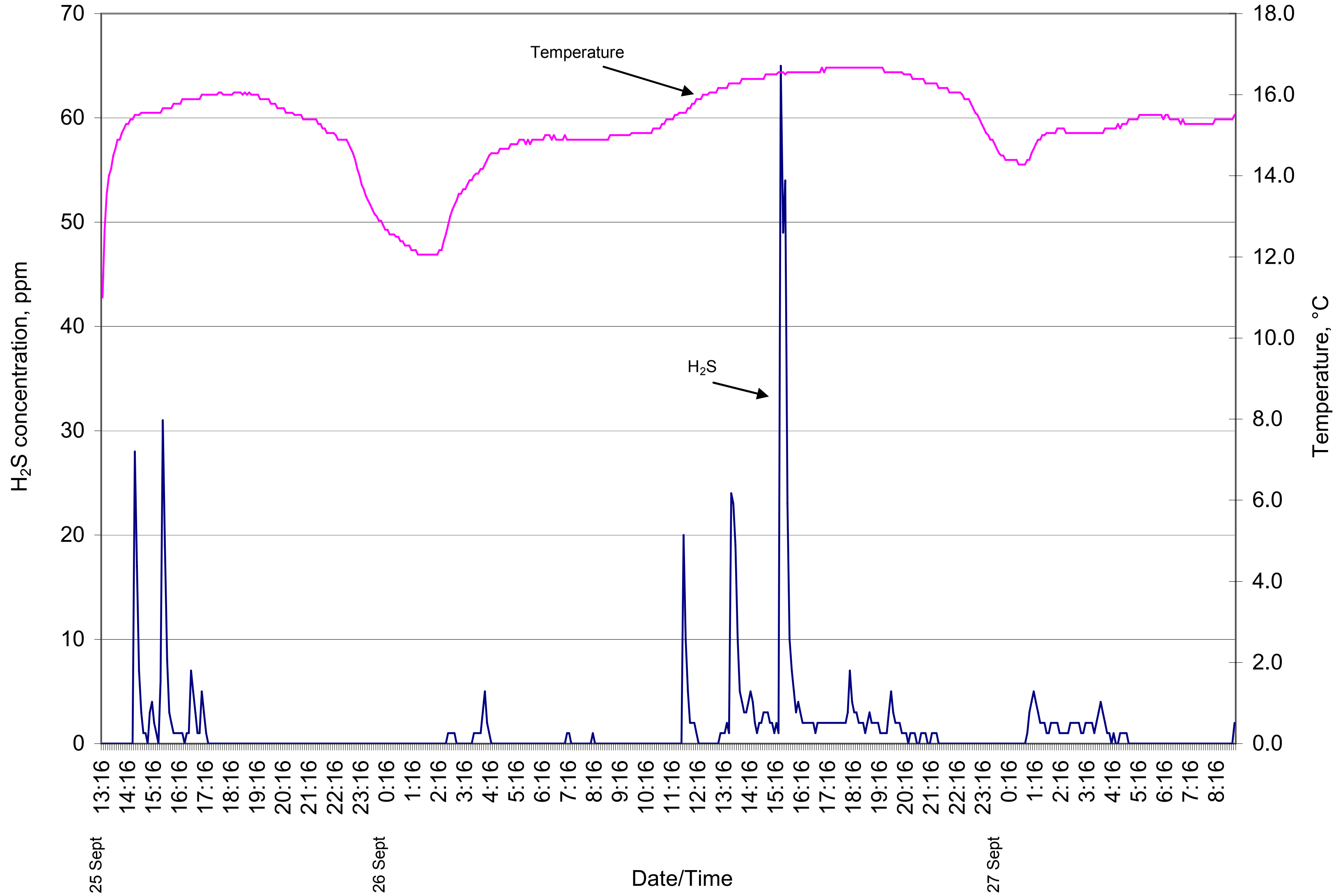
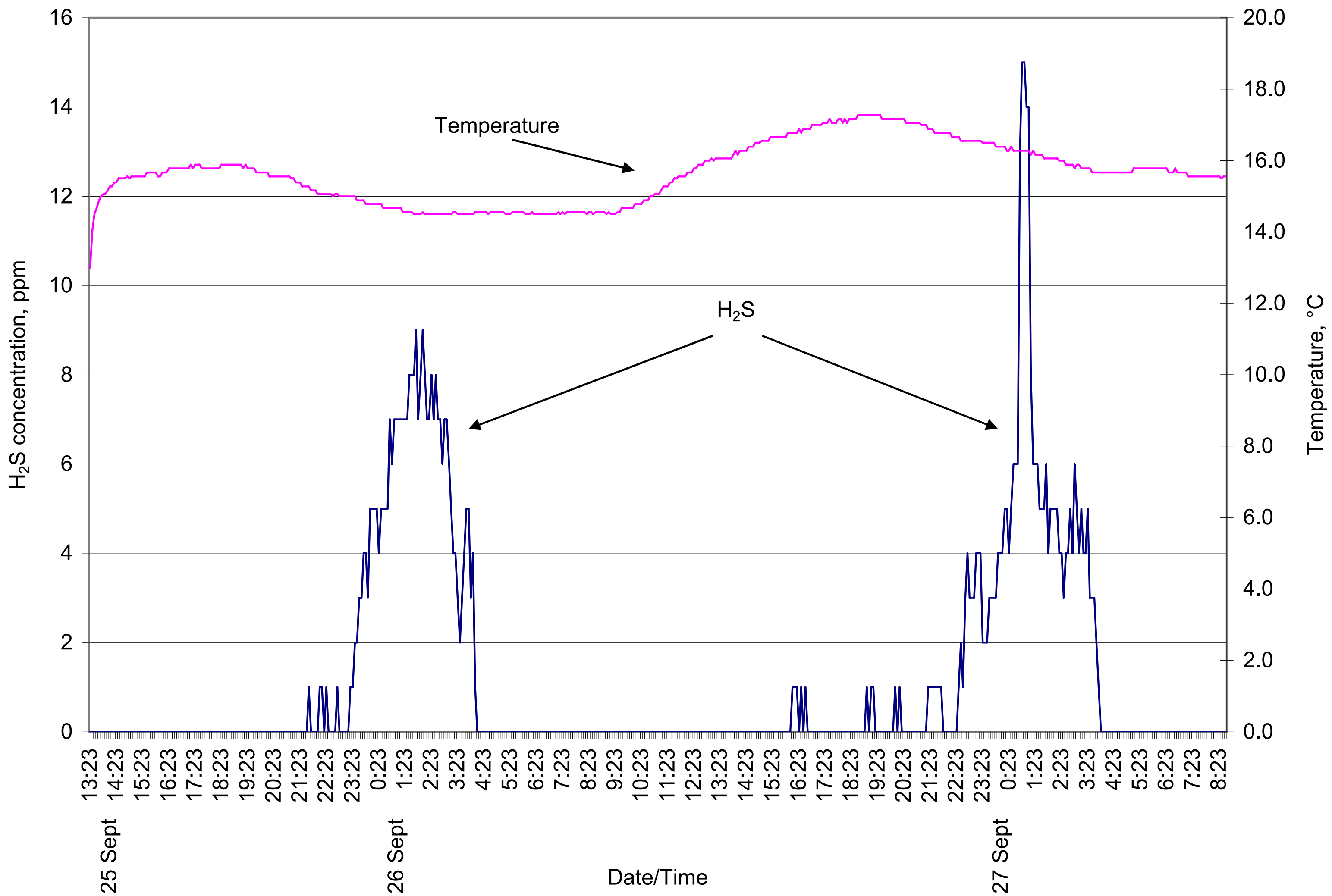


FIGURE 16.2
WINNIPEG SOUTH END WPCC GRIT CHAMBER ROOM
Hydrogen Sulfide Levels
25-27 September, 2007
Average = 1.25 ppm



and treatment of this air stream is essential. The sludge holding tank is proposed to be replaced. The design of the replacement tank could affect the characteristics of the odorous air, e.g., a continuously aerated tank could reduce the high levels of H_2S, methyl mercaptan, and other reduced sulphur compounds that form under anaerobic conditions.

16.4.7 Septage Receiving Area

This sample (No. 14) showed moderately high odor levels, but for some reason, low concentrations of reduced sulfur compounds. It is possible that the odor was associated with some volatile organic compounds not identified in the sulfur scan. Because septage typically has high potential for release of objectionable odors, odor control measures are appropriate for this source.

16.5 EVALUATION

16.5.1 Odor Sourcing Control

Stantec originally proposed to conduct odor dispersion modeling in order to determine the degree of odor reduction necessary to prevent odor complaints from residents in the vicinity of the plant. Dispersion modeling is also used to help determine which sources need to be treated and which sources can be exhausted to the atmosphere without treatment. The City decided not to conduct the modeling as part of the Conceptual Design; instead, opting to start the evaluation based on a conservative approach to odor control that would ensure adequate treatment of odors with little or no off-site impact. If this approach proves to be cost prohibitive, they will reconsider undertaking odor dispersion modeling or part of the Detailed Design in order to confirm lower cost odor treatment alternatives will yield satisfactory results.

Virtually every “wet” process used to treat wastewater or sludge at SEWPCC releases odor. As wastewater undergoes further treatment, odor emissions decrease, and the character of the odor changes from a “sewage” or “rotten egg” odor to a less objectionable “musty” or “earthy” odor. Processes typically slated for odor control at wastewater treatment plants include the following:

- raw sewage pumping
- screening and grit removal
- primary clarification
- sludge holding
- sludge thickening
- sludge stabilization

- sludge dewatering

Air from aeration tanks and bioreactors is typically not treated unless residents are in close proximity to the plant or dispersion modeling indicates a potential impact. Air from final (secondary) clarifiers is rarely treated.

Table 16.2 lists the odor sources potentially requiring control at the upgraded SEWPCC. As can be seen, the odor sources represent a combination of existing and new sources. Table 16.3 shows the estimated "odor emission" rate of odor sources at the upgraded SEWPCC; along with their ranking. The highest priorities for odor control are the sludge holding tanks and sludge fermenters, followed by the PST rooms, grit room, and wet well. The bioreactors, DAF thickeners, and septage receiving are lower priority based on odor emission rate calculations.

The expected air flowrates from odorous processes are also included in Table 16.2. Some of the existing process rooms can be ventilated at different rates. For example, PST No. 3 has a winter ventilation rate of 24,460 m^3/hr and a "maintenance" ventilation rate of 81,500 m^3/hr, approximately three times the winter rate. PSTs 1 and 2 have a winter rate of 36,720 m^3/hr, and a "maintenance" rate of 110,160 m^3/hr, also three times the winter rate. Overall, the air flows from the PST rooms represent about 35 percent of the total odorous air exhaust rate under winter conditions (low flow), and 44 percent under summer conditions.

For purposes of calculating the total air flowrate requiring treatment, it is assumed that both PSTs would be ventilated at the summer flowrate. During high-flow maintenance events, excess air would be bypassed to the existing stack. The total flowrate of air directed to odor control would be 218,000 m^3/hr, or 128,300 cfm. Without the bioreactors, the air flowrate is reduced to approximately 180,000 m^3/hr or 106,000 cfm.

Table 16.2 - Estimated Air Flows from Odor Sources; SEWPCC; Winnipeg, MB

Source	Existing (E) or New (N)	Air Exchange Rate (AC/hr)	Air Flowrate m^3/hr
PS wet well	E	--	16,990
Screen room/grit tanks	E	--	28,730 (lo) 38,230 (hi)
Grit bldg expansion (?)	N	12	9,530
PSTs Nos. 1 & 2	E	3.6 winter 5 summer 10 maint	36,720 (lo) 54,720 (med) 110,160 (hi)
Scum troughs and hoppers		--	940

Source	Existing (E) or New (N)	Air Exchange Rate (AC/hr)	Air Flowrate m^3/hr
PST No. 3	E	3 winter 5 summer 10 maint	24,460 (lo) 40,770 (med) 81,540 (hi)
Scum troughs and weirs	E	--	940
Bioreactors infl. gallery (?) headspace	 N N	 6 12	 2,500 34,710
DAF headspace	N	12	2,500
Fermenter headspace	N	12	11,460
Sludge holding tanks	N	12	4,100
Septage receiving	E	--	1,700
		TOTAL (HI) **TOTAL (MED)** **TOTAL (LO)**	**314,360** **218,150** **175,080**

m^3/hr x 0.5885 = cfm

`

Table 16.3 - Estimated Odor Emission Rates for Odor Sources at SEWPCC

Source	Expected Odor Concentration (D/T)	Air Flowrate (m^3/hr)	Odor Emission Rate (D/T x m^3/hr)	Rank
Wet well	2,000	16,990	34.0×10^6	5
Screen/grit	1,000	47,760	47.8×10^6	4
PST rooms	1,000	95,490	95.5×10^6	3
Primary weirs	10,000	1,880	18.8×10^6	6
Bioreactors	500	37,210	18.6×10^6	7
DAF headspace	5,000	2,500	12.5×10^6	8
Sludge fermenter	10,000	11,460	115×10^6	2
Sludge holding	30,000	4,100	123×10^6	1
Septage receiving	5,000	1,700	8.5×10^6	9

The air flowrates from each process are somewhat conservative and will be re-evaluated during the detailed design. However, maintaining adequate ventilation is important to ensure capture of the odorous air and to prevent “fugitive” odor leakage by maintaining a slight negative pressure. This is particularly important for strong odor sources such as the sludge holding tanks and sludge fermenters. Good ventilation prevents the build-up of explosive gases and helps control corrosion. Ventilation of these spaces at less than six air changes per hour is not recommended.

16.6 ODOR TREATMENT TECHNOLOGY

With the exception of the air from the sludge holding tank, odor and constituent levels measured at SEWPCC were quite low. Even in the wet well and grit chamber rooms, average H_2S was only 1 to 1.5 ppm. At these levels, two technologies would be appropriate: activated carbon adsorption and biofiltration. These alternatives are described below:

16.6.1 Activated Carbon Adsorption

Activated carbon has been used for odor control at wastewater treatment plants for many years. Virgin activated carbon is effective for a wide range of VOC’s as well as high-molecular weight sulfur compounds. However, this media has limited capacity for removal of low-molecular weight H_2S gas. In the past, this limitation was overcome by impregnating the carbon with a caustic material to help adsorb the H_2S. This made the media difficult to handle and dispose of. Today, new carbon media has been developed which has a high capacity to remove H_2S without the hazardous impregnate. The operating cost of carbon is largely a function of the frequency at which the activated carbon media must be replaced. High odorant loadings can quickly exhaust the media, resulting in the need to change out the carbon in as little as several months. Low odorant loadings, such as expected from most processes at SEWPCC, result in a long lifetime of the media, and replacement may be as infrequent as once every two years or more. Replacing the media in an activated carbon adsorber can be a labor-intensive process. To ensure a low loading and a long media life, it may be prudent to treat the high H_2S sources (sludge holding tank and fermenters) with a separate technology.

The advantages of activated carbon adsorption include the following:

1. Ability to produce and outlet (exhaust) with low odor levels.

2. Very simple – the only moving part is the fan.

3. Low day-to-day O&M.

4. Ability to handle a wide range of odorants.

5. Relatively small footprint.

Disadvantages of activated carbon adsorption include:

1. Multiple units required for high air flows (each adsorber can treat 20,000 to 30,000 cfm).

2. High costs to replace carbon media when exhausted.

16.6.2 Biofiltration

Biofiltration is an odor treatment process that has been used for many years in Europe, and that has enjoyed wide application in North America during the past 15 years. The two types of biofilters include engineered "in-ground" systems that typically employ a blend of wood chips and other organic media to serve as a substrate for biological growth, and pre-engineered systems that are often modular designs incorporating a proprietary media. One Canadian supplier of biofilters uses a manufactured media with a guaranteed lifetime of 10 years. This overcomes the main disadvantage of conventional "wood-chip" biofilters: decomposition of the media that can result in media compaction, increased head loss, and short-circuiting of the air to be treated.

Biofilters have become the technology of choice for many WWTP odor control applications. The advantages of biofiltration include the following:

1. Ability to produce an outlet (exhaust) with low odor levels.

2. Low O&M requirements, consisting mostly of managing media moisture levels.

3. Ability to handle a wide range of odorants with proper design.

4. "Green technology" with no requirement for chemicals.

Disadvantages of biofilters include:

1. Decomposition of organic media, requiring replacement in 2 to 4 years.

2. Large footprint.

16.7 PRELIMINARY DESIGN CRITERIA FOR CENTRALIZED SYSTEM

Table 16.4 shows the preliminary design criteria for an odor control system assuming a centralized system treating a blend of odorous air from those sources listed in Table 16.3 (except bioreactors and septage receiving facility). Because of its remote location, the septage receiving facility would have its own odor control system. Bioreactor air would be discharged up the existing stack and dispersed without treatment.

Table 16.4 - Preliminary Design Criteria for SEWPCC Odor Control System - Centralized Biofilter System

Parameter	Value
Air flowrate[1,2]	180,000 m^3/hr
Inlet H_2S average[3] peak	10 ppm 40 ppm
Other reduced sulfur average peak	0.5 ppm 2.0 ppm
Inlet odor concentration average peak	3,000 D/T 12,000 D/T
Expected performance % removal H_2S % removal TRS % removal odor	 99% 95% 90%

1. Does not include septage receiving (separate system) or bioreactors (vented up stack)
2. Assumes ventilation of PST space to odor control system at summer ventilation rates.
3. Assumes inclusion of high-H_2S sources (sludge holding tank and fermenter)

Of the 180,000 m^3/hr of odorous air flow, approximately half is associated with the PST rooms. The size of the odor control system(s) could be reduced significantly if this source were not included. Currently, this air is discharged up the stack. However, not treating air from either the PST rooms or the bioreactors increases the risk that odors would be detectable downwind at levels that would cause complaints. If the City wishes to evaluate the alternative of not treating the air from the PST rooms, odor dispersion modeling is essential to assess the risk of this approach.

With the PST room air included, the recommended strategy is to convey the odorous air to a central biofilter system for treatment. This would allow significant dilution of the strong, difficult-to-treat odors from the sludge holding tanks and sludge fermenters such that they could be economically treated in the biofilter. A separate odor treatment system for these sources would be very costly to operate and would involve either chemical scrubbing or thermal oxidation, as biological systems would probably not perform well with these high loadings of reduced sulfur compounds.

A proposal was solicited from a Canadian biofilter vendor for a field-erected biofilter system using a proprietary, manufactured, non-degradable media. Concrete, rectangular cells would be cast-in-place. These would house the air humidification and air distribution plenum, approximately 2 m (deep) of media, and an irrigation system to maintain proper moisture levels. The cells would be covered with concrete panels and each fitted with a short (3 m) stack to disperse any residual odor. Such a system would provide excellent performance at relatively low operating cost compared to other alternatives that rely on chemicals (chemical scrubbers), fuel (thermal oxidizers), or expendable media (activated carbon).

The septage receiving facility is also slated for odor control. Because of its remote location, a separate odor control system is recommended consisting of a 1,700 m^3/hr, deep bed activated carbon adsorber to treat air from the septage holding tank. The FRP vessel would contain a 1 m deep layer of activated carbon designed for hydrogen sulfide and sewage odors. Other than the fan, maintenance consists of periodically replacing the spent carbon (estimated frequency of once per year). The carbon media is non-hazardous and can be disposed of in a landfill.

Table 16.5 provides an opinion of probable cost for a central biofilter odor control system for the majority of the odorous air, and a remote activated carbon system for the septage receiving facility.

As previously discussed, the odorous air from the two PST rooms accounts for about half of the air flowrate proposed for treatment. The air flows assume that the PST rooms are ventilated to odor control at the summer flowrate (combined flow of 95,000 m^3/hr), and that air flows in excess of this amount during maintenance would be bypassed to the stack. Otherwise, the total air flow requiring treatment increases by 55,000 m^3/hr to account for the ventilation of PSTs 1 & 2 under maintenance conditions.

Sending room air from the PSTs up the stack without treatment would reduce the volume of air requiring treatment by 95,000 m^3/hr, and may make de-centralized alternatives more cost-effective since there would be fewer space constraints with the lower air flow. However, since 37,000 m^3/hr of bioreactor air is already proposed to be discharged up the stack without treatment, adding 95,000 m^3/hr of PST air would almost triple the flow of odorous air into the atmosphere. This strategy is not recommended unless dispersion modeling indicates an “acceptable” impact on downwind odor levels with both bioreactor and PST air released to the atmosphere.

16.8 ALTERNATIVE ODOR CONTROL STRATEGIES TO REDUCE COSTS

The City of Winnipeg reviewed the proposed strategy for a centralized biofilter system for all significant odor sources and found the costs of this approach to be prohibitive. To develop an alternative odor control strategy, it was assumed that the PST room air would be exhausted up the stack as is presently practiced. All other sources as described in Section 16.7 would be treated, including the more intense odors from the PST effluent launders and channels. Removing the PST room air reduces the total air flowrate requiring treatment by half. We have also refined the assumptions for air exchange rates to minimize the air flowrates and reduce the cost of the odor conveyance and treatment system. As with the previous odor control strategy, air from the bioreactors would be discharged up the stack without treatment.

Table 16.6 shows a summary of revised air flowrates for those odor sources that would be treated under this scenario. PST room air has not been included, and air exchange rates for solids handling processes not designed for man-entry have been reduced from 12 air changes

Table 16.5 - Opinion of Probable Cost
Winnipeg SEWPCC Odor Control System
September 10, 2008

Item No.	Description	Unit	Quantity	Material or Equipment Costs: Unit Price	Material or Equipment Costs: Total Price	Labour & Overhead	Total Costs
1.1	Site Works, Excavation and Backfill	LS	1	$200,000	$200,000	Included	$200,000
1.2	Substructure	LS	1	$700,000	$700,000	Included	$700,000
1.3	Structure Piles	LS	1	$300,000	$300,000	Included	$300,000
1.4	Central Biofilter Equipment	LS	1	$2,780,000	$2,780,000	$1,390,000	$4,170,000
1.5	Ductwork	LS	1	$1,500,000	$1,500,000	Included	$1,500,000
1.6	Septage Receiving Station Activated Carbon Filter	LS	1	$110,000	$110,000	Included	$110,000
	Subtotal Odour Control						**$6,980,000**

Assumptions:

1 180,000 m^3/hr central biofilter treats odours from the wet well, screen and grit room, primary clarifiers, DAF headspace, fermenter headspace, and sludge holding tank.

2 Bioreactor air (37,200 m^3/hr) is discharged up the existing stack without treatment.

3 Final Clarifiers are vented directly to atmosphere.

4 1,700 m^3/hr activated carbon system treats odours from the septage receiving facility.

per hour (AC/hr) to 6 AC/hr. This reduces the total air flow from 180,000 to 77,000 m^3/hr (45,500 cfm). The PST rooms alone accounted for as much as 95,000 m^3/hr.

Table 16.6 - Odor Sources Requiring Treatment; Alternative Control Strategies[1]; SEWPCC; Winnipeg, MB

Source	Existing (E) or New (N)	Air Exchange Rate (AC/hr)	Air Flowrate m^3/hr
PS wet well	E	--	16,990
Screen room/grit tanks	E	--	38,230 (hi)
Grit bldg expansion	N	12	9,530
Primary effluent launders and scum hoppers	E	--	1,880
DAF headspace	N	6	1,250
Fermenter headspace	N	6	5,730
Sludge holding tanks	N	6	2,050
Septage receiving	N	--	1,700
Total flowrate			77,360

m^3/hr x .5885 = cfm

1. Assumes air from PST rooms and bioreactors is discharged up existing stack without treatment.

16.8.1 Alternative No. 1 – Biofilter and Thermal Oxidizer

Under this strategy, there would be three separate odor control systems: a 67,000 m^3/hr (40,000 cfm) biofilter serving the influent wet well, screen/grit areas, and the PST effluent launders, a 9,000 m^3/hr (5,000 cfm) thermal oxidizer for the high-strength odors from the sludge fermenter, sludge holding tank and DAF thickener headspace, and a 1,700 m^3/hr (1,000 cfm) activated carbon adsorber for the remote septage receiving facility. A separate carbon adsorption system was considered for the PST effluent launders as the vessel could potentially be placed inside one of the rooms. However, the relatively high levels of H_2S (25 ppm) would exhaust the carbon too quickly and result in frequent carbon change-outs and high O&M costs. For these reasons, a biofilter to treat all of the raw wastewater sources (influent pump station, screening/grit removal, and primary effluent weirs) is the preferred approach.

Table 16.7 provides an opinion of probable cost for the alternative odor control strategy as described.

The capital cost is about half the cost of the previous alternative that treats all the air from the PST rooms. However, the operating cost of the thermal oxidizer alone is estimated by the vendor to be as much as $400,000/yr. The high operating costs of this option dramatically reduce the practicality of implementing a large thermal oxidizer at the SEWPCC.

Table 16.7 - Opinion of Probable Cost; Winnipeg SEWPCC Odor Control Systems - Alternative Strategy #1

Item	Cost, $
Biofilter	
Site work and concrete	390,000
Equipment	1,075,000
Installation at 50%	537,500
Ductwork allowance	200,000
Thermal Oxidizer	
Equipment	750,000
Installation at 50%	375,000
Ductwork allowance	100,000
Activated Carbon (septage receiving)	
Equipment	70,000
Installation at 50%	35,000
Ductwork allowance	10,000
TOTAL	3,542,5000

Assumptions:

1. 67,000 m^3/hr biofilter treats odors from wet well, screen/grit rooms, primary effluent launders
2. 9,000 m^3/hr thermal oxidizer treats odors form sludge fermenters, sludge holding tanks, and DAF thickeners
3. 1,700 m^3/hr activated carbon system treats odors from septage receiving facility
4. Air from PST rooms and bioreactors discharged up existing stack without treatment

16.8.2 Alternative No. 2 – Biofilter

The use of a thermal oxidizer for the high-strength odor sources is not an economical solution for the SEWPCC. As an alternative a conservatively designed biofilter system to handle the additional 9,000 m^3/hr of foul air was developed. Discussions were held with a leading biofilter vendor in Canada to assess the level of performance that might be expected if the high-strength odors from the sludge fermenters and sludge holding tanks was blended with the air from the influent pump station, screen/grit area, and PST effluent weirs. The total air flowrate would be 76,000 m^3/hr (45,000 cfm).

Table 16.8 is an opinion of probably cost for a biofilter to treat the combined air from the influent pump station, screen/grit area, PST effluent weirs, sludge fermenters, sludge holding tanks, and DAF headspace. As with all alternatives, the remote septage receiving facility would be served by a separate activated carbon adsorber.

Although this option requires longer ductwork runs to convey the odors from the sludge-handling processes, the capital cost is significantly lower. Further, odor reduction is accomplished biologically, without the need for chemicals and/or fuel. This greatly reduces the operation and maintenance costs of the odor control facilities.

Table 16.8 - Opinion Of Probable Cost; Winnipeg SEWPCC Odor Control Systems - Alternative Strategy #2

Item	Cost, $
Biofilter	
Site work and concrete	450,000
Equipment	1,236,000
Installation at 50%	618,000
Ductwork allowance	500,000
Activated Carbon (hauled wastewater receiving)	
Equipment	70,000
Installation at 50%	35,000
Ductwork allowance	10,000
TOTAL	2,919,000

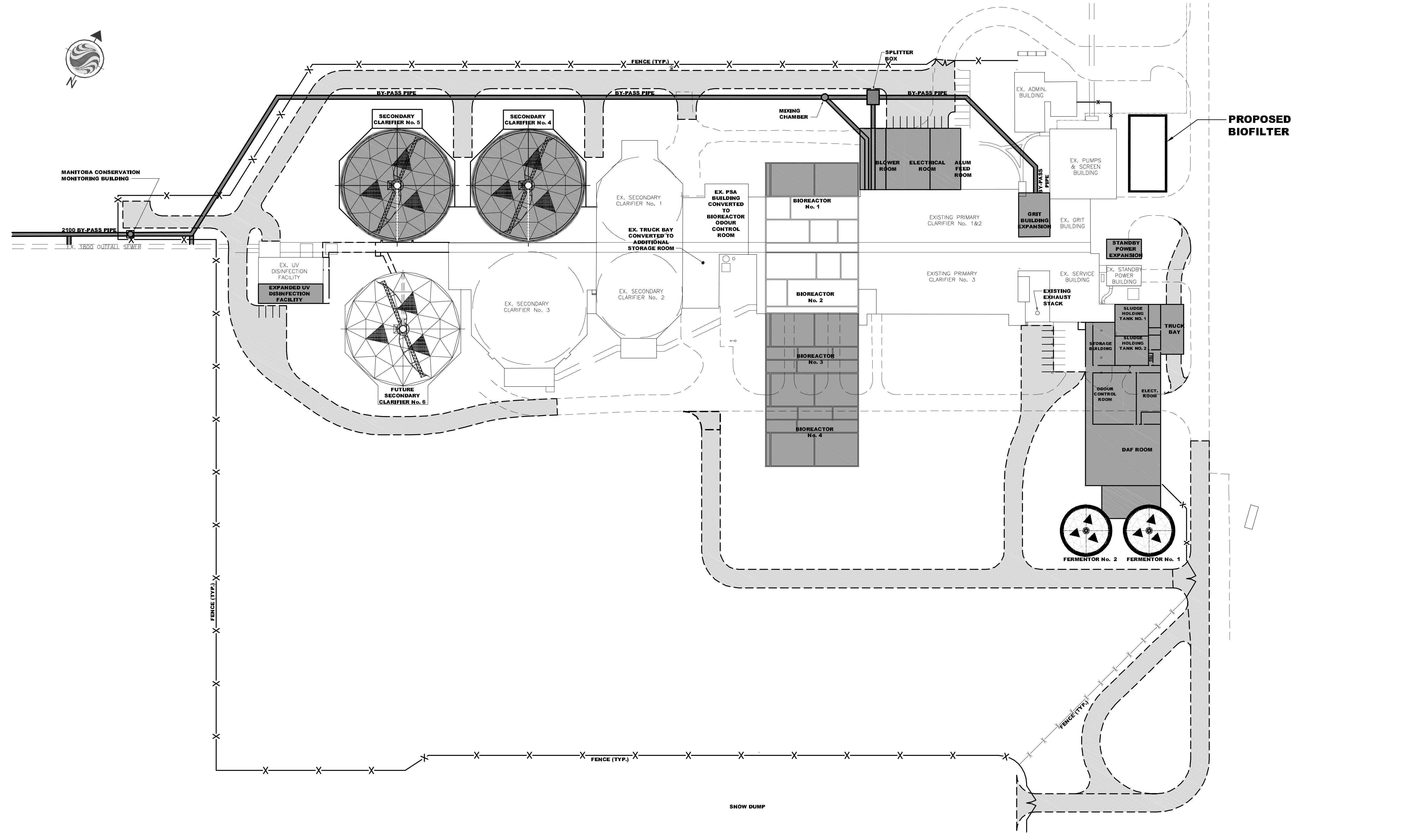
Assumptions:

1. 76,000 m^3/hr biofilter treats odors from wet well, screen/grit rooms, primary effluent launders, sludge fermenters, sludge holding tanks, and DAF thickeners
2. 1,700 m^3/hr activated carbon system treats odors from septage receiving facility
3. Air from PST rooms and bioreactors discharged up existing stack without treatment

16.9 DESIGN RECOMMENDATIONS

A conservatively designed biofilter to serve the major sources of odor is the most cost-effective strategy to control odors from the high-priority odor sources at SEWPCC. The biofilter would serve the influent pump station, screen/grit rooms, PST weirs, sludge fermenters, sludge holding tanks, and DAF thickeners. A remote carbon adsorber would treat the small volume of odorous air from the septage receiving facility. Air from the PST rooms and bioreactors would be discharged up the existing stack. Figure 16.3 shows a possible location for the biofilter that. It is in close proximity to the high-volume odor sources such as the screen/grit rooms that would require larger ductwork. The high-strength, low volume sources (sludge fermenters, holding tanks, and DAF thickeners) would be conveyed a relatively long distance, but the ductwork would be small diameter (600 mm) compared to that required for the headworks odors (1,200 to 1,500 mm).

Table 16.9 summarizes the conceptual design criteria for the new odor control systems. The biofilter inlet conditions account for the increased loading from the sludge holding tank and fermenter. The air characteristics may vary depending on the operation. For example, it is assumed that the sludge holding tank would be continuously ventilated and that sludge storage times would be minimized to reduce H_2S formation. One concern is that, although the biofilter



METRIC
WHOLE NUMBERS INDICATE MILLIMETRES
DECIMALIZED NUMBERS INDICATE METRES

APEGM
Certificate of Authorization
Stantec Consulting Ltd.
No. 1301 Expiry: April 30, 2009

LOCATION APPROVED
UNDERGROUND STRUCTURES

SUPV. U/G STRUCTURES COMMITTEE | DATE

NOTE:
LOCATION OF UNDERGROUND STRUCTURES AS SHOWN ARE BASED ON THE BEST INFORMATION AVAILABLE BUT NO GUARANTEE IS GIVEN THAT ALL EXISTING UTILITIES ARE SHOWN OR THAT THE GIVEN LOCATIONS ARE EXACT. CONFIRMATION OF EXISTENCE AND EXACT LOCATION OF ALL SERVICES MUST BE OBTAINED FROM THE INDIVIDUAL UTILITIES BEFORE PROCEEDING WITH CONSTRUCTION.

B.M.
ELEV.

NO. | REVISIONS | DATE | BY

Stantec Consulting Ltd.
905 Waverley Street, Winnipeg, Manitoba
Tel 204-489-5900 Fax 204-453-9012

DESIGNED BY | CHECKED BY
DRAWN BY | APPROVED BY
HOR. SCALE: VERTICAL: | RELEASED FOR CONSTRUCTION:
DATE 08.04.24 | DATE

ENGINEER'S SEAL

TENDER NO.

THE CITY OF WINNIPEG
WATER AND WASTE DEPARTMENT

SOUTH END WATER POLLUTION CONTROL CENTRE

ALTERNATIVE ODOR CONTROL STRATEGY #2

CITY DRAWING NUMBER | FIGURE 16.3 | SHEET OF

01/000

may achieve 90% odor reduction, very high inlet loadings could cause outlet odor levels to also be high (e.g., 2,000 D/T).

Table 16.9 - Conceptual Design Criteria; Winnipeg SEWPCC Odor Control Systems - Alternative Strategy #2

Parameter	Value
1. BIOFILTER	
Air flowrate	76,000 m^3/hr
Inlet H_2S	
average	15 ppm
peak	60 ppm
Other reduced sulphurs	
average	2 ppm
peak	5 ppm
Inlet odor concentration	
average	5,000 D/T
peak	20,000 D/T
Expected performance	
% removal H_2S	99%
% removal TRS	95%
% removal odor	90%
2. ACTIVATED CARBON	
Air flowrate	1,700 m^3/hr
Inlet H_2S	
average	2 ppm
peak	20 ppm
Other reduced sulphurs	
average	0.5 ppm
peak	2 ppm
Inlet odor concentration	
average	3,000 D/T
peak	15,000 D/T
Expected performance	
% removal H_2S	99%
% removal TRS	95%
% removal odor	90 %

As part of the detailed design, it will be necessary to conduct odor dispersion modeling. The purpose of the modeling is two-fold:

1. Estimate the predicted downwind impact of discharging mildly odorous air from the PST rooms and bioreactors.

2. Assess the impact of biofilter emissions at high inlet loadings.

Should the modeling indicate any potential odor impact with biofilter emissions, the following options will be considered:

1. Discharge of biofilter exhaust via short stack(s).
2. Discharge of biofilter exhaust through existing tall stack.
3. Polishing of biofilter exhaust using activated carbon.