13.10 Landfill Gas Analysis

SCS ENGINEERS

LANDFILL GAS ANALYSIS FOR FORMER GUN RANGE WITHIN CENTRAL PARK

Presented to:
City of Huntington Beach
2000 Main Street
Huntington Beach, CA 92648

Presented by:

SCS ENGINEERS
3900 Kilroy Airport Way
Long Beach, CA
(562) 426-9544

February 4, 2009
File No. 01204111.10

Offices Nationwide
www.scsengineers.com

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1 INTRODUCTION

SCS Engineers (SCS) was retained by the City of Huntington Beach (City) to perform a landfill gas (LFG) analysis of the former Huntington Beach Police Officer's Rifle and Pistol Range (Site) located within Central Park for inclusion in an Environmental Impact Report (EIR), which is being prepared by RBF Consulting. The purpose of the study was to develop an understanding of the LFG-related hazards and the potential for LFG to occur on the Site, as the Site is located within the closed, Gothard Street and Huntington Beach Landfills (Landfills).

In order to perform a LFG impact analysis, an environmental baseline relative to LFG was developed. The baseline describes the existing site conditions, including the extent of the waste beneath the site, cover material over the waste, the LFG collection system, and required monitoring and reporting related to air quality and LFG. The baseline was used to develop a model to predict the amount of LFG that could be generated from the closed landfills. The concept of collection efficiency can provide an indication of how well LFG controls are performing. The collection efficiency is a ratio of the amount of LFG collected to the amount of LFG that is generated. From this analysis, adequacy of the existing LFG controls was evaluated to provide recommendations for remediating hazards from the potential of LFG to occur on the Site.

2 ENVIRONMENTAL BASELINE

The environmental baseline was developed to summarize factors used to evaluate the potential for LFG to cause exposure and resulting hazards. Factors of the baseline included the condition of the site, the amount and age of waste, the cover placed over the waste, and existing environmental controls. These factors were then analyzed and the amount of LFG generated from the Landfills was modeled using the U.S. Environmental Protection Agency's (EPA) LFG emissions model (LANDGEM).

CHARACTERISTICS OF LFG AND POTENTIAL HAZARDS

The organic materials buried in a landfill decompose aerobically producing a gas roughly containing 50 percent methane, 50 percent carbon dioxide, and trace quantities of other gasses. Methane is odorless, colorless, flammable, and potentially explosive. Methane gas can be explosive at concentrations between 5 and 15 percent by volume in air, given an ignition source, and methane can be flammable beyond a concentration of 15 percent. Carbon dioxide is also a colorless, odorless gas; however it is non-combustible. Both methane and carbon dioxide are simple asphyxiates. The trace gasses are the source of odors within LFG. Examples of the odor causing trace constituents include esters, phenols, organic acids, solvents, and sulfur compounds. In general, practices to correct nuisance odors from landfills include landfill cover improvements and installation and operation of LFG collection and control system (GCCS). Organic air emissions from landfills may include some toxic compounds with carcinogenic and non-carcinogenic health effects. The five major effects of LFG emissions are human health and vegetation effects from ozone produced by non methane organic compounds (NMOC) emissions; carcinogenicity and

other possible non-cancer health effects; global warming effects from methane emissions; explosion hazards; and odor nuisance (EPA, 1991).

SITE DESCRIPTION

The Site is approximately 4.91-acres and was previously the former Huntington Beach Police Officer's Rifle and Pistol Range and the former Orange County (County) Transfer Station. The Rifle Range was closed in 1997 due to unstable soils. The Site is located within Landfills of approximately 50-acres containing areas of municipal solid waste (MSW) and inert construction and demolition material (C&D). In general, the Landfills contain 18.3-acres of C&D waste and 33.2-acres of mixed MSW waste, as shown in Appendix 1, Figure 1. The Landfills were operated as burn dumps from September 1947 until September 1956; after this date, the Landfills were reportedly operated as a spread and cover landfill operation. County records indicate approximately 1.1 million cubic yards of mixed MSW refuse was deposited between the Landfills at the time of their closures in 1962. The City operated a C&D landfill until 1982, where approximately 210,000 tons cubic yards of C&D waste was placed. The Site is located over the mixed MSW portion of the Landfills. Nuisance odor complaints have not been an issue for the Landfills to date.

The Site is located at an approximate elevation of 50 feet above mean sea level (MSL). Various investigations have estimated the depth of refuse is about 35-feet deep. The Landfills received a soil cover of variable thickness, ranging 4 to 25 feet. The soil cover contains 400,000 cubic yards (CY) of silty sand which was dredged from the Santa Ana River bottom. These sands were placed without controlled compaction resulting in differential settlement and shifting of the cover. Placement of the cover occurred prior to and through 1993. Asphalt paving is present along the entry driveway and in the former gun range staging area. There are several wooden, metal, and cinder block structures remaining from the former gun range area, 20-feet tall wood post fencing surrounds the site to the north, east, and west, and the Site has been overgrown with vegetation.

ENVIRONMENTAL CONTROLS

There are two GCCSs located within the footprint of the Landfills that perform LFG management; however, the Site has no GCCS and does not perform LFG monitoring. To the north and west of the Site is the Huntington Beach Sports Complex, which was constructed over a 30-acre portion of the Landfills, has an active GCCS consisting of a network of 34 vertical LFG wells, a 10-horsepower LFG blower facility with activated carbon canister scrubbers, and 6 multi-depth LFG perimeter monitoring probes. This system currently collects approximately 40 standard feet per cubic minute (SCFM) of LFG at a methane content near 30%. To the east of the Site is Gothard Street Landfill, a 12-acre portion of the Landfills, which contains a GCCS consisting of 9 vertical LFG extraction wells, a blower facility, and 5 LFG perimeter monitoring probes. The system currently collects 20 to 40 SCFM of LFG with methane content less than 20%; the collected LFG is released to the atmosphere with no treatment.

The GCCS from Huntington Beach Sports Complex and the Gothard Street Landfill are permitted through South Coast Air Quality Management District (SCAQMD) and are subject to the Rule 1150.1. A brief description of the SCAQMD and the Rule 1150.1 are provided in the subsequent section.

LFG GENERATION MODEL

The amount of LFG generated from a landfill can be modeled over time. The EPA LANDGEM was developed to quantify the production of gaseous emissions from landfills. The LANDGEM is a first-order decay model that can allow input of waste parameters. In general, the model parameters include the amount and age of waste, a region specific decay constant (k), the potential methane generation capacity (Lo). A k of 0.03 $year^{-1}$ and a Lo of 2690 cubic feet per ton was selected for the Landfills based on model calibration database developed by SCS from actual data from over 35 landfills located in similar climates. Additional input parameters used for the model included rainfall of 15 inches per year and 1.1 million cubic yards of mixed MSW (as well as the 210,000 cubic yards of inert C&D waste which was modeled as MSW waste to be conservative). The waste was converted to tons based on a compaction rate of 900 pounds per cubic yard and distributed evenly as 33,000 tons per year from 1947 to 1962. The C&D was treated as MSW waste and was distributed with the same compaction rate and distributed evenly as 3,150 tons per year from 1957 to 1982.

The result of the Landfills model includes a peak generation of LFG at year 1963 of 137 scfm at 50 percent methane. The current LFG generation modeled for 2008 is 40 sfcm at 50 percent methane, Figure 1. The current collection rate from the Huntington Beach Sports Complex is 40 scfm at 30 percent methane and the Gothard Street Landfills is 30 scfm at 20 percent methane. To comparatively evaluate LFG of different methane concentrations it is useful to normalize the LFG to 50 percent methane. The normalized LFG to 50 percent methane collected from the Huntington Beach Sports Complex is 24 scfm and the Gothard Street Landfill is 12 scfm, for a combined collection of 36 scfm, indicating a collection efficiency near 90 percent. This is possible as the cover is substantial in some areas of the Landfills, and the GCCS is likely collecting atmosphere (*i.e. air)* through the cover as evident by the lower methane content. The lower methane content could also indicate a depletion of available LFG, resulting in a drawing in of atmospheric air. In addition, both GCCSs maintain compliance with their SQAQMD 1150.1 permits which contains rigorous LFG management requirements to ensure the capture of LFG. The Rule 1150.1 is described in the subsequent section.

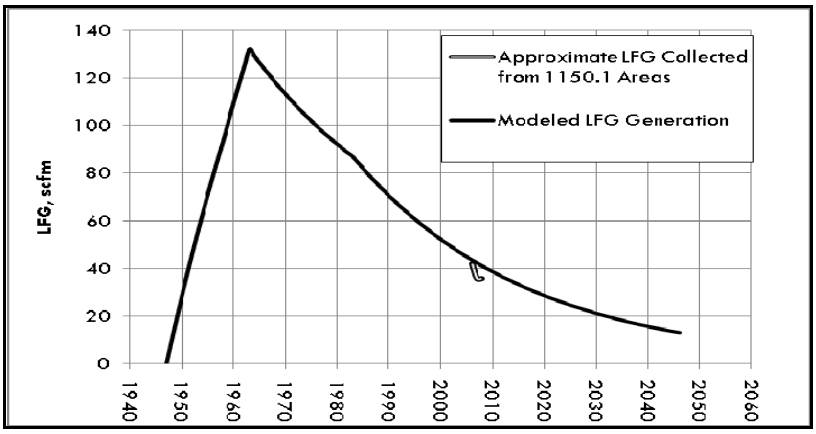

Figure 1. Comparison of Modeled LFG generation and Collected LFG, Normalized to 50 Percent Methane

3 LAWS AND REGULATIONS REGARDING LFG

Regulation of air quality is achieved through federal and state ambient air quality standards (SAAQS) and emission limits for individual sources of air pollutants. These standards are implemented and enforced at the state and local level.

STATE

The California Air Resources Board (ARB), California's state air quality management agency, regulates mobile emissions sources and oversees the activities of County Air Pollution Control Districts (APCDs) and regional Air Quality Management Districts (AQMDs). The CARB regulates local air quality indirectly by SAAQS and vehicle emission standards by conducting research activities, and through its planning and coordinating activities. Other ARB duties include monitoring air quality. The ARB has established and maintains, in conjunction with local air pollution control districts (APCDs) and Air Quality Management Districts, a network of sampling stations that monitor what the pollutants levels are actually present in the ambient air.

California has adopted ambient standards that are more stringent than the federal standards for the criteria air pollutants. Under the California Clean Air Act (CCAA), patterned after the federal CAA, areas have been designated as attainment or non-attainment with respect to SAAQS.

California State law defines toxic air contaminants (TACs) as air pollutants having carcinogenic effects. The State Air Toxics Program was established in 1983 under AB1807 (Tanner). A total of 191 substances have been designated TACs under California law; they include the 188 (federal) hazardous air pollutants (HAPs) adopted in accordance with AB 2728. The Air Toxics "Hot Spots" Information and Assessment Act of 1987 (AB 2588) seeks to identify and evaluate risk from air toxics sources; AB 2588 does not regulate air toxics emissions. TAC emissions from individual facilities are quantified and prioritized. "High-priority" facilities are required to perform a health risk assessment and, if specific thresholds are violated, are required to communicate the results to the public in the form of notices and public meetings. Depending on the risk levels, emitting facilities are required to implement varying levels of risk reduction measures. The SCAQMD implements AB 2588, and is responsible for prioritizing facilities that emit air toxics. The landfills under consideration here would be under the low priority category for AB 2588.

The Calderon Amendments to the California Health and Safety Code (Section 41805.05) require that all landfills perform gas and ambient air testing for ten compounds (vinyl chloride, benzene, ethylene dibromide, ethylene dichloride, methylene chloride, perchloroethylene, carbon tetrachloride, methyl chloroform, trichloroethylene, and chloroform), and report the results to the local Air Districts. The primary objective of these tests, the solid waste assessment test (ASWAT), is to provide a screening basis to characterize landfill air releases and subsurface gas migration at landfills. This site performed an ASWAT under the original requirements form 1986, and no further action is required.

CFR Part 258 (Subtitle D) and CCR Title 27

California Code of Regulations (CCR) Title 27 contains requirements for installation of a perimeter and/or structure monitoring network to monitor the landfill perimeter and on-site structures. These

requirements are administered by the California Integrated Waste Management Board (CIWMB), the Local Enforcement Agency (LEA), and the SCAQMD. Title 27 requirements can only mandate a GCCS be installed to resolve gas migration issues when the regulatory limits are exceeded.

The landfill owner/operator must implement measures to ensure that combustible gas concentrations do not exceed (1) the lower explosive limit (LEL), or 5% methane by volume in soils at the permitted facility boundary; or (2) 25% of the LEL (1.25% methane by volume) in facility structures. The areas of the Landfills with GCCSs perform monitoring of the landfill perimeter and on-site structures and have maintained compliance with Title 27.

Assembly Bill 32 (AB32), California Global Warming Solutions Act of 2006

Provisions of this legislation give the CARB jurisdiction to:

- Require reporting of "Greenhouse" gas (GHG) (methane and carbon dioxide) emissions.
- Set GHG emissions limits.
- Mandate reductions in GHG emissions.
- Set up compliance and enforcement mechanisms.

AB32 was signed into law September 27, 2006, and the effects it may have on landfills are uncertain. The first set of requirements from AB32 includes an early action rule for landfills. CARB has proposed the following requirements for landfills with 450,000 or more tons of refuse in place, which have received waste within the last 30 years:

- Install a GCCS designed to handle the maximum expected gas generation rate for the entire landfill.
- Annual source test for any gas control device for methane destruction efficiency of 99%.
- Limit surface emissions to 500 parts per million by volume (ppmv) as methane.
- Integrated surface sampling similar to SCAQMD Rule 1150.1.
- Quarterly surface emissions monitoring on a 25 foot spacing across the landfill.
- Limit component leaks to less than 200 ppmv as methane.
- Conduct monthly cover integrity monitoring.

These requirements must become effective by January 2010, and full compliance could be required as early as January 2012. As such, the CARB rule will likely be the first air quality requirement to trigger GCCS installation at the landfill. Based on current exemption criteria, the Landfills should be exempt since they have not received waste within the last 30 years. However, the rule is still in draft form, so all of the details are not known at this time and criteria could change.

REGIONAL

The South Coast Air Quality Management District (SCAQMD) was formed in 1977 and is the responsible agency for attaining state and federal clean air standards in South Coast Basin. The

basin includes portions of the counties of Los Angeles, Riverside, and San Bernardino and all of Orange County.

The SCAQMD has stringent regulations regarding gaseous emissions from closed and active MSW landfills through their Rule 1150.1. Among other conditions, the 1150.1 Rule requires landfills to operate a GCCS to prevent the concentration of total organic compounds (TOC), as measured as methane, in the following:

- Subsurface LFG monitoring probes less than five percent TOC by volume
- Surface of the landfill, less than 50 parts ppmv TOC as determined by integrated samples taken on numbered 50,000 square foot landfill grids.
- Surface of the landfill, less than 500 ppmv above background as determined by instantaneous monitoring at any location on the landfill.

In addition to monitoring for TOC, the Rule 1150.1 requires monthly or quarterly representative sampling of TAC's at the landfill surface. A core group of 18 TAC's required to be sampled, Table 1.

Table 1. Rule 1150.1 Required Carcinogenic and Toxic Air Contaminants (Core Group) at MSW Landfills

1. Benzene C_6H_6
2. Benzyl Chloride $C_6H_5H_2C1$
3. Chlorobenzene C_6H_5C1
4. 1,2 Dibromoethane (Ethylene Dibromide) $BrCH_2CH_2Br$
5. Dichlorobenzene $C_6H_4C1_2$
6. 1,1 Dichloroethane (Ethylidene Chloride) CH_3CHC1_2
7. 1,2 Dichloroethane (Ethylene Dichloride) $C1H_2H_2C1$
8. 1,1 Dichloroethene (Vinylidene Chloride) $CH_2 : CC1_2$
9. Dichloromethane (Methylene Chloride) CH_2C1_2
10. Hydrogen Sulfide H_2S
11. Tetrachloroethylene (Perchloroethylene) $C1_2C : CC1_2$
12. Tetrachloromethane (Carbon Tetrachloride) $CC1_4$
13. Toluene $C_6H_5CH_3$
14. 1,1,1 Trichloroethane (Methyl Chloroform) CH_3CC1_3
15. Trichloroethylene $CHC1 : CC1_2$
16. Trichloromethane (Chloroform) $CHC1_3$
17. Vinyl Chloride $CH_2 : CHC1$
18. Xylene $C_6H_4(CH_3)_2$

Recent Rule 1150.1 reporting was reviewed for both the Huntington Sports Complex and the Gothard Street Landfill. Both sites are in compliance and have not required corrective action. The boundary probes have had no detection of methane above 5 percent. For surface emissions monitoring, there has been no instantaneous results of TOC as measured as methane above 500 ppm or integrated results above 50 ppm.

4 ALTERNATIVES AND RECOMMENDATIONS

The presence of LFG at the Site could have the possible adverse effects of NMOCs, TACs, odors, or explosive conditions. The LFG analysis provided indicated a collection efficiency at 90 percent and above, which is considered excellent for any landfill. The MSW portion of the landfills is approximately 33.2-acres and the C&D portion is approximately 18.3-acres. The portion of the MSW which does not contain a GCCS is approximately 6.5-acres, of which 4.91-acres is the Site. The total GCCS coverage is approximately 80 percent of the MSW footprint and 52 percent of the entire site footprint. Based on this analysis, SCS has provided three alternatives that relate to the potential for LFG hazards to occur on the Site.

Alternative 1: No action. Under this alternative the Site conditions and operation would remain as is. It is important to recognize that without the implementation of LFG monitoring program, it is impossible to identify whether LFG is present on the Site. A concern would be the accumulation methane in an on-site structure where an ignition source could cause an explosion; an ignition source could be as minor as static charge of walking across carpet in leather shoes. This is particularly a concern as the waste and the cover beneath the Site received minimal compaction, and settling has occurred and will continue to occur. The settlement can cause preferential pathways for LFG migration; LFG uncollected by the one of the existing GCCSs of the Landfills could begin to escape through cracks in the cover over the Site.

Alternative 2: Implement a LFG monitoring program. Under this alternative, at minimum, the structures located on the site should be monitored for the presence of LFG on a quarterly basis. Note, this would not ensure the detection of the accumulation of LFG in a structure, as atmospheric conditions and the settlement can change LFG pathways on a daily or even hourly basis. A more recommended monitoring program would be to extend the Rule 1150.1 monitoring, including the surface monitoring, which is conducted on the Huntington Beach Sports Complex portion of the Landfills to the Site. SCS believes the structure monitoring would be required under Title 27.

Alternative 3: Provide LFG collection to the Site and develop a LFG monitoring program. Under this alternative the GCCS at the Huntington Beach Sports Complex could be expanded to collect LFG from new vertical wells placed on the Site. A conceptual layout is provided in Appendix 1, Figure 2, showing five new vertical LFG extraction wells which connect to the main header of the Huntington Beach Sports Complex GCCS. This would provide near complete coverage of the MSW portion of the Landfills. In addition, a LFG monitoring program would be implemented as described in Alternative 2.

SCS recommends Alternative 3 to best provide safeguard of the presence of LFG and LFG hazards on the Site. Although the LFG analysis indicates the existing GCCSs of the Landfills provide substantial if not superior LFG collection, the significant settlement that occurs across the Landfills can create preferential pathways for LFG migration resulting in possible site impacts. Without LFG monitoring program, LFG cannot be detected on the Site. The operation of the LFG collection wells placed over this Site could be controlled in response to the monitoring results, providing mitigation measures should LFG emissions be detected.

5 LFG EMISSION REDUCTIONS AS A RESULT OF EXPANDED GCCS

Expansion of the GCCS at the Huntington Beach Sports Complex portion of the Landfills would cause a decrease in LFG emissions to the atmosphere. An analysis of reductions in reactive organic compounds (ROC), TACs, greenhouse gasses (GHG), and odorous emissions that are expected to occur with the GCCS expansion was conducted. Air Pollutant Emission Factors, AP-42, were used to calculate the total amount of emissions generated. Note, it is recognized AP-42 default values generally over estimates emission generation for LFG; however, these values were used to provide a maximum generation possible. The calculation of the current emissions released was based on emission reductions from the Huntington Beach Sports Complex collection only, as the Gothard Street portion does not treat the collected LFG.

The tabulated results of the emissions reduction analysis are provided in Appendix 2, Table A. The total emissions generated are based on both Landfills. The current emissions released are total emissions generated minus the reduction received from the activated carbon treatment from the Huntington Beach Sports complex. Note, that carbon adsorption treatment has no effect on methane or carbon dioxide emissions, so no benefit can be realized for GHG without combustion of LFG. The emissions released after the improvements is based on an additional 10 percent of emissions reduction received from the expansion of the Huntington Beach Sports Complex GCCS on to the Site. The magnitude of the emission reductions achieved for ROG and TAC are insubstantial and should not be considered as a significant benefit to the system; however, even small amounts of LFG can accumulate over time and present a potential explosion risk.

6 CONCLUSION

An expanded GCCS and a LFG monitoring program is recommended for the Site. The basis is the potential for explosive conditions that could occur due to the accumulation of methane in the existing or future structures. Although the LFG analysis conducted indicates a high collection efficiency, this recommendation is based on the potential of future settlement due to the placement of the landfill cover without compaction and minimal compaction of waste, which can result in variable pathways of LFG. In addition settlement within the landfill has potential of causing impacts to the existing LFG wells, causing a reduced LFG collection. Since LFG monitoring is not currently conducted of the Site, it is not possible to determine whether LFG is currently present or if LFG becomes present. From a regulatory perspective, the expanded GCCS would have a minimal impact in reducing LFG emissions, but it would provide an additional level of safety against explosive gas hazards. The GCCS expansion and a LFG monitoring system would allow for the detection of LFG and allow for remediation if needed.

7 REFERENCES

1) City of Huntington Beach – Former Firing Range Remedial Action Plan, Hart Crowser, October 14, 2002
2) Geotechnical Report, Central Park Sports Complex, Huntington Beach, California, AGRA Earth and Environmental, Novemeber29, 2000
3) 1150.1 Reports, Huntington Beach Sports Complex, SCS Engineers, 2006 and 2007
4) 1150.1 Report, Gothard Street Landfill, OC Waste and Recycling, August 8, 2008
5) Phone conversations, Mike Wong P.E., Senior Civil Engineer, OC Waste and Recycling

Appendix 1: Site Figures

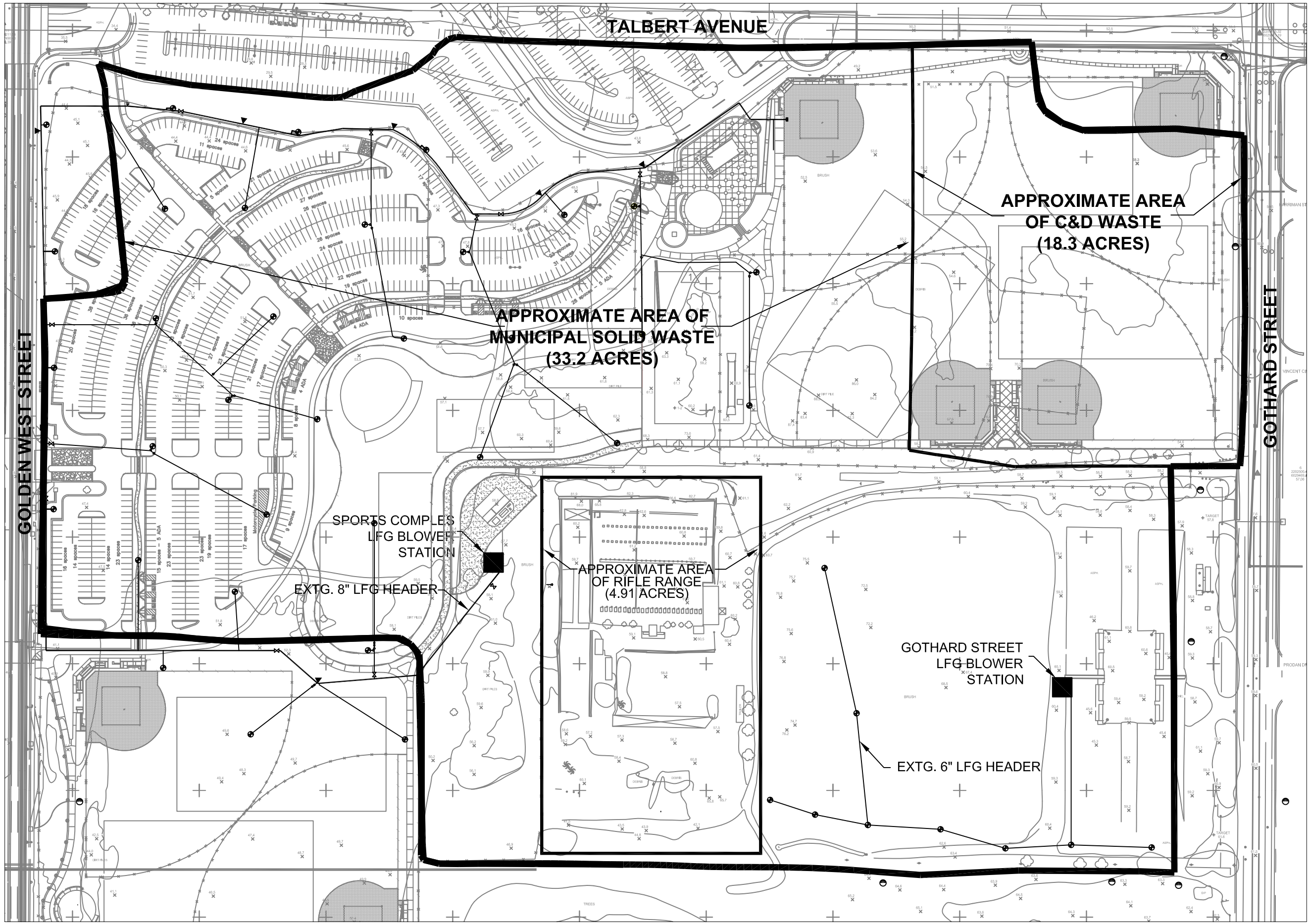

FIGURE 1: EXISTING SITE CONDITIONS

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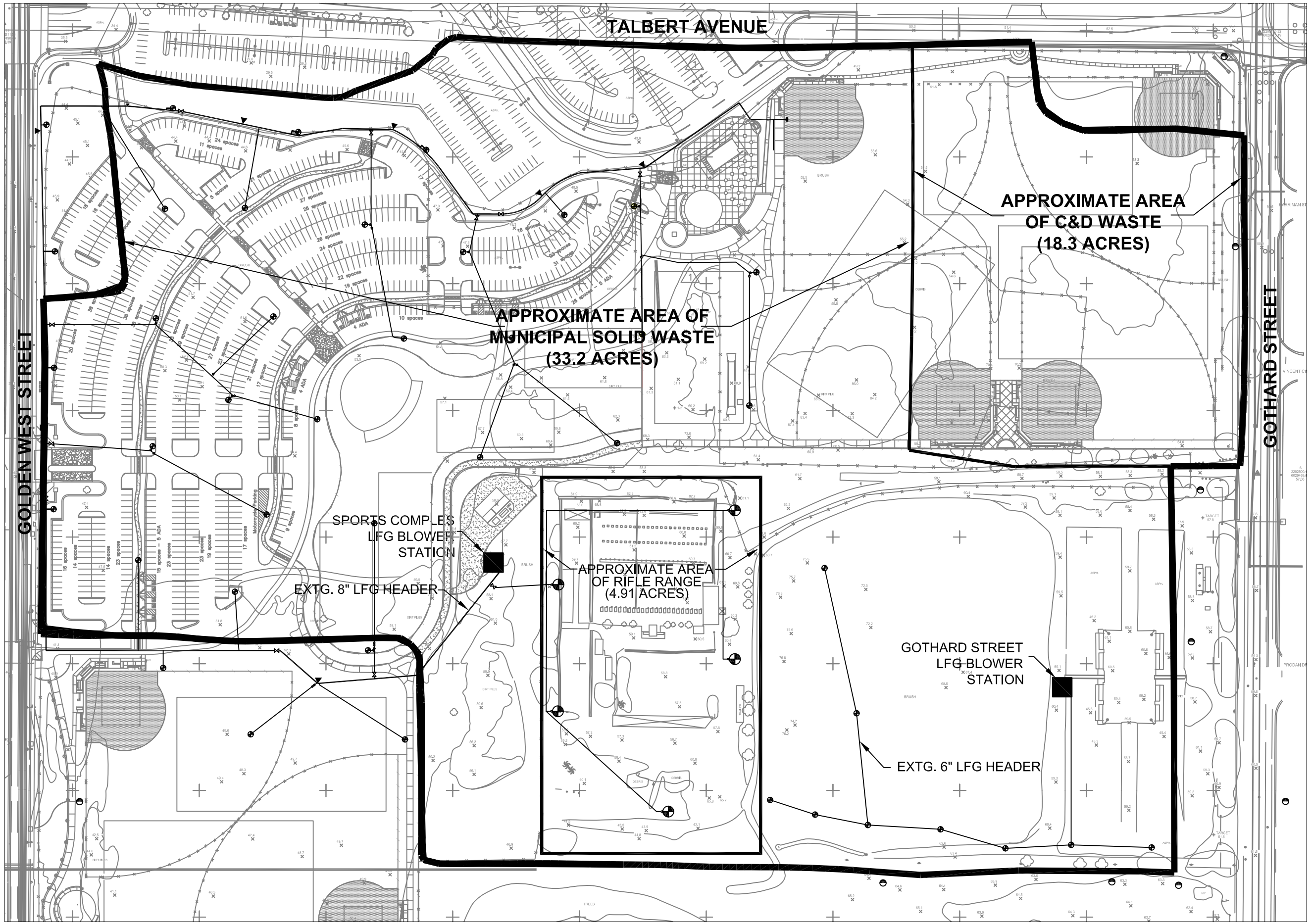

FIGURE 2: EXPANDED LFG SYSTEM TO RIFLE RANGE

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Appendix 2: Emissions Analysis

TABLE A. COMPARATIVE EMISSIONS FROM PROJECT

	COMPOUNDS	Total Emissions Generated (tons/yr)	Current Emissions Released (tons/yr)	Emissions Released After Improvements (tons/yr)	Net Decrease in Emissions from Improvement (tons/yr)
	1,1,1-Trichloroethane (methyl chloroform)	1.79E-03	7.17E-04	5.38E-04	1.79E-04
	1,1,2,2-Tetrachloroethane	5.17E-03	2.07E-03	1.55E-03	5.17E-04
	1,1-Dichloroethane	6.65E-03	2.66E-03	1.99E-03	6.65E-04
	1,1-Dichloroethene	5.42E-04	2.17E-04	1.63E-04	5.42E-05
	1,2-Dichloroethane	1.14E-03	4.54E-04	3.41E-04	1.14E-04
	1,2-Dichloropropane	5.69E-04	2.28E-04	1.71E-04	5.69E-05
	Acrylonitrile	9.35E-03	3.74E-03	2.81E-03	9.35E-04
	Benzene	4.15E-03	1.66E-03	1.25E-03	4.15E-04
	Carbon disulfide	1.24E-03	4.94E-04	3.71E-04	1.24E-04
	Carbon tetrachloride	1.72E-05	6.89E-06	5.17E-06	1.72E-06
	Carbonyl sulfide	8.24E-04	3.29E-04	2.47E-04	8.24E-05
	Chlorobenzene	7.87E-04	3.15E-04	2.36E-04	7.87E-05
	Chloroethane (ethyl chloride)	2.35E-03	9.39E-04	7.04E-04	2.35E-04
	Chloroform	1.00E-04	4.01E-05	3.01E-05	1.00E-05
	Chloromethane (methyl chloride)	1.70E-03	6.78E-04	5.09E-04	1.70E-04
	Dichlorobenzene	8.64E-04	3.45E-04	2.59E-04	8.64E-05
	Dichloromethane (methylene chloride)	3.33E-02	1.33E-02	9.98E-03	3.33E-03
	Ethylbenzene	1.37E-02	5.47E-03	4.10E-03	1.37E-03
	Ethylene dibromide	5.26E-06	2.10E-06	1.58E-06	5.26E-07
	Hexane	1.59E-02	6.37E-03	4.77E-03	1.59E-03
	Mercury (total)	1.63E-06	6.51E-07	4.88E-07	1.63E-07
	Methyl ethyl ketone	1.43E-02	5.73E-03	4.30E-03	1.43E-03
	Methyl isobutyl ketone	5.32E-03	2.13E-03	1.60E-03	5.32E-04
	Perchloroethylene (tetrachloroethylene)	1.72E-02	6.87E-03	5.15E-03	1.72E-03
	Toluene	1.01E-01	4.02E-02	3.02E-02	1.01E-02
	Trichloroethylene	1.03E-02	4.12E-03	3.09E-03	1.03E-03
	Vinyl chloride	1.28E-02	5.11E-03	3.83E-03	1.28E-03
	Xylenes	3.56E-02	1.43E-02	1.07E-02	3.56E-03
	NMOC (as hexane)	9.65	3.86	2.89	0.96
	ROG	224.40	224.40	224.40	0.00
	CO2	615.69	615.69	615.69	0.00

Note: LFG collected from Gothard Street Landfill is not treated; therefore, emissions are not reduced.