

APPENDIX F

LFG RECOVERY ESTIMATES

SCS ENGINEERS

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MEMORANDUM

TO: Lochlin Caffey, Republic / Keller Canyon Landfill Company, Inc.
Susan Klassen, Sonoma County

FROM: Joseph Miller, SCS Engineers
Ambrose McCready, P.E., SCS Engineers

SUBJECT: **Landfill Gas Recovery Estimates, Sonoma Central Disposal Site
Sonoma County, California**

SCS Engineers (SCS) has prepared landfill gas (LFG) recovery projections for the Sonoma County Central Disposal Site, in Sonoma County California (Landfill). The estimates of current and projected LFG recovery were prepared using SCS's in-house recovery model. The estimates were used as a basis of sizing future LFG collection and control system upgrades.

SCS prepared the LFG recovery model for the Landfill based on the following input parameters:

- **Refuse Filling History and Projections:** Waste receipt data (disposal rates) for the period 1971 through 2005 were provided by Sonoma County. During the period 2005 through September 2010, disposal operations at the Landfill were temporarily suspended and wastes were delivered to out-of-county disposal sites. Waste disposal rates for the period 2010 and 2011 are based on information provided by Republic Services / Keller Canyon Landfill Company, Inc., the contracted landfill operator. The County projects that full resumption of disposal operations at the Landfill will commence in 2012 with forecasted waste flow commitments resulting in an annual disposal rate of 240,000 tons per year. The disposal rate is projected to increase by 1 percent annually until projected remaining airspace (5.4 million tons) is exhausted in approximately year 2031.
- **Methane Decay Rate Constant (k):** A value of 0.051 per year was selected for the Landfill, based on precipitation data for the Santa Rosa, California area.
- **Ultimate Methane Recovery Potential (L₀):** An L₀ value of 2,900 cubic feet per ton was used based on calibration of the model to agree with actual reported LFG flows.
- **System Coverage:** Collection system coverage is estimated at 75 percent during the active life of the landfill (pre-closure). Historic collection system coverage was adjusted so that projected LFG recovery matched actual historical recovery. Actual

historical recovery (LFG deliveries to the landfill gas fired power generation facility [PGF] and/or LFG flare) were reported by the County for the period 1994 through 2009. Collection system coverage is expected to increase to 80 percent following placement of the final cover system.

The results of the model are presented in *Exhibits 1* and *2*. Potential LFG recovery rates are normalized for a methane content of 50 percent by volume.

For the current and assumed future waste disposal rates, the model predicts LFG recovery will remain relatively steady and vary between 2,100 and 2,200 standard cubic feet per minute (scfm). For comparison, the existing LFG-fueled PGF is rated for a cumulative fuel intake of up to 4 million cubic feet per day (cfd) of LFG. This is equivalent to approximately 2,800 scfm. The existing LFG flare is rated for approximately 1,500 scfm capacity.

LIMITATIONS

The LFG model used by SCS applies the same first-order decay equation and variables as the U.S. Environmental Protection Agency's Landfill Gas Emissions Model (LandGEM). Unlike LandGEM which estimates LFG generation, the LFG model developed by SCS estimates LFG recovery and applies k and L_0 factors that are calibrated to LFG flow rates measured at the landfill being modeled, or developed by SCS using a database of 764 years of LFG flow and methane data from nearly 200 landfills with operational LFG collection systems. The LFG recovery projections are based on our engineering judgment as of the date of this report. Because the L_0 and k values developed by SCS for modeling LFG recovery at U.S. landfills do not provide information on LFG emissions, they should not be used for any regulatory purpose and are not consistent with U.S. EPA regulation and guidance for LFG modeling for Clean Air Act programs.

This report has been prepared in accordance with the care and skill generally exercised by reputable LFG professionals, under similar circumstances, in this or similar localities. The LFG recovery projections are based on our engineering judgment as of the date of this report. No warranty, express or implied, is made as to the professional opinions presented herein. Changes in the landfill property use and conditions (for example: variations in rainfall, waste disposal rates, water levels, landfill operations, final cover systems, or other factors) may affect future gas recovery at the landfill. SCS does not guarantee the quantity or the quality of the available landfill gas.

EXHIBIT 1. LFG RECOVERY PROJECTION
Sonoma Central Disposal Site, Sonoma County CA

Year	Disposal Rate	Refuse In-Place	LFG Recovery Potential			LFG System Coverage	LFG Recovery from Existing and Planned System		
	(tons/yr)	(tons)	(scfm)	(mmcf/day)	(mmBtu/yr)	(%)	(scfm)	(mmcf/day)	(mmBtu/yr)
1971	316,667	316,667	0	0.00	0	0%	0	0.00	0
1972	316,667	633,334	175	0.25	46,420	0%	0	0.00	0
1973	316,667	950,001	340	0.49	90,532	0%	0	0.00	0
1974	316,667	1,266,668	498	0.72	132,450	0%	0	0.00	0
1975	316,667	1,583,335	648	0.93	172,284	0%	0	0.00	0
1976	316,667	1,900,002	790	1.14	210,138	0%	0	0.00	0
1977	316,667	2,216,669	925	1.33	246,109	0%	0	0.00	0
1978	316,667	2,533,336	1,054	1.52	280,292	0%	0	0.00	0
1979	316,667	2,850,003	1,176	1.69	312,775	0%	0	0.00	0
1980	316,667	3,166,670	1,292	1.86	343,644	0%	0	0.00	0
1981	328,504	3,495,174	1,402	2.02	372,977	50%	701	1.01	186,488
1982	340,784	3,835,958	1,514	2.18	402,587	50%	757	1.09	201,293
1983	353,522	4,189,480	1,626	2.34	432,525	50%	813	1.17	216,262
1984	366,737	4,556,217	1,740	2.51	462,841	50%	870	1.25	231,421
1985	380,446	4,936,663	1,856	2.67	493,588	50%	928	1.34	246,794
1986	394,667	5,331,330	1,973	2.84	524,815	50%	987	1.42	262,408
1987	409,420	5,740,750	2,093	3.01	556,574	50%	1,046	1.51	278,287
1988	424,724	6,165,474	2,214	3.19	588,917	50%	1,107	1.59	294,458
1989	440,600	6,606,074	2,338	3.37	621,895	50%	1,169	1.68	310,947
1990	457,070	7,063,144	2,465	3.55	655,560	50%	1,232	1.77	327,780
1991	460,298	7,523,442	2,594	3.74	689,966	50%	1,297	1.87	344,983
1992	463,549	7,986,991	2,719	3.92	723,135	50%	1,360	1.96	361,567
1993	466,823	8,453,814	2,839	4.09	755,131	50%	1,420	2.04	377,565
1994	440,422	8,894,236	2,955	4.26	786,015	50%	1,478	2.13	393,008
1995	422,808	9,317,044	3,051	4.39	811,495	70%	2,136	3.08	568,046
1996	431,832	9,748,876	3,133	4.51	833,125	70%	2,193	3.16	583,187
1997	442,565	10,191,441	3,215	4.63	855,002	70%	2,250	3.24	598,502
1998	455,435	10,646,876	3,299	4.75	877,366	70%	2,309	3.33	614,156
1999	462,999	11,109,875	3,386	4.88	900,503	70%	2,370	3.41	630,352
2000	494,884	11,604,759	3,473	5.00	923,599	70%	2,431	3.50	646,520
2001	499,872	12,104,631	3,573	5.14	950,221	75%	2,680	3.86	712,666
2002	490,829	12,595,460	3,671	5.29	976,251	75%	2,753	3.96	732,188
2003	486,119	13,081,579	3,759	5.41	999,660	75%	2,819	4.06	749,745
2004	342,341	13,423,920	3,840	5.53	1,021,215	75%	2,880	4.15	765,911
2005	186,774	13,610,694	3,838	5.53	1,020,622	75%	2,878	4.14	765,467
2006	0	13,610,694	3,750	5.40	997,254	75%	2,812	4.05	747,941
2007	0	13,610,694	3,563	5.13	947,670	75%	2,672	3.85	710,752
2008	0	13,610,694	3,386	4.88	900,550	75%	2,540	3.66	675,413
2009	0	13,610,694	3,218	4.63	855,774	75%	2,413	3.48	641,830
2010	37,050	13,647,744	3,058	4.40	813,224	75%	2,293	3.30	609,918
2011	148,200	13,795,944	2,926	4.21	778,220	75%	2,195	3.16	583,665
2012	240,000	14,035,944	2,862	4.12	761,250	75%	2,147	3.09	570,938
2013	242,400	14,278,344	2,852	4.11	758,581	75%	2,139	3.08	568,936
2014	244,820	14,523,164	2,844	4.10	756,397	75%	2,133	3.07	567,298
2015	247,270	14,770,434	2,838	4.09	754,675	75%	2,128	3.06	566,007
2016	249,740	15,020,174	2,833	4.08	753,399	75%	2,125	3.06	565,049
2017	252,240	15,272,414	2,830	4.07	752,548	75%	2,122	3.06	564,411
2018	254,760	15,527,174	2,828	4.07	752,106	75%	2,121	3.05	564,079
2019	257,310	15,784,484	2,828	4.07	752,055	75%	2,121	3.05	564,041
2020	259,880	16,044,364	2,829	4.07	752,381	75%	2,122	3.06	564,285
2021	262,480	16,306,844	2,832	4.08	753,067	75%	2,124	3.06	564,800
2022	265,100	16,571,944	2,835	4.08	754,100	75%	2,127	3.06	565,575

EXHIBIT 1. LFG RECOVERY PROJECTION
Sonoma Central Disposal Site, Sonoma County CA

Year	Disposal Rate	Refuse In-Place	LFG Recovery Potential			LFG System Coverage	LFG Recovery from Existing and Planned System		
	(tons/yr)	(tons)	(scfm)	(mmcf/day)	(mmBtu/yr)	(%)	(scfm)	(mmcf/day)	(mmBtu/yr)
2023	267,750	16,839,694	2,841	4.09	755,466	75%	2,130	3.07	566,599
2024	270,430	17,110,124	2,847	4.10	757,152	75%	2,135	3.07	567,864
2025	273,130	17,383,254	2,854	4.11	759,147	75%	2,141	3.08	569,360
2026	275,860	17,659,114	2,863	4.12	761,439	75%	2,147	3.09	571,079
2027	278,620	17,937,734	2,873	4.14	764,017	75%	2,155	3.10	573,013
2028	281,410	18,219,144	2,883	4.15	766,872	75%	2,163	3.11	575,154
2029	284,220	18,503,364	2,895	4.17	769,994	75%	2,171	3.13	577,495
2030	287,060	18,790,424	2,908	4.19	773,372	75%	2,181	3.14	580,029
2031	289,930	19,080,354	2,922	4.21	776,999	75%	2,191	3.16	582,749
2032	0	19,080,354	2,936	4.23	780,866	80%	2,335	3.36	620,960
2033	0	19,080,354	2,790	4.02	742,040	80%	2,219	3.20	590,085
2034	0	19,080,354	2,651	3.82	705,145	80%	2,108	3.04	560,745
2035	0	19,080,354	2,520	3.63	670,084	80%	2,004	2.89	532,864
2036	0	19,080,354	2,394	3.45	636,767	80%	1,904	2.74	506,369
2037	0	19,080,354	2,275	3.28	605,106	80%	1,809	2.61	481,192
2038	0	19,080,354	2,162	3.11	575,019	80%	1,719	2.48	457,267
2039	0	19,080,354	2,055	2.96	546,428	80%	1,634	2.35	434,531
2040	0	19,080,354	1,952	2.81	519,259	80%	1,553	2.24	412,925

Methane Content of LFG Adjusted to: 50%
Selected Decay Rate Constant (k): 0.051
Selected Ultimate Methane Recovery Rate (Lo): 2,900 cu ft/ton

Exhibit 2. LFG Recovery Projection
Sonoma Central Disposal Site, Sonoma County

