APPENDIX A

LANDFILL ENGINEERING – 95% DESIGN REVISION 1
EVALUATION OF LANDFILL GAS GENERATION

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EVALUATION OF LANDFILL GAS GENERATION

ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

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August 2002

EVALUATION OF
LANDFILL GAS GENERATION

ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

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Evaluation Of
Landfill Gas Generation

Rocky Flats Environmental Technology Site

1.0 EVALUATION SUMMARY

This report presents an evaluation of the Daniel B. Stephens & Associates (DBS&A) assessment of Landfill Gas Generation for the present landfill at the Rocky Flats Environmental Technology Site (RFETS). After reviewing the landfill gas generation assessment, Earth Tech Inc. found that the waste volume used for the landfill gas generation calculation did not consider exclusion of the non-organic waste material. Earth Tech reviewed the waste stream data and estimates that only 50 percent of the total waste volume is organic and decomposable (see Attachment 1 and 2). A revised gas generation analysis was performed using the EPA Landfill Gas Generation Model and a new gas generation rate was calculated (See Attachment). From the landfill gas generation rate a new landfill gas flux through the landfill final cover was also calculated and compared with the DBS&A Report from April 2002.

The values for the landfill gas generation rate and flux from this re-evaluation (20.31 cfm and 2.22×10^{-5} cfm/sq.ft) were significantly less than the DBS&A Report from April 2002 (gas generation rate of 50.3 cfm and flux of 1×10^{-4} cfm/sq.ft). Therefore, the amount of gas that will be emitted through the landfill cover will be substantially less than previously anticipated, by our calculations.

Earth Tech believes, based on these calculations, that a gas collection system, or venting layer, will not be required to ensure proper performance of a soil final landfill cover. With the installation of a geosynthetic cover system, passive vents can be installed to ensure equalization of pressures beneath the geosynthetic layer with varying barometric pressures above.

The following attachments include:

1. Rocky Flats Refuse Intake Data
2. Waste Stream Characterization
3. EPA Landfill Gas generation Model
4. Landfill Gas Generation Report
5. Landfill Methane Emission Model
6. Landfill Gas Vent Trench Calculations

Evaluation Of
Landfill Gas Generation

Rocky Flats Environmental Technology Site

1.0 EVALUATION SUMMARY

This report presents an evaluation of the Daniel B. Stephens & Associates (DBS&A) assessment of Landfill Gas Generation for the present landfill at the Rocky Flats Environmental Technology Site (RFETS). After reviewing the landfill gas generation assessment, Earth Tech Inc. found that the waste volume used for the landfill gas generation calculation did not consider exclusion of the non-organic waste material. Earth Tech reviewed the waste stream data and estimates that only 50 percent of the total waste volume is organic and decomposable (see Attachment 1 and 2). A revised gas generation analysis was performed using the EPA Landfill Gas Generation Model and a new gas generation rate was calculated (See Attachment). From the landfill gas generation rate a new landfill gas flux through the landfill final cover was also calculated and compared with the DBS&A Report from April 2002.

The values for the landfill gas generation rate and flux from this re-evaluation (20.31 cfm and 2.22×10^{-5} cfm/sq.ft) were significantly less than the DBS&A Report from April 2002 (gas generation rate of 50.3 cfm and flux of 1×10^{-4} cfm/sq.ft). Therefore, the amount of gas that will be emitted through the landfill cover will be substantially less than previously anticipated, by our calculations.

Earth Tech believes, based on these calculations, that it is likely that a gas collection system, or venting layer, will not be required to ensure proper performance of the final landfill cover. Once the final soil source, final cover soil properties, and final cover thickness is determined, a concluding evaluation of the gas flux, its impact on the final cover vegetation, and the need for a gas venting layer will be completed.

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APPENDIX A

ATTACHMENT 1
ROCKY FLATS REFUSE INTAKE DATA

Rocky Flats Refuse Intake Data
Revised 7/22/02

Year	Waste Volume (Tons)	Megagrams (Mg)	Megagrams Cumm. (Mg.)
1968	2545	2314	2314
1969	2545	2314	4627
1970	2545	2314	6941
1971	2545	2314	9255
1972	2545	2314	11568
1973	2545	2314	13882
1974	2545	2314	16195
1975	2500	2273	18468
1976	2500	2273	20741
1977	2500	2273	23014
1978	2500	2273	25286
1979	2500	2273	27559
1980	2500	2273	29832
1981	2500	2273	32105
1982	2500	2273	34377
1983	2500	2273	36650
1984	2500	2273	38923
1985	2500	2273	41195
1986	2500	2273	43468
1987	7032	6393	49861
1988	7032	6393	56254
1989	7032	6393	62646
1990	7032	6393	69039
1991	7032	6393	75432
1992	2991	2719	78151
1993	2991	2719	80870
1994	2991	2719	83589
1995	2991	2719	86308
1996	2991	2719	89027
1997	2991	2719	91746

Note: Waste Reciepts assume 50% inorganic material for emission calculation purposes.

(FROM APRIL 2002 DBS&A REPORT)

Table E-1. In-Place Waste Volume and Mass at the Present Landfill Rocky Flats Environmental Technology Site

Year	Volume of Waste In-place (cubic yards)	Mass of Waste In-place (tons)	Mass of Waste In-place (megagrams)
1968	10,178	5,089	4,616
1969	10,178	5,089	4,616
1970	10,178	5,089	4,616
1971	10,178	5,089	4,616
1972	10,178	5,089	4,616
1973	10,178	5,089	4,616
1974	10,178	5,089	4,616
1975	10,000	5,000	4,535
1976	10,000	5,000	4,535
1977	10,000	5,000	4,535
1978	10,000	5,000	4,535
1979	10,000	5,000	4,535
1980	10,000	5,000	4,535
1981	10,000	5,000	4,535
1982	10,000	5,000	4,535
1983	10,000	5,000	4,535
1984	10,000	5,000	4,535
1985	10,000	5,000	4,535
1986	10,000	5,000	4,535
1987	28,125	14,063	12,755
1988	28,125	14,063	12,755
1989	28,031	14,016	12,712
1990	28,125	14,063	12,755
1991	28,125	14,063	12,755
1992	11,964	5,982	5,426
1993	11,964	5,982	5,426
1994	11,964	5,982	5,426
1995	11,964	5,982	5,426
1996	11,964	5,982	5,426
1997	11,964	5,982	5,426
Total	403,561	201,781	183,020

APPENDIX A

ATTACHMENT 2
WASTE STREAM CHARACTERIZATION

Appendix A

Waste Streams to the Present Landfill from 1968 to 1986 (WSIC)

Table II
Hazardous Waste Stream to Landfill
(1986)

BUILDING NO.	WASTE NO.	WASTE NAME	WASTE TYPE	QUANTITY GENERATED	UNITS	GENERATION FREQUENCY
460	02410	metal chips	metal	0		
460	02500	metal chips	metal	0		
460	23570	metal chips	metal	0		
460	02340	metal chips	metal	0		
460	00590	mercury light bulbs	solid	5		
460	02320	metal chips	metal	0		
460	02400	metal chips	metal	0		
460	23590	metal chips	metal	0		
460	01780	empty containers	empty containers	100		
460	02380	metal chips	metal	0		
460	02330	metal chips	metal	0		
460	01580	kimwipes and rags	solid	165		
460	02360	metal chips	metal	0		
460	02450	metal chips	metal	0		
460	23600	metal chips	metal	0		
460	23530	metal chips	metal	0		
460	02310	metal chips	metal	0		
460	23470	metal chips	metal	0		
460	02430	metal chips	metal	0		
460	02490	metal chips	metal	0		
460	02420	metal chips	metal	0		
528	15360	kimwipes	solid	10		periodically
549	07300	empty containers	empty containers	100		as needed
562	09840	paper towels with oil	solid	20		varies
668	09570	rags with methyl alcohol	solid	50		intermittant
705	20180	kimwipes	solid	15		as needed
708	10690	rags w/freon and trichloroethane	solid	200		
727	09520	paper towels with oil/freon TF	solid	100		intermittant
771	22010	deionizer exchange resin column	solid	5		yearly
771	22230	bottles, cartons, gloves, kimwipes	solid	15000		continuous
771	22210	liquid chemical containers	solid	4000		continuous
775	22030	trash paper	solid	200		none
776	12120	soiled kimwipes	solid	365		daily
776	12130	empty containers	empty containers	365		daily
776	12100	empty containers	empty containers	365		daily
776	12000	soiled kimwipes	solid	1200		once per day
776	12180	soiled kimwipes	solid	4000		daily
776	12090	soiled kimwipes	solid	365		daily
779	19730	metal chips	metal	10000		2/week
780	09590	rags with trichloroethane	solid	50		infrequent
780	09580	empty paint cans	solid	50		infrequent
881	04660	metal and plastic chips	solid	10000		
881	04760	dirty kimwipes	solid	100		
881	03240	waste resin	solid	4		continuous
886	03180	kimwipes	solid	10		
886	03200	chemicals in cabinet	organic	50		infrequent
910	06340	filter backwash	aqueous	100000		weekly
991	07490	reject rings	solid	1880		weekly

Table II
Hazardous Waste Stream to Landfill
(1986)

BUILDING NO.	WASTE NO.	WASTE NAME	WASTE TYPE	QUANTITY GENERATED	UNITS	GENERATION FREQUENCY
111	06700	film packs and positives	solid	50	lbs/yr	
123	03100	broken badges	solid	200		as occurs
123	03120	waste vials	solid	100		batch
123	02930	waste resin	solid	5		batch
123	03160	waste resin	solid	100		as required
125	02560	filters	solid	5		Change once/year
125	02640	silicone oil filters	solid	5		
125	02580	kimwipes	solid	100		continuous
334	07070	mineral and asbestos dust	solid	200		as appropriate
367	06930	empty cans, bags and containers	empty containers	100		as needed
377	09960	oil filters	solid	5		pmo schedule
440	01500	kimwipes and rags from paint booth	solid	500		
440	00120	composite kimwipe drum	solid	600		
440	01460	foam trimmings	solid	200		
440	01410	empty paint cans	empty containers	100		
440	00390	metal chip dumpster	solid	2000		
440	00170	R-compound	organic	2640		
440	01470	kimwipes and rags	solid	500		
440	01480	kimwipes and rags	solid	500		
440	01440	kimwipes and rags	solid	500		
440	01420	paint filters	solid	300		
443	00320	contaminated rags	solid	200		as needed
444	14120	sst, iron metal chips	metal	1200		continuous
444	11920	sump sludge	solid	200		varies
453	11130	paper towels	solid	2		intermittent
460	23520	metal chips	metal	0		
460	23560	metal chips	metal	0		
460	01640	air filters	solid	0		
460	23540	metal chips	metal	0		
460	23610	metal chips	metal	0		
460	02350	metal chips	metal	0		
460	02460	metal chips	metal	0		
460	23620	metal chips	metal	0		
460	02300	metal chips	metal	0		
460	01750	metal chip composite	metal	100000		
460	23510	metal chips	metal	0		
460	02290	metal chips	metal	0		
460	02480	metal chips	metal	0		
460	02440	metal chips	metal	0		
460	01650	water filters	solid	0		
460	01830	water filters (x-ray)	solid	50		
460	02280	metal chips	metal	0		
460	01600	compressor filters	solid	40		
460	23580	metal chips	metal	0		
460	02270	metal chips	metal	0		
460	02370	metal chips	metal	0		
460	23550	metal chips	metal	0		
460	01370	film packs	solid	30		
460	02390	metal chips	metal	0		

Table I
Solid Waste Stream to Landfill
(1986)

BUILDING NO.	WASTE NO.	WASTE NAME	WASTE TYPE	QUANTITY GENERATED	UNITS	GENERATION FREQUENCY
770	22640	metal chips/scraps	metal	3276	lbs/yr	biweekly
771	22250	empty containers & surgical gloves	solid	5000		every 2 weeks
771	22470	plastic scraps	solid	2900		daily
771	22450	metal chips	metal	3275		weekly
771	22460	combustibles	solid	5000		daily
776	12020	wood & plastic chips/dust	solid	10400		weekly (200 lbs./wk)
776	12010	empty containers	empty containers	100		occasionally
776	12030	soiled kimwipes	solid	2080		weekly (40 lbs/wk)
776	12040	empty containers	empty containers	2080		weekly (40 lbs/wk)
778	15040	trash in canisters	solid	800		continuous
778	15210	sanitary trash	solid	500		continuous
778	15050	metal/wood shavings	solid	2000		continuous
778	15060	sanitary trash	solid	500		continuous
778	15090	sanitary trash	solid	500		continuous
778	15210	metal/wood shavings	solid	2000		continuous
778	15140	trash	solid	1000		continuous
778	15310	sanitary trash	solid	500		continuous
779	19050	sanitary trash	solid	1300		continuous
779	15480	trash	solid	1000		continuous
779	15400	kimwipes	solid	480		periodically
779	19060	metal shavings/fines	metal	300		continuous
779	15730	water chiller filters	solid	10		monthly
779	15460	plastics grindings	organic	500	gal/yr	continuous
779	19200	machine fines	metal	300	lbs/yr	continuous
779	15410	mixed trash	solid	500		continuous
779	19190	sanitary trash	solid	500		continuous
779	15450	grindings metal	metal	1000		continuous
783	11780	sump sludge	solid	200		intermittent
850	04940	toner and dispersant bottles	empty containers	5		intermittant
865	04240	stainless steel grinding paper	solid	6		per year
865	04280	mold compound	solid	50		
865	04290	photography lab solid wastes	solid	240		
865	04330	metal scraps	metal	260		
881	04670	aerosol, paint and thinner cans	empty containers	200		
881	04620	dirty kimwipes	solid	200		as needed
881	04710	uncontaminated solid waste	solid	5000		
881	04610	other metal chips	metal	600		
881	05070	rags and kimwipes	solid	100		
885	05110	rags	solid	100		
886	03190	copy machine waste	solid	40		
910	06360	diatomaceous earth	solid	54750		weekly/monthly
910	07560	wastewater sludge	solid	0		intermittant
966	06840	empty containers	empty containers	100		intermittent
980	06550	kimwipes	solid	1500		daily
980	06960	sawdust soaked with oil seepage	solid	900		daily
980	06590	metal scrap	metal	5000		daily
980	06530	metal scrap	metal	2000		daily
980	06520	fiberglass resins and catalysts	solid	1000		intermittent
980	06500	metal scraps	metal	5000		daily
980	06570	oily rags	solid	480		daily
980	06510	rags with mineral spirits	solid	1480		daily
980	06490	empty containers	empty containers	100		intermittent
980	06580	oily rags	solid	480		daily
991	07510	toner & dispersant containers	empty containers	100		monthly
991	07500	empty paint containers	empty containers	100		
T750	06010	empty toner/dispersant containers	empty containers	100		monthly
T750	06040	kimwipes	solid	100		as needed
T750	06020	soiled kimwipes	solid	100		as needed

Table 1
Solid Waste Stream to Landfill
(1986)

BUILDING NO.	WASTE NO.	WASTE NAME	WASTE TYPE	QUANTITY GENERATED	UNITS	GENERATION FREQUENCY
460	00820	used kimwipes	solid	0	lbs/yr	as needed
460	00830	used oil filters	solid	0		as needed
460	01110	empty containers	empty containers	100		intermittent
460	01100	kimwipes and rags	solid	165		as needed
460	00450	used kimwipes and rags (ult)	solid	280		as needed
460	01270	kimwipes	solid	40		as needed
460	23650	apron filter	solid	2		once/6 mon
460	23790	bijur filter screen	solid			once 6/mon
460	01240	empty containers	empty containers	100		as needed
460	09000	used oil filters	solid	0		to be determined
460	23640	turret res. filter	solid	2		once/6 mon
460	23750	inline coolant filter	solid	2		once/6 mon
460	01190	kimwipes	solid	100		as needed
460	01340	kimwipes and rags	solid	60		as needed
460	01170	sludge	solid	1200		to be determined
460	01120	kimwipes and rags	solid	165		as needed
460	00630	film packs	solid	48		
460	01110	empty containers	empty containers	100		intermittent
460	23740	rough inline filter	solid	2		once/6 mon
460	23720	oil filter	solid	2		once/6 mon
460	01070	used kimwipes and floor dry	solid	48		as needed
60	00760	used kimwipes	solid	24000		as needed
460	01320	kimwipes	solid	200		as needed
460	01180	used oil filters	solid	2000		weekly
460	00780	used kimwipes and floor dry	solid	350		as needed
460	00980	metal chips	metal	40		
460	01010	used oil filters	solid	15		as needed
551	06320	metal cuttings	metal	300		
551	06310	spray paint cans	empty containers	100		
551	06300	kimwipes and degreasing residue	solid	300		
560	11810	sump sludge	solid	200		1 to 2 years
563	20580	sump sludge	solid	200		intermittent
662	04040	used filters	solid	20		intermittnat
662	04000	kimwipes	solid	200		continuous
662	04030	broken parts	solid	100		as occurs
664	17500	empty containers	empty containers	100		daily
664	17510	used rags	solid	200		daily
664	17590	solid waste	solid	500		continuous
701	17620	solid waste	solid	200		daily
705	20280	kimwipes	solid	1		as needed
705	20240	polishing pads	solid	2		as needed
705	20300	metal and glass scraps	solid	100		daily
705	20250	kimwipes	solid	3		as needed
705	20620	dumpster	solid			
705	20060	kimwipes	solid	20		as needed
705	20310	office trash	solid	1000		daily
705	20410	sump sludge	solid	20		continuous
708	10650	HEPA filters	solid	200		PMO schedule
709	11700	sump sludge	solid	200		varies
711	20530	sump sludge	solid	200		varies
712	20590	sump sludge	solid	200		varies
713	20600	sump sludge	solid	200		varies
732	15020	filters	solid	300		once per month
750	09100	empty toner/developer containers	empty containers	3		intermittent
750	09020	empty fixer/developer containers	empty containers	100		as required
750	09110	kimwipes	solid	100		intermittent
[illegible]0	09070	microfilm wrapper	solid	100		continuous
[illegible]	09060	empty containers	empty containers	100		intermittent
[illegible]0	09090	kimwipes	solid	100		intermittent
770	22570	rags	solid	365		occasionally
770	22650	combustibles	solid	4700		daily

Table I
Solid Waste Stream to Landfill
(1986)

BUILDING NO.	WASTE NO.	WASTE NAME	WASTE TYPE	QUANTITY GENERATED	UNITS	GENERATION FREQUENCY
439	00090	kimwipes	solid	200	lbs/yr	as needed
440	00140	aluminum and sst chips	metal	500		
440	00180	kimwipes and rags	solid	500		as needed
440	00160	empty containers	empty containers	100		as needed
440	01390	kimwipes and rags	solid	500		
440	00200	kimwipes and rags	solid	500		as needed
441	00220	toner	empty containers	100		as needed
442	00260	respirator cartridges	solid	100		
442	00250	defective HEPA filters	solid	50		as appropriate
445	15340	trash	solid	500		continuous
445	15280	trash	solid	500		continuous
445	15260	carbon dust	solid	20800		continuous
445	15290	steel shavings	metal	5000		continuous
445	15270	carbon scraps	solid	10000		continuous
445	15300	steel scraps	metal	5000		continuous
449	11070	rags	organic	200		
449	11060	empty paint cans and containers	empty containers	10		
449	11090	miscellaneous trash	solid	660		
454	11890	sump sludge	solid	800		intermittent
457	11860	sump sludge	solid	200		intermittent
460	00910	used kimwipes and floor dry	solid	0		as needed
460	00940	used kimwipes	solid	302		as needed
460	23630	bijur filter screen	solid	2		once/6 mon
460	00600	used kimwipes and rags	solid	200		as needed
460	23770	bijur filter screen	solid			once/6 mon
460	00770	used oil filters	solid	70		as needed
460	23690	air filter	solid	2		once/6 mon
460	00880	metal chips	metal	0		to be determined
460	01000	used kimwipes	solid	55		as needed
460	23710	bijur filter screen	solid	2		once/6 mon
460	00370	used oil filters	solid	20		4 per year
460	01080	kimwipes	solid	150		as needed
460	00840	used kimwipes and floor dry	solid	0		as needed
460	01250	kimwipes and rags	solid	165		as needed
460	23800	bijur filter screen	solid			
460	00460	used kimwipes and rags (vap)	solid	280		as needed
460	01310	kimwipes	solid	50		as needed
460	23680	hydraulic intake filter	solid	2		once/6 mon
460	00640	kimwipes and rags	solid	110		
460	23850	air inlet filter	solid			once/6 mon
460	00810	metal chips	metal	0		to be determined
460	01090	empty paint cans	empty containers	100		
460	23700	bijur filter screen	solid	2		once/6 mon
460	00930	used filters	solid	1800		to be determined
460	01360	kimwipes and floor dry	solid	20		as needed
460	23660	hydraulic system filter	solid	2		once/6 mon
460	01060	discarded containers	empty containers	100		intermittent
460	00890	used kimwipes	solid	0		as needed
460	01050	metal chips	metal	300		to be determined
460	01200	empty chem. and solvent containers	empty containers	100		intermittent
460	01230	kimwipes w/Freon	solid	165		as needed
460	00710	kimwipes, gloves and gauze	solid	0		as needed
460	00710	used kimwipes, gloves and gauze	solid	580		as needed
460	00490	used kimwipes and gloves	solid	110		as needed
460	00950	used kimwipes and floor dry	solid	110		as needed
460	01140	kimwipes and rags	solid	165		as needed
460	00570	nuocure	solid	100		
460	00750	metal chips	metal	0		to be determined
460	23780	bijur filter screen	solid			
460	00380	used kimwipes and gauze	solid	150		as needed
460	01280	kimwipes and floor dry	solid	40		as needed

Table I
Solid Waste Stream to Landfill
(1986)

BUILDING NO.	WASTE NO.	WASTE NAME	WASTE TYPE	QUANTITY GENERATED	UNITS	GENERATION FREQUENCY
111	06780	developer and fixer containers	empty containers	10	lbs/yr	as needed
111	06630	kimwipes and rags	solid	240		continous
111	06610	toner and dispersant containers	empty containers	3		2 per month
111	06820	empty developer and fixer container	empty containers	100		as needed
111	06680	empty solvent containers	empty containers	3		1 per month
111	06640	empty toner containers	empty containers	10		3 per week
111	06690	kimwipes and rags	solid	240		continous
111	06670	empty ink cans	empty containers	12		3-4 per month
111	06800	kimwipes and filmpacks	solid	100		as needed
111	06650	demineralizer system filters	solid	24		1 per month
111	06760	kimwipes and rags	solid	100		
111	06740	empty chemical containers	empty containers	100		as needed
121	04810	solid waste	solid	100		intermittant
121	04780	gun patches	solid	50		continuous
123	02830	waste resin	aqueous	3		batch
123	03080	batteries,metalwire,used elec.comp.	solid	500		continuous
123	03000	empty vials	solid	100		batch
123	02880	waste resin	solid	50		batch
123	03070	kimwipes	solid	200		continuous
124	01910	settling basin sludge	aqueous	500000	gal/yr	batch
124	00010	microstrainer backwash	aqueous	180000	gal/yr	summer operation
124	00020	clarifier underflow	aqueous	1500000	gal/yr	continuous
124	00030	sand filter backwash	aqueous	1500000	gal/yr	intermittent
124	01660	dried sludge	solid	5000	lbs/yr	once/ 6 months
125	02550	kimwipes	solid	100		continuous
125	02730	oil filters	solid	5		intermittant
130	07350	copy machine toner	empty containers	100		as needed
130	07400	rejected bags	solid	200		as needed
130	07330	polaroid film backings	solid	100		as needed
130	07390	kimwipes	solid	100		as needed
130	07360	packing materials	solid	100		intermittent
130	07380	water conditioning filters	solid	5		twice per month
130	07340	floor sweepings	solid	100		as needed
223	06840	compressor oil filter	solid	1		1 filter/2 years
331	06430	oil filters and used parts	solid	500		daily
331	06440	paint and body-filler cans	solid	200		as needed
333	06230	shavings	solid	100		daily
333	06220	sawdust	solid	100		as needed
333	06110	filters	solid	200		weekly
333	06210	blast waste	solid	1500		as needed
333	06140	empty cans	empty containers	100		as needed
333	06080	empty paint cans	solid	200		as needed
333	06200	scrapings	solid	200		as needed
333	06180	empty cans	empty containers	100		as needed
333	06130	rags	solid	300		as needed
333	06150	disposed equipment	solid	1000		as needed
333	06090	empty paint cans	solid	500		as needed
334	07050	wood/plastic shavings	solid	500		continous
334	07060	floor scrap	solid	200		daily
334	07110	other metal waste	metal	500		
334	06950	enamel residue	solid	100		intermittent
334	07250	miscellaneous solid waste	metal	500		daily
334	07140	scrap metal	metal	500		daily
334	07160	fluorescent light tubes	solid	1000		as needed
334	07120	used filters	solid	2		as needed
334	07130	metal and silica waste	solid	500		intermittent
335	07040	fire extinguisher chemicals	aqueous	200	gal/yr	as needed
73	11640	sump sludge	solid	100	lbs/yr	yearly
439	00070	kimwipes and rags	solid	200		as needed
439	00110	empty cans and containers	empty containers	100		as needed
439	00060	metal chips	metal	500		daily

APPENDIX A

ATTACHMENT 3
EPA LANDFILL GAS GENERATION MODEL

Rocky Flats Gas Generation Model

Rev. July 2002

Model Parameters

Lo : 100.00 m^3 / Mg
k : 0.0400 1/yr
NMOC : 4000.00 ppmv
Methane : 50.0000 % volume
Carbon Dioxide : 50.0000 % volume

Landfill Parameters

Year Opened : 1968 Current Year : 2002 Year Closed: 1997
Capacity : 91746 Mg

Model Results

Year	Refuse In Place (Mg)	Methane Emission Rate (Mg/yr)	Methane Emission Rate (Cubic m/yr)
1969	2.314E+03	6.175E+00	9.256E+03
1970	4.628E+03	1.211E+01	1.815E+04
1971	6.942E+03	1.781E+01	2.669E+04
1972	9.256E+03	2.329E+01	3.490E+04
1973	1.157E+04	2.855E+01	4.279E+04
1974	1.388E+04	3.360E+01	5.037E+04
1975	1.620E+04	3.846E+01	5.765E+04
1976	1.847E+04	4.302E+01	6.448E+04
1977	2.074E+04	4.740E+01	7.104E+04
1978	2.302E+04	5.160E+01	7.735E+04
1979	2.529E+04	5.565E+01	8.341E+04
1980	2.756E+04	5.953E+01	8.923E+04
1981	2.984E+04	6.326E+01	9.482E+04
1982	3.211E+04	6.685E+01	1.002E+05
1983	3.438E+04	7.029E+01	1.054E+05
1984	3.666E+04	7.360E+01	1.103E+05
1985	3.893E+04	7.678E+01	1.151E+05
1986	4.120E+04	7.984E+01	1.197E+05
1987	4.347E+04	8.277E+01	1.241E+05
1988	4.987E+04	9.659E+01	1.448E+05
1989	5.626E+04	1.099E+02	1.647E+05
1990	6.265E+04	1.226E+02	1.838E+05
1991	6.905E+04	1.349E+02	2.022E+05
1992	7.544E+04	1.466E+02	2.198E+05
1993	7.816E+04	1.481E+02	2.221E+05
1994	8.088E+04	1.496E+02	2.242E+05
1995	8.360E+04	1.510E+02	2.263E+05
1996	8.632E+04	1.523E+02	2.283E+05
1997	8.903E+04	1.536E+02	2.302E+05
1998	9.175E+04	1.548E+02	2.321E+05
1999	9.175E+04	1.487E+02	2.230E+05
2000	9.175E+04	1.429E+02	2.142E+05
2001	9.175E+04	1.373E+02	2.058E+05
2002	**9.175E+04**	**1.319E+02**	**1.977E+05**

2003	9.175E+04	1.268E+02	1.900E+05
2004	9.175E+04	1.218E+02	1.825E+05
2005	9.175E+04	1.170E+02	1.754E+05
2006	9.175E+04	1.124E+02	1.685E+05
2007	9.175E+04	1.080E+02	1.619E+05
2008	9.175E+04	1.038E+02	1.556E+05
2009	9.175E+04	9.971E+01	1.495E+05
2010	9.175E+04	9.580E+01	1.436E+05
2011	9.175E+04	9.204E+01	1.380E+05
2012	9.175E+04	8.843E+01	1.326E+05
2013	9.175E+04	8.496E+01	1.274E+05
2014	9.175E+04	8.163E+01	1.224E+05
2015	9.175E+04	7.843E+01	1.176E+05
2016	9.175E+04	7.536E+01	1.130E+05
2017	9.175E+04	7.240E+01	1.085E+05
2018	9.175E+04	6.956E+01	1.043E+05
2019	9.175E+04	6.684E+01	1.002E+05
2020	9.175E+04	6.421E+01	9.625E+04
2021	9.175E+04	6.170E+01	9.248E+04
2022	9.175E+04	5.928E+01	8.885E+04
2023	9.175E+04	5.695E+01	8.537E+04
2024	9.175E+04	5.472E+01	8.202E+04
2025	9.175E+04	5.257E+01	7.880E+04
2026	9.175E+04	5.051E+01	7.571E+04
2027	9.175E+04	4.853E+01	7.275E+04
2028	9.175E+04	4.663E+01	6.989E+04
2029	9.175E+04	4.480E+01	6.715E+04
2030	9.175E+04	4.304E+01	6.452E+04
2031	9.175E+04	4.136E+01	6.199E+04
2032	9.175E+04	3.973E+01	5.956E+04
2033	9.175E+04	3.818E+01	5.722E+04
2034	9.175E+04	3.668E+01	5.498E+04
2035	9.175E+04	3.524E+01	5.282E+04
2036	9.175E+04	3.386E+01	5.075E+04
2037	9.175E+04	3.253E+01	4.876E+04
2038	9.175E+04	3.126E+01	4.685E+04
2039	9.175E+04	3.003E+01	4.501E+04
2040	9.175E+04	2.885E+01	4.325E+04
2041	9.175E+04	2.772E+01	4.155E+04
2042	9.175E+04	2.664E+01	3.992E+04
2043	9.175E+04	2.559E+01	3.836E+04
2044	9.175E+04	2.459E+01	3.685E+04
2045	9.175E+04	2.362E+01	3.541E+04
2046	9.175E+04	2.270E+01	3.402E+04
2047	9.175E+04	2.181E+01	3.269E+04
2048	9.175E+04	2.095E+01	3.141E+04
2049	9.175E+04	2.013E+01	3.017E+04
2050	9.175E+04	1.934E+01	2.899E+04
2051	9.175E+04	1.858E+01	2.785E+04
2052	9.175E+04	1.785E+01	2.676E+04
2053	9.175E+04	1.715E+01	2.571E+04
2054	9.175E+04	1.648E+01	2.470E+04
2055	9.175E+04	1.584E+01	2.374E+04
2056	9.175E+04	1.521E+01	2.280E+04
2057	9.175E+04	1.462E+01	2.191E+04
2058	9.175E+04	1.404E+01	2.105E+04
2059	9.175E+04	1.349E+01	2.023E+04

2060	9.175E+04	1.296E+01	1.943E+04
2061	9.175E+04	1.246E+01	1.867E+04
2062	9.175E+04	1.197E+01	1.794E+04
2063	9.175E+04	1.150E+01	1.724E+04
2064	9.175E+04	1.105E+01	1.656E+04
2065	9.175E+04	1.061E+01	1.591E+04
2066	9.175E+04	1.020E+01	1.529E+04
2067	9.175E+04	9.798E+00	1.469E+04
2068	9.175E+04	9.414E+00	1.411E+04
2069	9.175E+04	9.045E+00	1.356E+04
2070	9.175E+04	8.690E+00	1.303E+04
2071	9.175E+04	8.350E+00	1.252E+04
2072	9.175E+04	8.022E+00	1.202E+04
2073	9.175E+04	7.708E+00	1.155E+04
2074	9.175E+04	7.406E+00	1.110E+04
2075	9.175E+04	7.115E+00	1.067E+04
2076	9.175E+04	6.836E+00	1.025E+04
2077	9.175E+04	6.568E+00	9.845E+03
2078	9.175E+04	6.311E+00	9.459E+03
2079	9.175E+04	6.063E+00	9.088E+03
2080	9.175E+04	5.825E+00	8.732E+03
2081	9.175E+04	5.597E+00	8.389E+03
2082	9.175E+04	5.378E+00	8.060E+03
2083	9.175E+04	5.167E+00	7.744E+03
2084	9.175E+04	4.964E+00	7.441E+03
2085	9.175E+04	4.769E+00	7.149E+03
2086	9.175E+04	4.582E+00	6.869E+03
2087	9.175E+04	4.403E+00	6.599E+03
2088	9.175E+04	4.230E+00	6.341E+03
2089	9.175E+04	4.064E+00	6.092E+03
2090	9.175E+04	3.905E+00	5.853E+03
2091	9.175E+04	3.752E+00	5.624E+03
2092	9.175E+04	3.605E+00	5.403E+03
2093	9.175E+04	3.463E+00	5.191E+03
2094	9.175E+04	3.328E+00	4.988E+03
2095	9.175E+04	3.197E+00	4.792E+03
2096	9.175E+04	3.072E+00	4.604E+03
2097	9.175E+04	2.951E+00	4.424E+03
2098	9.175E+04	2.836E+00	4.250E+03
2099	9.175E+04	2.724E+00	4.084E+03
2100	9.175E+04	2.618E+00	3.923E+03
2101	9.175E+04	2.515E+00	3.770E+03
2102	9.175E+04	2.416E+00	3.622E+03
2103	9.175E+04	2.322E+00	3.480E+03
2104	9.175E+04	2.231E+00	3.343E+03
2105	9.175E+04	2.143E+00	3.212E+03
2106	9.175E+04	2.059E+00	3.086E+03
2107	9.175E+04	1.978E+00	2.965E+03
2108	9.175E+04	1.901E+00	2.849E+03
2109	9.175E+04	1.826E+00	2.737E+03
2110	9.175E+04	1.755E+00	2.630E+03
2111	9.175E+04	1.686E+00	2.527E+03
2112	9.175E+04	1.620E+00	2.428E+03
2113	9.175E+04	1.556E+00	2.333E+03
2114	9.175E+04	1.495E+00	2.241E+03
2115	9.175E+04	1.437E+00	2.153E+03
2116	9.175E+04	1.380E+00	2.069E+03

2117	9.175E+04	1.326E+00	1.988E+03
2118	9.175E+04	1.274E+00	1.910E+03
2119	9.175E+04	1.224E+00	1.835E+03
2120	9.175E+04	1.176E+00	1.763E+03
2121	9.175E+04	1.130E+00	1.694E+03
2122	9.175E+04	1.086E+00	1.627E+03
2123	9.175E+04	1.043E+00	1.564E+03
2124	9.175E+04	1.002E+00	1.502E+03
2125	9.175E+04	9.629E-01	1.443E+03
2126	9.175E+04	9.252E-01	1.387E+03
2127	9.175E+04	8.889E-01	1.332E+03
2128	9.175E+04	8.540E-01	1.280E+03
2129	9.175E+04	8.206E-01	1.230E+03
2130	9.175E+04	7.884E-01	1.182E+03
2131	9.175E+04	7.575E-01	1.135E+03
2132	9.175E+04	7.278E-01	1.091E+03
2133	9.175E+04	6.992E-01	1.048E+03
2134	9.175E+04	6.718E-01	1.007E+03
2135	9.175E+04	6.455E-01	9.675E+02
2136	9.175E+04	6.202E-01	9.296E+02
2137	9.175E+04	5.958E-01	8.931E+02
2138	9.175E+04	5.725E-01	8.581E+02
2139	9.175E+04	5.500E-01	8.245E+02
2140	9.175E+04	5.285E-01	7.921E+02
2141	9.175E+04	5.077E-01	7.611E+02
2142	9.175E+04	4.878E-01	7.312E+02
2143	9.175E+04	4.687E-01	7.026E+02
2144	9.175E+04	4.503E-01	6.750E+02
2145	9.175E+04	4.327E-01	6.485E+02
2146	9.175E+04	4.157E-01	6.231E+02
2147	9.175E+04	3.994E-01	5.987E+02
2148	9.175E+04	3.837E-01	5.752E+02
2149	9.175E+04	3.687E-01	5.527E+02
2150	9.175E+04	3.542E-01	5.310E+02
2151	9.175E+04	3.404E-01	5.102E+02
2152	9.175E+04	3.270E-01	4.902E+02
2153	9.175E+04	3.142E-01	4.709E+02
2154	9.175E+04	3.019E-01	4.525E+02
2155	9.175E+04	2.900E-01	4.347E+02
2156	9.175E+04	2.787E-01	4.177E+02
2157	9.175E+04	2.677E-01	4.013E+02
2158	9.175E+04	2.572E-01	3.856E+02
2159	9.175E+04	2.471E-01	3.705E+02
2160	9.175E+04	2.375E-01	3.559E+02
2161	9.175E+04	2.281E-01	3.420E+02
2162	9.175E+04	2.192E-01	3.286E+02
2163	9.175E+04	2.106E-01	3.157E+02
2164	9.175E+04	2.023E-01	3.033E+02
2165	9.175E+04	1.944E-01	2.914E+02
2166	9.175E+04	1.868E-01	2.800E+02
2167	9.175E+04	1.795E-01	2.690E+02
2168	9.175E+04	1.724E-01	2.585E+02
2169	9.175E+04	1.657E-01	2.483E+02
2170	9.175E+04	1.592E-01	2.386E+02
2171	9.175E+04	1.529E-01	2.292E+02
2172	9.175E+04	1.469E-01	2.202E+02
2173	9.175E+04	1.412E-01	2.116E+02

2174	9.175E+04	1.356E-01	2.033E+02
2175	9.175E+04	1.303E-01	1.953E+02
2176	9.175E+04	1.252E-01	1.877E+02
2177	9.175E+04	1.203E-01	1.803E+02
2178	9.175E+04	1.156E-01	1.732E+02
2179	9.175E+04	1.111E-01	1.665E+02
2180	9.175E+04	1.067E-01	1.599E+02
2181	9.175E+04	1.025E-01	1.537E+02
2182	9.175E+04	9.849E-02	1.476E+02
2183	9.175E+04	9.463E-02	1.418E+02
2184	9.175E+04	9.092E-02	1.363E+02
2185	9.175E+04	8.736E-02	1.309E+02
2186	9.175E+04	8.393E-02	1.258E+02
2187	9.175E+04	8.064E-02	1.209E+02
2188	9.175E+04	7.748E-02	1.161E+02
2189	9.175E+04	7.444E-02	1.116E+02
2190	9.175E+04	7.152E-02	1.072E+02
2191	9.175E+04	6.872E-02	1.030E+02
2192	9.175E+04	6.602E-02	9.896E+01
2193	9.175E+04	6.343E-02	9.508E+01
2194	9.175E+04	6.095E-02	9.135E+01
2195	9.175E+04	5.856E-02	8.777E+01
2196	9.175E+04	5.626E-02	8.433E+01
2197	9.175E+04	5.405E-02	8.102E+01
2198	9.175E+04	5.193E-02	7.785E+01
2199	9.175E+04	4.990E-02	7.479E+01
2200	9.175E+04	4.794E-02	7.186E+01
2201	9.175E+04	4.606E-02	6.904E+01

APPENDIX A

ATTACHMENT 4
LANDFILL GAS GENERATION REPORT

CALCULATION SHEET

JOB ID 57378
COST CODE .0101

CLIENT _____ SUBJECT Gas Generation Prepared By DBB Date 7-23-02

PROJECT Rocky Flats Landfill Calculations Reviewed By MSN Date 7-23-02

Approved By _____ Date __

PURPOSE: To estimate the quantity of landfill gas generated from Rocky Flats Landfill utilizing the EPA Landfill Gas Generation Model. Secondly, estimate the landfill gas flux through the landfill final cover. Finally, compare these values with the previous results of the gas generation report prepared in April 2002 by others.

METHODS AND ASSUMPTIONS:

From the waste stream characterization tables, provided in OU 7 Final Work Plan, it was assumed that a conservative value for the organic materials within the waste stream was 50% by Volume.

The April 2003 Gas Generation Report utilized the full waste stream volume to estimate the gas generation rate. For this calculation we will exclude 50% of the waste stream volume to account for the inorganic waste materials that will not produce landfill gas.

From the previous gas generation report the methane generation constant, k = 0.04. This k-value will be used in the model.

From the previous gas generation report the methane generation potential, Lo= 100. This Lo-value will be used in the model

The EPA Model tabulates separately the main constituents of landfill gas (methane and carbon dioxide), therefore we will assume a 50/50 ratio of methane and carbon dioxide. For our calculation, the methane generation rate must be multiplied by 2 in order to obtain the total gas generation rate.

CALCULATION:

Based on the model output provided, the following gas generation flow rate and flux was estimated for the year 2002:

Methane Emission Rate = 197,700 cubic meters/year (From Attachment)

Total Landfill Gas Emission Rate = 395,400 cubic meters/year
395,400 cu.m/yr (35.3 cu.ft/cu.m) (1 year/365 days) (1day/24 hrs.) (1hr/60min.) = 26.56 cfm (Flow Rate)

Flux = Gas Flow Rate/Landfill Area = 26.56 cfm/ 21 acres = 2.90×10^{-5} cfm/sq.ft.

JOB ID 57378
COST CODE .0101

CLIENT _____ SUBJECT Gas Generation Prepared By DBB Date 7-23-02

PROJECT Rocky Flats Landfill Calculations Reviewed By MSN Date 7-23-02

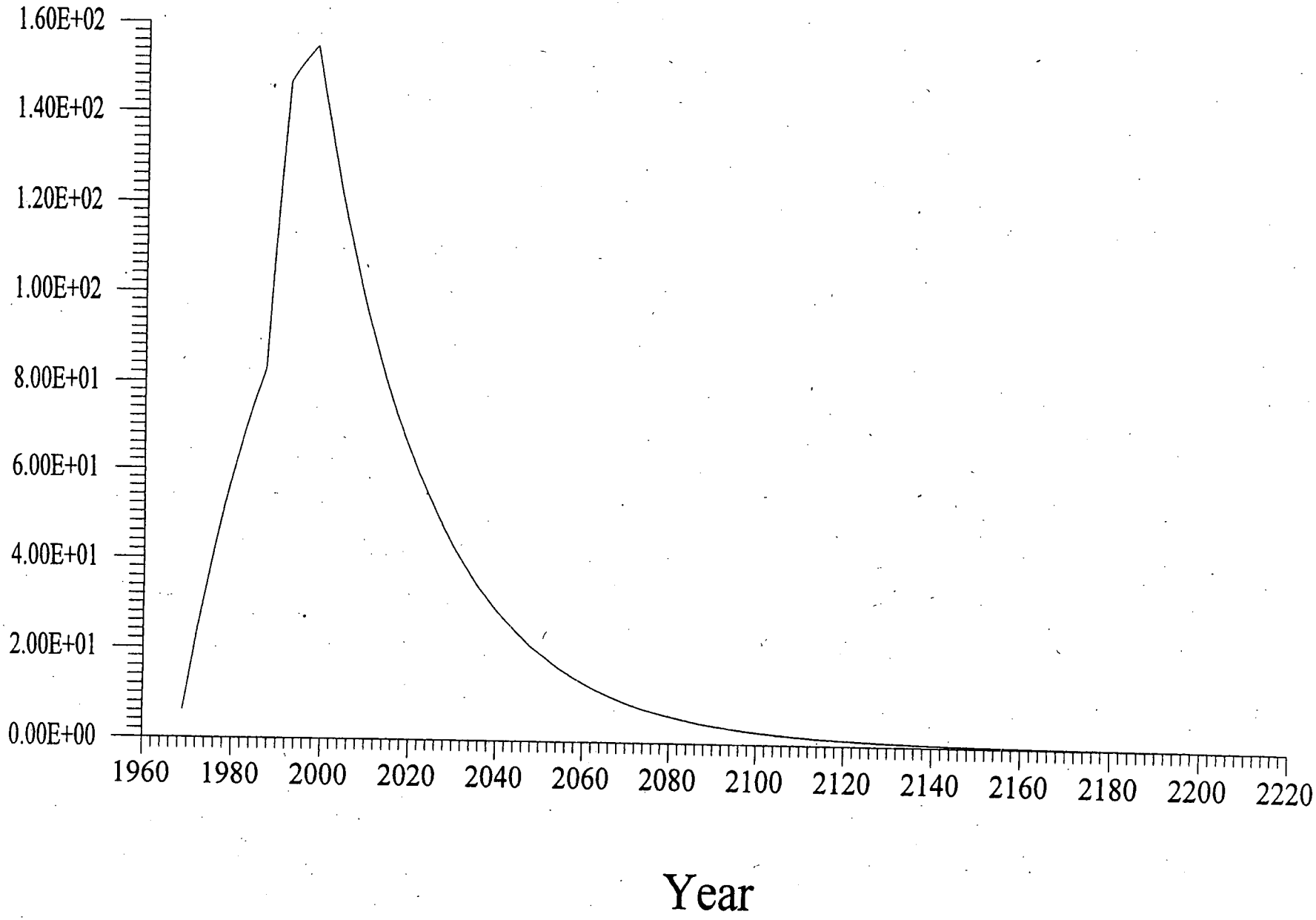
Approved By _____ Date __

CONCLUSIONS:

The values for gas flow rate and flux from this calculation are significantly less than the April 2002 Gas Generation report (gas generation rate of 50.3 cfm and flux of 1×10^{-4} cfm/sq.ft.).

When preparing a gas generation report, one must consider the waste stream characteristics carefully and since the inorganic materials do not contribute to landfill gas generation it is important to exclude them in order to get a more accurate value.

Projected Methane Emissions



APPENDIX A

ATTACHMENT 5
LANDFILL METHANE EMISSIONS MODEL

Rocky Flats Landfill

Purpose:

To estimate the subsurface concentration of LFG at the root zone utilizing the projected flux rate by a copy righted Landfill Methane Emissions Model developed by Kurt Sopkas of Argonne National Laboratories (1996).

Methods and Assumptions:

Determine the mass flux rate for the waste/cover boundary using the projected emissions of LFG and methane. Compare flux to published modeled fluxes for various cover materials.

Assumes a methane concentration of 30% at the waste/cover boundary. Note that soils test data shows that concentrations of methane on average were less than 10% at 1 foot below grade. Since additional materials will be placed on the site, the use of 30% is conservative.

Calculations:

Acreage:		21	acres
Methane Emissions Rate:		197,700	cubic meters/year
		13.3	cubic feet/minute
Total Landfill Gas Emissions Rate:		395,400	cubic meters/year
		26.6	cubic feet/minute
Methane Flux:		1.45E-05	cfm/sq.ft.
Total Landfill Gas Flux:		2.90E-05	cfm/sq.ft.
STD ATMOSPHERIC PRESSUF	14.7	psia	
STD TEMPERATURE	68.0	° F	528.0 ° R
Universal Gas Constant - R:	10.7	scf-psia/lb-mole °R	
Std. Volume:	385.4	scf/lb-mole	

	Volume	MOL. WT.		MOL. WT. Fraction
CH4	50%	16.0	8.0	lb/lb-mole
CO2	50%	44.0	22.0	lb/lb-mole
Total :	100%		30.0	lb/lb-mole

Methane Density:	0.042	lbs/scf
LFG Density:	0.078	lbs/scf
Methane Mass Flux:	6.0E-07	lbs/minute per sq ft
LFG Mass Flux:	2.3E-06	lbs/minute per sq ft

Refuse/Cover Boundary

Methane Mass Flux:	4.25E-01	$g/m^2/day$
LFG Mass Flux:	1.59	$g/m^2/day$

Cover Attenuation Factor

The cover factor is the ratio of the emission factor of the cover to the emission factor of the base condition (no cover and 30% methane)

0.0305 published by Kurt Spokas (Argonne National Laboratory, 1996)

Modeled Soil Porosity:	0.4	
Modeled Soil Moisture:	17%	
Thickness of Layer:	30.0	inches

Root Zone Boundary

Methane Mass Flux:	1.30E-02	$g/m^2/day$
LFG Mass Flux:	4.86E-02	$g/m^2/day$
Methane Volumetric Flux:	4.4E-07	cf/sqft per minute
LFG Volumetric Flux:	8.9E-07	cf/sqft per minute

Assuming a 1 inch thick control volume, a constant flux, and a constant concentration within the control volume:

	5.315E-06	cf gas/cf control volume
	1.31E-05	cf gas/cf pore space
Expected Methane Concentration	13.1	ppmv
	1.063E-05	cf gas/cf control volume
	2.62E-05	cf gas/cf pore space
Expected LFG Concentration	26.2	ppmv

References:

Spokas, K., General Description of LMEM (Landfill Methane Emission Model) with Comparison to Field Measurements of Methane Emission Rates from the Surface of Landfills, Presented at the Nineteenth International Madison Waste Conference, September 25-26, 1996, Department of Engineering Professional Development, University of Wisconsin-Madison.

Bogner, J., K.Spokas, M. Niemann, L. Niemann, and A. Granfield, Field measurements of methane and non-methane organic compound emissions at the Greene Valley Landfill, Proceedings from Waste Tech '97, Phoenix, Arizona, Sponsered by Environmental Industries Association/National Solid Waste Management Association, 1997.

APPENDIX A

ATTACHMENT 6
LANDFILL GAS VENT TRENCH CALCULATIONS

CLIENT Rocky Flats Env.Tech.Site **SUBJECT** Gas Vent **Prepared By** DBB **Date** 12/10/03

PROJECT Landfill Gas Collection System Design Trench Calculations **Reviewed By** MSN **Date** 12/10/03

Approved By RT **Date** 12/10/03

PURPOSE: To determine the spacing recommended between the gas vent trenches for the gas management system design and layout.

METHODS AND ASSUMPTIONS:

- A modified form of Darcy's equation for radial fluid flow was used to evaluate the gas extraction well radii of influence.

- A trench depth of 8 feet was assumed over the entire landfill.

- The density of waste = 44.44 lb_m / ft^3

- Waste permeability factor = 2.681×10^{-11} ft^2

  Permeability is defined as a measure of the ability of a porous media to transmit fluids. While the permeability of waste within a landfill can vary greatly, it is assumed to be a constant for ease of calculation in the spreadsheet. A reasonable Absolute Permeability value for waste is 2.681×10^{-11} ft^2. This number was calculated by Earth Tech by applying Darcy's Law for Linear Compressible Fluid Flow to the movement of landfill gas through waste and assuming the following:

  (1) Steady state flow conditions exist.
  (2) The pore space of the waste is 100% saturated with the flowing fluid (landfill gas).
  (3) The viscosity of the flowing fluid is constant.
  (4) Isothermal conditions in the waste prevail.
  (5) Flow is laminar, horizontal and linear since waste grain size is relatively small and the velocity of fluid flow is low.

- The gas generation rate of the waste = 0.05 cf / lb waste - year. This measurement is based on an average of gas generation rates for C&D waste.

- Typical gas temperature within the landfill = 86°F (based on typical landfill gas temperatures for a Western United States Landfill).

CALCULATION:

The parameters described under methods and assumptions will be used to calculate the ROI for each proposed gas vent trench. Calculations were performed in a spreadsheet format because of the repetitive nature of the approaches.

CLIENT Rocky Flats Env.Tech.Site **SUBJECT** Gas Vent **Prepared By** DBB **Date** 12/10/03
PROJECT Landfill Gas Collection Trench Calculations **Reviewed By** MSN **Date** 12/10/03
System Design **Approved By** RT **Date** 12/10/03

The ROI calculation table/spreadsheet (Attachment 1) requires as input the gas extraction well identification number, gas generation rates, permeability factor, refuse density, gas temperature, trench length and depth. Given these inputs, the spreadsheet calculates the ROI for each gas vent trench.

Refer to the attached spreadsheet for details of the gas vent trench information.

CONCLUSION:

Based on the results of the gas vent trench layout analysis for the RFETS, and the current limit of waste information a total of 3 gas extraction trenches are proposed for the gas management system.

Attachment 1

Radius of Influence Calculation

Rocky Flats Enviromental Technology Site

Assumes standard conditions are 14.7 psia, 60 Deg. F.

GAS TRENCH NO.	GAS GENERATION RATE (FT3/LBm*YR)	PERMEABILITY FACTOR x 10E-11 (FT2)	REFUSE DENSITY (LBm/FT3)	GAS TEMPERATURE (DEG. F)	Trench Length (FT)	Trench Depth (FT)	Vertical Extent Limiting Factor	Vertical Influence (FT)	Static Pressure (in WC)	**ROI (FT)**	**GAS FLOW (SCFM)**
T-1	0.05	2.681	44.44	86	930	8	2.00	8.00	0.10	54	2
T-2	0.05	2.681	44.44	86	890	8	2.00	8.00	0.10	54	2
T-3	0.05	2.681	44.44	86	870	8	2.00	8.00	0.10	54	2
T-4	0.05	2.681	44.44	86	840	8	2.00	8.00	0.10	54	2

WELL NO.	DEFAULT OVERLAP (%)	CALCULATED OVERLAP (%)	AREA OF INFLUENCE OF WELL (SQ. FT.)	CHORD LENGTHS					
				CHORD 1 (FT)	CHORD 2 (FT)	CHORD 3 (FT)	CHORD 4 (FT)	CHORD 5 (FT)	CHORD 6 (FT)
T-1	0	0	9172.00	0	0	0	0	0	0
T-2	0	0	9172.00	0	0	0	0	0	0
T-3	0	0	9172.00	0	0	0	0	0	0
ERR	0	ERR	ERR	0	0	0	0	0	0
ERR	0	ERR	ERR	0	0	0	0	0	0
ERR	0	ERR	ERR	0	0	0	0	0	0
T-4	0	0	9172.00	0	0	0	0	0	0

CALCULATION OF INERT SOIL MATERIAL THICKNESSES

INERT MATERIAL IS SUBTRACTED FROM TOTAL VOLUME OF INFLUENCE TO YIELD TOTAL DECOMPOSABLE MATERIAL VOLUME

WELL NO.	COVER DEPTH (FT)	LIFT THICKNESS (FT)	INTERIM COVER DEPTH (FT)	INTERMEDIAT COVER DEPTH TOTAI (FT)
T-1	0	10	0.5	0
T-2	0	10	0.5	0
T-3	0	10	0.5	0
ERR	0	10	0.5	ERR
ERR	0	10	0.5	ERR
ERR	0	10	0.5	ERR
T-4	0	10	0.5	0

APPLIED VACUUM CALCULATION

TRENCH DEPTH (FT)	APPLIED VACUUM ("WC)
10	0.2
20	1
50	2
100	4
150	6

Regression Output:

Constant		-0.0183673
Std Err of Y Est		0.19897698
R Squared		0.99020004
No. of Observations		4
Degrees of Freedom		2
X Coefficient(s)	0.04040816	
Std Err of Coef.	0.00284253	