ANNEXE 10

Simulation de la production de biogaz avec LandGEM^{mc}

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**                                                                              **
**                                                                              **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE                   **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                    **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                       **
**                    USAE WATERWAYS EXPERIMENT STATION                         **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY                  **
**                                                                              **
**                                                                              **
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PRECIPITATION DATA FILE:    C:\DOCUME~2\LOGICI~1\HELP307\30098B.D4
TEMPERATURE DATA FILE:      C:\DOCUME~2\LOGICI~1\HELP307\30098B.D7
SOLAR RADIATION DATA FILE:  C:\DOCUME~2\LOGICI~1\HELP307\30098B.D13
EVAPOTRANSPIRATION DATA:    C:\DOCUME~2\LOGICI~1\HELP307\30098B.D11
SOIL AND DESIGN DATA FILE:  C:\DOCUME~2\LOGICI~1\HELP307\300983MY.D10
OUTPUT DATA FILE:           C:\DOCUME~2\LOGICI~1\HELP307\300983my.OUT


TIME:  10:51     DATE:  10/21/2004


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     TITLE:  RIGMRIM - Cellule avec 3m de MR

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     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                  LAYER  1
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                  TYPE 1 - VERTICAL PERCOLATION LAYER
                      MATERIAL TEXTURE NUMBER   0
          THICKNESS                    =     20.00   CM
          POROSITY                     =      0.4170 VOL/VOL
          FIELD CAPACITY               =      0.0450 VOL/VOL
          WILTING POINT                =      0.0180 VOL/VOL
          INITIAL SOIL WATER CONTENT   =      0.1427 VOL/VOL
          EFFECTIVE SAT. HYD. COND.    =  0.100000005000E-02 CM/SEC


                                  LAYER  2
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                  TYPE 1 - VERTICAL PERCOLATION LAYER
                      MATERIAL TEXTURE NUMBER  18
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THICKNESS	=	300.00	CM
POROSITY	=	0.6710	VOL/VOL
FIELD CAPACITY	=	0.2920	VOL/VOL
WILTING POINT	=	0.0770	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2920	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000005000E-02	CM/SEC

LAYER 3

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 1

THICKNESS	=	60.00	CM
POROSITY	=	0.4170	VOL/VOL
FIELD CAPACITY	=	0.0450	VOL/VOL
WILTING POINT	=	0.0180	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1608	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.999999978000E-02	CM/SEC
SLOPE	=	2.20	PERCENT
DRAINAGE LENGTH	=	25.0	METERS

LAYER 4

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

THICKNESS	=	0.15	CM
POROSITY	=	0.0000	VOL/VOL
FIELD CAPACITY	=	0.0000	VOL/VOL
WILTING POINT	=	0.0000	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.199999996000E-12	CM/SEC
FML PINHOLE DENSITY	=	0.00	HOLES/HECTARE
FML INSTALLATION DEFECTS	=	0.00	HOLES/HECTARE
FML PLACEMENT QUALITY	=	4 - POOR	

LAYER 5

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	0.30	CM
POROSITY	=	0.4170	VOL/VOL
FIELD CAPACITY	=	0.0450	VOL/VOL
WILTING POINT	=	0.0180	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0450	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000005000E-02	CM/SEC

LAYER 6

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 20

THICKNESS	=	0.50	CM
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL

INITIAL SOIL WATER CONTENT	=	0.0100	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	10.0000000000	CM/SEC
SLOPE	=	2.20	PERCENT
DRAINAGE LENGTH	=	25.0	METERS

LAYER 7

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

THICKNESS	=	0.15	CM
POROSITY	=	0.0000	VOL/VOL
FIELD CAPACITY	=	0.0000	VOL/VOL
WILTING POINT	=	0.0000	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.199999996000E-12	CM/SEC
FML PINHOLE DENSITY	=	0.00	HOLES/HECTARE
FML INSTALLATION DEFECTS	=	0.00	HOLES/HECTARE
FML PLACEMENT QUALITY	=	4 - POOR	

LAYER 8

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 17

THICKNESS	=	0.50	CM
POROSITY	=	0.7500	VOL/VOL
FIELD CAPACITY	=	0.7470	VOL/VOL
WILTING POINT	=	0.4000	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.7500	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.300000003000E-08	CM/SEC

LAYER 9

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	15.00	CM
POROSITY	=	0.4170	VOL/VOL
FIELD CAPACITY	=	0.0450	VOL/VOL
WILTING POINT	=	0.0180	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0449	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000005000E-02	CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE # 6 WITH BARE GROUND CONDITIONS, A SURFACE SLOPE OF 2.% AND A SLOPE LENGTH OF 50. METERS.

SCS RUNOFF CURVE NUMBER	=	86.20	
FRACTION OF AREA ALLOWING RUNOFF	=	65.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.0000	HECTARES

EVAPORATIVE ZONE DEPTH	=	20.0	CM
INITIAL WATER IN EVAPORATIVE ZONE	=	2.853	CM
UPPER LIMIT OF EVAPORATIVE STORAGE	=	8.340	CM
LOWER LIMIT OF EVAPORATIVE STORAGE	=	0.360	CM
INITIAL SNOW WATER	=	7.612	CM
INITIAL WATER IN LAYER MATERIALS	=	101.169	CM
TOTAL INITIAL WATER	=	108.782	CM
TOTAL SUBSURFACE INFLOW	=	0.00	MM/YR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
Lamartine Quebec

STATION LATITUDE	=	47.08 DEGREES
MAXIMUM LEAF AREA INDEX	=	0.00
START OF GROWING SEASON (JULIAN DATE)	=	144
END OF GROWING SEASON (JULIAN DATE)	=	260
EVAPORATIVE ZONE DEPTH	=	20.0 CM
AVERAGE ANNUAL WIND SPEED	=	17.00 KPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	70.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	69.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	76.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	78.00 %

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR CARIBOU MAINE

NORMAL MEAN MONTHLY PRECIPITATION (MM)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
63.0	56.7	74.1	69.5	93.7	83.0
100.6	111.7	96.1	90.7	78.1	88.5

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR CARIBOU MAINE

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES CELSIUS)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
-11.8	-10.0	-4.1	3.4	10.9	16.2
19.3	18.0	12.8	6.7	0.0	-7.8

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR CARIBOU MAINE
AND STATION LATITUDE = 47.08 DEGREES

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AVERAGE MONTHLY VALUES (MM) FOR YEARS 1 THROUGH 20

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	71.05	72.11	68.21	46.97	82.94	79.57
	105.21	100.14	99.88	87.95	77.83	90.14
STD. DEVIATIONS	19.01	25.35	40.16	17.92	33.01	27.29
	31.89	38.99	42.42	31.22	25.47	31.64
RUNOFF						
TOTALS	0.000	0.005	66.370	117.044	3.736	0.824
	1.522	1.453	2.078	1.288	5.292	2.547
STD. DEVIATIONS	0.000	0.021	55.586	65.141	5.652	1.259
	3.727	1.625	3.197	2.502	10.925	9.695
EVAPOTRANSPIRATION						
TOTALS	10.900	10.064	14.224	17.028	65.657	66.041
	77.331	71.150	58.930	36.547	18.410	9.848
STD. DEVIATIONS	1.387	1.569	2.812	9.859	19.700	23.974
	19.234	22.773	14.111	7.876	5.856	1.462
LATERAL DRAINAGE COLLECTED FROM LAYER 3						
TOTALS	20.4822	6.7882	3.0500	7.4028	46.8473	54.0245
	30.5991	21.8008	24.3444	32.6121	33.4659	42.5795
STD. DEVIATIONS	11.0486	3.2389	1.2011	7.1172	18.3240	12.5226
	10.5034	8.7728	12.7978	15.3587	16.6532	19.6989
PERCOLATION/LEAKAGE THROUGH LAYER 4						
TOTALS	0.0002	0.0001	0.0000	0.0001	0.0004	0.0004
	0.0002	0.0002	0.0002	0.0002	0.0003	0.0003
STD. DEVIATIONS	0.0001	0.0000	0.0000	0.0001	0.0001	0.0001
	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
LATERAL DRAINAGE COLLECTED FROM LAYER 6						
TOTALS	0.0002	0.0001	0.0000	0.0001	0.0003	0.0004
	0.0002	0.0002	0.0002	0.0002	0.0003	0.0003
STD. DEVIATIONS	0.0001	0.0000	0.0000	0.0001	0.0001	0.0001
	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
PERCOLATION/LEAKAGE THROUGH LAYER 8						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

PERCOLATION/LEAKAGE THROUGH LAYER 9

TOTALS	0.0010	0.0009	0.0010	0.0009	0.0010	0.0009
	0.0010	0.0010	0.0009	0.0010	0.0009	0.0010
STD. DEVIATIONS	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (CM)

DAILY AVERAGE HEAD ON TOP OF LAYER 4

AVERAGES	4.3465	1.5835	0.6474	1.6209	9.8179	11.7485
	6.4899	4.6261	5.3346	6.9085	7.3191	8.9897
STD. DEVIATIONS	2.3435	0.7632	0.2549	1.5558	3.6739	2.6165
	2.2192	1.8598	2.7954	3.2333	3.6232	4.1162

DAILY AVERAGE HEAD ON TOP OF LAYER 7

AVERAGES	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 20

	MM		CU. METERS	PERCENT
PRECIPITATION	982.01	(109.847)	9820.1	100.00
RUNOFF	202.158	(45.3911)	2021.58	20.586
EVAPOTRANSPIRATION	456.130	(45.4448)	4561.30	46.449
LATERAL DRAINAGE COLLECTED FROM LAYER 3	323.99683	(69.76321)	3239.968	32.99323
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.00244	(0.00052)	0.024	0.00025
AVERAGE HEAD ON TOP OF LAYER 4	57.861	(12.339)		
LATERAL DRAINAGE COLLECTED FROM LAYER 6	0.00243	(0.00052)	0.024	0.00025

PERCOLATION/LEAKAGE THROUGH LAYER 8	0.00001	(0.00000)	0.000	0.00000
AVERAGE HEAD ON TOP OF LAYER 7	0.000	(0.000)		
PERCOLATION/LEAKAGE THROUGH LAYER 9	0.01145	(0.00117)	0.115	0.00117
CHANGE IN WATER STORAGE	-0.289	(2.2445)	-2.89	-0.029

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 20

	(MM)	(CU. METERS)
PRECIPITATION	61.10	611.000
RUNOFF	85.475	854.7507
DRAINAGE COLLECTED FROM LAYER 3	3.67448	36.74483
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.000026	0.00026
AVERAGE HEAD ON TOP OF LAYER 4	224.837	
MAXIMUM HEAD ON TOP OF LAYER 4	273.182	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	10.9 METERS	
DRAINAGE COLLECTED FROM LAYER 6	0.00003	0.00027
PERCOLATION/LEAKAGE THROUGH LAYER 8	0.000000	0.00000
AVERAGE HEAD ON TOP OF LAYER 7	0.000	
MAXIMUM HEAD ON TOP OF LAYER 7	0.296	
LOCATION OF MAXIMUM HEAD IN LAYER 6 (DISTANCE FROM DRAIN)	0.0 METERS	
PERCOLATION/LEAKAGE THROUGH LAYER 9	0.000037	0.00037
SNOW WATER	402.45	4024.4553

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.4170
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0180

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering

Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 20

LAYER	(CM)	(VOL/VOL)
1	2.9882	0.1494
2	87.5999	0.2920
3	8.7054	0.1451
4	0.0000	0.0000
5	0.0135	0.0450
6	0.0050	0.0100
7	0.0000	0.0000
8	0.3750	0.7500
9	0.6507	0.0434
SNOW WATER	7.866	

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