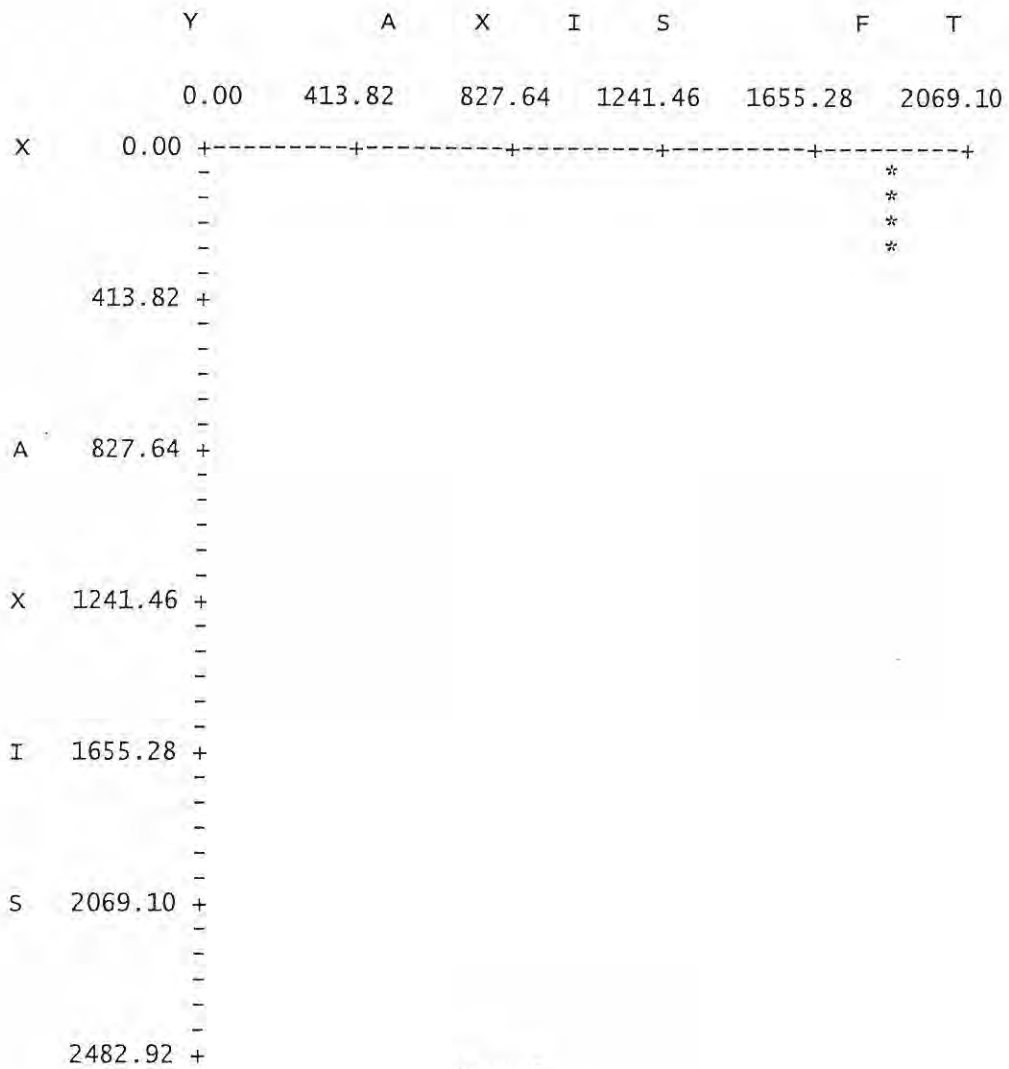
Interim Waste (Block).txt

Point No.	X-Surf (ft)	Y-Surf (ft)
1	117.64	1861.18
2	120.24	1860.57
3	125.18	1859.81
4	174.94	1860.27
5	176.22	1865.11
6	179.53	1868.85
7	183.07	1872.39
8	185.66	1876.67
9	186.62	1881.00

*** 3.330 ***

1



```
                -
                -
                -
                -
                -
F    2896.74    +
                -
                -
                -
                -
                -
T    3310.56    +
```

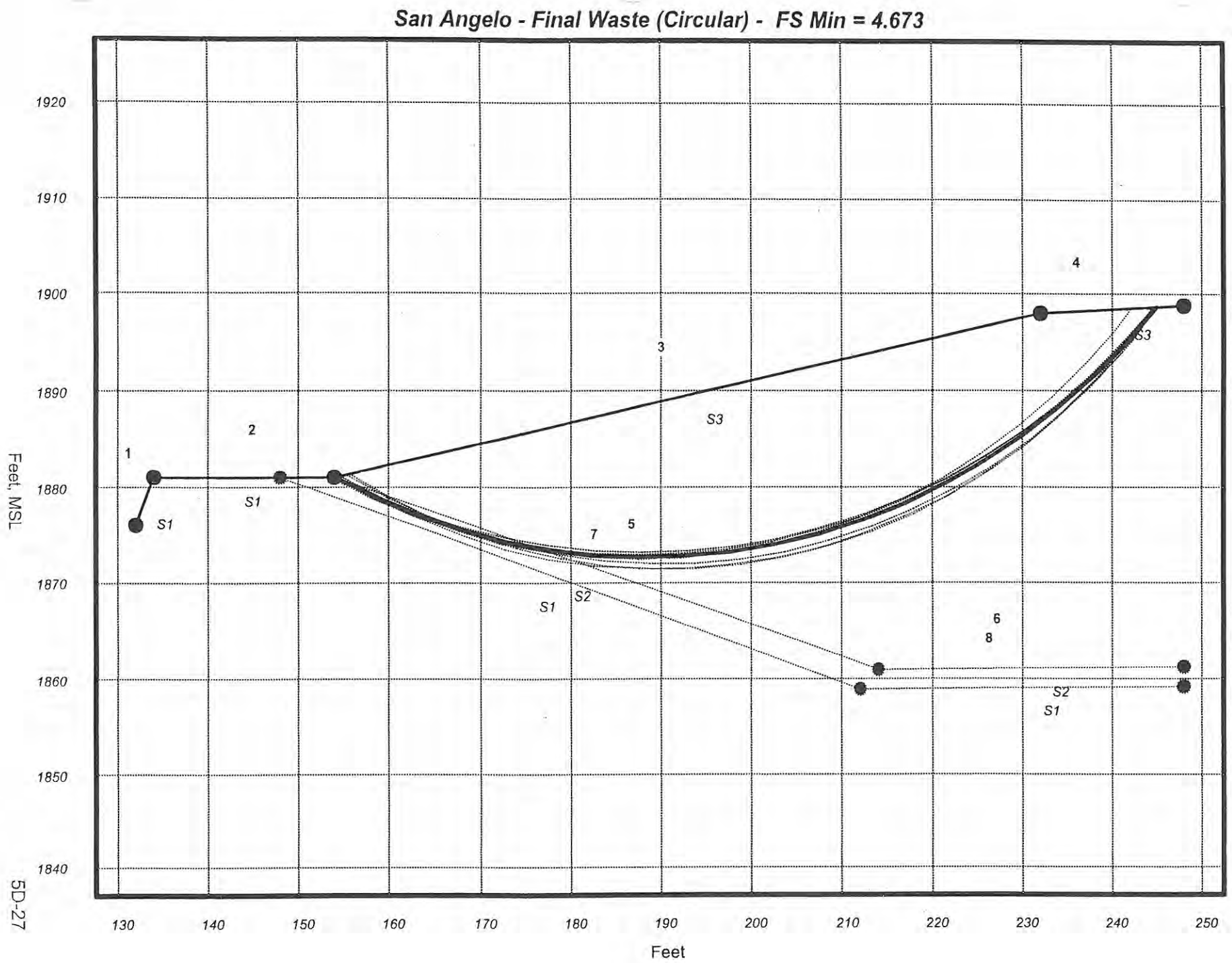
FINAL WASTE SLOPE STABILITY – CIRCULAR ANALYSIS PCSTABL6 INPUT PARAMETERS

BOUNDARY COORDINATES

The geometry was developed from the typical landfill section with the left most x-coordinate assigned a value of 132.

ISOTROPIC SOIL PARAMETERS

The site soil material was designated as Soil Type 1, the liner system was designated as Soil Type 2 and the solid waste was designated as Soil Type 3. The unit weight and effective strength paramters for the materials are provided on page 5D-3.


San Angelo - Final Waste (Circular) - FS Min = 4.673
1920
1910
1900
1890
1880
1870
1860
1850
1840
Feet, MSL
130
140
150
160
170
180
190
200
210
220
230
240
250
Feet
1
2
3
4
5
6
7
8
S1
S2
S3
5D-27

Final Waste (Circular).txt
** PCSTABL6 **

by
Purdue University

1

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer's Method of Slices

Run Date:	10/4/2008
Time of Run:	9:45
Run By:	JAV
Input Data Filename:	run.in
Output Filename:	result.out
Unit:	ENGLISH
Plotted Output Filename:	result.plt

PROBLEM DESCRIPTION San Angelo - Final Waste (Circular)

BOUNDARY COORDINATES

4 Top Boundaries
8 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	132.00	1876.00	134.00	1881.00	1
2	134.00	1881.00	154.00	1881.00	1
3	154.00	1881.00	232.00	1898.00	3
4	232.00	1898.00	248.00	1898.80	3
5	154.00	1881.00	214.00	1861.00	2
6	214.00	1861.00	248.00	1861.20	2
7	148.00	1881.00	212.00	1859.00	1
8	212.00	1859.00	248.00	1859.20	1

1

ISOTROPIC SOIL PARAMETERS

3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	128.9	140.0	250.0	24.0	0.00	0.0	0
2	123.0	130.0	27.0	21.0	0.00	0.0	0
3	50.0	50.0	250.0	23.0	0.00	0.0	0

1

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

400 Trial Surfaces Have Been Generated.

20 Surfaces Initiate From Each Of 20 Points Equally Spaced Along The Ground Surface Between X = 152.00 ft.
and X = 157.00 ft.

Each Surface Terminates Between X = 240.00 ft.
and X = 245.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = 0.00 ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

1

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	154.11	1881.02
2	158.61	1878.85
3	163.25	1876.99
4	168.01	1875.45
5	172.86	1874.23
6	177.78	1873.34
7	182.75	1872.79
8	187.74	1872.57
9	192.74	1872.68
10	197.72	1873.14
11	202.66	1873.93
12	207.53	1875.05
13	212.32	1876.50
14	216.99	1878.26
15	221.54	1880.34
16	225.94	1882.72
17	230.17	1885.39
18	234.20	1888.34
19	238.03	1891.56
20	241.64	1895.02
21	244.93	1898.65

Circle Center At X = 188.5 ; Y = 1946.7 and Radius, 74.1

*** 4.673 ***

Individual data on the 23 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Force Norm (lbs)	Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	0.4	2.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	4.1	443.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	4.6	1323.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	4.8	2052.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	4.8	2603.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	3.2	1879.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	1.8	1093.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	5.0	3393.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	5.0	3779.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	5.0	4067.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	5.0	4250.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	4.9	4328.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	4.9	4299.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	4.8	4167.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	4.7	3938.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	4.5	3620.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	4.4	3225.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	4.2	2765.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	1.8	1076.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	2.2	1158.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	3.8	1581.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	3.6	919.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	3.3	284.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	153.84	1881.00
2	158.31	1878.75
3	162.93	1876.83
4	167.67	1875.24
5	172.51	1874.00
6	177.43	1873.10
7	182.40	1872.56
8	187.39	1872.37
9	192.39	1872.54
10	197.36	1873.06
11	202.29	1873.94
12	207.13	1875.17
13	211.88	1876.74
14	216.50	1878.64
15	220.98	1880.87
16	225.29	1883.41
17	229.40	1886.25
18	233.30	1889.38

19	236.97	1892.78
20	240.38	1896.43
21	242.06	1898.50

Circle Center At X = 187.5 ; Y = 1942.4 and Radius, 70.1

*** 4.691 ***

1

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	154.11	1881.02
2	158.65	1878.95
3	163.33	1877.17
4	168.11	1875.71
5	172.98	1874.56
6	177.91	1873.74
7	182.88	1873.24
8	187.88	1873.07
9	192.88	1873.23
10	197.85	1873.71
11	202.79	1874.52
12	207.66	1875.66
13	212.44	1877.11
14	217.12	1878.87
15	221.68	1880.93
16	226.09	1883.29
17	230.33	1885.93
18	234.39	1888.85
19	238.25	1892.03
20	241.90	1895.45
21	244.88	1898.64

Circle Center At X = 188.0 ; Y = 1949.2 and Radius, 76.1

*** 4.692 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	154.63	1881.14
2	159.12	1878.93
3	163.75	1877.04
4	168.49	1875.47
5	173.34	1874.23
6	178.26	1873.32
7	183.22	1872.76
8	188.22	1872.54

9	193.22	1872.66
10	198.20	1873.12
11	203.13	1873.93
12	208.00	1875.07
13	212.77	1876.55
14	217.44	1878.35
15	221.97	1880.46
16	226.34	1882.89
17	230.54	1885.60
18	234.54	1888.60
19	238.33	1891.87
20	241.88	1895.39
21	244.74	1898.64

Circle Center At X = 188.9 ; Y = 1945.3 and Radius, 72.7

*** 4.699 ***

1

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	153.58	1881.00
2	158.07	1878.81
3	162.70	1876.92
4	167.45	1875.36
5	172.30	1874.12
6	177.21	1873.21
7	182.18	1872.63
8	187.17	1872.40
9	192.17	1872.50
10	197.15	1872.94
11	202.09	1873.72
12	206.97	1874.83
13	211.76	1876.27
14	216.44	1878.03
15	220.99	1880.10
16	225.39	1882.48
17	229.61	1885.15
18	233.65	1888.10
19	237.48	1891.32
20	241.08	1894.78
21	244.44	1898.49
22	244.55	1898.63

Circle Center At X = 188.2 ; Y = 1946.1 and Radius, 73.7

*** 4.699 ***

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	153.58	1881.00
2	158.09	1878.85
3	162.74	1877.01
4	167.50	1875.48
5	172.35	1874.27
6	177.27	1873.39
7	182.24	1872.84
8	187.24	1872.62
9	192.24	1872.74
10	197.22	1873.19
11	202.16	1873.97
12	207.03	1875.08
13	211.82	1876.52
14	216.50	1878.27
15	221.06	1880.33
16	225.47	1882.69
17	229.71	1885.34
18	233.76	1888.26
19	237.61	1891.45
20	241.24	1894.89
21	244.63	1898.57
22	244.68	1898.63

Circle Center At X = 188.0 ; Y = 1947.4 and Radius, 74.8

*** 4.701 ***

1

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	153.58	1881.00
2	158.11	1878.88
3	162.77	1877.07
4	167.54	1875.58
5	172.40	1874.40
6	177.33	1873.54
7	182.30	1873.02
8	187.29	1872.82
9	192.29	1872.96
10	197.27	1873.43
11	202.21	1874.23
12	207.08	1875.35
13	211.87	1876.79
14	216.55	1878.55
15	221.10	1880.61
16	225.51	1882.97
17	229.75	1885.62
18	233.81	1888.54
19	237.66	1891.73
20	241.30	1895.16
21	244.51	1898.63

Circle Center At X = 187.7 ; Y = 1948.2 and Radius, 75.4

*** 4.706 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	155.42	1881.31
2	159.83	1878.95
3	164.39	1876.91
4	169.09	1875.20
5	173.91	1873.84
6	178.80	1872.83
7	183.76	1872.18
8	188.75	1871.89
9	193.75	1871.96
10	198.73	1872.39
11	203.67	1873.17
12	208.54	1874.32
13	213.31	1875.81
14	217.96	1877.64
15	222.47	1879.80
16	226.81	1882.28
17	230.96	1885.07
18	234.90	1888.15
19	238.60	1891.51
20	242.05	1895.13
21	244.96	1898.65

Circle Center At X = 190.3 ; Y = 1941.1 and Radius, 69.2

*** 4.707 ***

1

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	154.37	1881.08
2	158.75	1878.68
3	163.30	1876.60
4	167.99	1874.85
5	172.79	1873.45
6	177.67	1872.39
7	182.62	1871.70
8	187.61	1871.35
9	192.61	1871.38
10	197.60	1871.76
11	202.54	1872.49
12	207.42	1873.59

13	212.21	1875.03
14	216.88	1876.82
15	221.41	1878.93
16	225.78	1881.37
17	229.95	1884.11
18	233.92	1887.15
19	237.66	1890.47
20	241.16	1894.05
21	244.38	1897.87
22	244.94	1898.65

Circle Center At X = 189.8 ; Y = 1940.6 and Radius, 69.2

*** 4.708 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	155.68	1881.37
2	160.03	1878.89
3	164.55	1876.75
4	169.21	1874.95
5	174.00	1873.51
6	178.88	1872.43
7	183.83	1871.72
8	188.82	1871.38
9	193.82	1871.42
10	198.80	1871.84
11	203.74	1872.63
12	208.60	1873.78
13	213.37	1875.30
14	218.00	1877.17
15	222.48	1879.39
16	226.79	1881.94
17	230.89	1884.80
18	234.76	1887.96
19	238.39	1891.40
20	241.74	1895.11
21	244.47	1898.62

Circle Center At X = 190.8 ; Y = 1937.9 and Radius, 66.5

*** 4.714 ***

1

Y A X I S F T

0.00 417.74 835.47 1253.21 1670.95 2088.68

X 0.00 +---------+---------+---------+---------+---------+

```
                                                                    *
                                                                    *
                                                                    *
          417.74 +
                 |
                 |
                 |
                 |
                 |
A         835.47 +
                 |
                 |
                 |
                 |
                 |
X        1253.21 +
                 |
                 |
                 |
                 |
I        1670.95 +
                 |
                 |
                 |
                 |
S        2088.68 +
                 |
                 |
                 |
                 |
          2506.42 +
                 |
                 |
                 |
                 |
F        2924.15 +
                 |
                 |
                 |
                 |
T        3341.89 +
```

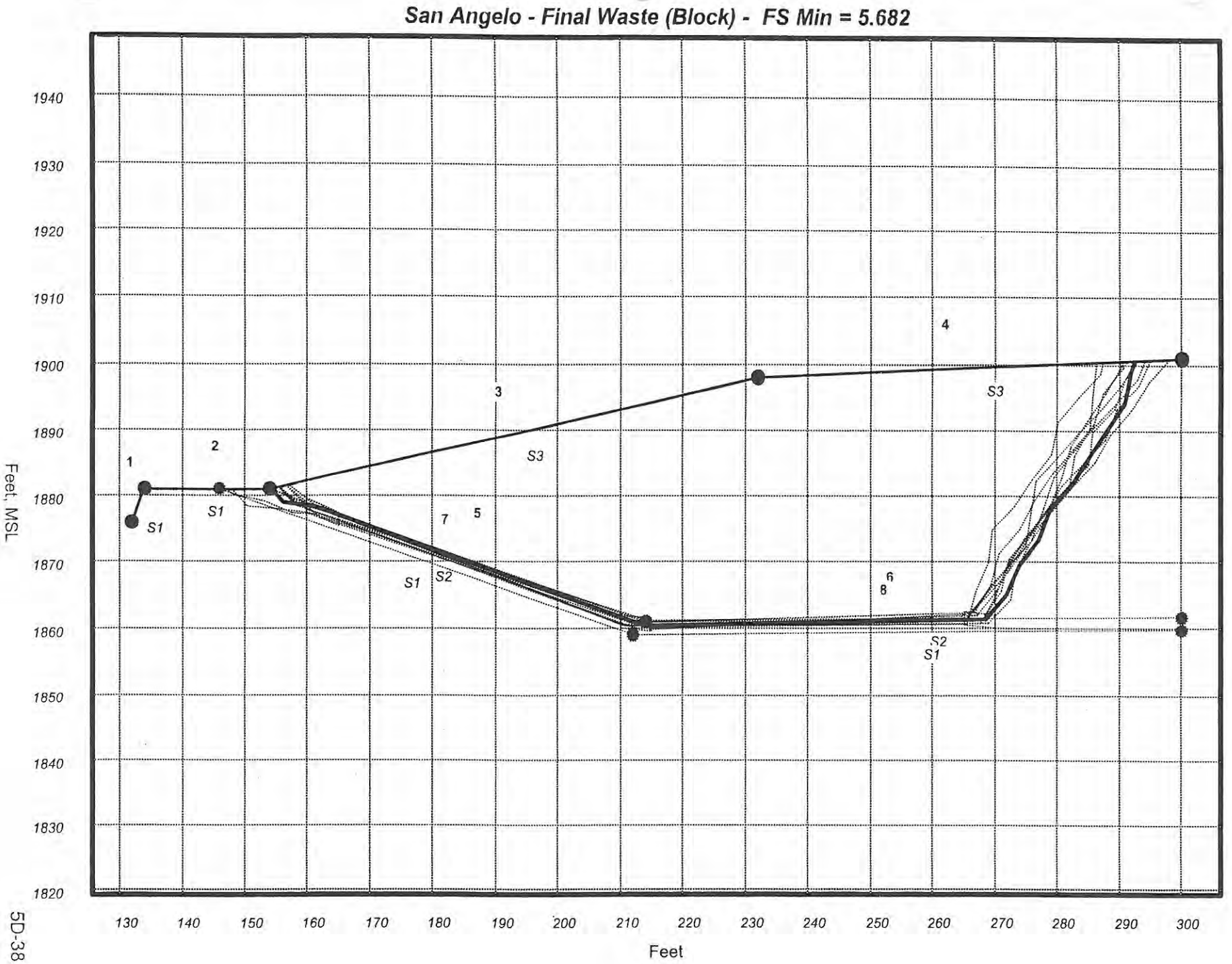
FINAL WASTE SLOPE STABILITY – BLOCK ANALYSIS
PCSTABL6 INPUT PARAMETERS

BOUNDARY COORDINATES

The geometry was developed from the typical landfill section with the left most x-coordinate assigned a value of 132.

ISOTROPIC SOIL PARAMETERS

The site soil material was designated as Soil Type 1, the liner system was designated as Soil Type 2 and the solid waste was designated as Soil Type 3. The unit weight and effective strength paramters for the materials are provided on page 5D-3.


San Angelo - Final Waste (Block) - FS Min = 5.682
1940
1930
1920
1910
1900
1890
1880
1870
1860
1850
1840
1830
1820
Feet, MSL
130
140
150
160
170
180
190
200
210
220
230
240
250
260
270
280
290
300
Feet
1
2
3
4
5
6
7
8
S1
S2
S3

Final Waste (Block).txt
** PCSTABL6 **

by
Purdue University

1

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer's Method of Slices

Run Date:	10/4/2008
Time of Run:	9:55
Run By:	JAV
Input Data Filename:	run.in
Output Filename:	result.out
Unit:	ENGLISH
Plotted Output Filename:	result.plt

PROBLEM DESCRIPTION San Angelo - Final Waste (Block)

BOUNDARY COORDINATES

4 Top Boundaries
8 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	132.00	1876.00	134.00	1881.00	1
2	134.00	1881.00	154.00	1881.00	1
3	154.00	1881.00	232.00	1898.00	3
4	232.00	1898.00	300.00	1900.90	3
5	154.00	1881.00	214.00	1861.00	2
6	214.00	1861.00	300.00	1861.70	2
7	146.00	1881.00	212.00	1859.00	1
8	212.00	1859.00	300.00	1859.70	1

1

ISOTROPIC SOIL PARAMETERS

3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	128.9	140.0	250.0	24.0	0.00	0.0	0
2	123.0	130.0	27.0	21.0	0.00	0.0	0
3	50.0	50.0	250.0	23.0	0.00	0.0	0

1

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Sliding Block Surfaces, Has Been Specified.

20 Trial Surfaces Have Been Generated.

3 Boxes Specified For Generation Of Central Block Base

Length Of Line Segments For Active And Passive Portions Of Sliding Block Is 5.0

Box No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Height (ft)
1	160.00	1878.50	165.00	1876.50	2.00
2	210.00	1861.00	215.00	1860.50	2.00
3	265.00	1861.50	270.00	1861.00	2.00

1

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Janbu Method * *

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	154.02	1881.00
2	156.24	1878.97
3	161.21	1878.44
4	213.89	1860.28
5	268.57	1861.26
6	271.88	1865.01
7	273.93	1869.57
8	277.14	1873.41
9	278.99	1878.05
10	282.48	1881.63
11	285.17	1885.85
12	287.96	1889.99
13	290.79	1894.12
14	291.89	1898.99
15	292.43	1900.58

*** 5.682 ***

Individual data on the 18 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Force Norm (lbs)	Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	2.2	242.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	5.0	1086.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	52.7	51676.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.1	186.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	18.0	32866.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	36.6	70175.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.2	311.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	3.1	5732.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	2.0	3322.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	3.2	4549.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	1.9	2244.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	3.5	3531.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	2.7	2212.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	2.8	1734.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	2.8	1185.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	1.1	219.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	0.5	21.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	155.59	1881.35
2	158.09	1878.87
3	162.94	1877.64
4	210.04	1860.56
5	265.79	1861.58
6	268.71	1865.64
7	272.17	1869.25
8	274.85	1873.47
9	278.01	1877.35
10	280.86	1881.46
11	284.31	1885.08
12	287.84	1888.62
13	289.67	1893.27
14	293.16	1896.85
15	295.00	1900.69

*** 5.759 ***

1

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	147.87	1881.00
2	150.46	1878.42
3	155.46	1878.10
4	160.40	1877.38

5	214.92	1860.14
6	267.13	1861.99
7	270.38	1865.79
8	272.97	1870.08
9	275.90	1874.13
10	279.23	1877.85
11	282.72	1881.43
12	286.10	1885.11
13	288.68	1889.40
14	291.92	1893.21
15	294.69	1897.37
16	298.05	1900.82

*** 5.929 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	153.98	1881.00
2	155.92	1880.29
3	160.29	1877.87
4	210.86	1860.46
5	267.72	1860.71
6	270.20	1865.05
7	272.13	1869.67
8	275.13	1873.66
9	278.15	1877.65
10	281.64	1881.23
11	285.15	1884.79
12	285.71	1889.76
13	289.16	1893.37
14	291.12	1897.97
15	292.53	1900.58

*** 6.328 ***

1

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	157.07	1881.67
2	157.20	1881.54
3	161.20	1878.55
4	210.83	1860.33
5	265.15	1861.13
6	268.69	1864.67
7	272.01	1868.40
8	274.92	1872.47
9	275.74	1877.40

10	276.56	1882.34
11	280.10	1885.87
12	283.44	1889.59
13	286.95	1893.15
14	290.32	1896.85
15	293.15	1900.61

*** 6.364 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	155.34	1881.29
2	158.04	1878.68
3	162.79	1877.10
4	214.98	1860.98
5	266.72	1862.24
6	269.37	1866.48
7	270.62	1871.32
8	274.02	1874.99
9	276.36	1879.40
10	279.25	1883.48
11	282.59	1887.20
12	285.84	1891.01
13	287.46	1895.74
14	290.66	1899.58
15	291.19	1900.52

*** 6.580 ***

1

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	147.17	1881.00
2	148.10	1880.10
3	153.00	1879.13
4	157.71	1877.46
5	162.69	1876.97
6	212.48	1859.91
7	269.00	1860.71
8	272.53	1864.25
9	273.55	1869.15
10	275.99	1873.51
11	277.91	1878.13
12	279.54	1882.86
13	282.70	1886.73
14	285.83	1890.63
15	289.35	1894.18

16	292.85	1897.75
17	294.19	1900.65

*** 6.646 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	155.49	1881.32
2	157.77	1879.44
3	162.62	1878.22
4	211.03	1861.13
5	268.22	1861.50
6	271.06	1865.62
7	272.22	1870.48
8	275.63	1874.15
9	278.77	1878.03
10	280.69	1882.65
11	282.17	1887.43
12	284.89	1891.62
13	287.73	1895.74
14	290.46	1899.92
15	290.62	1900.50

*** 6.786 ***

1

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	156.67	1881.58
2	158.30	1880.02
3	162.04	1876.69
4	214.72	1859.69
5	265.89	1862.18
6	269.29	1865.85
7	272.45	1869.72
8	275.99	1873.26
9	278.63	1877.50
10	281.97	1881.23
11	282.76	1886.16
12	285.24	1890.50
13	285.61	1895.49
14	286.31	1900.32

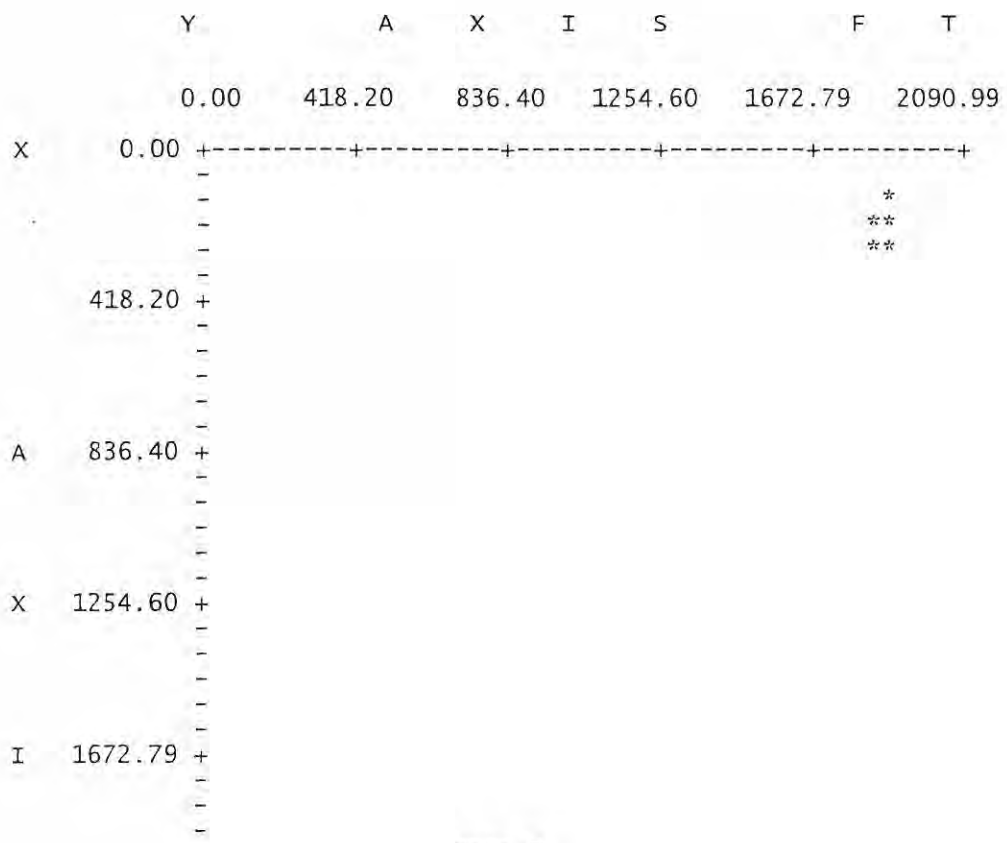
*** 6.994 ***

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	156.65	1881.58
2	160.01	1878.80
3	210.61	1860.43
4	265.58	1860.59
5	266.85	1865.42
6	268.98	1869.94
7	269.61	1874.90
8	273.14	1878.45
9	276.11	1882.47
10	279.18	1886.42
11	280.18	1891.32
12	283.51	1895.05
13	287.04	1898.60
14	287.31	1900.36

*** 7.060 ***

1



```
                -
                -
S    2090.99    +
                -
                -
                -
                -
                -
    2509.19     +
                -
                -
                -
                -
                -
F    2927.39    +
                -
                -
                -
                -
                -
T    3345.59    +
```

REFERENCE TABLES

Table 8-3.1 Typical Engineering Properties of Compacted Materials[a]

Group Symbol	Soil Type	Range of Maximum Dry Unit Weight, gm/cm^3 (pcf)	Range of Optimum Water, Content Percent	Typical Value of Compression (Percent of Original Height)		Typical Strength Characteristics			Typical Coefficient of Permeability cm/sec (ft/min)	Range of CBR Values	Range of Subgrade Modulus k kPa/mm (lb/cu in)
				At 138 kPa (20 psi)	At 345 kPa (50 psi)	Cohesion (as compacted) kPa (psf)	Cohesion (saturated) kPa (psf)	Effective Stress Envelope deg			
CL	Inorganic clays of low to medium plasticity	1.52-1.92 (95-120)	34-12	1.3	2.5	86 (1800)	13 (270)	28	5×10^{-8} (10^{-7})	15 or <	14-54 (50-200)
OL	Organic silts and silt-clays of low plasticity	1.28-1.60 (80-100)	33-21	----	----	----	----	----	----	5 or <	14-27 (50-100)
MH	Inorganic clayey silts, elastic silts	1.20-1.52 (75-95)	40-24	2.0	3.8	72 (1500)	20 (420)	25	2.5×10^{-7} (5×10^{-7})	10 or <	14-27 (50-100)
CH	Inorganic clays of high plasticity	1.28-1.68 (80-105)	36-19	2.6	3.9	103 (2150)	11 (230)	19	5×10^{-8} (10^{-7})	15 or <	14-34 (50-150)
OH	Organic and silty clays	1.20-1.60 (75-100)	45-21	----	----	----	----	----	----	5 or <	7-27 (25-100)

Notes: 1. All properties are for condition of Standard Proctor maximum density except values of k and CBR, which are for CE55 maximum density.
2. Typical strength characteristics are for effective strength envelopes and are obtained from USBR data.
3. Compression values are for vertical loading with complete lateral reinforcement.
4. (>) Indicates that typical property is greater than the value shown. (.....) Indicates insufficient data available for an estimate.

TRI/ENVIRONMENTAL, INC.
A Texas Research International Company

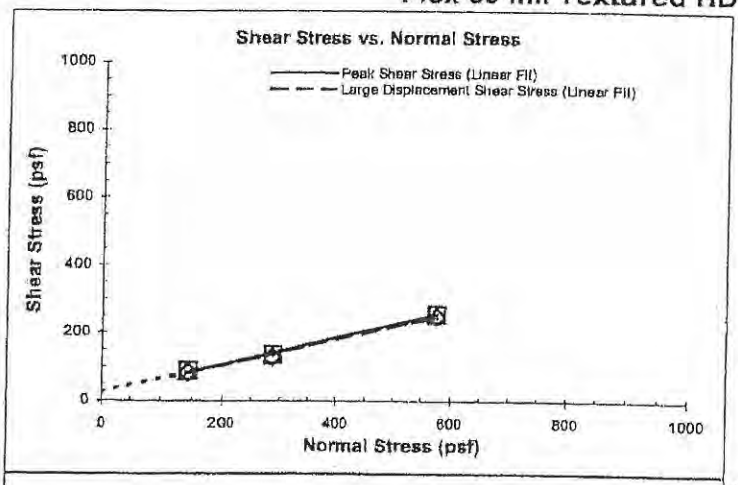
Interface Friction Test Report

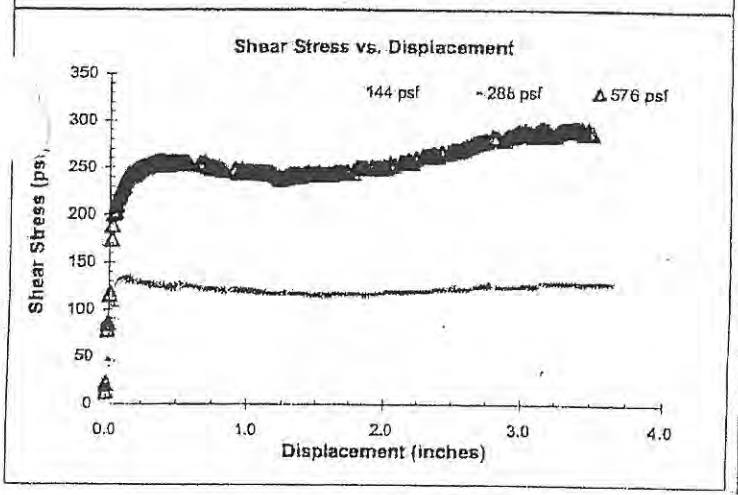
Client: **Landtec Engineers**
Project: **San Angelo Landfill, Sector 9C**
Test Date: 03/07/06-03/08/06

TRI Log#: E2243-17-09
Test Method: ASTM D 6243

John M. Allen, E.I.T., 03/10/2006
Quality Review/Date

Tested Interface: Soil vs Bentomat ST GCL #1132 (non-woven against geomembrane) vs Ploy Flex 60 mil Textured HDPE Geomembrane





Test Results		
	Peak	Large Displacement (@ 3.4 in.)
Friction Angle (degrees):	21.4	21.0
Y-intercept or Adhesion (psf):	27	23

Test Conditions

Upper Box: Soil remolded to 96 pcf at 20% moisture content
Floating: Bentomat ST GCL (non-woven down)
Lower Box: Ploy Flex 60 mil textured HDPE Geomembrane

Box Dimensions: 12"x12"x4"

Interface Conditioning: Interface soaked and loading applied for a minimum of 24 hour prior to shear.

Test Condition: Wet

Shearing Rate: 0.04 inches/minute

Test Data

Specimen No.	1	2	3
Bearing Slide Resistance (lbs)	9	11	13
Normal Stress (psf)	144	288	576
Corrected Peak Shear Stress (psf)	88	134	255
Corrected Large Displacement Shear Stress (psf)	82	128	246
Peak Secant Angle (degrees)	31.3	25.0	23.9
Large Displacement Secant Angle (degrees)	29.7	24.0	23.1
Asperity (mils)	31.0	30	38.2

Soil Characterization			
USCS:	NA	Proctor Type:	NA
LL:	NA	Max. Dry Density (pcf):	NA
PL:	NA	Optimum Moisture Content:	NA

The testing herein is based upon accepted industry practice as well as the test method listed. Test results reported herein do not apply to samples other than those tested. TRI neither accepts responsibility for nor makes claim as to the final use and purpose of the material. TRI observes and maintains client confidentiality. TRI limits reproduction of this report, except in full, without prior approval of TRI.

9063 Bee Caves Road □ Austin, TX 78733-6201 □ (512) 263-2101 □ (512) 263-2558 □ 1-800-880-TEST

TABLE 6.2: COMPILATION OF THE AVAILABLE SHEAR STRENGTH DATA ON MSW
SOURCE: GEOSYNTEC (1993)

REFERENCE	TYPE OF DATA	RESULTS	COMMENTS
Oweis (1985)	Laboratory tests on baled waste	ϕ = 15° to 25° c = 1400 psf (67 kPa)	No data on waste types, density, or test methods is provided. Results correspond to a limiting strain of 15 to 20%.
Oweis (1985)	Field load test at landfill in southern California	ϕ = 10° and c = 1000 psf (48 kPa) to ϕ = 26° and c = 0	Values represent lower-bound strengths as the slope did not fail. Results are for relatively low normal stresses. Assumed unit weight of MSW is 45 pcf (7 kN/m³).
Oweis (1985) and Dvirnoff and Munion (1986)	Back calculation based on failure of a landfill foundation on marsh clays and silts	ϕ = 10° and c = 500 psf (24 kPa) to ϕ = 30° and c = 0	Values unreliable due to uncertainty in the back analysis and strain incompatibility between waste and foundation.
Pagotto and Rimoldi (1987)	Back calculation from the results of plate bearing tests	ϕ = 22° and c = 600 psf (29 kPa)	No data on waste types, test procedures, or test results are provided.
Earth Technology (1988)	Small-scale triaxial tests on wastes from LACSD Puente Hills landfill	ϕ = 24° and c = 2,600 psf (124 kPa) to ϕ = 35°	Strength with cohesive component associated with cover soil dominant waste; cohesionless strength for refuse dominated waste.
Landva and Clark (1990)	Laboratory direct shear tests on municipal solid waste	ϕ = 24° and c = 450 psf (22 kPa) to ϕ = 39° and c = 400 psf (19 kPa)	Normal stresses up to about 10,000 psf (480 kPa). Shear box size was approximately 11 in. (275 mm) by 17 in. (425 mm). Lower value corresponds to shredded waste, not used.
Singh and Murphy (1990)	Laboratory tests performed by others	ϕ = 0 and c = 700 psf (34 kPa) to ϕ = 42° and c = 0	Strength values bracket a range of results compiled from work of various researchers and consulting organizations.
Seigel et al. (1990)	Small-scale direct shear tests on wastes from OH	ϕ = 39° to ϕ = 53°	Confining pressures from 2,000 to 12,000 psf (100 to 570 kPa). Lower value of ϕ is based upon conservative interpretation.
Richardson and Reynolds (1991)	Large direct shear tests performed in situ	ϕ = 18° to 43°and c = 200 psf (10 kPa)	Normal stresses from 200 to 800 psf (10 to 40 kPa). Unit weight of waste and cover soil estimated to be 96 pcf (15 kN/m³).

ATTACHMENT 6

COST FOR CLOSURE

Attachment 6 – Cost for Closure of the currently approved Site Development Plan has been deleted and moved to Attachment 8 – Cost Estimates for Closure and Postclosure Care. The revised Attachment 8 describes in detail the items and costs associated with the facility's closure during the active life of the landfill. The closure cost estimate can be found in Appendix 8A – Closure Cost Estimate Calculations.

Buddy Garcia, *Chairman*
Larry R. Soward, *Commissioner*
Bryan W. Shaw, Ph.D., *Commissioner*
Glenn Shankle, *Executive Director*

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Protecting Texas by Reducing and Preventing Pollution

November 15, 2007

The Honorable J. W. Lown
Mayor of San Angelo
P. O. Box 1751
San Angelo, Texas 76902-1751

Re: Municipal Solid Waste (MSW) – Tom Green County
City of San Angelo - MSW Permit No. 79A
Permit Modification: Closure and Post Closure Care Plans and Cost Estimates
WWC Nos. 11700390, 11863226 and 11910681, CN602718405 / RN102143294

Dear Mayor Lown:

We have reviewed your application for a municipal solid waste permit modification dated May 10, 2006, received by the MSW Permits Section on May 26, 2006, and the revisions dated August 15 and October 3, 2007, requesting to update the facility Site Development Plan by revising the closure and post closure care plans and cost estimates. The information presented is technically sufficient for a municipal solid waste permit modification.

Enclosed is a copy of the above referenced modification which is now part of your permit and should be attached thereto. The documentation prepared and submitted to support the modification request shall be considered as requirements of the permit.

If you have questions concerning this matter, please contact Mr. Arthur Denny at (512) 239-6610. When addressing written correspondence, please use Mail Code 124 (MC 124).

This action is taken under authority delegated by the Executive Director of the Texas Commission on Environmental Quality.

Sincerely,

Richard C. Carmichael, Ph.D., P.E.
Manager, Municipal Solid Waste Permits Section
Waste Permits Division

RCC/ALD/ff

Enclosure

cc: ✓Mr. Kenneth Welch, P.E., Biggs & Mathews Environmental, Mansfield
Mr. Ron Lewis, P.E., Public Works Director, City of San Angelo
Mr. Jason Quiton, Trashaway Services, Inc., San Angelo

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

MODIFICATION TO

MUNICIPAL SOLID WASTE PERMIT NO. 79A

CITY OF SAN ANGELO LANDFILL

Municipal Solid Waste Permit No. 79A is hereby modified as follows:

Description of Change:

This permit modification authorizes revisions to the facility Site Development Plan to update the closure and post closure care plans and cost estimates. The details of this permit modification are contained in the application dated to May 10, 2007, received by the MSW Permits Section on May 26, 2006, and the revisions dated August 15 and October 3, 2007. The new closure cost estimate is $2,927,992.10 and the new post closure cost estimate is $2,514,765.00.

Part of Permit Modified:

Part IV, Site Development Plan,
Attachment 5, Final Closure Plan, complete replacement,
Attachment 6, Costs for Closure, complete replacement,
Attachment 7, Post Closure Care Plan, complete replacement, and a new
Attachment 8, Cost Estimates for Closure and Post Closure Care.

This modification is a part of Permit No. 79A and should be attached thereto.

APPROVED, ISSUED, AND EFFECTIVE in accordance with Title 30 Texas Administrative Code Chapter 305, Sections 305.70(j)(6) and 305.70(j)(30).

ISSUED DATE:

NOV 15 2007

For the Commission

SAN ANGELO LANDFILL
TOM GREEN COUNTY, TEXAS
TCEQ PERMIT APPLICATION NO. MSW 79

PERMIT MODIFICATION

PART III - SITE DEVELOPMENT PLAN
ATTACHMENT 7
POSTCLOSURE CARE PLAN

Prepared for

City of San Angelo

April 1994
Revised July 1994
Revised April 2007
Revised August 2007

Revised October 2007



Prepared by

BIGGS & MATHEWS ENVIRONMENTAL
1700 Robert Road • Mansfield, Texas 76063 • 817-563-1144

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1 INTRODUCTION
30 TAC §§330.63(i), 330.463

1.1 Facility Description

The San Angelo Landfill is an existing 275-acre, Type I Municipal Solid Waste Disposal Facility (TCEQ Permit No. MSW 79) owned by the City of San Angelo. The facility is currently operated by Trashaway Services, Inc., under contract to the City of San Angelo. The San Angelo Landfill is located approximately 3 miles northeast of the City of San Angelo on Old Ballinger Highway. The facility is outside the city limits of San Angelo, within unincorporated Tom Green County.

1.2 Regulations

This Postclosure Care Plan has been prepared consistent with 30 TAC §330.463. Requirements include the following:

- The owner shall maintain right of entry and conduct maintenance and remediation as needed to maintain the integrity of the final cover system, vegetation, and drainage control; correct any events detrimental to the integrity of the closed unit, and prevent surface run-on/run-off from damaging the final cover system.
- The owner shall maintain and operate the leachate collection system.
- The owner shall maintain and monitor the groundwater monitoring system.
- The owner shall maintain and operate the landfill gas monitoring system.

2 POSTCLOSURE CARE ACTIVITIES 30 TAC §§330.463(b), 330.465

2.1 Monitoring and Maintenance

In accordance with 30 TAC §330.463(b), postclosure care maintenance will commence immediately upon completion of final closure requirements set forth in the Attachment 5 – Final Closure Plan. After certification of the completion of closure requirements as accepted by the executive director, the City of San Angelo will conduct postclosure care for 30 years unless the TCEQ approves or requires a postclosure care period of a different duration. Postclosure care maintenance will consist, at a minimum, of the following requirements to be carried out by the City of San Angelo.

- Retain the right of entry and maintain all rights-of-way to the closed landfill.
- Conduct site inspections a minimum of semiannually.
- Conduct maintenance and/or remediation activities, as needed, to maintain the integrity and effectiveness of the final cover, site vegetation, and stormwater drainage appurtenances.
- Prevent surface run-on and runoff from eroding or otherwise damaging the final cover system.
- Correct the effects of settlement, subsidence, ponded water, erosion, or other events or failures inasmuch as these situations are detrimental to the integrity of the closed landfill.
- Maintain and operate the leachate collection system in accordance with §330.331 and 330.333. However, the City of San Angelo reserves the right to request TCEQ approval to stop managing leachate if it can be demonstrated that leachate no longer poses a threat to human health and the environment.
- Maintain the groundwater monitoring system and monitor groundwater. In accordance with 30 TAC §330.417(b), the monitoring frequency will be semiannual. Parameters to be monitored will be those constituents listed in 30 TAC §330.417. However, the City of San Angelo reserves the right to request TCEQ approval of 1) an alternative monitoring frequency and 2) an alternative list of parameters to be monitored. Such requests will be based on supporting data available at the time of the request.
- Maintain and operate the landfill gas monitoring system in accordance with 30 TAC §330.371. The minimum monitoring frequency will be quarterly; however, the City of San Angelo reserves the right to request TCEQ approval for an alternate

monitoring frequency. Such a request will be based on supporting data available at the time of the request.

2.2 Decreasing Postclosure Care Period

The length of the postclosure care maintenance period may be decreased by the TCEQ if the City of San Angelo submits a documented certification, signed by an independent registered professional engineer, including all applicable documentation necessary to support the certification that demonstrates a reduced period is sufficient to protect human health and the environment. Applicable documentation may include data from monitoring of groundwater, surface water, leachate levels, landfill gas, and the status of the ongoing corrective action program. The certified documentation must be reviewed and approved by the TCEQ prior to decreasing the length of the postclosure care maintenance period.

2.3 Increasing Postclosure Care Period

The length of the postclosure care maintenance period may be extended by the TCEQ if it is determined that an increased duration is necessary to protect human health and the environment. It is understood that the City of San Angelo will receive appropriate notification of any such proposed changes prior to the TCEQ's final determination.

2.4 Completion of Postclosure Care Period

Upon completion of the postclosure care maintenance period, the City of San Angelo will submit to the TCEQ documented certification, signed by an independent registered professional engineer, verifying that postclosure care maintenance has been completed in accordance with the approved Postclosure Care Plan. The submittal will include all documentation necessary for certification of completion of postclosure care maintenance. The certification will be placed in the site operating record upon approval. In addition, the City of San Angelo will submit to the executive director a request for voluntary revocation of the facility permit.

3 PERSON RESPONSIBLE FOR CONDUCTING POSTCLOSURE CARE ACTIVITIES 30 TAC §330.463(b)(3)(B)

At the time of the development of this document, the following person is responsible for the overall management of this landfill:

Director of Operations
City of San Angelo
P.O. Box 1751
San Angelo, Texas 76902
(325) 657-4206

The person responsible for conducting postclosure activities is subject to change. However, as part of the closure notification to the TCEQ, as required by 30 TAC §330.457(f)(2), the City of San Angelo will notify the TCEQ regarding the responsible person.

4 POST CLOSURE LAND USE 30 TAC §§330.951-964

4.1 Intended Use

There are no current planned uses for the San Angelo Landfill after closure. Should use of the closed landfill not associated with solid waste activities be considered, plans will be prepared and submitted to the TCEQ for review and approval.

4.2 Constraints on Postclosure Construction

There are no plans to construct buildings or other structures on the closed San Angelo Landfill. Nevertheless, any future construction activities on the closed landfill will be subject to the provisions of 30 TAC §§330.951-964, which require, among other things, prior approval of the TCEQ.

5 POSTCLOSURE CARE COST ESTIMATE 30 TAC §§330.463(b)(3)(D)

The estimated cost of hiring a third party to conduct postclosure care activities in accordance with the postclosure care plan will depend upon the stage of development of the landfill. The detailed cost estimate is provided in Attachment 8 – Cost Estimates for Closure and Postclosure Care.

Buddy Garcia, *Chairman*
Larry R. Soward, *Commissioner*
Bryan W. Shaw, Ph.D., *Commissioner*
Glenn Shankle, *Executive Director*

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Protecting Texas by Reducing and Preventing Pollution

November 15, 2007

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Mayor of San Angelo
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WWC Nos. 11700390, 11863226 and 11910681, CN602718405 / RN102143294

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Enclosed is a copy of the above referenced modification which is now part of your permit and should be attached thereto. The documentation prepared and submitted to support the modification request shall be considered as requirements of the permit.

If you have questions concerning this matter, please contact Mr. Arthur Denny at (512) 239-6610. When addressing written correspondence, please use Mail Code 124 (MC 124).

This action is taken under authority delegated by the Executive Director of the Texas Commission on Environmental Quality.

Sincerely,

Richard C. Carmichael, Ph.D., P.E.
Manager, Municipal Solid Waste Permits Section
Waste Permits Division

RCC/ALD/ff

Enclosure

cc: ✓Mr. Kenneth Welch, P.E., Biggs & Mathews Environmental, Mansfield
Mr. Ron Lewis, P.E., Public Works Director, City of San Angelo
Mr. Jason Quiton, Trashaway Services, Inc., San Angelo

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

MODIFICATION TO

MUNICIPAL SOLID WASTE PERMIT NO. 79A

CITY OF SAN ANGELO LANDFILL

Municipal Solid Waste Permit No. 79A is hereby modified as follows:

Description of Change:

This permit modification authorizes revisions to the facility Site Development Plan to update the closure and post closure care plans and cost estimates. The details of this permit modification are contained in the application dated to May 10, 2007, received by the MSW Permits Section on May 26, 2006, and the revisions dated August 15 and October 3, 2007. The new closure cost estimate is $2,927,992.10 and the new post closure cost estimate is $2,514,765.00.

Part of Permit Modified:

Part IV, Site Development Plan,
Attachment 5, Final Closure Plan, complete replacement,
Attachment 6, Costs for Closure, complete replacement,
Attachment 7, Post Closure Care Plan, complete replacement, and a new
Attachment 8, Cost Estimates for Closure and Post Closure Care.

This modification is a part of Permit No. 79A and should be attached thereto.

APPROVED, ISSUED, AND EFFECTIVE in accordance with Title 30 Texas Administrative Code Chapter 305, Sections 305.70(j)(6) and 305.70(j)(30).

ISSUED DATE:

NOV 15 2007

For the Commission

SAN ANGELO LANDFILL
TOM GREEN COUNTY, TEXAS
TCEQ PERMIT APPLICATION NO. MSW 79

PERMIT MODIFICATION

PART III - SITE DEVELOPMENT PLAN
ATTACHMENT 8
COST ESTIMATES FOR CLOSURE AND POSTCLOSURE CARE

Prepared for

City of San Angelo

April 2007
Revised August 2007

Revised October 2007



Prepared by

BIGGS & MATHEWS ENVIRONMENTAL
1700 Robert Road • Mansfield, Texas 76063 • 817-563-1144

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1 INTRODUCTION
30 TAC §330.63(j)

Cost estimates are required for any municipal solid waste landfill facility whose debts and liabilities are the debts and liabilities of a State or of the United States. In the event of forced closure, which occurs when a solid waste landfill facility can no longer operate because of an inability to manage the incurred debts and liabilities, operations will be assumed by the TCEQ. The cost estimates for closure care, postclosure care, and corrective action have been prepared for the San Angelo Landfill and are consistent with 30 TAC §330.503, 330.507, and 330.509.

2 CLOSURE COST ESTIMATE
30 TAC §330.503(a),(b)

The largest area requiring final cover is depicted on Figure 8.1. Final cover will be constructed over the areas that have not received final cover and general earthfill will be placed to provide positive surface water drainage.

Final closure activities are outlined in Attachment 5 – Final Closure Plan. The estimated closure costs for the largest area requiring final cover are presented on Table 8-1. Calculations and supporting data for cost estimates are included in Appendix 8A. The closure cost estimate includes the cost for evaluation, design, construction, contract administration, bonds, and legal fees. The cost will be adjusted annually as indicated in Section 4.

Financial assurance for closure care of the facility will be established by the City of San Angelo in the amount of the estimated closure cost presented on Table 8-1. Continuous financial assurance coverage for closure will be provided until the site is officially placed under the postclosure maintenance period and all requirements of the final closure plan have been approved by the executive director in writing.

3 POSTCLOSURE CARE COST ESTIMATE
30 TAC §330.507(a), (b)

The postclosure care period is 30 years for a Type I municipal solid waste facility. During this period, maintenance is required to assure the integrity and effectiveness of the final cover system, monitoring systems, erosion protection facilities, and the stormwater drainage appurtenances. The estimated postclosure care cost is presented on Table 8-2.

The postclosure care cost estimate is based on Attachment 7 – Postclosure Care Plan and provides costs for the routine operation, maintenance and monitoring of the final cover system, gas monitoring system, active landfill gas collection and control system, groundwater monitoring system, leachate collection system, and stormwater drainage appurtenances. This estimate for routine maintenance and monitoring predicts the cumulative cost throughout the 30-year postclosure care period. Calculations and supporting data for the postclosure care cost estimate are included in Appendix 8B. The costs will be adjusted annually as indicated in Section 4.

Financial assurance for postclosure care of the facility will be established by the City of San Angelo in the amount of the estimated postclosure care costs presented on Table 8-2. Continuous financial assurance coverage for postclosure will be provided until the site is officially released in writing by the executive director from the postclosure care period and all requirements of the postclosure care plan.

4 CORRECTIVE ACTION COST ESTIMATE 30 TAC §330.509(a), (b)

In accordance with the modified Corrective Action Plan approved by the TCEQ in March, 2006, a LFG collection system has been installed at the landfill. Additional groundwater monitoring wells were installed at new locations and in appropriately screened intervals at the previous locations. A groundwater monitoring well installation report was submitted to the TCEQ. Groundwater monitoring has continued in the existing wells and to establish background in the newly installed wells. After establishment of background in the new wells, they will become the point of compliance wells.

The submittal of the Hydrogeologic Evaluation report in November 2006 represents the final requirement of Phase I of the modified Corrective Action Plan, although the extraction well analysis portion of this analysis is ongoing. The approved Corrective Action Plan schedule calls for the Nature and Extent evaluation, Assessment of Corrective Measures and Selection of Remedy to be prepared in late 2007. Because the LFG collection system is likely to be the selected remedy and because the system has now been installed, it is likely that the effectiveness of the system may be partially known by that time.

A LFG collection and control system has been installed and operational as of October 12, 2006. As-built construction drawings have been submitted to the TCEQ Enforcement Division, the TCEQ Solid Waste Permitting Group, and the TCEQ Region 8 office in San Angelo in accordance with the agreed order of April 29, 2006.

Further groundwater sampling will provide a long term evaluation of the effectiveness of the LFG extraction system in reducing groundwater contaminants concentrations. Groundwater monitoring will be conducted in accordance with the approved groundwater monitoring schedule.

The Corrective Action Plan requires quarterly groundwater sampling of all groundwater monitoring wells and monthly landfill gas monitoring in all landfill gas perimeter probes. The estimated corrective action cost is presented on Table 8-3.

The corrective action cost estimate is based on the approved Corrective Action Plan and provides costs for the additional groundwater monitoring events and landfill gas monitoring events. This estimate for these monitoring events predicts the cumulative cost throughout the 30-year postclosure care period. Calculations and supporting data for the corrective action cost estimate are included in Appendix 8C. The costs will be adjusted annually as indicated in Section 4.

Financial assurance for the corrective action required at the facility will be established by the City of San Angelo in the amount of the estimated corrective action costs presented on Table 8-3. Continuous financial assurance coverage for corrective action will be provided until the site is officially released in writing by the executive director from all requirements of the corrective action program after completion of all work specified in the corrective action plan.

5 COST ESTIMATE ADJUSTMENTS
30 TAC §§330.503(a)(2-3) and 330.507(a)(2-3)

During the active life of the unit, the City of San Angelo will annually adjust the cost estimates for inflation within 60 days prior to the anniversary date of the establishment of the financial instrument(s). The adjustment may be made by recalculating the costs of closure in current dollars, or by using an inflation factor derived from the most recent *Implicit Price Deflator for Gross National Product* published by the United States Department of Commerce in its Survey of Current Business. The inflation factor is the result of dividing the latest published annual deflator by the deflator for the previous year. The first adjustment is made by multiplying the cost estimate by the inflation factor. The result is the adjusted cost estimate. Subsequent adjustments are made on an annual basis by multiplying the latest adjusted cost estimate by its respective inflation factor.

An increase in the closure care, postclosure care, or corrective action cost estimate and the amount of financial assurance will be made if changes to the closure care, postclosure care, or corrective action plans or the landfill conditions increase the maximum cost. A permit modification request will be submitted to revise Attachment 8 - Cost Estimates for Closure and Postclosure Care as additional waste disposal footprint is developed.

A reduction in the closure care, postclosure care, or corrective action cost estimate and the amount of financial assurance may be requested if the cost estimate exceeds the maximum costs at any time during the remaining life of the unit or postclosure care remaining over the postclosure care period. The City of San Angelo will submit written notice to the executive director of the detailed justification for the reduction of the cost estimates and the amount of financial assurance. A request for reduction in the cost estimate and financial assurance will be submitted as a permit modification.

TABLES

Table 8-1
Closure Cost Estimate

No.	ITEM		COST
1.0	**Engineering Costs**		
1.1	Topographic Survey	$	6,875.00
1.2	Boundary Survey	$	2,750.00
1.3	Site Evaluation	$	2,750.00
1.4	Development of Plans	$	18,625.00
1.5	Administration	$	10,000.00
1.6	Inspection and Testing	$	372,500.00
1.7	Groundwater Consultant	$	-
1.8	Permits	$	10,000.00
	Engineering Total	$	423,500.00
2.0	**Construction Costs**		
2.1	Final Cover System		
2.1.1	Intermediate Cover	$	89,400.00
2.1.2	Infiltration Layer	$	596,000.00
2.1.3	Flexible Membrane Cover	$	448,000.00
2.1.4	Drainage Layer	$	252,000.00
2.1.5	Erosion Layer	$	447,000.00
2.1.6	General Fill	$	37,500.00
2.2	Landfill Gas Management System	$	149,000.00
2.3	Vegetation	$	111,750.00
2.4	Site Grading and Drainage	$	149,000.00
2.5	Site Fencing and Security	$	-
2.6	Leachate Collection System	$	-
2.7	Monitor Wells	$	-
2.8	Gas Probes	$	-
	Construction Total	$	2,279,650.00
	Engineering and Construction Total	$	2,703,150.00
	Contingency	$	135,157.50
3.0	**Administrative Costs**		
3.1	Contract Performance Bond	$	40,547.25
3.2	TCEQ Contract Admin/Legal Fees	$	50,000.00
	Total	$	2,928,854.75



Table 8-2
Postclosure Care Cost Estimate

No.	ITEM	ANNUAL COST
1.0	Engineering Costs	$ 54,320.00
2.0	Construction / Maintenance Costs	$ 14,890.00
3.0	Leachate Disposal Costs	$ 40.00
4.0	Landfill Gas Management Costs	$ 7,445.00
	Subtotal	$ 76,695.00
5.0	Administration	$ 7,669.50
	Annual Postclosure Costs	**$ 84,364.50**
	Total Postclosure Costs	**$ 2,530,935.00**

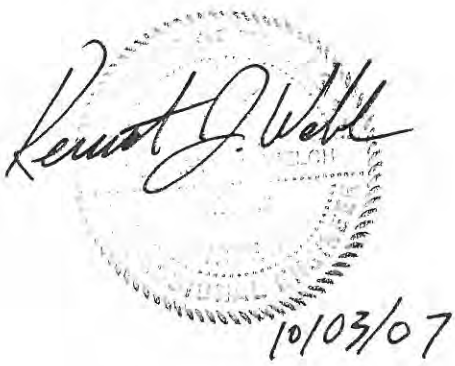


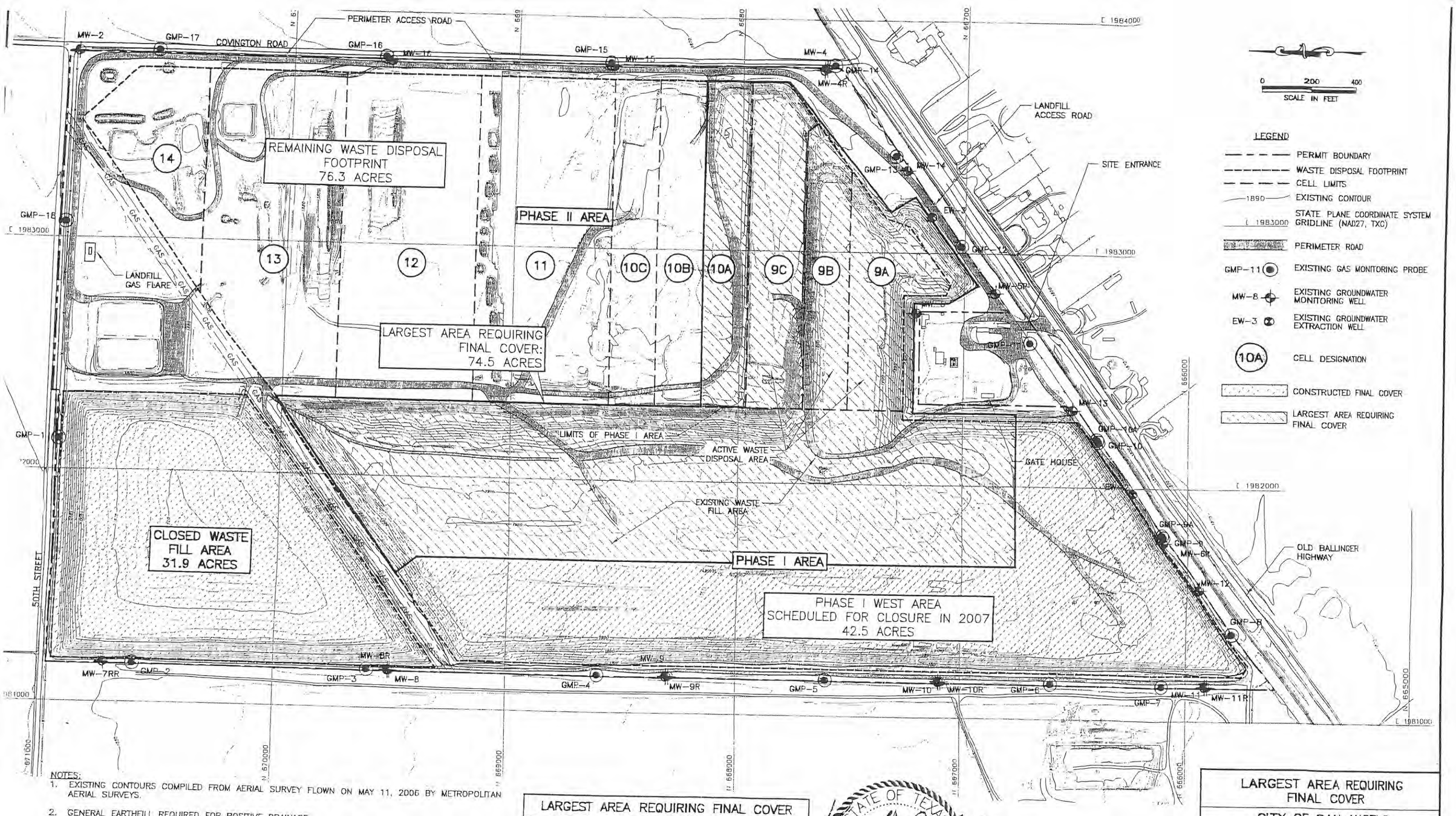
Table 8-3
Corrective Action Cost Estimate

No.	ITEM	ANNUAL COST
1.0	Engineering Costs	$ 48,000.00
	Subtotal	$ 48,000.00
2.0	Administration	$ 4,800.00
	Annual Corrective Action Costs	**$ 52,800.00**
	Total Corrective Action Costs	**$ 1,584,000.00**



10/03/07

FIGURES



NOTES:

1. EXISTING CONTOURS COMPILED FROM AERIAL SURVEY FLOWN ON MAY 11, 2006 BY METROPOLITAN AERIAL SURVEYS.
2. GENERAL EARTHFILL REQUIRED FOR POSITIVE DRAINAGE.
3. THE LARGEST AREA REQUIRING FINAL COVER IS 74.5 ACRES.
4. NO ADDITIONAL GROUNDWATER MONITORING WELLS OR GAS MONITORING PROBES ARE REQUIRED.
5. THE CLOSED WASTE FILL AREA HAS CERTIFIED FINAL COVER. THE FCSER FOR THE CLOSED WASTE FILL AREA WAS SUBMITTED TO TCEQ FEBRUARY 8, 2007.
6. PHASE I WEST AREA IS SCHEDULED TO HAVE FINAL COVER CONSTRUCTED IN LATE 2007.
7. SUBTITLE D LINED AREAS TOTAL 45.4 ACRES. CELLS 9A, 9B, 9C, AND 10A IN PHASE II TOTAL 28.0 ACRES. SUBTITLE D LINED AREAS IN PHASE I TOTAL 17.4 ACRES.

LARGEST AREA REQUIRING FINAL COVER	
PHASE I	46.5 AC
PHASE II	28.0 AC
TOTAL	74.5 AC

STATE OF TEXAS
KENNETH J. WELCH
60773
REGISTERED PROFESSIONAL ENGINEER
5/10/07

ISSUED FOR PERMITTING PURPOSES

NO.	BY	DESCRIPTION	DATE
		REVISIONS	

LARGEST AREA REQUIRING FINAL COVER

CITY OF SAN ANGELO
SAN ANGELO LANDFILL
PERMIT MODIFICATION

BIGGS & MATHEWS ENVIRONMENTAL
CONSULTING ENGINEERS
MANSFIELD
DALLAS • WICHITA FALLS
817-563-1144

DSN: MAS	DATE: 05/07	ATTACHMENT
DWN: RMP	SCALE: GRAPHIC	8.1
CHK: KJW	DWG:	

APPENDIX 8A

CLOSURE COST ESTIMATE CALCULATIONS

30 TAC §330.503(a)



Includes Pages 8A-1 through 8A-6

CLOSURE COST ESTIMATE CALCULATIONS
30 TAC §330.503(a)

The largest area requiring final cover throughout the active life of the landfill encompasses an area of approximately 74.5 acres that includes portions of the Phase I and Phase II areas of the San Angelo Landfill. Figure 8.1 depicts the largest area requiring final cover. After the final cover is placed, general earthfill will be required to fill the area excavated for the subsequent lined areas to provide positive drainage off of the closed cells to a perimeter drainage system to convey surface water runoff away from the closed area. The total area of the landfill requiring final cover will depend upon the stage of development at the time of closure. The following sections describe the line items of the cost estimate calculations for the scenario considered.

1.0 ENGINEERING COSTS

The engineering costs are partly based on the entire 275 acres having to be administratively closed, but most cost items depend on the stage of development, as indicated by Figure 8.1.

1.1 Topographic Survey

A topographic survey will be required to determine the existing grades of the landfill. The topographic survey will be used to evaluate permit compliance and to design the grading, final cover system, and drainage system. The cost of the topographic survey is based on the entire permit boundary.

1.2 Boundary Survey

A boundary survey is required for the filing of the affidavit of closure and deed recording of any area of the site that has received waste and publishing a Public Notice of the Closing Activities. The cost of the boundary survey is based on the entire permit boundary.

1.3 Site Evaluation

A site evaluation will be performed to identify waste disposal areas, analyze drainage and erosion protection, and to determine other site operational features that are not in compliance with the permit. The site evaluation also includes analysis of groundwater samples, gas probes, and review of site operating records. The cost of the site evaluation is based on the entire permit boundary.

1.4 Development of Plans

The final closure plan will be revised to reflect the changes to the final grading and drainage plans, specifications for vegetation, and design of any other improvements to bring the site into compliance with the permit. Construction plans, specifications and contract documents will be prepared in suitable detail to allow the project to be competitively bid. The cost of development of plans is based on the largest area requiring closure.

1.5 Administration

A consultant will advertise the project, receive the bids, evaluate the bids, award the closure construction contract and administer the contract during construction. The cost of administration was calculated on the lump sum basis.

1.6 Closure Inspection and Testing

Closure inspection and testing includes observations by the professional of record during closure construction, thickness and permeability verifications, and preparation of a closure certification report. The cost of inspection and testing is based on the largest area requiring closure.

1.7 Groundwater Consultant

The groundwater monitor well system has been developed in accordance with Attachment 12 - Groundwater Monitoring Program. It is not anticipated that revisions will be necessary.. The cost of a groundwater consultant is not required.

1.8 Permits

A consultant will prepare plans, specifications, and other documents necessary for compliance with applicable federal and state laws, and requirements for the proper closure of the site. The cost of permits was calculated on the lump sum basis.

2.0 CONSTRUCTION COSTS

The San Angelo Landfill will continue to develop Phase II of the facility. Figure 8.1 depicts the largest area requiring final cover. After the final cover is placed, general earthfill will be required to fill the area excavated for the subsequent lined areas. The earthfill will be graded to provide positive drainage off of the closed cells to a perimeter drainage system to convey surface water away from the closed area. The total area of the landfill requiring final cover will depend upon the stage of development at the time of closure. Construction costs include construction and final closure costs for the areas requiring final cover.

2.1 Final Cover System

The final cover system for the Phase I area consists of a 12-inch-thick intermediate cover layer, a geosynthetic clay liner (GCL) layer, and a 12-inch-thick erosion layer. The amount of materials required for the Phase I final cover system is based on the largest Phase I area requiring closure, 46.5 acres.

The final cover system for the Phase II area consists of a 12-inch-thick intermediate cover layer, a geosynthetic clay liner (GCL) layer, a 40-mil LLDPE flexible membrane cover, drainage layer, and a 12-inch-thick erosion layer. The amount of materials required for the Phase II final cover system is based on the largest Phase II area requiring closure, 28.0 acres.

2.1.1 Intermediate Cover

A 12-inch-thick layer of intermediate cover will be left in place and regraded prior to placement of the GCL layer. Intermediate cover will be required to be placed over the active area.

2.1.2 GCL Layer

A GCL layer, having a permeability less than or equal to $5x10^{-9}$ cm/sec will be placed over the area requiring final cover. The amount of GCL required is based on the largest area requiring closure.

2.1.3 Flexible Membrane Cover

A 40-mil LLDPE, or engineer-approved equivalent geomembrane, will be placed over the Phase II area requiring final cover. The amount of flexible membrane required is based on the largest Phase II area requiring closure.

2.1.4 Drainage Layer

A geotextile will be installed as the drainage layer on top slopes and a geocomposite will be installed as the drainage layer on the side slopes. The amount of drainage layer required is based on the largest Phase II area requiring closure.

2.1.5 Erosion Layer

The 12-inch-thick erosion layer, consisting of earthen material capable of sustaining plant growth, will be placed over the GCL layer (in Phase I) or the drainage layer (in Phase II). The amount of material required for the erosion layer is based on the largest area requiring closure.

2.1.6 General Fill

General fill will be placed in the area excavated within the next area to be developed. The earthfill will be graded to provide positive drainage off of the closed cells to a perimeter drainage system. The amount of general fill required is based on providing positive drainage.

2.2 Landfill Gas Management System

The City of San Angelo has installed an active LFG control system on the area where final cover is currently placed. The cost for an active LFG control system includes well construction for the area requiring final cover. The cost of an active LFG management system will depend on the largest area requiring closure.

2.3 Vegetation

Vegetative erosion protection will be established over the surface of the completed cover and general fill. The costs are based on seeding with native grasses and the application of appropriate fertilizer. The vegetation requirements will depend upon the largest area requiring closure.

2.4 Site Grading and Drainage

Site grading and drainage includes the final grading at the site, drainage improvements on the landfill cap, and sedimentation controls. The amount of grading that will be required will depend on the largest area requiring closure.

2.5 Site Fencing and Security

Site fencing and security for the entire landfill is already in place. No expenses will be incurred for this item.

2.6 Leachate Collection System Completion

At the time of closure, the LCS will have been installed in existing cells. No expenses will be incurred for this item.

2.7 Groundwater Monitor Well Installation

Groundwater monitor wells have been installed during site development. No wells will be required to be installed.

2.8 Gas Monitoring Probes

Gas monitoring probes have been installed during site development. No probes will be required to be installed.

3.0 ADMINISTRATIVE COSTS

3.1 Contract Performance Bond

The cost of a performance bond is based on 1.5 percent of the total cost of engineering and construction.

3.2 TCEQ Administration of Contracts and Legal Fees

A lump sum of $50,000 has been included to account for the TCEQ administration of contracts and legal fees.

Required: Estimate the cost to hire a third party to conduct final closure activities.

References: 1 Texas Natural Resources Conservation Commmission, *Cost Estimate Handbook for Closure and Postclosure Care*, Version 1, August 1993.

Solution:

Final closure will require construction of final cover over	74.5	acres of Phase I and Phase II
Final closure will require construction of final cover over	46.5	acres of Phase I
Final closure will require construction of final cover over	28.0	acres of Phase II
Final closure will require administrative closure of	275	acres
Final closure will require the installation of	0	monitor wells
Final closure will require the installation of	0	gas probes
Final closure will require the installation of	74.5	LFG acres

No.	ITEM	QTY	UNIT	UNIT COST	TOTAL COST
1.0	**Engineering Costs**				
1.1	Topographic Survey	275	ac	$ 25.00	$ 6,875.00
1.2	Boundary Survey	275	ac	$ 10.00	$ 2,750.00
1.3	Site Evaluation	275	ac	$ 10.00	$ 2,750.00
1.4	Development of Plans	74.5	ac	$ 250.00	$ 18,625.00
1.5	Administration	1	LS	$ 10,000.00	$ 10,000.00
1.6	Inspection and Testing	74.5	ac	$ 5,000.00	$ 372,500.00
1.7	Groundwater Consultant	0	LS	$ -	$ -
1.8	Permits	1	LS	$ 10,000.00	$ 10,000.00
	Engineering Total				$ 423,500.00
2.0	**Construction Costs**				
2.1	Final Cover System				
2.1.1	Intermediate Cover	74.5	ac	$ 1,200.00	$ 89,400.00
2.1.2	GCL Layer	74.5	ac	$ 8,000.00	$ 596,000.00
2.1.3	Flexible Membrane Cover	28.0	ac	$ 16,000.00	$ 448,000.00
2.1.4	Drainage Layer	28.0	ac	$ 9,000.00	$ 252,000.00
2.1.5	Erosion Layer	74.5	ac	$ 6,000.00	$ 447,000.00
2.1.6	General Fill	50,000	cy	$ 0.75	$ 37,500.00
2.2	Active Landfill Gas System	74.5	ac	$ 2,000.00	$ 149,000.00
2.3	Vegetation	74.5	ac	$ 1,500.00	$ 111,750.00
2.4	Site Grading and Drainage	74.5	ac	$ 2,000.00	$ 149,000.00
2.5	Site Fencing and Security	0	ac	$ -	$ -
2.6	Leachate Collection System	0	lf	$ -	$ -
2.7	Monitor Wells	0	ea	$ -	$ -
2.8	Gas Probes	0	ea	$ -	$ -
	Construction Total				$ 2,279,650.00
	Engineering and Construction Total				$ 2,703,150.00
	Contingency	5%	%		$ 135,157.50
3.0	**Administrative Costs**				
3.1	Contract Performance Bond	1.5%	%		$ 40,547.25
3.2	TCEQ Contract Admin/Legal Fees	1	LS	$ 50,000.00	$ 50,000.00
	Total				$ 2,838,854.75

*This closure cost estimate was developed in 2007 dollars.

APPENDIX 8B

POSTCLOSURE CARE COST ESTIMATE CALCULATIONS

30 TAC §330.507(a)



10/03/07

Includes Pages 8B-1 through 8B-3

POSTCLOSURE CARE COST ESTIMATE CALCULATIONS
30 TAC §330.507(a)

The postclosure care period is 30 years for a Type I municipal solid waste facility. During this period, maintenance is required to assure the integrity and effectiveness of the final closure system, monitoring systems, erosion protection facilities, and the stormwater drainage appurtenances. Postclosure cost estimates were calculated for the scenario depicted on Figure 8.1.

The postclosure care cost estimates are based on Attachment 7 – Postclosure Care Plan and provide costs for the routine operation, maintenance and monitoring of the final cover system, gas monitoring system, active landfill gas collection and control system, groundwater monitoring system, leachate collection system, and stormwater drainage appurtenances required after final closure. These estimates for routine maintenance and monitoring predict the cumulative cost throughout the 30-year postclosure care period. The following sections describe the line items of the postclosure cost estimate calculations.

1.0 ENGINEERING COSTS

1.1 Postclosure Plan

The postclosure plan provides a schedule for routine maintenance of the final cover system, the LCS, active landfill gas collection and control system, and the gas and groundwater monitoring systems. The Postclosure Care Plan is presented in Attachment 7.

1.2 Site Inspections

Annual site inspections will be performed. Site inspections will identify areas experiencing settlement or subsidence, erosion, or other drainage-related problems, and will note the condition of the LCS, active landfill gas collection and control system, gas monitoring system, and groundwater monitoring system.

1.3 Correctional Plans and Specifications

Correctional plans and specifications include the costs for a consultant to prepare construction plans and specifications to correct problems identified during the site inspections. This cost is dependent upon the quality of care taken during the closure of the site and ongoing maintenance during previous postclosure care years. The cost

may be significantly higher during earlier postclosure care years and be reduced to zero cost during the end of the postclosure care period.

1.4 Site Monitoring

Semiannual groundwater sampling and analysis will be performed for the groundwater monitoring wells. Quarterly gas monitoring will also be performed for the gas monitoring probes and on-site building monitors.

2.0 CONSTRUCTION/MAINTENANCE COSTS

Postclosure construction/maintenance will be required to correct problems identified during the site inspections and as specified by the correctional plans and specifications. These costs will also include ongoing site maintenance, cover and drainage maintenance, and annual seeding and mowing costs. Included in this item is the plugging of the groundwater monitoring wells and gas monitoring probes at the end of the postclosure care period.

3.0 LEACHATE DISPOSAL

During the postclosure care period, the volume of leachate being generated should decrease substantially due to the completion of the final cover system. An average leachate generation rate of approximately 500 gallons per year was used over the postclosure care period. An approximate disposal rate of $0.08 per gallon for transportation, treatment, and disposal costs was assumed.

4.0 LANDFILL GAS MANAGEMENT SYSTEM

The installed LFG collection and control system will require routine operation and maintenance (O&M). The annual O&M cost for the active gas system is assumed to be $50 per acre.

5.0 ADMINISTRATION

The cost for a third party to administer postclosure care activities is assumed at 10 percent of the annual postclosure costs.

POSTCLOSURE COST ESTIMATE
LARGEST AREA REQUIRING POSTCLOSURE CARE

Prepared by: ALN
Date: 10/3/2007
Checked by: KJW
Date: 10/3/2007

Required: Estimate the cost to hire a third party to conduct postclosure care activities.

References: 1 Texas Natural Resources Conservation Commmission, *Cost Estimate Handbook for Closure and Postclosure Care*, Version 1, August 1993.

Solution:

Postclosure care period =	30 years
Permit area =	275 acres
Waste footprint[1] =	148.9 acres
Number of monitor wells =	20 wells
Number of gas probes =	20 probes

No.	ITEM	ANNUAL QTY	UNIT	UNIT COST	TOTAL COST
1.0	**Engineering Costs**				
1.1	Postclosure Plan	NA	LS	$ -	$ -
1.2	Site Inspections	275	ac	$ 25.00	$ 6,875.00
1.3	Correctional Plan and Specifications	148.9	ac	$ 50.00	$ 7,445.00
1.4.1	Groundwater Monitoring (semiannually)	40	event	$ 800.00	$ 32,000.00
1.4.2	Landfill Gas Monitoring (quarterly)	80	event	$ 100.00	$ 8,000.00
2.0	**Construction / Maintenance Costs**	148.9	ac	$ 100.00	$ 14,890.00
3.0	**Leachate Disposal**	500	gal	$ 0.08	$ 40.00
4.0	**Landfill Gas Management**	148.9	ac	$ 50.00	$ 7,445.00
	Subtotal				$ 76,695.00
5.0	**Administration**	10	%		$ 7,669.50
	Annual Postclosure Cost				$ 84,364.50
	Total Postclosure Cost				**$ 2,530,935.00**

*This postclosure cost estimate was developed in 2007 dollars.

[1]The waste footprint includes the largest area requiring final cover (74.5 acres), the Phase I West Area scheduled for closure in 2007 (42.5 acres), and the northwest closed waste fill area (31.9 acres) for a total of 148.9 acres.

APPENDIX 8C

CORRECTIVE ACTION COST ESTIMATE CALCULATIONS

30 TAC §330.509(a)



Includes Pages 8C-1 through 8C-2

CORRECTIVE ACTION COST ESTIMATE CALCULATIONS
30 TAC §330.509(a)

The corrective action cost estimate is based on the approved Corrective Action Plan and provides costs for the additional groundwater monitoring events and landfill gas monitoring events. This estimate for these monitoring events predicts the cumulative cost throughout the 30-year postclosure care period. The following sections describe the line items of the postclosure cost estimate calculations.

1.0 ENGINEERING COSTS

1.1 Corrective Action Plan

The Corrective Action Plan provides a schedule for additional groundwater monitoring and landfill gas monitoring events. The Corrective Action Plan was approved by the TCEQ in March 2006.

1.2 Site Monitoring

Groundwater sampling and analysis for the corrective action program requires two additional sampling events per year. Landfill gas monitoring for the corrective action program requires an additional eight monitoring events per year.

2.0 ADMINISTRATION

The cost for a third party to administer corrective action activities is assumed at 10 percent of the annual corrective action costs.

CORRECTIVE ACTION COST ESTIMATE

Required: Estimate the cost to hire a third party to conduct corrective action activities during the postclosure care period.

References:
1. Texas Natural Resources Conservation Commmission, *Cost Estimate Handbook for Closure and Postclosure Care*, Version 1, August 1993.

Solution:

Postclosure care period = 30 years
Number of monitor wells = 20 wells
Number of gas probes = 20 probes

No.	ITEM	ANNUAL QTY	UNIT	UNIT COST	TOTAL COST
1.0	**Engineering Costs**				
1.1	Corrective Action Plan	NA	LS	$ -	$ -
1.2.1	Groundwater Monitoring (semiannually)[1]	40	event	$ 800.00	$ 32,000.00
1.2.2	Landfill Gas Monitoring (quarterly)[2]	160	event	$ 100.00	$ 16,000.00
	Subtotal				$ 48,000.00
2.0	**Administration**	10	%		$ 4,800.00
	Annual Corrective Action Cost				$ 52,800.00
	Total Corrective Action Cost				**$ 1,584,000.00**

*This corrective action cost estimate was developed in 2007 dollars.
[1]Groundwater monitoring for the corrective action program requires 2 additional sampling events per year.
[2]Landfill gas monitoring for the correcitve action program requires 8 additional monitoring events per year.

Bryan W. Shaw, Ph.D., *Chairman*
Carlos Rubinstein, *Commissioner*
Toby Baker, *Commissioner*
Zak Covar, *Executive Director*

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Protecting Texas by Reducing and Preventing Pollution

May 10, 2013

Mr. Shane Kelton
Director of Operations
San Angelo Landfill
City of San Angelo
P. O. Box 1751
San Angelo, Texas 76902

Re: San Angelo Landfill – Tom Green County
Municipal Solid Waste – Permit No. 79
Permit Modification – Landfill Gas Management Plan – Incorporate Installation Report for Replacement Gas Monitoring Probe GMP-11A
Tracking No. 17100310; RN102289576/CN600251615

Dear Mr. Kelton:

We have reviewed your application for a municipal solid waste permit modification dated April 12, 2013, requesting a modification to the Landfill Gas Management Plan for the referenced facility, to incorporate the installation report for replacement gas monitoring probe GMP-11A and make revisions to the plan to reflect the probe replacement. The information presented is technically sufficient for a municipal solid waste permit modification.

Enclosed is a copy of the above referenced modification which is now part of your permit and should be attached thereto. The documentation prepared and submitted to support the modification request shall be considered as requirements of the permit.

If you have questions concerning this matter, please contact Mr. Arten Avakian at (512) 239-4419. When addressing written correspondence, please use mail code MC 124.

This action is taken under authority delegated by the Executive Director of the Texas Commission on Environmental Quality.

Sincerely,

Christine M. Bergren, Manager
Municipal Solid Waste Permits Section
Waste Permits Division

CMB/AJA/pt

cc: Mr. Kenneth Welch, P.E., Biggs & Mathews Environmental, Mansfield

Texas Commission on Environmental Quality

Modification to
Municipal Solid Waste Permit No. 79
San Angelo Landfill

Municipal Solid Waste Permit No. 79 is hereby modified as follows:

Description of Change:

This modification incorporates the installation report for replacement gas monitoring probe GMP-11A into the Landfill Gas Management Plan and makes minor revisions to the plan to reflect the probe replacement.

The details of this permit modification are contained in the application dated April 12, 2013.

Parts of Permit Modified:

- Part III of the Application
  - Attachment 9 (Landfill Gas Management Plan)
    - Title page and table of contents
    - Revised Sections 2.1 (page 9-3) and 3.1.2 (page 9-5)
    - Adjusted pagination (pages 9-6 and 9-7)
    - Appendix 9A (Landfill Gas Monitoring Probe Plan)
      - Revised Attachment 9A.1 (drawing – LFG Monitoring Plan)
      - Revised Attachment 9A.2 (drawing and table –Monitoring Probe Detail)
    - Appendix 9B (Report and Recording Forms)
      - Revised Landfill Gas Monitoring Report
    - Appendix 9C (Installation of Landfill Gas Monitoring Probes)
      - Added title page to existing July 2005 Landfill Gas Probe Installation Report
      - Added March 2013 Gas Probe Installation Report
      - Added appendix page numbers

This modification is a part of Permit No. 79 and should be attached thereto.

Approved, Issued, and *Effective* in accordance with Title 30 Texas Administrative Code Chapter 305, Sections 305.70(j)(18), and Chapter 330, Section 330.371.

Issue Date: MAY 10 2013

For the Commission

Kathleen Hartnett White, *Chairman*
Larry R. Soward, *Commissioner*
Martin A. Hubert, *Commissioner*
Glenn Shankle, *Executive Director*

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Protecting Texas by Reducing and Preventing Pollution

November 21, 2006

Mr. Ron Lewis
Public Works Director
City of San Angelo
PO Box 1751
San Angelo, TX 76902-1751

Re: Municipal Solid Waste (MSW) – Tom Green County
San Angelo Landfill - MSW Permit No. 79
Permit Modification – Attachment 9: Landfill Gas Management Plan
WWC No. 11515832; RN102289576 / CN600251615

Dear Mr. Lewis:

We have reviewed your application for a municipal solid waste permit modification dated September 19, 2006, received on September 22, 2006 requesting modification of the Landfill Gas Management Plan to require the concentrations of landfill gas to be measured by volume in air for the referenced facility. The information presented is technically sufficient for a municipal solid waste permit modification.

Enclosed is a copy of the above referenced modification which is now part of your permit and should be attached thereto. The documentation prepared and submitted to support the modification request shall be considered as requirements of the permit.

If you have questions concerning this matter, please contact Mr. Harold Pearson at (512) 239-4465. When addressing written correspondence, please use Mail Code 124 (MC 124).

Sincerely,

Richard C. Carmichael, Ph.D., P.E.
Manager, Municipal Solid Waste Permits Section
Waste Permits Division

RCC/HP/fp

Enclosure

cc: Mr. Kenneth J. Welch, P.E., Biggs & Mathews Environmental, Mansfield

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

MODIFICATION TO

MUNICIPAL SOLID WASTE PERMIT No. 79

SAN ANGELO LANDFILL

Municipal Solid Waste Permit No. 79 is hereby modified as follows:

Description of Change:

Incorporate revised Landfill Gas Management Plan pages to require the concentrations of landfill gas to be measured by volume in air.

The details of this permit modification are contained in the application dated September 19, 2006, received on September 22, 2006.

Part of Permit Modified:

Site Development Plan – Attachment 9: Landfill Gas Management Plan pages, Cover Sheet (9-i), 9-ii, 9-1, 9-2, 9-5, 9-6, and 9-7.

This modification is a part of Permit No. 79 and should be attached thereto.

APPROVED, ISSUED, AND EFFECTIVE in accordance with Title 30 Texas Administrative Code Chapter 305, Section 305.70(j)(23).

ISSUED DATE:

NOV 2 1 2006

For the Commission

Received & Scanned
3/16/06

Kathleen Hartnett White, *Chairman*
R. B. "Ralph" Marquez, *Commissioner*
Larry R. Soward, *Commissioner*
Glenn Shankle, *Executive Director*

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Protecting Texas by Reducing and Preventing Pollution

March 14, 2006

The Honorable J. W. Lown, Mayor
City of San Angelo
P.O. Box 1751
San Angelo, Texas 76902-1751

Re: City of San Angelo Landfill - MSW Permit No. 79
Permit Modification for Landfill Gas Management Plan and Groundwater Monitor Installation
Technical Review Completed
WWC Tracking No. 11198250; RN102289576 / CN600251615

Dear Mayor Lown:

We have reviewed your application for a municipal solid waste permit modification dated December 9, 2005 and received by the Municipal Solid Waste (MSW) Permits Section on December 13, 2005, regarding the above referenced MSW facility, to authorize the revision of the Landfill Gas Management Plan and Groundwater Monitoring Program. The revisions will include the installation of an active gas collection system, with monthly sampling of all landfill gas monitoring probes, the installation of ten new groundwater monitoring wells, and authorization for use of low flow purging. The information presented is technically sufficient for a permit modification and we have prepared a draft modification.

Enclosed is a copy of the above referenced modification which is now part of your permit and should be attached thereto. The documentation prepared and submitted to support the modification request shall be considered as requirements of the permit. The facility is responsible for compliance with any applicable air requirements.

If you have questions concerning this matter, please contact Mr. Lisa Saunders at (512) 239-5211. When addressing written correspondence, please use Mail Code (MC 124).

Sincerely,

Richard C. Carmichael, Ph.D., P.E.
Manager, Municipal Solid Waste Permits Section
Waste Permits Division
Texas Commission on Environmental Quality

LRS/ff

Enclosures

cc: Mr. Kenneth J. Welch, P.E., Senior Engineer, Biggs & Mathews Environmental

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

MODIFICATION TO

MUNICIPAL SOLID WASTE PERMIT No. 79

San Angelo Landfill Facility

Municipal Solid Waste Permit No. 79 is hereby modified as follows:

Description of Change:
Modification of the Landfill Gas Management Plan and the Groundwater Monitoring Program to include the installation of an active gas collection system, with monthly sampling of all landfill gas monitoring probes, installation of ten new groundwater monitoring wells, and authorization for use of low flow purging. Executive Director authorization must be received prior to plugging and abandonment of existing on-site monitoring wells.

The details of this permit modification are contained in the application dated December 9, 2005 and received by TCEQ on December 13, 2005.

Part of Permit Modified:

Attachment 9, Landfill Gas Management Plan
Attachment 12, Groundwater Monitoring Program

This modification is a part of Permit No. 79 and should be attached thereto.

APPROVED, ISSUED, AND EFFECTIVE in accordance with Title 30 Texas Administrative Code Section 305.70(k)(5), §330.56(n), and §305.70(l).

ISSUED DATE:

MAR 0 2 2006

For the Commission

SAN ANGELO LANDFILL
TOM GREEN COUNTY, TEXAS
TCEQ PERMIT APPLICATION NO. MSW 79

PERMIT MODIFICATION

ATTACHMENT 9
LANDFILL GAS MANAGEMENT PLAN

Prepared for

City of San Angelo

September 2005
March 2, 2006September 2006

Revised April 2013



Prepared by
BIGGS & MATHEWS ENVIRONMENTAL
1700 Robert Road • Mansfield, Texas 76063 • 817-563-1144
TEXAS BOARD OF PROFESSIONAL ENGINEERS
FIRM REGISTRATION NO. F-256
TEXAS BOARD OF PROFESSIONAL GEOSCIENTISTS
FIRM REGISTRATION NO. 50222

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1 INTRODUCTION

1.1 Scope

This landfill gas (LFG) management plan has been developed for the San Angelo Landfill consistent with the requirements set forth in 30 TAC §330.371. The LFG management plan provides a site-specific approach to implementing LFG monitoring. This plan describes the proposed LFG monitoring network and discusses the operation and monitoring of this network, the verification of monitoring results, notification procedures, and outlines possible remediation activities, if required. The LFG management plan also provides a means to control the build-up of LFG pressure within the landfill, which could be detrimental to the landfill cover.

It is the intent of the San Angelo Landfill to comply with other applicable federal and state regulations. These include the Environmental Protection Agency's (EPA's) Clean Air Act, Section 111(b), New Source Performance Standards (NSPS) for municipal solid waste (MSW) landfills and the requirements of the TCEQ Office of Air Quality.

The NSPS for MSW landfills applies to landfills with design capacities greater than 2.5 million megagrams (2.75 million tons) or 2.5 million cubic meters. Since the design capacity of the San Angelo Landfill will exceed 2.5 million megagrams and 2.5 million cubic meters, the non-methane organic compound (NMOC) emissions at the site may eventually exceed 50 megagrams per year, requiring installation of a LFG collection and control system per the NSPS. Consistent with the NSPS, the San Angelo Landfill will make the necessary submittals to the TCEQ, which administers the NSPS. If required per the NSPS, a LFG collection and control system will be installed, operated, and monitored per the NSPS requirements.

The current design capacity of the San Angelo Landfill is below the NSPS design capacity applicability limit and will remain below the NSPS NMOC emission rate of 50 mg/year for some time. The San Angelo Landfill is presently in compliance with the NSPS requirements through submittals of the necessary compliance reports to the TCEQ Office of Air Quality. The San Angelo Landfill received approval from TCEQ that the NMOC sampling and Analysis Report submitted in 2000 demonstrated that the landfill was in compliance through 2004 and that site specific NMOC testing would be required in 2005. Although an active landfill gas control system is not required by the TCEQ or Federal regulations, City of San Angelo plans to install an active LFG control system at the landfill as the site is developed. Information is included in this plan to identify the conceptual LFG control system. A permit modification and/or registration will be submitted to the TCEQ for an LFG collection and control system for incorporation into the TCEQ permit for the San Angelo Landfill as required by the regulations. City of San Angelo proposes to install an active LFG collection and control system over a portion of the disposal area as documented in Appendix 14E.

1.2 Purpose

Compliance with §330.371 requires landfills to implement a routine LFG monitoring program to verify that: (1) the concentration of methane does not exceed 1.25 percent methane by air volume in facility structures (excluding LFG collection and control system components), and that (2) the concentration of methane does not exceed 5 percent methane by air volume at the facility permit boundary.

The purpose of this LFG management plan is to provide guidelines for management of LFG at the site. These guidelines cover the evaluation of LFG migration at the points of compliance (permit boundary) and in structures on the permitted site. This will be verified by monitoring LFG concentrations at or within the facility permit boundary and within onsite buildings. Various options for LFG migration mitigation are discussed in Section 5 of this attachment.

2 SITE CHARACTERISTICS

2.1 Introduction

Twenty permanent LFG monitoring probes have been installed along the permit boundary to detect potential LFG migration. The installed LFG monitoring probes serve as the point of compliance regarding LFG migration. The LFG monitoring probes are located such that the maximum spacing between the LFG monitoring probes does not exceed 1,000 feet. Each monitoring probe location is designed to monitor soil strata above the higher of either the lowest measured groundwater level at the monitoring point or the lowest current or planned future elevation of waste within 1,000 feet of the monitoring point. The existing LFG monitoring probe locations are shown on Attachment 9A.1 – Existing Landfill Gas Monitoring Plan in Appendix 9A. The landfill gas monitoring probes were installed in 1994, May 2005, and in February 2013. Refer to Appendix 9C – Installation of Landfill Gas Monitoring Probes for a copy of the installation report, including the probe details.

2.2 Soil Conditions

The site geologic conditions present at the San Angelo Landfill are discussed in Attachment 12A – Groundwater Monitoring Plan.

2.3 Hydrogeologic Conditions

The hydrogeologic conditions present at the San Angelo Landfill are discussed in detail in Attachment 12 – Groundwater Monitoring Plan.

2.4 Hydraulic Conditions

Hydraulic conditions at the San Angelo Landfill are discussed in Attachment 4 – Runon/Runoff Control Plan.

2.5 Facility Structures Within the Property Boundary

The San Angelo Landfill has a permitted boundary of approximately 257-acres, of which approximately 224-acres will be available for waste placement. There are no facility structures located within the permit boundary. The gatehouse and maintenance facility are located outside the permit boundary as shown on Attachment 9A.1 – Existing Landfill Gas Monitoring Plan in Appendix 9A. All facility enclosed structures will be monitored for the presence of LFG as described in Section 3.2.1 of this attachment.

2.6 Underground Utilities

There is one existing underground utility line and easement within the disposal footprint of the landfill. The existing utility is an existing 10-inch natural gas pipeline owned and maintained by Atmos Energy. Passive vents will be installed outside the easement where the easement exits the permit boundary. Refer to Attachment 9A.1 for the location of the proposed passive utility vents.

2.7 Offsite Structures

The facility structures are located outside the permit boundary as shown on Attachment 9A.1 in Appendix 9A.

There are several structures located off site within 1,000 feet of the waste fill area. These structures are private residences and businesses located south of Old Ballinger Highway. As shown on Attachment 9A.1 of Appendix 9A, LFG monitoring probes have been installed along the entire perimeter boundary of the site adjacent to existing waste disposal areas to detect potential off-site migration of LFG.

3 MONITORING

3.1 Perimeter Monitoring

3.1.1 Perimeter Monitoring Network

The LFG monitoring probe network at the landfill includes a total of twenty existing LFG monitoring probes located along the permit boundary. Locations of the monitoring probes are shown in Appendix 9A, Attachment 9A.1. Additional probes may be installed between the waste disposal footprint and the permit boundary, if required by TCEQ. Permanent LFG monitoring probes of a single-tube design have been installed and are used to detect the presence of migrating LFG.

3.1.2 Landfill Gas Monitoring Probes

LFG monitoring probes have been installed along the perimeter of the waste fill area and landfill permit boundary.

Boring logs and typical construction details for the LFG probes GMP-13 through GMP-18 were submitted to the TCEQ as part of the Gas Monitoring Probe Installation Report and are provided in Appendix 9C. GMP-1, 2, and GMP-4 through GMP-12 were previously installed, boring logs for these gas probes are not available. GMP-11 was damaged and has been plugged and replaced with GMP-11A. A copy of the Methane Gas Probe Installation Report for the plugging of GMP-11 and installation of GMP-11A is included in Appendix 9C. Future LFG monitoring probes will be installed in accordance with the detail shown on Attachment 9A.3 - Monitoring Probe Detail, if additional LFG monitoring probes are required.

3.1.3 Monitoring Procedures

Perimeter Monitoring System

During each monitoring event, the probes will be monitored for the following parameters:

- Methane concentration, as measured in percent by volume in air.
- Oxygen concentration, as measured in percent by volume in air.
- Static pressure, as measured in inches water column, gauge.
- Depth to ground water, as measured in feet.

Monitoring for gas composition, pressure and temperature will be performed using a portable Landtec® GEM-500, or equivalent, capable of measuring the required parameters. The instrument will be calibrated against a known methane and oxygen

standards prior to each monitoring event. The instrument may also be checked against known gas standards in the event of encountering methane concentrations at or near regulatory compliance levels, or questionable or suspicious monitoring results. The monitoring equipment will be calibrated and maintained in accordance with the manufacturer's recommended procedures. Manufacturer's maintenance and calibration requirements for the monitoring instruments will be maintained on site with the LFG monitoring records described in Section 3.3.

The monitoring device will have a suction sampling line equipped with a quick-disconnect fitting. This fitting will match up with a corresponding quick-disconnect fitting on the top of each probe to enable gas samples to be drawn directly into the monitoring instrument without diluting the sample. The indicator will give a direct reading of the methane concentration in percent by volume in air. Static gas pressure will be measured and recorded in inches of water column.

After these parameters are measured, the probe of a liquid level indicator will be lowered into the LFG probe through an opening located on the top of the LFG probe to measure water level (if any) inside the LFG probe. If no water is present, the level indicator will be used to verify and report total depth of probe to assure that a probe is not obstructed.

Monitoring will be conducted by a qualified landfill representative or a qualified consultant. To avoid artificially impacting the probe static pressure during the induction of the gas sample into the instrument, the static pressure will be measured and recorded prior to measuring gas composition. The operation of the monitoring equipment will be as recommended by the instrument manufacturer.

3.1.4 Maintenance Procedures

Each time LFG monitoring is conducted, the sampler will inspect the integrity of the LFG monitoring probes. The sampler will record pertinent information on the Quarterly Landfill Gas Monitoring Report (see Appendix 9B - Reporting and Recording Forms) or similar forms. The Quarterly Landfill Gas Monitoring Report will be kept on file at the facility. The sampler will perform the following at each monitoring event:

- Verify that the LFG monitoring probe is clearly labeled on the outer casing or lid.
- Verify that the protective casing is intact and is not bent or excessively corroded.
- Verify that the concrete pad is intact (no evidence of cracking or heaving).
- Verify that the padlock is functional.
- Verify that the inner casing is intact.

If damage or excessive wear to the LFG monitoring probe is observed, it will be reported to the City of San Angelo and to the Landfill Manager. If it is not possible to repair the LFG monitoring probe and the damage can potentially affect the accuracy of future monitoring results, the LFG monitoring probe will be decommissioned and replaced with

a new LFG monitoring probe in accordance with Sections 3.1.2 and 3.4 of this attachment. The replacement LFG monitoring probe will be replaced within sixty days from the date the permit modification requesting replacement is submitted to TCEQ.

The combustible gas-monitoring instrument will be calibrated and maintained in accordance with the manufacturer's instructions.

3.2 Monitoring of Facility Structures

3.2.1 Monitoring Procedures

On-site buildings and structures designed for human occupation will be monitored, at a minimum quarterly, with either a portable combustible gas indicator or continuously with a continuous LFG monitor/alarm that will provide an audible alarm if methane concentrations exceed 1.25 percent methane by air volume.

If allowable methane concentration limits are exceeded within structures, the building will be immediately evacuated and ventilated by opening doors and windows. Notification consistent with procedures in Section 4.2 of this attachment will be implemented immediately.

3.2.2 Maintenance Procedures

If continuous LFG monitors/alarms are used, they will be calibrated and maintained in accordance with the manufacturer's recommendations. Continuous LFG monitors/alarms will be tested, following the manufacturer's testing specifications.

3.3 Recordkeeping/Reporting

Field monitoring data records will be maintained for the methane monitoring and kept on site as part of the site operating record. Field data will be recorded on the Landfill Gas Monitoring Report form (or similar form) as shown in Appendix 9B - Reporting and Recording Forms.

Monitoring results will be placed in the Site Operating Record. Monitoring probes will be monitored quarterly or more frequently if required by TCEQ. The LFG monitoring program will continue for a period of thirty years after the final closure of the facility or until the owner or operator receives written authorization from the TCEQ to revise or discontinue the program.

3.4 Backup Plan for Monitoring Probes and Continuous Monitors

The following is a back-up plan to be used if monitoring probes or continuous monitoring devices, if installed, become unusable or inoperative.

Stationary Perimeter Probes

1. Damaged or inoperative perimeter probes will be repaired within thirty days from the date of damage or replaced within 60 days from the date the permit modification requesting replacement is submitted to TCEQ.

2. Upon completion of the replacement probe, an installation report including boring logs and construction details will be submitted to the TCEQ.

3. Should a monitoring event occur prior to replacement of a damaged probe, a barhole will be placed next to the damaged probe or vent, and a portable gas monitor used until the probe or vent is replaced.

Stationary Combustible Gas Monitor

1. Damaged or inoperative stationary combustible gas monitors will be repaired within thirty days from the date of damage or replaced within sixty days from the date the permit modification requesting replacement is submitted to the TCEQ.

2. A portable gas indicator calibrated in the LEL range for methane will be used bi-weekly until the damaged or inoperative stationary unit is replaced.

4 ACTION PLAN

4.1 Initial Response Measures

As required under 30 TAC §330.56(n)(3)(A) this action plan has been prepared for the protection of human health in the event concentrations of methane exceed allowable limits either within onsite buildings or at the permit boundary of the site. The appropriate emergency response is different for each situation; therefore, the plan will address the situations for buildings and permit boundaries separately.

This plan also recognizes that a single-event exceedance of allowable limits on a gas indicator or alarm does not necessarily mean that the concentration of methane has actually exceeded allowable levels. Therefore, a procedure for verifying the validity of a single-event exceedance on a gas indicator or alarm is described below.

4.1.1 Emergency Action

The initial action in the event methane is detected at levels above regulatory limits is to protect human health. The specific response depends on circumstances of the situation.

Buildings/Structures. If the monitoring device in a facility building/structure is triggered, or if gas-monitoring equipment indicates that the methane concentration has exceeded the regulatory limit, the building/structure is to be evacuated of all personnel immediately and the Landfill Site Manager will be notified. Personnel (except for qualified monitoring personnel) will not be allowed to re-enter the affected building/structure until additional measures are taken. Following evaluation of the structure, the structure will be vented to allow dissipation of methane, if appropriate. Additional measures including monitoring the structure to determine the extent and source of the methane, and remedial actions such as sealing of cracks or connections may be taken. Verification procedures are described in Section 4.1.2. Notification consistent with procedures in Section 4.2 of this attachment will be conducted immediately.

Permit Boundary. If methane levels above the regulatory limit are detected at the permit boundary in one of the LFG monitoring probes, the Landfill Site Manager will be notified. The immediate emergency response measure will be for the Landfill Site Manager to determine if any nearby buildings or structures (including off site) are at risk and if evacuation of the buildings or structures should be requested. Site personnel and/or adjacent property owners will be directed away from the area, if appropriate. Additional monitoring will be conducted consistent with Section 4.1.2 to verify methane levels.

Once immediate actions have been completed to protect human health, notification consistent with procedures in Section 4.2 of this attachment will be conducted immediately.

4.1.2 Verification Procedures

Once emergency measures have been taken to protect human health, the Landfill Site Manager will require monitoring personnel to begin verification procedures. Such procedures are intended to determine if the methane levels detected are accurate, or if erroneous levels have been detected due to equipment malfunction or other reasons. Field monitoring data records will be maintained for the methane verification monitoring and kept on site as part of the site operating record.

Buildings/Structures. Properly trained monitoring personnel using the following procedures will accomplish verification of detected methane levels in the facility structures:

- Monitor methane levels throughout the building/structure using a calibrated portable gas indicator. In particular, readings will be taken in each room and in confined spaces (i.e., closets). If there are natural gas appliances in the building/structure, they should be checked for leaks.

- Determine if continuous monitoring equipment, if installed, is working properly.

If concentrations of explosive gases above the regulatory limit are not detected (i.e., a malfunction or erroneous reading is suspected), personnel may return to the building/structure. Methane monitoring using a portable combustible gas detector will continue daily for one week after the incident. If levels of methane above the regulatory limit are not detected during that week, daily monitoring will cease and routine monitoring will resume.

In the event concentrations of methane above the regulatory limit are detected during initial verification procedures or during the follow-up procedures in the ensuing week, notification and remediation procedures must be implemented, as described in Sections 4.2 and 5 of this attachment.

Permit Boundary. Monitoring personnel using the following procedures will accomplish verification of methane levels above the regulatory limit in LFG monitoring probes:

- Recalibrate gas detection equipment according to recommended procedures.

- Immediately recheck the methane concentration in the LFG monitoring probe.

- Recheck the methane concentration daily for one week.

If concentrations of methane above the regulatory limit are not detected in the above verification procedure routine monitoring procedures will resume.

In the event concentrations of methane above regulatory limits are detected during the above verification procedures, notification and remediation procedures must be implemented, as described in Sections 4.2 and 5 of this attachment.

4.2 Notification Procedures

When methane concentrations above the regulatory limit have been detected in the monitoring probes or within any onsite structures, the monitoring personnel will notify the Landfill Manager, who in turn will immediately notify the City of San Angelo. The city will immediately take steps to ensure the protection of human health. Notification will be made immediately in accordance with §330.56(n)(3)(i). Notification will be made to the Executive Director of the TCEQ, TCEQ Region 8 Office, city, county, local government officials, emergency officials and any residents within 1,000 feet of the reading.

When methane levels above the regulatory limit have been detected (refer to Section 4.1.1 of this Attachment), the Landfill Manager and the City of San Angelo will place in the site operating record the methane gas levels detected and a description of the steps taken to ensure protection of human health within seven days of detection in accordance with §330.56(n)(3)(B). Written notification will also be sent to the TCEQ Region 8 Office within seven days outlining the steps taken.

5 REMEDIATION PLAN

Once monitoring has detected that methane levels are above regulatory limits in the buildings/structures or in one or more LFG monitoring probes, remediation actions will be implemented within sixty days. The first remediation action will be an investigation of the cause of the methane levels. The investigation may include some or all of the following elements, depending on the circumstances:

- Bar-hole probe or hydropunch testing in the vicinity of the impacted monitoring probe
- Sampling and laboratory analysis of LFG monitoring probe samples to determine concentration of methane and trace compounds
- Additional LFG probe monitoring
- Installation of additional monitoring probes
- Inspection of the LFG control system
- Installation of an active landfill gas collection system

Using accumulated data, an assessment will be made to determine an appropriate course of action to mitigate the migration of LFG. Such actions will vary with the specific incident, and may include but not limited to additional control systems. A remediation plan will be submitted as a Permit Modification in accordance with 30 TAC §305.70(j), if required for changes in the LFGMP, in monitoring frequency, installation of additional gas probes, construction of trenches or vents, expansion of the active landfill gas collection system, or other changes required for modification, for approval by the TCEQ prior to implementation. The incident-specific remediation plan, based on results of the investigation, will be submitted within sixty days of detection, copies of the remediation plan will be placed in the operating record and provided to the Executive Director of the TCEQ along with notification that the plan has been implemented. The Executive Director may establish an alternative schedule for demonstrating compliance.

The San Angelo Landfill was upgraded to Subtitle D standards with the 1994 Subtitle D Permit Modification. The landfill gas monitoring system consisting of GMP-1 through GMP-12 was installed in 1994 with two additional gas probes GMP-9A and GMP-10A installed in 1996. Beginning with the initial landfill gas monitoring event, the methane levels in a number of the gas monitoring probes exceeded the regulatory limit. The San Angelo Landfill proceeded consistent with the requirements of approved Landfill Gas Management Plan to develop an approach for landfill gas migration remediation. A series of passive landfill gas vent trenches and landfill gas vent wells were installed along the west and south permit boundary, adjacent to the waste disposal areas. Refer

to Appendix 9D for the location of the passive landfill gas venting system and copies of available TCEQ permit modification approvals.

The passive landfill gas venting system has not been effective in controlling landfill gas migration along the west and south permit boundary. As a result of continued landfill gas migration, an active landfill gas collection system is proposed. Refer to Section 6 – Landfill Gas Control System and Appendix 9E – Active Landfill Gas Collection System for the proposed active landfill gas collection system. The passive landfill gas venting system will be plugged during construction of the active landfill gas collection system.

6 LFG CONTROL SYSTEM

An active LFG control system is not required by the TCEQ or federal regulations at this time based on the current in-place waste disposal capacity. A passive landfill gas well system will be installed to allow venting of landfill gas through the final cover system as the final cover system is installed. However, due to landfill gas migration, the City of San Angelo is planning to install an active LFG control system to control landfill gas migration along the west and south permit boundary. A permit modification and/or registration, if required, will be submitted to the TCEQ for expansion of the proposed LFG control system.

The timing for expansion of the active LFG control system will depend on waste disposal capacity, fill patterns, and other factors; however, controls will typically be installed within 2 years of waste fill areas reaching final grades. An LFG control system may also be installed as necessary to provide a means to control odors associated with LFG.

6.1 Passive Landfill Gas Wells

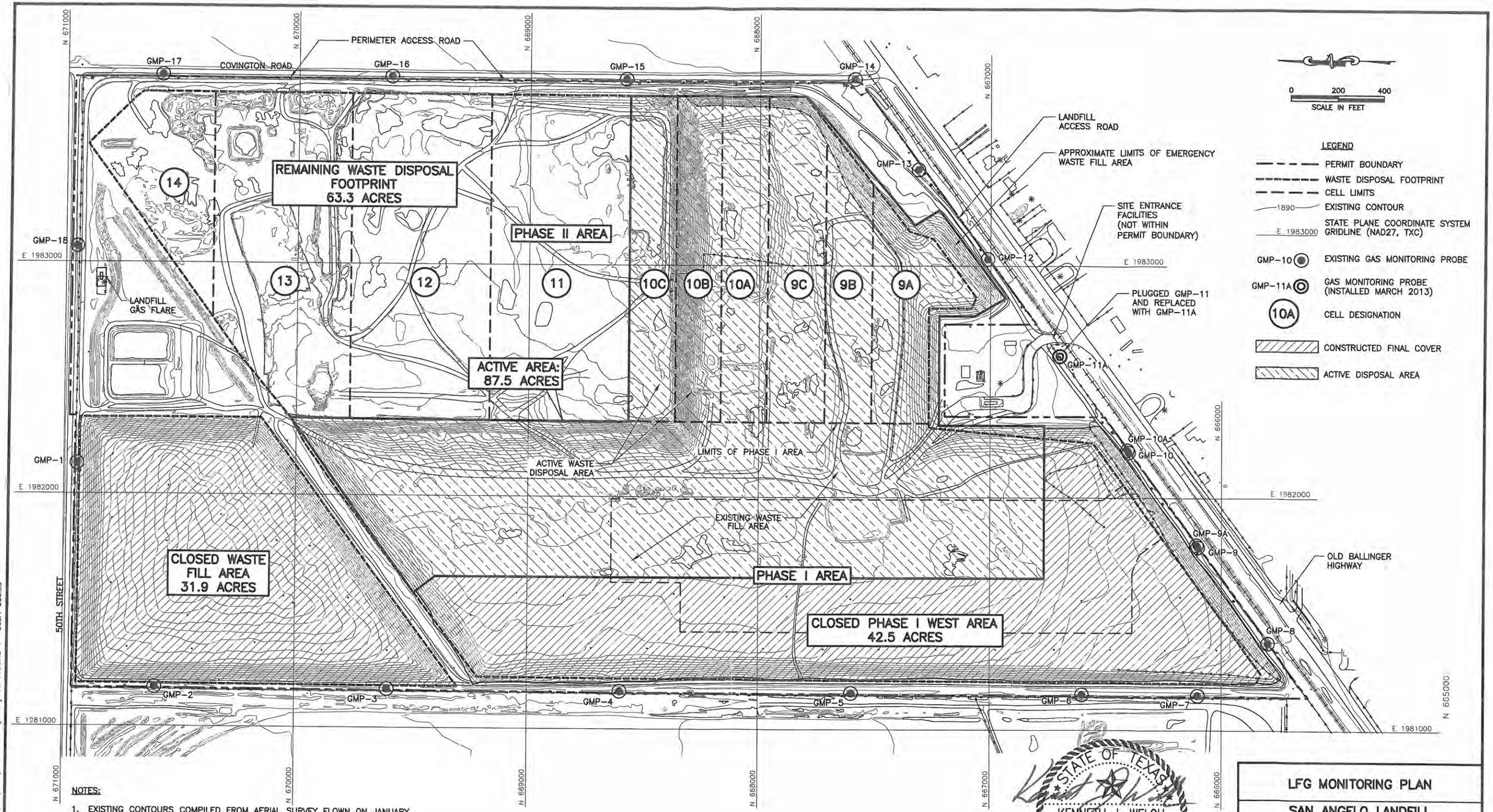
The City of San Angelo proposes to install landfill gas wells as the landfill is developed and reaches final cover grades to provide for passive venting of landfill gas through the final cover system. The location of these proposed landfill gas wells are designed on 250-foot centers as depicted on Attachment 9A.3. These wells will be installed to provide for converting to an active landfill gas system if required in the future. Refer to Attachment 9A.4 for the passive landfill gas well detail.

6.2 Active Landfill Gas Collection System

An active landfill gas system is proposed to be installed to collect LFG to mitigate elevated methane levels in landfill gas probes along the west and south permit boundary. The system is designed to allow expansion as other areas of the landfill are brought to grade for the current permitted condition. Refer to Appendix 9E for a copy of the limits of the proposed active landfill gas collection system and the design parameters.

APPENDIX 9A

LANDFILL GAS MONITORING PROBE PLAN



NOTES:

1. EXISTING CONTOURS COMPILED FROM AERIAL SURVEY FLOWN ON JANUARY 26, 2012 BY COOPER AERIAL SURVEYS.
2. SAN ANGELO LANDFILL PERMIT BOUNDARY, WASTE DISPOSAL FOOTPRINT, LIMITS OF LINED AREAS, SECTOR DESIGNATIONS AND MONITORING SYSTEMS BASED ON MSW PERMOT NO. 79 PERMIT DOCUMENTS.
3. EXISTING WASTE LIMITS CONSIST OF NORTH DISPOSAL AREA (CLOSED), PHASE I WEST DISPOSAL AREA, EMERGENCY WASTE FILL AREA, AND CELLS 9A THROUGH 10C.
4. WASTE DISPOSAL CONDUCTED IN OLD DISPOSAL AREAS IN ACCORDANCE WITH STATE REGULATIONS AT THAT TIME.
5. GMP-11 PLUGGED. REPLACEMENT PROBE GMP-11A INSTALLED MARCH 2013.

STATE OF TEXAS
KENNETH J. WELCH
60773
REGISTERED PROFESSIONAL ENGINEER
4/12/2013

REVISIONS						
REV	DATE	DESCRIPTION	DWN BY	DES BY	CHK BY	APP BY
1	04/13	ADD GMP-11A	BBB	KJW	KJW	KJW

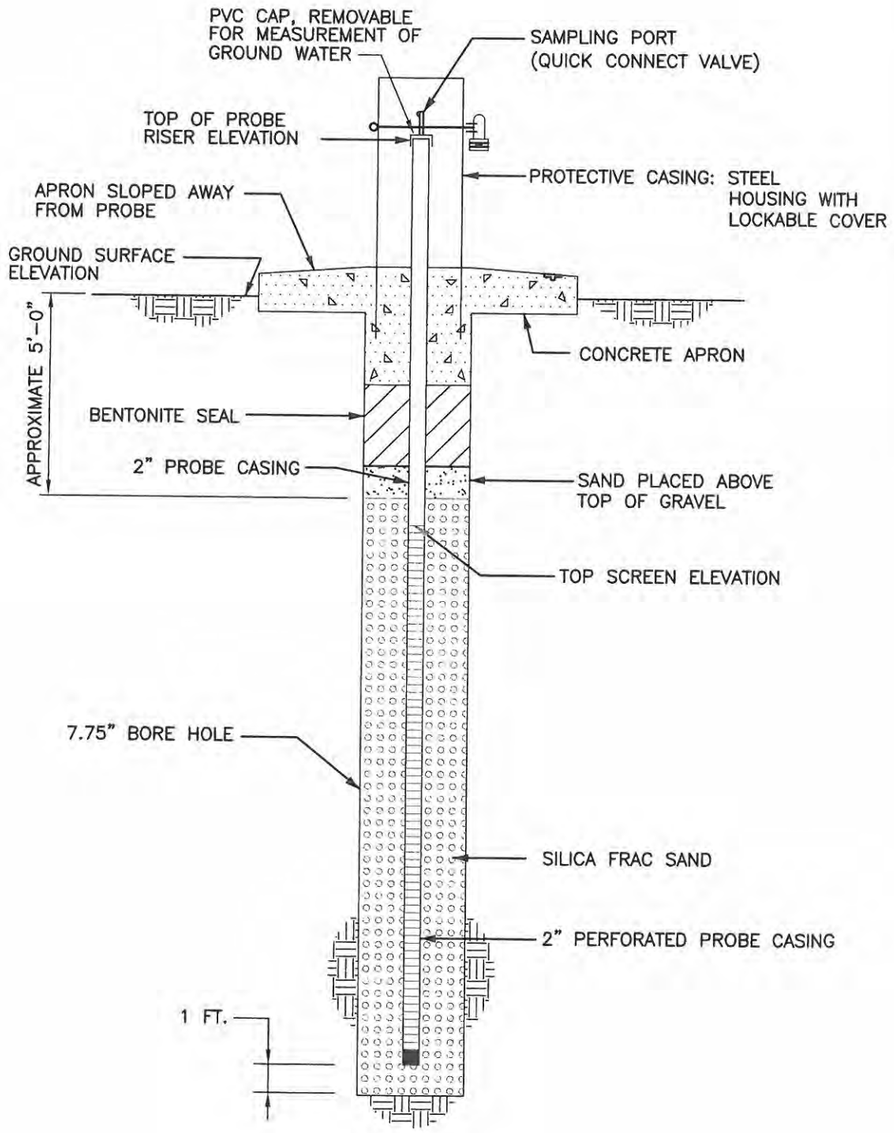
LFG MONITORING PLAN

SAN ANGELO LANDFILL
REPUBLIC SERVICES, INC.
MSW PERMIT NO. 79

BIGGS & MATHEWS ENVIRONMENTAL
CONSULTING ENGINEERS
MANSFIELD
DALLAS • WICHITA FALLS
817-563-1144
TBPE FIRM NO. F-256 TBPG FIRM NO. 50222

DSN. KJW	DATE : 07/05	ATTACHMENT	
DWN. SRC	SCALE : GRAPHIC	9A.1	
CHK. KJW	DWG : ATT-9A.1.dwg		

J:\225\02\112\ATT-9A.1.dwg Layout: FIGURE 1 User: bboles



MONITORING PROBE (TYPICAL) GMP1
9A.2

NOTE:

1. PROBES WILL BE INSTALLED TO MONITOR THE SOIL STRATA ABOVE THE HIGHER OF THE SEASONAL LOW WATER LEVEL AT THE MONITORING POINT OR THE LOWEST CURRENT OR PLANNED FUTURE ELEVATION OF WASTE WITHIN 1,000 FEET OF THE MONITORING PROBE.
2. ALL SIZES AND DIMENSIONS ARE APPROXIMATE.

GAS MONITORING PROBES

MONTIORING PROBE	NORTHING	EASTING	APPROXIMATE GROUND ELEVATION (FT-MSL)	PROBE DEPTH (FT)	APPROXIMATE BOTTOM PROBE ELEVATION (FT-MSL)
GMP-1	670943.6953	1982131.0697	1878.0	20	1858.0
GMP-2	670600.2517	1981168.5785	1879.5	20	1859.5
GMP-3	669584.6270	1981163.6750	1877.0	20	1857.0
GMP-4	668599.1449	1981161.2267	1874.5	20	1854.5
GMP-5	667599.9489	1981155.8078	1874.0	20	1854.0
GMP-6	666602.1807	1981152.0569	1874.0	20	1854.0
GMP-7	666102.2598	1981149.1222	1872.5	20	1852.5
GMP-8	665798.2633	1981374.1277	1870.0	20	1850.0
GMP-9	666102.8491	1981788.2324	1871.5	20	1851.5
GMP-9A	666108.3698	1981796.9559	1871.5	40	1831.5
GMP-10	666402.9797	1982196.0021	1871.5	20	1851.5
GMP-10A	666408.2846	1982205.2498	1871.5	40	1831.5
GMP-11A	666700.4319	1982609.6540	1870.3	21	1849.3
GMP-12	667012.4540	1983029.2449	1870.0	20	1850.0
GMP-13	667290.1370	1983404.1730	1869.5	20	1849.5
GMP-14	667607.9040	1983777.3150	1869.4	20	1849.4
GMP-15	668530.2020	1983791.6720	1870.8	20	1850.8
GMP-16	669528.9950	1983794.7620	1872.7	20	1852.7
GMP-17	670527.3160	1983798.3180	1875.3	20	1855.3
GMP-18	670937.5480	1983055.3670	1877.3	20	1857.3

STATE OF TEXAS
KENNETH J. WELCH
60773
REGISTERED PROFESSIONAL ENGINEER
4/12/2013

MONITORING PROBE DETAIL

SAN ANGELO LANDFILL
REPUBLIC SERVICES, INC.
MSW PERMIT NO. 79

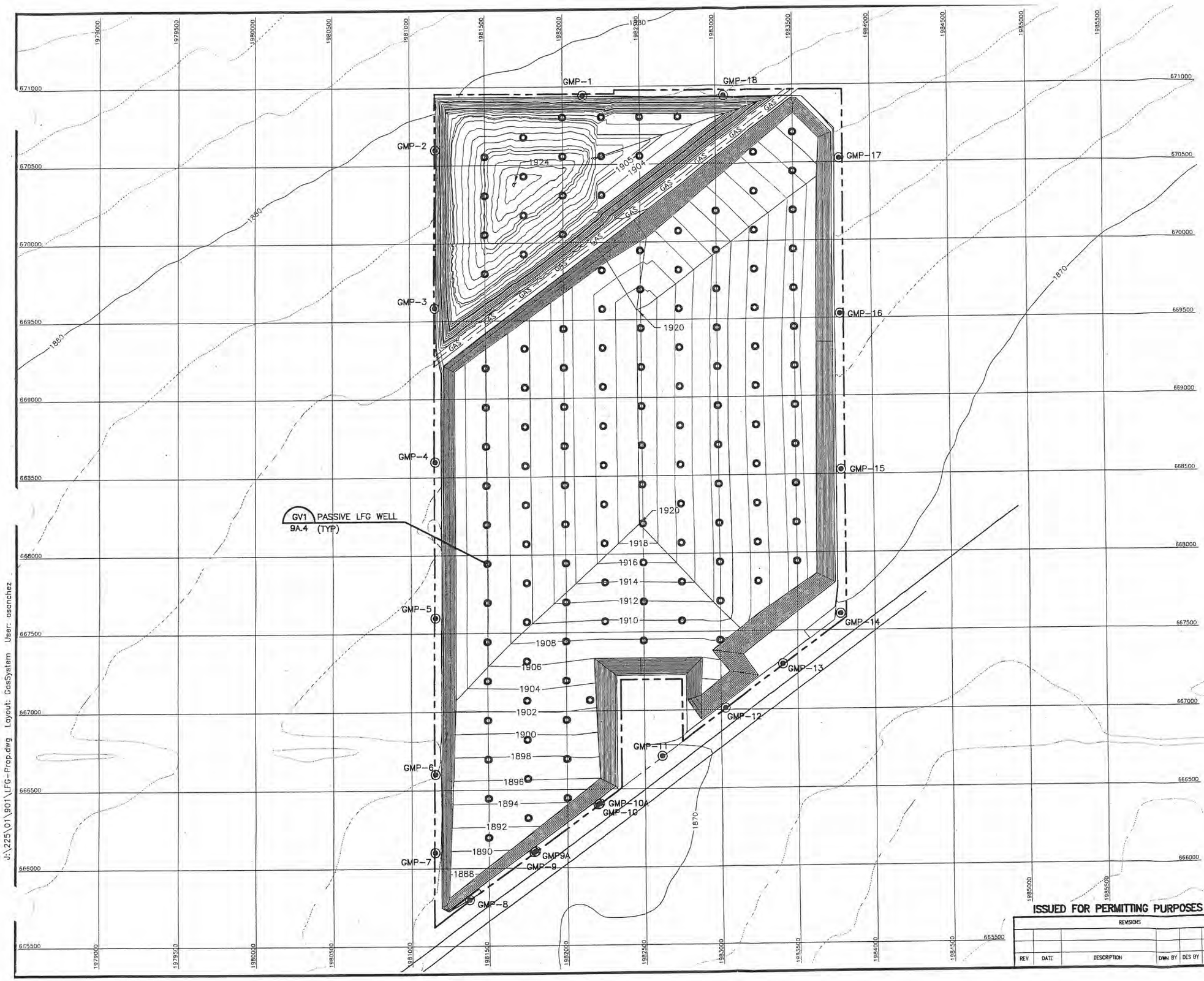
BIGGS & MATHEWS ENVIRONMENTAL
CONSULTING ENGINEERS
MANSFIELD
DALLAS • WICHITA FALLS
817-563-1144
TBPE FIRM NO. F-256 TBPG FIRM NO. 50222

REVISIONS						
REV	DATE	DESCRIPTION	DWN BY	DES BY	CHK BY	APP BY
1	04/13	ADD GMP-11A	BBB	KJW	KJW	KJW

DSN. KJW DATE : 07/05
DWN. RMP SCALE : GRAPHIC
CHK. KJW DWG : MontProbeDetail.dwg

ATTACHMENT 9A.2

J:\225\02\112\MontProbeDetail.dwg Layout: 9A.2 User: bbales



0 300 600
SCALE IN FEET

LEGEND

- PERMIT BOUNDARY
- LIMIT OF WASTE
- GMP-11 EXISTING GAS MONITORING PROBE
- PROPOSED LFG WELLS
- 1870 FINAL COVER CONTOURS
- 1870 PRELANDFILL CONTOURS

NOTES:

1. ALL SIDESLOPES ARE A 4:1 GRADE
2. EXISTING CONTOURS FROM USGS SAN ANGELO, NORTH DEM.
3. WELL SPACING 250' O.C.
4. LFG WELLS TO BE INSTALLED AS PASSIVE LFG WELLS.
5. PASSIVE LFG WELLS MAY BE CONVERTED TO ACTIVE LFG WELLS IN FUTURE IF REQUIRED.

STATE OF TEXAS
KENNETH J. WELCH
60773
REGISTERED PROFESSIONAL ENGINEER
7/06/05

ISSUED FOR PERMITTING PURPOSES ONLY

REVISIONS						
REV	DATE	DESCRIPTION	DWN BY	DES BY	CHK BY	APP BY

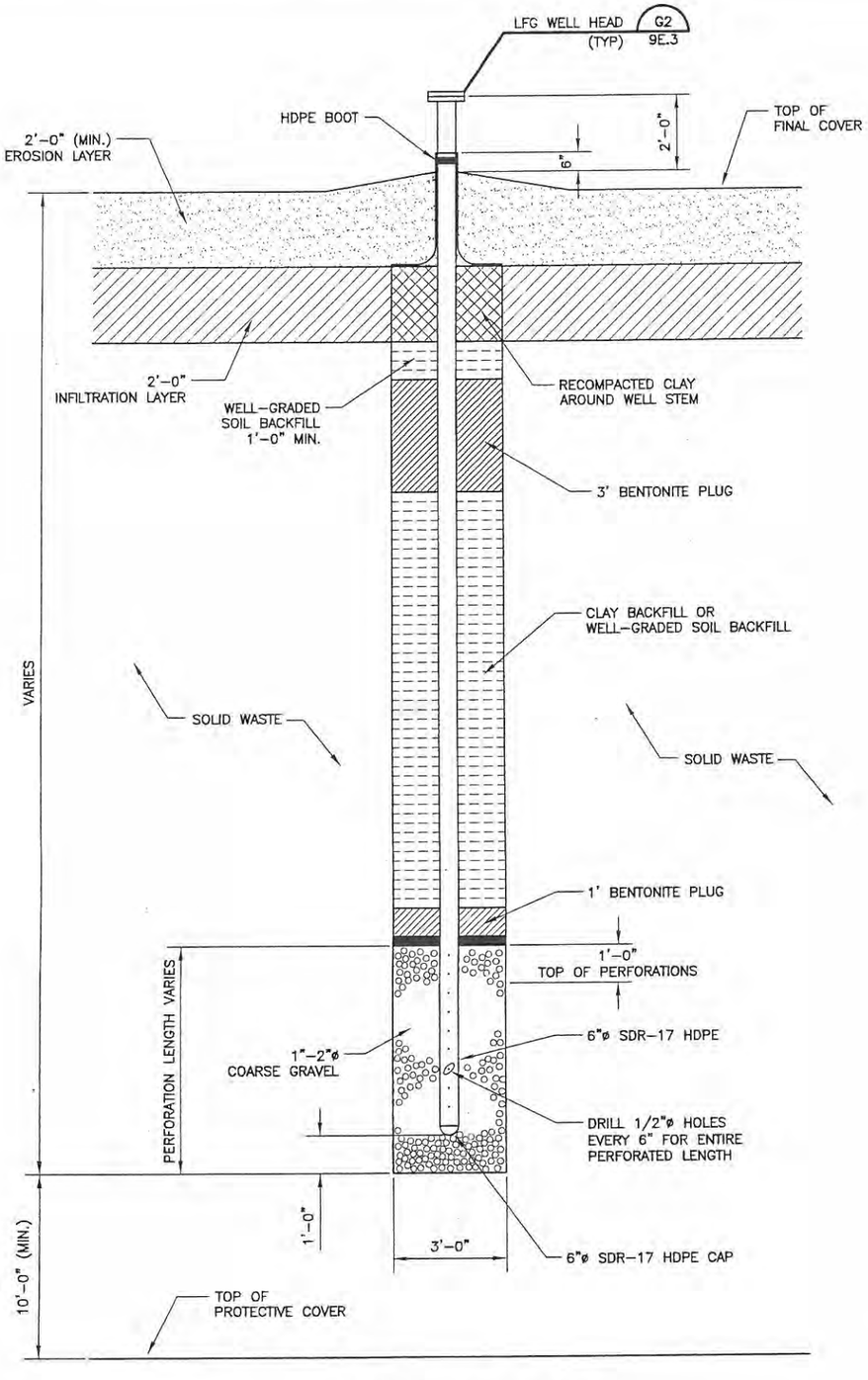
PROPOSED PASSIVE LFG WELL LOCATION PLAN

CITY OF SAN ANGELO SAN ANGELO LANDFILL MSW PERMIT NO. 79

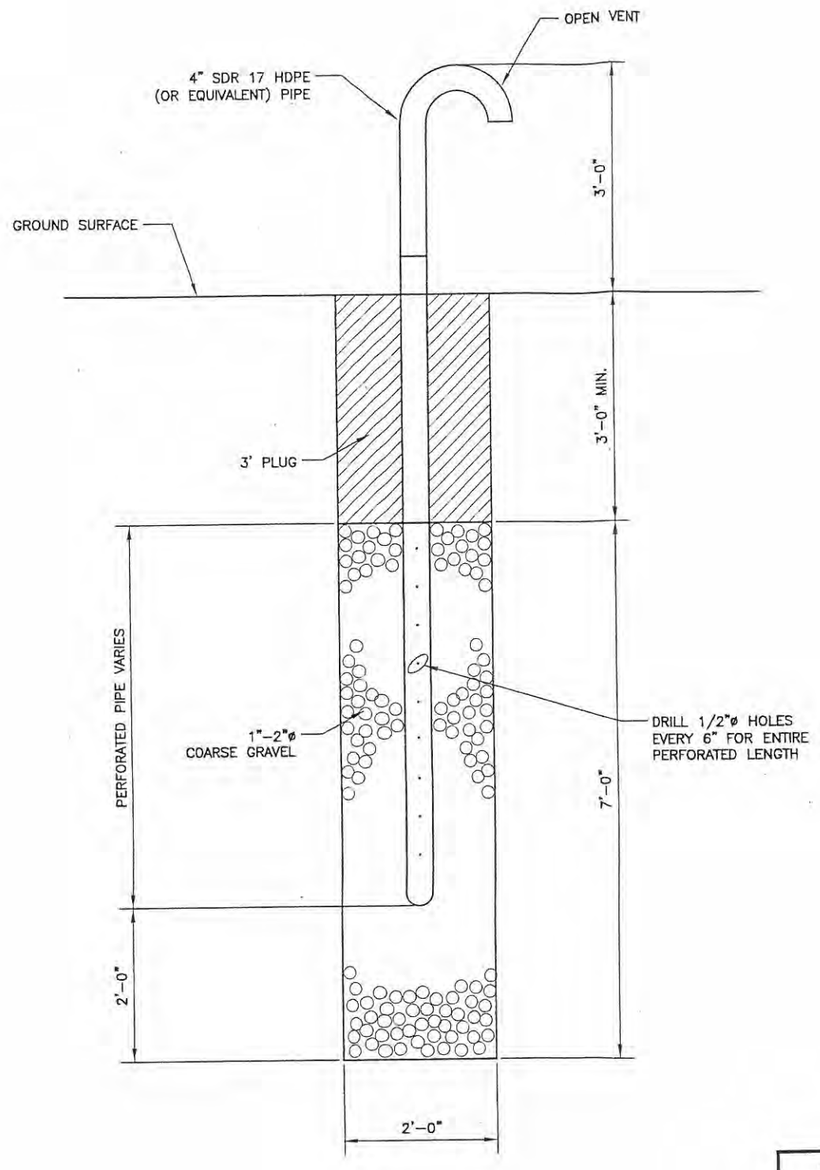
BIGGS & MATHEWS ENVIRONMENTAL
CONSULTING ENGINEERS
ARLINGTON • DALLAS
MANSFIELD • WICHITA FALLS
817-563-1144

DSN. KJW	DATE : 07/05	ATTACHMENT	
DWN. RMP	SCALE : GRAPHIC	9A.3	
CHK. KJW	DWG : LFG-Prop.dwg		

J:\225\01\901\LFG-Prop.dwg Layout: GasSystem User: osonchez



PASSIVE LFG WELL GV1
SCALE: NOT TO SCALE 9A.4



UTILITY VENT (TYPICAL) UV1
SCALE: NOT TO SCALE 9A.4

NOTES:
1. LFG WELLS ARE DESIGNED TO BE CONVERTED TO AN ACTIVE LFG COLLECTION SYSTEM, IF REQUIRED.
2. ALL SIZES AND DIMENSIONS ARE APPROXIMATE.

STATE OF TEXAS
KENNETH J. WELCH
60773
REGISTERED PROFESSIONAL ENGINEER
7/06/05

ISSUED FOR PERMITTING PURPOSES ONLY

REVISIONS						
REV	DATE	DESCRIPTION	DWN BY	DES BY	CHK BY	APP BY

TYPICAL GAS SYSTEM DETAILS

CITY OF SAN ANGELO
SAN ANGELO LANDFILL
MSW PERMIT NO. 79

BIGGS & MATHEWS ENVIRONMENTAL
CONSULTING ENGINEERS
ARLINGTON • DALLAS
MANSFIELD • WICHITA FALLS
817-563-1144

DSN. KJW	DATE : 07/05	ATTACHMENT	
DWN. RMP	SCALE : GRAPHIC	9A.4	
CHK. KJW	DWG : GasVent.dwg		

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APPENDIX 9B

REPORT AND RECORDING FORMS

SAN ANGELO LANDFILL

LANDFILL GAS MONITORING REPORT

Sampled by:_____

Date:_____ Time:_____ Temperature:_____

Weather_____ Bar. Pressure (Optional):_____

Monitoring Equipment:_____ Date of Calibration:_____

PROBE NO.	GROUND SURFACE ELEVATION	PROBE SCREEN ELEVATION RANGE	% METHANE	% O_2 (Opt.)	PRESSURE (Optional)	DEPTH TO GROUNDWATER (from top of casing in ft) optional	PROBE INTEGRITY VERIFIED Yes/No
1							
2							
3							
4							
5							
6							
7							
8							
9							
9A							
10							
10A							
11A							
12							
13							
14							
15							
16							
17							
18							

STRUCTURE	% METHANE	COMMENTS
Gatehouse\Office		
Maintenance Building		

APPENDIX 9C

INSTALLATION OF LANDFILL GAS MONITORING PROBES

LANDFILL GAS PROBE INSTALLATION REPORT

JULY 2005

(GMP-3, 13 THROUGH 18)

BIGGS & MATHEWS ENVIRONMENTAL
Consulting Engineers ♦ Hydrogeologists
Mansfield ♦ Arlington ♦ Dallas ♦ Wichita Falls

July 1, 2005
Project 225-01-901

Richard Carmichael, Ph.D., P.E., CIH
Municipal Solid Waste Division MC-124
Texas Commission on Environmental Quality
P. O. Box 13087
Austin, Texas 78711

Re: San Angelo Landfill
TCEQ MSW Permit No. 79, Tom Green County
Landfill Gas Monitoring Probe Installation Report

Dear Dr. Carmichael:

On behalf of the City of San Angelo, enclosed is the Landfill Gas Monitoring Probe Installation Report for the City of San Angelo Landfill TCEQ MSW Permit No. 79. We are providing you with two copies of the report; one copy has been sent directly to the Region 8 office. This report documents the installation of seven landfill gas (LFG) monitoring probes. Installation procedures for the monitoring probes are described in the following sections. Procedures were performed consistent with Texas Commission on Environmental Quality (TCEQ) regulations and guidelines.

If you have any questions, please do not hesitate to contact us.

Sincerely,

BIGGS & MATHEWS ENVIRONMENTAL

Michael R. Widner, P.G.
Field Services Manager

cc: Mr. Ron Lewis, City of San Angelo (4)
Mr. Mark Newman, TCEQ Region 8, San Angelo

F:\MRW\Field Services\San Angelo\Probe Install Report.doc

CITY OF SAN ANGELO LANDFILL

LANDFILL GAS MONITORING PROBE INSTALLATION REPORT

Prepared for

The City of San Angelo

July 2005



Prepared by

Biggs & Mathews Environmental
1700 Robert Road
Mansfield, Texas 76063
(817) 563-1144

Project 225-01-901

CONTENTS

1	**INTRODUCTION**		1
2	**LANDFILL GAS MONITORING PROBE INSTALLATION**		2
	2.1	Drilling	2
	2.2	Well Installation	2
	2.3	Surface Completion	2
	2.4	Surveying	2
3	**LANDFILL GAS MONITORING SYSTEM CONSTRUCTION CERTIFICATION**		2

APPENDIX A
Landfill Gas Monitoring Probe Boring Logs

APPENDIX B
Landfill Gas Monitoring Probe Installation Data Sheets

APPENDIX C
State of Texas Well Reports



FIGURES AND TABLES

FIGURES

Figure 1 – Landfill Gas Monitoring Probe Location Map

TABLES

Table 1 Landfill Gas Monitoring Probe Details

1 INTRODUCTION

The San Angelo Landfill is an existing 247-acre, Type I Municipal Solid Waste Disposal Facility owned by the City of San Angelo. The San Angelo Landfill is located in Tom Green County, Texas and provides waste disposal capacity for residences and businesses in the City of San Angelo and surrounding areas. The San Angelo Landfill is located approximately 2 miles northeast of the City of San Angelo on Old Ballinger Highway.

The current landfill gas management plan was approved as part of the 1994 Subtitle D permit modification upgrades. The perimeter landfill gas (LFG) monitoring network consists of 20 permanent LFG monitoring probes installed along the permit boundary to detect potential LFG migration. Twelve LFG monitoring probes GMP-1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11 and 12 were installed in 1994 and served as the point of compliance for the western and southern sides of the landfill. Due to landfill gas migration GMP-9A and GMP-10A were installed to a depth of 40 feet in 1996. GMP-3 was recently damaged due to remedial efforts.

The newly installed LFG monitoring probes GMP-3, 13, 14, 15, 16, 17 and 18 serve as the point of compliance regarding LFG migration for the permit boundary for the southern and eastern portions of the landfill. The LFG monitoring probes are located such that the maximum spacing between the LFG monitoring probes does not exceed 1,000 feet. Each monitoring probe location is designed to monitor soil strata above the higher of either the lowest measured groundwater level at the monitoring point or the lowest current or planned future elevation of waste within 1,000 feet of the monitoring point.

The LFG monitoring probes were installed consistent with guidelines presented in the TCEQ Municipal Solid Waste Division "Methane Monitoring Handbook", Version 2, December 1993. This report describes and documents the drilling, installation procedures, and results obtained during the exploration and installation of seven LFG monitoring probes (GMP-3, 13, 14, 15, 16, 17 and 18) at the San Angelo Landfill.

2 LANDFILL GAS MONITORING PROBE INSTALLATION

2.1 Drilling

Locations of the LFG monitoring probes are shown on Figure 1. Installation of GMP-3, 13, 14, 15, 16, 17 and 18 occurred on April 18 and 19, 2005. Borings for these probes were advanced using air rotary procedures with a truck-mounted drilling rig. The drilling produced a 7.75-inch annular outside diameter. A Texas Registered Professional Geologist using visual-manual procedures in general accordance with ASTM Standard D 2488 logged the borehole. Boring logs are included in Appendix A.

2.2 Well Installation

The probes consist of 2-inch diameter, flush-threaded PVC (Schedule 40), with 0.01-inch slotted PVC screens. The probe screens vary in length but extend to within 5 feet of the surface. The filter-pack is silica frac sand and is placed from total well depth to about 1 foot above the top of the well screen. The remainder of the well bore consists of Bentonite pellets hydrated in place. The Landfill Gas Monitoring Probe Installation Data Sheets are included in Appendix B. State of Texas well reports were filed with the Texas Water Well Drillers Board and are included in Appendix C.

2.3 Surface Completion

Surface constructions for gas monitoring probes GMP-3, 13, 14, 15, 16, 17 and 18 were completed with 4-foot by 4-foot by 6-inch thick steel reinforced concrete pads. The LFG monitoring probes include steel upright protective casings containing the following; PVC cap, quick connect sample port, pad lock, gravel in the annular space and representative ID markings. Four steel posts were installed around monitor probes.

Logs of monitoring wells (Appendix A), TCEQ Monitoring Well Data Sheets (Appendix B) and State of Texas Well Reports (Appendix C) are provided with this report.

2.4 Surveying

Well locations and elevations were surveyed by the City of San Angelo, upon completion of the drilling operations. Survey data for each well are included in Table 1.

Table 1
LFG Monitoring Probe Details

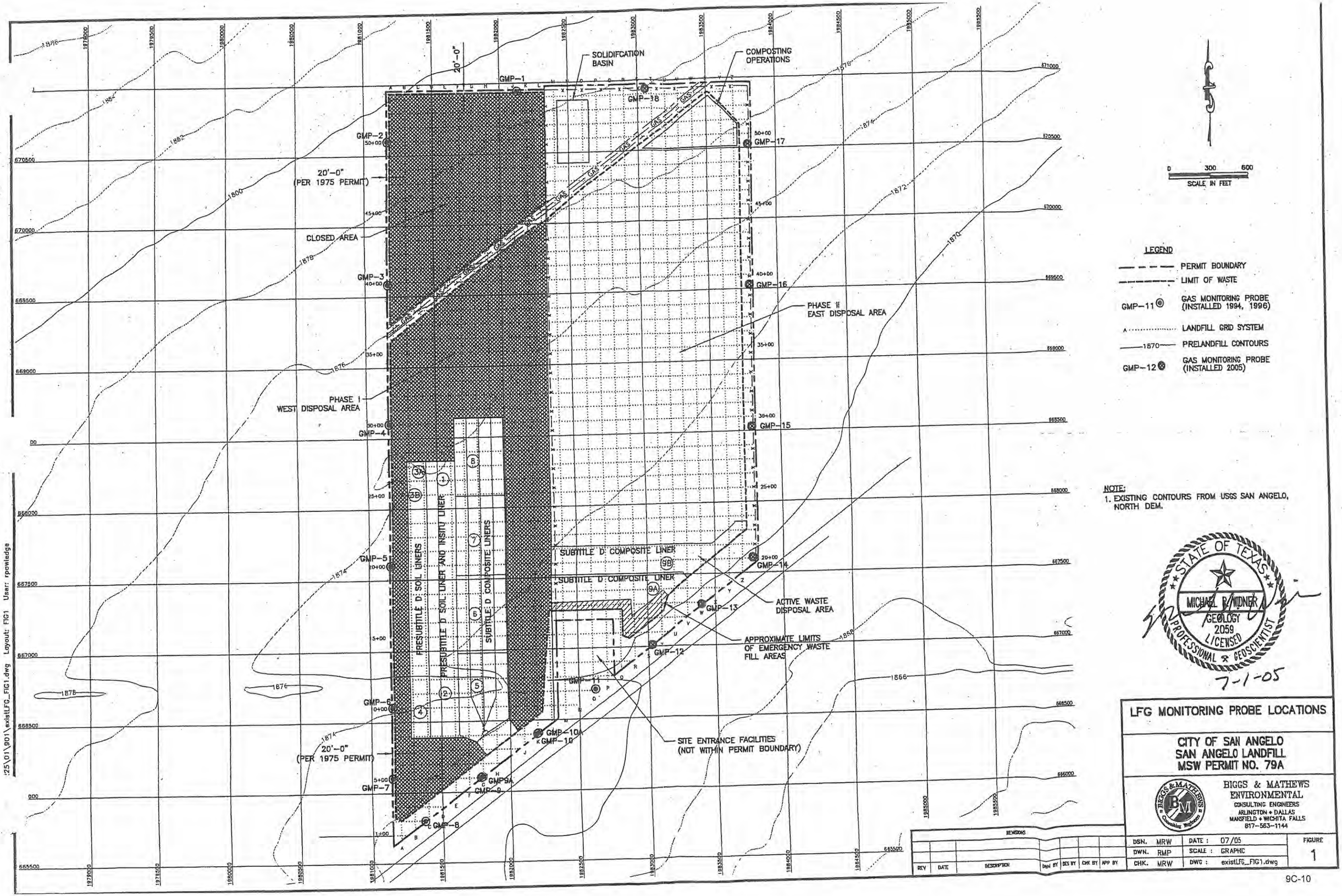
LFG Monitoring Probe Number	Northing	Easting	Surface Elevation	Bottom Elevation	Probe Total Depth
GMP-3	669584.6	1981163.6	1877.03	1857.03	20.0
GMP-13	667290.1	1983404.2	1869.46	1849.46	20.0
GMP-14	667607.9	1983777.3	1869.42	1849.42	20.0
GMP-15	668530.2	1983791.7	1870.81	1850.81	20.0
GMP-16	669528.9	1983794.7	1872.70	1852.70	20.0
GMP-17	670527.3	1983798.3	1875.34	1855.34	20.0
GMP-18	670937.5	1983055.4	1877.25	1857.25	20.0

3 MONITORING SYSTEM CONSTRUCTION CERTIFICATION

The current Landfill Gas Management Plan was approved as part of the 1994 Subtitle D Permit Modification upgrades for the City of San Angelo Landfill, TCEQ Permit No. 79. The perimeter landfill gas monitoring probes were installed at the locations, depths, and general details as provided for in the approved Landfill Gas Management Plan.

The landfill gas monitoring probe installation was performed by and under the supervision of Michael R. Widner, P.G. Mr. Widner is a registered professional geologist in Texas and a qualified scientist as defined in 30 TAC §330.2. The landfill gas monitoring probes were installed consistent with the Landfill Gas Management Plan, as approved by TCEQ.

FIGURES



NOTE:
1. EXISTING CONTOURS FROM USGS SAN ANGELO, NORTH DEM.

STATE OF TEXAS
MICHAEL R. WIDNER
GEOLOGY
2059
LICENSED
PROFESSIONAL GEOSCIENTIST

7-1-05

LFG MONITORING PROBE LOCATIONS

CITY OF SAN ANGELO
SAN ANGELO LANDFILL
MSW PERMIT NO. 79A

BIGGS & MATHEWS ENVIRONMENTAL
CONSULTING ENGINEERS
ARLINGTON • DALLAS
MANSFIELD • WICHITA FALLS
817-563-1144

REVISIONS						
REV	DATE	DESCRIPTION	Dsn BY	DES BY	CHK BY	APP BY

DSN. MRW	DATE : 07/05		FIGURE
DWN. RMP	SCALE : GRAPHIC		1
CHK. MRW	DWG : existLFG_FIG1.dwg		

25\01\901\existLFG_FIG1.dwg Layout: FIG1 User: rpowledge

APPENDIX A
Landfill Gas Monitoring Probe Logs

LOG OF GAS MONITORING PROBE NO. GMP- 3

Project Description: **City of San Angelo Landfill**
Tom Green County, Texas

Biggs and Mathews Environmental
1700 Robert Road
Mansfield, TX 76063
Phone: (817) 563-1144
Fax: (817) 563-1224

Location: **E 1981163.600 N 4358.830**

Surface El.: **1877.03 ft. msl**
Completion Depth: **20.0 ft.**
Date Boring Started: **4/18/05**
Date Boring Completed: **4/18/05**

Depth, feet	Samples	Symbol / USCS	MATERIAL DESCRIPTION	Gas Monitoring Probe Construction Details	Hand Penetrometer, tsf	Penetration Blows/Foot	Moisture Content, %	Unit Dry Weight, lb/cu ft.	Liquid Limit	Plastic Limit	Plasticity Index	% Passing No. 200 Sieve	Unc. Compressive Strength, tsf
0			CLAY, SILTY, grayish-red										
			1873.03										
5			CLAY, SILTY, grayish-orange-pink										
			1871.03										
			CLAY, SILTY, light brown										
10													
15													
20			1856.03										
25													
30													
35													
40													
45													
50													

Drilling Contractor: **ABEL Drilling**
Drilling Method: **Rotary Air**
Sampling Method: **Cuttings @ 2' intervals**
Geologist/Engineer: **K. Combest**
Project No.: **225-01-901**

Groundwater Observations	
Date	Depth

Remarks:

LOG OF GAS MONITORING PROBE NO. GMP- 3
PAGE 1 OF 1

The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.

BME LOG SAN ANGELO.GPJ BME.GDT 6/30/05

LOG OF GAS MONITORING PROBE NO. GMP-13

Project Description: **City of San Angelo Landfill**
Tom Green County, Texas

Biggs and Mathews Environmental
1700 Robert Road
Mansfield, TX 76063
Phone: (817) 563-1144
Fax: (817) 563-1224

Location: **E 1983404.200 N 667290.100**

Surface El.: **1869.46 ft. msl**
Completion Depth: **20.0 ft.**
Date Boring Started: **4/18/05**
Date Boring Completed: **4/18/05**

Depth, feet	Samples	Symbol / USCS	MATERIAL DESCRIPTION	Gas Monitoring Probe Construction Details	Hand Penetrometer, tsf	Penetration Blows/Foot	Moisture Content, %	Unit Dry Weight, lb/cu ft.	Liquid Limit	Plastic Limit	Plasticity Index	% Passing No. 200 Sieve	Unc. Compressive Strength, tsf
0			CLAY, SILTY, dusty brown										
			1867.46										
			CLAY, SILTY, mod. brown										
5			1861.46										
			CLAY, SILTY, grayish-orange-pink										
10													
15													
20			1848.46										
25													
30													
35													
40													
45													
50													

Drilling Contractor: **ABEL Drilling**
Drilling Method: **Rotary Air**
Sampling Method: **Cuttings @ 2' intervals**
Geologist/Engineer: **K. Combest**
Project No.: **225-01-901**

Groundwater Observations	
Date	Depth

Remarks:

BME LOG SAN ANGELO.GPJ BME.GDT 6/30/05

LOG OF GAS MONITORING PROBE NO. GMP-13
PAGE 1 OF 1

The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.

LOG OF GAS MONITORING PROBE NO. GMP-14

Project Description: **City of San Angelo Landfill**
Tom Green County, Texas

Biggs and Mathews Environmental
1700 Robert Road
Mansfield, TX 76063
Phone: (817) 563-1144
Fax: (817) 563-1224

Location: **E 1983777.300 N 667607.900**

Surface El.: **1869.42 ft. msl**
Completion Depth: **20.0 ft.**
Date Boring Started: **4/18/05**
Date Boring Completed: **4/18/05**

Depth, feet	Samples	Symbol / USCS	MATERIAL DESCRIPTION	Gas Monitoring Probe Construction Details	Hand Penetrometer, tsf	Penetration Blows/Foot	Moisture Content, %	Unit Dry Weight, lb/cu ft.	Liquid Limit	Plastic Limit	Plasticity Index	% Passing No. 200 Sieve	Unc. Compressive Strength, tsf
0			CLAY, SILTY, dusty brown										
			1865.42										
5			CLAY, SILTY, mod. brown										
			1861.42										
10			CLAY, SILTY, grayish-orange-pink										
15													
20			1848.42										
25													
30													
35													
40													
45													
50													

Drilling Contractor: **ABEL Drilling**
Drilling Method: **Rotary Air**
Sampling Method: **Cuttings @ 2' intervals**
Geologist/Engineer: **K. Combest**
Project No.: **225-01-901**

Groundwater Observations

Date	Depth

Remarks:

BME LOG SAN ANGELO.GPJ BME.GDT 6/30/05

LOG OF GAS MONITORING PROBE NO. GMP-14
PAGE 1 OF 1

The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.

LOG OF GAS MONITORING PROBE NO. GMP-15

Project Description: **City of San Angelo Landfill**
Tom Green County, Texas

Biggs and Mathews Environmental
1700 Robert Road
Mansfield, TX 76063
Phone: (817) 563-1144
Fax: (817) 563-1224

Location: **E 1983791.700 N 668530.200**

Surface El.: **1870.81 ft. msl**
Completion Depth: **20.0 ft.**
Date Boring Started: **4/18/05**
Date Boring Completed: **4/18/05**

Depth, feet	Samples	Symbol / USCS	MATERIAL DESCRIPTION	Gas Monitoring Probe Construction Details	Hand Penetrometer, tsf	Penetration Blows/Foot	Moisture Content, %	Unit Dry Weight, lb/cu ft.	Liquid Limit	Plastic Limit	Plasticity Index	% Passing No. 200 Sieve	Unc. Compressive Strength, tsf
0			CLAY, SILTY, dusty brown										
			1866.81										
5			CLAY, SILTY, mod. brown										
			1864.81										
			CLAY, SILTY, grayish-orange-pink										
10													
15													
			1852.81										
			CLAY, SILTY, mod. brown										
20			1849.81										
25													
30													
35													
40													
45													
50													

Drilling Contractor: **ABEL Drilling**
Drilling Method: **Rotary Air**
Sampling Method: **Cuttings @ 2' intervals**
Geologist/Engineer: **K. Combest**
Project No.: **225-01-901**

Groundwater Observations

Date	Depth

Remarks:

BME LOG SAN ANGELO.GPJ BME.GDT 6/30/05

LOG OF GAS MONITORING PROBE NO. GMP-15
PAGE 1 OF 1

The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.

LOG OF GAS MONITORING PROBE NO. GMP-16

Project Description: **City of San Angelo Landfill**
Tom Green County, Texas

Biggs and Mathews Environmental
1700 Robert Road
Mansfield, TX 76063
Phone: (817) 563-1144
Fax: (817) 563-1224

Location: **E 1973794.700 N 669528.900**

Surface El.: **1872.70 ft. msl**
Completion Depth: **20.0 ft.**
Date Boring Started: **4/18/05**
Date Boring Completed: **4/18/05**

Depth, feet	Samples	Symbol / USCS	MATERIAL DESCRIPTION	Gas Monitoring Probe Construction Details	Hand Penetrometer, tsf	Penetration Blows/Foot	Moisture Content, %	Unit Dry Weight, lb/cu ft.	Liquid Limit	Plastic Limit	Plasticity Index	% Passing No. 200 Sieve	Unc. Compressive Strength, tsf
0			CLAY, SILTY, dusty brown										
			1870.70										
5			CLAY, SILTY, light brown										
			1862.70										
10			CLAY, SILTY, grayish-orange-pink										
			1856.70										
15			CLAY, SILTY, light brown										
			1851.70										
20													
25													
30													
35													
40													
45													
50													

Drilling Contractor: **ABEL Drilling**
Drilling Method: **Rotary Air**
Sampling Method: **Cuttings @ 2' intervals**
Geologist/Engineer: **K. Combest**
Project No.: **225-01-901**

Groundwater Observations	
Date	Depth

Remarks:

BME LOG SAN ANGELO.GPJ BME.GDT 6/30/05

LOG OF GAS MONITORING PROBE NO. GMP-16
PAGE 1 OF 1

The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.

LOG OF GAS MONITORING PROBE NO. GMP-17

Project Description: **City of San Angelo Landfill**
Tom Green County, Texas

Biggs and Mathews Environmental
1700 Robert Road
Mansfield, TX 76063
Phone: (817) 563-1144
Fax: (817) 563-1224

Location: **E 1983798.300 N 670527.300**

Surface El.: **1875.34 ft. msl**
Completion Depth: **20.0 ft.**
Date Boring Started: **4/18/05**
Date Boring Completed: **4/18/05**

Depth, feet	Samples	Symbol / USCS	MATERIAL DESCRIPTION	Gas Monitoring Probe Construction Details	Hand Penetrometer, tsf	Penetration Blows/Foot	Moisture Content, %	Unit Dry Weight, lb/cu ft.	Liquid Limit	Plastic Limit	Plasticity Index	% Passing No. 200 Sieve	Unc. Compressive Strength, tsf
0			CLAY, SILTY, dusty brown										
			1873.34										
			CLAY, SILTY, light brown										
5													
10													
15			1859.34										
			CLAY, SILTY, light brown										
			1855.34										
20			CLAY, SILTY, mod. reddish-brown										
			1854.34										
25													
30													
35													
40													
45													
50													

Drilling Contractor: **ABEL Drilling**
Drilling Method: **Rotary Air**
Sampling Method: **Cuttings @ 2' intervals**
Geologist/Engineer: **K. Combest**
Project No.: **225-01-901**

Groundwater Observations	
Date	Depth

Remarks:

BME LOG SAN ANGELO.GPJ BME.GDT 6/30/05

LOG OF GAS MONITORING PROBE NO. GMP-17
PAGE 1 OF 1

The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.

LOG OF GAS MONITORING PROBE NO. GMP-18

Project Description: **City of San Angelo Landfill**
Tom Green County, Texas

Biggs and Mathews Environmental
1700 Robert Road
Mansfield, TX 76063
Phone: (817) 563-1144
Fax: (817) 563-1224

Location: **E 1983055.400 N 670937.500**

Surface El.: **1877.25 ft. msl**
Completion Depth: **20.0 ft.**
Date Boring Started: **4/18/05**
Date Boring Completed: **4/18/05**

Depth, feet	Samples	Symbol / USCS	MATERIAL DESCRIPTION	Gas Monitoring Probe Construction Details	Hand Penetrometer, tsf	Penetration Blows/Foot	Moisture Content, %	Unit Dry Weight, lb/cu ft.	Liquid Limit	Plastic Limit	Plasticity Index	% Passing No. 200 Sieve	Unc. Compressive Strength, tsf
0			CLAY, SILTY, dusty brown										
			1875.25										
			CLAY, SILTY, light brown										
5			1871.25										
			CLAY, SILTY, light brown										
10													
15			1861.25										
			CLAY, SILTY, mod. brown										
			1859.25										
20			CLAY, SILTY, mod. reddish-brown										
			1856.25										
25													
30													
35													
40													
45													
50													

Drilling Contractor: **ABEL Drilling**
Drilling Method: **Rotary Air**
Sampling Method: **Cuttings @ 2' Intervals**
Geologist/Engineer: **K. Combest**
Project No.: **225-01-901**

Groundwater Observations	
Date	Depth

Remarks:

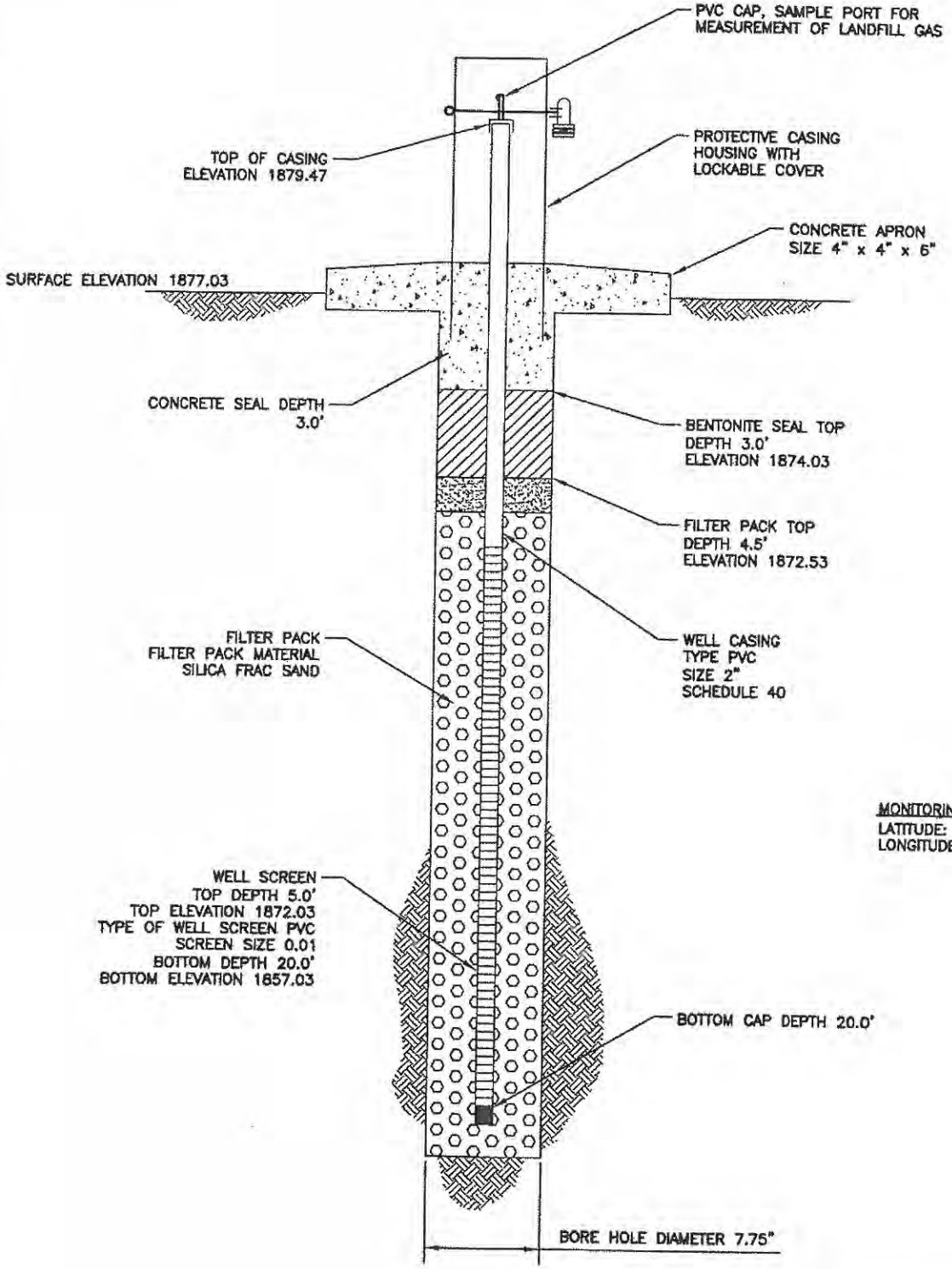
BME LOG SAN ANGELO.GPJ BME.GDT 6/30/05

LOG OF GAS MONITORING PROBE NO. GMP-18
PAGE 1 OF 1

The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.

APPENDIX B
Landfill Gas Monitoring Probe Details





J:\225\01\901\LFG_ProbeDet.dwg Layout: GMP 3 User: rpowledge

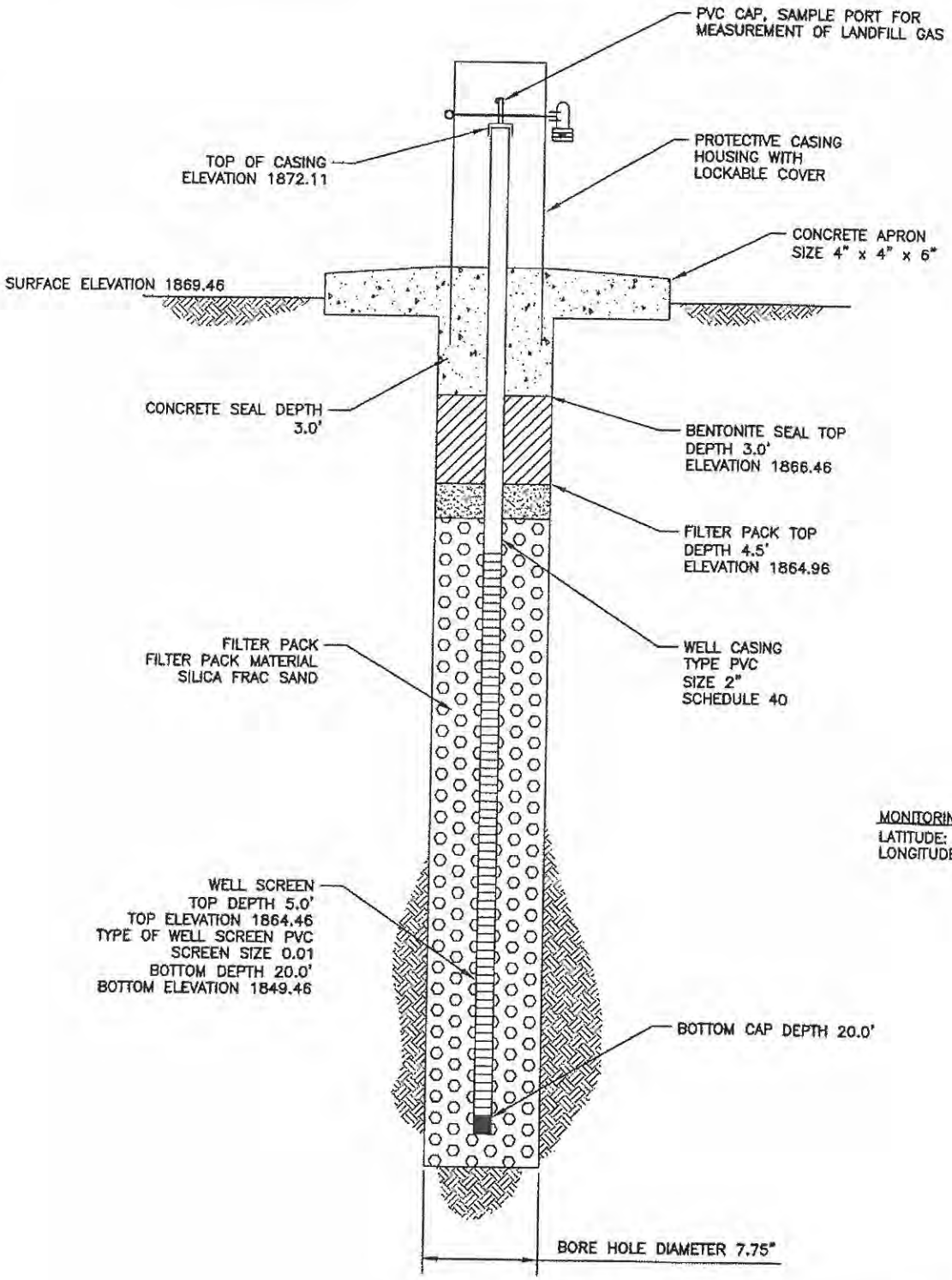
GAS MONITORING PROBE DETAIL GMP-3

CITY OF SAN ANGELO SAN ANGELO LANDFILL PROBE INSTALLATION REPORT

BIGGS & MATHEWS ENVIRONMENTAL
CONSULTING ENGINEERS
ARLINGTON • DALLAS
MANSFIELD • WICHITA FALLS
817-563-1144

REVISIONS							
REV	DATE	DESCRIPTION	DWN BY	DES BY	CHK BY	APP BY	

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CHK. MRW	DWG :LFG_ProbeDet.dwg	



GAS MONITORING PROBE DETAIL GMP–13

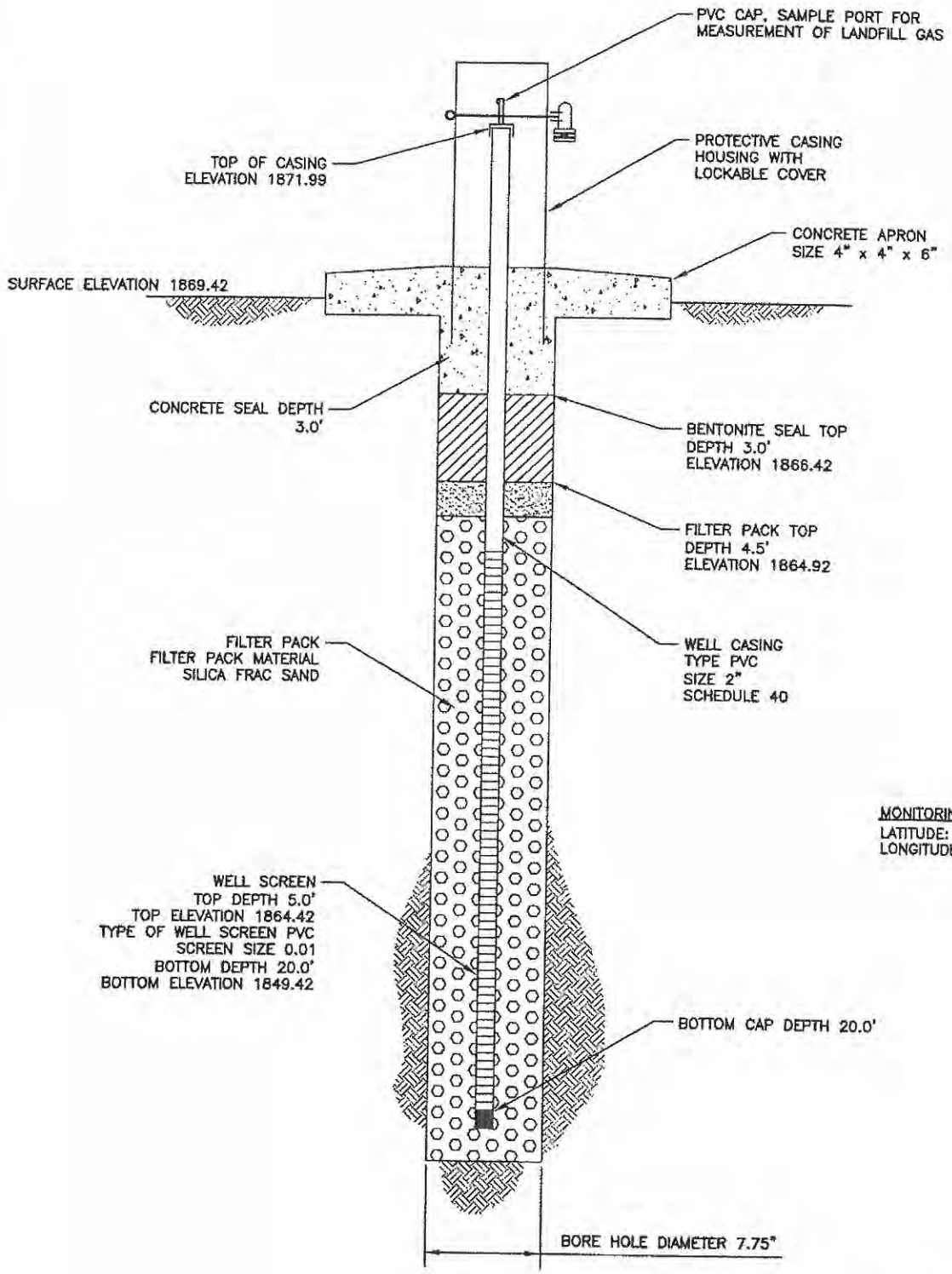
CITY OF SAN ANGELO
SAN ANGELO LANDFILL
PROBE INSTALLATION REPORT

BIGGS & MATHEWS ENVIRONMENTAL
CONSULTING ENGINEERS
ARLINGTON • DALLAS
MANSFIELD • WICHITA FALLS
817-563-1144

REVISIONS						
REV	DATE	DESCRIPTION	DWN BY	DES BY	CHK BY	APP BY

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CHK. MRW	DWG :LFG_ProbeDet.dwg	

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J:\225\01\901\LFG_ProbeDet.dwg Layout: GMP 14 User: rpowledge

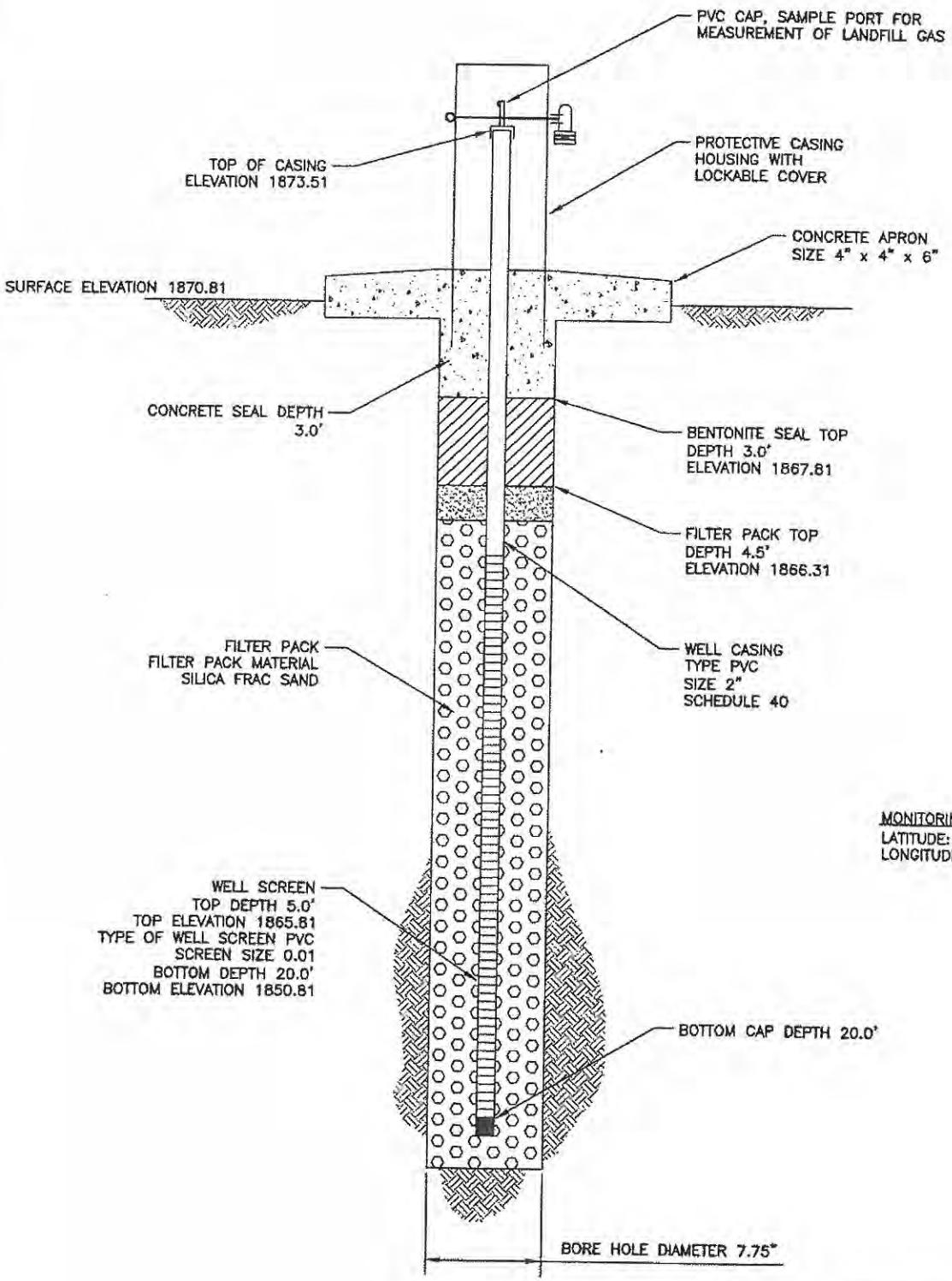
GAS MONITORING PROBE DETAIL GMP-14

CITY OF SAN ANGELO SAN ANGELO LANDFILL PROBE INSTALLATION REPORT

BIGGS & MATHEWS ENVIRONMENTAL
CONSULTING ENGINEERS
ARLINGTON • DALLAS
MANSFIELD • WICHITA FALLS
817-563-1144

REVISIONS						
REV	DATE	DESCRIPTION	DWN BY	DES BY	CHK BY	APP BY

DSN. MRW	DATE : 07/05	DRAWING 3
DWN. RMP	SCALE : GRAPHIC	
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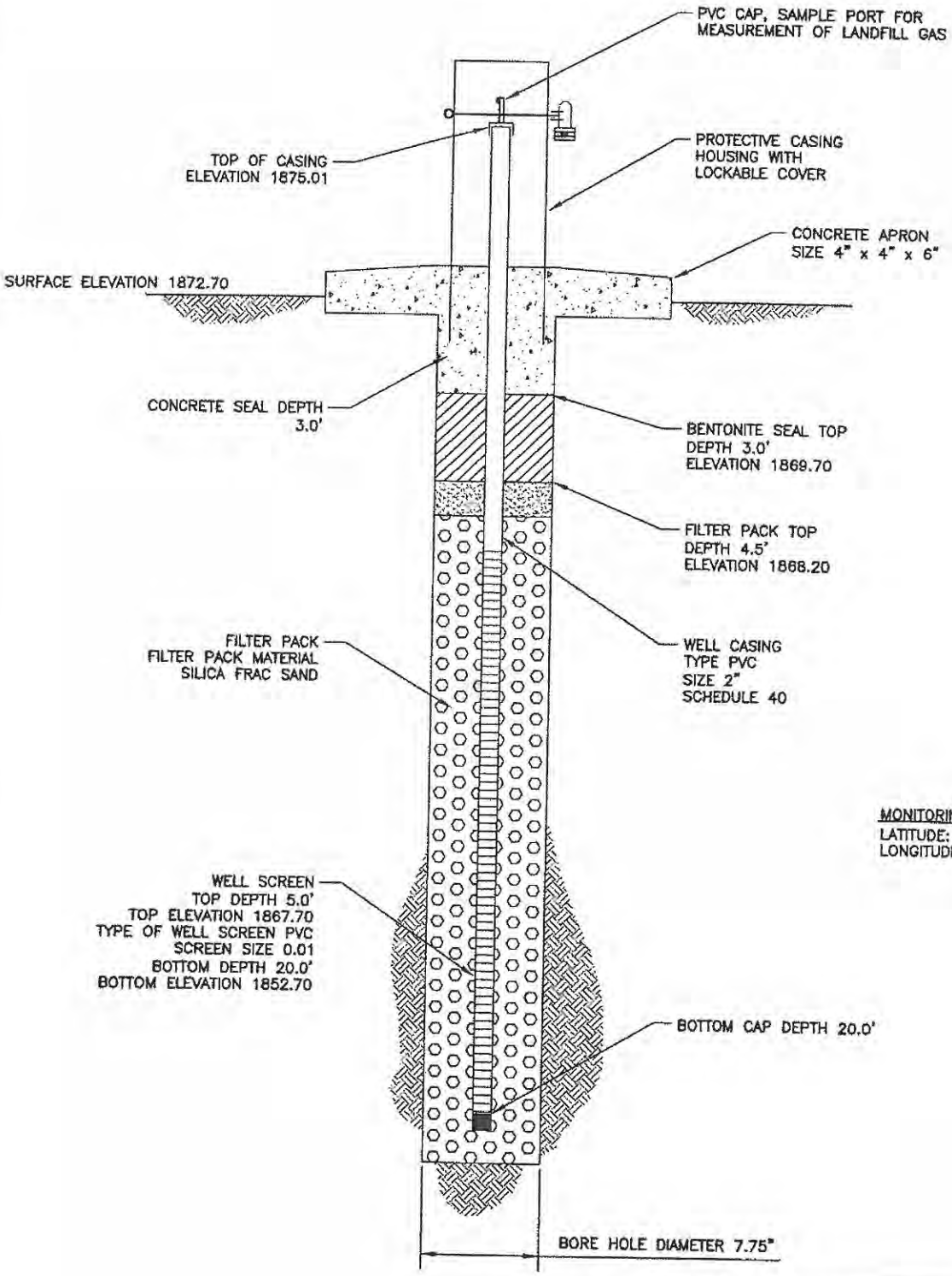
GAS MONITORING PROBE DETAIL GMP–15

CITY OF SAN ANGELO SAN ANGELO LANDFILL PROBE INSTALLATION REPORT

BIGGS & MATHEWS ENVIRONMENTAL
CONSULTING ENGINEERS
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817–563–1144

REVISIONS						
REV	DATE	DESCRIPTION	DWN BY	DES BY	CHK BY	APP BY

DSN. MRW	DATE : 07/05	DRAWING 4
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GAS MONITORING PROBE DETAIL GMP–16

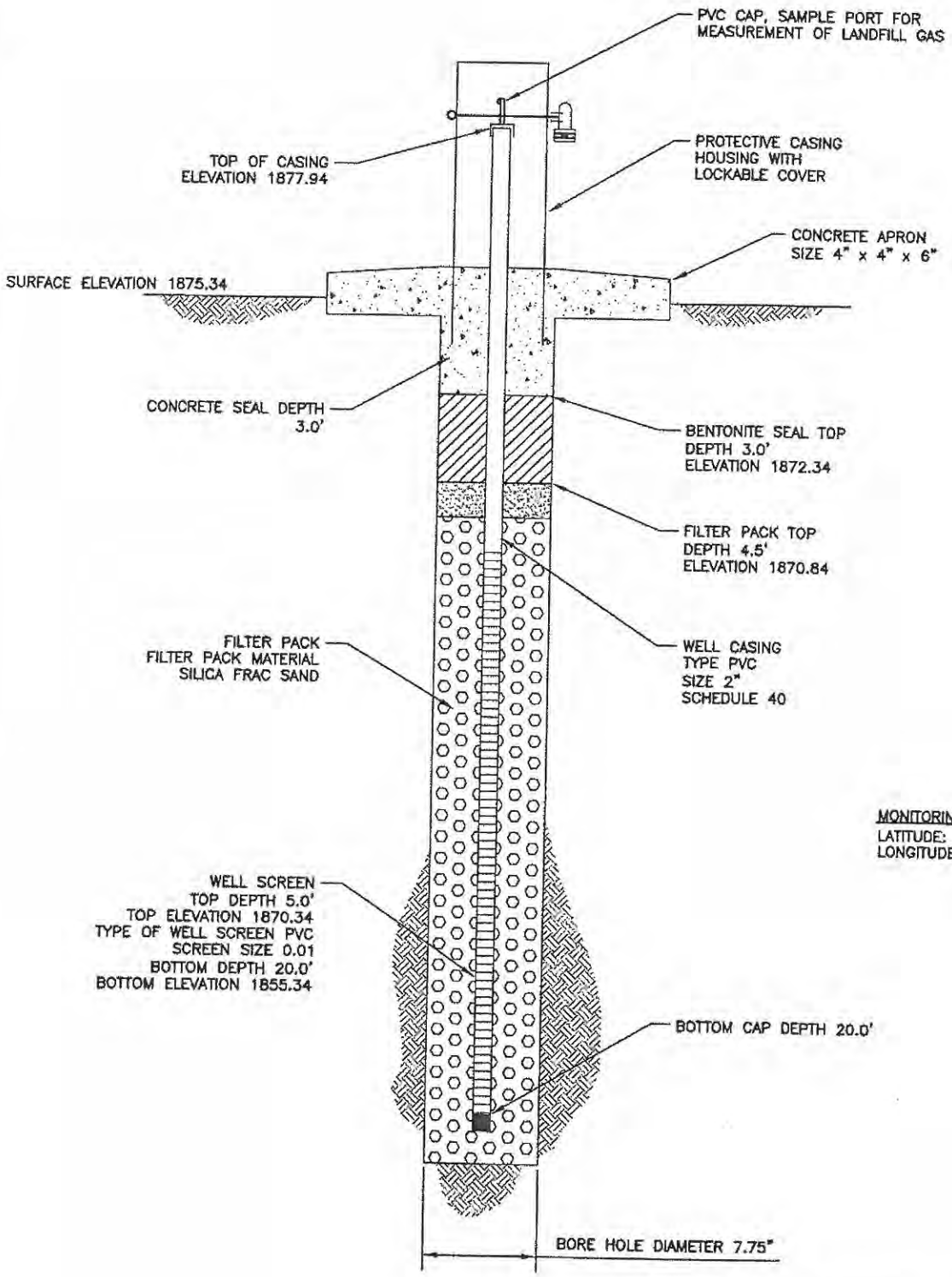
CITY OF SAN ANGELO SAN ANGELO LANDFILL PROBE INSTALLATION REPORT

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CONSULTING ENGINEERS
ARLINGTON • DALLAS
MANSFIELD • WICHITA FALLS
817-563-1144

REVISIONS						
REV	DATE	DESCRIPTION	DWN BY	DES BY	CHK BY	APP BY

DSN. MRW	DATE : 07/05	DRAWING 5
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J:\225\01\901\LFG_ProbeDet.dwg Layout: GMP 17 User: rpowledge

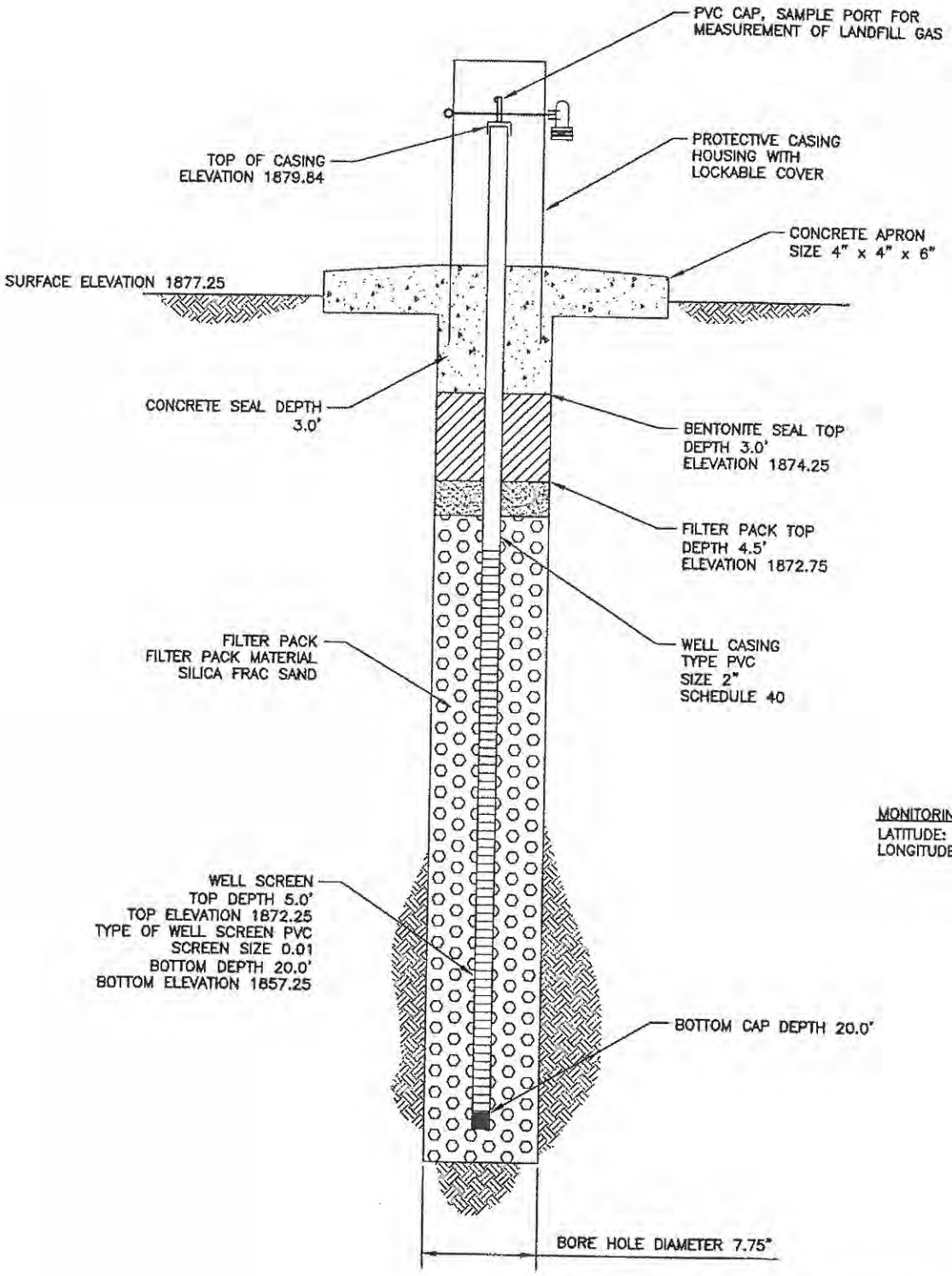
GAS MONITORING PROBE DETAIL GMP–17

CITY OF SAN ANGELO SAN ANGELO LANDFILL PROBE INSTALLATION REPORT

BIGGS & MATHEWS ENVIRONMENTAL
CONSULTING ENGINEERS
ARLINGTON • DALLAS
MANSFIELD • WICHITA FALLS
817–563–1144

REVISIONS						
REV	DATE	DESCRIPTION	DWN BY	DES BY	CHK BY	APP BY

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CHK. MRW	DWG :LFG_ProbeDet.dwg	



GAS MONITORING PROBE DETAIL GMP-18

CITY OF SAN ANGELO SAN ANGELO LANDFILL PROBE INSTALLATION REPORT

BIGGS & MATHEWS ENVIRONMENTAL
CONSULTING ENGINEERS
ARLINGTON • DALLAS
MANSFIELD • WICHITA FALLS
817-563-1144

REVISIONS						
REV	DATE	DESCRIPTION	DWN BY	DES BY	CHK BY	APP BY

DSN. MRW	DATE : 07/05	DRAWING 7
DWN. RMP	SCALE : GRAPHIC	
CHK. MRW	DWG :LFG_ProbeDet.dwg	

J:\225\01\901\LFG_ProbeDet.dwg Layout: GMP 18 User: rpowledge

APPENDIX C
State of Texas Well Reports

STATE OF TEXAS WELL REPORT for Tracking #61069

Owner:	City of San Angelo	Owner Well #:	GMP 3
Address:	PO Box 1751 San Angelo , TX 76902	Grid #:	43-29-9
Well Location:	Municipal Landfill San Angelo , TX 76905	Latitude:	31 30 28 ~~31° 30' 01" N~~
Well County:	Tom Green	Longitude:	100 23 38 ~~100° 23' 18" W~~
Elevation:	No Data	GPS Brand Used:	Garmin
Type of Work:	New Well	Proposed Use:	Monitor

Drilling Date: Started: 4/18/2005
Completed: 4/18/2005

Diameter of Hole: Diameter: 7 7/8 in From Surface To 21 ft

Drilling Method: Air Rotary

Borehole Completion: Gravel Packed From: (No Data) ft to (No Data) ft
Gravel Pack Size:

Annular Seal Data: 1st Interval: From 3 ft to 4.5 ft with 1 (#sacks and material)
2nd Interval: From 0 ft to 3 ft with 2 (#sacks and material)
3rd Interval: No Data
Method Used: No Data
Cemented By: Abel Water Systems
Distance to Septic Field or other Concentrated Contamination: 200 ft
Distance to Property Line: 4 ft
Method of Verification: Measured
Approved by Variance: No Data

Surface Completion: Surface Slab Installed

Water Level: Static level: Dry ft. below land surface on (No Data)
Artesian flow: No Data

Packers: No Data

Plugging Info: Casing or Cement/Bentonite left in well: No Data

Type Of Pump: No Data

Well Tests: No Data

Water Quality: Type of Water: None
Depth of Strata: No Data
Chemical Analysis Made: No
Did the driller knowingly penetrate any strata which contained undesirable constituents: No

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.

Company Information: Abel Water Systems
P.O. Box 348

	San Angelo , TX 76902
Driller License Number:	**2972**
Licensed Well Driller Signature:	**Clark Abel**
Registered Driller Apprentice Signature:	**No Data**
Apprentice Registration Number:	**No Data**
Comments:	**No Data**

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

TEX. OCC. CODE Title 12, Chapter 1901.251, authorizes the owner (owner or the person for whom the well was drilled) to keep information in Well Reports confidential. The Department shall hold the contents of the well log confidential and not a matter of public record if it receives, by certified mail, a written request to do so from the owner.

Please include the report's Tracking number (Tracking #61069) on your written request.

Texas Department of Licensing & Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880

DESC. & COLOR OF FORMATION MATERIAL

From (ft) To (ft) Description
0 to 3 Gray/Red silty clay
3 to 12 Light brown Clay silt
12 to 21 Light brwon clay silt

CASING, BLANK PIPE & WELL SCREEN DATA

Dia. New/Used Type Setting From/To
2" New slotted FJ PVC 20 to 5 .010
2" New solid FJ PVC 5 to +2

STATE OF TEXAS WELL REPORT for Tracking #61057

Owner:	City of San Angelo	Owner Well #:	GMP 13
Address:	PO Box 1751 San Angelo , TX 76902	Grid #:	43-29-9
Well Location:	Municipal Landfill San Angelo , TX 76905	Latitude:	31° 30' 05" N
Well County:	Tom Green	Longitude:	100° 23' 12" W
Elevation:	No Data	GPS Brand Used:	Garmin
Type of Work:	New Well	Proposed Use:	Monitor

Drilling Date: Started: 4/18/2005
Completed: 4/18/2005

Diameter of Hole: Diameter: 7 7/8 in From Surface To 21 ft

Drilling Method: Air Rotary

Borehole Completion: Gravel Packed From: (No Data) ft to (No Data) ft
Gravel Pack Size:

Annular Seal Data: 1st Interval: From 3 ft to 4.5 ft with 1 (#sacks and material)
2nd Interval: From 3 ft to 0 ft with 2 (#sacks and material)
3rd Interval: No Data
Method Used: No Data
Cemented By: Abel Water Systems
Distance to Septic Field or other Concentrated Contamination: No Data
Distance to Property Line: 4 ft
Method of Verification: Measured
Approved by Variance: No Data

Surface Completion: Surface Slab Installed

Water Level: Static level: Dry ft. below land surface on 4/18/2005
Artesian flow: No Data

Packers: No Data

Plugging Info: Casing or Cement/Bentonite left in well: No Data

Type Of Pump: No Data

Well Tests: No Data

Water Quality: Type of Water: None
Depth of Strata: No Data
Chemical Analysis Made: No
Did the driller knowingly penetrate any strata which contained undesirable constituents: No

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.

Company Information: Abel Water Systems
P.O. Box 348

	San Angelo , TX 76902
Driller License Number:	2972
Licensed Well Driller Signature:	Clark Abel
Registered Driller Apprentice Signature:	No Data
Apprentice Registration Number:	No Data
Comments:	No Data

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

TEX. OCC. CODE Title 12, Chapter 1901.251, authorizes the owner (owner or the person for whom the well was drilled) to keep information in Well Reports confidential. The Department shall hold the contents of the well log confidential and not a matter of public record if it receives, by certified mail, a written request to do so from the owner.

Please include the report's Tracking number (Tracking #61057) on your written request.

Texas Department of Licensing & Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880

DESC. & COLOR OF FORMATION MATERIAL

From (ft) To (ft) Description
0 to 1 Dusty Brown loam
1 to 5 med brown silty clay
5 to 21 Gray/Orange/pink clay silt

CASING, BLANK PIPE & WELL SCREEN DATA

Dia. New/Used Type Setting From/To
2" New Slotted FJ PVC 20 to 5 .010
2" New Solid FJ PVC 5 to +2

STATE OF TEXAS WELL REPORT for Tracking #61061

Owner:	City of San Angelo	Owner Well #:	GMP 14
Address:	PO Box 1751 San Angelo , TX 76902	Grid #:	43-29-9
Well Location:	Municipal Landfill San Angelo , TX 76905	Latitude:	31° 30' 08" N
Well County:	Tom Green	Longitude:	100° 23' 07" W
Elevation:	No Data	GPS Brand Used:	Garmin
Type of Work:	New Well	Proposed Use:	Monitor

Drilling Date: Started: 4/18/2005
Completed: 4/18/2005

Diameter of Hole: Diameter: 7 7/8 in From Surface To 21 ft

Drilling Method: Air Rotary

Borehole Completion: Gravel Packed From: (No Data) ft to (No Data) ft
Gravel Pack Size:

Annular Seal Data: 1st Interval: From 3 ft to 4.5 ft with 1 (#sacks and material)
2nd Interval: From 3 ft to 0 ft with 2 (#sacks and material)
3rd Interval: No Data
Method Used: No Data
Cemented By: Abel Water Systems
Distance to Septic Field or other Concentrated Contamination: 200 ft
Distance to Property Line: 4 ft
Method of Verification: Measured
Approved by Variance: No Data

Surface Completion: Surface Slab Installed

Water Level: Static level: Dry ft. below land surface on (No Data)
Artesian flow: No Data

Packers:

Plugging Info: Casing or Cement/Bentonite left in well: No Data

Type Of Pump: No Data

Well Tests: No Data

Water Quality: Type of Water: None
Depth of Strata: No Data
Chemical Analysis Made: No
Did the driller knowingly penetrate any strata which contained undesirable constituents: No

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.

Company Information: Abel Water Systems
P.O. Box 348

	San Angelo , TX 76902
Driller License Number:	2972
Licensed Well Driller Signature:	Clark Abel
Registered Driller Apprentice Signature:	No Data
Apprentice Registration Number:	No Data
Comments:	No Data

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

TEX. OCC. CODE Title 12, Chapter 1901.251, authorizes the owner (owner or the person for whom the well was drilled) to keep information in Well Reports confidential. The Department shall hold the contents of the well log confidential and not a matter of public record if it receives, by certified mail, a written request to do so from the owner.

Please include the report's Tracking number (Tracking #61061) on your written request.

Texas Department of Licensing & Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880

DESC. & COLOR OF FORMATION MATERIAL

From (ft) To (ft) Description
0 to 1 Dusty Brown loam
1 to 6 Med Broun silty clay
6 to 21 Gray/Orange/Pink clay silt

CASING, BLANK PIPE & WELL SCREEN DATA

Dia.	New/Used	Type	Setting From/To
2"	New	Slotted FJ PVC	20 to 5 .010
2"	New	Solid FJ PVC	5 to +2

STATE OF TEXAS WELL REPORT for Tracking #61064

Owner:	City of San Angelo	Owner Well #:	GMP 15
Address:	PO Box 1751 San Angelo , TX 76902	Grid #:	43-29-9
Well Location:	Municipal Landfill San Angelo , TX 76905	Latitude:	31° 30' 17" N
Well County:	Tom Green	Longitude:	100° 23' 07" W
Elevation:	No Data	GPS Brand Used:	Garmin
Type of Work:	New Well	Proposed Use:	Monitor

Drilling Date: Started: 4/18/2005
Completed: 4/18/2005

Diameter of Hole: Diameter: 7 7/8 in From Surface To 21 ft

Drilling Method: Air Rotary

Borehole Completion: Gravel Packed From: (No Data) ft to (No Data) ft
Gravel Pack Size:

Annular Seal Data: 1st Interval: From 3 ft to 4.5 ft with 1 (#sacks and material)
2nd Interval: From 3 ft to 0 ft with 2 (#sacks and material)
3rd Interval: No Data
Method Used: No Data
Cemented By: Abel Water Systems
Distance to Septic Field or other Concentrated Contamination: 200 ft
Distance to Property Line: 4 ft
Method of Verification: Measured
Approved by Variance: No Data

Surface Completion: Surface Slab Installed

Water Level: Static level: Dry ft. below land surface on (No Data)
Artesian flow: No Data

Packers: No Data

Plugging Info: Casing or Cement/Bentonite left in well: No Data

Type Of Pump: No Data

Well Tests: No Data

Water Quality: Type of Water: None
Depth of Strata: No Data
Chemical Analysis Made: No
Did the driller knowingly penetrate any strata which contained undesirable constituents: No

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.

Company Information: Abel Water Systems
P.O. Box 348

	San Angelo , TX 76902
Driller License Number:	2972
Licensed Well Driller Signature:	Clark Abel
Registered Driller Apprentice Signature:	No Data
Apprentice Registration Number:	No Data
Comments:	No Data

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

TEX. OCC. CODE Title 12, Chapter 1901.251, authorizes the owner (owner or the person for whom the well was drilled) to keep information in Well Reports confidential. The Department shall hold the contents of the well log confidential and not a matter of public record if it receives, by certified mail, a written request to do so from the owner.

Please include the report's Tracking number (Tracking #61064) on your written request.

Texas Department of Licensing & Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880

DESC. & COLOR OF FORMATION MATERIAL

From (ft) To (ft) Description
0 to 1 Dusty Brown loam
1 to 5 Med Brown silty clay
5 to 11 Gray/orange/pink clay silt
11 to 21 Med Brown clay silt

CASING, BLANK PIPE & WELL SCREEN DATA

Dia.	New/Used	Type	Setting From/To
2"	New	Slotted FJ PVC	20 to 5 .010
2"	New	Solid FJ PVC	5 to +2

STATE OF TEXAS WELL REPORT for Tracking #61065

Owner:	City of San Angelo	Owner Well #:	GMP 16
Address:	PO Box 1751 San Angelo , TX 76902	Grid #:	43-29-9
Well Location:	Municipal Landfill San Angelo , TX 76905	Latitude:	31° 30' 27" N
Well County:	Tom Green	Longitude:	100° 23' 07" W
Elevation:	No Data	GPS Brand Used:	Garmin
Type of Work:	New Well	Proposed Use:	Monitor

Drilling Date: Started: 4/18/2005
Completed: 4/18/2005

Diameter of Hole: Diameter: 7 7/8 in From Surface To 21 ft

Drilling Method: Air Rotary

Borehole Completion: Gravel Packed From: (No Data) ft to (No Data) ft
Gravel Pack Size:

Annular Seal Data: 1st Interval: From 3 ft to 4.5 ft with 1 (#sacks and material)
2nd Interval: From 3 ft to 0 ft with 2 (#sacks and material)
3rd Interval: No Data
Method Used: No Data
Cemented By: Abel Water Systems
Distance to Septic Field or other Concentrated Contamination: 200 ft
Distance to Property Line: 4 ft
Method of Verification: Measured
Approved by Variance: No Data

Surface Completion: Surface Slab Installed

Water Level: Static level: Dry ft. below land surface on (No Data)
Artesian flow: No Data

Packers: No Data

Plugging Info: Casing or Cement/Bentonite left in well: No Data

Type Of Pump: No Data

Well Tests: No Data

Water Quality: Type of Water: None
Depth of Strata: No Data
Chemical Analysis Made: No
Did the driller knowingly penetrate any strata which contained undesirable constituents: No

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.

Company Information: Abel Water Systems
P.O. Box 348

	San Angelo , TX 76902
Driller License Number:	2972
Licensed Well Driller Signature:	Clark Abel
Registered Driller Apprentice Signature:	No Data
Apprentice Registration Number:	No Data
Comments:	No Data

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

TEX. OCC. CODE Title 12, Chapter 1901.251, authorizes the owner (owner or the person for whom the well was drilled) to keep information in Well Reports confidential. The Department shall hold the contents of the well log confidential and not a matter of public record if it receives, by certified mail, a written request to do so from the owner.

Please include the report's Tracking number (Tracking #61065) on your written request.

Texas Department of Licensing & Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880

DESC. & COLOR OF FORMATION MATERIAL

From (ft) To (ft) Description
0 to 1 dusty Brown loam
1 to 5 Light brown clay silt
5 to 13 Gray/orange clay silt
13 to 21 Light brown clay silt

CASING, BLANK PIPE & WELL SCREEN DATA

Dia. New/Used Type Setting From/To
2" New slotted FJ PVC 20 to 5 .010
2" New solid FJ PVC 5 to +2

STATE OF TEXAS WELL REPORT for Tracking #61066

Owner:	C.S.A.	Owner Well #:	GMP 17
Address:	PO Box 1751 San Angelo , TX 76902	Grid #:	43-29-9
Well Location:	Municipal Landfill San Angelo , TX 76905	Latitude:	31° 30' 37" N
Well County:	Tom Green	Longitude:	100° 23' 07" W
Elevation:	No Data	GPS Brand Used:	Garmin
Type of Work:	New Well	Proposed Use:	Monitor

Drilling Date: Started: 4/18/2005
Completed: 4/18/2005

Diameter of Hole: Diameter: 7 7/8 in From Surface To 21 ft

Drilling Method: Air Rotary

Borehole Completion: Gravel Packed From: (No Data) ft to (No Data) ft
Gravel Pack Size:

Annular Seal Data: 1st Interval: From 3 ft to 4.5 ft with 1 (#sacks and material)
2nd Interval: From 3 ft to 0 ft with 2 (#sacks and material)
3rd Interval: No Data
Method Used: No Data
Cemented By: Abel Water Systems
Distance to Septic Field or other Concentrated Contamination: 200 ft
Distance to Property Line: 4 ft
Method of Verification: Measured
Approved by Variance: No Data

Surface Completion: Surface Slab Installed

Water Level: Static level: Dry ft. below land surface on (No Data)
Artesian flow: No Data

Packers: No Data

Plugging Info: Casing or Cement/Bentonite left in well: No Data

Type Of Pump: No Data

Well Tests: No Data

Water Quality: Type of Water: None
Depth of Strata: No Data
Chemical Analysis Made: No
Did the driller knowingly penetrate any strata which contained undesirable constituents: No

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.

Company Information: Abel Water Systems
P.O. Box 348

	San Angelo , TX 76902
Driller License Number:	2972
Licensed Well Driller Signature:	Clark Abel
Registered Driller Apprentice Signature:	No Data
Apprentice Registration Number:	No Data
Comments:	No Data

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

TEX. OCC. CODE Title 12, Chapter 1901.251, authorizes the owner (owner or the person for whom the well was drilled) to keep information in Well Reports confidential. The Department shall hold the contents of the well log confidential and not a matter of public record if it receives, by certified mail, a written request to do so from the owner.

Please include the report's Tracking number (Tracking #61066) on your written request.

Texas Department of Licensing & Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880

DESC. & COLOR OF FORMATION MATERIAL

From (ft) To (ft) Description
0 to 1 Dusty brown loam
1 to 9 Light brwon clay silt
11 to 18 Light brwon clay silt
18 to 21 Med Reddish brown silt

CASING, BLANK PIPE & WELL SCREEN DATA

Dia. New/Used Type Setting From/To
2" New slotted FJ PVC 20 to 5 .010
2" New solid FJ PVC 5 to +2

STATE OF TEXAS WELL REPORT for Tracking #61068

Owner:	City of San Angelo	Owner Well #:	GMP 18
Address:	PO Box 1751 San Angelo , TX 76902	Grid #:	43-29-9
Well Location:	Municipal Landfill San Angelo , TX 76905	Latitude:	31° 30' 41" N
Well County:	Tom Green	Longitude:	100° 23' 16" W
Elevation:	No Data	GPS Brand Used:	Garmin
Type of Work:	New Well	Proposed Use:	Monitor

Drilling Date: Started: 4/18/2005
Completed: 4/18/2005

Diameter of Hole: Diameter: 7 7/8 in From Surface To 21 ft

Drilling Method: Air Rotary

Borehole Completion: Gravel Packed From: (No Data) ft to (No Data) ft
Gravel Pack Size:

Annular Seal Data: 1st Interval: From 3 ft to 4.5 ft with 1 (#sacks and material)
2nd Interval: From 3 ft to 0 ft with 2 (#sacks and material)
3rd Interval: No Data
Method Used: No Data
Cemented By: Abel Water Systems
Distance to Septic Field or other Concentrated Contamination: 200 ft
Distance to Property Line: 4 ft
Method of Verification: Measured
Approved by Variance: No Data

Surface Completion: Surface Slab Installed

Water Level: Static level: Dry ft. below land surface on (No Data)
Artesian flow: No Data

Packers: No Data

Plugging Info: Casing or Cement/Bentonite left in well: No Data

Type Of Pump: No Data

Well Tests: No Data

Water Quality: Type of Water: None
Depth of Strata: No Data
Chemical Analysis Made: No
Did the driller knowingly penetrate any strata which contained undesirable constituents: No

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.

Company Information: Abel Water Systems
P.O. Box 348

	San Angelo , TX 76902
Driller License Number:	2972
Licensed Well Driller Signature:	Clark Abel
Registered Driller Apprentice Signature:	No Data
Apprentice Registration Number:	No Data
Comments:	No Data

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

TEX. OCC. CODE Title 12, Chapter 1901.251, authorizes the owner (owner or the person for whom the well was drilled) to keep information in Well Reports confidential. The Department shall hold the contents of the well log confidential and not a matter of public record if it receives, by certified mail, a written request to do so from the owner.

Please include the report's Tracking number (Tracking #61068) on your written request.

Texas Department of Licensing & Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880

DESC. & COLOR OF FORMATION MATERIAL

From (ft) To (ft) Description
0 to 1 Dusty brown loam
1 to 4 Light brown clay silt
4 to 11 light brown clay silt
11 to 17 Med brwon clay silt
17 to 21 Med reddish brwon clay silt

CASING, BLANK PIPE & WELL SCREEN DATA

Dia. New/Used Type Setting From/To
2" New slotted FJ PVC 20 to 5 .010
2" New solid FJ PVC 5 to +2

GAS PROBE INSTALLATION REPORT

MARCH 2013

(GMP – 11A)

Hydrogeologic / Environmental Testing
Groundwater Specialists
P. O. Box 1364 • Alvin, Texas 77512

March 15, 2013
H/ET 2012-12-19

Texas Commission on Environmental Quality
Municipal Solid Waste Permit Section
P.O. Box 13087 - MC 124
Austin, Texas 78711-3087

Attention: Mr. Arten Avakian

Methane Gas Probe Installation
City of San Angelo Landfill
Permit No. 79
Tom Green County, Texas

Dear Mr. Avakian,

Hydrogeologic/Environmental Testing (H/ET) is pleased to submit this installation report on behalf of the City of San Angelo Landfill

This report represents the proper installation and certification of one (1) methane probe into the methane gas probe system. We are submitting this report for Texas Commission on Environmental Quality approval and for the incorporation of this document into the Site Development Plan.

This document verifies the system installed will meet the requirements pertaining to the installation and development of the sites' landfill gas monitoring system. Hydrogeologic/Environmental Testing feels that the system will function as a detection system to protect the migration of landfill gas from the facility.

The facility is in compliance with 30 TAC §330.371. Hydrogeologic/Environmental Testing, it's subcontractors, and suppliers have provided a quality product to our client. We feel that we have met all the regulatory requirements. We thank you in advance for your consideration and review of this installation report.

Respectfully submitted,
HYDROGEOLOGIC/ENVIRONMENTAL TESTING

STATE OF TEXAS
3/15/2013
STEFAN STAMOULIS
GEOLOGY
333
LICENSED
PROFESSIONAL GEOSCIENTIST

Stefan Stamoulis
Principal Hydrogeologist
TX 333
SS/cs

Local (409) 927-4500 • Fax (409) 927-4540

Hydrogeologic / Environmental Testing
Groundwater Specialists
P. O. Box 1364 • Alvin, Texas 77512

March 15, 2013
H/ET 2012-12-19

Texas Commission on Environmental Quality
Municipal Solid Waste Permit Section
P.O. Box 13087 - MC124
Austin, Texas 87811-3087

Attention: Mr. Arten Avakian

Methane Gas Probe Installation
City of San Angelo Landfill
Permit No. 79
Tom Green County, Texas

Dear Mr. Avakian,

INTRODUCTION

This report describes and documents the installation procedures and results obtained during the drilling at the City of San Angelo Landfill, Permit No. 79, in Tom Green County, Texas. The installation was performed by Hydrogeologic/Environmental Testing (H/ET), and its drilling sub-contractors for the facility.

PURPOSE AND SCOPE

The purpose of the methane probe installation has been to replace a damage probe location. The system was installed as proposed and approved in the permit modification approved on February 1, 2013, by the Texas Commission on Environmental Quality.

The scope of work for this project consisted of the following:

- Drilling and logging a total of one (1) gas probe location;
- Installing one (1) methane gas probe designated as GMP-11A;
- Constructing concrete pads with protective casings;
- Plugging and abandonment of one (1) methane gas probe designated as GMP-11;
- Preparing a factual installation report for submittal to the City of San Angelo Landfill, and to the Texas Commission on Environmental Quality.

Local (409) 927-4500 • Fax (409) 927-4540

FIELD INVESTIGATION

The field investigation consisted of drilling and logging one (1) boring and installing one (1) methane gas probe. The investigation was executed to drill and install the methane gas probe as a replacement to the damage probe.

SUPERVISION

The field investigation was conducted and performed under the direct supervision of a Hydrogeologic/Environmental Testing, geologist who was on site during the field investigation and methane gas probe installation activities.

DRILLING AND SAMPLING

The drilling operation for the boreholes and subsequent probe installation was conducted on February 18, 2013. Drilling operations were conducted in general accordance with ASTM and/or Corps of Engineers' (COE) procedures. In instances where ASTM or COE procedures have not been developed or were not appropriate, these items were performed in general accordance with Hydrogeologic/Environmental Testing, standard operating procedures or generally accepted practices.

DRILLING

The boring was advanced with a truck mounted drill rig utilizing air rotary methods. The drilling equipment and downhole tools were decontaminated with a high-pressure steam cleaner prior to beginning the borehole.

LOGGING OF BORINGS

The boring was field logged by a Hydrogeologic/Environmental Testing geologist using visual-manual procedures, in general accordance with ASTM standard D2488. Field logs were used to prepare the final boring log.

PRESENTATION OF DATA

The probe location designated as GMP-11A is presented on the Methane Gas Probe Location map presented in Appendix A as Plate A.1. The final boring log is presented in Appendix A as Plate A.3. General notes to the boring log, which describe symbols used on the log, is presented as Plate A.2, also in Appendix A.

BOREHOLE INSTALLATIONS

Upon completion of the borehole, a methane gas probe was installed in the annular space. (Section "Methane Gas Probe Installation" of this report discusses the installation procedure for the gas probe).

METHANE GAS PROBE INSTALLATION

Presented below is a description of the drilling methods, installation techniques, and documentation of the methane gas probe and surface completion.

DRILLING METHODS

Drilling and installation of the gas probe designated as GMP-11A was executed on February 18, 2013. The borehole for the installation of the gas probe was advanced using the air rotary method with a truck mounted drill rig. The bit produced an annular outside diameter of 6 ½ inches. The borehole was visually logged by a Hydrogeologic/Environmental Testing, geologist using visual-manual procedures in general accordance with ATSM standard D2488. The field logs and data were used to produce the final boring log for the methane gas probe, which is presented in Appendix A.

METHANE GAS PROBE CONFIGURATION

The installation was performed consistent with the proposed probe configuration. The probe was designed to contain screen sections from 5.0 to 20.0 feet. The probe was constructed with 2- inch flush threaded PVC. The screen slot size consisted of 0.010-inch openings. Pea gravel 3/8-inch was installed in the screen zone. A bentonite seal was placed on top of the gravel layer to a distance of three foot below ground surface.

INSTALLATION TECHNIQUES FOR THE METHANE PROBES

Installation of the methane gas probe began when the total depth was achieved. The geologist and drilling crew, using disposable vinyl gloves, assembled the required riser and screen section. The probe assembly was then lowered inside the annular space and set in place. The 3/8 inch pea gravel was placed in the annular space by hand pouring. Measurements of the gravel depths were performed continuously as the pea gravel was installed into place. The bentonite chips were placed inside the annular space and allowed to drop into place. Continuous measurements of the bentonite were performed as it was being installed.

SURFACE COMPLETION

The methane gas probe was designed to contain a (4' X 4') concrete surface pad and upright protective casings. The protective casing was gravel filled in the annular spacing and contained a lock. The location contains a quick disconnect for sampling. The methane gas probe is designated with representative markings. Completion details concerning the specific design are included on the methane gas probe installation sheets located in Appendix B presented as Plates B.1. Texas Water Wells Drillers Logs are located in Appendix C presented as Plates C.1.

METHANE MEASUREMENT

Methane monitoring will be performed as stated in the Site Development Plan on a quarterly basis.

SURVEYING

The surveying was performed by Surveying and Mapping, Inc., of Dallas, Texas, as a sub-consultant. The surveying was performed on February 28, 2013. The survey data has been summarized below:

SURVEY SUMMARY					
Well Designation	**Latitude**	**Longitude**	**Natural Ground Elev.**	**Survey Pin**	**Elevation PVC Top of Casing**
GMP-11A	31°29'59"	100°23'22"	1870.31'	1870.87'	1872.76'

PLUGING AND ABAONDMENT

Plugging and abandonment was performed on one (1) existing methane gas probe designated as GMP-11.

Plugging was performed on February 18, 2013. A copy of the Texas Department of Licensing and Regulations, State of Texas Plugging Reports for GMP-11 is presented in Appendix D as Plate D.1.

REPORT CLOSURE

This report has been prepared for the City of San Angelo Landfill, Permit No. 79, Tom Green County, Texas, at the specific site and with the purpose described herein. This report represents documentation and techniques for the drilling, and the installation of one (1) methane gas probe, located at the City of San Angelo Landfill.

The services performed in this report are consistent with the agreement between Hydrogeologic/Environmental Testing, and our client, and with the Texas Commission on Environmental Quality accepted principals and practices. This report is solely for the use and information of the Texas Commission on Environmental Quality and the City of San Angelo Landfill, unless otherwise noted.

It is the opinion of Hydrogeologic/Environmental Testing that methane probe GMP-11A was installed and will function as intended. Hydrogeologic/Environmental Testing feels that all requirements concerning the installation are in compliance with MSWMR 30 TAC §330.159.

Hydrogeologic/Environmental Testing is submitting this installation report as certification that all requirements have been met and for the approval of the Texas Commission on Environmental Quality.

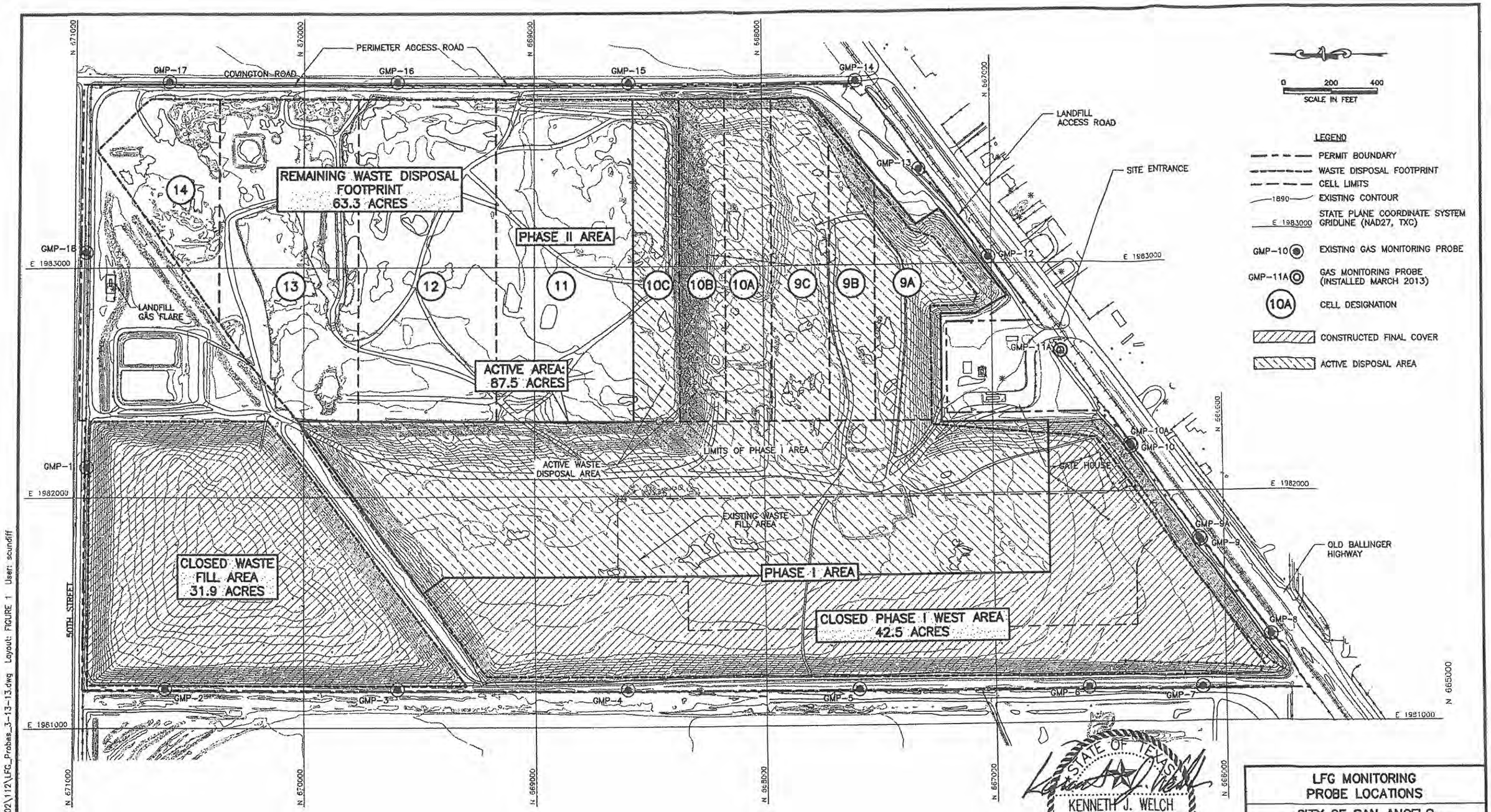
Respectfully submitted,
Hydrogeologic/Environmental Testing

STATE OF TEXAS
3/15/2013
STEFAN STAMOULIS
GEOLOGY
333
LICENSED
PROFESSIONAL GEOSCIENTIST

Stefan Stamoulis
Principal Hydrogeologist
TX 333

SS/cs
Enclosures

APPENDIX A



NOTES:

1. EXISTING CONTOURS COMPILED FROM AERIAL SURVEY FLOWN ON JANUARY 26, 2012 BY COOPER AERIAL SURVEYS.
2. GMP-11 PLUGGED. REPLACEMENT PROBE GMP-11A INSTALLED MARCH 2013.

STATE OF TEXAS
KENNETH J. WELCH
60773
REGISTERED PROFESSIONAL ENGINEER
3/13/13

ISSUED FOR PERMITTING PURPOSES

REVISIONS						
REV	DATE	DESCRIPTION	DWN BY	DES BY	CHK BY	APP BY

LFG MONITORING PROBE LOCATIONS

CITY OF SAN ANGELO SAN ANGELO LANDFILL PERMIT MODIFICATION

BIGGS & MATHEWS ENVIRONMENTAL
CONSULTING ENGINEERS
MANSFIELD • WICHITA FALLS
817-563-1144

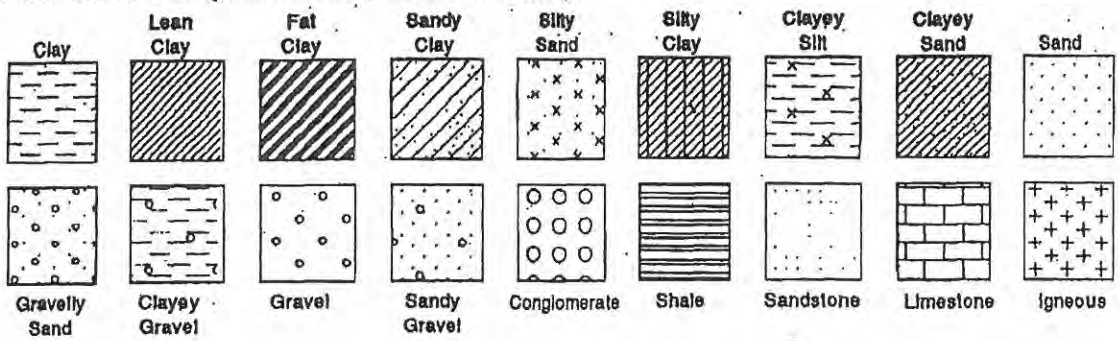
DSN.	KJW	DATE : 03/13	FIGURE 1
DWN.	SRC	SCALE : GRAPHIC	
CHK.	KJW	DWG : LFG_Probes_3-13-13.dwg	

J:\225\02\112\LFG_Probes_3-13-13.dwg Layout: FIGURE 1 User: scundiff

Plate A.1
9C-48

GENERAL NOTES

SOIL OR ROCK TYPES (shown in symbols column)



DRILLING AND SAMPLING SYMBOLS:

U = Thin-walled Tube – 3" O.D., unless otherwise noted

S = Split Barrel Sampler – 2" O.D., unless otherwise noted
Example: 25 = 25 blows/12" after 6" seating interval;
50 / 7 = 50 blows / 7" after 6" seating interval;
REF = 50 blows < 6"

C = Double Tube Core Barrel

T = THD Cone Penetrometer
Example: T60 = 60 blows/12"; T4.5" = 100 blows/4.5"

A = Auger Sample

W = Wash Sample

P = Packer Test

D = Denison Sample

RELATIVE DENSITY OF COARSE-GRAINED SOILS

PENETRATION RESISTANCE BLOWS/FOOT	RELATIVE DENSITY
0 – 4	Very loose
4 – 10	Loose
10 – 30	Medium Dense
30 – 50	Dense
Over 50	Very Dense

CONSISTENCY OF FINE-GRAINED SOILS

UNCONFINED COMPRESSIVE STRENGTH, Qu, tsf	CONSISTENCY
Less than 0.25	Very soft
0.25 to 0.50	Soft
0.50 to 1.00	Firm
1.00 to 2.00	Stiff
2.00 to 4.00	Very Stiff
4.00 and Higher	Hard

TERMS CHARACTERIZING SOIL STRUCTURE:

Slickensided	Having inclined planes of weakness that are slick and glossy in appearance.
Fissured	Containing shrinkage cracks, frequently filled with fine sand or silt; usually more or less vertical.
Laminated	Composed of thin layers of varying color and texture.
Interbedded	Composed of alternate layers of different soil types.
Calcareous	Containing appreciable quantities of calcium carbonate.
Well Graded	Having wide range in grain sizes and substantial amounts of all intermediate particle sizes.
Poorly Graded	Predominantly of one grain size, or having a range of sizes with some intermediate size missing.

DEGREE OF WEATHERING:

Unweathered	No visible sign of decomposition or discoloration.
Slightly weathered	Slight discoloration inwards from open fractures, otherwise similar to unweathered.
Moderately weathered	Discoloration throughout, strength somewhat less than unweathered rock.
Highly weathered	Discoloration throughout, strength much less than unweathered rock.

SUBSURFACE CONDITIONS:

Soil and rock descriptions on the boring logs are a compilation of field data as well as from laboratory testing of samples on those strata for which laboratory classification test results are presented on the boring logs. These classifications are based only on the actual samples tested, and classification is then assigned to the remainder of the stratum interval based on visual classification. If laboratory classification test results are not presented on the boring log for a particular stratum, then that stratum was classified by visual-manual procedures only. The stratification lines represent the approximate boundary between materials and the transition can be gradual.

Classification of soils based upon visual-manual procedures were performed in general accordance with ASTM Standard D2488. Classification of soils based upon laboratory test results was performed in general accordance with ASTM Standard D2487.

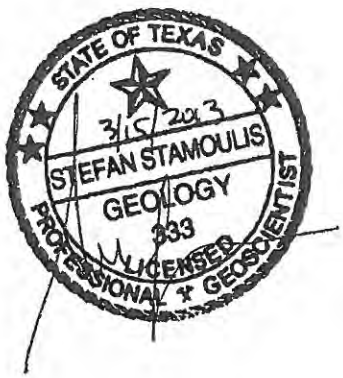
Water-level observations have been made in the borings at the times indicated. It must be noted that fluctuations in the ground-water level may occur due to variations in rainfall, hydraulic conductivity of soil strata, construction activity, and other factors.

LOG OF BORING NO. GMP-11A

Project Description: **City of San Angelo Landfill**
San Angelo, Texas - Tom Green Co. Permit No. 79

Location: **31°29'59"/100°23'22"**
Surface El.: **1870.31'**

Depth, feet	Samples	Symbol / USCS	MATERIAL DESCRIPTION	Pocket Penetrometer, TSF	Penetration Blows / Foot	Recovery %	RQD	Moisture Content, %	Unit Dry Weight, lb/cu ft.	Liquid Limit	Plastic Limit	Plasticity Index	% Passing No. 200 Sieve	Unc. Compressive Strength, tsf
0			**CLAY, SILTY,** brown to dark brown, stiff.											
4.5			**CLAYEY SILT,,** tan to light pinkish tan, with calcareous nodules, dry, hard, with limestone fragments.											
12.0			**SILTY CLAY,** tan to light brown, dry, hard.											
21.0														



Completion Depth: **21.0**
Date Boring Started: **2/18/13**
Date Boring Completed: **2/18/13**
Engineer/Geologist: **Stamoulis**
Project No.: **2012-12-19**

Remarks: **Installed gas probe upon completion of borehole. See Plate B.1 for well specifications.**

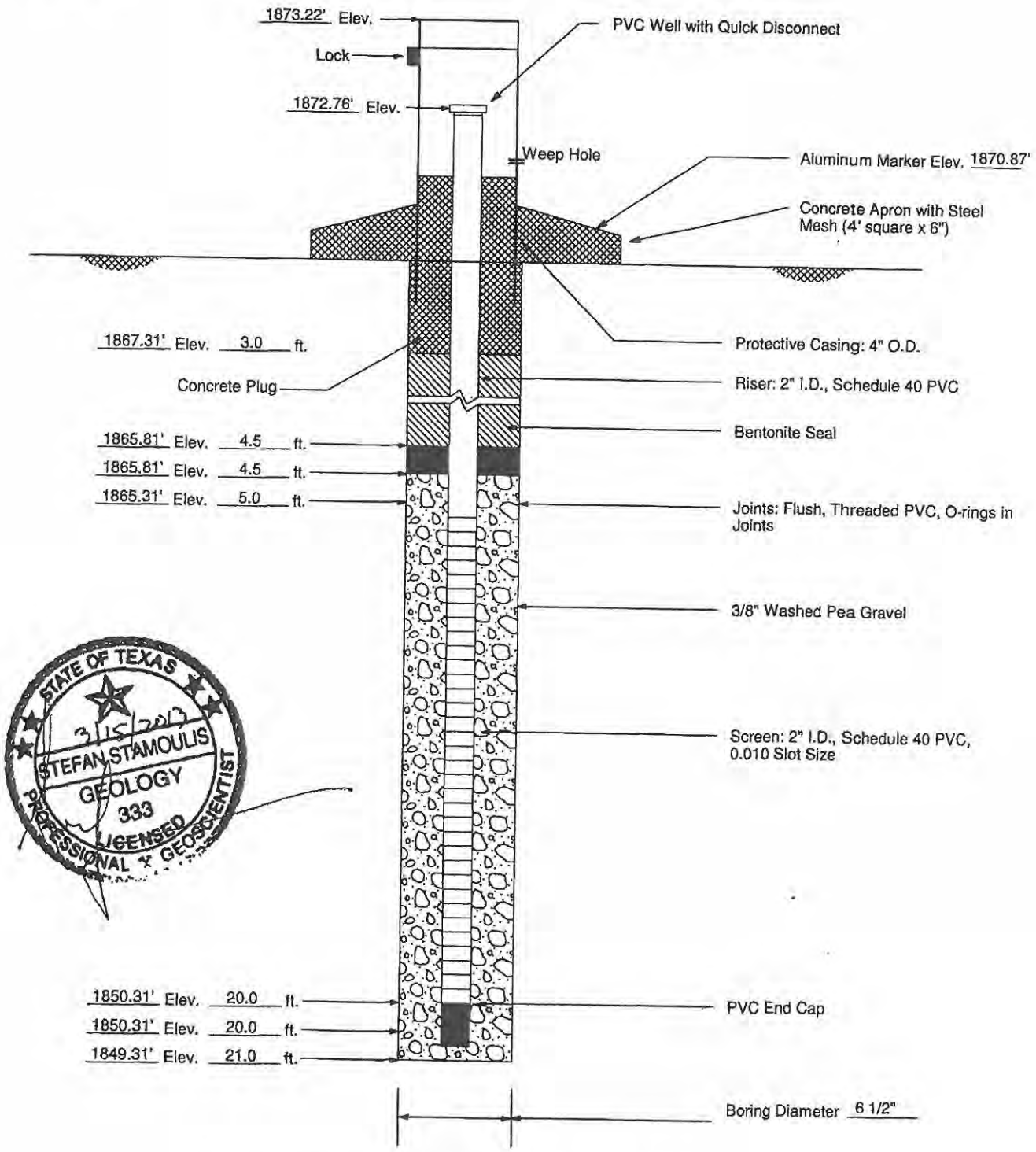
Hydrogeologic/Environmental Testing

The stratification lines represent approximate strata boundaries. In situations, the transition may be gradual.

PLATE A.3

APPENDIX B

City of San Angelo Landfill
Permit No. 79
San Angelo, Texas - Tom Green Co.



METHANE GAS PROBE NO. GMP-11A

Project No. 2012-12-19

Plate B.1

APPENDIX C

STATE OF TEXAS WELL REPORT for Tracking #312906

Owner:	**City of San Angelo**	Owner Well #:	**GMP-11A**
Address:	**3002 Old Ballinger Highway San Angelo , TX 76903**	Grid #:	**43-37-3**
Well Location:	**3002 Old Ballinger Highway San Angelo , TX 76903**	Latitude:	**31° 29' 59" N**
Well County:	**Tom Green**	Longitude:	**100° 23' 22" W**
Elevation:	**No Data**	GPS Brand Used:	**Garmin**
Type of Work:	**Replacement Well**	Proposed Use:	**Monitor**

Drilling Date: Started: **2/18/2013**
Completed: **2/18/2013**

Diameter of Hole: Diameter: **6 1/2 in From Surface To 21 ft**

Drilling Method: **Air Rotary**

Borehole Completion: Gravel Packed From: **4.5 ft to 21 ft**
Gravel Pack Size: **3/8 pea**

Annular Seal Data: 1st Interval: **From 0 ft to 3 ft with 1 cemt (#sacks and material)**
2nd Interval: **From 2 ft to 4.5 ft with 1 Bent chip (#sacks and material)**
3rd Interval: **No Data**
Method Used: **Poured**
Cemented By: **Driller**
Distance to Septic Field or other Concentrated Contamination: **No Data**
Distance to Property Line: **No Data**
Method of Verification: **No Data**
Approved by Variance: **No Data**

Surface Completion: **No Data**

Water Level: Static level: **No Data**
Artesian flow: **No Data**

Packers: **No Data**

Plugging Info: Casing or Cement/Bentonite left in well: **No Data**

Type Of Pump: **No Data**

Well Tests: **No Data**

Water Quality: Type of Water: **No Data**
Depth of Strata: **No Data**
Chemical Analysis Made: **No Data**
Did the driller knowingly penetrate any strata which contained undesirable constituents: **No Data**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.

Company Information: **Hydrogeologic/Environmental Testing**
17226 East Highway 6

PLATE C.1

	Alvin , TX 77511
Driller License Number:	**54882**
Licensed Well Driller Signature:	**Stefan Stamoulis**
Registered Driller Apprentice Signature:	**No Data**
Apprentice Registration Number:	**No Data**
Comments:	**No Data**

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

TEX. OCC. CODE Title 12, Chapter 1901.251, authorizes the owner (owner or the person for whom the well was drilled) to keep information in Well Reports confidential. The Department shall hold the contents of the well log confidential and not a matter of public record if it receives, by certified mail, a written request to do so from the owner.

Please include the report's Tracking number (Tracking **#312906**) on your written request.

Texas Department of Licensing & Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880

DESC. & COLOR OF FORMATION MATERIAL

From (ft) To (ft) Description
0-4 Clay (silty) brown to dark brown, w/ rootlets.
4-12 Clayey silt, w/ calcareous nodules, w/ trace limestone fragments, tan to light pink.
12-21 Silty clay, tan to light brown, dry hard.

CASING, BLANK PIPE & WELL SCREEN DATA

Dia.	New/Used	Type	Setting From/To
2"	**New**	**Riser 0-5 Sch 40**	
2"	**New**	**Screen 5-20 0.010**	

APPENDIX D

STATE OF TEXAS PLUGGING REPORT for Tracking #86267

Owner:	**City of San Angelo**	Owner Well #:	**GMP-11**
Address:	**3002 Old Ballinger Highway San Angelo , TX 76903**	Grid #:	**43-37-3**
Well Location:	**3002 Old Ballinger Highway San Angelo , TX 76903**	Latitude:	**31° 29' 59" N**
Well County:	**Tom Green**	Longitude:	**100° 23' 22" W**
		GPS Brand Used:	**Garmin**

Well Type: **Monitor**

HISTORICAL DATA ON WELL TO BE PLUGGED

Original Well Driller:	**Unknown**
Driller's License Number of Original Well Driller:	**No Data**
Date Well Drilled:	**5/24/1994**
Well Report Tracking Number:	**No Data**
Diameter of Borehole:	**2 inches**
Total Depth of Borehole:	**21 feet**

Date Well Plugged:	**2/18/2013**
Person Actually Performing Plugging Operation:	**Stamoulis**
License Number of Plugging Operator:	**54882**
Plugging Method:	**Tremmie pipe cement from bottom to top.**
Plugging Variance #:	**No Data**
Casing Left Data:	1st Interval: **0 inches diameter, (No Data) ft to (No Data) ft** 2nd Interval: **No Data** 3rd Interval: **No Data**
Cement/Bentonite Plugs Placed in Well:	1st Interval: **From 0 ft to 21 ft; Sack(s)/type of cement used: 2.5 Cemt** 2nd Interval: **No Data** 3rd Interval: **No Data** 4th Interval: **No Data** 5th Interval: **No Data**

Certification Data:	The plug installer certified that the plug installer plugged this well (or the well was plugged under the plug installer's direct supervision) and that each and all of the statements herein are true and correct. The plug installer understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.
Company Information:	**Hydrogeologic/Environmental Testing**

PLATE D.1

	17226 East Highway 6 **Alvin , TX 77511**
Plug Installer License Number:	**54882**
Licensed Plug Installer Signature:	**Stefan Stamoulis**
Registered Plug Installer Apprentice Signature:	**No Data**
Apprentice Registration Number:	**No Data**
Plugging Method Comments:	**No Data**

Please include the plugging report's tracking number (Tracking **#86267**) on your written request.

Texas Department of Licensing & Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880

APPENDIX 9D

PASSIVE LANDFILL GAS VENTING SYSTEM



7/06/05

FOR PAGE 9D-1

1 PASSIVE LANDFILL GAS VENTING SYSTEM

The San Angelo Landfill was upgraded to Subtitle D standards with the 1994 Subtitle D Permit Modification. The landfill gas monitoring system consisting of GMP-1 through GMP-12 was installed in 1994 with two additional gas probes GMP-9A and GMP-10A installed in 1996. Beginning with the initial landfill gas monitoring event, the methane levels in a number of the gas monitoring probes exceeded the regulatory limit. The San Angelo Landfill proceeded consistent with the requirements of approved Landfill Gas Management Plan to develop an approach for landfill gas migration remediation. A series of passive landfill gas vent trenches and landfill gas vent wells were installed along the west and south permit boundary, adjacent to the waste disposal areas. Refer to Attachment 9D.1 for the location of the passive landfill gas venting system.

The installation of the passive landfill gas venting system was authorized through a series of permit modifications or notification to TCEQ through submittal of landfill gas monitoring results reports. The approximate location and date of installation of the landfill gas vent trenches and landfill gas vertical vents are shown.

The passive landfill gas venting system has not been effective in controlling landfill gas migration along the west and south permit boundary. As a result of continued landfill gas migration, an active landfill gas collection system is proposed. Refer to Section 6 – Landfill Gas Control System and Appendix 9E – Active Landfill Gas Collection System for the proposed active landfill gas collection system. The passive landfill gas venting system will be plugged during construction of the active landfill gas collection system.

GMP-1
GMP-18
LFG VENT TRENCH INSTALLED APRIL 1995
50+00 GMP-2
50+00 GMP-17
CLOSED AREA
LFG VENT TRENCH INSTALLED NOVEMBER 1995
45+00
45+00
40+00 GMP-3
40+00 GMP-16
PHASE I WEST AREA
PHASE II EAST AREA
35+00
35+00
LFG VENT TRENCH INSTALLED MARCH 1995
GMP-4
30+00
30+00 GMP-15
LFG VERTICAL VENTS (2) INSTALLED FEBRUARY 2003
25+00
25+00
LFG VENT TRENCH INSTALLED APRIL 2002
GMP-5
20+00
20+00 GMP-14
SUBTITLE D COMPOSITE LINER
SUBTITLE D COMPOSITE LINER
LFG VERTICAL VENTS (3) INSTALLED FEBRUARY 2003
15+00
GMP-13
ACTIVE WASTE DISPOSAL AREA
APPROXIMATE LIMITS OF EMERGENCY WASTE FILL AREAS
GMP-12
LFG VENT TRENCH INSTALLED OCTOBER 1999
GMP-11
GMP-6
10+00
SITE ENTRANCE FACILITIES (NOT WITHIN PERMIT BOUNDARY)
GMP-10A
GMP-10
LFG VENT TRENCH INSTALLED JULY 1997
LFG VERTICAL VENTS (7) INSTALLED FEBRUARY 2003
5+00
GMP-7
GMP9A
GMP-9
LFG VENT TRENCH INTALLED OCTOBER 1999
LFG VENT TRENCH INSTALLED FEBRUARY 1996
GMP-8
1+00
LFG VENT TRENCH INSTALLED OCTOBER 1998
PRESUBTITLE D SOIL LINERS
PRESUBTITLE D SOIL LINER AND INSITU LINER
SUBTITLE D COMPOSITE LINERS
GAS
1800
1870
1875
1825
1850
671000
670500
670000
669500
669000
668500
668000
667500
667000
666500
666000
665500
1979000
1979500
1980000
1980500
1981000
1981500
1982000
1982500
1983000
1983500
1984000
1984500
1985000
1985500

0 300 600
SCALE IN FEET

LEGEND
- PERMIT BOUNDARY
- GMP-11 EXISTING GAS MONITORING PROBE
- LANDFILL GRID SYSTEM
- 1870 PRELANDFILL CONTOURS
- VERTICAL LFG VENT
- LFG VENT TRENCH

NOTE:
1. EXISTING CONTOURS FROM USGS SAN ANGELO, NORTH DEM.
2. EXISTING PASSIVE VENT TRENCH AND PASSIVE VENT WELLS BASED ON MSW PERMIT NO. 79 PERMIT DOCUMENTS.

STATE OF TEXAS
KENNETH J. WELCH
60773
REGISTERED PROFESSIONAL ENGINEER
7/06/05

ISSUED FOR PERMITTING PURPOSES ONLY

REVISIONS						
REV	DATE	DESCRIPTION	DWN BY	DES BY	CHK BY	APP BY

EXISTING LFG PASSIVE VENTING PLAN

CITY OF SAN ANGELO
SAN ANGELO LANDFILL
MSW PERMIT NO. 79

BIGGS & MATHEWS ENVIRONMENTAL
CONSULTING ENGINEERS
ARLINGTON • DALLAS
MANSFIELD • WICHITA FALLS
817-563-1144

DSN. KJW	DATE : 07/05	ATTACHMENT	
DWN. RMP	SCALE : GRAPHIC	9D.1	
CHK. KJW	DWG : vents.dwg		

J:\225\01\901\vents.dwg Layout: 9D.1 User: asanchez

Robert J. Huston, *Chairman*
R. B. "Ralph" Marquez, *Commissioner*
John M. Baker, *Commissioner*
Jeffrey A. Saitas, *Executive Director*

COPY

TEXAS NATURAL RESOURCE CONSERVATION COMMISSION

Protecting Texas by Reducing and Preventing Pollution

September 11, 2001

The Honorable Johnny Fender
Mayor of San Angelo
P.O. Box 1751
San Angelo, TX 76902

RE: Solid Waste - Tom Green County
City of San Angelo Landfill - MSW Permit No. 79
Permit Modification - Methane Gas System
Tracking No. 7418

Dear Mayor Fender:

Enclosed is a copy of the above referenced permit modification for a municipal solid waste facility issued pursuant to Chapter 361, Texas Health & Safety Code. The documentation, including the application, prepared and submitted to support the modification request shall be considered a part of this permit and shall be considered as operational requirements of this permit.

If you have any questions regarding this letter, please contact Ms. Marilyn Czimer Long, at (512) 239-0761.

Sincerely,

Jerry Allred, Manager
MSW Permits Section
Waste Permits Division

JA/mcl

Enclosure

cc: Mr. W. H. Wilde, P.E., City of San Angelo
Mr. Kyle Combest, Combest Geoscience
Mr. Ed Rhodes, Republic Industries, Inc.

Combest Geoscience

Geological / Hydrological Consulting & Testing

915/655-4302 off
915/655-4304 fax
915/656-2537 mob

23 S. Washington Street • San Angelo, Texas 76901

19 July 2001

COPY

TNRCC - PERMITS DIVISION
MSW Permits Section MC-124
P.O. Box 13087
Austin, Texas 78711-3087
Attn: Ms. Ada Lichaa

Subject: City of San Angelo MSWLF
Permit 79 - Tom Green County
Request for Class I permit modification to gas system

Dear Ms. Lichaa:

During the 1st and 2nd quarters of 2001, methane concentrations in GMP 5 exceeded the allowable concentration of 5%. To correct for this condition, the City of San Angelo installed a vent trench next to GMP 5 (Figure 1; Figure 2). The trench was constructed using the same design approved by the TNRCC on 01 December 1999.

A gas measurement at GMP 5 on 17 July 2001 found 0% methane, proving that the vent trench is effective. With the success of this trench, all GMPs are now within regulatory limits. The City of San Angelo is also in the process of installing trenches near GMPs 2, 7, and 8 to vent any potential gas migration at these areas (Figure 1; Figure 2). These vent trenches will remain as a permanent part of the gas management system.

This is a request for a Class I permit modification for the design and implementation of the improvements described above and shown on Figures 1 and 2. Included with this request is a certification statement to comply with 30 TAC 305.44.b. All documents relating to this request, that are approved by the TNRCC, will be attached to Section 9 of the landfill permit (relating to the Landfill Gas Management Plan).

If you need addition information regarding this permit modification request, please call us at 915/655-4302. Thank you.

Sincerely,

Debbie Greenacre
Environmental Scientist

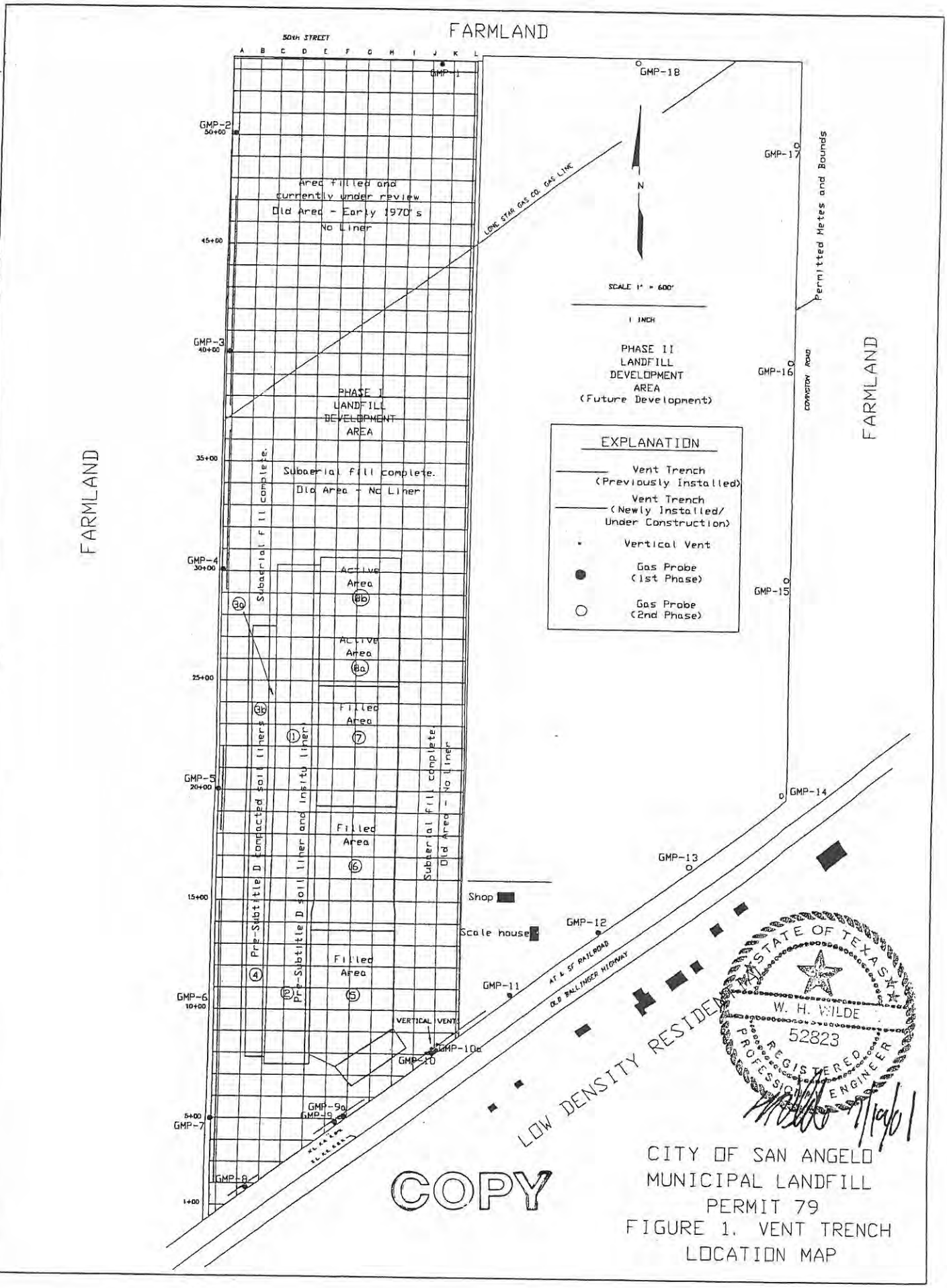
xc w/attachment:
Will Wilde, P.E., City of San Angelo
Adam Hernandez, TNRCC Region 8
Bobby Pilkington, Trashaway Services, Inc.
Ed Rhodes, Republic Industries, Inc.

COPY

CERTIFICATION

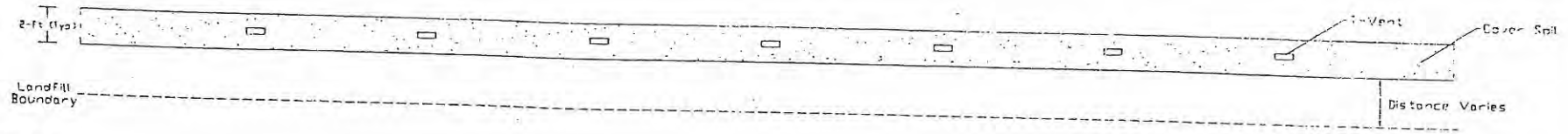
I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Certified by: [signature]
Title: Public Works Director
Date: July 19, 2001

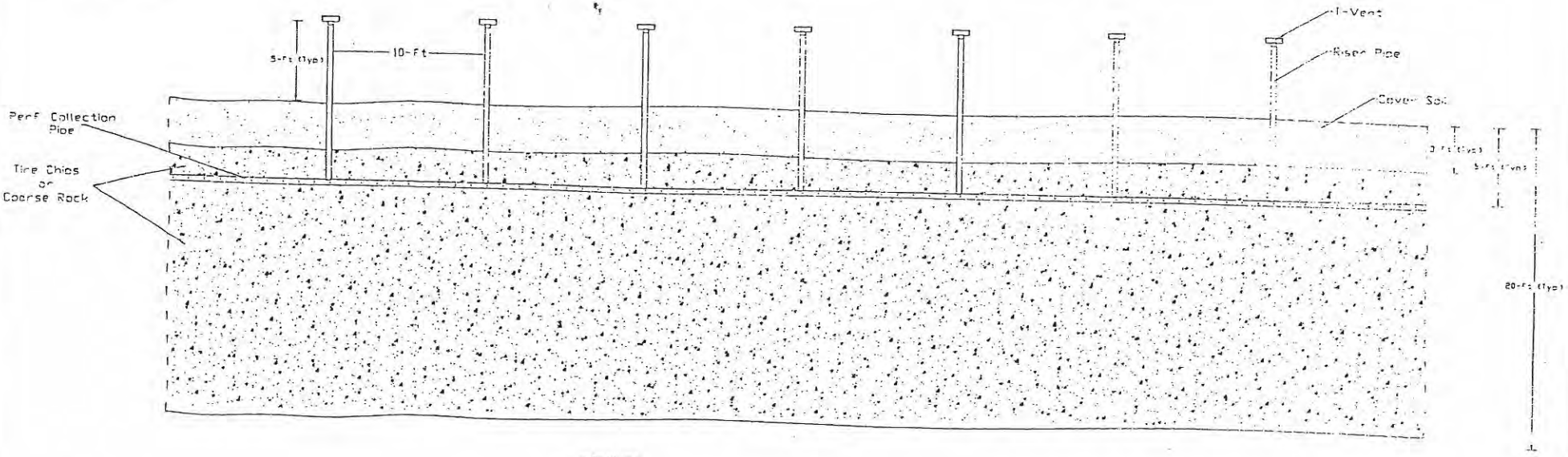


CITY OF SAN ANGELO
MUNICIPAL LANDFILL
PERMIT 79
FIGURE 1. VENT TRENCH
LOCATION MAP

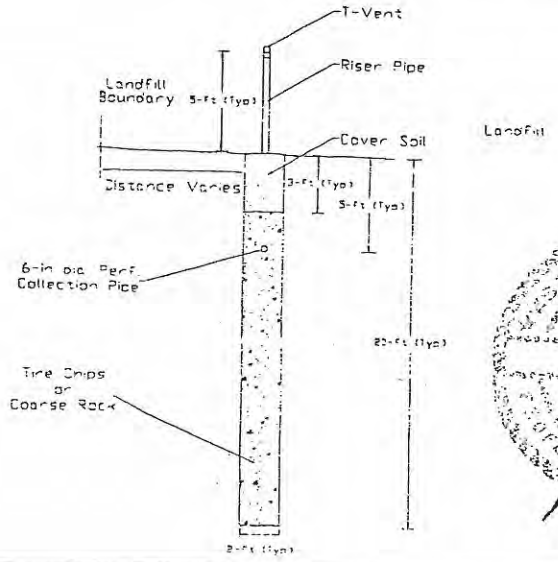
T iew



Front View



Side View





7/19/01

SAN ANGELO MSW F
Tom Green Co., Texas
Permit No. 79
Figure 2 Methane Gas
Venting System

COPY

Robert J. Huston, *Chairman*
R. B. "Ralph" Marquez, *Commissioner*
John M. Baker, *Commissioner*
Jeffrey A. Saitas, *Executive Director*

JUN 4 2001

COPY

TEXAS NATURAL RESOURCE CONSERVATION COMMISSION

Protecting Texas by Reducing and Preventing Pollution

May 30, 2001

The Honorable Johnny Fender
Mayor of San Angelo
P.O. Box 1751
San Angelo, TX 76902

RE: Solid Waste - Tom Green County
City of San Angelo Landfill - MSW Permit No. 79
Permit Modification - Methane Gas System
Tracking No. 6554

Dear Mayor Fender:

Enclosed is a copy of the above referenced permit modification for a municipal solid waste facility issued pursuant to Chapter 361, Texas Health & Safety Code. The documentation, including the application, prepared and submitted to support the modification request shall be considered a part of this permit and shall be considered as operational requirements of this permit.

If you have any questions regarding this letter, please contact Ms. Marilyn Czimer Long, at (512) 239-0761.

Sincerely,

Jerry Allred, Manager
MSW Permits Section
Waste Permits Division

JA/mcl

Enclosure

cc: Mr. W. H. Wilde, P.E., City of San Angelo
Mr. Kyle Combest, Combest Geoscience
Mr. Ed Rhodes, Republic Industries, Inc.

TEXAS NATURAL RESOURCE CONSERVATION COMMISSION

COPY

MODIFICATION TO

MUNICIPAL SOLID WASTE PERMIT Nº MSW-79

CITY OF SAN ANGELO

Municipal Solid Waste Permit No. MSW-79 is hereby modified as follows:

Description of Change: Reconstruct one (1) vent trench and install three (3) vertical gas vents to enhance the existing methane gas system.

The methane gas trench located next to gas probes GMP 10 & GMP 10A was reconstructed and three (3) vertical gas vents were installed near GMP 10 & GMP 10A to enhance the Subtitle D methane gas system. It was received by the Texas Natural Resource Conservation Commission on May 16, 2001. It was prepared by Combest Geoscience on behalf of the City of San Angelo and it was signed, and sealed by Mr. W. H. Wilde, P.E., (#52823), City of San Angelo, on May 6, 2001.

List of Items Revised in Site Development Plan: Attachment 14 - Landfill Gas Management Plan

This modification is a part of Permit No. MSW-79 and should be attached thereto.

APPROVED, ISSUED, AND EFFECTIVE in accordance with 30 Texas Administrative Code Section 305.70(i).

ISSUED DATE:

MAY 3 0 2001

For the Commission

Combest Geoscience

Geological / Hydrological Consulting & Testing
915/655-4302 off
915/655-4304 fax
915/656-2537 mob

S. Washington Street • San Angelo, Texas 76901

14 May 2001

COPY

TNRCC - PERMITS DIVISION
MSW Permits Section MC-124
P.O. Box 13087
Austin, Texas 78711-3087
Attn: Ms. Ada Lichaa

Subject: City of San Angelo MSWLF
Permit 79 - Tom Green County
Responses to TNRCC 10 Apr 2001 letter
Request for Class I permit modification to gas system
Tracking Number 4568

Dear Ms. Lichaa:

TNRCC comments in a letter dated 10 April 2001 (Attachment A) asked for responses relating to the Selection of Remedy for the City of San Angelo MSWLF. TNRCC comments #1 and #2 required responses within 30 days, and comments #5 and #6 required responses within 60 days. Responses to comments #1 and #2 were submitted in a letter dated 02 May 2001 from COMBEST GEOSCIENCE to the TNRCC. On behalf of the City of San Angelo, responses for TNRCC comments #5 and #6 are as follows:

1. Reference is made to TNRCC comment #5 regarding the laboratory reporting limit (RL) for methylene chloride. As noted by the TNRCC, the laboratory RL of 10 ug/L for methylene chloride is greater than the MCL which is 5 ug/L. The RL for this sample run was higher than usual because of trace levels of methylene chloride in laboratory ambient air. After re-examining the chromatographs, ERMI Laboratory was able to lower the methylene chloride RL to 5 ug/L. Revised laboratory data sheets are in Attachment B.

2. Reference is made to TNRCC comment #6 which requested information about vent trench maintenance and effectiveness of repairs. Beginning in January 2001, the following improvements were made to the gas remediation system:

- The vent trench located next to GMPs 10 and 10A was reconstructed using the same design as approved by the TNRCC on 01 December 1999 (Figure 1; Figure 2); and
- Three vertical gas vents were installed to total depths of 44-ft near GMPs 10 and 10A. Construction details and locations of the vertical gas vents are shown on Figures 1 and 2.

These activities have successfully decreased methane to 0% in GMPs 10 and 10A. Specific dates on which readings were found to be 0% were 30 March 2001, 02 April 2001, 05 April 2001, and 07 May 2001.

COPY

Please consider this letter as a permit modification request for the design and implementation of the improvements described above and shown on Figures 1 and 2. Included with this request is a certification statement on the following page to comply with 30 TAC 305.44.b. All documents relating to this request that are approved by the TNRCC will be attached to Section 9 of the landfill permit (relating to the Landfill Gas Management Plan).

If you need addition information regarding the responses to TNRCC comments #5 and #6 or the permit modification request, please call us at 915/655-4302. Thank you.

Sincerely,

Debbie Greenacre

Debbie Greenacre
Environmental Scientist

xc w/attachment:
Will Wilde, P.E., City of San Angelo
Adam Hernandez, TNRCC Region 8
Bobby Pilkington, Trashaway Services, Inc.
Ed Rhodes, Republic Industries, Inc.

COPY

CERTIFICATION

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Certified by: [signature]

Title: Public Works Director

Date: 7/6/01

COPY

FIGURES

DESC. GMP- 1
STA. 53+43.7 x J+31.1
X= 1982131.0697
Y= 6706B3.6983
SLAB ELEV. 1880.86
PVC ELEV. 1882.77
GROUND ELEV. 1880.00

DESC. GMP- 2
STA. 50+00.2 x A-31.4
X= 1981168.5785
Y= 670600.2517
SLAB ELEV. 1880.60
PVC ELEV. 1882.46
GROUND ELEV. 1879.00

DESC. GMP- 3
STA. 39+99.5 x A-34.5
X= 1981165.4709
Y= 669599.5288
SLAB ELEV. 1877.07
PVC ELEV. 1878.94
GROUND ELEV. 1876.50

DESC. MW-8
STA. 38+99.3 x A-32.2
X= 1981164.7543
Y= 669499.3054
SLAB ELEV. 1878.80
PVC ELEV. 1879.19
GROUND ELEV. 1876.30

DESC. GMP- 4
STA. 29+99.2 x A-36.8
X= 1981161.2267
Y= 668599.1449
SLAB ELEV. 1874.75
PVC ELEV. 1877.02
GROUND ELEV. 1874.30

DESC. MW-9
STA. 25+99.0 x A-38.8
X= 1981158.9245
Y= 668299.0228
SLAB ELEV. 1874.06
PVC ELEV. 1876.36
GROUND ELEV. 1873.50

DESC. GMP- 5
STA. 19+99.9 x A-44.2
X= 1981155.8078
Y= 667599.9489
SLAB ELEV. 1872.39
PVC ELEV. 1874.32
GROUND ELEV. 1871.70

DESC. MW-10
STA. 14+98.9 x A-43.5
X= 1981156.4614
Y= 667096.8885
SLAB ELEV. 1872.00
PVC ELEV. 1874.46
GROUND ELEV. 1871.60

DESC. GMP- 6
STA. 10+02.2 x A-47.9
X= 1981152.0569
Y= 666602.1807
SLAB ELEV. 0.00
PVC ELEV. 1873.99
GROUND ELEV. 1871.30

DESC. GMP- 7
STA. 5+02.3 x A-50.9
X= 1981149.1222
Y= 666102.2598
SLAB ELEV. 1872.48
PVC ELEV. 1874.52
GROUND ELEV. 1871.90

DESC. MW-11
STA. 3+02.4 x A-51.2
X= 1981148.7886
Y= 665902.4069
SLAB ELEV. 1872.20
PVC ELEV. 1875.04
GROUND ELEV. 1871.80

DESC. GMP- 8
STA. 1+98.3 x B+74.1
X= 1981374.1277
Y= 665798.2633
SLAB ELEV. 1874.37
PVC ELEV. 1876.34
GROUND ELEV. 1873.70

DESC. GMP- 9
STA. 5+02.8 x F+88.2
X= 1981788.2324
Y= 666102.8491
SLAB ELEV. 1870.77
PVC ELEV. 1872.75
GROUND ELEV. 1870.30

DESC. GMP- 9A
STA. 5+08.4 x F+97.0
X= 1981796.9559
Y= 666108.3698
SLAB ELEV. 1870.84
PVC ELEV. 1873.08
GROUND ELEV. 1870.5

DESC. GMP-10
STA. 8+03.0 x J+96.0
X= 1982196.0021
Y= 666402.9797
SLAB ELEV. 1870.39
PVC ELEV. 1872.40
GROUND ELEV. 1870.00

DESC. GMP- 10A
STA. 8+08.3 x K+05.2
X= 1982205.2498
Y= 666408.2845
SLAB ELEV. 1870.64
PVC ELEV. 1872.56
GROUND ELEV. 1870.2

DESC. GMP-11
STA. 11+08.9 x D+14.9
X= 1982614.8784
Y= 666708.9465
SLAB ELEV. 1870.46
PVC ELEV. 1872.31
GROUND ELEV. 1869.90

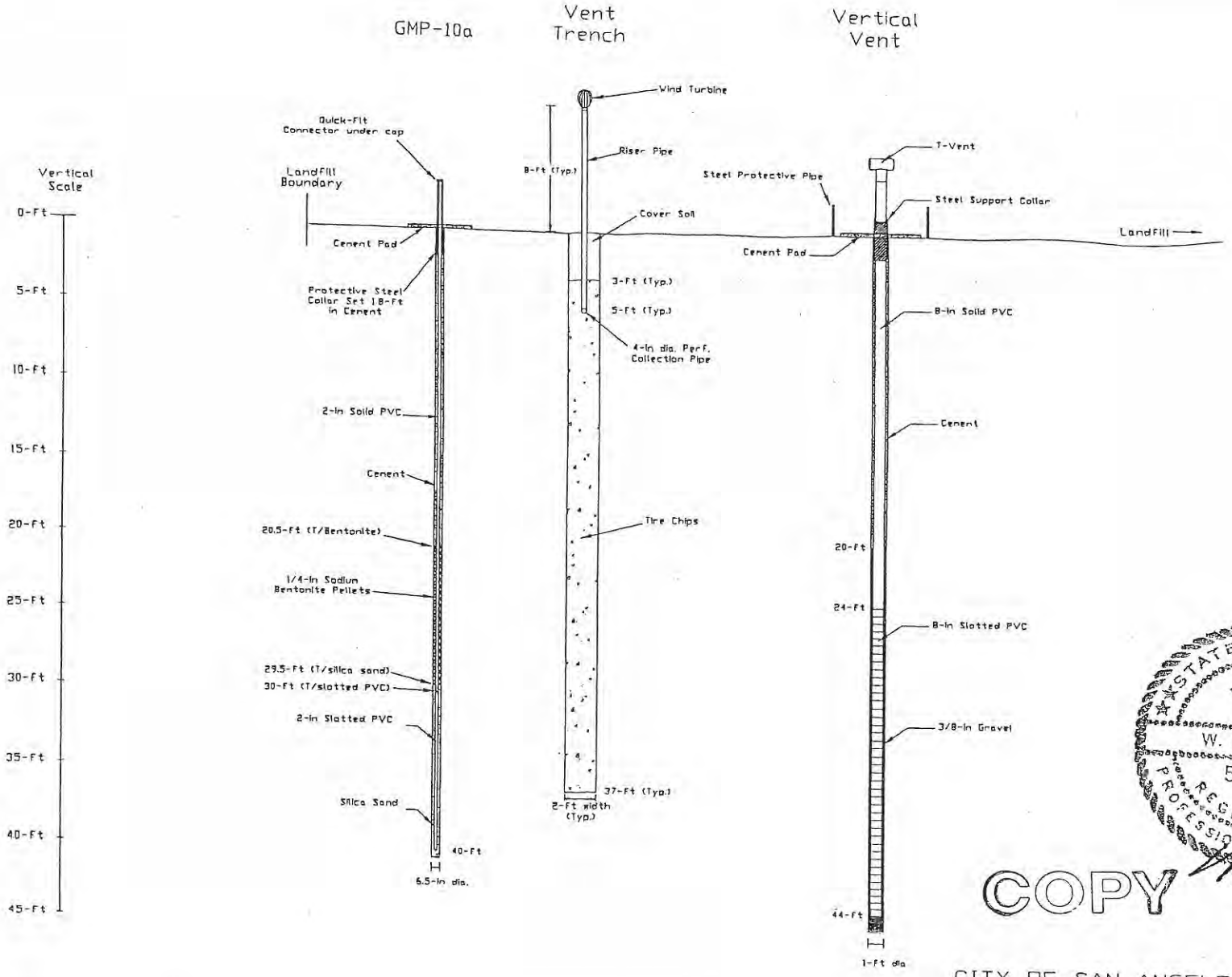
DESC. GMP-12
STA. 14+12.4 x S+
X= 1983029.2448
Y= 667012.4540
SLAB ELEV. 1870.22
PVC ELEV. 1872.11
GROUND ELEV. 1869.50

EXPLANATION

- ● = Gas monitoring probe (Phase I)
- ○ = Gas monitoring probe (Phase II)
- ▲ = Ground-water monitoring well
- ····· = Landfill grid system
- —— = Lined area
- (4) = Liner number
- —— = Leachate lines
- —— = Vent trench
- • = Vertical Vent

COPY

CITY OF SAN ANGELO MSWLF
PERMIT 79
TOM GREEN COUNTY, TEXAS
FIGURE 1. SITE MAP



Refer to Figure 1 for locations of GMPs, Vent Trenches, and Vertical Vents.

STATE OF TEXAS
W. H. WILDE
52823
REGISTERED PROFESSIONAL ENGINEER

COPY

5/6/01

CITY OF SAN ANGELO MSWLF
PERMIT 79
TOM GREEN COUNTY, TEXAS
Figure 2. Methane Gas Venting System

Robert J. Huston, *Chairman*
R. B. "Ralph" Marquez, *Commissioner*
John M. Baker, *Commissioner*
Jeffrey A. Saitas, *Executive Director*

DEC 8 1999

COPY

TEXAS NATURAL RESOURCE CONSERVATION COMMISSION

Protecting Texas by Reducing and Preventing Pollution

December 2, 1999

The Honorable Johnny Fender
Mayor of San Angelo
P.O. Box 1751
San Angelo, TX 76902

RE: Solid Waste - Tom Green County
City of San Angelo Landfill - MSW Permit No. 79
Permit Modification - Methane Gas System
Tracking No. M99

Dear Mayor Fender:

Enclosed is a copy of the above referenced permit modification for a municipal solid waste facility issued pursuant to Chapter 361, Texas Health & Safety Code. The documentation, including the application, prepared and submitted to support the modification request shall be considered a part of this permit and shall be considered as operational requirements of this permit.

If you have any questions regarding this letter, please contact Ms. Marilyn Czimer Long, at (512) 239-0761.

Sincerely,

Dorca Zaragoza-Stone

Dorca Zaragoza-Stone, Manager
MSW Permits Section
Waste Permits Division

DZS/mcl

Enclosure

cc: Mr. W. H. Wilde, P.E., City of San Angelo
Mr. Kyle Combest, Combest Geoscience

TEXAS NATURAL RESOURCE CONSERVATION COMMISSION

COPY

MODIFICATION TO

MUNICIPAL SOLID WASTE PERMIT Nº MSW-79
ISSUED ON JANUARY 27, 1984
TO CITY OF SAN ANGELO

Municipal Solid Waste Permit No. MSW-79 is hereby modified as follows:

Description of Change: Construct vent trenches to enhance methane gas system.

The methane gas trenches are constructed to enhance the Subtitle D methane gas system. It was received by the Texas Natural Resource Conservation Commission on October 14, 1999. It was signed, and sealed by Mr. W. H. Wilde, P.E., (#52823), on October 7, 1999.

List of Items Revised in Site Development Plan: Part III, Attachment 14, Landfill Gas Management Plan

This modification is a part of Permit No. MSW-79 and should be attached thereto.

APPROVED, ISSUED, AND EFFECTIVE in accordance with 30 Texas Administrative Code Section 305.70(i).

ISSUED DATE:

DEC 0 1 1999

For the Commission

The City Of

San Angelo, Texas

P. O. Box 1751 - Zip 76902

COPY

October 6, 1999

Ms. Dorca Zaragoza-Stone
TNRCC
Municipal Solid Waste Division - Permits MC 124
P.O. Box 13087
Austin, TX 78711-3087

RE: San Angelo MSWLF (Permit 79)
Tom Green County, Texas
Request for Class I permit modification to gas system

Dear Ms. Dorca Zaragoza-Stone:

As indicated in 1999 gas reports, methane concentrations in a few of the perimeter gas probes have exceeded allowable concentrations (5% methane in air). To correct for this condition, the City of San Angelo is requesting a Class I permit modification to allow for the installation of vent trenches at areas shown on Figure 1. A description of these areas can be found in a September 27 report entitled, "August 1999 Methane Gas Survey, San Angelo Municipal Solid Waste Landfill, Tom Green County, Texas (Permit 79)." This report was submitted to Mr. H. Tom Collins, P.E., in the TNRCC Remediation Division.

Construction details of the vent trenches are shown on Figure 2.

Because this is a request for a permit modification, the certification shown below is included to comply with 30 TAC 305.44.b. If you need additional information for the permit modification, please call me at 915 657-4206.

Sincerely,

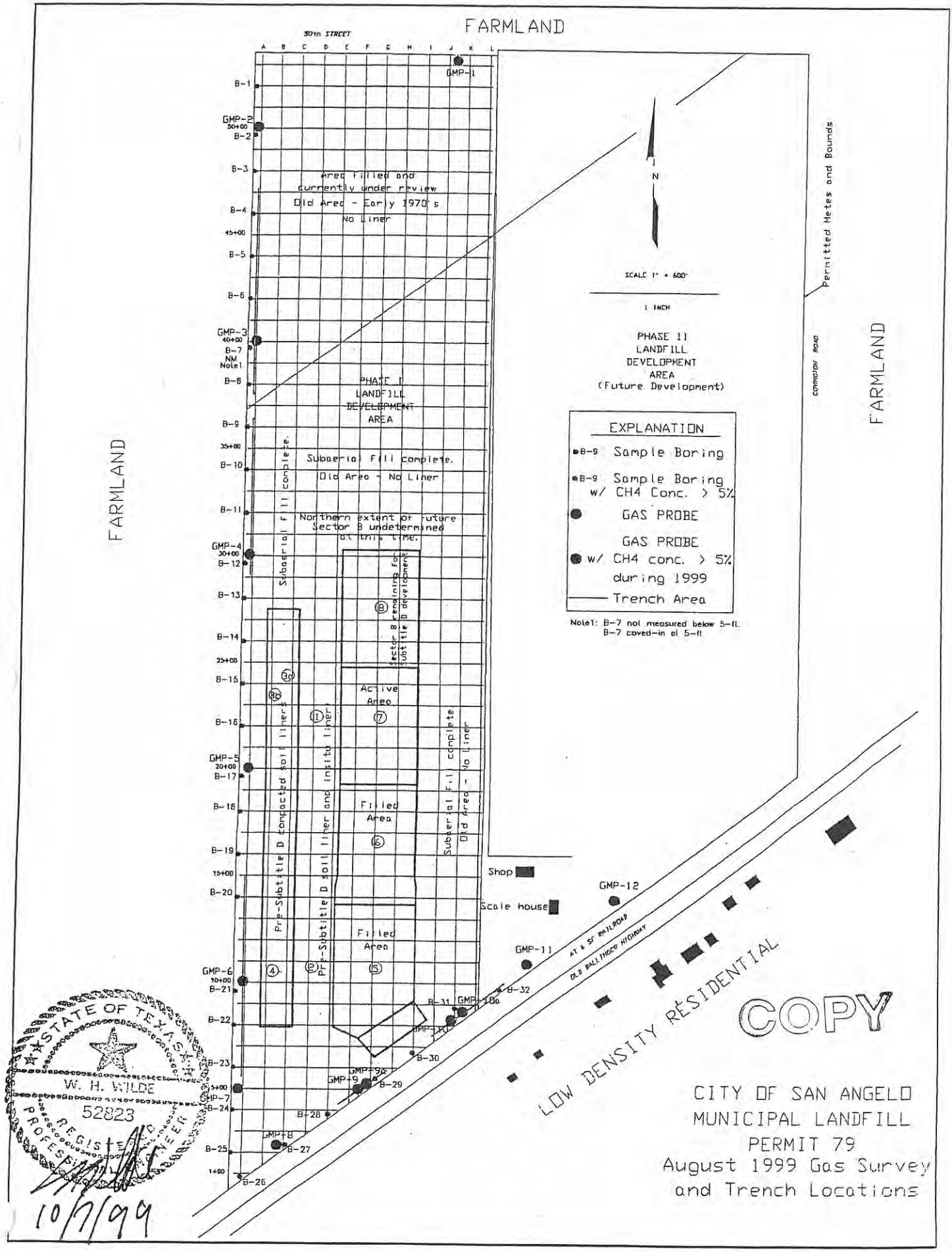
W. H. Wilde
Public Works Director

CERTIFICATION

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Certified by: [signature]
Title: Public Works Director
Date: 10/7/99

COPY



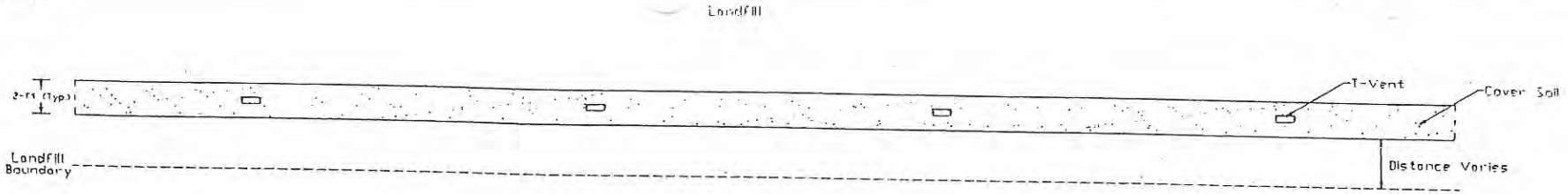
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CITY OF SAN ANGELO
MUNICIPAL LANDFILL
PERMIT 79
August 1999 Gas Survey
and Trench Locations

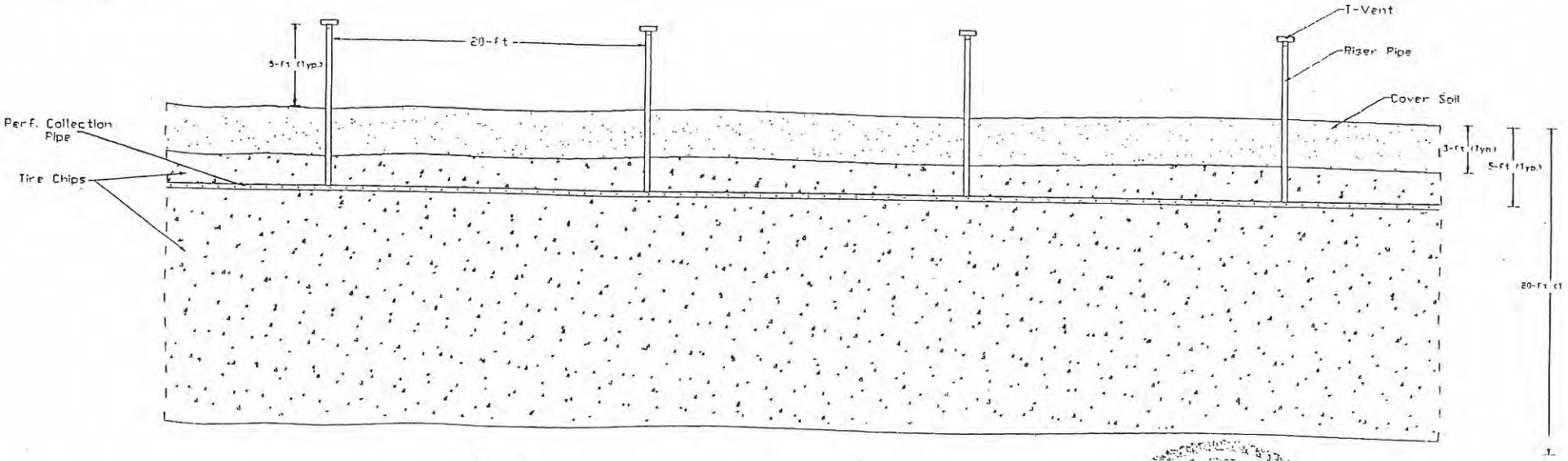
STATE OF TEXAS
W. H. WILDE
52823
REGISTERED PROFESSIONAL ENGINEER

10/7/99

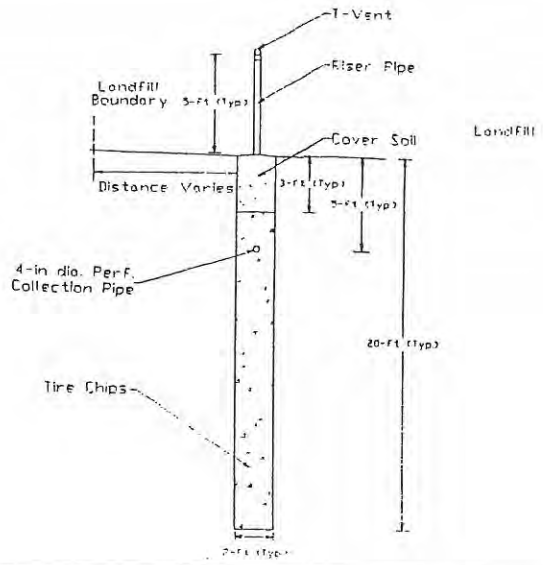
Top View



Front View



Side View





10/7/99

COPY

SAN ANGELO MSWLF
Tom Green Co., Texas
Permit No. 79
Methane Gas Venting System

APPENDIX 9E

ACTIVE LANDFILL GAS COLLECTION SYSTEM



7/06/05

FOR PAGE 9E.1

1 ACTIVE LANDFILL GAS COLLECTION SYSTEM

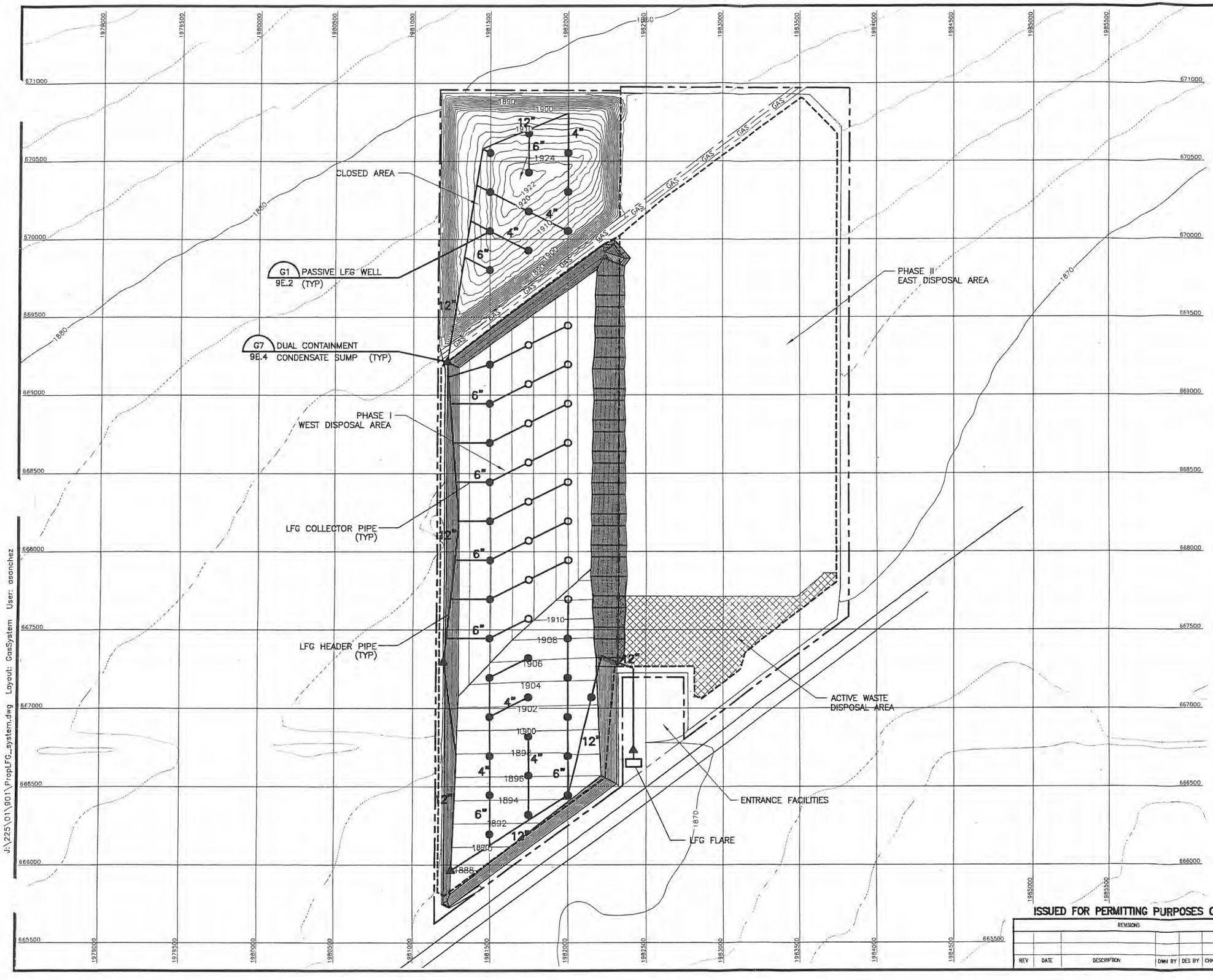
An active landfill gas system is proposed to be installed to collect LFG to mitigate elevated methane levels in landfill gas probes along the west and south permit boundary. The system is designed to allow expansion as other areas of the landfill are brought to grade for the current permitted condition. Refer to Attachment 9E.1 for the limits of the proposed active landfill gas collection system. The proposed permit level details are included in Attachment 9E.2 through 9E.4.

The landfill gas collection system includes installation of the blower/flare system, 4-inch lateral lines and associated valving, 6-inch header lines and associated valving, 12-inch main line to the blower/flare system, landfill gas wells and condensate sumps. The gas collection system and wells will be constructed of HDPE pipe.

HDPE SDR-17 lateral piping will be required for 4-inch, 6-inch, and 12-inch pipe. In general, a minimum of 6-inches of sand bedding will be maintained below the piping. The lateral piping will be installed a minimum of two feet below grade and backfilled with clean soil. Lateral piping will maintain a minimum of three percent slope towards the header. The header pipe will maintain a minimum of three percent slope towards the condensate sumps. Refer to the drawings for typical permit details.

Extraction wells will be constructed of 6-inch HDPE SDR-17 pipe. They will extend to within ten feet of the bottom of the landfill. In general 2-inch wellheads will be installed for controlling vacuum and LFG flow from each well. Initially thirty-five extraction wells will be installed; however, the gas collection and control system has been designed for the entire site once closed.

A flare station skid consisting of the flare unit capable of ninety-eight percent destruction of non-methane organic compounds (NMOC's), dual blowers, flow totalizer, temperature recorder, and air compressor for operating condensate sumps will be installed as part of the proposed active landfill gas collection system. The flare facility will be designed to accommodate potential future expansions.



0 300 600
SCALE IN FEET

LEGEND

PERMIT BOUNDARY

LIMIT OF WASTE

GMP–11 EXISTING GAS MONITORING PROBE

NOTES:

1. ALL SIDESLOPES ARE A 4H:1V GRADE
2. EXISTING CONTOURS FROM USGS SAN ANGELO, NORTH DEM.
3. WELL SPACING 250' O.C.
4. PROPOSED ACTIVE LFG SYSTEM
   - PROPOSED LFG WELLS
   - FUTURE LFG WELLS
5. ACTIVE LFG SYSTEM DESIGNED TO ACCOMMODATE FUTURE EXPANSION.
6. LFG FLARE LOCATION TO BE DETERMINED BASED ON LANDFILL/SITE ENTRANCE FACILITY DEVELOPMENTS.

STATE OF TEXAS
KENNETH J. WELCH
60773
REGISTERED PROFESSIONAL ENGINEER
7/06/05

ISSUED FOR PERMITTING PURPOSES ONLY

REVISIONS						
REV	DATE	DESCRIPTION	DWN BY	DES BY	CHK BY	APP BY

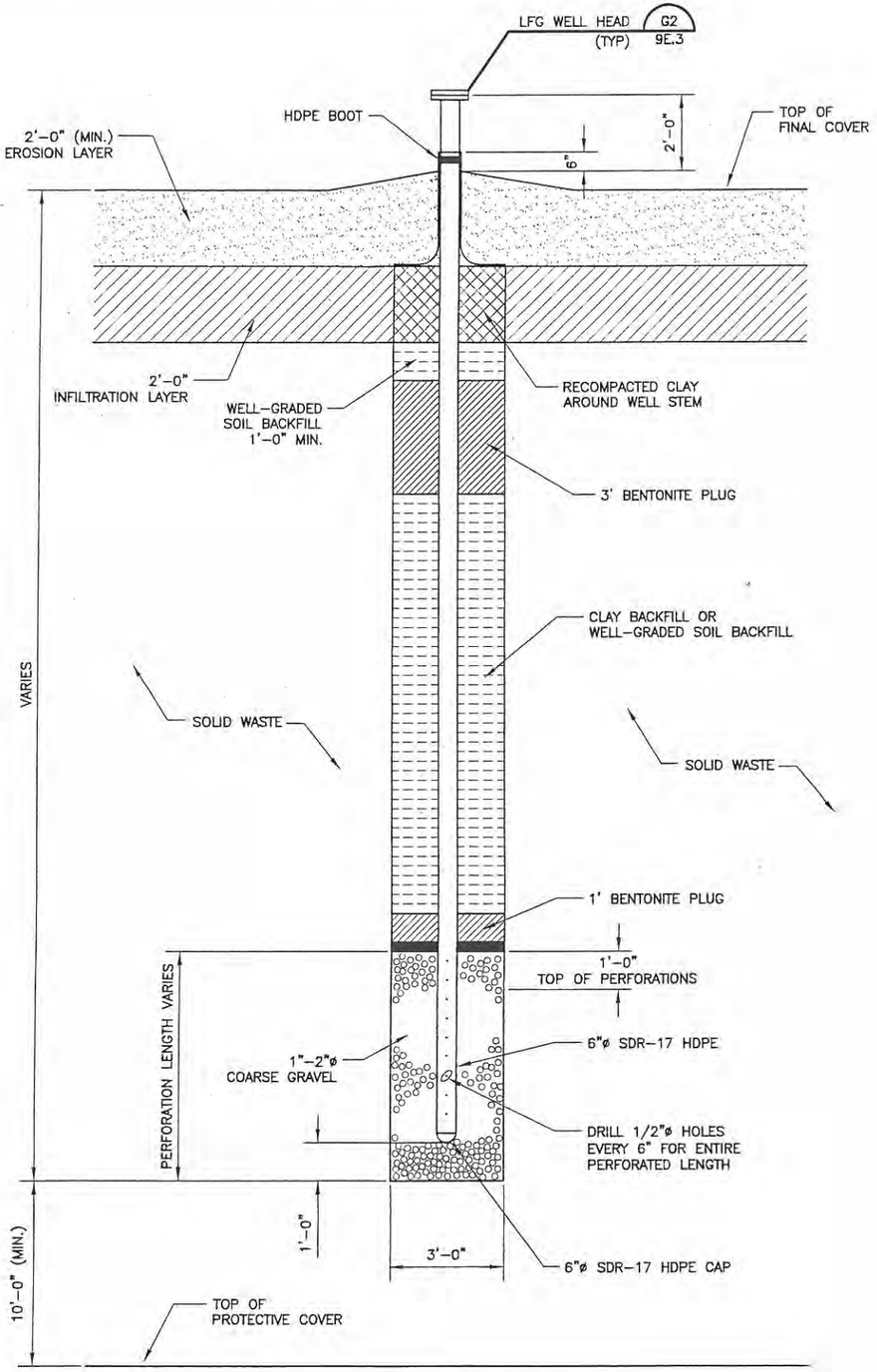
PROPOSED ACTIVE LFG SYSTEM

CITY OF SAN ANGELO
SAN ANGELO LANDFILL
MSW PERMIT NO. 79

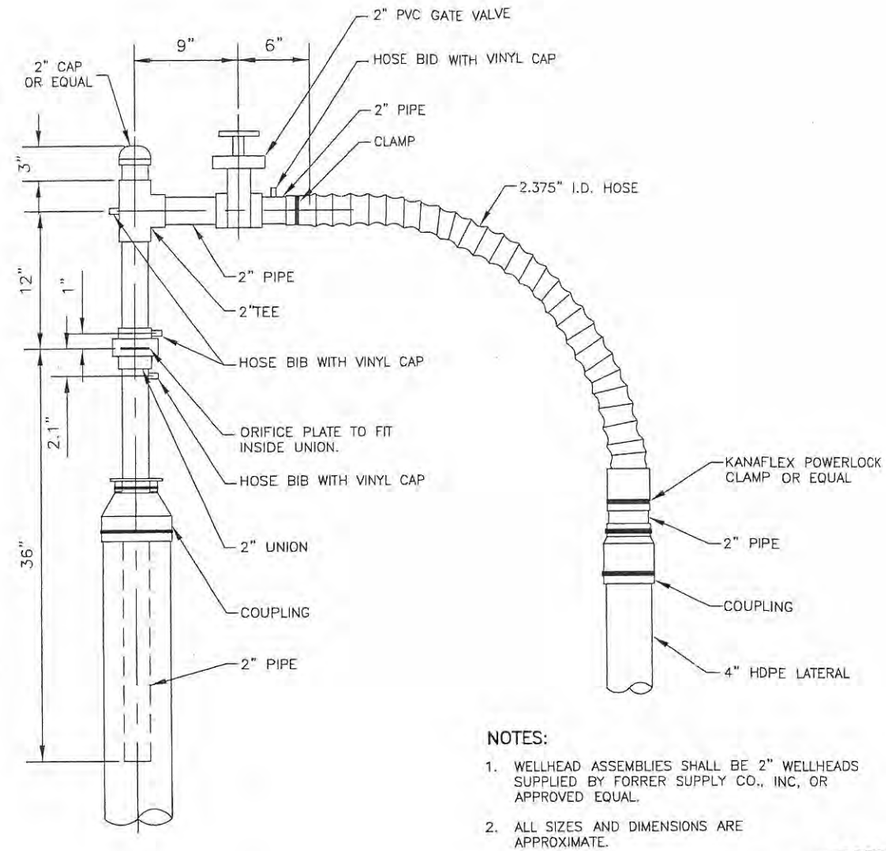
BIGGS & MATHEWS ENVIRONMENTAL
CONSULTING ENGINEERS
ARLINGTON • DALLAS
MANSFIELD • WICHITA FALLS
817–563–1144

DSN. KJW	DATE : 07/05	ATTACHMENT	
DWN. RMP	SCALE : GRAPHIC	9E.1	
CHK. KJW	DWG : PropLFG_system.dwg		

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PASSIVE LFG WELL G1 9E.2
NTS



NOTES:

1. WELLHEAD ASSEMBLIES SHALL BE 2" WELLHEADS SUPPLIED BY FORRER SUPPLY CO., INC, OR APPROVED EQUAL.
2. ALL SIZES AND DIMENSIONS ARE APPROXIMATE.

LFG WELLHEAD G2 9E.2
(TYP)
NTS

NOTES:

1. LFG WELLS ARE DESIGNED TO BE CONVERTED TO AN ACTIVE LFG COLLECTION SYSTEM, IF REQUIRED.
2. ALL SIZES AND DIMENSIONS ARE APPROXIMATE.

STATE OF TEXAS
KENNETH J. WELCH
60773
REGISTERED PROFESSIONAL ENGINEER
7/06/05

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REVISIONS						
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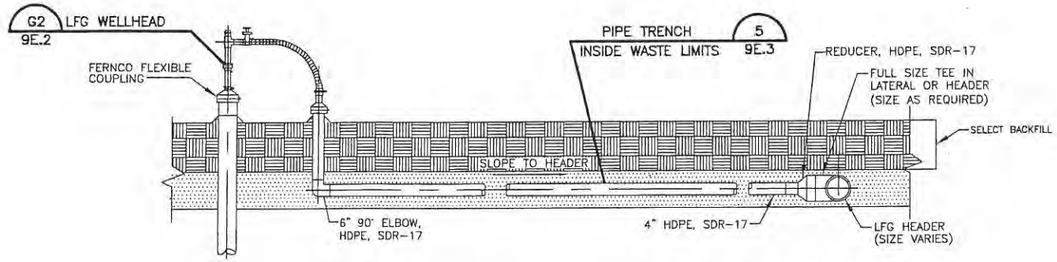
TYPICAL GAS SYSTEM DETAILS

CITY OF SAN ANGELO
SAN ANGELO LANDFILL
MSW PERMIT NO. 79

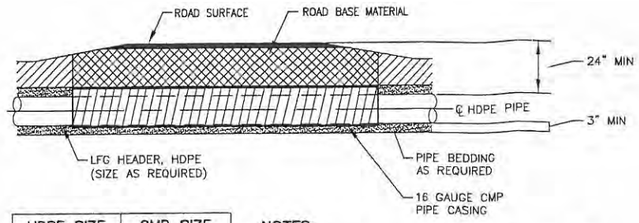
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CONSULTING ENGINEERS
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817-563-1144

DSN. KJW	DATE : 07/05	ATTACHMENT	
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CHK. KJW	DWG : GasVent.dwg		

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LFG LATERAL G3
NTS 9E.3

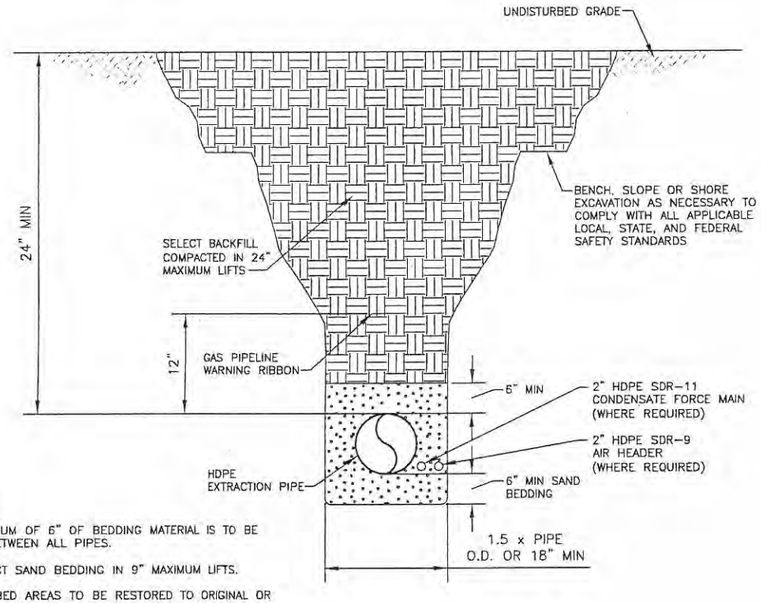


HDPE SIZE	CMP SIZE
6"	12"
10"	18"
12"	24"
18"	30"

NOTES:

1. SLOPE ROAD CROSSING IN DIRECTION OF LFG FLOW.
2. ALL PIPE SIZES AND DIMENSIONS ARE APPROXIMATE.
3. ALL SIZES AND DIMENSIONS ARE APPROXIMATE.

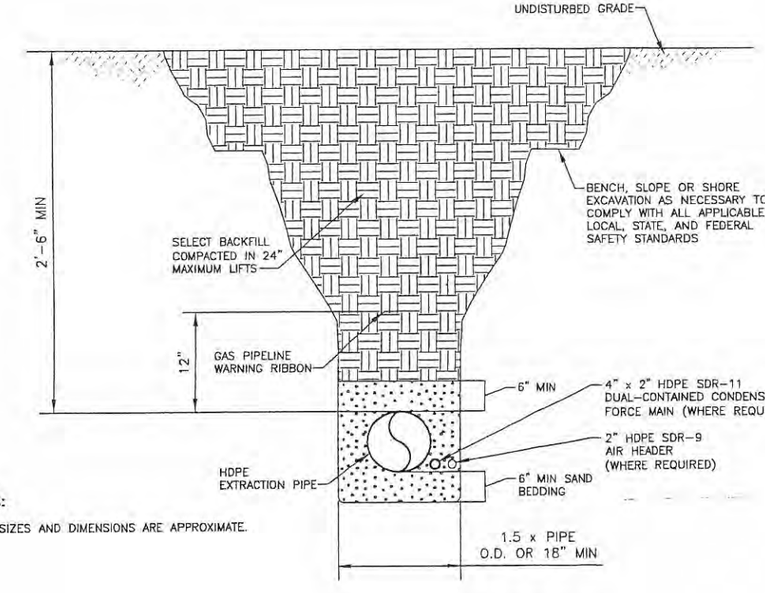
LFG LATERAL G4
NTS 9A.3



NOTES:

1. A MINIMUM OF 6" OF BEDDING MATERIAL IS TO BE PLACED BETWEEN ALL PIPES.
2. COMPACT SAND BEDDING IN 9" MAXIMUM LIFTS.
3. DISTURBED AREAS TO BE RESTORED TO ORIGINAL OR BETTER CONDITION.
4. WHERE THE FINAL CAP IS DISTURBED, IT SHALL BE RESTORED TO MEET PERMITTED REQUIREMENTS.
5. ALL SIZES AND DIMENSIONS ARE APPROXIMATE.

PIPE TRENCH (INSIDE WASTE LIMITS) G5
NTS 9E.3



NOTES:

1. ALL SIZES AND DIMENSIONS ARE APPROXIMATE.

PIPE TRENCH (OUTSIDE WASTE LIMITS) G6
NTS 9E.3



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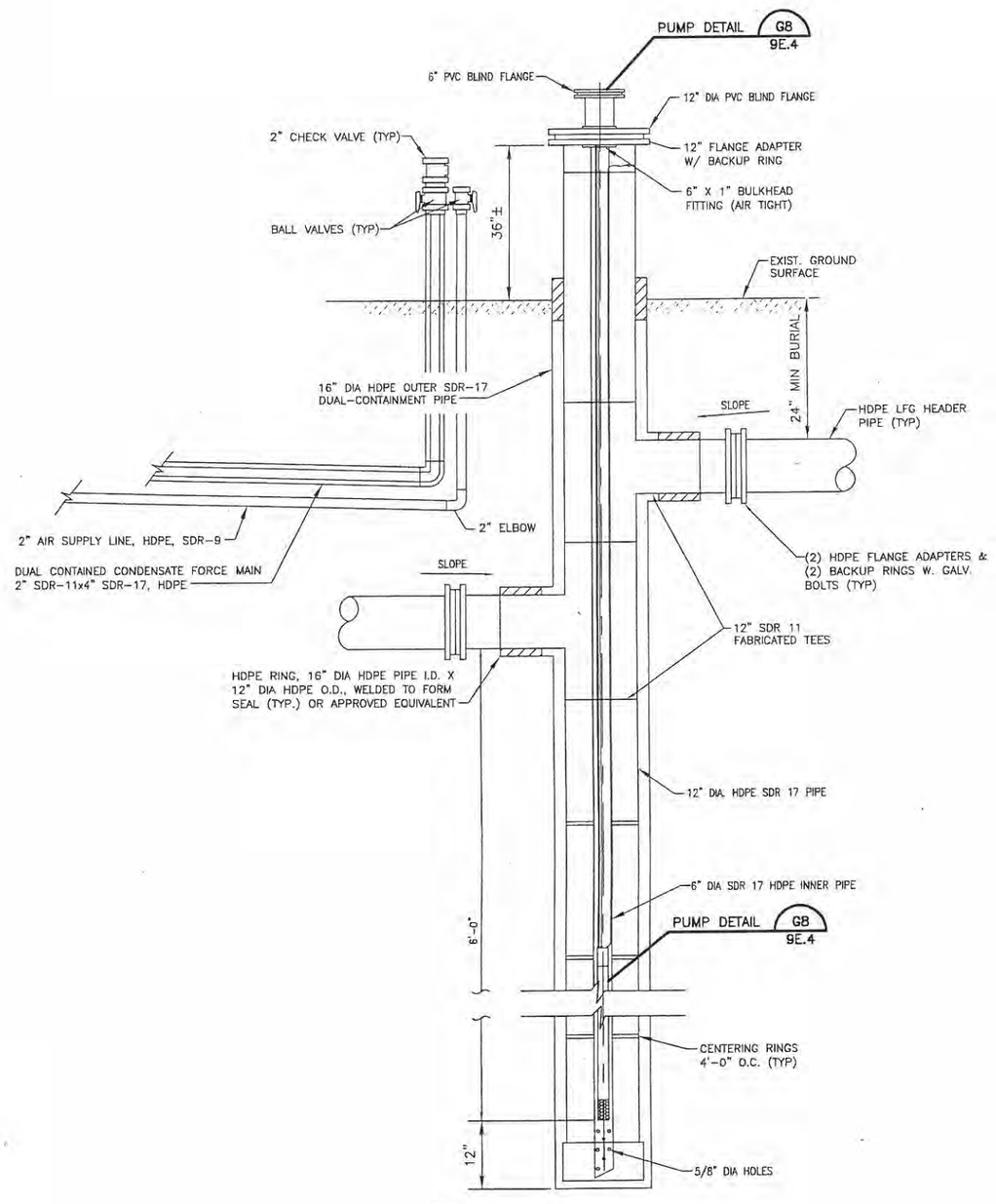
ACTIVE LFG SYSTEM DETAILS

CITY OF SAN ANGELO
SAN ANGELO LANDFILL
MSW PERMIT NO. 79A

BIGGS & MATHEWS ENVIRONMENTAL
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DSN. KJW	DATE : 07/05	ATTACHMENT
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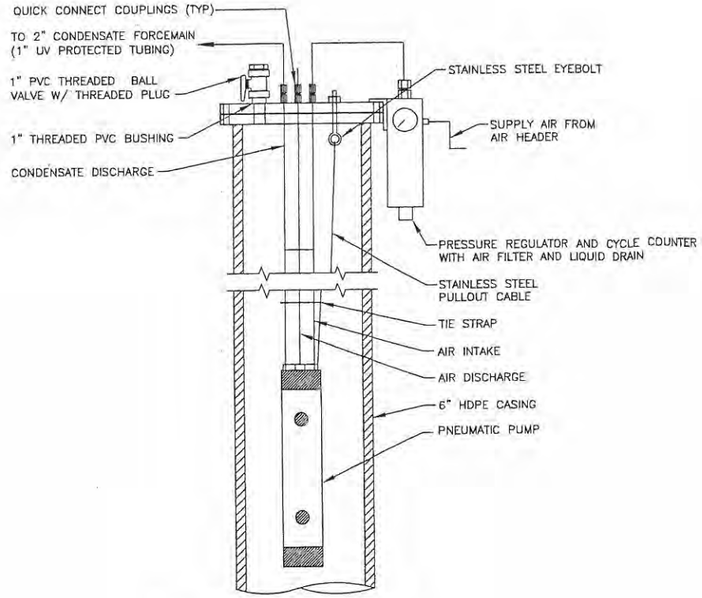


NOTE:

1. ALL SIZES AND DIMENSIONS ARE APPROXIMATE.

DUAL CONTAINMENT CONDENSATE SUMP G7 9E.4
NTS

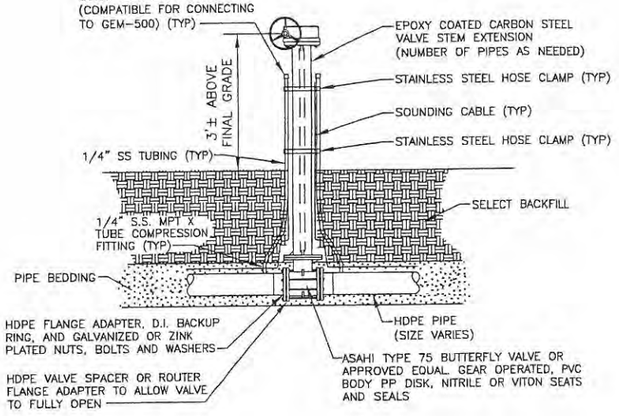
(OUTSIDE LIMITS OF WASTE ONLY)



NOTE:

1. ALL SIZES AND DIMENSIONS ARE APPROXIMATE.

PUMP DETAIL G8 9E.4
NTS



NOTE:

1. ALL SIZES AND DIMENSIONS ARE APPROXIMATE.

ISOLATION VALVE G9 9E.4
NTS



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REVISIONS						
REV	DATE	DESCRIPTION	DWN BY	DES BY	CHK BY	APP BY

ACTIVE LFG SYSTEM DETAILS

CITY OF SAN ANGELO
SAN ANGELO LANDFILL
MSW PERMIT NO. 79A

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817-563-1144

DSN. KJW	DATE : 07/05		ATTACHMENT	
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