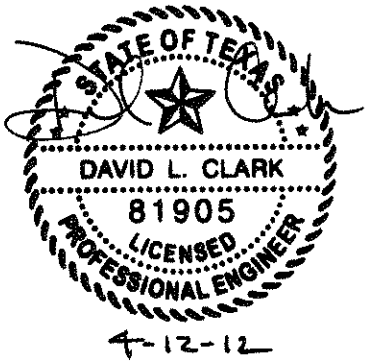
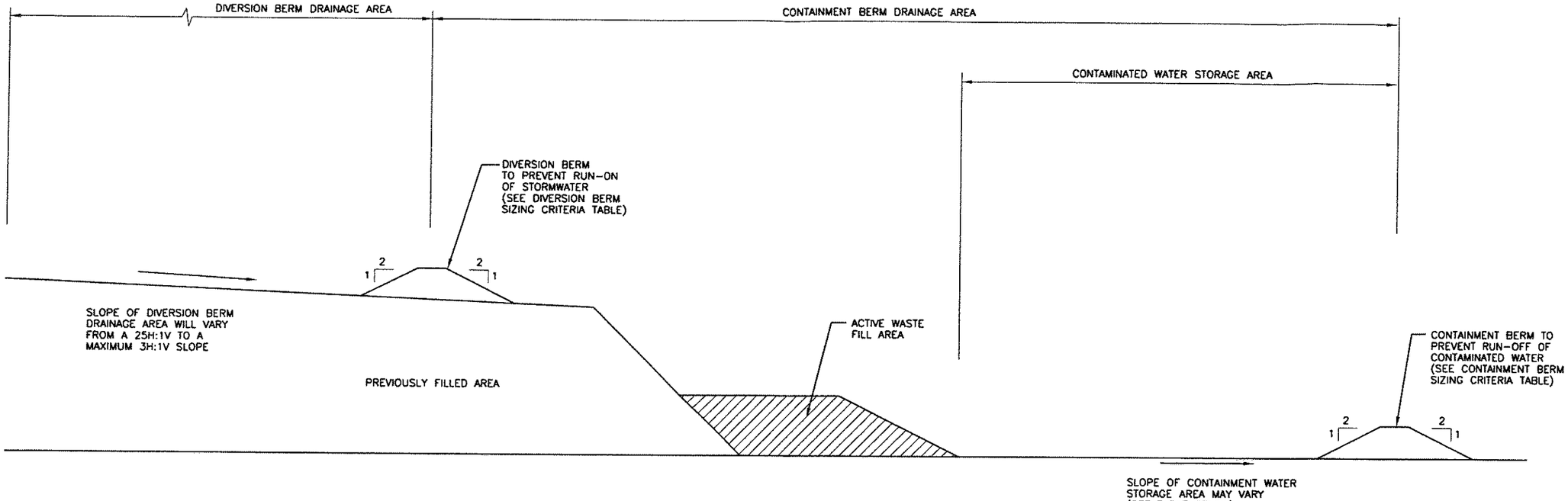
SKYLINE LANDFILL

APPENDIX D6-C
CONTAINMENT/DIVERSION BERM DESIGN



Includes pages D6-C-1 through D6-C-3



CONTAINMENT BERM SIZING CRITERIA

CONTAINMENT BERM DRAINAGE AREA (ACRES)	CONTAINMENT WATER STORAGE AREA (ACRES)	FLOOR SLOPE OF CONTAMINATED WATER STORAGE AREA	REQUIRED MINIMUM HEIGHT OF CONTAINMENT BERM (FT)
0.5	0.35 0.25 0.20	1 % 2 % 4 %	1.5 2.2 3.5
1.0	0.50 0.35 0.25	1 % 2 % 4 %	2.2 3.0 4.4
1.5	0.60 0.40 0.30	1 % 2 % 4 %	2.6 3.5 5.2

NOTE: CONTAINMENT BERMS WILL BE SIZED TO CONTAIN STORMWATER FROM THE 25 YEAR, 24 HOUR STORM EVENT. THE CRITERIA ARE BASED ON A MINIMUM DOWNSLOPE CONTAINMENT BERM LENGTH OF 100 FEET AND A FREEBOARD OF 0.5 FT.

DIVERSION BERM SIZING CRITERIA

DIVERSION BERM DRAINAGE AREA (ACRES)	MINIMUM 4%			MAXIMUM 33%		
	FLOW RATE (CFS)	FLOW DEPTH (FT)	REQUIRED MINIMUM DIVERSION BERM HEIGHT (FT)	FLOW RATE (CFS)	FLOW DEPTH (FT)	REQUIRED MINIMUM DIVERSION BERM HEIGHT (FT)
0.5	3.3	0.5	1.5	3.3	0.9	1.9
1.0	6.5	0.6	1.6	6.5	1.1	2.1
1.5	9.8	0.7	1.7	9.8	1.3	2.3

NOTE: DIVERSION BERMS WILL BE SIZED TO DIVERT STORMWATER FROM THE 25 YEAR, 24 HOUR STORM EVENT AND A FREEBOARD OF 1 FT.

STATE OF TEXAS
DAVID L. CLARK
81905
REGISTERED
PROFESSIONAL ENGINEER
4-12-12

CONTAMINATED WATER RUNON/RUNOFF DETAILS

WASTE MANAGEMENT OF TEXAS, INC.
SKYLINE LANDFILL
MAJOR PERMIT AMENDMENT

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

TBPE FIRM NO. F-256 | TBPG FIRM NO. 50222

ISSUED FOR PERMITTING PURPOSES ONLY

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

DSN. SAB | DATE : 04/12
DWN. SRC | SCALE : GRAPHIC
CHK. DLC | DWG : D6_C1.dwg

DRAWING D6-C1

J:\101\01\120\ATT D\D6_C1.dwg Layout: Layout1 User: scundiff

Skyline Landfill
Diversion Berm Design

Required: Determine the necessary dimensions of the diversion berms.

Method:

1. Determine the flow using the Rational Method.
2. Calculate flow capacity using Manning's Method.

References:

1. Texas Department of Transportation, Hydraulic Design Manual, Revised October 2011.
2. United States Geologic Survey, *Atlas of Depth-Duration Frequency of Precipitation Annual Maxima for Texas*, 2004.

Solution: Diversion berms will be designed to pass the 25-year, 24-hour storm event. The Rational Method (Q = CIA) was used to determine the runoff.

25-Year Rainfall Depth (Pd) =	1.42	in	(Ref. 2, extrapolated for 10 min)
Time of Concentration (tc) =	10	min	(conservative minimum value)
Rainfall Intensity (I) =	8.5	in/hr	(Ref. 1, I = Pd/tc)
Runoff Coefficient (C) =	0.7		
Running berm slope =	0.5	%	
Manning's n =	0.03		
Right side slope =	2	:1	

Drainage Area (A) (ac)	0.5		1.0		1.5	
Peak Flow (cfs)	3.0		6.0		8.9	
Berm Evaluation						
Left Side Slope	3:1	25:1	3:1	25:1	3:1	25:1
Flow Depth (ft)	0.9	0.5	1.1	0.6	1.3	0.7
Flow Area (sf)	2.0	3.4	3.0	4.9	4.2	6.6
Wetted Perimeter (ft)	4.9	13.6	5.9	16.4	7.0	19.1
Velocity (fps)	2.0	1.4	2.2	1.6	2.5	1.7
Berm Capacity (cfs)	4.0	4.7	6.8	7.6	10.6	11.5

Skyline Landfill
Containment Berm Design

Required: Size containment berms to contain contaminated water around the working face.

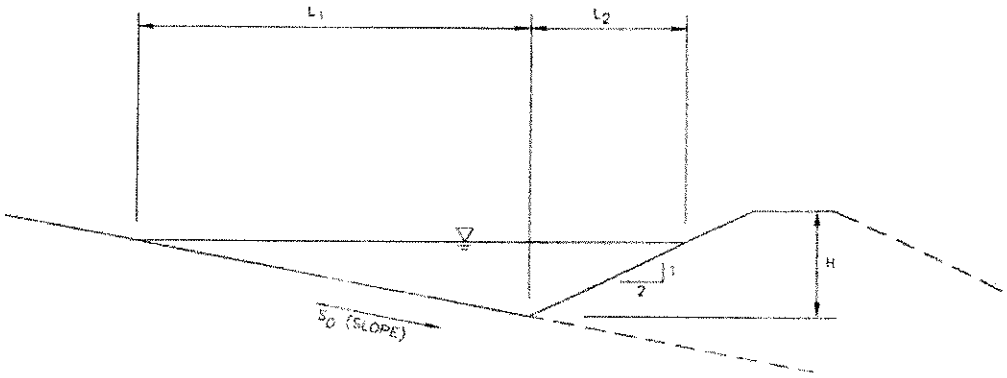
References: 1) Technical Paper No. 40: Rainfall Frequency Atlas of the United States.

Solution: Determine the storage volume required for the 25-year, 24-hour rainfall for Dallas County.

$V_R = CAR$

where: V_R = required storage volume (cf)
C = runoff coeffecient = 0.7
A = drainage area (acres)
R = 25-year, 24-hour rainfall = 7.4 in Ref. 1

Size the storage area from the following figure:



$A_s = (L_1 + L_2)H / 2$ Storage Area = $W(L_1 + L_2)$

where: A_s = cross section area (sf) W = storage width (ft)
$L_1 = H / S_o$
$L_2 = 2H$

Drainage area	Required Volume	W	Storage Area	S_o	L_1	L_2	H	As	Vs
ac	cf	ft	ac	ft/ft	ft	ft	ft	sf	cf
0.5	9,402	100	0.35	0.01	152	3.0	1.5	118.5	11,854
0.5	9,402	100	0.25	0.02	109	4.4	2.2	123.3	12,334
0.5	9,402	100	0.20	0.04	87	7.0	3.5	163.9	16,394
1	18,803	100	0.50	0.01	218	4.4	2.2	241.9	24,193
1	18,803	100	0.35	0.02	152	6.1	3.0	241.7	24,174
1	18,803	100	0.25	0.04	109	8.7	4.4	256.2	25,616
1.5	28,205	100	0.60	0.01	261	5.2	2.6	348.4	34,838
1.5	28,205	100	0.40	0.02	174	7.0	3.5	315.7	31,574
1.5	28,205	100	0.30	0.04	131	10.5	5.2	368.9	36,887

SKYLINE LANDFILL

APPENDIX D6-D
SECONDARY CONTAINMENT VOLUME CALCULATIONS

Includes pages D6-D-1 through D6-D-2

Skyline Landfill
SECONDARY CONTAINMENT CALCULATION

Required:

1. Verify that the secondary containment area will contain a worst-case release from the two existing storage tanks and precipitation from the 25-year, 24-hour rainfall event.

References:

1. Texas Department of Transporation, *Hydraulic Design Manual*, Revised October 2011.
2. United States Geologic Survey, *Atlas of Depth-Duration Frequency of Precipitation Annual Maxima for Texas*, 2004.

Solution:

a) ***Provided Volume***

Calculate the provided secondary containment volume.

Containment Area Dimensions

Length of containment area =	L =	400 ft
Width of containment area =	W =	200 ft
Containment area =	A =	80,000 sf
Containment berm height =	h =	3 ft

$$V_{CONTAINMENT} = A \times h$$
$$V_{CONTAINMENT} = 240{,}000 \text{ cf}$$

Freeboard

Freeboard =	f =	0.5 ft

$$V_{FREEBOARD} = f \times A$$
$$V_{FREEBOARD} = 40{,}000 \text{ cf}$$

Provided Secondary Containment Volume

$$V_{PROVIDED} = V_{CONTAINMENT} - V_{FREEBOARD}$$
$$\mathbf{V_{PROVIDED} = 200{,}000 \text{ cf}}$$

b) ***Required Volume***

Calculate the required secondary containment volume, which is the sum of rainfall volume and storage tank volume above freeboard level.

Rainfall Volume

Calculate the rainfall volume that will collect in the containment area during the 25 year, 24-hour rainfall event.

From Reference 2, the 25-year, 24-hour rainfall event is 7.4 inches for Dallas County, Texas.

25-year, 24-hour rianfall depth =	D =	7.40 in.	(Ref. 2)
Containment area =	A =	80,000 sf	

$$V_{RAINFALL} = D \times A$$
$$V_{RAINFALL} = 49{,}333 \text{ cf}$$

Skyline Landfill
SECONDARY CONTAINMENT CALCULATION

Storage Tank1 Volume

Tank diameter =	d =	14.0 ft
Tank area =	A_{TANK} =	154 sf
Tank height =	h_t =	29 ft
Height above freeboard level =	h_{tf} =	26.5 ft

Tank volume above freeboard = $V_{TANK1} = h_{tf} \times A_{TANK}$

V_{TANK1} = 4,077 cf

Storage Tank2 Volume

Tank diameter =	d =	12.0 ft
Tank area =	A_{TANK} =	113 sf
Tank height =	h_t =	20 ft
Height above freeboard level =	h_{tf} =	17.5 ft

Tank volume above freeboard = $V_{TANK2} = h_{tf} \times A_{TANK}$

V_{TANK2} = 1,978 cf

Total Tank Volume Above Freeboard Level

$V_{TANKS} = V_{TANK1} + V_{TANK2}$

V_{TANKS} = 6,055 cf

Required Secondary Containment Volume

$V_{REQUIRED} = V_{RAINFALL} + V_{TANKS}$

$\mathbf{V_{REQUIRED}}$ = **55,389 cf**

c) ***Conclusion***

$\mathbf{V_{PROVIDED}}$ = **200,000 cf**

$\mathbf{V_{REQUIRED}}$ = **55,389 cf**

Therefore, the provided secondary containment area will contain the required worst-case release from the two storage tanks and precipitation from the 25-year, 24-hour rainfall event.