RESPONSE 32

APPENDIX III-2B-2

ACTIVE FACE RUN-ON CONTROL BERM SIZING

ACTIVE FACE RUN-ON CONTROL BERM SIZING

Made By: HPR
Checked by: MX
Reviewed by: CGD

1.0 OBJECTIVE

Develop run-on control berm design for the active waste working face.

2.0 DESIGN CRITERIA

1) The proposed soil berm is at 2-foot high as measured from the invert of the channel to the top of berm, with the invert sloped at 2% in the direction of flow. The side slope of the soil berm are 4H:1V and 2H:1V.

2) The allowable flow velocity in the proposed diversion channel is 5 ft/sec.

3) Manning's equation is used to calculate the channel flow capacity.

4) Rational method is used to back-calculate the allowable drainage area based on the channel flow capacity.

3.0 METHOD

I) Mannings's equation

$$Q = \frac{1.49}{n} A R^{2/3} S^{1/2}$$

Where:

Q = flow rate
A = cross-sectional area of the flow
R = hydraulic radius
S = slope
n = Manning's n for grass-lined channels = 0.035

II) Rational Method

Q=CIA

Where:

Q = Runoff flow rate;
C = Runoff coefficient = 0.7 for slopes greater than 5% (Reference 1);
i = Rainfall intensity coefficient (Reference 1, TxDot data as shown in Table 2);
A = Drainage area.

STATE OF TEXAS
12/5/16
CHARLES G. DOMINGUEZ
83247
LICENSED
PROFESSIONAL ENGINEER

GOLDER ASSOCIATES INC.
Professional Engineering Firm
Registration Number F-2578

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4.0 CALCULATIONS

Using Manning's equation the channel capacity is calculated as 27.4 cfs as shown in Table 1.

Using 27.4 cfs as a limiting factor, the maximum subbasin drainage area for the proposed run-on control berm is calculated as 4.1 acres as shown in Table 2. Depending on the actual size of the upstream watershed, the run-on control berm size can be adjusted.

Table 1: Channel Flow Capacity

Q (cfs)	Slope (ft/ft)	Left Side Slope (H:1V)	Right Side Slope (H:1V)	Channel Depth (ft)	Bottom Width (ft)	Mannings n	Max Velocity (fps)	Max Normal Flow Depth (ft)	Shear Stress (lb/ft^2)	Available Freeboard (ft)
27.4	0.02	2	4	2	0	0.035	**5**	**1.4**	1.8	0.6

Table 2: Runoff Calculation

County
Bell

Baylor
Bee
Bell
Bexar
Blanco
Borden
Bosque
Bowie
Brazoria

Coefficient	2-year	5-year	10-year	25-year	50-year	100-year
e (in)	0.798	0.78	0.773	0.771	0.754	0.751
b	56	69	77	90	93	102
d (mins)	8	8.5	8.5	8.5	8.5	8
Intensity (in/hr)*	5.6	7.1	8.1	9.5	10.3	11.6

Coefficient	2-year	5-year	10-year	25-year	50-year	100-year
e (mm)	0.798	0.78	0.773	0.771	0.754	0.751
b	1422	1753	1956	2286	2362	2591
d (mins)	8	8.5	8.5	8.5	8.5	8

* for Time of Concentrati	10	Minutes at a Minimum
C =	0.7	For Slopes Greater than 5%
A =	4.1	Acres
Q =	27.4	cfs = channel flow capacity from Table 1

5.0 CONCLUSION

A typical run-on control berm of 2 ft high is proposed, which can collect and convey potential storm water run-on to the active face from an upstream watershed of 4.1 acres, at maximum. Depending on the actual size of the upstream watershed, the run-on control berm size can be adjusted.

6.0 REFERENCE

1) Texas Department of Transportation "Hydraulic Design Manual" Revised March 2004.

APPENDIX III-2B-1

ACTIVE FACE RUNOFF CONTROL BERM SIZING

ACTIVE FACE RUNOFF CONTROL BERM SIZING

Made By: VJE
Checked by: MX
Reviewed by: CGD

1.0 OBJECTIVE

Calculate the required size of the stormwater containment berm at the landfill active face as a function of plane area of the active area.

2.0 GIVEN

- Waste slope of 4H:IV
- 25 years, 24 hour storm event of 7.9 inches;
- Berm slope of 2H:1V;
- 1.0 ft. freeboard on berm

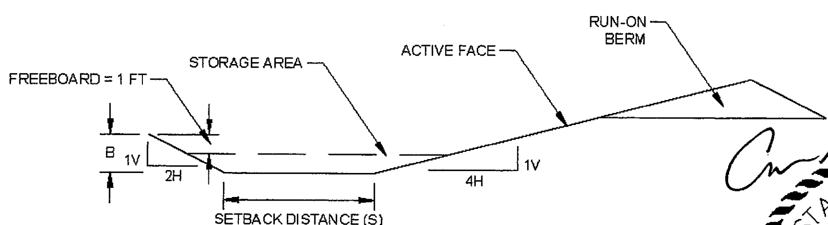
3.0 ASSUMPTIONS

- Stormwater run-on to the active face will not be allowed
- 50 percent run-off from the active face, i.e., 50% infiltration

4.0 CALCULATION

Derive relationships for the amount of runoff from the 7.9 inch design storm and the available storage volume as a function of the active face area.

Cross-section of the Active Face and Containment Berm



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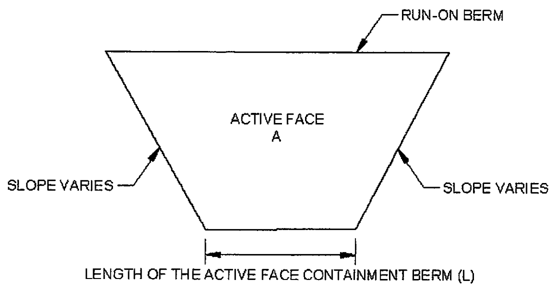
Elevation View of the Active Face and Containment Berm



4.1 Runoff, R

$$R = .5\left(7.9 \div 12\,{}^{in}/_{ft}\right) \times A = \frac{0.66}{2} \times A = .33 \times A$$

Where:

R = total runoff into the active area containment berm (cf)
A = total area of the active face (sf)

4.2 Storage, V

$$V = L \times \left(\frac{S + (S + (B-1) \times 2 \times (B-1) \times 4)}{2}\right) \times (B-1)$$

$$V = (3B^2 + (S-6) \times B - S + 3) \times L$$

Where:

V = storage capacity an active face containment berm (cf)
L = length of the active face containment berm (ft)

4.3 Height of Berm, B

Now set runoff, R, equal to storage, V, and solve for the height of berm, B.

$$B = \frac{6 - S + \sqrt{S^2 + 7.92\frac{A}{L}}}{6}$$

For typical site operations, the maximum berm height will be 6 ft. The operator can vary the berm length and setback distance to limit the berm height to 6 ft.

Now plot B versus L for various values of S and A. Figures 1 through 8 present the plots for active working areas of 10,000, 20,000, 30,000, 40,000 sf, etc., respectively.

4.4 Procedure To Select Berm Size

Procedure to select berm size using Figures 1 through 8:

1) Determine the active face area (A);

2) Select a figure from Figures 1-8 that has an active area closest to, but no less than the actual A. For example, if A=25,000, choose Figure 3 (A=30,000);

3) Determine the minimum setback distance (S) for the daily operation, and select the corresponding curve. If the setback distance falls between the numbers shown on the figure, the closest but smaller value of S will be used. For example, if S=25 ft, choose the curve representing 20 ft; and

4) Measure the length of the active face containment berm, and determine the required berm height from the selected curve. Figures 1 through 8 cover a wide range of berm length (i.e. toe width of the active face) for normal waste fill operations. If the actual berm length is longer than the maximum value on the curve, the maximum berm length on the can be used to determine a conservative berm height. If the actual berm length is shorter than the minimum value on the curve, the operator can use equation (1) above to determine berm height.

Example using attached figures: A = 10,000 sf, s = 20 ft, L = 200 ft => B = 1.8 ft (from Figure 1, curve S = 20 ft).

5.0 CONCLUSION

Figures 1 through 8 and the procedure discussed above provide guidance for determining the size of the stormwater containment berm based on the height of the active face (runoff area), the length of the containment berm, and the setback distance from the active face. The equations presented in this calculation may be used to determine the required berm height for various active face areas, berm lengths, and setback distances.

Figure 1. Berm Height vs. Berm Length for Various Setbacks

A = 10,000 sf

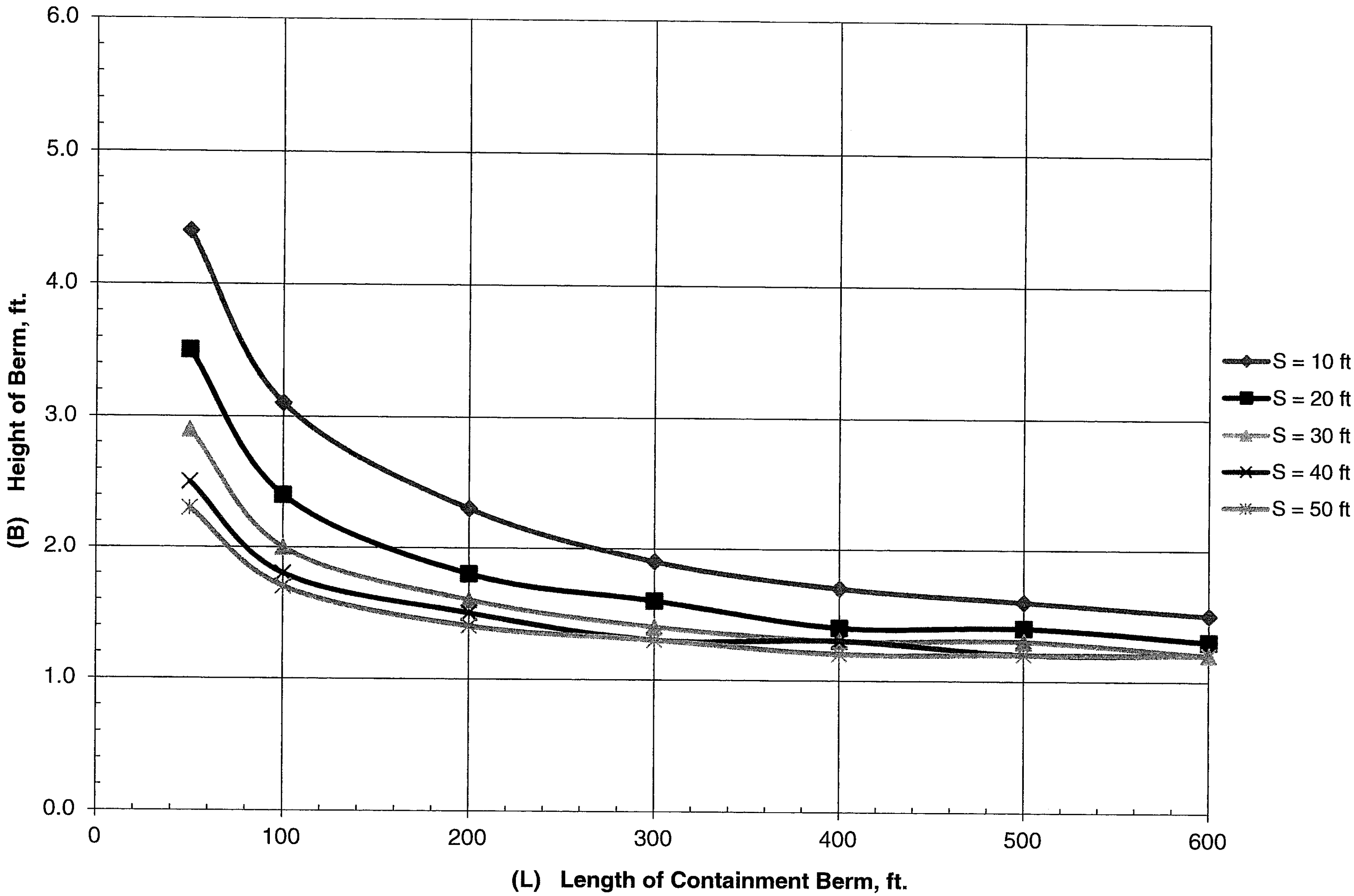


Figure 2. Berm Height vs. Berm Length for Various Setbacks

A = 20,000 sf

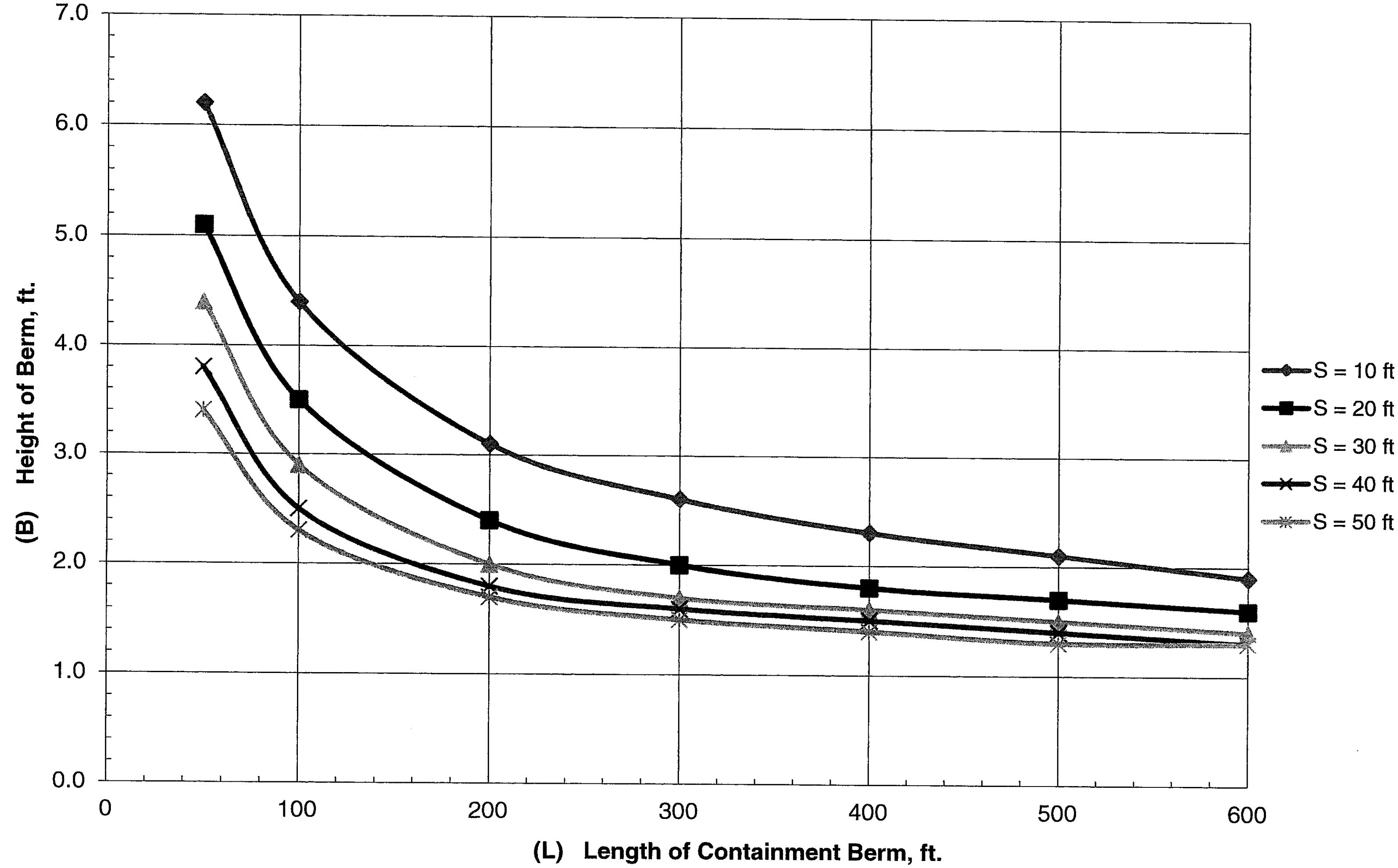


Figure 3. Berm Height vs. Berm Length for Various Setbacks

A = 30,000 sf

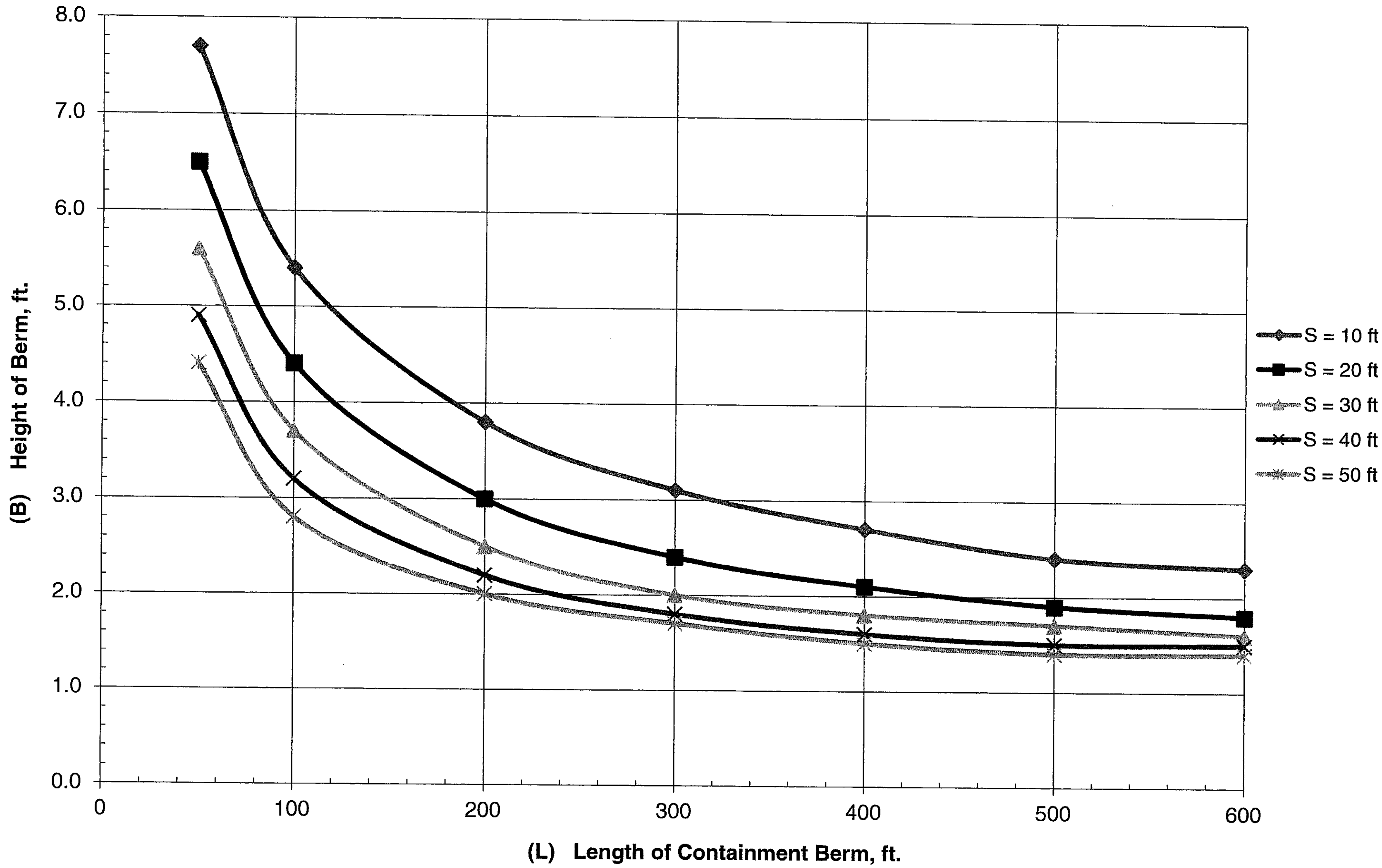


Figure 4. Berm Height vs. Berm Length for Various Setbacks

A = 40,000 sf

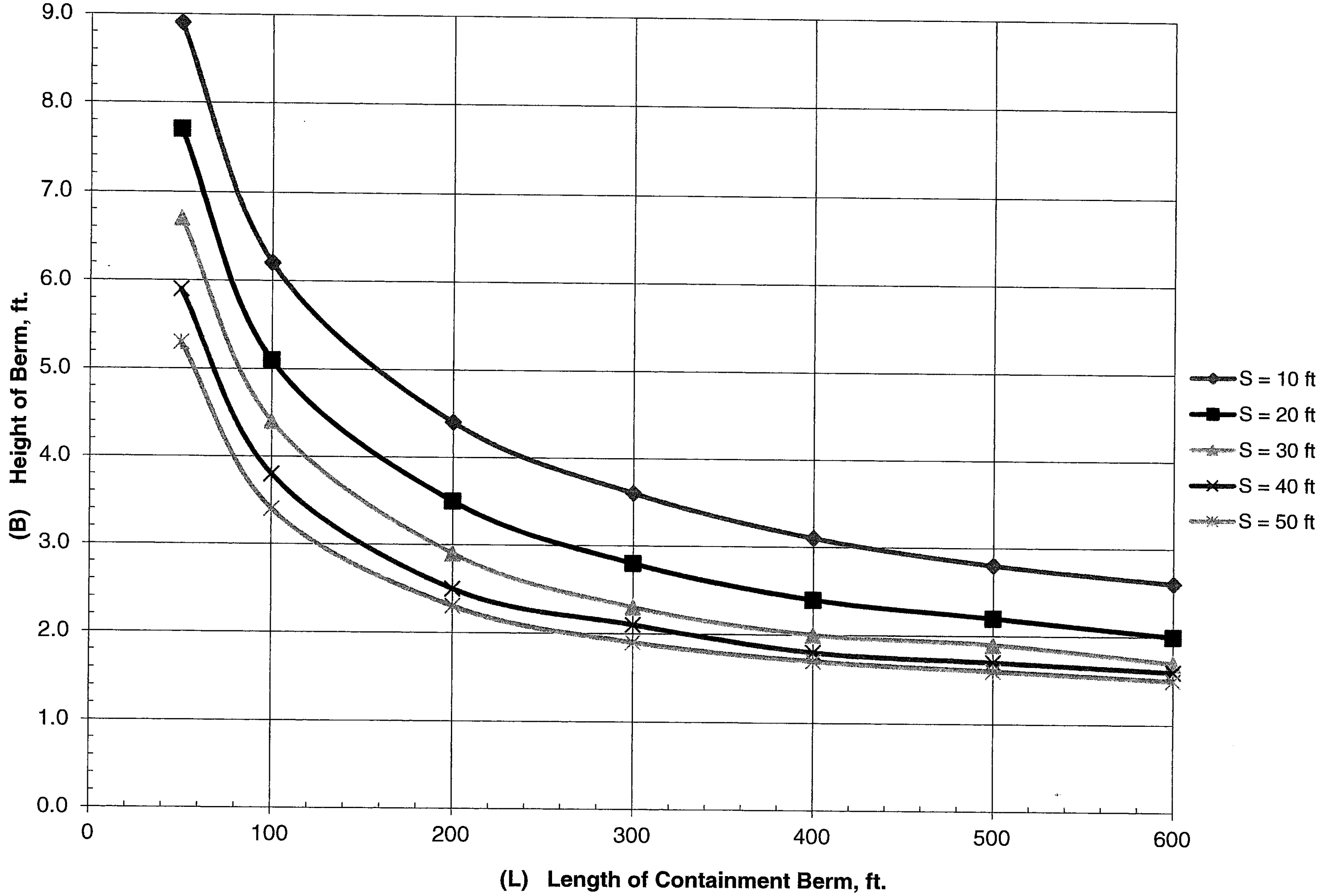


Figure 5. Berm Height vs. Berm Length for Various Setbacks

A = 50,000 sf

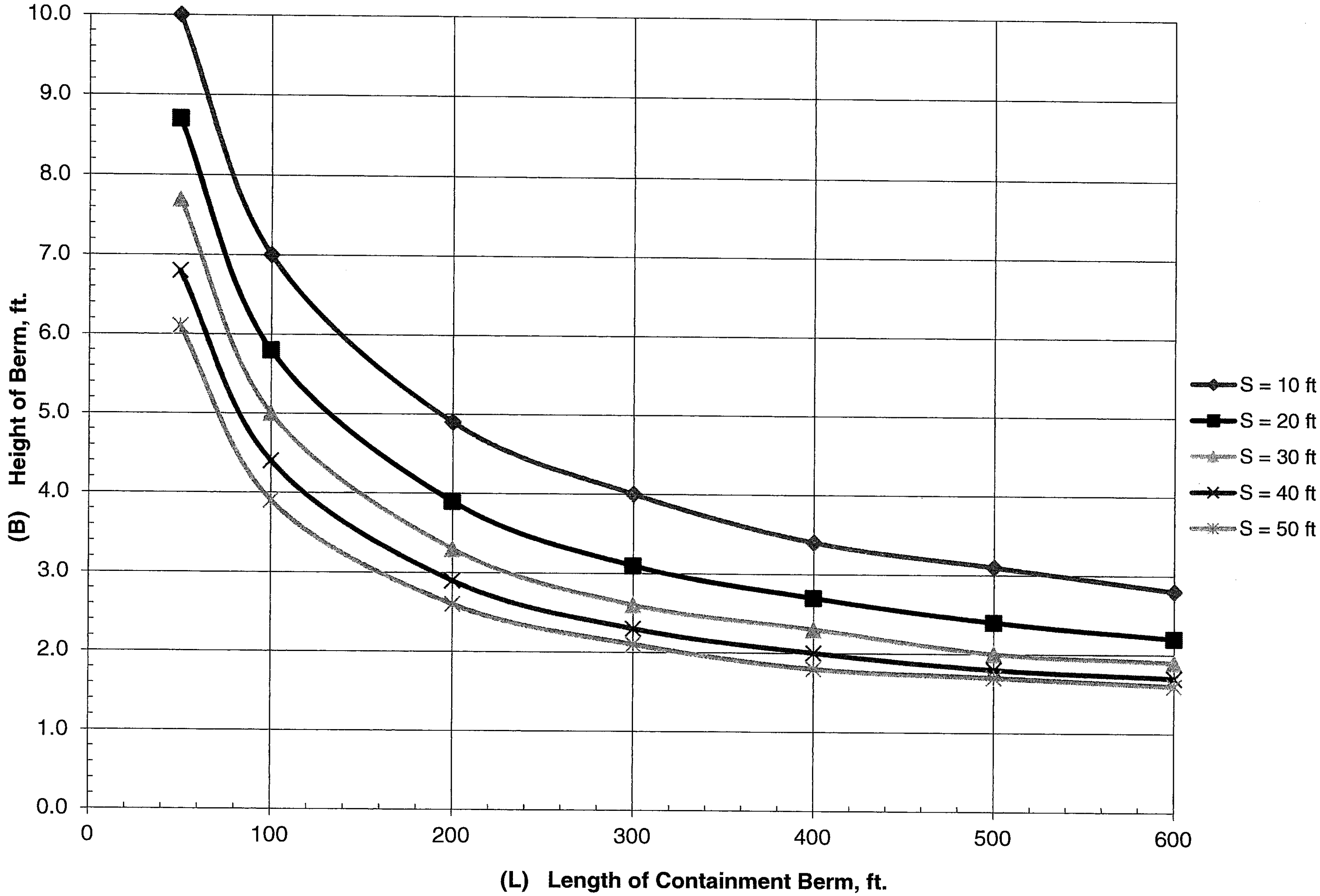


Figure 6. Berm Height vs. Berm Length for Various Setbacks

A = 60,000 sf

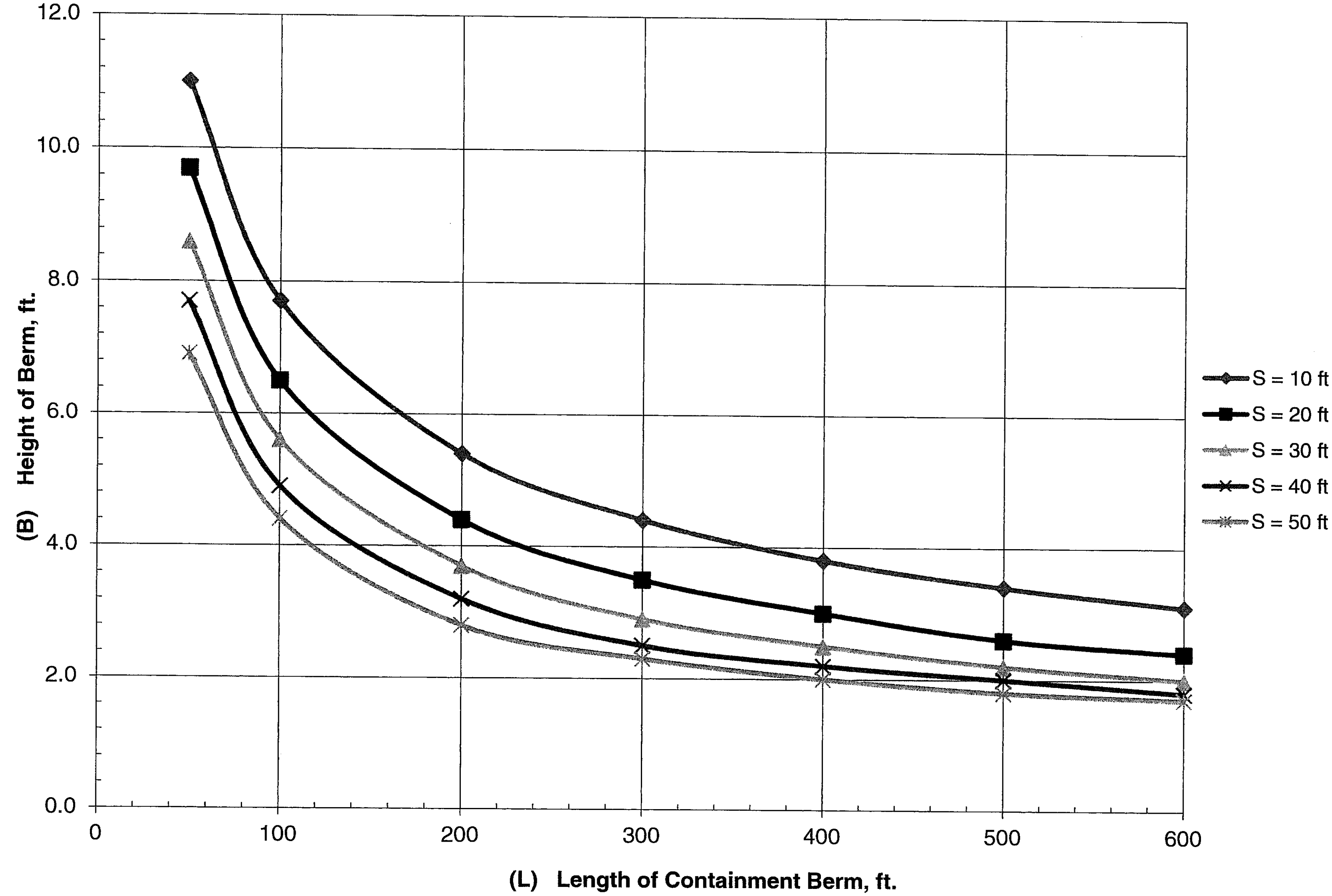


Figure 7. Berm Height vs. Berm Length for Various Setbacks

A = 70,000 sf

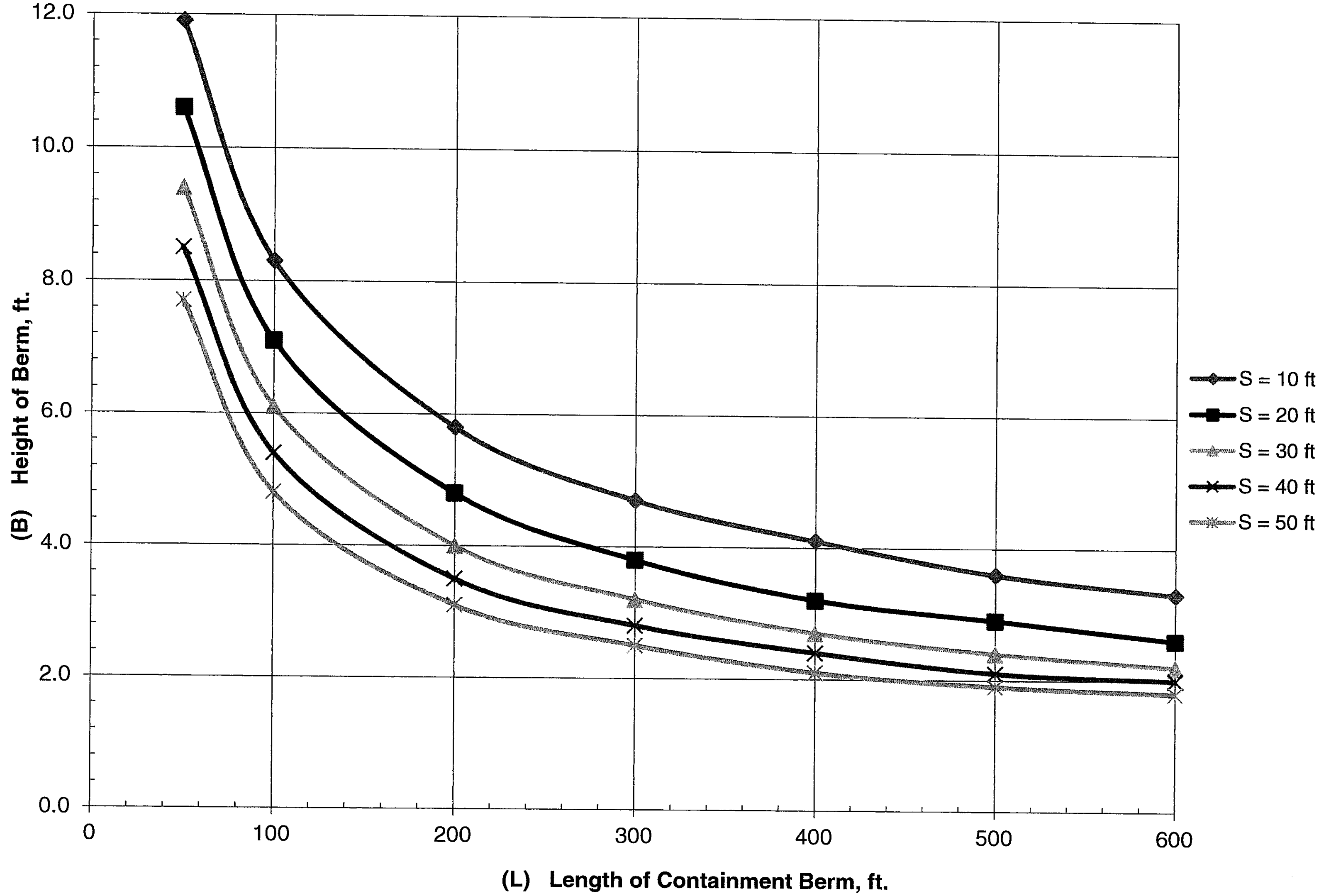


Figure 8. Berm Height vs. Berm Length for Various Setbacks

A = 80,000 sf