

**STORM DRAIN AND SWALE CAPACITY**  
*for*  
**HERRING BROOK MEADOWS**  
**SCITUATE, MA**

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**Calculate Peak Discharges for Subcatchment Areas using Rational Method (25-Year Design Flood Frequency):**

$$Q = C i A$$

where:

Q = Peak Discharge Flowrate (ft.<sup>3</sup> / second)

C = Runoff Coefficient

i = Average Rainfall Intensity (in. / hr.) for a Storm Duration Equal to the Time of Concentration, T<sub>c</sub>

A = Drainage Area (acres)

**Calculate Storm Drain Diameter Assuming Full Flow Conditions using Manning Equation:**

$$D = 1.335 \left( \frac{n Q}{\sqrt{S}} \right)^{\frac{3}{8}}$$

where:

D = Storm Drain Diameter (ft.)

n = Manning Roughness Coefficient

Q = Flowrate (ft.<sup>3</sup> / sec.)

S = Slope of Storm Drain (ft. / ft.)

**Calculate Stone Lined Channel Capacity Assuming Full Flow Conditions using Manning Equation:**

$$V = \frac{Q}{A} = \frac{1.49 r^{\frac{2}{3}} s^{\frac{1}{2}}}{n}$$

where:

Q = Flowrate (ft.<sup>3</sup> / sec.)

V = Velocity (ft/sec)

A = Cross Sectional Area of Swale (ft<sup>2</sup>)

r = Hydraulic Radius =  $\frac{a}{p_w} = \frac{\text{Area}(ft^2)}{\text{Wetted Perimeter}(ft)}$

n = Manning Roughness Coefficient

s = Slope of Storm Drain (ft. / ft.)

**FLOWS FROM CATCH BASIN 1:**

**CRITERIA:**

$$A = 59,147 \text{ ft.}^2 = \mathbf{1.358 \text{ Acres}}$$

$$\text{Impervious Areas} = 1.122 \text{ Acres}$$

$$\text{Pervious Areas} = 0.237 \text{ Acres}$$

$$T_c = \text{Assumed to be less than 5 minutes}$$

$$i = \mathbf{5.3 \text{ in / hr.}}$$
 (See attached Intensity – Duration – Frequency Curve for Barnstable, MA)

$$C_{\text{impervious}} = 0.90 \text{ (Paved Parking Area)}$$

$$C_{\text{pervious}} = 0.20$$

**ANALYSIS:**

$$C_{\text{avg}} = \frac{(1.122 \text{ acres})(0.9) + (0.237 \text{ acres})(0.2)}{1.358 \text{ acres}} = 0.778$$

$$Q = (0.778) \left( 5.3 \frac{\text{in.}}{\text{hr.}} \right) (1.358 \text{ acres}) = 5.60 \frac{\text{ft.}^3}{\text{sec.}}$$

$$D = 1.335 \left( \frac{n Q}{\sqrt{S}} \right)^{\frac{3}{8}} = 1.335 \left( \frac{0.011 (5.60)}{\sqrt{0.006}} \right)^{\frac{3}{8}} = 1.23 \text{ ft.} = 14.84 \text{ inches}$$

**USE 15" HDPE Storm Drain with  $S = 0.006 \text{ ft / ft}$**

**(When  $Q = 5.60 \text{ ft.}^3 / \text{sec.}$ , velocity  $5.51 \text{ ft. / sec.}$ )**

**Maximum Capacity =  $5.92 \text{ ft.}^3 / \text{sec.}$**

**FLOWS FROM CATCH BASIN 2:**

**CRITERIA:**

$$A = 33,308 \text{ ft.}^2 = \mathbf{0.765 \text{ Acres}}$$

$$\text{Impervious Areas} = 0.293 \text{ Acres}$$

$$\text{Pervious Areas} = 0.472 \text{ Acres}$$

$T_c$  = Assumed to be less than 5 minutes

$i = \mathbf{5.3 \text{ in / hr.}}$  (See attached Intensity – Duration – Frequency Curve for Barnstable, MA)

$$C_{\text{impervious}} = 0.90 \text{ (Paved Parking Area)}$$

$$C_{\text{pervious}} = 0.20$$

**ANALYSIS:**

$$C_{\text{avg}} = \frac{(0.263 \text{ acres})(0.9) + (0.472 \text{ acres})(0.2)}{0.765 \text{ acres}} = 0.43$$

$$Q = (0.43) \left( 5.3 \frac{\text{in.}}{\text{hr.}} \right) (0.765 \text{ acres}) = 1.74 \frac{\text{ft.}^3}{\text{sec.}}$$

$$D = 1.335 \left( \frac{n Q}{\sqrt{S}} \right)^{\frac{3}{8}} = 1.335 \left( \frac{0.011 (1.74)}{\sqrt{0.006}} \right)^{\frac{3}{8}} = 0.79 \text{ ft.} = 9.48 \text{ inches}$$

**USE 12" HDPE Storm Drain with  $S = 0.006 \text{ ft / ft}$**

**(When  $Q = 1.74 \text{ ft.}^3 / \text{sec.}$ , velocity =  $4.07 \text{ ft. / sec.}$ )**

**Maximum Capacity =  $3.27 \text{ ft.}^3 / \text{sec.}$**

**FLOWS FROM CATCH BASIN 3:**

**CRITERIA:**

**A = 27,423 ft.<sup>2</sup> = 0.630 Acres**

Impervious Areas = 0.342 Acres

Pervious Areas = 0.287 Acres

T<sub>c</sub> = Assumed to be less than 5 minutes

**i = 5.3 in / hr.** (See attached Intensity – Duration – Frequency Curve for Barnstable, MA)

C<sub>impervious</sub> = 0.90 (Paved Parking Area)

C<sub>pervious</sub> = 0.20

**ANALYSIS:**

$$C_{avg} = \frac{(0.342 \text{ acres})(0.9) + (0.287 \text{ acres})(0.2)}{0.604 \text{ acres}} = 0.605$$

$$Q = (0.605) \left( 5.3 \frac{\text{in.}}{\text{hr.}} \right) (0.604 \text{ acres}) = 1.94 \frac{\text{ft.}^3}{\text{sec.}}$$

$$D = 1.335 \left( \frac{n Q}{\sqrt{S}} \right)^{\frac{3}{8}} = 1.335 \left( \frac{0.011 (1.94)}{\sqrt{0.0065}} \right)^{\frac{3}{8}} = 0.81 \text{ ft.} = 9.72 \text{ inches}$$

**USE 12" HDPE Storm Drain with S = 0.0065 ft / ft**

**(When Q = 1.94 ft.<sup>3</sup> / sec., velocity = 4.29 ft. / sec.)**

**Maximum Capacity = 3.40 ft.<sup>3</sup> / sec.**

**COMBINED FLOWS:**

**Flows from CB1, CB2 and CB3**

$$5.60\text{cfs} + 1.74\text{cfs} + 1.94\text{cfs} = \underline{\mathbf{9.28\text{ cfs}}}$$

**ANALYSIS:**

$$D = 1.335 \left( \frac{nQ}{\sqrt{S}} \right)^{\frac{3}{8}} = 1.335 \left( \frac{0.011(9.28)}{\sqrt{0.006}} \right)^{\frac{3}{8}} = 1.48 \text{ ft.} = 17.78 \text{ inches}$$

**USE 18" HDPE Storm Drain with S = 0.006 ft / ft  
(When Q = 9.28 ft.<sup>3</sup> / sec., velocity = 6.21 ft. / sec.)  
Maximum Capacity = 9.64 ft.<sup>3</sup> / sec.**

