10SR011

YARD WASTE IMPROVEMENTS - WEST BLVD NORTH

Drainage Calculations: Rational Method

$Q = c\,i\,a$

paved area: $c_{10} = 0.90$
$c_{100} = 0.93$

undeveloped: $c_{10} = 0.55$
$c_{100} = 0.65$

intensity (5 min) $i_{10} = 6.37$ in
$i_{100} = 9.48$ in

existing area:
paved = 12,540 sf = 0.288 ac
undeveloped = 3000 sf = 0.069 ac

new area:
paved = 15,540 sf = 0.357 ac

10-YEAR FLOWS

Existing $Q = 0.90\,(6.37)\,0.288 + 0.55\,(6.37)\,0.069$
$= 1.89$ cfs

New $Q = 0.90\,(6.37)\,0.357$
$= 2.05$ cfs

100-YEAR FLOWS

Existing $Q = 0.90\,(9.48)\,0.288 + 0.55\,(9.48)\,0.069$
$= 2.82$ cfs

New $Q = 0.90\,(9.48)\,(0.357)$
$= 3.05$ cfs

USE WEIR TO REDUCE NEW FLOWS TO EXISTING LEVELS

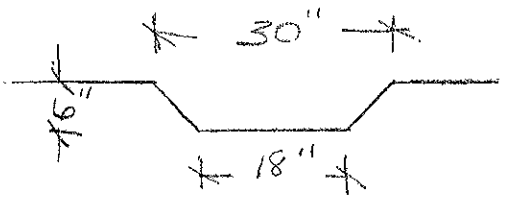
Francis Formula

$Q = 3.33\,(b - 0.2h)\,h^{3/2}$

$Q_{10} = 1.89$ $Q_{100} = 2.82$
$b = 0.5'$ (current)

10-yr $1.89 = 3.33\,(b - 0.1)\,.5^{3/2}$
$b - 0.1 = 1.89 / 3.33 / .5^{3/2}$
$b = 1.7'$

100-yr $2.82 = 3.33\,(b - .1)\,.5^{3/2}$
$b - .1 = 2.82 / 3.33 / .5^{3/2}$
$b = 2.5'$



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Rip-Rap

$V = \frac{2.82\ ft^3/s}{1\ ft^2} = 2.82\ ft/sec$

Velocity is less than 3 ft/sec, therefore not required in grass established areas. Riprap will only be used to protect 10 ft disturbed areas.

2-15-10

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Rapid City Area
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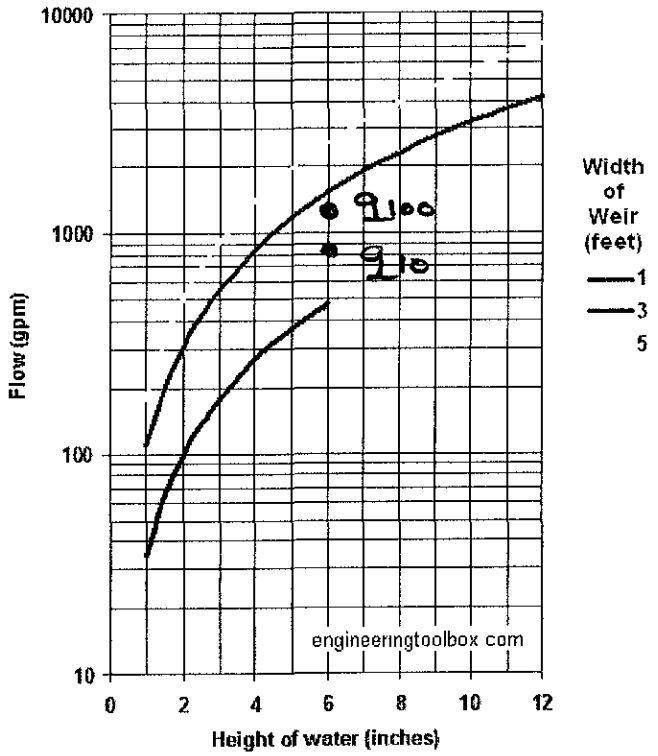


q_{10} = 848 gpm

q_{100} = 1266 gpm

Triangular or V-Notch Weir

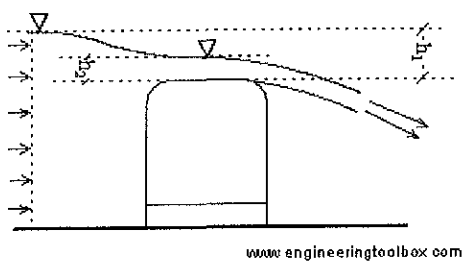
For a triangular or v-notch weir the flow rate can be expressed as:

$$q = 8/15\ c_d\ (2\ g)^{1/2}\ \tan(\theta/2)\ h^{5/2} \qquad (2)$$

where

θ = *v-notch angle*

Broad-Crested Weir



For the broad-crested weir the flow rate can be expressed as

$$q = c_d\ h_2\ b\ (\ 2\ g\ (h_1 - h_2)\ )^{1/2} \qquad (3)$$

Measuring the Levels

For measuring the flow rate it's obviously necessary to measure the flow levels, then use the equations above for calculating. It's common to measure the levels with:

- ultrasonic level transmitters, or
- pressure transmitters

Ultrasonic level transmitters are positioned above the flow without any direct contact with the flow Ultrasonic level transmitters can be used for all measurements. Some of the transmitters can even calculate a linear flow signal - like a pulse signal or *4 - 20 mA* signal - before transmitting it to the control system.