prepared in sufficient detail to ensure that peak runoff rates are reasonably accurate.

Runoff models shall be developed for the following cases:

Case 1. Pre-development conditions.

Case 2. Post-development conditions.

Case 3. Fully urbanized conditions in the entire drainage basin.

Cases 1 & 2 are utilized to determine the required detention volume and the type of outlet structure to be provided, and shall be analyzed for the three storm recurrence frequencies required above.

Detention facilities shall be designed such that peak outflow rates from the facility for Case 2 are no greater than the rates determined in Case 1 for each of the three storm recurrence frequencies required.

The storage volume provided shall not be less than the difference in total runoff volume between Case 1 and Case 2.

Case 3 is used determine the size of the overflow spillway. Case 3 need only be analyzed for the 1% AEP ("100-year") storm.

312.5.5 Spillways and Outlet Structure Hydraulics

Outlet structures be composed of culverts, weirs, orifices, and other hydraulic elements for which reliable data is available.

Weir coefficients shall be as given in King's Handbook of Hydraulics (Reference 312.4). Coefficients for broad-crested weirs interpolated from the values given in King's Handbook are given below in Table 312.1.

TABLE 312.1
DISCHARGE COEFFICIENTS FOR BROAD-CRESTED WEIRS

Depth (ft.)	Coefficient for 6" thick wall	Coefficient for 8" thick wall	Coefficient for 12" thick wall
0.20	2.80	2.77	2.69
0.25	2.83	2.79	2.70
0.30	2.86	2.80	2.71
0.40	2.92	2.84	2.72
0.50	3.00	2.90	2.74
0.60	3.08	2.95	2.75

TABLE 312.1 (continued)
DISCHARGE COEFFICIENTS FOR BROAD-CRESTED WEIRS

Depth (ft.)	Coefficient for 6" thick wall	Coefficient for 8" thick wall	Coefficient for 12" thick wall
0.70	3.19	3.03	2.80
0.75	3.25	3.08	2.83
0.80	3.30	3.12	2.85
0.90	3.31	3.16	2.92
1.00	3.32	3.20	2.98
1.25	3.32	3.25	3.11
1.50	3.32	3.29	3.24
1.75	3.32	3.31	3.27
2.00	3.32	3.32	3.30
2.50	3.32	3.32	3.31
>2.5	3.32	3.32	3.32

Capacity of broad-crested slot and V-notch weirs shall be determined by the following formula, developed by Joe Wilson at the University of Missouri-Rolla:

$$Q = 0.86 H + (3.65 w + 5.82 z) H^{1.5}, \text{ where}$$

Q = flow rate in cubic feet per second
H = upstream head (ponded depth above slot invert plus any velocity head) in feet. H = 6 feet maximum.
w = slot invert width perpendicular to flow, in feet $0.333 < w < 2.0$ feet.
z = slope of slot sides expressed in terms of z horizontal to 1 vertical. $0 < z < 0.6$

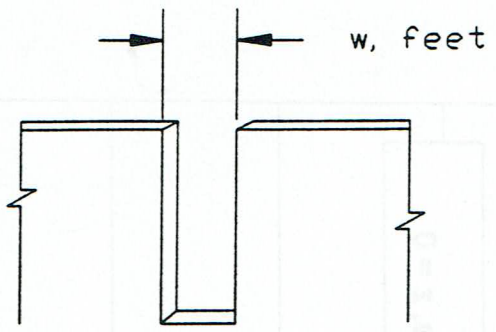
A definition sketch and capacity charts for v-notch spillways are shown in Figures 312.1 through 312.9.

Weir coefficients for trapezoidal weirs shall be determined from based upon the ratio of headwater depth to crest width (Reference 312.5), as shown in Figure 312.10.

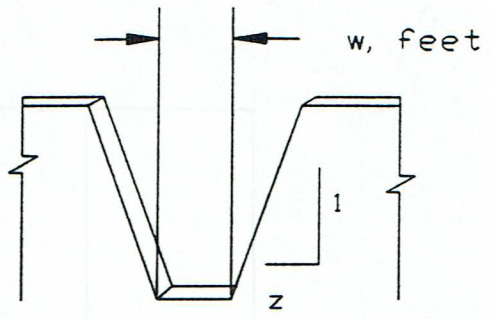
Culvert capacities shall be determined using the methods in Federal Highway Administration HDS-5 (Reference 312.5).

Discharge coefficient for all orifice shapes shall be 0.6 unless supporting data is submitted for other values.

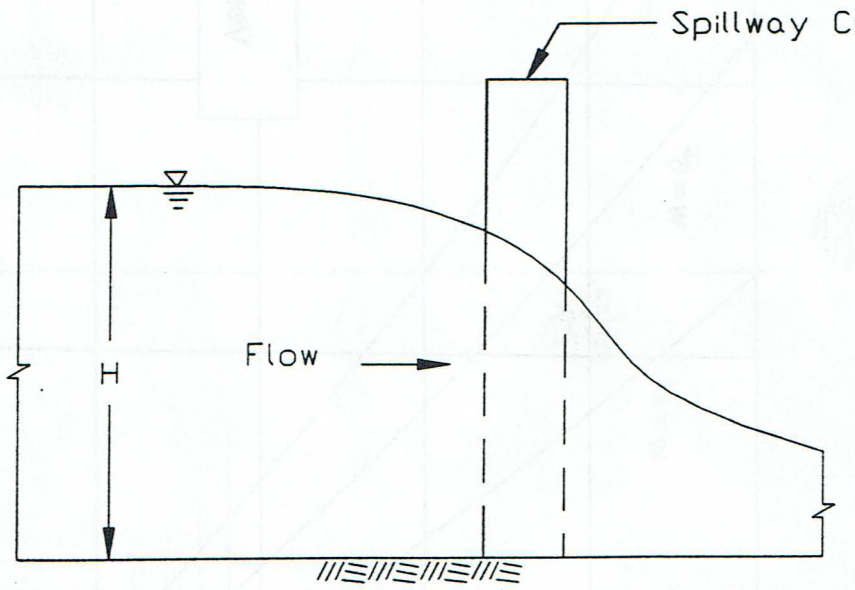
Where outlet structure capacities are determined automatically by the software used in performing the detention basin analysis, values included in the software package may be used provided they are generally accepted and properly documented.



Vertical Slot Outlet



Sloping Slot Outlet



Slot Outlet Definition Sketch

FIGURE 312.1