Solution:

1. From exhibit 2-7A, RTSC-NE-ENG-220, sheet 6 of 14 for CN = 75 and with 4.5 inches rainfall: runoff = 2.04 inches

2. Try an emergency spillway crest @ 110.0 MSL. Principal spillway capacity = 34.88 cfs (figure 6-25 with an estimated 10-foot head (110.0-100.0)). Release rate = 35 cfs/200 acres = 0.175 cfs/acre (round to 0.18 cfs/acre)

3. From exhibit 11-9 determine temporary storage needed for 2.04 inches of runoff and an estimated outflow discharge of 0.18 cfs/acre. Temporary storage = 1.0 inch

Temporary storage in acre-feet =

$$\frac{1.0 \text{ in } (200 \text{ ac})}{12 \text{ in/ft}} = 16.67 \text{ (round to 17) acre-feet}$$

4. Check storage:

Total storage = 31 AF conservation use + 17 AF temporary storage
= 48 AF
Elevation @ 48 AF = 110.9 MSL (from storage curve)

Therefore, the actual head = 10.9 feet, which is more than the 10 feet assumed and actual discharge is approximately 36 cfs. This should be verified by recomputing storage using 36 cfs capacity. The check in this example showed no change is needed because the release rate remains at 0.18 cfs/acre. Therefore, temporary storage requirements = 17 acre-feet.

5. Check weir flow to determine if the spillway will discharge 36 cfs at 110.9 MSL.

Inlet proportions table (figure 6-27) suggests 30-inch diameter riser for 24-inch conduit. Entering the curves (figure 6-27) with capacity of 36 cfs and 30-inch diameter riser shows that pipe will flow full at h values in excess of 1.3 feet. Therefore, full pipe flow is assured at 110.9 MSL (h = 110.9 - 108.5 = 2.4 feet).

Example 2

Assume the same storage curve, drainage area, curve number, rainfall, outlet centerline elevation, conduit length and conservation pool elevation as in example 1, but a maximum elevation of 110.5 MSL is given for the crest of the emergency spillway. Determine the minimum diameter for the conduit.

Solution:

1. Runoff = 2.04 inches (exhibit 2-7A, RTSC-NE-ENG-220, p. 2-50.6 with 4.5 inches rainfall and CN = 75)

2. Determine temporary storage

Total storage = 45 acre-feet (@ 110.5 MSL)
Conservation storage = 31 acre-feet (@ 108.5 MSL)
Temporary storage = 45 acre-feet - 31 acre-feet = 14 acre-feet

$$= \frac{14 \text{ AF}}{200 \text{ ac}} (12 \text{ in/ft}) = 0.84 \text{ inches}$$

3. Determine required release rate (exhibit 11-9)

Release rate = 0.27 cfs/acre (exhibit 11-9 with 2.04 inches runoff and 0.84 inches storage)
Required principal spillway capacity = 0.27 (200 acres) = 54 cfs

4. Determine conduit size

A 30-inch diameter CMP conduit 70 feet long will discharge approximately 61 cfs (from figure 6-25) with a head of 10.5 feet. Therefore, use a 30-inch diameter conduit.

5. Check weir flow

h = head on weir = 110.5 MSL - 108.5 MSL = 2.0 feet

Table on figure 6-27 recommends a 36-inch diameter riser for a 30-inch diameter conduit.

Using a capacity of 61 cfs and a 36-inch diameter riser, the curves indicate that the conduit will flow full at depths over 1.7 feet head (h). Therefore, pipe will flow full at design elevation.