

8.3.5 Allowable Pipe Materials

Refer to Road and Bridge Standards PC-1.*

8.3.6 Other Design Considerations

8.3.6.1 Buoyancy Protection

When water is displaced by embankment material or by a culvert, a buoyant or upward force exists. If the buoyant force is greater than the weight of the object displacing the water, flotation will occur. Pipe flotation (or hydrostatic uplift) can be a problem where the following conditions exist:

- Lightweight pipe is used (i.e., corrugated metal or plastic)
- Pipe is on a steep grade (usually inlet control)
- There is little or no weight on the end of the pipe (i.e., flat embankment slopes, minimal cover and/or no endwalls)
- High headwater depths ($HW/D > 1.0$)

8.3.6.2 Relief Opening

Where multiple-use culverts or culverts serving as relief openings have their outlet set above the normal stream flow line, special precautions should be provided to prevent headcuts, erosion from undermining the culvert outlet, or damage to downstream properties due to concentrated flow.

8.3.6.3 Land Use Culverts

Land use culverts are installations where storm drainage requirements are combined with other land based uses, such as farm or pedestrian crossings. For such installations:

- The land use is temporarily forfeited during the design flood, but is available during lesser floods
- Two or more barrels may be required, with one situated to be dry during floods less than the selected design flood
- The outlet of the higher land use barrel may need protection from headcutting
- The culvert should be sized so as to ensure that it can serve its intended land use function up to and including a 2-year flood
- The height and width constraints should satisfy the hydraulic or land use requirements, whichever use requires the larger culvert

8.3.6.4 Erosion and Sediment Control

Temporary erosion and sediment control measures should be included in the construction plans. These measures include the use of the following: sediment basins

* Rev 9/09