## Appendix 8A-2 Symbols

| Symbol | Definition | Units |
|---|---|---|
| A | Area of cross section of flow | $ft^2$ |
| B | Barrel or box width | in or ft |
| $C_d$ | Overtopping coefficient (Weir coefficient) | - |
| $C_r$ | Discharge coefficient | - |
| D | Culvert diameter or barrel height | in or ft |
| d | Depth of flow | ft |
| $d_{50}$ | Mean stone size diameter | in or ft |
| $d_B$ | Critical depth at riprap basin overflow | ft |
| $d_c$ | Critical depth | ft |
| $d_E$ | Equivalent brink depth | ft |
| $d_n$ or $d_o$ | Normal depth | ft |
| $F_r$ | Froude Number | - |
| g | Acceleration due to gravity | $ft/s^2$ |
| H | Total headloss | ft |
| $H_b$ | Bend headloss | ft |
| $H_E$ | Entrance headloss | ft |
| $H_f$ | Friction losses | ft |
| $H_g$ | Grate losses | ft |
| $H_j$ | Junction losses | ft |
| $H_L$ | Total energy losses | ft |
| $H_o$ | Outlet or exit headloss | ft |
| $h_s$ | Depth of riprap basin | ft |
| $H_v$ | Velocity head | ft |
| $h_o$ | Hydraulic grade line height above outlet invert | ft |
| HW | Headwater depth (subscript indicates section) | ft |
| $HW_i$ | Headwater depth as a function of inlet control | ft |
| $HW_o$ | Headwater depth above outlet invert | ft |
| $HW_{oi}$ | Headwater depth as a function of outlet control | ft |
| $HW_r$ | Headwater depth above roadway | ft |
| $K_e$ | Entrance loss coefficient | - |
| $k_t$ | Submergence coefficient | - |
| L | Length of culvert or length of roadway crest | ft |
| $L_B$ | Length of riprap basin | ft |
| $L_s$ | Length of dissipating pool | ft |
| n | Manning's roughness coefficient | - |
| $P_w$ | Wetted perimeter | ft |
| Q | Discharge | cfs |
| $Q_d$ | Discharge through the culvert | cfs |

## Appendix 8A-2 Symbols

| Symbol | Definition | Units |
|---|---|---|
| $Q_t$ | Design or check discharge at culvert | cfs |
| R | Hydraulic radius (A/P) | ft |
| $S_o$ | Slope of culvert | ft/ft |
| TW | Tailwater depth above invert of culvert | ft |
| V | Average velocity of flow | fps |
| $V_B$ | Average velocity at riprap basin overflow | fps |
| $V_d$ | Average velocity in downstream channel | fps |
| $V_L$ | Average velocity at length (L) downstream from brink | fps |
| $V_o$ | Average velocity of flow at culvert outlet | fps |
| $V_u$ | Average velocity in upstream channel | fps |
| $W_B$ | Width of riprap basin at overflow | ft |
| $W_o$ | Width dimension of culvert shape | ft |
| $\gamma$ | Unit weight of water | $lbs/ft^3$ |