Culvert design on low and high gradient streams

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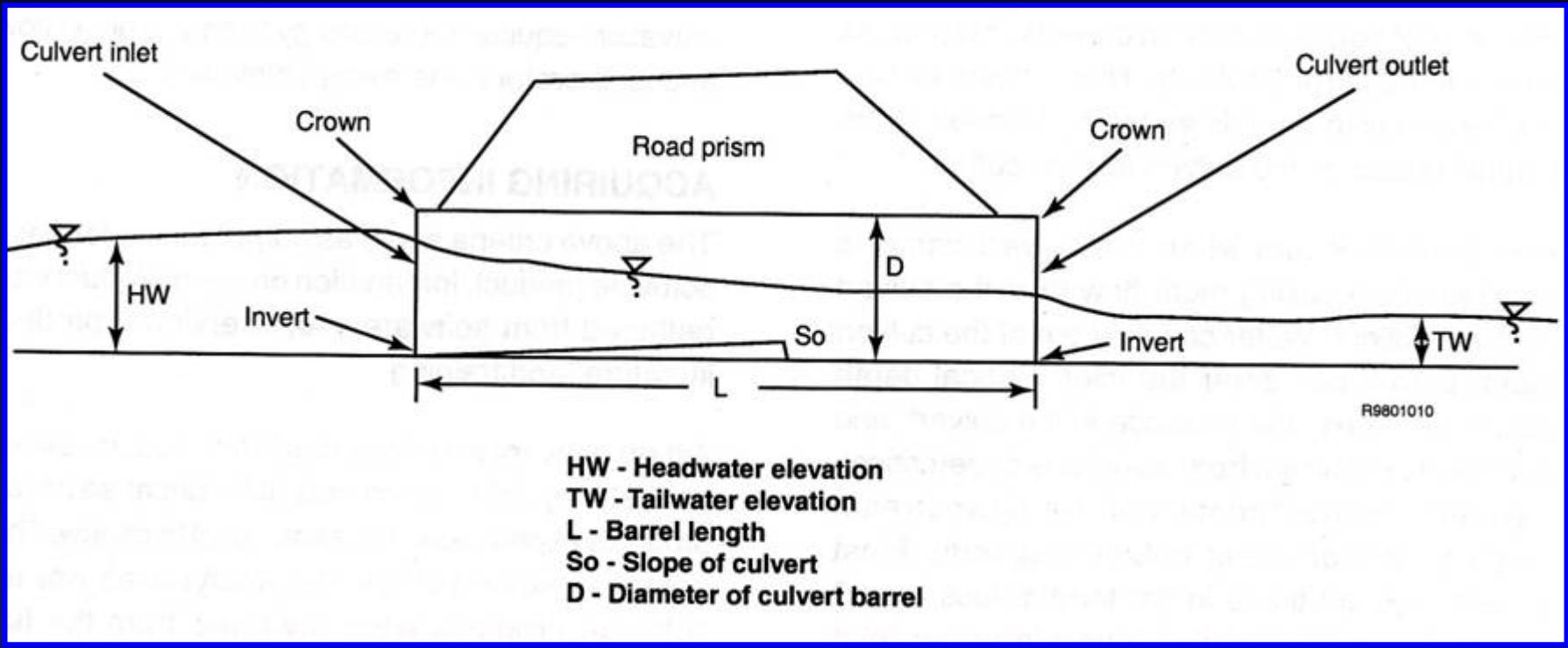
Overview

- Culvert Hydraulics
- Culvert Design Methods
  - Low Gradient
  - High Gradient
- Hydrology
- Site Assessment
- Alignment and Profile
- Bed and Banks
- Structure
- Sediment Mobility and Stability

Culvert hydraulics terms



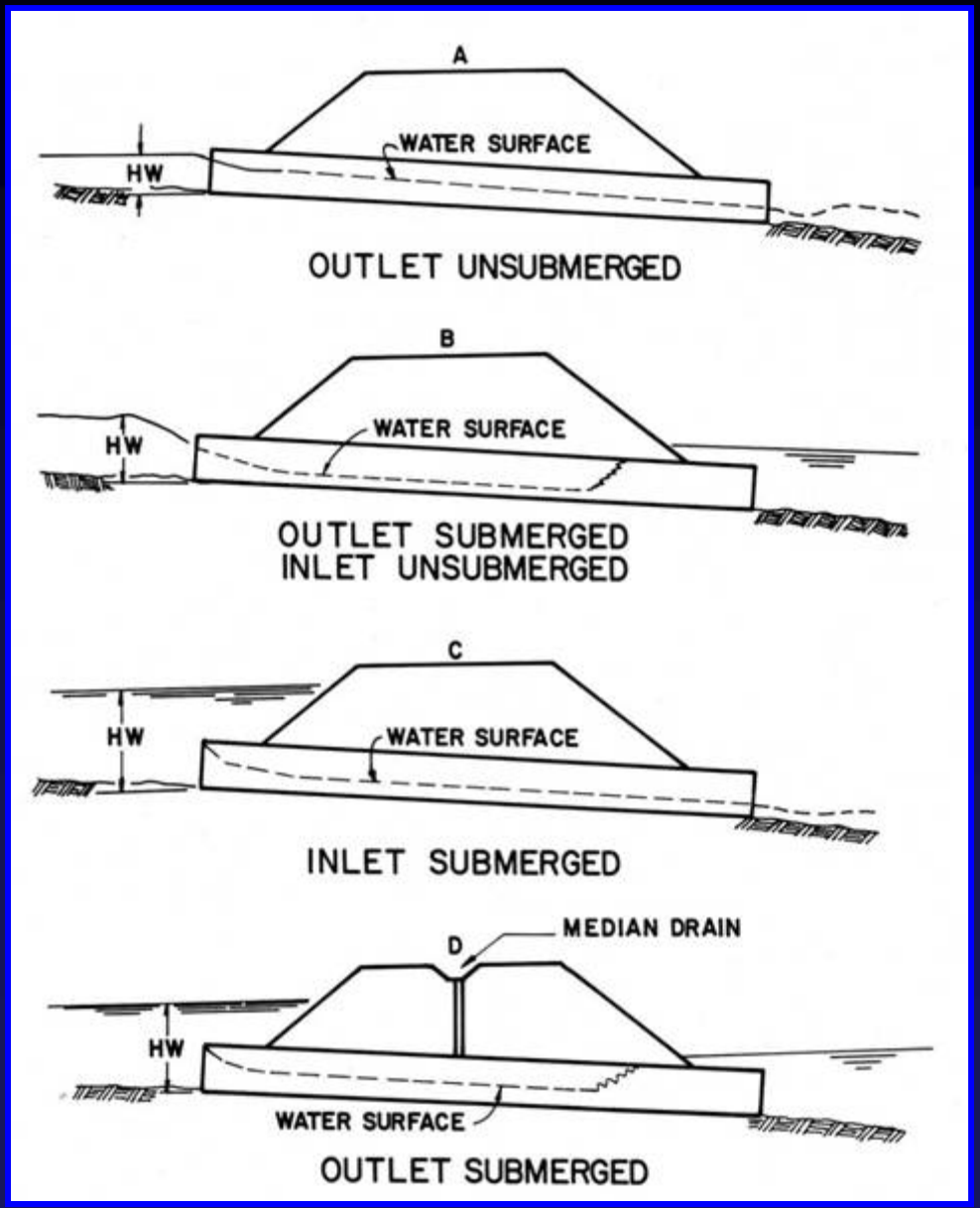
- Invert, Headwater (HW), Tailwater (TW)
- Headwater/Depth Ratio (HW/D): HW / pipe diameter or depth
- Supercritical Flow: high velocity, shallow water
- Subcritical Flow: low velocity, deep water

Inlet control

Culvert geometry at inlet controls flow

- Flow determined by HW elev and inlet characteristics
- Flow in culvert is supercritical
- Culvert can convey more flow than inlet will accept

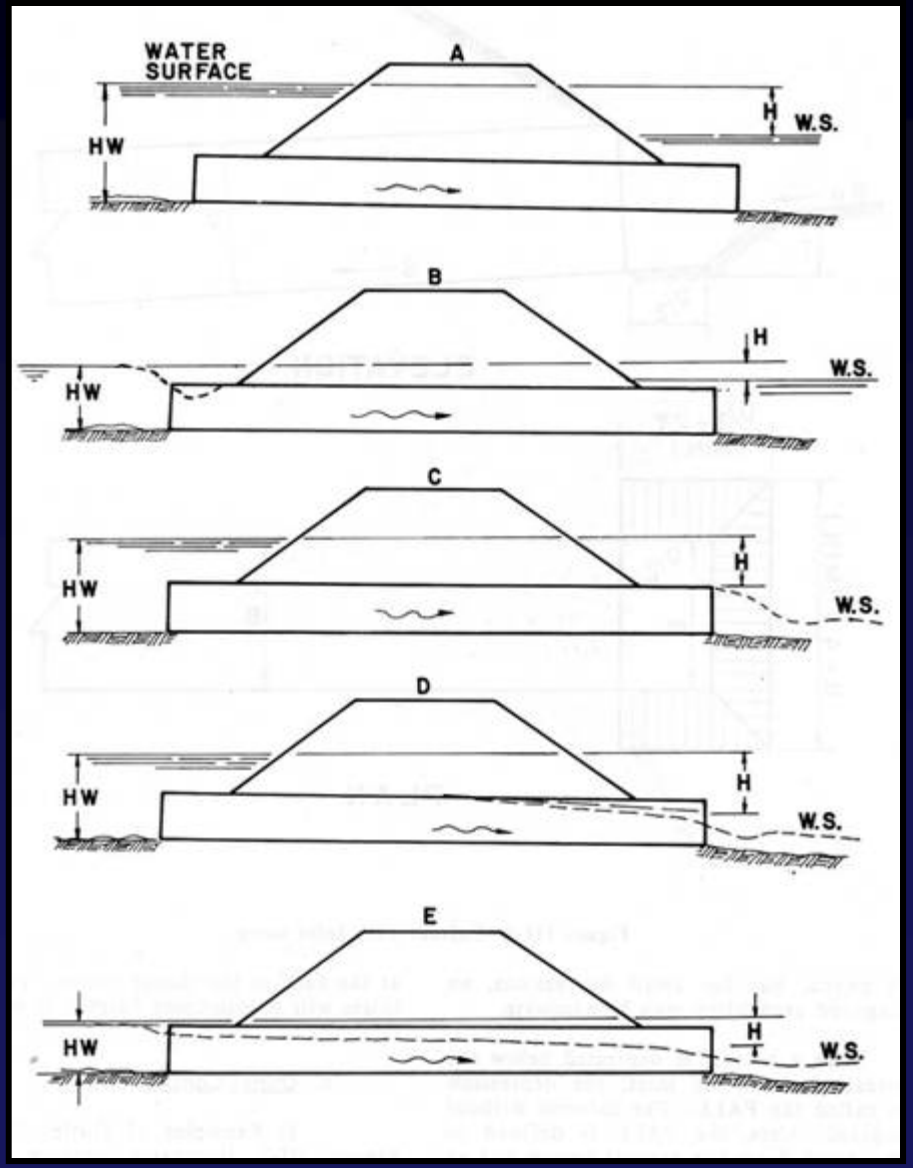
Inlet control



Outlet control

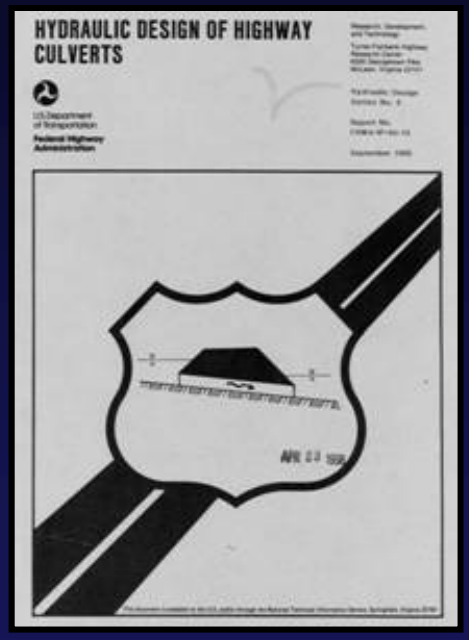
- Tailwater, culvert inlet and barrel characteristics (slope, length, roughness) control flow
- Flow in culvert is subcritical or under pressure
- Culvert inlet can convey more flow than barrel

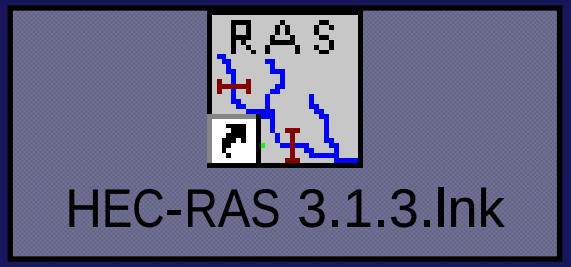
Outlet control



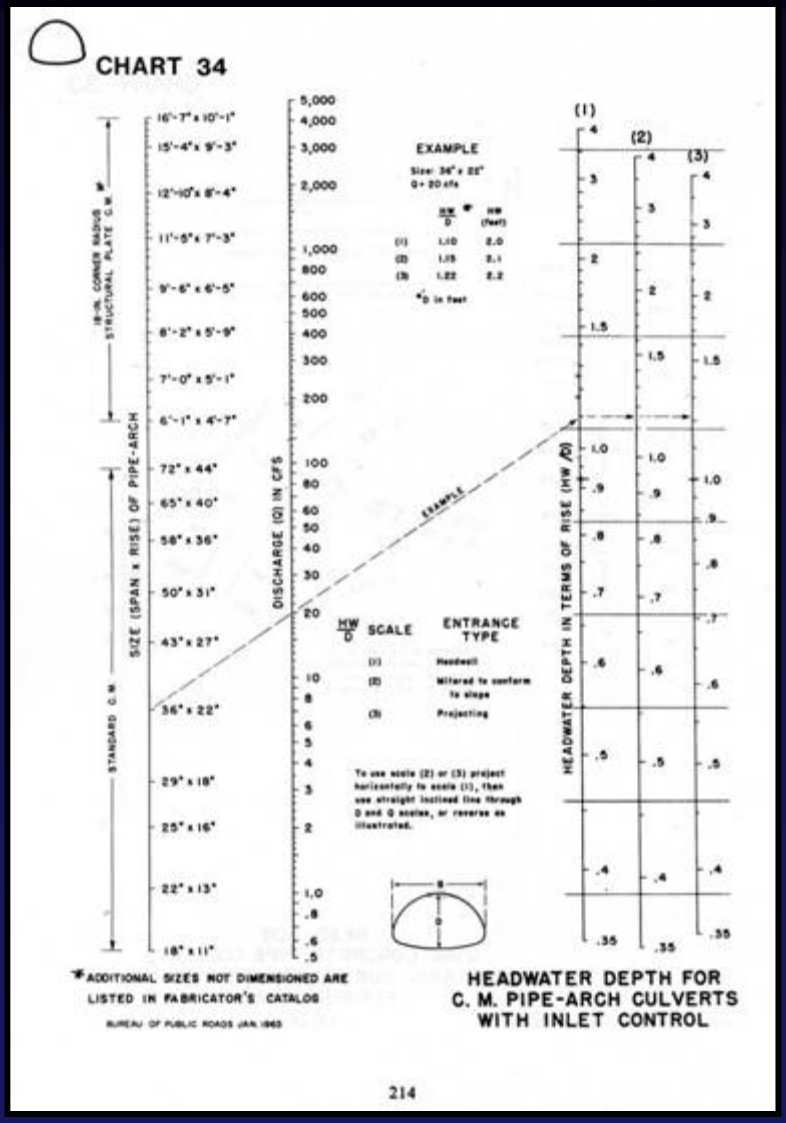
Hydraulic analyses for culverts

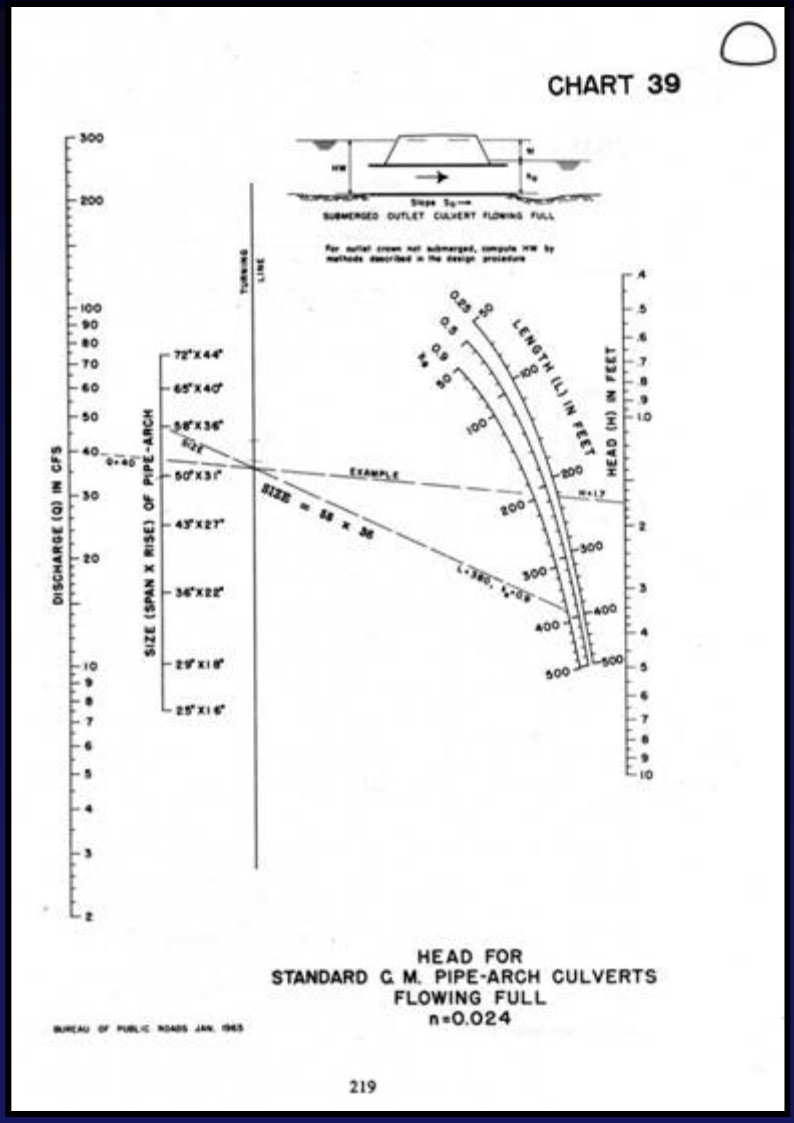
- HDS-5 Nomographs
- Computer Models:
  - HEC-RAS
  - HY-8 FHA
  - Culvertmaster





Hydraulic analyses for culverts





Hydraulic analyses for culverts