

Culvert Assessment and Prioritization in New York State

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Northeastern Transportation
and Wildlife Conference

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Water Resources Institute
Cornell University

OUTLINE

1. Introduction to Culvert Prioritization Program – Goals, program overview, current status
2. Methods
 1. Field assessment
 2. Capacity modeling
3. Steps towards implementation

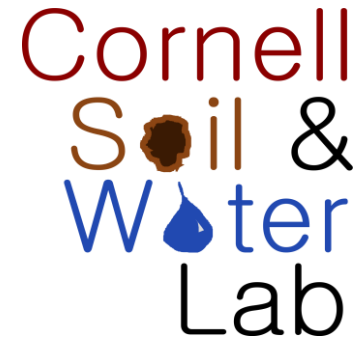


INTRODUCTION

- Collaboration began in 2013



**Hudson River
Estuary Program**

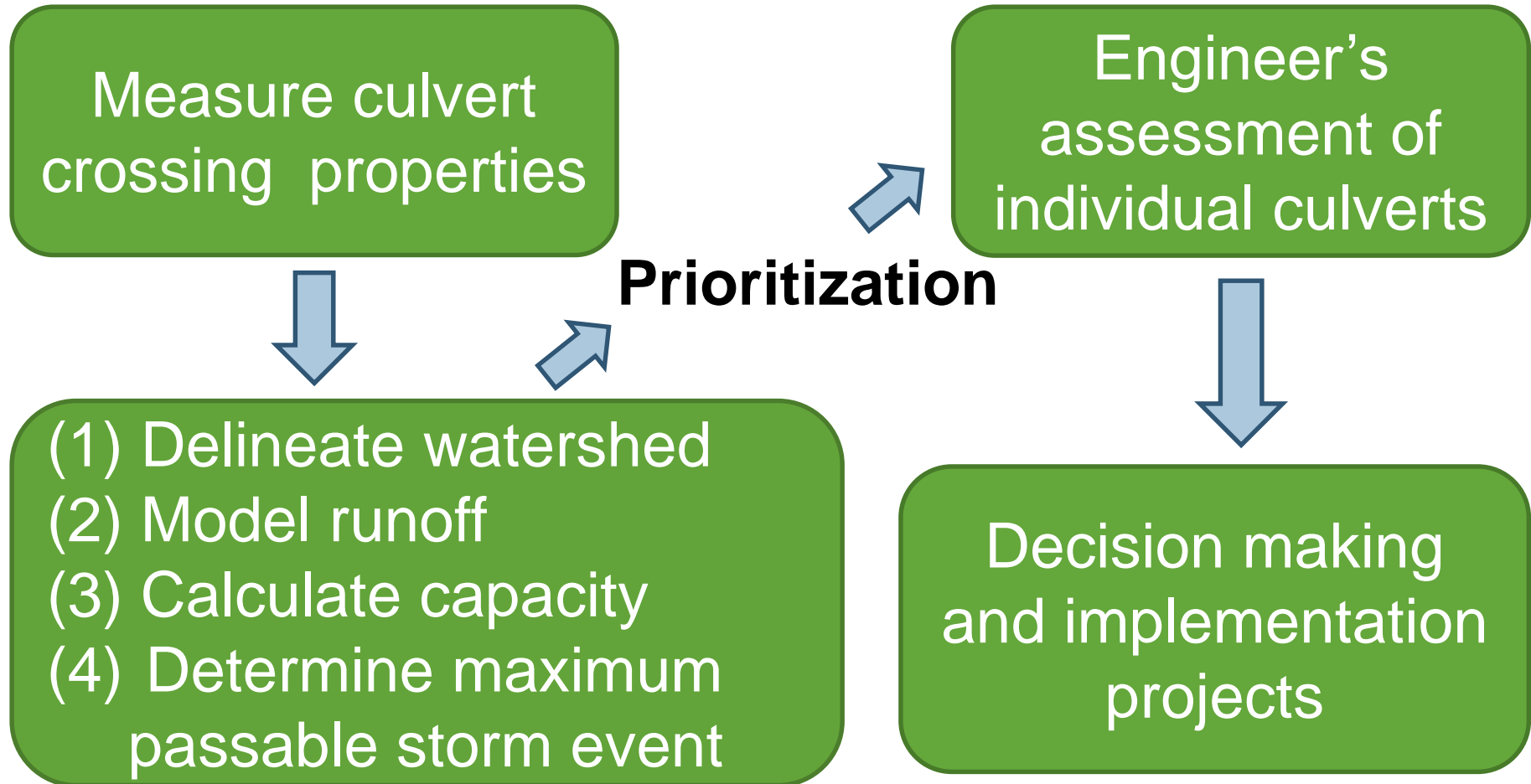


- **Goal:** create a program, consisting of field assessment and a modelling tool, to rapidly evaluate risk of culvert flooding in the Hudson River Estuary



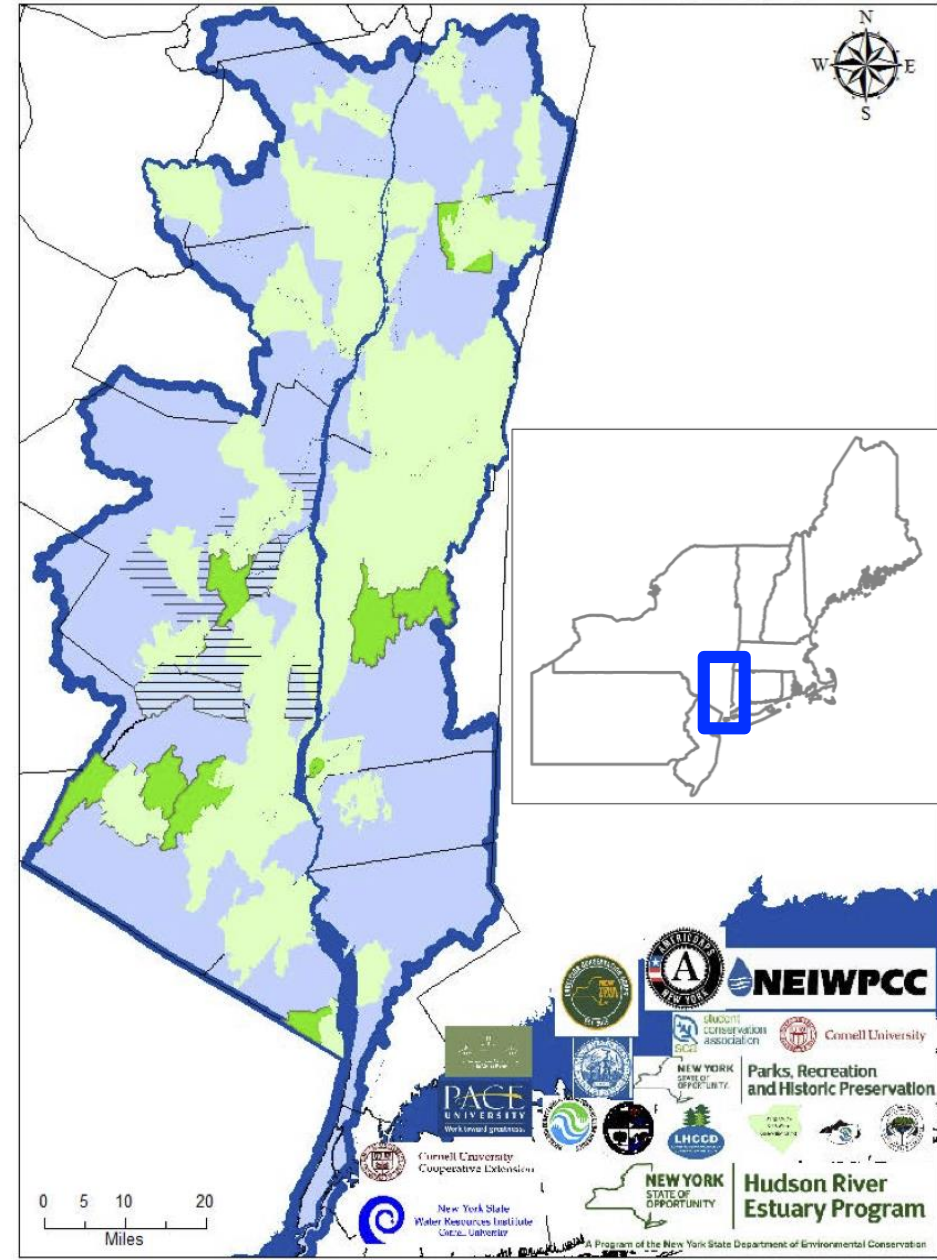
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PROGRAM OVERVIEW



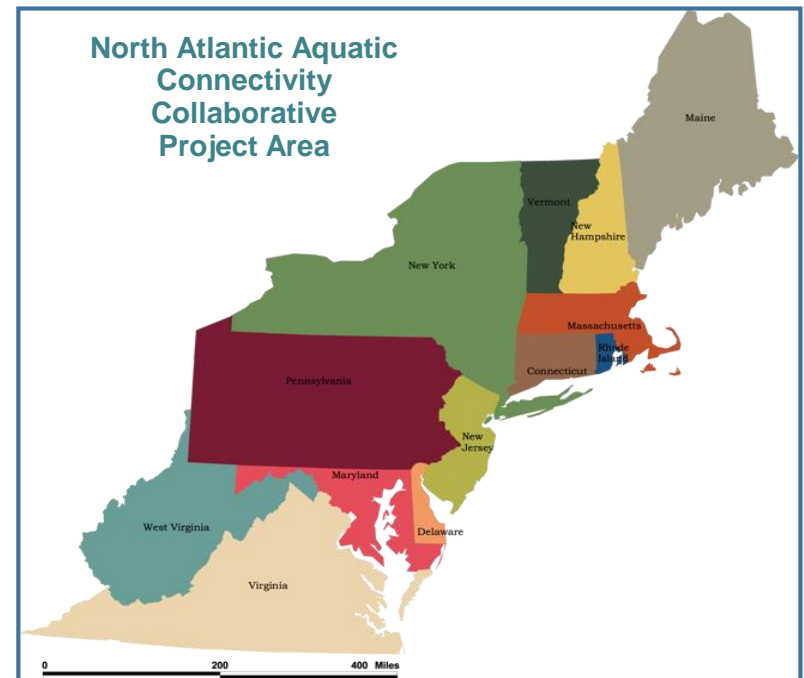
CURRENT STATUS

- >10,000 culverts in watershed
- 2015 Hudson River Action Agenda goal: assess 50% of culverts by 2020.
- Sept. 2018: 46.9%



METHODS – FIELD ASSESSMENT

- North Atlantic Aquatic Connectivity Collaborative (NAACC) protocol
- Field data stored on NAACC database
- Aquatic Organism Passability (AOP) score calculated from 14 parameters



METHODS – CAPACITY MODELING

Model outputs:

Culvert capacity and maximum passable storm return period for...

- Current climate conditions
- Future climate conditions (2050)



MODEL WORKFLOW

Culvert data

- GPS locations, dimensions, other crossing data



Watershed Delineation and Characterization

- ArcGIS model builder



Peak Discharge

- TR-55 Python script



Capacity

- Inlet Control Python script

Return periods

- Python script compares peak discharge to culvert capacity



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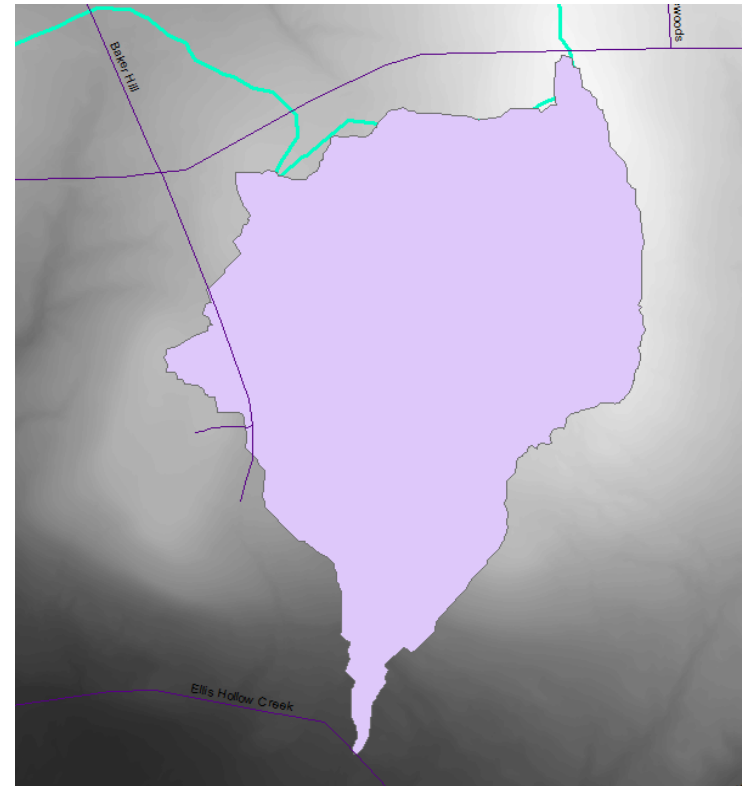
WATERSHED DELINEATION

Inputs:

- Culvert GPS location
- 10m DEM
- NHD flowlines
- CN raster

Outputs:

- Watershed area
- Time of concentration
- Average CN



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PEAK DISCHARGE

USDA TR-55 model

Inputs:

- WS area, Tc, CN
- 24-hr rainfall for current storm events in county



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Outputs:

- Peak discharge values for the 1, 2, 5, 10, 25, 50, 100, 200 and 500 yr *current* storm events and NRCC 2050 projections



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CAPACITY

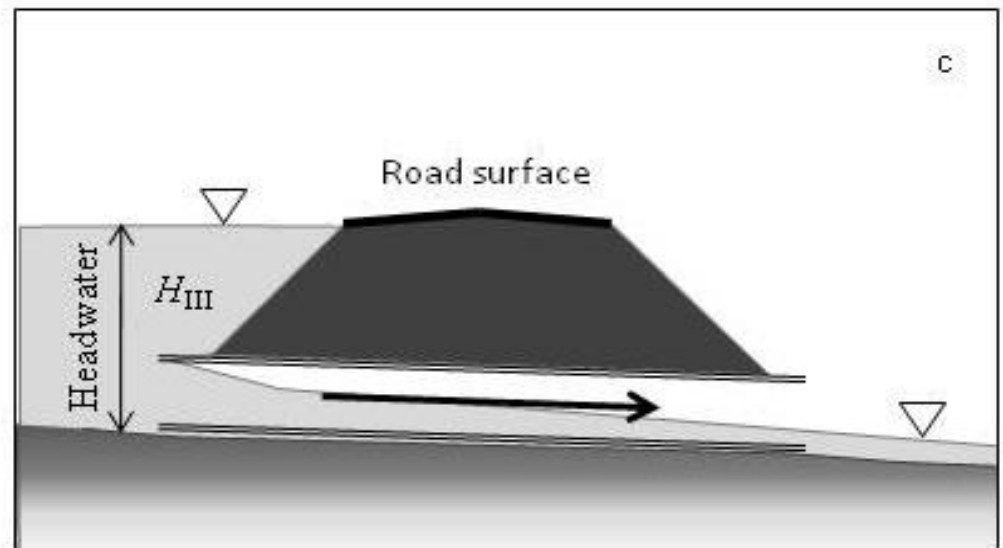
Submerged, inlet control eqn. from FHWA

Inputs:

- Culvert dimensions and characteristics

Outputs:

- Capacity



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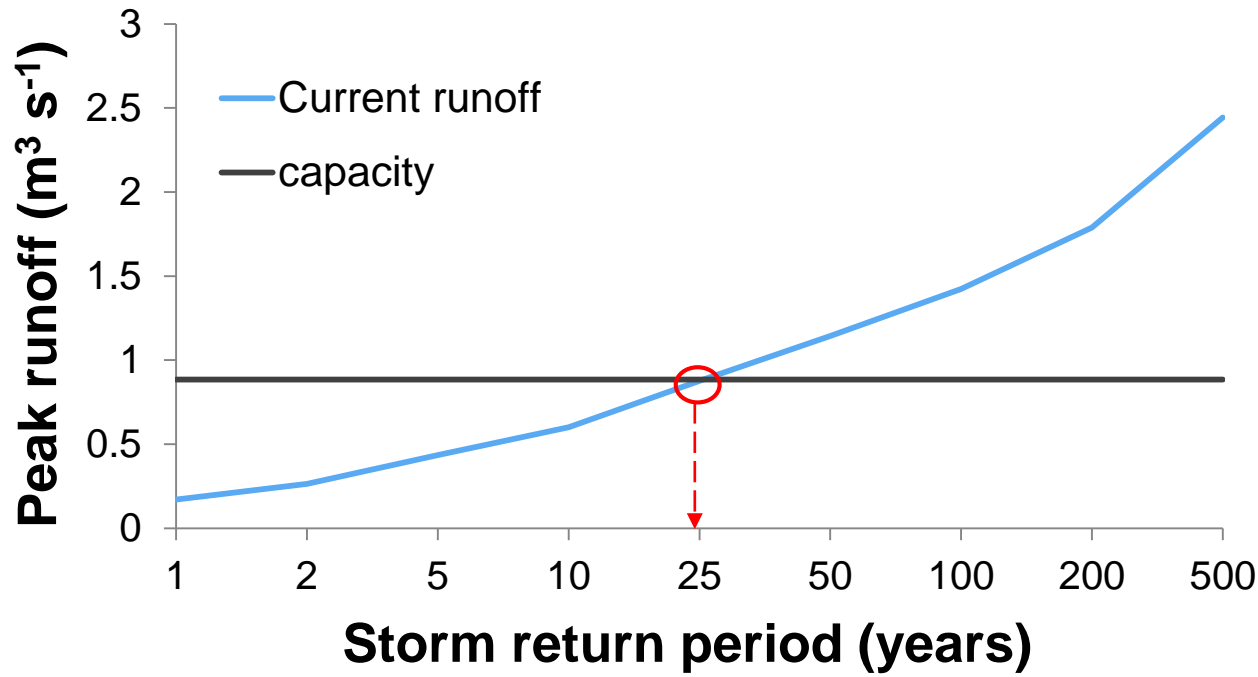
RETURN PERIODS

Inputs:

- Peak discharges
- Culvert capacity

Outputs:

- Maximum passable return period



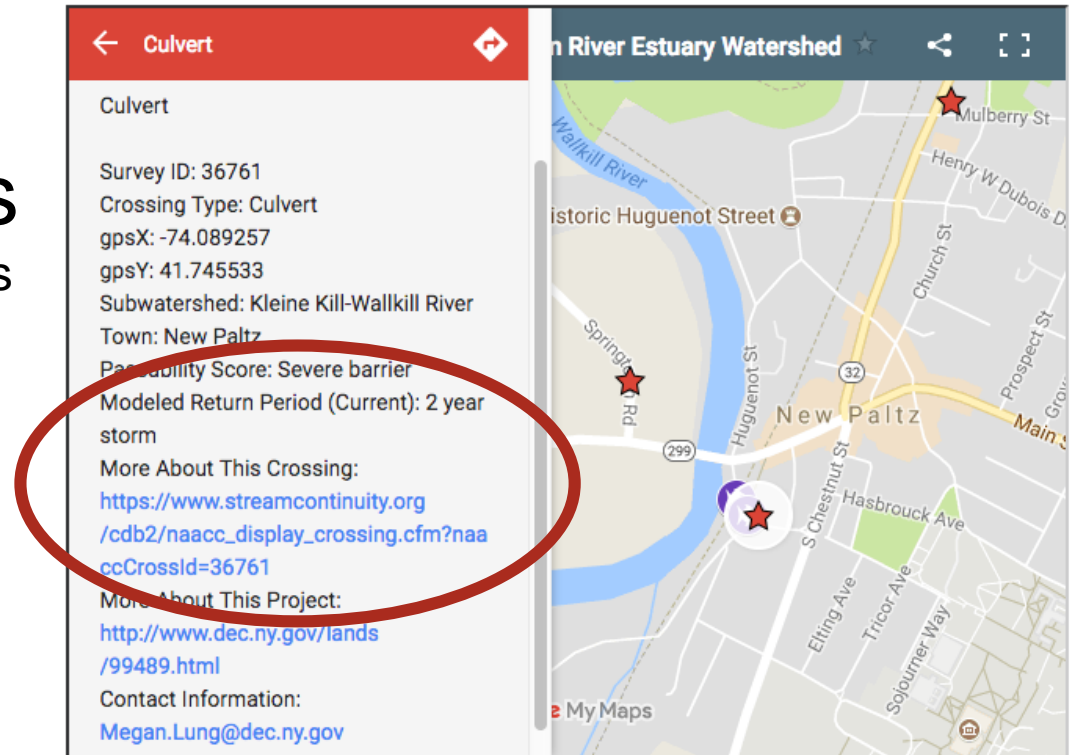
IMPLEMENTATION

Interactive Aquatic Connectivity mapper

- <https://wri.cals.cornell.edu/hudson-river-estuary/watershed-management/aquatic-connectivity-and-barrier-removal-culvert-dams/>

Municipal management plans

- <https://www.dec.ny.gov/press/113838.html>



The screenshot displays a mobile application interface. On the left, a red header bar contains a back arrow and the word "Culvert". Below this, a white panel lists details for a specific culvert: Survey ID: 36761, Crossing Type: Culvert, gpsX: -74.089257, gpsY: 41.745533, Subwatershed: Kleine Kill-Walkkill River, Town: New Paltz, and a red star icon. A red oval highlights the "Permeability Score: Severe barrier" and "Modeled Return Period (Current): 2 year storm" text. Below this, there are links for "More About This Crossing" and "More About This Project", and "Contact Information" for Megan.Lung@dec.ny.gov. On the right, a map titled "Hudson River Estuary Watershed" shows the Walkkill River flowing through New Paltz, with various streets and a red star icon marking the culvert location.



For more information,
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Dr. Becky Marjerison

Dave Gold

Andrew Meyer

Megan Lung

James Knighton

Dr. Todd Walter



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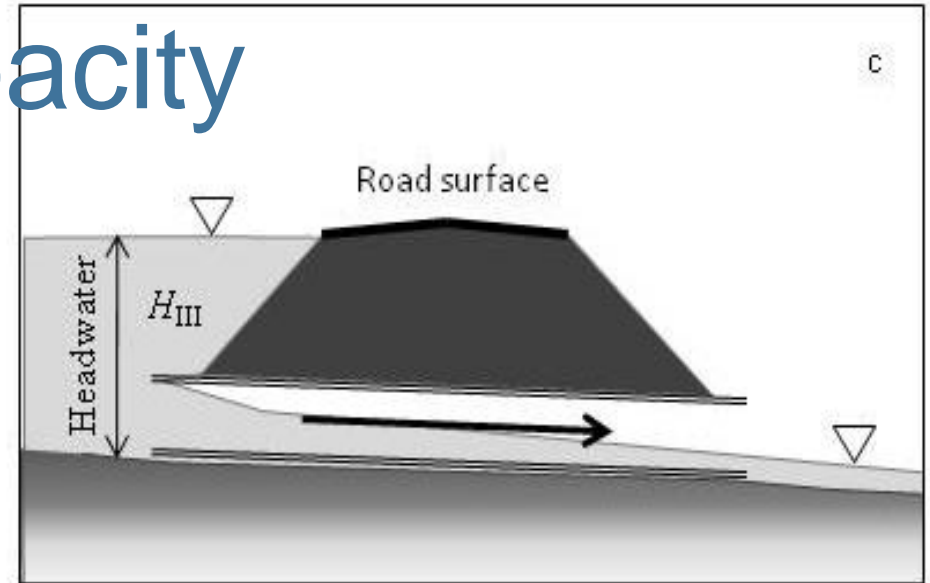


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Capacity



• Capacity Calculation

- Inlet control:

$$q = A_c \sqrt{D} \sqrt{\frac{H_{III} - y - k_s s_a}{c}}$$

- q =culvert peak flow capacity ($\text{m}^3 \text{s}^{-1}$)
- A_c =culvert cross-sectional area (m^2)
- D =culvert diameter (m)
- H_{III} =headwater depth, from culvert invert to top of road (m)
- Y, c =tabulated constants (table A.3)
- K_s =slope adjustment constant; -0.5 (mitered inlets +0.7)