

Jun 22nd, 10:00 AM - 10:15 AM

Stream Crossings I: Stream Sim Lite: Incorporating Stream Simulation Concepts into Vermont Statewide Culvert Design and Construction Standards

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Vermont Department of Fish and Wildlife

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Stream Sim Lite

Incorporating stream simulation concepts into Vermont statewide culvert design and construction standards

Rich Kirn

Vermont Department
of Fish and Wildlife







Bridge =

Passage

Culvert =

Barrier

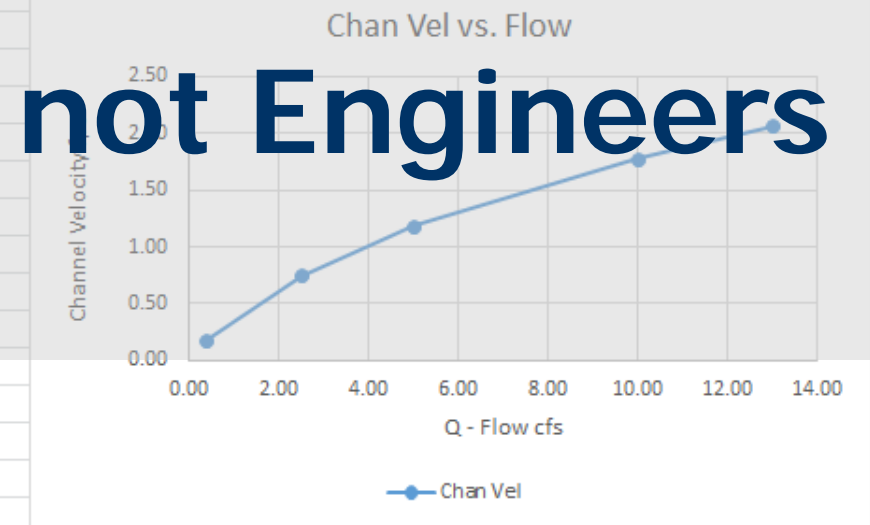
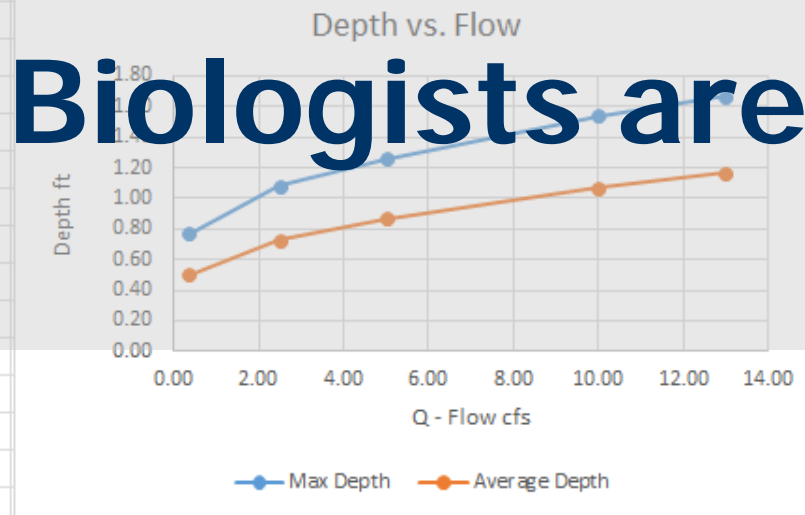


Culvert Treatments

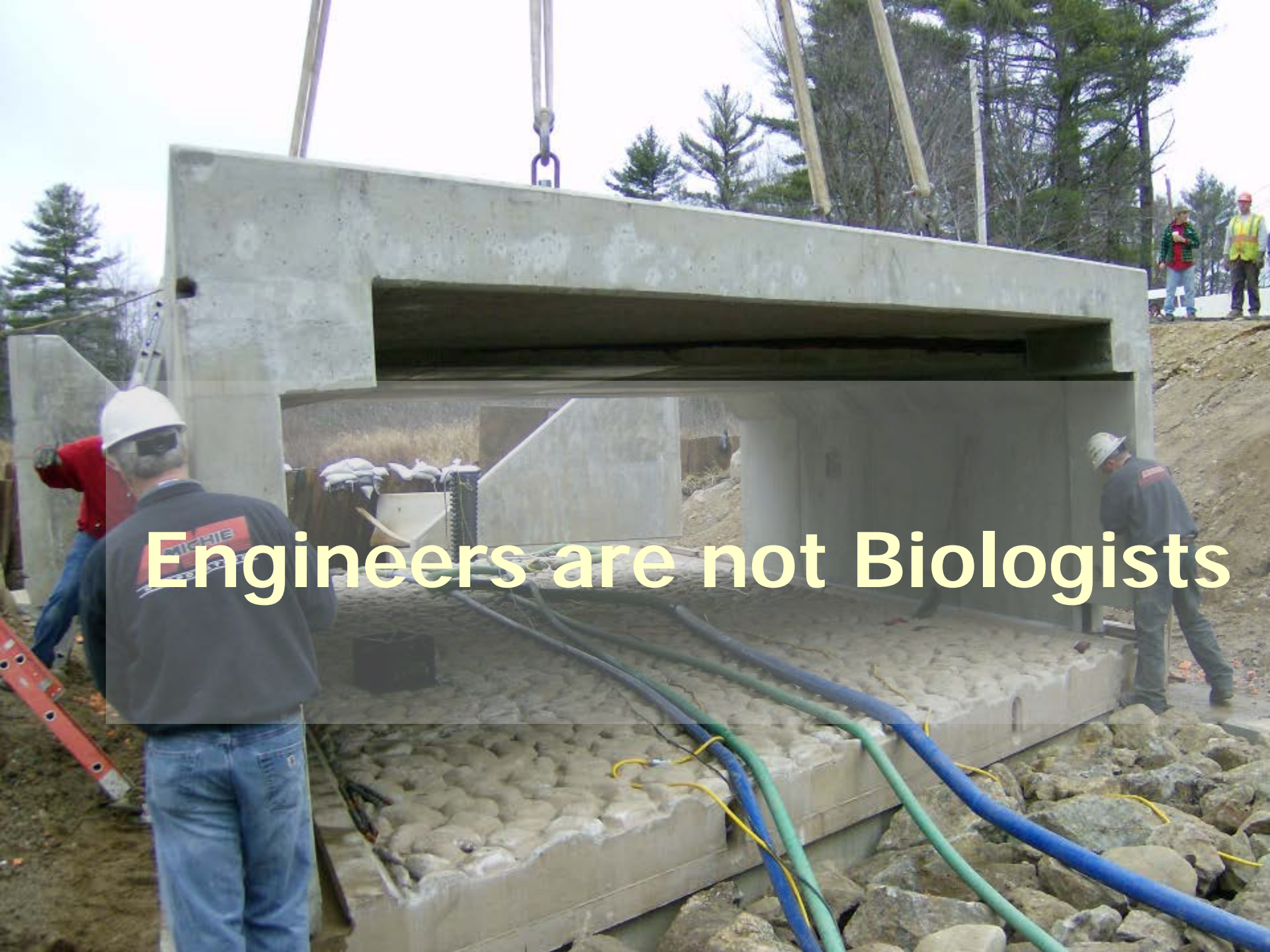
- Baffles / sills
- "Oversize"
- Embedment



		Slope=	0.03								
Mid Culvert location:											
220											
	Q	Min Chan El	WSEL	Max Depth	Average Depth	Chan Vel	Flow Area	Hyd Radius	EDF		
LFF	0.35	101.50	102.27	0.77	0.50	0.17	2.03	0.46	0.32		
	2.50	101.50	102.58	1.08	0.73	0.75	3.34	0.64	1.40		
	5.00	101.50	102.76	1.26	0.87	1.19	4.22	0.74	2.22		
	10.00	101.50	103.04	1.54	1.07	1.78	5.61	0.88	3.34		
HFF	13.00	101.50	103.17	1.67	1.17	2.07	6.28	0.95	3.88		



Biologists are not Engineers



Engineers are not Biologists

Guidelines for the Design of Stream/Road Crossings for
Passage of Aquatic Organisms in Vermont



Kozmo Ken Bates, P.E., Kozmo, Inc.

Rich Kirn, Vermont Department of Fish and Wildlife

March, 2009



AOP Guidelines

- Technical engineering document
- Developed with VTTrans & VDEC
- VT specific biology & hydrology
- Stream Simulation

Implementation Challenges

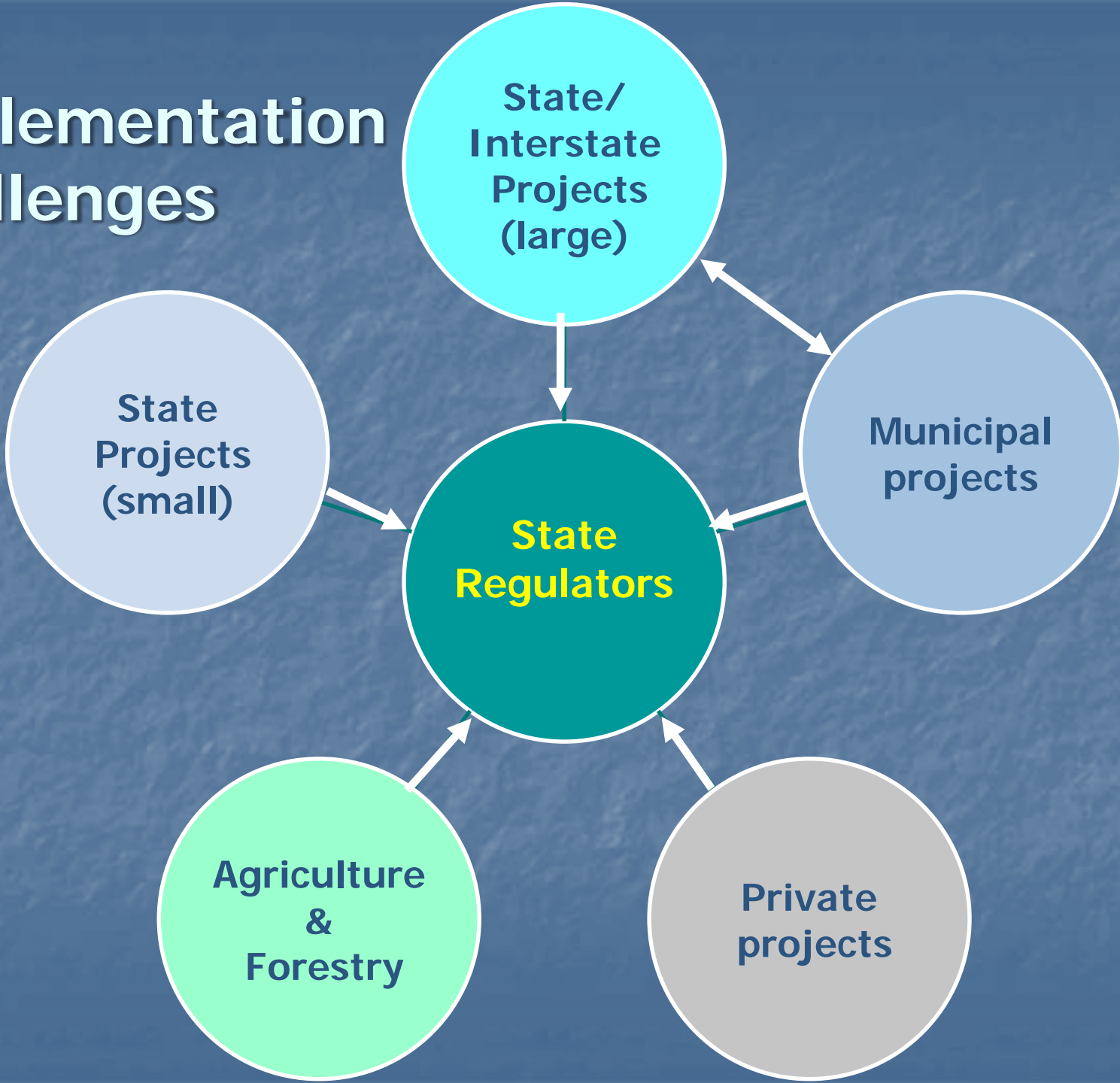
- Design, Construction and Regulatory Review Expertise
 - Hydraulic Engineering
 - Structural Engineering
 - Fluvial Geomorphology
 - Aquatic Biology
 - Regional staff with varied background & expertise
 - Project development & design process varies

AOP Design Workshops

- **Technical Workshops (w/ Kozmo Bates)**
 - State & consulting engineers
 - Biologists / River Scientists
 - Regulators
- **Informational Workshops**
 - Town / state road crews
 - Transportation planners



Implementation Challenges



VTrans Large Project Development

- Environmental Unit – resource ID
- Hydraulics Unit – evaluate, options
- Scoping Unit – develop alternatives
- Multidisciplinary Review
- Plan Development – structures engineers or consultants
- **Permit Review**
- Bid Process
- Resident Engineer - Construction oversight

Municipal Culvert Process

Request VTrans hydraulic study



Hydraulic report with options



Town purchases culvert



Town seeks state permit



Geomorphic and ecological review

Revised Municipal Culvert Process

Request VTrans Hydraulic Study



Hydraulic report with options consistent with agency criteria



Town Seeks State Permit

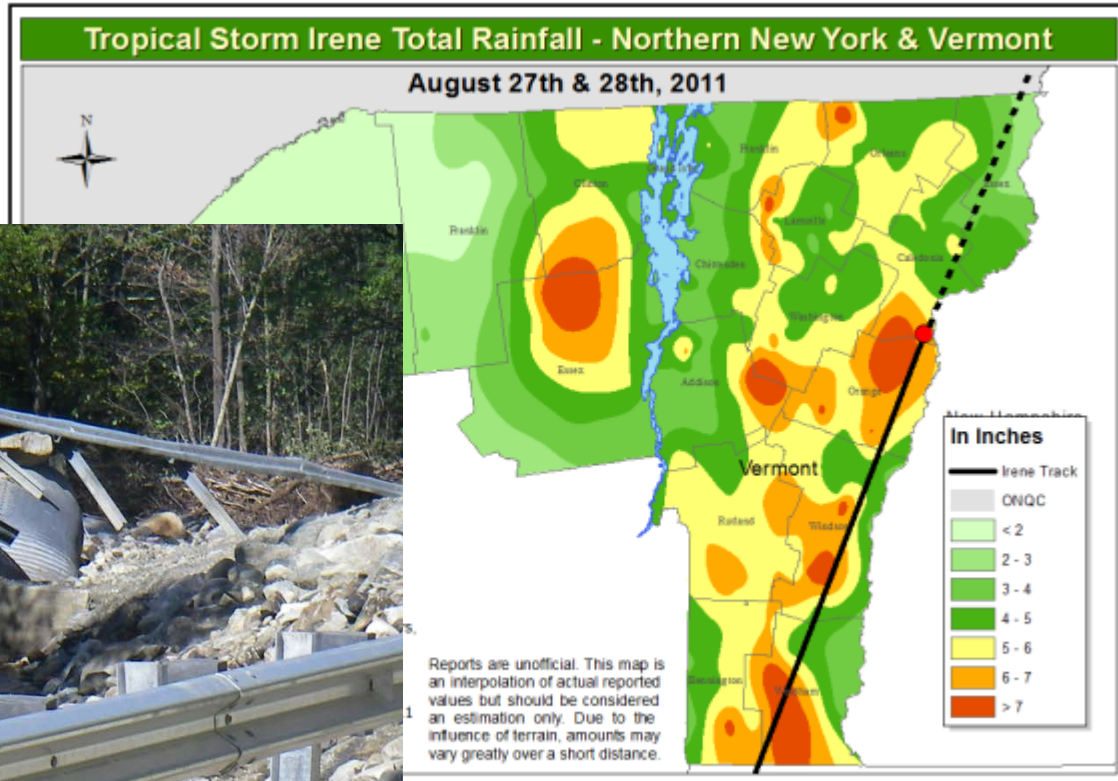


Geomorphic and ecological review



Town purchases culvert

2011 Tropical Storm Irene



2013 AOP Re-evaluation

- Biologist & Engineer
- Common issues:
 - Embedment depth
 - Substrate size
 - Slope



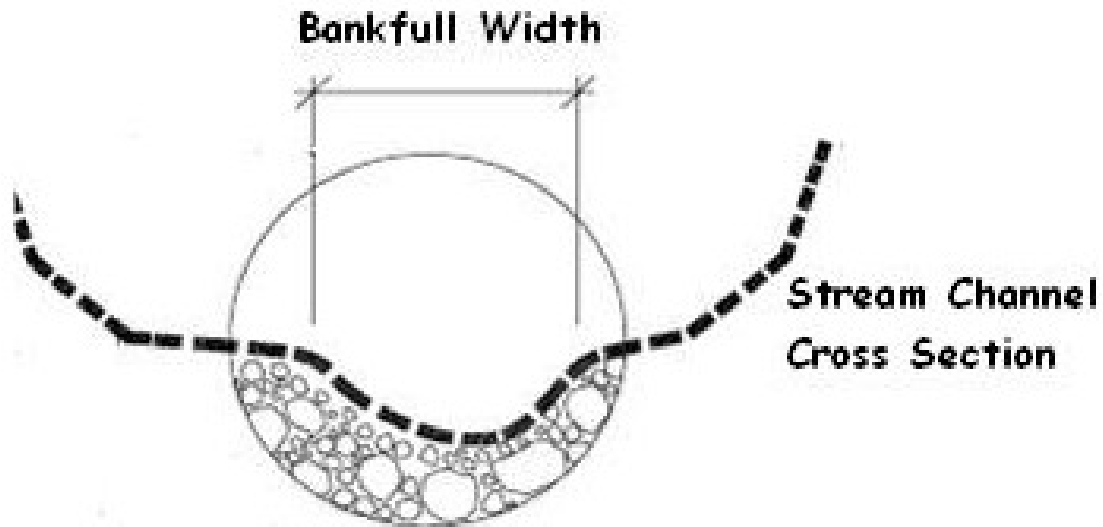
2013 VT Stream Alteration General Permit Revision

- Design Standards:
 - Width
 - Profile
 - Embedment
 - Opening height
 - Infill
- Performance Standards
 - AOP
- Adopted as Town Standards



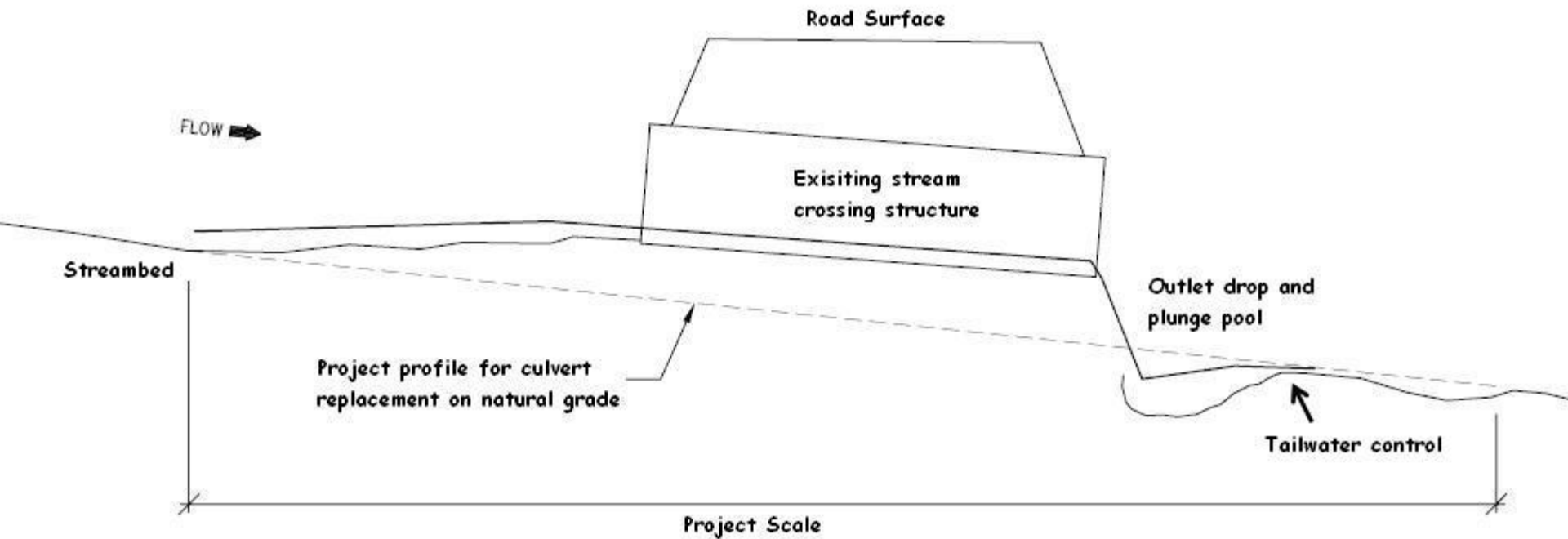
Design Standards

1.0 – 1.2 X Bankfull Width



Design Standards

Structure profile matches stream profile



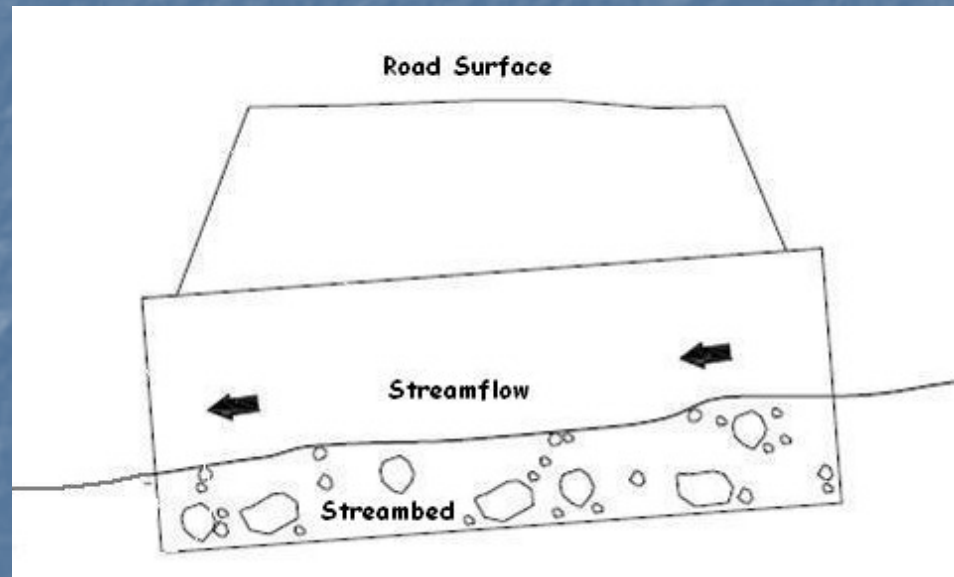
Design Standards

Opening height ≥ 4.0 BF depth



Design Standards

Embedment = 30% H (18" min)



Velocity (ft/s @ Q50)	Embedment (in)
≤ 9	18
9-10.9	24
11-12.9	36
13-15	48



Design Standards

Infill Gradation (inches)

Velocity (ft/s @ Q50)	Infill Type	100%	50%	25%
≤9	E1	≤18"	≤12"	≤2"
9-10.9	E2	≤24"	≤18"	≤2"
11-12.9	E3	≤36"	≤24"	≤2"
13-15	E3	≤48"	≤36"	≤2"

Performance Standards

Connectivity Standard:

A person shall not change the course, current, or cross-section of a watercourse so as to create a physical obstruction or velocity barrier to the movement of aquatic organisms or change the vertical streambed profile in a manner that impedes the movement of aquatic organisms

Performance Standards

New or replacement culverts:

The structure shall not obstruct the movement of aquatic life indigenous to the waterbody beyond the actual duration of construction. No activity may disrupt the necessary life cycle movements of those species of aquatic life.....

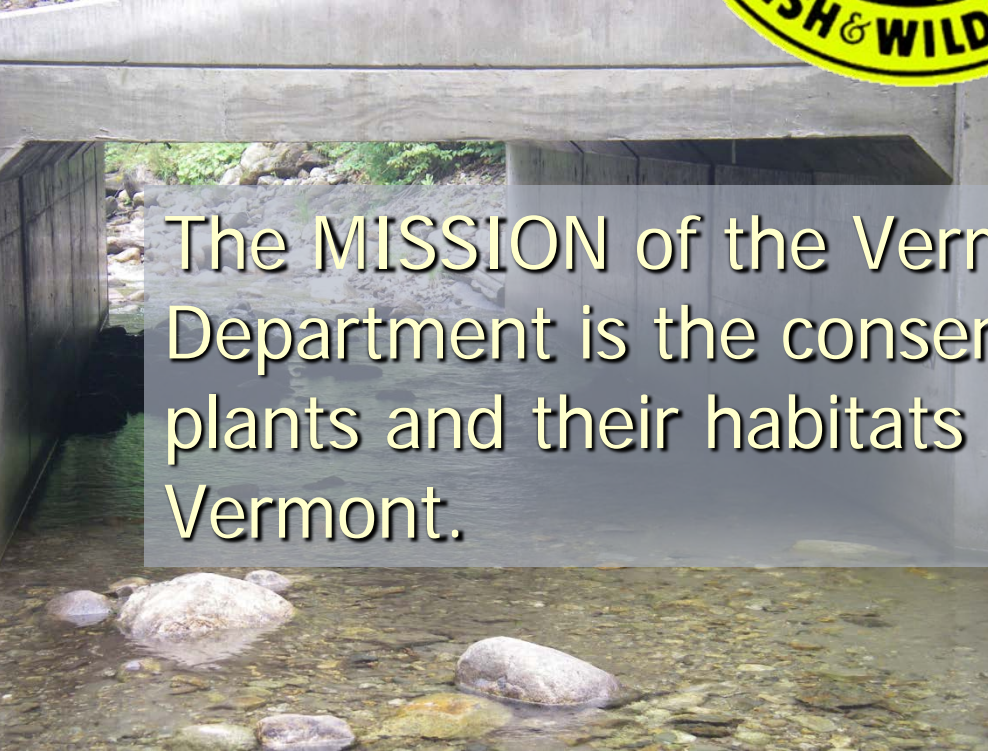


AOP = Expeptation

Lessons Learned

The background of the slide is a photograph of a highway guardrail in the foreground, with a river and a bridge structure visible in the distance. The text is overlaid on this image.

- Guidelines and trainings important... but not enough
- Interdisciplinary approach (program/project)
- Incorporate both design and performance standards into regulations
- Apply to new and replacement structures
- Need to consider and adjust to constraints of regulatory and project development structure
- Post project performance evaluation critical to long-term success



The MISSION of the Vermont Fish & Wildlife Department is the conservation of fish, wildlife and plants and their habitats for the people of Vermont.