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DEVELOPMENT OF SELF-CLEANING BOX CULVERTS

(IHRB RESEARCH PROJECT TR-719)

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**Principal Investigator,
Dr. Marian Muste**
Research Engineer and Adjunct Professor
IIHR-Hydrosience & Engineering
Civil and Environmental Engineering
The University of Iowa
Iowa City, Iowa 52242
C. Maxwell Stanley Hydraulics Lab
marian-muste@uiowa.edu
319-384-0624
<http://www.iihr.uiowa.edu>

About
IIHR-HYDROSCIENCE & ENGINEERING



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Phase III (2017-2020)

BACKGROUND

Building on the outcomes of a series of research projects funded by IHRB since 2006, the present study aims at developing solutions to mitigate the initiation and subsequent development of sediment deposits at multi-box culverts. The backbone of the previous studies was finding solutions that permanently solve the sedimentation problem by using the self-cleaning concept. This concept relies entirely on the use of the stream's hydraulic power for passing downstream the culvert the suspended and bed loads carried by the stream. During more than 10 years of research, our team identified three possible candidates for reducing or completely eliminating the formation of sediment deposits at 3-box culverts: a) filled-based (Design A); upstream curtain wall (Design B), and c) downstream weir (Design C).

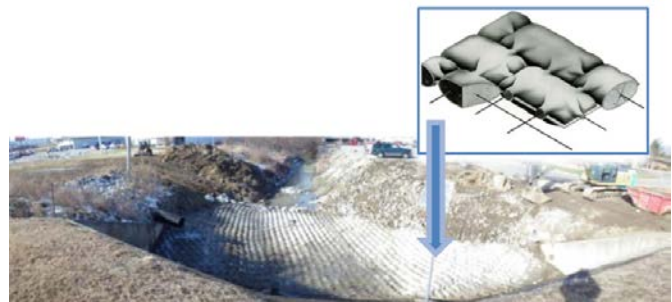
OBJECTIVES

The main objectives of this research are:

- Implementation of the self-cleaning Design A in the downstream area of the FHWA #031711 culvert using guidelines developed through previous TR 619 research.
- Monitoring and assessing the overall pre-construction behavior of the FHWA #364790 located immediately downstream the FHWA #031711 culvert.
- Design, construct, and monitor Design C as implemented at FHWA #364790 culvert.
- Synthesize the findings of pre- and post-construction observations on the overall performance of the culverts to mitigation sediment initiation and development

RETROFITTING SOLUTIONS

Design A: Articulated block mats



Design C: Low-head weir downstream the culvert



MONITORING METHODS

Real-Time Kinetic GPS surveys



Drone surveys

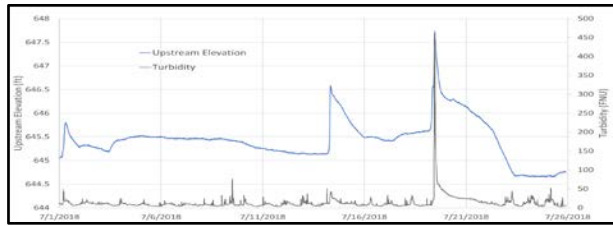


Soil core sampling



Hydro-morphological characterization

The monitoring program was designed and implemented at culverts from September 2017 to December 2019. The monitoring goals were to document individual and cumulative effects of storms propagating through the culverts with special attention given to sedimentation. For this purpose, a thorough set of observations have been made and subsequently corroborated with the flow and sediment transport passing through the culverts.



IMPLEMENTATION OF THE SELF-CLEANING DESIGNS

The evidence garnered in this phase of the study demonstrates the good performance of the self-cleaning structures in mitigating the sediment deposition at culverts. The design concepts can be implemented at the culvert construction time or can be applied by retrofitting culverts that displayed sedimentation concerns.

CULVERT INLET

CULVERT OUTLET

FHWA #031711 culvert site



FHWA #364790 culvert site

