VERMONT
AGENCY OF TRANSPORTATION

FACT SHEET

Hydraulic Inspection Vehicle Explorer (HIVE 2.0) for Culverts Upgrade

PROJECT TITLE
HIVE-II: Updated Culvert Inspection Vehicle

STUDY TIMELINE
October 2019 – September 2020

INVESTIGATORS
Dryver Huston, UVM, PI
Tian Xia, UVM, Co-PI
Jonathan Burton, UVM
Logan Griswold, UVM
Daniel Orfeo, UVM

VTRANS CONTACTS
Michelle Redmond, AOT Technician
Steven Stanley, AOT Technician

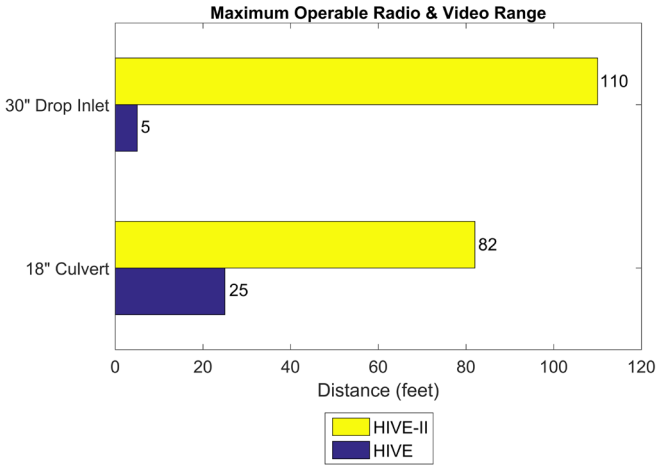
KEYWORDS
Culvert, hydraulic, inspection, robot, vehicle

More information about the VTrans Research Program, including additional Fact Sheets, can be found at: http://vtrans.vermont.gov/planning/research

Introduction or Problem Statement

The Vermont Agency of Transportation inspects approximately 9,600 small culverts annually. During inspection, a small remotely controlled vehicle drives through a culvert and streams video back to the operator. However, of the two inspection vehicles currently available to VTrans, the "Crawler" is too costly for widespread deployment, and the Hydraulic Inspection Vehicle Explorer ("HIVE") is unable to transmit video from deep within long culverts. In this project, a next-generation culvert inspection vehicle, the "HIVE 2.0", is designed to meet VTrans requirements for efficient and effective low-cost culvert inspection.

HIVE 2.0



Performance of HIVE 2.0 versus original HIVE (Longer bars are better)

Methodology or Action Taken

A Heng Long 1/16-scale remote control hobby tank was chosen for the HIVE2.0 chassis due to its compact size, low cost, and continuous tracks. Continuous tracks allow it to meet VTrans requirements to span a 6-inch (152 mm) separation gap and remain stationary on a 20-degree slope. A combination of field tests of available options and improved understanding of radio wave propagation in culverts led to increased radio control and video wireless telemetry ranges. Total materials cost of the HIVE 2.0 is less than $1500.

Conclusions or Next Steps

Compared to the original HIVE, the HIVE 2.0 offers much greater operating range, improved capability to traverse obstacles and gaps, and precise distance encoding from a tether spool with a digital revolution counter. The figure above shows that the HIVE-II equipped with a 5.8 GHz video transmitter provides 100+ feet (30.5+ m) of additional range when operating in a 30-inch (752 mm) drop inlet, and 50+ feet (15.2+ m) of additional range in an 18-inch (457 mm) culvert.

Potential Impacts and VTrans Benefits

Proper inspection of small culverts can prevent roadway failures, traffic disturbances, and costly unexpected repairs. HIVE 2.0 is a potential useful low-cost tool aiding in culvert inspections.