Evaluation of Box Culvert Maintenance Methods

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<thead>
<tr>
<th>FHWA Report Number:</th>
<th>FHWA/OH-2015/7</th>
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</thead>
<tbody>
<tr>
<td>Report Publication Date:</td>
<td>February 2015</td>
</tr>
<tr>
<td>ODOT State Job Number:</td>
<td>134839</td>
</tr>
<tr>
<td>Project Duration:</td>
<td>16 months</td>
</tr>
<tr>
<td>Start Date:</td>
<td>September 2013</td>
</tr>
<tr>
<td>Completion Date:</td>
<td>January 2015</td>
</tr>
<tr>
<td>Total Project Funding:</td>
<td>$229,339</td>
</tr>
<tr>
<td>Research Agency:</td>
<td>University of Akron</td>
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For copies of this final report go to [http://www.dot.state.oh.us/research](http://www.dot.state.oh.us/research).

Project Background

ODOT devotes a significant amount of time to cleaning large (>34" for boxes and >48" for circular) culverts. Traditional methods, such as use of a vactor truck, are time-consuming, expensive, and frequently require confined space entry by maintenance crews. ODOT is interested in investigating culvert cleaning alternatives that would lead to cost savings and improved safety for personnel. Remote control equipment could be such an alternative and was the focus of this research.
Study Objectives

There are five primary objectives in this study:
Objective One – Determine current large culvert cleaning practices in all ODOT districts and in other states with a focus on maintenance costs, schedules, and best management practices.
Objective Two – Identify manufacturers of remote controlled equipment and make a recommendation for use in Ohio considering cost, reliability, safety, and performance.
Objective Three – Evaluate equipment in the field and determine advantages/disadvantages.
Objective Four – Calculate cleaning efficiencies and compare to traditional methods.
Objective Five – Assess the deployment strategies and make recommendations.

Description of Work

This study was performed in two phases. The first phase focused on gathering background information on available culvert cleaning alternatives. Published and unpublished literature was reviewed and web, email, and phone surveys were conducted on Department of Transportation officials from multiple states including Ohio. At the conclusion of these background investigations, the decision was made to acquire and field evaluate a remote controlled culvert cleaner from Rohmac, Inc., a MicroTraxx MT 3234 unit. In the second phase of the study, the machine was deployed to seven culverts in Ohio during July and August of 2014. Performance statistics and general operation notes were collected. Using machine characteristics and the information gathered during the field evaluation, a list of culverts eligible to be cleaned by the unit, referred to as candidates culverts, were queried from the Ohio culvert database. The degree these candidate culverts were blocked was assessed while investigating the need for large culvert cleaning in each of the twelve ODOT districts.

Research Findings & Conclusions

Background research showed that remote controlled equipment had been used to clean large culverts in at least four other states. For the seven large culverts in this study, cleaning using the MicroTraxx MT 3234 machine was quite effective. The average removal efficiency of the equipment was 12 cubic yards of material removed from the culvert for every hour the equipment was in operation. Higher removal efficiencies were observed on large span culverts and those with high debris depths while smaller openings and poor access to the culvert mouth by the excavator yielded reduced removal efficiencies. An average crew of five workers was deployed with the equipment to each site but an additional two workers were needed for traffic control if the support equipment had to be located in the clear zone or roadway.

Equivalent data for culvert cleaning with the vactor truck is lacking so a direct comparison cannot be made between the methods. One culvert in the study had been cleaned using both methods with the remote controlled equipment finishing in two days what took a vactor truck two weeks to clean. Cleaning using the remote controlled equipment was also the preferred method of the workers.

There is significant demand for culvert cleaning utilizing remote controlled equipment. Considering opening size, material, and inlet/outlet structures, an evaluation of over 80,000 culverts inventoried in the Ohio culvert database results in a candidate list of nearly 8,600 culverts. Considering environmental regulations, in most cases, cleaning with the remote controlled equipment can be permitted but equipment operators must determine a work plan for each site and should contact the District Environmental Coordinator for approval of that work plan in each instance. Of the 8,600 candidates, 400 culverts were estimated to be at least 30% obstructed at the time of inspection. An obstruction of at least 30% requires immediate cleaning according to ODOT guidelines. In addition, there are over 13,000 bridge structures where cleaning maintenance using remote controlled equipment would be valuable. Several districts show incomplete culvert inventories suggesting candidate culvert totals may be
underestimated. Considering four different cleaning demand factors, Districts 3, 5, 8, 10, and 11 shows the greatest need for equipment deployment.

**Recommendations for Implementation of Research Findings**

The research has determined that, generally, the use of remote controlled culvert cleaning equipment and, specifically, the MicroTraxx MT3234 unit evaluated in this study are effective and efficient at cleaning large culverts. It is anticipated that for most large culverts, using remote controlled cleaning equipment would be the preferred option. In one observed case, the remote controlled equipment cleaned a culvert 4-5 times faster than the traditional method. A flow chart provided in the final report identifies important culvert and site characteristics that must be considered when deployment locations are assessed and decided upon.

To continue making advancements in optimizing the large culvert cleanout process, researchers recommend collecting performance data using the tracking sheet. Researchers also recommend the purchase of the MicroTraxx SL 436 unit, which provides greater maneuverability within the stream channel, and comparing its operation to the MT 3234. Lastly, it is recommended that ODOT log each time a culvert is cleaned so that long-term, state-wide demand can be better assessed and lifetime maintenance costs for each culvert can be estimated.