FORAS
DESIGN REPORT

MDOT Bessemer Project

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Date:	14 April 2020
Project:	MDOT Bessemer
Submittal:	Final Report

FORAS

Re: CE 4905 Senior Design Spring 2020

LETTER OF TRANSMITTAL

To: Melanie Kueber Watkins **Copy to:** MDOT

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REMARKS:

Attached is the final report for the MDOT Bessemer project written by FORAS. This report, titled "FORAS DESIGN REPORT: MDOT Bessemer Project", represents the efforts of undergraduate students in the Civil and Environmental Engineering Department of Michigan Technological University. While the students worked under the supervision and guidance of associated faculty members, the contents of this report should not be considered professional engineering.

BY: _____Katy Gula_____

If enclosures are not as noted, kindly notify us at once.

Acknowledgments

FORAS would like to thank our sponsor, MDOT, for providing us with this project and allowing us to tour their facilities. Thank you to Trevor Sholten of MDOT for providing feedback and guidance throughout the process. We would also like to thank Michigan Tech's Civil and Environmental Department and the faculty and staff who helped us along the way. A special thanks to our advisor, Dr. Melanie Watkins, for all of the help and support over the course of this project.

I. Executive Summary

MDOT will be replacing a 1.8 mile stretch of road in the downtown area in the City of Bessemer in 2021. FORAS was given the task of assessing and redesigning the storm sewer and Powder Mill Creek Bridge for MDOT, along with redesign of the water main and sanitary sewer for the City of Bessemer. These projects will be constructed during the same period. The road was originally built in 1954 and no documentation of replacement of these systems were provided, so it is assumed that they are at least as old as the road.

The water main design coincides with sanitary sewer elements in determining pipe material type and location. Sanitary sewer must be 1-1.5 feet lower than the water main in depth and 10 ft away laterally to protect the water main from any possible contamination according to Ten States Standards. Downtown Bessemer is provided with 173,333 gallons of water per day, as noted by the City of Bessemer in the Water Quality Reports. A value of 120 GPM was used in the water simulation for water main. Due to current water usage and population, the existing 16 inch diameter water main is sufficient and does not need to be resized but does need to be replaced, as it has aged and deteriorated.

For the sanitary sewer, the connections of the sewer lines were approximated based on the location of the manholes. The current diameters of the pipes were assumed to be proficient for the current wastewater flow rate of the town, but pump information is needed to make conclusive recommendations.The recommended material for the sewer is PVC. The final design elements included connecting the sanitary sewer lines, finding the flowrate of wastewater from both residential and commercial establishments, finding a durable and cost effective pipe material, and sizing the sanitary sewer lines based on the demand for a given section of pipe.

For the storm sewers, the condition of each manhole and catch basin was assessed and taken into account when deciding on what structures needed to be replaced and which ones required minor repairs or cleaning. Calculations of drainage area and rainfall events were taken into account when sizing the new pipe sections of the system. After assessment, it is recommended that 45 of the structures and all piping be replaced with class A pipes. The recommended new pipes range in size from 12 to 36 inch diameters. The different forms of low impact development recommended for this job include the following: silt fences, dust control, inlet protection fabric drops, and vegetative buffers.

For the bridge design, the existing structure’s condition was assessed to determine whether replacement was necessary and the extent of required updates. The existing structure is a 40 ft bridge and concrete box culvert crossing the Powder Mill Creek. A model of the existing conditions was created and the 50 year design flow rate was

tested. Upon reviewing this model, no overtopping occurred and it was determined that complete reconstruction of the bridge was unnecessary. Rather, less disruptive design updates, erosion control improvements, and bridge maintenance have been opted for. Culvert embedment, possible replacement of riprap channel lining, and repavement of the road surface are recommended.

With the recommended remediations to the systems listed above, an estimated cost and schedule were formulated. The estimated cost of the entire project came out to be $3,121,599. The largest cost of the project will be the removal and replacement of the water main, coming in at just over $1.4 million. As for the estimated schedule, it was found to take about 223 work days to complete the project. There would need to be a break for winter from November until April, which would result in the project taking about two construction seasons to complete.