To: Yassmin Gramian, Secretary of Transportation, PennDOT
From: Michael Rodriguez, Policy Analyst, Infrastructure and Research Policy Committee
Date: December 6th, 2022
Subj: Bridge Maintenance in Pennsylvania – Efficient and Effective Drone Inspections

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ABSTRACT

The purpose of this memorandum is to provide Secretary Yassmin Gramian with an analysis of and recommendations for improving the status of bridge maintenance in Pennsylvania. ASCE bases recommendations on a review of the cost for bridge repair, and how innovations in technology such as drones can have a positive impact on bridge inspections. A substantial decrease in cost to inspect bridges, as a benefit of utilizing drones, leads the ASCE to recommend the following: (1) increase the frequency of bridge inspections and (2) introduce the implementation of drone technology for performing bridge inspection work.

PENNSYLVANIA'S BRIDGES ARE CRUMBLING

The United States has more than 600,000 bridges but is dealing with the consequences of aging infrastructure with over 40,000 deemed in poor condition.[1] As of 2021 Pennsylvania is no exception with 3,198 bridges (13.8% of all bridges) classified in poor condition.[2] Although the number of bridges in poor condition have decreased, Pennsylvania is ranked 2nd in the nation for states with the highest count of bridges in poor condition.[3] This is partially a result of a declining rate of improvement across the nation caused by the backlog of bridge repairs and the inadequate funds to meet the expected demands of maintenance.[4] The effects of these circumstances are being experienced locally – in January of this year, Pittsburgh experienced a bridge collapse that is estimated to cost $24 million to replace.[5] Fortunately, this will be aided through President Biden's infrastructure legislation, but there is more to be done so that the other thousands of bridges in Pennsylvania can see proactive maintenance before a critical failure happens.

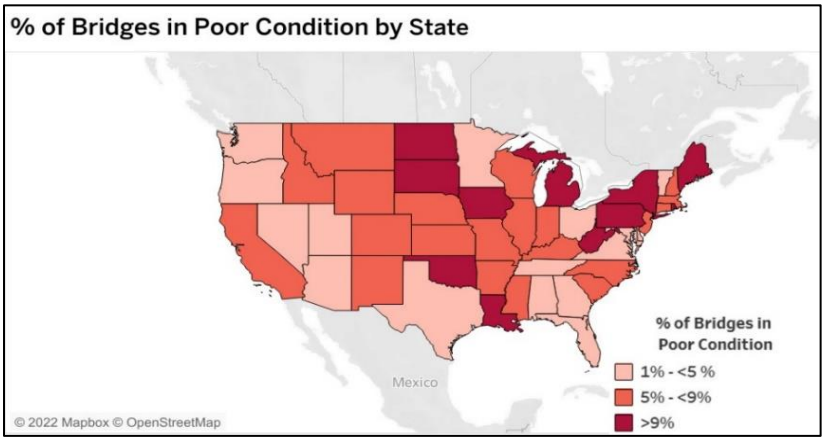

Figure 1: Percent of Bridges in Poor Condition Across the United States.[6]

CURRENT BRIDGE INSPECTION PROCESS IS COSTLY

PennDOT outlines the main procedure of bridge inspection is a visual review of the condition of a bridge. This may entail: the need to control or restrict traffic, cost for usage of an inspection vehicle, and getting enough staff to conduct the inspection.[7] This traditional procedure of inspecting a bridge requires thousands of dollars and weeks to even months to complete. Across the state each day this intensive process is done for 70 bridges.[8]

The process of inspecting bridges is a key component in the life of a bridge. With respect to federal requirements bridges need to be physically evaluated once every two years.[9] For Pennsylvania that is about 18,000 bridges a year that require an inspection.[10] But, as shown in Figure 2, the FHWA Bridge Performance forecast model shows with the current rates of inspection and preservation of bridges predicts that by the year 2048 the number of bridges that will degrade to a poor condition (squares) will exceed the number of bridges in a good condition (triangles).

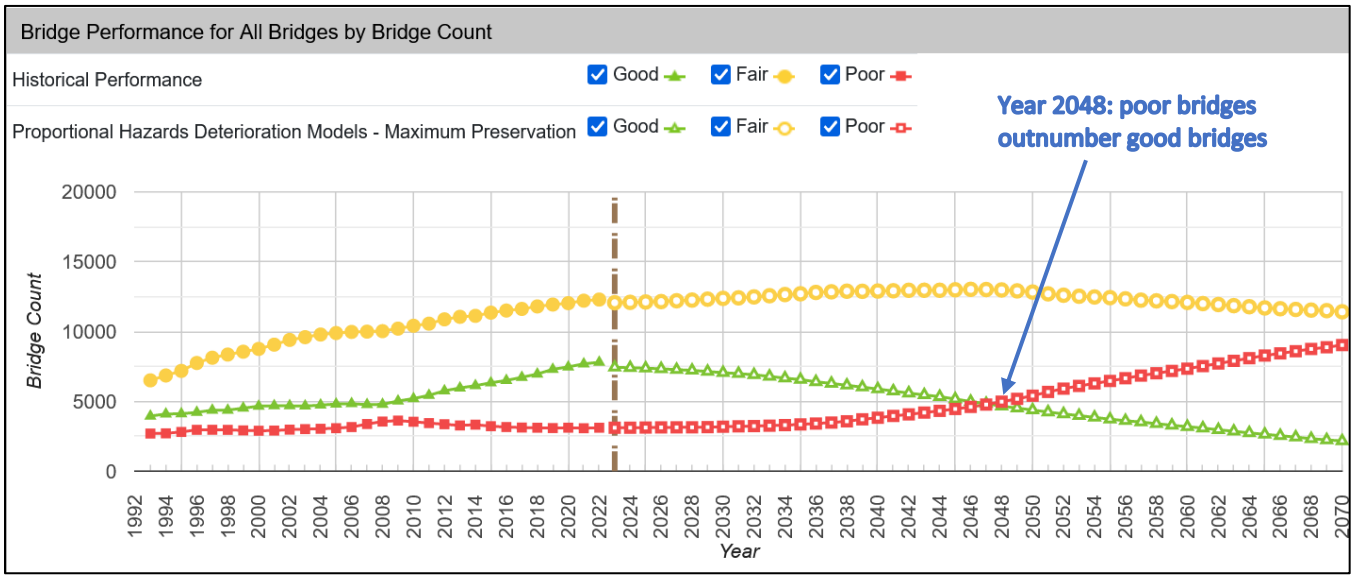

Figure 2: Model forecasting the number of bridges by condition in Pennsylvania.[11]

PENNSYLVANIA NEEDS INNOVATION FOR BRIDGE MAINTENANCE

The current traditional method for inspecting bridges is resource intensive, time consuming, and disruptive.[12] Utilizing drones for bridge inspections offer a more efficient and faster method for inspecting bridges and meeting the needs of infrastructure in the state.[13] Equipping an inspection team with the latest drone technology can help PennDOT save money, time, and resources to catch up with the large demand of bridge maintenance across the state. Some state DOT's have already begun to use drones for inspections and experienced positive results.

Michigan, (a state with 11% of all bridges in poor condition) estimated that a bridge inspection could be done in 25% of the time a manual inspection would take with the added benefit of costly nearly 5% of the total cost of a traditional inspection.[14] This was accomplished without any need to construct a work zone and with the increased safety. When a drone is used for a bridge inspection there is no need to acquire an inspection vehicle and no requirement to control traffic.

Similarly, Minnesota (a state with 5% of all bridges in poor condition), realized an average cost savings of 40% when utilizing a drone for a bridge inspection.[15] There were other various benefits

that could not be quantified such as the improved inspection information gained, that would allow for more effective decision making in relation to maintenance requirements.

ALTERNATIVES TO DRONE INSPECTIONS

One alternative method for inspecting bridges is with inspectors who are certified by the Society of Professional Rope Access Technicians (SPRAT). These SPRAT inspectors are trained to utilize ropes and climbing techniques to traverse a bridge for physical inspection.[16] A case study was performed on the Daniel Carter Beard Bridge comparing the performance of SPRAT inspection to that of data collected by a drone, and the results reveal that much of the deterioration captured in the rope inspection did not have adequate images while the drone was able to capture the entire area of the bridge.[17]

Another approach for some states has been to increase their gas tax. Currently Pennsylvania has the third highest tax rate in the United States on gas at 58.7 cents per gallon.[18] These funds are utilized to put towards bridge maintenance. The implications of legislation that would increase the gas tax is out of the scope of this recommendation, but it should be noted that this approach is not proactive enough to meet the growing demands of bridge repair. Many states across the country have chosen to raise their gas tax the current backlog of repairs has yet to see significant change.[19] By having more frequent and clear inspection data provided by drones the backlog of maintenance can be addressed by catching issues earlier and more often with a smaller cost.

Additionally, a survey conducted in 2019 by the American Association of State Highway and Transportation Officials found that 36 state departments of transportation have provided support for drone inspection operations.[20] Among these states are newly hired staff to manage and pilot drones, funds towards drone inspection programs, and the creation of centers deploying drones for research. Local companies have begun showing potential for inspecting bridges, such as AERAS using drones capable of inspecting bridges in Pittsburgh within hours.[21] This along with institutions across the state that are conducting drone research exemplifies the potential for PennDOT to expand work that is currently underway.[22]

ASCE RECOMMENDATIONS FOR IMPROVING PENNSYLVANIA'S BRIDGES

Considering that drones are an efficient and cost-effective way to inspect bridges, the ASCE recommends that Secretary Yassmin Gramian:

- Develop partnerships with the University of Pittsburgh and AERAS to establish a program for evaluating the potential for drone usage in bridge inspections
- Approve PennDOT to hire and or train staff to operate drones for bridge inspections

CONCLUSION

Traditional methods for inspecting bridges are presently very time intensive and costly, and forecasted to not be enough to keep up with the preservation demands of bridges in Pennsylvania. In comparison, drones show to be very capable and requires less to operate for inspecting bridges. Pennsylvania needs an innovative approach for its aging infrastructure. Therefore, the American Society of Civil Engineers encourages Secretary Yassmin Gramian to consider drones as a cost effective and time saving practice for inspecting bridges in Pennsylvania.

Notes

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