QUANTITATIVE RISK ANALYSIS OF FREQUENTLY FLOODED HIGHWAYS AND A RISK MANAGEMENT FRAMEWORK FOR USE AT THE DELAWARE DEPARTMENT OF TRANSPORTATION (DelDOT), USA

ABSTRACT Many countries are going to be experiencing increased storm surge and flood event frequency and severity. Highway assets will be most vulnerable to climate change with authorities facing challenging decisions on risks and prioritisation to deliver increased asset resilience. Delaware is the lowest average elevation state in the USA and so is especially vulnerable to flood events (see plate 1 and 2). Mott Macdonald, working with DelDOT, have developed methodologies and tools to assist with assessments and funding decisions.

The paper describes a standardised methodology adopted by DelDOT that allows for risk and resilience to be modeled across multiple threats and probabilities at the network level based on modeling at the individual asset/location level. Importantly, the paper will show how risk and resilience are pulled into the more general State of Good Repair (SOGR) trade-off analysis tool developed by DelDOT using a standard data structure. The paper will show how different levels of anticipated risk and resilience tolerances require different levels and rates of funding. The risk framework draws from previous National Cooperative Highway Research Program (NCHRP) and other work and constitutes a fully quantitative analysis.

The paper will include a case study of the framework - the identification of segments of highway from Delaware's State maintained highways that are vulnerable to flooding across multiple event frequencies ranging from 'Sunny Day flooding' from normal tide action, through 1:10, and 1:100 flood events using the Federal Emergency Management Agency (FEMA) flood maps. The presentation will discuss the optimisation and prioritisation of future actions needed over the next 15-30 years with respect to raising sections of highway, based on benefit cost analysis using quantitative risk and resilience modelling, including use of the TVC approach (Threat Probability, Vulnerability, Consequence) adopted by DelDOT, and the quantitative definition of resilience from Frangipol et al.