

Development of a Climate Adaptation Strategy for the InnovA58 Highway in the Netherlands

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ABSTRACT

Climate change induced extreme weather events may affect the functionality of (federal) highways and therefore pose a risk for safety and traffic flow. As the asset manager of the main road system in The Netherlands, **Rijkswaterstaat** has to ensure that road networks continue their operational functions, both now and in the future. Therefore **adaptation strategies** are needed to develop and maintain **climate resilient infrastructure, integrated in the environment**. To develop such a strategy, the **ROADAPT methodology** - developed in response to the 'CEDR call 2012: Road owners adapting to climate change' – and **Dynamic Adaptation Policy Pathways** were tested on a planned Dutch highway project, InnovA58. We conclude by stating that both methods are useful to assess vulnerability and potential measures for road infrastructure, and to increase adaptive design. An area-oriented approach is needed, since climate resilience requires regionally tailored solutions.

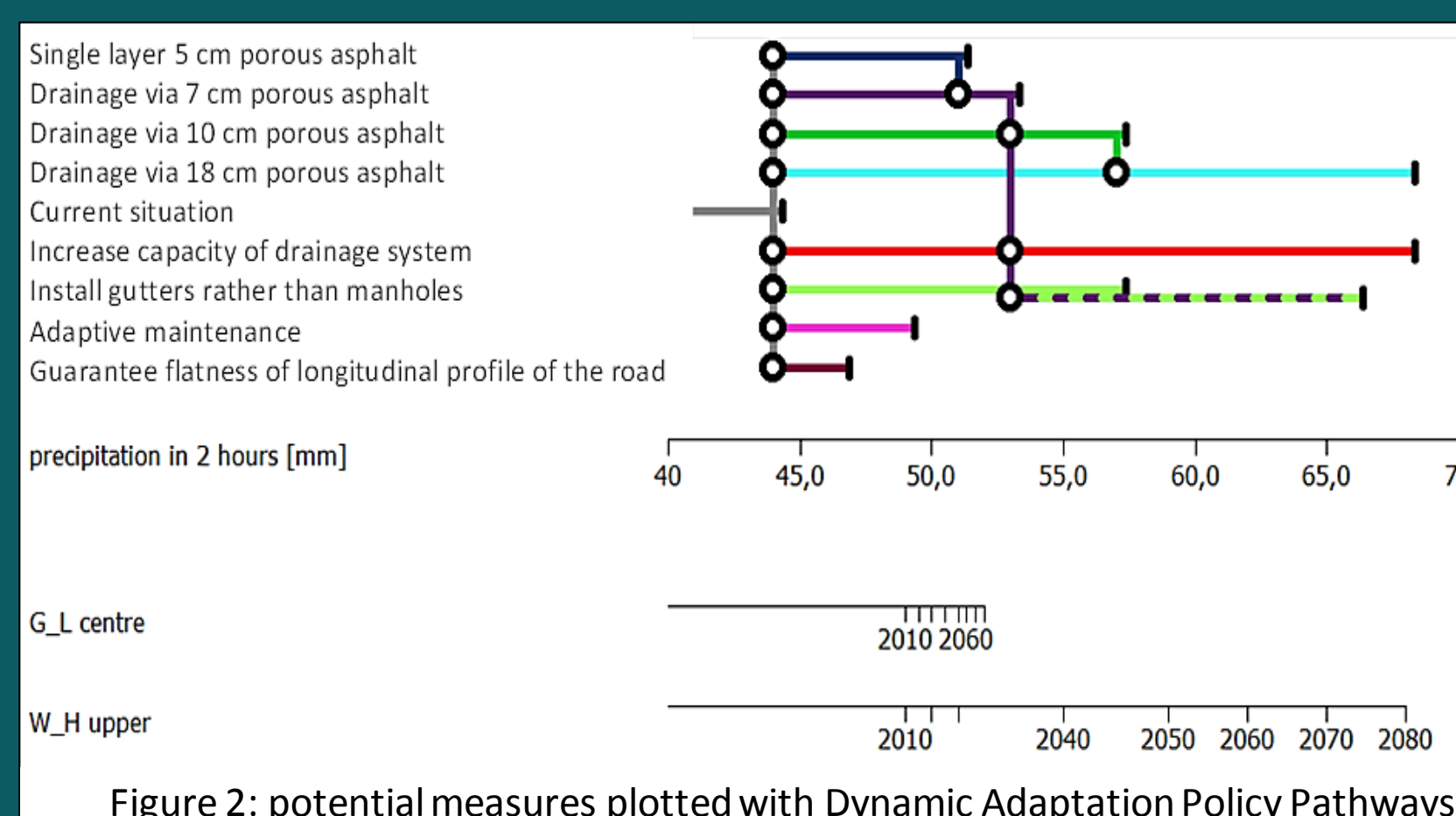
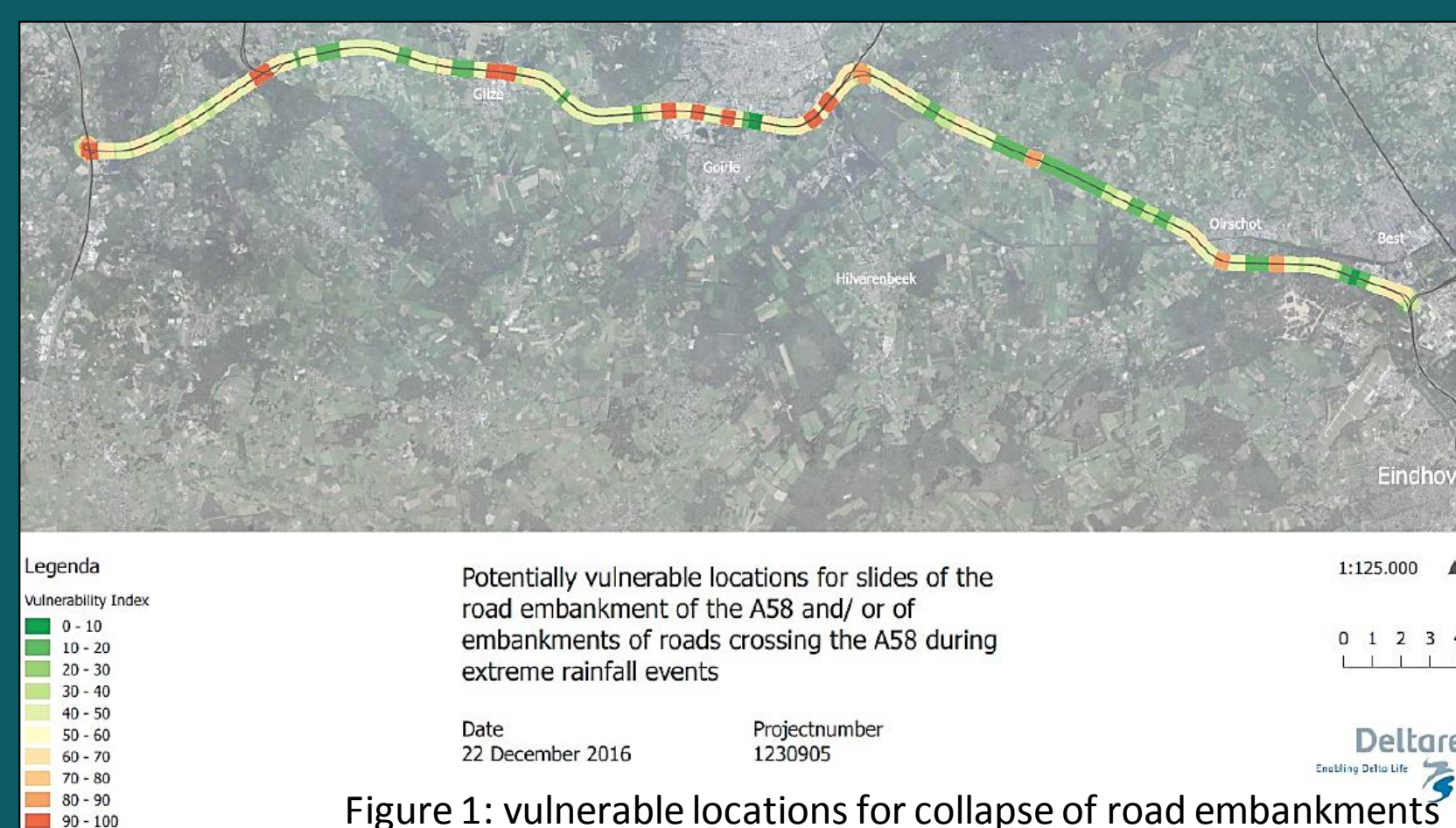
CASE STUDY

- The InnovA58, highway, the Netherlands, is used as a test case. The project area experiences heavy downpours, which are increasing as the climate changes, resulting in localized flooding and need for enhanced storm water management. The project is currently in the planning phase, and construction is expected to begin in 2020;
- A process has been designed to assess risks, vulnerability and possible measures for the InnovA58 highway and the close environment (see table 1), using the ROADAPT methodology and Dynamic Adaptation Policy Pathways.

RESULTS

The application of the ROADAPT and the Dynamic Adaptation Policy Pathways methodologies on the InnovA58 has led to output that resulted in an adaptation strategy for the highway. The output consists of:

- Risk matrices:** in the Quick Scan workshops risks of current and future climate were identified and plotted on risk matrices;
- Selection of top risks:** top risks were derived from the risk matrices and potential measures identified (see fig. 1);
- Vulnerability maps:** the ROADAPT Vulnerability Assessment led to GIS maps, presenting the most vulnerable locations of the InnovA58 project (see fig. 2);
- Impact Assessment:** the ROADAPT Socio-economic Impact Assessment was carried out to assess which measures are potentially viable;
- Adaptation Strategy:** potentially viable measures have been plotted to establish an adaptation strategy for the InnovA58 (see table 2).



| Key risks | Possible measures (non exhaustive list) |
|--|---|
| Flooding of infrastructure as a result of inundation | <ul style="list-style-type: none"> Enlarge capacity of the existing bridges and/or culverts (wider/higher) Elevating the road Realizing upstream water retention Increase maintenance |
| Flooding of infrastructure due to extreme precipitation | <ul style="list-style-type: none"> Increase capacity of rainwater drainage system Use gutters rather than gullies Increase inclination of the road Dimension/design intersections for extreme precipitation |
| Erosion of embankments | <ul style="list-style-type: none"> Improving erosion protection |
| Loss of safety due to splash and spray | <ul style="list-style-type: none"> Thicker asphalt for water drainage or vertical/central drains under the asphalt Intensifying management and maintenance of verges and rainwater drainage Adaptive lighting/ notifications on the road |
| Flooding of streams and urban areas due to extreme precipitation | <ul style="list-style-type: none"> Realizing water retention Infiltration of pump water into aquifer Preventing rainwater to drain into urban drainage systems |

Table 2: Top risks for the InnovA58 and potential measures



| Process steps | Actions taken |
|----------------------------------|---|
| Quick Scan | Two workshops: <ul style="list-style-type: none"> To determine climate threats for the A58 infrastructure and surrounding environment To determine key risks and potential measures |
| Vulnerability Assessment | GIS-methodology for mapping distinctive vulnerabilities in the road network |
| Socio-economic Impact Assessment | Two methods: <ul style="list-style-type: none"> Cost Effectiveness Analysis Cost Benefit Analysis |
| Adaptation Strategy | Dynamic Adaptation Policy Pathways to determine an adaptation strategy |

Table 1: Research strategy InnovA58 case

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CONCLUSION

- The ROADAPT method provides a clear tool for generating and assessing risks, consequences and possible measures;
- In addition, the Dynamic Adaptation Policy Pathways provide insight into which measures can be combined into an adaptation strategy;
- However, the methodologies are dependent on the input of local knowledge and the ROADAPT method is line-oriented, rather than area-oriented.
- Therefore, to be able to make an integral assessment of climate resilience of the road and its environment, a process that incorporates an area-oriented approach is absolutely needed. Such an area-oriented approach should be adaptive in itself, since future climate conditions and effectiveness of measures is uncertain.

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