

Executive Summary

The seventh meeting for the 2020-2023 cycle for Technical Committee 1.4: Climate Change and Resilience of Road Networks for the World Road Association (PIARC) was held in Oslo Norway in hybrid format from 19-20th June 2023. The meeting was attended by Caroline Evans (Infrastructure Victoria), Chair of the Technical Committee 1.4, Louis Bettini (Main Roads Western Australia), English-Speaking Secretary, and Stuart Woods (Waka Kotahi NZ Transport Agency), Working Group 2 Co-Leader.

In this cycle the Technical Committee (TC) is addressing two issues:

- 1.4.1 Uniform and holistic methodological approaches to Climate Change and other hazards resilience
- 1.4.2 Update of the PIARC Climate Change Adaptation Framework.

The main activities of the meeting were for TC 1.4 to:

- Organise two plenary sessions including to:
 - Obtain updates from the Chair, Strategic Theme Coordinator and Technical Advisor for Strategic Theme 1.
 - Discuss the 2024-2027 PIARC Strategic Plan including the topics included for TC1.4:
 - Development of a Resilience Framework for Road Networks – Climate Change and Other Hazards
 - Best practice in Organisational Resilience for Enhancing Road Networks
 - Provide an overview of the Indonesian International Seminar on Climate Change Impacts and Road Resilience, held jointly with TC 1.4 in Yogyakarta, Indonesia from November 22-23rd 2022. This involved an update of the forthcoming publication of a General Report, summarising the outcomes of the Seminar.
 - Discuss preparations and technical sessions/workshops being coordinated by TC 1.4's for the World Road Congress in Prague, Czech Republic from 2nd -6th October 2024.
 - Hold parallel Working Group meetings to progress and finalise the two individual products of TC1.4.

Background

Within the PIARC Strategic Plan exists Strategic Theme 1: Road Administrations. This strategic theme includes five Technical Committees, one of which is PIARC Technical Committee 1.4 which addresses climate change and other hazards resilience of road infrastructure, and update of the *International Climate Change Adaptation Framework for Road Infrastructure*.

In this cycle, the activities of the TC 1.4 are divided into two Working Groups and an internal Taskforce:

- Working Group 1 (WG1) Uniform and holistic methodological approaches to Climate Change and other hazards resilience. This WG aims to explore the effectiveness of a PIARC all-hazard approach for resilient road networks using case studies.
- Working Group 2 (WG2) Update of the PIARC Climate Change Adaptation Framework. This WG aims to update the Framework originally developed in 2012-2015, and builds on the work of the previous cycle (2016-2019) by TC E.1 Adaptation Strategies and Resilience which formulated proposals for the refinement of this Framework. These refinements and previous work will form the basis for updating the Framework within this cycle.
- Case Study Taskforce formed to consolidate case studies to assist in the development of the Working Group reports.

Work Program

TC 1.4 is focussed on expanding the collective knowledge for climate change adaptation and resilience to include impacts of climate change and other hazards, such as aging of infrastructure, climate change, natural disasters and cyber-security hazards. It extends the products developed in the previous cycle and aims to disseminate best-practice knowledge on methodological approaches for climate change and resilience with a top-down/whole-of-system perspective. The outputs and expected deadlines for each of the issues in TC 1.4 are described in the Strategic Plan and summarised below:

Strategies/Objectives	Outputs	Expected Deadlines
1.4.1 Uniform and holistic methodological approaches to Climate Change and other hazards resilience		
<ul style="list-style-type: none"> • Identification of hazards and environmental threats within the context of road infrastructure resilience (in consultation with other relevant TC's). • Approaches to: <ul style="list-style-type: none"> ○ Risk management within the context of resilience ○ Decision-making and uncertainties/deep uncertainties ○ Emergency management with the context of resilience ○ Resilience management and resilience engineering • Economic, social and environmental aspects of resilience management <ul style="list-style-type: none"> ○ Identification of the socio-economic impacts of hazards on roads ○ Identification of decision areas that need enhanced socio-economic information, and on the key users of such information. ○ Impact and socio-economic evaluation of measures to increase resilience on the availability of road transport infrastructure, and the cost effectiveness of different adaptation strategies • Define criteria to implementation of resilience into asset management practice (in consultation with other relevant TC's e.g. TC 3.3 Asset Management) • Encourage coordination with other TCs and TFs, such as T.C.1.5 – Disaster Management, T.C.2.4 – Road Network Operation/ITS, T.C.3.2 – Winter Service, T.C.3.3 – Asset Management, T.C.3.4 – Environmental Sustainability in Road Infrastructure and Transport, T.F.3.1 – Road Infrastructure and Transport Security, T.C.4.1 – Pavements, T.C.4.2 – Bridges, T.C.4.3 – Earthworks, T.C.4.4 – Tunnels and T.F.4.1 – Road Design Standards. 	Collection of Case Studies	Completed December 2021
	Full report based on case studies	August 2023
Issue: 1.4.2. Update of the PIARC International Climate Change Adaptation Framework for Road Infrastructure		
<ul style="list-style-type: none"> • Update of the PIARC Climate Change Adaptation Framework based in the work carried out on the other ToR of this T.C.: <ul style="list-style-type: none"> ○ Setting a strict separation of processes and methodologies. ○ Split the framework into two separate parts: <ul style="list-style-type: none"> ▪ Part 1: Processes and their descriptions. ▪ Part 2: Overview of possible methodologies for risk assessment and risk management, their data requirements and application limits. This is based on the work carried out by TC E.1 (2016-2019), and on case studies of holistic resilience approaches to be collected through a survey/questionnaire preformed together with WG1. • Consideration of new and innovative methodological approaches, in particular criticality assessment, adaptation pathways and evaluation of the overall economic, social and environmental value of adaptation measures. • Introduce the concept of holistic resilience in the Framework, where suitable. 	Roundtable with participation of all relevant TCs and TFs	Completed February 2022
	Update Climate Change Adaptation Framework for Roads	July-August 2023

To date TC1.4 has produced the following reports related to its work program:

- Terminology on Resilience and Coordination with Related PIARC Technical Committees: Internal document (2021)
- Climate Change, Other Hazards and Resilience of Road Networks: A PIARC Collection of Case Studies (2022)

TC1.4 also produced reports together with other PIARC TC's:

- COVID-19: initial impacts and responses to the pandemic from road and transport agencies: TC1.4 was a member of the PIARC COVID-19 Response Team (2020)
- General Report: International Seminar on Climate Change, Resilience and Disaster Management for Roads: Summary of PIARC Seminar in Yogyakarta, TC 1.4, TC 1.5 and REAAA (Forthcoming August 2023).

Meeting Outputs

The meetings comprised two days of Plenary meetings, followed by a Technical Site Tour. A significant aspect of the TC 1.4 plenary meeting was to hold parallel Working Group meetings to progress and finalise the two individual products of TC1.4 as above. TC1.4 also received updates from PIARC General Secretariat on governance, conferences, publication and other matters. The meetings also allowed for other relevant topics to be discussed at the Plenary sessions as summarised below.

Discussion of the 2024-2027 PIARC Strategic Plan

The PIARC Strategic Plan assists with aligning the work undertaken by TCs with the organisational goals of PIARC. The topics proposed for the Terms of Reference of TC1.4 for 2024-2027 are:

- Development of an all-hazards resilience framework for road networks – This topic will extend the work undertaken in previous cycles covering resilience approaches for climate change and other hazards. It will involve developing an updated version of the PIARC Climate Change Adaptation Framework for Road Infrastructure (2000-2023 cycle) as a resilience framework covering changing hazard risks, climate hazards, natural hazards (geotechnical) and pandemics. It will identify medium to long term vulnerability and risk assessment methods that take into account both climatic and non-climatic risks and for the identification and assessment of critical infrastructure.
- Best practice in understanding organisational resilience for road networks – Organisational resilience is essential to organise, resource, promote and maintain a sustainable activity, serving users and the necessary movement of goods, services and people. The purpose of this work is to assess how resilience is understood, implemented, measured and evaluated in road organisations. This includes the identification of institutional attributes that can make an organisation adaptive enough to respond to changes over time to address the climatic and non-climatic threats, such as processes supportive to resilience in road management decision-making, existence of specific work units facilitating network resilience improvement in a road agency, flexibility of internal/external stakeholders engagement process to accommodate new ideas or best practices elsewhere with appropriate validation and so on. The work will identify common attributes and processes and different approaches used and identify the relationships of road resilience within complex systems, including resilience at the network-wide level, arterial and asset levels.

Overview of the Indonesian International Seminar on Climate Change Impacts and Road Resilience, held jointly with TC 1.5 in Yogyakarta, Indonesia from November 22-23rd 2022.

Caroline Evans, Chair and Stuart Woods provided a summary presentation on the key themes and outcomes of the Seminar.

The Seminar comprised 52 speakers and moderators, and aimed to feature current practice on Climate Change, Resilience and Disaster Management for Roads. The focus was to share knowledge with local authorities, administrators, the private sector, and those responsible for road traffic and safety, design engineers, design consultants, road network administrators, contractors, control and technical assistance consultants, academics, researchers, engineering students interested in the subject, and experts in other domains of expertise related to climate change, resilience, and disaster management for roads. The Seminar covered the following topics:

- Adapting to Climate Change Risks and Disaster Management
- Building Capacity for Adaptation and Resilience (Economic, Social, and Environmental)
- Best Practices on Climate Change Resiliency and Disaster Management.

Overall, it was considered a successful event, professionally run and with attendance of over 300 in-person, and approximately 100 online. The key observations from the seminar included:

- Natural hazards and climate change challenges are similar across countries which emphasised the importance of the topic.
- The maturity of systems and processes to deal with hazards is essential to minimise the impacts, and the consequences of events can vary as result
- There is an increased desire globally on being proactive, rather than reactive for climate change events – as it makes overall economic sense
- Data acquisition is becoming more extensive and analysis more complex - geospatial mapping is becoming standard practice
- The 3 or 4Rs (concept is being widely considered (in various models). The approaches are similar including organisations implementing process for continuous improvement and learning.

A Seminar proceedings report has been compiled and will be published in late July-early August 2023. It is titled International Seminar on Climate Change, Resilience and Disaster Management: Summary of the Indonesian International Seminar will be available at [International Seminars Proceedings - PIARC](#).

Discuss preparations for TC 1.4's participation in the World Road Congress in Prague, Czech Republic in October 2024.

TC 1.4 will be involved in five sessions at the World Road Congress in Prague, October 3rd to 6th, 2023 as follows:

- Technical Session 1.4 – Climate Change and Resilience
- Foresight Session with TC 1.3, TC 1.4 and ITF: Sustainable Financing for Decarbonization
- Foresight Session with UNECE (United Nations Economic Commission for Europe): Stress testing of road infrastructure to climate change hazard
- WG1 TC 1.4 Workshop with TC 3.3. Asset Management, Resilience and Asset Management
- WG2 TC Workshop on the Climate Change Adaptation Framework.

Technical Visit

The technical tour took place on the 21st of June and visited the following sites:

- The Norwegian Water Resources and Energy Directorate – Presentation of the National warning system for landslides and avalanches
- Oslo School of Architecture and Design (AHO) - "Norwegian Scenic Routes" - 30th Anniversary exhibition.
- Oslo Municipality Presentation of the municipality's Climate Strategy.
- Field visit, Hovinbekken.



Norwegian Awareness level spectrum for weather, flood and landslide

The Norwegian Water Resources and Energy Directorate includes the Norwegian Avalanche Warning Service which services all water related natural hazards. The Services works with a variety of agencies to manage avalanche risk, produce terrain maps, forecasts, advice and observations and provide training online for snow observation. Road authorities 'trigger' avalanches to mitigate risk. Rainfall induced landslides and flooding is a growing problem in Norway with the significant risk being: debris flows in steep brooks; rainfall and snowmelt induced debris flows and rainfall and/or snowfall induced slush flows.



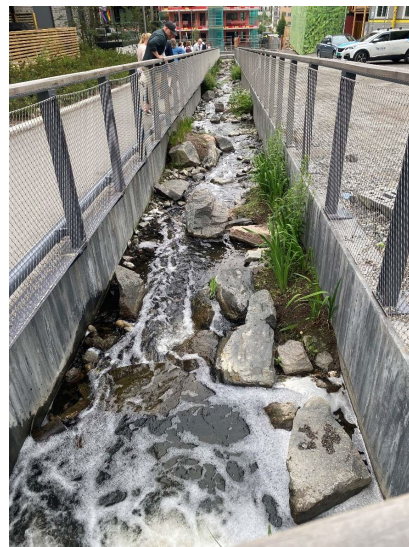
Trucks utilising passenger vehicle charging infrastructure in Oslo

The Oslo Municipality climate strategy includes a Climate Budget which is integrated into the ordinary municipality budget and identifies scope 1 & 2 emissions reduction measures. A key focus overall is to encourage people to walk, cycle or use public transport and avoid using a car. Oslo has a toll ring around the city centre which controls congestion and also incentivizes EV use (through a lower toll). Key statistics include:

- 83% of cars sold in Oslo in 2022 were fully electric
- 34% of cars in Oslo are electric
- Van sales are going electric: 38% in Oslo, 24% Norway
- Electric truck sales: 9% Oslo, 4% Norway
- Biogas truck sales: 16% Oslo, 5% Norway



Norwegian Scenic Routes Exhibition



Living stream for water management in Oslo

Public charging infrastructure is still seen as a barrier to EV uptake, with infrastructure availability for heavy vehicles starting to be an issue. Trucks are using CCS2 plugs and utilising the existing 150kw charging infrastructure but require at least 350kw. Zero emission vehicle construction sites have been successfully implemented. Key outcomes include that the sites are quiet, there is less vibration, businesses in the vicinity remain open and workers are less tired.

The Norwegian Scenic Routes Exhibition at the Oslo School of Architecture and Design showcased the road side stopping places that have been architecturally designed, and delivered by the Norwegian Public Roads Authority, in an effort to improve the tourism experience for road users.

The Field visit of Hovinbekken demonstrated a water drainage and stream management that was part of the cities climate adaptation practices. Water is managed through a dual drainage system, both culvert and living stream, that provided improved amenity for the city itself. A 'sculpture stream' segment of the drainage system was delivered using zero emission construction.

Conclusions and Future Meetings

The Work Plans for the TC and outputs to date are on-time and on-schedule. Due to the leadership positions appointed, Australia and New Zealand are well positioned to contribute and learn from the Work Program with the issues being highly relevant to an Australasian Road and Transport Agency context.

The proposed schedule for future meetings of the TC are as follows:

- Meeting 8: October 2023 – WRC Czech Republic (Prague)

Caroline Evans (Chair of TC 1.4)

Principal Policy Advisor
Infrastructure Victoria

Louis Bettini (English Speaking Secretary)

Principal Advisor Sustainability
Main Roads

Stuart Woods (Co-Leader Working Group 2)

Lead Advisor – Resilience
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July 2023