HIWAY

Pavement Recycling

Climate Resilience and Carbon Footprint Reduction

Nick Schilov
Technical and Innovation Manager - NZ

June 2024

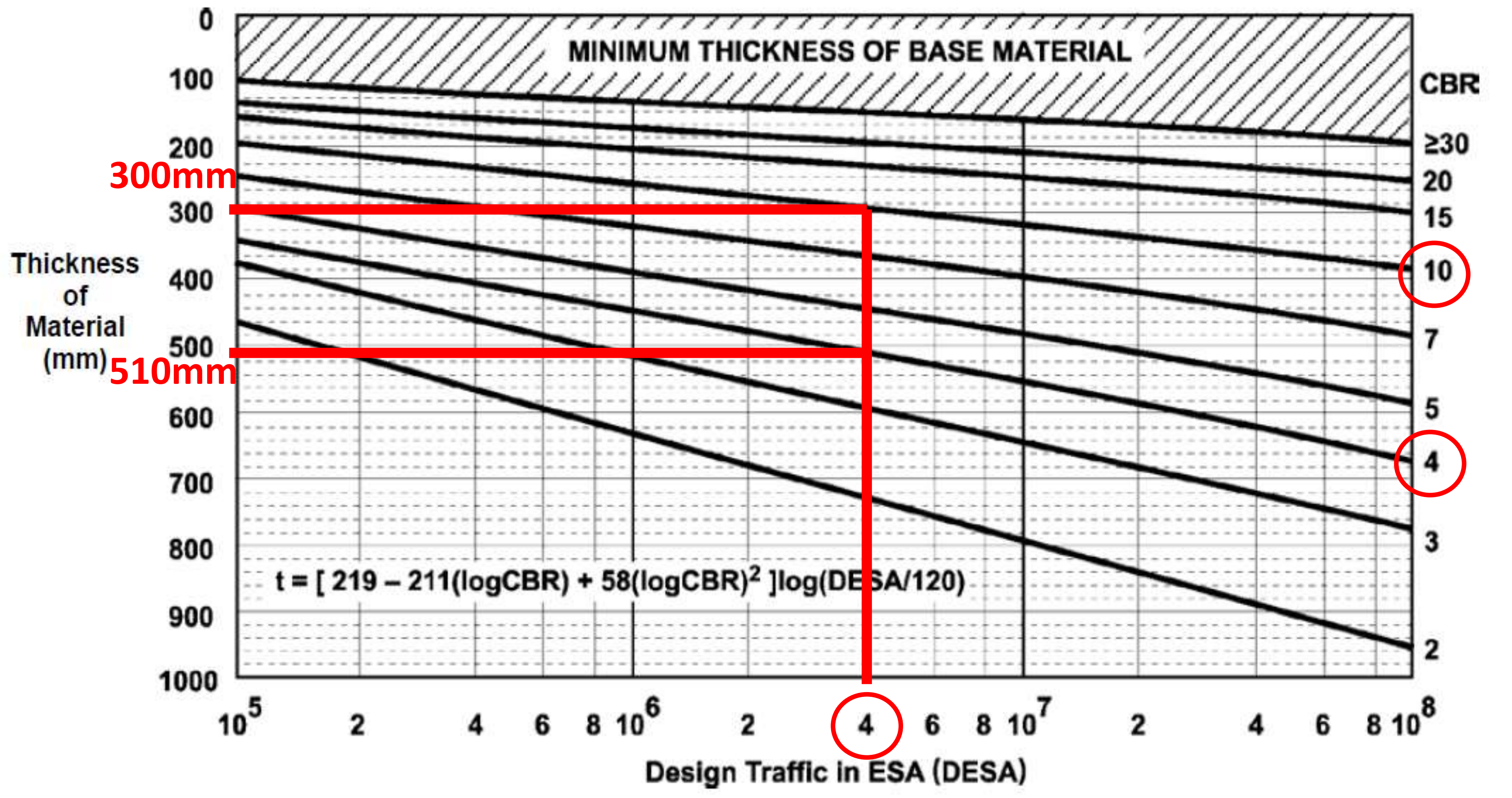
Root Cause Pavement Issues

Typical Pavement Construction

NZ / Aus Typical State Highway / Secondary Roads / Collectors

- Chip seal over Basecourse / Subbase. Sometimes thin asphalt surfacing
- Designed to provide strong and stable foundation
- Protect underlying soil subgrade from damage

Figure 8.4: Design chart for granular pavements with thin bituminous surfacing



Moisture Sensitivity

- No performance criteria for aggregate
- We rely on materials specifications (NZTA M/4) and;
- Construction specifications (NZTA B/2 or B/5)
- Pavement design is to Austroads and the NZTA Supplements

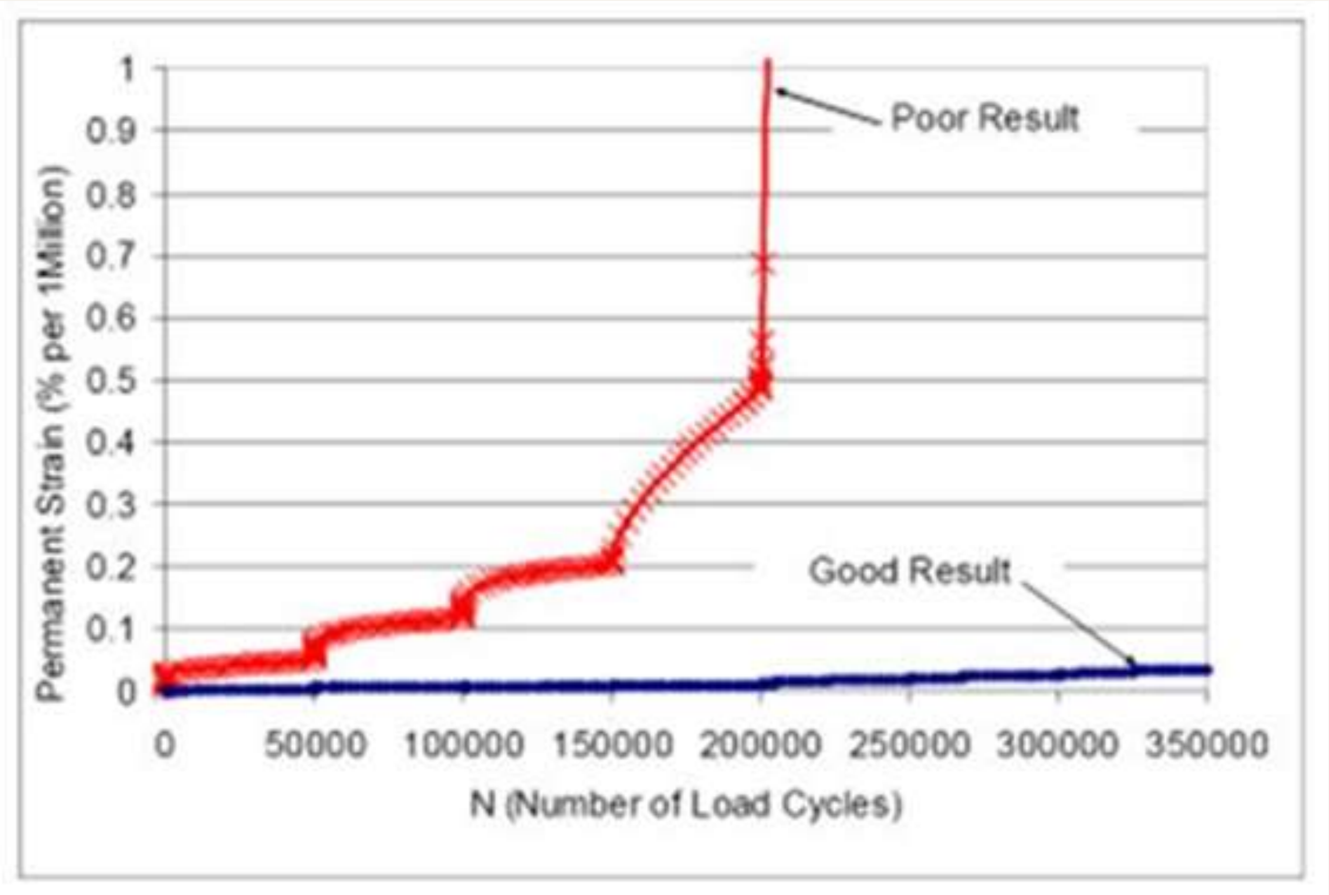
Surfacing Relied on to Protect Underlying Aggregate

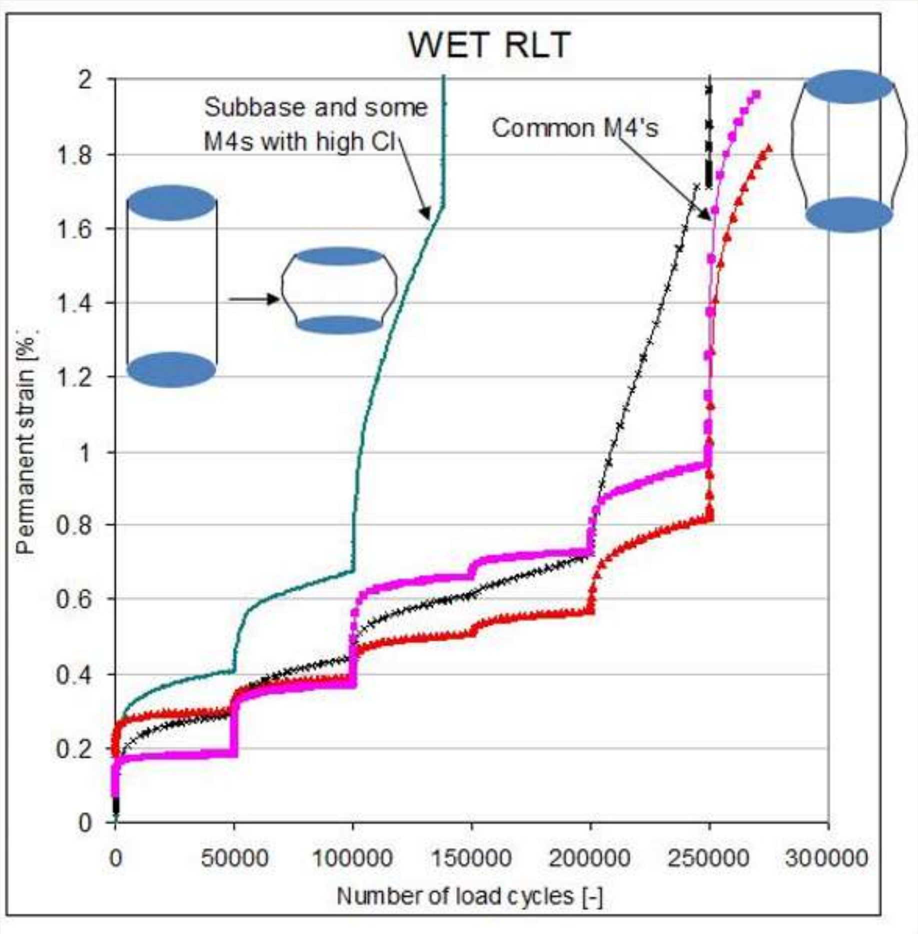
- **Water is the #1 enemy of a granular pavement**
- **All granular materials have some level of moisture sensitivity – especially marginal**
- **Water enters through a number of mechanisms - flooding, old/oxidised/ leaky surfacing, poor swale/subsoil drains, patching, rutting, tyre action**
- **Materials tests in laboratory tend to be in dry / moist condition – so do not account for moisture ingress / lack of egress**

Aggregates are Moisture Sensitive

Performance of Many Aggregates Seriously Compromised when Saturated – Repeated Load Triaxial Test (RLT)

- **Research has been done on dry vs. wet aggregate performance**

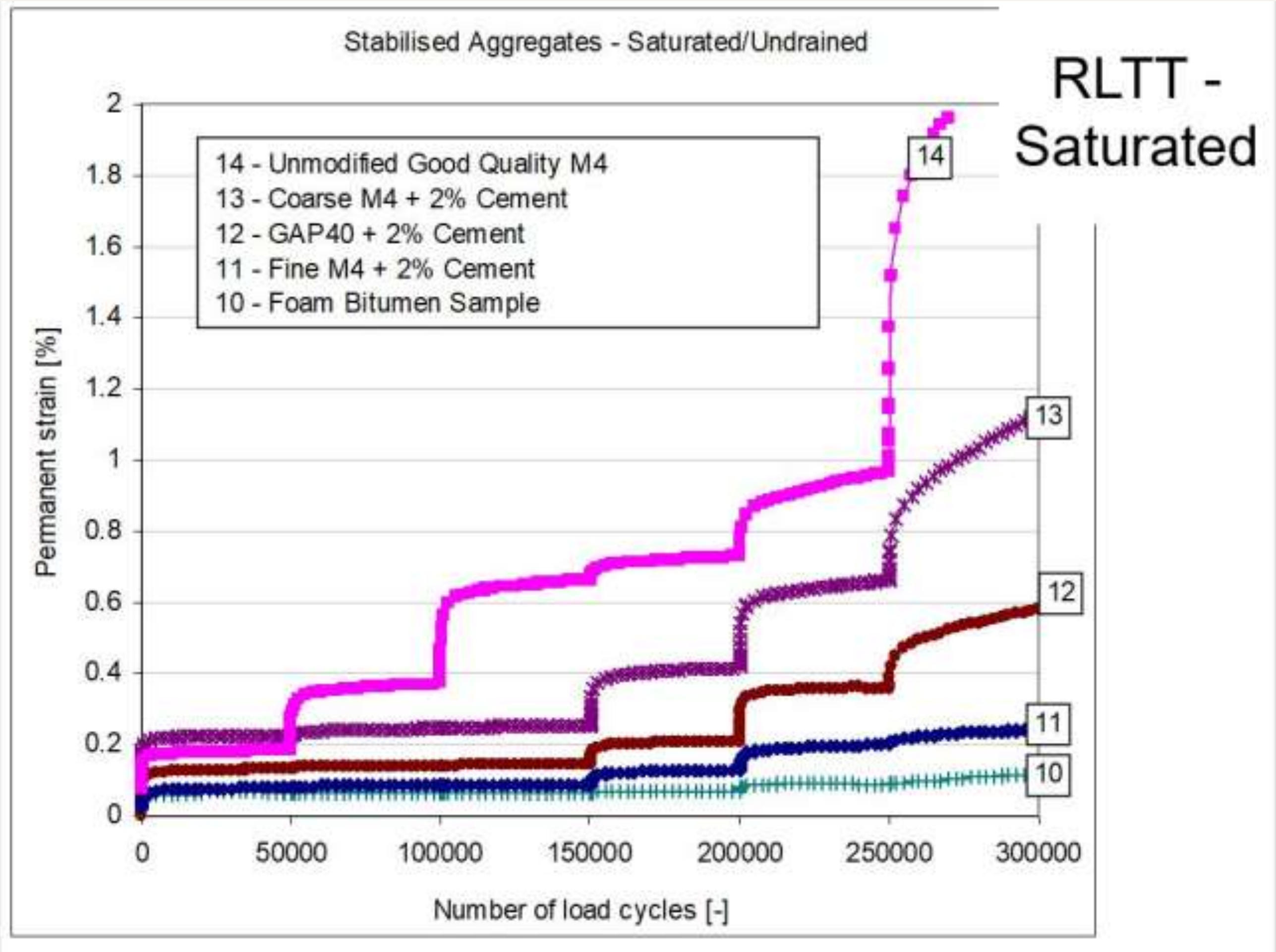




Make Aggregate Less Moisture Sensitive

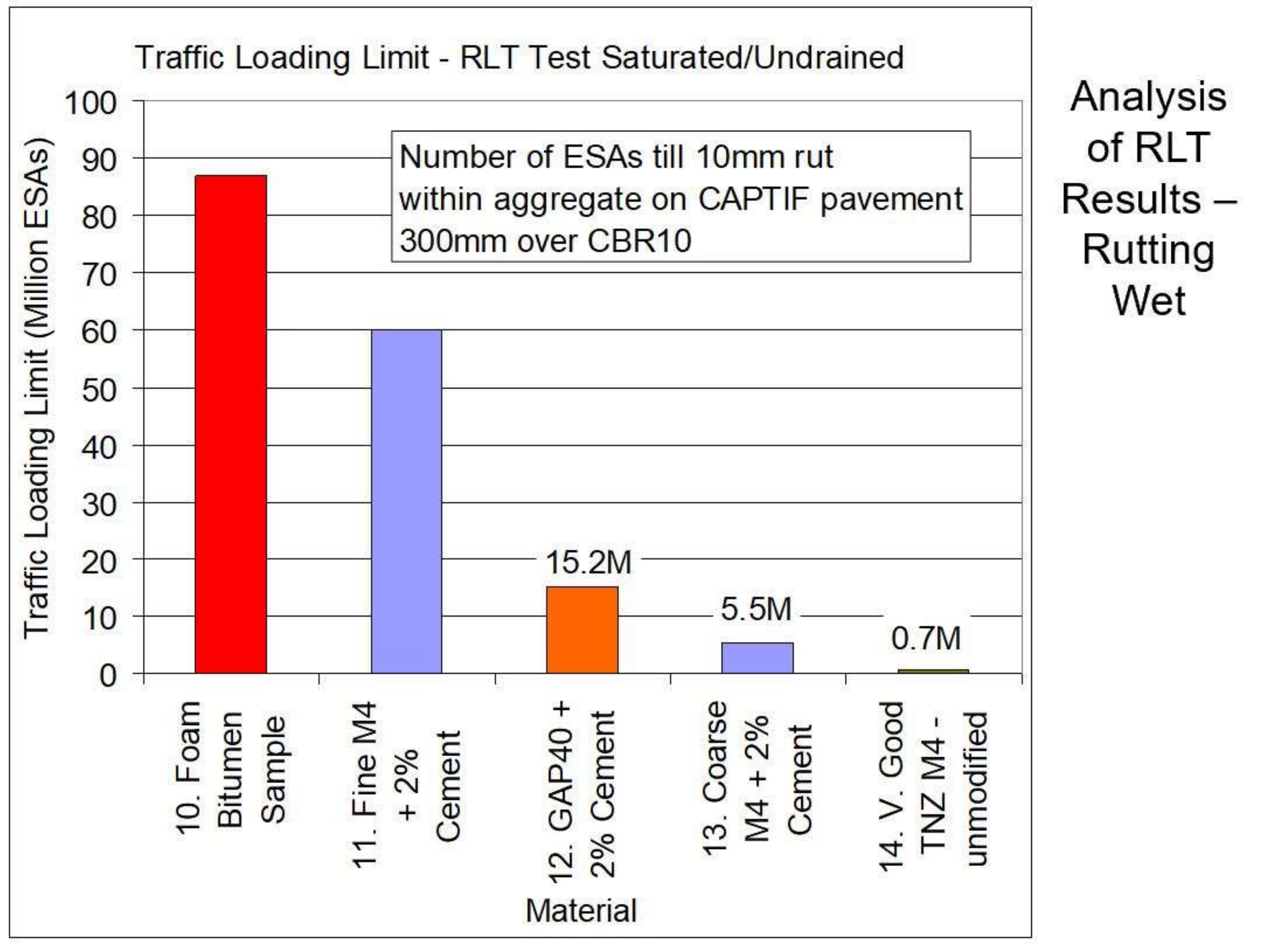
Reducing Moisture Sensitivity

- **Consider use of RLT in saturated / undrained conditions**
- **Stabilised basecourse rut resistance improves – and gets to excellent depending on treatment.**
- **Need to manage durability and crack risk**
  leaky surfacing, poor swale/subsoil drains, patching, rutting, tyre action
- **Materials tests in laboratory tend to be in dry / moist condition**



Loading Limits (CAPTIF)

- **Various Base Types Tested – WET!!!**



Benefits of Pavement Recycling for Resilience

Benefits of Recycling Pavements

- Correct mechanical deficiencies (PSD and/or plasticity)
- Increase the strength of granular material
- Increase the modulus or bearing capacity of a material
- Improve resilience by reducing the permeability and/or moisture
- sensitivity
- Reuse and recycle existing materials, reducing the amount of material to landfill & reduce demand on finite virgin aggregates.
- Double life = half materials
- Provide cost-effective pavement configurations
- Speedy construction
- Sustainability - reduce carbon footprint

Why Recycle???

Waka Kotahi has established policies and specifications that support resource efficiency and are in line with government aspirations. These are not yet fully integrated into the decision-making processes and contracts of Waka Kotahi.

Further challenges include:

- Large consumption of virgin materials (aggregate represents the largest raw material used by volume for highways construction. In 2018 New Zealand generated approximately 33.7 million tonnes of aggregates, of which 22 million tonnes were used for road construction[3]).
- Regional shortages of premium aggregate materials, leading to longer transport distances and associated impacts.
- Significant contribution of haulage and distribution of quarried aggregates to the number of heavy vehicles using the road network and associated impacts (representing 15% of total freight movements in 2017/18)[4].
- Low levels of recycling (recycled materials made up about 2.2 % of the pavement materials used in Waka Kotahi maintenance contracts in 2019[5]).
- Large production of waste materials from construction and demolition which is putting pressure on already constrained landfill and cleanfill sites. Many of these materials have suitable properties as roading materials.
- Significant carbon footprint (a 2020 study showed carbon emission estimates from eight construction projects ranged between 102 to 209,264 tonnes of carbon dioxide equivalent (CO_2e) and from two maintenance projects annual emissions were 137 and 388 tonnes CO_2e per annum)[6].

- **From: TE HIRINGA O TE TAIAO - OUR RESOURCE EFFICIENCY STRATEGY – June 2021**

Australian Experience

Australian Solution to Moisture Sensitivity

Investing in research and innovation has paid big dividends for Queensland's Dpt of Transport and Main Roads, with millions of dollars saved in the wake of Cyclone Debbie through more resilient pavements.

The Department's foamed bitumen pavements, are more resilient to flooding, and have survived unscathed in the worst-hit parts of the state.

When 3 m floodwaters inundated Camp Cable Road on Mt Lindsay Highway, district staff feared the worst. When waters receded, however, the foamed bitumen pavement was found completely intact.

While some conventional thin asphalt/granular pavements, such as Rosewood-Karrabin Road in Ipswich, suffered catastrophic damage from flooding, **foamed bitumen pavements in similar circumstances showed amazing resilience.**

**IPWEA 2019*


QUEENSLAND DEPARTMENT OF TRANSPORT AND MAIN ROADS

Transport & Main Roads Chief Engineer Julie Mitchell says these are just the latest encouraging examples of foamed bitumen's resilience. "We are already using this technology widely in coastal regions of Queensland and seeing excellent results".

"By using foamed bitumen, the department is not only saving on the cost of construction, but also on the cost of maintaining & rehabilitating roads after natural disasters like Debbie."

Tropical Cyclone Debbie in 2017 tested infrastructure - Caroline Evans, Chair of climate change & road network resilience committee for the World Road Association (PIARC). "**When the waters receded the FBS pavements were still intact, so they didn't need to be fully rehabilitated afterwards.**"

FBS has also been applied to other roads as part of Queensland's move to makes its roads more flood-resistant and is proving more cost-effective than traditional asphalt. Queensland faces considerable challenges as it has the longest state-controlled road network of any Australian state or territory with over **33,300km of roads**. So far it has built **1,000km of foamed bitumen road** and is "continuing to develop foamed bitumen techniques", according to its transport department.

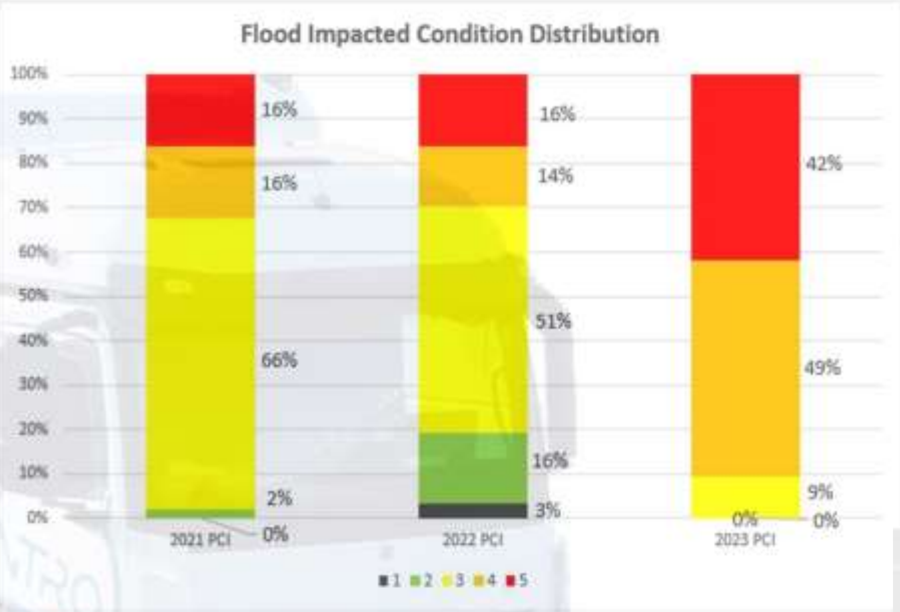
BBC Feb 2022

Victorian Network – 2022 Flood Impact

iPAVE Survey 2023 Snapshot of findings

- NTRO 2021, i Pave analysis highlighted requirement for increased network investment
- Significant investment in FY21 &FY22 into rural roading infrastructure (predominantly granular solutions)
- 2022 i Pave reported significant improvement in network condition
- 2023 Road structural assessment following flood events indicated **significant reductions** in remaining life
- Areas with significant change in the need for, and cost of pavement works, were identified as flood damaged
- Of the 8,400 km surveyed, 707 km were flood affected
- The cost associated with the additional pavement intervention works was **$290m**
- The predominant trigger was the reduction in remaining life based on change in **structural** condition

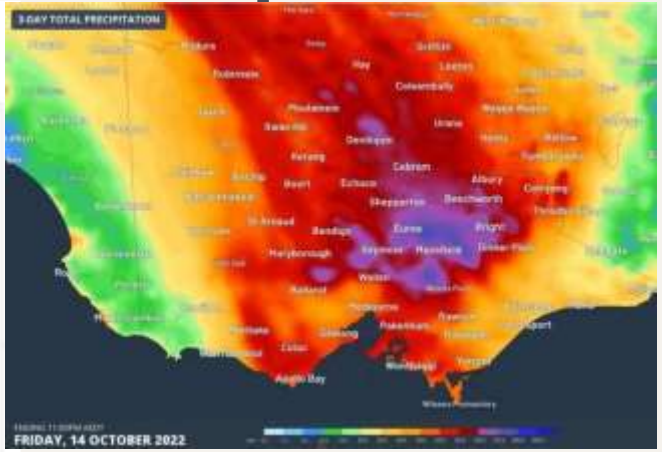
Pavement Structural Condition



2021 survey | 2022 survey | 2023 survey after flood

Very Good
Good
Fair
Poor
Very Poor

NTRO NATIONAL TRANSPORT RESEARCH ORGANISATION



3-Day Rainfall >300mm in places

8,400km Surveyed
707km Flood Affected

Where Insitu Recycling is Being Used

- •Solar Farms
- •Wind Farms
- •Railway Networks
- •Ports
- •Airports
- •Mines
- •Hardstands
- •Heavily Trafficked Roads
- •Local Roads – Sealed
- •Unsealed Roads




Emissions Reduction and Recycling

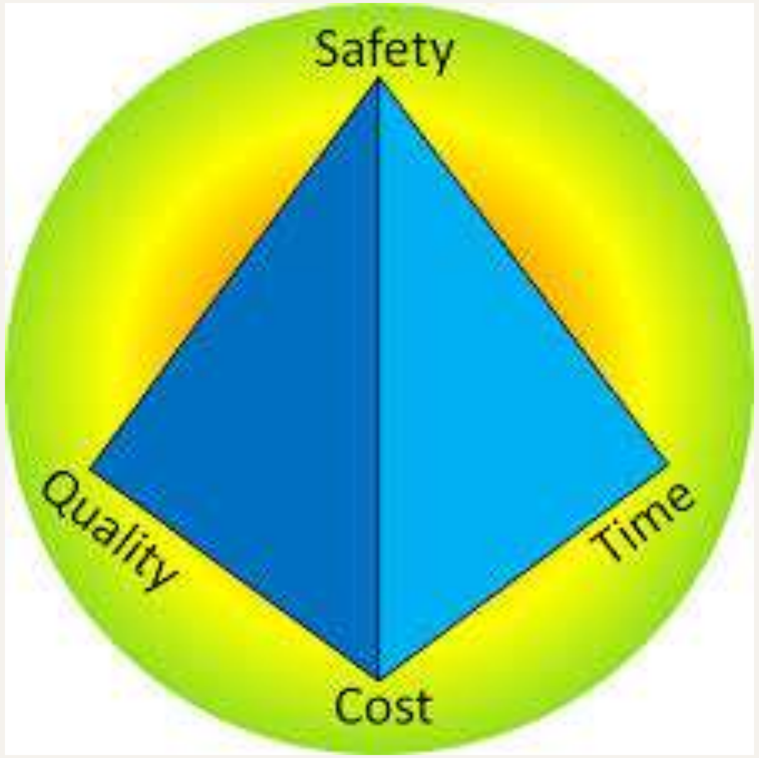
What We Can Influence

We used to look at quality, price & time - then safety too
Recycling focus not consuming limited resources

Carbon emissions is a major focus
Responsibility for reducing carbon emissions
Focus on design with low carbon emission

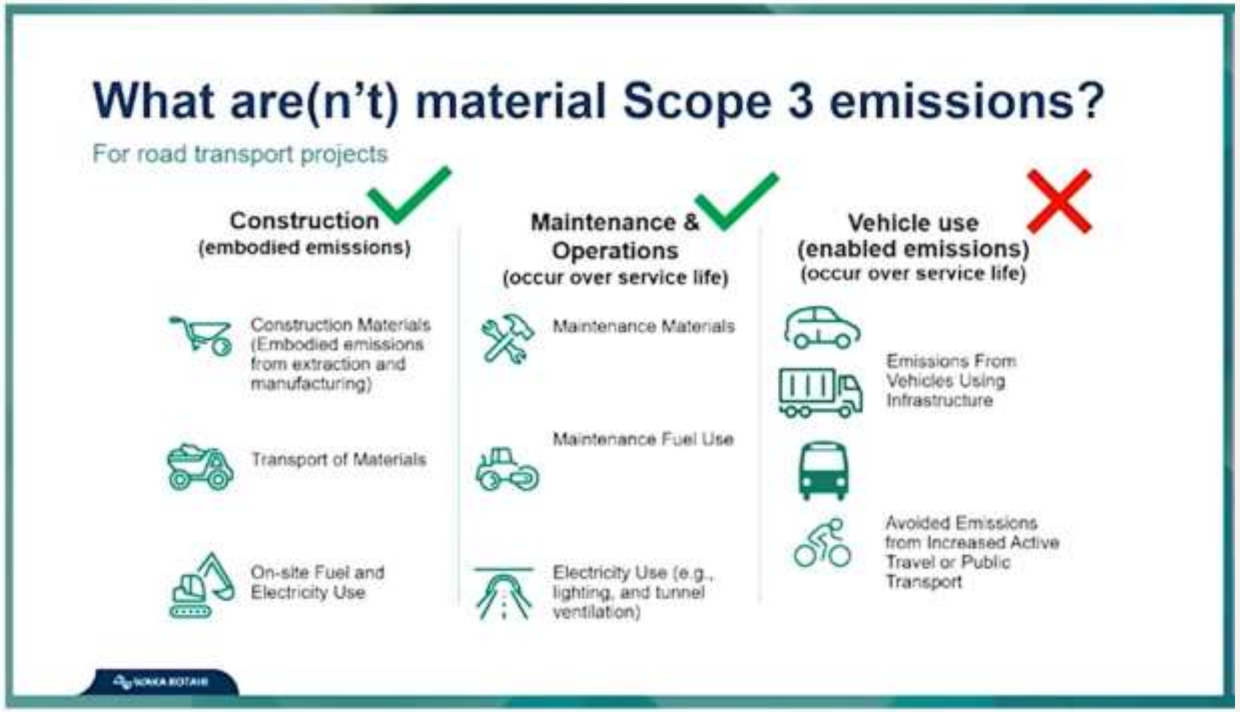
No easy way to do it – no bespoke carbon calculator for recycling / stabilisation industry.
Zero carbon – possible? Offsets excluded from accounting
So…what are carbon emissions?

What we can control?
- Reduce our customer Scope 3 emissions
- Reduce our own Scope 1 & 2 emissions



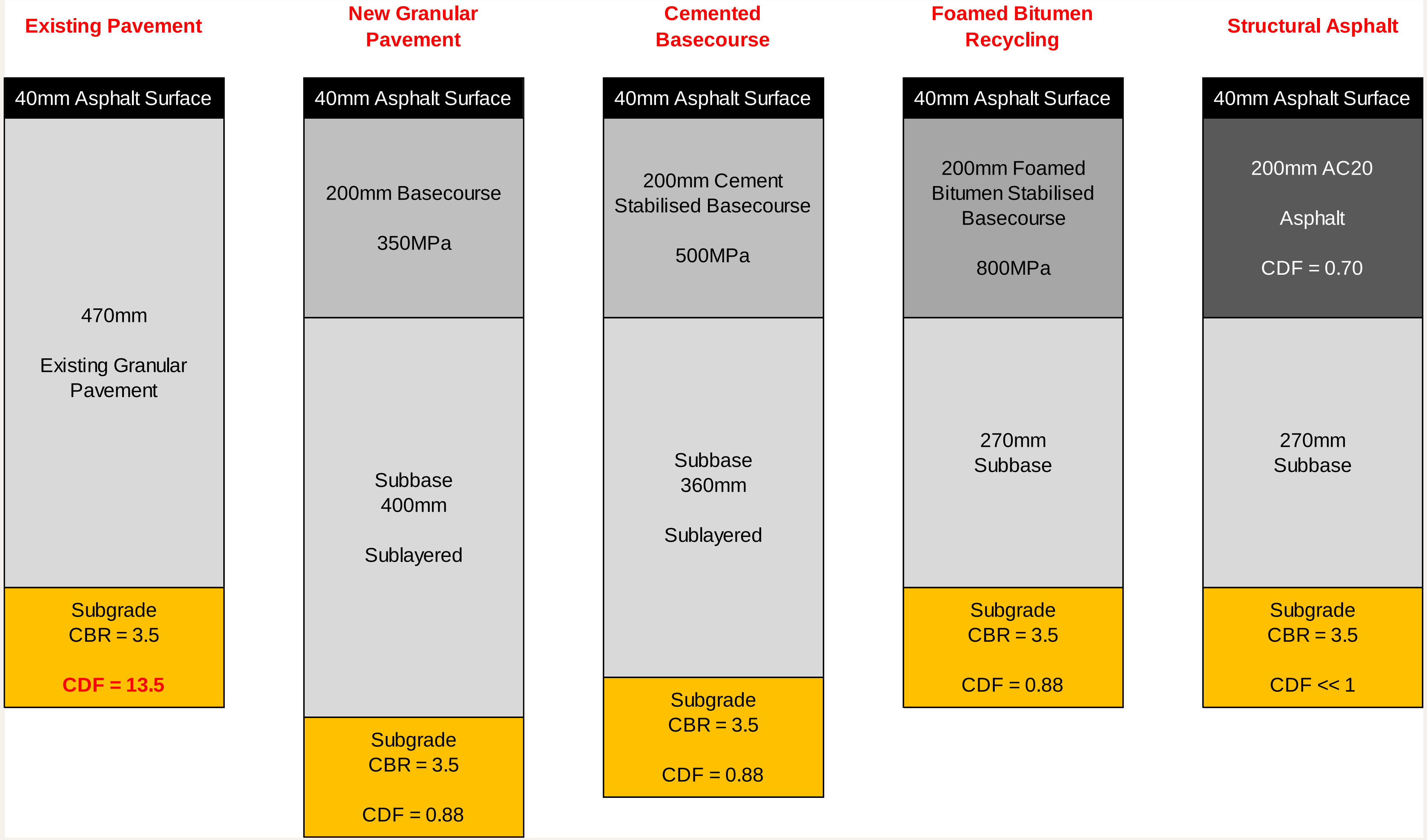
Emissions Scope Breakdown

Note – Waka Kotahi has LCAP and PEET sustainability assessment tools

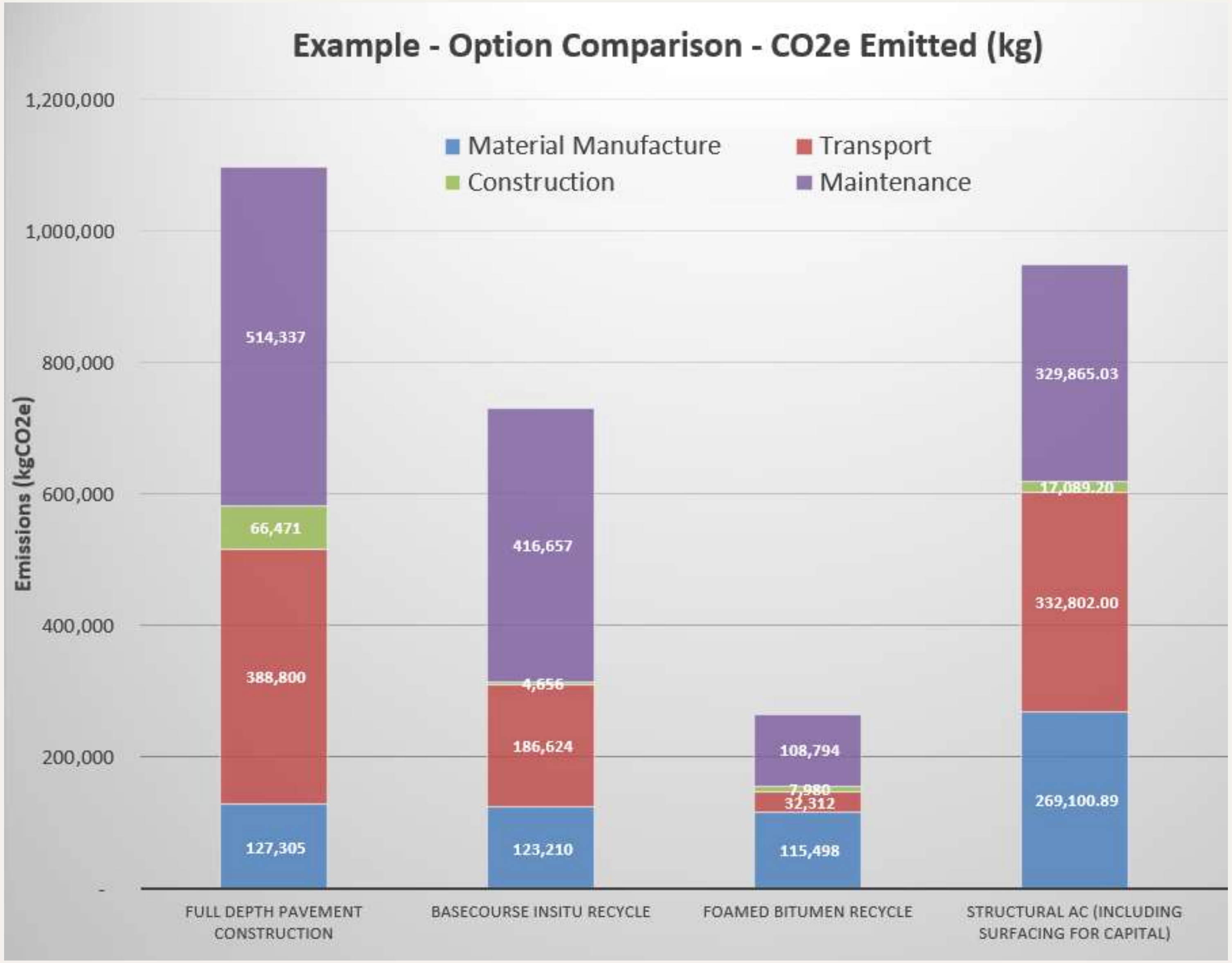


Source: www.plana.earth & Waka Kotahi – Delivering Sustainability & Climate Reporting Conference Feb 2023

What Are We Comparing?



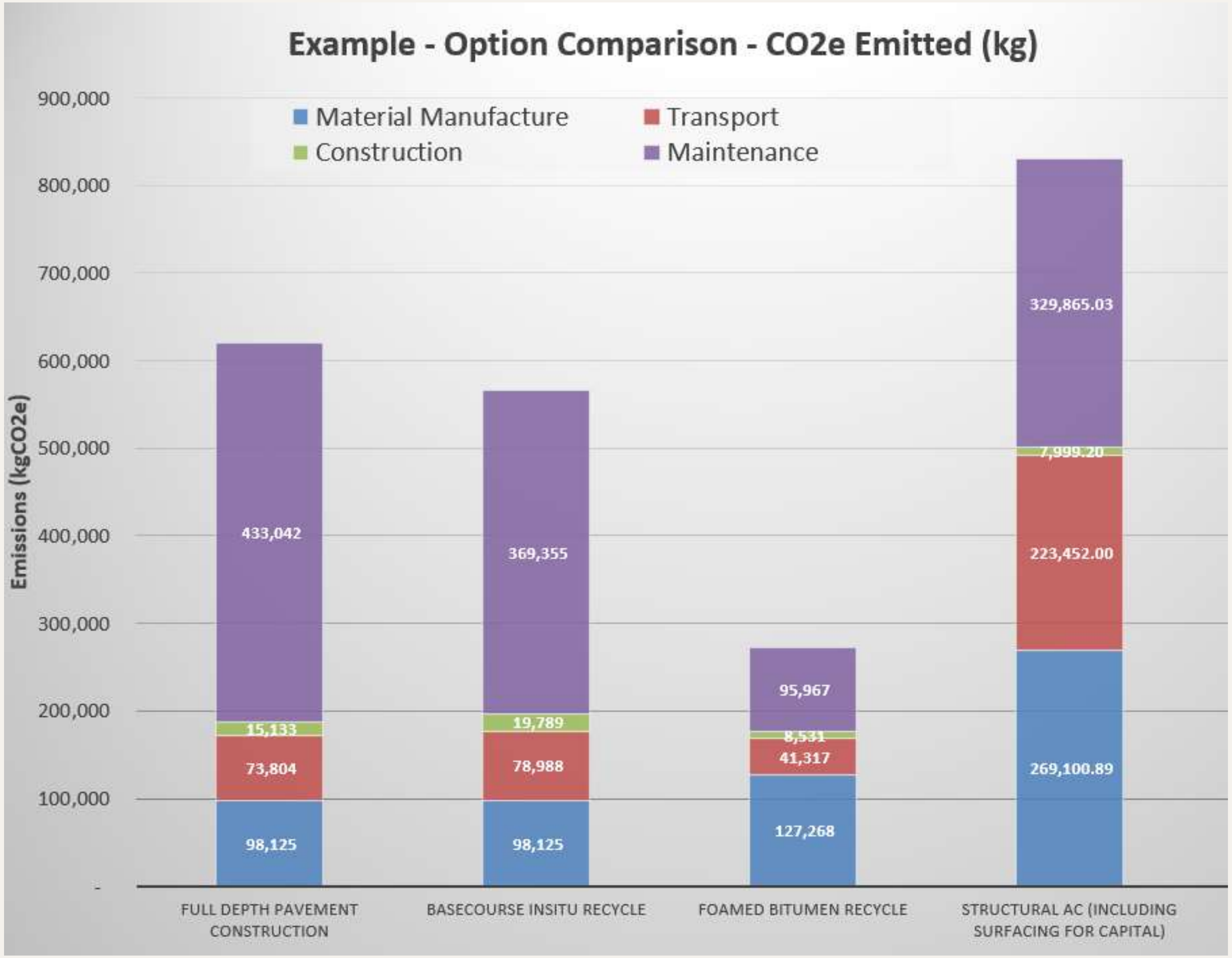
Carbon Emissions - Example



Example Parameters
Inadequate Existing Pavement Structure
Level Constrained (e.g. Urban with K&C)

SAC – no structural maintenance over 40-years – 2 x resurfacing only

Carbon Emissions - Example



Example Parameters
Inadequate Existing Pavement Structure
Not Level Constrained (e.g. Overlay)

SAC – no structural maintenance over 40-years – 2 x resurfacing only

Summary

Resilience and Lower Emissions

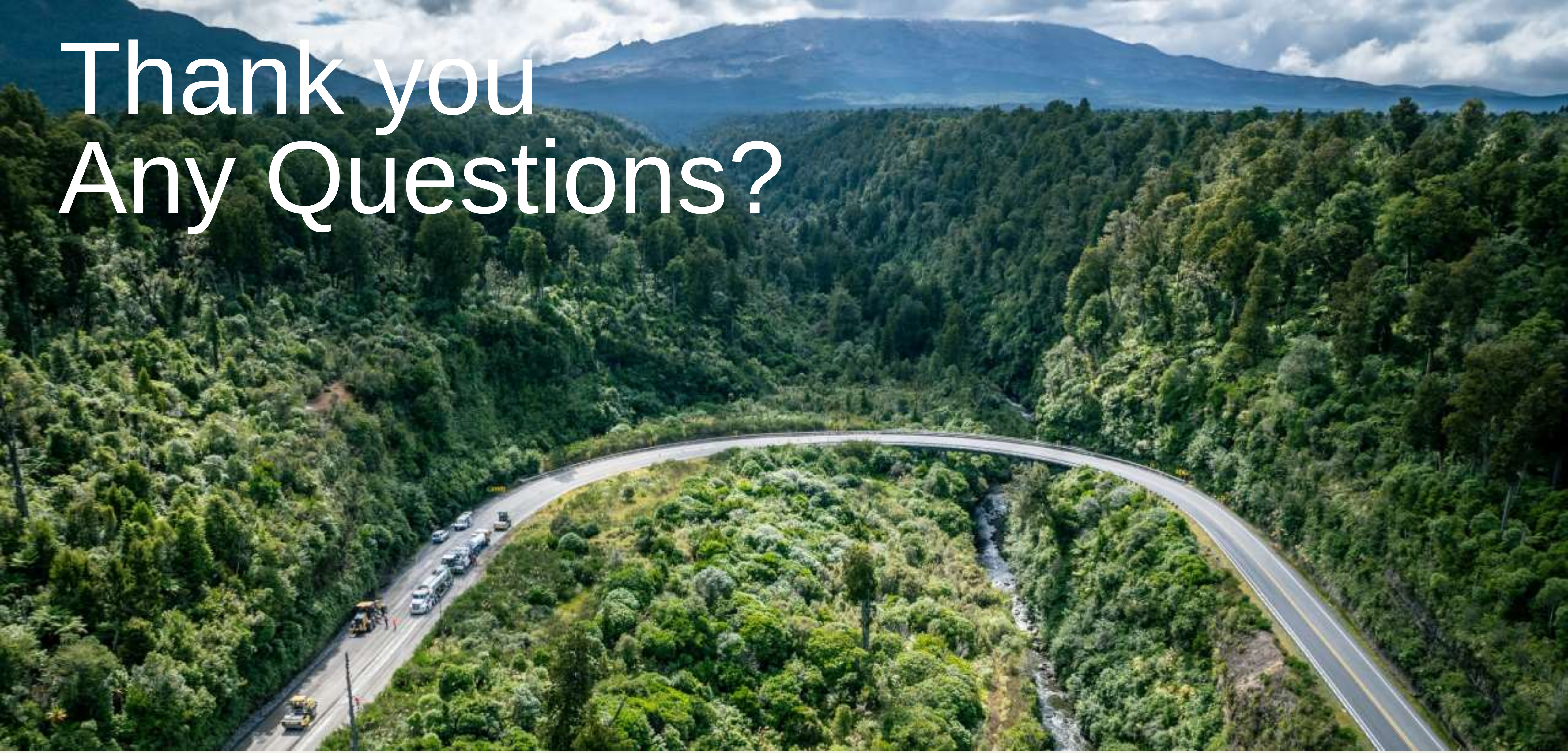
Use of insitu pavement recycling – particularly with foamed bitumen has been demonstrated in the laboratory and in practice to provide a moisture resilient basecourse which performs better than traditional granular treatments.

Where drainage is inadequate, the pavement is significantly more resilient with a well-constructed foamed bitumen basecourse.

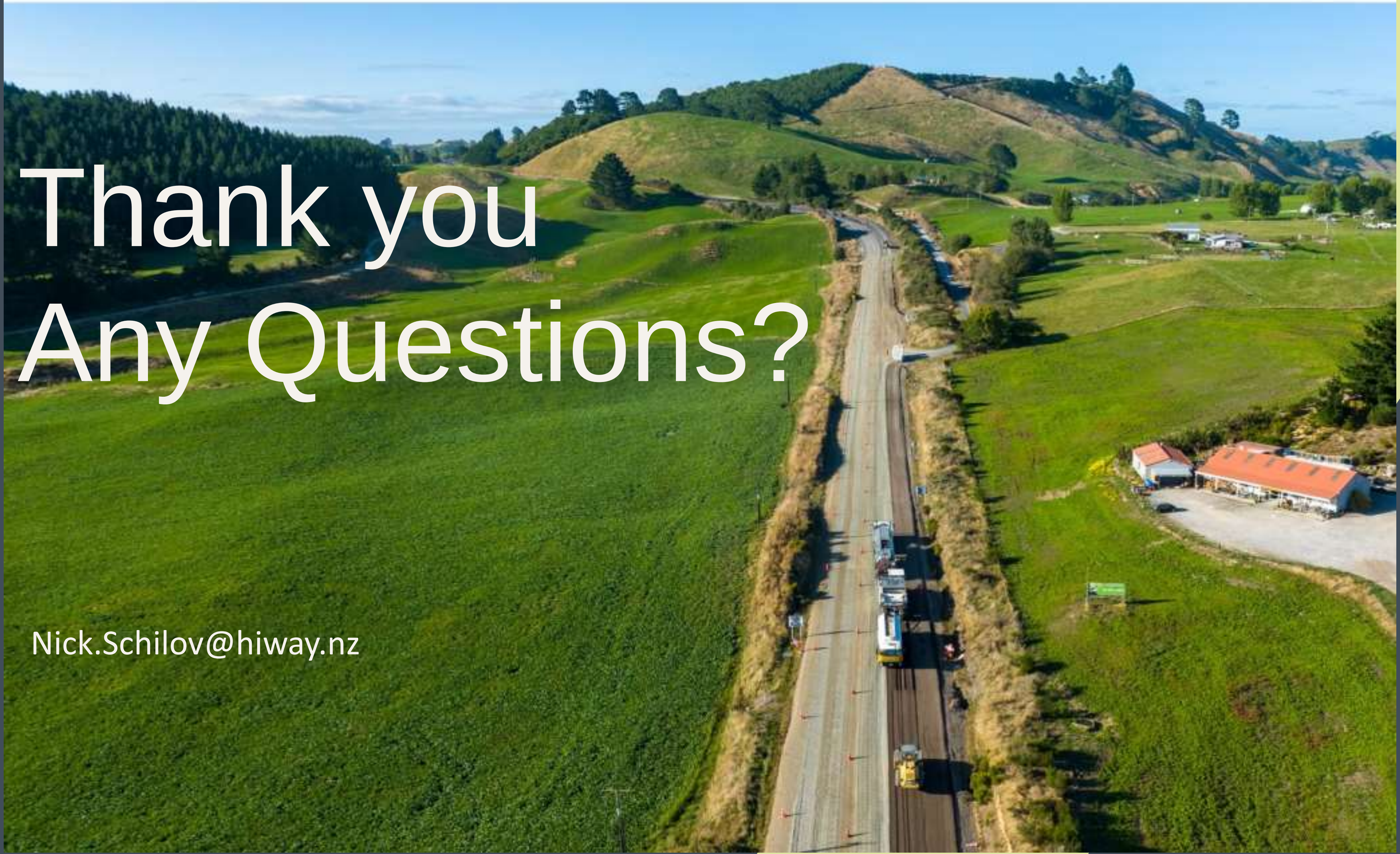
The insitu treatment is typically:

- Faster to construct
- Uses less finite aggregate resource
- Has a lower carbon footprint – particularly when considering whole of life.

Thank you
Any Questions?



Nick.Schilov@hiway.nz



Thank you
Any Questions?

Nick.Schilov@hiway.nz