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Implementation of Demonstration Sections along the Bago to Talawanda Road

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- Objectives of Research
  - Create year round access to rural areas
  - Local resource-based improvement
  - Identify cost effective community based methods of construction
  - Introduce previously trialled surfaces under SEACAP and other methods
  - Extend the knowledge of rural road construction in Tanzania

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- Bago to Talawanda

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- Bago to Talawanda
  - 20.2 km long
  - Low volume rural road
  - Provides access to villages, farms and schools
  - Flat and straight terrain
  - Subgrade of sandy soils and expansive clays
  - Hot/Humid/Dryish climate

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- Bago to Talawanda

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- Design Approach
  - Environmentally optimised design (EOD) approach
  - Identify and locate the most problematic sections along the road
  - Apply durable, cost effective pavement structures at these locations
  - Apply less expensive pavements in areas of satisfactory year round access

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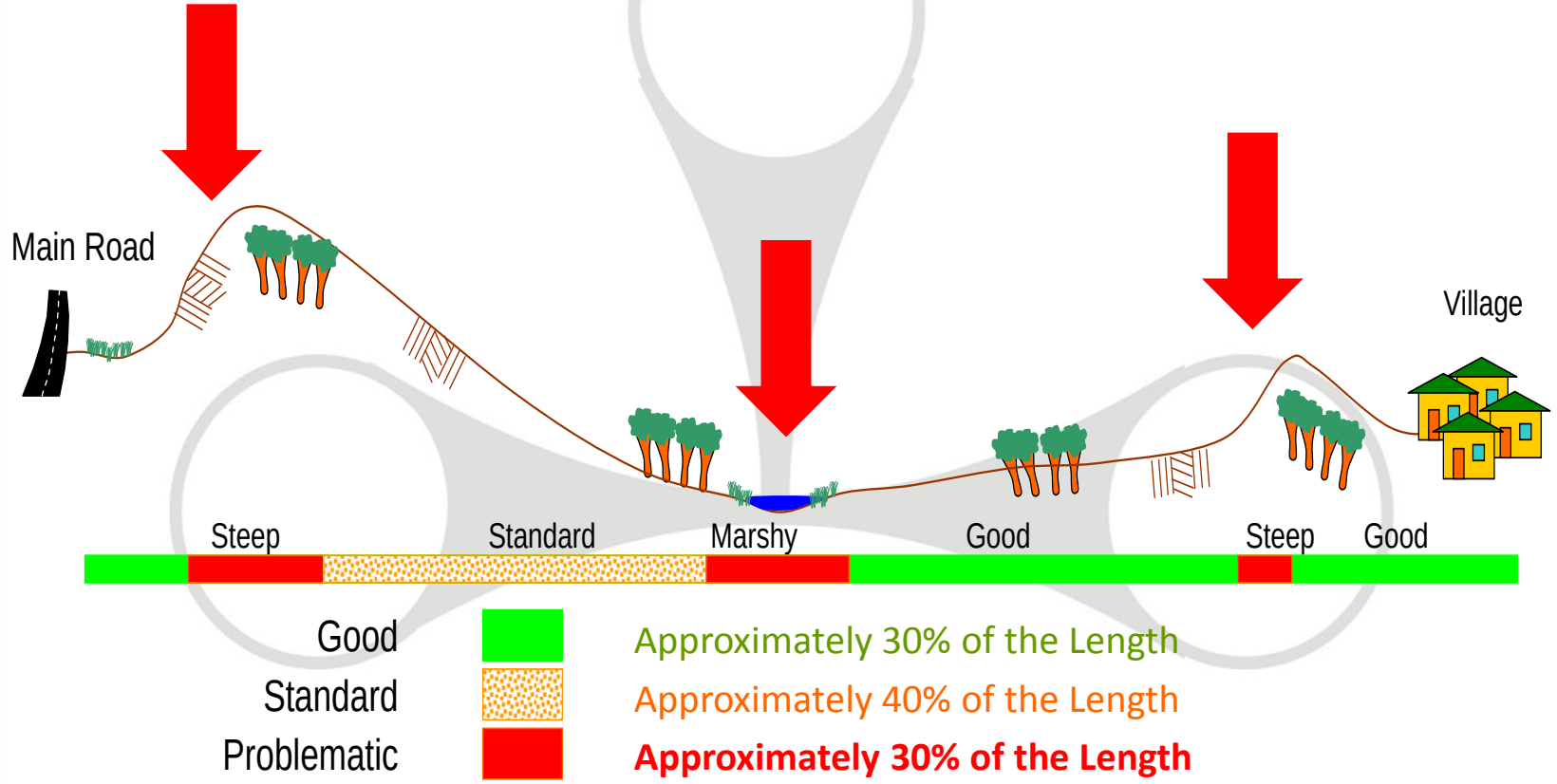
- Environmentally Optimised Design (EOD)



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Environmentally Optimised Design (Bago to Talawanda)		
Surface	Length (km)	Length (%)
Engineered Natural Surface (Good)	6.3	32
Gravel Wearing Course (Standard)	8.1	40
Paved Surface (Problematic)	5.5	28

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- Identifying Problem Sections
  - Steep Gradients – Above 8%
  - Sharp Bends
  - Muddy Tracks
  - Erosion Channels
  - Slippery Surface
  - Poor Subgrade
  - Loose Sand
  - Soft Wet Areas

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- Identifying Problem Sections
  - Visual assessment during the wet and dry seasons
  - Use of Local knowledge
  - Alignment trial pits to test the in-situ soils
  - Drainage assessment

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- Pavement design
  - Pavement structure was based on the Tanzanian Pavement and Materials Design Manual
  - Adapted for low volume roads
  - Use of marginal local materials
  - Minimum layer thicknesses and material quality were specified
  - Minimum carriageway width (3m) was specified with no shoulders
  - Designed as single lane with frequent passing bays

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- Standard Gravel Pavement

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- Hand Packed Stone

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- Hand Packed Stone
  - Locally sourced naturally cubic marly limestone blocks 150-200 mm thick
  - Placed on a 50 mm sand bedding
  - Smaller chips are then packed into any gaps and voids filled with sand or gravel
  - Can accommodate some movement thus chosen on subgrade of Black Cotton Soil

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- Single Otta Seal with Sand Seal

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- Single Otta Seal with Sand Seal

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- Single Otta Seal with Sand Seal
  - 150 mm Marly limestone natural gravel base with MC-30 prime
  - MC-3000 bitumen used
  - Locally sourced quartzitic gravel aggregate layer
  - Second layer using locally sourced alluvial sand
  - One month period between seals
  - Used at beginning of the road due to higher traffic volume and to reduce dust pollution

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- Double Sand Seal

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- Double Sand Seal
  - 150 mm Marly limestone gravel base primed with MC-30 bitumen
  - MC-3000 bitumen used
  - Locally sourced alluvial sand
  - One month between seals during which the road was open to traffic

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- Slurry Seal

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Slurry Seal

- Slurry Seal is a relatively thin surfacing (8mm)
- Consists of crusher dust, bitumen emulsion, water, cement/lime
- Can be mixed in a normal concrete mixer
- Spreading using rubber squeegees
- Compacted with lightly loaded truck
- Suitable for low volume traffic to reduce dust pollution

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- Double Surface Dressing

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- Double Surface Dressing
  - 80/100 primary grade bitumen followed by a 14mm sized aggregate.
  - Secondary bituminous application and dressing with 7mm sized aggregate.
  - Geogrid subgrade/sub-base interface to help stiffen black cotton soil sub-base
  - Surface erosion control geosynthetic- reduce wearing of bitumen surface

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- Double Surface Dressing

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- Double Surface Dressing

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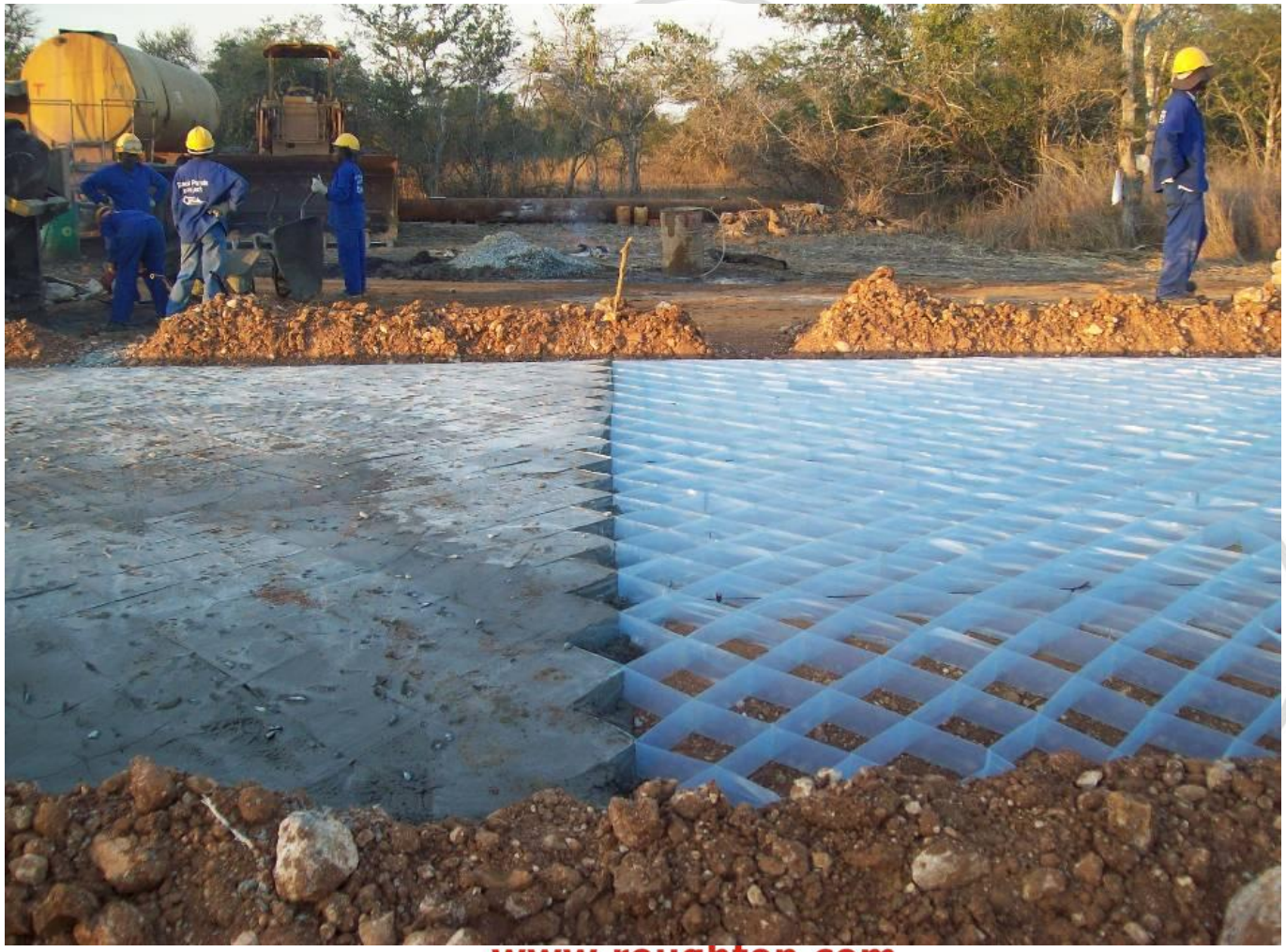
- Concrete Geocells



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- Concrete Geocells
  - Manufactured plastic formwork is used to construct in-situ concrete paving
  - The plastic formwork is sacrificial and remains embedded in the concrete
  - Geocell structure enables some movement in pavement

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- Concrete Strips

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- Concrete Strips
  - 20MPa Concrete strips cast in-situ 100 mm thick.
  - Transverse concrete strip installed at 5 m intervals between wheel tracks reduce excessive water and erosion
  - Efficient use of concrete on steep terrain

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- Engineered Natural Surface

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- Engineered Natural Surface
  - Used where the existing subgrade material comprises natural gravel with good quality characteristics
  - In-situ soil was graded, reshaped and compacted
  - Used on good sections that are passable during wet seasons

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➢ Costs of the pavements

Section	Surfacing Type	Costs (US$)	
		Total Cost/km (US$)	Cost/m² (US$)
1	Single Otta seal with a sand seal (26 mm)	85,685	17.14
2	Hand Packed Stone (150 mm)	65,138	13.86
3	Concrete Strips (100 mm - Reinforced)	66,525	14.15
4	Geocells (75 mm)	64,869	12.97
5	Double Surface Dressing (20 mm)	99,460	19.89
7	Concrete Strips (100 mm - Unreinforced)	52,361	11.14
8	Double Sand Seal (20 mm)	79,198	15.84
9	Gravel Wearing Course	9,888	1.98
14	Slurry Seal (8 mm)	67,683	13.54

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- Construction Issues
  - Lessons Learnt
    - Sufficient training necessary for unfamiliar methods, materials and surfaces
    - Not all materials can be sourced locally
    - Quality control important during construction

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- Base Line Data-Monitoring Programme
  - Photographic recording
  - Visual inspection - surface condition logging
  - Surface profile measurement
  - Rut measurement
  - Surface roughness - MERLIN apparatus
  - Traffic counts
  - GPS monitoring
  - DCP testing

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- Monitoring Beacons
  - Located either side of the road on demonstration sections
  - Sections <200 m at 10 m intervals
  - Sections >200 m at 20 m intervals
  - Ensure consistency in collecting monitoring data

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- Monitoring Beacons

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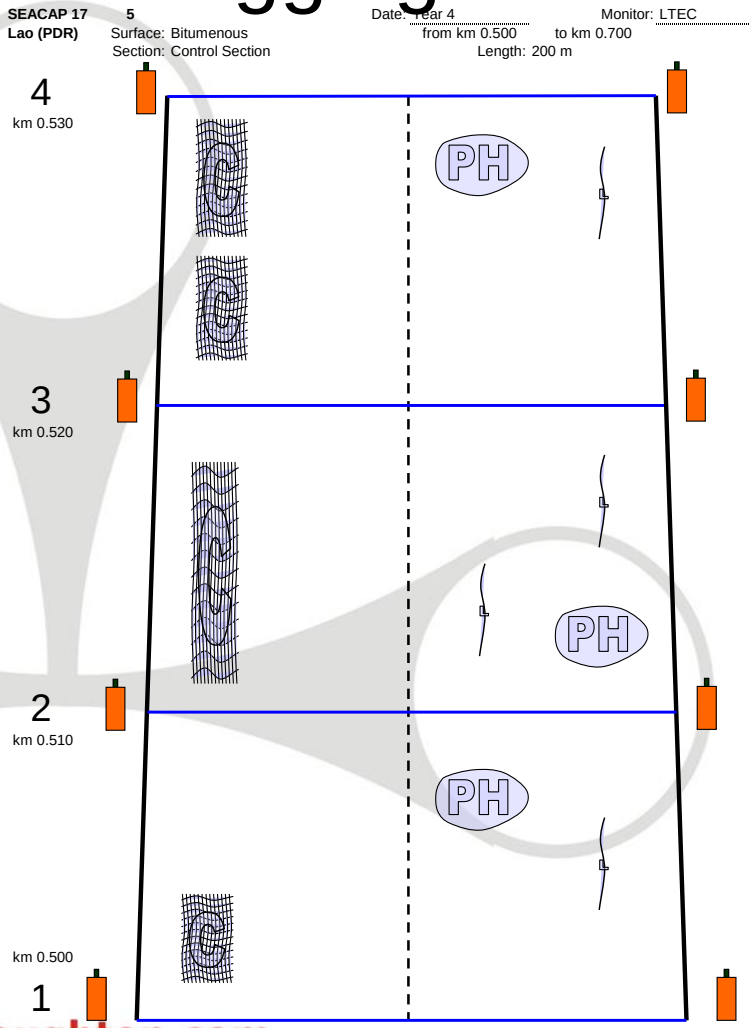
- Surface Condition Logging

Year 5



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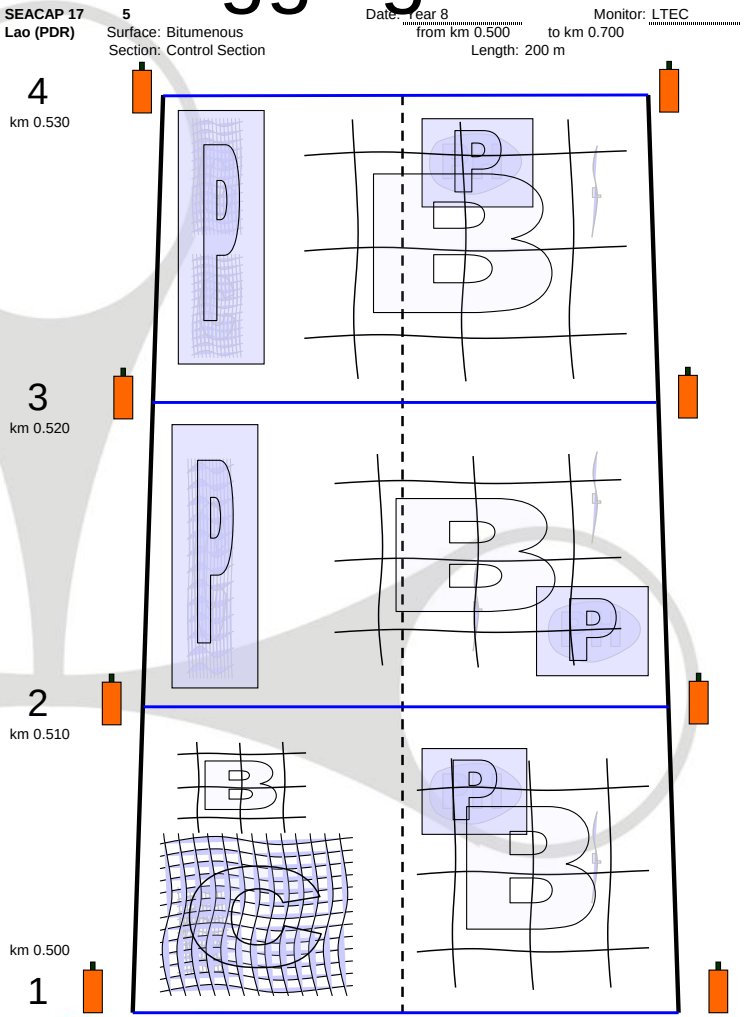
- Surface Condition Logging

Year 8



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- Surface profile measurement

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- Surface profile measurement

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- Rut measurement

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- Surface Roughness – MERLIN

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- Traffic Counts
  - Traffic counts have been carried out at two locations along the road before and after construction of the demonstration sections
  - Monitor change in traffic behaviour

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- GPS Monitoring
  - GPS drive through condition survey
  - Performed before and after construction on demonstration sections
  - Uses vehicle speed to identify areas of poor road condition

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- Long Term Monitoring Framework
  - Demonstration sections will be monitored by the Consultant for the next 2 years at 6 month intervals
  - District engineers will continue monitoring of the road for a further 8 years

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Conclusions

- Importance of spending significant time in the field to identify and assess problematic areas during the wet season
- Whole life considerations must be taken into account when selecting pavement types, for example; gravel/ sand seals/ concrete
- Maximise incorporation of local materials in the design and selection of the different pavement structures

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Conclusions

- More expensive all-weather surface types are more appropriate for spot improvements rather than paving long stretches of year round trafficable gravel road
- Sufficient training should be provided to the contractor for unfamiliar surfacing types to ensure a high quality of work.
- Future monitoring will be used to assess the long term performance of these demonstration sections

Thank you