CENTRE FOR PAVEMENT EXCELLENCE ASIA PACIFIC LIMITED

Road Construction - A New Approach

Presentation outline

- Introduction
- CPEAP Strengths
- Partnerships
- Research
- Stabilising Benefits
- Technical Details

Centre for Pavement Excellence Asia Pacific Ltd (CPEAP)

CPEAP offers subgrade and pavement stabilisation solutions encompassing geotechnical evaluation and pavement design options for a wide range of construction applications and pavement maintenance requirements.

Definitions:

- *Pavement:*

  A broad term for any layered material compacted by engineering means.

- *Pavement stabilisation:*

  A general term for any physical, chemical, biological, or combined method of changing a natural material to meet an engineering purpose.

Introduction

Preventing Failures

Stabilisation can be a solution

- **For upgrading standards**
- **For remedial applications**
- **For new construction**

Introduction

Environment Friendly

Introduction CPEAP Services

- CPEAP can recommend the most appropriate design solution from a wide range of available additives
- Stabilisation enables stronger, faster construction than conventional gravel roads with lower whole of life costs
- Services include soil analysis, pavement design, construction supervision and accreditation of designs
- Consulting fees usually a negotiable percentage of the estimated construction cost for the project pavements
- Training clients' engineers and other practitioners in pavement stabilisation standards and practices available
- All work in accordance with CPEAP codes & protocols

Centre for Pavement Excellence Asia Pacific Ltd (CPEAP)

Vision

To provide data from real projects to academia in support of excellence in research and promote education in the principles of pavement stabilisation.

Mission

- Support research, education and training in the principles of stabilisation across the Asia-Pacific Region
- Ensure engineers across the region have access to education programs in soil stabilisation
- Make available to engineers the analysis and findings of soil characteristics, under different climates and loadings, when mixed with various stabiliser additives
- Produce Technical Bulletins, Guidelines, Standards and Codes based upon audited research outcomes

CPEAP Strengths

Personnel

Chairman - Professor Anoop Swarup

Prof. Anoop Swarup is Vice Chancellor Jagran Lakecity University and Chairman Centre for Global Nonkilling. A Fulbright Visitor to the United States in 2004, he is an expert on Strategic Studies, Finance, Management and Environment. He holds a Doctorate in Science, distinguished University Medals (first position) in Master of Science and Master of Philosophy; holds Master of Science from DSSC Wellington and the University of Madras as well as MBA (Finance & Strategy) from the AGSE, Swinburne University, Melbourne. Anoop is Chairman of the Board of Centre for Pavement Excellence Asia Pacific Limited and of its Governing Council of Advisors.

CEO - Brian O'Donnell

Mr Brian O'Donnell is an eminent engineer with 57 years experience across various disciplines within the broader field of Civil Engineering. He has been a senior executive in Local Government and private organisations and has held significant leadership roles in Engineers Australia and Universities since commencing at the Victorian Road Authority in 1959. Brian is Chief Executive Officer of the Centre for Pavement Excellence Asia Pacific Limited.

CPEAP Strengths

Personnel

COO - Jerzy Ordega

Mr Jerzy Ordega has a background in mechanical engineering and Master of Business Administration. With over 30 years experience in international business, his managerial skills cover international trade, global finances, landmark construction and start-ups with innovative technologies. Jerzy is Company Operating Officer of Centre for Pavement Excellence Asia Pacific Limited.

Director – Marketing, Finance, International Trade - Kishore Bardeja

Mr. Kishore Bardeja has more than 30 years of experience in Marketing, Marketing Planning and International Trade. He is well versed in all aspects of international trade and project finance. He is currently Director for Marketing, Finance and International Trade of Centre for Pavement Excellence Asia Pacific Limited.

CPEAP Strengths

Personnel

Director & Research Committee Chair - Professor Sujeeva Setunge

Prof. Sujeeva Setunge is Deputy Dean of Research and Innovation, School of Engineering, RMIT University. She has established expertise in infrastructure management and forecasting deterioration/failure of infrastructure; with strengths in delivering outcomes for industry through design standards for new construction materials, predictive modelling for infrastructure management and enhancing infrastructure resilience in responding to climate change. She has published over 200 papers, completed 32 PhD students and manages a large research budget. She is Director of Centre for Pavement Excellence Asia Pacific Limited and chairs its Governing Council's Research Committee.

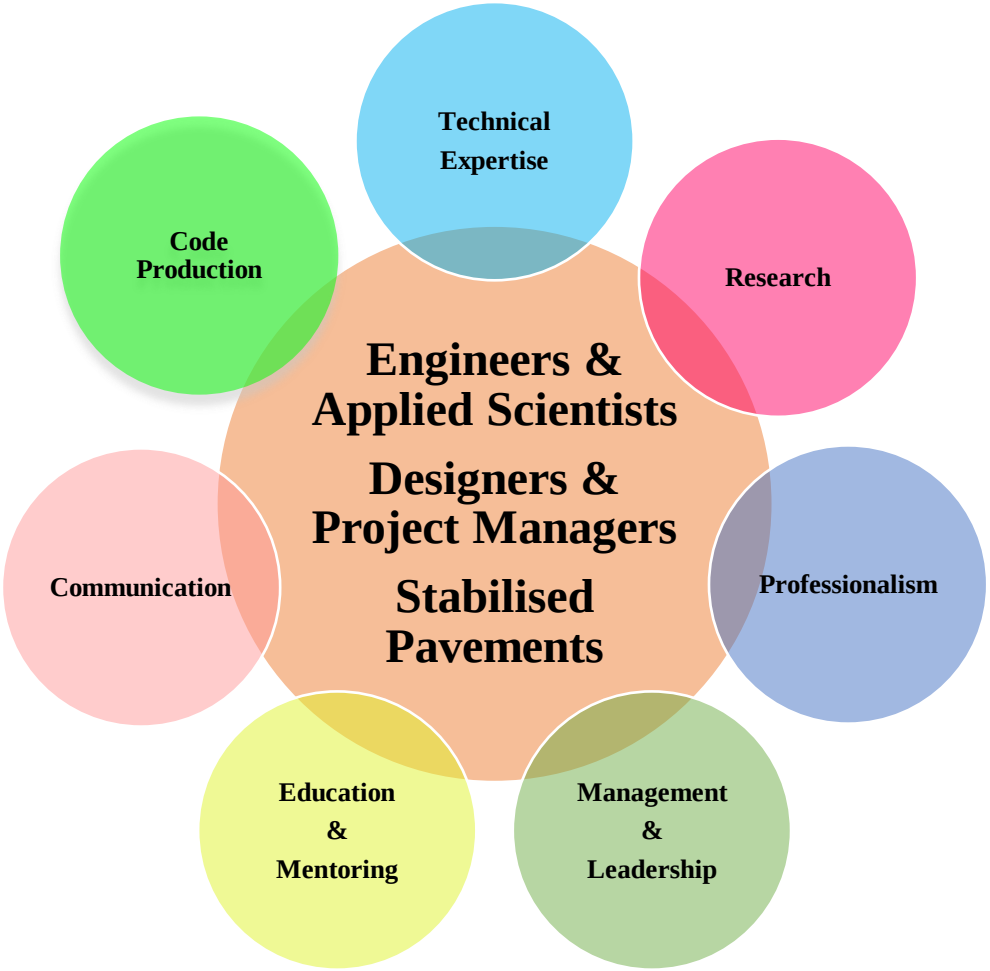
Director – Research & Development - Paul Mitchell

Mr Paul Mitchell is a Certified Practicing Engineer with 50 years experience in civil engineering infrastructure, including roads and water sensitive urban design. He is a Member of the Order of Australia, APEC Engineer and a representative of his profession in the Asia Pacific Region for fifteen years. Paul has been a consultant to the land development industry, local government and state road authorities. He is currently Director for Research and Development of Centre for Pavement Excellence Asia Pacific Limited.

What CPEAP Does

- An alternative technology consultant with considerable industry experience
- Consulting on featured projects to design and supervise stabilised pavements
- A collaboration of leading institutions for pavement research
- Will transfer its knowledge to clients by training local people in stabilisation techniques

CPEAP Strengths Core Competencies



CPEAP Constitution

The Company is a registered non-profit company limited by guarantee

- ❑ The following are eligible to be Members:
  - Any person/entity who has a demonstrated interest in the Company;
  - Any person/entity that would benefit the Company by becoming a member;
  - Any person/entity in a category the Company has determined to be eligible.
- ❑ A Member is entitled to one vote at a General Meeting of the Company.
- ❑ The Board has prescribed that approved Membership (after 2016) has no fees attached.

Membership Process

Organisations, companies or individuals can apply using the form prescribed by the Company

- ❑ An Applicant not a natural person must appoint a natural person as its Representative.
- ❑ Written appointment of a Representative may set out either or both of:
  - what the Representative is appointed to do; and
  - any restrictions on what the Representative may do.
- ❑ The name and address of the Representative will be entered in the Company Register

Support Group of Eminent Engineers - Asia

MEMBER	INSTITUTION
Professor Tai Sik Lee	Civil Engineering, Hanyang University, South Korea [also Past President of Korean Society for Railways , Past President of Korean Society of Civil Engineers]
Professor R. Nesamoorthy	Registrar, Jagran Lakecity University, Bhopal, India
Professor Pyeong Jun Yoo	Korea Institute of Civil Engineering and Building Technology (KICT)
Professor (Dr.) Navin Chand	Former Chief Scientist/Head, Advanced Materials and Processes Research Institute and CSIR India (Retired)
Ir. Dr Albert T. Yeung	Associate Professor (Geotechnical), University of Hong Kong [Past Chairman, Asian Civil Engineering Coordinating Council]
Datuk Ir. Lim Chow Hock	Former Director Dept. Irrigation & Drainage, Malaysia (Retired) [Past President, ASEAN Federation of Engineering Organisations]
Dr. Kazumasa ITO	Director, CTI Engineering Co., Ltd. (CTIE), Japan [JFES Representative to WFEO and Lecturer, Tokyo University]
Er. Ashok Kumar Basa	Director, B Engineers & Builders Ltd, India [also Past President, Institution of Engineers (India) & WFEO Subcommittee on Capacity Building for Natural Disaster Risk Management]
Professor Luh-Maan Chang	Director, High-Tech Facility Research Center, National Taiwan University [also Asian Civil Engineering Coordinating Council]
Professor Xila Liu	Dept. of Civil Engineering, Shanghai Jiao Tong University, China [WFEO Member, Committee on Education in Engineering, Vice - President, Federation of Engineering Organisations Asia Pacific]

Support Group of Eminent Engineers - Australia

MEMBER	INSTITUTION
Dr. Richard Yeo	National Interest Services, Executive Manager , ARRB Group [currently seconded to Austroads]
Professor Colin Cole	Director, Centre for Railway Engineering, Central Queensland University
Professor Sujeeva Setunge	Deputy Dean, Civil Engineering School, RMIT University [also Project Leader Bushfire & Natural Hazards CRC]
Dr. Dilan Robert	Lecturer, Civil Engineering School, RMIT University [PhD in soil-structure interaction, Cambridge]
Professor Hossam Abuel-Naga	Associate Professor, Civil Engineering, La Trobe University
Professor Karu Karunasena	Engineering Faculty, University of Southern Queensland [also Assessor, Australian Research Council Discovery Projects]
Professor Colin Duffield	Discipline Leader, Infrastructure Engineering Dept., Melbourne University [also a Board member of Infrastructure Australia]
Associate Professor Wenhui Duan	Director, Nanoscience-based Construction Materials Manufacturing Hub, Monash University

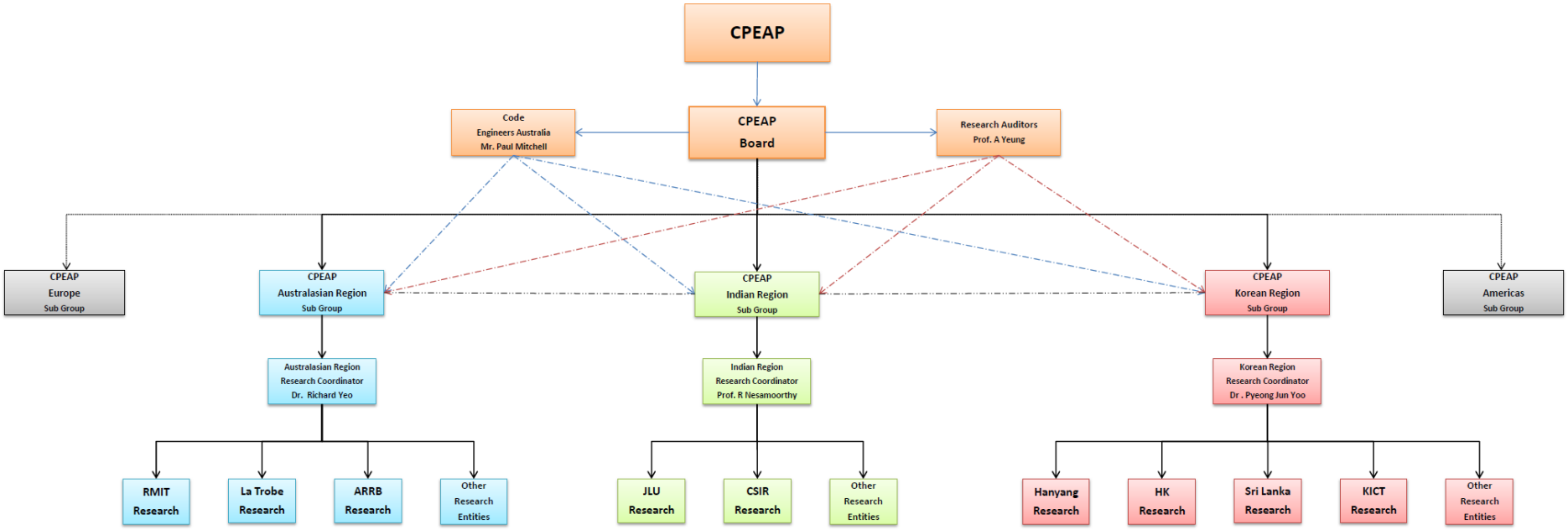
RMIT

- A global university of technology, design and enterprise
- Civil Engineering at RMIT has ranked within 51-100 in the world, based on QS ranking 2016
- As a global university of technology and design, RMIT strongly supports research initiatives to solve problems of critical global perspective.

RMIT and CPEAP

- Centre for Pavement Excellence Asia Pacific Limited engages and supports RMIT University in leading its research work.
- Civil Engineering at RMIT has state of the art facilities for pavement research in new Civil laboratories at its Bundoora East Campus.
- The Civil Engineering School is well placed to contribute to the aims and objectives of its partnership with CPEAP.

Structure



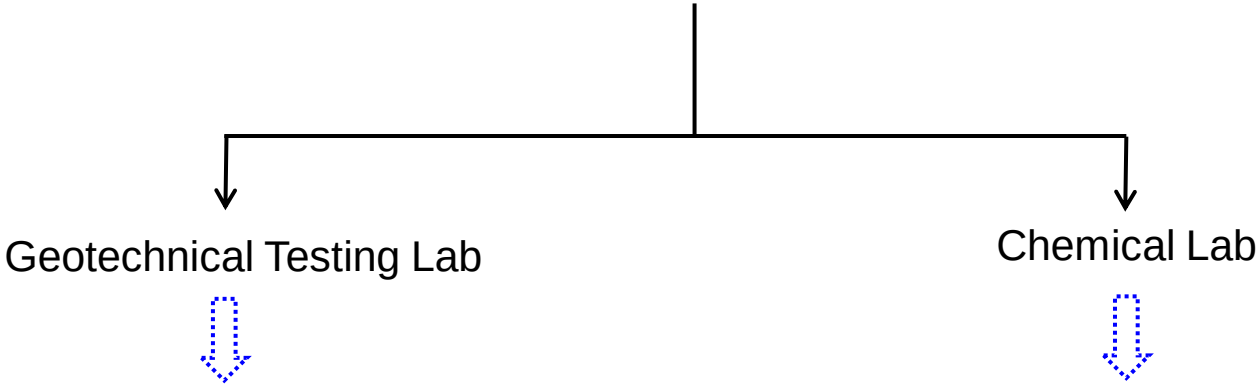
Note: * Sri Lanka research already follows established programs by KICT
* 2 trials in India and Sri Lanka to commence October / November

Education & Training Committee Chair

Dr. Dilan Robert

Dr Dilan Robert is a lecturer in Civil Engineering at RMIT University with over 10 years research and industry experience in infrastructure projects. After gaining his PhD in soil-structure interaction from the University of Cambridge, he worked in London for 2 years on various engineering projects as a geotechnical engineer. Dilan has published over 40 peer reviewed technical papers in soil-structure analysis and chairs the Centre for Pavement Excellence Asia Pacific Limited Governing Council's Education and Training Committee.

RMIT Lab Resources for CPEAP



Possesses In-house capability to conduct all the recommended tests for pavement materials analysis.

Possesses water testing instruments such as TOC, spectrophotometer, fluorimeter, turbidity meter, pH meter, AAS, HPLC, GC, incubator, oven, DO meter and various membrane rigs etc.

Civil Engineering Labs
Soil Lab
Triaxial Lab
Temperature control lab
Asphalt Testing Lab
Environment lab
Humidity Chambers
Light structures lab
Heavy structure lab
Concrete lab
Material store
Mould making facility
Material testing lab

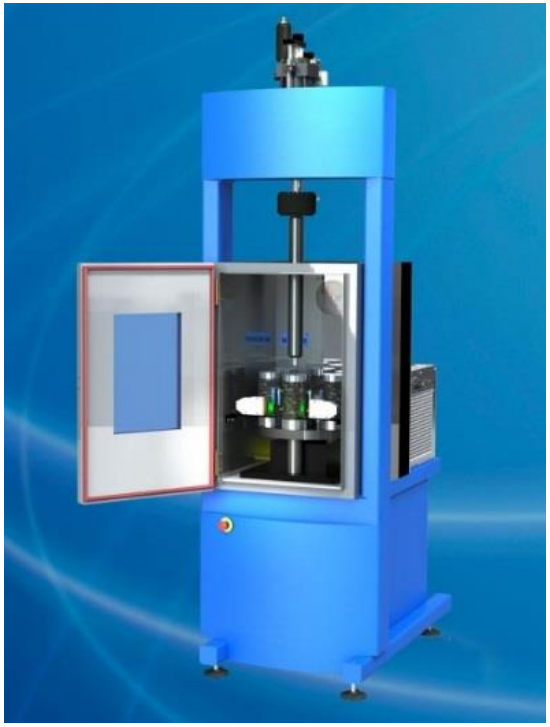
Geotechnical Testing Labs

Research

Laboratory Equipment

Triaxial Testing

Plasticity Index Testing



Dynamic Modulus Testing

- CPEAP investigation, design, supervision and training activities is up to date with technology
- Partners Universities in soil testing, evaluation of additives and comparing alternative mixtures
- Has commitment to partnerships for the training of undergraduates & engineering practioners
- Research program will publish codes, standards and technical bulletins suitable for local use

Major Patching – Draper St. Victoria

Major Patching

Draper Street Rehabilitation, Victoria

[Given 160m x 6.4m x 100mm depth of excavation]

Conventional Methods

Cost of 100mm excavation: (160 x 6.4 x 100/1000 x 2.4 x $43.20)		= $10,617
Cost of Asphalt:	(160 x 6.4 x $66)	= $67,584
	TOTAL COST	**= $78,201**
Cost of Fine Crushed Rock (base and top):	(160 x 6.4 x $143)	= $128,128
Sealing cost:	(160 x 6.4 x $9.00)	= $ 9,216
	TOTAL COST	**= $147,961**

Enzyme Treatment

Cost of Machinery:		= $8,000
Cost of 150mm depth Enzyme: (160 x 6.4 x 150/1000 x 1/30 x $320)		= $1,638
Cost of Cement (2%):	(2/100 x 160 x 6.4 x 150/1000 x 2 x $200)	= $1,229
Sealing cost:	(160 x 6.4 x $9.00)	= $9,216
	TOTAL COST	**= $20,083**

Shoulder Hazard Repair

Plains Road, Lara, Victoria

Before rehabilitation with enzyme stabilisation treatment

Shoulder Rehabilitation

Mill Road & Plains Road, Lara, Victoria

[Existing road seal 4 m's wide shoulders 1 m, Road 1.7 m's long]

Conventional Method

Cost of 150mm excavation: (1700 x 2.0 x 150/1000 x 2.4 x $43.20)		= $52,877
Cost of rock:	(1700 x 2 x 2.4 x $25 x 150/1000)	= $30,600
Cost of machinery/traffic control:	($5,000/day x 5 days)	= $25,000
Patching allowance Cost:		= $25,000
Sealing cost:	(1700 x 6 x$9)	= $91,800
	TOTAL COST	**= $225,277**

Enzyme Treatment

Cost of Machinery:		= $ 8,000
Cost of 150mm depth Enzyme: (1700 x 6 x 150/1000 x 1/30 x $320)		= $16,320
Cost of Rock(recycled):	(50/1000 x 1700 x 6 x $20 x 2.4)	= $24,480
Cost of Cement (1.5%): (1.5/100 x 1700 x 6 x 150/1000 x 2 x $200)		= $ 9,180
Sealing cost:	(1700 x 6 x $9)	= $91,800
	TOTAL COST	**= $149,780**

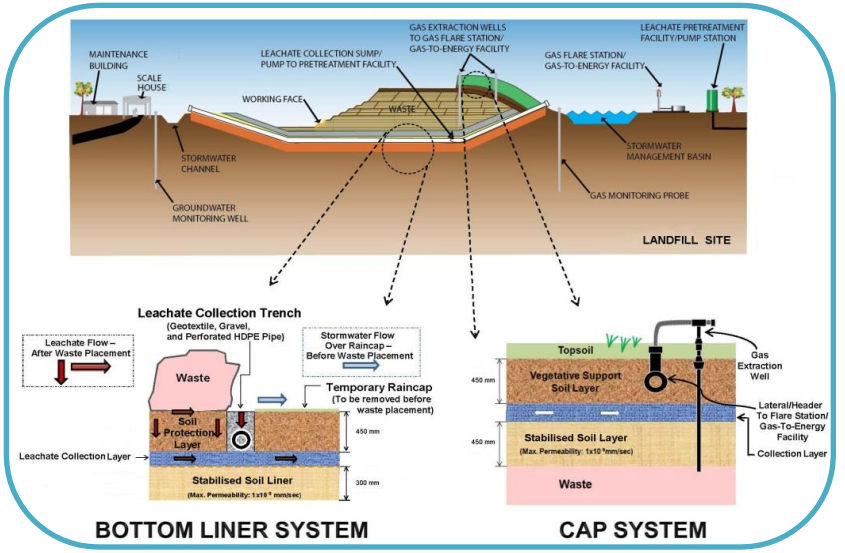
Stabilisation - Resheeting Unsealed Roads

Engineering Solutions – Applications for Soils

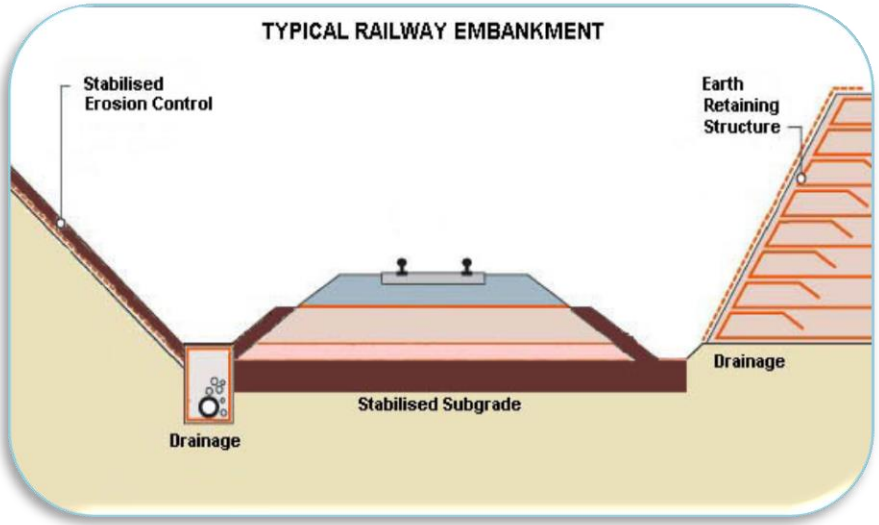
- Levee bank surface protection and structural keys
- Sealing landfill cells (leachate & gas containment)
- Railway embankments and subgrades
- Waterproof lining of earthen dams and lagoons
- Reinstatement of washouts and land slips
- Building slab subgrade (pier and beam foundations)
- Remediation of soil liquefaction

Stabilising Benefits

Embankment Erosion



Leachate & Gas Containment



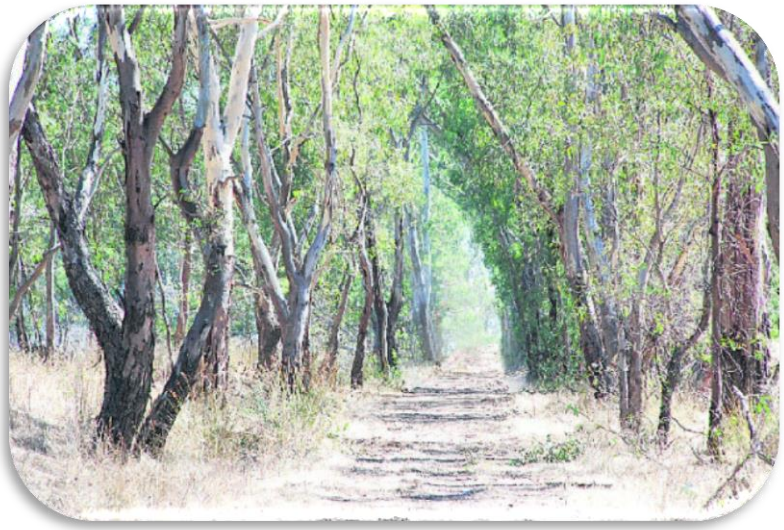
Railway Construction

Dams & Ponds

Stabilisation Solutions - Roadwork Projects

- Unsealed bicycle and walking trails
- Pavements for unsealed roads
- Improving low level waterway crossings
- Subgrade improvement – capping layers
- Embankment strengthening at bridge abutments
- All-weather temporary access roads
- Aerodrome, port & freight terminal pavement capping

Stabilising Benefits



Rural Bicycle Trail

Reconstruction

Ford Erosion

Sealed Pavement

Stabilising Additives Can Include (but are not limited to)

- Lime
- Cement
- Chemical
- Polymers
- Enzymes
- Foam Bitumen
- Wood resin

(Additives also can be mixed with one another)

Stabilising Equipment

Regulated Tanker

Flat Roller

Stabiliser Mill

Mixing by Grader

Enzymes as a Soil Stabiliser

- Fermented from organic materials
- Environmentally safe & 100% biodegradable
- Non-toxic & non-hazardous
- A multiple enzyme based stabiliser produced
- Used in over 30 countries world wide
- Made in the USA

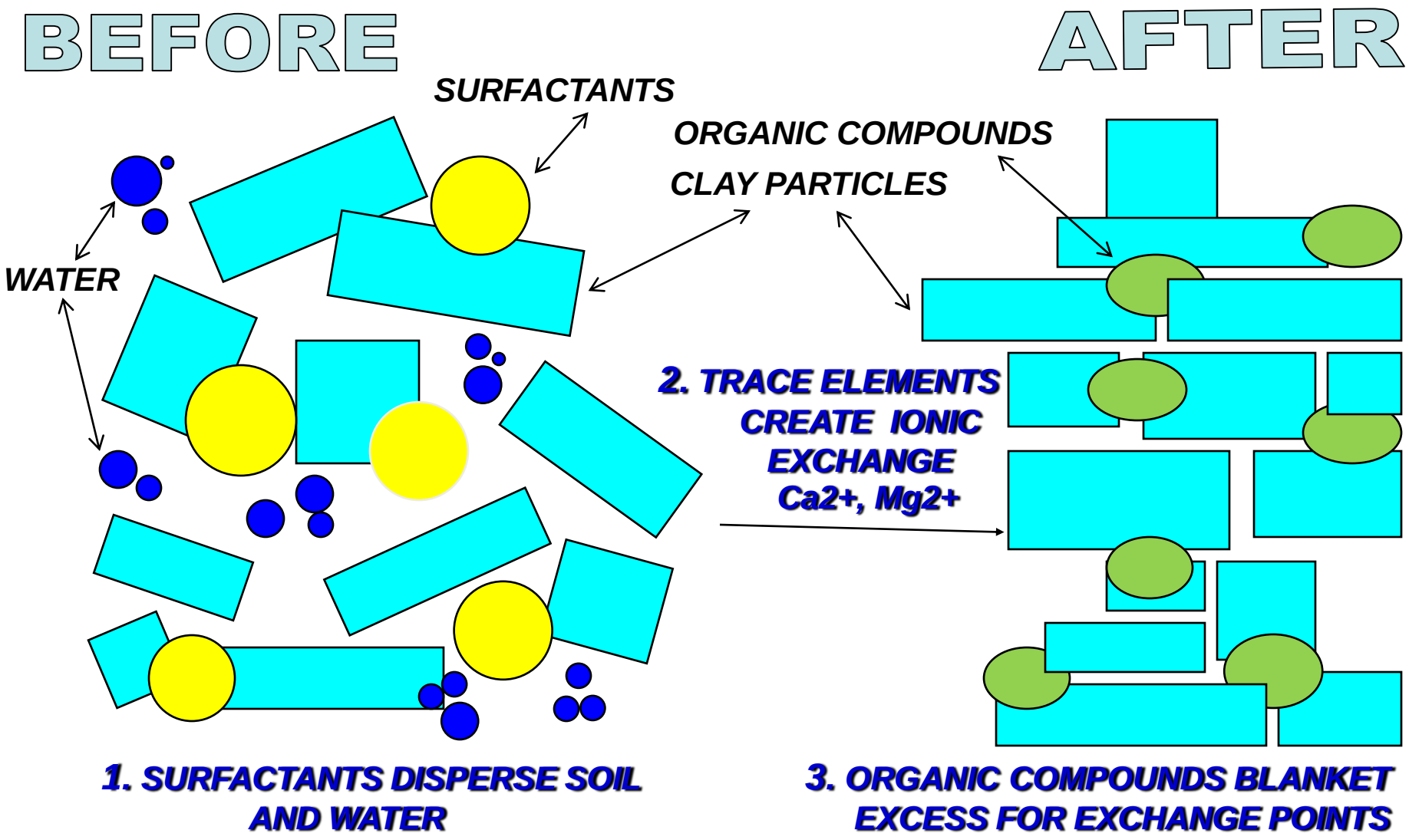
What Enzymes Do

- Increase soil density & load bearing capacity
- Lower the permeability
- Facilitate the use of existing/local materials
- Enable less compactive effort in construction
- Stabilised layer unaffected by temperature
- Conventional construction costs (using high grade aggregates) are significantly reduced

How Enzyme Stabiliser Works

- Soil Stabiliser interacts with clay changing the soil's molecular structure
- This accelerates the cohesive bonding of soil particles
- Uses less water than normally needed in bonding
- Finally producing a dense permanent mass

Visual of the Molecules



What Needs To Be Done

- Desktop evaluation (geology and local knowledge)
- Sampling of subsurface soils (and existing pavement)
- Physical and chemical testing (with/without additives)
- Reporting (results, options and recommendations)
- Design (utilising best available materials/additives)
- Construction supervision (advice, testing and reporting)
- Post construction certification

Soils Analysis Required

- Gradation (minimum requirements apply, including 18% cohesive fines <75 micron)
- Plastic Index (minimum PI of 6%)
- Maximum dry density and optimum moisture
  (for calculating construction water volume)
- Soil pH (Range should be 4.5 – 8.0)

Thank you