Ipswich City Council: Foam Bitumen Stabilisation Journey – Case Study

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Ipswich City Council

AustStab
Pavement Recycling and Stabilisation Association

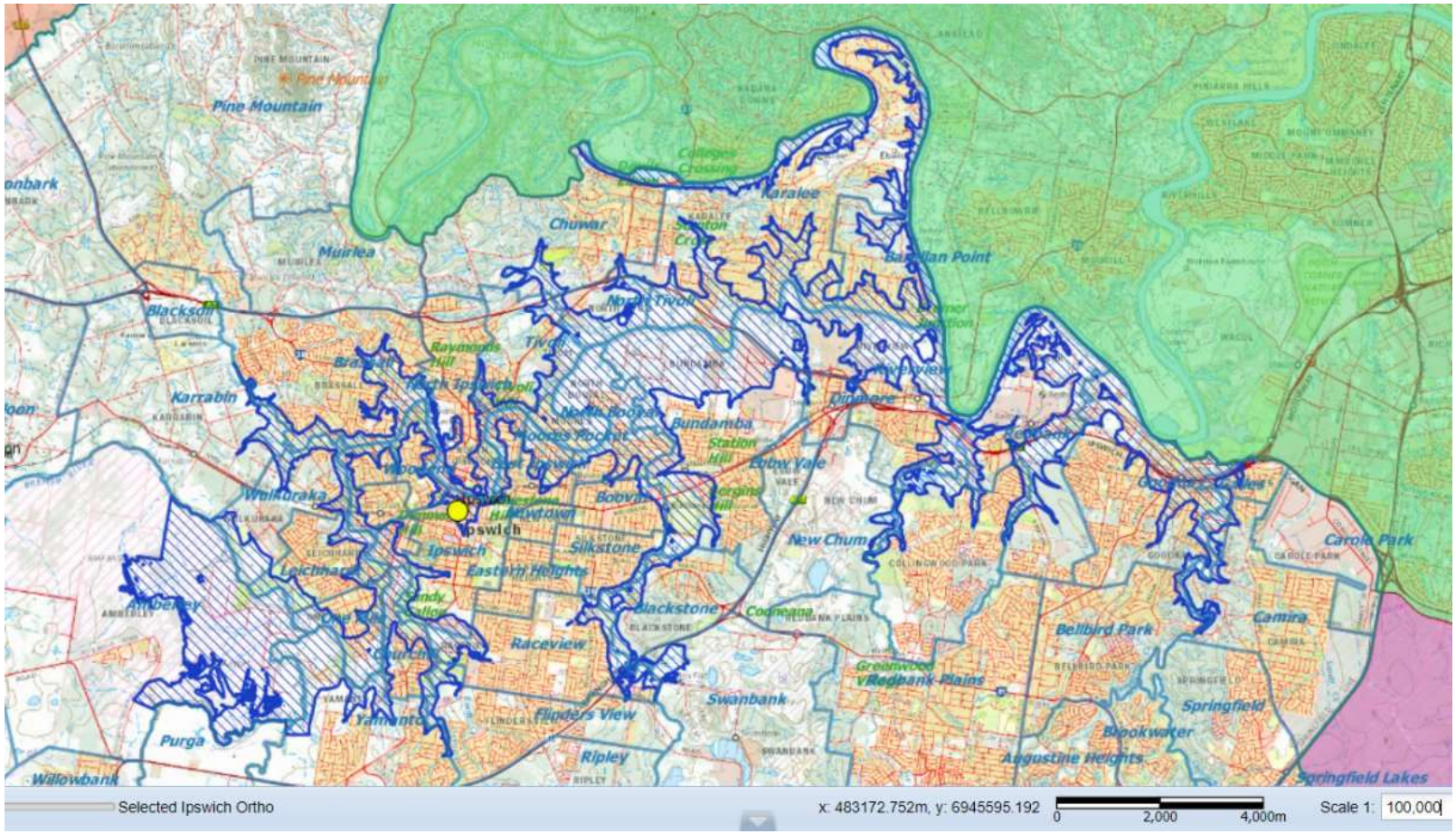
Topics to be Covered

- Why consider foam bitumen
- Lessons learned

Why Consider Foam Bitumen?

1) Flood resilience
2) Economics

Flood Resilience - 1974 Flood Event:



Economics:

Treatment	Cost as % of Full Reconstruction
Full Reconstruction	100%
Plant Mixed Foam Bitumen	65%
Mill & Fill	60%
Insitu Foam Bitumen Stabilisation	53%

LESSONS LEARNED

Lesson #1
Terminology needs to be clear

- Make clear distinction between ‘insitu stabilised’ foam bitumen & ‘plant mixed’ foam bitumen
  - Sad tale of Kennedy Drive

Lesson #1 (Cont'd)

- Kennedy Drive Pavement:

  Original pavement report:

  60mm AC14M (C320) Asphalt Surface Layer
  10mm C170 Initial Seal Coat
  200mm Foam Bitumen Stabilised Layer
  Existing granular pavement

  Future pavement report:

  60mm AC14M (C320) Asphalt Surface Layer
  10mm C170 Initial Seal Coat
  200mm Insitu Foam Bitumen Stabilised Layer
  Existing granular pavement

Lesson #1 - Outcome

- Make clear distinction between ‘**insitu** stabilised’ foam bitumen & ‘**plant mixed**’ foam bitumen

Lesson #2

Preventing over-topping Damage

Ipswich St, Grandchester (2018):

<u>500mm Pavement:</u>

7mm Final Seal

10mm Primer Seal

125mm Unbound Base Type 2.2 (CBR 60)

125mm Unbound Base Type 2.4 (CBR 30)

250mm Unbound Base Type 2.5 (CBR 15)

Lesson #2

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125mm Unbound Base Type 2.2 (CBR 60)

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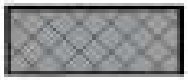
250mm Unbound Base Type 2.5 (CBR 15)


1 Mar 2022 11:50:03 am
59 Ipswich Street
Grandchester
City of Ipswich
Queensland

Lesson #2 - Preventing over-topping Damage:

Ipswich St, Grandchester (2023):

TYPE 1 PAVEMENT REPAIR / RESEAL (2 COAT SEAL) - FULL WIDTH



14/7mm DOUBLE DOUBLE SEAL, WITH BASE REPAIR AS SPECIFIED BELOW

TOP COAT: S45R at 0.9 L/m2 residual binder. 7mm aggregate (spread rate of 225m2/m3)

BOTTOM COAT: S45R at 1.5 L/m2 residual binder. 14mm aggregate (spread rate of 103m2/m3)

BASE REPAIR: Grade remaining material down to upper base level of originally constructed road (167mm below FSL). Import and re-compact imported 150mm Plant Mixed Foam Bitumen in accordance with TMR Specification MRTS09

Lesson #2 - Preventing over-topping Damage:

Lesson #3
The Sad Tale of Settler Way

Settler Way:

Settler Way


Kookaburra Park West Boat Ramp
Kookaburra Park - West Boat Ramp
Kookaburra Park
Kookaburra Park
Settler Way
Settler Way
Settler Way
Carlock Promenade
Carlock Promenade
Carlock Promenade
Conorbar Pl
Raven Ct
Brisbane River
Brisbane River
Sugars
Happy Pots Australia
Nautilus
Palma Pl
Balmoral Grove
Seahorse Ct
Settler Way


16 June 2023 6:51:00 am
103 Settler Way
Karalee
City of Ipswich
Queensland


29 June 2023 8:01:55 am
138 Settler Way
Karalee
City of Ipswich
Queensland

Settler Way

- Potential Differences Between Sections:
  - Pavement:
    - *Grading*
    - *Atterberg Limits*
    - *Foam Bitumen Mix*
    - *Moisture Content*
  - Subgrade:
    - *CBR*
    - *Plastic Index (PI)*
    - *Moisture Content*

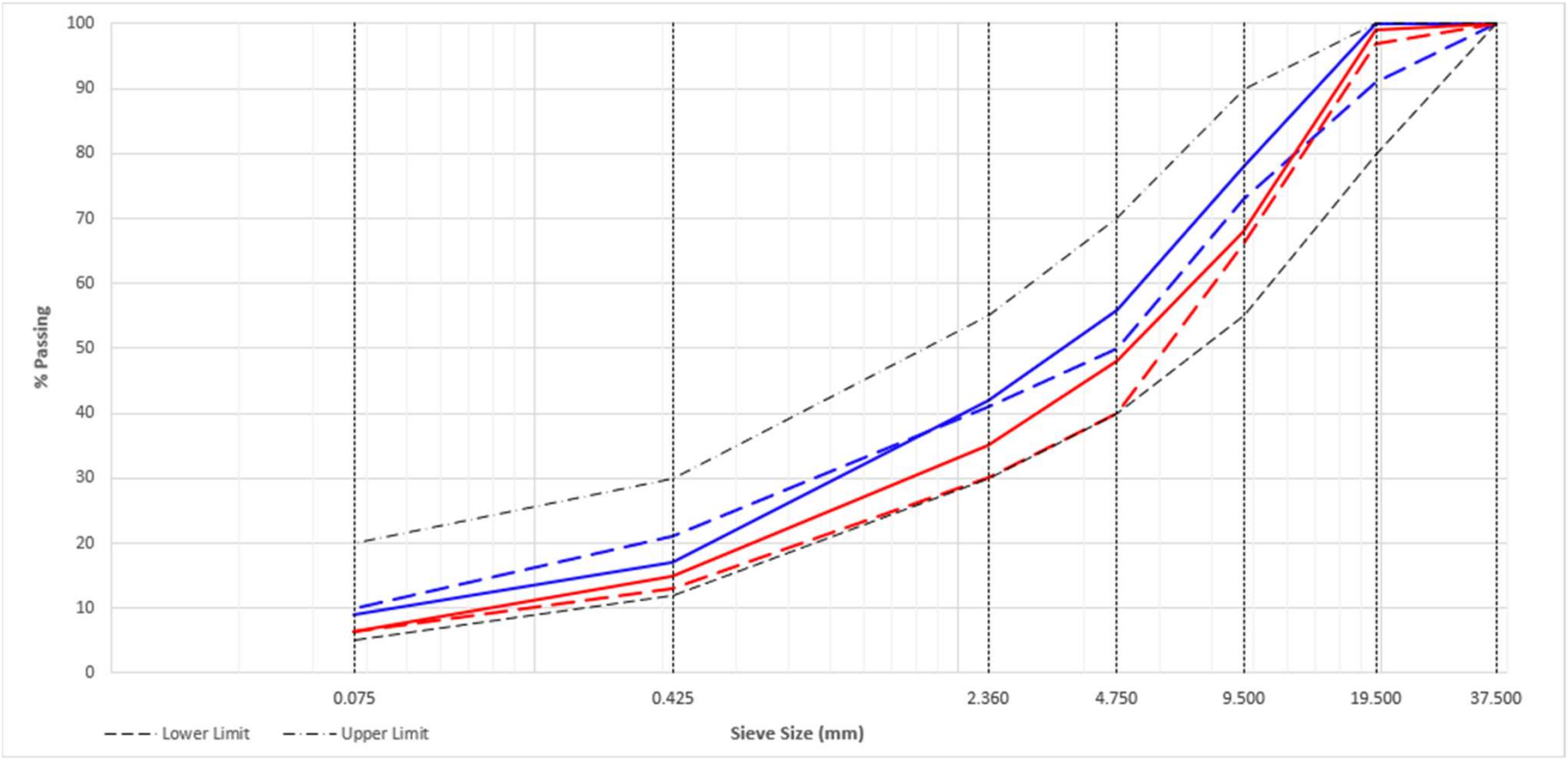
Settler Way – Subgrade Moisture

	Southern Section	Northern Section
Pavement:		
Linear Shrinkage (max.)	3.8	4.6
Plastic Index (max.)	5.6	8.4
Foam Bitumen Mix	Identical	Identical
Moisture	6.5%	5.2%
Subgrade:		
Design CBR	5.0	2.5
Swell (Max.)	1.6	2.3
Moisture (Average)	0.87 x OMC	1.15 x OMC
Moisture (Max.)	1.01 x OMC	1.73 x OMC

Settler Way

- *But wait, there's more!*

Settler Way


100
90
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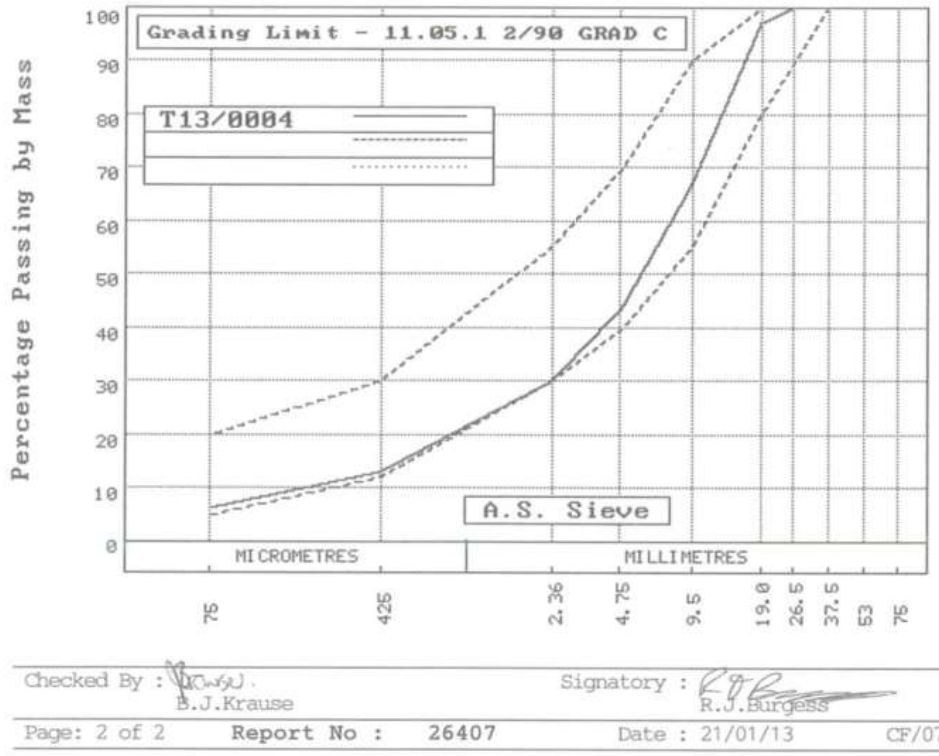
0
% Passing
0.075
0.425
2.360
4.750
9.500
19.500
37.500
Lower Limit
Upper Limit
Sieve Size (mm)



Report on Foam Bitumen Stabilised Material (UMATTA RESULTS)

Client: Pavement Rehabilitation
Address: 55 Butterfield Street, Herston QLD 4006
Project: Gore Highway
Sender's No.: T13/0004
Job No.: 26528A
Sampled By: Client
Material Source: Insitu / G.B Quarry - Cypress Mountain
Date Sampled: 05/12/2012
Nature of Sample: 40% Insitu / 60% Quarry
Sampling Method: -

TEST RESULTS MODULUS

Article Number	Specimen Number	Date of Initial Modulus	Elastic Modulus (MPa) Test Age (All samples tested at ambient temperature)			
			Initial Modulus	3 Day 40°c Oven Cured Modulus	3 Day Soaked Modulus	Retained Modulus (%)
S13/178	3A	17/05/2013	1276	2123	1255	59
	3B		793	2263	1122	50
	3C		676	1683	956	57
	3D		861	2184	1143	52
Average Modulus (MPa)			902	2063	1119	54

Variation(s) to Test Method: -
Remark(s): Sample tested as received. Q10A details supplied by Material Services Toowoomba, PO Box 845 Toowoomba QLD 4350. Accreditation Number 2302. Report Number 26398
Checked By:
Signatory: Anthony Neary
Senior Materials Technologist

Just complies with MRTS05 'C' grading coarse limit.

Report on Foam Bitumen Stabilised Material (UMATTA RESULTS)

Client:	Pavement Rehabilitation		
Address:	55 Butterfield Street, Herston QLD 4006		
Project:	Gore Highway	Sender's No.:	T13/0002
Job No.:	285/28A/-	Sampled By:	Client
Material Source:	Insitu / GLH Quarry - Captains Mountain	Date Sampled:	05/12/2012
Nature of Sample:	40% Insitu / 60% Quarry	Sampling Method:	-
Sampling Location:	CH. 54.00 / Quarry Stockpile	Sample Description:	40/60 Blend
Test Method:	Modulus determined in accordance with the relevant sections of AS2891.13.1		
	Q110A – Dry Density / Moisture Relationship (Standard Compaction)		

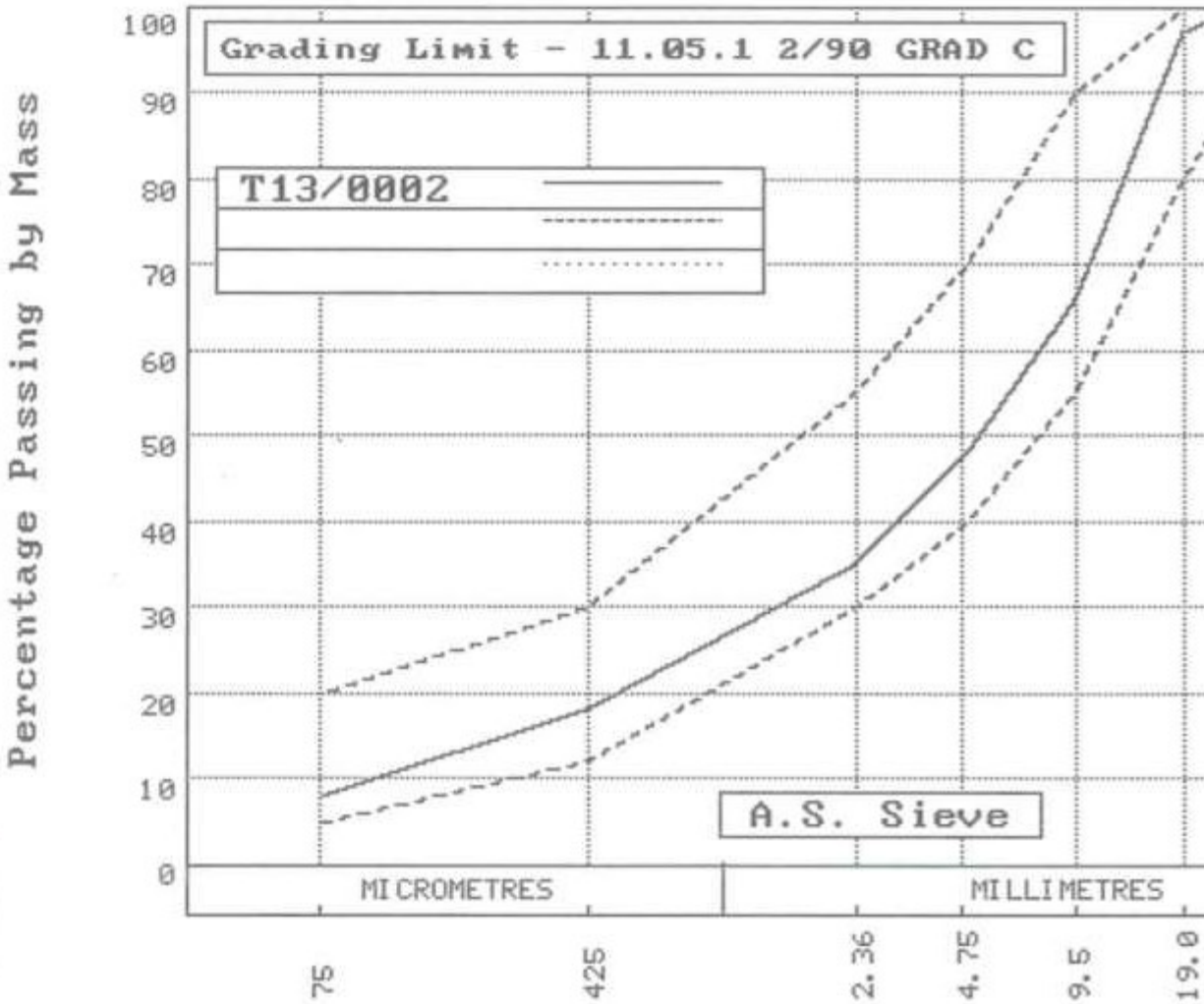
TEST RESULTS

Percentage of Foaming Agent Added to Bitumen (Stable Foam A)	0.5
Percentage of Class 170 Bitumen Added	2.5

Bitumen & Lime Properties Article Numbers	
Expansion Ratio	812/259B

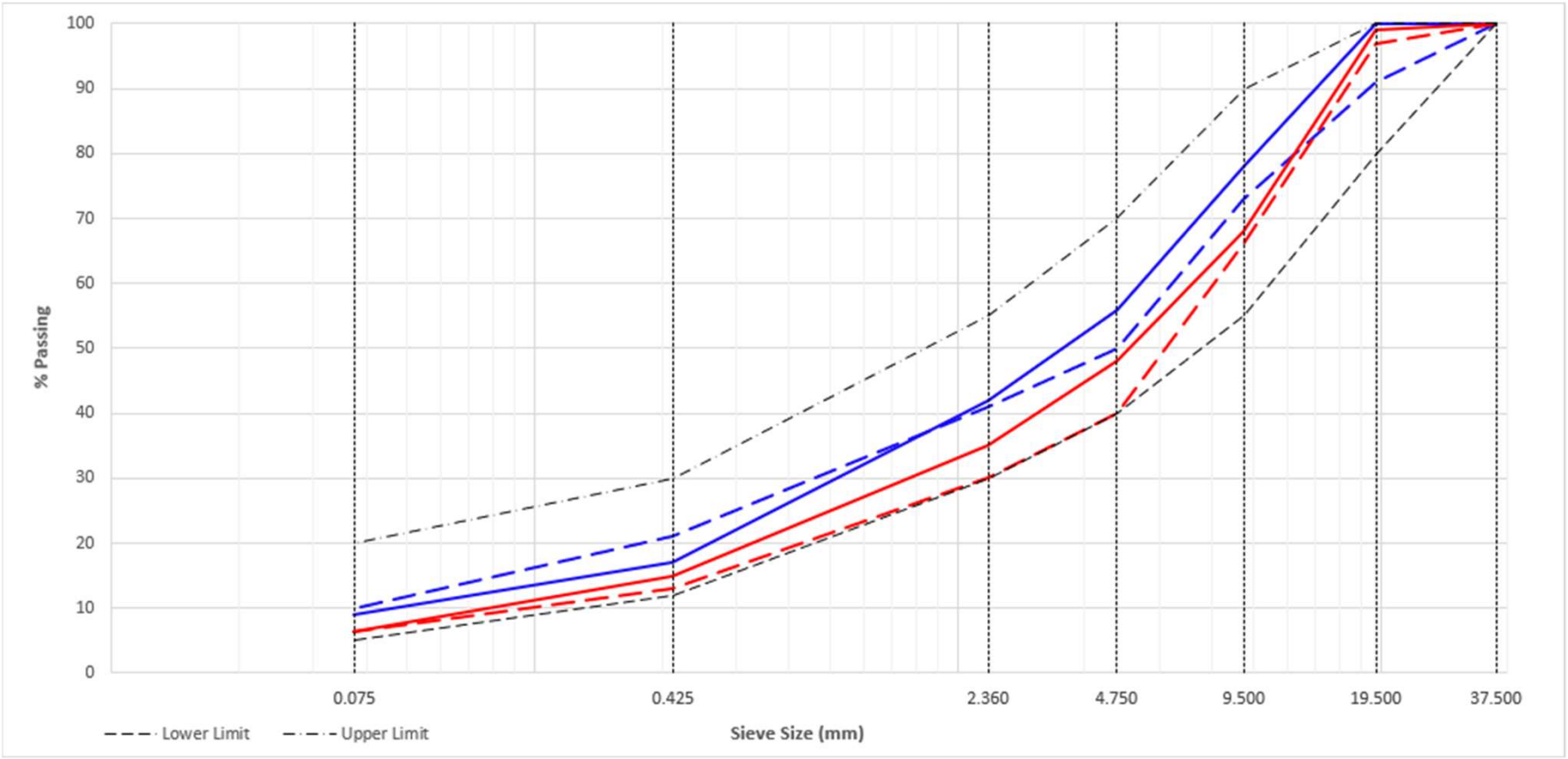
ODULUS

cimen mber	Date of Initial Modulus	Elastic Modulus (MPa) Test Age (All samples tested at ambient temperature)			
		Initial Modulus	3 Day 40°c Oven Cured Modulus	3 Day Soaked Modulus	Retained Modulus (%)
1	08/10/2013	339	3669	2315	63
2		351	3982	2261	57
3		360	4131	2410	58
4		364	3880	2392	62
odulus (MPa)		354	3916	2344	60



ease in lower envelope limit: enhances the fines content;
ces permeability; increases surface area.

Settler Way


100
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0.075
0.425
2.360
4.750
9.500
19.500
37.500
Lower Limit
Upper Limit
Sieve Size (mm)

Settler Way

- *But wait, there's more!*

Settler Way – Compaction

- MRTS07C – *Table 8.6.19 – **Minimum** compaction requirements*:

Vibrating pad foot roller	For layer thickness < 200 mm: not required	For layer thickness 200 – 325 mm: 21 tonnes	1
Vibrating smooth drum roller	For layer thickness < 200 mm: 16 tonnes	For layer thickness 200 – 325 mm: 16 tonnes	1
Multi-tyre roller	Minimum 12 tonnes		1

- In worst performing part of northern section – 185mm FBS
  - 22t vibrating pad foot roller – possibly not required?
  - 20t vibrating steel drum roller – possibly too heavy?
  - 2.5t twin drum roller
  - 16t Multi tyred roller – possibly too heavy?

Settler Way

- *But wait, there's more!*

Settler Way – Subgrade Insitu CBR

	Southern Section	Northern Section
Pavement:		
Linear Shrinkage (max.)	3.8	4.6
Plastic Index (max.)	5.6	8.4
Foam Bitumen Mix	Identical	Identical
Moisture	6.5%	5.2%
Subgrade:		
Effective CBR below FBS layer based on subgrade Insitu CBR	17	7
Swell (Max.)	1.6	2.3
Moisture (Average)	0.87 x OMC	1.15 x OMC
Moisture (Max.)	1.01 x OMC	1.73 x OMC

Settler Way

- *But wait, there's more!*

Settler Way – Existing Pavement 'Dig-ability'

	Southern Section	Northern Section
Pavement:		
'Dig-ability' (Hard / Moderate / Easy)	Moderate to dig	Easy to dig
Subgrade:		
Effective CBR below FBS layer based on subgrade Insitu CBR	17	7
Swell (Max.)	1.6	2.3
Moisture (Average)	0.87 x OMC	1.15 x OMC
Moisture (Max.)	1.01 x OMC	1.73 x OMC

Lesson #3 – Settler Way

- So …….. what happened on Settler Way (Northern Section)?
  - Highly permeable pavement (PSD & ‘easy to dig’) on top of:
  - Pool of excess water in subgrade with:
  - Heavier than the minimum required compaction equipment, pumping water into the FB stabilised pavement

Lesson #4 – Mill out after stabilisation

Summary of Lessons Learned:

1) Make clear distinction between “plant mixed” & “insitu” FBS
2) Where pavement subject to inundation, foam bitumen is preferred option
3) Check support under FBS layer based on subgrade insitu CBRs prior to construction:
   a) Where support CBR < 7.0 – Possible SHOWSTOPPER?
4) Where subgrade MC > OMC – RED FLAG!
5) Where pavement PSD at lower envelope boundary – RED FLAG!
6) Where ‘dig-ability’ of exist. pavement under FB layer ‘easy to dig’ – RED FLAG!
7) Where red flags encountered, need to examine options: -
   a) Consider blending with fresh material to push PSD curve towards middle of envelope.
   b) Carefully plan compaction methodology
   c) At what stage do we abandon insitu FBS?
8) Where K&C - mill out for surface layer <u>after</u> stabilisation

Possible future research projects?:

1) Develop *Risk Score Tool* to better understand the risk of water pumping?
2) Develop Compaction Methodology to minimise water pumping
3) Gain better understanding of required support under insitu FBS

Possible future research projects?:

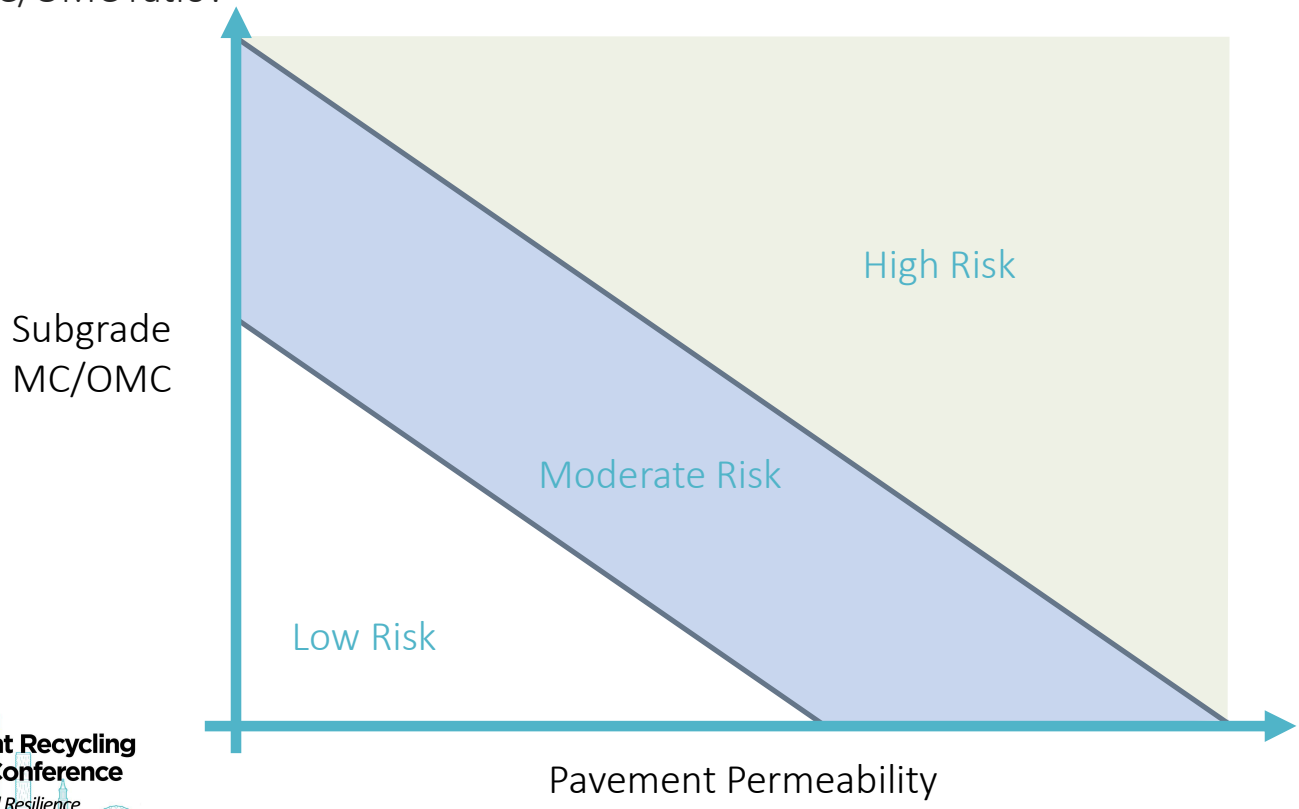
1.) Develop Risk Score Tool – Option 1:

a) *Allocate risk points for each of the red flags identified?*
b) *Sum of risk points = Risk Score (eg low risk to extreme)?*
c) *Decision to proceed with FBS depends on risk appetite for particular project?*

Possible future research projects?:

1.) Develop Risk Score Tool – Option 2

Should we develop some form of risk score relationship between pavement permeability and Subgrade MC/OMC ratio?



Possible future research projects?:

2.) Develop Compaction Methodology to minimise water pumping

a) Up to what layer thickness of FB should we apply static roll initially before switching to vibration mode and still achieve compaction in lower portion of layer?
b) How many passes in static mode before vibrating?
c) If high risk of water pumping, can we lift depth threshold before using vibrating padfoot?
d) What is ideal roller speed?
e) What degree of vibrating impact is appropriate but still effective?
f) TMR Spec identifies minimum compaction equipment –, but……what is maximum where pumping subgrade moisture is a risk?

Possible future research projects?:

3.) Gain better understanding of required support under insitu FBS layer

a) Eg if no red flags, why not accept say CBR 4.0 support?

Thanks to:

- Scott Young (SPA)
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