

Stabilization of road structures with fly ash as binder component – through demo projects to full scale use



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Stabilization & solidification



- Surface stabilization

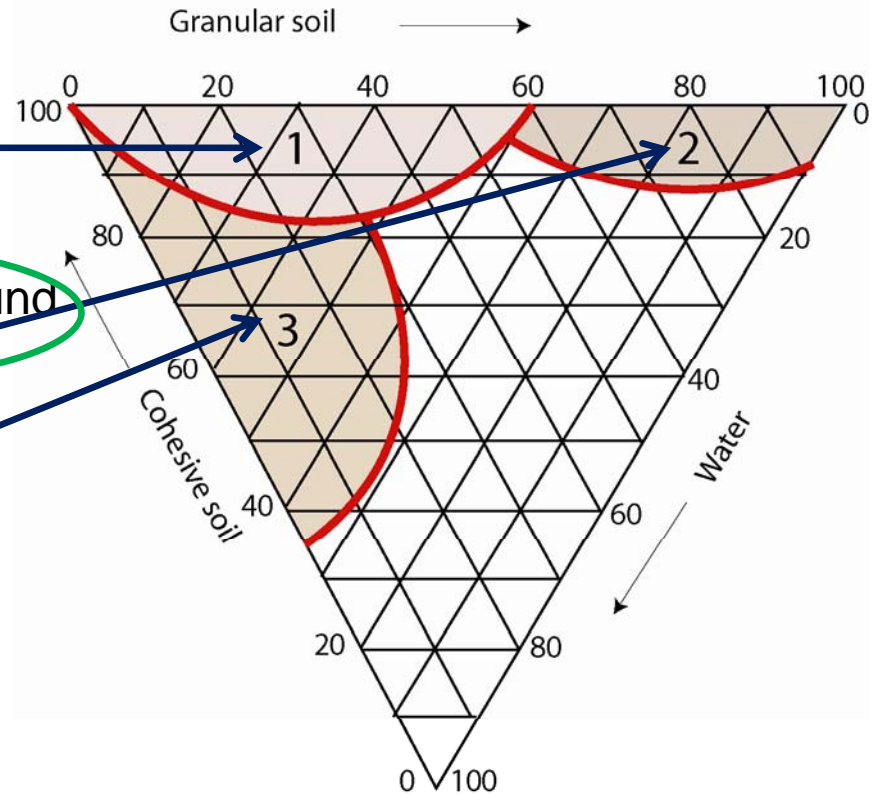
- Subgrades (1)

- Stabilization of unbound layers (2)

- Deep mixing (3)

- Column stabilization

- Mass stabilization



Binder components

- Cement (CEM II/A-LL 42.5R)



- Lime



- Merit 5000 (Blast Furnace Slag)

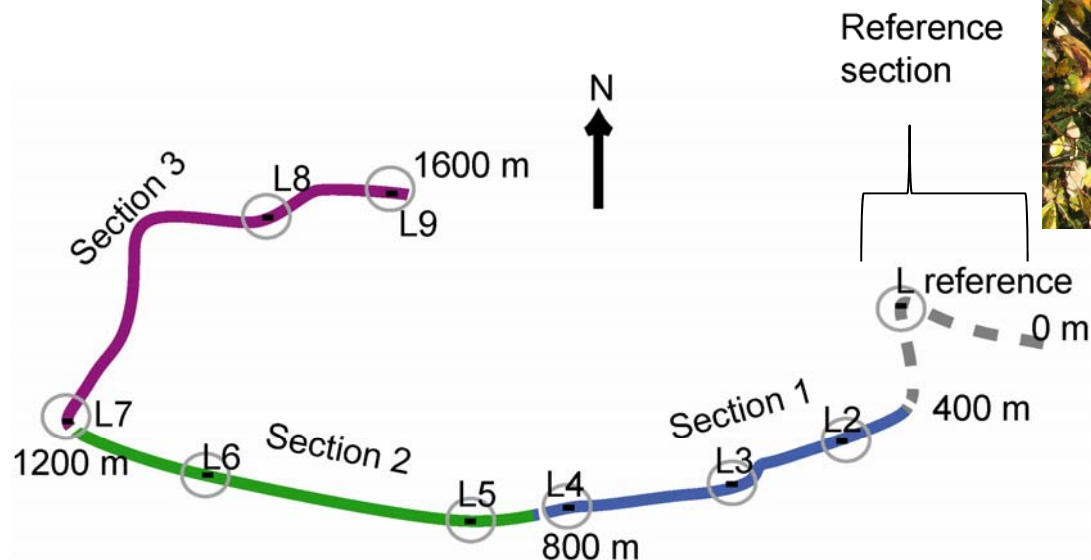


- Fly ash (Bio peat coal or mixture fuels)



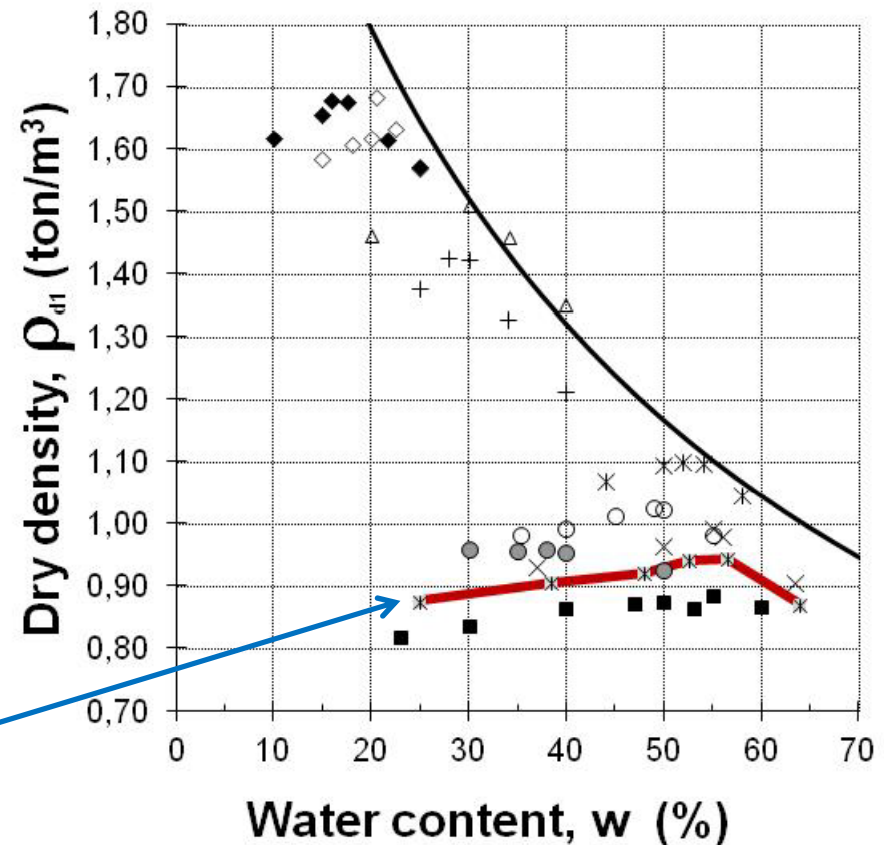
Introduction

- Fly ash as binder component
 - Characterization
 - Field test, Hallstavik
 - Stakeholder opinion



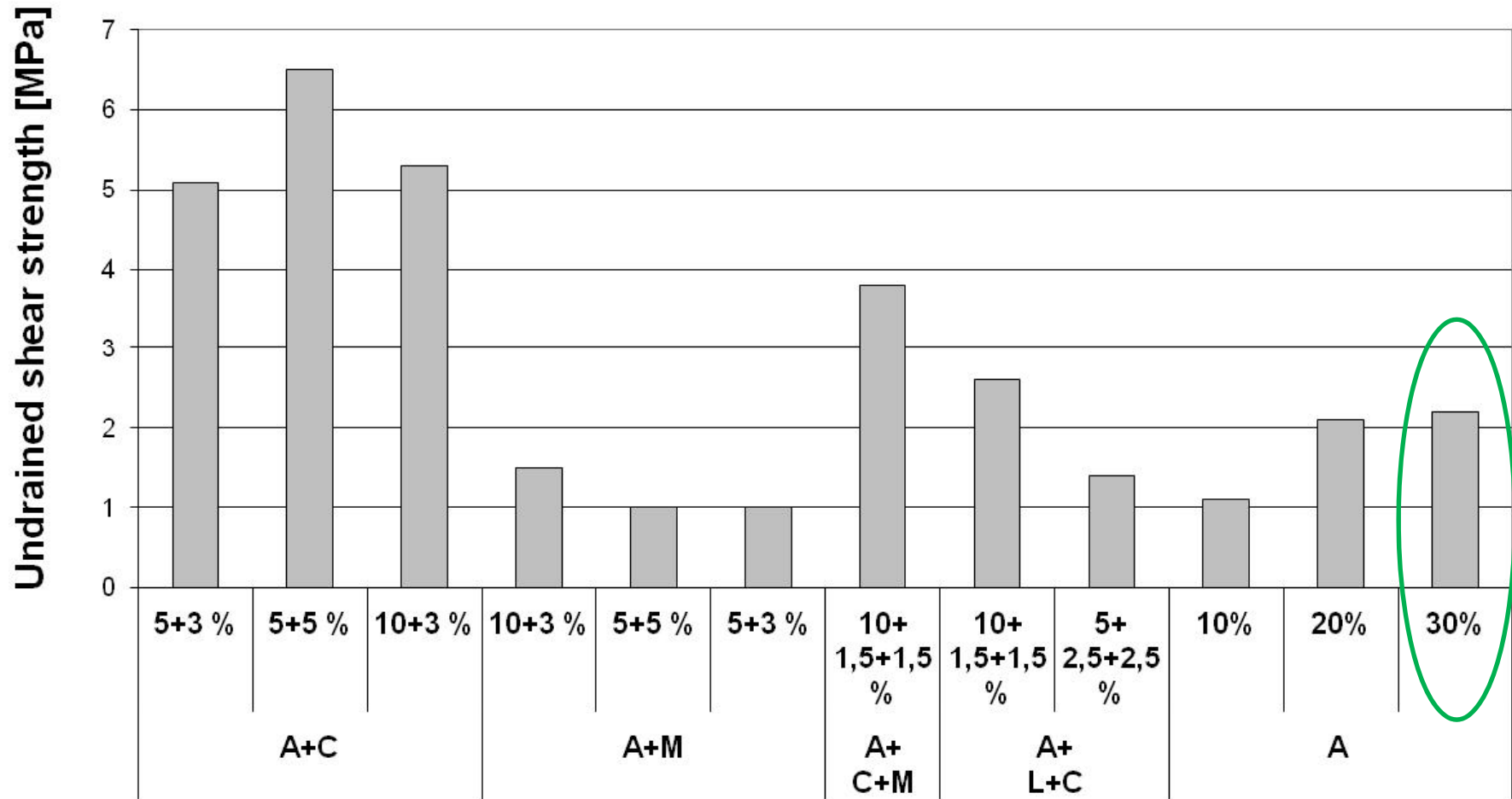
Fly ash

- Characterization (fly ashes from 10 producers)
 - Particle size distribution
 - Compaction properties
 - Cementing properties
 - Permeability
 - Content /leachability
 - etc.



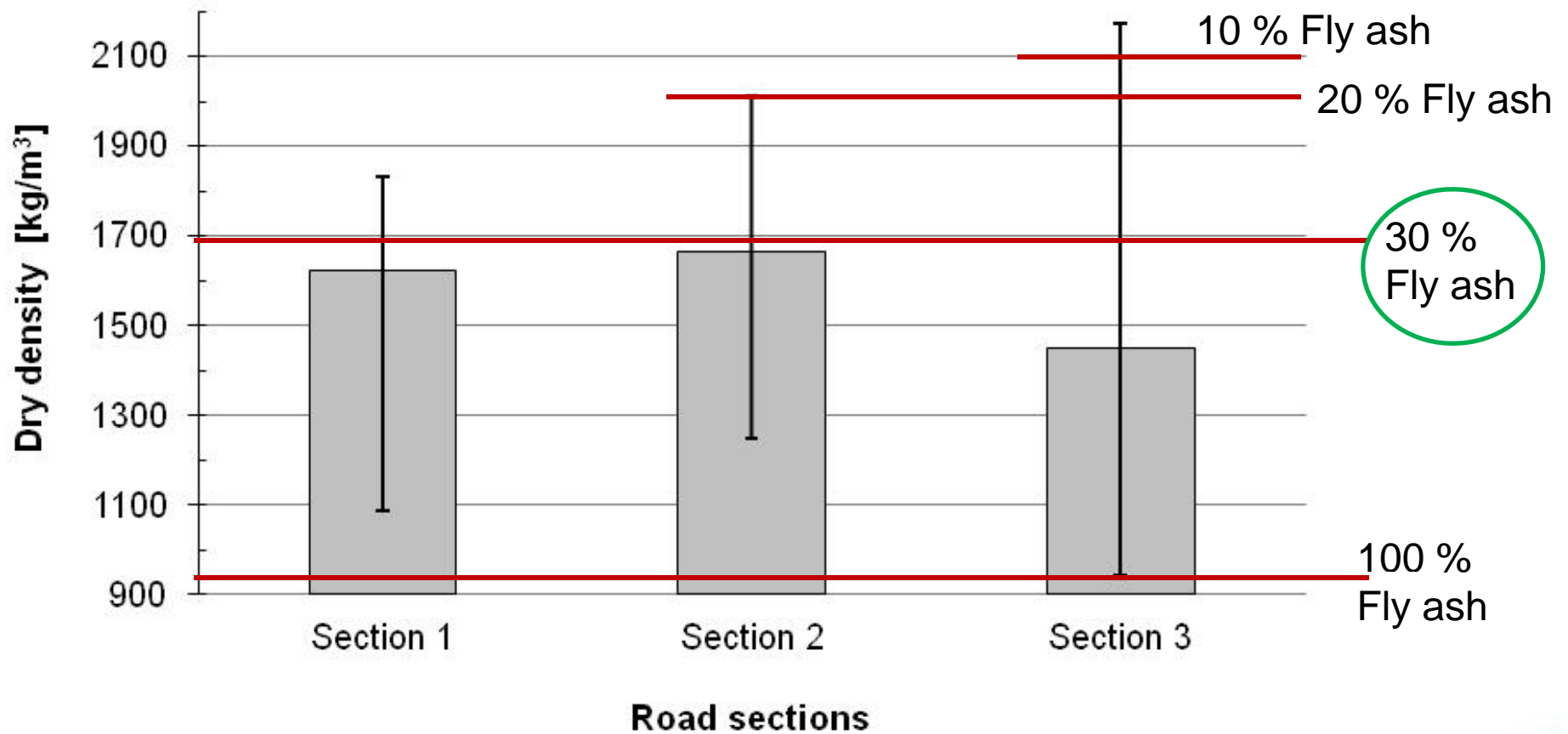
Fly ash from
Holmen Paper, Hallstavik

Gravel stabilized with binder mixtures (Fly ash (A), Cement (C), Merit 5000 (M) & Lime (L))

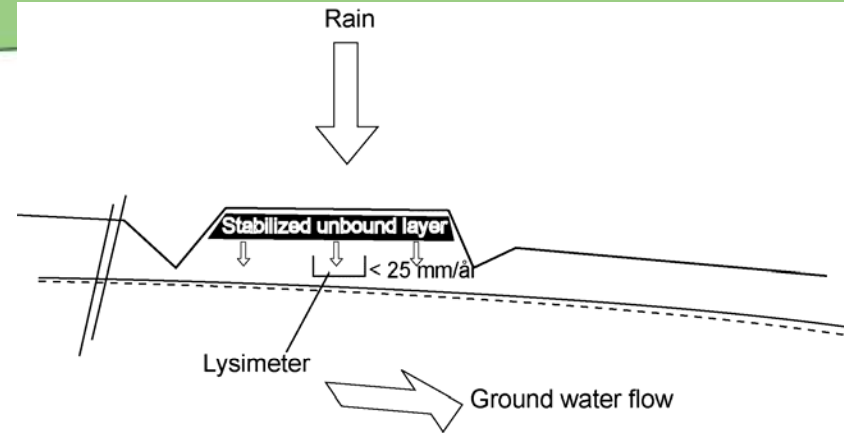


Field control - Compaction

Aim: 1,7 ton/m³ (30 % fly ash)



- Field control
 - Lysimeters



	L2-L9					L referens	Drinking water standard
Element	2005	2006	2007	2008	2009	(2005-2009)	SLVFS 2001:30
As µg/liter	14.1	7.8	7,8	6,3	10,9	< 1	10 µg/liter
Cd µg/liter	0,08	0,07	0,15	<0,05	<0,05	< 0,05	5 µg/liter
Cr µg/liter	0,67	1,15	2,75	1,55	1,16	2,4	50 µg/liter
Cu µg/liter	3,8	3,2	2,2	2,1	3,1	3,6	2000 µg/liter
Hg µg/liter	<0,02	<0,02	<0,02	<0,02	<0,02	0,04	1 µg/liter
Ni µg/liter	1,1	0,9	1	1	0,8	0,7	20 µg/liter
Pb µg/liter	0,2	<0,2	<0,2	<0,2	<0,2	0,2	10 µg/liter
Sulfat mg/liter	205	288	340	178	210	77	100 mg/liter
Electric conductivity mS/m	151	127	120	92	88	65	250 mS/m



Bearing capacity & quality

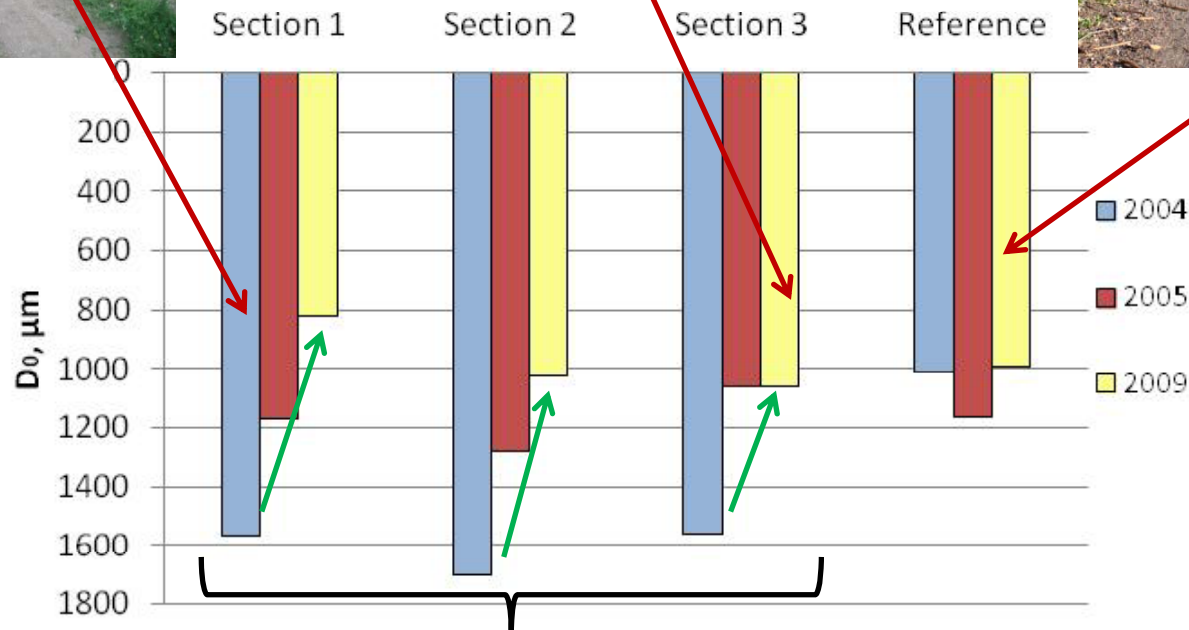
Road section 1
(2004 – before stabilization)



Road section 3
(2009)



Reference
(2009)



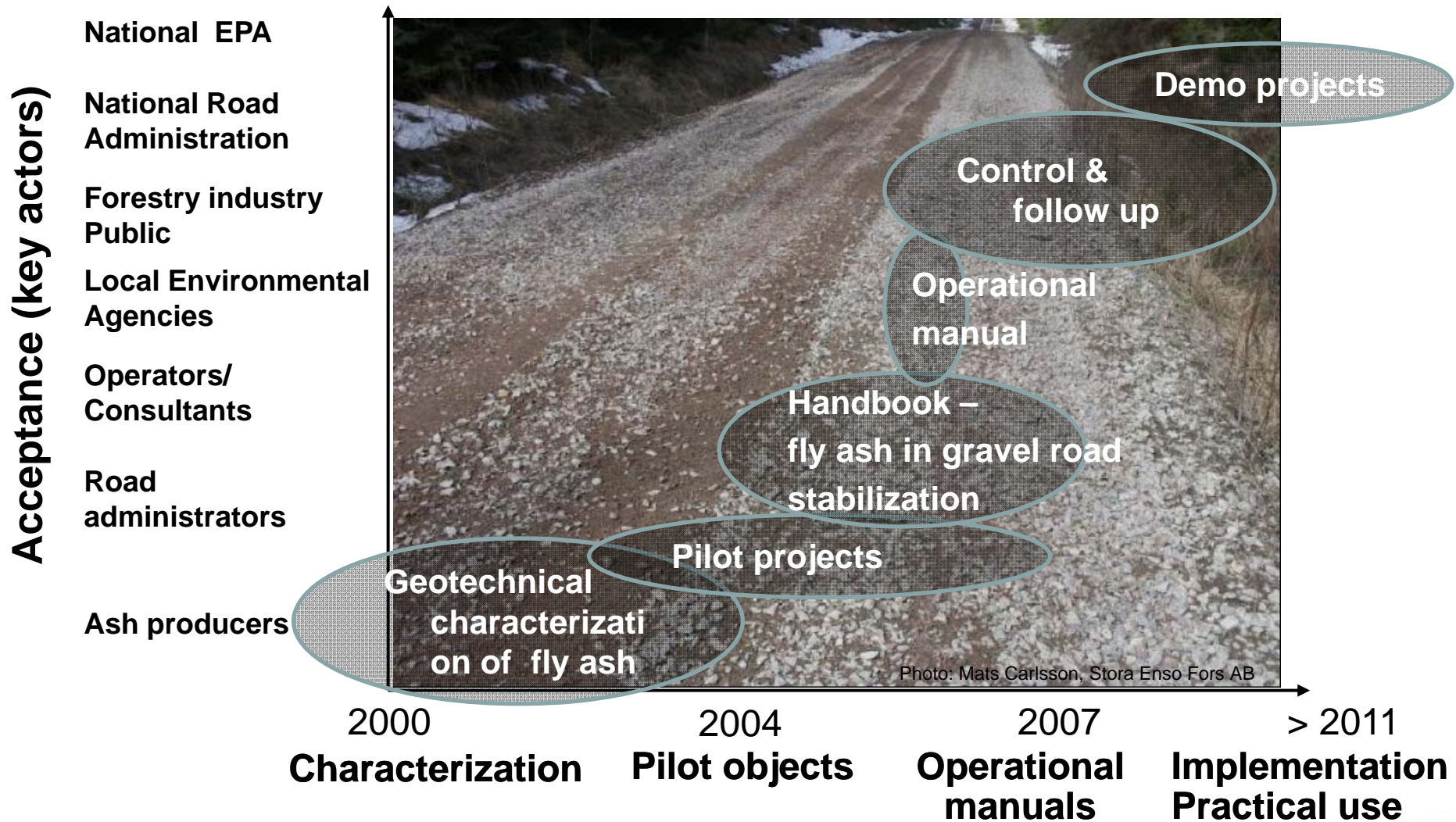
Good bearing capacity
Poor quality (pot holes)

Improved bearing capacity & good road quality (6 years)

SWOT – Fly ash as binder component

<p style="text-align: center;">Strength</p> <p><i>Climate smart ground stabilization</i></p> <p><i>Low material costs</i></p>	<p style="text-align: center;">Weakness</p> <p><i>Limited supply of fly ash</i></p> <p><i>Varying quality between different fly ash</i></p> <p><i>Total content and environmental load</i></p>
<p style="text-align: center;">Opportunity</p> <p><i>Recycling saves natural resources</i></p> <p><i>Binder mixtures of construction cement and fly ash compensate limited supply of fly ash</i></p> <p><i>Development of improved logistic and operational description (potential)</i></p>	<p style="text-align: center;">Threat</p> <p><i>Competition by other uses of fly ash: land fill closure, fertilizer (to increase tree growth)</i></p> <p><i>Fly ash is waste with limitations in use</i></p> <p><i>Producers regard fly ash as a waste and handles it as waste</i></p>

Acceptance vs. project orientation



Summary

- Fly ashes are excellent road building materials
 - from bio energy, peat and coal
- Environmental acceptance needed
 - pilot projects necessary
- Fly ash as binder component –Good potential
 - small volumes
- Stabilization has technical and economical potential.
 - Durability, cold climate, bearing capacity