Engineering Geology of M4 Motorway Kilcock - Kinnegad

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Breaking Ground - Dublin Castle - 11th November 2005

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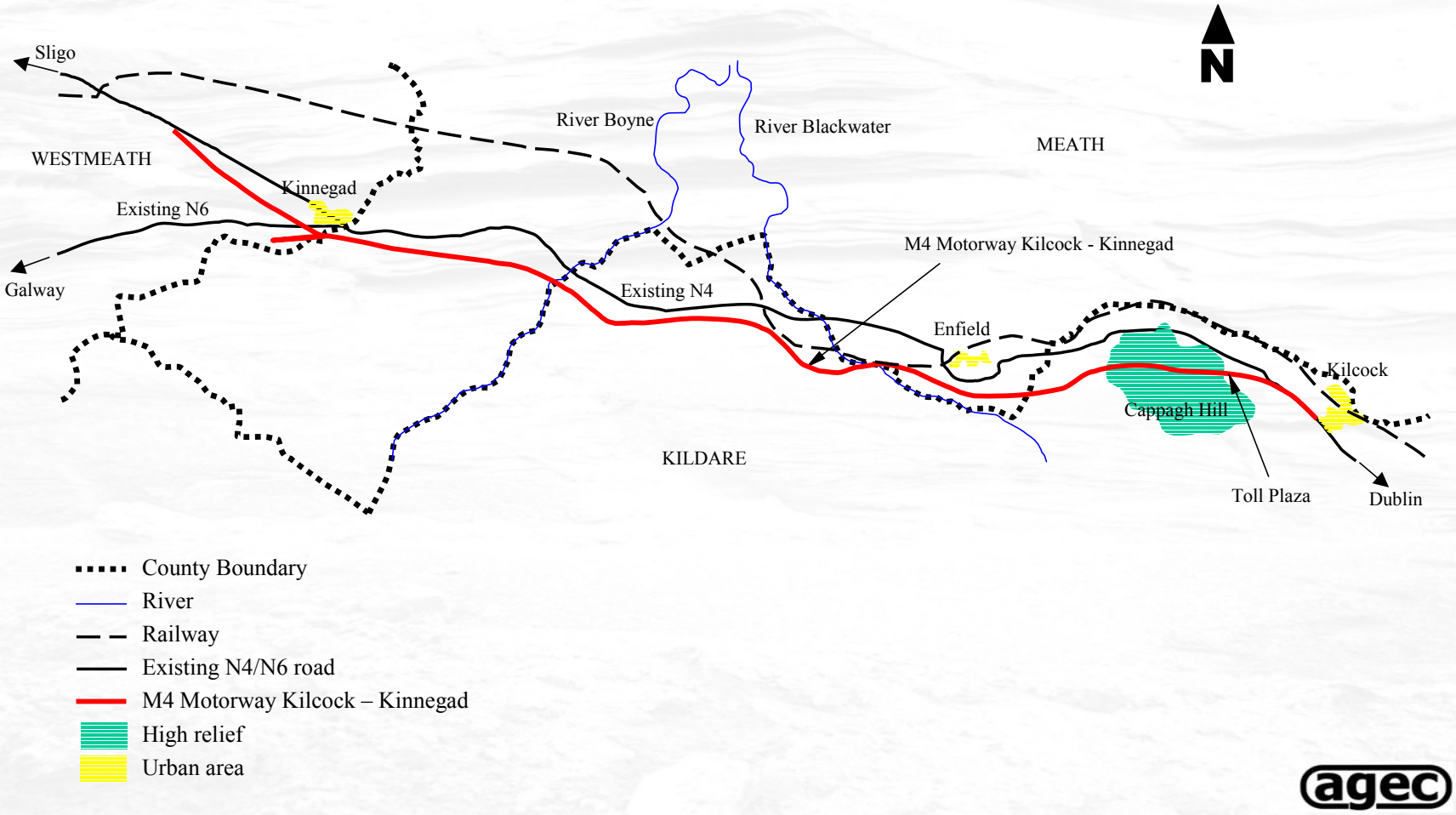
Introduction

Road scheme type	Public Private Partnership (PPP)
Contractors for the road	Ferrovial Agroman/SIAC
Concessionaire	Eurolink Consortium
Start/end dates	Mid 2003/late 2005
Estimated cost (NRA)	€550 million
Length of main line	36.4 km of dual carriageway
Number of major structures	30
Total volume of material moved	5.4 million m^3
Total volume of rock excavated	1 million m^3

Location

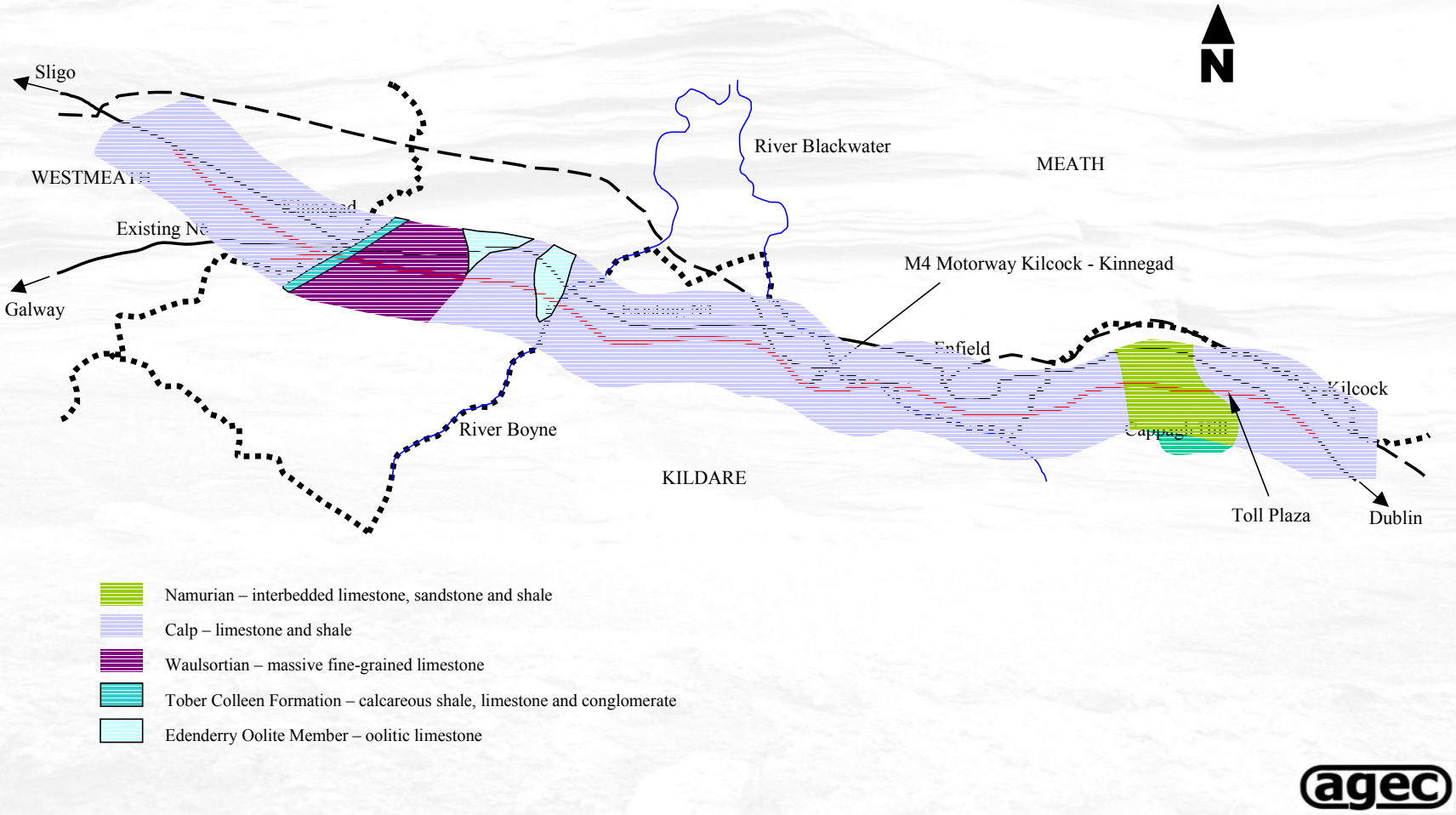
M4 Motorway Kilcock - Kinnegad

Location

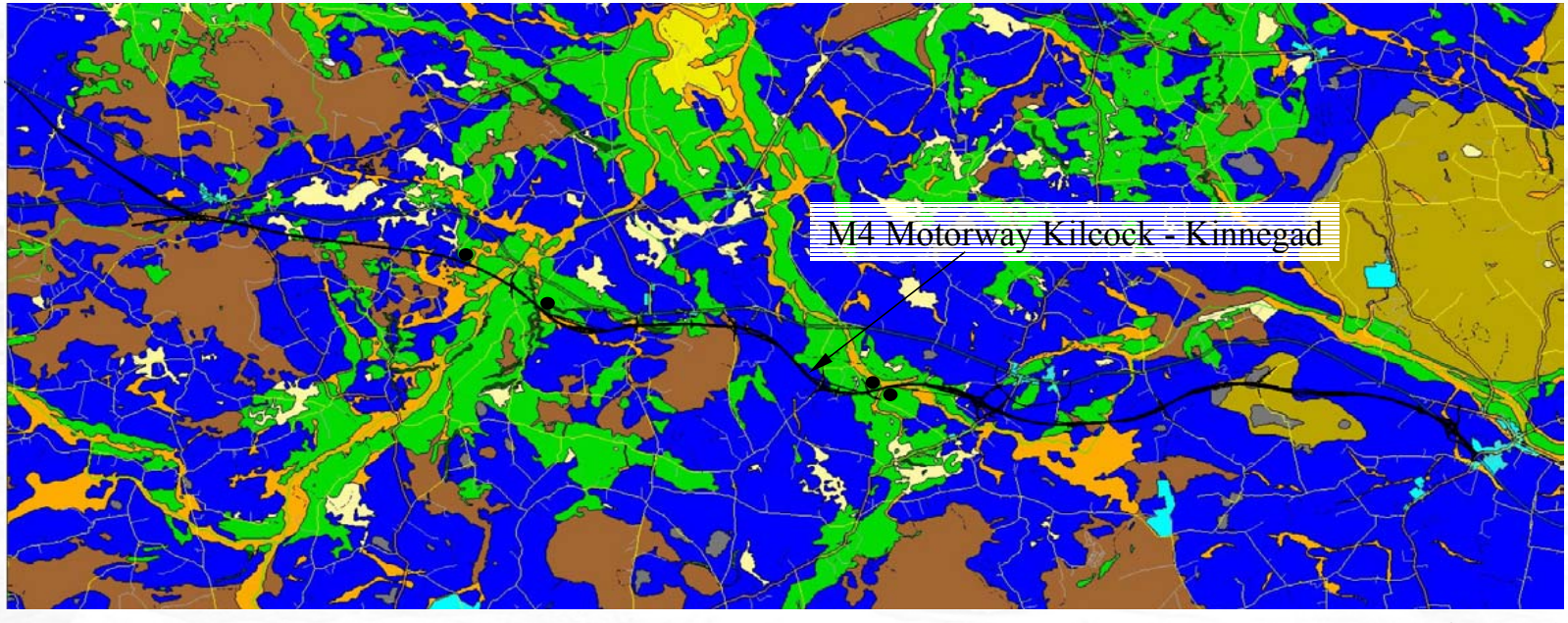

Sligo
WESTMEATH
Kinnegad
Existing N6
Galway
River Boyne
River Blackwater
MEATH
M4 Motorway Kilcock - Kinnegad
Existing N4
Enfield
Kilcock
Cappagh Hill
KILDARE
Toll Plaza
Dublin
N
County Boundary
River
Railway
Existing N4/N6 road
M4 Motorway Kilcock – Kinnegad
High relief
Urban area

agec

Location and Geological Setting - Rocks



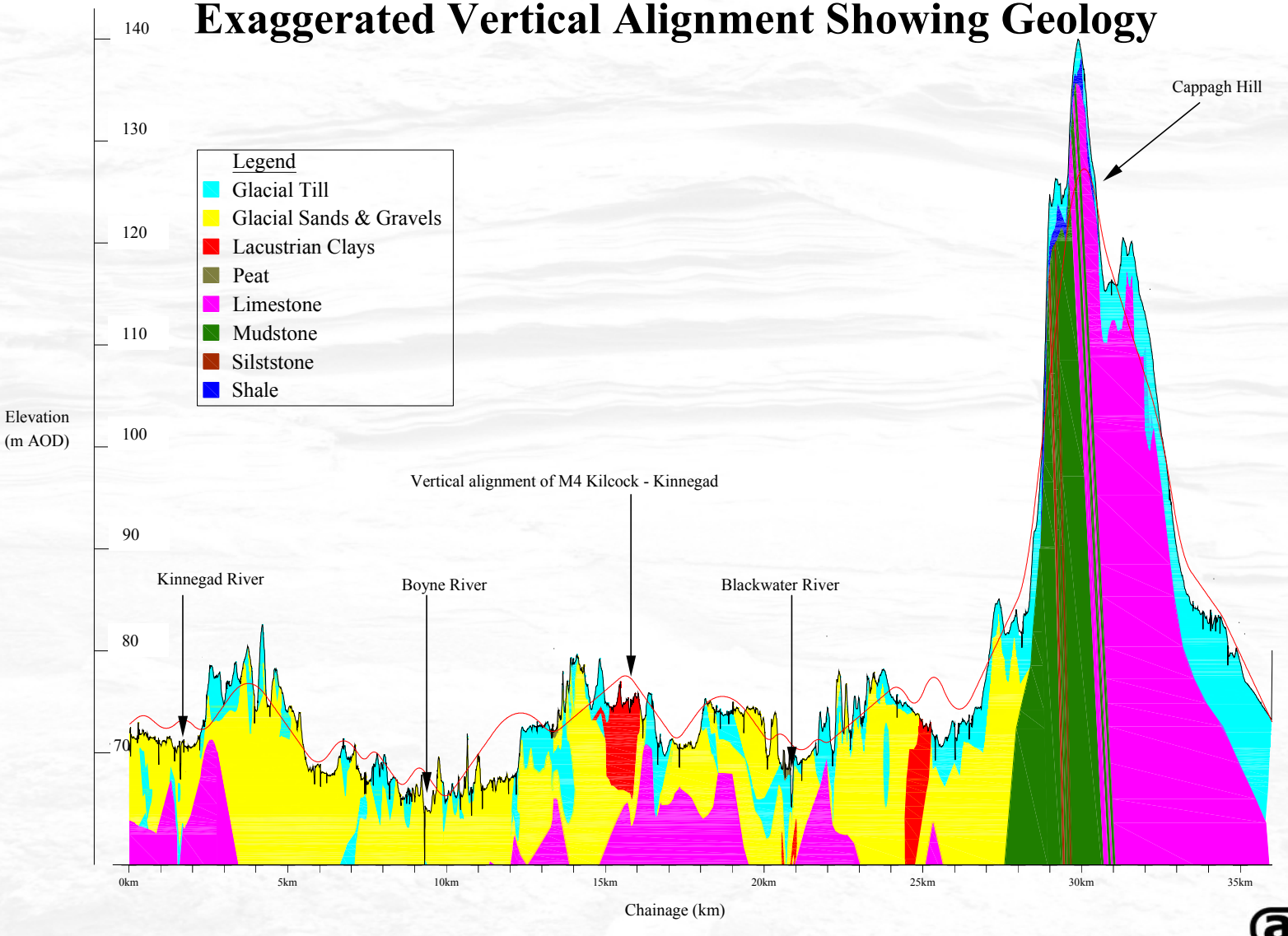
Location and Geological Setting - Soils



Source: Meehan (2005)

- Alluvium
- Peat
- Esker gravel
- Gravel
- Lacustrine clay/silt
- Till derived from limestone
- Till derived from Namurian sandstone and shale
- Bedrock
- Man-made ground
- Borrow area

Exaggerated Vertical Alignment Showing Geology



Main Soil and Rock Types Encountered

Main Soil Types

- Alluvial/Lacustrine Deposits
- Glacial Till
- Glacial Sand and Gravel
- Peat Deposits
- Topsoil

Main Rock Types

- Nanoose (limestone, sandstone and shale)
- Limestone (various)

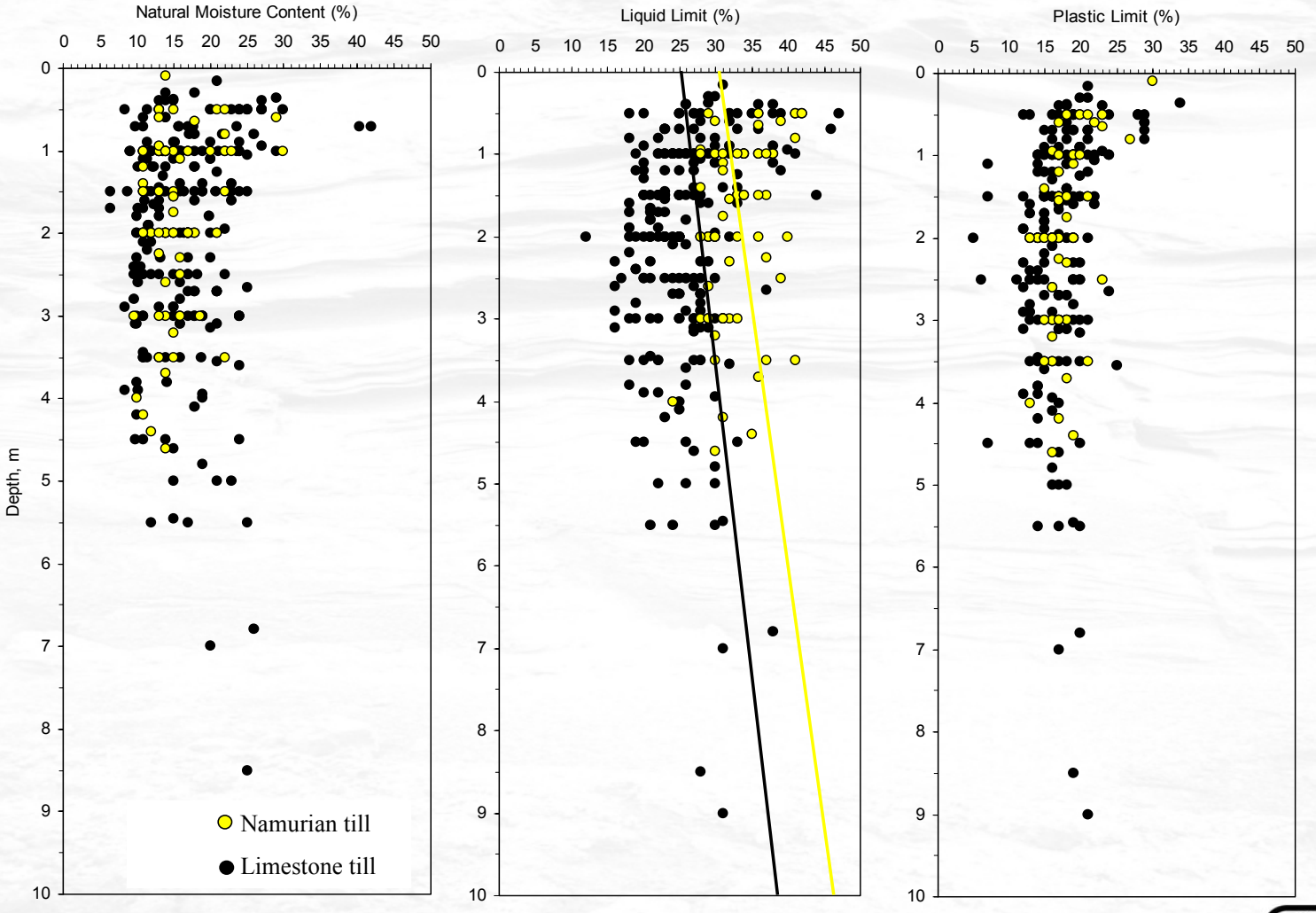
Glacial Till

- Most commonly encountered soil type
- Approximately 0.9million m^3 excavated
- Till described as sandy gravely clay of low plasticity consisting of predominantly a fine matrix with varying amounts of coarser material.
- Two main till types present along the route

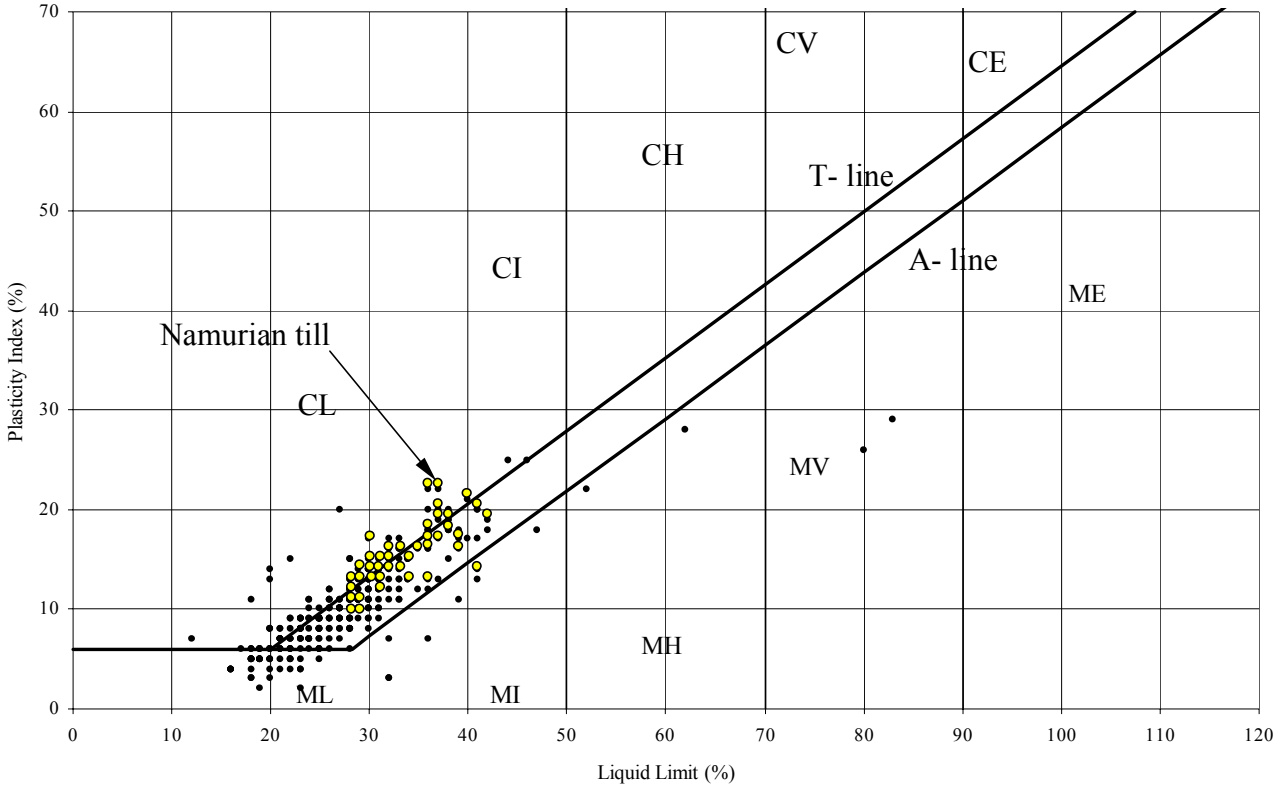
  - Limestone derived till

  - Sandstone and shale derived till (Namurian)

Glacial Till- Characteristics



Glacial Till- Characteristics



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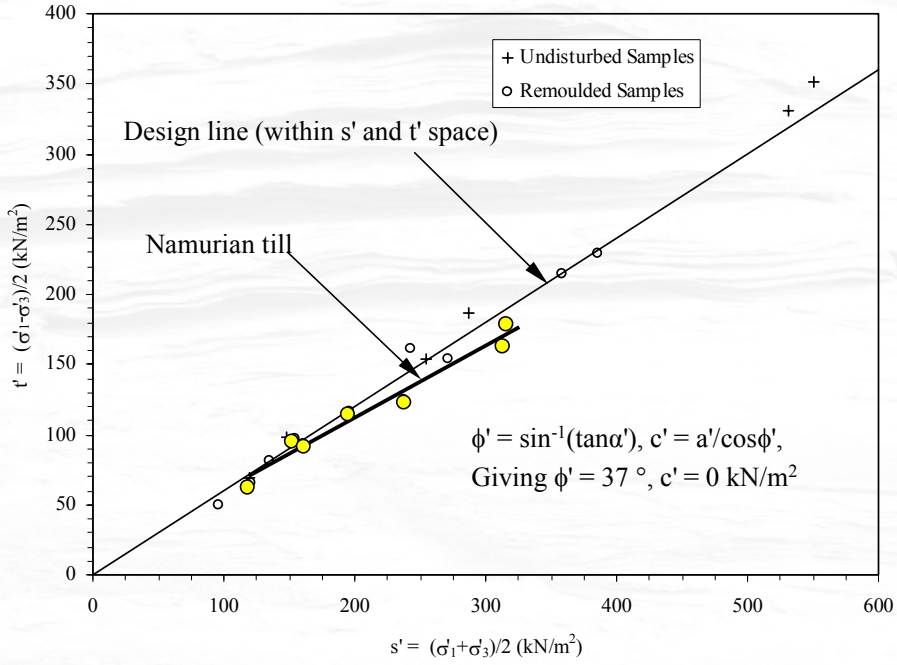
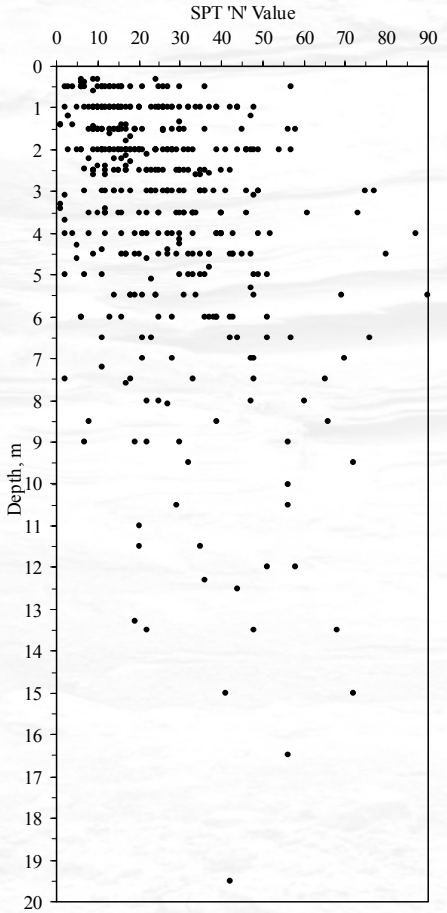
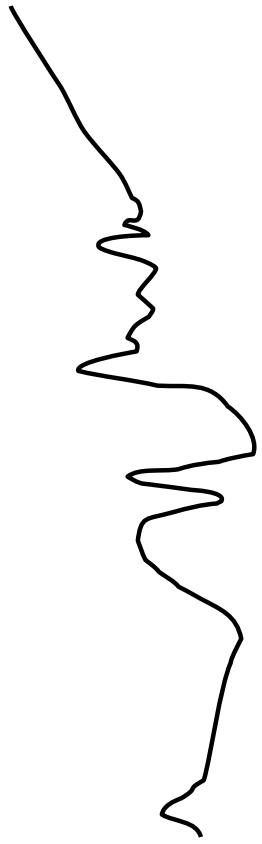


Glacial Till- Characteristics





Glacial Till - Engineering Design

Slopes

Comprised some 23 fill and 22 cut slopes

Height from a few metres to 15m, length c.100m to 1500m

Cut slopes typically 1(v):2(h)

Fill slopes typically 1(v):2(h) or flatter

Pavements

CBR typically 2% to 6%

Acceptability

Can vary widely (depth, type of till, drainage)

Typical greater than 60%

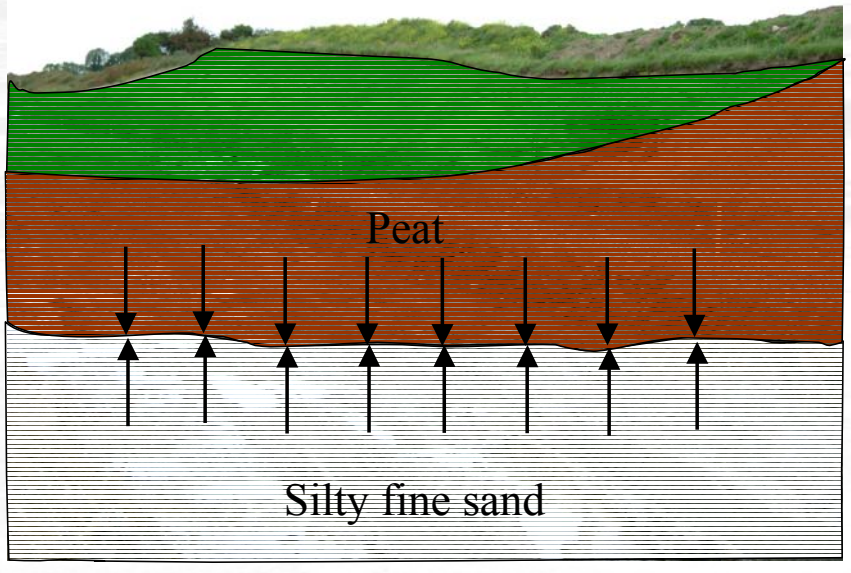
Soils – Glacial Till

Soils – Soft Ground

Soft ground areas

Excavation of soft ground

Soils – Quick Conditions



Quick conditions

Solution – membrane and rock fill

Soils - Borrow Pits

Before

After

(side view)

Namurian Rock at Cappagh Hill

Rock type in Cappagh Hill area only

Rock comprised interbedded mudstones, siltstones, sandstones, calcareous mud/siltstone, argillaceous limestone

Cutting in rock up to 20m high and 1.5km long

Adverse joints with relatively low friction, variable rock quality

Design options comprised

- 1(v): 0.8(h) cut slope with some rock support measures
- 1(v):1.5(h) cut slope with no rock support measures (adopted)

Generally not practical to separate rock for re-use as Class 6 fill

Approximately 0.8 million m^3 of rock excavated from Cappagh Hill

Rock – Cappagh Hill

Inter-bedded nature of Namurian within cutting

Rock – Cappagh Hill

Thicker competent sandstone beds exposed in cutting

Rock – Cappagh Hill

Cappagh Hill cutting during construction

Rock – Cappagh Hill

Cappagh Hill cutting nearing completion

Closing Remarks

Most engineering roadworks carried out within glacial soils

Soils/quaternary maps provide useful guide into engineering behaviour

Knowledge of origin of soil types important

Glacial till dominant soil type (variable)

Borehole investigation at Cappagh Hill showed reasonable rock quality

Weathering and inter-bedded nature of rock resulted in poor rock quality

Road opening date **12 December 2005**


Finish