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How the West Was One

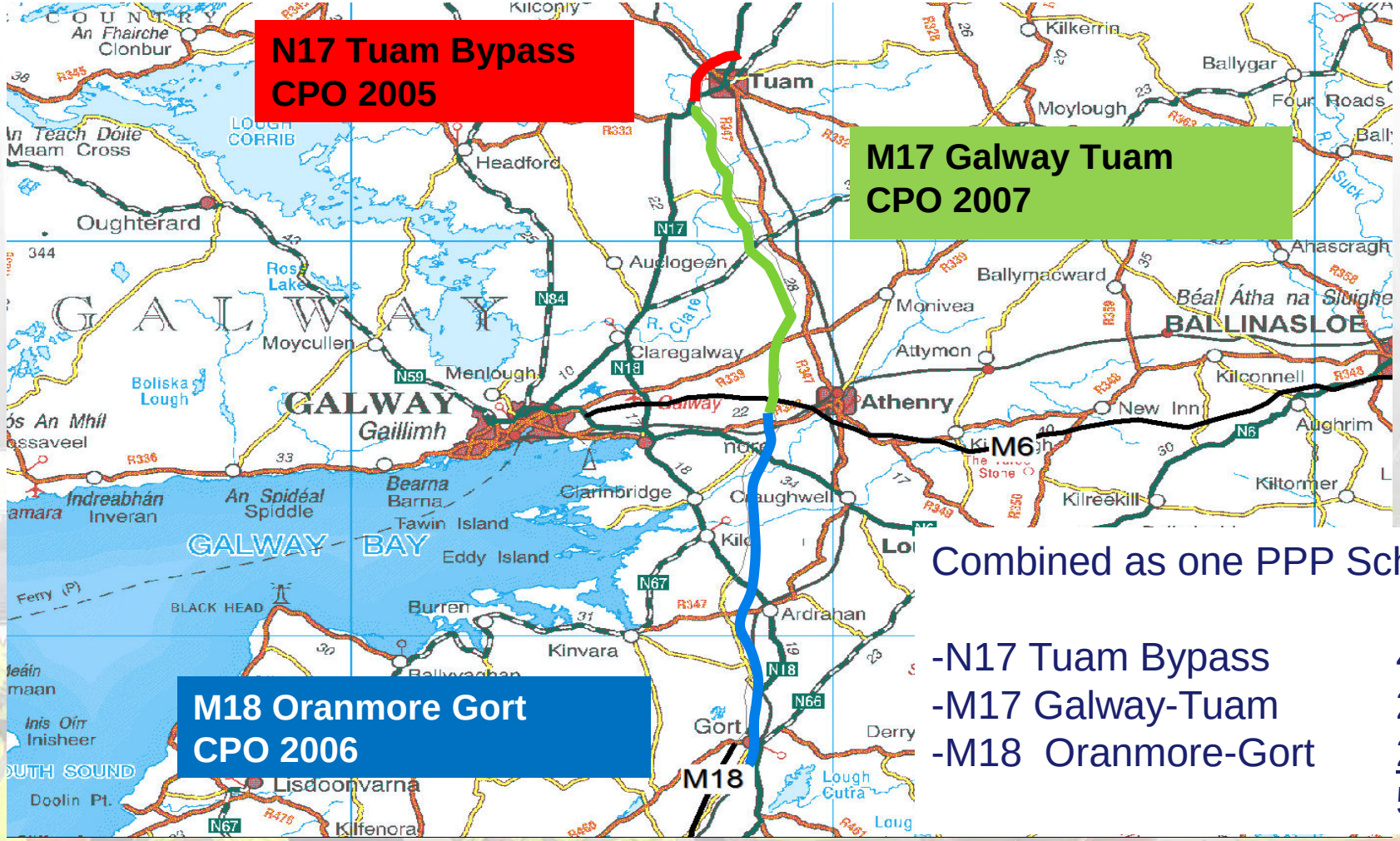
N17N18 Gort to Tuam PPP Scheme

Project Background And Pavement Aspects

Outline of Presentation

Overview of Project	**John Crowley** **DirectRoute Tuam (Construction) Ltd.**
Design and Construction Challenges	**Eamon Daly** **CH2M Barry**
Pavement Aspects	**David Fanthorpe** **CH2M Barry**

N17/N18 Gort To Tuam PPP Scheme

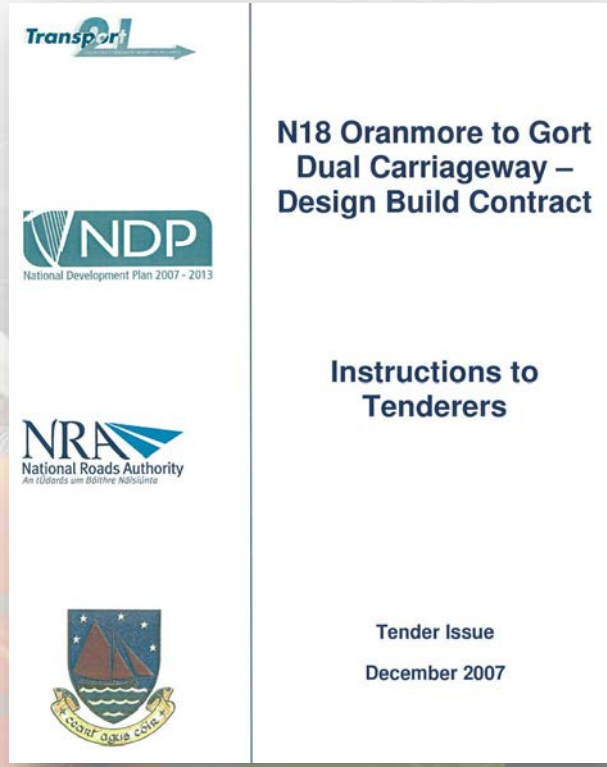


Combined as one PPP Scheme

-N17 Tuam Bypass	4km
-M17 Galway-Tuam	26km
-M18 Oranmore-Gort	27km
	57km

N17/N18 – History of Project - 1

- 3 Separate Projects
- 3 Separate Statutory Process Approvals
- N18 D&B Tender Process 2008
- D&B Tender Process not completed due to economic downturn



N17/N18 – History of Project - 2

- 3 Projects combined into single PPP Project
- Procurement commenced Spring 2009
- 4 PPP Consortia Prequalified
- Stage 1 Submissions November 2009
- Stage 2 BAFO Submission August 2010 - Preferred Bidder No 1
- Second BAFO Submission August 2011 - Preferred Bidder No 2
- Procurement Suspended and Reopened
- Financial Close - April 2014

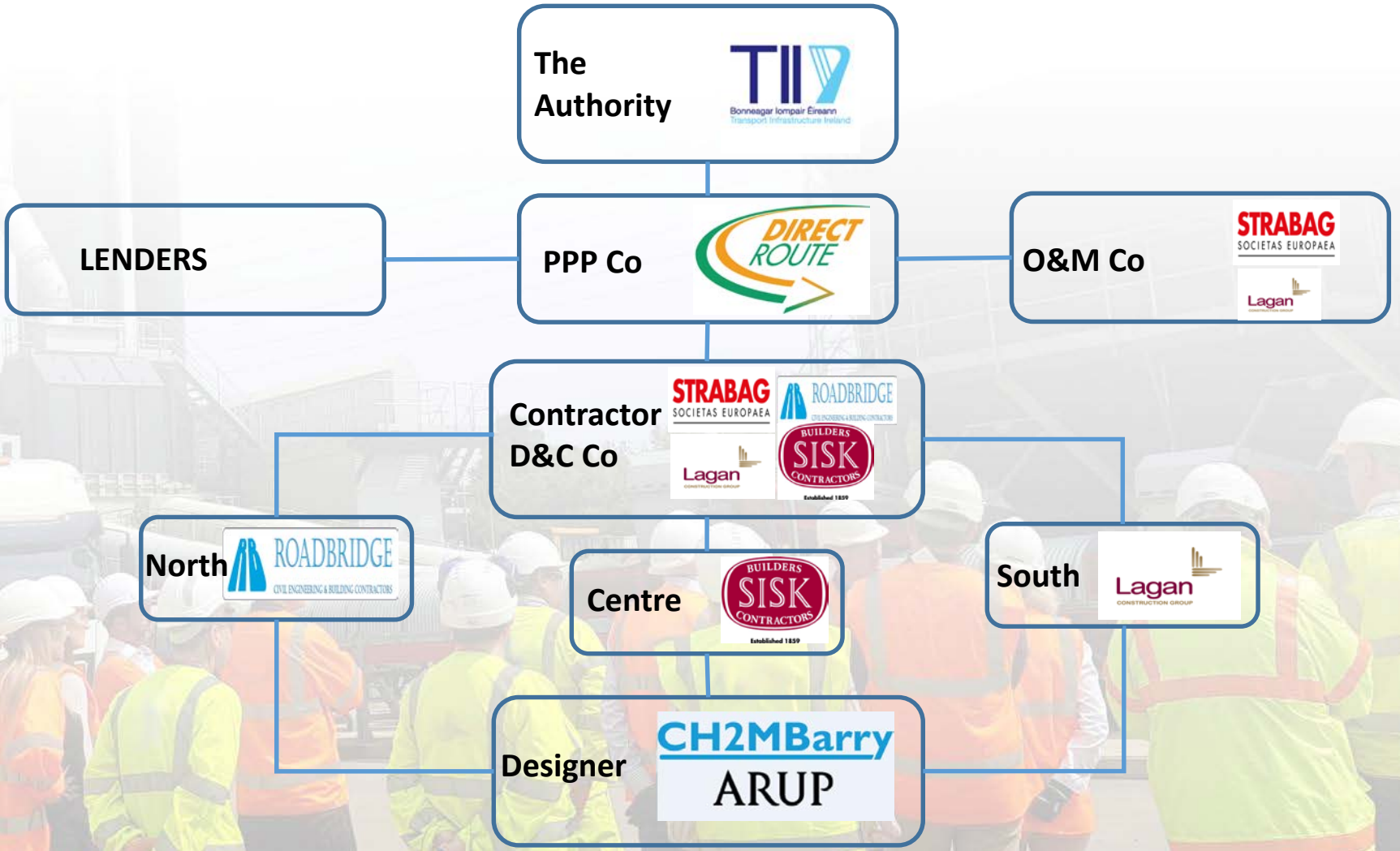
N17/N18 Delivery Programme

• Financial Close	April 2014
• Mobilisation, Advance Work & Detailed Design	April–Dec 2014
• Construction Start	January 2015
• N17/N18 Motorway Opening	Q4 2017
• Operation & Maintenance	2017 - 2042

N17/N18 – PPP Model

- 25 year concession period (2017-2042)
- Private sector designs, builds, finances and operates (incl. maintenance) the Project Road
- Private sector funds construction
- PPP Co. receives availability payments over 25 years
- Road returns to public sector with prescribed residual life

PPP Structure – DirectRoute Team



Design Joint Venture

- Design Joint Venture consists of joint venture between CH2M Barry and Arup
- Tender Design was completed in 2010 and forms the Conceptual Design
- CH2M Barry are designers for the northern half of the scheme, Arup designers for the southern half of the scheme
- Design commenced in May 2014 with the preparation of a Design Manual to standardise design approach across the Scheme
- Max Design Team at Peak: Design Office: 93 Site: 25
- Design is now complete. As-builts being produced

Scheme Information – Key Elements

- 53km of Standard Dual Carriageway Motorway
- 4km of Type 2 Dual Carriageway
- 4 grade Separated junctions including a major junction with the M6 Motorway
- Link Roads, Side Road Diversions and Access Roads
- 71 Principal Structures including road bridges, river bridges, rail bridges, footbridges, accommodation bridges and culverts,
- 33 other structures including retaining walls, gantry signs and VMS signs
- Fencing, Safety Barriers, drainage, communications, earthworks, signage, lining, landscaping, lighting, utilities, environmental and ancillary road works

Scheme Information – Key Quantities

Material	Quantity
Bulk Earthworks	4,340,071m^3
Rock	1,827,053m^3
Suitable & Unsuitable Material	2,513,017m^3
Fencing	150,000m
Structures	71 number
Structural Concrete	30,000m^3
CBM	198,324m^3
804	236,098m^3
Blacktop	210,720m^3

Key Design Challenges

- Three Contractors – Two Designers – Different Requirements
- The design of significant Peat areas within the Tuam Bypass and on the M17 south of Tuam
- Design of earthworks through karst areas
- Flooding
- Environmental
- Structures
- Pavement

Key Construction Challenges

- Three Separate Design Supervision Teams with a DSR overseeing all three
- Three Separate Contractors
- Three Separate Authority's Representative supervision teams
- The management of areas of significant Peat
- Construction through areas of Karst Features within limestone bedrock
- Construction of the Rathmorrissy Interchange over the live M6 Galway – Ballinasloe Motorway
- Construction over watercourses – prevention of an impact on the watercourse and maintaining the integrity of river banks for wildlife

Environmental Challenges

- Scheme encroaches into the catchment area of the Lough Corrib SAC and crosses the Abbert and Grange tributary rivers

- Scheme is adjacent to the Coole – Garryland Complex (SAC, pNHA, SPA, SNR) and Kiltiernan Turlough (SAC, pNHA)

- Nationally rare plants present – Mudwort, Dropwort, Alder, Buckthorn, Lady's Tresses, Orchid and Wood Bitter Vetch

cSAC – Candidate Special Area of Conservation,
pNHA – Potential National Heritage Area,
SPA – Special Protection Area,
SNR – Statutory Nature Reserve

Environmental Challenges

The habitats of protected species that are located within the scheme –

Whooper Swan

Pine Martin

Bewicks Swan

Otter

Lesser Horsehoe Bat

Environmental Mitigation

Coole Green Accommodation Overbridge

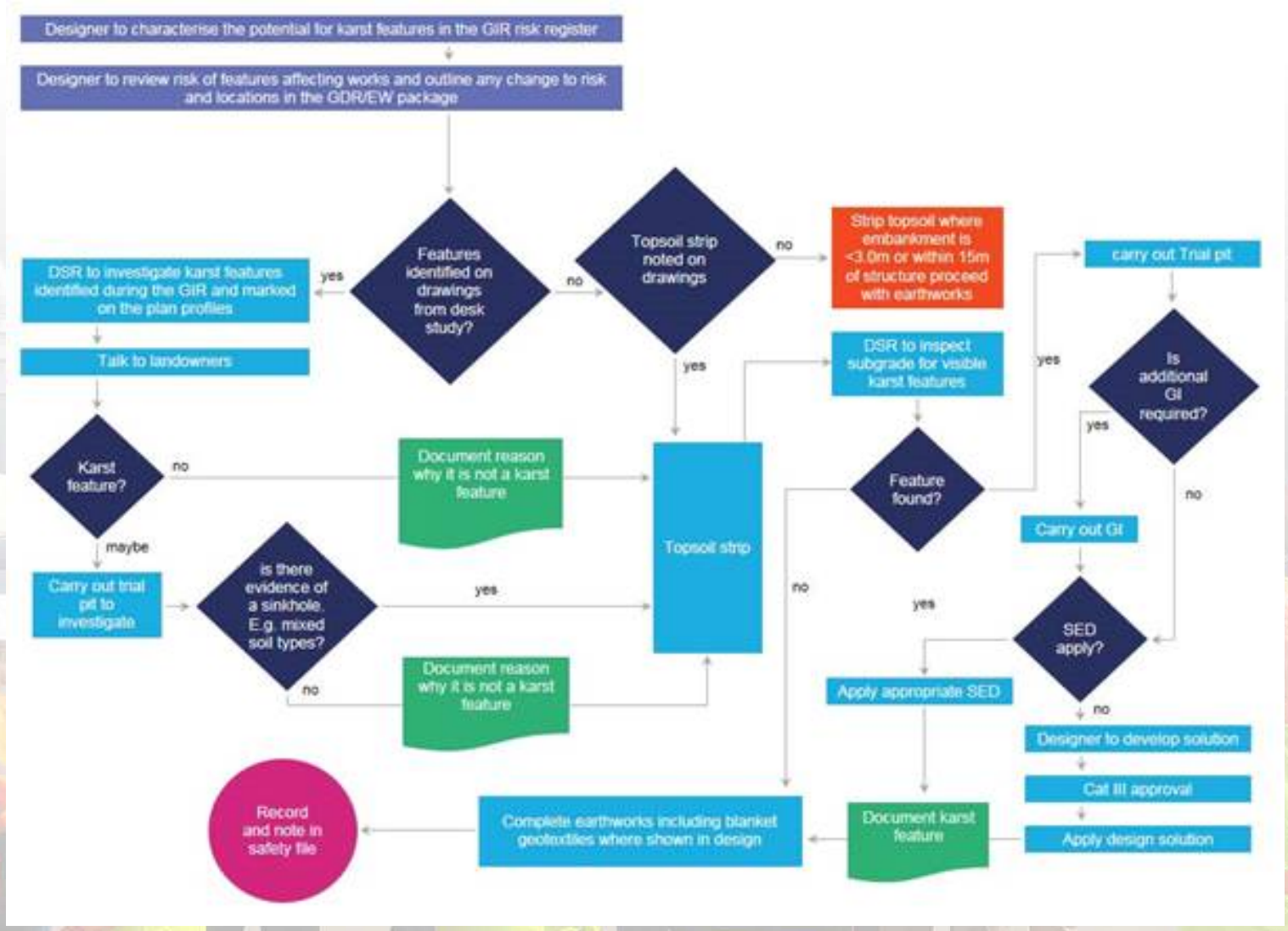
Flooding – Nov 2015

Flooding – Nov 2015

Mitigation against Flooding

- Drainage Blanket
- Road Design Levels
- Flood Relief Culverts

Earthworks - Karst Protocol



Karst Features at Structures

M17 Ballinphuil Overbridge

- 8 conduit karst features converging at the Central Pier
- Clay filled void
- 12m in length
- 8m in width
- 8m to solid rock

Ballinphuil: How did we fix this on Site?

Karst Features at Structures

M17 Ballygaddy Overbridge

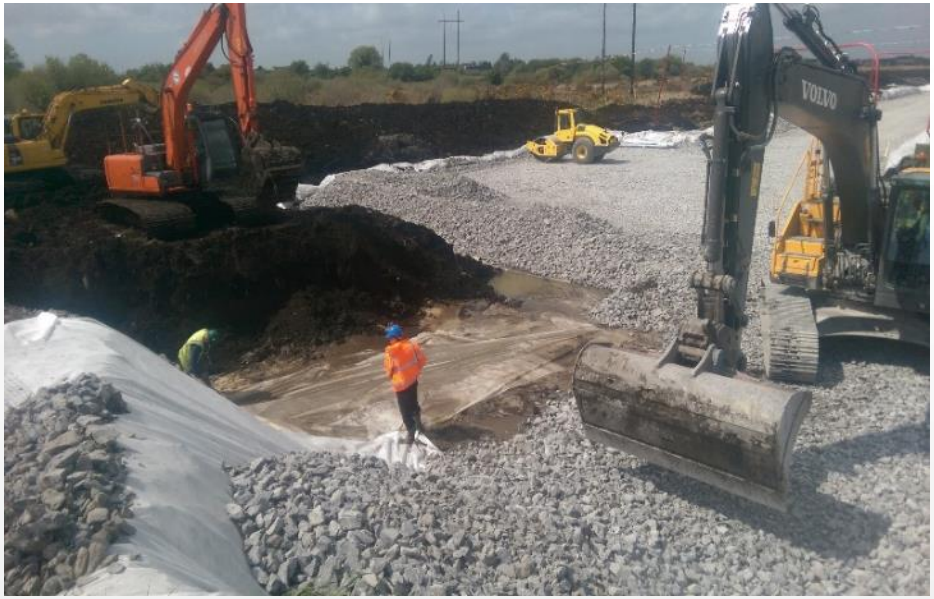
- Large Linear Karst Feature
- Saturated sand filled void
- 3.5m width
- Minimum 20m in length
- 13m to solid rock

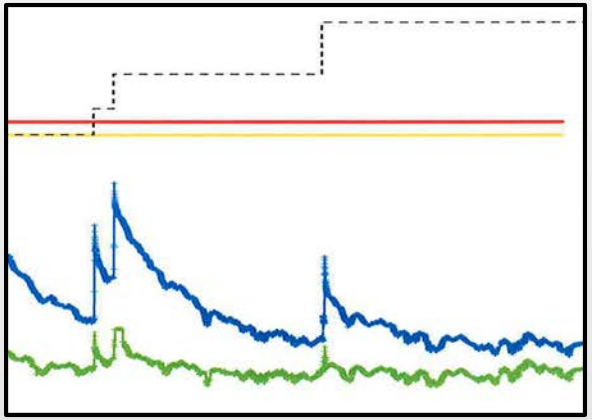
Ballygaddy: How did we fix this on Site?

Soft Ground Treatment

Soft Ground

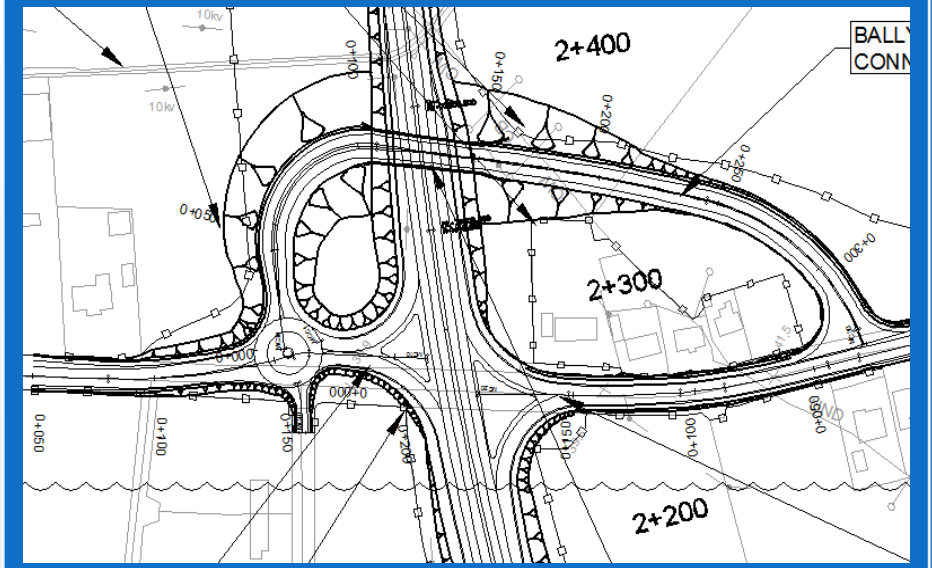
- Approx. 3km of soft ground
- Vertical band drains at 1.0m spacing
- 5 Loading stages
- Up to 7m of embankment
- 1.5 years duration
- Constant monitoring of instrumentation. PWP, inclinometers, settlement plates, etc.



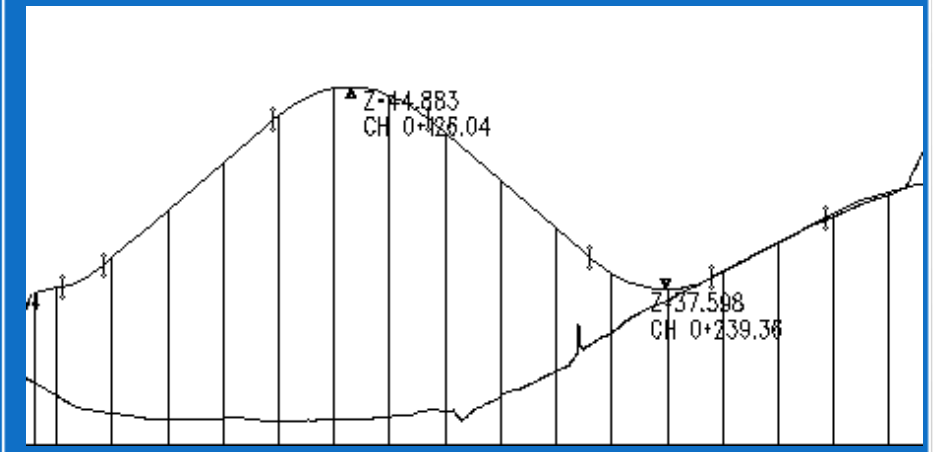


Structures - OB23 – Long span variable depth concrete beam

Plan on highway alignment



Elevation on reference design



Rathmorrissy Junction

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Pavement

Pavement Design for the N17/N18 Gort to Tuam Project Road is an analytically designed Flexible Composite Pavement, designed in accordance with TRL Report 615

Non-Project Road – designed to standard method (Chpt 4-5 of HD25-26) for a 40 year design life

Why analytical Design?

- Common on many PPP Projects
- Based on customising design to locally available materials and construction methods
- Maximise whole life value
- However, additional testing required to prove design assumptions are achieved in situ.

Why Flexible Composite Pavement?

- Site won Aggregate – very significant limestone rock ideal for aggregate
  - Sustainable use of Material
  - Cost Efficiency

Flexible Composite design in soft ground?

- Assumed foundation CBR of 15% proved through testing
- Primary settlement fully achieved and significant secondary settlement achieved through maintaining surcharge beyond required design period
- Use of geosynthetics as reinforcement to pavement layers eg Kilmore Roundabout
- Reduced crack induced spacings to 2m.

All reducing the potential for settlement or reflective cracking

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Typical Pavement Make-up for Design Traffic of 36-56msa based on Analytical design

Layer	Clause	Mat.	Grade of Binder	Thickness (mm)
Surface Course	942	SMA 10 surf PMB 65/105-60 des		30
Binder Course	929	AC 20 dense bin des	40/60	55
Upper-Base	929	AC 32 dense base des	40/60	75
Thickness of Asphalt				**160**
Lower-Base	822	CBGM B C12/15		180
Sub-base	808	Type B		100
Capping	613	6F1 r 6F2		-
TOTAL THICKNESS (mm)			**440 mm**	

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Pavement Construction

CGBM Placement M17 Corofin

Tuam Bypass Ch150 NB - Wearing Course

Wearing course M17 Corofin

Tuam Bypass Ch 400 – Sand patch testing

Pavement Handback Requirements (Schedule 25) – 10 year residual life handback requirement in common with other PPP Schemes

Pavement Maintenance & Survey Requirements (Schedule 7 Annex 4 to Part 1)
Maintenance work will be identified by:

- Surface characteristics – Skidding Resistance – SCRIM
  Ride Quality – AAN Testing for rutting and texture
- Structural Performance – Visual defects
  Residual Life assessed by FWD
  Pavement layer Thickness – ground radar and or coring/pitting

Pavement Intervention Strategy developed based on design to maximise design life of pavement.

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Maintenance Assessment Surveys – Survey characteristics

Performance Indicator	Measuring Equipment	International Standard/ Guidelines	NRA Guide-lines	Survey Frequency (years)				Investigatory Levels				Minimum Performance Levels During the Operations				Minimum Performance Levels at Handback			
				H/S	L1	L2/L3	Slip Roads	H/S	L1	L2/L3	Slip Roads	H/S	L1	L2/L3	Slip Roads	H/S	L1	L2/L3	Slip Roads
SCRIM Reading (SR) (see Note 3)	SCRIM (Skidding Resistance)	HD 28	See paragraph 3.1 of this Annex 4 to Part 1	Refer to Notes 3 - 6	1	2	1	Average SCRIM Coefficient (as defined in Annex 3 of HD 28/04) less than 0.40 (Site category A) and less than 0.50 (Site category Q) as per Table 4.1 of HD 28/04				Average SCRIM Coefficient (as defined in Annex 3 of HD 28/04) greater that 0.35 (Site category A) and greater than 0.15 (Site category Q) as per Table 4.1 of HD 28/04				Average SCRIM Coefficient (as defined in Annex 3 of HD 28/04) greater than 0.40 (Site category A) and greater than 0.50 (Site category Q) as per Table 4.1 of HD 28/04			
nternational Roughness Index (IRI)	RSP		See paragraph 3.1 of this Annex 4 to Part 1	Refer to Notes 7 - 9	1	2	1		IRI of 80% of the 20m sections greater than 2.3 m/km in each 200m				IRI of 80% of the 20m sections not greater than 2.5 m/km and 100% of the 20 metre sections not greater than 2.7 m/km in each 200m				IRI of 80% of the 20m sections not greater than 2.3 m/km and 100% of the 20 metre sections not greater than 2.5 m/km in each 200m		
Surface Texture (MPD)	RSP		See paragraph 3.1 of this Annex 4 to Part 1	Refer to Note 9	1	2	1		Average MPD greater than 1.0				Average MPD greater than 0.8				Average MPD greater than 1.2		
Rut Depth	RSP		See paragraph 3.1 of this Annex 4 to Part 1	Refer to Note 10	1	2	1		More than one 20m section with Rut Depth exceeding 9mm in each 200m				(i) Not more than two 20m sections greater than 9mm in each 200m, and (ii) Average Rut Depth not exceeding 6mm				(i) Average Rut Depth not exceeding 5mm, and (ii) Not more than one 20m section exceeding 9mm in each 200m		

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Maintenance Assessment Surveys – Structural Performance

		Relevant Standard/Guidelines		Survey Frequency (years)				Investigatory Levels				Minimum Performance Levels During the Operations				Minimum Performance Levels at Handback (pursuant to Part 3 of Schedule 4)			
		Reference	Survey Category																
Performance Indicator	**Measuring Method**			**H/S**	**L1**	**L2/L3**	**Slip Roads**	**H/S**	**L1**	**L2/L3**	**Slip Roads**	**H/S**	**L1**	**L2/L3**	**Slip Roads**	**H/S**	**L1**	**L2/L3**	**Slip Roads**
Surface Condition (Cracking/ Spalling)	Visual Condition Survey	Refer to Notes 1 & 5 below	Bituminous Surfacing	Refer to Note2	4	4	4	WC>5%				WC not > 10%				WC not > 5%			
			Concrete Surfacing	Refer to Note2	4	4	4	STEP > 5mm SPALL > 5% FAIL > 5%				STEP not > 10mm SPALL not > 10% FAIL not > 10%				STEP not > 5mm SPALL not > 5% FAIL not > 5%			
Structural capacity	Falling Weight Deflectometer	HD 29 (DMRB Section 7.3.2.5) and paragraph 3.2 (b) of thisAnnex 4 to Part 1 and Note 3 below		Refer to Note 2	4	4	4	RESIDUAL LIFE (Years)				RESIDUAL LIFE (Years)				i) Average residual life overall > 10 years, and			
								<10	<10	<10	<10	>5	>5	>5	>5	ii) Minimum Residual Life > 5 years			

1. Key to Visual Condition terms
   WC Single longitudinal wheelpath cracking and multiple wheelpath cracking and crazing as defined in DMRB 7.3.2.3 Table 3.1
   10% WC in ten percent of wheelpath length
   STEP Measured step at joint or crack
   SPALL Shallow or deep spalling as percentage of joint length
   FAIL Failure criteria defined in RR87 as percentage of bays For CRCP apply the RR87 criteria to 25m Lane Length
2. Assessment to be carried out as required, as detailed in this Part.
3. Key to FWD terms
   RESIDUAL LIFE – Residual life to critical conditions in years, see section 4 of this Annex 4 to Part 1 for details of procedure
   Average Residual Life – Calculated for each 200 metre section of lane and then averaged
   MINIMUM RESIDUAL LIFE – Calculated for each 500 metre section of lane
4. Key to general terms: H/S – Hard Shoulder; L1, L2 and L3 – Lane 1, Lane 2, and Lane 3.
5. Visual Condition Survey Guidelines: For CRCP (100mm or more surfacing) apply bituminous surfacing criteria; for rigid pavements with 25mm or less bituminous surfacing apply concrete criteria; for rigid pavements with 25-100m depth of surfacing apply both criteria.
6. Each lane, hardshoulder and auxiliary lane each to be tested, reported and assessed against Minimum Performance Levels as separate entities, unless otherwise set out in the Specification.

Maintenance Strategy

Year of Operation	Planned Treatment
10-12 years	Milling, then Inlay of 30-40mm TSCS
23-25 years	Milling, then inlay of 30-40mm TSCS

These treatments will achieve a minimum 40 year design life of the pavement exceeding handback requirements of Concession period + 10 Years