ALOP/DSU coverage for tunnelling risks?

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ALOP/DSU coverage for tunnelling risks?

Major PD Loss History

Major tunnel losses						
O/C Y	Project	Type of contract	Method	Type of loss	Cause of loss	€m
1994	Great Belt Link, Denmark		TBM	Ingress of water		32
1994	Munich, Germany		NATM	Collapse	Faulty design(soil)	2
1994	Heathrow Express Link, UK		NATM	Collapse	Faulty workmanship	150
1994	Taipei Metro, Taiwan		TBM	Ingress of water	Faulty workmanship	12
1995	Los Angeles Metro, USA		TBM	Collapse	Faulty workmanship	16
1995	Taipei Metro, Taiwan		TBM	Ingress of water	Faulty workmanship	30
1999	Hull Yorkshire Tunnel, UK	design and build	TBM	Collapse	Faulty design?	64
1999	Anatolian Highway, Turkey			E/Q	E/Q	121
2000	Taegu Metro, Korea		Cut and Cover	Collapse	Faulty design/work	13
2000	TAV Bologne – Florence, Italy		NATM	Collapse		5
2002	Taiwan High Speed Railway	design and build	NATM	Collapse		11
2002	Autoroute A86 – Rueil, France		TBM	Fire		11
2003	Shangai Metro		Freezing	Collapse	Faulty workmanship	69
2004	Singapore Metro, Singapore	design and build	Cut and Cover	Collapse	Faulty design/work	41
2005	Barcelona Metro, Spain		NATM	Collapse		t.b.a.
2005	Lausanne Metro, Switzerland			Collapse		t.b.a.
2005	Lane Cove Tunnel, Sydney,		NATM	Collapse		t.b.a.
2005	Kaohsiung Metro, Taipei		TBM	Collapse	Faulty workmanship	12
	18 major losses				Total	>571

Reaction of the markets

- Refrain from underwriting CAR tunnel risks
- Control the risk by way of
  - Limiting the indemnity (tunnel clause)
  - Introducing risk management (Code of Practice)

Increasing demand for ALOP/DSU coverage

More and more tunnels are being built worldwide

Tunnels projects are privately planned and financed

- **Risks are shifted from public bodies to contractors and transferred to the insurers**
- **Lenders need protection against delay in start-up**

In short: increasing demand for higher exposed risks

ALOP/DSU coverage for tunnelling risks?

As-If ALOP/DSU Loss History

Major tunnel consequential losses delays in month						
O/C Y	Project	Type of contract	Method	Type of loss	Cause of loss	Months
1994	Great Belt Link, Denmark		TBM	Ingress of water		12
1994	Munich, Germany		NATM	Collapse	Faulty design(soil)	10
1994	Heathrow Express Link, UK		NATM	Collapse	Faulty workmanship	14
1994	Taipei Metro, Taiwan		TBM	Ingress of water	Faulty workmanship	12
1995	Los Angeles Metro, USA		TBM	Collapse	Faulty workmanship	15
1995	Tapei Metro, Taiwan		TBM	Ingress of water	Faulty workmanship	18
1999	Hull Yorkshire Tunnel, UK	Design and build	TBM	Collapse	Faulty design?	26
1999	Anatolian highway, Turkey			E/Q	E/Q	36
2000	Taegu Metro, Korea		Cut and Cover	Collapse	Faulty design/work	9
2000	TAV Bologne – Florence, Italy		NATM	Collapse		0
2002	Taiwan High Speed Railway	Design and build	NATM	Collapse		0
2002	Autoroute A86 – Rueil, France		TBM	Fire		6
2003	Shangai Metro		Freezing	Collapse	Faulty workmanship	47*
2004	Singapore Metro, Singapore	Design and build	Cut and Cover	Collapse	Faulty design/work	18*
2005	Barcelona Metro, Spain		NATM	Collapse		24*
2005	Metro Lausanne, Switzerland			Collapse		t.b.a.
2005	Lane Cove Tunnel, Sydney,		NATM	Collapse		0
2005	Kaohsiung Metro, Taipei		TBM	Collapse	Faulty workmanship	24*
	14 major losses with resulting delay				Total	> 271

ALOP/DSU coverage for tunnelling risks?

As-if ALOP/DSU loss amount

((271 – (14x3)) x 2.5 = EUR 572m

As-if total loss amount (PD + ALOP/DSU)

571 + 572 = EUR 1143m

What would have been the reaction ?

ALOP/DSU coverage for tunnelling risks?

As-if ALOP/DSU net rate

Net rate (of annual SI) = loss frequency x average delay / 12

Loss frequency = 14 / total number of projects

Assumptions made

- Average value of a project = EUR 375m
- Net rate for PD cover = 1% needed for a net L/R 100%
- Time excess = 6 months

As-if ALOP/DSU net rate

Net rate (of annual SI) = loss frequency x average delay / 12

Loss frequency = 14 / total number of projects

Total value of all projects = 571 / 1% = EUR 57100m

Total number of projects = 57100 / 375 = 152

Loss frequency = 14 / 152 = 9.2%

Average delay = 271 / 14 = 19.4 months

Net rate = 9.2% x (19.4 – 6) / 12 = 10.3% of annual SI

As-if ALOP/DSU net rate

Many assumptions have to be made

Exact calculcation not possible, but

Rough net rate estimate = 8.5%~9.0% of annual SI

Is such a rate affordable?

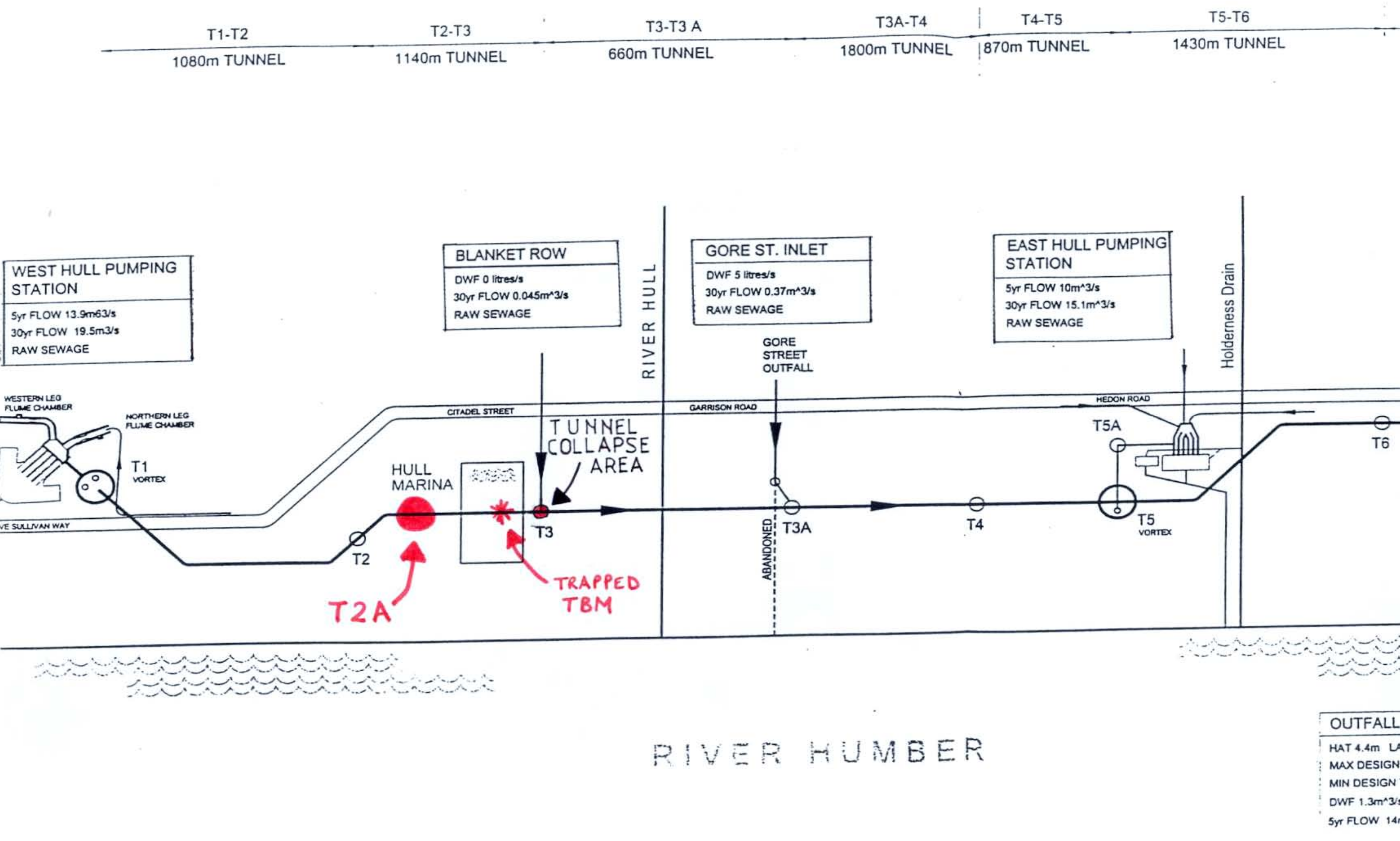
ALOP/DSU coverage for tunnelling risks?

Loss examples – Type of Losses

Type of event	Number of events
Natural events	
•Earthquake	1
•Flood	
Fire	1
Collapses	13
Other	
•Water inlet	3
•Deformations	
Losses to tunnelling equipment	
Total	18

ALOP/DSU coverage for tunnelling risks?

Loss example : Hull Sewer Tunnel (dol: 16.11.1999)



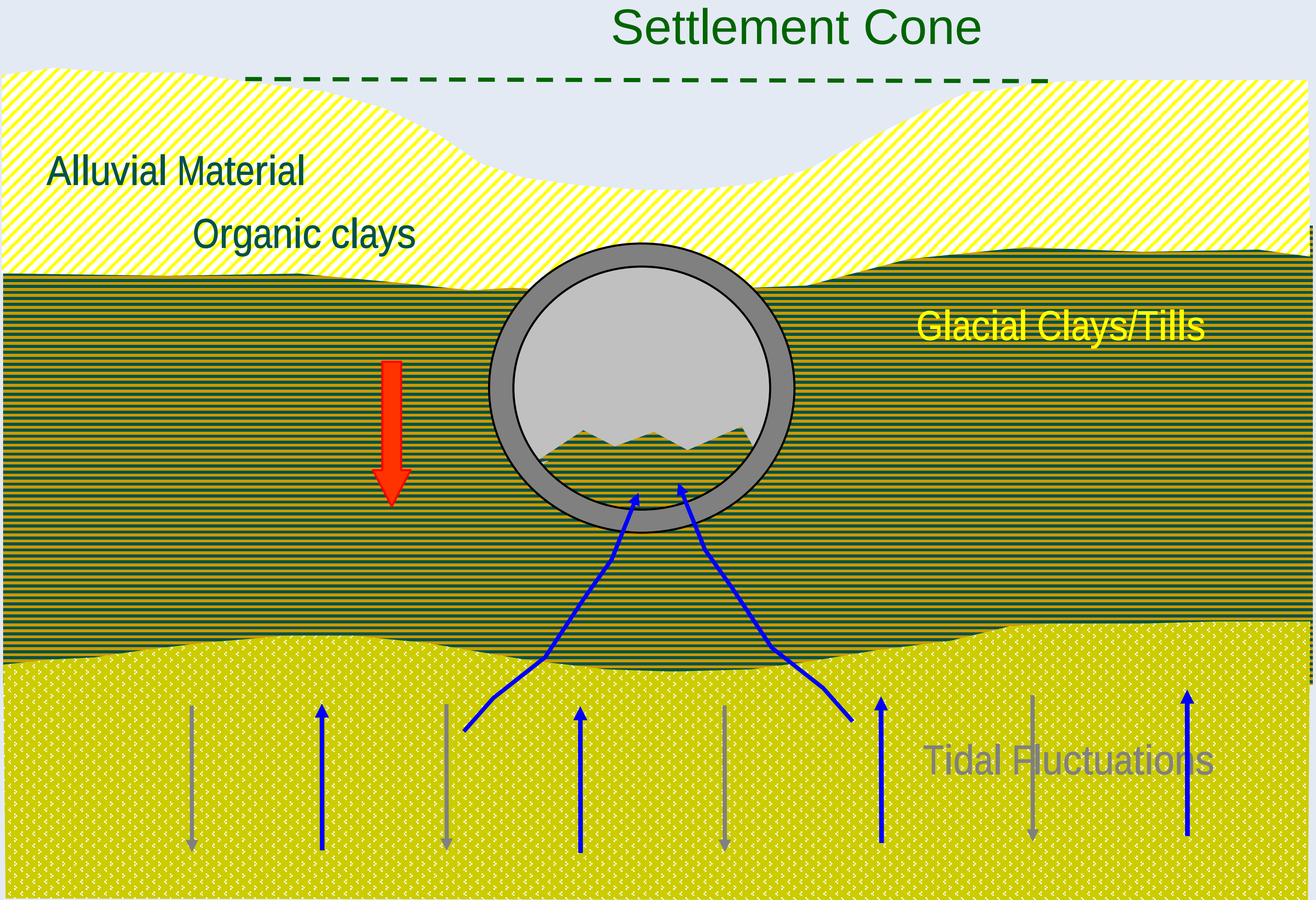
ALOP/DSU coverage for tunnelling risks?

Loss example : Hull Sewer Tunnel (dol: 16.11.1999)

Shaft T3

ALOP/DSU coverage for tunnelling risks?

Loss example : Hull Sewer Tunnel (dol: 16.11.1999)



Loss example : Hull Sewer Tunnel (dol: 16.11.1999)

Repair works (100m collapsed)

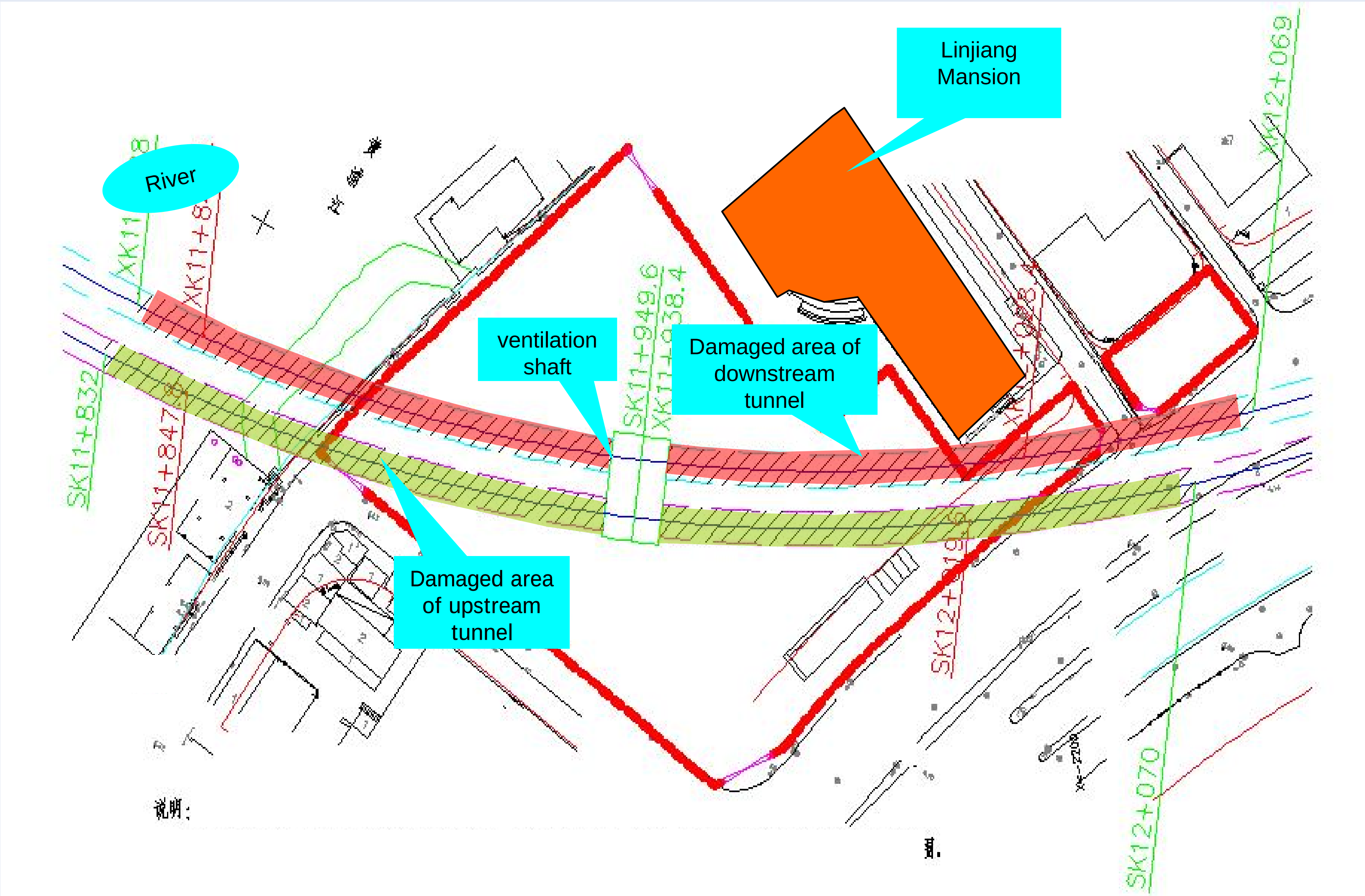
- Horizontal ground freezing from shaft, in 5 stages (20m each)
- Excavation with roadheader
- Sprayed concrete lining (heated shotcrete)

Overal delay: 26 months consisting of

- Mitigation measures (prevention of further damages on surface)
- Soil investigations
- Design of repair method
- Repair works

ALOP/DSU coverage for tunnelling risks?

Loss example : Shanghai Metro (dol: 1.07.2003)



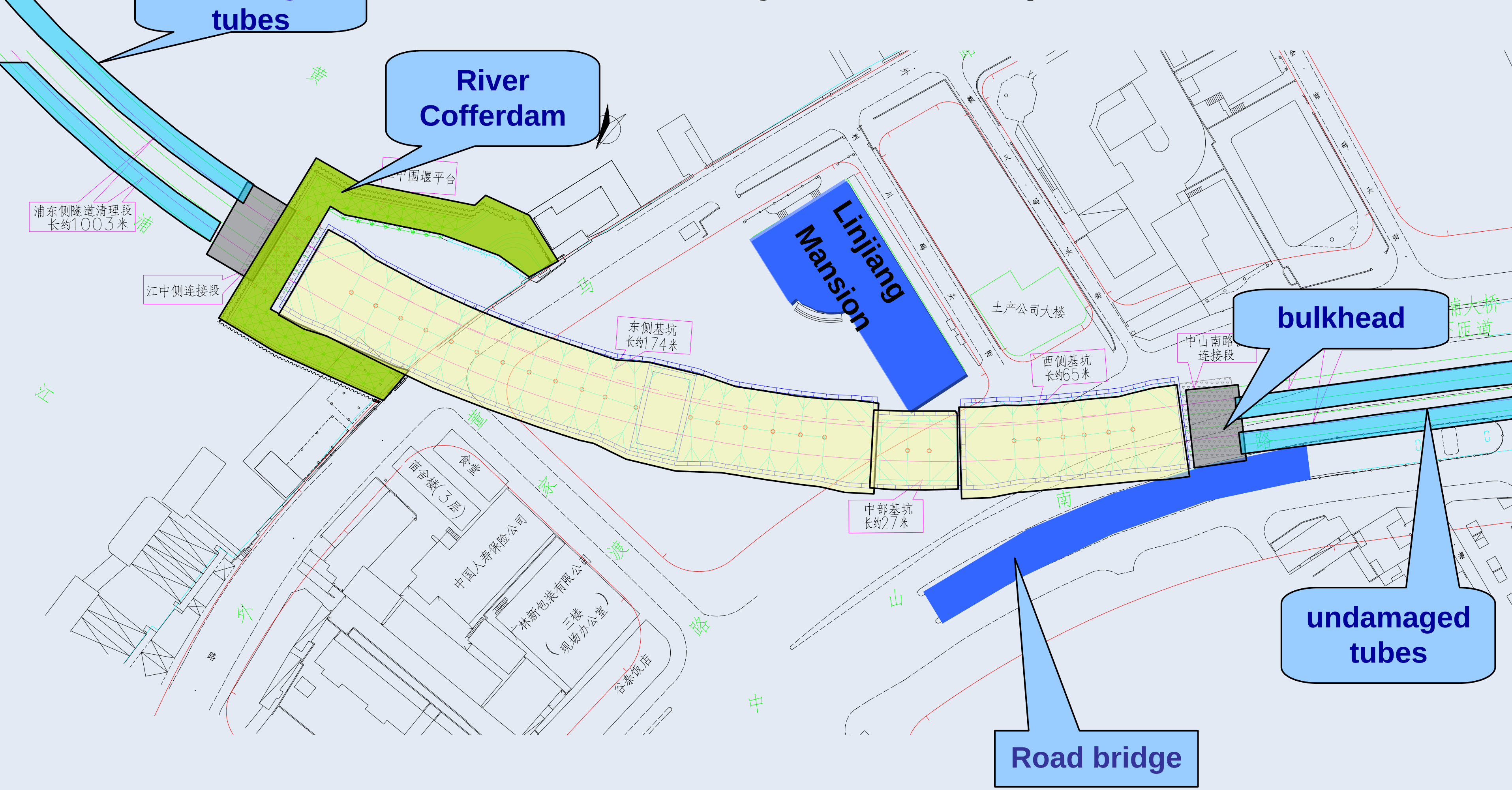
ALOP/DSU coverage for tunnelling risks?

Loss example : Shanghai Metro (dol: 1.07.2003)

ALOP/DSU coverage for tunnelling risks?

Loss example : Shanghai Metro (dol: 1.07.2003)

Layout of the repair works



ALOP/DSU coverage for tunnelling risks?

Loss example : Shanghai Metro (dol: 1.07.2003)

View of the repair works

ALOP/DSU coverage for tunnelling risks?

Loss example : Shanghai Metro (dol: 1.07.2003)

Repair works (2 x 250m collapsed)

- Open trenches 40 m deep (diaphragm walls)
- Cofferdam platform for section under the river

Overal delay: 47 months consisting of

- Mitigation measures (prevention of further damages on surface)
- Design of repair method 11 months
- Repair works 36 months

Lessons learned: why is the delay so high?

- First step: pouring all kind of materials into the crater
- Therefore delayed access to the damaged section
- Soil investigations are often needed to determine the cause of loss
- Repair method differs from original construction method
- Time needed to design the repair method
- Soil consolidation often needed before repair can begin
- Time consuming repair works

Otherwise as in EAR no possibility of reducing the delay with extra charges to speed up the delivery of spare parts

ALOP/DSU coverage for tunnelling risks?

What would have been the effect of the Code of Practice?

Major tunnel consequential losses delays in month							with TCoP
O/C Y	Project	Type of contract	Method	Type of loss	Cause of loss	Months	Months
1994	Great Belt Link, Denmark		TBM	Ingress of water		12	12
1994	Munich, Germany		NATM	Collapse	Faulty design(soil)	10	0
1994	Heathrow Express Link, UK		NATM	Collapse	Faulty workmanship	14	0
1994	Taipei Metro, Taiwan		TBM	Ingress of water	Faulty workmanship	12	0
1995	Los Angeles Metro, USA		TBM	Collapse	Faulty workmanship	15	15
1995	Tapei Metro, Taiwan		TBM	Ingress of water	Faulty workmanship	18	0
1999	Hull Yorkshire Tunnel, UK	Design and build	TBM	Collapse	Faulty design?	26	26
1999	Anatolian highway, Turkey			E/Q	E/Q	36	36
2000	Taegu Metro, Korea		Cut and Cover	Collapse	Faulty design/work	9	0
2000	TAV Bologne – Florence, Italy		NATM	Collapse		0	0
2002	Taiwan High Speed Railway	Design and build	NATM	Collapse		0	0
2002	Autoroute A86 – Rueil, France		TBM	Fire		6	6
2003	Shangai Metro		Freezing	Collapse	Faulty workmanship	47	47
2004	Singapore Metro, Singapore	Design and build	Cut and Cover	Collapse	Faulty design/work	18	0
2005	Barcelona Metro, Spain		NATM	Collapse		24	0
2005	Lausanne Metro, Switzerland			Collapse		t.b.a.	t.b.a.
2005	Lane Cove Tunnel, Sydney, AUS		NATM	Collapse		0	0
2005	Kaohsiung Metro, Taipei		TBM	Collapse	Faulty workmanship	24	24
	14 major losses with consequential delay (without TCoP)				Total	271	
	7 major losses with consequential delay (with TCoP)				Total		166

New as-if ALOP/DSU net rate

Net rate (of annual SI) = loss frequency x average delay / 12

Loss frequency = 7 / 152 = 4.6%

Net rate = 4.6% x (23.7 – 6) / 12 = 6.8% of annual SI

Rough net rate estimate = 5.5% of annual SI

Is such a rate still affordable?

How can ALOP/DSU be covered?

- **Obtain an affordable net rate**
- **Such a rate should be in the range of 2.5%**
- **No possibility to further reduce the frequency**
- **Therefore the indemnity period has to be limited**

ALOP/DSU coverage for tunnelling risks?

Limitation of the indemnifiable delay

Exclusion of delays resulting from:

- Loss or damage to TBMs or other equipment
- Stoppage of works due to enquiries from authorities
- Time needed to re-design
- Special ground treatment in crossing faults
- Construction of shafts or caverns to free or repair a TBM
- Use of compressed air or ground freezing

Maximum indemnity period: 12 months

Linking the IP and the length of the damaged section

Project	Delay (month)	Length (meter)	2 x length (meter) days	2 x length / 30 months	IP (month)
Hull	26	100	200	6.7	6.7
Shanghai	47	500	1000	33.3	12.0
Singapore	18	150	300	10.0	10.0
Kaoshiung	24	320	640	21.3	12.0

ALOP/DSU coverage for tunnelling risks?

Example of endorsement

Section III – ALOP/DSU

Special conditions concerning projects involving the construction of tunnels and galleries.

For the purpose of this Section, the indemnifiable delay in the commencement of full Commercial Operation of the Project attributable to each occurrence of Damage is the delay directly due to and not exceeding the time taken to complete the repair or reinstatement of each occurrence of Damage to its condition prior to such occurrence without taking into account any further delay attributable to :

- Loss or damage to TBMs or other mechanical equipment
- Stoppage of works requested by any authorities
- Measures needed to stabilise the ground condition immediately after the loss occurrence
- The time needed to design the repair method and to redesign the further excavation method
- Measures which become necessary to improve or stabilise ground conditions before the repair can be done
- Construction of caverns or shafts to free or repair a damaged TBM

The indemnifiable delay in days attributable to occurrences of Damage affecting tunnels and galleries shall in addition be limited to x days per metre of the immediate damaged section.

Maximum recommended indemnity period: 365 days

General conclusion

Up to now no ALOP/DSU tunnel loss known

ALOP/DSU for tunnels has a tremendous loss potential that should not be underestimated

Therefore a very meticulous risk assessment is needed

If ALOP/DSU coverage has to be granted, then:

- **Full compliance with Code of practice**
- **Special endorsement to limit the indemnifiable delay**

Thank you for your attention