Iarnród Éireann's Management of Earth Structures
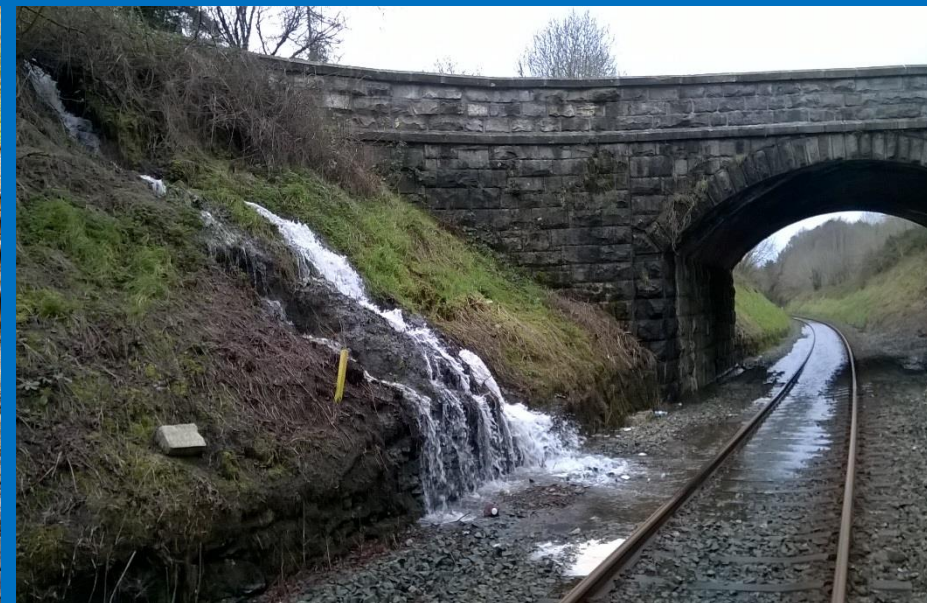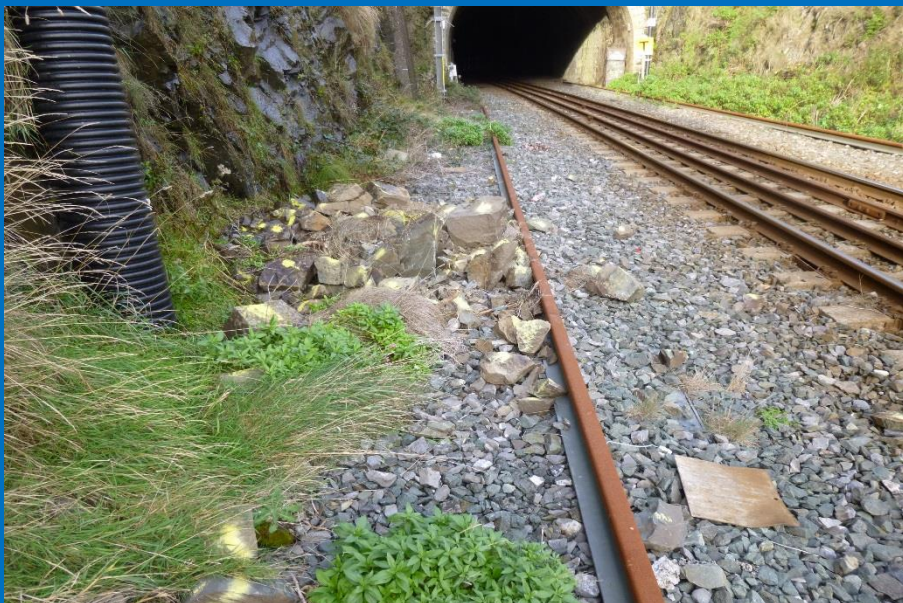
Risk Management – the unpredictable asset base

- 3,700 assets on the operational network tota

  1,300km in length

- Do not conform to any current design standa

- Built from mid-1800's to 1900

- Built using basic construction techniques and local

  materials

- Stability of these steep slopes is provided by transient

  suctions therefore making them particularly

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Recent failure incidents on the Irish Rail network

Risk Management – the unpredictable asset base

- Incidents happen throughout the network – a challenge for all rail networks

- Various scales and impacts

- A range of factors impacting – animal burrowing, de-vegetation works, failure of drainage systems and so on

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Risk Management – external influences

- While assets do not confirm to modern standards, if left alone they can function well

- When impacted by external influences, they become vulnerable

- An increasing number of incidents influenced by third parties/adjacent land owners

- Significant impacts from climate change

- These impacts are difficult to control

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External Influences

Increased Frequency of Extreme Weather Events

Longer, Wetter Winters

Iarnród Éireann Irish Rail
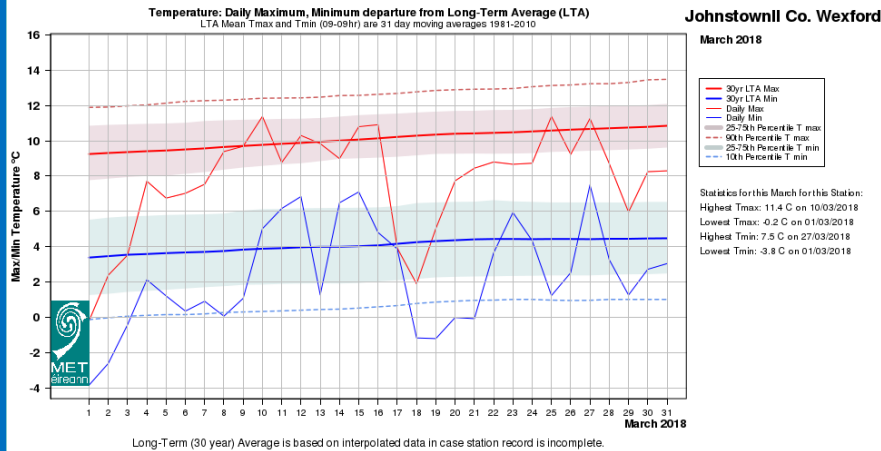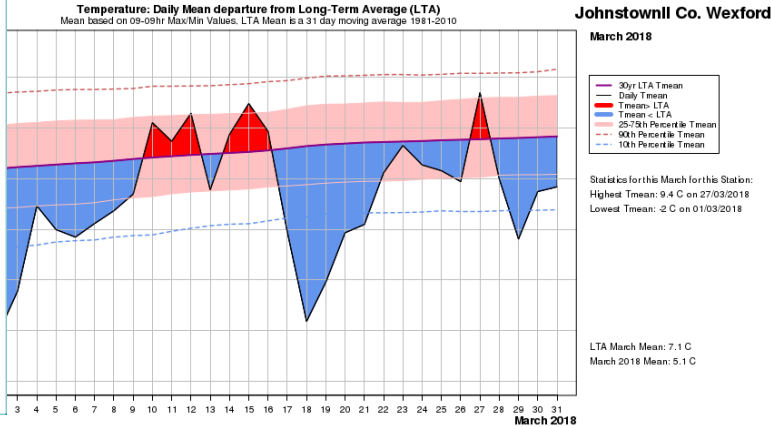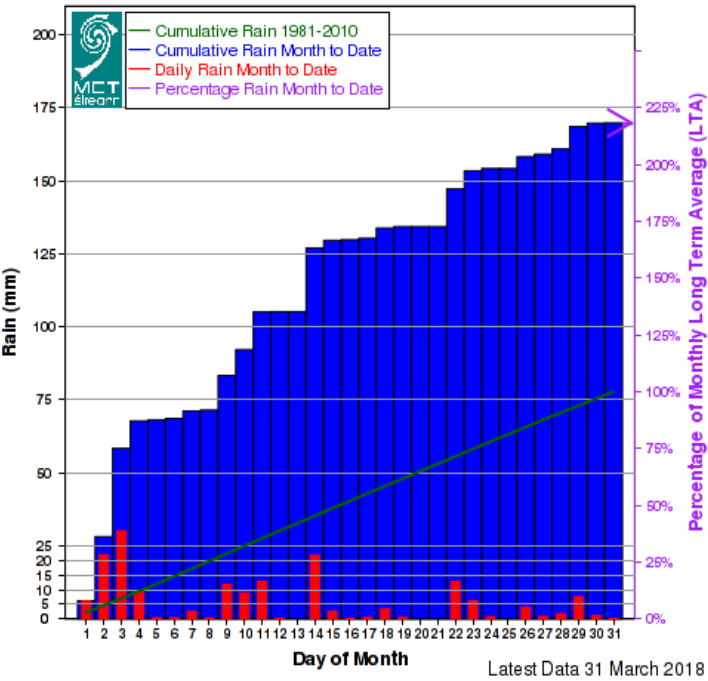
Climate Change Impacts

Risk Management – requirement for a Decision Support Tool (DST)

- Overall objective to support Engineers, Asset Inspectors and Infrastructure Managers in the decision making processes around risk and maintenance of assets

- Provide objective scientific based decision support to supplement the asset inspection processes

- Objectively assist in prioritisation so as to optimise appropriation of available funding

- Demonstrate value for money

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Risk Management – requirement for a Decision Support Tool (DST)

- Subjective prediction methods not accurate

- Assessments predominantly limited to visual inspection, qualitative only and therefore subjective

- Full network prioritisation required

- Cost of reactive works >>> preventative interventions

Challenges

➢ Negative pore water pressure (suction) » failures after rainfall events

How was the DST developed?

- Extensive data collection, LiDAR analysis, existing geological and geotechnical information

- Definition of different failure types e.g. translational, rotational, wedge

- Development of probabilistic model using first order reliability method

- Development of degradation factors and refinement of model

- Vulnerability assessment

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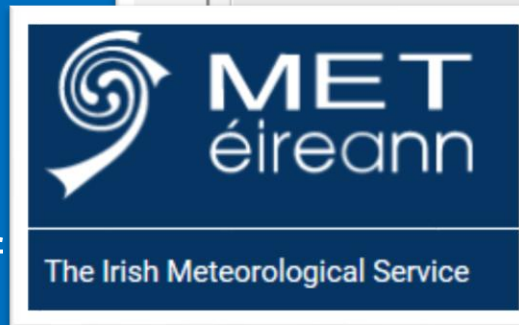# Capabilities of the C&E Risk Model and DST

- Calculates probability of failure for each asset

- Calculates the risk associated with each asset

- Incorporates features and signs of distress noted at inspections

- Calculates risk based on impact to railway – distance to track, train speeds, frequency etc

- Can model different remediation scenarios to determine best risk reduction intervention, best value

- Can import further geotechnical information, update degradation factors and other parameters – ultimately gets smarter over time!

- Models assets for predicted rainfall events by asset, route, region

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Capabilities of the C&E Risk Model and DST

- Model is aligned with the national forecasting body, Met Éireann

- Simulates rainfall events to identify risks arising from adverse weather events

- This is particularly valuable in the context of

Kilsheelan Case Study

➢ No defects found at most recent inspection

➢ Rated in good condition (in normal conditions)

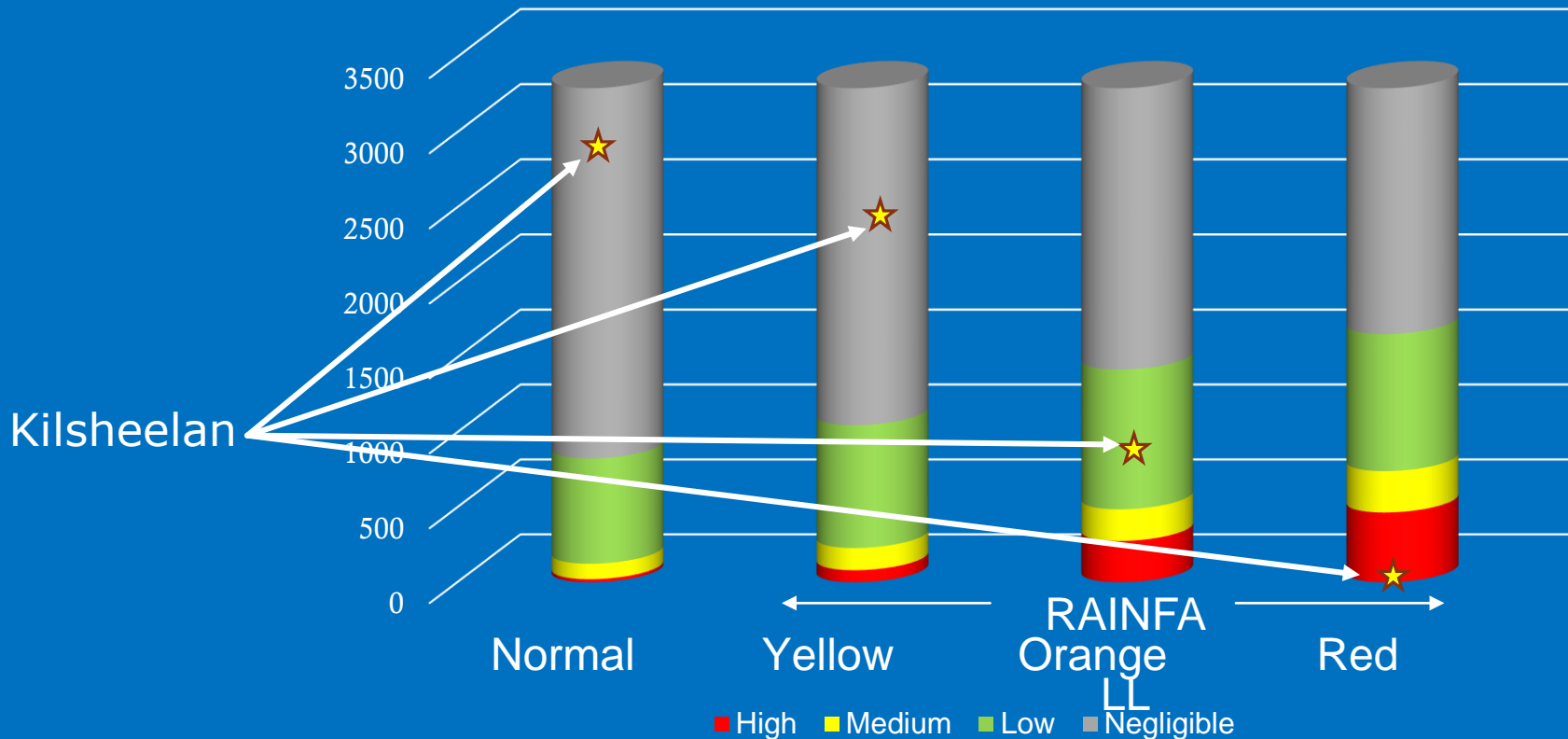A fairly typical embankment:

5.7m high

47 slope angle

2m clearance

Condition score 1 (good)

Kilsheelan Case Study

C&E DST Results

Kilsheelan Case Study

Embankment had multiple Category 1 failures on March 15th following extreme rainfall event

Kilsheelan Case Study

Influencing Factors

Snow on slope

Trees sheltering slope

Third Party Drainage

Historic Side-Casting

Recurring ponding

But most importantly, an extremely intense and sustained rainfall event

Kilsheelan Case Study

How is the C&E DST Managed?

- ➢ Information taken from SAP every 6 months

- ➢ Model run for

- - Normal conditions and Rainfall Events

- ➢ Results issued to relevant Engineers and Infrastructure Managers

- ➢ Information reviewed, particularly for high risk assets

- ➢ Decisions taken on

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What is the model used for?

| Budget Submissions for maintenance and renewals	Strategic Plans	Additional Inspection of high risk assets	Cost/ benefit analysis	Adverse Weather Plans	Reduce Risk Over Time

Probability and Risk analysis can be carried out at any time for any asset or group of assets including scenario analysis, planned works evaluation

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The DST is only one of a number of inputs into the management of cuttings & embankments

Integration of all inputs is key to the overall management and safe provision of this asset base
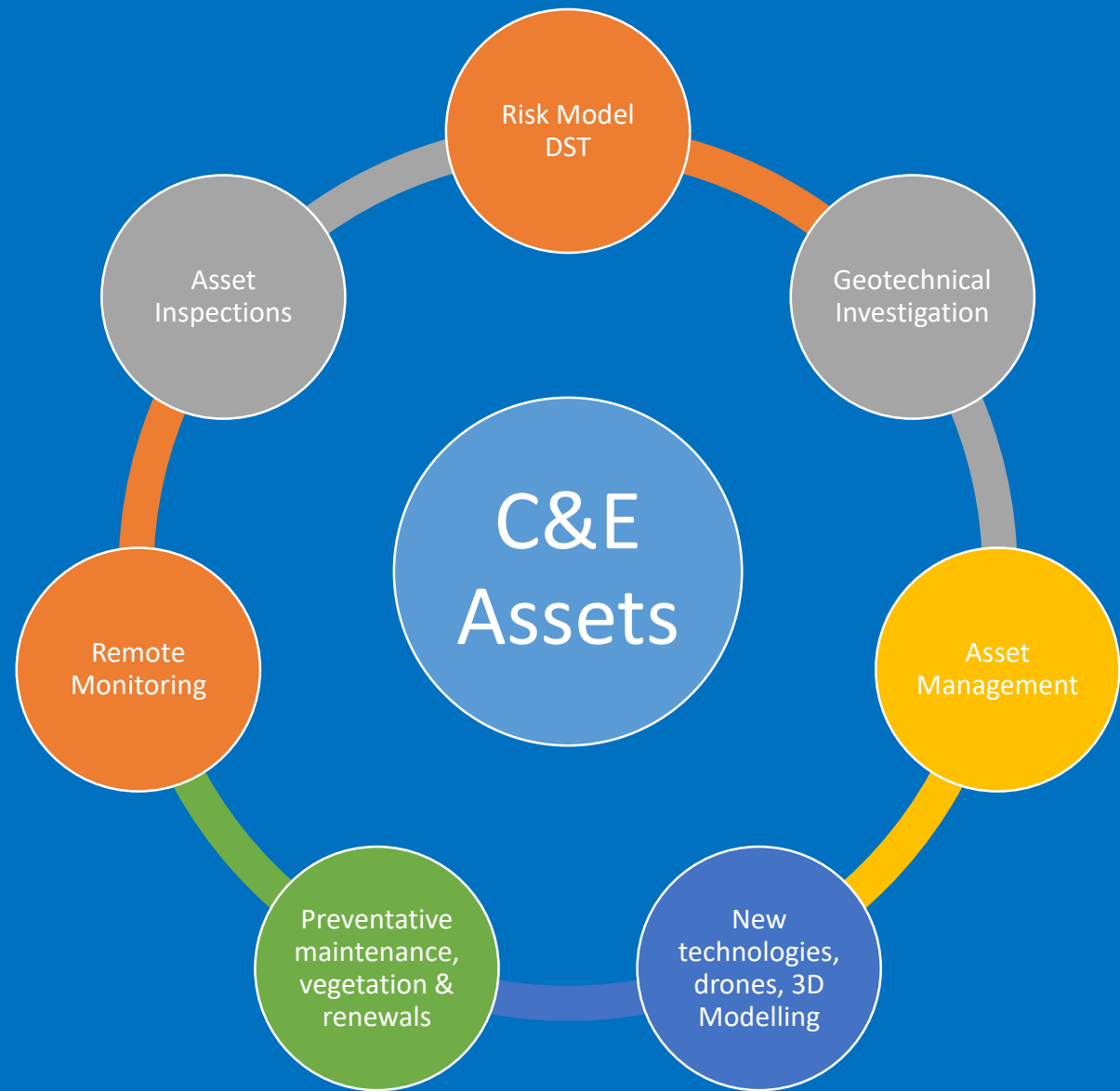
Summary

- The DST is one of a number of asset and risk management tools now used by IÉ
- It provides objective qualitative and quantative information to inspectors to help make informed decisions, identify risk and prioritise interventions
- It assesses probability of failure and risk of each asset and models these collectively
- This innovative software is a valuable addition to the overall asset and risk management of an asset base that can be difficult to predict, in particular in the context of climate change and the associated changing environment

C.C.E. – Decision Support Tools

C.C.E. – Cutting and Embankments Risk Model

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Thank you!

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