U.S. Department of Transportation

Welcome to a Webinar Sponsored by FTA and FHWA . . .

Using Asset Management to Adapt to Weather Extremes:
Lessons Learned from Transport for London

Thursday, December 15, 2011, 10:30am - 12pm US Eastern time (3:30 - 5pm London time)

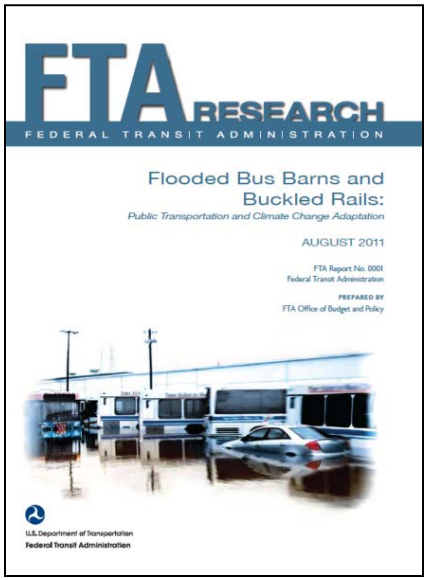
The webinar will begin shortly.

- Please type your **name and affiliation** in the chat box so that we may know who is participating.
- Please also enter **questions/comment**s in the chat box at any time.
- Audio will be broadcast through your computer speakers/headphones. If you do not have these, you may use the conference line: 877-873-8018, participant code: 305-3084.

Speakers: From FTA: Aaron James. From FHWA: Butch Wlaschin. From TfL: Helen Woolston, Matthew Webb, Steven Tyler, Martin Brown, and Les Hawker.

FTA Adaptation Initiative

- **Report** examines climate impacts, strategies, risk management tools
- **Pilots** of transit agency adaptation assessments – selection to be announced soon (at least one to focus on asset management systems)
- **Workshops and webinars** – workshops held 8/3/11 in Los Angeles, 10/5/11 in New Orleans. Next in DC, Mar 2012. Webinars 8/8/11, 12/15/11. Recording on web.
- **Dear Colleague Letter and Policy Statement** – describes impacts on FTA goals and commits FTA to action



Above available at **www.fta.dot.gov/sustainability**

Click on “FTA Climate Change Adaptation Initiative”

FTA Climate Change Adaptation Initiative

Subway tunnels, busways, rail tracks, and maintenance facilities are vulnerable to increased flooding from more frequent and intense rain storms, rising sea level, and storm surges. Extreme heat can deform rail tracks, stress materials, reduce asset life, and jeopardize customer and worker health and safety. In fact, recorded weather data already shows increases in heat waves and heavy precipitation, which are affecting transit now. While transit and other sectors can and must play a role in reducing greenhouse gas emissions to lower the severity of impacts, because of the level of emissions already in the atmosphere, some climate changes are already in the pipeline and responsible risk management calls for adaptive responses to reduce vulnerability. FTA seeks to be a partner with the transit industry in responding to this challenge and we have a number of resources and opportunities available.

1. Dear Colleague Letter
2. **Policy Statement**: FTA Statement, DOT Statement
3. NEW **FTA Report** - Flooded Bus Barns and Buckled Rails: Public Transportation and Climate Change Adaptation. Examines projected climate impacts on U.S. transit, climate change adaptation efforts by domestic and foreign transit agencies, transit adaptation strategies, risk management tools, and incorporation of adaptation into transit agency organizational structures and processes.
4. **Pilots**: Applications due August 25. Will fund transit agencies or partnerships with transit agencies to assess the vulnerability of transit agency assets and services to climate change hazards such as heat waves and flooding. Request for applications
5. **Workshops and Webinars**:

Workshops

1st Workshop: Held August 3, 2011 in Los Angeles. Description and presentations - Full Summary of Workshop

2nd Workshop: To be held October 5, 2011 in New Orleans Workshop Summary and Presentations

Announcing 3rd Workshop: Scheduled for March 21-22, 2012 in Arlington, VA. Further details forthcoming.

Webinars

1st Webinar: Held August 8, 2011. View recording and presentations - Meeting Notes

NEW **Announcing 2nd Webinar: To be held Thursday, December 15th, 2011** - Using Asset Management to Adapt to Weather Extremes: Lessons Learned from Transport for London

WEBINAR: Using Asset Management to Adapt to Weather Extremes
WEBINAR: Transit and Climate Change Adaptation
Transit Climate Change Adaptation Seminar
State of Good Repair in an Era of Climate Change

Introductory Remarks

Aaron James, Director, Office of Engineering, FTA

Butch Wlaschin, Director, Office of Asset Management, FHWA


Transport
for London

Using Asset Management to Adapt to Weather Extremes:

Lessons Learned from Transport for London

Helen Woolston, Environment and Climate Change Coordinator

Matthew Webb, London Underground Climate Change Strategy Manager

Steven Tyler, London Underground Senior Planner, Asset Strategy and Planning

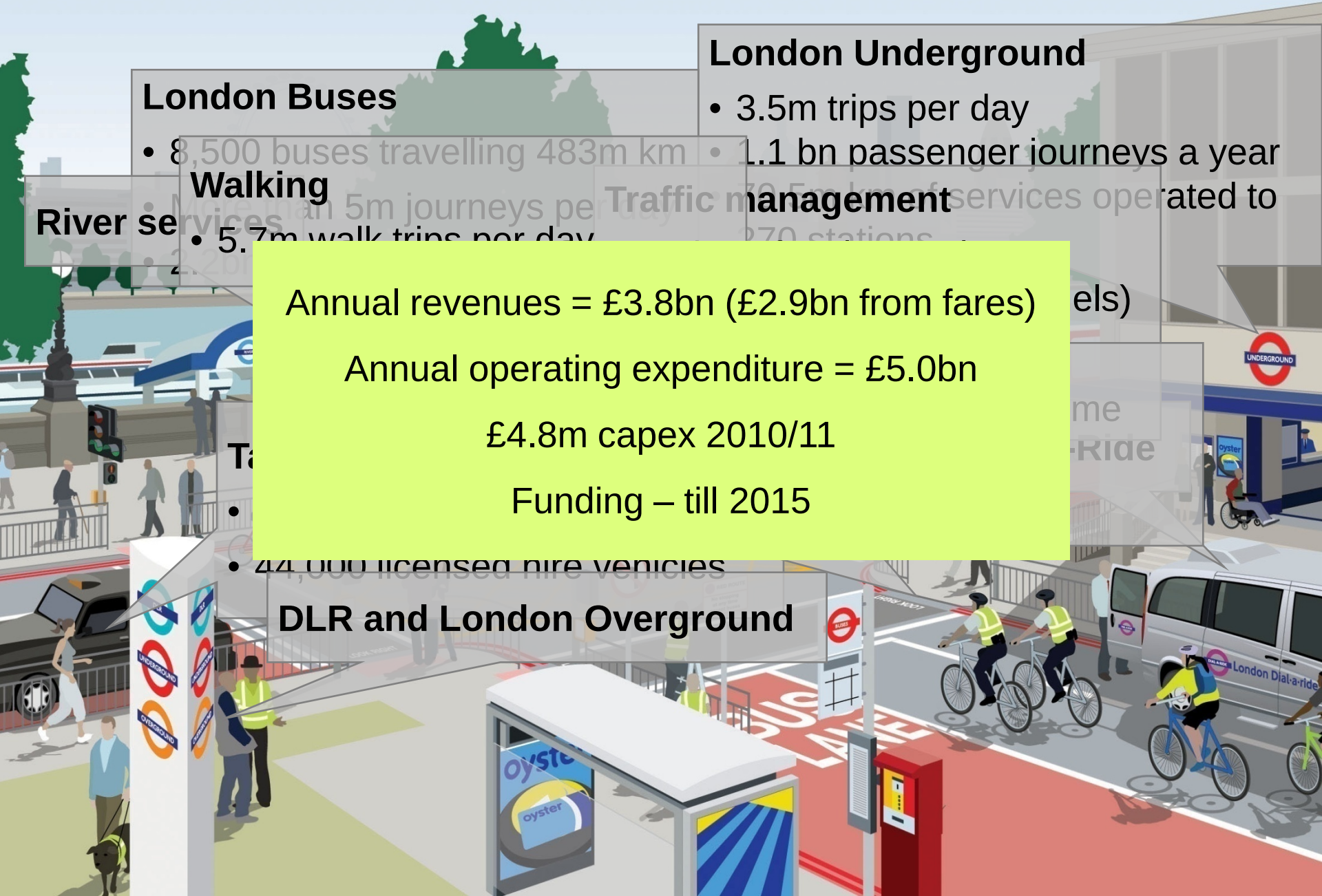
Martin Brown, London Rail Director Health Safety and Environment

Les Hawker, Roads Directorate Highways Asset Manager

Agenda

- Overview
  - UK Climate Projections
  - Risk Assessment
- Current Management of Extreme Weather
  - Asset Management in London Underground
  - Highways Adaptation and Plans
  - Rail
- Future Planning
  - Next Steps
  - Crossrail design

Transport for London



London Buses

- 8,500 buses travelling 483m km

London Underground

- 3.5m trips per day
- 1.1 bn passenger journeys a year

Walking

- 5.7m walk trips per day

Annual revenues = £3.8bn (£2.9bn from fares)

Annual operating expenditure = £5.0bn

£4.8m capex 2010/11

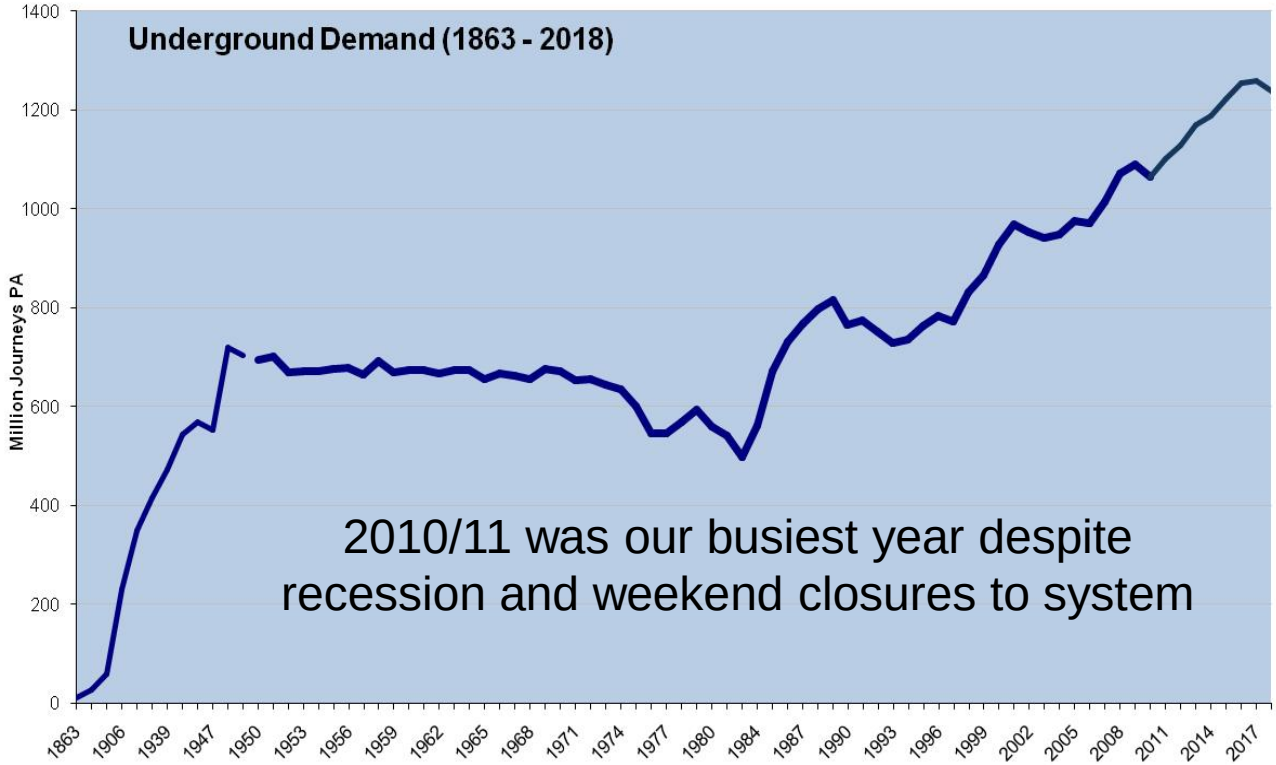
Funding – till 2015

DLR and London Overground

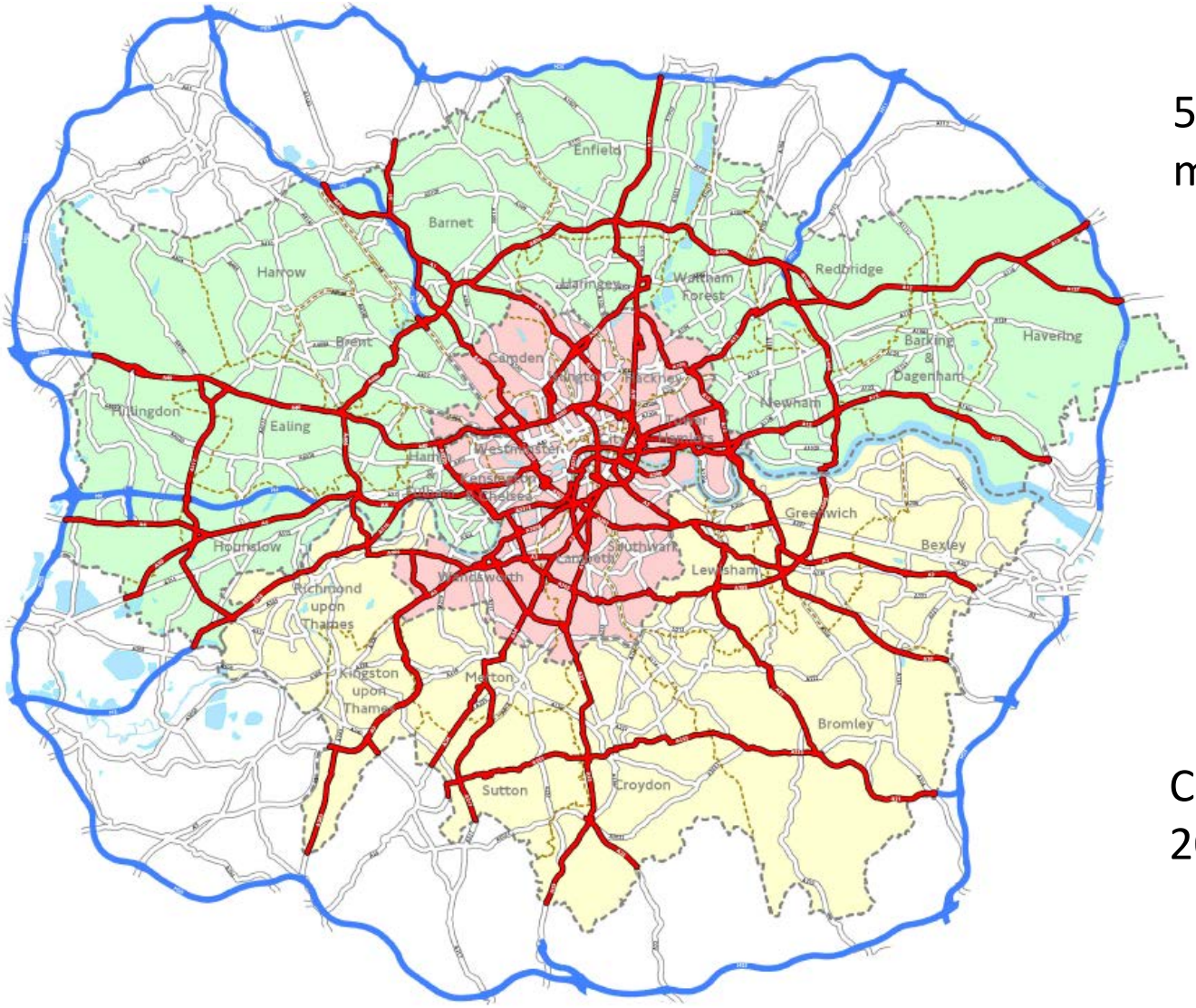
Customer Demand is increasing and set to grow further...

- Employment is the key driver of demand

... over a billion journeys a year



TfL Road Network - TLRN



580 km of London's most important roads

Contracts run from 2007 - 2013

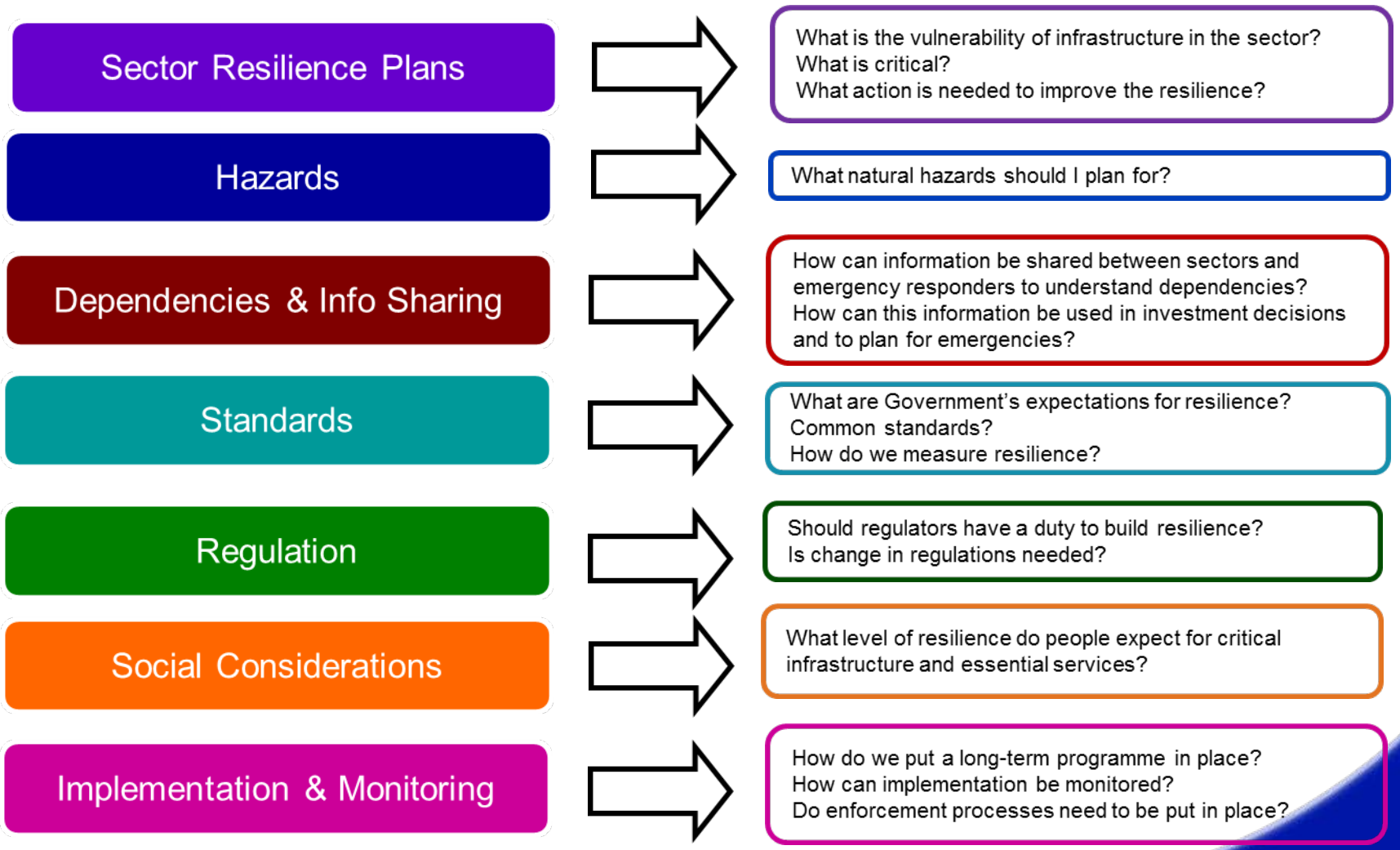
Vulnerability of Critical Infrastructure, Summer 2007 Floods in SW England



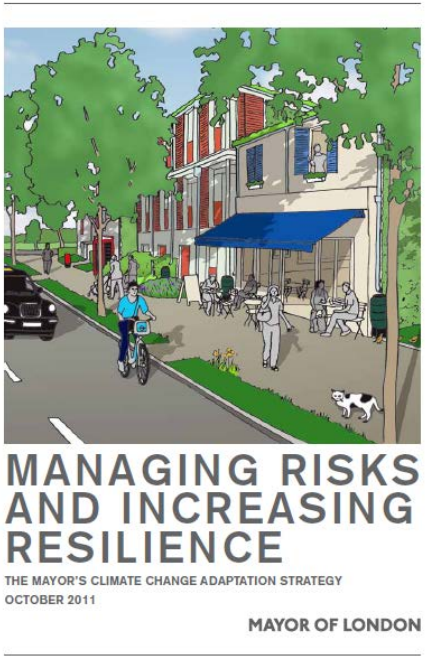
Impacts on critical infrastructure:

- 350,000 people without clean water for up to 17 days
- 42,000 people without power in Gloucester for 24 hours
- 10,000 people trapped on M5 Motorway overnight
- Many others stranded on the rail network
- Hospitals, schools and care homes

Pitt Report : Improving Resilience to Natural Hazards



Managing Extreme Weather and Climate Change - UK Legal and London's Political Requirements



- The United Kingdom's Climate Change Act of 2008 requires government agencies (including TfL) to report on how they have evaluated and planned for climate change impacts
- The Mayor of London's new Climate Change Adaptation Strategy

TfL's climate change risk analysis process

Communicate the climate projections

Assess the impacts on services and assets

Quantify and prioritize the risks

Review the plans eg LU assets, Highways

TfL's analysis of climate change information

- **The UK government provided climate change projections for the country in 2009 that include a range of scenarios and confidence levels http://ukclimateprojections.defra.gov.uk/**

Flooding
Water Resources
Overheating
Air Quality
Subsidence and heave
Wind Storms
Global climate events

Communicated by stories, backed up by data

Eg By the 2040s, European summers like 2003 could become normal; by the 2060s they would be cool

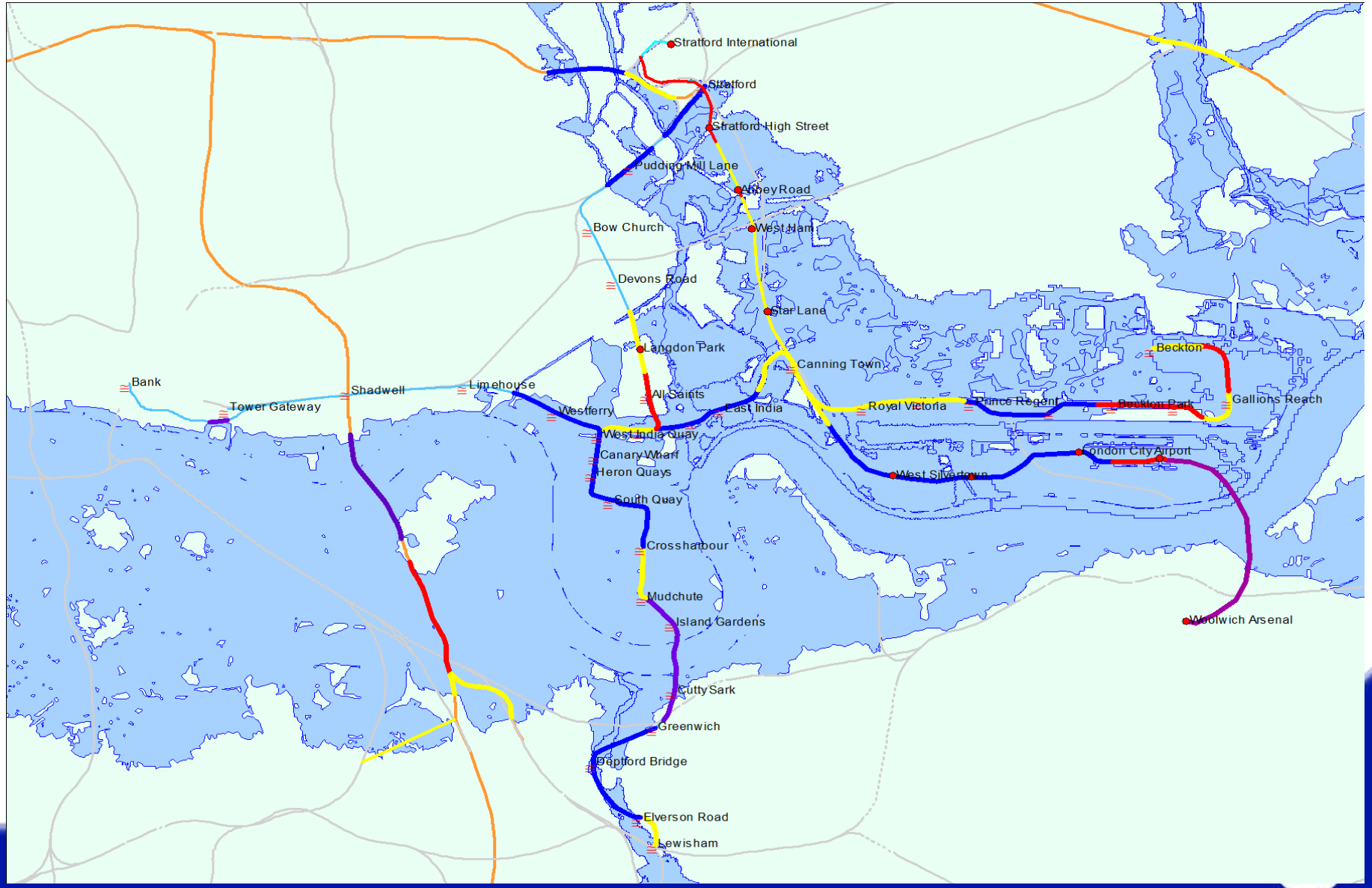
Assets

Tracks
Drainage
Bridges
Embankments
Signals
Stations
Green estate
Surfaces – platforms, footways, pavements
Transport interchanges
And ...?

Planned build eg stations, upgrades

Services, people and customer information

Flood maps : predicted worst case



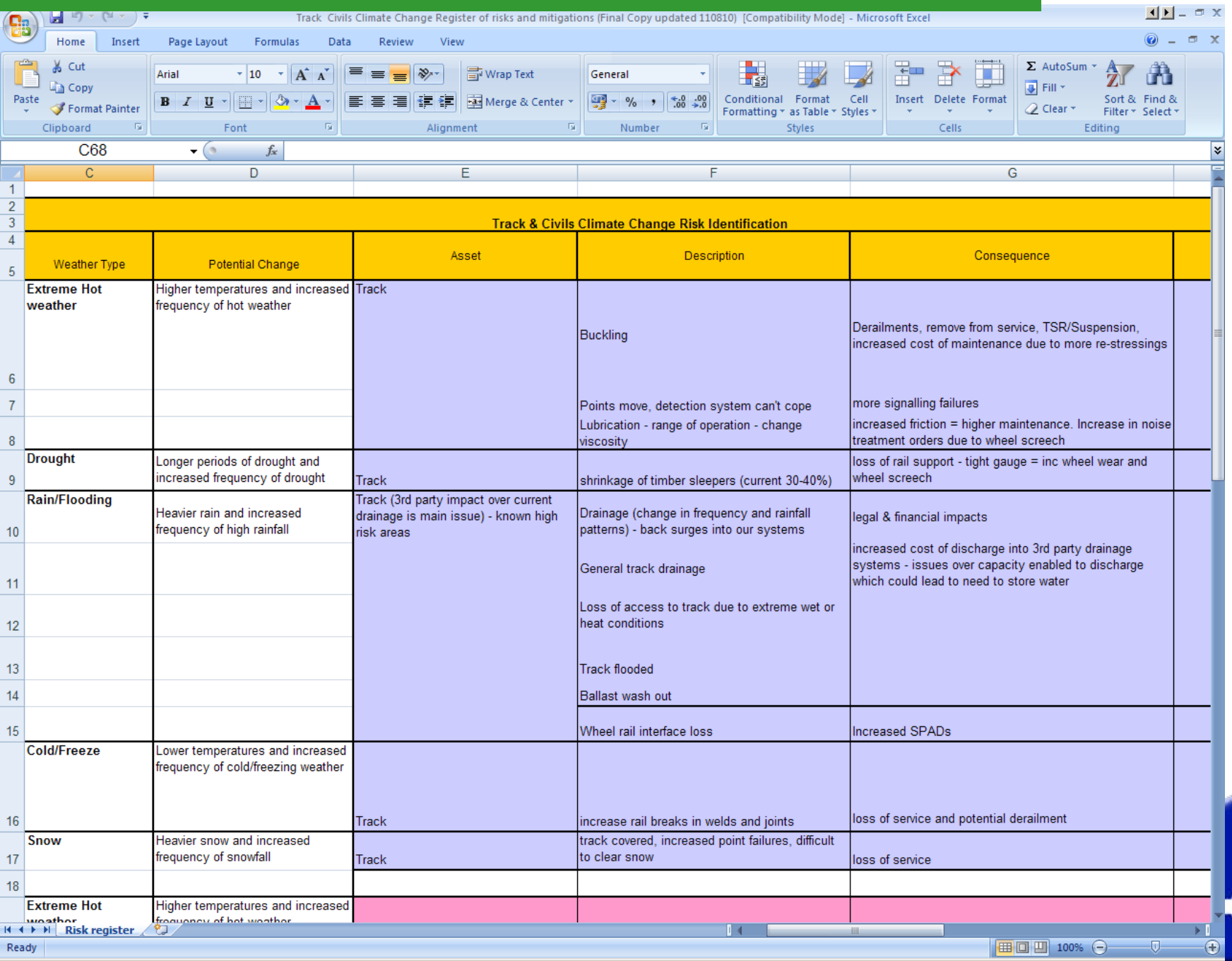
Using TfL's risk assessment methodology

Measure	Probability	Cost	Time	Customer	Reputation
Risk	% likelihood occurrence this financial year or numbers of events in terms of year(s)	Decrease in revenue/increase in cost in financial year	Delay to achievement of key milestone	Reduction in customer service	Level or type of media coverage/ impact on relationship with stakeholders
Very high	≥75% Once or more per year	>£250m	≥52 weeks delay	Catastrophic asset loss for several weeks/months, affecting several lines. Repair timescales in months with total loss of service during that time Example: Major inundation of several lines from river tidal surge flooding	Prolonged and targeted hostile media campaign lasting at least 1- 5 years – -aimed at decreasing net advocacy amongst external stakeholders -challenging organisational competence in key public safety areas Example: Sustained media campaign against Railtrack following various safety incidents
High	50% - 75% More than once in 2 years	£175-250M	36-52 weeks delay	Major adverse impact such as: •disruption/loss of customer service on more than one line for several weeks •major event resulting in injuries and fatalities Example: Kings Cross Fire	• Continuous hostile media coverage of up to 1 year • Significant decrease in net advocacy amongst external stakeholders • Major organisational changes resulting from an event. e.g. removal of accountable individuals from post
Medium	20% – 50% Between once in 2 to once in 5 years	£100-175M	24-36 weeks delay	Adverse impact such as: •Loss of train service on one line for several weeks •loss of a single-ended train depot/ train staff depot/ station •no injuries or fatalities •significant & ongoing disruption to core business services Example: Chancery Lane Derailment; Moorgate accident	• Ongoing critical & aggressive media campaign coverage lasting the duration of an event • Decrease in net advocacy amongst external stakeholders. • Significant challenge by regulators & stakeholders into relation to management of organization. • Targeted and critical parliamentary questions being asked • Severe & ongoing disruption actions taken by internal stakeholders (employees, unions, equality groups etc)
Low	5% - 20% Less than once in 5 years	£50-100M	12-24 weeks	Disruption to customer service for several days, or series of days Example: •series of network-wide 1 day strikes loss of train service on one line for several days	• Sporadic media coverage triggered by related events e.g. in print for several days over a period of time • Regulators and stakeholder intrusion is heightened by the event • Greater scrutiny by regulators & stakeholders in relation to management of organisation • Internal stakeholders (employees, unions, equality group etc) carrying out limited industrial action e.g. series of 1 day strikes

Using TfL's risk assessment methodology – positive aspects

Very Low	≤5% Less than once in 20 years	Increase revenue/decrease costs by less than £250K in one financial year	Milestone would be achieved less than 13 weeks early	Improvements to customer service eg: •improved ambience/information •minor improvement to journey times •small increases in satisfaction	• Positive 'word of mouth' by customers • Positive public awareness
Low	5% - 20% Less than once in 5 years	Increase revenue/decrease costs by between £250K-1M in one financial year	Milestone would be achieved more than 13 weeks but less than 26 weeks early	Improvements to customer service as above	• Minor/short-term positive local media coverage • Improved relations with regulators & stakeholders
Medium	20% – 50% Between once in 5 years & once in 2 years	Increase revenue/decrease costs by between £1-5M in one financial year	Milestone would be achieved more than 26 weeks but less than 39 weeks early	Improvements to customer service Permanently improved customer satisfaction ratings (between 1-5% improvement on current scores)	Positive media coverage and enhanced relations with regulators & stakeholders eg headline television coverage or front page In Evening Standard for one day
High	50% - 75% More than once in 2 years	Increase revenue/decrease costs by between £5-10M in one financial year	Milestone would be achieved more than 39 weeks but less than 52 weeks early	Noticeable & permanent improvement in customer service resulting in significantly improved customer satisfaction ratings (a ≥5% improvement on current scores)	Significant positive media coverage and enhanced relations with regulators & stakeholders for more than a week
V High	≥75% Once or more per year	Increase revenue/decrease costs by more than £10M in one financial year	Milestone would be achieved over 52 weeks early	Major & permanent improvement in customer service resulting in significantly improved customer satisfaction ratings (a ≥10% improvement on current scores)	Significant positive media coverage and enhanced relations with regulators & stakeholders for a period of weeks

TfL's tracks and civils risk assessment



Track Civils Climate Change Register of risks and mitigations (Final Copy updated 110810) [Compatibility Mode] - Microsoft Excel

Home | Insert | Page Layout | Formulas | Data | Review | View

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	C	D	E	F	G
1					
2	**Track & Civils Climate Change Risk Identification**				
3					
4	Weather Type	Potential Change	Asset	Description	Consequence
5	**Extreme Hot weather**	Higher temperatures and increased frequency of hot weather	Track	Buckling	Derailments, remove from service, TSR/Suspension, increased cost of maintenance due to more re-stressings
6				Points move, detection system can't cope	more signalling failures
7				Lubrication - range of operation - change viscosity	increased friction = higher maintenance. Increase in noise treatment orders due to wheel screech
8	**Drought**	Longer periods of drought and increased frequency of drought	Track	shrinkage of timber sleepers (current 30-40%)	loss of rail support - tight gauge = inc wheel wear and wheel screech
9	**Rain/Flooding**	Heavier rain and increased frequency of high rainfall	Track (3rd party impact over current drainage is main issue) - known high risk areas	Drainage (change in frequency and rainfall patterns) - back surges into our systems	legal & financial impacts
10				General track drainage	increased cost of discharge into 3rd party drainage systems - issues over capacity enabled to discharge which could lead to need to store water
11				Loss of access to track due to extreme wet or heat conditions	
12				Track flooded	
13				Ballast wash out	
14				Wheel rail interface loss	Increased SPADs
15	**Cold/Freeze**	Lower temperatures and increased frequency of cold/freezing weather	Track	increase rail breaks in welds and joints	loss of service and potential derailment
16	**Snow**	Heavier snow and increased frequency of snowfall	Track	track covered, increased point failures, difficult to clear snow	loss of service
17					
18	**Extreme Hot weather**	Higher temperatures and increased frequency of hot weather			

Risk register

Ready

100%

Example of TfL climate change impacts risk heat map

1- Extreme Hot Weather - Key track, signals, & communications assets and staff & passengers.

2- Rain & Flooding - Track & signal drainage

3- Cold & Freeze - Impact on track integrity

4- Rain & Flooding – Key infrastructure drainage

5- Drought - Vegetation impact

6- Snow – track, signalling and depot operations

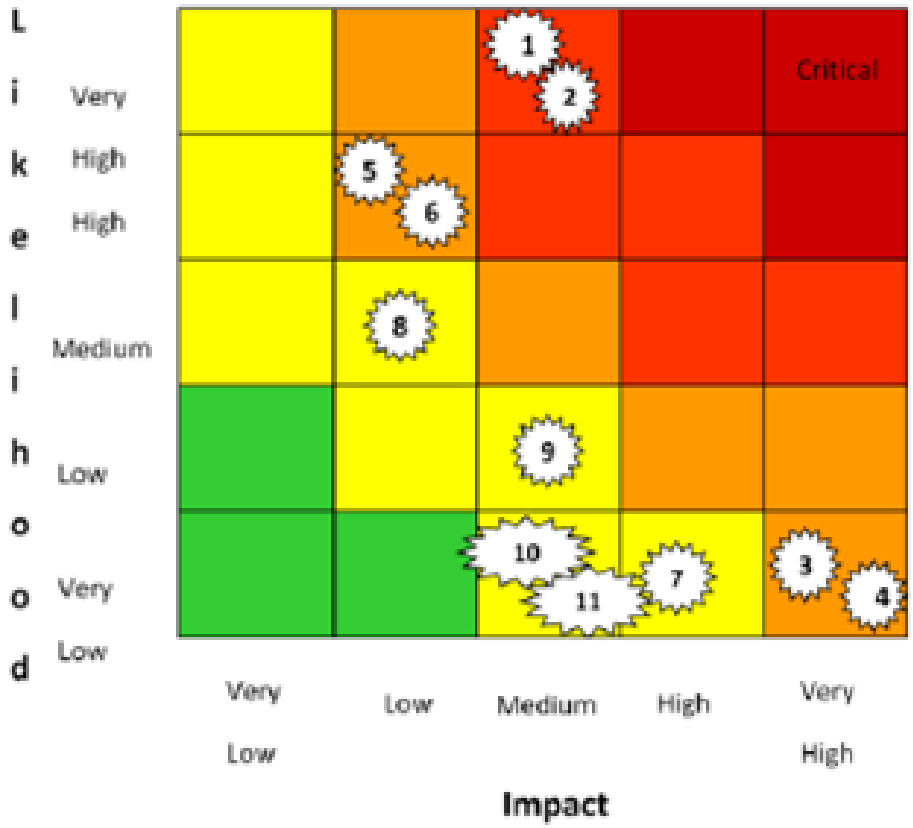
7- Cold & Freeze - Train system components

8- Cold & Freeze – Slips/trips for staff and customers.

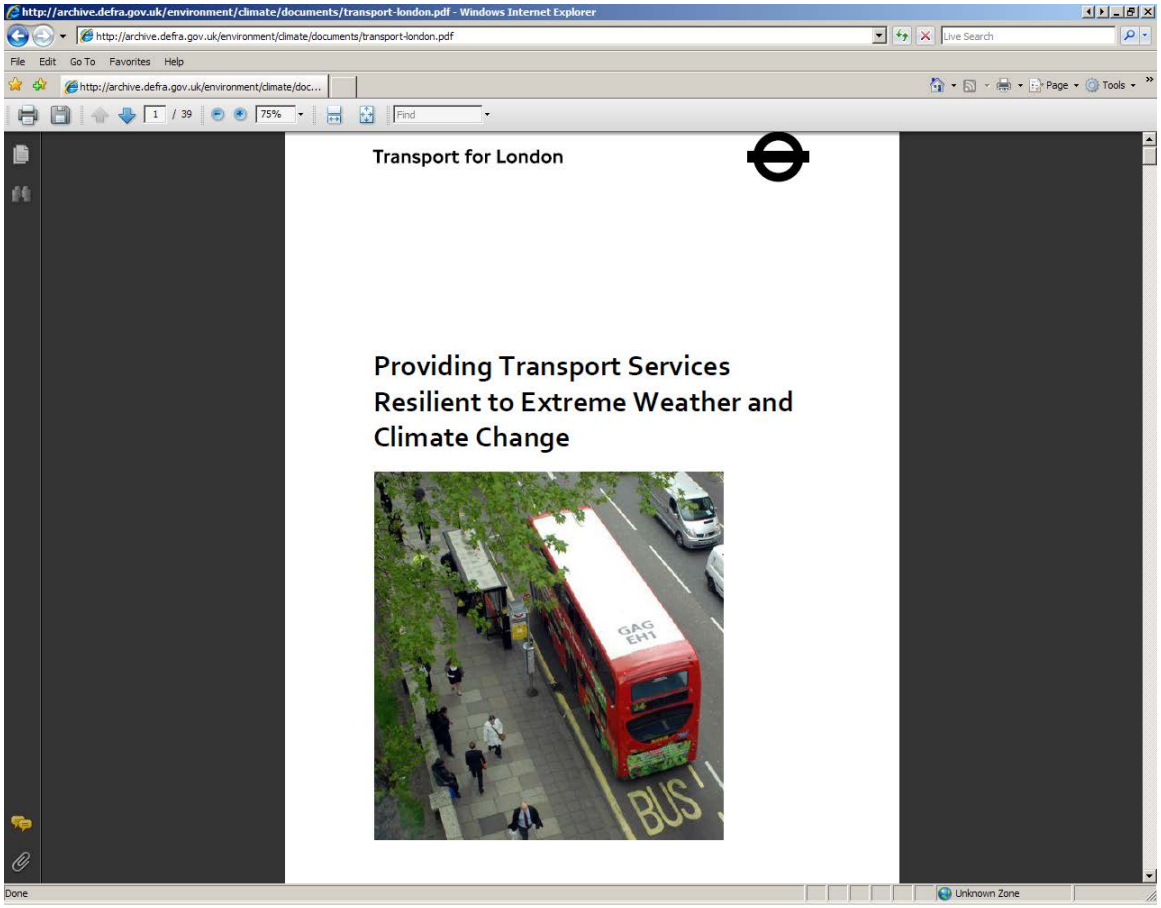
9- Rain, Flooding and snow - Damage to inside of carriages

10- Wind- Damage to infrastructure, track and vegetation.

11- Drought - Ground stability impacts



TfL's Adaptation Report



- http://www.defra.gov.uk/environment/climate/sectors/reporting-authorities/reporting-authorities-reports/

Defra/Cranfield Review of TfL's Report

- TfL clearly considers climate change to be a key issue for long term planning and it is excellent to see that consideration of the issues is being embedded into business practices
- TfL's good quality report clearly demonstrates actions being taken to prepare both TfL's infrastructure and operations for the impacts of climate change
- TfL's decision to ensure that climate change is being actively considered in investment decisions like Crossrail and the specification for new London buses is good practice
- Further work could be done on identifying the potential risks from specific issues such as pluvial flooding
- TfL might wish to develop longer term climate change adaptation strategies as opposed to shorter term weather risks. This could include assessment of the costs and benefits of adaptation measures

Current Management of Extreme Weather in London Underground

Some of TfL's Existing Adaptation Initiatives

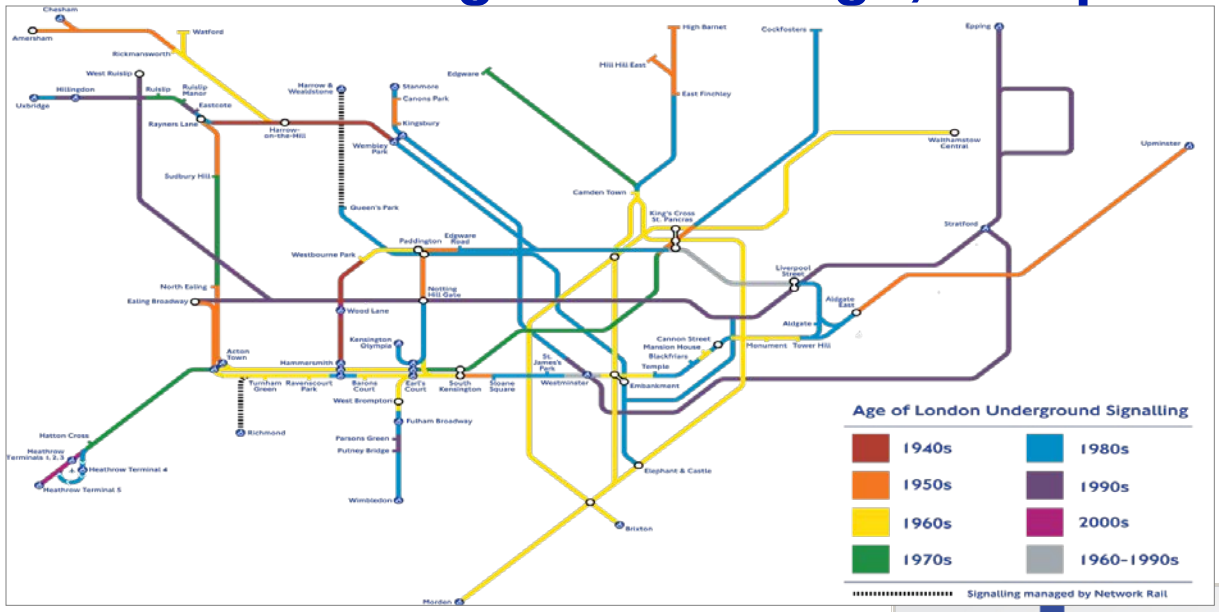
Simple interventions where possible:

- White painted roofs on buses
- Industrial-sized fans on the Tube

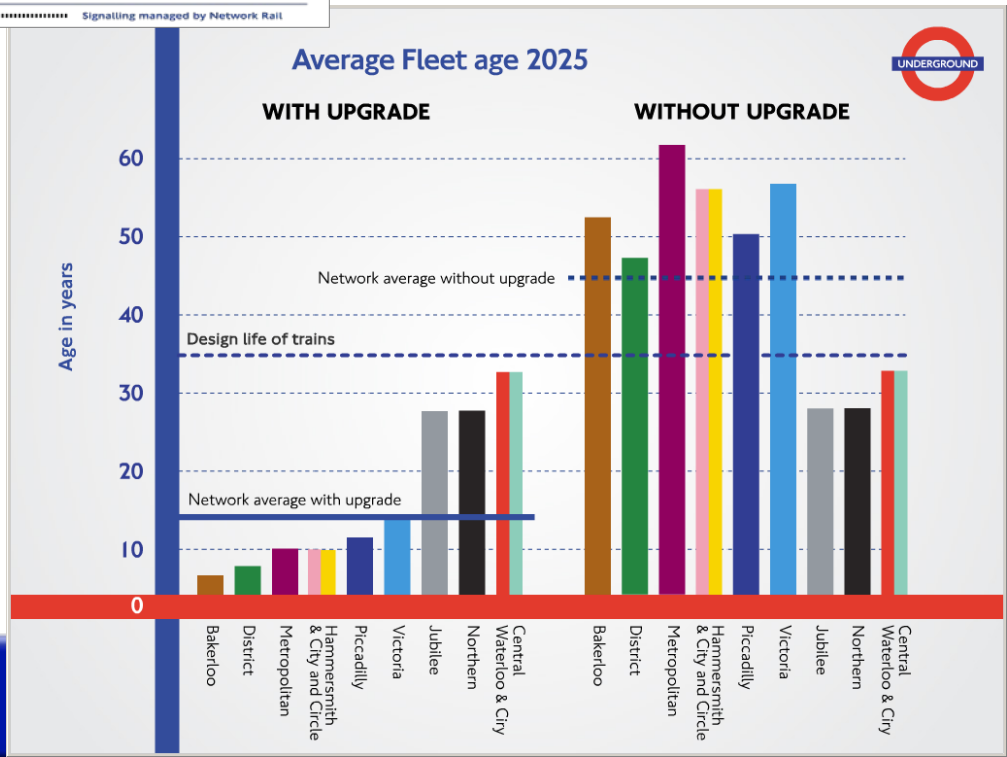
Tube cooling represents a major challenge:

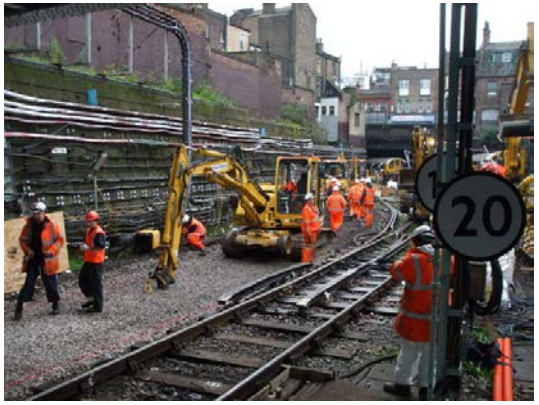
- Groundwater cooling at Victoria station
- Air-conditioned sub-surface trains
- Testing systems for deep Tube lines

London Underground - Large, complex and old asset base



- Diverse asset base evolved over a long time
- Asset catalogue and condition assessment only now completing

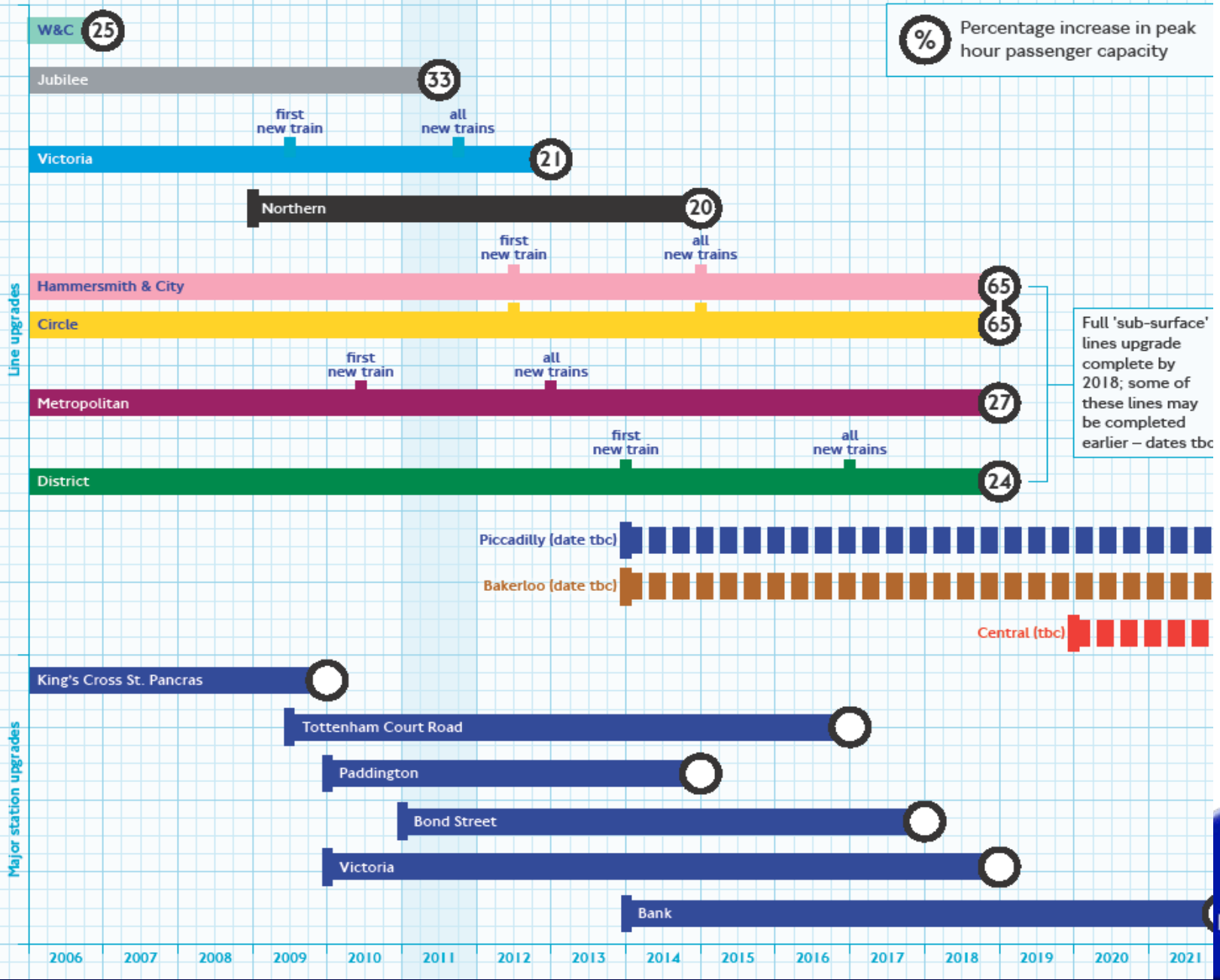




LU is responsible for managing & operating all assets

- **Infrastructure : track, stations, civils, lifts and escalators**
- **Train systems : signalling, rolling stock, power, communications**

OUR UPGRADE PLAN



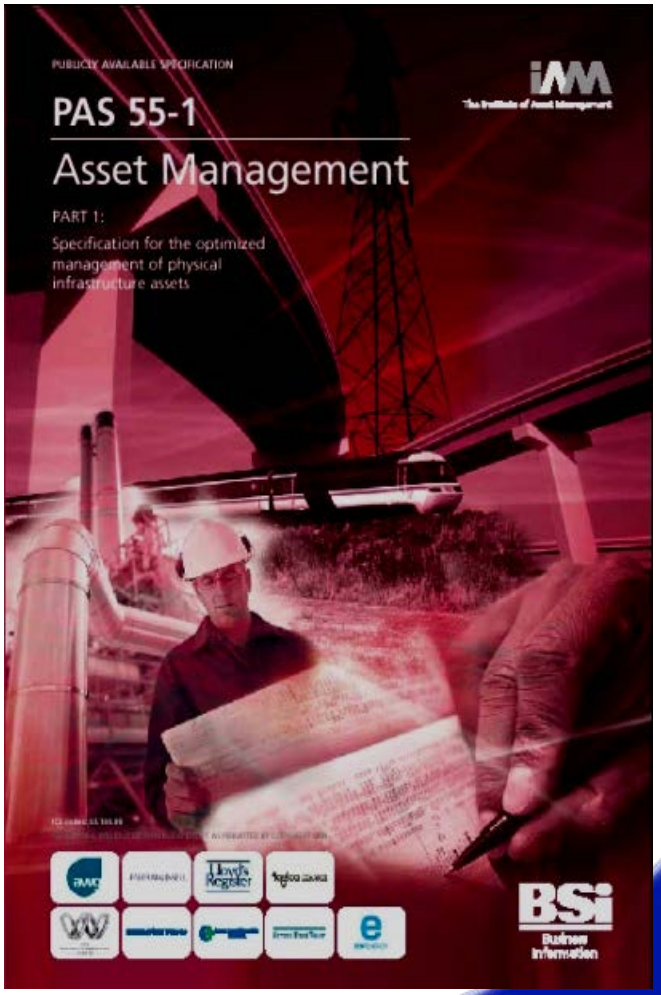
PAS 55: What is it?

• British Standards Institutions' specification on asset management 2008

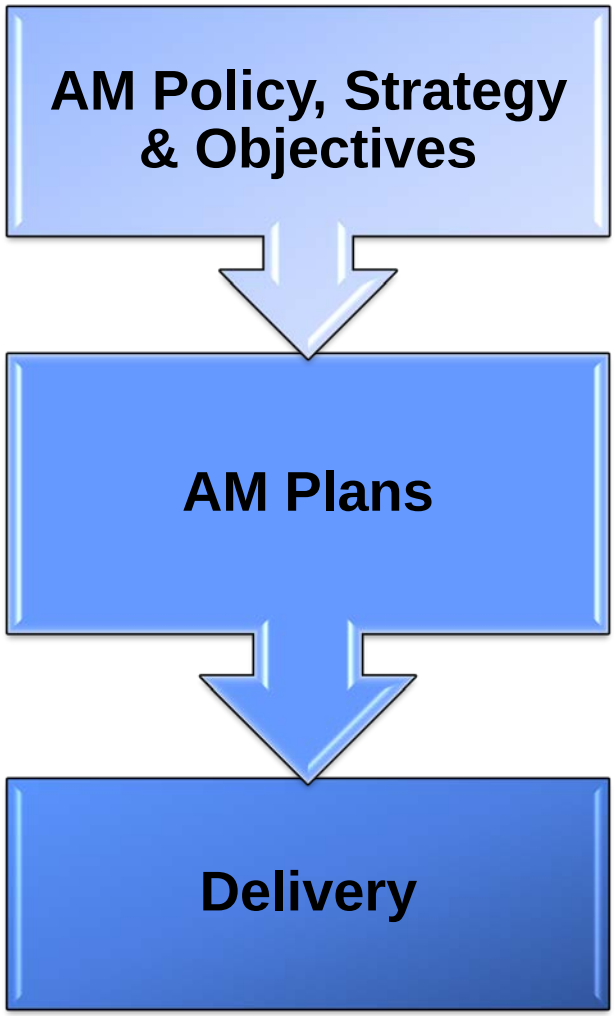
• PAS 55 provides a single structured approach and objectivity across 28 aspects of asset management, from strategy, delivery and support processes.

• Enables integration of the asset lifecycle: from the first recognition, through design, acquisition, construction, utilisation, maintenance, renewal, and ultimate disposal.

• Provides a common language for cross-functional discussion

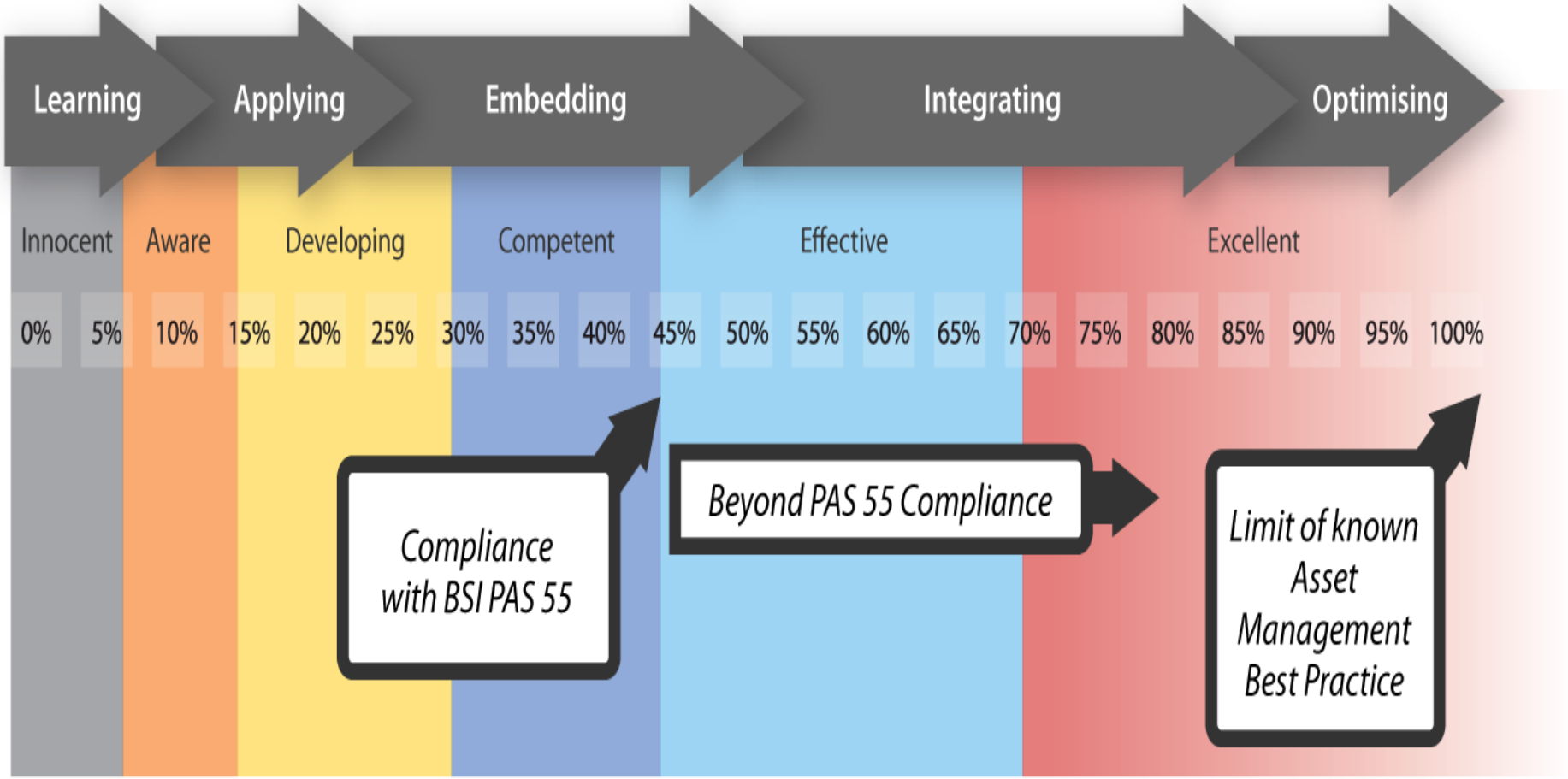


What PAS 55 requires – line of sight

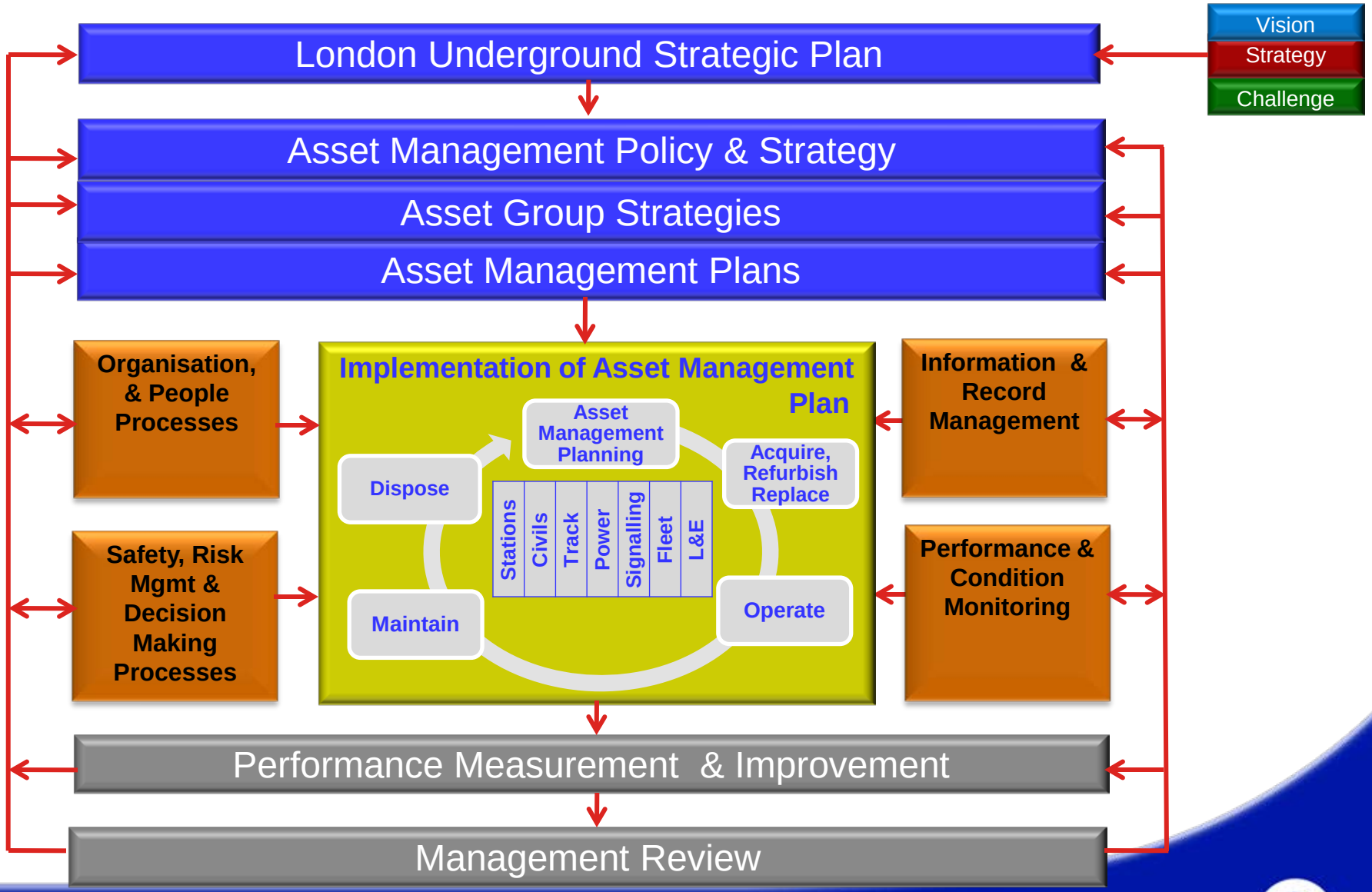


- Delivery aligned to strategy & funds allocated in line with criticality
- Understanding of whole life cost decisions balancing risk, cost & performance
- Consistent processes across all areas
- Clear roles & responsibilities
- Robust information management, doc control & records management
- Understand, & consistently quantify risk
- Interface across the whole supply chain

So where are we on AM maturity journey?



Asset Management Framework



Asset Group Strategies

- Sets the specific context for each asset
- Strategic objectives defined
- Strategies for sub-assets fleshed out
- Supply Chain & Delivery approach
- Asset Management Capability and Development areas
- Governance and Asset Risk Management processes

No.	Asset Management Strategic Objectives	Asset Group Measure (to 2017/18)
5	**Climate Change Adaptation**	• Ensure new drainage systems are able to cope with increased rainfall intensity and duration into the future. • Identify Earth Structures at risk from increased rainfall. Flow monitors have been installed to identify the occurrence of a significant rainfall event, which will trigger special inspections of these assets. • Identify Earth Structures at risk from shrink and swell effects, which can affect Track performance and may potentially lead to a loss of Track stability. • Review structures at risk of scour, to assess the risk for increased levels of water in the future.

Asset Management Planning –example

Earth Structures Failure Mechanisms due to Inclement Weather

- Flow Failure
- Frost Shattering of Chalk Cuttings
- Prolonged Rainfall
- Flooding or Scour

Risk Factors

- Slope Angle, Geometry, Geology, Factor of Safety, Previous Instability, Adjacent Land Use, Vegetation, Existing Drainage Capacity

Consequence Severity Factors

- Distance from Track, Frequency of Trains, Train Speed, Track Geometry

Mitigation Measures

- Raising Awareness and Understanding
- Installation of Rainfall Gauges for measurement and early warning.
- Trigger levels and Emergency Response Plan
- Risk Assessment & Works Prioritisation
- Monitoring

Bridges and Structures

- Scour Risk Assessments Undertaken
- Prioritisation of Mitigation Works

Drainage

- Design Standards have been updated to take into account climate change predictions
- Network Drainage Model identifies flooding hotspots
- Collaboration with Local Authorities

Asset Management Planning – other examples of adapting to weather

Asset specific examples:

- Fleet – maintenance activities (Winterisation / Summerisation) and future rolling stock design (EVO1 train).
- Stations – heat and cooling on the tube study, contingency plans for station flooding and future streetscape integrated design process.
- Track – design standards allow for built in redundancy, maintenance activity to stress test the asset.

Planning Horizons:

- Short term – TfL funding settlement to 2014/15.
- Medium term – TfL business plan forecast to 2020/21.
- Long term – use of whole life cost models to project over the life of the assets e.g. Rolling stock, nominal design life of 40 years.
- Scenario planning for assets to encompass all 3 horizons.

Current Management of Extreme Weather in TfL Highways

Highways Flooding

- <u>Current Situation</u>
- Flooding Hotspots are mapped across the Transport for London Road Network
- Flooding events are already having an impact on network operation. From the *flooding hotspot register* 300 events have occurred over the last year, with 106 causing significant disruption to traffic. In addition capacity issues from third part assets is already a cause of flooding on the network

Highways - Action on Pumping Stations

- Monitor known flooding hotspots and increase cyclic maintenance of pumping stations where necessary
- Review appropriateness of design guidance and specification for pumps
- Prioritised 3 year investigation and refurbishment programme of 113 pumping stations
- Installation of telemetry (remote monitoring) on critical pump stations

Highways - Action on Gullies

- Cyclic maintenance programmes are in place where frequency of gully emptying increased at high risk locations
- Flooding hotspots checked by Contractors when adverse weather warning received
- Prioritisation of capital resurfacing programme to include surface drainage issues
- Review appropriateness of design guidance and adequacy of current gully standards

Highways - Action on Linear Drainage

- Appropriateness and adequacy of current drainage standards reviewed
- Prioritised investigation programme targeted from the hotspots register and network intelligence gained from the cyclic and reactive programmes
- Condition assessment surveys of drainage undertaken prior to final design of major resurfacing projects

Highways - Flooding Collaboration

- Collaboration with "Drain London" forum and on implementing recommendations
- Collaboration with 3rd parties such as Thames Water to upgrade their facilities i.e. drainage outfall

Communication

- Road users are informed of real time hazards via London Traffic Control Centre through VMS and updates on TfL website which serves to modify road user behaviour through improved communications

Highways - Action on Extreme Heat

- Appropriateness and adequacy of current pavement standards reviewed
- Increase network intelligence and develop hotspots database
- Utilise rut resistant materials such as EME2
- Introduce general and principal inspections regime for embankments and cuttings

Highways – Managing Extreme Cold

- Background
- 3 extremely cold winters in succession
- Severe disruption, salt shortages and a pothole epidemic across UK which became a political issue
- Emergency funding issued last 2 winters to deal with potholes
- Review commissioned by Dept for Transport, which reported Dec 6th, undertaken by Chief Economists and Government Scientists

Highways - Managing Extreme Cold

- Review on Best Practice in dealing with Potholes due to report in March 2012 having considered Asset Management, Proactive Maintenance, Design Standards, Investment Strategies, and Forward Planning
- Improve the resilience of the highway network to disruption by improvements in salt storage, salt spreader calibration and staff training

Current Management of Extreme Weather in TfL Rail

Context for Rail within TfL

- Development of a focus on the concept of Critical National Infrastructure
- Development of Asset Management Standard : PAS 55
- Links to National Rail sustainability work
- Desire to enhance system resilience, links the question of asset management together with weather extremes
- Resilience being “the ability of a system or organisation to withstand and recover from adversity”

Rail concerns about sustainability

- Making the ‘Case for Rail’
- Linking Asset Management, management of assets and climate extremes : note not climate change as such
- Data is key : treat data as a key asset
- Making the business case for better asset management is about short term and long term balances

Asset management and management of assets

Managing the assets before and after weather strikes : Golden asset tags

Design and maintenance of the assets so weather impact is reduced – under rail pickup

Designing for climate impact

New Cross Depot

- Depot build incorporates underground tanks
- These tanks have been designed to hold worst case storm rainwater
- Rainwater held and reused for train wash, which is attached to depot building

The importance of communication

Key findings

***People and services* (as well as assets)**

Managing Customer Expectations:

- Planned and real time information

Stakeholders:

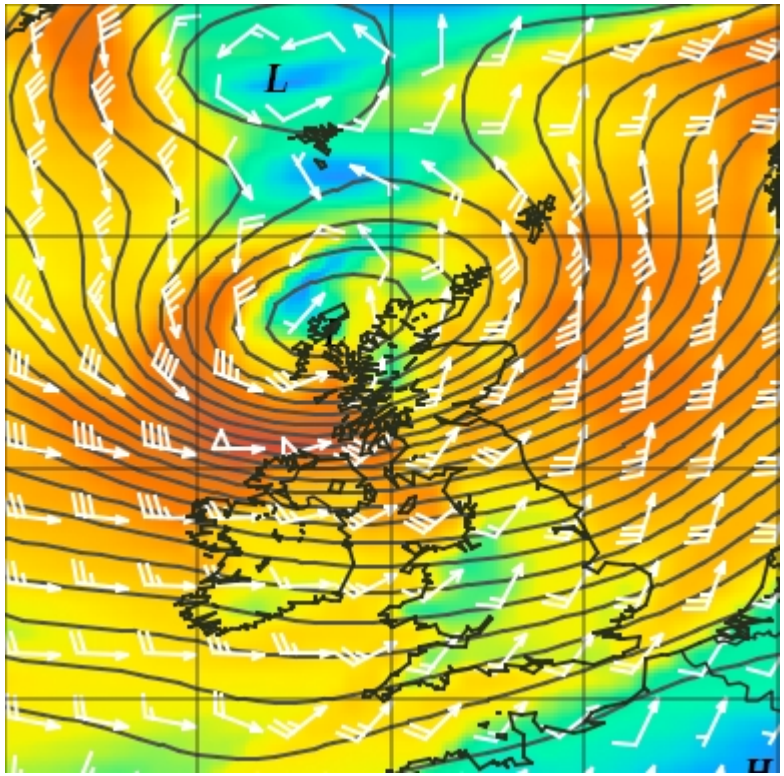
- Liaising with key employers
- Organisations with interdependencies

Secondary aspects of excess water

Embankment failure

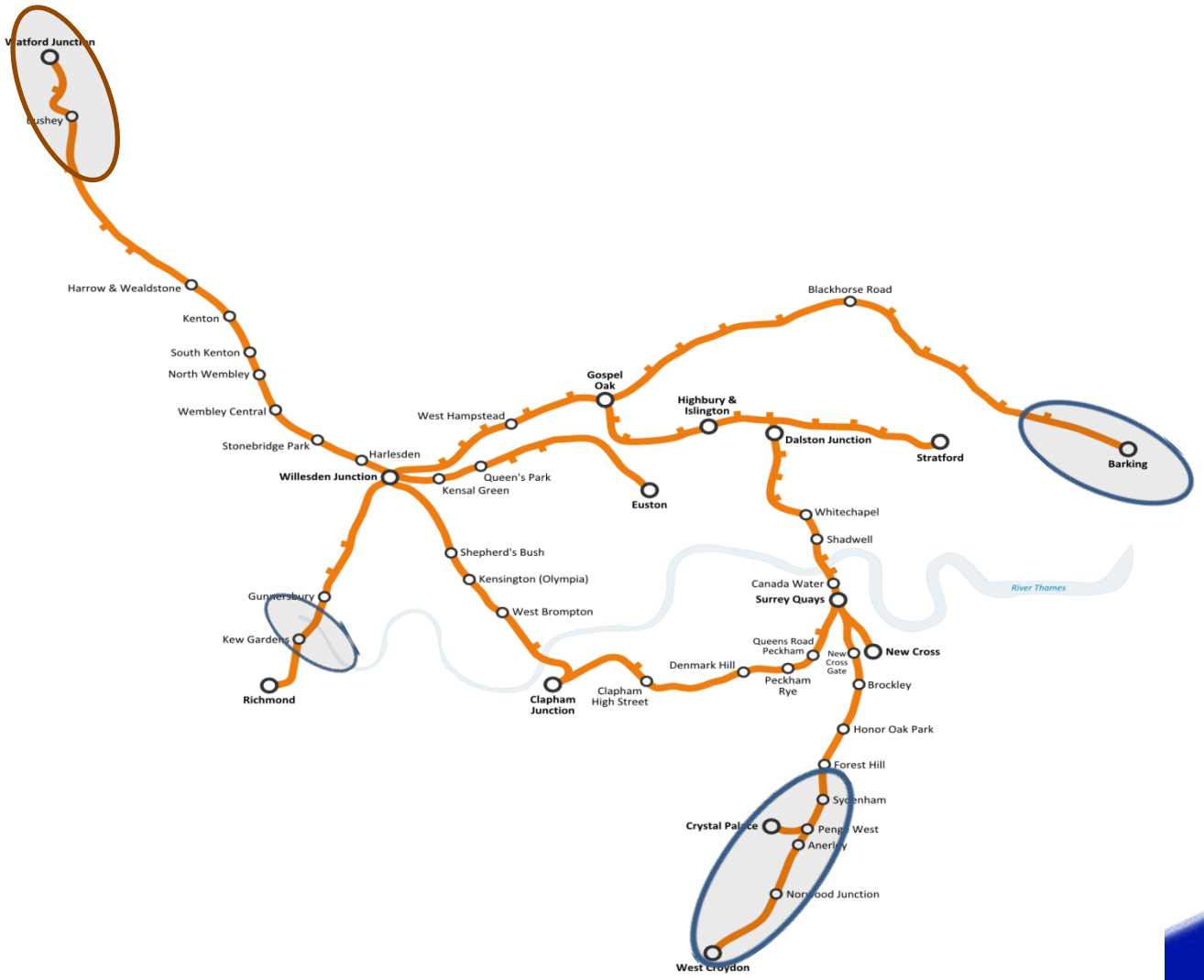
- Weak inspection programme
- Failure of design at top of embankment
- Third party mains failure
- Has leading to design changes
- Changes made to the procedure for checking embankment
- Network Rail controls

Wind maps



- Data driven change
- Looking as speed extremes
- Understanding seasonal variation
- Using this to alter exiting preventative maintenance regimes
- Remote sensing
- Beginning to plan for upgrade strengthening
- New project built in

Temperature Maps



Developing the case for weather input to asset management

- Planning for ‘worst case’ is accepted design practice; keep pushing for these extremes
- Building in resilience from initial design is the only viable way, remediating cases very hard
- Marginally greater ‘resilience costs’ may not make simple bottom line business case, reputational damage may change this
- The weather data to make the case exists, use it

Future Plans

Next steps

- Funding impact on long term ability to manage impacts of climate change
  - How do we measure the impact of climate change on TfL?
  - What are the long term issues of deferring work or engineering out adaptation works due to funding constraints.
    - Increased costs due to lack of asset resilience?
- Increased level of understanding of the interdependencies
  - Develop protocol of communication
- Asset & Business planning
  - Feedback loop within asset/business plans to trigger work once climate threshold reached

Designing Crossrail

- Where possible, the design includes ‘passive’ flood protection measures
  - such as raising entry or egress levels, raising track or cill levels, or extending portal walls
- Then ‘active’ flood protection measures and procedures have been identified such as flood gates and stop logs
- Design standards for passive fluvial flood protection have been set at all tunnel portals at risk of fluvial flooding against a best estimate peak flood level of a 1 in 200 year return period
- All Crossrail rolling stock will be mechanically cooled and maintained at a temperature of not more than 29˚ c and all platforms in the Central section will be mechanically cooled and maintained at a temperature of no more than 27˚ c

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helenwoolston@tfl.gov.uk