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Head of Asset Care Delivery

Dublin Airport part of daa Group

Hudson Bay 26th March 2019

Traffic Highlights

31.5 million

WHERE OUR PASSENGERS ARE FLYING?

FLIGHTS

233 thousand

TOP 5 DESTINATIONS

1. London
2. Amsterdam
3. Manchester
4. New York
5. Birmingham

PASSENGER NUMBERS

31.5 million

Naisc Eitilte
Flight Connections

2.1 million

TERMINALS

TERMINAL 1

61% of the passenger traffic

TERMINAL 2

39% of the passenger traffic

DAILY AVERAGE TRAFFIC

86 thousand passengers

639 flights

BUSIEST DAY

June 29

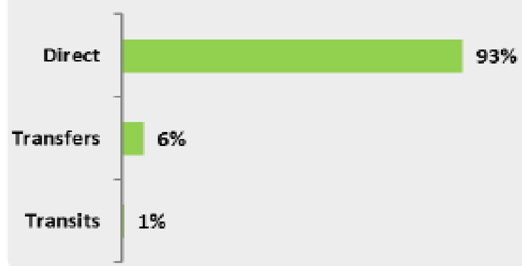
116 thousand passengers

* Subject to Change

CARGO

151* thousand tonnes

TRAFFIC STATISTICS



SCHEDULED DESTINATIONS AND AIRLINES

6 new airlines

AEROFLOT Russian Airlines
CATHAY PACIFIC
海南航空 HAINAN AIRLINES
CROATIA AIRLINES
ICELANDAIR
Lauda motion

+16 routes & services

177 destinations

45 airlines

2,500+ departing flights per week in peak

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Rehabilitation and Enhancements

of

Runway 10-28

and

Associated Taxiway Infrastructure at Dublin Airport

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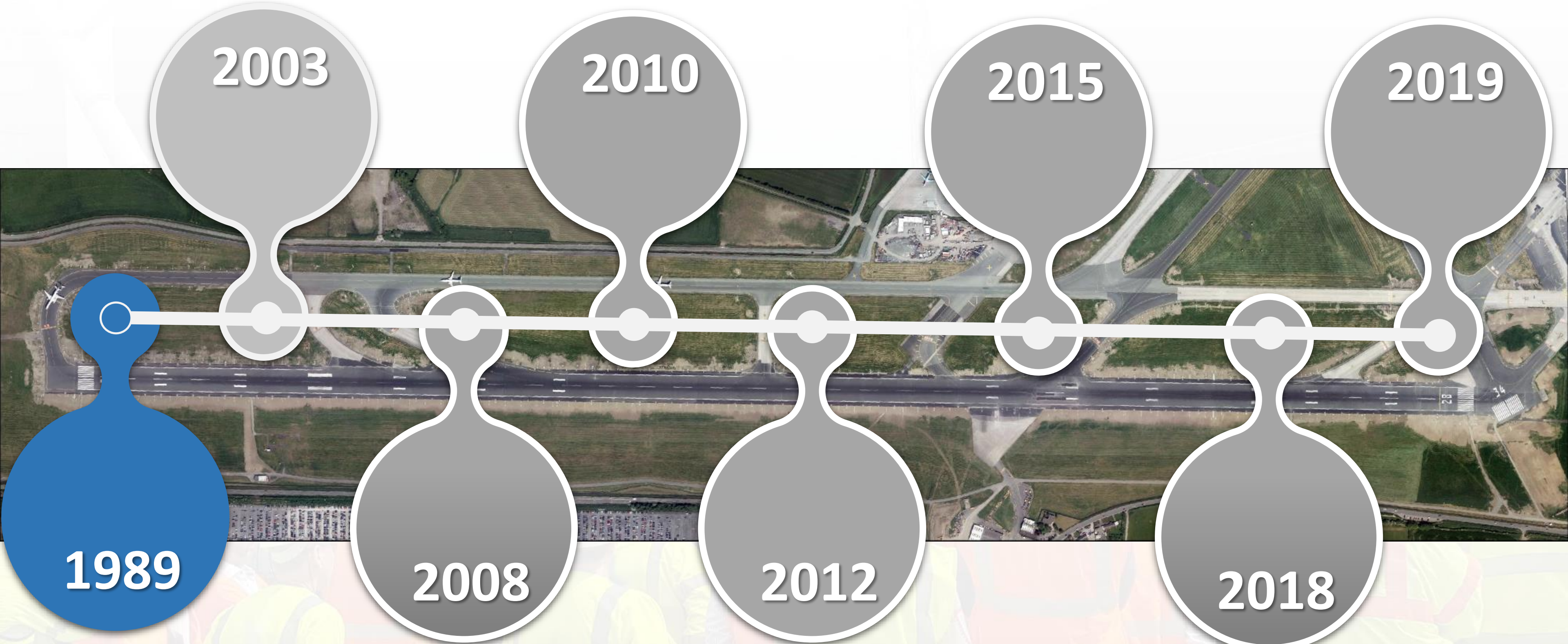


Historical Background

- December 1985 - Government approval to build Runway 10-28 at Dublin Airport
- 1986 - Design aircraft B747-400

(MTOW B747-400 was 387,000 Kg)

- Rigid pavement construction

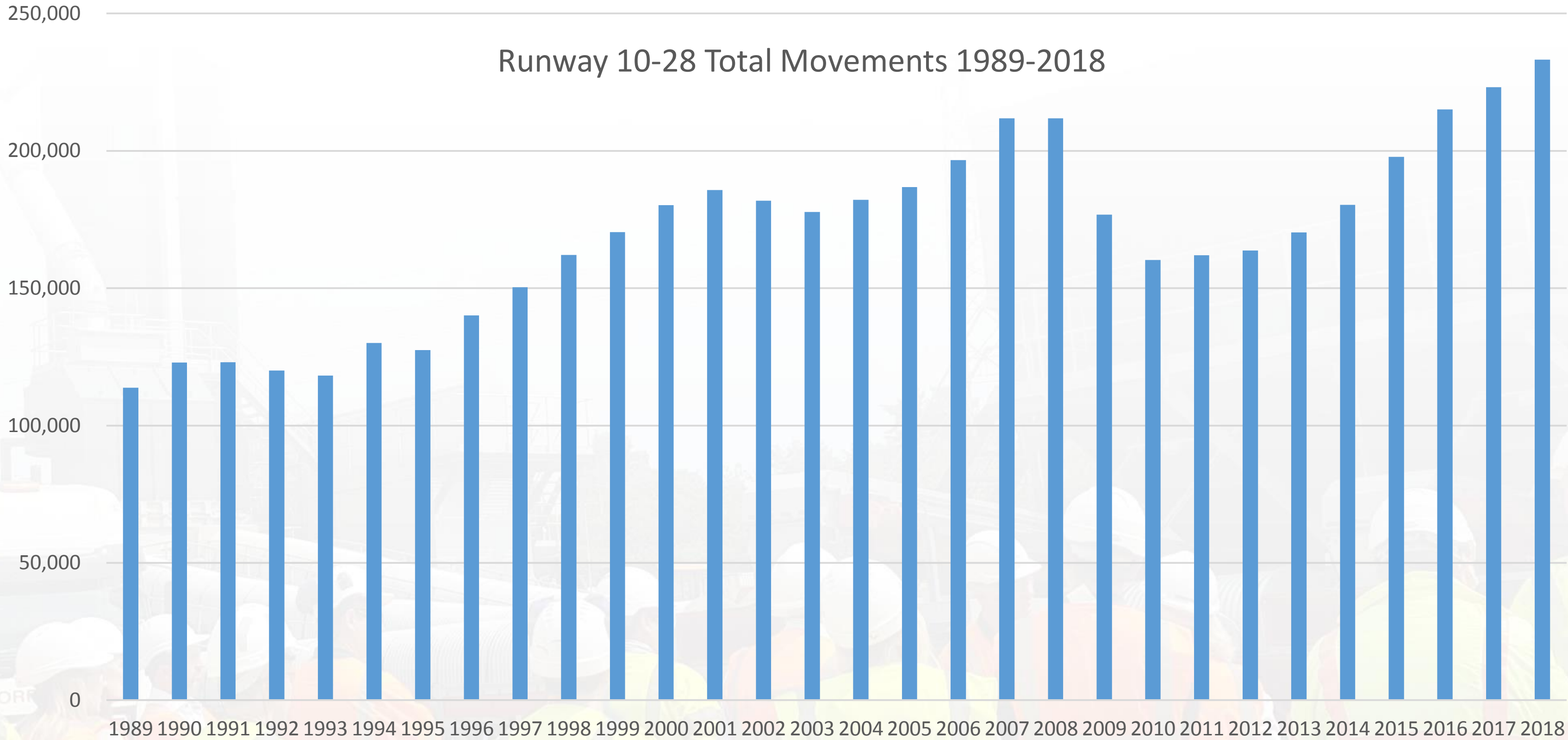
Long design life and low maintenance and ability to sustain repeated heavy wheel loading without surface deformation

- 1987 – 18 month construction

  programme commences

- 1989 - 21st June 1989 Runway 10-28 goes

into service (2,637m)



- 4.5 Million aircraft movements over the life
- Peak of 223k movement in 2018 and growing
- Average daily movements in 2018 of 639 with a peak of 780 on 15th June 2018

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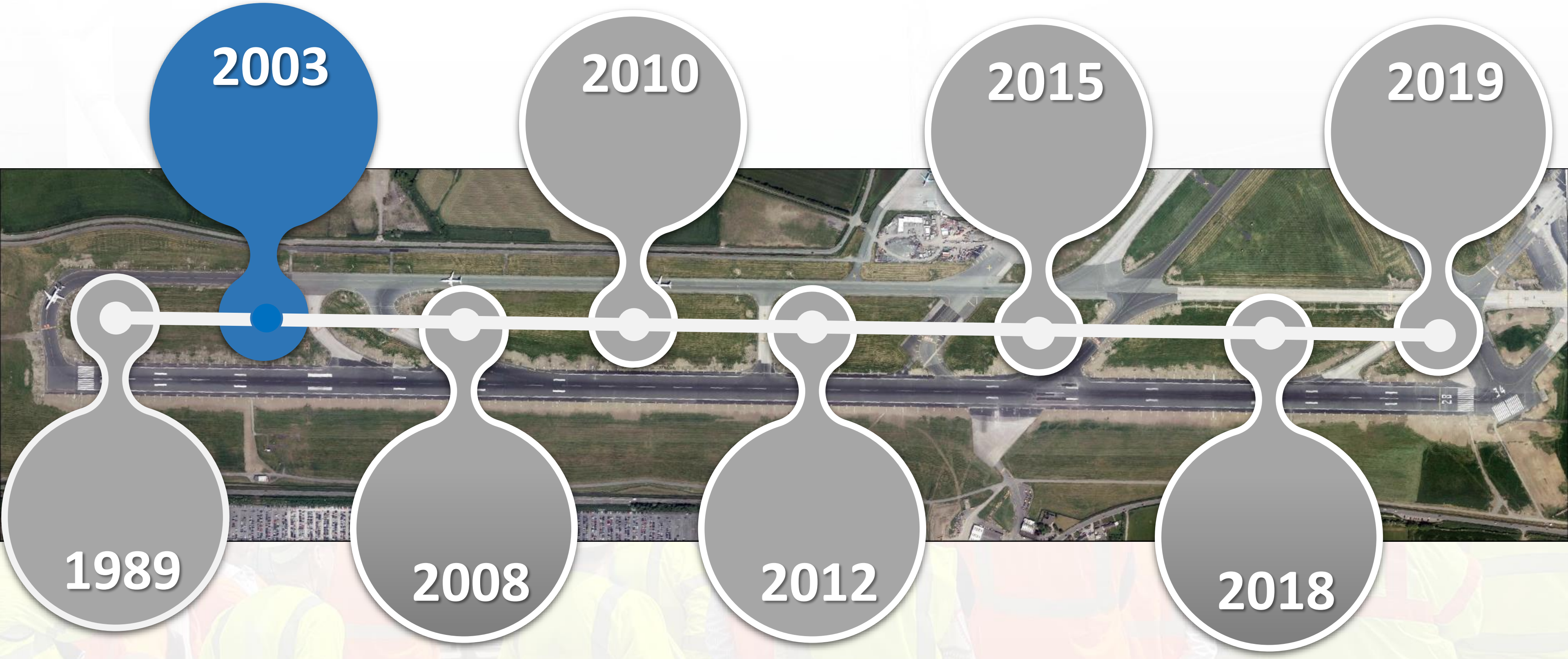

Pavement Deterioration Observed

- In 2003 a pavement evaluation was carried out by consultants PMS. The evaluation indicated that the pavement was in very good condition, however, the structural life of the pavement was being consumed rapidly due to the increase in traffic and the change in traffic mix to much heavier aircraft.
- The report estimated that the **remaining life of the pavement was about 9 years (up to 2012)** based on the predicted traffic at the time.
- The evaluation also concluded that the **runway friction values had also been dropping** over the past few years and that additional runway grooving would be required in the short term.

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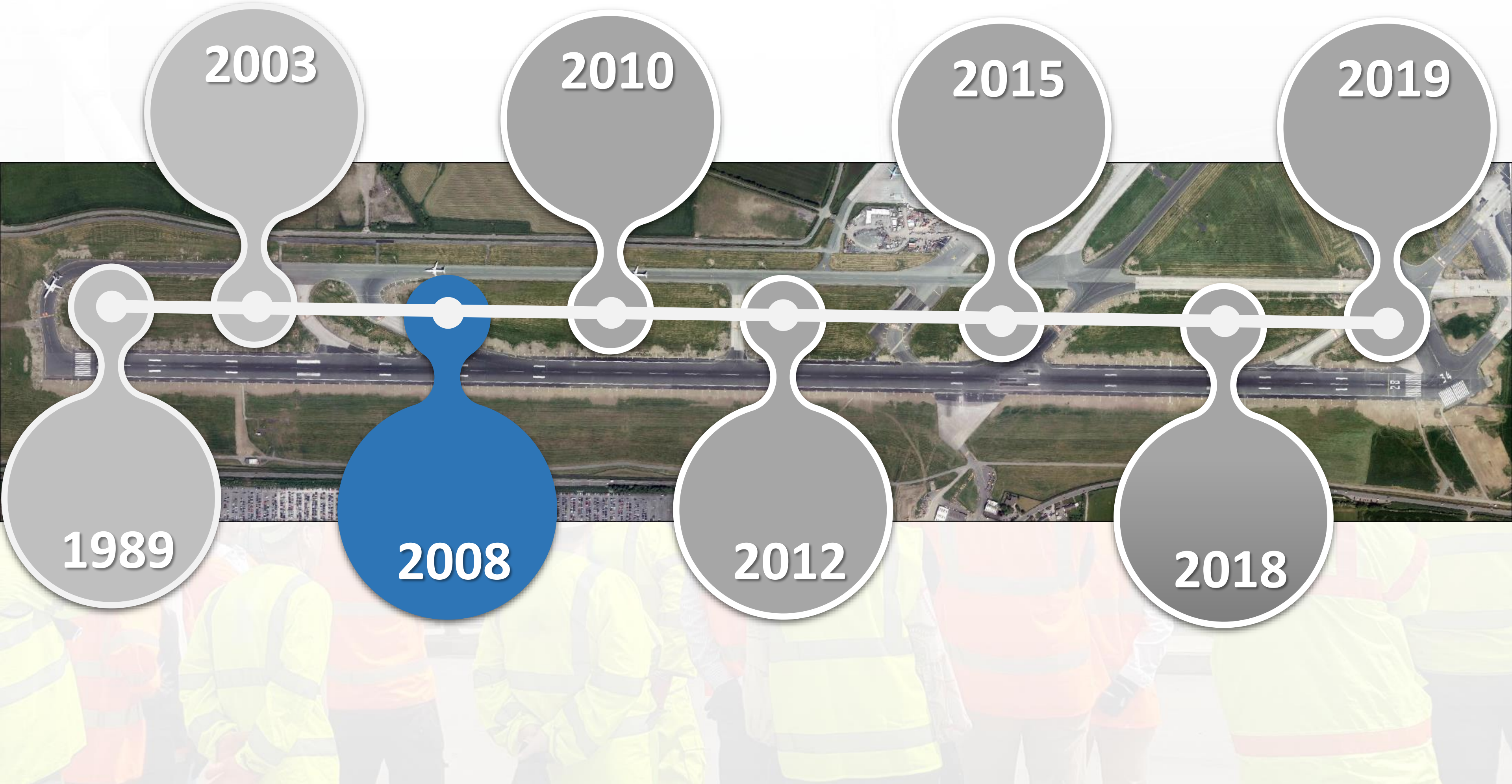
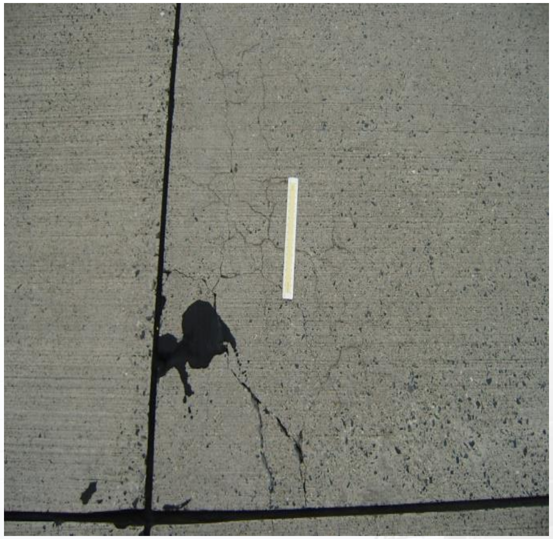
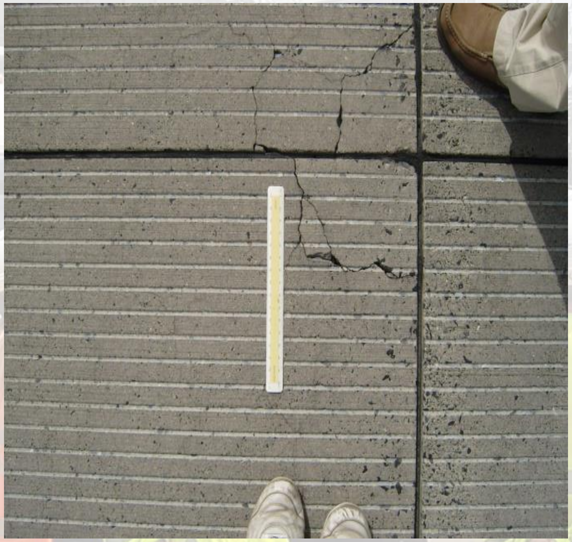


Increased Maintenance/Serviceability Impact





Runway Rehabilitation Study Commissioned

- Fehily Timoney Ramboll (FTR) commissioned to carryout feasibility study to determine optimum rehabilitation options.
- Pavement evaluation confirmed **the remaining life of the pavement to be in the region of 4 to 6 years (expiring 2011 to 2013)**
- At the time Dublin Airport were planning to construct **NR with an operational timeline of 2012.**
- Option study carried to review best options available for the business with reference to cost, operational impact and extending the life of the pavement until such time that the new NR becomes operational.

Pavement Rehabilitation Options Presented to Airlines

Subject	Alternative 0	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Technical Impact	Nothing will be done with the runway except the scheduled works in 2008 consisting of partial slab repairs, partial joint replacement and grooving of the surface	The runway will receive a new wearing course having excellent friction. Existing thickness of bound layers will be maintained.	The runway will receive a new surface treatment having excellent friction. Existing thickness of bound layers will be slightly reduced.	The runway will receive a complete new 3 layers base, binder and wearing course with grooving reducing the likelihood of future runway closures to a minimum the next 10 to 15 years.	The runway will receive a complete new 3 layers base, binder and thin layer wearing course having excellent friction reducing the likelihood of future closures to a minimum the next 10 to 15 years.
Financial Impact	-	€ 5,586,000	€ 5,874,000	€ 16,160,000	€ 14,560,000
Estimated Functional Service Life	3 – 5 years	8 - 10 years	6 - 8 years	10 – 15 years	10 – 12 years
Estimated Structural Service Life	3 – 5 years	6 - 10 years	6 - 10 years	20 years	20 years
Work Programme	-	Approx. 80 working nights without closure (20 weeks)	Approx. 80 working nights without closure (24 weeks)	Approx. 180 working nights without closure (45 weeks)	Approx. 170 working nights without closure (42 weeks)
Maximum ICAO category while construction	CAT III	CAT III	CAT III	CAT I	CAT I

Table 13 Summary of impact on pavement refurbishment alternatives.

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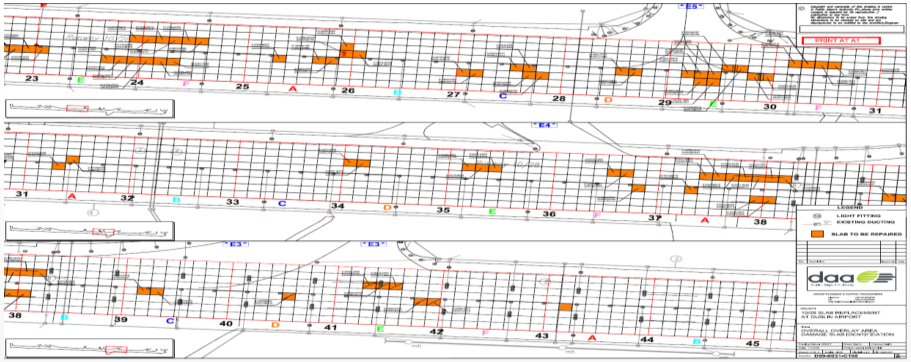
Preferred Options

- Options were presented to our airlines partners and our regulator in Q4 of 2009
- In December 2009 following the production of a Runway serviceability plan the following recommendations pertaining to the runway were made:
- Major Slab Replacement works and joint replacement needed urgently
- TPFC non structural overlay project should proceed as soon as possible



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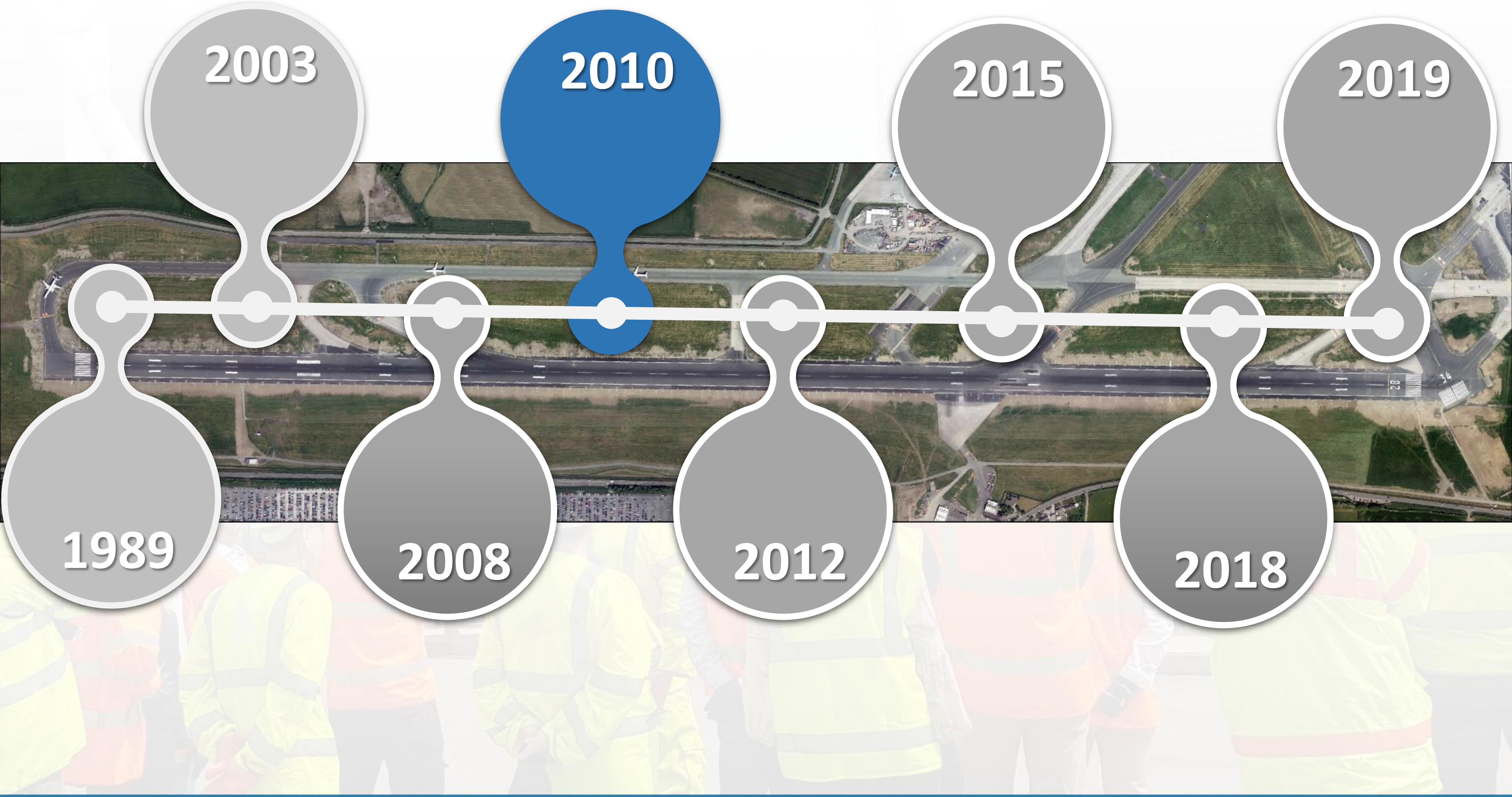

TPFC Overlay Commenced (Nov 2010 – April 2011)

- BBI Appointed in August 2010
- 19 Weeks Programme (23:00-05:00) Closure
- 22mm TPFC Overlay – "Novachip" Concept
- Thick Layer Polymer Modified Emulsion Sprayed in
- Emulsion Boils and Mixes into the Open Graded Asphalt and Secures the Aggregates into the Matrix
- Copenhagen Airport/Johannesburg Airport
- Replacement of c 130 PQC Slabs
- 142,000m2 of TPFC Overlay in 4 Phases
- 1 Year Maintenance Programme

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April 2011

1D200503 Photo: © Peter Barrow Photography 12th May 2011 Tel: 0872-559638

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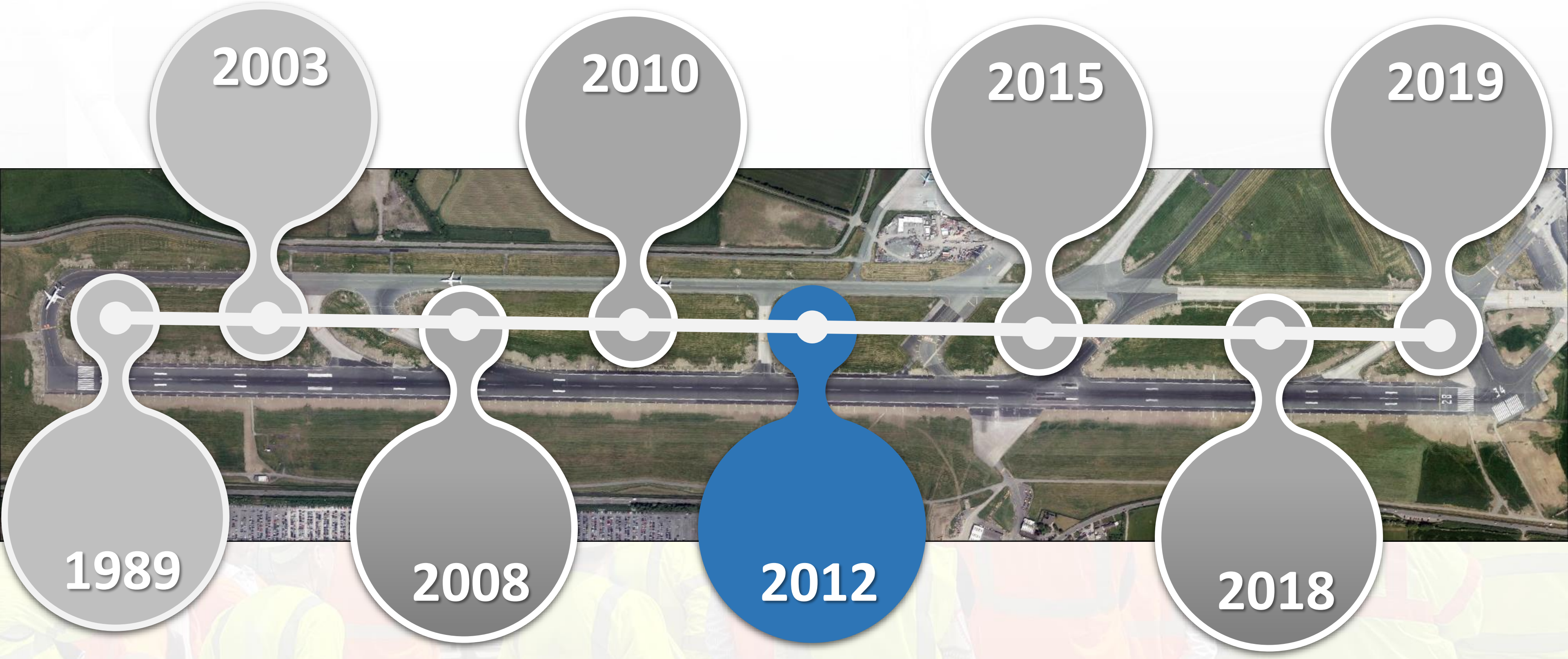

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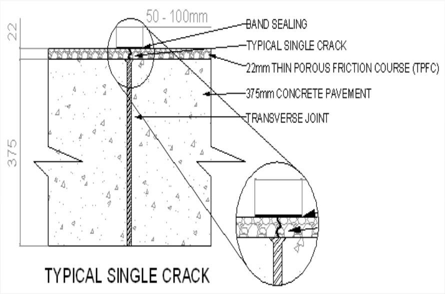
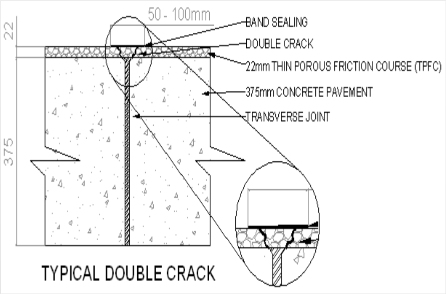
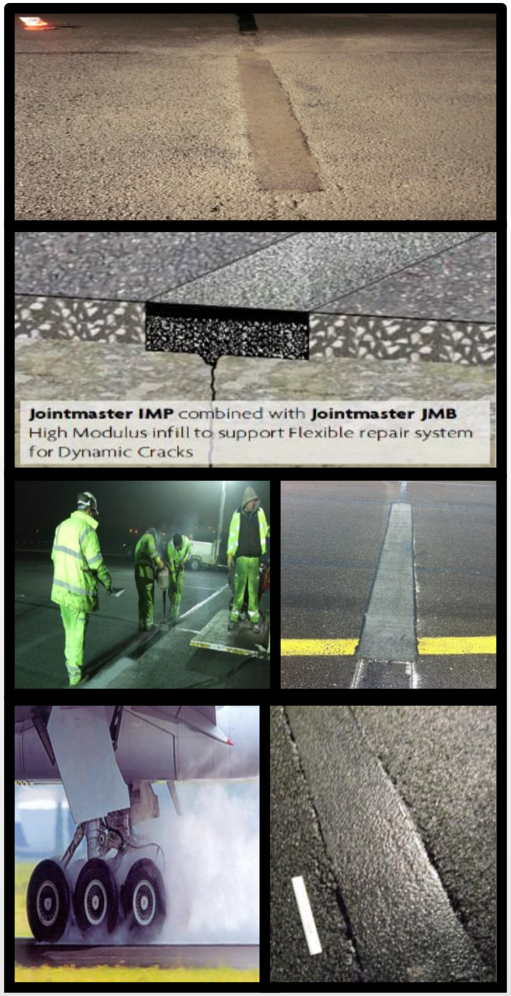
Runway Serviceability Issues

- March 2012 – Runway Closure (FOD) contamination by over-banding Materials
- March 2012 – FTR visited Site and noted that the degree of reflective cracking was consistent with what they would have anticipated after 6yrs life
- May 2012 – August 2012 – Rephalt Temporary Repair Materials used by the Asset Care - Airfield Maintenance Teams. This short Term Solution (bought some time)
- August 2012 – FTR/daa agree joint remedial solution





Short/Medium Term Remedial Solution



- Joint-master IMP combined with Joint-master JMB – Rhino –UK Product (HAPAS Approved)
- FTR's analyses of the anticipated horizontal and vertical movement of the existing slabs and comparison with the properties of the Joint-master IMP/JMB system and concluded that the joint repair method has sufficient flexibility to accommodate the anticipated movements
- October 2012 – FTR/daa/UCD/Sandberg Explore Joint-master Solution (FEA)
- OBS 45 and OBS 60 used for over-banding no contamination issues reported

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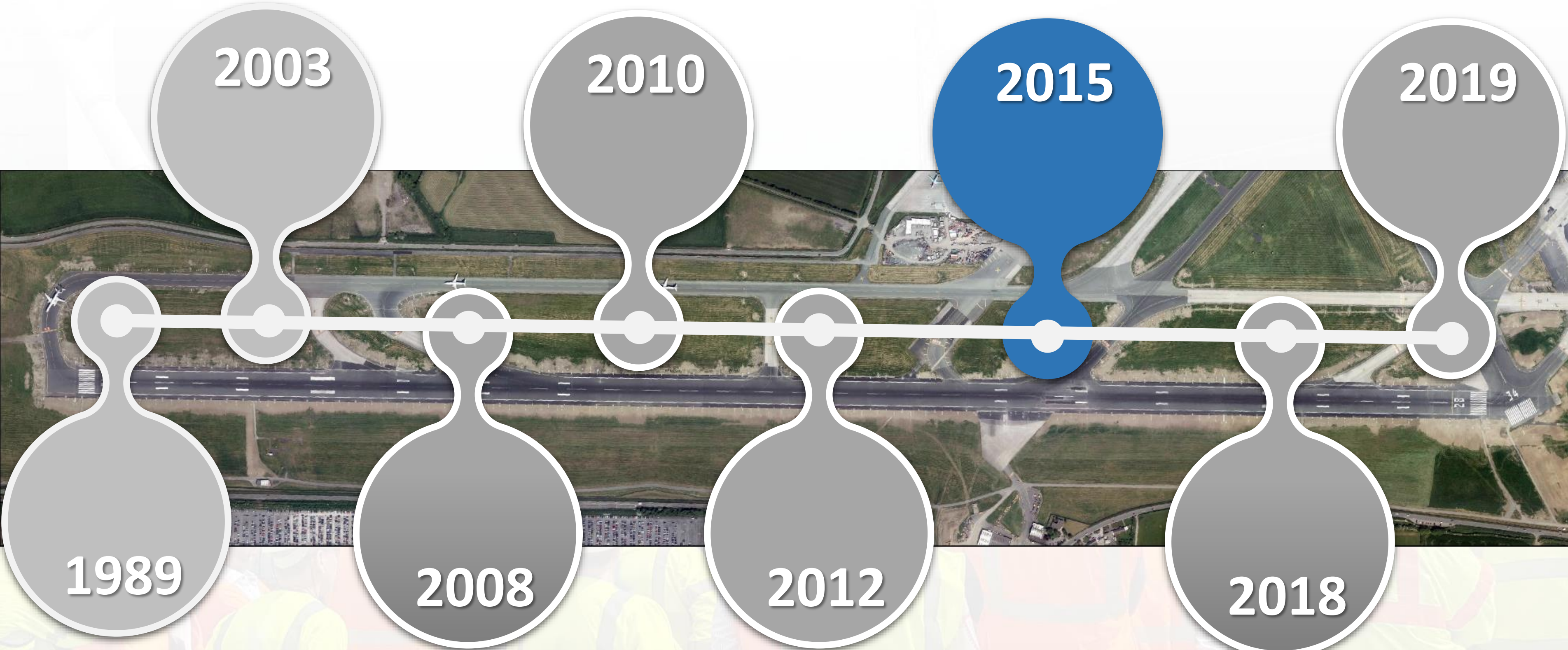
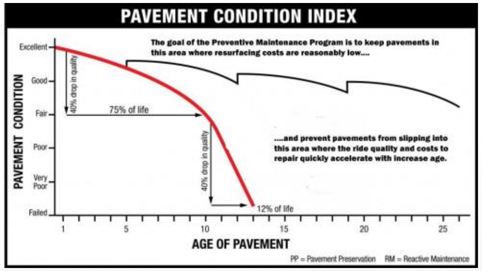


Project Inception – Linked to Asset Life Cycle



- ISO 55001 and Risk Model
- 25 Million PAX Forecast 2017
- Funding Secured – CIP 2014-2018
- Pavement end of life - AGL systems end of life , serviceability and safety, maintainability challenges, escalating maintenance costs
- Second Runway - Runway 16-34 approaching end of life
- NR Runway considerations 2019 commencement

Project Scope

- Structural Overlay to 10-28
- Runway AGL Upgrade Runway 10-28
- Structural Overlay to Taxiways Echo 3, Echo 6 and Bravo 7
- Taxiway B3 and B2 AGL upgrades
- Taxiway widening B7, E6, E1 and B1
- Taxiway Re-designation Project enabling Works

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Key Project Timelines – D&B Contract

Date	Activity
2014	Condition Surveys of Runway - URS
Early 2015	Appointment of Consultants CH2M
March 2015 – July 2015	Feasibility Study
July 2015 – Sept 2015	Outline Design
Sept 2015 – Nov 2015	Preparation of Tender Documents (Employers Requirements Documents) – D&B Contract
Nov 2015 – Mar 2016	Tender Stage
Mar 2016 – July 2016	Tender Evaluation and Signing of Contract
July 2016	Appointment of D&B Contractor Lagan Clare JV
July 2016 – Oct 2016	Detailed Design and Mobilisation to Site
Nov 2016	Commencement of Runway Closures

Structural Overlay Employers Requirements

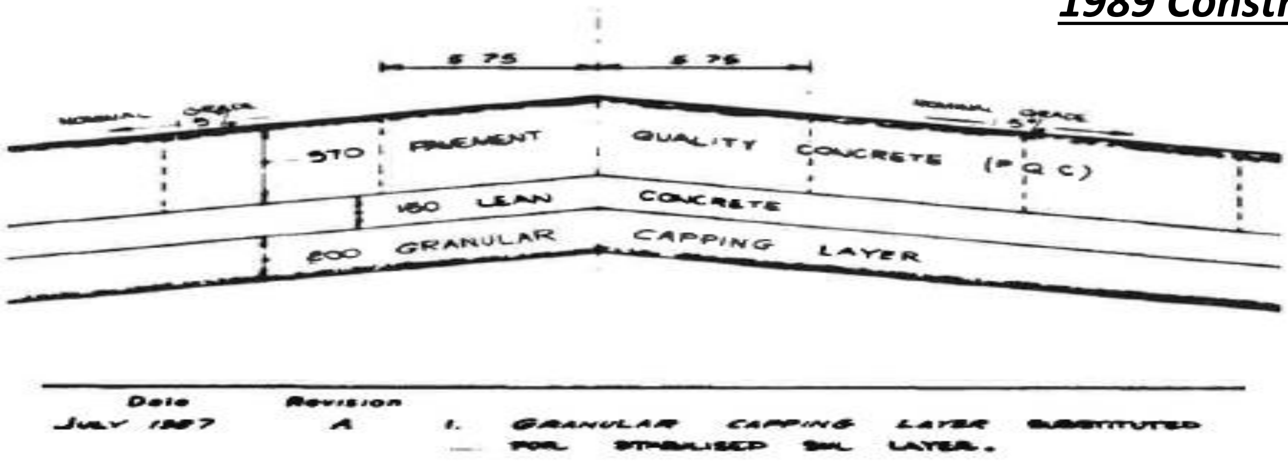
- Design Aircraft is the **B777-300ER** at (MTOW)
- Frequency of traffic is Medium (i.e. 100,000 coverages over the life)
- The surface course shall be **grooved Marshall Asphalt**
- The following should be used in the pavement design: Defence estates design and maintenance guidance **DMG 027 (pavement design) and DMG 033 (reflective cracking on airfield pavements)**
- **Minimum overlay thickness to be 150mm** with a design Life of the new pavement to be **15 years with life to first maintenance of 10 Years**
- Installation of a **glass grid reinforcing** layer between the base and binder layers

	UNITS	777-200LR	777F	777-300ER
MAXIMUM DESIGN	LB	768,000	768,800	777,000
TAXI WEIGHT	KG	348,358	348,722	352,441
PERCENT OF WT ON MAIN GEAR		SEE SECTION 7.4		
NOSE GEAR TIRE SIZE	IN.	43 X 17.5 R 17, 32 PR		
NOSE GEAR	PSI	218	218	
TIRE PRESSURE	KG/CM^2	15.3	15.3	
MAIN GEAR TIRE SIZE	IN.	52 X 21 R 22, 36 PR		
MAIN GEAR	PSI	218	221	
TIRE PRESSURE	KG/CM^2	15.3	15.5	

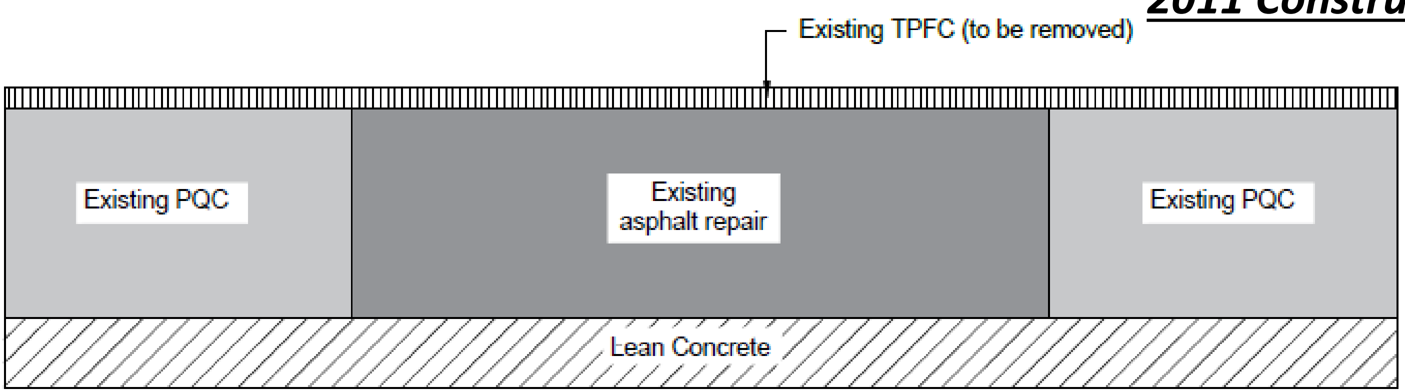
7.2 LANDING GEAR FOOTPRINT
MODEL 777-200LR, -300ER, 777F

Existing Pavement Details

1989 Construction



2011 Construction



LCJV Pavement Design Solution

- **RPS and Unihorn commissioned on behalf of LCJV to design the pavement to meet the Employer Requirements**
- RPS demonstrate that 150mm Marshall Asphalt overlay of existing concrete pavement (following the removal of the 22mm TPFC) will meet the requirements of DMG 027
- RPS conclude that 150mm overlay of existing concrete slabs in un-modified Marshall Asphalt would lead to reflective cracking in excess of that permitted in the ER's and DMG 033 this is validated by Unihorn modelling
- Unihorm commissioned to model the impact of the introduction of SealOflex 5-50 (HT) in the 50mm base course.
- The report concludes that the incorporation of Sealoflex in the base course of the 150mm overlay negates the need for reinforcement in the underlying concrete pavement. They did state however that it would have a positive effect if included.
- Unihorn model the proposed pavement design 150mm structural overlay, SealOflex 5-50 (HT) in base course and model with reference to the life to 1st maintenance requirements as set out in the employers requirements

Unihorn Analysis and Recommendations

- The analysis focused on controlling the percentage of reflective cracking during the first 3 years of life (reflective cracking less than 1%) and during the first 10 years (reflective cracking less than 15%)
- Reflective cracking can be due to two major mechanisms 1) thermally induced cracking and 2) traffic related cracking
- From the analysis it was concluded that 150mm thick with a 5% polymer modified sealOflex asphalt concrete meets the employers requirements and DMG 033.
- It also concluded that at locations with a load transfer capacity of less thank 70% CompoGrid CG200 should be applied on the milled PQC

Polymermodified Sealoflex 5-50 (HT) Asphalt Concrete

Name:	**AC 16 mm with 5.0 % elastomeric PMB (PG 82-22)**
Short name:	AC 16 + 5.0 % PMB (PG 82-22)
Short description:	this is a high quality elastomeric polymer modified asphalt concrete that can be used in wearing courses, in binder courses, as well as in base courses. Compared with conventional asphalt concrete, the polymer modified asphalt concrete has the following advantages: ➢ Better durability and better resistance to ageing; ➢ Better creep resistance to prevent permanent deformation of the asphalt layer, also at high temperatures; ➢ Better tensile strength and toughness to prevent the development of (reflective) cracking.
Composition:	57 % aggregate (> 2 mm) 37 % sand (> 0.063 mm < 2 mm) 6 % filler (< 0.063 mm)

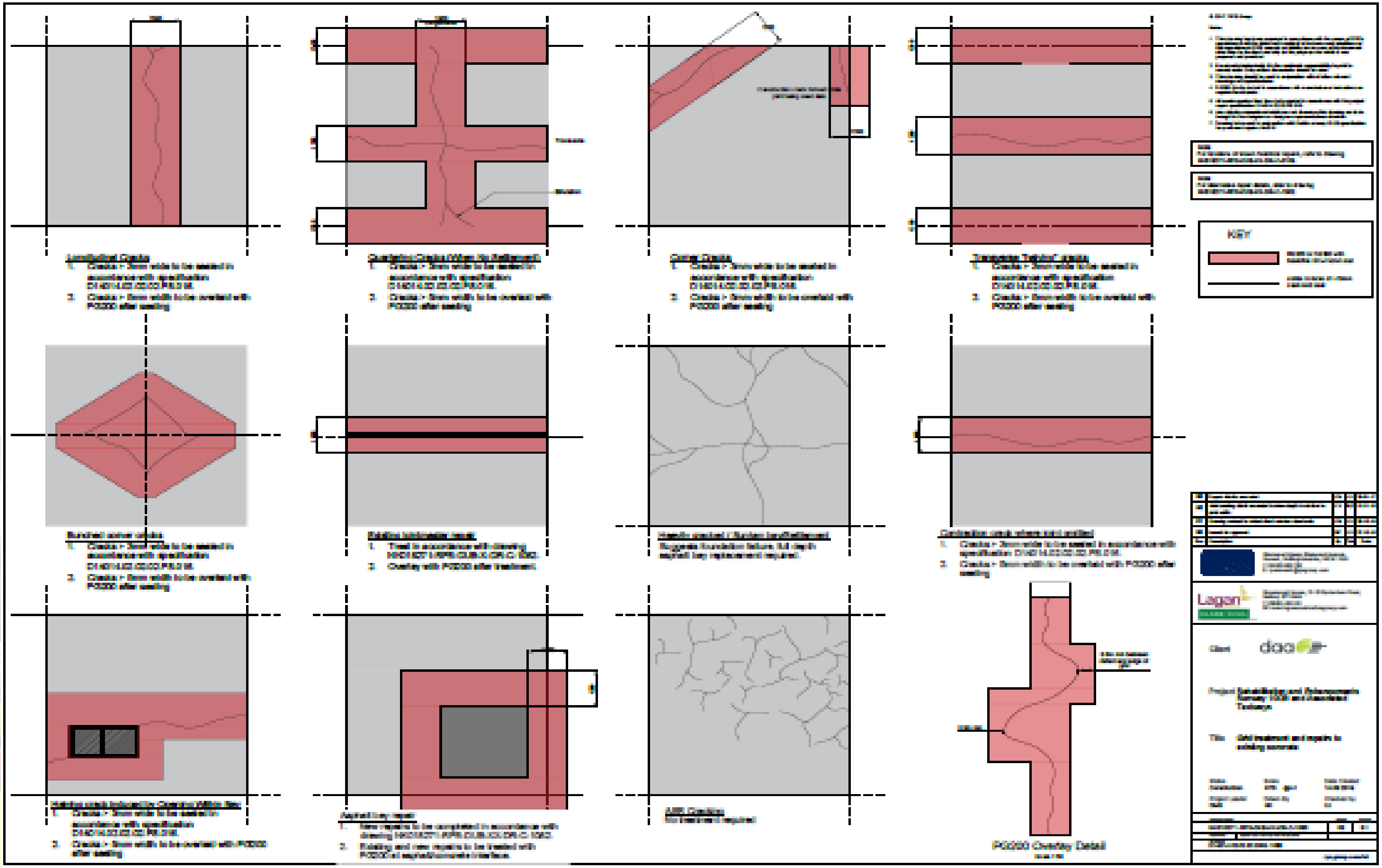
The gradation complies with Superpave asphalt mixture gradation requirements for 19 mm nominal size mixture

Volumetrics:	Air voids: 2.5 % VMA: 14 % VFB: 82 %

DESCRIPTION		TEST METHOD	SPECIFICATION	CLASS
Essential requirements				
Penetration	at 25 °C	EN 1426	60-90 [mm x 0.1]	5
Softening Point R&B		EN 1427	≥ 90 °C	2
Cohesion Force-ductility	at 5 °C	EN 13589	≥ 11.5 J/cm2	-
Displacement till break	at 5 °C		≥ 30 cm	-
Energy 20-40 cm	at 10 °C		≥ 3 J/cm2	7
Change of Mass after hardening		EN 12607-1	< 0.3 % m/m	2
Retained penetration after hardening		EN 12607-1 / EN 1426	≥ 70 %	7
Increase in softening point after hardening		EN 12607-1 / EN 1427	≤ +2 °C	2
Flash Point		EN ISO 2592	>250 °C	2
Additional requirements				
Fraaß breaking point		EN 12593	≤ -16 °C	7
Elastic recovery	at 5 °C	EN 13398	- %	-
	at 25 °C		≥ 90 %	2
Storage stability				
Difference Softening point 185 °C		EN 13399	≤ 2 °C	2

PROPERTY		TEST METHOD	SPECIFICATION
Density	at 25 °C (indication)		1025 kg/m3
Viscosity	at 135 °C (indication)	EN 13302 / EN 13702-2	2000-4500 mPa·s
	at 185 °C (indication)	(approx. SR = 5 1/s)	250-450 mPa·s
Asphalt mixing and short term storage temperature*			190 °C
Maximum storage temperature*			Max. 205 °C

Pavement Design Details



Typical Daily Construction Timeline

Time	Activity
17:15	Concall between ADM, ATC, Met Eireann and OIM
17:30	Go/No Go Decision
18:00	Batching Commences
20:00	Workers arrive to site
21:30	Nightly Briefing
23:00	Runway Possession Granted
23:10	A-Frames in place and work commences
23:10 – 23:30	Contractor mobilises
23:30 – 00:00	Removal of lights and planing off TPFC
00:00 – 01:30	Repairs to Concrete/Install Glass Grid

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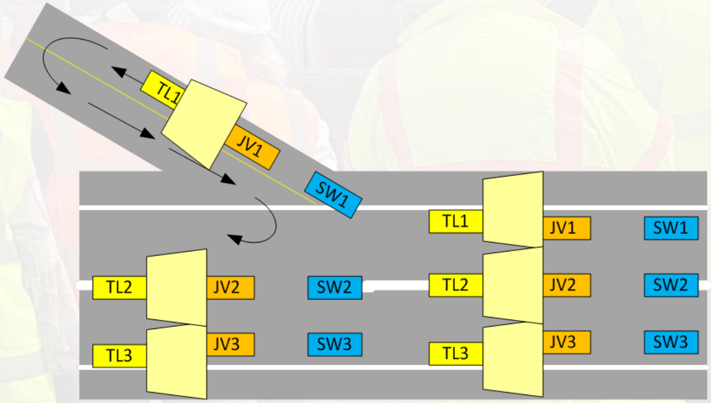
Time	Activity
01:30 – 03:00	Laying of Asphalt
02:00	Mid Shift Briefing
03:00 – 03:30	Re-install lights and Line marking
03:00 – 04:00	Tidy of work areas and removal of plant/equip
04:00	Friction Testing coefficient of friction confirmed/AGL Lighting Checks/Compliance validation
04:15	Commence FOD Sweep
04:15 – 04:55	FOD Sweep
05:00	Reinstatement of Runway
05:00 – 06:00	Post Shift Briefing and Planning next shift works



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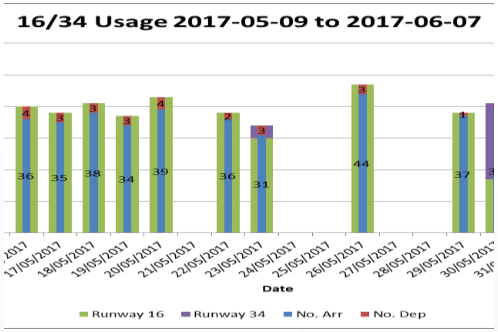
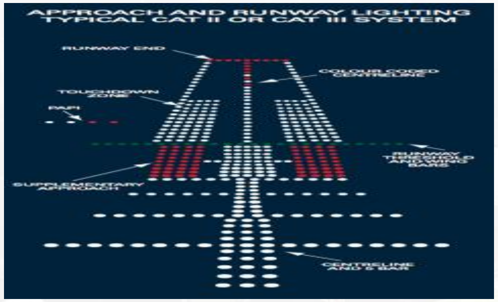
Delivery Challenges

- Weather
- Stakeholder (IAA/Airlines/Community)
- Safety – Operational and Occupational
- Noise
- Security
- Design
- Quality
- Scope Creep
- Un-grooved Runway constraint
- Maintain CAT III AGL Services
- Cost





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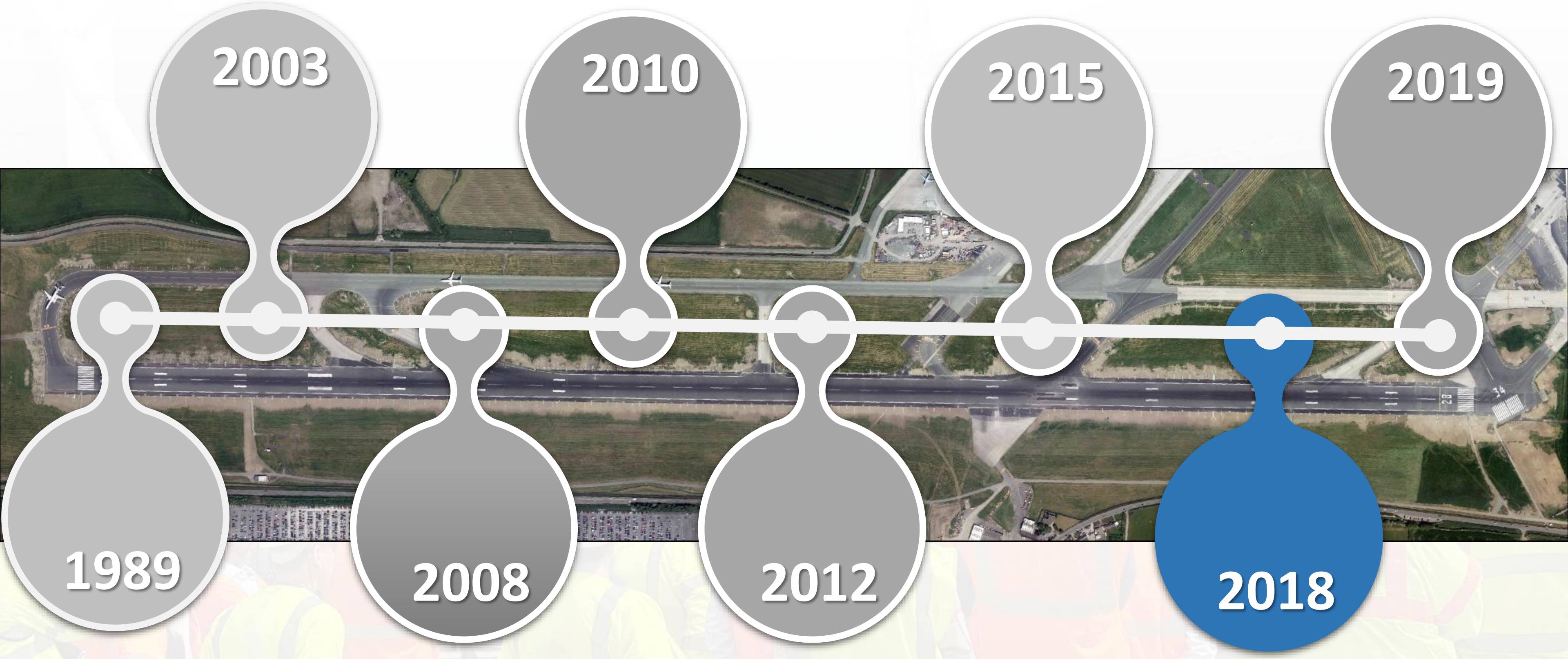

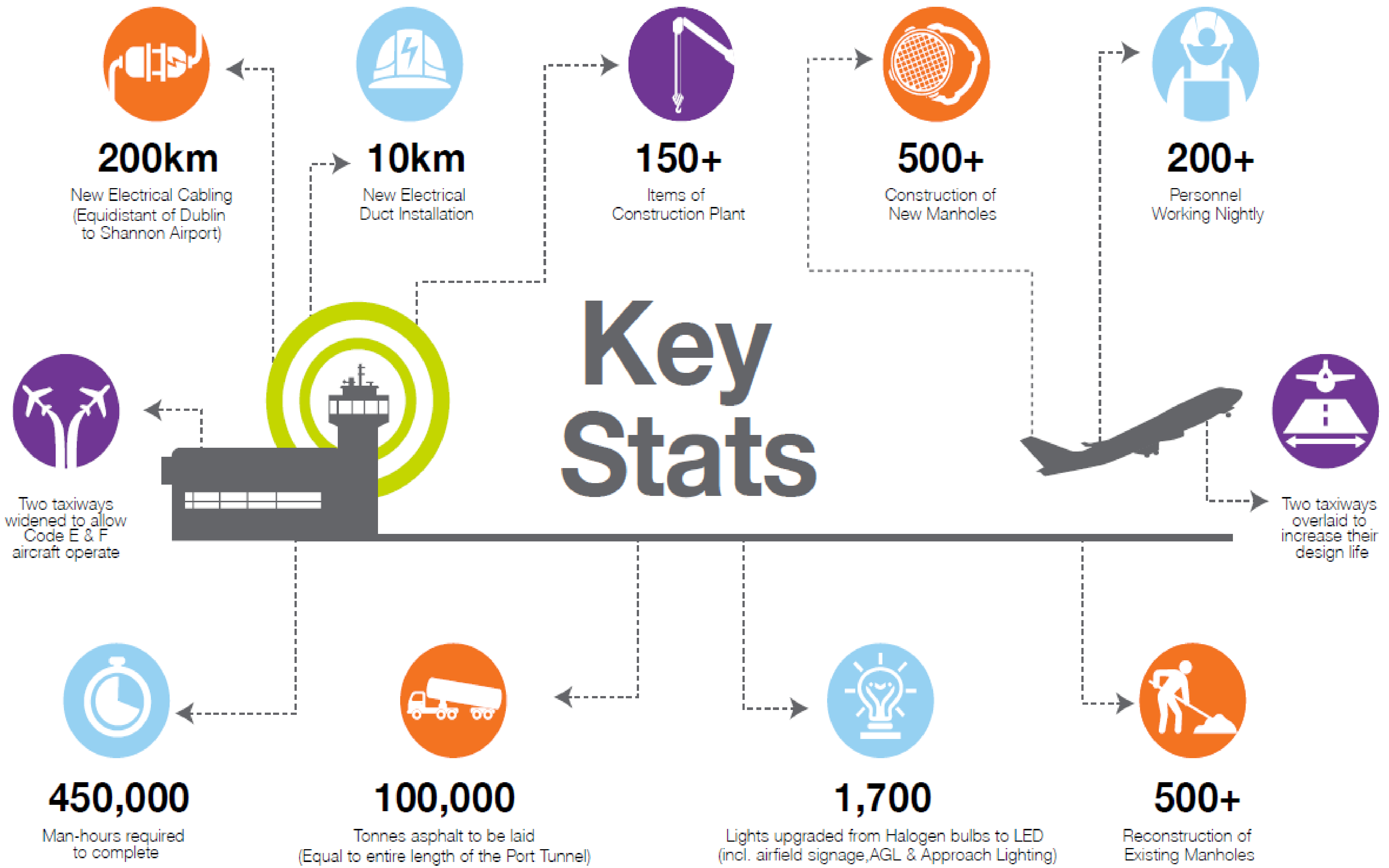
Key Stats
200km
New Electrical Cabling (Equidistant of Dublin to Shannon Airport)
10km
New Electrical Duct Installation
150+
Items of Construction Plant
500+
Construction of New Manholes
200+
Personnel Working Nightly
Two taxiways widened to allow Code E & F aircraft operate
Two taxiways overlaid to increase their design life
450,000
Man-hours required to complete
100,000
Tonnes asphalt to be laid (Equal to entire length of the Port Tunnel)
1,700
Lights upgraded from Halogen bulbs to LED (incl. airfield signage,AGL & Approach Lighting)
500+
Reconstruction of Existing Manholes

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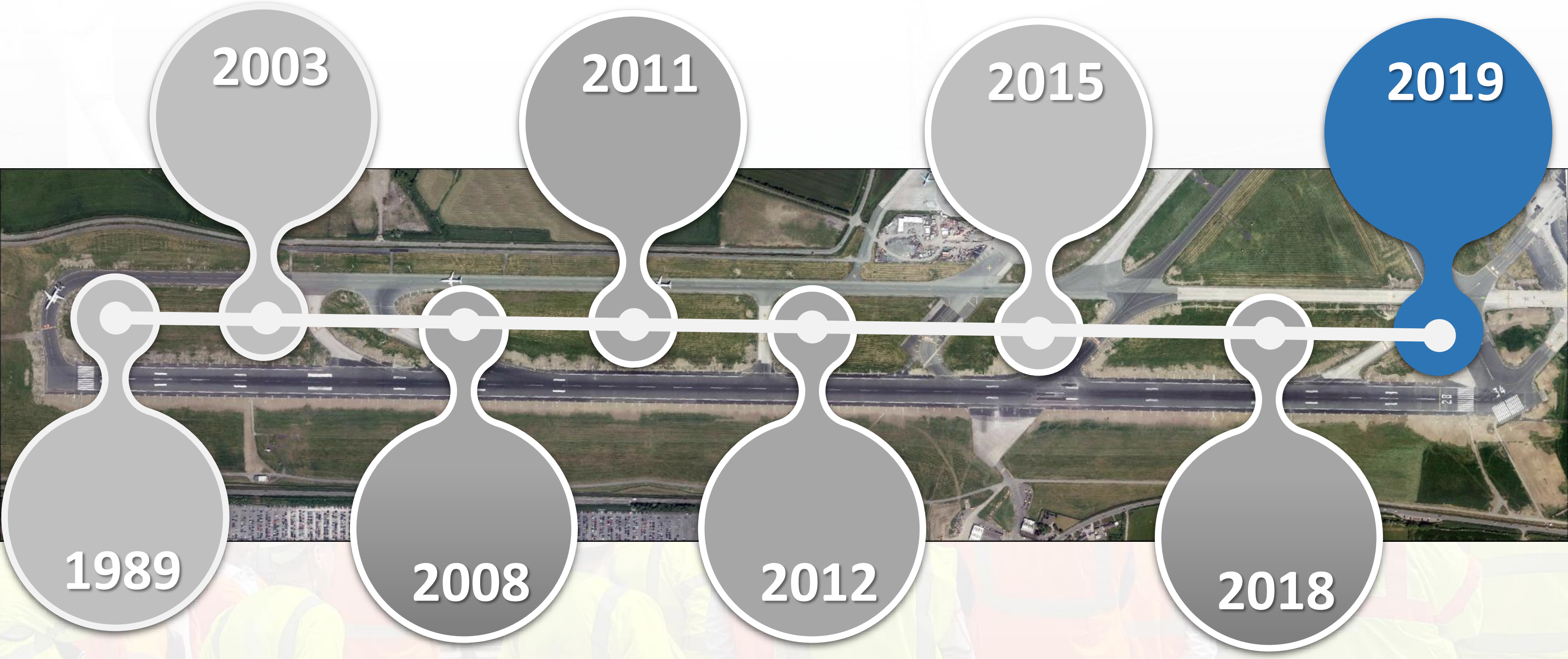

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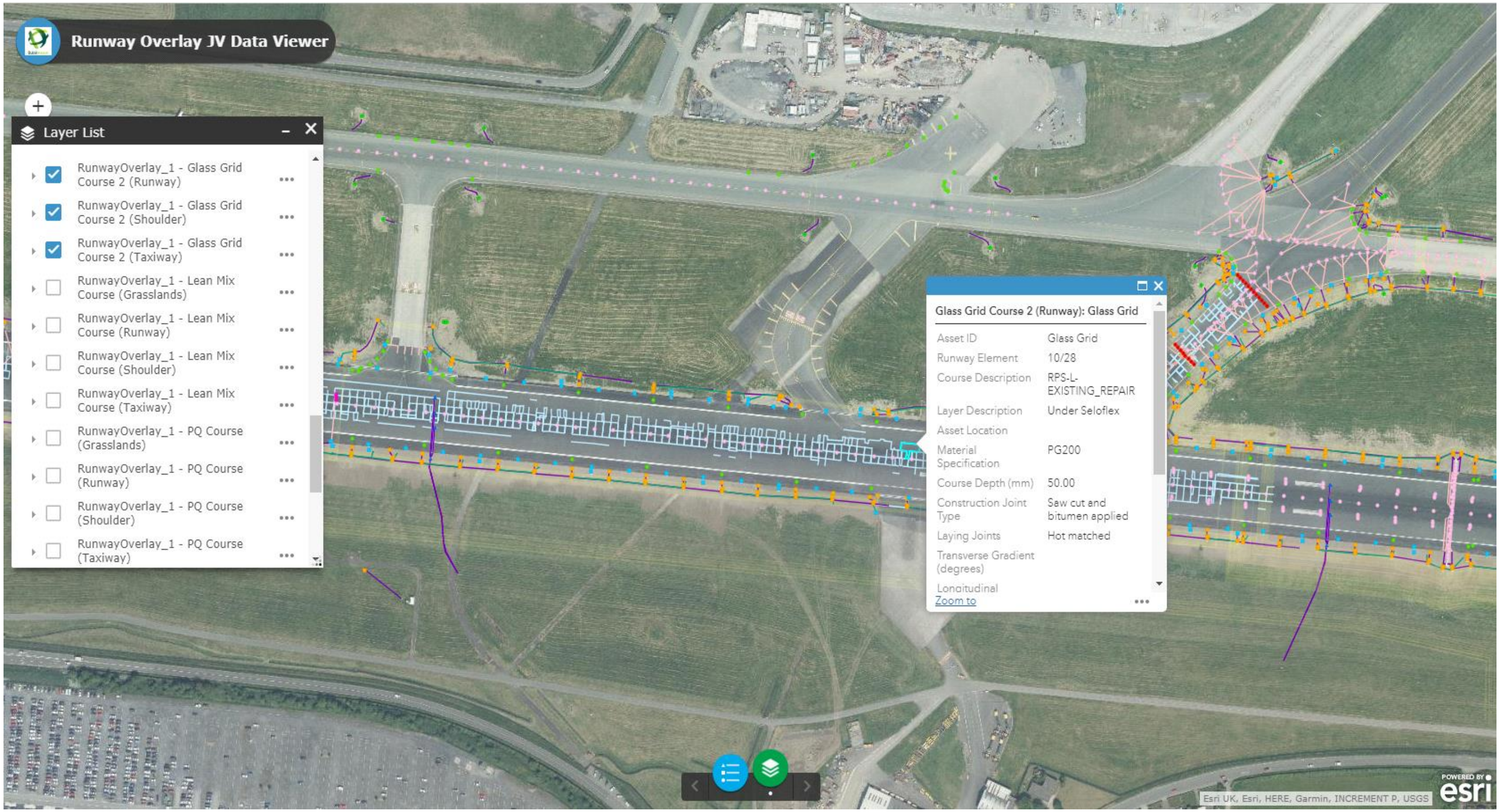

Document Classification: Class 1 - General

Pavement Maintenance 2019

- Rubber Quantities Removed to-date:

  - ✓ July - 2.02 T
  - ✓ Sept - 1.86 T
  - ✓ Oct - 1.82 T
  - ✓ Dec - 2.1 T

- All waste rubber removed and disposed of in accordance with Contractor’s environmental management plan (EMP) at a licenced waste facility (AES, Bord na Mona)

- Contractor currently investigating options for re-use of the waste rubber as a continuous improvement

Before and After Treatment

- Typical weight of a B737 Tyre is 72KGS. The rubber removal in 6 months since July 2018 is equivalent to 110 B737 Tyres

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THANK YOU