



Airfield Operations Conference & Equipment Expo
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What Lies Beneath:

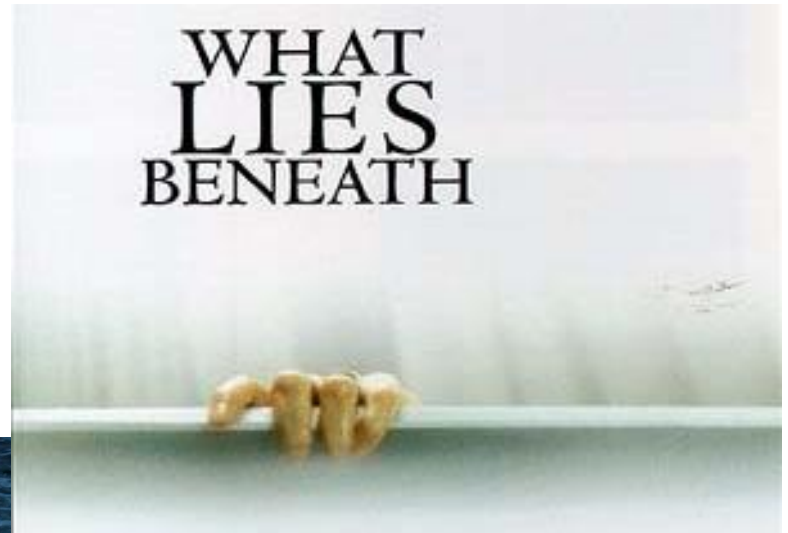
Identification & Mitigation of Moisture
Damage on Runway 08R-26L at YVR

Presented by:

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Airports + Aviation Group

September 20, 2017

It's *What You Can't See* That Will Cause You Grief



Presentation Outline

- RWY 08-26 Background Information/ Construction History
- Steps Taken to Identify Moisture Damage (Stripping) & Recommendations to Mitigate Moisture Damage
- Design Concept Scope (Fast Tracked)
- Concurrent Work & Project Constraints
- Project Implementation & Key Features
- Typical Nightly Resources & Progress
- Discussion & Questions



Background Information/ Construction History

- Original runway 08-26: 28 cm PCC; 5+600 to 8+200/ 30 m wide, 1951
- Widened & extended to 5+000 to 8+350 to 60 m wide, 36 cm PCC 1961
- Resurfaced with HMAC, 1974, 1985 & 2003/2004
- 1974: Full width, full length 10 cm thick HMAC overlay
- 1985: Keel section (30 m) inlay, 5+000 to 8+350, 4 to 6 cm deep
- 2003-2004: Full width asphalt inlay/overlay, variable thickness (with liquid anti-strip additive)
- 08R extended with PCC (2004)
- 26L RESA addition, 45 cm PCC (March 2016 to September 2017)



And yes, I was there in 1974, 1985, 2003/2004

Then



Now



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SWIFT 2017

Background Information (08R-26L, D5/D)



Steps Taken to Identify Moisture Damage

- Airfield Pavement Management System development in progress
- Added “Urgent Needs Assessment” done during RESA work nighttime closures, April 2016, report May 2016
- Highlighted distresses on 08R-26L (localized raveling, interconnected fine cracks, possible moisture damage, rutting & tire ‘dimpling’)
- Systematic coring & visual of cores, dense spacing in areas of concern in centre 20 m; moisture damage observations reported, (first group, 96 cores)
- Systematic coring & visual of cores, outer 20 m each side of centreline, full length of runway (second group, 34 cores)
- Total, 130 x 10 cm diameter cores
- Interim report & recommendations July 2016
- Final report & recommendations November 2016



Examples: Urgent Airside Needs Assessment Observations, 08R-26L (accentuated by low level light)



Raveling; interconnected fine cracks near 13-31



Tire “dimpling”, rutting, shoving on centreline near 26L



Tire “dimpling”, rutting, shoving, south side of centreline near 26L



Tire “dimpling”, rutting, shoving, south side of centreline near 26L



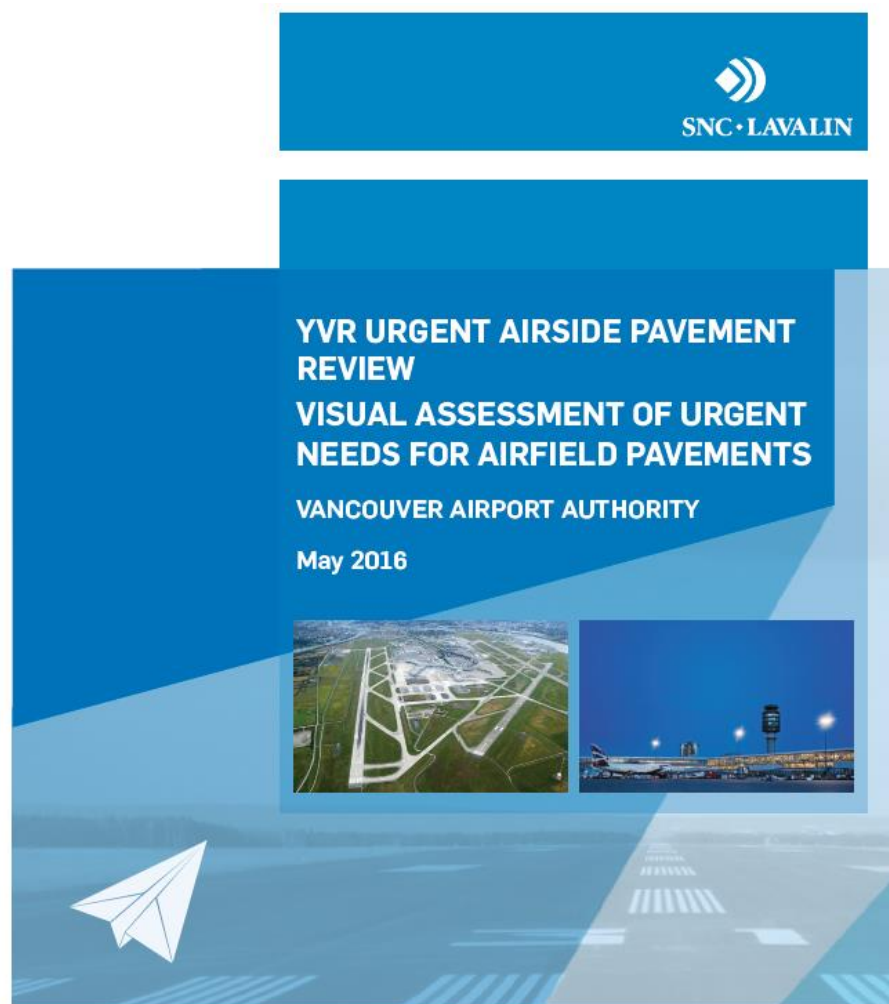
Tire “dimpling”, rutting, shoving, north side of centreline near 26L



Inset light, missing perimeter sealer, perimeter raveled



Urgent Airside Pavement Review Report, May 2016



Critical Area Coring Recommended In High Severity Distress Locations



Example Observations – Coring Round 1



Obtaining initial cores, June 2016



First group of cores, critical areas, June 2016



Cores grouped by station & offsets, June 2016



Cores grouped by station & offsets, June 2016

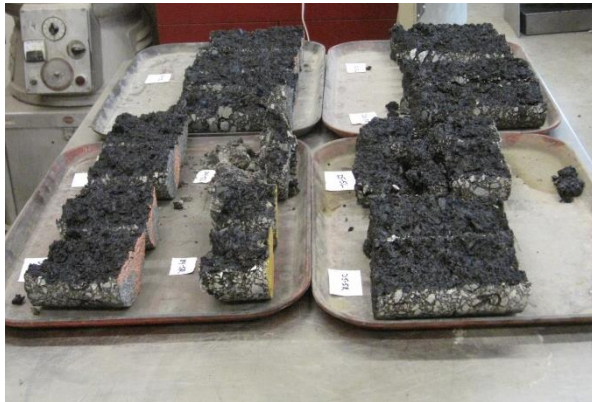


Cores heated to $\sim 60^{\circ}\text{C}$, split in lab; moisture damage rated L, M, H severity



Cores heated to $\sim 60^{\circ}\text{C}$, split in lab; moisture damage rated L, M, H severity

Core Preparation & Visual Assessment in Lab



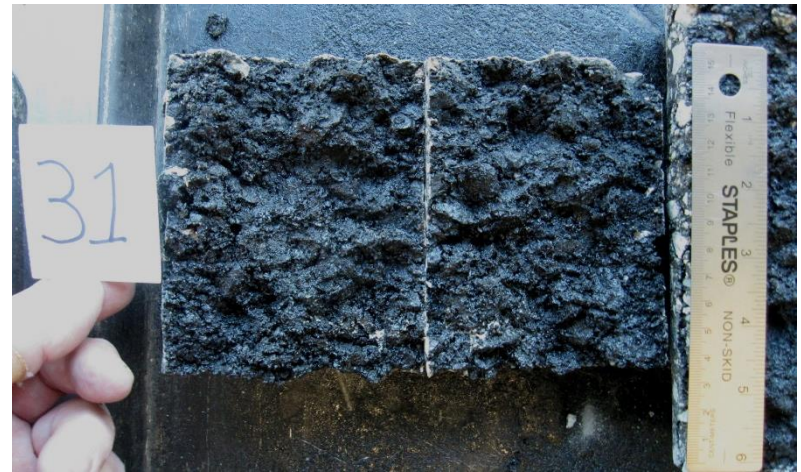
Core Assessment - Moisture Damage Interim Report, July 2016



Example Observations - Core Samples, Round 1



High severity, 0 to 75 mm; low severity, 75 mm to 130 mm



Low severity, 0 to 110 mm

Key Recommendations - Moisture Damage Report

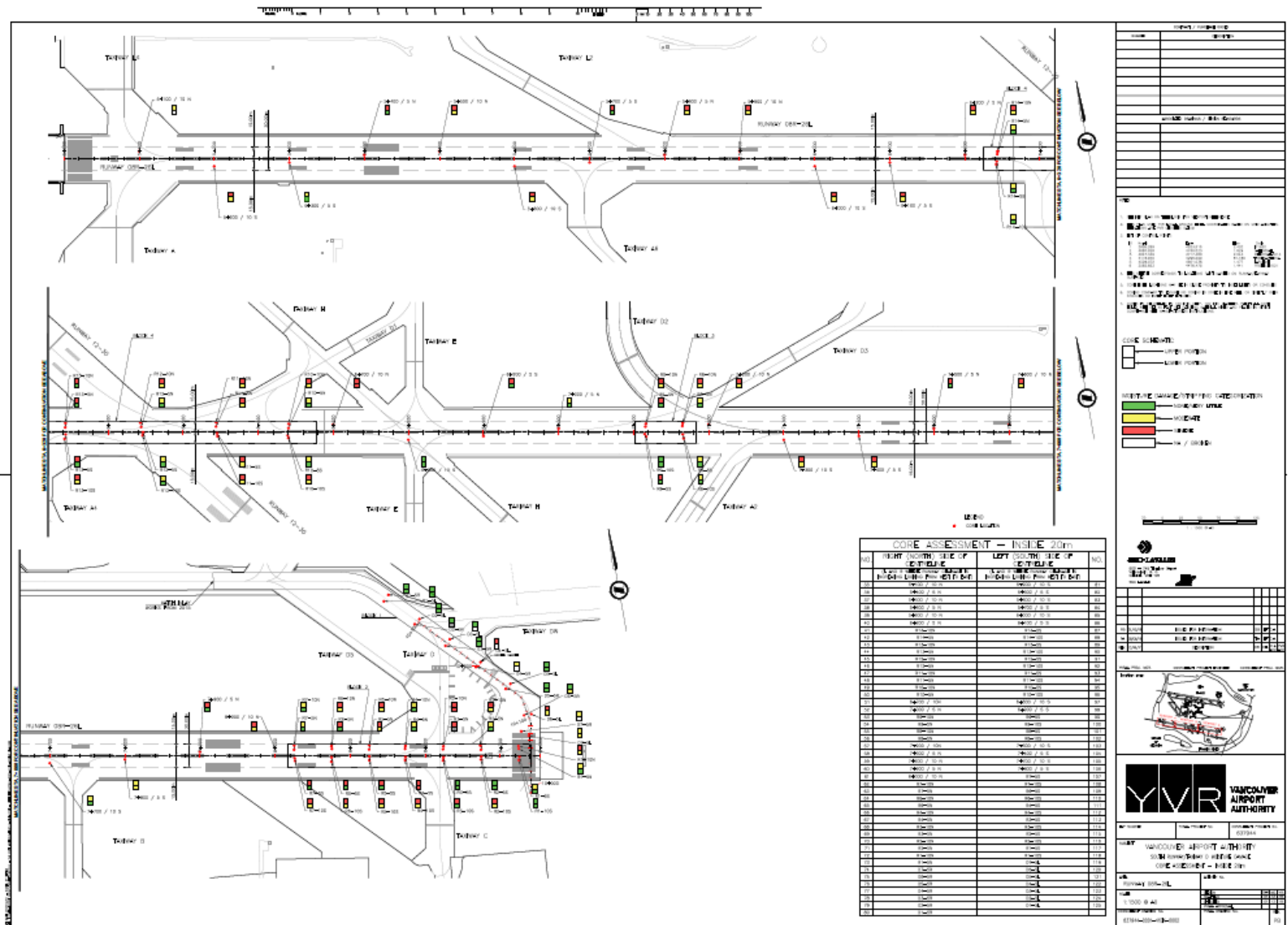
- Address distresses as soon as possible, FOD risk, unplanned intervention; limited window for rehabilitation work due to upcoming North Runway RESA work/closure (2018 - 2020)
- For the asphalt resurfacing, to include:
- Tensile Strength Ratio $\geq 80\%$ with freeze thaw cycling
- Add 1-2% hydrated lime for improved stripping resistance
- Use polymer-modified PGAC asphalt binder with double, high temperature grade bump (70-22 or better due to slow moving & standing aircraft)
- Provide early “heads up” to paving industry



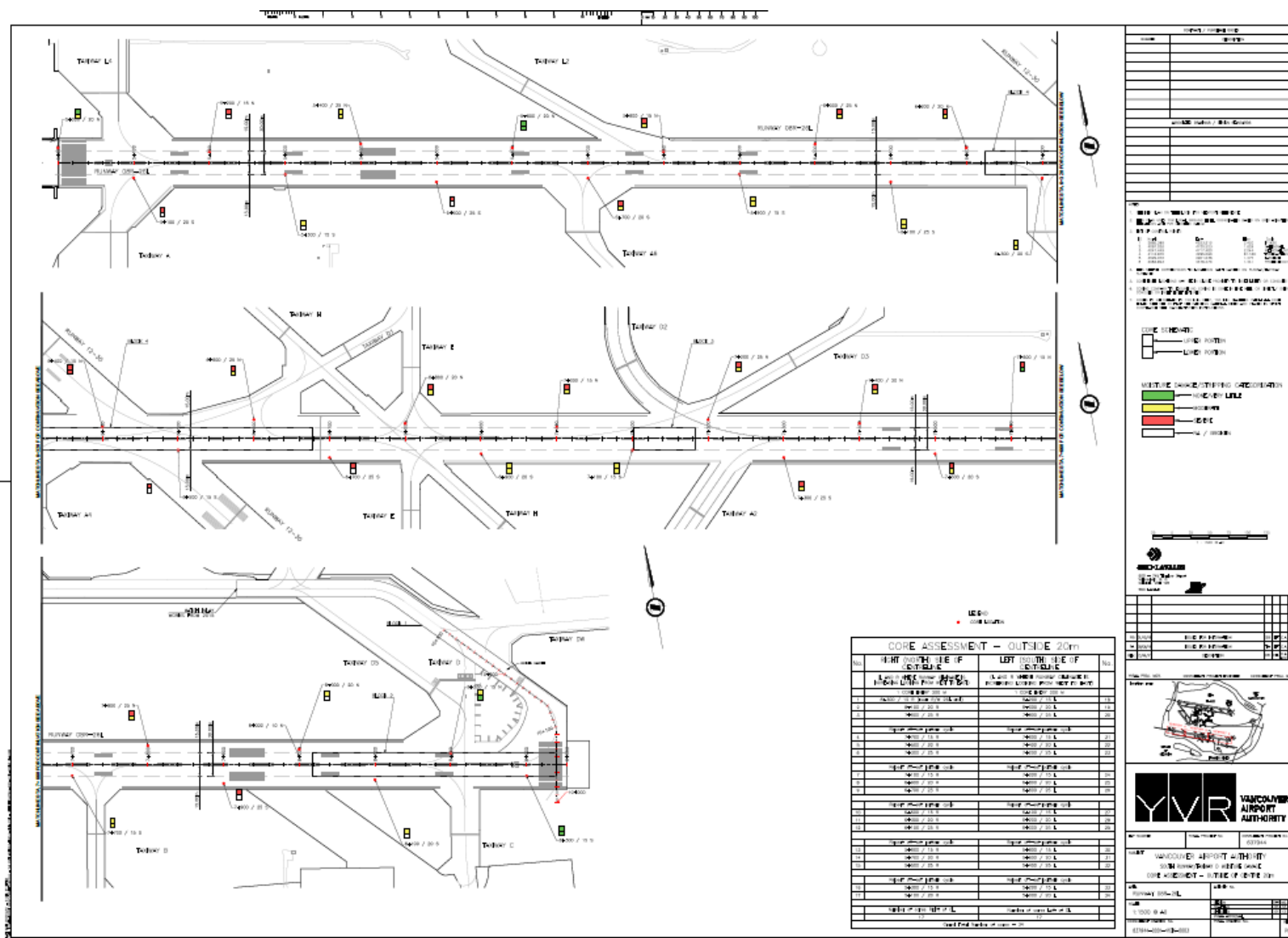
Core Assessment - Moisture Damage Final Report November 2016



Core Layout & Severity Mapping November 2016 Report (Centre 20 m)



Core Layout & Severity Mapping November 2016 Report (Outer 20 m)



Design Concept Scope - Fast Tracked



Design Concept – Scope Overview

- Resurface (mill & fill/inlay) minimum 30 m wide, minimum 75 mm deep, spanning centreline; require **very robust** asphalt mix
- Widen resurfacing to 60 m at 08R threshold, 13-31 intersection, 26L threshold & taxiways D/ D5
- Extend inlay ~20 m into all connecting taxiways & cross runway
- Remove & replace inset lights
- Replace paint markings (temporary & permanent)

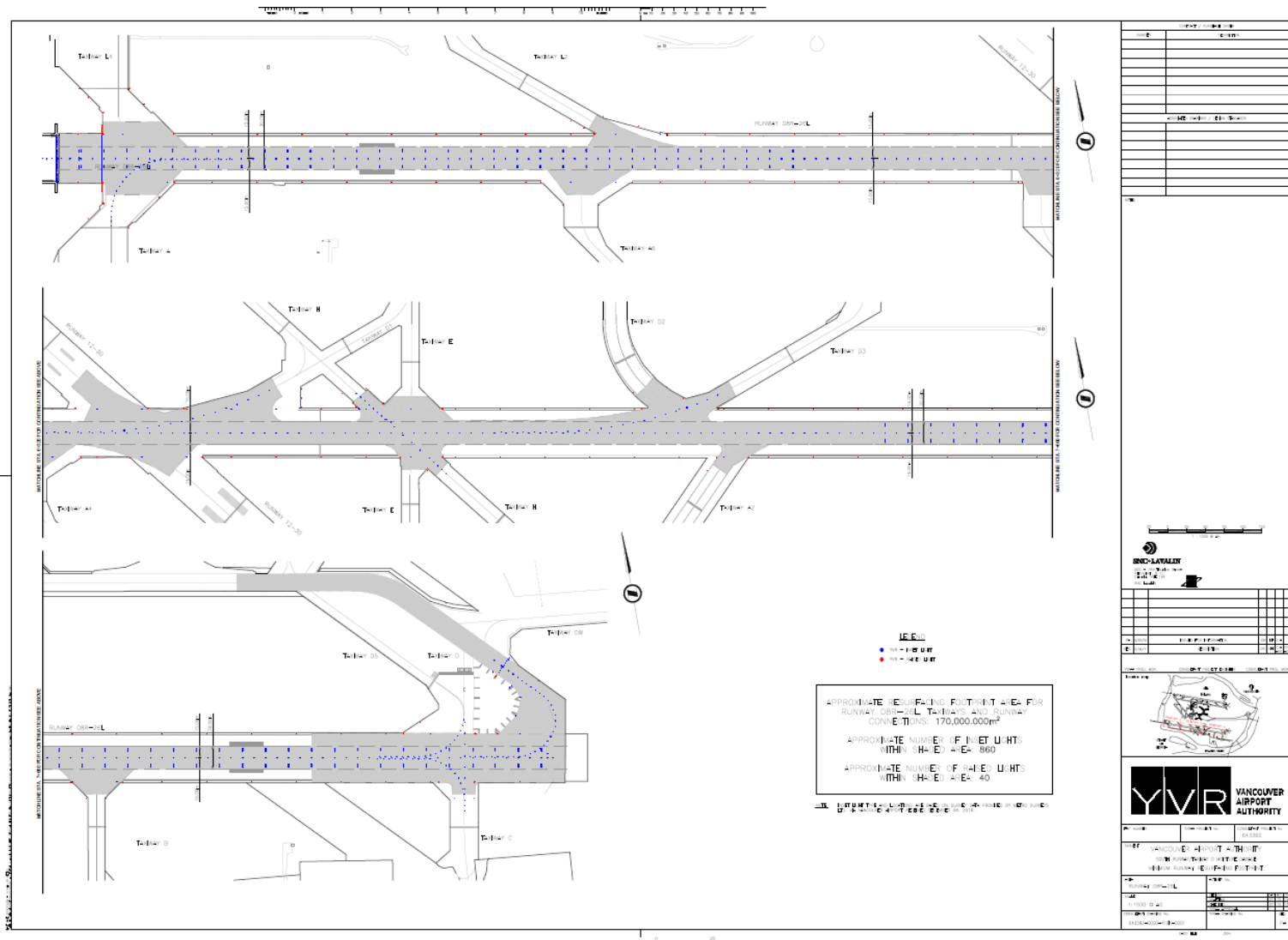


Key Technical Specification Elements - Final

- **Tensile Strength Ratio $\geq 90\%$** , 5 freeze thaw cycles
- High stability HMA (≥ 12.5 kN) with 100% fracture, 2 faces
- Include **1-2% hydrated lime** in HMA for stripping resistance (*not liquid*)
- **Polymer-modified PGAC (70-22** or better, slow/standing aircraft, per AASHTO M320, Table 2 & AASHTO T350 [**MSCR**])
- Echelon paving with Topcon **Laser GPS grade control** (or equal); **Material Transfer Vehicle** for each paver
- **Rut and moisture resistance testing** (Hamburg [HWTD], APA or similar, AASHTO T324, maximum 5.0 mm/8,000 cycles
- **Profilograph** to ASTM E1274 <110 mm per 1,000 m, each shift
- **On site (Sea Island) asphalt plant dedicated to project**



Design Concept Scope – Resurfacing Footprint



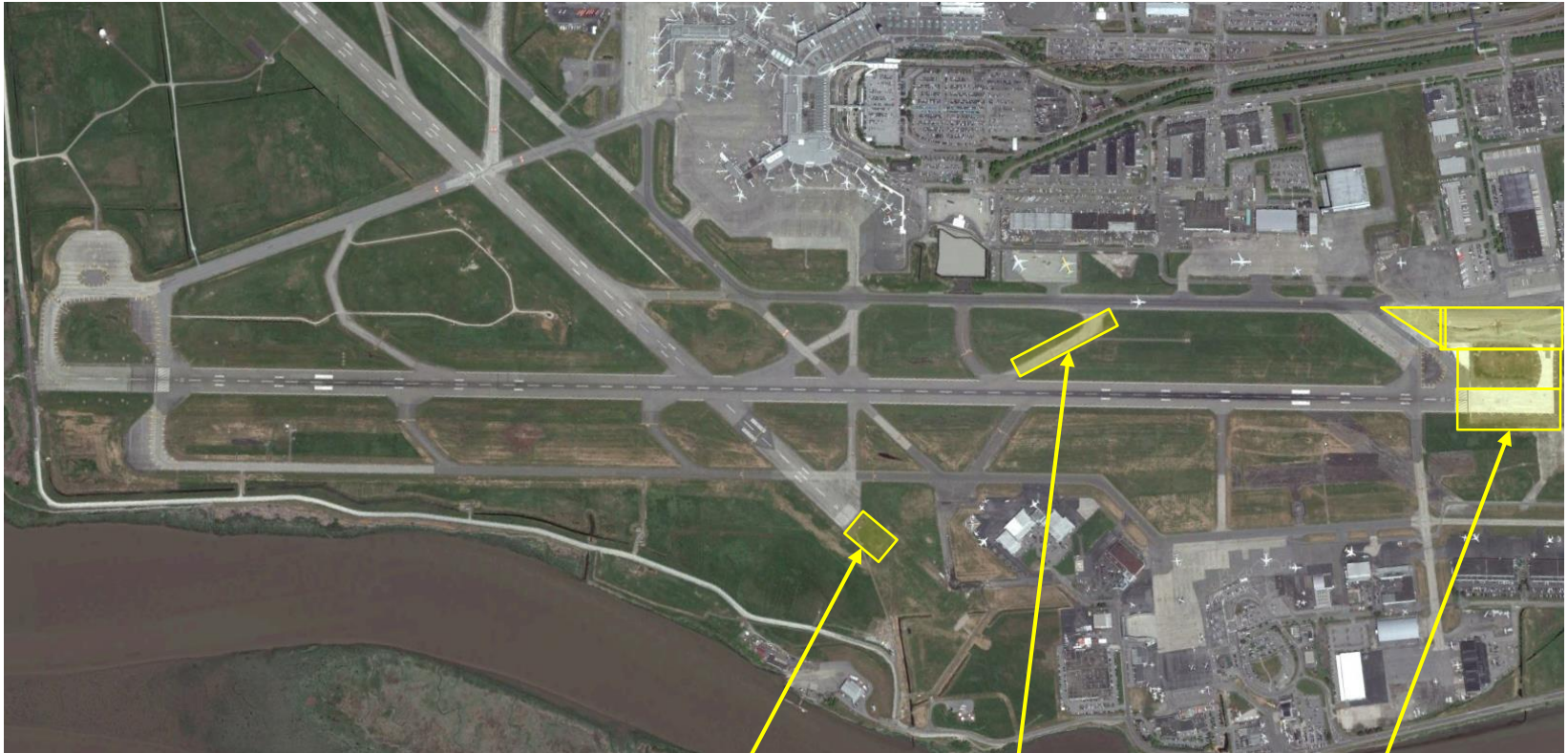
Project Timeline - Fast Track

Project Timeline	Date
* Award Consultant Design & Const. RFP	January 17
Issue Contractor RFP (at 90% design)	February 2
Contractor RFP Close	March 13
Contractor RFP Award	April 25
Design/Issue 100% CFCs	April 26
Contractor Mobilization	April 26 - May 31
Construction Start	June 1
Substantial Completion	September 1
Total Completion	September 15
* Associated Engineering filled same role for 1985 & 2004 rehabilitation, this helped expedite the detailed design & specification preparation	

Project Constraints & Concurrent Work



Project Constraints & Concurrent Work



Concurrent Projects: RWY 13-31 RESA, TWY D3 Fillets, RWY 26L RESA,

Work Days/ Hours; Final Design Scope/Quantities

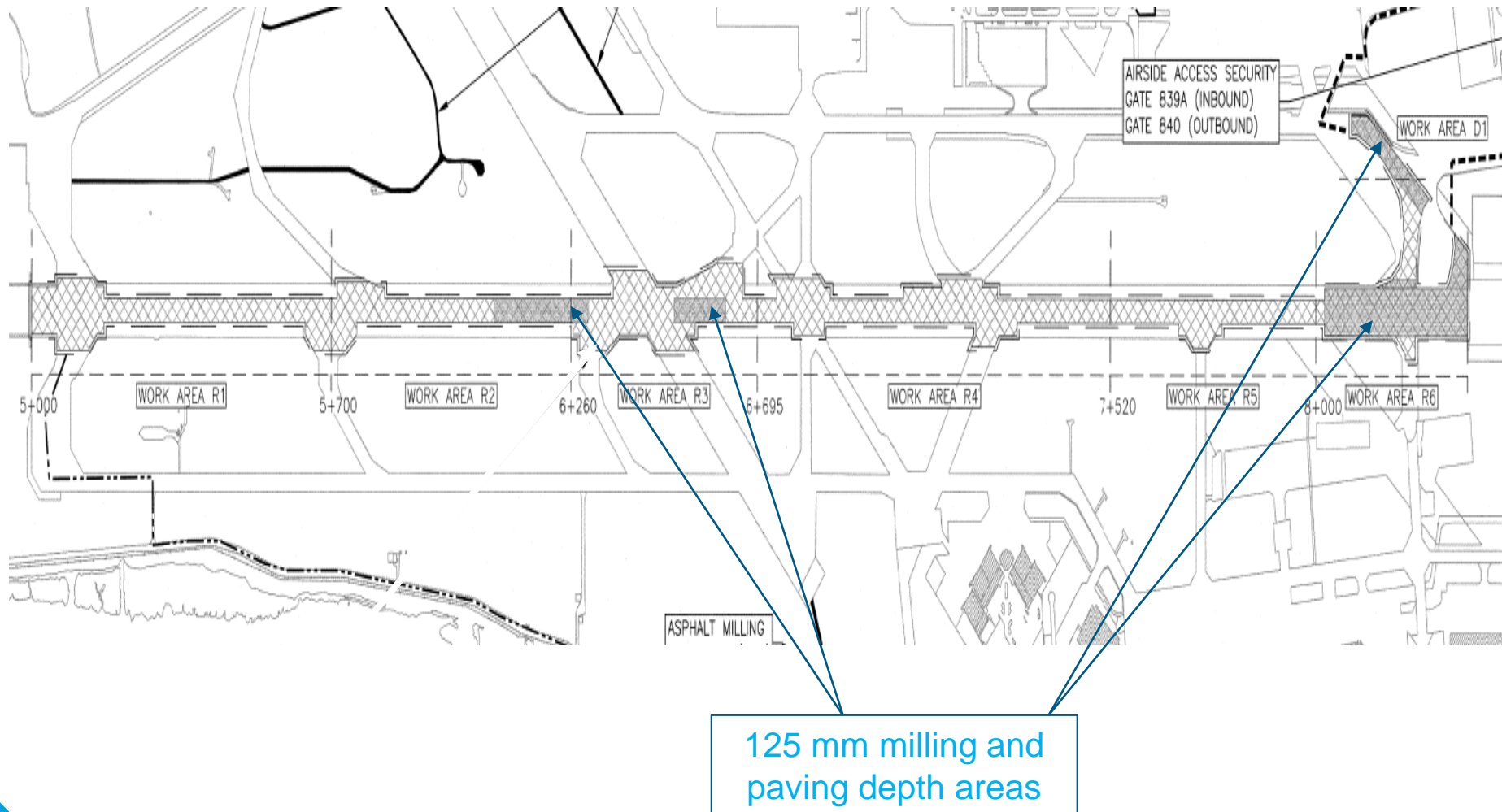
- Scheduled runway closure (26L RESA) June 1 to September 15
- Work hours 22:00 to 06:00, 6 days per week
- 3,300 m runway resurfacing length, 30 m over keel section; some 60 m wide sections; taxiway & runway tie-ins; partial D/D5
- 165,000 m² cold milling; 75 mm (75%) & 125 mm (25%) depths
- 39,000 t HMA; 2,100 t 70-22 Polymer Modified AC (70-28); 600 t hydrated lime
- Remove and replace 930 inset lights
- 60,000 linear metres paint markings, various widths
- Airside Security Escorts by cash allowance, designated source
- Construction cost ~\$12.3 M



Project Implementation/ Key Features

The Project Team	
Owner:	Vancouver Airport Authority
Consultant Project Manager:	SNC Lavalin Inc.
Design/Construction Consultant:	Associated Engineering (BC) Ltd.
General Contractor:	Jacob Bros. Construction Inc.
Milling/Paving Subcontractor:	Lafarge Canada Inc.
Electrical Subcontractor:	Tristar Electric Inc.
Survey:	Pro-Tech Surveys Ltd.
Quality Control/Quality Management:	Metro Testing/CCMET
Paint Markings:	Hicks Striping & Curbing
Quality Assurance Testing:	exp Services Inc.

Final Design Resurfacing Footprint, 75/125 mm



'Typical' Nightly Resources & Progress

- 80-115 construction workers (excluding adjacent projects)
- 70 pieces of heavy equipment
 - Two cold milling machines each with Topcon Millimeter GPS grade control system; two pavers in echelon, one with joint heater system; 2/1 Material Transfer Vehicle; 3 to 5 sweeper/vacuum trucks; truck mounted high speed profiler; asphalt emulsion distributor truck & portable sprayer; 10 to 16 haul trucks; on-site QC testing lab (groundside)
- 8 to 16 Security Escorts each shift
- Mill & pave 60 to 200 lineal metres subject to location & width, some 75 mm, some 125 mm (2 lifts)
- Completed milling & paving over 43 shifts with 2 rain day cancellations (variable nightly areas & tonnage)
- Substantial completion September 20
- Completion expected to be within budget



Asphalt Mix Design - Key Qualities

Physical Requirements	Mix Design Results	Specification
Design AC Content, % dry agg	5.1	5.5 minimum *
Stability at 60°C, kN	21.0	12.5 minimum
Flow, mm	3.6	2 - 4
Air Voids, %	3.7	3 - 5
VMA, %	14.4	14.0 minimum
Film Thickness, μm	9.9	7.5 minimum
Retained Stability, %	93	75 minimum
Dust to Asphalt Ratio	1.0	0.8 - 1.6
TSR %, with 5 freeze-thaw cycles	99.0 (w/ 1.25% lime)	90 minimum
Hamburg Wheel Track Device test, mm, 20,000 cycles @ 50°C	(-) 2.4	(-) 5.0 max.
PGAC, with MSCR	70-28	70-22 PM



Work in Progress



Work in Progress





Discussion & Questions



Thank-you!



Values that guide us

Our values keep us anchored and on track. They speak to how we run our business, how we express ourselves as a group, and how we engage with our stakeholders and inspire their trust.

Teamwork & excellence

We're innovative, collaborative, competent and visionary.

Customer focus

Our business exists to serve and add long-term value to our customers' organizations.

Strong investor return

We seek to reward our investors' trust by delivering competitive returns.

Health & safety, security and environment

We have a responsibility to protect everyone who comes into contact with our organization and the environment we work in.

Ethics & compliance

We're committed to ethical business.

Respect

Our actions consistently demonstrate respect toward our stakeholders.

