FOAMED ASPHALT STABILIZED BASE (FASB) – ANOTHER TOOL FOR AIRFIELD PAVEMENT STRUCTURAL REHABILITATION?

The Solution for the 2013 Groundside Road (Russ Baker Way) Rehabilitation Project at YVR

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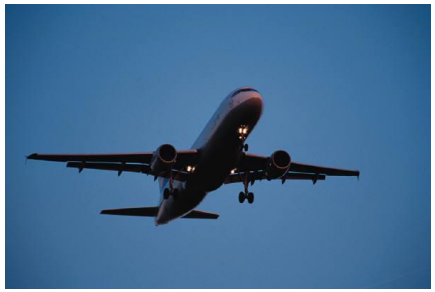
SWIFT is about airfield pavements, not highway pavements!



Yes it is…

<u>But</u> many (all?) of the same challenges apply to airfield pavements as for highway pavements including:

- **Insufficient pavement strength for current traffic mix & loading "legacy pavements"**
- **Geometric constraints**
- **Operational constraints/duration of work**
- **Financial constraints**
- **So….**

Presentation Outline

- Project Background & Site Information
- Rehabilitation Options
  - Options considered
  - Selected solution
- Project Execution/Getting' 'Er Done
  - The Foamed Asphalt Stabilized Base (FASB) Process
- Observations & Conclusions
  - Results
  - Advantages / Benefits

Questions?

Project Background & Site Information

Russ Baker Way Northbound spring 2013 – alligator/fatigue cracking, rutting, etc.

Project Background & Site Information

Russ Baker Way Southbound spring 2013 – alligator/fatigue cracking, rutting, etc.

Russ Baker Way Background & Site Conditions

- Russ Baker Way, North and Southbound lanes, Miller Road to Inglis Drive
- Overall roadway: ~1.7 kms, 4 – 6 lanes divided with no-post barriers, grass & raised medians & some curb & gutter
- Constructed via Federal Ministry of Transport, early 1970's
- Inglis end resurfaced during No. 2 Road Bridge construction
- Richmond-Vancouver commuter route; YVR Terminal(s) access routes; air-freight; fire hall; BCIT campus; bus route
- Fatigue issue concentrated in wheel paths between Miller Road & north of Gilbert, ~1.25 kms

Russ Baker Way Location Context

To YVR Main Terminal

Arthur Laing Bridge to Vancouver

No. 2 Road Bridge to Richmond

Dinsmore Bridge to Richmond

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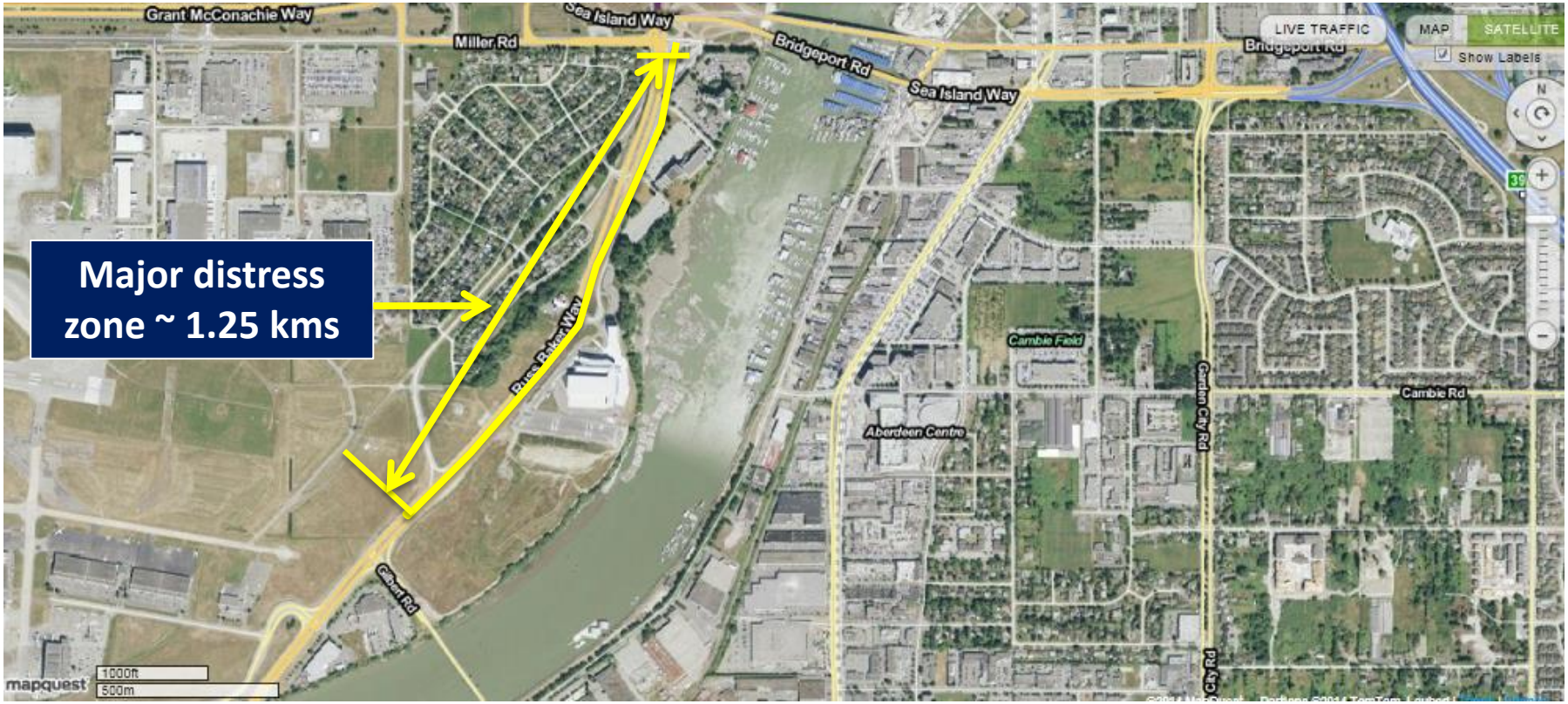
Russ Baker Way Location – Major Distress Zone



Russ Baker Way Background & Site Conditions

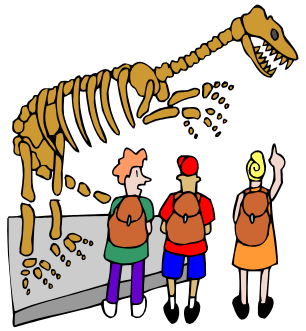
Relative strength & condition assessed, March 2010, including:

- Benkelman Beam deflection testing
- Visual condition
- As-built drawings for pavement structure
- Test pits at road edge from BCIT campus road widening work

- City of Richmond traffic data, 2006 “arterial road” 53,230 (ADT) north of Gilbert
- City of Richmond traffic data, 2006 “arterial road” 37,300 (ADT) south of Gilbert
- Preliminary pavement rehabilitation options provided in 2010 (by others)

As Built Records (Transport Canada historical)

- Asphalt concrete pavement: 90 mm (3.5”)
- Crushed granular base: 230 mm (9”)
- Select sand sub-base: 450 mm (18”)
- Compacted sub-grade: 300 mm (12”)



City of Richmond “Standard” Divided Arterial roadway pavement section:

- Asphalt concrete pavement: 150 mm (6”)
- Crushed granular base: 230 mm (9”)
- Granular sub-base: 500 mm (20”)
- Compacted sub-grade: 300 mm (12”)
- Design MPSR < 1.00 mm

Preliminary Rehabilitation Options (2010)

1. Overlay with 50 mm new hot mix asphalt: reflection cracking, limited term solution.
2. Partial Reconstruction: remove existing asphalt pavement, re-compact granular base & partial base gravel replacement/thickening; 150 mm of new hot mix asphalt: medium term solution. Partial strengthening. Reflection cracking mitigated?
3. Full Depth Reclamation: Pulverize & reinstate with 230 mm +/- additional granular base and 150 mm new HMA (~ 380 mm increase in pavement elevation/impact of adjacent pavement/curb & gutter, etc.). Strengthened. Reflection cracking mitigated.

Next Steps (2013) – Detailed Design/Construction

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28 shallow test holes - confirm layer thicknesses, assess granular qualities; complete topo survey

Next Steps (2013) – Detailed Design/Construction

1. Establish 2-3 alternative rehabilitation options considering expected pavement performance, traffic, geometric and cost constraints
2. Provide cost estimates for options
3. Pro's & con's of options
4. Provide recommendations
5. Include optional pay items & pricing in tender as applicable

SNC-Lavalin - Rehabilitation Option(s)

1. Cold-mill & inlay 65 mm – limited functional life, no increase in strength, reflection cracking, return of fatigue cracking
2. Remove 90 mm asphalt & 60 mm granular base & dispose, replace with 150 mm HMA – disruptive, existing material wasted
3. Divide roadway into 3 segments; vary treatments based on deflections, distress severity & extent
4. Deep repair Miller and Gilbert intersection segments (1 & 3): remove asphalt & granular to 150 mm, replace with new HMA
5. Full depth reclamation to 325 mm (no additives) remove 125 mm base, grade & re-compact base, place 150 mm new HMA
6. Full depth reclamation to 325 mm, remove 125 mm base& re-use; grade & re-compact , FASB to 200 mm, place 125 mm of new HMA (-19 mm, high stability)

Selected Rehabilitation Option

1. Divide roadway into 3 segments; vary treatments (3 segments, 3 treatments) based on deflections, traffic, distress severity & extent
2. Segments 1 & 3: deep repair Miller and Gilbert intersection segments (remove asphalt & granular to 150 mm, replace with new HMA)
3. Cold-mill & inlay non-thru lanes & shoulders (65 mm)
4. Segment 2: Pulverize to 325 mm, remove 125 mm of pulverized granular & re-use; grade & re-compact, (option for FSAB) place 150 mm/125 mm of new HMA
5. Detailed contractor Traffic Management Plan required

Tenders Results

Full Depth Reclamation (FDR) without FASB	Full Depth Reclamation (FDR) with FASB
$ 0.00	**+ 15 %**

~ 15% additional cost considers net savings associated with 25 mm reduction in HMA thickness

YVR Engineering chose to use FASB technology due to expected improvement in long-term pavement performance: more robust; less waste. Wanted to assess process and performance for potential use on other groundside roads and selected airfield pavements

FDR/FASB grading and removal/replacement 06:00-20:00; asphalt paving 20:00-06:00. Option to work 7 days per week.

Key Dates/Construction Progress

Key Milestones	Date
Award (Columbia Bitulithic Ltd./Lafarge)	July 4, 2013
Construction Start (detours/traffic prep)	July 25, 2013
Pulverizing starts (southbound)	July 31, 2013
FASB Southbound & HMA Paving	August 9-20 (2 days curing)
FASB Northbound & HMA Paving	August 21-September 3 (2 days curing)
Intersection deep repair/mill & inlay	August 27-**September 3**
Paint Markings/Signals	September 5-25
Substantial Performance	October 3, 2013
Total Performance (including added work)	October 11, 2013 (includes south terminal loading areas (2), Agar Drive & new bike path paving)

Steps for FASB / Repaving Process

1. Foamed Asphalt Stabilized Base mix design (by contractor/3rd party testing lab)
2. Asphalt concrete pavement/granular base reclamation (pulverization), 125 mm removal, re-grading & compaction
3. Foamed Asphalt Stabilized Base (FASB) processing, compaction, fine grading & curing
4. Place new HMA (coarser mix, high stability; surface lift paved in echelon with hot joints)

FASB Mix Requirements (200 mm)

Property	Minimum
Dry Stability, @ 25°C, kN	9.0
Retained Stability @ 25°C, % (24 hrs)	50
Dry Indirect Tensile Strength, kPa	300
Wet Indirect Tensile Strength, kPa	150
Tensile Strength Ratio, %	50
Bitumen Content, %	2.5
Cement Content, %	1.0
Field Compaction, % max. modified proctor dry density	98

In accordance with Wirtgen Cold Recycling Manual, 2nd Edition (2004) and Project Specifications

Gettin' 'Er Done – the FASB Process

Wirtgen WR2500S Reclaimer (pulverizing)

Wirtgen WR2500S Reclaimer and water tanker truck (pulverizing)

Gettin' 'Er Done – the FASB Process

Pulverized, re-graded and re-compacted granular base before FASB treatment (southbound lanes)

Pulverized, re-graded granular base before FASB treatment (southbound lanes)

Gettin' 'Er Done – the FASB Process

Cement powder applied to granular surface, before foaming treatment

Wirtgen WR2500S reclaimer led by asphalt cement nurse truck, followed by water tanker truck

Gettin' 'Er Done – the FASB Process

FSAB bitumen addition metering system

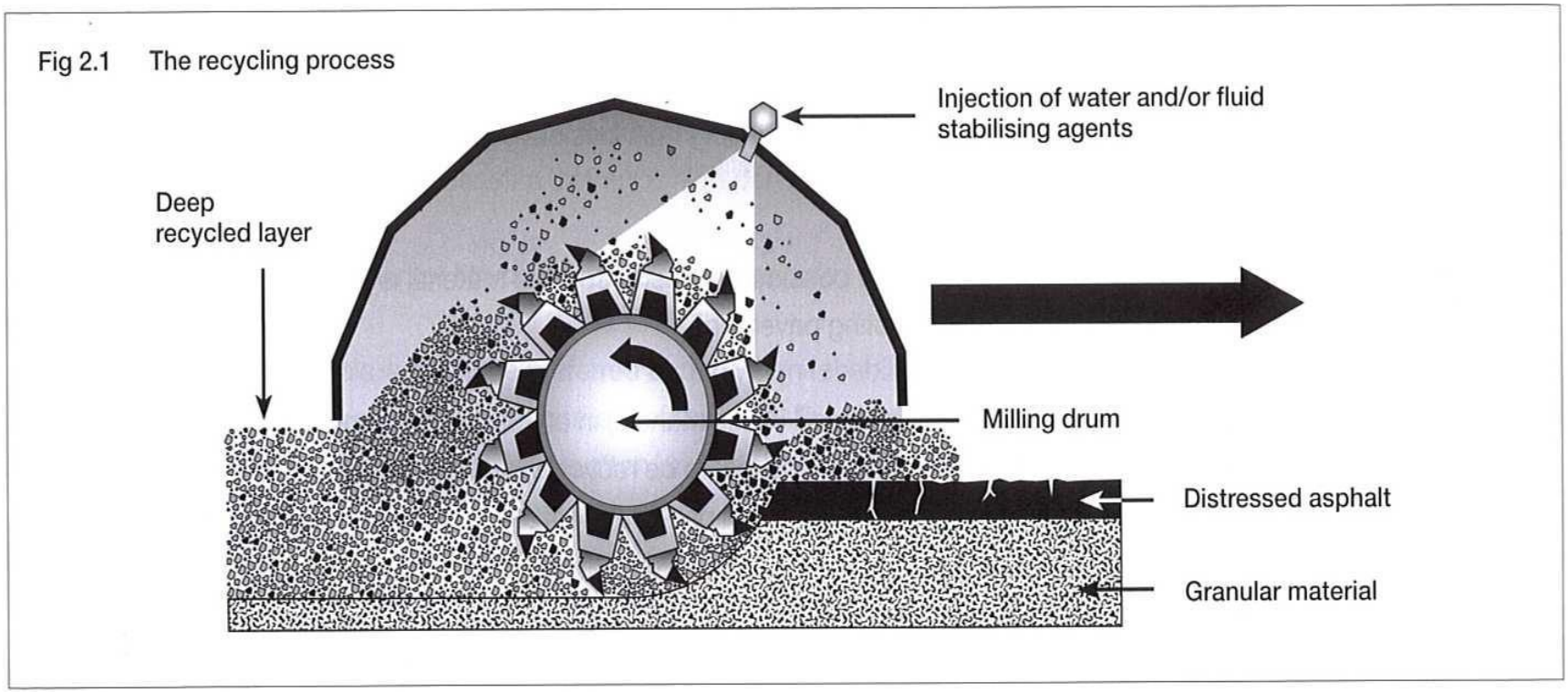
Cement distributer with metering system

Gettin' 'Er Done – the FASB Process

Cutter holders/bits in pulverizing chamber of reclaimer

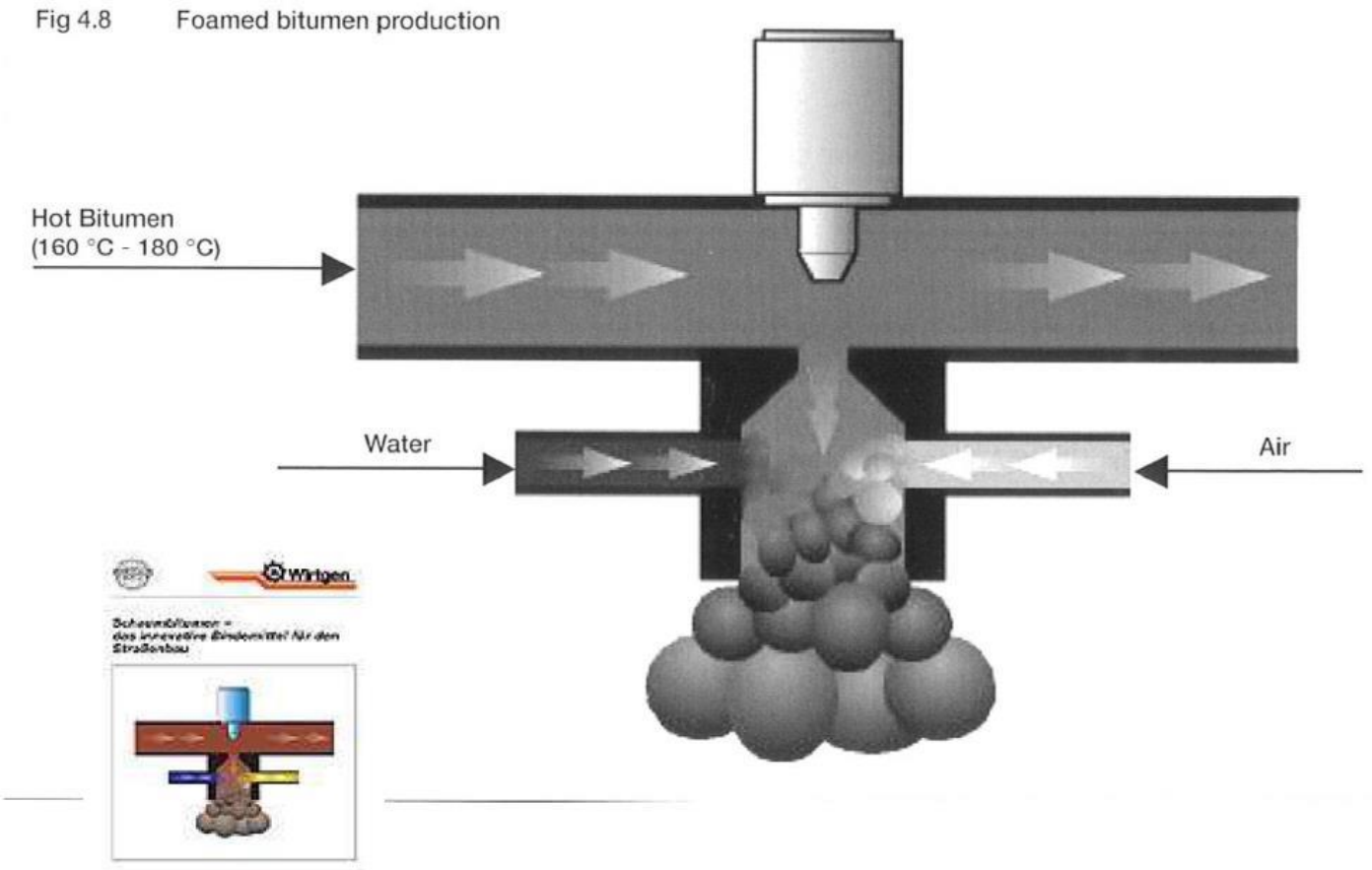
Finished FASB after fine grading & compaction, ready for HMA paving

Gettin' 'Er Done – the FASB Process



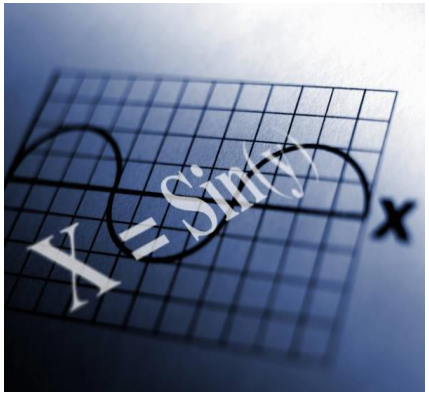
The FASB Process, schematic courtesy of Wirtgen

Gettin' 'Er Done – Bitumen Foaming Process



The FASB Process, schematic courtesy of Wirtgen

Post Construction Observations & Conclusions



- QC by Contractor, QA by YVR/Consultant
- FASB test properties met specifications, including all compaction tests (≥ 98 % MMPDD) & TSR's > 50%
- Stability of FASB mix: all tests > 24 kN (to 35 kN) > 9.0 kN specified
- HMA test properties met specifications, including compaction tests (> 97%)
- Benkelman Beam test comparison by lane, before (2010) versus after (2013) – achieved target deflection of < 1.00 mm MPSR (highest MPSR was 0.86 mm, lowest 0.72 mm)

Advantages & Benefits Achieved

- ✓ Traffic disruptions reduced by avoiding major layer strengthening/thickening/excavation
- ✓ Existing pavement materials recycled or re-used
- ✓ MPSR was lowered by up to 38 %
- ✓ Major reduction in relative strength variability of rehabilitated pavement
- ✓ Replacement HMA thickness reduced by 25 mm (~ 17 %)
- ✓ Trucking of unused material was nearly eliminated (excess used on site), RAP will be re-used by supplier in new HMA

Advantages & Benefits Achieved

- ✓ Major reduction in need for new aggregate & asphalt ("green")
- ✓ Major reduction in truck hauling

- ✓ Reflection cracking from underlying, cracked asphalt layer eliminated
- ✓ Longitudinal profile, cross-section & ride quality dramatically improved; surface drainage improved
- ✓ Project completed within budget & schedule
- ✓ Contractor's Traffic Management was excellent & disruption very limited; work completed before seasonal traffic increase

Before and After – A Team Effort!

Russ Baker Way, Northbound from Cessna Drive (before)

Russ Baker Way, Northbound from North of Cessna Drive (after)

Russ Baker road improvement project well-planned

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Editor:

Often during road construction, there are unavoidable delays, some frustrations and complaints despite the best efforts of all involved.

Since I drive into Vancouver for work along Russ Baker Way, I have to compliment the traffic engineering efforts of YVR and the City of Richmond. Firstly, the road was in serious need of repair and, secondly, the design of the traffic diversion while the work is being done is brilliant. The delays have been almost non-existent and that is entirely due to the planning and traffic pattern design.

I can't remember a more efficient or better planned traffic diversion and you deserve credit.

Andy Hobbs

Richmond

A Viable Airfield Pavement Rehabilitation Solution!

Discussion & Questions…???

Thanks for your time and attention!

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