Building what matters

2019 CAPTG Workshop, Sheraton Vancouver Wall Centre, Vancouver, BC

The Development and Implementation of an Airport Pavement Management System (APMS) at YVR

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Presented by: Ken Fyvie & Carl Abdallah

**captg** Canadian Airfield Pavement Technical Group

2019 CAPTG Workshop, Sheraton Vancouver Wall Centre, Vancouver, BC

Outline

1. YVR: Airfield General information

2. YVR Pavement Condition Assessment Process
   a. Inception scope for YVR APMS (2016-2017)
   b. Ongoing scope for YVR PMS (2018-2021; opt 2022-2027)

3. Methodology and Logistics

4. Field Data Mining and Inventory

5. Analysis and Findings to Date

6. Key Observations
   a. First complete 3-year cycle on airfield pavements
   b. Budgeting/financial observations

7. Questions & Answers

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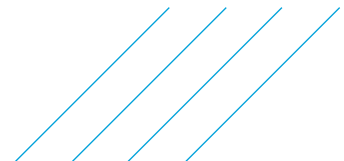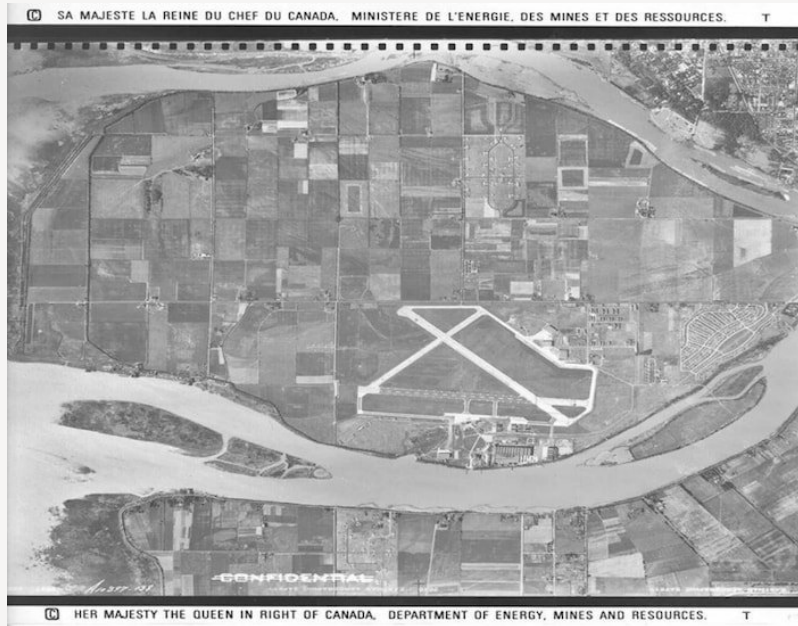
YVR: Airfield General Information

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YVR: Airfield General Information

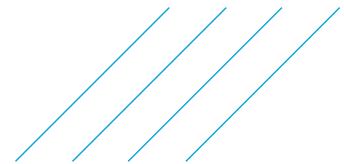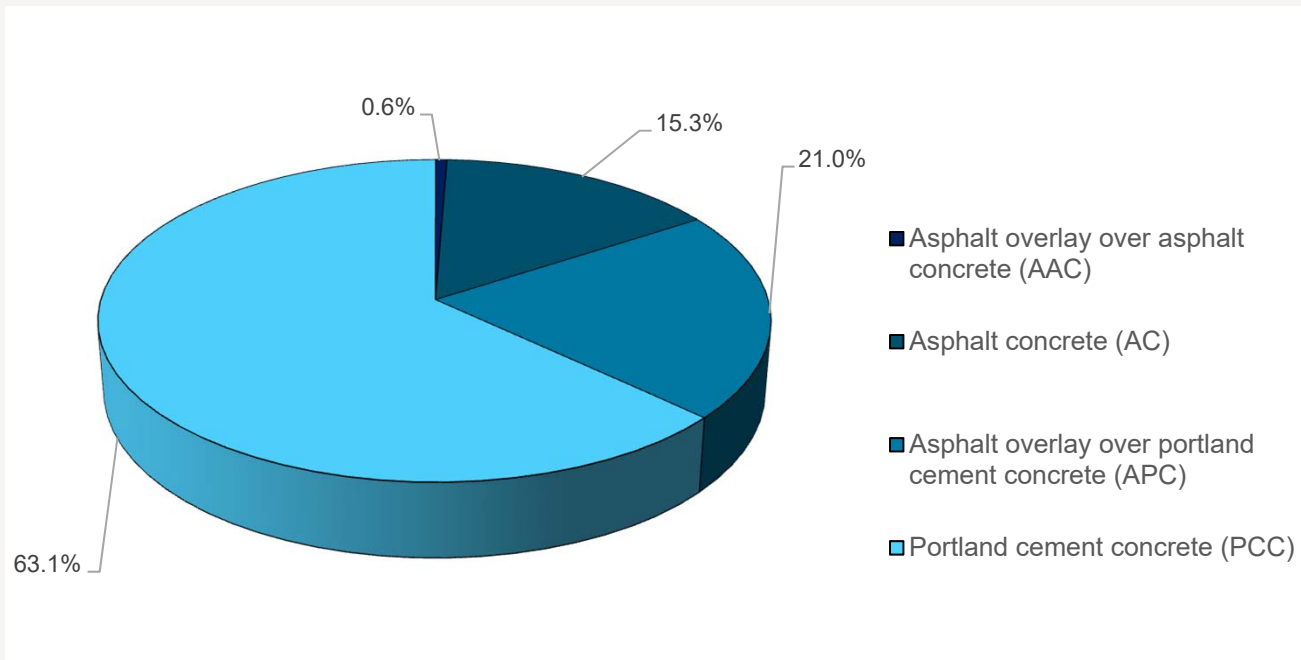| Pavement Branches	Pavement Details
Runway 08R-26L, original runway, 1951 to present ("South Runway")	Now: 3,505m x 61m, Combination of PCC, AC & Composite (AC over PCC)
Runway 13-31, secondary runway, 1960	2,226m x 61m, PCC with some Composite (AC over PCC)
Runway 08L-26R, parallel runway, 1997 ("North Runway")	3,030m x 61m PCC throughout (with maintenance HMA inlay patch repairs & panel replacements)
Taxiways include 5 parallels (A, D, F, M, H) plus **numerous** connecting TWYs (J, V, L, C, etc.)	Varies (PCC, AC, Composite)
Seven Commercial Aprons: I, II, III, IV, V, VI, VIII.	~ 955,000m2 (PCC, AC, Composite)
Total airfield pavement area	~ 2,570,000m2 (plus RESAs)

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YVR: Airfield General Information

Latest Key Statistics

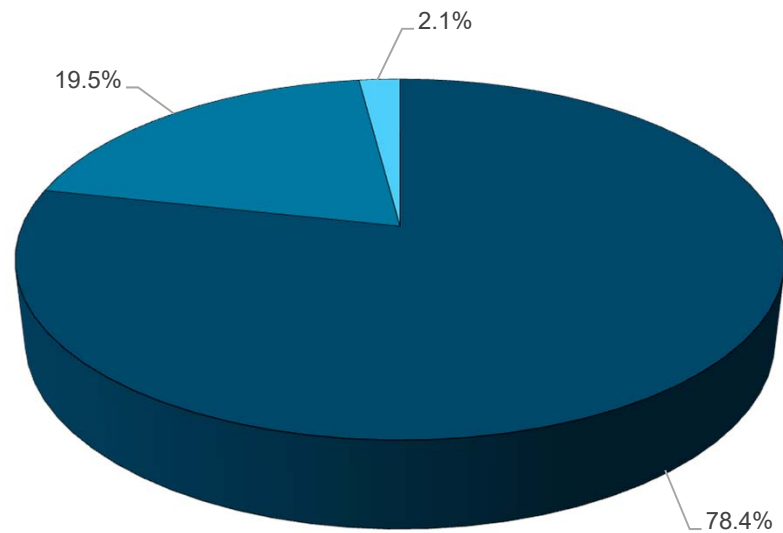| Description	Details
Annual PAX (2018 Enplaned & Deplaned)	Reached 25M at December 18, 2018 (2 years ahead of forecast) 2018: 25,936,907
Cargo (2018 all forms)	338,180 tonnes
Movements (2018)	Runway: 295,870 Non-runway: 42,203 All: 338,073

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YVR: Airfield General Information
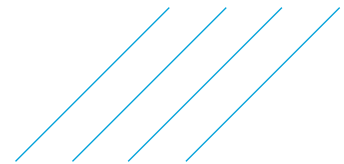
General Composition of YVR Airfield Pavements

Pie chart segments:
- 0.6%
- 15.3%
- 21.0%
- 63.1%

Legend:
- Asphalt overlay over asphalt concrete (AAC)
- Asphalt concrete (AC)
- Asphalt overlay over portland cement concrete (APC)
- Portland cement concrete (PCC)

YVR: Airfield General Information

Airfield Pavement Rankings by Operational Importance

2.1%

19.5%

78.4%

■ Primary ■ Secondary □ Tertiary

YVR Pavement Condition Assessment Process

YVR Pavement Condition Process	
(~1944) to 1992	Performed by TC: Using Inventory Sections & Plan Codes; Technical Summary with pavement types, limits, areas, layer types & thicknesses, contract nos., year, estimated rehab. year, pavement documented from last TC update in 1985 & later through project as-builts
1992 - 2015	Performed by YVRAA in-house per: TC Airport Pavement Evaluation - Condition Surveys AK-68-32-000 (January 1985)
2016-2017; 2018-2021; option to extend from 2022 to 2027	Performed by SNCL for YVRAA per: 1) ASTM D5340-12(2018) for Airport Pavement PCI Surveys 2) ASTM D6433-18 for Roads & Parking Lots

YVR Pavement Condition Assessment Process

Inception Scope for YVR APMS 2016-2017

2016 - 2017

› Review available 'COTS' PMS systems; provide recommendation & rationale

› Recommended PMS system: (Micro) PAVER™ adopted

› Develop standard naming conventions; identify airside network branches & sections

› Establish branches, sections & limits based on historical records, orthophotos, as-builts; verify visually, adjust as needed; pavement construction history/layers per TC and YVR historical records & project as-built records

› Layout sections; establish sample units & survey sample units (10% sampling rate)

YVR Pavement Condition Assessment Process

Inception Scope for YVR APMS 2016-2017

2017 - 2018
› Report PCI, SCI, FOD indices each year end, 2016 and 2017; provide go-forward recommendations
› Complete PCI Inspections, approximately 1/3 of pavements in each of two years; two crews & leads; primarily nighttime, some daytime
› 100% of PCC slabs (~4,040 slabs) inspected on 08L-26R (North Runway) in 2017

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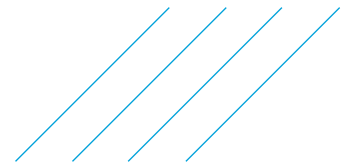
YVR Pavement Condition Assessment Process
Ongoing Scope for YVR PMS 2018-2027
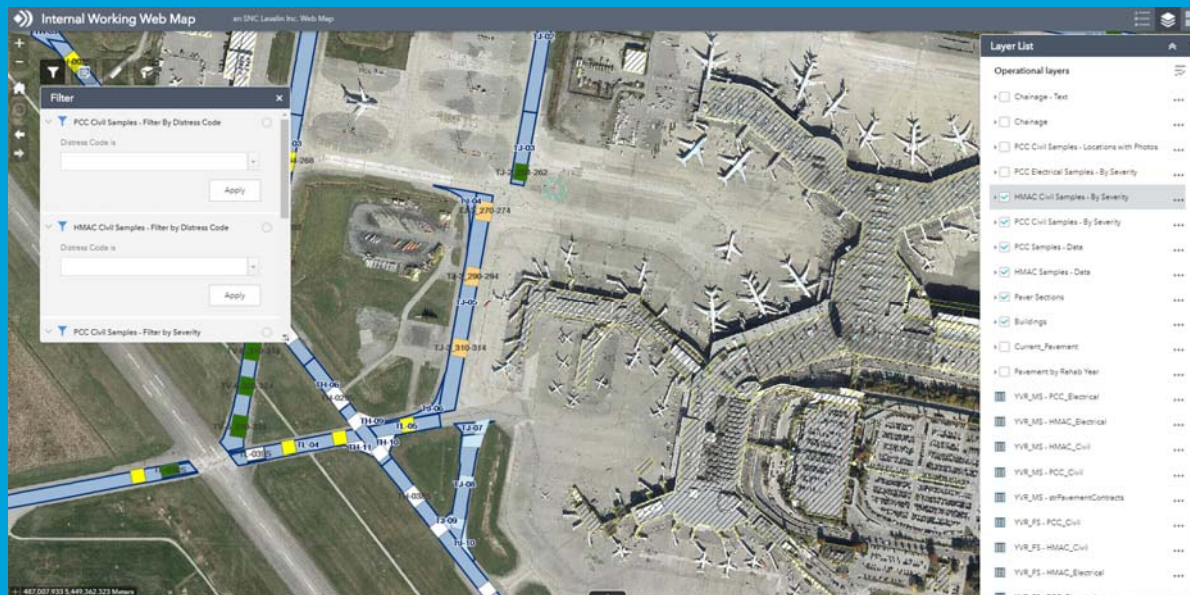
YVR Pavement Condition Assessment Process
Ongoing Scope for YVR PMS 2018-2027

2018 - 2021

› Complete final year inspections for first 3-year assessment cycle (2018)

› Report on first 3-year assessment cycle of airfield PMS network (early 2019)

› Develop work plans & costing for M&R, global & preventative maintenance programs (major capital/PDR projects are separate)

› Prepare Capital Investment Plans (Maintenance & Rehabilitation strategies & budget scenarios); update annually

› Provide CAD, GIS network plans & update PAVER database annually

› Provide comprehensive Engineering & Executive reports annually

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YVR Pavement Condition Assessment Process

Ongoing Scope for YVR PMS 2018-2021, 2022-2024, 2025-2027

2018-2021 (extend through 2027)

› 25% of PCC slabs inspected on North Runway (08L-26R) in 2019

› Complete bi-weekly, nighttime inspections of North Runway; monitor & report observed distresses from April 2018 to March 2019, oversee urgent repairs

› Create 2nd network; assess all airside service roads (AC & gravel)

› Create 3rd network; assess all groundside roads & parking lots (PCC, AC, Composite)

› Report PCI, SCI & FOD indices annually, including IRI on groundside and airside roads

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Methodology and Logistics

Methodology
Field Survey

Majority are primary surfaces = <u>limited access</u> = Need for:

- Efficient field survey to minimize time on the ground and mitigate operational impact

- Accurate & trustworthy equipment & tools to avoid loss of time & need for returning to site

- Reliable field Data Collection; yearly training review for staff

- <u>User Friendly</u> software that integrates into YVR current system

- Transferable Network for new team members & YVR staff

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Methodology

Field Survey

Tools:

Hand tools: paint, measuring wheels, straightedge, graduated measuring wedge

Environmentally friendly Equipment:

Solar light plant, electric vehicle, waterproof tablets, LCMS

Digital Solutions:

ArcGIS Pro, ArcGIS Online corporate account, Collector Map setup for PAVER & CAD transfer

Methodology
Data Collection

1. Collect all existing historical pavement data

2. Build digital representation of the Airfield Branches, Sections & Samples in CAD & GIS

3. Publish GIS webmap for data collection using ArcGIS Pro into the online corporate account

4. Validate the Survey Sample Units as representative in the field using the Collector APP

5. Coordinate access & field survey data collection with YVR Airside Operations

6. QA collected field data in real-time using ArcGIS online

7. Transfer the shapefiles & data sets to PAVER for analysis

8. Complete a full cycle every 3 years
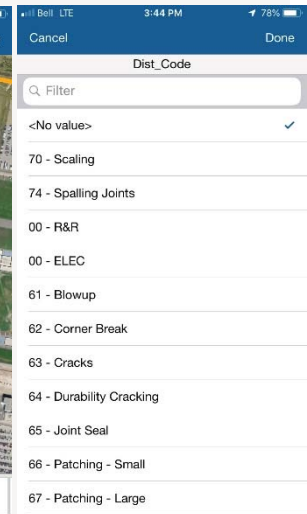
GIS & Mobile Applications

Use Mobile apps to capture geospatial data in the field that can be transferred to desktop in real-time (Collector, ArcGIS online & desktop)
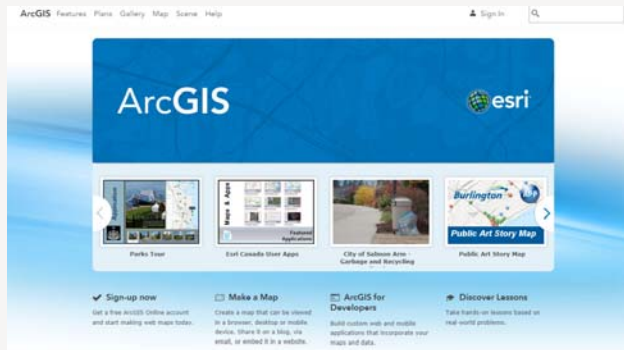
Field Data Mining and Inventory

GIS Creation & Mobile Application (Collector), Example with Images

Field Data Mining and Inventory
Field Sample Layout
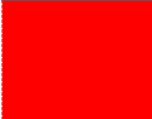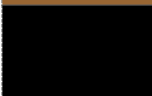
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ASTM PCI Rating Scale & Descriptions

ASTM PCI Colour Legend[3]	PCI Range[1]	Rating Definitions
	86-100	**GOOD**: Pavement has minor or no distresses and should require only routine maintenance.
	71-85	**SATISFACTORY**: Pavement has scattered low-severity distresses that should require only routine maintenance.
	56-70	**FAIR**: Pavement has a combination of generally low- and medium severity distresses. Near-term maintenance and repair needs mat range from routine to major.
	41-55	**POOR**: Pavement has low-, medium- and high severity distresses that probably cause some operational problems. Near-term M&R needs range from routine to major.
	26-40	**VERY POOR**: Pavement has predominantly medium- and high-severity distresses that cause considerable maintenance and operational problems. Near-term M&R needs will be major.
	11-25	**SERIOUS**: Pavement has mainly high-severity distresses that cause operational restrictions; immediate repairs are needed.
	0-10	**FAILED**: Pavement deterioration has progressed to the point that safe vehicle operations are no longer possible; complete reconstruction is required.

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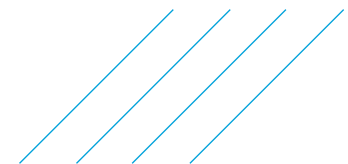
YVR Selected PCI Level of Service - Action Triggers

		Level of Service	
		Average PCI for **All Sections**	
Hierarchy	**Facility Type**	**Target or Desirable**	**Minimum Acceptable**
Primary	Runway Taxiway Apron	80 80 75	75 70 70
Secondary	Runway Taxiway Apron	80 75 70	70 65 65
Tertiary	All	60	55

Analysis and Findings to date (2018 example)

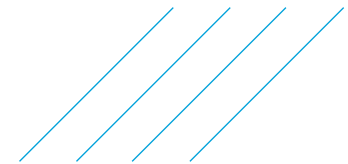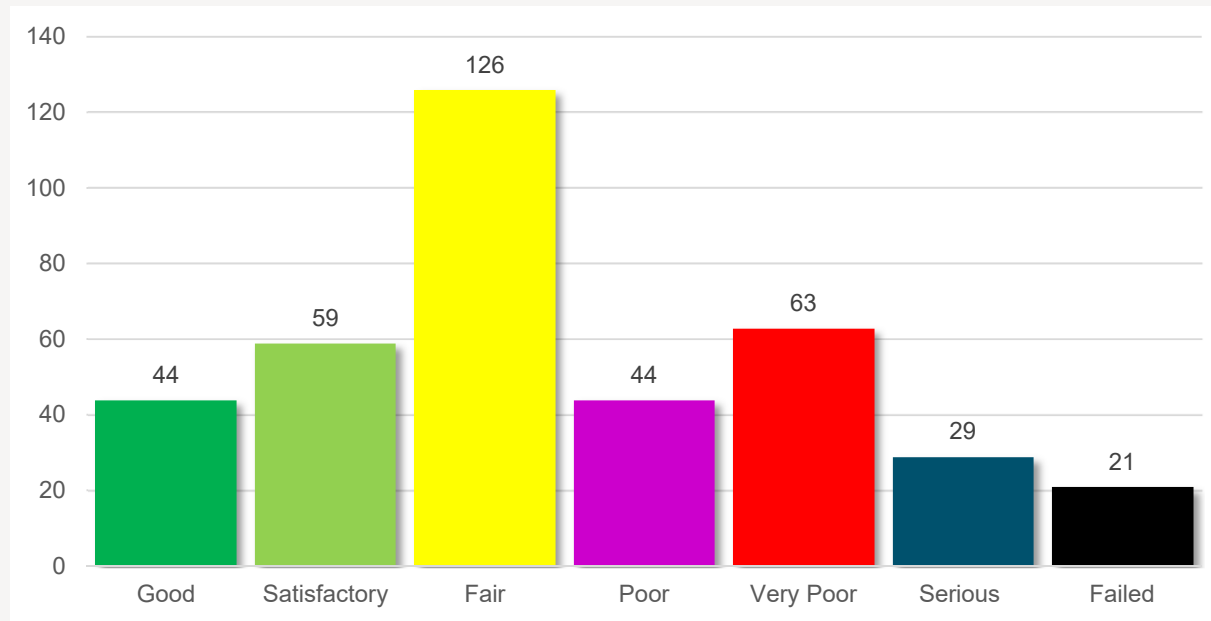| Branch ID	Rank	No of Sections	Average PCI	Weighted Average PCI	ASTM Descriptive Rating	Simplified Descriptive Rating	Reached Pavement Restoration Trigger?
TD	P	3	63	75	Satisfactory	Good	No
TJ	P	6	65	54	Poor	Poor	Yes
TM	P	3	55	55	Poor	Poor	Yes
TM1	P	3	65	69	Fair	Fair	Yes
TM2	P	3	81	81	Satisfactory	Good	No
TM3	P	3	76	73	Satisfactory	Good	No
TM4	P	3	70	77	Satisfactory	Good	No
TM5	P	3	65	67	Fair	Fair	Yes
TM6	P	3	85	85	Satisfactory	Good	No
TM7	P	1	71	71	Satisfactory	Good	No
TM8	P	1	85	85	Satisfactory	Good	No
TM9	P	1	61	61	Fair	Fair	Yes
TM10	P	1	85	85	Satisfactory	Good	No
TV	P	6	71	68	Fair	Fair	Yes

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Distribution of Latest ASTM PCI Rating by Surface Area (m^2)

Good	(green)
Satisfactory	(light green)
Fair	(yellow)
Poor	(magenta)
Very Poor	(red)
Serious	(brown)
Failed	(black)

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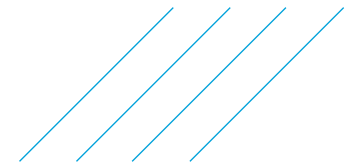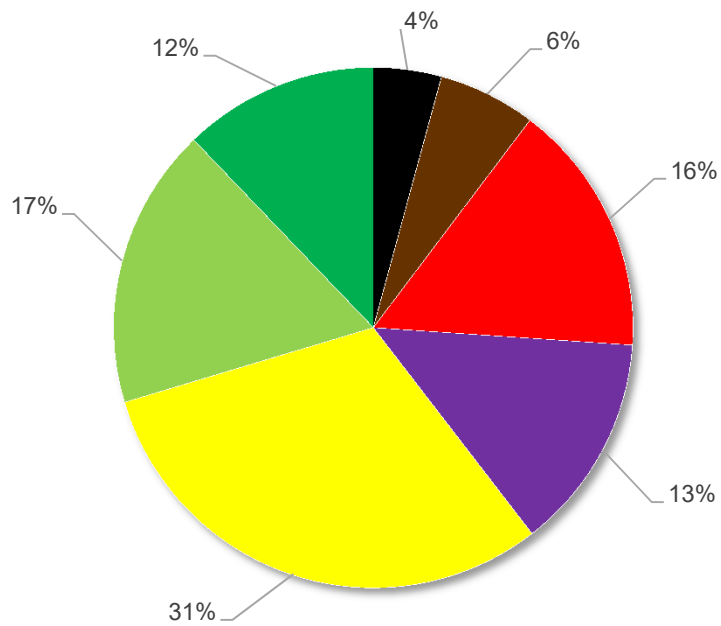
Distribution of Latest PCI by No. of Sections (ASTM Method)

Process & Procedures – LCMS: Airside & Groundside Roads & Parking Lot Data Collection
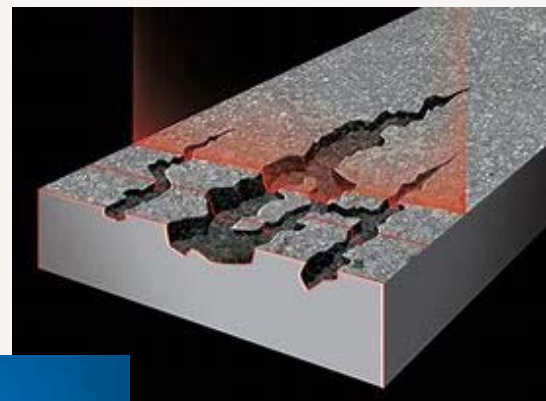
Key Observations,
First 3-Year (Full) Cycle on Airfield Pavements

- Limited routing options on primary surfaces combined with an increase in heavy traffic has accelerated the appearance of pavement distresses.
- This has prompted a review of pavement restoration triggers & PCN calculations .
- Overall Average Weighted PCI of 66.
- Need for analysis of average weighted PCI by the most typical operational routes.


Section Condition Report (2018 Summary)						
Pavement Database: YVR - Vancouver International Airport						
Age Category	Average Age at Inspection	Total Area (SqM)	Number of Sections	Arithmetic Average PCI	Standard Deviation PCI	Weighted Average PCI
00-02		166,671.84	19	93.63	15.36	96.92
03-05	4	16,978.77	7	75.86	10.25	61.28
06-10	9	59,235.63	11	61.64	21.65	48.44
11-15	12	81,670.10	21	59.33	27.62	72.19
16-20	17	170,000.62	40	62.88	20.99	59.08
21-25	21	548,417.63	96	65.65	21.09	70.22
26-30	27	9,827.01	5	44.80	11.63	33.94
31-35	33	73,295.71	17	48.47	36.18	40.86
36-40	37	52,231.94	10	52.90	22.99	50.68
41-50	46	192,120.19	19	57.37	27.27	69.70
ALL	39	2,009,801.26	386	64.07	23.76	66.25
Over 50	71	639,351.81	141	63.91	21.03	61.42

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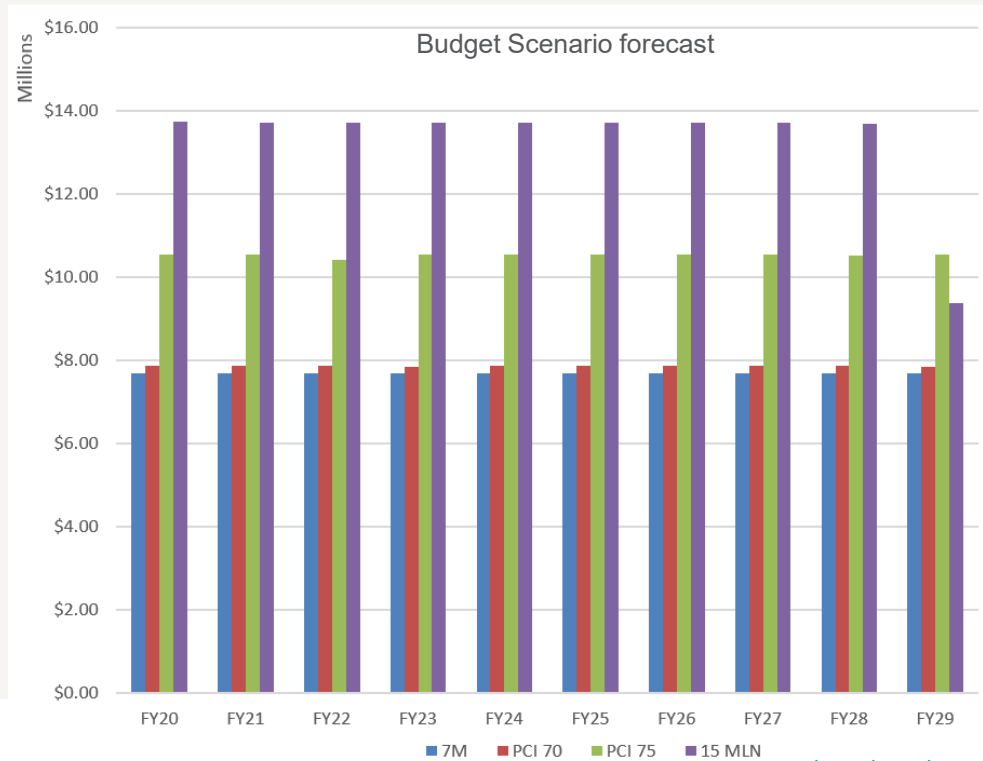
Key Observations,
First Year of 2nd Cycle on Airfield Pavements

Section Condition Report (2019 Summary)						
Pavement Database: YVR - Vancouver International Airport						
Age Category	Average Age at Inspection	Total Area (SqM)	Number of Sections	Arithmetic Average PCI	Standard Deviation PCI	Weighted Average PCI
00-02	1	137,736.14	15	99.27	1.44	99.58
03-05	5	58,620.09	10	71.80	11.78	66.10
06-10	9	48,871.53	10	62.60	22.48	47.66
11-15	13	90,143.47	24	61.71	27.50	74.31
16-20	18	178,844.73	40	59.05	22.62	57.03
21-25	22	548,511.05	96	70.30	22.91	73.97
26-30	27	9,828.38	5	44.80	11.63	33.94
31-35	34	73,299.00	17	48.00	35.55	40.60
36-40	38	63,091.60	11	58.55	25.39	64.79
41-50	46	191,988.63	19	58.84	28.03	73.46
ALL	41	2,079,184.58	396	65.35	24.59	67.93
50+	74	678,249.96	149	64.77	21.54	62.43
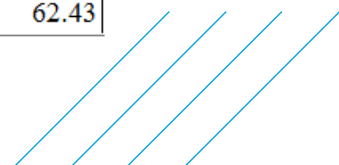
Key Observations,
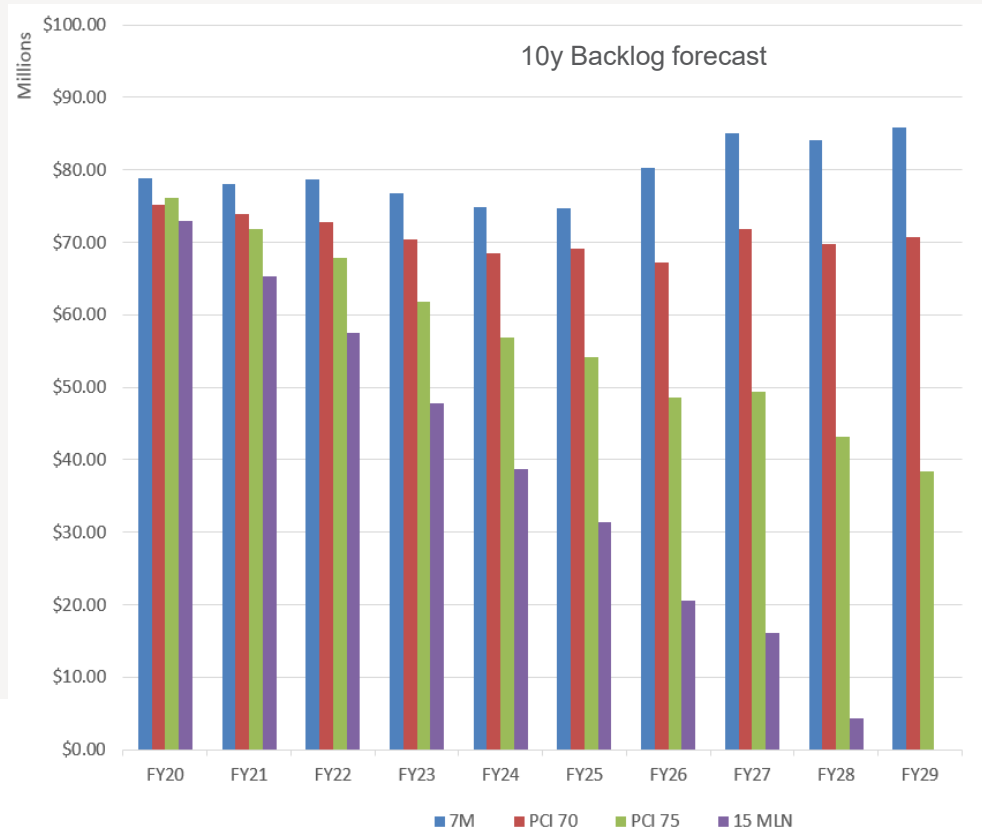## Budgeting/financial considerations

Based On:

- Performance modeling
- Prioritization categories
- M&R triggers based on priorities
- Unit Costs input for CAPEX & MSS budgeting
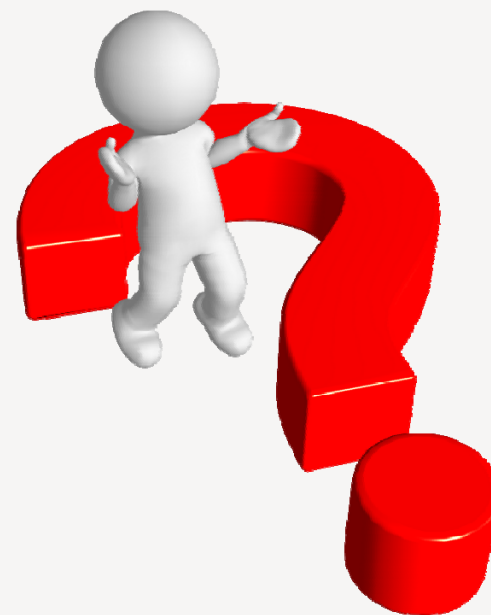- Analysis of Different Budget Scenarios.

Budget Scenario forecast

(Legend: 7M, PCI 70, PCI 75, 15 MLN)

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Key Observations,

Budgeting/financial considerations

10y Backlog forecast

(Millions)

	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	FY29
7M	78.8	78.0	78.6	76.7	74.7	74.6	80.3	85.1	84.2	85.7
PCI 70	75.3	74.0	72.7	70.4	68.5	69.1	67.2	71.8	69.7	70.6
PCI 75	76.1	71.8	67.8	61.8	56.9	54.3	48.6	49.4	43.2	38.3
15 MLN	72.9	65.3	57.5	47.8	38.6	31.3	20.5	16.0	4.2	

■ 7M   ■ PCI 70   ■ PCI 75   ■ 15 MLN

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Questions / Comments

Our values are the essence of our company's identity.
They represent how we act, speak and behave together,
and how we engage with our clients and stakeholders.

SAFETY

We put safety at the heart of
everything we do, to safeguard
people, assets and the environment.

INTEGRITY

We do the right thing,
no matter what, and are
accountable for our actions.

COLLABORATION

We work together and embrace
each other's unique contribution
to deliver amazing results for all.

INNOVATION

We redefine engineering
by thinking boldly, proudly
and differently.

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