2012 AERONAUTICAL NOISE MANAGEMENT REPORT

-VANCOUVER AIRPORT AUTHORITY-

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INTRODUCTION

As a community based organization, the Airport Authority is committed to the long-term health and vitality of our surrounding communities, and is dedicated to operating Vancouver International Airport (YVR) in a manner that minimizes negative impacts on the environment, while supporting the community demands for safe and efficient 24-hour airport services.

In 2012, YVR served over 17.6 million passengers and accommodated approximately 296,400 movements, making YVR the second busiest airport in Canada. To manage the resulting noise impacts on the surrounding community, the Airport Authority has a comprehensive aeronautical noise management program. This report provides a summary of efforts that were undertaken to manage noise at YVR for calendar year 2012, as well as information and statistics on aircraft operations, aircraft fleet mix, noise concerns, runway usage, and results of noise monitoring in the community.

The primary goal of this report is to share information with the community about noise management activities and to facilitate informed dialogue between stakeholders involved in managing aircraft noise. Data and information compiled for this report helps in discussions with members of the YVR Aeronautical Noise Management Committee (ANMC), a consultative group that provides advice and input on the development of initiatives through a collaborative process. The Airport Authority wishes to thank all ANMC members for their contributions in 2012.

THE HIGHLIGHTS

2012 saw the completion of a number of major initiatives contained in the 2009-2013 YVR Noise Management Plan. Below is a description of these initiatives.

REVIEW OF NIGHT OPERATIONS - Initiative #1

Initiative #1 in the 2009-2013 YVR Noise Management Plan outlines efforts to manage noise during the night-time hours. In 2012, the Airport Authority completed a study of night-time operations at YVR to assist with reviewing the current guidelines for granting approval for jet operations between the hours of mid-night and 0700 local.

Under the current guidelines, request for jet operations at night are evaluated by the Airport Authority against their benefits to the broader community. In general, operations that carry passengers or cargo are approved, whereas ferry (repositioning) operations and technical stops (refueling) are denied.

Based on the results of the study, the Airport Authority will maintain the current night approval guidelines and will not be proposing additional night access restrictions due to the following reasons:

1. Wide body aircraft departures at night use the most modern and quietest technology available.
2. The majority of flights at night are associated with cargo and courier operations, with some scheduled passenger flights to Asia. All these flights are of high value and important for the community and the economy of BC. As the demand for these flights continue to grow, YVR must be able to respond and accommodate the growing demand.

GROUND RUN-UP ENCLOSURE PROJECT - Initiative #4

Initiative #4 in the 2009-2013 YVR Noise Management Plan identifies efforts to further manage noise impacts from engine run-up operations. As part of the work under this initiative, the Airport Authority began constructing a dedicated Ground Run-up Enclosure (GRE) in 2011 and opened the facility for operations on 25 January 2012. This $12 million project culminated over four-years of work, starting with the identification of potential sites and initial design. This project was undertaken in close consultation with members of the YVR Aeronautical Noise Management Committee (ANMC), which provided invaluable input throughout the process.

The GRE at YVR is the first of its kind in Canada, and is a specially designed three sided facility that reduces noise while allowing aircraft to conduct run-ups in a safe environment. The GRE is designed to accommodate high power run-ups of propeller and business jet aircraft maintained by operators located on the south side of the airport (south of the south runway). These operators account for approximately 60% of the run-ups performed at YVR each year.

There are approximately 2,000 sound absorbing panels that line the inside wall of the GRE, which are designed to reduce or redirect noise away from residential areas located close to the airport property. Acoustical and aerodynamic verification testing, completed as part of commissioning, demonstrated up to a 50% reduction in the

levels of engine run-up noise heard in the community. The GRE also includes an in ground glycol collection system to allow the facility to be used for deicing operations in the winter if required. More information on run-ups and the GRE can be found starting on page 14 of this report.

NOISE MONITORING TERMINAL STRATEGIC ASSESSMENT - Initiative #11

Initiative #11 in the 2009-2013 YVR Noise Management Plan outlines work to assess the network of Noise Monitoring Terminals (NMTs) connected to the Aircraft Noise & Operations Monitoring System. The objective of the assessment was to examine the appropriateness of location, redundancy, and the potential for additional NMTs to enhance monitoring and data collection in the community. The study was completed by Landrum & Brown, with the final report and presentation to the ANMC delivered in September 2012.

The assessment concluded that the current NMT network provides excellent coverage – there are 20 NMTs strategically located throughout the Lower Mainland. The assessment did recommend consideration be given to relocate NMTs #12 and #13. These two terminals are located on airport property on Sea Island and as consequence provide minimal value to residential communities. NMTs #12 and #13 are long-established monitoring locations with significant levels of data and as such, the Airport Authority will not be relocating any NMTs within the network at this time. However, the Airport Authority will review opportunities for relocation that may arise in the future.

The review also concluded that measuring aircraft sound at NMT locations far from the airport is a challenge, as the sound from aircraft at these locations is low compared to the ambient background sound level and therefore contributes very little to the overall noise at the location. Aircraft would still be audible as the human ear and brain can differentiate and identify aircraft from other background noise. At sites closer to the airport, aircraft sound levels are sufficiently higher than the background ambient noise levels to allow for measurement.

FLOAT PLANES - Initiative #7

Operational Best Practices

Initiative #7 in the 2009-2013 YVR Noise Management Plan outlines work to mitigate impacts from YVR float plane operations on the Middle Arm of the Fraser River. In 2012, a number of operational best practices were identified in close consultation with the float plane operators. As a result of this work, the following wording was approved by Transport Canada and will be published in the 2013 editions of the *Canada Flight Supplement* and the *Water Aerodrome Supplement:*

Consistent with safe aircraft operations, the following are recommended operational procedures:

1. **Take-offs Westbound and landings Eastbound are preferred when wind and water conditions permit.**
2. **Use low RPM reduced noise take-off when able.**
3. **Avoid departure routes that fly over the City of Richmond, whenever possible.**
4. **Avoid using "reverse thrust" after landing to slow the aircraft.**
5. **Maintain 500 feet ASL when flying the Westminster Hwy downwind route.**
6. **Join the downwind circuit for the Westbound landing after passing the TERRA NOVA waypoint unless directed by ATC.**

Missed Approach Procedures

In early 2012, the altitude of transit routes over the City and airport used by float planes travelling between Vancouver Harbour and Victoria Harbour was raised by NAV CANADA, to avoid conflict with the missed approach altitude for the north runway. While this change was made to enhance aviation safety, it did have a community benefit as float planes now operate at higher altitude while transiting over the City.

AERONAUTICAL NOISE MANAGEMENT COMMITTEE - Initiative #14

Initiative #14 in the 2009-2013 YVR Noise Management Plan outlines work to enhance communication with stakeholders, including reviewing the Terms of Reference and the functions of the ANMC. To gather information on how the ANMC was functioning, a survey was administered to members in September 2012. Feedback was extremely positive and reaffirmed that the ANMC is working well as a forum to provide input and advice on noise management strategies and projects.

YVR OPERATIONS IN REVIEW

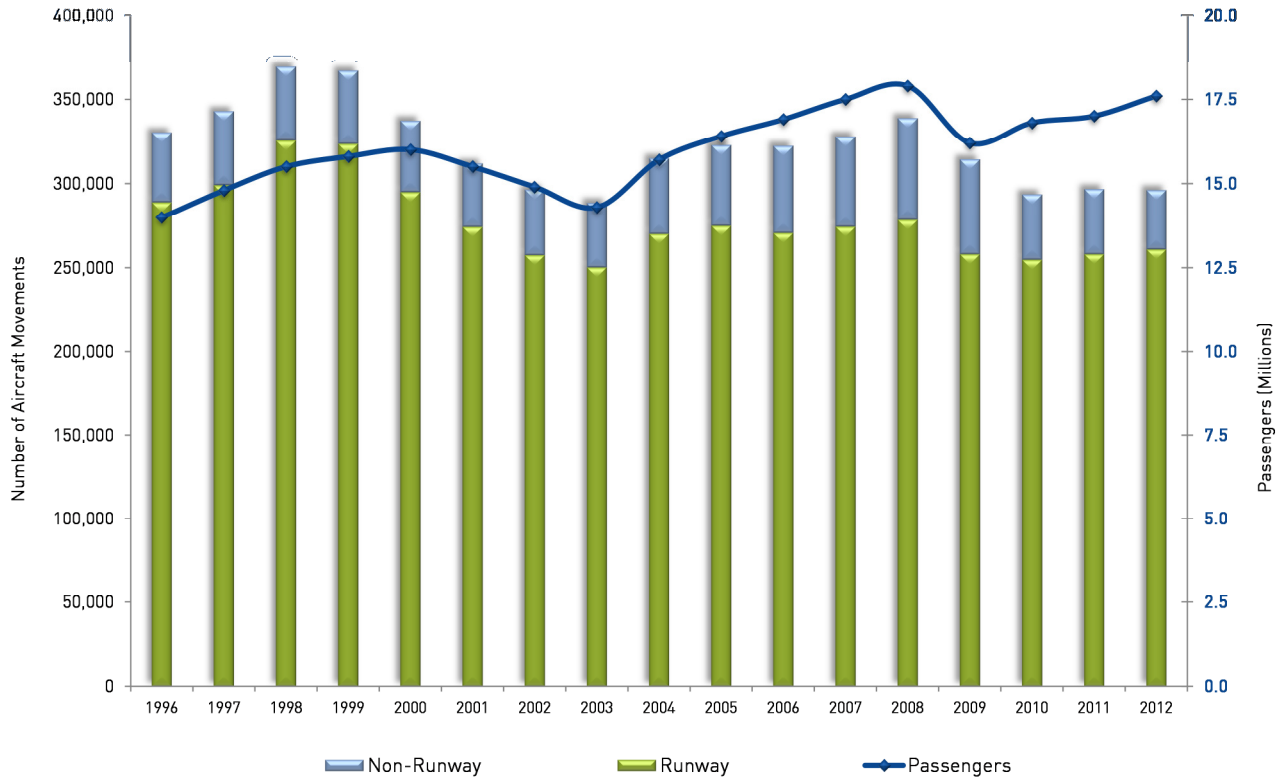
In 2012, there were positive indications of growth at YVR since the decline in aircraft movements and passengers that began in 2008 due to the slowing global economy. While there was a slight decrease in the total aircraft movements[1], the number of passengers and cargo tonnage experienced an increase compared to 2011.

Table 1 and Figure 1 present the operational statistics for 2012. As illustrated in Figure 1, the annual number of aircraft movements peaked in 1998. Since then, the number of movements has decreased, but the number of passengers served has continued to slowly increase. This means that aircraft are now carrying more passengers per aircraft movement, which is a benefit with respect to noise and air emissions.

Table 1: Aircraft Operations at YVR, 2012

Total Movements	296,394	-0.2% decrease from 2011
Total Cargo (Tonnes)	227,203	1.5% increase from 2011
Total Passengers	17,506,901	3.3% increase from 2011

Figure 1: YVR Annual Aircraft Movements & Passenger Statistics, 1996-2012

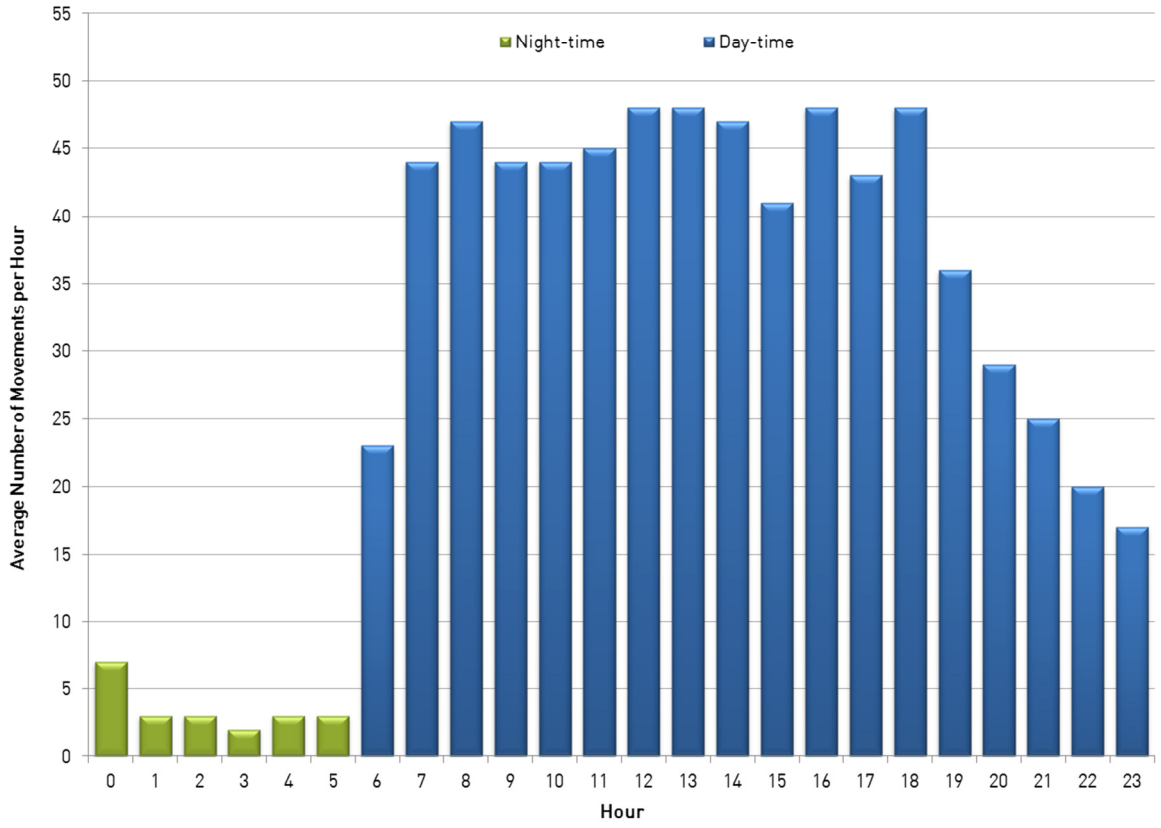


[1] Total movements include runway and non-runway (float planes and helicopters) movements.

Like most other international airports around the world and all international airports in Canada, YVR operates 24-hours a day. While the majority of aircraft movements occur during the day-time hours[2], there are some operations during the night-time hours[3] primarily associated with the cargo/courier industry and some scheduled passenger flights to Asia-Pacific.

Approximately 97% of all aircraft activity occurs during the day-time hours. As illusrated in Figure 2, the peak times for aircraft movements during a typical day occurs during the hours of 0700, 1200, 1300, 1600, and 1800. Movements during the night-time hours account for less than 3% of all aircraft activity at YVR. This translates to approximately 21 movements between the hours of mid-night and 0600. Most of these movements are arrivals, which are significantly quieter than departures.

Figure 2: Average Number of Runway Movements per Hour, 2012



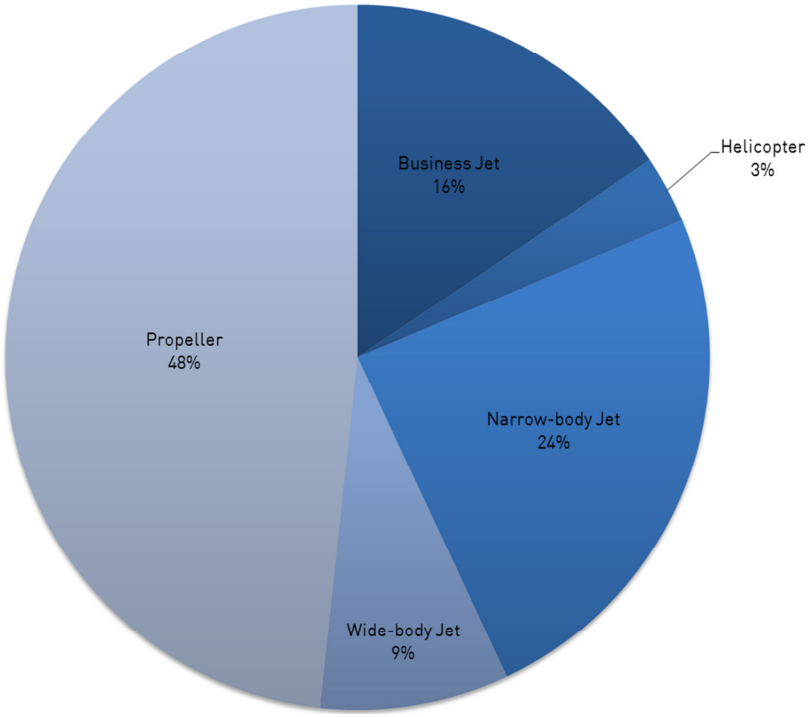
[2] Day-time is defined as the hours between 0600 - midnight.
[3] Night-time is defined as the hours between midnight - 0600.

OPERATIONAL SNAPSHOT – FLEET MIX

YVR accommodates a very diverse and unique mix of aircrafts. There are a number of large commercial airlines, which use large wide-bodied jet aircraft, and a number of regional airlines that serve the Province and Western Canada with smaller propeller aircraft. This diversity in the fleet mix presents a tremendous challenge for air traffic control to integrate the wide range of aircraft sizes and differing performance characteristics in a safe and efficient manner. Figure 3 provides a breakdown of 2012 total movements by the following aircraft categories:

- wide-body jets (e.g., B747; B777),
- narrow-body jets (e.g., B737, CRJ),
- business jets (e.g., Citation, Learjet),
- propeller (e.g., Dash-8, Navajo, Beech), and
- helicopter (e.g., S76, B412).

Figure 3: Breakdown of Aircraft Types Operating at YVR, 2012



As illustrated, almost half (48%) of all movements at YVR are with propeller aircraft. Jazz Aviation, Pacific Coastal, Harbour Air, and Central Mountain Air are the top four operators of propeller aircraft – accounting for approximately 70% of all propeller operations. The Bombardier Dash-8, Beech 1900, de Havilland Beaver, and the Piper Navajo are the most common propeller aircraft operating at YVR. The most common jet aircraft at YVR are the Embraer 190, Boeing 737-700/800, and the Airbus 320. These aircraft types account for approximately 46% of all jet operations. Air Canada, WestJet, Jazz Aviation, and United Airlines are the four top operators of jet aircraft – accounting for approximately 75% of all jet operations.

JET AIRCRAFT FLEET MIX BY NOISE CERTIFICATION

International Civil Aviation Organization – Annex 16

The ICAO is an agency of the United Nations, and establishes principles and techniques for the planning and development of international air transportation to ensure safe and orderly growth. ICAO prescribes standards for noise with the goal of promoting reduction at the source. These standards are contained in *Annex 16: Volume I Environmental Protection - Aircraft Noise*, and categorizes jet aircraft as either Chapter 2, Chapter 3, or Chapter 4 depending on measured noise levels during prototype development[4]. The Chapter 4 standard, which was made applicable for new aircraft certified after 1 January 2006, represents the quietest and best technology available.

An analysis was performed to determine the noise certification of jet aircraft movements at YVR in 2012. Table 2 below presents the results of the analysis according to the Gross Take-off Weight (GTOW) of the aircraft. As illustrated, 89% of all jet aircraft operating at YVR meet Chapter 4 noise standards.

Table 2: ICAO Noise Certification of Jet Operations at YVR, 2012

ICAO Noise Certification	GTOW < 34,000kg (n=18,600)	GTOW less than 34,000kg	
		Narrow Body (n=99,670)	Wide Body (n=25,710)
Chapter 3	11%	8%	2%
Chapter 4	89%	92%	98%

Airports Council International - Noise Rating Index

Airports Council International (ACI) is a non-profit global trade organization that represents the world's airports. When the Chapter 4 standard was adopted by ICAO, ACI concluded that the standard was insufficient to manage noise impacts and created the ACI Aircraft Noise Rating Index ("Index") as a tool to better define the wide ranging noise performance of aircraft within the Chapter 3 and Chapter 4 categories.

Based on measured noise levels in comparison to Chapter 3 noise certification limits, the aircraft are placed into one of six categories of noise performance. These range from "A" (quietest) to "F" (noisiest). Table 3 breaks down the percentage of aircraft operating at YVR based on this Index.

Table 3: ACI Noise Rating Index of Jet Operations at YVR, 2012

ACI Noise Rating Index	GTOW < 34000kg (n=18,600)	GTOW greater or equal to 34,000kg	
		Narrow Body (n=99,670)	Wide Body (n=25,710)
A	88%	3%	13%
B	1%	9%	50%
C	<1%	81%	23%
D	-	<1%	10%
E	1%	6%	2%
F	1%	2%	2%
UNKNOWN	9%	-	-

[4] To reduce aircraft noise exposure on communities, the Government of Canada legislated the phase-out of Chapter 2 jet aircraft over 34,000kg from operation in Canada by the year 2002. These aircraft are no longer permitted to operate in Canada and were either retired from operation or modified to meet Chapter 3 standards.

Gross Take-off Weight less than 34,000kg Category

This category contains business jets and smaller regional jets. The majority of aircraft in this category have an ACI Noise Rating Index of 'A'. The main aircraft in this 'A' category include the:

- CRJ-100/200 series (with CF34-3A1/3B1 engines)
- Learjet 31
- Learjet 45
- Cessna Citation V (model 560)

Gross Take-off Weight greater or equal to 34,000kg Narrow Body Category

This category has a high percentage of aircraft with an ACI Noise Rating Index of 'C'. The main aircraft in this 'C' category include the:

- E190 (with CF34-10E5A1G05 engines)
- B737-700 (with CFM56-7B-22 engines)
- A320 (with CFM56-5A1 engines)

Gross Take-off Weight greater than or equal to 34,000kg Wide Body Category

This category has a high percentage of aircraft with an ACI Noise Rating Index of 'B'. The main aircraft in this 'B' category include the:

- A330-200 (with Trent 772B-60 engines)
- B77W (with GE90-115BL/2 engines)
- B767-300 (with PW4060 engines)
- B77L (with GE90-110B1L engines)

Summary

With over 90% of the landings and take-offs by aircraft that meet the *quietest* ICAO Chapter 4 noise standards and ACI's Noise Rating Index of 'C' or better, it can be concluded that aircraft operating at YVR are some of the quietest aircraft in the industry.

AIR TRAFFIC FLOW

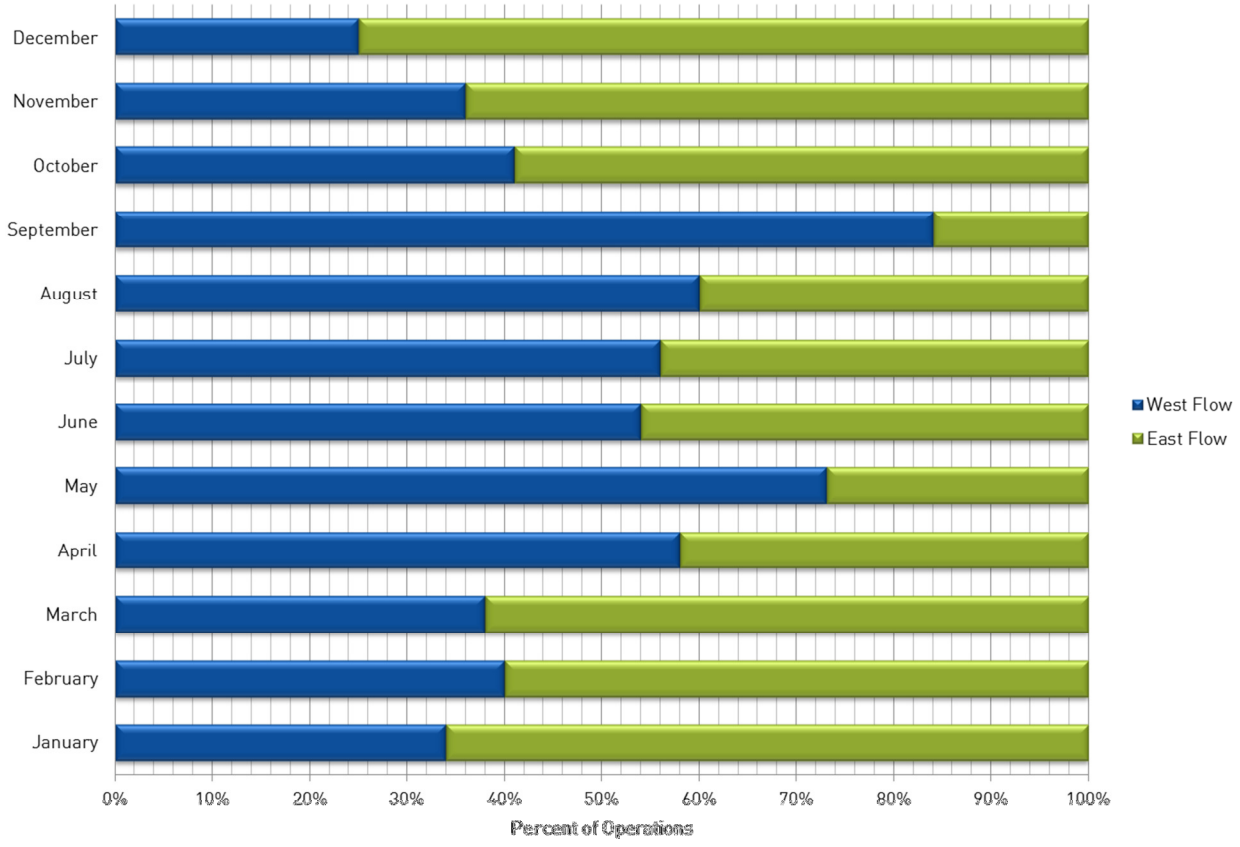
YVR has two parallel runways and a crosswind runway. The parallel runways – 08R/26L and 08L/26R - are aligned in an east-west direction (aligned with magnetic headings of 083°and 263°) and the crosswind runway - 12/30 - is oriented in a northwest and southeast direction (aligned with magnetic headings of 125° and 305°).

Aircraft flight routes over the Lower Mainland are highly dependent on the active runway, which is determined by the wind conditions on the airfield. For safety reasons aircraft must land and take-off into the wind. Based on historical observations, departures and arrivals in an easterly direction (runway 08L and 08R active) are more common during the Fall and Winter months, and departures and arrivals in a westerly direction (runway 26L and 26R active) are more common during the Spring and Summer months. It may be possible for wind conditions to change throughout the course of a day, resulting in a change to the active runway.

Westerly flow of traffic is preferred to reduce noise exposure on the community as it places the noisiest operations (departures) over the Strait of Georgia. In addition, during the night-time hours when the winds are calm, air traffic control will attempt to keep both arriving and departing aircraft over the Strait of Georgia in an effort to minimize noise on the community.

Figure 4 illustrates the monthly relationship between the easterly and westerly flow of traffic throughout 2012. Overall, the wind conditions slightly favored westerly flow in 2012, especially during the month of September.

Figure 4: Monthly Distribution of Air Traffic Flow at YVR, 2012



RUNWAY USE

At YVR, there were no significant changes in how the runways were utilized in 2012 from 2011. Consistent with previous years, the south runway (08R/26L) was closed at night for an 8-week period over the summer to accommodate airfield lighting and maintenance work. During this period, air traffic was diverted to the north runway (08L/26R) which is normally closed to all operations between the hours of 2200-0700, except for emergencies, weather, and airfield maintenance activities. Runway 08R/26L is the main 24-hour runway and the Airport Authority schedules and organizes maintenance and work on this runway to minimize its closure.

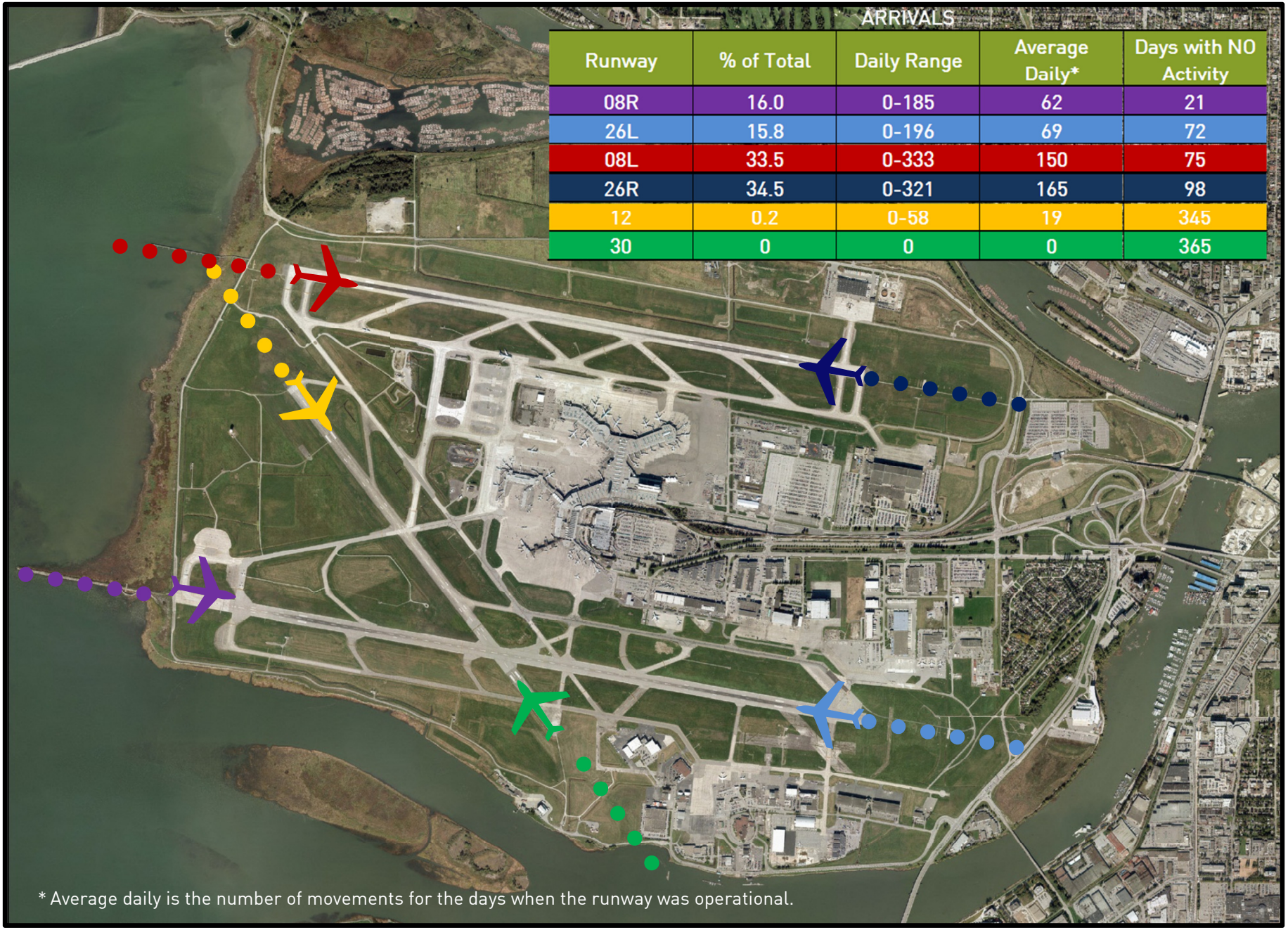
Table 4 provides information on the runway utilization for 2012. As demonstrated, departures usage favor 08R/26L and arrival usage favors 08L/26R. Figures 5 and 6 illustrate graphically the runway utilization information provided in Table 4.

Table 4: YVR Runway Utilization, 2012

ARRIVALS					DEPARTURES			
Days in 2012 with NO Activity	Daily Range	% Of Total	Average Daily[A]	Runway	Average Daily[A]	% Of Total	Daily Range	Days in 2012 with NO Activity
21	0-185	16.0%	62	08R	200	48.1%	0-414	47
72	0-196	15.8%	69	26L	213	49.9%	0-418	56
75	0-333	33.5%	150	08L	19	1.0%	0-68	298
98	0-321	34.5%	165	26R	21	0.7%	0-49	319
345	0-58	0.2%	19	12	32	0.3%	0-85	353
365	0	0	0	30	0	0	0	365

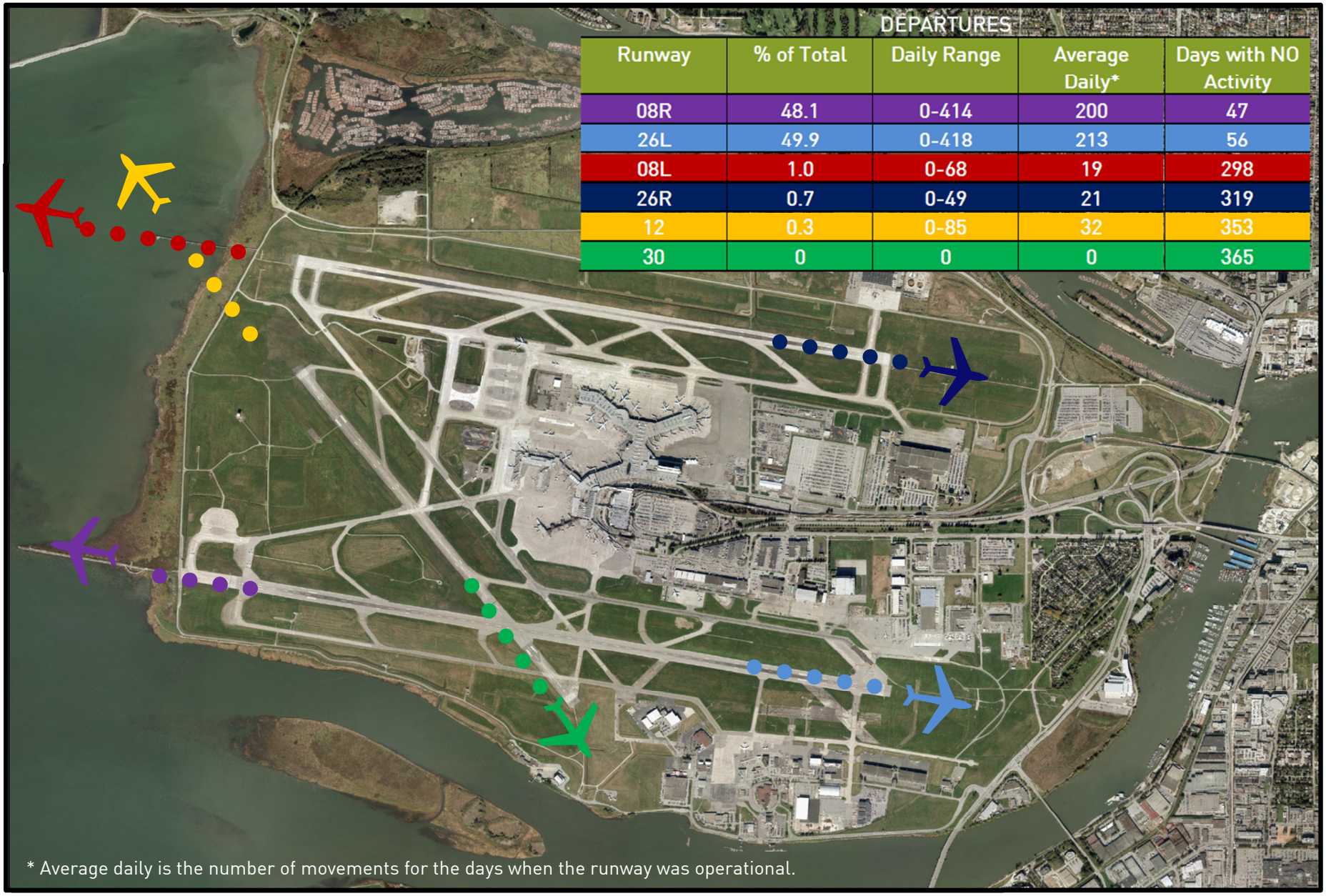
[A]This number represents the average number of movements for the days when the runway was operational.

Figure 5: YVR Runway Utilization – ARRIVALS, 2012



Runway	% of Total	Daily Range	Average Daily*	Days with NO Activity
08R	16.0	0-185	62	21
26L	15.8	0-196	69	72
08L	33.5	0-333	150	75
26R	34.5	0-321	165	98
12	0.2	0-58	19	345
30	0	0	0	365

Figure 6: YVR Runway Utilization – DEPARTURES, 2012



RUN-UPS

Regular maintenance is a regulatory requirement by Transport Canada and manufacturers to ensure the aircraft is safe to operate. Engine run-ups are performed as a part of maintenance work and involve running the engines at high power for a period of time to stress components and to simulate flight conditions. This is done to ensure that maintenance work has been done properly, and that the aircraft is safe to return to service. Run-ups occur at all times of the day, but those that occur at night may result in disturbance to residents located close to airport.

YVR Run-up Directives and Procedures

In an effort to reduce noise impacts from run-ups, the Airport Authority maintains directives and procedures which prescribe how and when run-ups can be performed. Maintenance operators must request permission of YVR Operations to perform a run-up, and approved run-ups will be assigned a location and heading to ensure safety and to minimize noise impacts on surrounding communities. Information on all maintenance run-ups are logged by the Airport Authority, and these are records are routinely analyzed to track run-up activity and identify trends.

YVR Run-up Activity

Over the last five years, there has been an increase in the number of run-ups performed at YVR. This could be attributed not only to increased maintenance activity, but also because of continued engagement with the operators and diligent work to ensure understanding of the run-up directive and procedures. Table 5 provides a breakdown of run-up activity at YVR over the last five years.

Table 5: Number of Run-ups Performed at YVR, 2008-2012

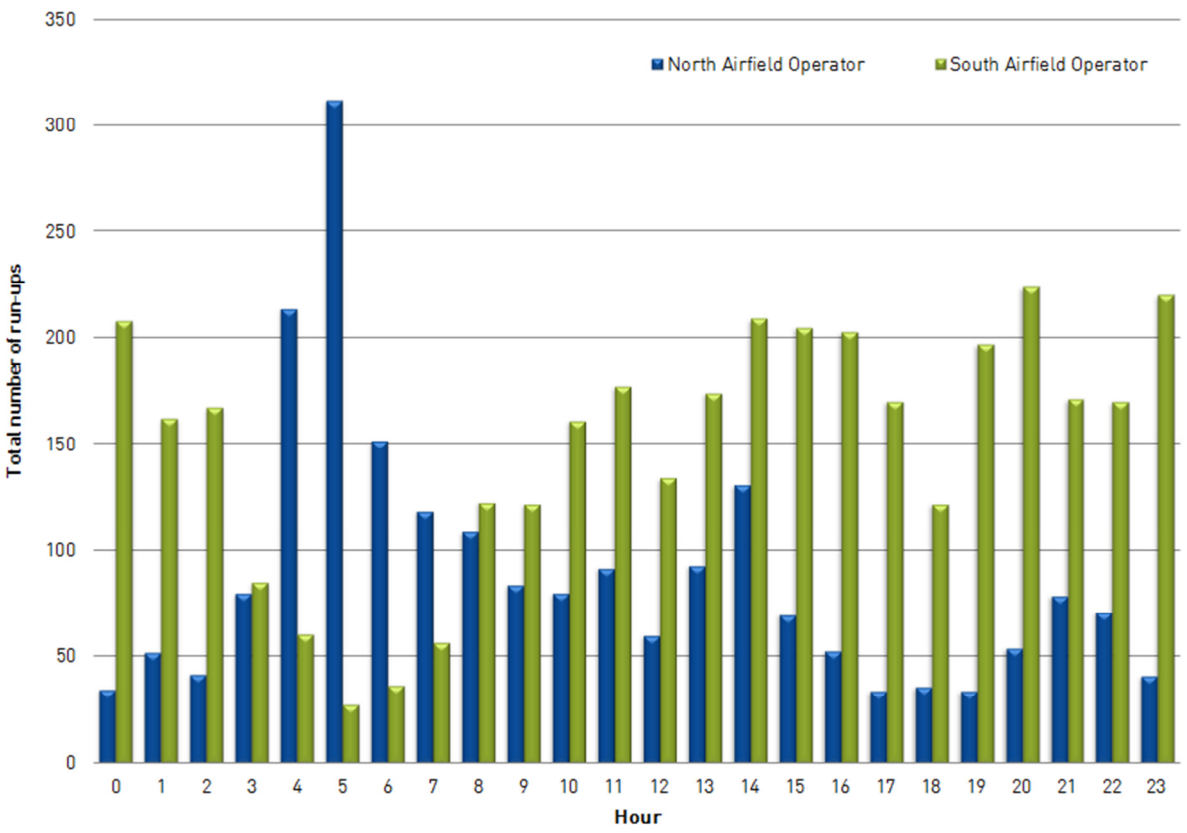
Year	Number of Approved Run-ups
2008	3,889
2009	3,715
2010	4,114
2011	5,701
2012	5,706

For the purpose of analysis, operators conducting run-ups are divided into two distinct areas – those that are located on the north airfield and those that are located on the south airfield, with the south runway acting as the dividing line. North airfield operators account for 40% of all run-up activities at YVR. These are generally performed by the larger commercial airlines, such as Jazz Aviation and Air Canada.

Run-ups by south airfield operators account for approximately 60% of all run-ups at YVR. These are generally done by propeller aircraft associated with smaller operators that have their maintenance facilities on the south airfield.

As illustrated in Figure 7, the busiest hours for run-ups by north airfield operators is between 0400-0600. The busiest hour for run-ups by south airfield operators is at 2000 hours. However, as Figure 7 illustrates, south airfield operators are consistently busy throughout the day with the early morning hours of 0300-0700 having the least amount of run-up activity.

Figure 7: Number of run-ups conducted for each hour at YVR by North & South Airfield Operators, 2012



Ground Run-up Enclosure (GRE)

To reduce noise from the high number of propeller run-ups by operators located on the south airfield, the Airport Authority constructed Canada's first GRE and the facility was opened on 25 January 2012. The GRE can accommodate high power run-ups by propeller and business jet aircraft maintained on the south airfield. The facility is designed to provide an average of 15 dB noise reduction, and residents to the south of YVR experience a 50% reduction in run-up noise.

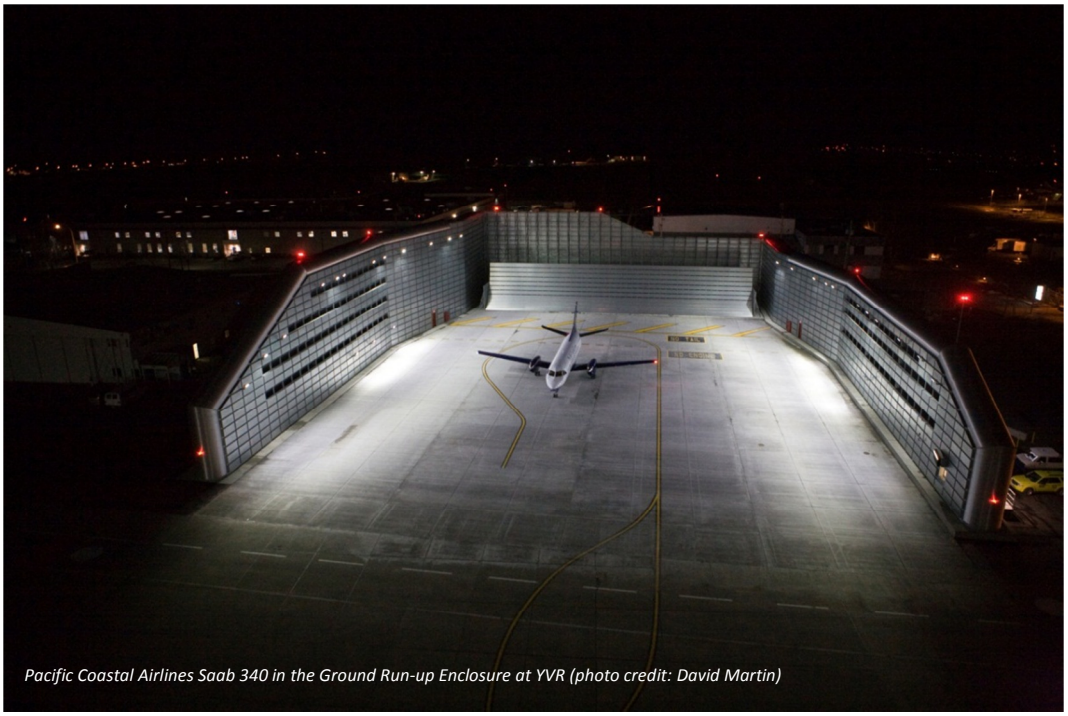
In 2012, 25% of all run-ups at YVR, including those on the north and south airfield, were conducted in the GRE. Table 6 provides a more detailed breakdown of south airfield run-ups and their location in comparison with the GRE.

Table 6: South Airfield Run-ups, Power Setting and Location, 2012

Power Setting	Location	Approx. % of South Airfield Run-ups
Above Idle	GRE	79%
	Apron III	18%
	Apron II	3%
Full Power	GRE	90%
	Apron III	10%

As illustrated in Table 6, the majority of high powered run-ups (i.e. 'Above Idle' and 'Full Power') were performed in the GRE. The limited number of 'Full Power' run-ups not performed in the GRE occurred between the hours of 0900 and 2100. Records show that there were eight 'Above Idle' run-ups that were not conducted in the GRE, but rather on Apron III during the night hours of 2200 and 0700, but were less than 10 minutes in duration. The GRE is used only 10% of the time for 'Idle' run-ups, which is to be expected since these run-ups are generally very short in duration and are not as intrusive to the community compared to higher powered run-ups.

The GRE has been a great success from reducing noise in the community and operator usability. Operators often request use of the facility for their run-ups due to its safe and controlled setting.



Pacific Coastal Airlines Saab 340 in the Ground Run-up Enclosure at YVR (photo credit: David Martin)

COMMUNITY ENGAGEMENT

Education & Awareness

A key component of the YVR Aeronautical Noise Management Program is to educate and provide the community with information on airport operations and aircraft noise management activities. The following are some examples of education and awareness initiatives undertaken in 2012.

- Hosting quarterly meetings of the ANMC and posting meeting minutes on the airport's website.
- Discussing noise issue at the annual YVR Chief Pilot's meeting and presenting the YVR Fly Quiet Awards.
- Offering community noise information seminars.
- Providing access to the WebTrak community flight tracking system.

Aeronautical Noise Management Committee

Stakeholder involvement and consultation is an integral component to managing aircraft noise. The forum for this at YVR is the ANMC, whose membership includes a wide variety of stakeholders, including: cities, government, air traffic control, first nations, airlines, industry associations, and various departments within the Airport Authority (full membership list is provided in Appendix A). The objective of the ANMC is to discuss and address noise issues in a consultative and collaborative process. The ANMC also provides a forum for dialogue, exchange of ideas, and improved understanding between all stakeholders.

The ANMC meets quarterly and members are appointed independently by their respective organizations. In 2012, the major topics discussed at each of the quarterly meetings are presented below. Full minutes for each meeting are posted on the web and are available at www.yvr.ca

Quarter I Meeting – Discussion Highlights

- Ground Run-up Enclosure: project update provided (the GRE opened on 25 January 2012).
- 2011 Annual Noise Report: discussed and presented the results of data analysis.
- Runway End Safety Area (RESA): discussed the impending requirement for RESA by Transport Canada.
- Control Zone Working Group: provided an update on work program.

Quarter II Meeting - Highlights

- ANMC members were provided a tour of the airfield and the GRE.

Quarter III Meeting - Highlights

- NMT Strategic Assessment: Landrum & Brown presented final report and discussed recommendations.
- Night Operations: provided preliminary results of a study on night operations at YVR.
- ANMC Survey: distributed survey to provide feedback to the Airport Authority on how the Committee is functioning and to identify any improvements that would ensure that time is well spent at meetings.

Quarter IV Meeting - Highlights

- Night operations study at YVR: result of study on night operations at YVR presented.
- ANMC Survey: results of the committee survey presented along with recommended changes to meeting format.
- Noise Management Plan: work plan to create the 2014-2018 YVR Noise Management Plan presented and discussed.

YVR Fly Quiet Awards

The 2011 YVR Fly Quiet Awards were presented at the annual YVR Chief Pilot's Meeting. This is the sixth year for these awards and the goal is to raise the awareness of community noise issues within the aviation community. Eligibility to win includes:

1. The airline must not be in suspected violation of any of the published Noise Abatement Procedures.
2. The airline must have the lowest average annual noise level for their aircraft category (as measured by the Aircraft Noise & Operations Monitoring System).
3. The airline must fly regular services at YVR.

The winners of the 2011 awards included: Horizon Air (propeller category); United Airways (narrow-body jets); and Japan Airlines (wide-body jets). Award winners for past years are presented in Table 7

Table 7: Fly Quiet Award Winners, 2007-2011

YEAR	Propeller Wing	Narrow Body Jets	Wide Body Jets
2011	Horizon Air	UNITED	JAL JAPAN AIRLINES
2010	Pacific Coastal AIRLINES	U·S AIRWAYS	JAL JAPAN AIRLINES
2009	Horizon Air	ups	air transat
2008	Pacific Coastal AIRLINES	MEXICANA	AIR NEW ZEALAND
2007	Horizon Air	WESTJET	JAL JAPAN AIRLINES

Noise Information Seminars

The Airport Authority continued with its program of offering noise information seminars to members of the community. The objective of the seminars are to provide interested residents with information on the complex issue of noise management and provide an opportunity to ask questions about the YVR Aeronautical Noise Management Program. In 2012, sessions were offered for the months of August and October.

WebTrak

Aviation is a very complex subject. To assist residents to better understand flight operations and noise levels in their community, the Airport Authority provides YVR WebTrak, a web-based tool that allows residents to view 'real-time' and historical flight and noise data collected by the Aircraft Noise & Operations Monitoring System[5]. WebTrak is an extremely informative tool and allows residents to see the air routes and how aircraft navigate over the Lower Mainland. This can provide useful information to address concerns. WebTrak also allows residents to register complaints about specific aircraft or general concerns about aviation.

WebTrak can be accessed at the following link - WebTrak.

[5] For aviation security reasons, 'real-time' flight tracks are delayed by 10 minutes and other sensitive information is not shown. In addition, sensitive operations, such as law enforcement and military flights, are not displayed. Historical data (up to 30 days in the past) is available for replay. The intended use of WebTrak is to display the general location and flow of air traffic in the vicinity of YVR. Information is not intended for navigational or regulatory enforcement purposes.

NOISE CONCERNS

One of the goals of the YVR Aeronautical Noise Management Program is to provide the community with up-to-date information on the noise management efforts and initiatives. The community is able to contact the Airport Authority with their questions and concerns through one of the following means:

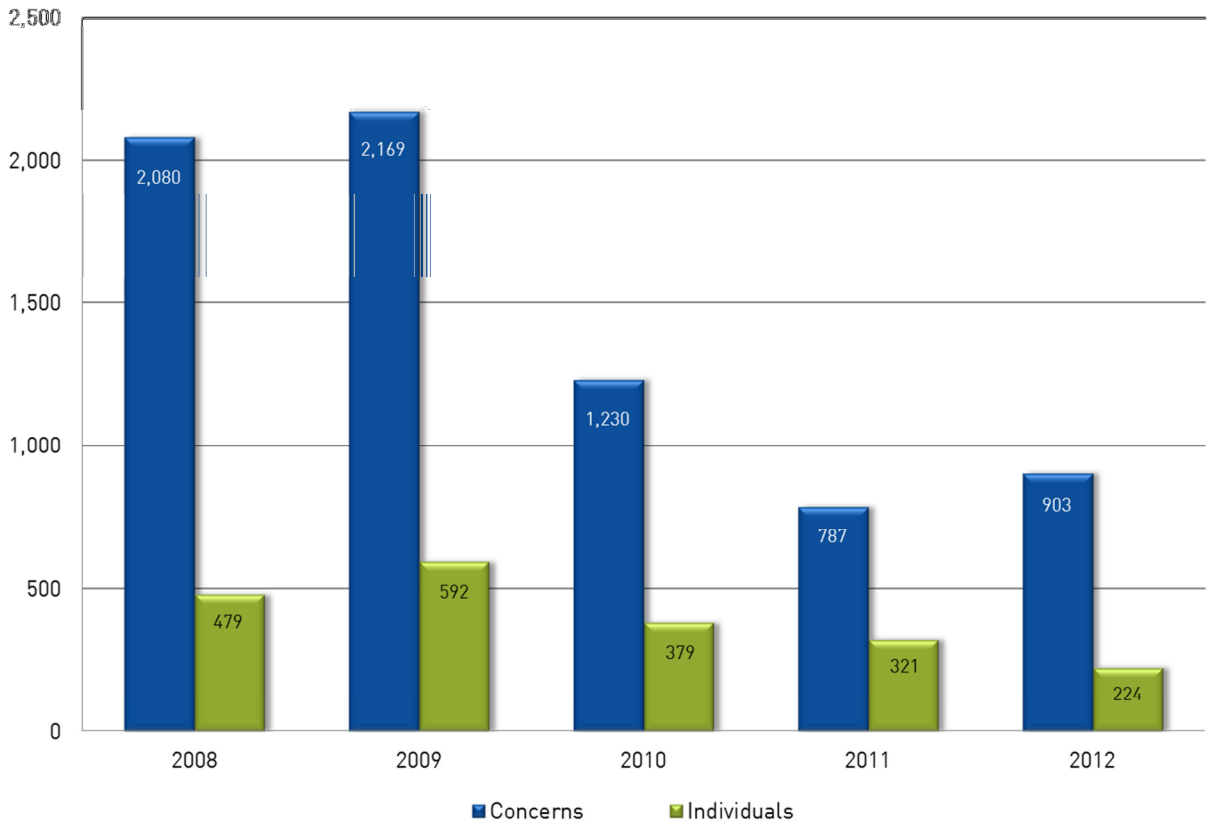
- Dedicated e-mail (noise@yvr.ca)
- WebTrak
- YVR Noise Information Line (604-207-7097), 24-hours.

Complaint information and investigation results are logged in a database, which is used to identify trends. The ANMC is provided a summary of complaints at each quarterly meeting and will review and discuss issues.

Number of Concerns

In 2012, the Airport Authority received 903 noise concerns from a total of 224 individuals. The volume of noise concerns increased by 15% compared to 2011; however, there was a 33% reduction in the number of individuals registering concerns. Figure 8 presents a breakdown on the number of concerns and individuals for the past five years, 2008-2012.

Figure 8: Number of Noise Concerns and Individuals, 2008-2012

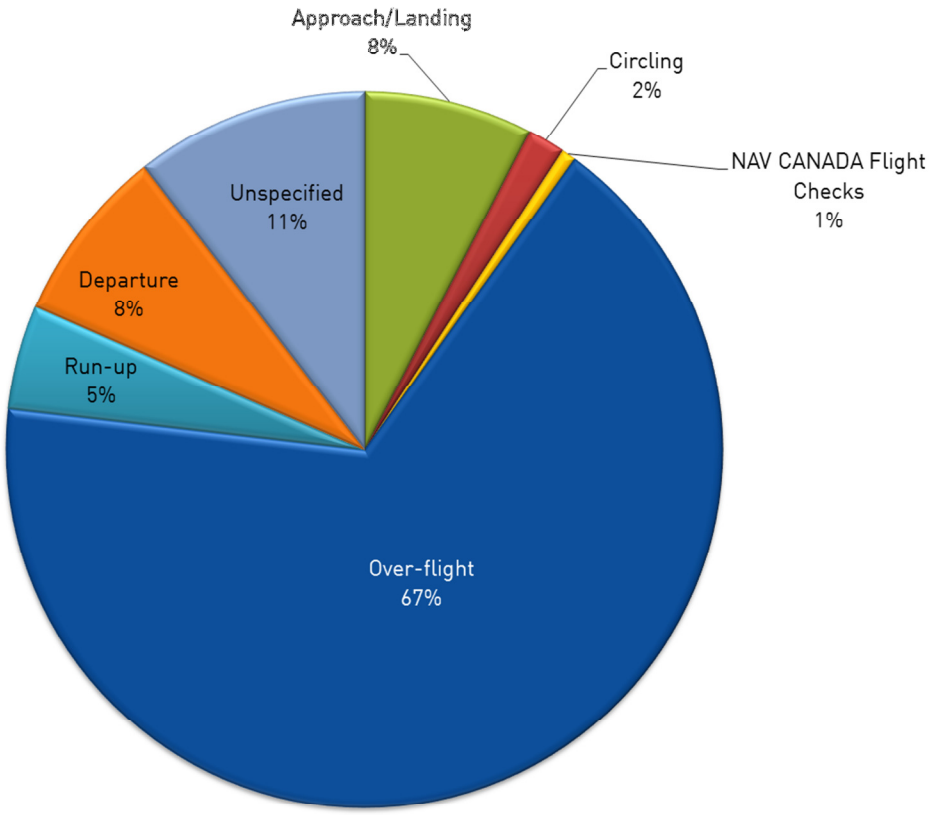


Noise Concern by Operation Type

Each noise concern that is registered is categorized into one of the following main operational categories: departure, arrival, over-flight, run-up, or circling. In some cases, Airport Authority staff categorizes the concern due to lack of information provided by the complainant. The nature of concerns varies greatly and often depends on where the individual lives with respect to the airport.

Figure 9 shows a breakdown of all noise concerns by operational categories. As a general observation, take-off and over-flight activities generate the most concern. Departure concerns originate from areas located in close proximity to the airport (e.g. Richmond), while over-flight concerns tend to originate in areas located further from the airport (e.g. Tsawwassen, Port Coquitlam, etc.). Concerns categorized as 'Unspecified' are logged via WebTrak where the individual does not specify a concern and we are not able to identify a specific operational concern from the information provided.

Figure 9: Concerns by Operational Category, 2012



Noise Concerns by Location

Whenever possible, individuals are asked to provide information on which City they live in, which allows us to determine where concerns are originating from. Figure 10 illustrates the number of concerns and individuals for the various Cities in the Lower Mainland.

Figure 10: Number of Concerns & Individuals by Location, 2012

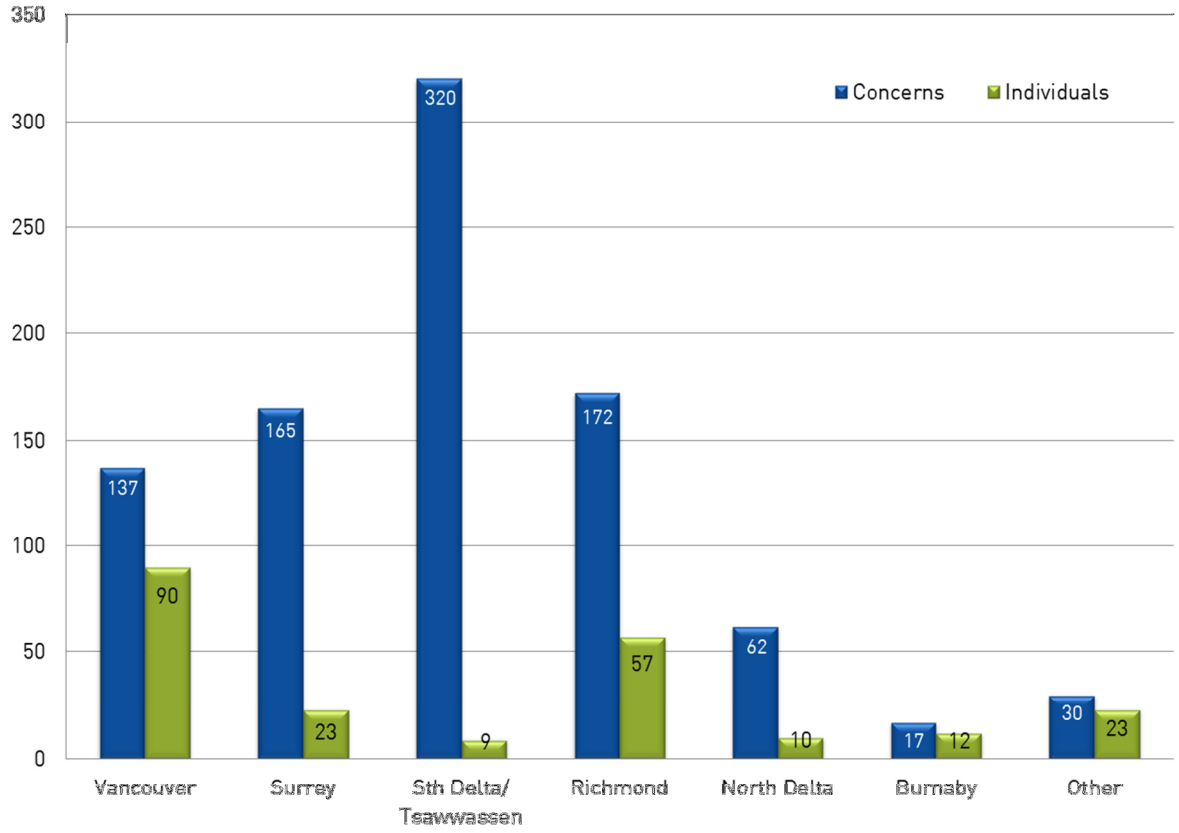


Figure 8 and 10 illustrates that there are a number of individuals that file multiple concerns over the year. In 2012, the top ten complainants registered:

- 540 concerns, constituting 60% of total concerns;
- 13 or more concerns each with the range being between 13-280;
- one individual, located greater than 10 nm (of 18.5 km) from the airport, registered 280 concerns (31% of all concerns for 2012)[6];
- 8 out of the 10 individuals are located further than 10 nm from the airport.

Figure 11 represents the geodistribution of concerns in the Lower Mainland. Locations closer to the airport exhibit a greater density of noise concerns due to the lower altitude of aircraft and regularity of aircraft activity in these locations. Figure 12 represents the geo-distribution and the frequency of concerns in the Lower Mainland.

[6] Under its Ground Lease with the Federal Government of Canada, the Airport Authority is responsible for managing noise concerns within 10 nautical mile (nm) of the airport. Concerns related to noise outside this area can be directed to Transport Canada.

Figure 11: Geo-distribution of Noise Concerns (with 10 nm radius identified), 2012

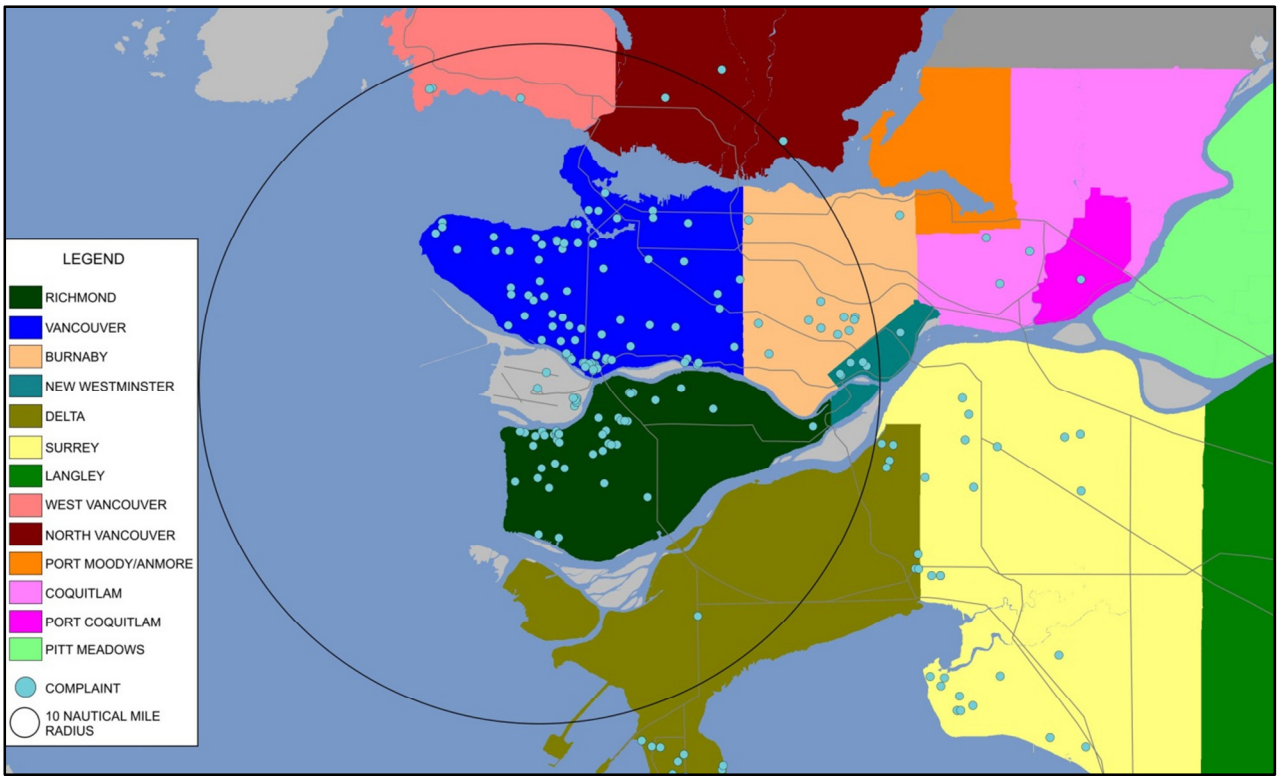
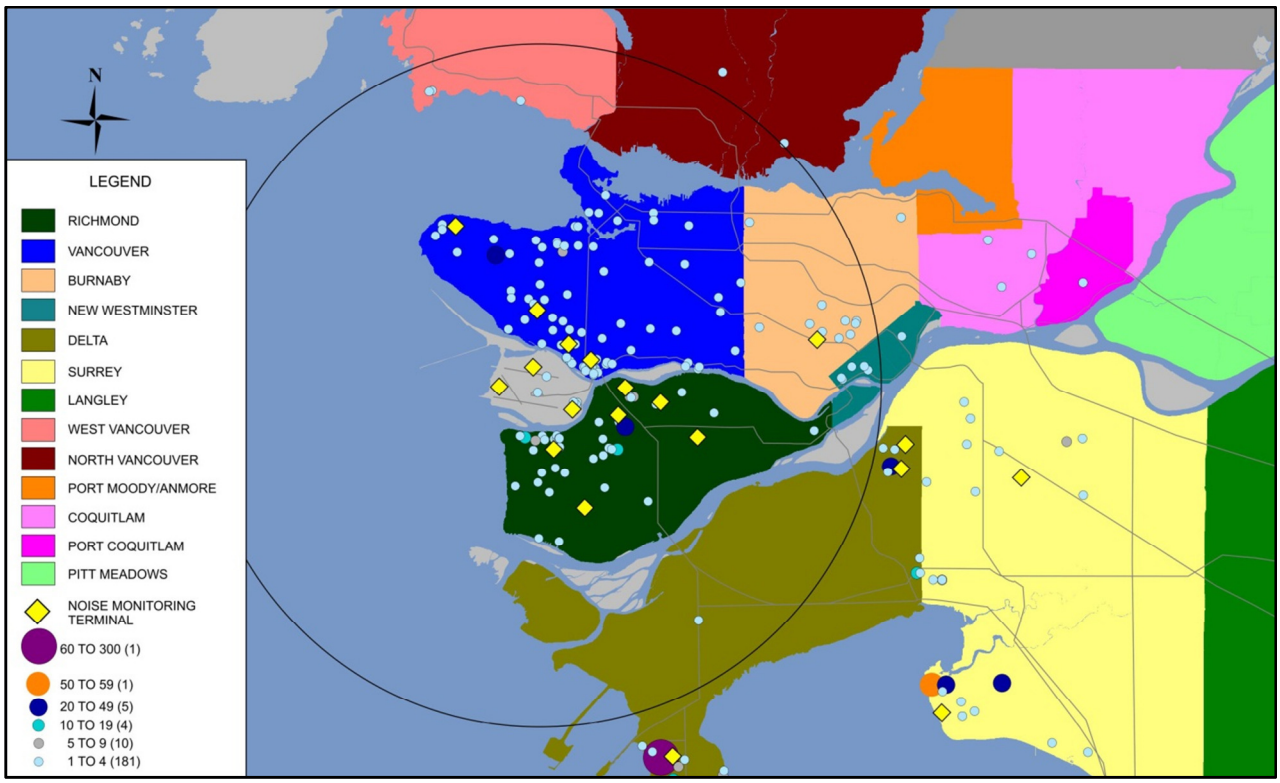


Figure 12: Frequency and Geo-distribution of YVR Noise Concerns (with 10nm radius identified), 2012



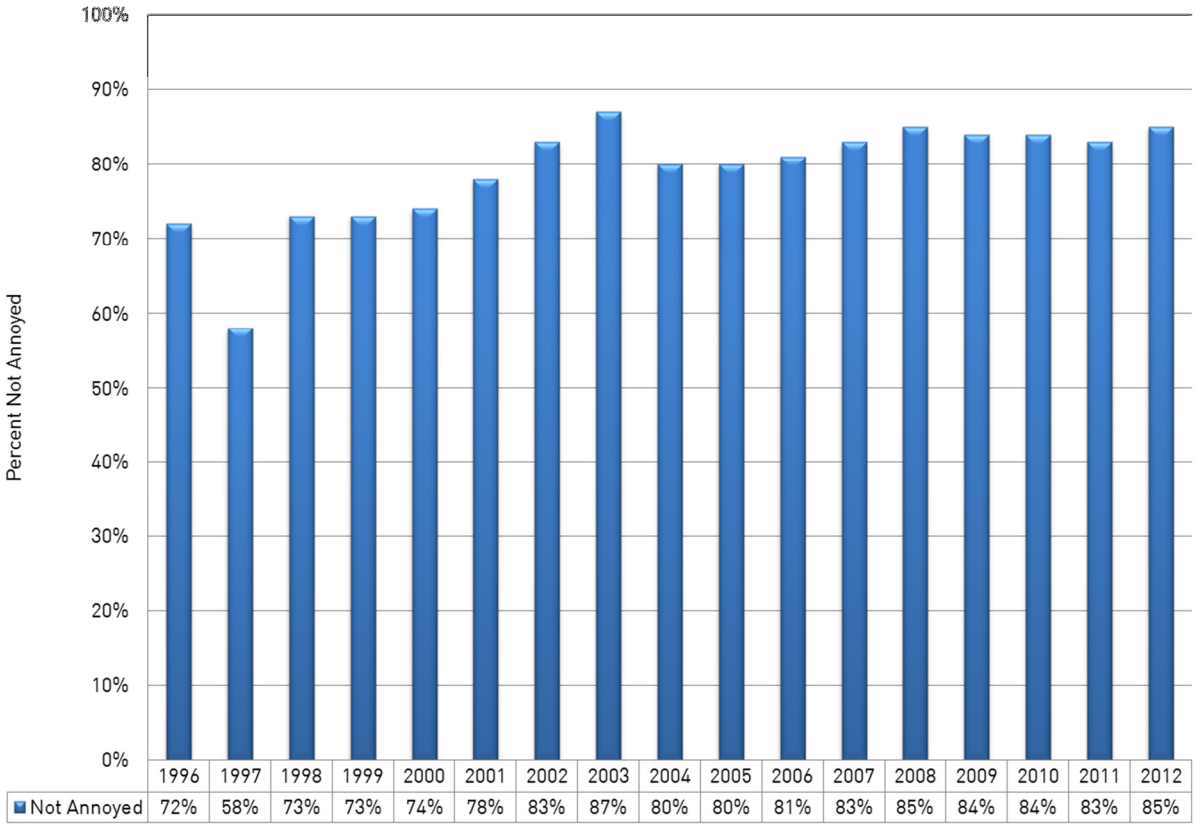
In Figure 12, each dot and its size represents a range of concerns originating from that area. As illustrated, seven individuals logged over 20 concerns with five out of the seven individuals living in areas well outside the 10 nm radius. Concerns outside the 10nm radius are generally related to over-flight activities where aircraft altitudes range from 6,000 feet Above Sea Level (ASL) to upwards of 15,000 feet ASL depending on location.

Community Survey

Since 1996, the Airport Authority has commissioned a third party survey to track public attitudes and opinions about YVR on a number of topics including impact of aircraft noise. This community survey represents the opinions of approximately 1,000 residents from across communities of the Lower Mainland and provides one means to gauge the level of community annoyance triggered by aircraft noise.

When asked, "*While you have been at home during the past year, have you been annoyed by aircraft noise in your neighbourhood?*" approximately 85% of the respondents in 2012 stated that they were *not* annoyed by aircraft noise. Figure 13 illustrates the trend since 1996.

Figure 13: Community Survey - Respondents Not Annoyed by Aircraft Noise, 1996-2012



	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Not Annoyed	72%	58%	73%	73%	74%	78%	83%	87%	80%	80%	81%	83%	85%	84%	84%	83%	85%

NOISE MONITORING DATA

The monitoring of noise levels and aircraft activity is a major component of the YVR Aeronautical Noise Management Program. To achieve this, the Airport Authority uses a Brüel & Kjær Aircraft Noise & Operations Monitoring System (ANOMS), which allows for an objective assessment of aircraft noise levels in the surrounding communities. The system also allows the identification of trends, supports proposed changes to procedures, and checks for compliance with published procedures.

ANOMS combines noise data collected at Noise Monitoring Terminals (NMT) with radar flight tracking data from NAV CANADA[7] and mapping data from a Geographic Information System (GIS). ANOMS correlates flight track data with noise monitoring data collected at each NMT sites around YVR. Figure 14 illustrates the NMT network and their relationship to runways at YVR. In 2009, the Airport Authority replaced and upgraded all hardware at the NMTs sites and expanded the network from 16 to 20 NMTs.

Figure 14: NMT Locations in the Lower Mainland

[7] NAV CANADA is the not-for-profit company with provides civil air navigation services in Canada. NAV CANADA provides air traffic control, flight information, weather briefings, aeronautical information services, airport advisory services, and maintains the electronic aids to navigation.

Annual Average Noise Levels (Leq)

There are numerous metrics available to assess noise. One common metric for community noise assessment is the equivalent sound level, or average noise level (Leq) measured over a given period of time. Table 8 presents the annual average Leq, measured in units of A-weighted decibel (or dBA), at each NMT for the last five years. Appendix B provides more annual Leq data for each NMT. The average noise levels, presented below, include contributions from all sources, including aircraft, motor vehicles, people, lawn mower, barking dogs, etc. A brief explanation on noise concepts and terminology is provided in Appendix C.

Table 8: Annual Average Noise Level (in dBA), 1995-2012

YEAR	NMT#1	NMT#2	NMT#3	NMT#4	NMT#5	NMT#6	NMT#7	NMT#8	NMT#9	NMT#10
2008	63.6	66.2	62.6	62.6	58.5	58.9	55.5	54.9	66.0	55.6
2009	62.6	65.9	56.4	61.3	58.5	58.5	53.3	52.3	50.4	54.6
2010	-	66.2	53.4	61.6	59.2	58.6	51.3	52.0	50.4	54.5
2011	-	65.3	53.2	61.6	60.8	58.2	51.6	51.8	50.4	54.2
2012	**-**	**65.5**	**53.5**	**60.9**	**58.8**	**58.2**	**-**	**52.2**	**50.7**	**54.0**
YEAR	NMT#11	NMT#12	NMT#13	NMT#14	NMT#15	NMT#16	NMT#17	NMT#18	NMT#19	NMT#20
2008	61.2	75.1	64.9	55.6	52.9	68.3	-	-	-	-
2009	61.0	76.2	61.9	55.0	52.2	64.2	56.6	53.6	55.7	54.4
2010	61.0	62.8	61.4	55.2	53.6	55.2	56.5	53.5	53.8	54.2
2011	60.9	68.3	60.8	56.4	52.4	54.9	56.5	53.4	55.9	54.4
2012	**60.1**	**63.9**	**59.5**	**55.1**	**52.9**	**54.9**	**53.5**	**53.9**	**53.9**	**53.4**

The majority of monitoring locations experienced a similar or lower level of noise than in previous years. NMT#12 experienced the largest decrease in noise levels (5.5 dBA) from 2011 to 2012. NMT #12 is located on the airfield and is positioned adjacent to a run-up location and the threshold of Runway 08R. Noise measured from this location will experience high variation due to the yearly disparity of activities on the airfield.

For a number of NMTs, the data shows a trend of decreasing noise levels within community (see Appendix B for the 1995-2012 data). This is particularly noticeable at the NMTs that have data dating back to 1995. In 1995, aircraft were significantly louder and there were more aircraft operations than in 2012.

Single Event Noise Level

Another metric used to assess noise is the single event noise level (SEL), also measured in dBA. The primary use of an SEL is to provide a comparison of noise events with different noise levels and durations. A brief explanation on noise concepts and terminology used in this report is provided in Appendix B.

Noise events at the NMT sites can be categorized as either *aircraft* or *non-aircraft*.

- Aircraft-related noise events are those associated with an aircraft operation based on radar flight track information. In most cases, the SEL for an aircraft related noise event is typically 10 dBA greater than the maximum noise level experienced during the event.
- Non-aircraft related noise events are associated with other sources in the community.

Table 9 presents the 2011 daily average number of aircraft and non-aircraft daily noise events above 70 dBA at each of the NMT locations. For those locations close to the airport or near major flight paths, the noise events tend to be primarily aircraft-related, whereas noise events at NMTs located farther from the airport are primarily non-aircraft related.

Table 9: Average Daily Noise Events at NMTs, 2012

NMT Site	Name	Location	Average number of DAILY noise events ≥ 70 dBA		
			Aircraft	Non-Aircraft	Total
1	Richmond General Hospital[A]	n/a			
2	Airside Burkeville	Templeton St., Richmond	107	102	209
3	Lynas Lane Park	Lynas Lane & Walton Rd., Richmond	11	25	36
4	Tomsett Elementary	Odlin Rd. and No. 4 Rd., Richmond	121	23	144
5	Bath Slough	Bath Rd. & Bath Slough, Richmond	159	19	178
6	Outer Marker	Westminster Hwy & No. 7 Rd., Richmond	94	32	126
7	Crofton School[B]	W41st & Blenheim St., Vancouver	-	-	-
8	McKechnie School	W59th & Maple St., Vancouver	2	12	14
9	UBC	Northwest Marine Dr., Vancouver	3	11	14
10	Marpole	W67th & Cartier St., Vancouver	6	26	32
11	Bridgeport	No. 4 Rd. & Finlayson Dr., Richmond	154	32	186
12	West Sea Island	Airside YVR, Richmond	93	100	193
13	North Sea Island	Ferguson Rd., Richmond	61	198	259
14	Annieville-Delview Second	9111-116th St., Delta	37	25	62
15	Alex Fraser Bridge	North Delta Rec. Ctr. 11415-84th Ave., Delta	39	59	80
16	Burnaby - St. Francis	6610 Balmoral St., Burnaby	3	8	11
17	Maple Lane Elementary	Alouette Dr. & Tweedsmuir Ave., Richmond	5	10	15
18	South Delta - Tsawwassen	53rd Street & 8A Ave., Delta	2	20	22
19	North Surrey	82A Ave. & 146th St., Surrey	12	64	76
20	South Surrey	20th Ave. & Ocean Forest Dr., Surrey	3	24	27

[A] The NMT was permanently removed from this location at the request of the property owner. The Airport Authority is continuing to look for a new location for this NMT.

[B] The NMT has been temporarily removed due to construction at the school. The NMT will be reinstalled once construction is complete.

Appendix A

YVR AERONAUTICAL NOISE MANAGEMENT COMMITTEE MEMBERSHIP

As of December 2012

MEMBERS:

Rick Hedley
Citizen Representative, Corporation of Delta

Margot Spronk
Citizen Representative, Richmond

Haydn Acheson
Citizen Representative, Richmond

Jonathan Parker
Citizen Representative, Vancouver

Meg Brown
Citizen Representative, Vancouver

Ron Sorenson
Citizen Representative, Surrey

Victor Wei
City of Richmond, staff representative

Lil Ronalds
City of Vancouver, staff representative

Paula Kolisnek
Corporation of Delta, staff representative

Craig MacFarlane
City of Surrey, staff representative

Doug Martin
Airline Operators Committee (Air Canada)

Don McLeay
National Airlines Council of Canada

Warren Lampitt
Air Canada

Terry Hiebert
Floatplane Operators Association

Scott MacPherson
Canadian Business Aviation Association

Marlene Keefe
Air Canada Pilots Association

Claudio Bulfone
Transport Canada

Brent Bell
NAV CANADA

Leona Sparrow
Musqueam Indian Band

Brett Patterson
Director Airside Operations, Airport Authority

Kirthi Roberts
Director, Environment, Airport Authority

Shaye Folk-Blagbrough
Environmental Analyst, Airport Authority

Mark Cheng
Supervisor Noise & Air Quality, Airport Authority

CHAIR PERSON:

Anne Murray
Vice-President Community & Environmental Affairs, Airport Authority

SECRETARIAT:

Jody Armstrong
Administrative Assistant, Airport Authority

Appendix B

NMT Sound Level Data 1995-2012

Data below represents the annual average Leq, measured in units of A-weighted decibel (or dBA), at each NMT from 1995- 2012.

YEAR	NMT#1	NMT#2	NMT#3	NMT#4	NMT#5	NMT#6	NMT#7	NMT#8	NMT#9	NMT#10
1995	69.9	71.2	58.0	69.7	59.0	59.3	52.4	53.1	-	-
1996	68.7	71.4	57.8	69.7	59.0	61.1	52.7	55.6	57.9	53.3
1997	64.8	71.8	57.0	69.1	60.5	59.3	52.8	54.0	57.9	53.7
1998	67.1	70.8	56.9	68.3	59.8	62.1	52.7	57.3	57.4	53.6
1999	64.4	71.0	58.5	68.3	60.2	62.0	52.9	54.4	58.1	65.6
2000	62.3	69.5	56.3	67.7	59.9	60.3	53.1	53.0	69.1	64.0
2001	62.1	67.9	55.4	66.6	59.3	60.1	51.9	55.1	59.9	55.6
2002	61.7	66.8	55.1	65.1	59.2	59.6	51.3	53.5	59.7	53.5
2003	66.4	67.7	54.0	66.2	58.2	65.3	51.1	56.9	57.5	54.5
2004	62.9	67.8	61.8	63.8	59.5	59.9	51.3	56.2	62.2	55.4
2005	63.1	67.3	54.1	63.0	59.3	60.0	51.9	54.0	60.9	55.5
2006	63.3	66.2	54.4	62.5	59.3	62.0	56.2	52.4	58.4	56.2
2007	63.9	66.1	59.6	62.7	58.5	59.2	56.3	59.0	63.6	56.1
2008	63.6	66.2	62.6	62.6	58.5	58.9	55.5	54.9	66.0	55.6
2009	62.6	65.9	56.4	61.3	58.5	58.5	53.3	52.3	50.4	54.6
2010	-	66.2	53.4	61.6	59.2	58.6	51.3	52.0	50.4	54.5
2011	-	65.3	53.2	61.6	60.8	58.2	51.6	51.8	50.4	54.2
2012	**-**	**65.5**	**53.5**	**60.9**	**58.8**	**58.2**	**-**	**52.2**	**50.7**	**54.0**

YEAR	NMT#11	NMT#12	NMT#13	NMT#14	NMT#15	NMT#16	NMT#17	NMT#18	NMT#19	NMT#20
1995	-	-	-	-	-	-	-	-	-	-
1996	58.1	69.4	-	-	-	-	-	-	-	-
1997	62.8	68.7	-	-	-	-	-	-	-	-
1998	62.0	68.4	-	-	-	-	-	-	-	-
1999	64.7	69.1	66.2	54.8	54.2	-	-	-	-	-
2000	62.0	66.9	62.0	54.7	53.2	-	-	-	-	-
2001	62.4	71.4	62.1	56.0	53.4	55.5	-	-	-	-
2002	61.3	68.9	60.0	57.2	54.4	55.2	-	-	-	-
2003	60.0	74.8	60.1	56.7	53.0	54.4	-	-	-	-
2004	62.4	63.9	63.9	55.8	53.6	55.1	-	-	-	-
2005	61.7	N/A	61.5	56.3	53.3	55.2	-	-	-	-
2006	61.3	65.0	62.7	59.8	53.6	55.0	-	-	-	-
2007	60.9	63.5	64.4	57.6	52.9	55.5	-	-	-	-
2008	61.2	75.1	64.9	55.6	52.9	68.3	-	-	-	-
2009	61.0	76.2	61.9	55.0	52.2	64.2	56.6	53.6	55.7	54.4
2010	61.0	62.8	61.4	55.2	53.6	55.2	56.5	53.5	53.8	54.2
2011	60.9	68.3	60.8	56.4	52.4	54.9	56.5	53.4	55.9	54.4
2012	**60.1**	**63.9**	**59.5**	**55.1**	**52.9**	**54.9**	**53.5**	**53.9**	**53.9**	**53.4**

Appendix C

NOISE METRICS, CONCEPTS & TERMINOLOGY

Below is a brief description of basic acoustical terms and metrics used in the assessment of aircraft noise.

A-Weighted Decibels (dBA)

Sound levels are measured in decibels with the A-weighting filter applied (dBA). The A-weighting filter closely resembles how the human ear responds to sound at different frequencies - the decibel values of sounds at low frequencies are reduced, as the human ear is less sensitive at low audio frequencies, especially below 1,000 Hz.

Equivalent Sound Level (LEQ)

Community noise from road, rail, aircraft and other local sources are rarely steady but will vary in intensity from second to second, minute to minute or hour to hour. When attempting to describe the overall noise exposure of a community over a period of time, it is necessary to average the noise level in some way. An average noise-level descriptor, such as the Equivalent Sound Level (Leq) is often used. The Leq, is a measure of the exposure resulting from the accumulation of A-weighted decibel sound levels over a particular time period (e.g., 1 hour, 8 hour, 24-hour). Conceptually, Leq may be thought of as a constant sound level over the period of interest that contains as much sound energy as the actual time-varying sound level with its normal peaks and valleys. It is important to realize, however, that the two signals (the constant one and the time-varying one) would sound very different from each other if compared in real life. Variations in the "average" sound level suggested by Leq are not an arithmetic value, but a logarithmic ("energy-averaged") sound level. Thus, loud events clearly dominate any noise environment described by the metric.

Sound Exposure Level (SEL)

The SEL is a function of both intensity and duration. SEL is a noise metric derived from the noise energy dose of a single sound event such as a single vehicle or train compressed to a single second of exposure. As such, the SEL reflects both the maximum sound level and the duration, or length of time, of the event. The SEL measures the subjective loudness, expressed as the energy of the event, as it would be experienced in a one second interval. As a result, the SEL of a given noise event is always greater than its maximum noise level. For an aircraft over-flight, the SEL is generally 10dBA higher than the maximum noise level experienced during the event. The normalization, to the duration of one second, enables the comparison of noise events with differing durations or maximum level. Additionally, since it is a cumulative measure, a higher SEL can result from either a louder or longer event, or some combination.

Vancouver Airport Authority
PO Box 23750 Airport Postal Outlet
Richmond, BC V7B 1Y7 Canada
www.yvr.ca

For questions regarding this report or aircraft noise, please contact us at the following:

E-mail: noise@yvr.ca
WebTrak
Fax: 604-276-6699
YVR Noise Information Line: 604- 207-7097

REPORTING:
Shaye Folk-Blagbrough, M. E. Des. – Environmental Analyst

Note on Reported Figures and Data:

The Airport Authority receives aircraft operations data from NAV CANADA. This data includes daily aircraft arrivals and departures at YVR as well as aircraft transiting through the Vancouver Control Zone. Every effort is made to verify and correct anomalies in the dataset, and numbers stated in report this may vary slightly from those reported by others.

Version 2.00
- April 25, 2013 -