2014 AERONAUTICAL NOISE MANAGEMENT REPORT

-VANCOUVER AIRPORT AUTHORITY-

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

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

Managing noise from aircraft operations has been a priority for the Airport Authority since assuming responsibility of YVR in 1992. Managing our impacts is integral to our sustainability framework, which integrates the economic, environmental, social and governance of our business. This framework is essential to our success and provides a responsible approach for our business objectives and our commitment to the local community.

In 2014, YVR welcomed 19.4 million passengers and accommodated approximately 310,000 aircraft landings and take-offs, making YVR the second busiest airport in Canada. To manage the effects of aircraft noise, the Airport Authority has a comprehensive Aeronautical Noise Management Program. 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 forum for independently appointed community and industry stakeholders that provides advice and input on the development of initiatives through a collaborative process.

WORK HIGHLIGHTS

Initiatives contained in the YVR Noise Management Plan are an integral part of advancing the goals of the YVR Aeronautical Noise Management Program. The Plan is a requirement under the Airport Authority's ground lease with Transport Canada, and the current Plan (2014-2018) can be found at www.yvr.ca.

This Plan contains ten areas of focus along with supporting initiatives. Work in 2014 helped support many of the initiatives and highlights are summarized below.

DRAFT AIRSPACE CHANGE COMMUNICATION & CONSULTATION PROTOCOL

In August 2014, the Minister of Transport sent a letter to eleven airports and NAV CANADA requesting industry to develop an approach to communication and consultation for changes to airspace and procedures. A working group of various airports was organized under the Canadian Airports Council to work collaboratively with NAV CANADA on this issue. As the process would affect all aviation partners, airlines were also invited to participate.

Significant work was undertaken throughout the end of August and September, which resulted in a draft Airspace Change Communication and Consultation Protocol (Protocol). The draft Protocol is supported by airports and NAV CANADA and aimes to define when communication versus consultation will occur, what constitutes communications and consultation, and the roles and responsibilities of involved parties when changes or new procedures are contemplated.

RUNWAY END SAFETY AREA (RESA) CONSULTATIONS

RESAs are specialized areas at the end of a runway that protect passengers and reduce the severity of damage to an aircraft in the unlikely event of an overrun or undershoot. The Airport Authority is proactively building RESAs to meet international recommendations and exceed the anticipated Canadian standard. Throughout the year, YVR noise management staff assisted with numerous stakeholder consultations for the RESA project.

The project schedule will see RESAs first built on the south and crosswind runways due to operational, environmental and financial factors. Planning for RESAs on the north runway is in the early stages and more information will be shared with the community and stakeholders once technical studies required for options analysis are completed.

Preparation work for construction on the south runway will start in April 2015 and RESA construction will begin on 19 May 2015. Once construction begins, nightly closures of the south runway will be required for a 16-week period. An additional 16 weeks of nightly south runway closures during the summers of 2016 and 2017 will be required to complete this work.

Full information on the YVR RESA project can be found at www.yvr.ca.

HOME OWNER AND NEW HOME BUYER BROCHURE

After receiving input from the YVR Aeronautical Noise Management Committee, content for a brochure and technical guide was created. Materials will be availabe at www.yvr.ca once design has been finalized. The objective of these materials is to provide information on noise exposure in areas of the city for potential home buyers and provide information on ways to insulate older dwellings located in high noise areas

YVR FLY QUIET AWARDS

The 2013 YVR Fly Quiet Awards were presented at the annual YVR Chief Pilot's Meeting. The goal of these awards is to raise awareness of noise issues within the aviation community. Eligibility criteria 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 2013 awards included: Jazz Aviation (propeller category); WestJet (narrow-body jets); and Japan Airlines (wide-body jets). Award winners for past years are presented in Table 1.

TABLE 1: YVR Fly Quiet Award Winners, 2011-2013

YEAR	Propeller Wing	Narrow Body Jets	Wide Body Jets
2013	Jazz	U·S AIRWAYS	中国南方航空 CHINA SOUTHERN AIRLINES
2012	Jazz	WESTJET	JAL JAPAN AIRLINES
2011	Horizon Air	UNITED	JAL JAPAN AIRLINES

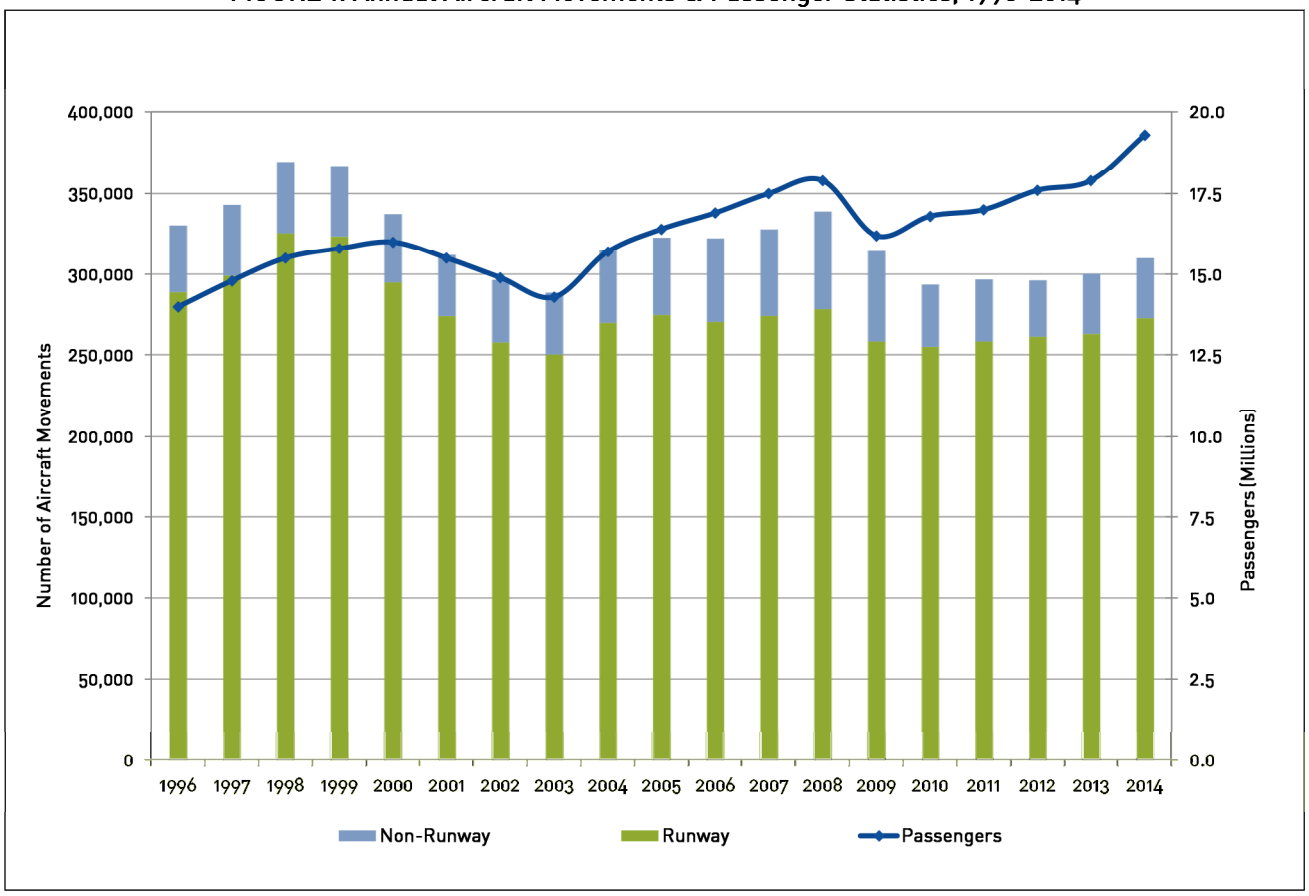
YVR OPERATIONS IN REVIEW

Aircraft movements, cargo tonnage and total passengers all experienced growth compared to 2013. Table 2 presents the annual operational statistics for 2014. Figure 1 illustrates the historical trend of aircraft movements and passengers at YVR, for the time period 1996-2014. As illustrated, the number of aircraft operations remains under the peak years for aircraft movements (1998 and 1999) yet the number of passengers continues to 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 2: Operational Statistics for YVR, 2014

Total Movements	310,139	3.2% increase from 2013
Total Cargo (Tonnes)	256,934	12.6% increase from 2013
Total Passengers	19,358,203	7.7% increase from 2013

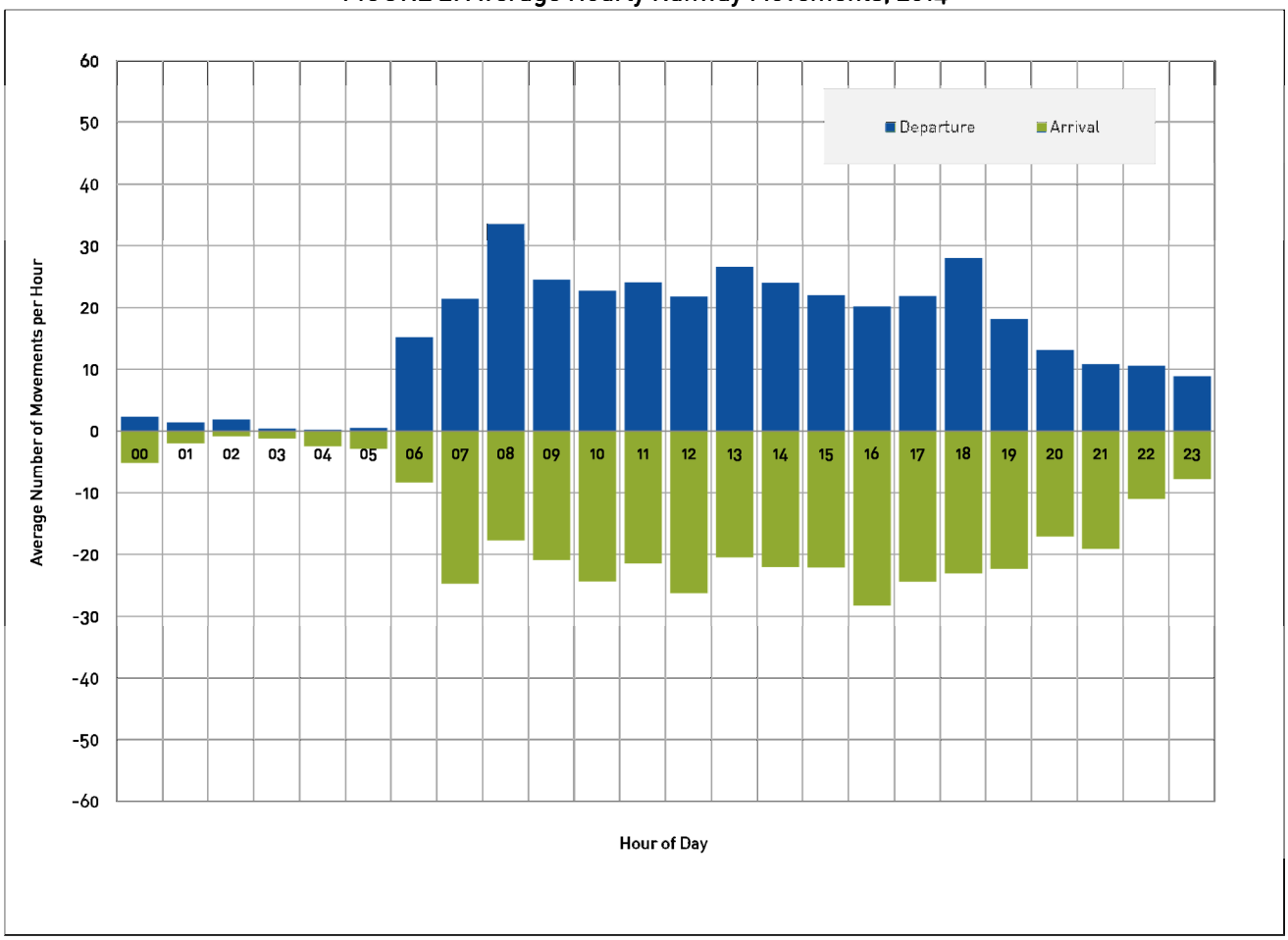
FIGURE 1: Annual Aircraft Movements & Passenger Statistics, 1996-2014



In 2014, approximately 97% of all aircraft activity at YVR occurred during day-time hours. As illustrated in Figure 2, aircraft movements increase starting at 6:00AM and continue throughout the day. Aircraft movements during the night-time hours[1] accounted for approximately 3% of total aircraft activity at YVR in 2014.

[1] For this report, night-time is defined as the time period between midnight and 6:00AM local.

FIGURE 2: Average Hourly Runway Movements, 2014



OPERATIONAL SNAPSHOT – NIGHT OPERATIONS

Like most 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, there are some operations during the night-time hours. These operations are primarily associated with the cargo/courier industry with some scheduled passenger flights to Asia-Pacific.

In 2014, there were approximately 7,730 aircraft movements during the night-time. On average, this equates to approximately 21 operations per day over the six-hour period from midnight to 6:00AM. Of these operations, approximately 70% are arrivals, which tend to be quieter than departures. The breakdown of the average night-time movements by aircraft type and operation is summarized in Table 3.

TABLE 3: Average Night-time Movements by Aircraft Type and Operation, 2014

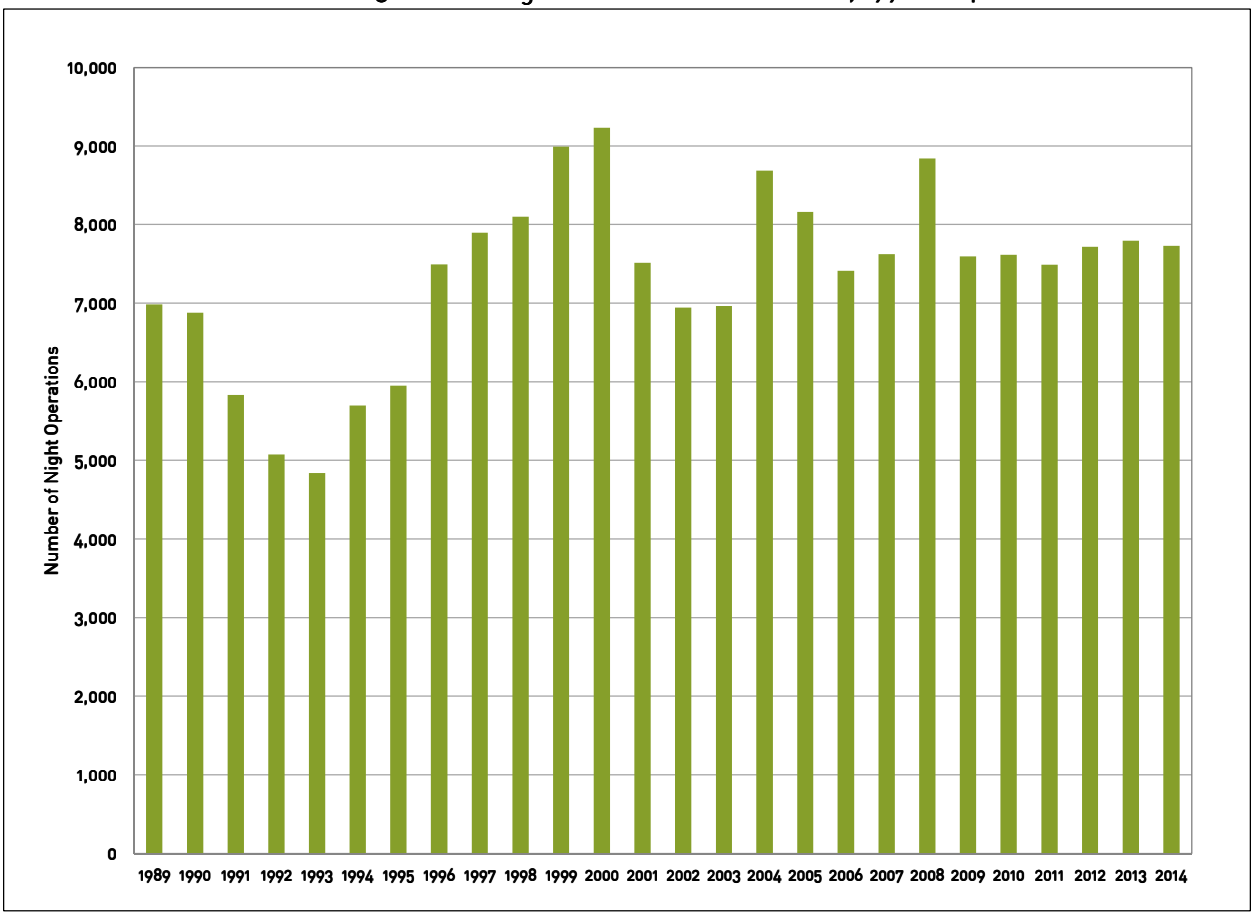
Aircraft Type	Operation	
	Arrival	Departure
Propeller	2	1
Business Jet	1	0
Narrow Body Jet	7	1
Wide Body Jet	3	5

Note: in 2014, 88% of the night-time movements by jets were with Chapter 4 noise certified aircraft.

- Propeller aircraft will include types such as the Dash-8, Navajo, Beech 1900, Saab 340, etc.
- Business jets will include types such as the Citation, Learjet, etc.
- Narrow-body jets will include the types such as the A320, B737, CRJ, E190, etc.
- Wide-body jets will include the types such as the B777, A340, A330, B767, etc.

YVR has always been open 24-hours a day, including when the facility was managed by Transport Canada prior to the transfer to the Airport Authority in 1992. Figure 3 illustrates the historical night-time movements at YVR for the years 1989 to 2014. As illustrated by this figure, the number of night-time operations has remained relatively the same since 2009, and the night-time operations in 2014 are well below the peak years 1999 and 2000.

FIGURE 3: Annual Night-time Movements at YVR, 1998-2014



OPERATIONAL SNAPSHOT – JET FLEET MIX BY NOISE CERTIFICATION

The International Civil Aviation Organization (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. The ICAO Committee on Aviation Environmental Protection (CAEP) 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 categorize jet aircraft as either Chapter 2, Chapter 3 or Chapter 4 depending on three measured noise levels (take-off, landing, and sideline) obtained during prototype development[2].

A noise standard for newly certified aircraft was confirmed at the 9th meeting of CAEP in February 2013. The new aircraft noise standard, which will be Chapter 14 of *Annex 16*, will apply to new large aircraft types certified after 2017 and to aircraft less than 55 tonnes after 2020. To meet this standard, aircraft must be at least 7 EPNdB (Effective Perceived Noise in Decibels) quieter than the current Chapter 4 standard. This reduction is cumulative over three measurements points: take-off, landing and sideline.

An analysis was performed to determine the noise certification of jet aircraft movements at YVR in 2014. Table 4 below presents the results of the analysis according to the Gross Take-off Weight (GTOW) of the aircraft. As illustrated, 94% of all jet aircraft operating at YVR meet Chapter 4 noise standards.

TABLE 4: ICAO Noise Certification of Jet Operations at YVR, 2014

ICAO Noise Certification	GTOW less than or equal to 34,000kg (n~16,900)	GTOW greater than 34,000kg	
		Narrow Body (n~98,470)	Wide Body (n~27,240)
Chapter 3	13%	6%	5%
Chapter 4	87%	94%	95%

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 and the crosswind runway, 13/31, is oriented in a northwest and southeast direction.

For safety reasons aircraft must land and take-off into the wind and the predominant winds are in either an easterly or westerly direction and in line with the two main parallel runways. 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. Related to this change in runway use direction, the aircraft flight routes will also change to accommodate the different arrival and departure routes associated with each runway.

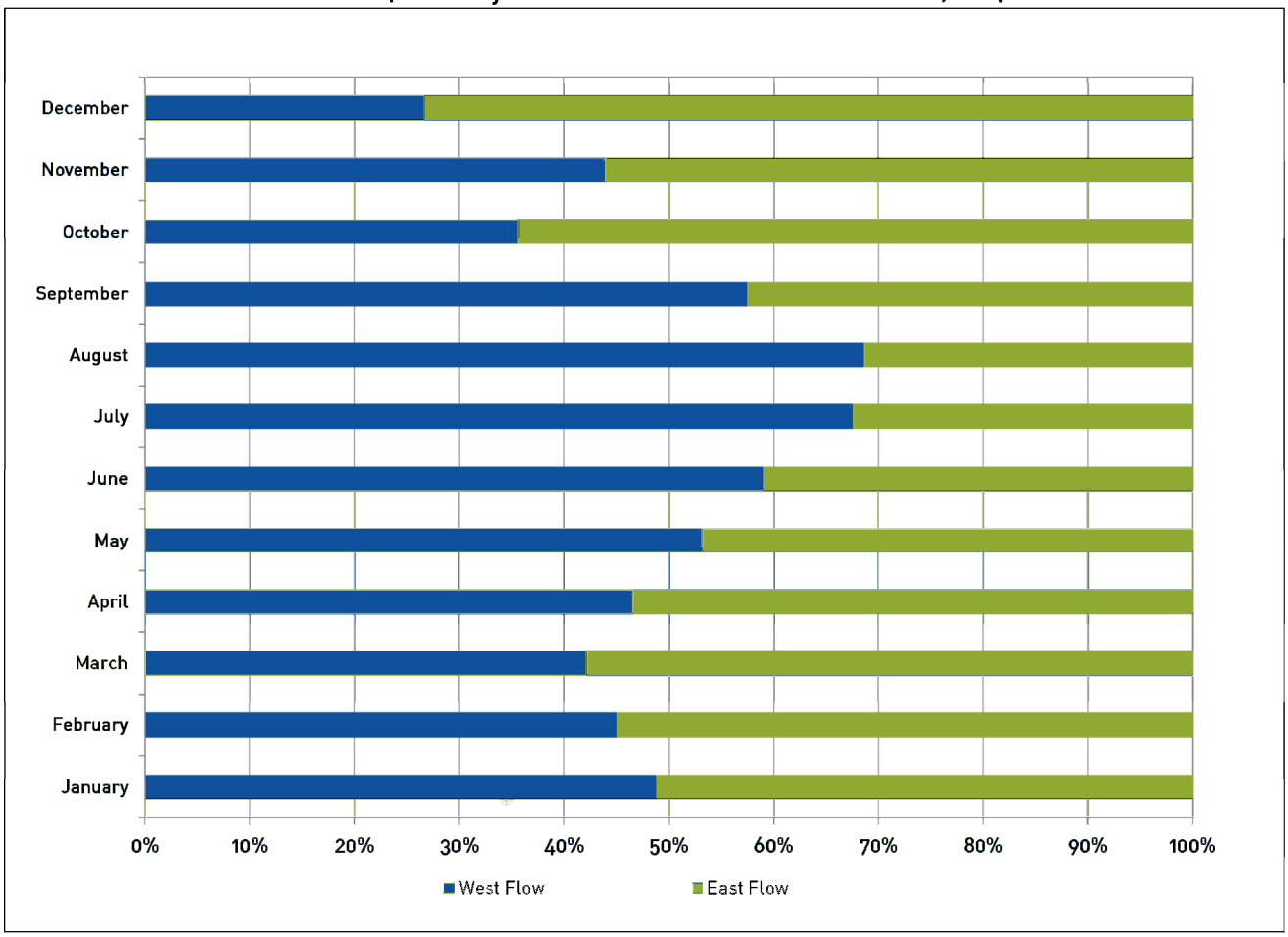
A westerly flow of traffic is the preferred mode of operation to reduce noise exposure on the community as this puts the noisiest operations (departures) over the Strait of Georgia. During the night-time hours, when the winds are calm, air traffic control will attempt to keep both arriving and departing aircraft over the Strait of Georgia in an effort to minimize

[2] 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.

noise on the community. However, this procedure of two-way flow is dependent on traffic volume and weather conditions and cannot be used all the time.

Figure 4 illustrates the monthly distribution between easterly and westerly flow on the parallel runways. Overall, the wind conditions were well balanced in 2014 with a 50% westerly flow and 50% easterly flow. However, as illustrated there are monthly and seasonal trends that can be observed.

FIGURE 4: Monthly Distribution of Air Traffic Flow at YVR, 2014



RUNWAY USE

At YVR, there were no significant changes in how the runways were utilized in 2014 from 2013. Consistent with previous years, the south runway (08R/26L) was closed at night for four weeks over the summer to accommodate maintenance work. During this period, aircraft were diverted to the north runway (08L/26R) which is normally closed to all operations between the hours of 10:00PM – 7:00AM (except for emergencies, weather, and airfield maintenance activities).

Figure 5 and 6 illustrate the runway usage distribution for arrivals and departures in 2014.

FIGURE 5: Runway Arrival Distribution, 2014

FIGURE 6: Runway Departure Distribution, 2014

RUN-UPS

Transport Canada requires regular maintenance to ensure aircraft are 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 ensures maintenance work has been done properly and that the aircraft is safe to return to service.

YVR RUN-UP DIRECTIVES AND PROCEDURES

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

YVR RUN-UP ACTIVITY

Over the last five years, run-ups have increased at YVR. This can be attributed to increased maintenance activity, continued engagement with the operators and diligent work to ensure understanding of the run-up directive and procedures. In 2014, there was a ten per cent decrease in the number of run-ups carried out at YVR. 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, 2010-2014

Year	Number of Approved Run-ups
2010	4,114
2011	5,701
2012	5,706
2013	5,157
2014	4,916

For the purpose of analysis, operators conducting run-ups are divided into two distinct areas of the airfield: 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. In 2014, north airfield operators accounted for approximately 47% of all run-up activities at YVR. Run-ups by south airfield operators accounted for the remaining 53% of all run-ups at YVR. The run-ups by south-airfield operators are generally done on propeller aircraft, as many of the smaller operators have their maintenance facilities on the south airfield.

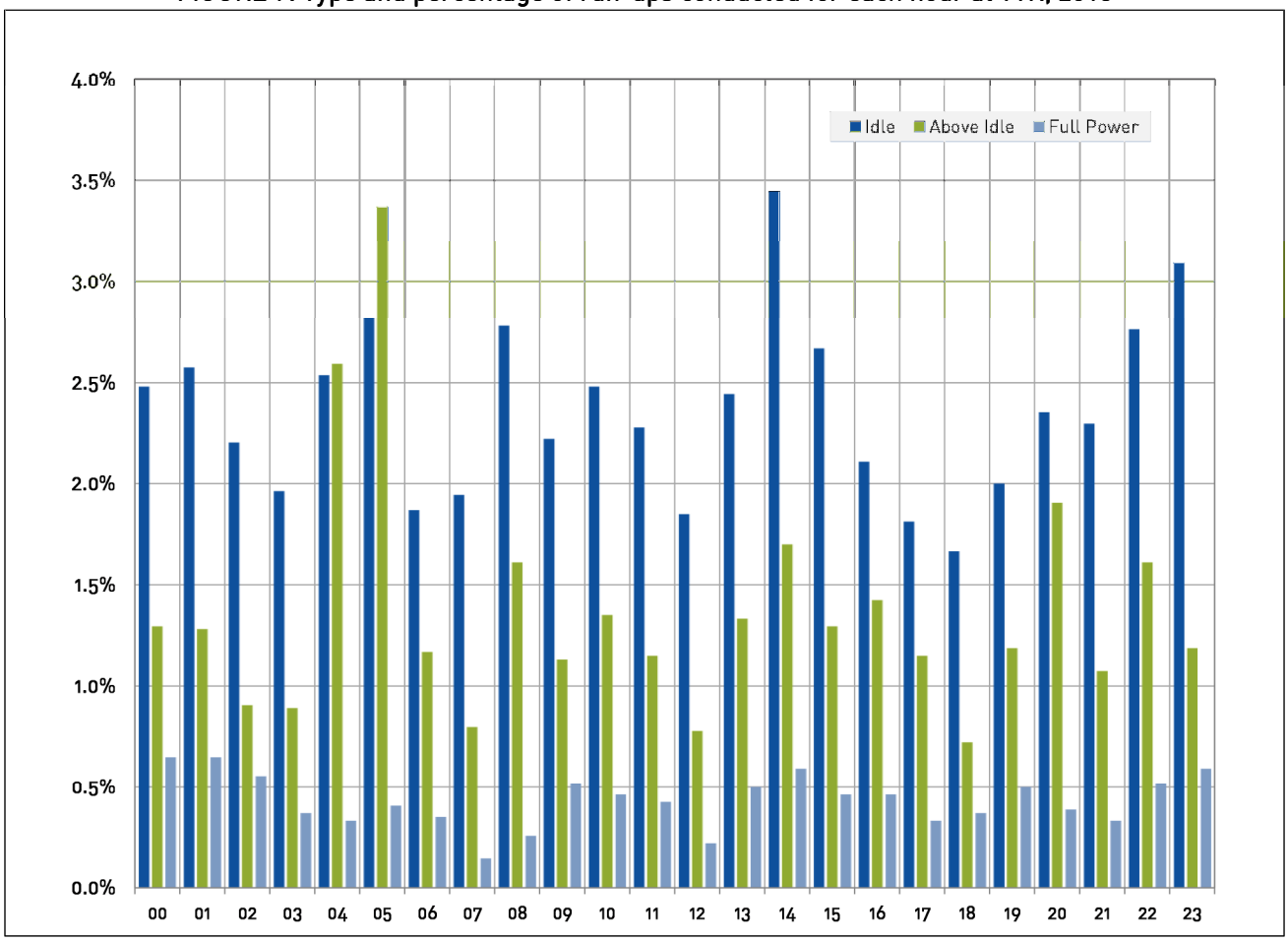
There are three distinct types of run-ups carried out by operators – Idle, Above Idle and Full Power. Full power run-ups are considered the nosiest because the engine runs at maximum power. Full power run-ups are very infrequent when compared to idle and above idle. This is due to the increased engine wear and fuel consumption associated with running engines at full power for prolonged periods. Table 6 provides a breakdown of run-up types and per cent total at YVR for 2014.

TABLE 6: Run-up Type (by power setting) Distribution, 2014

Run-up Category	Percent Total of Runs
Idle	53%
Above Idle	36%
Full Power	11%

Run-ups occur at all times of the day, but those that occur at night may result in disturbance to residents located close to the airport. As most aircraft are flying during the day, maintenance work and run-ups often need to be performed at night to ensure the aircraft are airworthy before returning into service the next morning. Figure 7 provides a percentage breakdown for all run-ups (n=100%) carried out at YVR in 2014 within the hour that the run-up occurred. As Figure 7 illustrates, 'Idle' runs are by far the most common, followed by 'Above Idle' which are followed by very few 'Full Power' runs. The busiest hours for 'Idle' run-ups were at the 1400 and 2300 hours, 'Above Idle' run-ups at 0400 and 0500, and 'Full Power' run-ups at 0000 and 0100 hours. However, as Figure 7 illustrates, operators are consistently busy throughout the day with run-ups being carried out at all times of the day.

FIGURE 7: Type and percentage of run-ups conducted for each hour at YVR, 2013



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 Ground Run-Up Enclosure (GRE) and the facility was opened on 25 January 2012. The GRE is designed to 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 dBA noise reduction and residents to the south of YVR experience a 50% reduction in run-up noise.

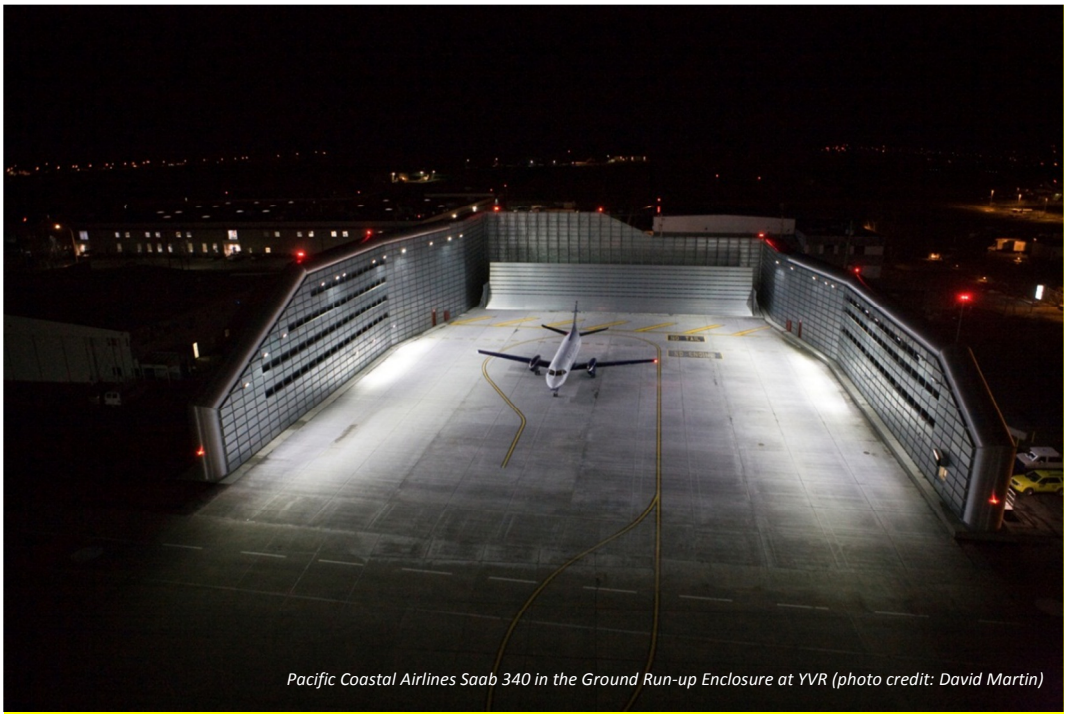
In 2014, 20% of all run-ups at YVR were conducted in the GRE. Table 7 provides a more detailed breakdown of south airfield run-ups and their location in comparison with the GRE.

TABLE 7: South Airfield Run-ups, Power Setting and Location, 2014

Power Setting	Location	Approx. % of South Airfield Run-ups
Above Idle	GRE	67%
	Apron III	31%
	Apron II	2%
Full Power	GRE	88%
	Apron I, II, III	12%

As illustrated in Table 7, the majority of south airfield high powered run-ups (i.e. 'Above Idle' and 'Full Power') were performed in the GRE.

The GRE has reduced noise in the community and has been a great success with operators, who 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)

NOISE CONCERNS

One of the goals of the YVR Aeronautical Noise Management Program is to provide the community with up-to-date information on 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.

Information provided by the complainant and investigation results are logged in a database, which is used to identify trends. The YVR Aeronautical Noise Management Committee is provided a summary of complaints at each quarterly meeting and will review and discuss issues.

NUMBER OF CONCERNS

In 2014, the Airport Authority received 1,754 noise concerns from 278 individuals[3]; this represents a 35% increase in concerns but a 0.4% decrease in the number of complainants over 2013. The increase in concerns can be attributed to one individual who submitted 47% (n=820) of all noise concerns in 2014. Of note, the top three complainants in 2014 registered 67% (n=1,181) of all concerns, resulting in the remaining 275 complainants submitting 573 concerns. Figure 8 presents a breakdown on the number of concerns and individuals for the past five years, 2010-2014.

NOISE CONCERNS BY LOCATION

Whenever possible, individuals are asked to provide information on which city they live in to help determine where in the Lower Mainland concerns are originating from. Figure 9 shows the number of concerns and individuals for the various cities in the Lower Mainland.

Figure 8 and 9 illustrate that there are a number of individuals who registered multiple concerns throughout the year. Facts about the top five complainants in 2014 include:

- Registering 1268 concerns, constituting 72% of all concerns;
- Registering 36 or more concerns each with the range being between 36-820;
- Three out of these five individuals are located further than 10 nautical miles from the airport. They registered 1,102 complaints.
- Two individuals residing within 10nm from the airport logged 166 concerns primarily related to float operations.

Figure 10 represents the geo-distribution 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 11 represents the geo-distribution and the frequency of concerns in the Lower Mainland, with the size of each dot representing the volume of concerns originating from that area.

[3] One household submitted 202 concerns. This household is not included in the analysis due to the high number of concerns submitted over the years.

FIGURE 8: Number of Noise Concerns and Individuals, 2009-2014

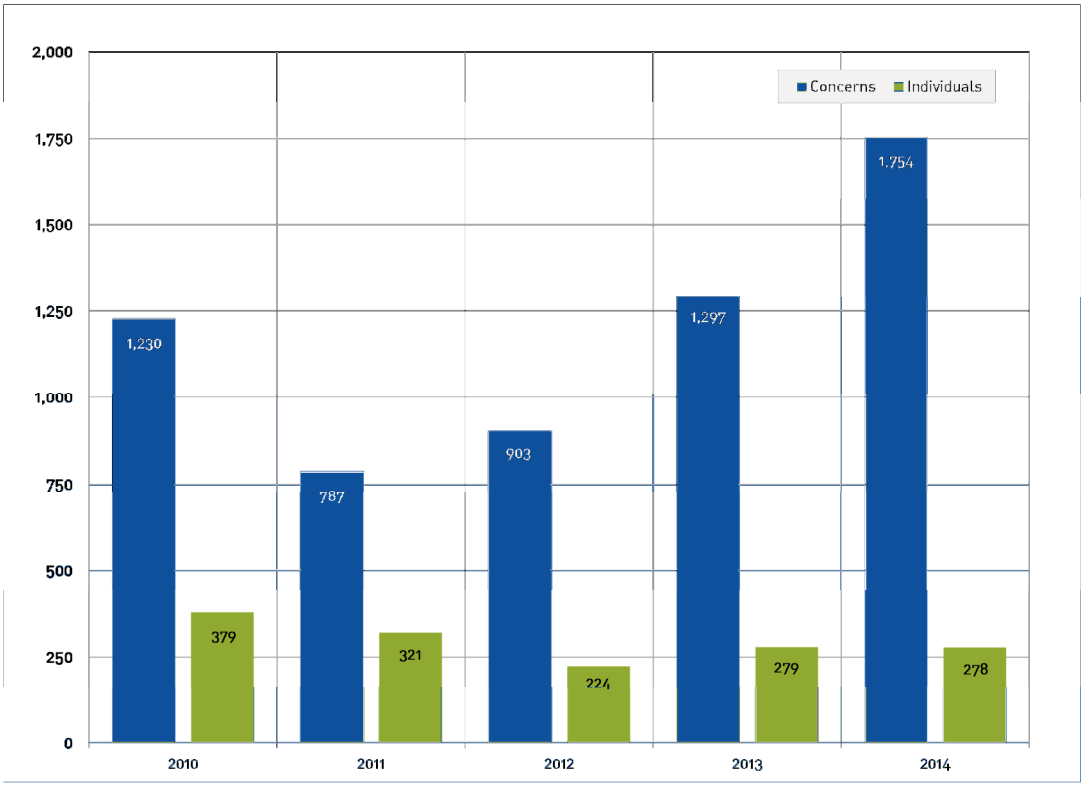


FIGURE 9: Number of Concerns & Individuals by Location, 2014

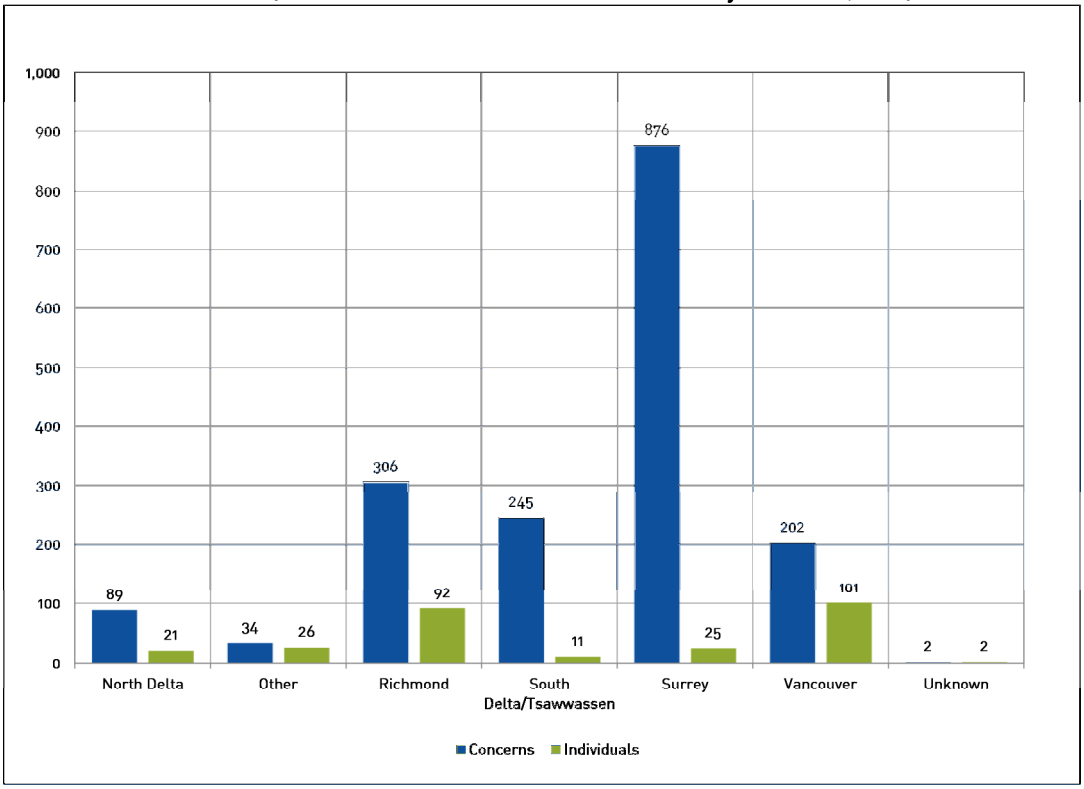


FIGURE 10: Geo-distribution of Noise Concerns, 2014

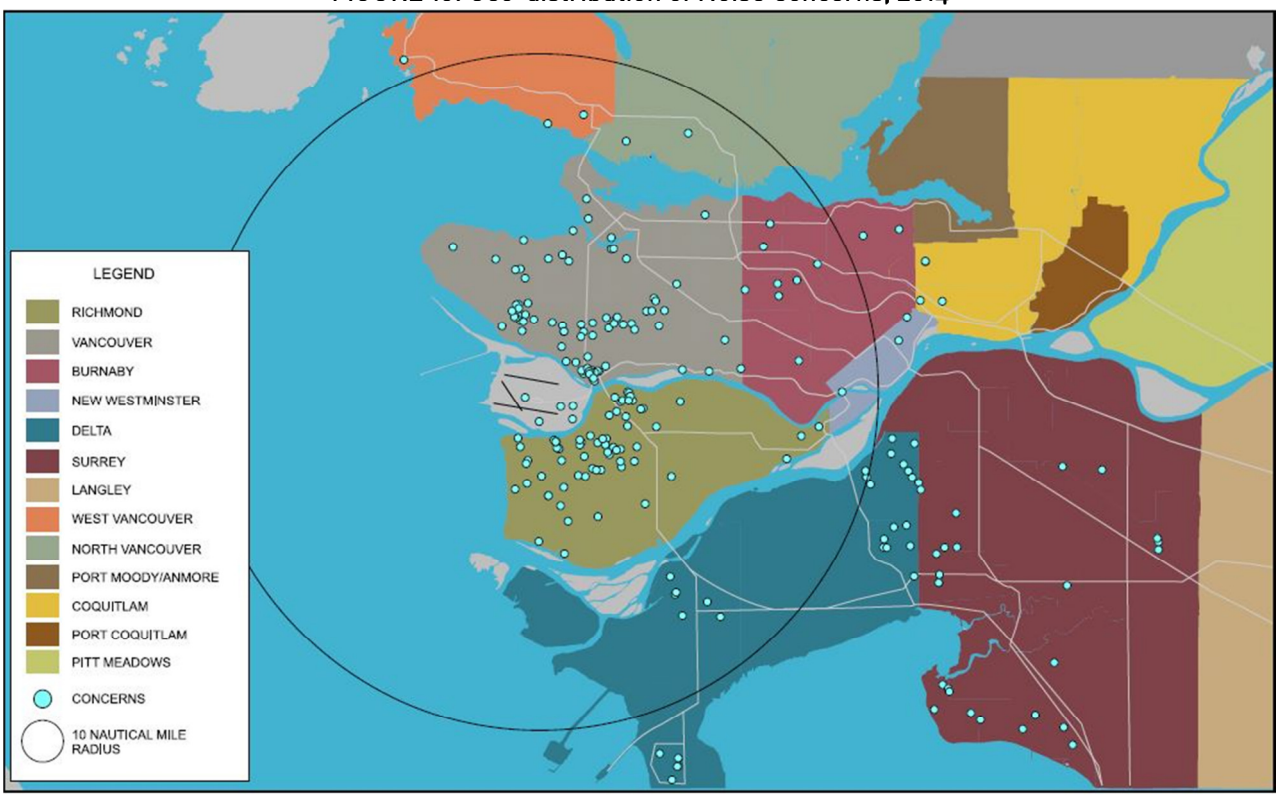
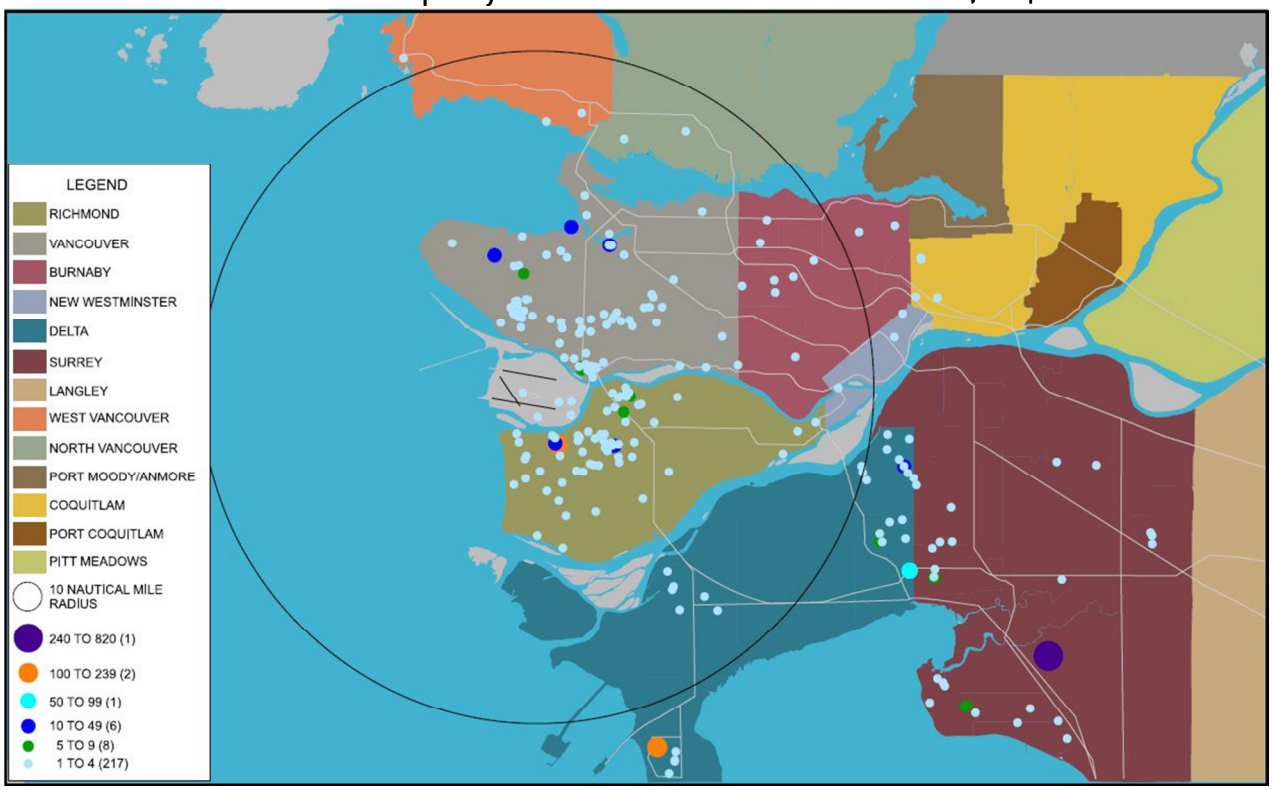


FIGURE 11: Frequency and Geo-distribution of Noise Concerns, 2014



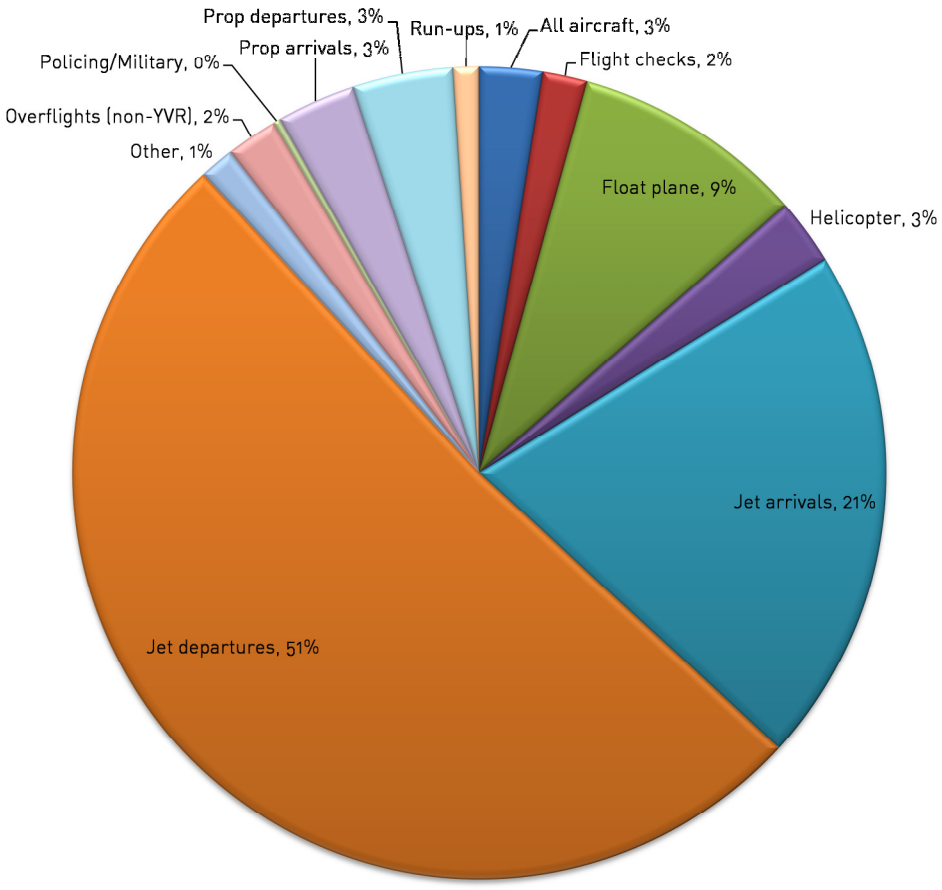
As illustrated, three individuals logged more than 100 concerns with two of them living in areas well outside the 10nm radius. Concerns outside the 10nm radius are generally related to over-flight activities and the air traffic routing over populated areas. Aside from these individuals, 7 individuals logged more than 10 concerns.

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 will categorize 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 12 shows a breakdown of all noise concerns received in 2014 by operational categories. As a general observation, take-off activities generate the most concerns. In 2014, jet departures made up 51% of all concerns. However, 88% of these concerns originated in areas located further from the airport (e.g. Surrey, Delta, etc.) where departing aircraft typically operate above 8,000 feet. The high number of these concerns were relate to a few individuals submitting multiple concerns. YVR float plane operations also made up a relatively high percentage (9%) of the total concerns in 2014, but this is again attributed to one individual from the City of Richmond submitting numerous concerns.

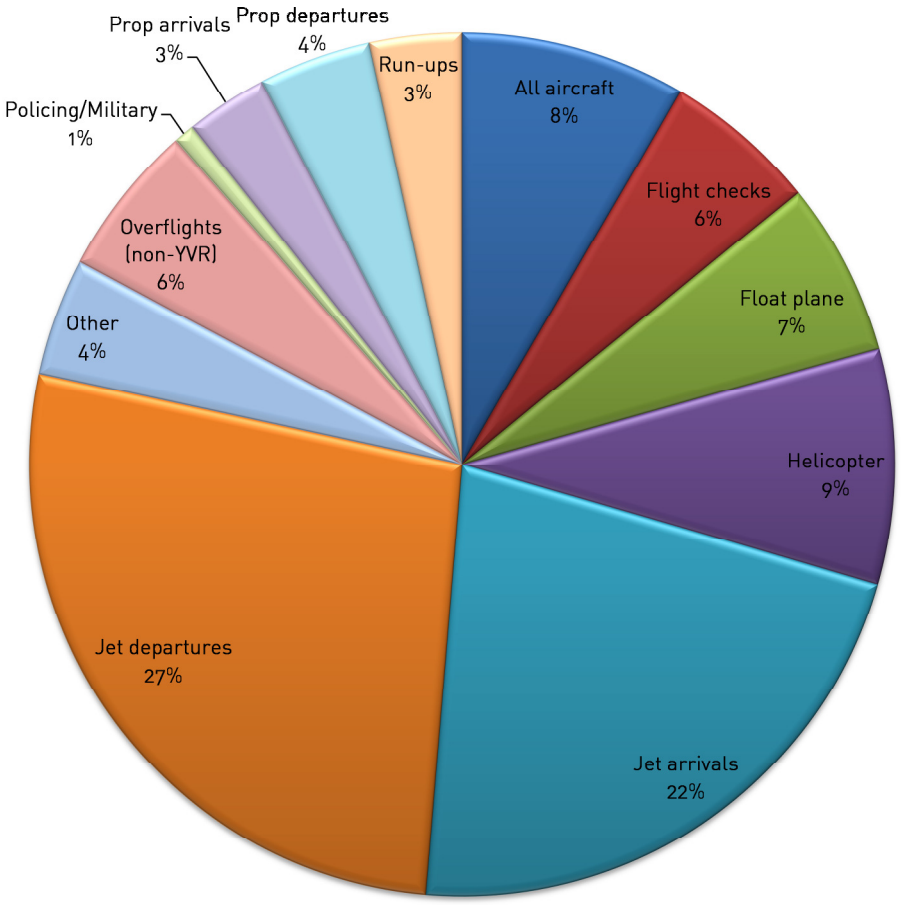
FIGURE 12: Concerns by Operational Category, 2014



Further analysis was conducted, but excluding the four individuals who submitted over 50 concerns. Figure 13 illustrates a breakdown of the concerns by operation types without these individuals and their concerns.

Jet departures still remained the top operational category associated with noise concerns, making up 27% of all concerns. However, in contrast to the first analysis, 74% of these concerns were registered from communities in the vicinity of the airport (e.g. Richmond and Vancouver) where residents are exposed to aircraft operating at lower altitudes. Helicopter activities generated a higher number of concerns than float plane operations in the second analysis, making up 9% of all concerns. The main complaints associated with helicopter operations were low flying and excessive noise. 'All aircraft' activity concerns are complaints related to general activities, with no specific type of operation specified; this category accounted for 8% of all concerns. Concerns related to Instrument Landing System (ILS) flight checks constituted 6% of the complaints. ILS flight checks are a mandatory maintenance routine conducted by NAV CANADA per annum to ensure ILS is in proper calibration to meet Transport Canada certification standards.

FIGURE 13: Concerns by Operational Category (excluding four individuals registering 50+ concerns), 2014

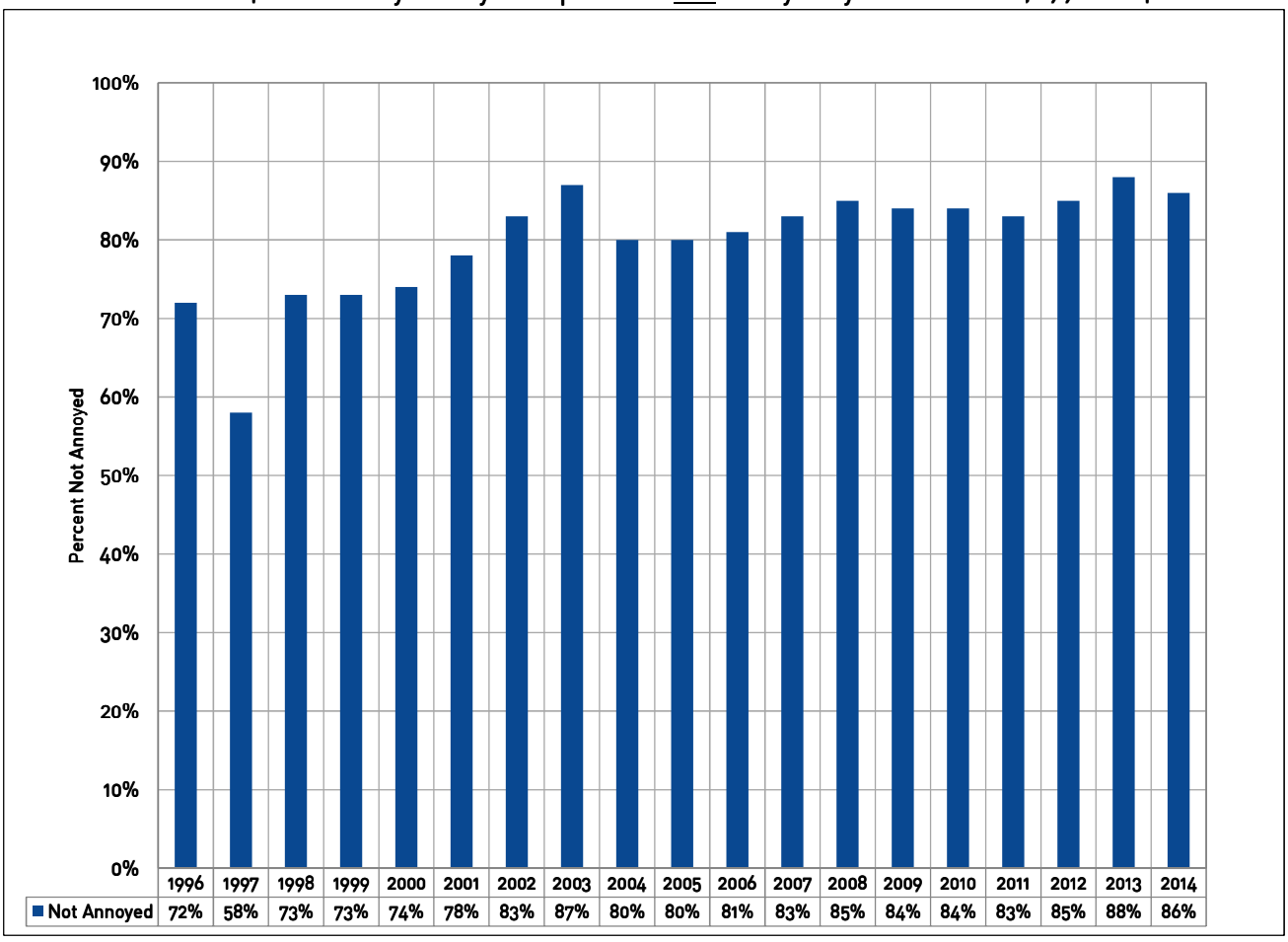


COMMUNITY SURVEY

Since the mid-1990s, 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 88% of the respondents in 2014 stated that they were *not* annoyed by aircraft noise. Figure 14 illustrates the trend since 1996.

FIGURE 14: Community Survey - Respondents Not Annoyed by Aircraft Noise, 1996-2014



NOISE MONITORING DATA

The monitoring of noise levels and aircraft activity in the vicinity of the airport 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[4] and mapping data from a Geographic Information System (GIS). ANOMS correlates flight track data with noise monitoring data collected at each NMT, which then allows an understanding of the contribution of aircraft noise at each site. Figure 15 illustrates the NMT network and their relationship to runways at YVR. In 2009, the Airport Authority replaced and upgraded all hardware at the NMT sites and expanded the network from 16 to 20 NMTs[5].

FIGURE 15: NMT Locations in the Lower Mainland

[4] NAV CANADA is the not-for-profit company that 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.

[5] The Airport Authority is currently exploring location options for NMT#1 (formerly on Richmond General Hospital). A new site is expected to be selected and installation completed in 2015.

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 location for the last five years. The average noise levels, presented below, include contributions from all sources, including aircraft, motor vehicles, people, lawn mower, barking dogs, etc.

TABLE 8: Annual Average Noise Level (in dBA), 2009-2014

YEAR	NMT#1	NMT#2	NMT#3	NMT#4	NMT#5	NMT#6	NMT#7	NMT#8	NMT#9	NMT#10
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
2013	-	65.8	53.4	60.1	58.6	60.1	-	53.0	51.0	55.3
2014		**65.0**	**52.7**	**60.6**	**58.5**	**69.4**		**55.4**	**50.3**	**54.4**

YEAR	NMT#11	NMT#12	NMT#13	NMT#14	NMT#15	NMT#16	NMT#17	NMT#18	NMT#19	NMT#20
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
2013	61.2	67.4	60.6	55.3	52.9	55.3	53.7	57.8	53.3	54.4
2014	**60.8**	**74.7**	**61.0**	**65.7**	**53.1**	**54.5**	**54.0**	**57.5**	**55.7**	**54.3**

SINGLE EVENT NOISE LEVEL

Another metric used to assess noise is the single event noise level (SEL), measured in dBA. For an aircraft fly-over (landing or take-off), the SEL represents the total acoustic energy above a prescribed reference threshold. In general, the SEL is typically 10 dBA greater than the maximum noise level experienced during the aircraft fly-over. The primary use of the SEL is to provide a comparison of noise events with different noise levels and durations.

While reference thresholds are set individually at each NMT according to the ambient noise levels in the area, thresholds are typically set between 65 and 70 dBA during the day (7:00AM – 10:00PM) and between 55 and 60 dBA during the night.

ANOMS categorizes noise events into types: correlated and uncorrelated. Correlated events are those associated with aircraft and uncorrelated events are those associated with other sound sources in the community. For NMTs located close to flight paths, noise events are primarily made up of aircraft related events, whereas noise events at NMTs located farther away from the airport and flight path are primarily made up of non-aircraft related events.

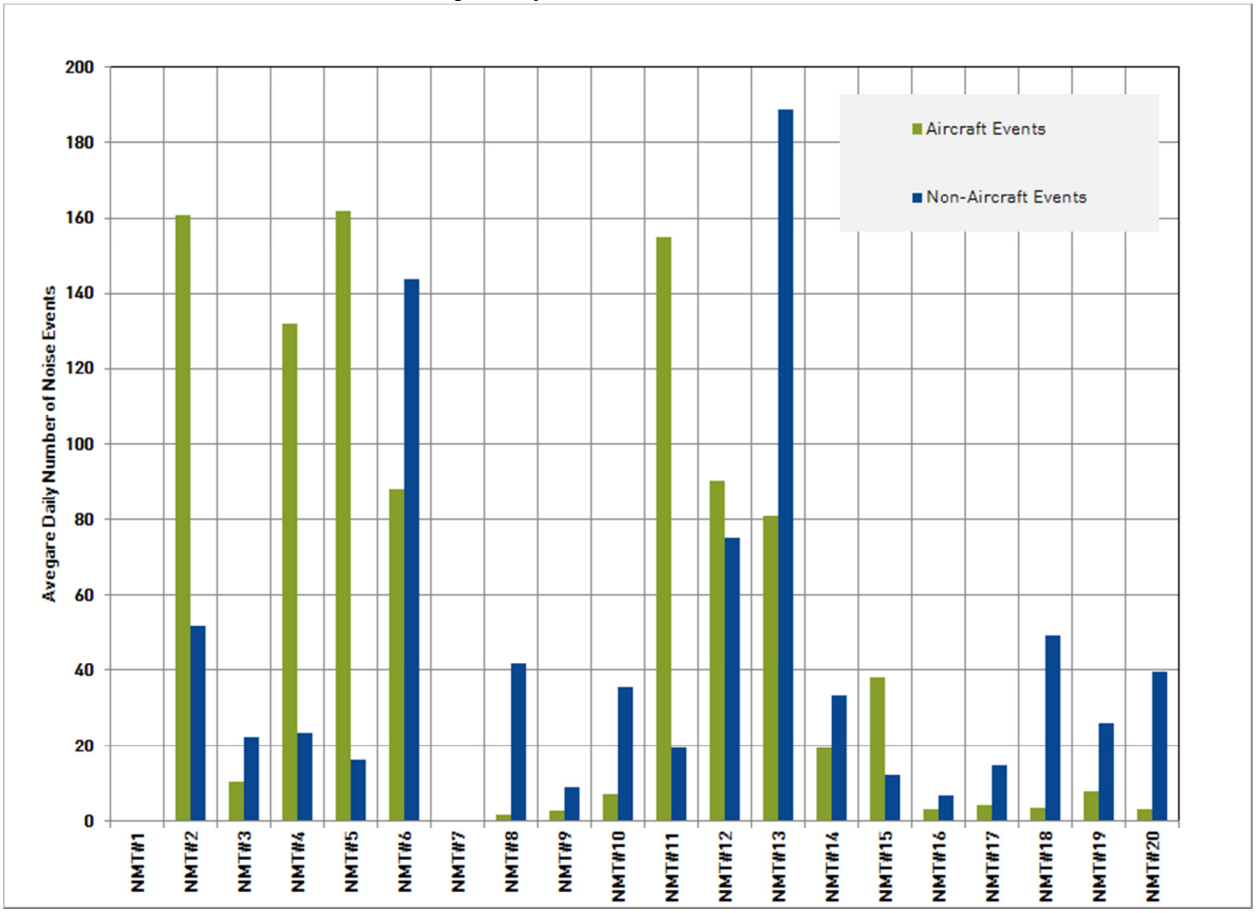
Table 9 presents the 2014 daily average number of aircraft and non-aircraft noise events above 70 dBA at each of the NMT locations and Figure 16 presents this same information graphically.

TABLE 9: Average Daily Number of Noise Events at NMTs, 2014

NMT #	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	161	52	213
3	Lynas Lane Park	Lynas Lane & Walton Rd., Richmond	10	23	33
4	Tomsett Elementary	Odlin Rd. and No. 4 Rd., Richmond	132	24	156
5	Bath Slough	Bath Rd. & Bath Slough, Richmond	162	16	178
6	Outer Marker	Westminster Hwy & No. 7 Rd., Richmond	88	144	232
7	Crofton School [B]	W41st & Blenheim St., Vancouver			
8	McKechnie School	W59th & Maple St., Vancouver	2	42	43
9	UBC	Northwest Marine Dr., Vancouver	3	9	12
10	Marpole	W67th & Cartier St., Vancouver	7	36	43
11	Bridgeport	No. 4 Rd. & Finlayson Dr., Richmond	155	19	175
12	West Sea Island	Airside YVR, Richmond	90	75	165
13	North Sea Island	Ferguson Rd., Richmond	81	189	270
14	Annieville-Delview Second	9111-116th St., Delta	19	33	53
15	Alex Fraser Bridge	North Delta Rec. Ctr. 11415-84th Ave., Delta	38	12	50
16	Burnaby - St. Francis	6610 Balmoral St., Burnaby	3	7	10
17	Maple Lane Elementary	Alouette Dr. & Tweedsmuir Ave., Richmond	4	15	19
18	South Delta - Tsawwassen	53rd Street & 8A Ave., Delta	3	49	53
19	North Surrey	82A Ave. & 146th St., Surrey	8	26	34
20	South Surrey	20th Ave. & Ocean Forest Dr., Surrey	3	39	43

[A] The NMT was removed from the Richmond General Hospital and a new site is expected to be selected and installation completed in 2015.
[B] The NMT has been temporarily removed due to construction at the school. The NMT will be reinstalled once construction is complete.

FIGURE 16: Average Daily Number of Noise Events at NMTs, 2014



AIRCRAFT NOISE LEVEL COMPARISON

Table 10 compares the average measured SEL at NMT#4 for several types of jet aircraft departing runway 08R. The data is categorized by stage length, which is the distance flown to the destination airport in nautical miles (nm). The stage length often significantly influences the measured take-off noise levels as an aircraft flying a longer distance will likely be heavier resulting in a lower climb profile, making it noisier to an observer on the ground.

Table 11 compares the average measured SEL at NMT#4 for several types of jet aircraft landing on runway 26L. Aircraft operating weight is not much of an issue for landings as noise during landing is primarily attributed to airframe and aerodynamic noise as the aircraft is configured for slower speeds.

NMT#4 is directly under the flight path for aircraft using the south runway and is approximately 3 km from the threshold of the runway.

Stage 1	0 - 500 nm
Stage 2	500 - 1,000 nm
Stage 4	1,500 - 2,500 nm
Stage 6	3,500 - 4,500 nm
Stage 7	Over 4,500 nm

TABLE 10: Average Take-off Noise Level as Measured at NMT#4 for Aircraft Departing Runway 08R

Aircraft Type	Trade Name	Category	Stage	Noise level
A306	AIRBUS A300-600R	Widebody	1	82.3
			2	84.3
			4	88.5
A310	AIRBUS A310	Widebody	1	87.9
			2	84.1
			4	88.7
			6	89.7
A319	AIRBUS A319	Narrowbody	1	85.7
			2	85.5
			4	87.1
			6	81.3
A320	AIRBUS A320	Narrowbody	1	87.3
			2	86.2
			4	87.5
A321	AIRBUS A321	Narrowbody	1	86.9
			2	86.7
			4	87.3
A332	AIRBUS A330-200	Widebody	1	88.4
			4	91.6
			6	92.2
			7	91.9
A333	AIRBUS A330-300	Widebody	1	87.6
			4	91.4
			6	92.6
			7	92.7
A342	AIRBUS A340-200	Widebody	4	92.9
			6	97.3
			7	98.2
A343	AIRBUS A340-300	Widebody	6	93.2
			7	95.5
A346	AIRBUS A340-600		6	93.2
B722	BOEING 727-200	Narrowbody	1	97.4
			2	99.6
			4	96.3
B732	BOEING 737-200	Narrowbody	1	95.5
			2	95.6

TABLE 10 (continued)

Aircraft Type	Trade Name	Category	Stage	Noise level
B733	BOEING 737-300	Narrowbody	1	86.1
			2	85.0
			4	90.1
B734	BOEING 737-400	Narrowbody	1	87.4
			2	88.6
			4	88.6
B735	BOEING 737-500	Narrowbody	1	85.4
			2	87.0
B736	BOEING 737-600	Narrowbody	1	84.3
			2	84.2
			4	83.0
B737	BOEING 737-700	Narrowbody	1	85.6
			2	85.4
			4	86.1
			6	85.2
B738	BOEING 737-800	Narrowbody	1	85.8
			2	86.4
			4	87.7
			6	88.3
B739	BOEING 737-900	Narrowbody	2	87.2
			4	88.4
B744	BOEING 747-400	Widebody	6	95.9
			7	96.2
B748	BOEING 747-8	Widebody	2	87.9
			6	94.4
			7	94.2
B752	BOEING 757-200	Narrowbody	1	84.3
			2	88.0
			4	86.6
			6	87.5
B762	BOEING 767-200	Widebody	1	85.5
			2	88.4
			4	90.7
B763	BOEING 767-300	Widebody	1	85.9
			2	88.5
			4	88.7
			6	90.2
			7	91.0

TABLE 10 (continued)

Aircraft Type	Trade Name	Category	Stage	Noise level
B772	BOEING 777-200	Widebody	4	89.6
			6	91.3
			7	92.0
B77L	BOEING 777-200LR	Widebody	4	89.0
			6	92.3
			7	91.3
B77W	BOEING 777-300ER	Widebody	1	84.7
			4	89.9
			6	90.7
			7	92.5
B788	BOEING 787	Widebody	4	86.4
			6	86.5
			7	87.7
CRJ2	CANADAIR RJ-200	Narrowbody	1	78.3
			2	78.9
CRJ7	CANADAIR RJ-700	Narrowbody	1	80.1
			2	82.2
CRJ9	CANADAIR RJ-900	Narrowbody	1	82.1
			2	82.7
E170	EMBRAER E170	Narrowbody	1	84.0
			2	87.1
E190	EMBRAER 190	Narrowbody	1	85.4
			2	86.2
			4	85.7

Of interest in comparison, the newest aircraft in the table is the Boeing 787 Dreamliner. This aircraft is a long-range, mid-size wide-body, twin-engine jet airliner developed by Boeing Commercial Airplanes. It is Boeing's most fuel-efficient airliner and the world's first major airliner to use composite materials as the primary material in the construction of its airframe. The 787 was designed to be 20% more fuel efficient than the 767 it is replacing. The 787 Dreamliner's distinguishing features include mostly electrical flight systems, a four-panel windshield, noise-reducing chevrons on its engine nacelles and a smoother nose contour.

Air Canada B787 Dreamliner

TABLE 11: Average Landing Noise Level as Measured at NMT#4 for Aircraft Landing on Runway 08R

Aircraft Type	Trade Name	Category	Noise Level
A306	AIRBUS A300-600R	Widebody	86.1
A310	AIRBUS A310	Widebody	85.6
A319	AIRBUS A319	Narrowbody	81.8
A320	AIRBUS A320	Narrowbody	82.1
A321	AIRBUS A321	Narrowbody	82.8
A332	AIRBUS A330-200	Widebody	84.4
A333	AIRBUS A330-300	Widebody	83.9
A342	AIRBUS A340-200	Widebody	83.7
A343	AIRBUS A340-300	Widebody	83.2
A346	AIRBUS A340-600	Widebody	85.3
B722	BOEING 727-200	Narrowbody	86.9
B732	BOEING 737-200	Narrowbody	85.4
B733	BOEING 737-300	Narrowbody	84.7
B734	BOEING 737-400	Narrowbody	85.1
B735	BOEING 737-500	Narrowbody	84.4
B736	BOEING 737-600	Narrowbody	82.2
B737	BOEING 737-700	Narrowbody	82.3
B738	BOEING 737-800	Narrowbody	83.8
B739	BOEING 737-900	Narrowbody	84.6
B744	BOEING 747-400	Widebody	87.3
B748	BOEING 747-8	Widebody	87.1
B752	BOEING 757-200	Narrowbody	84.8
B762	BOEING 767-200	Widebody	85.6
B763	BOEING 767-300	Widebody	86.0
B772	BOEING 777-200	Widebody	86.4
B77L	BOEING 777-200LR	Widebody	85.5
B77W	BOEING 777-300ER	Widebody	85.7
B788	BOEING 787	Widebody	83.0
CRJ2	CANADAIR RJ-200	Narrowbody	80.3
CRJ7	CANADAIR RJ-700	Narrowbody	81.4
CRJ9	CANADAIR RJ-900	Narrowbody	79.9
E170	EMBRAER E170	Narrowbody	81.9
E190	EMBRAER 190	Narrowbody	83.1

ENVIRONMENT – YVR Noise Management

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:
Rachel Min, B.A. – Noise Information Officer
Mark Christopher Cheng, M.Eng. (mech) – Supervisor Noise Abatement & Air Quality

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 1.00
- May 04, 2015 -