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**To:** Richmond City Council  
**From:** Councillor Bill McNulty  
Chair, Planning Committee  
**Date:** April 22<sup>nd</sup>, 2004  
**File:** 01-0107-10-03/2004-  
Vol 01  
**Re:** **PRELIMINARY FINDINGS: CITY AIRPORT NOISE AND RESIDENTIAL  
DEVELOPMENT POLICY CONSISTENCY RESEARCH**

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The Planning Committee, at its meeting held on April 20<sup>th</sup>, 2004, considered the attached report, and recommends as follows:

**Committee Recommendation**

1. That the report entitled: "Preliminary Findings: City Airport Noise and Residential Development Policy Consistency Research", (dated April 14, 2004 from the Manager, Policy Planning), together with the consultant's report, be received for information and be forwarded to the following:
  - (a) Vancouver International Airport Authority (VIAA);
  - (b) Central Mortgage and Housing Corporation (CMHC);
  - (c) Urban Development Institute (UDI);
  - (d) Greater Vancouver Home Builders' Association (GVHBA)
  - (e) Richmond Health Services (RHS);
  - (f) Advisory Committee on the Environment (ACE); and
  - (g) the public (e.g., community groups and associations);
  - (h) Transportation Canada;
  - (i) the Provincial Government
  - (j) Aviation Stakeholders
  - (k) all airlines operating out of Vancouver International Airportfor their comment by June 30, 2004, and that staff report back to Planning Committee by the first week of September, 2004.
  
2. That staff proceed with processing, all existing and new rezoning applications, to the full extent possible, in the absence of an interim noise policy.

Councillor Bill McNulty, Chair  
Planning Committee

Attach.

VARIANCE

Please note that staff recommended the following:

That the report entitled: "Preliminary Findings: City Airport Noise and Residential Development Policy Consistency Research", (dated April 14, 2004 from the Manager, Policy Planning), together with the consultant's report, be forwarded to the following:

- (a) Vancouver International Airport Authority (VIAA);
- (b) Central Mortgage and Housing Corporation (CMHC);
- (c) Urban Development Institute (UDI);
- (d) Greater Vancouver Home Builders' Association (GVHBA)
- (e) Richmond Health Services (RHS);
- (f) Advisory Committee on the Environment (ACE); and
- (g) the public (e.g., community groups and associations);

for their comment by May 30, 2004, and that staff report back to Planning Committee in late July 2004.

## Staff Report

### Purpose

The purpose of this report is to present the City's preliminary research findings regarding airport noise and how the City may establish more consistent residential development policies in light of airport noise.

At this time, no policy recommendations are made, as additional consultation with stakeholders is necessary.

### Origin

On October 14, 2003, Council approved the following resolution:

*(1) That the revised community planning priorities (set out in **Attachment 1** of the report dated September 25, 2003 from the Manager, Policy Planning), be approved.*

The approval included the following project: Airport noise residential consistency policy.

### Findings Of Fact

In December 2003, the City of Richmond issued a proposal call to engage the services of a consultant to assist the City in undertaking the research (Summary - see **Attachment 1**).

On January 26, 2004, the consultant team of Urban Systems Ltd. with Pryde, Schropp, McComb Inc. was retained to assist in conducting the research.

### Main Findings

The main findings of the consultant's report are presented in **Attachment 2**.

#### Note:

- The full consultant research report is over 300 pages and includes all appendices.
- For City Council:
  - the main consultant research findings (e.g., the first 80 pages) are present in **Attachment 2**, and
  - the full research report is presented in a separate binder, one binder for each Councillor.
- For the public and stakeholders, separate copies of the full consultant research report will be made available on the City's Web site and at the City Hall Front Counter.

### Official Community Plan Policy

The City's 1999 Official Community Plan (OCP) recognizes the:

- economic benefits and importance of the airport to the City and region, and
- impact of aircraft noise on the overall liveability and quality of life of Richmond residents and businesses.

While recognizing the jurisdiction of the Vancouver International Airport Authority (VIAA) in managing aircraft noise associated with Vancouver International Airport (YVR), the OCP acknowledges the increasing importance of noise issues as the volume of activity and the number of people affected increases; and that the City and VIAA must work together towards aircraft noise management through a variety of measures.

OCP policies address the:

- need to better coordinate land use planning to provide for orderly development based on noise and safety considerations in areas under the flight path;
- requirement for noise abatement covenants for sites being rezoned or subdivided for new residential development in areas requiring noise insulation;
- need to continue to seek ways to reduce noise at the source, where feasible, through the review and implementation of the VIAA's Noise Management Plan; and
- need for community input through participation in the VIAA Noise Management Committee.

#### *City Noise Covenant Areas*

The City's OCP seeks to lessen the exposure to aircraft noise on the indoor living environment of new housing by way of noise insulation within specific areas of the City (e.g., OCP Aircraft Noise Insulation Map) (see **Attachment 3**).

The policy applies to properties within identified OCP areas which redevelop (e.g., require a City rezoning and /or subdivision approval). The City policy requires property owners to:

- sign a restrictive covenant agreeing to have residential buildings designed to incorporate adequate sound measures against aircraft noise, as a condition of rezoning/subdivision approval, and
- retain a professional qualified in acoustics to determine the aircraft noise affecting the property and to determine the measures needed to satisfy CMHC noise insulation standards, prior to submitting a building permit application.

The City's policy is intended to indemnify the City against public and property owner complaints and lawsuits regarding airport noise.

#### *Noise Exposure Forecasts (NEF)*

##### *The NEF Model*

Noise Exposure Forecasts (NEF) are the official measurement used in Canada for aircraft noise assessment, and are used to delineate areas of high aircraft noise exposure, encourage compatible land use planning in the vicinity of airports, and predict annoyance caused by airport operations (see **Attachment 4**).

The NEF measures tolerance to aircraft noise and is based on the types of aircraft, the noise they make, their flight paths, the frequency of flights and the background (e.g., ambient) noise levels.

#### *Transport Canada Land Use Planning Guidelines*

The NEF model provides the basis for Transport Canada's Land Use Planning Guidelines which are to be used by provincial and local governments when making planning and development decisions in the vicinity of airports, such as Richmond. The Guidelines apply to all types of land uses and recommend that certain uses be permitted and not permitted in specific NEF zones. They also indicate what noise mitigation standards are to be applied.

### *CMHC Standards*

The NEF model also incorporates CMHC recommended acoustic design criteria to achieve acceptable indoor noise levels for residential construction.

### *Past City Practice*

The City has allowed residential development in some areas and discouraged it in other areas with similar NEF levels, for example:

- NEF 30 - 35 Contour

In this NEF contour, where there is moderately high noise, Transport Canada guidelines encourage no new residential development, but if allowed, state the need for:

- a noise impact assessment, and
- special acoustic treatment, if a local government chooses to permit such uses.

In this contour, the City, for a variety of reasons has both:

- encouraged residential development (e.g., Terra Nova, south City Centre, East and West Cambie), and
- discouraged residential development (e.g., West Bridgeport, north City Centre).

For example, the City informally discouraged residential development north of Cambie in the City Centre partly due to uncertainties regarding the airport lawsuit.

Where the City allowed such development, the City's noise mitigation guidelines (e.g., noise covenants), which are based on Transport Canada's guidelines, were followed.

- NEF 35 - 40 Contour

In this NEF contour, where there is high noise, Transport Canada guidelines state that no new residential development should be allowed. No development noise mitigation guidelines are stated.

In this contour, the City, for a variety of reasons has both:

- allowed residential development (e.g., Odlinwood, East Cambie) and
- not allowed residential development (e.g., adjacent to the Middle Arm and in the City Centre between Cambie Road and Alderbridge Way).

Where the City allowed such development, the City's noise mitigation guidelines were applied (e.g., noise covenants). These are the same City guidelines which are used for the NEF 30 - 35 contour.

### **Analysis**

*Federal (Transport Canada) Land Use Planning Guidelines.*

The use of the Transport Canada guidelines has revealed challenges which need to be addressed by both the City and VIAA.

These include the:

- inconsistent application of the Guidelines by both the City and VIAA (e.g., daycares located on Sea Island in 35+ NEF), and
- perceived inconsistencies within the Guidelines as to how certain uses are evaluated for noise in specific NEF zones (e.g., a place of worship is considered to be a more noise sensitive use than an office use, even though people are typically in a place of worship for a shorter period of time and facilities can be well insulated to mitigate noise).

#### *Addressing Past City Inconsistencies*

The past lack of consistency in the City's approach has made it difficult for staff to plan and to respond with certainty to development enquiries by property owners and residents (e.g., in the West Bridgeport, the west and north City Centre areas, and West Cambie). As well, the City's past practice has made it difficult for the VIAA to anticipate future City decisions and adequately prepare to respond to and mitigate them.

The benefits of addressing these inconsistencies include improved:

- co-ordination and management of City, community, developer and VIAA interests;
- policy consistency;
- certainty for the City, community, developers and the VIAA; and
- investment in the City (e.g., due to the proposed RAV line, if residential development is allowed in areas where it is currently discouraged).

#### *Premise of the Research*

It is important to note that the premise of the research was to assume that residential could locate in all NEF contours, if appropriate noise mitigation is employed. The consultant was requested to determine what indoor and outdoor noise mitigation standards and measures would be required, and their implications.

This approach was taken to provide the City with the widest range of information regarding development possibilities, noise mitigation standards and measures, and their implications.

However, the research premise does not mean that Council will adopt all the research findings as presented, or that it is the City's intent that residential uses be developed throughout the areas affected by aircraft noise. In addition, public consultation is recommended before Council makes any final decisions.

#### *Highlights Of The Preliminary Consultant Research States:*

While the preliminary research addresses many topics, the following presents the main highlights.

- City Role  
The City has control over land use.

- NEF Model  
The NEF model has strengths (e.g., well recognized, a reasonable indicator of nuisance) and weaknesses (e.g., it estimates the extent of noise and nuisance; there are variations of noise within the same NEF contour).
- *Possible NEF Types of Development (see Consultant Research Report- Table 7)*  
In summary, Table 7 of the consultant research report states that Council may consider residential development in the following Noise Exposure Frequency (NEF) areas:

NEF Area	Type Of Development
Less than 25 NEF	<ul style="list-style-type: none"> <li>- No land use restrictions.</li> <li>- No noise covenant or mitigation measures required.</li> </ul>
25 - 30 NEF	<ul style="list-style-type: none"> <li>- No land use restrictions.</li> <li>- Noise covenant and mitigation measures required.</li> </ul>
30 - 35 NEF	<ul style="list-style-type: none"> <li>- Noise sensitive uses limited to:                             <ul style="list-style-type: none"> <li>o residential towers</li> <li>o multiple dwellings</li> <li>o single family</li> <li>o live-work</li> <li>o work-live</li> <li>o day care</li> <li>o assembly – TDB on a case by case basis</li> </ul> </li> <li>- Noise covenant and new mitigation measures required as per consultant study.</li> </ul>
35 - 40 NEF	<ul style="list-style-type: none"> <li>- Noise sensitive uses limited to:                             <ul style="list-style-type: none"> <li>o residential towers</li> <li>o multiple dwellings</li> <li>o assembly - TDB on a case by case basis</li> </ul> </li> <li>- Noise covenant and new mitigation measures required as per consultant study.</li> <li>- Outdoor areas not considered viable for residential purposes.</li> </ul>
40 - 45 NEF	<ul style="list-style-type: none"> <li>- Noise sensitive uses limited to:                             <ul style="list-style-type: none"> <li>o residential towers</li> <li>o assembly - TDB on a case by case basis</li> </ul> </li> <li>- Noise covenant and new mitigation measures required as per consultant study.</li> <li>- Outdoor areas not considered viable for residential purposes.</li> </ul>

- *Types of Noise Mitigation Standards Per Type of Development and NEF Contour (see Consultant Research Report Table 7)*
  - For Mitigating Outdoor Noise  
The research indicates that “location” is the only effective way to mitigate for outdoor noise generated by aircraft. In other words, generally, the farther away that a use is from airport noise, the less noise and nuisance it will experience. This means that the planning of where development can locate is most important.
  - For Mitigating Indoor Noise  
The consultant research recommends indoor noise mitigation standards, depending on the type of development and its NEF location. For example, possible noise mitigation standards (as per CMHC’s indoor requirements) include:
    - Sleeping quarters: 0 NEF; and
    - Living quarters: 5 - 10 NEF.

This means that, if the City permits a certain type of development in an NEF contour, there will be certain noise mitigation standards which must be met through a variety of techniques (e.g., building, air conditioning and ventilation techniques) and that these noise mitigation standards will have varying implications.

#### *Implications of the Preliminary Research*

The preliminary research indicates that, while it is possible to build residential and other noise sensitive developments in the various NEF contours, there are significant and important partnership, legal, social, economic and environment considerations for all stakeholders.

For example, the research indicates that:

- residential towers could be considered in all NEF contour areas, HOWEVER, this may not actually be desirable in practice;
- single family residential uses should not be considered above 35 NEF, HOWEVER, Odlinwood is located in the 35 - 40 NEF; and
- section 34-5-6 (e.g., the quarter section northeast of Cambie and Garden City, which is in the 35-40 NEF contour), could be considered for residential towers and multi-family housing, but not for single family homes, HOWEVER, this may not be consistent with broader community planning objectives.

The research identifies and discusses some of these implications, mainly in Section 8 of the consultant report.

#### *The Need For Ongoing Co-operation and Consultation*

At this time, City staff have not analysed the implications of the preliminary research, as it is first necessary to receive feedback from the VIAA and stakeholders.



Continued consultation is necessary, as evidenced by the following:

- Vancouver International Airport Authority (VIAA)  
The City has advised VIAA staff of its research and has maintained ongoing communications with them. The VIAA has advised the City that it is very concerned regarding the City's research (see **Attachment 5**). The VIAA has also advised that it is about to undertake several consultant studies to provide more information regarding airport noise and how to manage development around the airport. For example, one study might review the varying noise levels within the NEF contours; another study might review the impacts of noise on residents.

- VIAA Noise Management Committee  
The Vancouver International Airport Authority (VIAA) manages airport related noise through its Noise Management Program which is aimed at minimizing the level of disturbance to those people living in communities in the vicinity of the airport while recognizing the legitimate need for continued aircraft operations. The Noise Management Plan prepared by VIAA must be approved by the Minister of Transport.

The VIAA Aeronautical Noise Management Committee includes citizen representatives from Vancouver, Richmond and Delta, municipal and provincial governments, industry associations, airport users, Transport Canada, NAV Canada and VIAA. The committee meets quarterly and provides a forum for the discussion and consideration of all airport related noise management issues.

Richmond's citizen representatives to the VIAA Noise Management Committee identified several key issues and initiatives which were considered in preparing the updated VIAA Five Year Noise Management Plan, 2004-2008.

At its regular meeting of March 10, 2004, the VIAA Noise Management Committee was provided with a briefing by City staff regarding the progress of the research. The Committee expressed an interest in reviewing the research findings.

- Advisory Committee on the Environment (ACE)  
At its regular meeting of February 18, 2004, ACE was provided with a briefing by City staff on the research Terms of Reference. ACE expressed an interest in reviewing the findings when it is prepared.
- Richmond Health Services  
City staff also arranged for the consultants to meet with Richmond Health Services staff to review the purpose and progress of the research. Richmond Health Services requested the opportunity to review the research to provide a public health perspective.
- Developers  
Developers are aware that the City wishes to establish a policy regarding airport noise before development proposals can be approved.

Nevertheless, two applications (e.g., the Suntech and Aberdeen Mall sites) for residential uses have been received in the area that will be affected by any new City noise mitigation policy. Those developers and others have requested the opportunity to review and comment on the research findings.

It is essential that the City and VIAA continue to work towards harmonizing the:

- City's Vision (Appealing, Livable and Well Managed) and development goals, and
- VIAA's airport and economic development goals, and operational efficiency and risk management objectives.

#### Summary

At this time, staff do not propose any policy recommendations because additional consultation is required.

As the planning of development in relation to airport noise involves the co-ordination of many interests, it is recommended that the City refer the research to the VIAA and community stakeholders for comment. This process will enable the City to hear a wide range of views prior to making any decisions regarding the management of development with respect to airport noise.

#### *Timing Of Next Steps*

Initially, City staff indicated to the VIAA, developers and stakeholders that, after the consultation process, they would be making policy recommendations to Planning Committee in late June 2004. Upon reviewing the preliminary consultant research, the complexity of the issue and the need for wide stakeholder consultation, staff find that this initial time frame is too short.

To provide a reasonable stakeholder consultation period, and adequate time for staff and the consultants to review the feedback and prepare policy recommendations, staff recommend that they report back to Planning Committee in late July 2004. This will delay City policy decisions by a month and in doing so similarly delay Council providing clarification to developers (e.g., Suntech and Aberdeen Mall) regarding their proposals.

#### *Financial Implications*

The financial implications of the research are significant for the City, VIAA, developers and community residents. The possible implications include:

- For VIAA
  - complaints, lawsuits, jeopardized airport expansion, reduced airport development, lost airport business, relocated airport activity due to complaints,
- City
  - OCP implementation, tax revenue ability, affect on City property development potential and revenues, RAV supportive development,

- Developers
  - development projects approved or denied, lost or gained property investment opportunities, development certainty,
- Residents
  - quality of life, livability, nuisance, complaints, law suits.

**Financial Impact**

Regarding the recommendation to consult – none

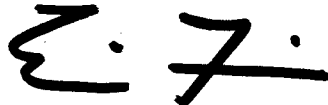
**Conclusion**

The City has conducted research regarding how to better manage development with respect to airport noise.

The consultant research findings indicate the possible types of residential and other development which may be considered in the various NEF contours, as well as noise mitigation standards.

No policy recommendations are made at this time.

Additional consultation is recommended, prior the City approving policies based on this research.



Eric Fiss, Policy Planner  
(4193)

EF:cas

# ATTACHMENT 1

## MODIFICATION TO THE TERMS OF REFERENCE RESEARCH TO REVIEW CITY AIRPORT NOISE - RESIDENTIAL DEVELOPMENT POLICY CONSISTENCY - FEBRUARY 20, 2004

### Study Premise

The research was based on the following premises:

NEF Contour	Assumptions Regarding Residential Uses	Indoor & Outdoor Airport Noise Mitigation Standards	Area Livability Criteria (in addition to existing OCP, Area Plan, Zoning Requirements)	Feasibility of Proposed Standards and Requirements
25 to 30	Residential uses will be allowed, subject to community planning, policies and requirements.	No work required	No work required	No work required
30 to 35	Generally, Transport Canada Guidelines state: <ul style="list-style-type: none"> <li>- New residential uses should not be undertaken,</li> <li>- but if the 'responsible authority' chooses to do so then: <ul style="list-style-type: none"> <li>- appropriate acoustic noise insulation features should be considered, and</li> <li>- a noise impact assessment study should be completed to show that residential development is not incompatible with aircraft noise.</li> </ul> </li> </ul>	Require research and standards	Require research and standards	Work required
	Residential uses will be allowed, under some conditions, subject to community planning, policies and requirements			
35 to 40	Generally, Transport Canada Guidelines state that residential development should not be undertaken.	Require research and updated noise mitigation: <ul style="list-style-type: none"> <li>- criteria</li> <li>- measures</li> </ul>	Require: <ul style="list-style-type: none"> <li>- research, and</li> <li>- updated area livability criteria.</li> </ul>	Work required
	Residential uses will be allowed, under some conditions, subject to community planning, policies and requirements.			
Greater than 40	Generally, Transport Canada Guidelines state that residential development should not be undertaken.	Require research and updated noise mitigation: <ul style="list-style-type: none"> <li>- criteria</li> <li>- measures</li> </ul>	Require: <ul style="list-style-type: none"> <li>- research, and</li> <li>- updated area livability criteria.</li> </ul>	Work required
	Residential uses will be allowed, under some conditions, subject to community planning, policies and requirements.			

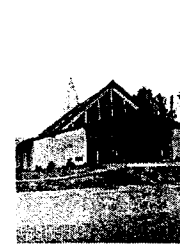
**Summary Consultant Report**

**Research To Review  
City Airport Noise and Residential Development  
Policy Consistency**

# Windsor View City Airport Noise

## Development Policy Consistency

### Windsor View City Airport NEF Mitigation Standards Version 5.0



By:  
Urban Systems Ltd.  
Pryde Schropp McComb, Inc

In collaboration with:  
Lidstone, Young and Anderson  
Wakefield Acoustics Ltd

Contract #2576P  
USL #: 1123.0000.00

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## **PART I – CITY AIRPORT NEF MITIGATION POLICY AND STANDARDS**

RESEARCH TO REVIEW CITY AIRPORT NOISE AND RESIDENTIAL DEVELOPMENT POLICY

CONSISTENCY – CONTRACT 2576P

CITY OF RICHMOND, BC

DRAFT FINAL REPORT – VERSION 5.0

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# PART I – CITY AIRPORT NEF MITIGATION POLICY AND STANDARDS

RESEARCH TO REVIEW CITY AIRPORT NOISE AND RESIDENTIAL DEVELOPMENT POLICY  
CONSISTENCY – CONTRACT 2576P  
CITY OF RICHMOND, BC

DRAFT FINAL REPORT – VERSION 5.0

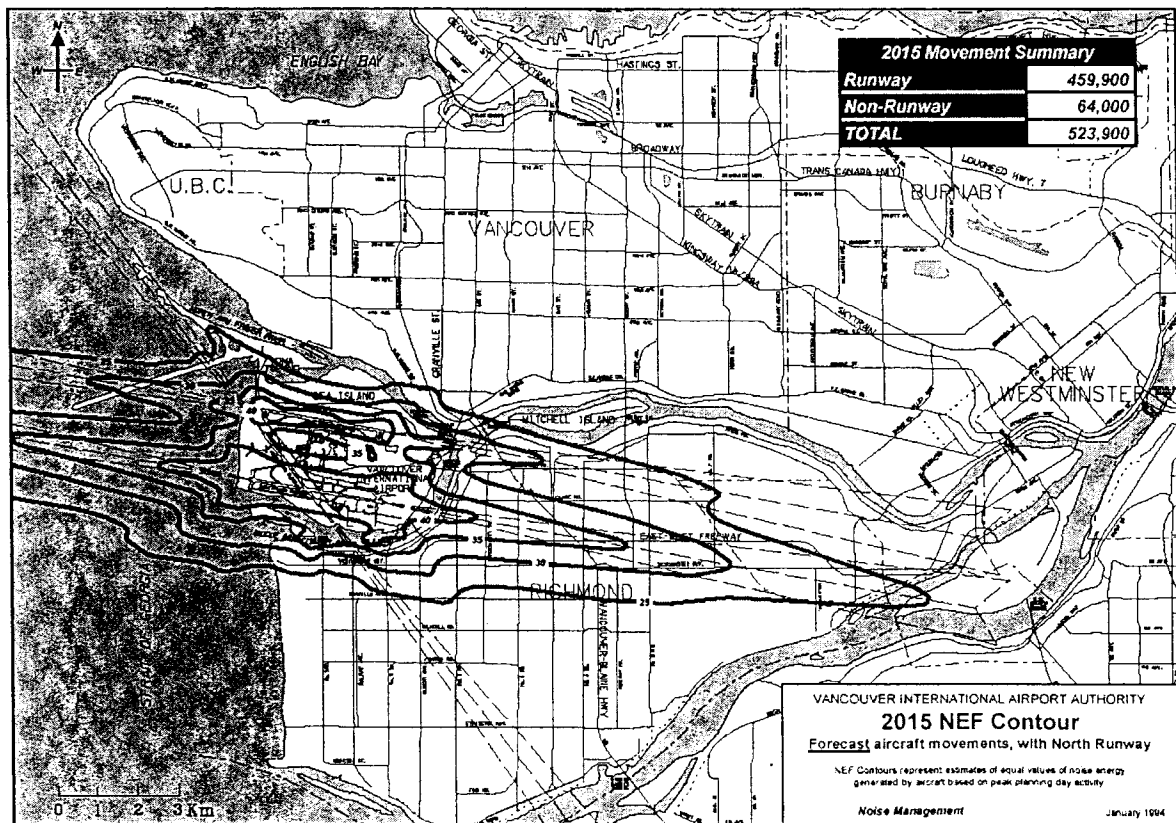
## 1.0 Introduction

### 1.1 BACKGROUND

The City of Richmond issued a Request for Proposals in the Fall of 2003 seeking to retain a team to Research City Airport Noise and Residential Development Policy Consistency. In early 2004, the project was awarded to the team of Urban Systems Ltd. and Pryde Schropp McComb, Inc. in association with Lidstone, Young and Anderson and Waskefield Acoustics Ltd.

Appendix A contains final revised Terms of Reference issued by the City of Richmond for the completion of this study.

A significant portion of the City of Richmond is exposed to airport noise resulting from aircraft operations in the vicinity of the Vancouver International Airport. The Figure below presents the influence of this noise exposure in terms of the Canadian Noise Exposure Forecast (NEF) system contours.



## **PART I – CITY AIRPORT NEF MITIGATION POLICY AND STANDARDS**

RESEARCH TO REVIEW CITY AIRPORT NOISE AND RESIDENTIAL DEVELOPMENT POLICY  
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The source of this information is the *2002 Noise Management Report* prepared by the Vancouver International Airport Authority. A copy of the 2002 Noise Management Report is contained in Appendix B. This and the historical annual Noise Management Reports are very informative and provide a great deal of background related to the airport, its noise management policies and mandates and a general review of the noise environment and measurement techniques around the airport. The reader is urged to review this document as a backgrounder for this study.

The presence of airport noise represents only half of the driving force behind the need to develop a consistent policy. The second consideration is the demand for residential and economic development opportunities, especially in Richmond's high-amenity downtown.

### **1.2 PURPOSE AND OBJECTIVES**

As detailed in the revised Terms of Reference contained in Appendix A, the purpose of this study was to conduct research to update the City of Richmond's policies concerning:

*Standards: indoor and outdoor airport noise exposure forecast (NEF) mitigation (e.g., insulation) standards and measures for residential, assembly and day care uses, to improve City policy consistency.*

*Area livability guidelines: for residential, day care and assembly uses within NEF areas, to improve internal and external building enjoyment.*

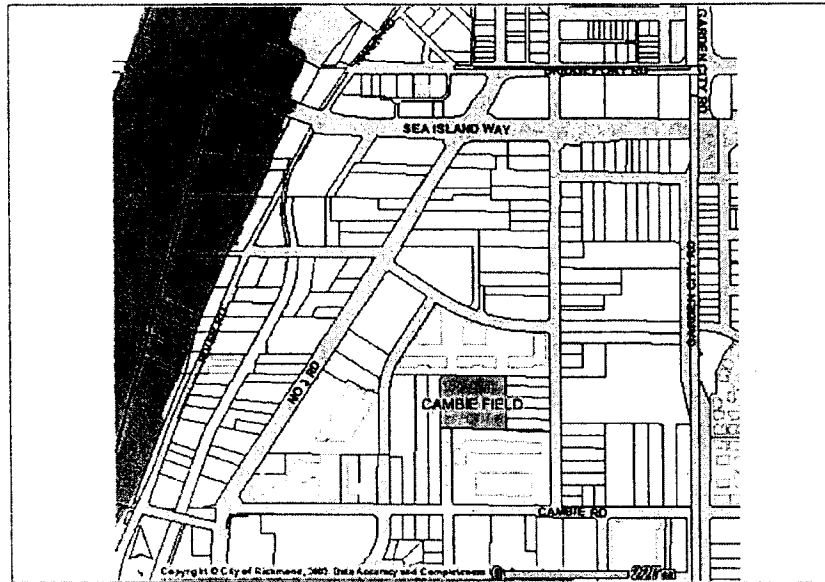
*Vision: a land use development vision for the north City Centre area (Section 28, 5-6)*

Part I of the overall project deals primarily with developing standards for indoor and outdoor noise mitigation and addresses issues of livability as part of the standard development. Part II of the project is intended to address developing a vision of the City Centre area. The figure below highlights the focus of the visioning exercise.

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The background information provided and standards proposed in Part I of this study are intended to offer a solid foundation on which the City of Richmond may develop its consistent policy with regards to airport noise and residential development. Despite using the City Centre area as a focus for this study, the standards and policies that are ultimately adopted are to be applicable to the City as a whole.

This report represents Part I of the overall project which is briefly summarized below:

1. Review of the Canadian NEF Model
2. Identify indoor and outdoor airport noise mitigation standards for the following types of uses:
  - a. residential uses
  - b. assembly uses
  - c. day care uses.
3. Identify how indoor living environments can be best achieved with respect to airport noise.
4. Identify how outdoor amenity and recreation environments can be best achieved with respect to airport noise

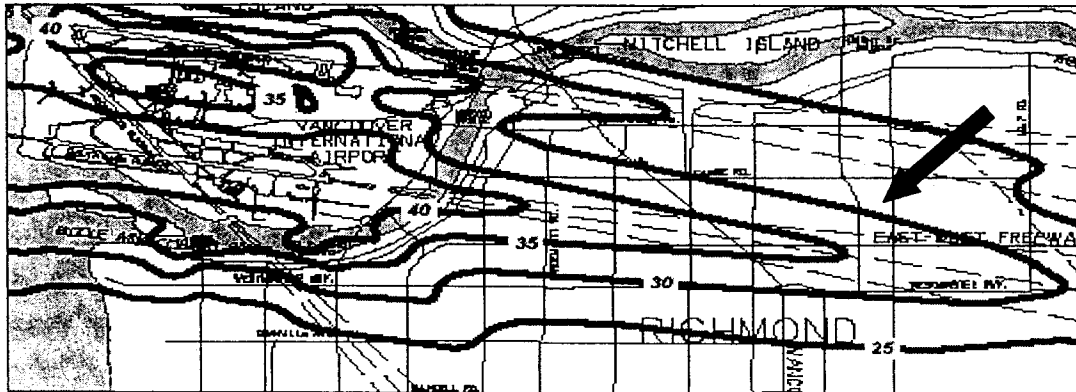
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### 1.3 STUDY CHALLENGES AND LIMITATIONS

While the question of where to plan for residential development around an airport may be quite simple in terms of the recommendations put forth by Transport Canada in their document TP1247E, the issue becomes much more complicated than that. Transport Canada does not recommend new residential development above the 30 NEF contour. The diagram below highlights the location of the 30 NEF for the long term noise exposure projection (2015 NEP) for YVR. It becomes quickly obvious that a blanket application of Transport Canada's recommendations is not a tenable concept as applied to the existing scenario at the City of Richmond.



As such, the Consultant team was tasked not to determine where the City can or cannot develop residential land uses, rather, the task was to develop how to plan for residential development while having regard for airport noise concerns.

While considering broad policy issues such as residential development policies, the study is limited in scope. This study explicitly considers airport noise and in no way takes into consideration other noise sources such as rail and road traffic. These other noise sources and their impacts on the development potential of residential land uses must be considered separately from that of airport noise.

Furthermore the standards explored and presented in this report are an attempt to strike a balance between the objectives of YVR and the City, which may differ significantly when considering residential development. Both have vested considerable interests in ensuring their respective operations are optimized and run as efficiently as possible. This is the crux of the challenge as each stakeholder has a conflicting objective:

- The City of Richmond wishes to maximize the development potential of lands, in this case to optimize the use of lands for residential development in areas potentially influenced by aircraft noise.

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- The Airport Authority seeks to minimize the potential for operational restrictions at the airport to ensure its marketability for air carrier and related businesses now and into the future.

The City's objective is in direct conflict with that of the Airport's in that by permitting residential development in areas influenced by airport noise, there is an increased potential for group or individual action against the City, the Airport or both, related to airport noise nuisance / annoyance. These actions can result in significant financial burden on the airport to defend itself and could result in operational restrictions to improve the noise environment around the airport and surrounding communities. These restrictions could also impact the marketability of the airport and impact its financial viability as well as existing and future opportunities.

The Airport's objective is in direct conflict with the City's need for additional residential development opportunities and potential. As can be seen in the above diagram, sterilizing all of the lands within the 30 NEF contour (contour within which no new residential is recommended by Transport Canada) affects a large area of the City. Similar to the airport impacts, this can affect the City's objectives of increasing the residential land base and associated revenue and services opportunities. Furthermore, it impacts the City's desire to provide diverse residential opportunities within the City Centre area.

Having said all of the above, both parties also recognize the importance each has in supporting the other. The above attempts to simply summarize the situation that both parties find themselves in. YVR in their 1999-2003 Noise Management Plan has clearly established an objective to develop Land Use Planning Guidelines for use by the surrounding communities. It is identified as an action plan on an annual basis. While the final date of completion was not indicated, it is clear that this work is in progress and will be completed in the near future. Specifically, their plan objectives under Land Use Planning are summarized below:

- Year 1 – Work towards provincial legislation and recognition of noise *compatible land use planning in Official Community Plans of municipalities adjacent to YVR*
- *With input from Ministry of Municipal Affairs, a land planning Policy Guideline is to be drafted by Airport Authority*
- *Work towards provincial legislation and recognition of noise compatible land use planning in Official Community Plans of municipalities adjacent to YVR*
- *Monitor compatible land use planning implementation*

The City of Richmond, reacting to community and Council pressures, initiated their own review of planning standards and guidelines as they relate to residential development in close

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proximity to airports. Having recognized their existing policy is dated, is not applied consistently and requires updating based on new research, the city initiated this study.

Since both the airport and City of Richmond must co-exist, it is recommended that this report be considered a first step in formalizing a policy related to residential development vis-à-vis airport noise. Ultimately, a cooperative and balanced approach must be achieved where both the City and Airport can minimize their impacts while ensuring that any final decisions with respect to land use are made in a responsible manner accounting for the health and welfare of the community.

As such, it is recommended that further consultations with the airport and other affected parties including, the public and the development community be held.

This report provides a single source summary of the following:

- City's Authority to Regulate Land Use
- Review of the Canadian NEF Model
- Land Use Planning Applications of the NEF System in Canada
- International Perspectives on Airport Noise and Residential Land Use
- Development of Noise Standards and Guidelines for Residential Development for the City of Richmond
- Impact and Mitigation Options Related to the proposed Standards and Guidelines on both the City of Richmond and YVR
- Conclusions and Final Considerations



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## **2.0 CITY’S AUTHORITY TO REGULATE LAND USE**

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### **2.1 REVIEW OF THE CONSTITUTION ACT, 1867**

Two broad jurisdictional boundaries need to be established to be able to understand the manner in which federal recommendations on airport noise and land use planning in the vicinity of airports are implemented. The first is the power to legislate in relation to airports and aeronautics. The second boundary applies to the jurisdiction to control land use.

In Canada, the division of powers between the federal and provincial governments is set out in the Constitution Act, 1867. Three sections in the constitution lay out the divisions of power. Section 91 outlines the powers of the Canadian parliament, section 92 describes the exclusive powers of the provincial legislatures, and section 132 provides powers to the federal government to meet “...Obligations of Canada or of any Province thereof, [...] towards Foreign Countries, arising under Treaties” (Constitution Act 1867, s. 132). First, the head of power for land use planning will be considered.

Section 92 provides each provincial legislature with the exclusive right to make laws pertaining to various classes of subject. Of particular interest to land use planning are sections 8, 13 and 16. These sections are excerpted below:

8. Municipal Institutions in the Province. [...]

13. Property and Civil Rights in the Province. [...]

16. Generally all Matters of a merely local or private Nature in the Province.  
(Constitution Act 1867, s. 8, s.13, s.16).

While any one of these sections could be used to justify the provincial jurisdiction in issues of land use planning, the three combined certainly affirm the province’s jurisdiction. Section 16 is of particular interest in that it captures classes of subjects not explicitly enumerated by the constitution in s. 92 as long as they are local or private and do not cross provincial boundaries. This is similar to the peace, order and good government power bestowed upon the federal government.

Section 91 of the Constitution Act addresses the powers of parliament. While within this section there is an enumeration of classes of subject that are within the jurisdiction of the federal government, the opening provision provides for the federal government to have all powers that are not exclusively listed as belonging to the provincial legislatures. This power is referred to as peace, order and good government (POGG) power. Obviously aeronautics is not explicitly mentioned in the Constitution Act of 1867, since powered flight was still years off in the future. However, history and constitutional law in Canada have transpired in such a way

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that another head of power stems from s. 132 of the constitution. This section reads as follows:

132. The Parliament and Government of Canada shall have all Powers necessary or Proper for performing the Obligations of Canada or of any Province thereof, as Part of the British Empire, towards Foreign Countries, arising under Treaties between the Empire and such Foreign Countries.  
(Constitution Act 1867).

In a case referred to the Privy Council during the 1930s, it was determined that while various subsections of s. 91 provide the federal government with the authority to legislate aeronautics, however the conclusion of World War I provided further authority. Specifically, during the 1919 Paris Peace Conference, France submitted that international cooperation on aviation originally born out of military necessity should be continued in the realm of civil aviation during times of peace. Ultimately 26 of the 38 Allied and Associated powers signed the International Air Convention. This convention prepared for the creation of the International Commission for Air Navigation, the precursor of the modern day International Civil Aviation Organization (ICAO). (ICAO 2001)

Due to the signing of the International Air Convention by Canada and the King on behalf of the British Empire, which invoked s. 138, as well as the powers laid out in s. 91, the Privy Council ruled "... that it was competent for the Parliament of Canada to pass the [Aeronautics] Act and authorize the Regulations in question..." (Macklein 1997, 111). Furthermore, in more recent rulings, *Johannesson v. West St. Paul* (1952) for example, Aeronautics was found to fall under the "national concern" dimension of the federal POGG power. Therefore, the power for the federal government to legislate aeronautics stems from multiple sources, and has been established by courts now for over 60 years.

The final form of government that needs to be considered is municipal. Municipalities and their powers are markedly different from those of the federal or provincial governments since their powers are not accorded to them through the Canadian constitution, but rather through statutes enacted by provincial legislatures. Section 92.8, excerpted above, clearly indicates that municipal institutions are creatures of the province. As such, the powers to affect land use planning and zoning, among others, are simply delegated to the municipality by the province through a provincial statute. Each province in Canada has different legislation dealing with municipal incorporation and planning. As such, there is a fair amount of variation among municipalities and between provinces. Specifically, municipal structure and powers are determined by provincial legislation.

## **2.2 REVIEW OF THE FEDERAL AERONAUTICS ACT**

The Aeronautics Act is the federal piece of legislation which deals with the multitude of concerns related to aeronautics in Canada. While the Act covers a wide breadth of topics, only two issues will be considered as relevant to this study: airport noise and airport zoning.

In general, the ultimate authority in regulating airport noise in Canada rests with Transport Canada. This authority is given through the Federal Aeronautics Act and by incorporation by reference, the associated Canadian Aviation Regulations (CAR). Section 4.9 of Canada's Aeronautics Act enables

*“...the Governor in Council to make regulations respecting aeronautics and, without restricting the generality of the foregoing, may make regulations respecting [...]*

*(f) noise emanating from aerodromes and aircraft;...”*

### **2.2.1 Aircraft / Airport Operations (Noise Abatement Procedures)**

Vancouver International Airport currently has in place Noise Abatement Procedures which deal with: departure procedures, arrival procedures, reverse thrust upon landing, night restrictions, engine run-up restrictions and altitude restrictions. These procedures represent Noise Operating Criteria as described below.

Under the enabling authority of the Aeronautics Act, Transport Canada can regulate airport/aircraft operations through the Canadian Aviation Regulations (CARs). In particular, CAR 602.105 Noise Operating Criteria outlines the following:

*No person shall operate an aircraft at or in the vicinity of an aerodrome except in accordance with the applicable noise abatement procedures and noise control requirements specified by the Minister in the Canada Air Pilot or Canada Flight Supplement, including the procedures and requirements relating to:*

- a) preferential runway*
- b) minimum noise routes*
- c) hours when aircraft operations are prohibited or restricted*
- d) arrival procedures*
- e) departure procedures*
- f) duration of flights*
- g) the prohibition or restriction of training flights*
- h) VFR or visual approaches*
- i) Simulated approach procedures*

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- j) *The minimum altitude for the operation of aircraft in the vicinity of the aerodrome.*

With respect to the above, the Minister has the authority to invoke penalties when the published procedures are not complied with for reasons other than safety of operation. The following summarizes these penalties:

### **103.08 Designated Provisions**

*“(1) The provisions set out in column I of the schedule to this Subpart (Table 1) are hereby designated as provisions the contravention of which may be dealt with under and in accordance with the procedure set out in Sections 7.7 to 8.2 of the Act.*

*(2) The amounts set out in column II of the schedule are the maximum amounts payable in respect of a contravention of the provisions set out in column I.*

*(3) A notice issued to a person by the Minister pursuant to subsection 7.7(1) of the Act shall specify*

- (a) the designated provision that the Minister believes has been contravened;*
- (b) the particulars of the alleged contravention;*
- (c) that payment of the amount specified in the notice will be accepted by the Minister as and in complete satisfaction of the amount of penalty for the alleged contravention and that no further proceedings under Part I of the Act will be taken against the person in respect of that contravention;*
- (d) that, if the person fails to pay the amount specified in the notice, a copy of the notice will be forwarded to the Tribunal and the Tribunal will determine whether the alleged contravention took place; and*
- (e) that the person will be provided with a full opportunity consistent with procedural fairness and natural justice to present evidence before the Tribunal and make representations in relation to the alleged contravention.*

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<b>Table 1</b>		
<b>SCHEDULE TO DESIGNATED PROVISIONS 103.08</b>		
<b>Designated Provision</b>	<b>Maximum Amount of Penalty (\$)</b>	
	<b>Individual</b>	<b>Corporation</b>
	<b>Column I</b>	<b>Column II</b>
<b>Section 602.105</b>	<b>5,000</b>	<b>25,000</b>
<i>Subsection 602.106 (1)</i>	250	1,250
<i>Section 602.152</i>	5,000	25,000
<i>Subsection 602.153 (1)</i>	5,000	25,000
<i>Section 602.156</i>	100	500
<i>Subsection 602.157 (1)</i>	5,000	25,000
<i>Subsection 602.157 (2)</i>	5,000	25,000
<i>Section 602.162</i>	100	500

This information is shown to demonstrate how aircraft operations can be regulated, if required. This is important, since this has a direct impact on the noise environment within the vicinity of the Airport. It further demonstrates how these procedures are published and since they are considered regulations, can be enforced.

It should be noted that CAR 602.105 was not developed with the intention that it be used to terminate operations on the basis of complaints of nuisance. It was developed as a formal tool to regulate a consensus between operators and concerned parties. The regulation provides the motivation for operators to adhere to the results of consensus and provides some assurance to concerned citizens that regulations can be enforced.

There are a number of other regulations that deal with aircraft noise and are noted below for reference, which are also indirectly related to this study:

- CAR 602.106 – Noise Restricted Runways
- CAR 507.20 – Certificate of Noise Compliance
- CAR 602.150-162 – Transition of Chapter 3 Aeroplanes
- CAR 602.14 0 – Minimum Altitudes and Distances

It should be noted that the above refers to noise abatement procedures (NAP), which are generally implemented at airports to address noise concerns related to *existing development and existing airport activity*. Although the process of implementing NAP can be initiated by the airport owner/operator, the review and approval process is subject to public and industry consultation and must ultimately be approved by the Federal Government. Refer to Appendix

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B for an excerpt of the Noise Abatement Procedures currently in place at the Vancouver International Airport.

### **2.2.2 Airport Zoning Regulations**

Part I, Section 5.4 (1) and Sections 5.5 to 5.81 of the Aeronautics Act (the “Act”) permits Airport Zoning which is a federal regulation that can:

- protect the airport’s obstacle limitation surfaces from obstructions including buildings, structures and natural growth i.e. trees (TP312, Chapter 4); and
- protect against disposal of waste attractive to birds; (TP1247, Part III); and
- protect against electronic interference with navigational aids(TP1247, Part II).

An Airport Zoning Regulation (AZR) may be enacted for an airport’s present or future aeronautical requirements. It is critical to note that AZRs are strictly implemented to ensure the safety of aeronautical activities. This lies well within the established jurisdiction of the Federal government. The YVR Zoning Regulations SOR/80-902 were enacted by the Minister of Transport in 1980 and notice of these regulations appears on the titles to the properties affected.

### **2.3 REVIEW OF BRITISH COLUMBIA MUNICIPAL ENABLING LEGISLATION**

The British Columbia Local Government Act and the Community Charter are central documents concerning municipalities, their creation, powers and relationship to the provincial level of government. When considering the City’s authority to regulate land use within its boundaries, multiple Parts of the Acts are pertinent:

- Section 7 of the Community Charter – Municipal Purposes
- Sections 8 and 9 of the Community Charter – Regulatory Powers in Relation to Building Construction and Other Matters
- Section 10 of the Community Charter – Conflicts with Provincial Law
- Part 21 of the Local Government Act – Provincial Building Regulations
- Part 26 of the Local Government Act – Planning and Land Use Management

It is explicitly stated in Part 2 Division 1 of the Community Charter that:

*2. The purposes of a municipality include*

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- (a) providing for good government of its community,*
- (b) providing for services and other matters for community benefit,*
- (c) providing for stewardship of the public assets of its community, and*
- (d) fostering the economic, social and environmental well-being of its community.*

It is with this in mind that municipalities can enact Bylaws, enforce building regulations and implement planning and land use management. Within Part 21 of the Local Government Act, section 692 authorizes the Minister of Community, Aboriginal and Women's Services to enact the Provincial Building Code and Regulations.

However, this does not prevent a municipality from enacting Municipal Building Regulations for "...the health, safety and protection of persons and property..." (s.53 of the Community Charter). Municipalities may under s.8(3)(l) of the Community Charter regulate, prohibit and impose requirements in relation to buildings and other structures. This authority must, if the bylaw establishes standards that are or could be dealt with by the Provincial Building Code, be exercised concurrently with the Minister of Community, Aboriginal and Women's Services. Under the Buildings and Other Structures Bylaws Regulation B.C. Reg. 86/2004, any municipal bylaw establishing standards that are additional to or different from standards established by the Building Code is prohibited unless it is approved by the Minister. This special concurrent authority regime is an exception from the more relaxed scheme in s.10 of the Community Charter whereby a municipal bylaw may establish more onerous standards than a generally applicable provincial law on the same matter.

Other regulatory powers in s.8 of the Community Charter that could be relevant in a City policy on this issue are the authority in relation to public health (s.8(3)(i)), which may only be exercised concurrently with the Minister of Health Services, and the authority in relation to nuisances, noise, vibration, or other matters liable to disturb the quiet, peace, rest, enjoyment, comfort or convenience of individuals or the public (s.8(3)(h)).

Finally, Part 26 of the Local Government Act deals with Planning and Land Use Management. Part 26 provides the usual zoning and related powers, including the powers to regulate the use and density of use of land and to prohibit land uses. One section of note is s.914 which addresses the issue of compensation. It states:

*914. (1) Compensation is not payable to any person for any reduction in the value of that person's interest in land, or for any loss or damages that result from the adoption of an official community plan or a bylaw under this Division or the issue of a permit under Division 9 of this Part.*

*(2) Subsection (1) does not apply where the bylaw under this Division restricts the use of land to a public use.*

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The Community Charter and the Local Government Act from which the City of Richmond derives its authority are critical documents to take into account when considering the City's authority to regulate.

### **2.4 REVIEW OF RELEVANT COURT PRECEDENTS RELATED TO FEDERAL / PROVINCIAL JURISDICTION**

A number of legal precedents have been established both within and without British Columbia. The cases listed below deal with numerous issues pertaining to airport noise, land use planning and jurisdictional issues.

#### **2.4.1 Sutherland v. Canada (The Attorney General of), (1997-11-14) BCSC**

- The plaintiffs claimed damages for nuisance and compensation for expropriation of their land, both allegedly arising from the use of the north runway at the Vancouver International Airport.
- The plaintiffs sought to have their claim in nuisance certified as a class proceeding, and to have themselves appointed as representative plaintiffs.
- Ultimately the judge dismissed the application to certify the case as a class proceeding.

#### **2.4.2 Sutherland v Attorney General of Canada – 2001 BCSC 1024**

- Three property owners claimed damages for nuisance including diminution of the value of their land which was alleged to arise from the operation of the north runway at the Vancouver International Airport.
- The landowners lived in the Tait Subdivision, which is within the Bridgeport area of Richmond.
- The claim of nuisance was grounded on allegations that the aeronautical activity of arriving and departing aircraft on the north runway creates "excessive, deafening and disturbing noise and vibrations" which has caused each of them "substantial and unreasonable interference with residential use and enjoyment" of their property.
- In particular:
  - interference with normal conversations inside and outside the home;
  - interference with the use of telephones, radio and television;



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- interference with daily tasks;
- interference with and reduction in the quality of rest and sleep;
- creation or aggravation of hypertension;
- interference with the reasonable and comfortable use of gardens, patios, yards and recreational property;
- interference in the normal use and enjoyment of community amenities in the affected areas;
- creation of fear and apprehension; and
- expulsion of noxious fumes in the vicinity of residential homes.
- The judge concluded that:
  - The plaintiffs succeeded in proving their claim that the defendants have created a nuisance from aircraft noise that effects the use and enjoyment of their properties in the Tait subdivision;
  - The plaintiffs have in common the substantial loss of amenity in respect of their outside patios, gardens, and grounds;
  - The conclusion the judge reached as to the existence of nuisance cannot be applied beyond the area of the Tait subdivision, and even within that subdivision individual evidence of claimants regarding their property and particular circumstances must be considered;
- The judge ultimately awarded damages to the three plaintiffs for the nuisance created by aircraft noise from the north runway.

### **2.4.3 Sutherland et al v. Van. Int'l. Airport – 2002 BCCA 106**

- This case saw both the Attorney General of Canada and the Vancouver International Airport Authority appeal the previous ruling awarding damages for nuisance.
- While the Appellate Court agreed that a nuisance was created by the construction and operation of the north runway, the court disagreed on whether or not the statutory authority was an appropriate defence.

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- The British Columbia Court of Appeal, unanimously found that the defence of statutory authority provides a complete defence for both the Government of Canada and the Airport Authority.
- The appeal was allowed and the plaintiff's action dismissed.
- It is to be noted that in May of 2003, the Supreme Court of Canada did not grant leave to appeal this decision.

### **2.4.5 Mullaney v. Red Deer (County No. 23), 1999 ABQB 434**

- The applicants sought a declaration that a section of a local land use bylaw, which was preventing the building of their retirement home near the Red Deer Airport, was *ultra vires* the municipal council's lawmaking authority.
- The section of the bylaw in question was aimed at airport improvement, operation, safety, capacity and future upgrading. In particular, it was designated setbacks from the public airports depending on runway length.
- The judge ruled that the bylaw section dealt with issues entirely within the exclusive jurisdiction of the Federal government. As such, the section was deemed to be *ultra vires* and to be of no force and effect.

## **2.5 SUMMARY OF THE CITY'S AUTHORITY TO REGULATE**

At a general level the City's authority to regulate stems primarily from The British Columbia Community Charter and the Local Government Act, which delegate authority from the Province to municipalities. When considering the authority to regulate in relation to airport noise, it is important to carefully consider the pith and substance of the proposed regulation.

Jurisdictional boundaries in relation to airport noise must be carefully minded. While the City may be within its authority to regulate land use and building construction for the purposes generally laid out for local governments, it should be made explicit that the municipality is not dealing with issues concerning aeronautics explicitly. Rather, it should be emphasized that the motivation for any regulation with regards to airport noise stems from the four purposes of local government as laid out by the Community Charter. These are:

- (a) providing good government for its community,*
- (b) providing services and other matters for community benefit,*
- (c) providing stewardship of the public assets of its community, and*
- (d) fostering the economic, social and environmental well-being of its community.*

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The City's authority to regulate is limited to mitigating the impact of airport noise on its citizens. It can not affect the source of the noise; that is the aeronautical activity taking place in proximity to sensitive land uses. Recognizing and respecting these limitations is important to developing effective noise mitigation policies and standards.

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## **3.0 REVIEW OF THE CANADIAN NEF MODEL**

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### **3.1 WHAT IS NOISE?**

Sound is a vibration that travels through a particular medium. Sound travels outwards from its source, similar to a pebble thrown into a pond. Humans are used to sensing sound that travels through air, and subsequently perceive it as perhaps beautiful or undesirable. When sound is perceived as undesirable, it is referred to as noise. (FAA 1985)

A particular sound is described by its amplitude, often expressed in decibels (dB). An increase of 10 dB of sound is perceived as twice as loud to a listener. Humans can barely perceive a change of 3 or 4 dB. Another characteristic of sound is its frequency. A sound's frequency changes how high or low the sound is perceived to be: for example the low rumble of a far off thunderstorm or the high pitch of a tweeting bird. Finally, it is important to note that most sounds are composed of a complex mixture of various frequencies to which the human ear has a differential response. This means that the ear does not weigh all frequencies equally when sensing a complex sound. Ultimately, the ear will perceive two sounds with the same energy level but different frequency mix, differently.

The differential response that the human has to frequencies can be taken account for when measuring noise by using a filter. The A-weighted filter is an example of a filter that approximates the human ear's response to various frequencies. The filter used to measure a sound directly affects the decibels reported by the measuring equipment. Consequently, the choice of filter can have an important impact on any calculation involving sound. Finally, the Sound Exposure Level (SEL) is used to describe the amount of noise for an entire event, such as an airplane flyby.

### **3.2 HISTORY OF THE CANADIAN NEF SYSTEM**

In Canada, the accepted measure of airport noise is the Noise Exposure Forecast (NEF). The NEF is a single number that rates overall airport noise for a single point. NEF contours (lines joining points of equal noise exposure) are often generated for the areas surrounding airports. A brief historical overview of the development of this metric is necessary to understand the current form and implementation of the NEF.

In his survey of the history of airport noise measures, the NRC's Bradley (1996A) states that the NEF metric evolved from the previously developed American Composite Noise Rating (CNR). While the CNR was being developed in the United States, a number of European noise metrics were also being developed. In the early 1960s the Noise and Number Index (NNI) was introduced in the United Kingdom. France and Germany quickly followed with the Psophique Index ( $I_p$ ) and the Störindex (Q) respectively. The development of these various

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noise metrics was due to the pervasive introduction of jet engine civil aircraft. These engines are significantly louder than the propeller engines they replaced and caused a significant and sudden increase in airport noise.

Prior to the current incarnation of the NEF, there were five major developmental steps beginning with the original CNR first proposed in 1952. This initial concept was to rate general “community” noise. The original system described responses to noise in terms of community response, mainly in terms of complaints and legal action. Through a series of case studies CNR values were compared to community response and a six-item scale was prepared. In 1955, the first revision to the CNR was conducted, reducing the scale from 6 items to 5, adding considerations for repeated sounds, as well as some other technical considerations. While this second version did a decent job of predicting community response to changes, it was not particularly effective in absolute terms. This meant that the second version was useful for predicting the relative change, but did not accurately predict the community response in absolute terms.

During the late 1950s the U.S. Air Force started to develop procedures for land use planning and evaluating noise around air bases. The CNR concept was specifically modified to account for aircraft noise and predicted aircraft noise levels. Procedures for predicting aircraft noise levels during ground run-up and aircraft in flight were developed, and a correction for time of day was made. The CNR was further refined in 1962 and included the use of Perceived Noise Levels (PNdB). This single value ranked the noise in terms of how noisy it was perceived to be. Some simplifications were also made to the system: reducing the number of time of day weightings to day or night, thus eliminating the evening category. This version of the CNR had three community response descriptors described in the table below:

<b>Composite Noise Rating, CNR</b>	<b>Description of Community Response</b>
< 100	Essentially no complaints would be expected. The noise occasionally interferes with certain activities of the resident.
100 to 115	Individuals may complain, perhaps vigorously. Concerted group action is possible.
> 115	Individual reactions would likely include repeated vigorous complaints. Concerted group action might be expected.

Finally in 1967, reports published by the FAA introduced the NEF as an evolution of the early CNR. This newest development included improvements in dealing with perceived noise levels, refined calculations by eliminating a limitation of performing calculations in 5 dB increments,

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and proposed new procedures for calculating expected aircraft noise levels for the new NEF measure. In addition, the manner in which the perceived noise level concept deals with pure tones and the duration of aircraft pass-bys was modified. This modification resulted in a new measure, termed Effective Perceived Noise Level (EPNL). The final modification to the previous system was weighting nighttime operations 16.7 times that of daytime operations. Bradley (1996B) notes that there was no evidence in the original reports to support this weighting. Despite the new measure, no new information on community response to aircraft noise was included.

The NEF measure has been used in various countries, including Canada, Australia, Yugoslavia and Hong Kong. However, it was never adopted by the United States where it was developed. Rather, the U.S. adopted the day-night sound level, Ldn, because of a political imperative for a single environmental noise measure across departments.

### **3.3 NEF EXPLAINED**

The section which follows describes the Canadian NEF system in some detail. For interested readers, the YVR Noise Management Report contained in Appendix B provides an additional source of useful information.

The Noise Exposure Forecast (NEF) is a single number rating of overall aircraft noise. It combines the noise levels of individual aircraft and the numbers of aircraft to give a single number rating of the average negative impact of the aircraft noise. The current NEF metric evolved from the earlier Composite Noise Rating (CNR) which was initially developed for general community noise situations and later modified to evaluate aircraft noise. While these measures were being developed in the United States, other early airport noise measures were being developed in Europe.

The Canadian Noise Exposure Forecast (NEF) was developed to encourage compatible land use planning in the vicinity of airports. NEFs are official contours and Transport Canada will support them to the level of accuracy of the input data. The NEF has the additional benefit of providing recommended acoustic design criteria to obtain acceptable indoor noise levels for residential, commercial and other construction.

Experience at 21 airports with respect to correlation's between noise complaints and the NEF contours are displayed below in Table 2. These response predictions were developed through statistical analysis of community response to aircraft noise in the 1960/70's.

As part of a 1996 NRC validation study of the Canadian NEF System, evidence from a study conducted for London's Heathrow airport and from major Swiss airports, which over a 20 year period showed no effect on changing attitudes to aircraft noise. This may suggest that Table 2 below may still be valid although it was developed on data that is some 30-40 years old. However, it is possible too, that different populations might react differently. As such the

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applicability of Table 2 in today's environment in Canada cannot be truly verified. Table 2 does however still form the basis of community noise response prediction in Canada.

Response Area	Response Prediction
>40 NEF	Repeated and vigorous individual complaints are likely. Concerted group and legal action might be expected.
35 - 40	Individual complaints may be vigorous. Possible group action and appeals to authorities.
30 – 35	Sporadic to repeated individual complaints. Group action possible.
< 30	Sporadic complaints may occur. Noise may interfere occasionally with certain activities of the resident.

A series of land use tables for aircraft noise considerations only are produced by Transport Canada as shown in the example to the right. This is only offered up as a guide and is mostly related to land use compatibility as related to airport noise.

Transport Canada does not support or advocate incompatible land use (especially residential housing) in areas affected by aircraft noise. These may begin as low as NEF 25. At NEF 30, speech interference and annoyance caused by aircraft noise are, on average, established and growing. By NEF 35, there effects are very significant. New residential development is therefore not compatible with NEF 30 and above, and should not be undertaken. As was previously detailed, jurisdictional boundaries do not permit the federal government to impose the NEF 30 limit on

4.5

TABLE 3  
LAND USE TABLES  
AIRCRAFT NOISE CONSIDERATIONS ONLY

This land use tabulation should not be considered as an exhaustive listing, but merely as examples of how various land uses would be assessed in the Noise Exposure Forecast context in terms of community response predictions.

- Indicates that new construction or development of this nature should not be undertaken.
- Indicates that new construction or development of this nature should not be undertaken. See Explanatory Note H.
- This particular land use may be acceptable in accordance with the appropriate noise and subject to the limitations indicated therein.
- The indicated land use is not considered to be adversely affected by aircraft noise and no special noise insulation should be required for new construction or development of this nature.

NOISE EXPOSURE FORECAST VALUES	RESPONSE AREAS			
	>40	40-35	35-30	<30
<b>RESIDENTIAL</b>				
Detached, Semi-Detached	No	No	No	Caution
Town Houses, Garden Homes	No	No	No	Caution
Apartments	No	No	No	Caution
<b>RECREATIONAL - OUTDOOR</b>				
Athletic Fields	No	Caution	Caution	Yes
Stadiums	No	No	Caution	Yes
Theatres Outdoor	No	No	Caution	Yes
Racetracks-Horses	No	Caution	Caution	Yes
Racetracks-Autos	Yes	Yes	Yes	Yes
Fairgrounds	Caution	Caution	Yes	Yes
Golf Courses	Yes	Yes	Yes	Yes
Beaches and Pools	Yes	Yes	Yes	Yes
Tennis Courts	No	Caution	Yes	Yes
Playgrounds	No	Caution	Caution	Yes
Marinas	Yes	Yes	Yes	Yes
Camping Grounds	No	No	Yes	Caution
Park and Picnic Areas	No	Caution	Yes	Yes

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provincial land use planning. These are recommendations only. However, these recommendations are “imposed” on projects within federal scope. The Canada Mortgage and Housing Corporation will generally only fund developments which meet their standards which are consistent with Transport Canada’s recommendations.

There are three types of noise exposure contours depending on the time element involved and are summarized as follows:

### **3.3.1 Noise Exposure Forecasts (NEFs)**

Traffic volume and aircraft type and mix used in calculating the noise contours are normally forecast for a period of between **five to ten** years into the future. Runway geometry must be the current layout, except that new and approved projects involving changes in the runways may be included, when the completion date of the project lies within the forecast period.

### **3.3.2 Noise Exposure Projections (NEPs)**

It is recognized that much land use planning involves projections beyond five years into the future, when aircraft fleet mixes and runway configurations are most likely to be different from the known conditions of today. To provide provincial and municipal authorities with long range guidance in land use planning, Transport Canada introduced the Noise Exposure Projection (NEP). The NEP is based on a projection of aircraft movements for **up to 20** years into the future and includes aircraft types and runway configurations that may materialize within this period. NEPs are official contours and Transport Canada will support them to the level of accuracy of the input data. The information required to produce an NEP must, at least, be contained in an Airport Master Plan.

### **3.3.3 Planning Contours**


The third type of noise contour is the Planning Contour which is produced to investigate planning alternates and must be labeled as such. Any agency may produce these contours as they do not have an official status. Examples of a planning contour may include composite contours (overlay of two or more different contours) or contours that project airport capacity or “what if” runway configurations.



### 3.4 VALIDATION OF THE CANADIAN NOISE METRIC

In 1996, Transport Canada commissioned the National Research Council to validate the Canadian NEF system. The following basic recommendations/conclusions were developed:

1. Recommends additional surveys be done in Canada to validate the negative effects of aviation noise.
2. Upgrade the NEF system software
3. Consider adopting an A-weighted NEF Measures (to permit field measurements to correlated modeled information)
4. NEFs should be supplemented with single event noise limits using the SEL metric to ensure the general noise environment, including particular worst case situations are considered.
5. Establish clear criteria for acceptable land use at various NEF levels
6. Efforts should be made to publish revised version of CMHC document on new housing and aircraft noise.
7. Encourage uniform national approach of the NEF System

 National Research Council Canada / Conseil national de recherches Canada

**NRC-CMRC**  
**NEF Validation Study:**  
**(3) Final Report**

Contract Report A-1505.6 (Final)

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With respect to the above recommendations, the confirmed actions taken by Transport Canada include:

1. NEF system software is in process of being updated. Initial Beta Testing of the software began in 2003. PSMI has been involved in the testing the software on behalf of NRC-Transport Canada.
2. NRC has completed a study along with recommendations and software design (referred to as IBANA – Insulating Buildings Against Noise from Aircraft) to reflect improved noise insulation techniques using current home building technology. The results of this work must now filter down to the provincial building code level which will involve a concerted effort on the part of Transport Canada and provincial authorities. The results of this study have no legal status in its current form. This

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work is intended to update the CMHC recommendations. Refer to Section 4.1.2 for additional information related to IBANA.

### **3.5 UNIQUE AND RELEVANT CHARACTERISTICS OF NEF SYSTEM**

The Canadian NEF System, due to its development history has some unique and relevant characteristics that are worth highlighting. These characteristics are worth bearing in mind as the airport noise mitigation standards proposed by this study are considered:

1. The Canadian NEF system will underestimate ground attenuation i.e. topography, vegetation etc... while the FAA's (DNL) system overestimates it. The result is that the Canadian NEF is, in most cases, much larger in area than those calculated using the FAA equivalent. This conclusion is the same when compared to the Australian NEF System.
2. The Canadian NEF system penalizes night-time operations by 12 dB whereas the FAA system uses 10 dB. The result, again, is a larger Canadian NEF contour versus the FAA modeled results.
3. The NEF system uses the concept of a 95<sup>th</sup> percentile planning day whereas the FAA uses an average day. The 95<sup>th</sup> percentile day approach results in increased modeled operations and larger contours.

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## 4.0 THE CANADIAN EXPERIENCE

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### 4.1 FEDERAL AND PROVINCIAL POLICIES AND TOOLS

#### 4.1.1 Canada Mortgage and Housing Corporation

In addition to Transport Canada and their Land Use Compatibility Tables discussed in the previous section, Canada Mortgage and Housing Corporation (CMHC) provides the following guidelines for consideration:

Upper Zone – Greater than 35 NEF is unsuitable for housing.

Intermediate Zone – Where NEF values are between 30 and 35, inclusive. This zone is unsuitable for housing unless adequate sound insulation is provided.

Lower Zone – Where NEF values are between 25 and 30 NEF. The provision of adequate insulation is recommended. The upper third of this zone is unsuitable for housing, i.e. between 28 and 30 NEF, when sound insulation proposed is substantially below that considered adequate.

#### 4.1.2 IBANA Project – National Research Council

The Insulating Buildings Against Noise from Aircraft (IBANA) project consisted of the following key components:

1. Laboratory measurements of the sound insulation of various building façade components including various wall and roof constructions as well as windows and the effects of vents.
2. Field measurements of the sound insulation of various configurations of a simple wood frame test house near Ottawa Airport.
3. Development of a procedure for conversion between laboratory and field measurements of sound insulation.



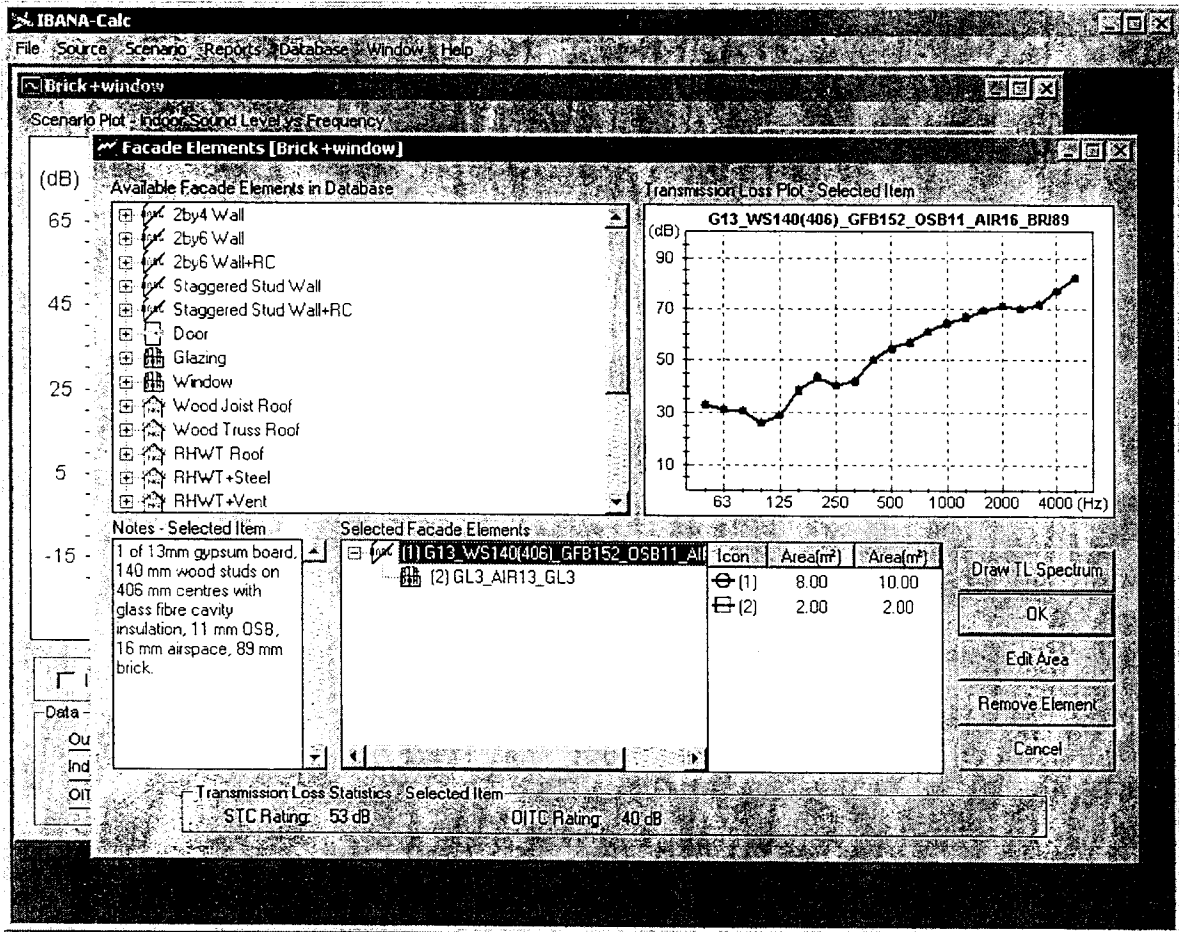
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4. Development of software to enable the more accurate and convenient design of the required sound insulation.
5. Field validation of the new design procedure.

Culmination of this work is the IBANA-Calc software.



The software is used to predict the level of sound attenuation provided by various types of construction and materials. While the software contains a database of construction materials which is primarily focused on materials used in standard housing construction, it is flexible in that new building materials and their sound transmission characteristics can be manually input. Consequently, IBANA can be used to determine the indoor noise environment for a large range of construction types, ranging from single family dwellings to high rise condominiums.

#### **4.1.3 Review of Nova Scotia's Approach**

A broad province wide policy concerning Airport Noise has not been thoroughly developed in Nova Scotia. The province recognizes that NEF contours are the valid metric for measuring airport noise. However, it is ultimately up to the individual municipalities to deal with airport noise within their policies and bylaws. This has been done at the Halifax Regional Municipality as will be discussed shortly.

#### **4.1.4 Review of the Policy Vacuum in Quebec**

Quebec is an example of a laissez-faire approach. There is no mention in Quebec legislation of airport noise as a unique problem. There is no provincial policy as in the case of Ontario, nor is there the provision for special planning regulations near airports, as in the case of Alberta. Noise, in a generic sense is mentioned in the Environment Quality Act in a number of sections, but airport noise is not singled out as being any different from any other noise source.

The lack of provincial initiative pertaining to airport noise and compatible land uses is indicative of possibly two attitudes. The first is that the government does not believe that there is a problem, so it need not address the issue. The second possible attitude is that the government acknowledges that there is a problem, but simply believes that it is unsolvable and that there is no use in trying to legislate any change.

#### **4.1.5 Review of the Ontario's Ministry of Municipal Affairs Provincial Policy Statement**

The Ontario Ministry of Municipal Affairs Provincial Policy Statement is considered by municipalities as part of their planning processes. Specifically, the Ontario Planning Act states that the Minister, the council of a Municipality, or a local board or a planning board and the Municipal Board when carrying out their responsibilities must have regard for policy statements. Excerpts from the current policy statement are found below.

- g. planning so that major facilities (such as airports, transportation corridors, [...]) and sensitive land uses are appropriately designed, buffered and/or separated from each other to prevent adverse effects from odour, noise and other contaminants.*

***To protect airports from incompatible development:***

- 1. New residential development and other sensitive land uses will be prohibited in areas near airports above 30 NEF/NEP, as set out on maps (as revised from time to time) approved by Transport Canada; but*
- 2. Redevelopment of existing residential uses and other sensitive land uses or infilling of residential and other sensitive land uses may be considered above*

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*30 NEF/NEP if it has been demonstrated that there will be no negative impacts on the longterm function of the airport.*

**4.1.6 Review of the Ministry of Environment of Ontario’s Noise Assessment Criteria in Land Use Planning Publication**

The Ministry of the Environment (MOE) has published a series of guidelines related to the noise assessment in land use planning. Within these guidelines, air traffic noise impacts are discussed and guidelines presented. The guidelines outline the position of the MOE on noise criteria for planning of sensitive land uses, in support of the Provincial Policy Statement under the Ontario Planning Act.

Noise Assessment Criteria in Land Use Planning (LU-131)

*Table 3 gives the aircraft noise criterion in terms of an NEF/NEP value in any outdoor area, including the Outdoor Living Area. The criterion applies to the entire 24-hour period. The distance separation from the airport and, consequently, the location of the noise sensitive land use with respect to the NEF/NEP contours, is the only measure that controls the outdoor noise impact.*

<b>TABLE 3</b>	
<b>Outdoor Aircraft Noise Criterion</b>	
<b>Time Period</b>	<b>NEF/NEP</b>
24 hours	30

It should be highlighted that the MOE states that the only measure that controls the outdoor noise impact of air traffic noise is the location of the noise sensitive land use with respect to the NEF/NEP contours. In other words, there is no effective mitigation for outside land uses.

*Table 4 gives the indoor aircraft noise criteria in terms of NEF/NEP values for the indicated type of indoor space. These criteria apply to the entire 24-hour period. The specified criteria are minimum requirements and apply to the indicated indoor spaces with the windows and doors closed.*

<b>TABLE 4</b>	
<b>Indoor Aircraft Noise Criteria</b>	
<b>(Applicable over 24-hour period)</b>	
<b>Type of Space Indoor</b>	<b>NEF/NEP</b>
<i>Living/dining areas of residences, hospitals, schools, nursing/retirement homes, day-care centres, etc.</i>	5
<i>Sleeping Quarters</i>	0

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*The indoor NEF/NEP values, specified in Tables 4 and A-2, are related to the actual "outdoor" values and their difference accounts for the acoustical insulation provided by the building. The indoor NEF values are calculated by converting the indoor sound levels, expressed as  $L_{eq}(24)$  (dBA), using the expression  $NEF = L_{eq}(24) - 31$  dBA.*

Consider that the indoor criteria for rail noise expressed as  $L_{eq}$  is 35 for sleeping quarters. Using the formula above,  $NEF = 35 - 31 = 4$  for indoor sleeping quarters. The published number is 0, which indicates a conservative Table 4.

**TABLE 5**  
**AIRCRAFT NOISE - 24 HOURS**

ASSESSMENT LOCATION	NEF OR NEP	VENTILATION REQUIREMENTS	NOISE CONTROL REQUIREMENTS	WARNING CLAUSE
ANY LOCATION ON PROPERTY OR LOT	Less than NEF 25	None required	Building compliant with the Ontario Building Code	Not required
	Greater or equal to NEF 25 to less than NEF 30	Provision for central air conditioning	Building components (walls, windows, etc.) must be designed to achieve indoor sound level criteria	Required Type C
	Greater than NEF 30	Central air conditioning	Building components (walls, windows, etc.) must be designed to achieve indoor sound level criteria	Required Type B and D

The three types of Warning Clauses described by the MOE are included below:

**TYPE B:**

*Purchasers/tenants are advised that despite the inclusion of noise control features in the development and within the building units, sound levels due to increasing road (rail) (air) traffic may on occasions interfere with some activities of the dwelling occupants as the sound levels exceed the Municipality's and the Ministry of the Environment's noise criteria.*

**TYPE C:**

*This dwelling unit has been fitted with a forced air heating system and the ducting, etc. was sized to accommodate central air conditioning. Installation of central air conditioning by the occupant will allow windows and exterior doors to remain closed, thereby ensuring that the indoor sound levels are within the Municipality's and the Ministry of the Environment's noise criteria. (Note: The location and installation of the outdoor air conditioning device should be done so as to comply with noise criteria of MOE Publication*

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*NPC-216, Residential Air Conditioning Devices and thus minimize the noise impacts both on and in the immediate vicinity of the subject property.)*

*TYPE D:*

*This dwelling unit has been supplied with a central air conditioning system which will allow windows and exterior doors to remain closed, thereby ensuring that the indoor sound levels are within the Municipality's and the Ministry of the Environment's noise criteria.*

### **4.1.7 Review of Manitoba's Approach**

Plan Winnipeg recognizes the economic importance of the Winnipeg International Airport and promotes the Airport as a centre of industrial development. The Plan is the most important document prepared by the City. It is a long-term plan that establishes direction for the City and the steps that need to be taken along the way. It requires that an Airport Vicinity Development Plan be prepared and endorsed by City Council. In addition, legislation passed by the Province of Manitoba, requires that an "Airport vicinity protection area" be designated in a Plan Winnipeg by-law amendment. Such changes to the Plan, and others, are necessary to clarify the original intent and to ensure that the policy statements become more closely tied to specifications. Refer to Appendix G for additional details.

### **4.1.8 Review of Alberta's Airport Vicinity Protection Area (AVPA) Regulation**

The approach adopted by the province is prescriptive in nature, although applied in a somewhat limited manner. The enabling statute for municipal land use planning in Alberta is the Alberta Municipal Government Act. Part 17 entitled Planning and Development of this act replaces the former Planning Act. Division 12: Bylaws and Regulations contains section 693 entitled Airport Vicinity Regulations that reads:

*693(1) The Lieutenant Governor in Council may make regulations establishing international airport vicinity protection areas surrounding the Calgary International Airport and the Edmonton International Airport; controlling, regulating or prohibiting any use and development of land within an international airport vicinity protection area.  
(Alberta Municipal Government Act 1995, s. 693.)*

While the above section makes specific mention of only the provinces two largest airports, section 693 (6) applies more generally to the remaining airports within the province:

*(6) The Lieutenant Governor in Council may make regulations by which municipalities may define land in the vicinity of an airport for purposes of this section prescribing how municipalities are to manage the use and development of land in the vicinity of an airport, and respecting the control, use and development of land in the vicinity of an airport.  
(Alberta Municipal Government Act 1995, s. 693.)*



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While the Alberta government seems to deal with its airports in two distinct manners, it is worth underlining that in neither case do they make the limits explicit in the legislation. Rather, it is in the regulations themselves that the real substance of the government's policy becomes clear. For the time being, only two regulations has been adopted and remain in force following these two sections. The Edmonton International Airport Airport Vicinity Protection Area (EIA AVPA) and the Calgary International Airport Vicinity Protection Area (CIA AVPA) regulations address the specific problem of airport noise and compatible land use planning.

### **4.2 AIRPORT SPECIFIC EXPERIENCES**

#### **4.2.1 Halifax International**

The situation at the Halifax International Airport is currently in flux. The Halifax Regional Municipality (HRM) recognizes that airport noise is a concern which must be addressed within the regional land use planning context. However, following the amalgamation of 22 municipalities, the HRM has recognized the need to update and consolidate it regional land use plan. Within the current incarnation, NEF contours are recognized and a statement is made to the affect that the HRM must work with the Federal and Provincial governments to acquire impacted lands.

The Halifax International Airport Authority (HIAA) also recognizes the need to address airport noise at the land use planning level. The HIAA has approached the HRM during the Regional Land Use Plan update process to ensure that airport noise compatibility issues are addressed. As part of this effort, the HIAA has initiated an NEF contour update process, so as to provide the Municipality with the most reliable and long-term contours possible for inclusion or reference within the revised land use plan.

#### **4.2.2 Montréal-Trudeau (Dorval)**

Aéroports de Montréal, the airport authority responsible for Montreal – Trudeau (Dorval) and Mirabel airports has an active noise management program. As with other airports, NEF contour maps are developed and made available to the public. However, there is no consistent application of mitigation measures, nor is there a city wide policy which addresses airport noise and land use planning.

#### **4.2.3 Ottawa International**

The Official Plan for the Regional Municipality of Ottawa-Carlton has included an Airport Vicinity Development Zone. The AVDZ identifies areas around airports where aircraft noise, as well as aviation safety related factors, must be considered when developing nearby.

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A supplementary zone, the Ottawa Airport Operating Influence Zone (OAOIZ) has also been delineated. This supplementary zone is a fixed line that follows physical features and is generally intended to follow the more restrictive of either the 30 NEF (1994) or 30 NEP (2014) contours. Within this prescribed zone, noise-sensitive developments, particularly residential, are not permitted except in particular circumstances.

Within the two zones mentioned above, the planning department is to apply the provisions of *Land Use in the Vicinity of Airports*, 7<sup>th</sup> Edition, published by Transport Canada. This document contains provisions that address noise, bird hazards, electromagnetic interference, obstacle limitation surfaces, and restrictions to visibility. Provisions included in *Noise Assessment Criteria in Land Use Planning, Publication LU-131*, October, 1997 published by the Ontario Ministry of the Environment must also be applied when determining the appropriateness of development within the zones.

Further constraints on development have also been implemented. For all land use proposals at or above the 25 NEF/NEP boundary a detailed noise study may be required as a condition of draft approval of subdivisions or condominiums, or as a condition of severance.

Residential infilling is permitted within the OAOIZ provided that it does not require approval of a plan of subdivision or amendment to a zoning by-law or official plan. However, the development must meet all noise attenuation requirements and other provisions of the Ottawa International Airport Zoning Regulations.

Finally, the regional Official Plan recognizes the need for consultation with various interests involved. The multi-agency Ottawa Airport Liaison Committee meets regularly to discuss and remedy any aircraft noise concerns. The regional government consults with the Airport Authority, Transport Canada and the Ministry of Municipal Affairs and Housing on issues that require expert advice.

### **4.2.4 Hamilton International**

A proposal for the development of a Hamilton International Airport Vicinity Protection Area (HIAVPA) was developed but was never adopted. The HIAVPA had four goals:

- to minimize future land use conflicts within noise impact areas,
- to provide specific definitions of compatible land uses,
- to promote opportunities for cohesive planning across multiple jurisdictions, and
- to protect space for future airport-related development.

Currently, Hamilton International Airport (HIA) has implemented a number of noise mitigation procedures. Specifically, noise abatement procedures to direct aircraft takeoffs towards

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sparsely populated areas and preferential runway operations to avoid flying over the City of Hamilton direct noise away from sensitive areas.

HIA also employs a noise tracking systems to monitor noise from aircraft to ensure compliance with operational procedures. HIA actively encourages the use of quieter Chapter 3 aircraft.

The Regional Municipality of Hamilton-Wentworth developed an Influence Area, introduced in 1995, that covers approximately two-thirds of the 25 NEF contour. The Proposed HIAVPA boundary would be 40% larger than the Regional Municipality Influence Area, and would follow the 25 NEF (1996) contour. This proposed area would include both current provincial (30 NEF) and regional (influence area) boundaries.

The current Regional Municipality Official Plan indicates that limits should be placed on “noise or land use sensitive” areas, responsibility of which is with the surrounding Towns of Ancaster and Glanbrook. The proposed HIAVPA plan would define clear development boundaries and noise sensitivity levels to ensure commonality across the three levels of government affected by airport operations, as related to land use planning and development. To date, the Region has not adopted the HIAVPA plan.

### **4.2.5 Toronto Lester B. Pearson International**

The authority that manages and operates LBPIA is the Greater Toronto Airports Authority GTAA. The authority is a not for profit corporation that was created in the context of the federal government’s divestiture initiative embodied by the NAP. The GTAA professes the same noise policies as Transport Canada. In the Noise Management chapter of their Master Plan the GTAA states: “...that the most effective way to minimize the impact of noise is through proper land use planning in the vicinity of airports.” (GTAA 1999, 48). To support this statement, the GTAA went further and defined a fixed Airport Operating Area (AOA) that is based on the 30 NEP contour.

The AOA approximates the 30 NEP contour projected to the maximum capacity of the airport. To facilitate the implementation and understanding of the area, rather than exactly following the ethereal path of the contour, the AOA is drawn to follow major physical features on the ground, such as arterial roads. In this way, the area does not cut lots in half and unduly complicate its interpretation. While the PPS and AOA do not explicitly encourage inter-jurisdictional decision-making, by establishing a boundary that crosses jurisdictions and is readily available for all, it allows for consistent planning efforts across municipal boundaries.

Having established this area and registered it with the Ministry of Municipal Affairs and Housing, the GTAA actively opposes all residential development within the 30 NEF contour. This is evident in the recent Ontario Municipal Board case between the GTAA and the Regional Municipality of Peel. The substance of this case was that the region wanted to

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amend its official plan to rezone previously established employment/industrial lands to residential. The airport objected to this on two fronts. The first was that much of the lands fell within the 30 NEF contour and all of the lands fell within the airport operating area. The second reason for the GTAA's opposition is not pertinent to the subject matter of this inquiry. Due to the timing of the case and of the development of the provincial policy statement, the Board's ruling was based on the previous policy context, which was significantly more relaxed than it is currently. The Board found that though residential development could meet the requirements set out in the previous policy environment, that it was obliged to determine "...whether a reasonable quality of residential environment will result". The board ultimately concluded that it is not normal for residents to have to be enclosed by triple glazed windows with the air conditioning on to enjoy their gardens.

The operating area delineated by the GTAA is an attempt to acknowledge that the noise management issue crosses political boundaries. However, the GTAA clearly acknowledges that land use planning is a provincial jurisdiction and that the authority can only participate in an advisory role. The GTAA's noise management policy does not end with land use planning. Through noise abatement initiatives and operating restrictions, it attempts to deal with pollution at the source. Finally, the GTAA attempts to encourage partnerships, cooperation and facilitation by establishing various committees, forums and workshops to deal with noise management issues at the airport. These include the GTAA Consultative Committee and the Noise Management Committee. However, it must be underlined that these committees, forums and workshops do not derive from a provincially imposed legislative requirement.

It is important to acknowledge the single greatest failure of the Ontario approach. It fails to address those residents that are already living near the airport and adversely affected, or those who will become adversely affected by airport expansion. The exemptions allowing infilling and redevelopment directly negate the possibility of preventing the increase of people affected by the airport.

As mentioned in the previous chapter, the manner in which Ontario's legislation addresses the PPS is somewhat awkward. The combination of the terms "shall" and "have regard to" within the same sentence is complicating. Whereas "shall" is an obligation, "have regard to" is much less obligating. Consequently, the weight placed on issues of provincial interest by planners and ultimately the OMB is not definitive. As such, the effectiveness of the inclusion of the 30 NEF limit is reduced.

### **4.2.6 Winnipeg International**

The City of Winnipeg has adopted the Airport Vicinity Development Plan (AVDP) to protect Winnipeg International Airport. The AVDP boundaries are approximated by the 25 NEF contour. The NEF configuration reflects the ultimate traffic volume at the airport and the potential for an additional runway to the northeast of the existing runway. Where possible the boundary follows major right-of-ways and individual property lines.

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The development and implementation of the AVDP involves three entities. The Executive Steering Committee sets overall policy and direction for the plan. This committee includes senior political representatives from the City of Winnipeg and the Rural Municipality of Rosser. The Management Advisory Board provides input and advice on direction, and action and is comprised of both public and private representatives. The administrative Support Group delivers the process and includes 14 individuals from three levels of government.

The AVDP is broken down into three strategic issues: economic development, land use and noise. The land use component considers main city streets that are located within the 25 NEF contour and the development to occur along these streets. Residential development is unrestricted beyond the 25 NEF contour. Within the 35 NEF contour, single and multiple family dwellings are limited to current densities. Between the 25 and 35 NEF boundaries, residential development is permitted up to a density of 85 units per hectare. Residential development in specific areas around the airport will only be permitted if the construction meets CMHC standards.

Noise management is dealt with in a variety of manners. There are ongoing citizen and technical review meetings to address possible noise reduction alternatives through a comprehensive communication program. Noise reduction initiatives include:

- strict controls on engine run-ups;
- ensure assignment of calm wind runway preference to more equitable split of aircraft over residential area, and preferred runways for night-time use;
- maintain assigned departure tracks and climb profiles;
- measure and evaluate the effectiveness of all procedures.

### **4.2.7 Edmonton International Airport Vicinity Protection Area**

A number of aspects of this regulation are worth some mention. First, the regulation does not only address airport noise, but also other land use issues that are addressed in Transport Canada's Land Use Planning in the Vicinity of Airports other 5 chapters. For example interference with radar, are considered. The area contained within the AVPA is larger than even the 25 NEF contour. The regulation is actually more of a broadly stroked development plan, identifying a variety of land use areas ranging from airport agricultural, airport residential to airport urban. Within each of the identified areas, various uses are identified and their permissibility for as many as 5 NEF ranges is stated. The tables within the regulation are an adaptation of Transport Canada's recommendations in TP1247 with some variations.

Finally, the EIA AVPA is particularly interesting since it is an overarching "development plan" that affects three municipalities, the City of Edmonton, the County of Leduc, No. 25 and the City of Leduc. While the municipalities can still approve development projects, they must meet

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the EIA AVPA requirements, as well as any requirements that the municipalities might also have. This allows for a consistent approach to a common problem faced by multiple municipalities.

However, the EIA AVPA has been undergoing changes. While the regulation has not been updated since the 1980s, Alberta Municipal Affairs has embarked on a process to update the regulation. This update is comprehensive since it considers not only the new NEF contours for the airport, but also rethinks its prescriptive approach to the issue of airport noise and land use planning. Furthermore, it has been reconceived to ensure that jurisdictional boundaries have been carefully respected.

The NEF contours on which this regulation will be based are a composite of two different airport development scenarios in the distant future, 2040. It was determined that this was the best way to ensure that no new noise constituencies were created in the future and was a reasonable estimate of the airport's capacity considering their existing airside configuration.

### **4.2.8 Calgary International Airport Vicinity Protection Area**

The Calgary International Airport is currently in the process reviewing its AVPA. The Calgary AVPA is similar in scope and approach to that of the Edmonton International Airport AVPA. This stems from the fact that both regulations were promulgated by the provincial government.

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## **5.0 INTERNATIONAL PERSPECTIVES ON AIRPORT NOISE AND RESIDENTIAL LAND USE**

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### **5.1 AUSTRALIA NEF**

The following is intended to provide a brief summary of the Australian NEF System and additional information can be found in Appendix F:

- It began as the American NEF.
- A significant amount of research during the late 1970s developed dose-response curve specifically for Australia.
- The major differences between the ANEF and the Canadian NEF include:
  - Night time is from 7pm to 7am and is weight at 6 dB as opposed to 10pm to 7 am weight at 12 dB.
  - Australia shows the 20 ANEF contour on mapping. However, this contour is hard to predict accurately.
- Publications indicate the actual location of the 20 ANEF is difficult to define accurately, mainly because of variation in aircraft flight paths.
- Table 2.1 of AS2021 the Australian Standards document for compatible land use planning vis-à-vis aircraft noise recommends residential is acceptable less than 20 ANEF, conditionally acceptable between 20 and 25 ANEF and unacceptable above 25 ANEF.
- As a comparison to other international standards, the Australian approach appears to be the most conservative. The following is an excerpt from a Discussion Paper published by Australia's Department of Transport and Regional Services.

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**Table 6.1: Comparison of Aircraft Noise Based Land Use Planning Controls \***

Noise Level (ANEF)	United States	United Kingdom	Australia	Germany	Canada	Other
> 40	No housing	No housing	No housing	No new Housing	Housing not Recommended	No new Housing
30 - 40	No new housing; insulation of existing housing at Sydney	No new housing; insulation of existing housing	No new housing; insulation of existing housing	Limited new housing	Housing not Recommended	Limited new housing
25 - 30	No new housing	<b>No restrictions</b>	No new housing	<b>No restrictions</b>	New housing with insulation	Restrictions in some States
20 - 25	New housing with insulation	<b>No restrictions</b>	No new housing	<b>No restrictions</b>	<b>No restrictions</b>	Restrictions in some States
< 20	<b>No restrictions</b>	<b>No restrictions</b>	<b>No restrictions</b>	<b>No restrictions</b>	<b>No restrictions</b>	<b>No restrictions</b>

\* As excerpted from AS2021

- A relatively new development in Australia is N70 mapping. The maps illustrate areas which have a certain number of events per day which are greater than 70 dBA. The contours usually go as low and 20 events per day of greater than 70 dBA. In the case of the EIS for the second Sydney Airport, a contour was shown for 10 – 20 events. It was found that this was not terribly accurate and was significantly larger than the 20 ANEF shown on typical maps.
- The N70 concept has proven to be extremely useful in communicating noise impacts with the general public in terms of every day concepts. It is not intended to replace the ANEF as a land use planning tool but rather to supplement it and provide additional information to the public within the ANEF contours and beyond as to the actual, practical noise impacts at their location. Another new tool being used in Australia is the Person-Events Index. (PEI).
- The Australian NEF has been developed as a National Standard. AS 2021-2000 : Acoustics - Aircraft noise intrusion - Building siting and construction. This is the 4<sup>th</sup> edition. Due to its development as a national standard, it has been rigorously evaluated.



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### 5.2 AMERICAN $L_{DN}$

Despite having been the original developers of the NEF system, the Americans never adopted the metric. Instead, in 1974, the American Environmental Protection Agency (EPA) identified the A-Weighted DNL metric was identified as the best descriptor. Part of the motivation for the development of the DNL was political pressure to have a single metric for all federal departments. At the time the EPA identified 55 dB as requisite to public health and welfare.

In 1979, the Federal Interagency Committee on Urban Noise (FICUN) was formed to develop Federal policy and guidance on noise. The committee's membership included the:

- Environmental Protection Agency (EPA),
- the FAA,
- the Federal Highway Administration, and the
- Departments of Defense (DOD), Housing and Urban Development (HUD), and Veterans Affairs (VA).

The report entitled *Guidelines for Considering Noise in Land Use Planning and Control* was issued in 1980. This report established the Federal government's DNL 65 dB standard and related guidelines.

In 1992, the Federal Interagency Committee on Noise (FICON) reaffirmed the appropriateness of using DNL as the standard noise metric in their report *Federal Agency Review of Selected Airport Noise Analysis Issues*.

The FAA has suggested that normal construction provides an outdoor to indoor Noise Level Reduction (NLR) of 20 dB. This suggests that an "acceptable" indoor noise level is 45 dB. This converts to approximately 10 NEF.

Further details on the American  $L_{DN}$  are contained within Table 4.

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## **6.0 CITY OF RICHMOND – THE CONTEXT**

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### **6.1 REVIEW OF THE VANCOUVER INTERNATIONAL AIRPORT AUTHORITY'S NEF RELATED POLICIES**

#### **6.1.1 General**

Through the lease with the Federal government, the Airport Authority is responsible for maintaining an Aeronautical Noise Management Committee whose members include:

- Citizen Representatives (Richmond, Vancouver, and Delta)
- City of Richmond (Planning)
- City of Vancouver (Vancouver Coastal Health Authority)
- Musqueam Indian Band
- Airlines (Air Canada and Air Canada Jazz)
- Air Transport Association of Canada
- Canadian Business Aircraft Association
- Nav Canada
- Transport Canada
- Vancouver International Airport Authority

In addition, YVR is also required to maintain and update an Airport Master Plan for the airport. It is understood based on consultations with YVR during this study that an update to the existing Master Plan is in progress with a projected completion year of 2006. This process will identify potential changes to the airport operating environment that may impact the current 2015 NEP contour map which should be considered in any future land use planning policies.

#### **6.1.2 Vancouver International Airport Authority's Noise Programs**

The Vancouver International Airport Authority has an active noise management programme in place. Through the use of Noise Monitoring and Flight Tracking systems, the establishment of various noise abatement procedures and the distribution of runway use, the Authority actively works to mitigate its noise impacts on surrounding communities.

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The Airport Authority is also responsible for the development and distribution of NEF contours for the airport. The contours provide a standardized basis from which surrounding municipalities may make informed land use planning decisions in relation to Airport Noise. It is important to note that the Authority is responsible for the preparation of the noise contours. They are submitted to Transport Canada for 3<sup>rd</sup> party technical review and are endorsed by Transport Canada but are not to be considered as Transport Canada approved contours. Since the devolution of airports from the federal government, the role of Transport Canada in the preparation of NEF contours has also been devolved to local entities, such as the Airport Authority.

Furthermore, the Airport Authority and the City of Richmond have entered into a contractual agreement which deals with non-aeronautical land use issues at the airport. Refer to Appendix E for excerpts from this agreement relevant to this study.

As part of its active efforts to mitigate noise, the Airport Authority, in cooperation and consultation with NavCanada and Transport Canada, has implemented a number of Noise Abatement Procedures. These procedures are excerpted in Appendix C. In summary, the noise abatement procedures address arrival and departure procedures, preferred runways dependent upon time of day and wind direction, reverse thrust on landing, engine run-up restrictions, altitude restrictions and restrictions on night time operations. It is important to note that noise abatement procedures require the cooperation of Nav Canada and the carriers, and that enforcement of the procedures falls to Transport Canada.

### **6.1.3 Vancouver International Airport Authority's Position on Airport Noise and Land Use Planning**

The Vancouver International Airport Authority has reiterated its position on a number of issues as related to airport noise and land use planning. The full text of a letter issued during the course of this study is available in Appendix D. In summary:

- The Authority states that it does not support increased residential and non-airport compatible development in high noise or high air traffic areas;
- compatible land use planning plays an integral role in airport noise management;
- improvements made by reductions at the source are annulled if residential housing is permitted to locate too close to the airport;
- reference is made to Transport Canada's TP1247 document and underlines that individual complaints may be vigorous and group action possible in areas of >30 NEF; and

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- legal notices on title may protect the Airport and City from suit, but will not prevent individuals from exerting political pressure on local politicians to demand changes in airport operations.

### **6.1.4 Evaluation of Community Response to Aircraft Noise Following Completion of Runway 08L/26R at Vancouver International Airport – BBN Technologies**

In 1995 and 1998, YVR commissioned social surveys of community response to noise exposure near the airport. The primary objectives included establishing a baseline understanding of how the community reacts to airport noise and to understand the impact of the new parallel runway construction. The generalized conclusions from these studies follow:

#### **1995 Study:**

- Respondents in the present study were somewhat more tolerant of aircraft noise than those interviewed in prior surveys; and
- Roughly similar percentages of respondents were highly annoyed by aircraft noise in the present interviewing areas as in other neighbourhoods elsewhere with comparable noise exposure

#### **1998 Study:**

- With exception of Bridgeport, roughly similar percentages of respondents were highly annoyed by aircraft noise in the present interviewing areas as in many other neighbourhoods elsewhere with comparable noise exposure;
- Respondents were more willing to describe themselves as highly annoyed by aircraft noise for non-acoustic reasons in the second round of interviews than in the first; and
- Respondents in the present study were less tolerant on average of aircraft noise than those interviewed elsewhere.

From the above report summaries, it can be ascertained that the community response to aircraft noise is generally consistent with the NEF-community prediction table below as estimated by the Canadian NEF System. This affirms that the table's use as a predictor of community response as a function NEF is reasonable and applicable to the YVR-City of Richmond context. The 1998 results do suggest that the general population may have become somewhat more sensitive to noise around the airport compared to the 1995 study.

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Community Response Prediction and NEFs	
Response Area	Response Prediction
>40 NEF	Repeated and vigorous individual complaints are likely. Concerted group and legal action might be expected.
35 - 40	Individual complaints may be vigorous. Possible group action and appeals to authorities.
30 – 35	Sporadic to repeated individual complaints. Group action possible.
< 30	Sporadic complaints may occur. Noise may interfere occasionally with certain activities of the resident.

## 6.2 REVIEW OF THE CITY'S EXISTING AIRPORT NOISE RELATED POLICIES

### 6.2.1 Existing Policy

During the fall of 1995, the City of Richmond adopted noise guidelines for construction of residential buildings in high air traffic noise areas. The applicable guidelines are applied to a predefined area of the city. The guidelines reference the 2011 NEF contours as the geographic basis for applying noise mitigation policies. While the most recent Airport Master Plan published the 2015 NEP, it was determined that both the 2011 NEF and 2015 NEP were sufficiently similar.

The noise mitigation policies apply to both single family as well as multi-family dwellings. The policies are not retro-active and apply to new housing that require either rezoning or subdivision approval and that fall generally at or above the 25 NEF. New residential construction within this area must be insulated to CMHC standards for indoor noise.

More specifically, for rezonings and subdivision, the City requires "Registration of a Restrictive Covenant agreeing to have new buildings designed to incorporate adequate sound measures against aircraft noise." Furthermore, at the time of building permitting the City requires inspection and certification that the measures have been incorporated.

### 6.2.2 Existing City Health Policy

The Richmond Health Policy entitled *Potential Impact of Aircraft Noise on Health in Residential Developments*, reviews health concerns as it relates to airport noise and residential development. Following a brief review of the NEF system and citing noise

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standards of the Central Mortgage and Housing Corporation, now the Canada Mortgage and Housing Corporation, the document proceeds to review health concerns.

The health concerns are categorized as physiological effects, psychological effects or subjective. The direct causal relationship between physical illness and urban noise (including aircraft noise) is not clear. While the policy considers effects on the cardiovascular system and sleep interference, the only conclusive health effects are related to hearing. However, the outdoor peak noise levels discussed in the document are outdated due to an important shift in the aircraft fleet operating at the Airport.

As part of the psychological effects considered, speech interference is highlighted. An indoor  $L_{eq}$  of 45 dBA or less is identified as requisite for complete speech intelligibility in a private home. When considering sleep disturbance, studies are highly inconsistent in the conclusions which are drawn.

Finally, subjective effects are considered. The community response level to airport noise from the CMHC is referenced in this section, as well as a Transport Canada Master Plan which correlated annoyance with aircraft noise with location within NEF contours. The results are summarized below for informational purposes.

<b>NEF</b>	<b>% Highly Annoyed</b>
23-28	7
29-33	12
34-38	20
39-43	31
44-48	45

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The document concludes:

*Although definitive quantitative relationships between sources of environmental noise (such as aircraft noise) and changes in physical and mental health have not been established, it is apparent that certain levels of environmental noise do affect activities in residential settings. [...] Municipal council should be given the opportunity of reviewing staff's concerns regarding noise levels and deciding whether it is appropriate to restrict or allow residential development in areas designated as being greater than 35 NEF.*

### **6.2.3 Challenges**

While the City of Richmond has considered airport noise at various times, it lacks a comprehensive and consistent policy on airport noise and residential development. Currently, residential development pressures are pressing the City to develop such a policy.

As mentioned in the first chapter of this study, the critical issue is to balance the economic and other benefits YVR brings to the community with the needs of the City to provide a livable environment for its existing and future residents. In addition, the City policy needs to strike a balance between various local, national and international standards which deal with the challenging issue of airport noise and land use compatibility. The following chapter seeks to develop a set of mitigation standards for airport noise and residential development so as to respond to these mounting development pressures.

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## **7.0 STANDARDS**

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### **7.1 GENERAL**

The need for consistent, easily understandable and feasible mitigation standards for the City of Richmond is clear. The need stems from two sources: first, the proximity of the airport to the city and its noise impact on the city; and second, the desire of the City to foster development while ensuring attractive and liveable options for complete communities.

A number of land uses were identified for study as part of the Terms of Reference. These included:

- Residential
  - Residential towers
  - Multiple dwelling uses
  - Live-work uses
  - Work-live uses
  - Single family uses
- Day care centres
- Assembly uses
- Others, as determined by the study.

Mitigation standards for both indoor and outdoor uses for the land uses identified above require examination.

#### **7.1.1 Nuisance and Livability as Motivators of Airport Noise Mitigation Standards**

Prior to the examination of indoor and outdoor noise mitigation standards, it is important to understand the driver behind any such standards. The Health Policy discussed in section 6.2.2 as well as current Health Canada documents fail to quantitatively identify significant health impacts associated with airport noise. Consequently, as with the NEF noise metric itself, the principal driver behind the development and setting of airport noise mitigation standards in the context of Richmond is nuisance.



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Having established that nuisance, and not health effects is the principal driver for noise mitigations standards, it is worth noting specific nuisance issues which are considered by the proposed and other noise mitigation standards. Speech interference, sleep disturbance and interference with daily activities such as watching television or listening to the radio are prime example of sources of nuisance. Not coincidentally, being able to have a conversation in your backyard without interruption, sleeping comfortably through the night and carrying out your daily activities all contribute to the overall livability of a residence.

To further refine the principal driver of the noise mitigation standards, it is fair to say that a reduction in nuisance relates to increased livability. In other words, providing a liveable environment, as far as airport noise is concerned, is a principal motivator to the establishment of airport noise mitigation standards.

### **7.2 PROPOSED INDOOR AND OUTDOOR AIRPORT NOISE MITIGATION STANDARDS**

#### **7.2.1 General**

The process to develop Noise Mitigations Standards for both indoor and outdoor noise is multi-phased. First a summary of existing standards will be presented (Table 4). From these, separate indoor and outdoor mitigation standards will be proposed. Next, these standards will be integrated into a combined standard. This combined standard represents the basic Mitigation Standards for airport noise. However, while these standards are based on nationally and internationally implemented standards, they may not take into account context specific considerations. For this reason, a review of the impacts on both the City of Richmond and the Vancouver International Airport was then be conducted. Following the review period of this Part 1 report, revisions/additions may be made to the Standards to mitigate the impacts on the two key stakeholders.

#### **7.2.2 Summary Review of Existing Standards (Indoor and Outdoor)**

While the goal of this study is to develop indoor and outdoor mitigation standards, the following review of existing standards deals with both mitigation standards at once (refer to Table 4). The rationale for this is that the bulk of airport noise mitigation standards that exist initially speak to the outdoor noise environment. This is due to the fact that airport noise metrics such as the Canadian NEF system, the Australian NEF system and the American DNL (expressed as  $L_{dn}$ ), measure the outdoor noise environment. There are however both implied and explicit references made to indoor noise standards in all of these systems. For example, the American FAA makes it clear in their legislation that conventional construction is expected to provide a 20 dB Outdoor to Indoor Noise Level Reduction (NLR). Consequently, it can be deduced that if 65 dB  $L_{dn}$  is an acceptable outdoor noise environment, 45 dB  $L_{dn}$  is the targeted indoor noise value.

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It is important to emphasize though, that while indoor noise environments can meet targeted noise levels even in areas of high noise impact, the outdoor standards will not be maintained at the same time. Thus, indoor and outdoor noise are not only related but also inseparable.

Since not all of the various land uses outlined earlier are dealt with explicitly in the referenced standards under review it is important to have a clear understanding of their meaning. Residential towers, multiple dwelling uses and single family uses are relatively standard and do not require a great deal of elaboration.

Live-Work and Work-Live uses refer to mixed land use districts which are comprised of residential and non-residential uses. The non-residential uses may include small offices, artist's lofts and small scale retail to name a few examples. The principal difference which distinguishes Live-Work use from Work-Live use is the preponderance of residential use. In the case of Live-Work use, the predominant use is residential. There is the expectation of being able to enjoy the quiet environment usually associated with a residential area. In the case of Work-Live uses, the commercial component takes precedence over the residential aspects. Noise, external employees and office visits are likely to occur in this situation. The expectation of quiet enjoyment is reduced as compared to live-work uses.

With the distinction made between Live-Work and Work-Live uses made at a general level, a decision as to how to treat them as part of this review can be made. Live-Work will be treated as a residential use similar to that of a single family dwelling whereas Work-Live will be treated as commercial use, similar to offices.

Day care use is also self-evident, and when not dealt with directly, will be treated as a school. The final use to consider is Assembly use. There are a number of possible types of assembly uses, from outdoor theatre to sports stadiums, athletic fields and parks and playgrounds. Possible indoor assembly uses include places of worship, indoor theatres, auditoriums and arenas. The expectations of the noise environment for each of the above note examples vary widely. Consequently, a definitive standard for such a broadly termed use may be difficult to define. Examples of assembly uses will be provided with the table and their context explained.

It should be noted that the standards summarized below are often expressed in units other than the Canadian NEF. Generally accepted conversions exist to express international standards in terms of the Canadian NEF and will be applied where appropriate.

For the most part, the standards established by both Canadian and international authorities can be separated in 3 distinct categories:

1. Normally acceptable;
2. Conditionally acceptable; and
3. Clearly unacceptable.

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Generally, those land uses that are conditionally acceptable have stipulations which require additional acoustic insulation and proven performance standards for indoor noise mitigation.

Table 4 below summarizes existing airport noise standards, locally, nationally and internationally.

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**Table 4**  
**Summary of Existing Airport Noise Mitigation Standards**

Source	Land Use	Residential towers	Multiple dwelling uses	Single family uses	Live-Work uses	Work-Live uses	Day Care Centres	Assembly uses
City of Richmond		< 25NEF → Normally acceptable.				No explicit standards	No explicit standards	No explicit standards
		> 25 NEF → Conditionally acceptable. Must meet CMHC standards for indoor noise. Furthermore, developers and builders of housing within this zone must enter into a Section 215 Restrictive Covenant.						
Transport Canada TP1247		All types of residential uses identified by TP1247 (detached, semi-detached, town houses, garden homes and apartments) are treated in the same manner.					TP1247 does not explicitly identify day care centres as part of its tables. It is proposed that day care centres are sufficiently similar to schools and community centres that the standards applied to those uses would be appropriate for day care centres.	For the purpose of this review, places of worship, auditoriums and indoor theatres are considered to represent assembly uses.
		25-30 NEF → Normally acceptable Although annoyance may begin as low as 25 NEF.			25-30 NEF → Generally acceptable.		25-30 NEF → Normally acceptable although borderline near 30 NEF.	25-30 NEF → Normally acceptable although borderline near 30 NEF.
		30-35 NEF → Conditionally acceptable Not normally recommended however, with appropriate insulation and a noise impact assessment study, residential construction could be permitted. Furthermore, the developer should be required to inform all prospective tenants of the airport noise environment.			30-35 → Conditionally acceptable Should only be approved following a detailed noise analysis and required noise insulation features are considered.		30-35 NEF → Conditionally acceptable Should only be approved following a detailed noise analysis and required noise insulation features are considered.	30-35 NEF → Conditionally acceptable Should only be approved following a detailed noise analysis and required noise insulation features are considered.
		30-35 NEF → Conditionally acceptable under previous edition of TP1247. > 35 NEF → Clearly unacceptable.			35 - 40 → Conditionally acceptable Should only be approved following a detailed noise analysis and required noise insulation features are considered. >40 NEF → Conditionally accepted Should be permitted only if associated with aviation activities. Conventional construction will generally not be adequate and specialized noise insulation will be required.		> 35 NEF → Clearly unacceptable.	35-40 NEF (Indoor theatres only) → Conditionally acceptable. Under conditions where it is deemed highly desirable to provide a facility it could be deemed acceptable following a detailed noise analysis and the required insulation features are included in the building design. > 35 NEF (all other) → Clearly unacceptable.

Table 4  
 Summary of Existing Airport Noise Mitigation Standards

Source	Land Use				Work-Live uses	Day Care Centres	Assembly uses
	Residential towers	Multiple dwelling uses	Single family uses	Live-Work uses			
Canada Mortgage and Housing Corporation New Housing and Airport Noise	25-28 NEF → Conditionally acceptable Provision of adequate sound insulation is recommended. 28-30 NEF → Conditionally acceptable When sound insulation is considered to be adequate. 30-35 NEF → Conditionally acceptable Unsuitable for housing unless adequate sound insulation is provided. > 35 NEF → Clearly unacceptable Unsuitable for housing. CMHC will NOT support social housing projects neither through direct financing nor subsidy. This is an important consideration when considering any residential development >35. Recommended Indoor Noise Exposure Levels Bedrooms: 0 NEF Living, Dining, Recreation: 5 NEF Kitchen, Bathroom: 10 NEF	No standards available	No standards available	No standards available	No standards available	No standards available	No standards available
Ministry of Environment of Ontario LU-131	Noise criteria within this document are given for Indoor NEF/NEP values. These values are not derived from contours maps but rather represent the outdoor NEF/NEP with the noise insulation factored in. Noise criteria within this document are not separated by type of residential use. However, reference is made to Sleeping Quarters and living quarters. Sleeping quarters: 0 NEF → Normally acceptable Living quarters: 5 NEF → Normally acceptable Outdoor < 30 NEF → Normally acceptable Outdoor > 30 NEF → Conditionally acceptable Provision for warning clauses on title in cases of redevelopment or infilling.	No standards available	No standards available	No standards available	No standards available	No standards available	No standards available
US Department of Housing and Urban Development	For housing projects the HUD defines Site Acceptability Standards based on the Exterior noise environment. < 65 dB L <sub>dn</sub> (30 NEF) → Normally acceptable 65 dB L <sub>dn</sub> (30 NEF) – 75 dB L <sub>dn</sub> (40 NEF) → Conditionally acceptable Special approvals, an environmental review and attenuation are required. A minimum of 5 decibels additional sound attenuation for buildings having noise-sensitive uses if the day-night average sound level is greater than 65 decibels but does not exceed 70 decibels, or a minimum of 10 decibels of additional sound attenuation if the day-night average sound level is greater than 70 decibels but does not exceed 75 decibels. This ultimately reduces the interior noise environment to 65 dB L <sub>dn</sub> (30 NEF). > 75 dB L <sub>dn</sub> (40 NEF) → Clearly unacceptable	No standards available	No standards available	No standards available	No standards available	No standards available	No standards available

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Table 4 Summary of Existing Airport Noise Mitigation Standards						
Source	Land Use		Live-Work uses	Work-Live uses	Day Care Centres	Assembly uses
	Residential towers	Multiple dwelling uses				
Federal Aviation Administration (US)	< 65 dB L <sub>dn</sub> (30 NEF) → Normally acceptable 65 dB L <sub>dn</sub> (30 NEF) – 70 dB L <sub>dn</sub> (35 NEF) → Conditionally acceptable Must achieve indoor environment of 45 dB L <sub>dn</sub> (5 NEF) through insulation. 70 dB L <sub>dn</sub> (35 NEF) – 75 dB L <sub>dn</sub> (40 NEF) → Conditionally acceptable Must achieve indoor environment of 45 dB L <sub>dn</sub> (10 NEF) through insulation.		< 65 dB L <sub>dn</sub> (35 NEF) → Normally acceptable. 65 – 70 dB L <sub>dn</sub> (35 NEF) → Normally acceptable. 70 dB L <sub>dn</sub> (35 NEF) – 75 dB L <sub>dn</sub> (40 NEF) → Conditionally acceptable Must achieve interior noise environment of 50 dB L <sub>dn</sub> (15 NEF) 75 dB L <sub>dn</sub> (40 NEF) – 80 dB L <sub>dn</sub> (45 NEF) → Conditionally acceptable Must achieve interior noise environment of 50 dB L <sub>dn</sub> (15 NEF) > 80 dB L <sub>dn</sub> (45 NEF) → Clearly not acceptable.	< 65 dB L <sub>dn</sub> (30 NEF) → Normally acceptable 65 dB L <sub>dn</sub> (30 NEF) – 75 dB L <sub>dn</sub> (40 NEF) → Conditionally acceptable Must achieve indoor environment of 45 dB L <sub>dn</sub> (10 NEF) through insulation. 70 dB L <sub>dn</sub> (35 NEF) – 75 dB L <sub>dn</sub> (40 NEF) → Conditionally acceptable Must achieve indoor environment of 45 dB L <sub>dn</sub> (10 NEF) through insulation. > 75 dB L <sub>dn</sub> (40 NEF) → Clearly unacceptable. Does not explicitly identify day care centres as part of its tables. It is proposed that day care centres are sufficiently similar to schools and that is what is excerpted below.	< 65 dB L <sub>dn</sub> (30 NEF) → Normally acceptable 65 dB L <sub>dn</sub> (30 NEF) – 70 dB L <sub>dn</sub> (35 NEF) → Conditionally acceptable Must achieve indoor environment of 45 dB L <sub>dn</sub> (10 NEF) through insulation. 70 dB L <sub>dn</sub> (35 NEF) – 75 dB L <sub>dn</sub> (40 NEF) → Conditionally acceptable Must achieve indoor environment of 45 dB L <sub>dn</sub> (10 NEF) through insulation. > 75 dB L <sub>dn</sub> (40 NEF) → Clearly unacceptable.	
Australian Standard AS 2021-1985 "Acoustics – Aircraft Noise Intrusion – Building Siting and Construction"	The Australian NEF is similar in design to the Canadian NEF system. Some differences exist such as time of day weightings. An approximate conversion based on regression analysis is NEF = ANEF + 3. The Australian standard also considers Building site acceptability based on maximum indoor noise levels. Refer to AS2021 Table 2.1 and 3.3 and Since this type of information is not readily available for Canadian airports, it has not been included in the standards review.					
Greater Toronto Airports Authority	< 20 ANEF (23 NEF) → Normally Acceptable 20 – 25 ANEF (23-28 NEF) → Conditionally Acceptable Some nuisance complaints may arise and incorporation of noise control features in the construction of residences may be appropriate. > 25 ANEF (28 NEF) → Clearly Unacceptable		< 20 - 25ANEF (23 – 28 NEF) → Normally Acceptable 25 – 30 ANEF (28-23 NEF) → Conditionally Acceptable An analysis of building noise reduction requirements by an acoustic consultant should be made and any necessary noise control features included in the design of the building. > 30 ANEF (33 NEF) → Clearly Unacceptable		< 20 ANEF (23 NEF) → Normally Acceptable > 20 ANEF (23 NEF) → Clearly Unacceptable Places of worship and theatres	< 20 ANEF (23 NEF) → Normally Acceptable > 20 ANEF (23 NEF) → Clearly Unacceptable
Edmonton AVPA	< 30 NEF → Normally Acceptable > 30 NEF → Clearly Unacceptable Actively opposes all residential development within the 30 NEF contour.		No Standard	No Standard	No Standard	No Standard
Permitted land uses in the AVPA are determined by district. The Airport-Urban District will be used for reference purposes of this review.						

Table 4 Summary of Existing Airport Noise Mitigation Standards							
Land Use	Residential towers	Multiple dwelling uses	Single family uses	Live-Work uses	Work-Live uses	Day Care Centres	Assembly uses
Source	< 25 NEF → Normally Acceptable 25-30 NEF → Conditionally Acceptable Construction of buildings shall conform to the exterior acoustic insulation requirements of the Alberta Building Code that applies to the construction for those NEF. The development officer shall indicate on the development permit the NEF Areas in which the proposed development would be located for reference of the building inspector at the time of the building permit application. > 30 NEF → Clearly Unacceptable.	< 25 NEF → Normally Acceptable 25-30 NEF → Conditionally Acceptable Construction of buildings shall conform to the exterior acoustic insulation requirements of the Alberta Building Code that applies to the construction for those NEF. The development officer shall indicate on the development permit the NEF Areas in which the proposed development would be located for reference of the building inspector at the time of the building permit application. > 30 NEF → Clearly Unacceptable.	< 25 NEF → Normally Acceptable 25-30 NEF → Conditionally Acceptable Construction of buildings shall conform to the exterior acoustic insulation requirements of the Alberta Building Code that applies to the construction for those NEF. The development officer shall indicate on the development permit the NEF Areas in which the proposed development would be located for reference of the building inspector at the time of the building permit application. > 30 NEF → Clearly Unacceptable.	< 25-30 NEF → Normally Acceptable. 30-40 NEF → Conditionally Acceptable. Construction of buildings shall conform to the exterior acoustic insulation requirements of the Alberta Building Code that applies to the construction for those NEF. The development officer shall indicate on the development permit the NEF Areas in which the proposed development would be located for reference of the building inspector at the time of the building permit application.	< 25 NEF → Normally Acceptable 25-35 NEF → Conditionally Acceptable Construction of buildings shall conform to the exterior acoustic insulation requirements of the Alberta Building Code that applies to the construction for those NEF. The development officer shall indicate on the development permit the NEF Areas in which the proposed development would be located for reference of the building inspector at the time of the building permit application. > 35 NEF → Clearly Unacceptable.	Great deal of variability depending on specific use.	
Calgary AVPA	Due to the fact that the provincial government enacted the regulation, as well as the Edmonton AVPA, the two regulations are very similar. Their principal differences lie in the special exemptions for pre-existing land uses. As such, the Calgary AVPA will be considered as having the same Noise Mitigation standards as the Edmonton AVPA.						
Halifax International Airport	While the airport develops the NEF/NEP contour maps, there is no formal policy at the airport, municipal or provincial level.						
Winnipeg Airport Vicinity Development Plan (AVDP)	The Winnipeg AVDP determines permitted land uses based on both NEF contour and population densities. Although it does not reflect reality on the ground for the sake of this comparison, All residential land uses in Richmond will be treated equally.						
Ottawa Airport Operating Influence Zone (OAOIZ)	Provisions in the Zone refer to TP 1247 and LU131 recommendations. Please refer to earlier sections.						
Montreal – Pierre Elliott Trudeau International	No standards						
	No standards	No standards	No standards	No standards	No standards	No standards	No standards
	No standards	No standards	No standards	No standards	No standards	No standards	No standards
	No standards	No standards	No standards	No standards	No standards	No standards	No standards
	No standards	No standards	No standards	No standards	No standards	No standards	No standards

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### **7.2.3 Proposed Standards**

#### **NEF Contour Selection**

As it is clear that the NEF will remain the dominant and standard method of evaluating airport noise in Canada, the Proposed Mitigation Standards will make reference to NEF contours as opposed to other metrics discussed in this study. It is proposed that the most current and longest term contours be incorporated into the Standards. In the case of the Vancouver International Airport, the most recent, and longest term contours available are the 2015 NEP. Using the long term contours is important as they will permit for the consistent application of noise mitigation standards over the long term.

#### **Indoor Noise Mitigation Standards**

The Ontario Ministry of the Environment LU131 documents were used as the basis for the standards described below. One of the principal reasons for this was the fact that it is one of the few documents to speak explicitly to the indoor noise environment from a high level planning perspective. That is to say, it was developed explicitly for land use planning and relates to the provincial policy statement which is a high level planning document. Furthermore, it is consistent with CMHC recommendations for housing in areas impacted by airport noise. CMHC Table C.1 – Recommended Indoor Noise Exposure Criteria states:

<b>Use of Space</b>	<b>Recommended Maximum Indoor Noise Exposure Criteria</b>
Bedrooms	0
Living, dining, recreation	5
Kitchen, Bathroom	10

It should be noted however, that the CMHC states that over the 35 NEF, housing is inappropriate.

The CMHC also speaks to the impact of open windows. While attenuation of 10-15 dB can be expected inside a residence with open windows, the CMHC clearly states that over 25 NEF, the indoor noise limits excerpted above can not be met with open windows.

Therefore, considering the CMHC recommendations and LU131, the proposed indoor noise mitigations standards are as follows below:



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Land Use	Indoor NEF*
Residential Towers	Sleeping quarters: 0 NEF Living quarters: 5 NEF
Multiple Dwellings	Sleeping quarters: 0 NEF Living quarters: 5 NEF
Single Family	Sleeping quarters: 0 NEF Living quarters: 5 NEF
Live-Work	Sleeping quarters: 0 NEF Living / Working area: 5 NEF
Work-Live	Sleeping quarters: 0 NEF Living / Working area: 10 NEF
Day Care Centres	5 NEF
Assembly	To be determined. The sensitivity of this type of land use is highly variable dependent upon the actual activities to take place.

\* The Indoor NEF values are not obtained from contour maps but rather represent the indoor sound level required following insulation of the building.

**Outdoor Noise Mitigation Standards**

When considering outdoor noise mitigation standards, the only true mitigation is location. Short of relocating the land use in question, an acceptable noise level for outdoor activities associated with particular land uses must be determined.

To develop the proposed standards for outdoor noise mitigation, consideration was given to the review conducted in the previous section. Furthermore, consideration was given to the likely expectation of users. With the exception of Assembly uses, outdoor use is generally incidental to the principal land use activity which takes place inside. It is reasonable to assume that a high-rise apartment/condo dweller will be less likely to expect to enjoy outdoor use of the property than an owner of a single family dwelling. The proposed Mitigation Standards take that into consideration.

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In determining normally acceptable and clearly unacceptable limits, consideration must be made to the land use in question. Outdoor amenity space and the activities likely to take part in them will be different depending on the ancillary indoor land use. For example, it is not very likely that many barbecues will take place on the common greenspace surrounding a residential high rise tower. Conversely, the backyard of a single family dwelling is likely to be used for barbecues and other activities where speech interference would be a significant inconvenience. Similarly to the indoor standards proposed in Table 5, the proposed standards below consider livability as discussed above with reference to the types of use expected to occur.

Land Use	Normally Acceptable	Clearly Unacceptable
Residential Towers	No outright restriction*	
Multiple Dwellings	< 40 NEF	> 40 NEF
Single Family	< 35 NEF	> 35 NEF
Live-Work	< 35 NEF	> 35 NEF
Work-Live	< 40 NEF	> 40 NEF
Day Care Centres	< 35 NEF	> 35 NEF
Assembly	< 30 NEF	To be determined based on proposed activity.

\* The terms of reference for the study state that residential will be permitted under certain circumstances over the 40 NEF contour. It was determined that Residential Towers were the most appropriate form of residential land use in such a high noise environment.

### Combined Indoor - Outdoor Standards

Having separately identified both indoor and outdoor mitigation standards, and having regard for the standards previously reviewed, a table which combines both indoor and outdoor mitigation standards was prepared.

The last three columns of Table 7 provide additional information to the proposed standards. "TP 1247 Consistent" will relate the proposed standard to TP 1247 and indicate whether the proposed standard is consistent with the recommendations in Transport Canada's TP 1247. This will permit quick comparison of the proposed standard to nationally accepted recommendations. Similarly, this is done for the CMHC Guidelines. The latter is important

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when considering the availability of CMHC support for certain residential developments. The City will have to consider the availability of CHMC support and the potential development impact should it not be available for a proposed type of development.

The rationalization column provides a brief explanation of the rationale behind the standards and the conditions associated with their land uses. It also provides insight into the issue of livability.

**Table 7  
 Proposed Combined Indoor – Outdoor Noise Mitigation Standards**

Land Use	Normally Acceptable	Conditionally Acceptable <sup>1</sup>	Clearly Unacceptable	TP 1247 Consistent	CMHC Consistent	Rationalization
Residential Towers	< 30 NEF	> 30 NEF Indoor Sleeping quarters: 0 NEF Living quarters: 5 NEF Provide replacement sound insulated amenities indoors	No outright restriction <sup>2</sup>	No	No	It was determined that with current technology sleeping and living quarters could be effectively insulated to provide a liveable indoor environment. The Fairmount Vancouver Airport Hotel reflects this adequately. Located at the airport itself, guest are insulated from aircraft and other outside noise outside their windows  While common outdoor amenity space is often required with this type of land use, a substitution by an equivalent indoor space should satisfy the needs of residents. This may include an indoor swimming pool, indoor exercise room with running track or solarium. These amenities would be common areas accessible to all residents.
Multiple Dwellings	< 30 NEF	30-40 NEF Indoor Sleeping quarters: 0 NEF Living quarters: 5 NEF Provide replacement sound insulated amenities indoors	> 40 NEF	No	No	It was determined that with current technology sleeping and living quarters could be effectively insulated to provide a liveable indoor environment.  As compared to Residential Towers, Multiple Dwellings are believed to be smaller in scope than Residential Towers. As such, the ability to provide equivalent indoor amenities is reduced. Furthermore, residents of multiple dwellings may have greater livability expectations.
Single Family	< 30 NEF	30-35 NEF Indoor Sleeping quarters: 0 NEF Living quarters: 5 NEF No special outdoor amenity requirement	> 35 NEF	Yes <sup>3</sup>	Yes <sup>3</sup>	It was determined that with current technology sleeping and living quarters could be effectively insulated to provide a liveable indoor environment.  The cut off at > 35 NEF is consistent with most standards concerning residential infilling. It should be noted that annoyances during outdoor activities may be an issue. Most standards do not recommend residential above the 30 NEF contour.  In the context of a Single Family Dwelling, it is clear that there can be no replacement of the outdoor amenity provided by for example, a backyard. As such, 35 NEF was selected as the limit.

Table 7  
 Proposed Combined Indoor - Outdoor Noise Mitigation Standards

Land Use	Normally Acceptable	Conditionally Acceptable <sup>1</sup>	Clearly Unacceptable	TP 1247 Consistent	CMHC Consistent	Rationalization
Live-Work	< 30 NEF	30-35 NEF Indoor Sleeping quarters: 0 NEF Living quarters: 5 NEF No special outdoor amenity requirement	> 35 NEF	Yes <sup>3</sup>	Yes <sup>3</sup>	The live-work land use was determined to be similar to the single family use.
Work-Live	< 30 NEF	30-40 NEF Indoor Sleeping quarters: 0 NEF Living quarters: 10 NEF	> 40 NEF	Yes <sup>3</sup>	Yes <sup>3</sup>	It was determined that with current technology sleeping and living quarters could be effectively insulated to provide a liveable indoor environment. It is expected that those choosing to live in a live-work setting reduced expectations for concerning livability. A trade off exists between the increased nuisance caused by airport noise and the increased livability of collocating employment and residential needs.
Day Care Centres	< 30 NEF	30-35 NEF Indoor: 5 NEF	> 35 NEF	Not explicit	Not explicit	It was determined that with current technology sleeping and living quarters could be effectively insulated to provide a liveable indoor environment. Children are often considered the most vulnerable of society. As such, limiting the outdoor noise exposure was deemed to be important. Furthermore, it was determined that the outdoor amenities associated with a day care centre could not be effectively replaced through the provision of indoor, noise insulated facilities.
Assembly	< 30 NEF	30-35 NEF Indoor: 5 NEF	To be determined by specific land use	Not explicit	Not explicit	Assembly land use encompasses a large variety of possible uses. When considering theatres and places of worship, an indoor 5 NEF was considered an appropriate level. When considering outside uses, it is highly dependent. A band shell may require an NEF of 30 or less whereas a soccer field could be supported by an NEF of 35. Careful consideration must be given to assembly uses on a case by case basis.

1 Land uses are acceptable pending confirmation that indoor noise environments meet certain standards and outdoor amenities or equivalent are possible.

2 The terms of reference for the study state that residential will be permitted under certain circumstances over the 40 NEF contour. It was determined that Residential Towers were the most appropriate form of residential land use in such a high noise environment.

3 The normally acceptable limit is respected. The conditionally acceptable limit is usually permitted in the case of redevelopment and infilling. Further confirmation with CMHC will be required in areas of > 30 NEF.

### **7.3 HOW TO IMPROVE INDOOR LIVING ENVIRONMENTS**

The recommended tool to improve indoor living environments is the use of state-of-the-art technical instruments. In Canada, the IBANA software system has been specifically designed to assist in the design and assessment of indoor noise environments. Its use by a trained acoustics professional will result in designs that meet or exceed the Indoor Mitigation Standards. Ultimately, it will fall to the residential developer to incorporate the necessary design features to meet the indoor noise standards once in place.

### **7.4 HOW TO IMPROVE OUTDOOR AMENITY AND RECREATION ENVIRONMENTS**

As stated previously, the only true outdoor mitigation is relocation. However, as is evident by the noise contour map presented at the start of this study, the option to relocate the sensitive land uses within the City of Richmond is limited.

An alternative to the relocation of noise sensitive outdoor land uses is to replace outdoor amenities with equivalent indoor amenities with the required acoustic insulation. However, this is not necessarily entirely possible and at some point becomes unreasonable and unliveable. Certainly one of the attractions to Richmond is its climate. The City has prided itself on the garden city concept which it emulates. To enclose all amenities would take away from the City.

Ultimately, a balance must be struck between the types of activities which can continue to take place outside despite the noise environment, and those which will require replacement with “indoor equivalents”. This is another set of considerations which are best dealt with during the second phase of the research project. Focus for the time being should be on the development of consistent standards.

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## **8.0 IMPACT-MITIGATION ASSESSMENT OF NEW STANDARDS / GUIDELINES**

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### **8.1 General**

The proposed standards and guidelines discussed in the previous chapter will impact the key stakeholders amongst others. This chapter seeks to examine the potential impacts on both the City of Richmond and the Vancouver International Airport. The anticipated impacts are numbered CR1 through CR4 for the City of Richmond. The impact identified for the Airport has been numbered VIA1.

Following an identification of the impacts, potential mitigations are considered for each of the identified potential impacts.

### **8.2 Impact of Proposed Mitigation Standards on the City of Richmond**

The implementation of the combined noise mitigation standards outlined above will impact the City of Richmond in a number of ways. Outlined below are the anticipated impacts on the City. Section 8.4 considers how to mitigate these impacts.

#### **CR1 Nuisance lawsuit launched by residents against City**

Despite efforts to mitigate airport noise, certain residents may be dissatisfied with the noise environment and decide to file lawsuits against the City.

#### **CR2 Liability and increased workload associated with City interpretation of Contours**

The proposed noise mitigation standards are based on NEF contours developed by the Airport Authority. The need to integrate these contours which change from time to time is an added burden on the City. Furthermore, NEF contours require some interpretation. NEF contours do not follow administrative or political boundaries and they regularly divide properties. The interpretation of these contours on a site by site basis required for development permit issuance could create a liability for the City.

#### **CR3 Increased Cost of Residential Development**

Due to the proposed mitigation standards, an important portion of new residential development in the City Centre would require acoustic insulation. This could have the impact of raising development costs of new residential units.

#### **CR4 Land Use Distribution**

Through Official Community Plans, Zoning Bylaws and other tools usually available to municipal planners, the City of Richmond has worked towards moulding development

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to meet its strategic goals. The proposed mitigation standards will likely have some limiting effects on development options and patterns.

### 8.3 Impact of Proposed Mitigation Standards on the Vancouver International Airport

#### VIA1 Permits Residential Development Closer than Generally Recommended by TP1247

It is possible that despite the use of strict indoor mitigation measures, residents may still object to airport noise in their neighbourhood. This could result in lawsuits being launched against the Airport Authority or in political pressure being exerted on various levels of government to try to impact airport operations.

### 8.4 Mitigation of Impacts on the City of Richmond and the Vancouver International Airport

#### 8.4.1 General

The table below summarizes the potential impacts identified above and recommended mitigations. Below are further descriptions of possible remedies related to covenants and nuisance advisory easements that may be considered as possible remedies to mitigate nuisance actions against the city or airport:

<b>Potential Impact</b>	<b>Recommended Mitigations</b>
CR1 Nuisance lawsuit launched by residents against City	<ul style="list-style-type: none"><li>• Nuisance easements are a possible mitigation. Further research into their implementation is required. Refer to section 8.4.2 for further information on nuisance easements.</li><li>• Restrictive Covenant that explicitly states the impact of airport noise and the requirements for acoustic insulation if applicable. Refer to section 8.4.3 for further clarification on Statutory Land Use Covenants.</li></ul>
CR2 Liability and increased workload associated with City interpretation of Contours	<ul style="list-style-type: none"><li>• Do not use references to contours. Instead, use planning blocks which define areas with common airport noise impacts and noise mitigation standards. This will eliminate the need to interpret contours on a site by site basis.</li></ul>



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<b>Table 8</b>	
<b>Potential Impacts of Proposed Noise Mitigation Standards and Recommended Mitigations</b>	
<b>Potential Impact</b>	<b>Recommended Mitigations</b>
	<ul style="list-style-type: none"> <li>• Ensure that the most up-to-date and long term contours are used so as to minimize the need to update plans.</li> </ul>
CR3 Increased Cost of Residential Development	<ul style="list-style-type: none"> <li>• The inclusion of acoustic insulation requirements may increase the costs for developers and home builders. However, this is a better scenario than restricting residential development or creating a significant new noise constituency, i.e. an annoyed noise impacted group.</li> <li>• A summary review of residential insulation projects was conducted. It would seem to indicate that for every 5 NEF over 30 NEF, an additional 8-12% of the construction cost would be required to insulate against airport noise. These numbers are provided for informational purposes only and apply only to standard residential construction. Due the nature of high rise construction, the percentage increase in cost for insulation will likely be smaller.</li> </ul>
CR4 Land Use Distribution	<ul style="list-style-type: none"> <li>• The application of the Proposed Noise Mitigation Standards will influence the options available to city planners when developing community plans.</li> <li>• As part of the development of the proposed standards, every effort was made to provide flexibility so as to allow the development of diverse housing projects.</li> </ul>
VIA1 Permits Residential Development Closer than Generally Recommended by TP1247	<ul style="list-style-type: none"> <li>• Similar to CR1, the implementation of Nuisance Easements and Restrictive Covenants should serve to mitigate a significant portion of the potential impact on the airport by allowing residential units to be located in such proximity.</li> <li>• It can be documented that the airport objected to allowing residential uses in high NEF areas. Refer to Appendix D.</li> </ul>

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### 8.4.2 Nuisance Easements

Nuisance easements may be used to protect nuisance land uses from private nuisance claims. In general terms an easement is a legal right of an owner of land that may be exercised in relation to an adjoining parcel of land; a common example would be a driveway easement that has been granted to permit an owner to have access over another person's land to reach their own land. A nuisance easement would give the owner of land on which a noxious or disruptive land use is conducted, to create a nuisance on adjoining land that would otherwise be actionable at common law. For example, the operator of a gravel crusher that is emitting dust and noise that a neighbour would be entitled to enjoin as a common law nuisance in legal proceedings against the operator, might purchase a nuisance easement from the neighbour before commencing operations. The easement, once registered in the land title office, would "run with the land" and bind successors in title to the owner who granted it.

If a nuisance easement in respect of aircraft noise and vibration were registered against the title to a development site, it would "run with the land" when the land is developed. Thus, if the land were subdivided into strata lots, the easement would charge each strata title. The easement would bar any common law nuisance action by the owner of that lot against the airport operator, and incidentally serve to notify persons searching the title that the property is located in the vicinity of an airport. The City of Vancouver has used nuisance easements to protect itself from claims by the purchasers of strata lots adjacent to bridges and bridge approaches, which generate noise, dust, motor vehicle emissions and vibration. ***There may be complications with the use of nuisance easements in the present case, given that the airport operator (YVR) is a different entity than the local government (City of Richmond) that would be giving the discretionary land use approvals in relation to which such easements could be negotiated.***

### 8.4.3 Statutory Land Use Covenants

Section 219 of British Columbia's *Land Title Act* authorizes local governments to hold statutory covenants dealing with the use of land. These are analogous to private restrictive covenants, and may include both negative and positive obligations on the owner of the land charged by the covenant. An example of a negative obligation would be a covenant not to use the land for a specified purpose. An example of a positive obligation would be a covenant to erect and maintain a fence or install and maintain a strip of landscaping. Such covenants may incidentally alert persons searching the title to the affected land to a particular factual situation. For example, a covenant prohibiting the construction of buildings below a particular elevation can give notice of the existence of a flood hazard.

Statutory covenants cannot be used for the "notification" purpose alone; they must contain a substantive obligation in relation to the use of land. As interests in land, covenants must be freely granted by the owner of the land, unless they are expropriated by the local government (an act that would require compensation to the owner). In British Columbia, statutory covenants are often granted to local governments as a condition of the granting of some sort

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of discretionary land use approval, such as a rezoning or the approval of a subdivision of land. In the present context, s.219 covenants may be useful as a mechanism for obliging an owner of land to construct buildings to a higher standard in relation to noise penetration than is required generally by the provincial Building Code, and incidentally informing persons searching the title to the land that the building is on an aircraft flight path. Such covenants could be required as a condition of rezoning land to permit the construction of buildings on the flight paths associated with the airport.

## **9.0 CONCLUSIONS AND FINAL CONSIDERATIONS**

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### **9.1 CONCLUSIONS**

This study has proposed an integrated set of noise mitigation standards which simultaneously consider both indoor and outdoor environments. The proposals are based on an understanding that the Canadian NEF system is the most appropriate metric for use in Canada for land use planning.

Furthermore, it was concluded that using the longest term contour available makes the most sense when considering land use compatibility issues. Rather than simply dealing with “today’s” problem, a long term vision in noise mitigation can reduce the risk of “growing into” a new noise problem years down the road.

Also important to the consideration of the proposed noise mitigation standards is that previous research in the YVR context has revealed that the anticipated responses to airport noise predicted by the NEF contours is applicable to the Richmond context.

The proposed mitigations contained within this study should be distributed to stakeholders so that comments can be received from those concerned. Only after this consultative process should mitigation standards be finally adopted.

### **9.2 FINAL CONSIDERATIONS**

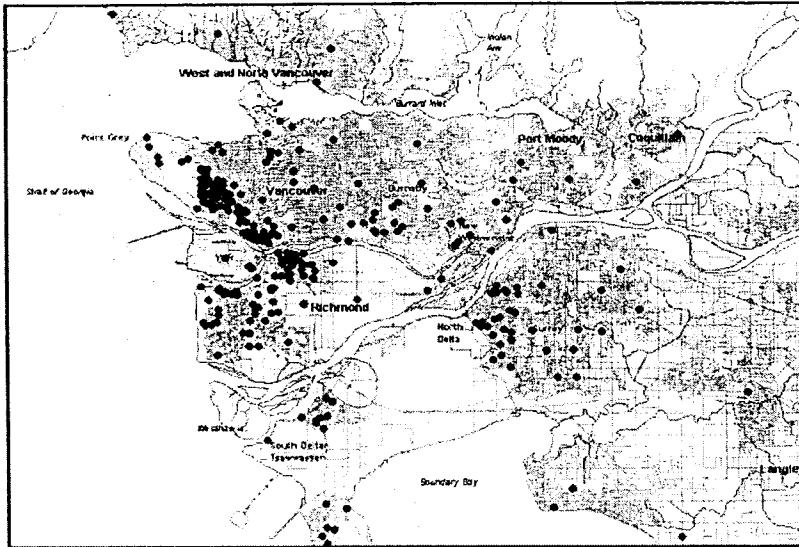
Airport Noise is not necessarily as “cut and dried” as might be suggested by NEF Contours and crisp maps. Furthermore airport noise impacts a large geographic area well beyond the limits of Richmond. The three following figures provided by YVR illustrate this well. The first figure illustrates the geographic distribution of received noise complaints. While the second and third figures show the typical tracks of aircraft as they arrive and depart the airport. All of these figures are intended to demonstrate the geographic extent to which aircraft noise and operations impact the land outside the actual airport boundary.

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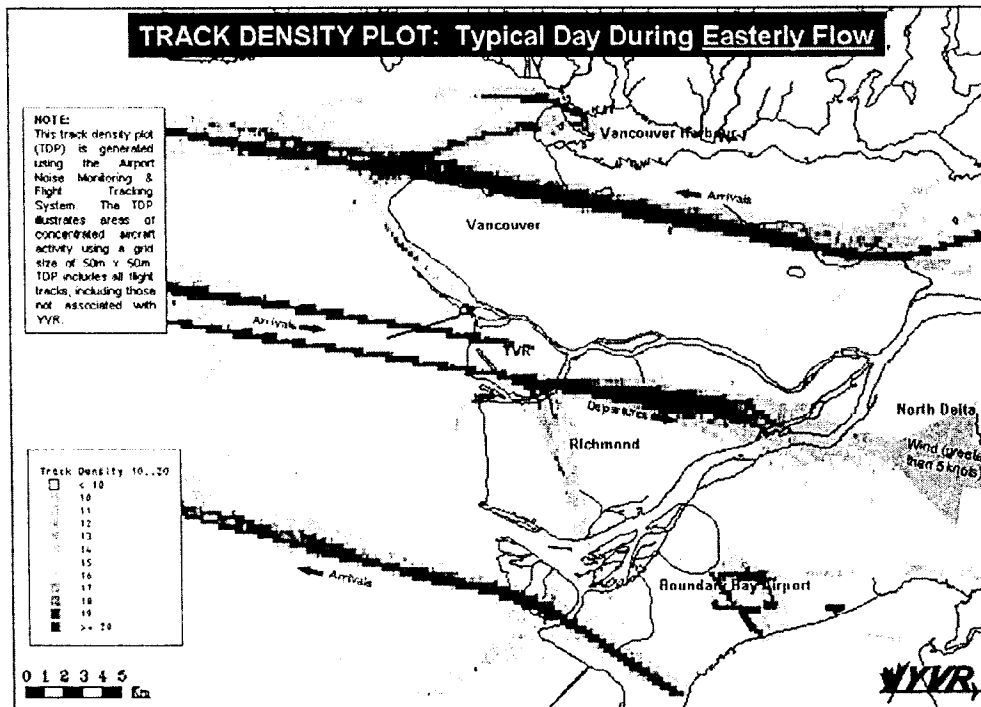
CITY OF RICHMOND, BC

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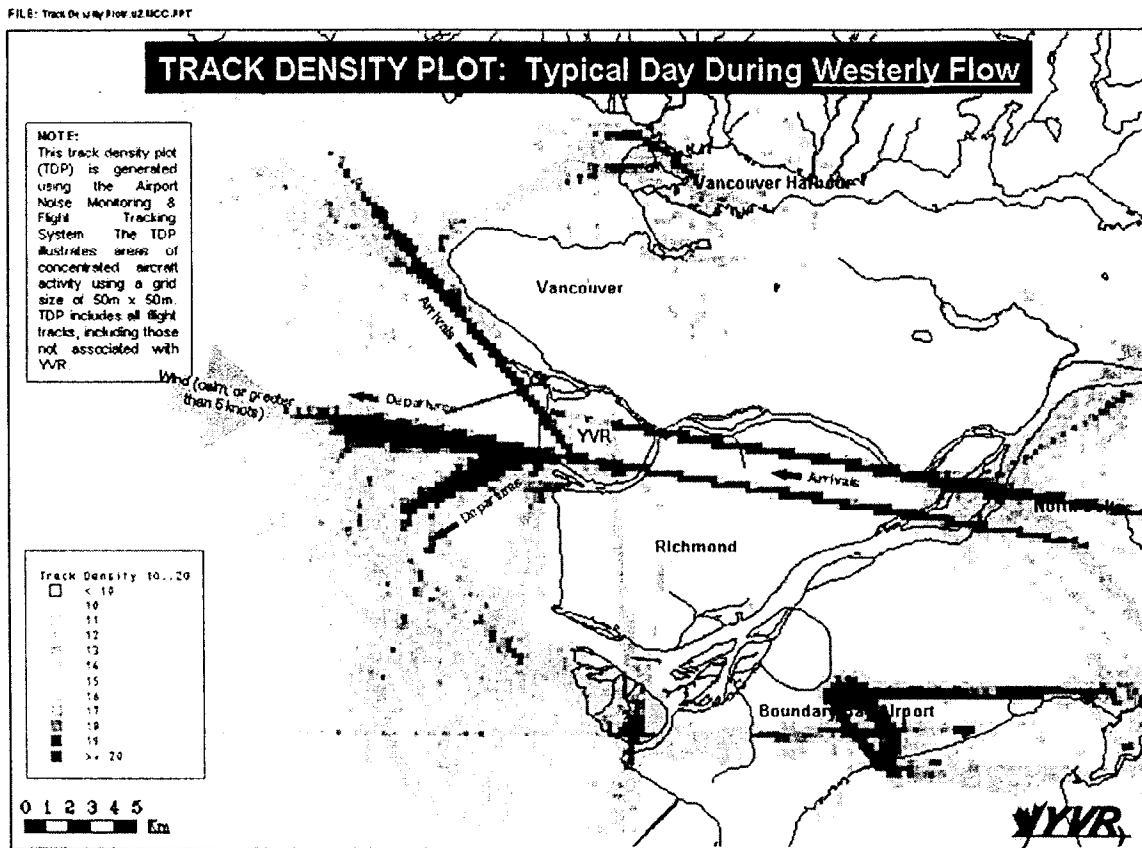


Courtesy of YVR

FILE: TBA De Luxe File v2.MCC.FPT



Courtesy of YVR



Courtesy of YVR

Some final considerations are summarized below:

This document should be reviewed with YVR and comments received for consideration. It is recommended that before formal adoption there needs to be further consultation and a cooperative and balanced approach to the final standards / guidelines through dialogue / negotiations with YVR. Furthermore through the agreement between the City and YVR (Appendix E) there is an obligation to consult each other on these issues.

- Density control in OCP updates should be considered. This is similar to Winnipeg AVDP and adds another layer of “planning” control. This should be considered for future OCP amendments.
- Closely linked to development and implementation of these standards are economic impacts. These must be considered or possibly studied further.
- Mitigations may also include improved communications. Australia is an excellent example and the reader directed to Appendix F for more on this topic. The concepts presented in this document are intended to provide targeted information tools which

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will enable noise sensitive people to make decisions that enable them to avoid aircraft noise.

- Noise complaints will occur outside the 30 and 25 NEF contours. This needs also to be considered as noise exposure and its impacts on people can be found within the NEF contours and outside the 25 NEF. The NEF is a tool for land use planning but lacks in communicating real life noise impacts to the public.
- It is important not to consider NEF contours on their own. It should also be considered that there will be aircraft movements which will generate noise beyond and outside the contours. It is important to re-emphasize the point that noise exists on either side of the contours, which appear as definitive lines when viewed on a map. This is an example how the use of N70 mapping, as used by the Australians, can provide clearer communication of the impact of airport noise on residents. Ultimately this could allow effective communication with the public regarding their noise expectations.

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## **11.0 GLOSSARY**

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**ACC:** Area Control Centre

**AIP:** Aeronautical Information Publication

**ALPA:** Air Line Pilots Association

**ANMS:** Airport Noise Monitoring System

**ASL:** Above Mean Sea Level

**ATAC:** Air Transport Association of Canada

**ATC:** Air Traffic Control

**ATS:** Air Traffic Services

**BPOC:** Before proceeding on course

**BPR:** Bypass Ratio

**CARAC:** Canadian Aviation Regulation Advisory Council

**CBAA:** Canadian Business Aircraft Association

**Chapter 2:** Noise certification class for jet aircraft - noisier and older technology (also known as Stage 2)

**Chapter 3:** Noise certification class for jet aircraft - quieter and newer technology (also known as Stage 3)

**CMHC:** Canada Mortgage & Housing Corporation

**day average sound level:** Time-average sound level between 0700 and 2200 hours. Unit, decibel (dB); abbreviation, DL; symbol,  $L_d$ . Note: Day average sound level in decibels is related to the corresponding day sound exposure level,  $L_{Ed}$ .

**day-night average sound level:** Twenty-four hour average sound level for a given day, after addition of 10 decibels to levels from 0000 to 0700 hours and from 2200 (10 p.m.) to 2400 hours. Unit, decibel (dB); abbreviation, DNL; symbol,  $L_{dn}$ . Note: Day-night average sound level in decibels is related to the corresponding day-night sound exposure level,  $L_{Edn}$ , where 86,400 is the number of seconds in a 24-hour day. A-frequency weighting is understood, unless another frequency weighting is specified explicitly.

**dBA:** A-weighted decibel

**EARP:** Environmental Assessment Review Process

**EIS:** Environmental Impact Statement

**EMU:** Environmental Monitoring Unit

**energy average:** Colloquial term for time-mean-square average of the sound pressures for of a series of sound signals.

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**energy summation:** Colloquial term loosely used to indicate addition of noncoherent sound signals by the sum of the squares of their sound pressures or the sum of their sound exposures.

**EPNdB:** Effective Perceived Noise Level in decibels

**EPR:** Engine Pressure Ratio

**FAA:** Federal Aviation Administration (U.S.)

**FAF:** Final Approach Fix

**FICON:** Federal Interagency Committee on Noise (U.S.)

**GIS:** Geographic Information System

**GPS:** Global Positioning System

**GTOW:** Gross Take-Off Weight

**ICAO:** International Civil Aviation Organization

**Annex 16:** ICAO Environmental Protection Document (details noise certification and limits)

**IFR:** Instrument Flight Rules

**ILS:** Instrument Landing System, made up of 3 degree glide-path and localizer

**JAA:** European Joint Aviation Authorities

**Kg:** Kilogram

**Kts:** Knots (speed expressed in nautical miles per hour)

**L90:** Background noise level (which is exceeded 90% of the time)

**LAA:** Local Airport Authority

**Leq:** Continuous equivalent sound level (average level)

**maximum sound level; maximum frequency-weighted sound pressure level:** Greatest fast (125 ms) A-weighted sound level within a stated time interval. Alternatively, slow (1000 ms) time-weighting and C-frequency-weighting may be specified. Unit, decibel (dB); abbreviation, MXFA; symbol,  $L_{AFmx}$  (or C and 5).

**Movement:** a take-off or a landing

**NAP:** Noise Abatement Procedures, which are federally regulated

**NEF:** Noise Exposure Forecast (based on 5 to 10 year forecasts)

**NEP:** Noise Exposure Projection (based on forecasts beyond 10 years but not passed 20 years)

**NLA:** New Large Aircraft

**Nm:** Nautical Mile (1.152 Statute Miles, 1.853 kilometres)

**NMT:** Noise Monitoring Terminal

**one-hour average sound level:** Time-average sound level during a time period of one hour. Unit, decibel (dB); abbreviation, 1HL; symbol,  $L_{1h}$ . Note: One-hour average sound level in

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decibels is related to the corresponding one-hour sound exposure level,  $L_{E1h}$ , where 3,600 is the number of seconds in one hour, 1 s is the reference duration for sound exposure, and sound exposure  $E$  is in pascal-squared seconds.

**Parallel Runway:** New 3,030m runway that opened in November 1996

**RAMP:** Radar Modernization Project

**Runway 07-25:** Water aerodrome for floatplanes

**Runway 08L:** 3,030m north runway (heading 080 degrees magnetic)

**Runway 08R:** 3,353m south main runway (heading 080 degrees magnetic)

**Runway 12:** 2,225m cross-wind runway (heading 120 degrees magnetic)

**Runway 26L:** 3,353m south main runway (heading 260 degrees magnetic)

**Runway 26R:** 3,030m north runway (heading 260 degrees magnetic)

**Runway 30:** 2,225m cross-wind runway (heading 300 degrees magnetic)

**RWY or Rwy:** Runway

**SEL:** Single event noise exposure level in dBA accounting for maximum noise level and duration

**SID:** Standard Instrument Departure

**sound exposure:** Time integral of squared, instantaneous frequency-weighted sound pressure over a stated time interval or event. Unit: pascal-squared second; symbol,  $E$ . Note: If frequency weighting is not specified, A-frequency weighting is understood. If other than A-frequency weighting is used, such as C-frequency weighting, an appropriate subscript should be added to the symbol; e.g.,  $E_C$ .

Duration of integration is implicitly included in the time integral and need not be reported explicitly. For the sound exposure measured over a specified time interval such as one hour, a 15-hour day, or a 9-hour night, the duration should be indicated by the abbreviation or letter symbol, for example one-hour sound exposure (1 HSE or  $E_{1h}$ ) for a particular hour; day sound exposure (DSE or  $E_d$ ) from 0700 to 2200 hours; and night sound exposure (NSE or  $E_n$ ) from 0000 to 0700 hours plus from 2200 to 2400 hours.

Day-night sound exposure (DNSE or  $E_{dn}$ ) for a 24-hour day is the sum of the day sound exposure and 10 times the night sound exposure. Unless otherwise stated, the normal unit for sound exposure is the pascal-squared second.

**sound exposure level:** Ten times the logarithm to the base ten of the ratio of a given time integral of squared instantaneous A-weighted sound pressure, over a stated time interval or event, to the product of the squared reference sound pressure of 20 micropascals and reference duration of one second. The frequency weighting and reference sound exposure may be otherwise if stated explicitly.

**sound level; weighted sound pressure level:** Ten times the logarithm to the base ten of the ratio of A-weighted squared sound pressure to the squared reference sound pressure of 20  $\mu\text{Pa}$ , the squared sound pressure being obtained with fast (F) (125 ms) exponentially

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weighted time-averaging. Alternatively, slow (S) (1000 ms) exponentially weighted time-averaging may be specified; also C-frequency weighting.

**sound pressure; effective sound pressure:** Root-mean-square instantaneous sound pressure at a point, during a given time interval. Unit, pascal (Pa). Note: In the case of periodic sound pressures, the interval is an integral number of periods or an interval that is long compared with a period. In the case of nonperiodic sound pressures, the interval should be long enough to make the measured sound pressure essentially independent of small changes in the duration of the interval.

**sound pressure level:** Ten times the logarithm to the base ten of the ratio of the time-mean-square pressure of a sound, in a stated frequency band, to the square of the reference sound pressure in gases of  $20 \mu\text{Pa}$ . Unit, decibel (dB); abbreviation, SPL; symbol,  $L_p$ .

**SPID:** Simultaneous Parallel Independent Departure

**TC:** Transport Canada

**TDP:** Track Density Plot

**time-average sound level; time-interval equivalent continuous sound level; time-interval equivalent continuous A-weighted sound pressure level; equivalent continuous sound level:** Ten times the logarithm to the base ten of the ratio of time-mean-square instantaneous A-weighted sound pressure, during a stated time interval  $T$ , to the square of the standard reference sound pressure. Unit, decibel (dB); respective abbreviations, TAV and TEQ; respective symbols,  $L_{AT}$  and  $L_{\text{aeq}T}$ .

**U.S.** United States of America

**VASIS:** Visual Approach Slope Indicator System

**VFR:** Visual Flight Rules

**VNAP:** Vertical Noise Abatement Procedure

**VOR:** Very High Frequency Omni-Range (a navigational aid)

**VTA:** VFR Terminal Area Chart

**YVR:** Vancouver International Airport

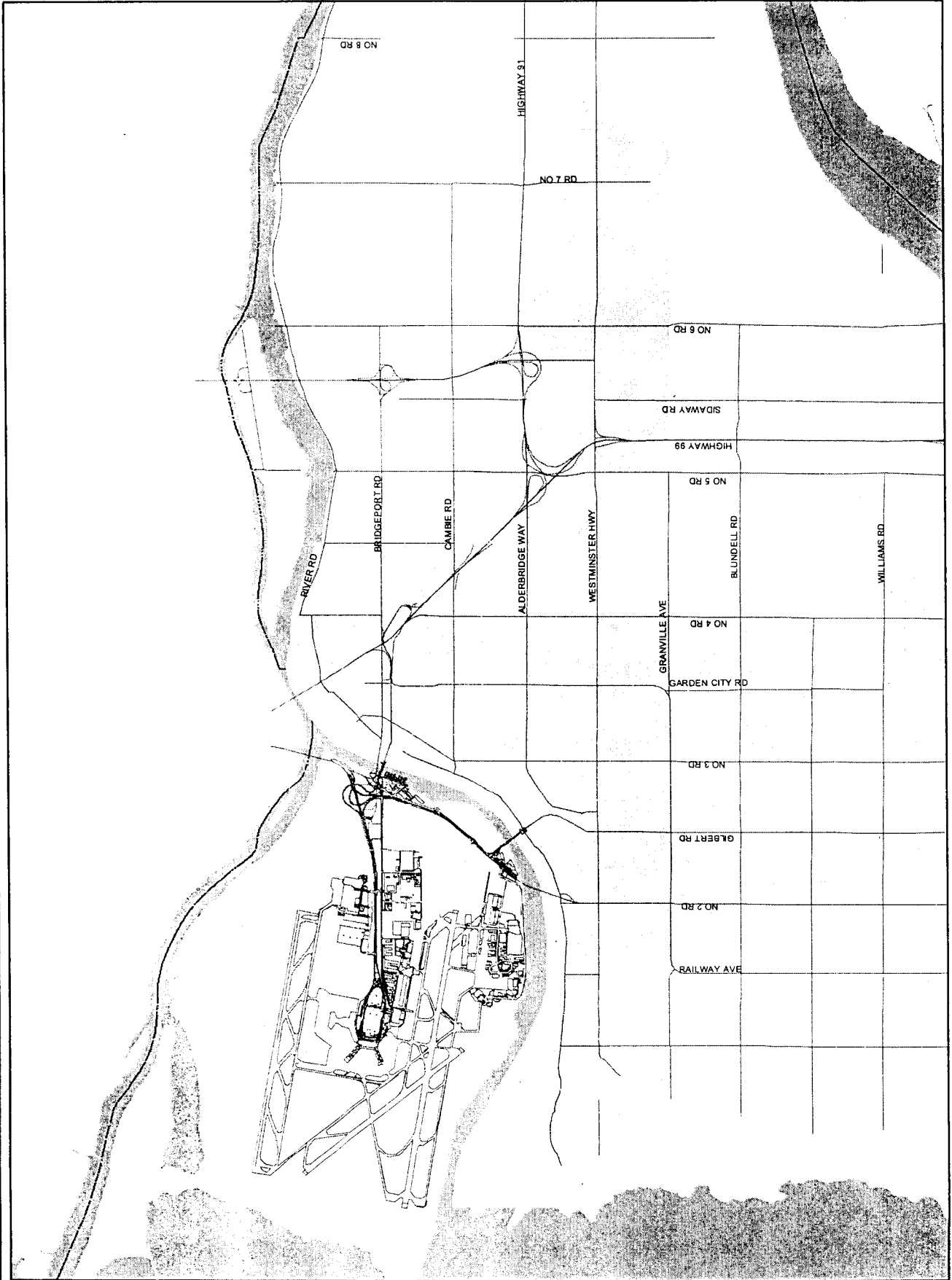
**YVRAA:** Vancouver International Airport Authority

**ATTACHMENT 3**

**RICHMOND OCP**

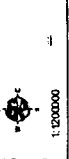
**AREA WHERE A RESTRICTIVE COVENANT FOR NOISE INSULATION IS REQUIRED**

Area Where a Restrictive Covenant for Noise Insulation is Required



Legend  
 Area of Restrictive Covenant For Noise Insulation is Required  
 Richmond Boundary

NOTE: The information shown on this map is derived from various sources and is NOT guaranteed as to its accuracy by the City of Richmond. The City of Richmond does not warrant the accuracy of the information shown on this map. The City of Richmond shall not be liable for any damages, including reasonable attorneys' fees, arising from the use of this map. The City of Richmond shall not be liable for any damages, including reasonable attorneys' fees, arising from the use of this map.



**ATTACHMENT 4**

**2015 NEF CONTOUR MAP**





**ATTACHMENT 5**

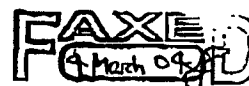
**VIAA LETTERS**

ATTACHMENT 5

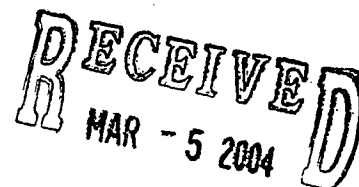


Vancouver International Airport Authority  
 Administration de l'aéroport international de Vancouver  
 P.O. Box 23750  
 Airport Postal Outlet  
 Richmond, B.C. Canada V7B 1Y7  
 Website: www.yvr.ca

4 March 2004



12801



Mr. Eric Fiss  
 Planner – Urban Design  
 CITY OF RICHMOND  
 6911 No. 3 Road  
 Richmond, BC V6Y 2C1

Dear Mr. Fiss

**RE: City of Richmond Residential Development Policy Consistency Study**

Thank you for the opportunity to meet with yourself, Mr. Ed Grifone (Urban Systems), and Mr. Bernhard Schropp (Pryde Schropp McComb Inc.) regarding the above study. The meeting provided a good opportunity for dialogue on some of our issues with respect to the study, and I would like to take this opportunity to highlight and expand on some of these issues.

- We do not support increased residential and non-airport compatible developments in high noise or high air traffic areas.
- We recommend the study consider advantages and disadvantages of allowing residential development in these high aircraft noise areas. This information should form the basis of decision making regarding future land uses.
- We believe that alternative noise metrics (other than annualized average noise contours) should be evaluated and considered for determining areas that may be suitable for residential development and providing clear communication of the impacts of airport noise.
- Compatible land use planning plays an integral role in airport noise management practices. Gains achieved through noise reduction at the source, or through operational procedures are lost if residential development is permitted to occur in high noise / air traffic areas.
- We believe this study should proceed carefully as any policy decisions being made now will affect future business opportunities by both the City and the Airport Authority.
- We suggest you interview Transport Canada to determine their views on residential developments in high noise / air traffic areas. According to Transport Canada's document *TP 1247E - Land Use in the Vicinity of Airports*, individual complaints may be vigorous and possible group action and appeals to authorities may occur in areas of +30 NEF. Transport Canada recommends against residential development within areas of +30 NEF, and recommends developers in the area of 25-30 NEF inform all prospective tenants or purchasers of residential units of possible impacts from aircraft noise.

## ATTACHMENT 5

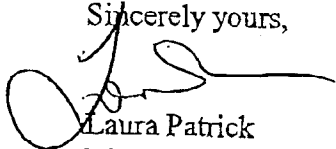
- While legal notices on title may prevent an individual from suing either the City or the Airport Authority, such notices will not prevent individuals or groups from exerting pressure on local politicians to demand changes to airport operations in the future. Curtailing air traffic means curtailing the economic benefits to the City of Richmond and the Province of BC as a whole.
- From the modified terms of reference you provided, the focus appears to be developing policy standards using north City Centre as a study area with the hopes of expanding its use to other areas. We believe this approach may not be effective, because other areas of the City are exposed to different levels of noise / air traffic, which should be considered as part of the study.

During the conversations at the meeting, the following pieces of supporting information were requested and I have directed my staff to assemble the information and distribute to the appropriate person(s).

- Electronic files for the 2011, 2011, and 2015 Noise Exposure Forecast Contours
- An electronic file illustrating the geographic complaint distribution for areas around the airport
- Sample flight tracks from the YVR Airport Noise Monitoring & Flight Tracking System
- A copy of the 1995 community response to airport noise social survey (by BBN Technologies)

We believe the City and the Airport Authority share the same goal – having an enjoyable liveable City with a strong vibrant first class international airport. We are extremely concerned with the direction being taken with this study. We seek to work with the City of Richmond to ensure that mutually acceptable solutions are developed.

Sincerely yours,



Laura Patrick  
Manager, Environment  
Vancouver International Airport Authority

Cc: Mr. Ed Grifone *via fax* (250) 763-5266  
Mr. Bernhard Schropp *via fax* (519) 389-4728



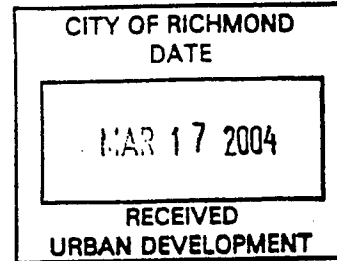
Vancouver International Airport Authority  
Administration de l'aéroport international de Vancouver  
P.O. Box 23750  
Airport Postal Outlet  
Richmond, B.C. Canada V7B 1Y7  
Website [www.yvr.ca](http://www.yvr.ca)

Larry Berg  
President and Chief Executive Officer

pc: TAG

March 16, 2004

Mr. George Duncan  
Chief Administrative Officer  
City of Richmond  
6911 No. 3 Road  
Richmond, BC  
V6Y 2C1



Dear Mr. Duncan:

**RE: City of Richmond Noise Compatibility Study**

I am writing to express the Vancouver International Airport Authority's strong opposition to the City allowing any increase in residential and non-airport compatible developments in high aircraft noise or high aircraft traffic areas.

We understand that the City is in the process of undertaking a study to determine how the City should proceed with residential developments within the +30 and +35 Noise Exposure Forecast (NEF) contour areas. All existing national and international standards and recommended practices, oppose residential development in high noise areas. We are concerned that the City would undertake a study to examine "how" to proceed with such development prior to determining "if" such developments could be built without creating additional pressures on the airport to curtail aircraft operations.

According to the Transport Canada document *TP 1247E - Land Use in the Vicinity of Airports*, new residential construction or developments within +30 NEF should not be undertaken. We agree with this assessment and will continue to oppose residential development in areas exposed to high noise and air traffic in order to reduce public pressure to restrict current and future operations at the airport. Such restrictions would affect our ability to serve the needs of Richmond and the Province as the premier global gateway between North America and Asia-Pacific.

We believe the City of Richmond and the Airport Authority share a common objective of furthering the economic and environmental goals of the citizens of Richmond and are interested in working collaboratively with the City on this important issue.

Mr. George Duncan  
Chief Administrative Officer, City of Richmond

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I would like to meet at your early convenience to discuss this further and will call your office to arrange a suitable time.

Yours truly,



Larry Berg  
President and CEO  
Vancouver International Airport Authority

cc: *Mr. Louis Ranger, Deputy Minister of Transport, Transport Canada*  
*Ms. Olga Ilich, Director, Vancouver International Airport Authority*  
*Ms. Anne Murray, Vice President, Community & Environmental Affairs, Vancouver International Airport Authority*