

The second and third measurement sets involved short-term 1/3-octave sound level logging while ALL penthouse noise sources atop the Research Tower were progressively shut off and returned to normal operation. One such round was measured on the upper-most level of Parking "B" (Figure 1), the final set being measured near the eastern edge of Parking "A". The measurements atop Parking "B" confirmed the Penthouse noise sources as the primary noise offender, while those on Parking "A" were done to assess the noise impact relative to the City Noise Bylaw. These latter measurements indicated a resultant sound level of 51 dBA while all penthouse noise sources were running and a nominal 47 dBA with all Penthouse noise source shut off. Given the relative distances involved, it was determined that the Penthouse noise sources just met the City Bylaw allowable sound level of 50 dBA at the residential property line. Thus the options available to the Owner of the Research Tower were to (a) indicate to the noise-affected Resident that further action was not required or (b) implement some degree of noise mitigation despite not being required by law. The latter was chosen.

The upper (solid) line on Figure 3 indicates the 1/3-octave spectrum measured immediately near the Penthouse exhaust systems on the Research Tower. There is a local maximum centered on the 800Hz and 1000Hz bands. The second trace (dashed) on Figure 3 is the combined effect of all Penthouse noise sources in operation, as measured on Parking "A". It is evident that the local maximum was still evident. The lowest (dotted) trace is the spectrum with all Penthouse noise sources off.

3 NOISE-CONTROL TREATMENT

The optional treatments were (1) mitigation at source by means of re-configuring the ductwork, introducing silencers and possibly obtaining a lower-noise type of exhaust fan and (2) constructing a noise shield externally in front of the set of exhaust louvres.

Several considerations covering relative costs, relative effectiveness for noise reduction, and the impact on the falcon played into the decision-making. It was considered that re-configuring the ductwork-and-exhaust-fans within the Penthouse could run as much as two-to-three times the expense of constructing a noise-shield. The advantage of re-configuring the exhaust systems was that it potentially could avoid any interference with the falcon and thus could be implemented without time restrictions. For the noise shield, while likely being less labor-intensive than the ductwork option, it would likely require relocating the bird-house or somehow integrating the birdhouse into the noise shield. There was concern that the "change-of-scenery" in the immediate vicinity of the bird-house could adversely affect the falcon in its nesting, feeding and parenting habits. Also,

it was deemed necessary to have a noise shield completed by 15-March, the usual time the falcon could be expected back. A relatively minor concern was that of visually integrating any new construction into older architecture directly exposed to public view. From the standpoint of noise control, it was deemed that either solution could provide the necessary degree of attenuation.

Mainly for reasons of cost, the Owner favored the noise-shield option. Therefore, a meeting was called between Building-staff, the acoustical consultant and a Provincial Wildlife biologist. It was determined that introduction of the noise shield and relocation of the bird-house would very likely *not* adversely affect the falcon. A detailed design for the wall was developed, submitted for approvals and subsequently built.

In this instance it would be quite feasible to construct a noise shield that provides barrier-type noise attenuation and forego any sound-absorbing lining. However, given the sensitivity that precipitated the study and the relatively small cost of adding the lining, it was decided to include a liner directly facing the exhaust-fan louvres. Traditionally, one would automatically opt for fibrous-based core material, usually wrapped in thin plastic to withstand effects of wind, water and winter and protected by expanded-metal mesh or, at minimum, wire mesh. However, since DOW-QUASH, a relatively new poly-ethylene based cellular product that provided maximum sound attenuation in the preferred frequency range, can be left directly exposed, it was determined to be the liner-of-choice.

Upon completion a follow-up visual inspection of the wall was done and a few spot measurements taken at grade. The noise reduction realized was a decrease for the "all systems on" condition by 4 dBA (from 51 to 47 dBA); thus the net sound level had been reduced to the "penthouse off" condition measured during earlier measurements. Subjectively, at Parking "A" it was necessary to listen intently to distinguish the exhaust-fans sound. Indications are that the falcon has continued its usual life-cycle patterns as though nothing has changed.

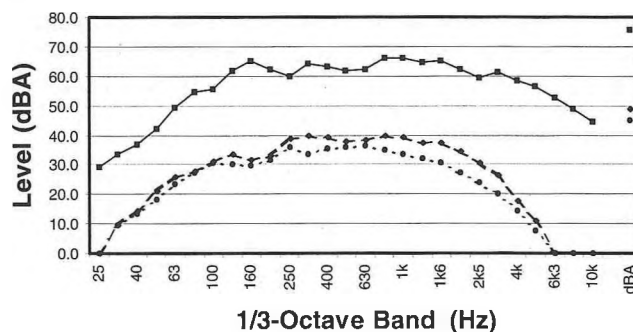


Figure 3 - 1/3-Octave Spectra

MODELLED TRENDS IN ENVIRONMENTAL NOISE LEVELS AS A FUNCTION OF LONG-TERM METEOROLOGY IN ALBERTA

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1. INTRODUCTION

Environmental noise surveys in rural settings are commonly conducted in Alberta. A frequently encountered scenario is that of a listener located near an industrial facility with no other sources of continuous noise nearby. When surveys are conducted to measure the noise level occurring at the listener's location, it is found that the noise level varies as a result of changes in meteorological conditions.

The current investigation looked at the predicted noise level for listeners located 1 km from a noise source with a sound power spectrum of a typical natural gas compressor station. Hourly meteorological data for a 5 year period was used to predict 43,824 hourly Leq noise levels at listener locations. The predictions were made for listeners 1 km away from the noise source in 4 cardinal wind directions. Meteorological data from 6 distinct air sheds was investigated. The purpose of the exercise was to investigate long-term trends in the hourly noise levels as a function of meteorology.

2. METHOD

An analytical algorithm was used to model the propagation of noise from the source to the listeners and to predict the noise levels at the listener locations. A predictive model had several advantages over real long-term measurements. Most real world noise surveys require extensive analysis to isolate the noise level of a single source from other sources of noise. With modelled noise levels, it was possible to analyze the idealized scenario of a listener near an industrial noise source with no other source of noise to contribute to or contaminate the noise level. With a model it was feasible to predict five years of hourly sound levels. It would not have been realistic to collect five years of real hourly sound levels. Finally, it was feasible to predict hourly noise levels in four different directions for locations in 6 different air sheds.

All predictive algorithms face the question of how well they model reality. It would have been ideal to compare the predicted noise levels of this investigation to real world data. However, it would have been impractical to acquire the data that would have been required for such a comparison.

"The Propagation of Noise from Petroleum and Petrochemical Complexes to Neighbouring Communities" algorithm as developed by the CONCOWE Special Task Force on Noise Propagation was used to predict the noise levels. This algorithm is specific to petroleum sector facility noise which is the most common source of environmental noise concern in Alberta. It was also selected as the algorithm for this study because it accounts for the influence of meteorological stability category.

Hourly meteorological data was obtained from Environment Canada's Meteorological Services Division. Hourly wind speeds, wind directions, relative humidities, and temperatures were obtained for five years from six air sheds encompassing the Edmonton Nampa, Calgary, Red Deer, Medicine Hat, Edson, and Peace River airports. The corresponding Pasquill stability classes for each hour in each air shed were obtained from Alberta Environment.

3. RESULTS

A set of hourly Leq dBA noise levels was generated for a listener located 1 km from the noise source in four cardinal wind directions (north, east, south, and west) for the six air sheds. The result was 24 sets of data that each encompassed 43,824 hourly Leq noise levels. The data was assessed using various statistical and graphical tools to identify trends and draw conclusions.

4. DISCUSSION

4.1 Total data set

In all sets of data, it was found that the Leq's of nighttime noise levels (10pm to 7am) were higher than daytime noise levels. The nighttime Leq's were on average 1.0 dBA higher than daytime noise levels.

Figure 1 illustrates a typical distribution of hourly Leq's at a listener location. In this example, the lowest hourly noise level was 21.2 dBA and the highest hourly noise level was 40.8 dBA in this example. The standard deviation of all hourly noise levels in the data was 4.5 dBA. The variation in hourly noise levels is relatively large.