SFDPH Program on Health, Equity, and Sustainability
Urban Health and Place Team
The San Francisco Noise Model – June 2010

The San Francisco Noise Model

Introduction

The San Francisco Noise Model estimates community noise levels in all areas of the City based on the generation and dispersion of traffic and industrial point source of noise emissions. It has the capacity to include airports and mass transit when appropriate. The model can estimate current or future noise levels for a street, land use parcel, neighborhood, community, or an entire city. The model can also identify the need for noise mitigation measures which include: barriers, substitution of quieter vehicles and equipment, and rerouting of noisy traffic. The model is an integral part of the citywide noise enforcement program and is especially useful in determining the various permitted noise levels associated with zoning districts in the noise ordinance and the implementation of acoustical building code standards.

Background and Development

The California Government Code requires cities and counties to develop noise elements as part of their General Plans. In 1974, the San Francisco Planning Commission adopted a comprehensive environmental protection plan which included a Transportation Noise Element. The Noise Element includes a map of noise levels throughout the county and is used to inform land use compatibility. The county or citywide noise map is also used to implement the State Building Code requirements for noise insulation in residential construction (California Building Code, Section 1207). San Francisco has not updated its Noise Element noise map since 1974. In 2005, the San Francisco Department of Public Health in collaboration with the Department of Building Inspection began to develop a noise model for all of San Francisco. The City noise map is an application of a noise model projected at the scale of the City. Our general steps involved in the development of the San Francisco Noise Model are described below:

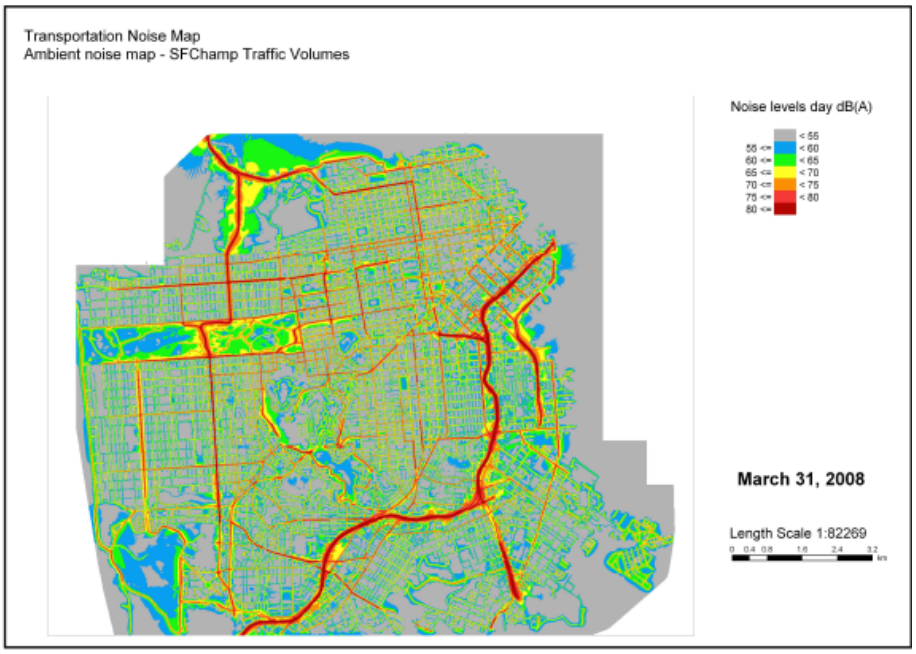
- Create or procure a GIS based map of the area to be modeled.
- Determine the traffic volumes and types of vehicles.
- Determine the temporal distribution of traffic, because the models penalize night noise through the use of the Ldn or CNEL metrics.
- Input the counts into a traffic noise model and calculate the noise exposures at varying distances.
- If possible, include topology and three-dimensional buildings in the analysis.
- Input fixed industrial noise sources as measured in field investigations.

Available sources of traffic data include local and county transportation authorities; departments of public works; environmental impact reports, bike and pedestrian plans; and transportation demand studies associated with mass transit. The San Francisco Noise Model uses data on hourly traffic counts and types from a local traffic model maintained by the county transportation authority called SFCHAMP which is based upon Census data and representative daily trip logs. Traffic volume and type data was input into a traffic model which includes speed, receptor distance, and road surface. A simple first order model for accomplishing this task is the FHWA-TNM Lookup Table Model found at: http://www.fhwa.dot.gov/environment/noise/tnm/tn_ver25lu.htm. For the San Francisco Noise Model, the first order TNM Lookup Table was elaborated with the introduction of SoundPLAN software which allows inclusion of topology and 3-dimensional buildings and provides detailed and precise exposure levels at the parcel level.

Collaborations/Constituencies Involved

The development of the San Francisco Noise Model represents collaboration between the San Francisco Department of Public Health, UC Berkeley School of Public Health, San Francisco Building Department, San Francisco Planning Department, San Francisco Municipal Transportation Agency, San Francisco County Transportation Authority, San Francisco Department of Technology and Information Services, San Francisco Office of Emergency Services, and Charles Salter and Associates, Acoustical Consultants.

SFDPH Program on Health, Equity, and Sustainability
Urban Health and Place Team
The San Francisco Noise Model – June 2010



Relevance to Health and Health Equity

Levels of community noise above 55 decibels (dB) are associated with a large number of adverse health conditions. According to the World Health Organization, reductions of noise by 6-14 dBA ("A" = weighted) result in subjective and objective improvements in sleep. Chronic road noise can affect cognitive performance of children including attention span, concentration and remembering, poorer reading ability, and poorer discrimination between sounds (London Health Commission, 2003). There is a clear dose-response relationship between environmental noise from traffic and high blood pressure (Van kempen E, 2002). Increasing community noise and traffic noise increases the risk of myocardial infarction at noise levels above 60 dBA (Babish, 2008). Noise can also interfere with speech communication outdoors, in the workplace and in the schoolrooms, interfering with the ability of people to perform their work (WHO, 1999). Finally, the combination of noise and poor quality housing has been associated with higher stress and stress hormone levels (Evans, 2004).

The mechanism for many of the relationships between noise and disease outcomes is thought to be mediated by physiologic stress response and elevated levels of cortisol and other stress hormones. In a recent SFDPH and UC Berkeley study of noise levels and annoyance in San Francisco (Seto, 2007), it was found that elevated noise levels disproportionately impact those living in high population density areas of San Francisco's Tenderloin and Chinatown neighborhoods. These high noise areas are also associated with low-income levels and limited English speaking ability.

Applications and Policy Targets

The San Francisco Noise Model can be used to identify those populations exposed to excessive noise. When coupled with other land use strategies, the Model can protect residents of new developments by ensuring that these homes are built to modern acoustical insulation standards. In addition the Model enables the identification of areas exposed to excessive noise and enables the implementation of mitigation measures which could include sound walls, electric trolley cars, hybrid buses, rerouting of heavy trucks, and reduced use of police and fire sirens.

For more information, please visit:
www.sfphes.org