Noise Mapping of Container Terminals at Ports of Long Beach & Los Angeles

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Outline

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  - Research Findings

- **Conclusion**

Introduction

- **Motivation**
  - Noise emissions from various transportation modes including seaports have become a major concern to environmental and governmental agencies in recent years.
  - Noise studies and modeling have been done extensively at major European cities and seaports (European Union directive 2002/49/EC). The United States lags behind the European countries in terms of noise mapping.
  - The Los Angeles-Long Beach port complex, the gateway to the Pacific Rim, is the nation's largest ocean freight hub and its busiest container port complex.
  - As the container sector of the Ports of Long Beach/Los Angeles have the highest growth potential, the levels of noise generated by cargo transportation and handling activities are especially of interest.

Introduction

- **Research Objective**
  - To determine, using noise mapping, the level of noise generated by the cargo handling and transport activities at the container terminals at the Ports of Long Beach & Los Angeles
- **Benefits and advantages of noise modeling/mapping**
  - Evaluate noise impacts
  - Identify noise hot spots
  - Facilitate the development of noise reduction measures
  - Predict noise impact of new and future development

Noise Mapping

Noise Mapping

- Noise map presents complex noise information in a clear and simple way on a physical map.
  - Takes into account all noise sources as well as the effects of obstacles and terrain.

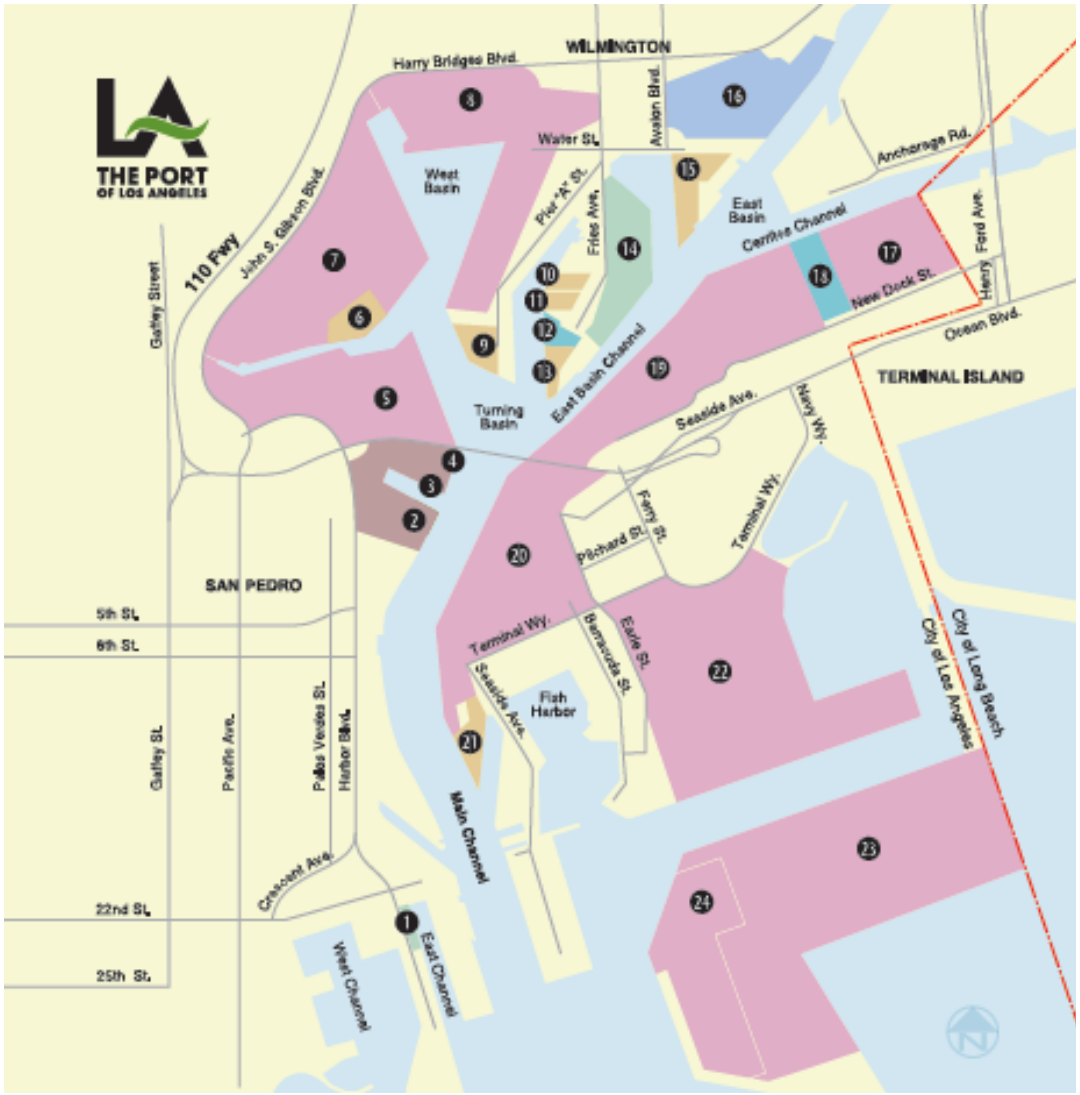
- Procedure of Noise mapping:
  - Collect noise and activity data for traffic and industry.
  - Create digital model of the buildings, screens, and topography.
  - Determine the noise levels and noise propagation to create the noise contours.

POLB Terminals

Container terminals

1. SSA Marine – Pier A
2. SSA Marine – Pier C
3. California United Terminals – Pier E
4. Long Beach Container Terminal – Pier F
5. International Transportation Service – Pier G
6. Pacific Container Terminals – Pier J
7. Total Terminals International – Pier T

PoLA Terminals



Container terminals

Berth 100: WEST BASIN CONTAINER TERMINAL

Berths 121-131: WEST BASIN CONTAINER TERMINAL

Berths 135-139: TRANS PACIFIC CONTAINER SERVICE CORP. (TraPac)

Berths 206-209: PORT OF LOS ANGELES CONTAINER TERMINAL

Berths 212-225: YUSEN CONTAINER TERMINAL

Berths 226-236: EVERGREEN CONTAINER TERMINAL

Berths 302-305: APL TERMINAL/GLOBAL GATEWAY SOUTH

Berths 401-404: APM TERMINALS/PIER 400

Berths 405-406: CALIFORNIA UNITED TERMINALS

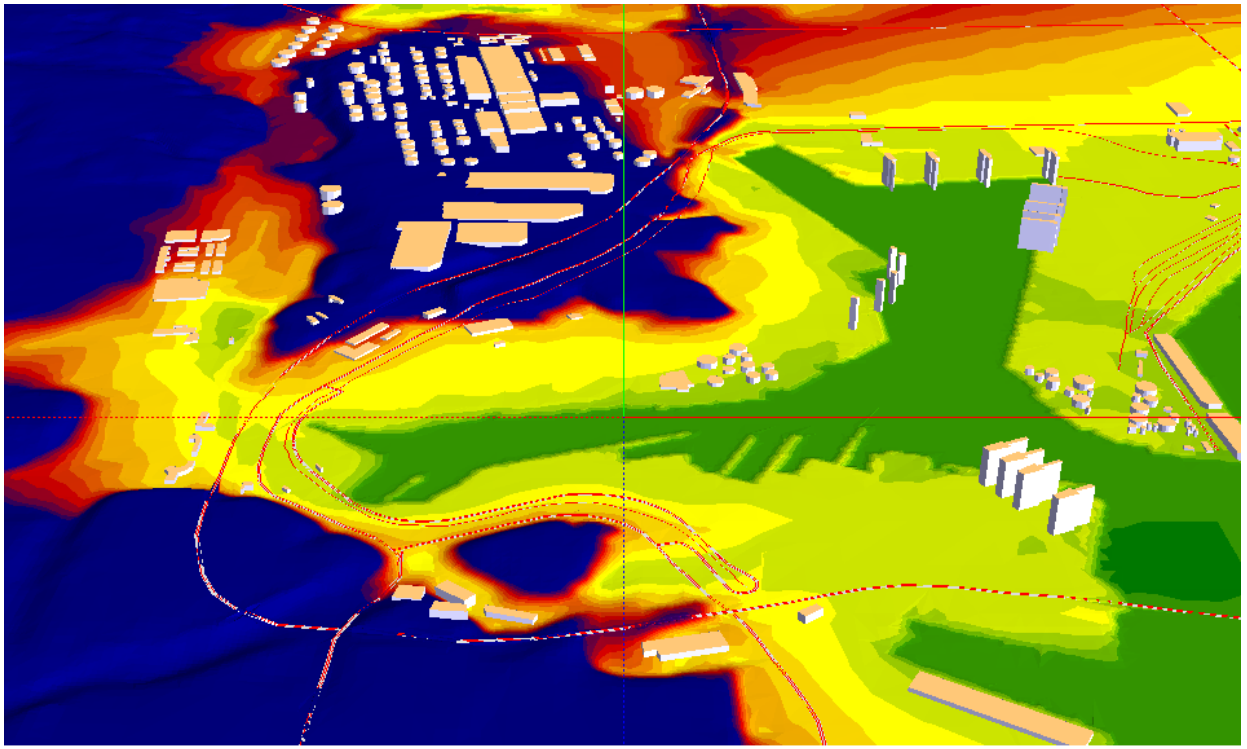
Data Needed for Noise Mapping

1. **Ground topography**
   - Ground contours and buildings/obstacles affect noise propagation.
2. **Source noise levels**
   - Noise characteristics of the ships, cranes, and container handling equipment must be determined.
   - Noise characteristics of trucks and trains are built into noise calculation standards.
3. **Operational information of noise sources**
   - From PoLB & PoLA Air Emission Inventory Report and field recordings.
     - number of ships at berth
     - volume of cargo to be handled
     - number of cranes, forklifts, tractors in operation
     - number of trucks and trains transporting cargo to and from the port

Digital spatial model of the Port

Spatial model includes:

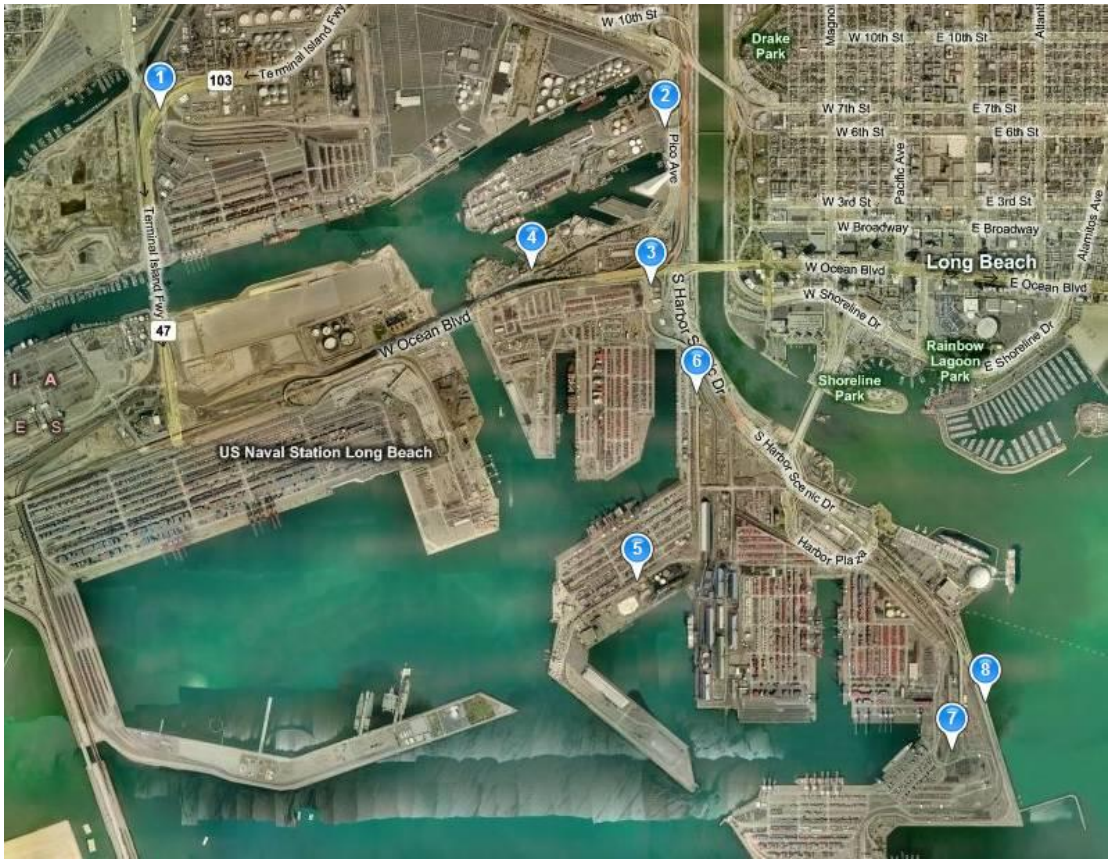
- Spot heights and contours
- Buildings (including height dimensions) and other obstacles in the study area
- Location of noise sources: industry, roads, and railways

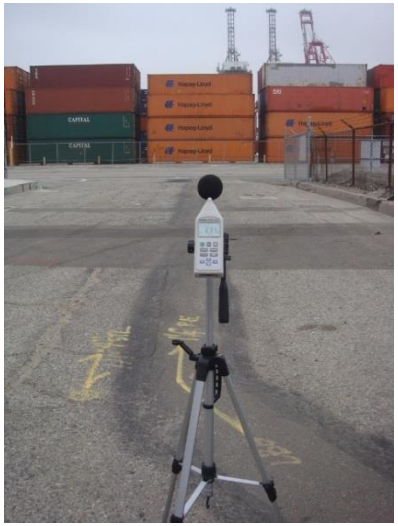


Field Noise Measurements and Data Collection

Field Noise Measurements and Data Collection

- 8 locations around the Port of Long Beach

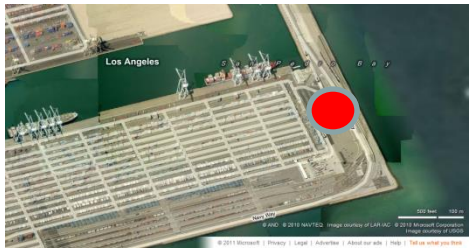


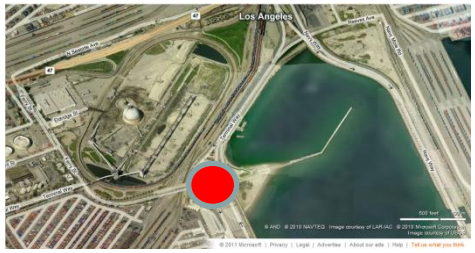


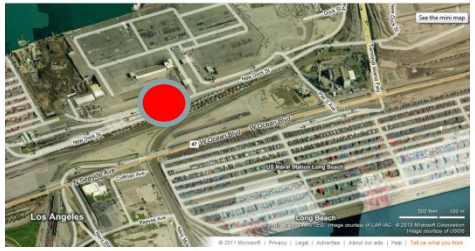
Sound meter set up in the field

Field Noise Measurements and Data Collection

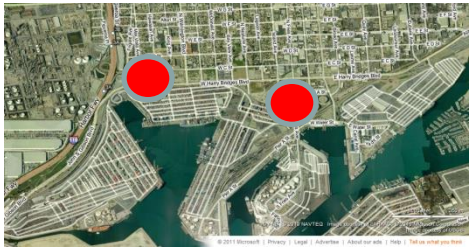
- 8 locations around the Port of Los Angeles







Location # 1 Berths 401-406
Location # 3 Berths 302-305
Location # 4 Berths 226-236
Location # 5 Berths 212-225
Locations # 6 & 7 Berths 135-139
Location # 8 Berth 100
Location # 9 Berths 121-131



Trucks and Rail Activity Data
Port of Long Beach

- Number of trucks for each pier by time period

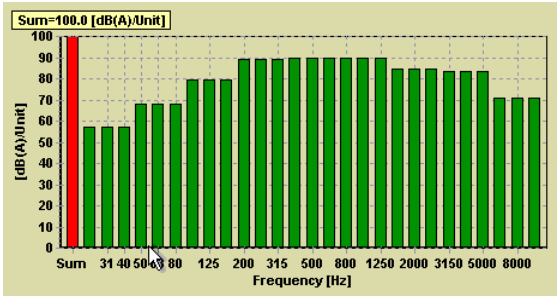
Pier	AM (6-9am)	MD (9am-3pm)	PM (3-7pm)	NT (7pm-6am)
A	237	1528	663	717
C	161	873	407	557
E	600	2183	858	884
F	406	1542	672	514
G	374	2321	975	938
J	163	1023	435	451
T	326	1897	744	514

  - The truck routes are obtained from the field and the data is then compiled for each road segment and entered into the model.

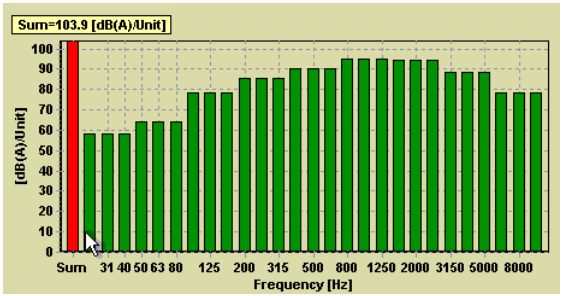
- Number of trains per day for each pier

Pier	Average # of trains per day	Average length of train (meters)
A	3	1744
F	3	1760
G	3	2648
J	2	1751
T	3	2165

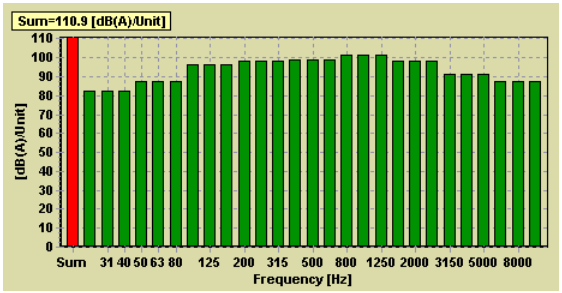
Sound characteristics of cargo handling equipment



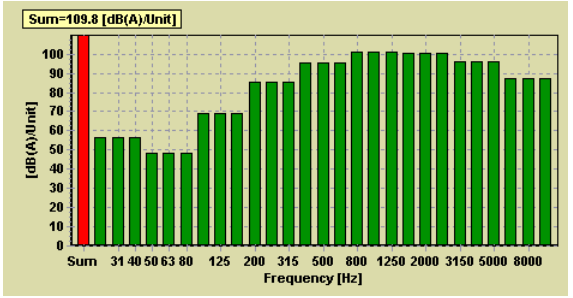
Sound power and spectrum of dockside crane



Sound power and spectrum of yard tractor



Sound power and spectrum of forklift



Sound power and spectrum of RTG crane

Ships and Cranes Activity Data

- Average number of container ships active per hour at each pier

Pier	# of ships per hour
A	1.24
C	0.67
E	1.74
F	1.16
G	1.44
J	0.83
T	1.48

- Average number of dockside cranes active per hour for each pier

Pier	# of dockside cranes active per hour
A	1.74
C	0.94
E	2.44
F	1.63
G	2.03
J	1.16
T	2.08

Cargo Handling Equipment Activity Data

- Number of cargo handling equipment active per hour by pier and time period

RTG Cranes				
Pier	AM (6-9am)	MD (9am-3pm)	PM (3-7pm)	NT (7pm-6am)
A	2.1	6.8	4.5	1.9
C	0	0	0	0
E	2.7	8.8	5.9	2.4
F	1.3	4.2	2.8	1.1
G	2.0	6.5	4.4	1.8
J	0.7	2.1	1.4	0.6
T	1.9	6.1	4.1	1.7
Forklifts/side-picks/top-handlers				
Pier	AM (6-9am)	MD (9am-3pm)	PM (3-7pm)	NT (7pm-6am)
A	3.6	11.7	7.8	3.2
C	1.5	4.7	3.1	1.3
E	1.9	6.1	4.1	1.7
F	1.3	4.3	2.9	1.2
G	3.2	10.3	6.9	2.8
J	3.0	9.8	6.5	2.7
T	1.9	6.0	4.0	1.6
Yard tractors				
Pier	AM (6-9am)	MD (9am-3pm)	PM (3-7pm)	NT (7pm-6am)
A	15.9	51.2	34.0	14.0
C	5.0	16.1	10.7	4.4
E	10.0	32.1	21.4	8.8
F	7.6	24.2	16.1	6.6
G	14.8	47.6	31.6	13
J	9.5	30.4	20.2	8.3
T	16.0	51.3	34.1	14.0

Trucks and Rail Activity Data
Port of LA

- Number of trucks for each terminal by time period

Berth	AM (6-9am)	MD (9am-3pm)	PM (3-7pm)	NT (7pm-6am)
401-406	715	4593	2037	2304
302-305	242	1557	690	781
226-236	429	2754	1221	1382
212-225	354	2275	1009	1141
135-139	180	1155	512	579
100	265	1702	755	854
121-131	321	2061	914	1034

- The truck routes are obtained from the field and the data is then compiled for each road segment and entered into the model.

Trucks and Rail Activity Data

- Number of trains per day for each terminal

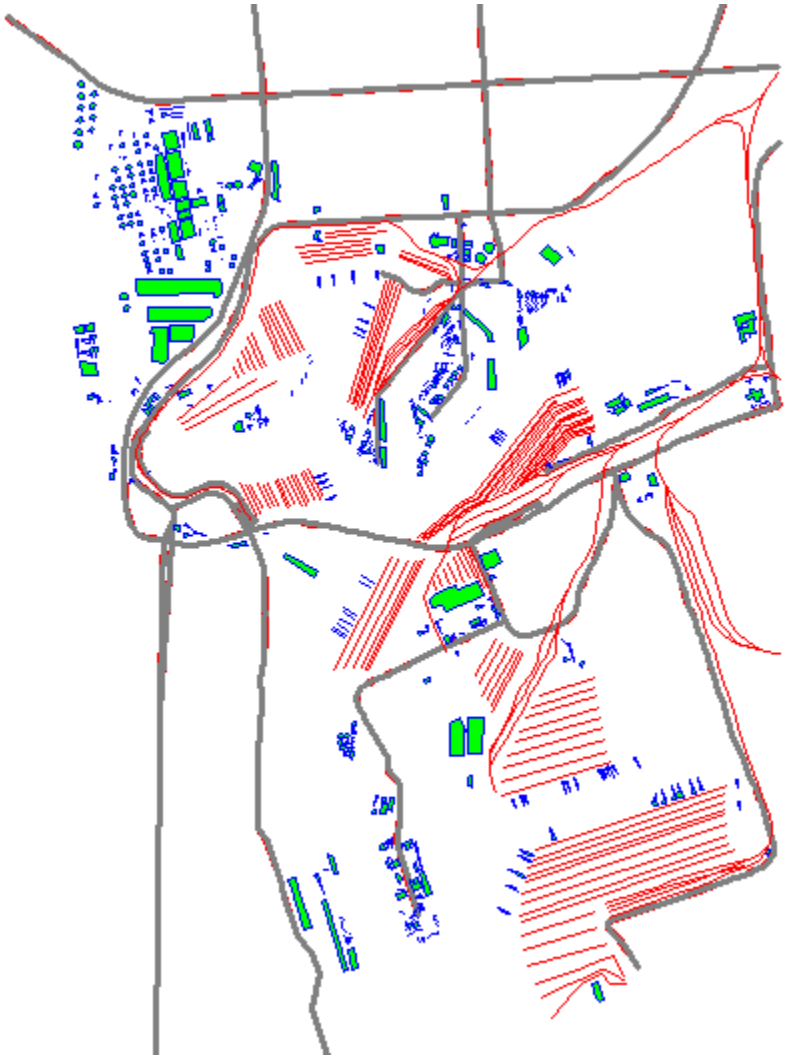
Berth	Average # of trains per day	Average length of train (meters)
401-406	6	2290
302-305	2	2328
226-236	4	2059
212-225	3	2268
135-139	2	1727
100	3	1697
121-131	3	2055

Cargo Handling Equipment Activity Data

- Number of cargo handling equipment active per hour by pier and time period

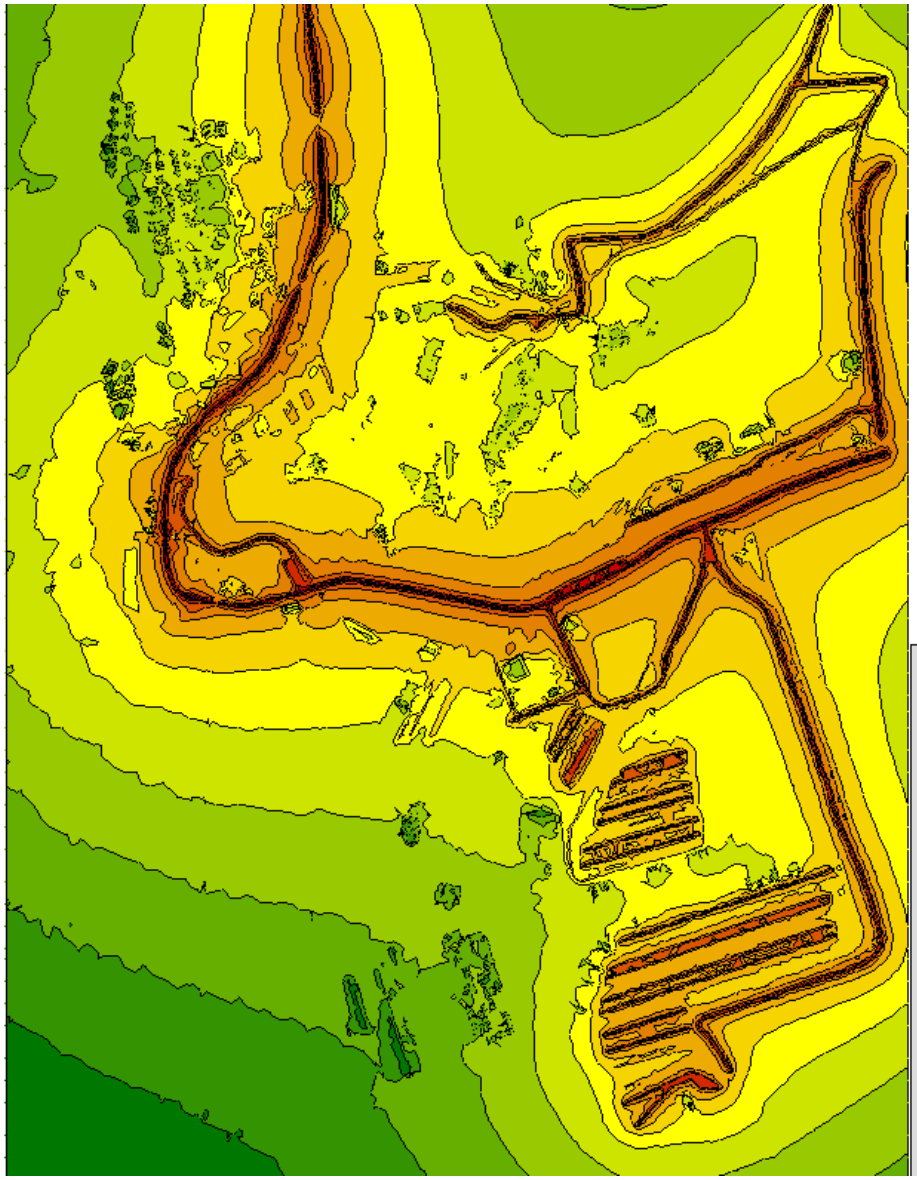
RTG Cranes				
Berth	AM (6-9am)	MD (9am-3pm)	PM (3-7pm)	NT (7pm-6am)
401-406	2.0	6.0	4.0	2.0
302-305	1.0	2.0	1.0	1.0
226-236	1.0	4.0	3.0	1.0
212-225	1.0	3.0	2.0	1.0
135-139	0.0	2.0	1.0	0.0
100	1.0	2.0	2.0	1.0
121-131	1.0	3.0	2.0	1.0
Forklifts/side-picks/top-handlers				
Berth	AM (6-9am)	MD (9am-3pm)	PM (3-7pm)	NT (7pm-6am)
401-406	10.0	32.0	21.0	9.0
302-305	3.0	11.0	7.0	3.0
226-236	6.0	19.0	13.0	5.0
212-225	5.0	16.0	10.0	4.0
135-139	3.0	8.0	5.0	2.0
100	4.0	12.0	8.0	3.0
121-131	4.0	14.0	9.0	4.0
Yard tractors				
Berth	AM (6-9am)	MD (9am-3pm)	PM (3-7pm)	NT (7pm-6am)
401-406	38.0	123.0	82.0	34.0
302-305	13.0	42.0	28.0	11.0
226-236	23.0	74.0	49.0	20.0
212-225	19.0	61.0	40.0	17.0
135-139	10.0	31.0	21.0	8.0
100	14.0	45.0	30.0	12.0
121-131	17.0	55.0	37.0	15.0

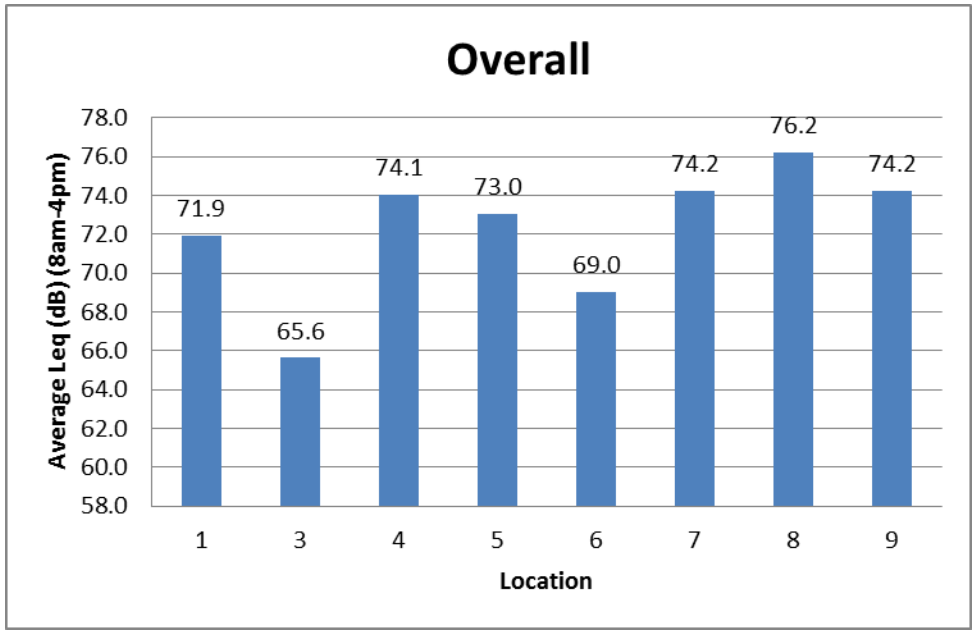
Location of sources

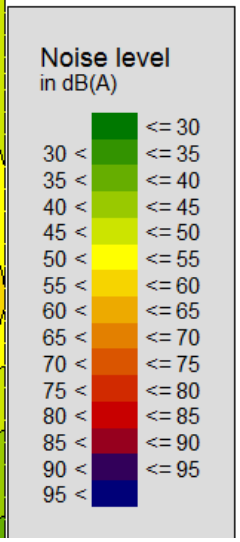


Results

Overall Noise Map for the Port of Los Angeles







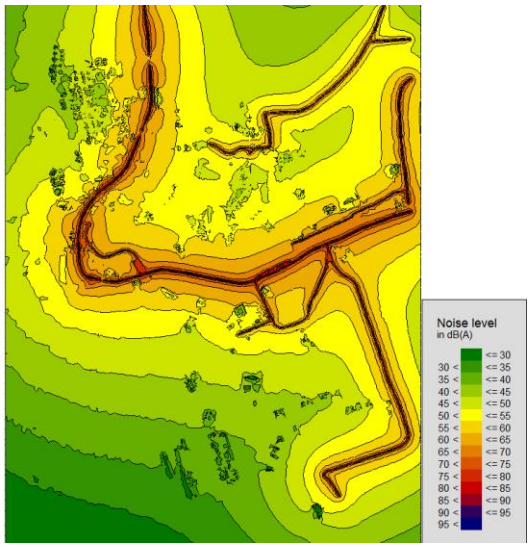
Overall Noise Map for the Port of Los Angeles

Comparison of noise levels

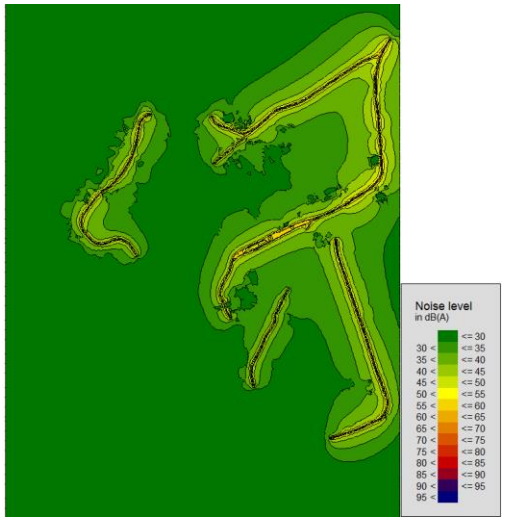
Location	Noise Levels given from the Noise Map (dB)	Average Noise Measured from the Field (dB)	Difference (dB)
1	70.3	71.9	-1.6
3	68.3	65.6	2.7
4	72.7	74.1	-1.4
5	74.2	73.0	1.2
7	72.4	74.2	-1.8
8	75.4	76.2	-0.8
9	74.4	74.2	0.2

Noise Map for A Specific Source (POLA)

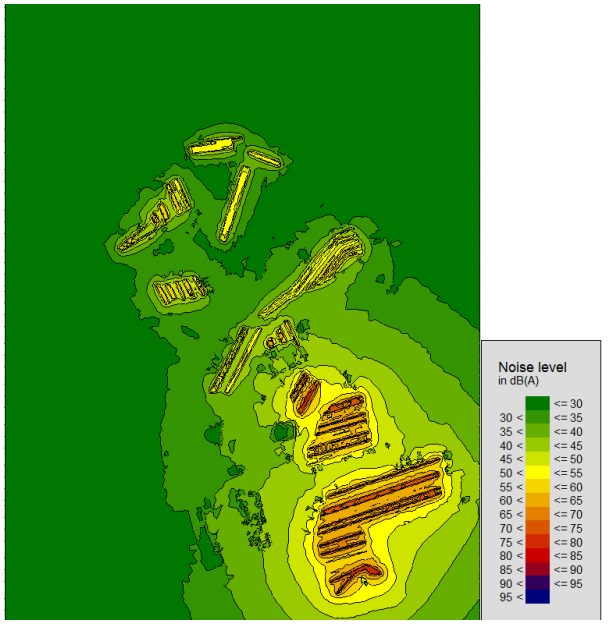
1) Trucks only



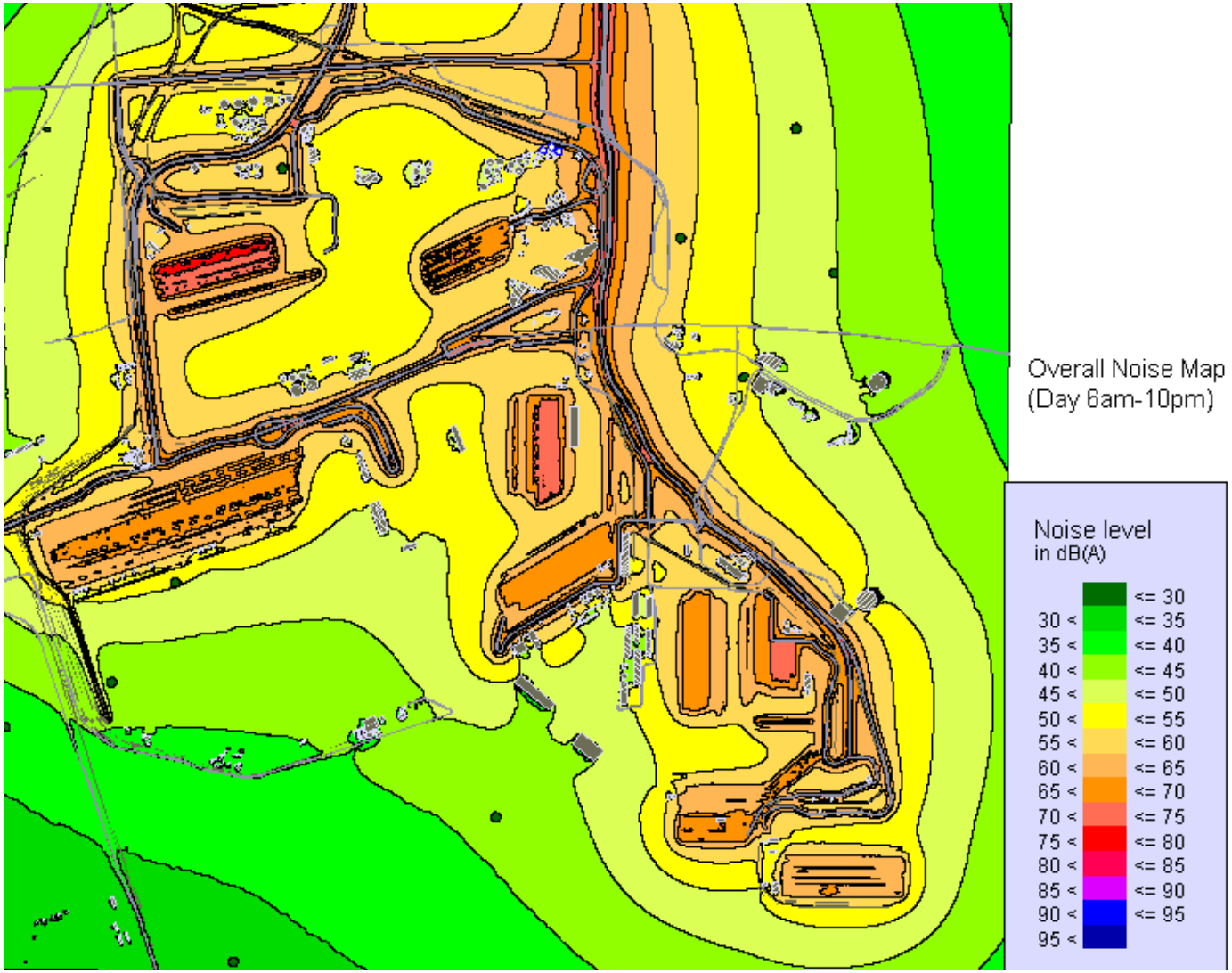
2) Trains only



3) Ships and cargo handling equipment only



Overall Noise Map for the Port of Long Beach

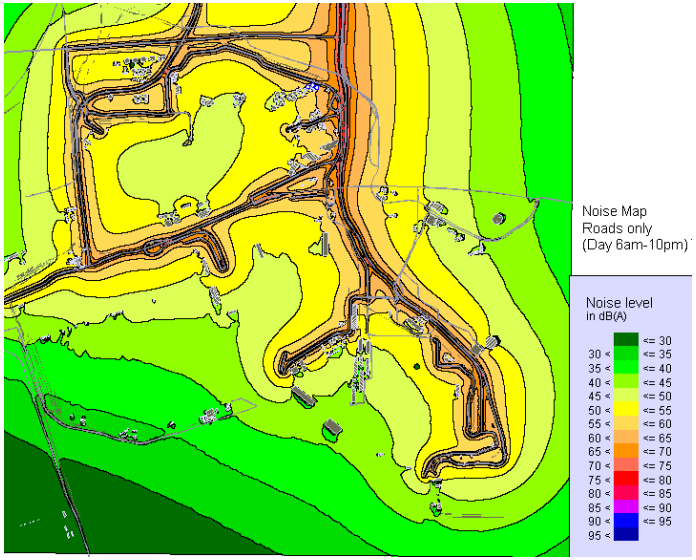


Comparison of Noise Levels

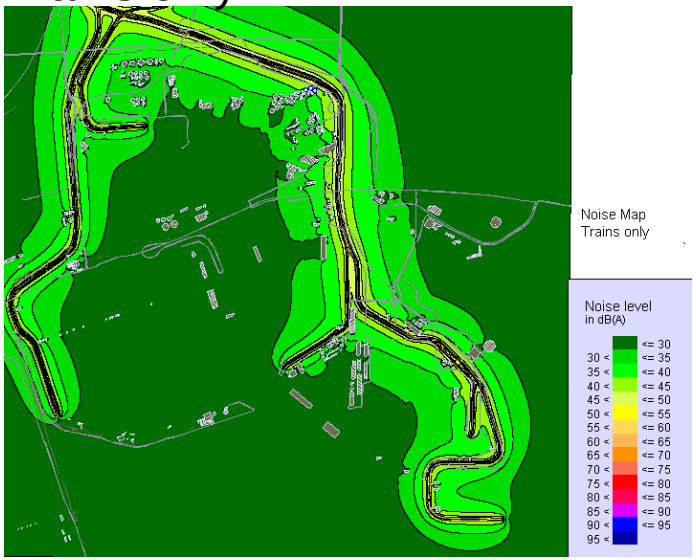
Location	Noise level from noise map (dB) (1)	Average noise level measured in the field (dB) (2)	Difference (dB) = (1) – (2)
1	67.2	71.6	-4.4
2	67.3	70.9	-3.6
3	62.5	72.8	-10.3
4	72.6	71.8	+0.8
5	67.2	68.8	-1.6
6	62.5	65.9	-3.4
7	64.9	66.1	-1.2
8	66.7	65.8	+0.9

Noise Map for A Specific Source (POLB)

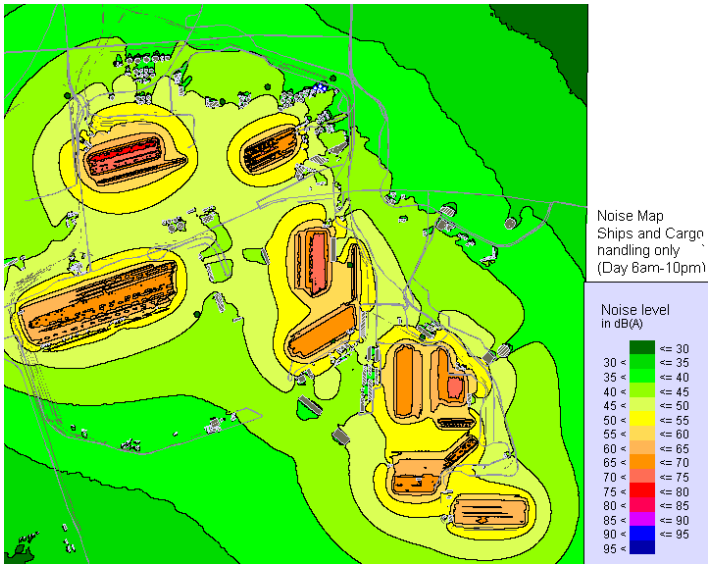
1) Trucks only



2) Trains only

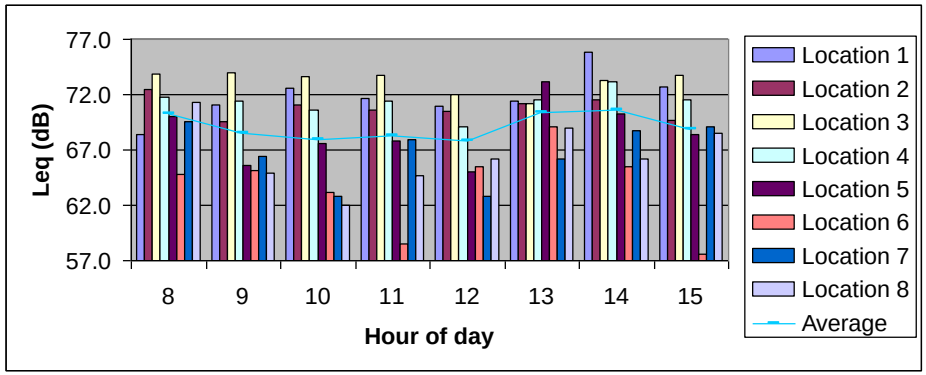


3) Ships and cargo handling equipment only

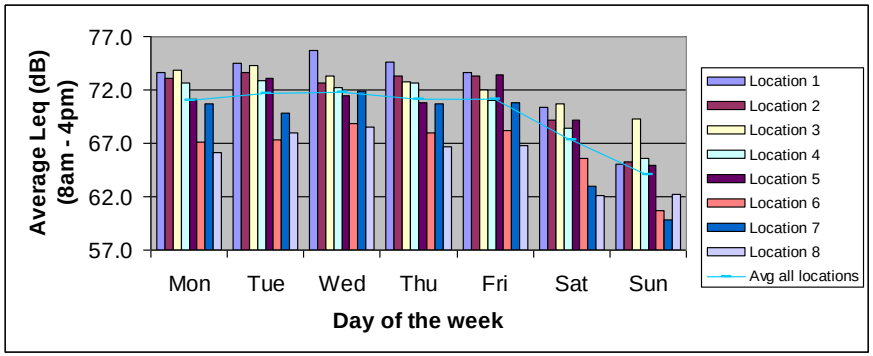


Noise Variation

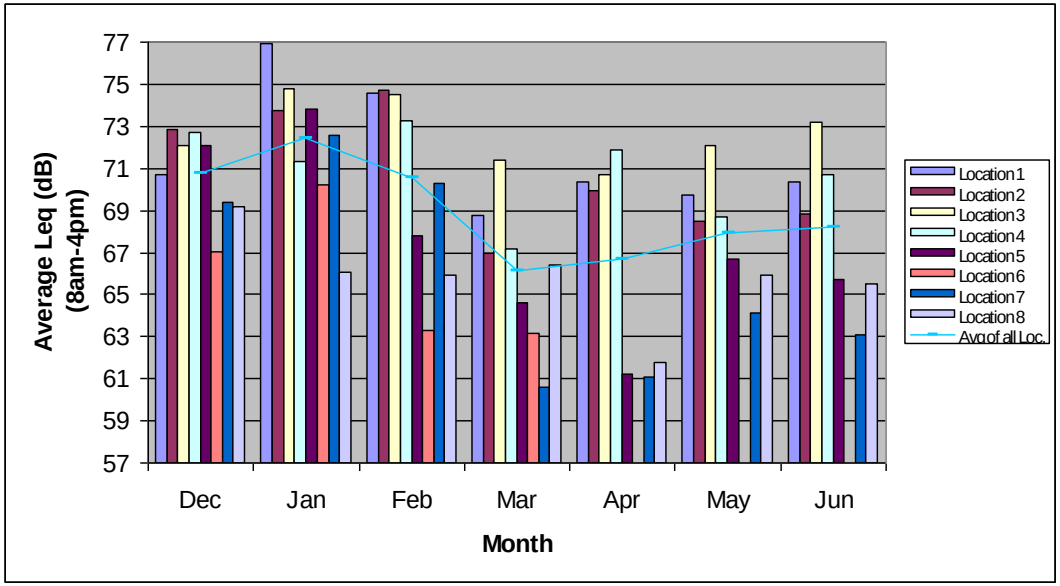
1) Hourly noise variation



2) Daily noise variation



3) Monthly noise variation



Research Findings

Research Findings

- **Significant noise sources**
  - Highest contribution of noise is from the truck activities, followed by the cargo handling activities. The contribution from the railroad noise is not significant.
  - Noise from the container truck traffic on the roads is within the Caltrans/FHWA limit of 71dB for developed land, 50 feet away from the roads (not including the freeways).
  - Noise from the cargo handling activities is well below the acceptable level of 75dB at a distance of 50feet, as stipulated by the LA municipal code for industrial equipment.

Research Findings

- **Sensitive areas**
  - Non-industrial area to the east of the LA River.
    - Noise level is below 60dB.
    - Within the Community Noise Exposure guidelines of the LA municipal code.
  - Queen Mary Hotel situated on the POLB
    - The noise level is only 55dB.
    - Within the Community Noise Exposure guidelines of the LA municipal code.
  - Residential area to the west of POLA
    - Noise level does not exceed 55dB during the day period.

Research Findings

- **Lessons learned**

Data collection : Significant noise sources should be identified at an earlier instance

Data validation: The data validation can be done by either validating the input data sets or measuring noise levels in selected locations and then attempting a comparison between the predicted and the measured noise levels.

It is very important to select locations that are close to the activities of interest.

Conclusion

- Noise distribution at the container terminals at the Port was modeled by means of noise mapping.
- Noise mapping is a very valuable tool allowing the assessment of the current noise situation in the port.
- The noise model can be used to predict the noise impact of future developments.
  - With this tool, the port authority can easily obtain crucial information for port development and planning applications.