Wilmington School & Residence
Sound Attenuation Program

Report #4:
Property Inventory and Mitigation Recommendations Report

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EXECUTIVE SUMMARY

This report presents an overview of the impacted residences and schools in the study area for the Harbor Community Benefit Foundation's (HCBF) Wilmington School and Residence Sound Attenuation Program (SAP). This report inventories schools and the residences determined to be highly-impacted, evaluates the exterior noise levels, evaluates the noise reduction capabilities of representative properties, determines the best option to provide sound mitigation treatments and evaluates overall program costs.

Considerable background information is provided in Section 2 as a result of an inventory (windshield survey) of the highly-impacted residential property and the impacted schools. A total of 280 residential properties were identified as being highly-impacted. A total of three schools were identified as being impacted.

The results of the inventory allowed the study team to analyze major architectural styles in the study area, determine housing typologies and select a sample of residential property for further evaluation (Section 3). Acoustical measurements were undertaken in the selected residential properties and the schools (Section 4). These measurements allowed the team to assess the noise reduction capabilities of the existing structures and to evaluate other building characteristics including ventilation systems.

A review of acoustical criteria is presented in Section 5. World Health Organization (WHO) and U.S. Environmental Protection Agency (EPA) criteria are used as the design criteria for both the residential properties and the schools. For residences design criteria included maximum nighttime interior L_{max} of 45 dBA, maximum daytime L_{eq} of 35 dBA and maximum nighttime L_{eq} of 30 dBA. For schools the design criteria included maximum daytime interior L_{max} of 58 dBA. Based on the exterior noise levels, the measured noise levels at the properties (Section 4) and the design criteria (Section 5) various treatment options were evaluated for both the residences and the schools.

For the residential properties the noise mitigation treatment options (Section 6) evaluated included normal acoustical treatment of windows and doors (Treatment Option #1) and a Quiet Room treatment (Treatment Option #2) that focused only on a higher level of treatment only for bedrooms that have a direct line-of-sight to the noise source.

For schools the noise mitigation options (Section 6) recommended that HCBF work with Los Angeles Unified School District and leverage The California Clean Energy Jobs Act (Proposition 39 (K-12) Program) to fund treatment options.

The projected acoustical performance is presented in Section 7. For the highly-impacted residences, the Quiet Room treatment (Treatment Option #2), will allow the daytime and nighttime L_{eq} WHO criteria to be met in almost all instances. In addition, while the maximum nighttime interior L_{max} are not met, these noise levels will be reduced considerably using the Quiet Room treatments. For the schools, the acoustical treatments (Treatment Strategy #2), will ensure that the maximum daytime L_{max} WHO criteria will be met. However, it should be noted that these noise levels already met the WHO criteria without acoustical treatments.

Lastly, the cost estimates for the acoustical treatments are provided in Section 8. For the highly-impacted residential property acoustical treatments using Treatment Option #2 are projected to cost over $5.7 million dollars at an average cost per residence of $20,405. For the schools, if HCBF were to self-fund, the acoustical treatments using Treatment Strategy #2 are projected to cost over $2.2 million dollars and averaging $21,190 per classroom based on treating 106 total classrooms in the three schools.

Section 8 also provides a brief discussion of the treatment costs of the impacted properties. While these properties were not yet studied in detail, treatment of an estimated 1,200 properties is estimated to cost $12 million dollars at an average cost per residence of $10,000.

The final step of this program is to determine what treatment option/strategy should be provided for each building type and to develop a plan of what schools and homes should have first priority in mitigation treatments. Given the limited amount of funding available for treatment, a prioritization methodology will have to be developed to allocate the available resources to address the areas of greatest cumulative noise impact. As more funding becomes available in the future, structures with less noise impact can be addressed with the ultimate goal of treating all eligible schools and residences.

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1.0 INTRODUCTION

This is the fourth report produced for the Harbor Community Benefit Foundation's (HCBF) Wilmington School and Residence Sound Attenuation Program (SAP). The first document, *Report #1: Measurement Report*, presented the results of a comprehensive noise-monitoring program to identify and, preliminarily, quantify noise sources associated with the Port of Los Angeles operations impacting the homes and schools of the Wilmington Community. The second document, *Report #2: Criteria and Prioritization Recommendations Report*, presented information and recommendations that are intended to be used by the HCBF Board to adopt specific criteria for determining eligibility of schools and homes for the Sound Insulation Program and to prioritize implementation of the program. The third deliverable for this project, *Report #3: Noise Contour Development Methodology Report*, discusses the development of, and presents, the noise contours from the port-related noise sources identified in the first report overlaid on aerial mapping.

This report, *Report #4: Property Inventory and Mitigation Recommendations Report*, presents an overview of the impacted residences and schools in the Wilmington Community. This report inventoried the schools and highly impacted residences in the study area, evaluated the exterior noise levels on some representative properties, evaluated the noise reduction capabilities of various buildings, evaluated the existing conditions of the buildings, and determined the best options for providing sound insulation treatments and reducing noise to the communities at a reasonable cost.

Previous reports have documented that the port-related noise impacts in the community are widespread and pervasive. It is also understood that the resources available to the HCBF to address these issues are limited, with only $815,000 budgeted for implementation of the SAP over the next four years. While the foundation will continue to search for additional funding resources to increase the amount available, it is very unlikely that there will be enough resources to provide sound attenuation for all residences and schools impacted by port-related noise in the foreseeable future.

This report is intended to give the HCBF Board the best available information regarding the impacts and the potential costs to implement a mitigation program.

Staff from Landrum & Brown (L&B) led a team of consultants in performing the mitigation study for these properties included in the Wilmington SAP. L&B staff was responsible for the overall project management at all properties included in the study. Staff from L&B and The Jones Payne Group (JPG) inventoried the properties, assessed the architectural conditions, design acoustical treatments and developed cost estimates for implementation of the recommended treatments. Staff from PBS Engineers, Inc. (PBS) provided input for the ventilation issues at the schools and residences. L&B was also responsible for the acoustical assessment including the acoustical testing, design recommendations, and on-going support during the design process.

The steps undertaken in this report were as follows:

1. Undertake a windshield survey or inventory of the estimated 200 highly-impacted residential properties to evaluate the various buildings styles.

2. Undertake an initial walk-through inspection of the three schools determined to be impacted in the study area. Background information on the building inventory and the initial walk-through of the schools is presented in Section 2.

3. Perform an evaluation of the buildings inventoried in #1 above to determine major architectural styles. This including an evaluation of the window, door, roof details and other structural elements that may require treatment. This information was used to develop the acoustical testing plan and helped determine the buildings, rooms, and elements that would be subjected to the acoustical testing. The results of this survey and analysis are presented in Section 3.

4. Perform a series of pre-modification noise measurements to determine the existing acoustical conditions of the various structures selected for further analysis. These measurements included testing a number of rooms in the various buildings to determine the building noise level reduction (NLR). Various elements were also tested to provide information for the design of the acoustical treatments.

   The measurements also included the determination of the average A-weighted spectrum of the typical noise source in the study area. This spectrum was developed from measuring a representative sample of truck and train pass-by's in the study area. The results of the acoustical testing performed at the selected residences and the three schools are presented in Section 4.

5. Use the test results from the pre-modification noise measurements to develop the program design goals. This information is presented in Section 5.

6. Develop acoustical treatment recommendations, based on acoustical modeling, which will ensure meeting the program design goals. The recommended acoustical treatments are discussed in Section 6.

7. Discuss the acoustical impacts based on the treatment recommendations and the design goals. The acoustical performance is discussed in Section 7.

8. Once acoustical treatments have been developed, order of magnitude cost estimates will be developed for program management and construction costs. These costs are presented in Section 8.

2.0 INVENTORY OF HIGHLY IMPACTED PROPERTIES

2.1 Residences (Highly-Impacted)

As part of the overview of impacted residences, a housing conditions inventory was conducted on the highly-impacted properties by staff from L&B and JPG on Tuesday July 23rd, 2013. Based on the eligibility and ranking criteria set in *Report #2: Criteria and Prioritization Report, Table 9 - Preliminary Residential PScore Priority Ranking by Impact Area*, and associated maps, the survey focused on three study areas. Residences in the study areas were evaluated on their exterior, rather than interior condition. This is typically referred to as a windshield survey. Staff drove study areas photo documenting the homes and noting major architectural styles. The general location and boundaries of the areas surveyed are indicated in the following figures and concentrations of highly-impacted properties are highlighted in purple. The highly-impacted residential areas are broken down into three general study areas. Figure 1 presents the Broad Avenue/Oceanside Street Study Area. Figure 2 presents the Hyatt Avenue/Alameda Street Study Area, while Figure 3 presents the Drumm Avenue Study Area.

While the Preliminary Impact Area map documents approximately 200 highly-impacted residences in the three impact zones, the survey actually identified 280 highly-impacted residences due to the presence of multiple units on a single parcel. In addition, numerous multi-family buildings were identified including a two-, three-, four- and eight-family unit buildings.

It should also be noted that thousands of impacted residential properties were not surveyed as part of this study. However, mitigation concepts for these homes are discussed in Section 6.

Key observations about the inventory are as follows:

1. ***Most Impacted Area*** – The area with the most impact exists in the Hyatt Avenue/Alameda Street Study Area.

    - Hyatt Avenue/Alameda Street Study Area has 132 highly-impacted parcels containing 185 units of housing.

    - Broad Avenue/Oceanside Street Study Area has 60 highly-impacted parcels containing 74 units of housing.

    - Drumm Avenue Study Area has 14 highly-impacted parcels containing 21 units of housing.

2. ***Age of Properties*** - The relative age of the properties ranged from the early 1900's to homes built within the last 10 years. Newer homes tend to be two-story stucco structures with tile roofs, many clustered in an area on Hyatt Avenue and McFarland Avenue. The older homes tend to be single story stucco structures varying in style from ranch, bungalow, and Spanish-style.

3. ***Code and Occupancy Violations*** - Properties in the impact areas show possible signs of code and occupancy violations including, but not limited to, un-permitted dwelling units, additions, carports, patio covers and porches.

Figure 1 Broad Avenue/Oceanside Street Study Area

Figure 2 Hyatt Avenue/Alameda Street Study Area

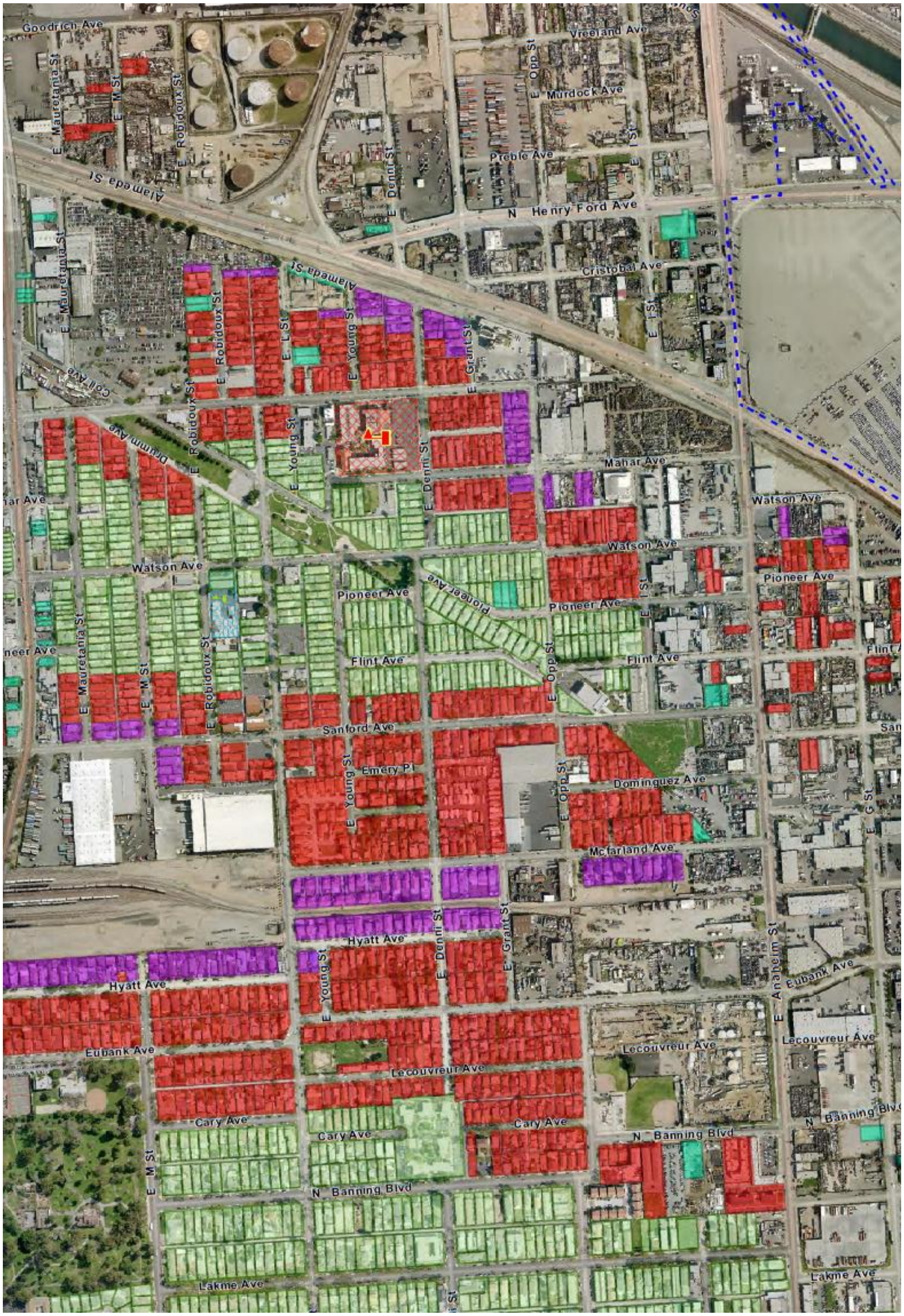


Figure 3 Drumm Avenue Study Area

4. ***McFarland Rail Line Area (P_{Score} Rank #1)*** - The area classified as the "McFarland Rail Line" is ranked number one (1) in the priority ranking by impact area and encompasses areas located in the north eastern section of the city. The area is located east of McFarland Avenue with the northern boundary of Pacific Coast Highway and the southern boundary being that of Anaheim Street.

   This site contains single-family housing in standard conditions on well-maintained lots. Streets and sidewalks are in good condition. Housing in this area has units in large lots. Most units are one- and two-story medium to large sized homes with enhanced landscaping. The majority of lots in this area have neatly trimmed lawns, no trash, and have well maintained driveways.

   The common architectural style found in this area is that of newer (2006) Mediterranean-style homes with Spanish tile roofing. The second most common is that of Ranch-style homes. Several examples of area housing are presented below.

5. ***Northern Rail Line Area (P_{Score} Rank #2) -*** The site classified as the "Northern Rail Line Area" ranked number two (2) in the priority ranking by impact area and encompasses areas located in the north eastern section of the city. The area has a northern boundary of Bond Street and Deloras Drive with the southern boundary that of 246th Street, west of Wilmington Avenue.

   This site contains single-family housing in standard conditions on well-maintained lots. Streets and sidewalks are in good condition. Housing in this area has units in medium size lots. Most units are single-story medium size homes with a few scattered two-story structures. Most lots in this area have well-kept lawns, walkways and driveways, and fencing is in good condition. While some lots may have flaws in lawns and driveways paving or deteriorated fencing, the majority do not.

   The common architectural style found in this area is that of 1940's Ranch-style housing with very few units with Spanish tile roofing. Several examples of area housing are presented below.

6. ***Alameda Street Area (P_{Score} Rank #3)*** - The “Alameda Street Area” is ranked number three (3) in the priority ranking by impact area and encompasses areas located in the north eastern section of the city. The area has a northern boundary of Pacific Coast Highway, with the southern boundary that of Anaheim Street, west of Alameda Street.

   This site contains both single- and multi-family residential. The housing conditions vary with some homes requiring minor repair to major repair. The streets and sidewalks are in fair condition. Housing in this area has units in small to medium size lots with very few two-story large homes. The maintenance issues found in this area include unkempt vegetation, litter in yards, deteriorated walkways, or deteriorated fencing. Some lots may have more serious issues, such as inoperable vehicles occupying the lot.

   The common architectural style found in this area is that of 1920’s Craftsman Bungalow. The second most common is that of Ranch-style homes. Several examples of area housing are presented below.

   Unpermitted conditions: Potential code and occupancy violations were observed in the study area.


7. ***Drumm Avenue, Sanford Avenue and Opp Street Area (P_{Score} Rank #6, #8, & #10)*** - The following areas share similar attributes and are very close in ranking, thus we will discuss the observations as an overall (generalized) view. The “Drumm Avenue, Sanford Avenue and Opp Street Area” encompass areas located in the southeastern section of the city. The three areas are separated with the Pacific Coast Highway splitting the three areas. The southern boundary is that of Anaheim Street, west of Alameda Street.

   This site contains both single- and multi-family residential. The housing conditions vary with some homes requiring minor repair to major repair. The majority of these lots are poorly maintained. The streets and sidewalks are in fair condition. Housing in this area has units in small to medium size lots with very few two-story homes. Landscaping in this particular area is in need of repair. Some of the neighborhoods are industrial in character, with residential use abutting industrial.

   The common architectural style found in this area is that of 1920’s Craftsman Bungalow. The second most common is that of Ranch-style homes. Several examples of area housing are presented below.

   Unpermitted conditions: Potential code and occupancy violations were observed in the study area.

Table 1 summarizes the housing conditions inventory for the highly-impacted residential housing completed back in July 2013. The table breaks down the inventory by the three study areas, type of housing, number of residential parcels and total number of housing units. A total of 280 residential units have been identified as being highly-impacted in the study areas. Appendix A presents a detailed breakdown on a parcel-by-parcel basis for each property considered highly-impacted.

Table 1
Summary of Highly-Impacted Residential Units

Study Area	Type of Housing	No. of Parcels	No. of Housing Units	Total Housing Units
Broad Avenue/ Oceanside Street	Single-Family	53	53	74
	Two-Family	5	10	
	Three-Family	1	3	
	Eight-Family	1	8	
Hyatt Avenue/ Alameda Street	Single-Family	88	88	185
	Two-Family	36	72	
	Three-Family	7	21	
	Four-Family	1	4	
Drumm Avenue	Single-Family	10	10	21
	Two-Family	2	4	
	Three-Family	1	3	
	Four-Family	1	4	
	Totals	206	280	280

2.2 Schools

As part of the schools overview, walk-throughs were conducted on three selected properties by staff from L&B and JPG on Thursday July 25th, 2013. Properties were selected based on the eligibility and ranking criteria set in *Report #2: Criteria and Prioritization Report*. Staff identified major construction styles with each school complex, noted ventilation and other technical issues, and determined the best approach to the acoustical testing. The three schools were located in three study areas and included the following:

- Wilmington Park Elementary School

- Broad Avenue Elementary School
- Hawaiian Avenue Elementary School

A discussion of the three schools is presented in the following sections.

Wilmington Park Elementary School – The Wilmington Park Elementary School is located in the Hyatt Avenue/Alameda Street Study Area (see Figure 2). The school is part of the Los Angeles Unified School District and is a K-5 configuration. The site is abutted by the Wilmington Park Early Education Center which was not surveyed. The campus consists of three primary structures and three modular structures, the confines of which are illustrated in the two aerials in Figure 4.

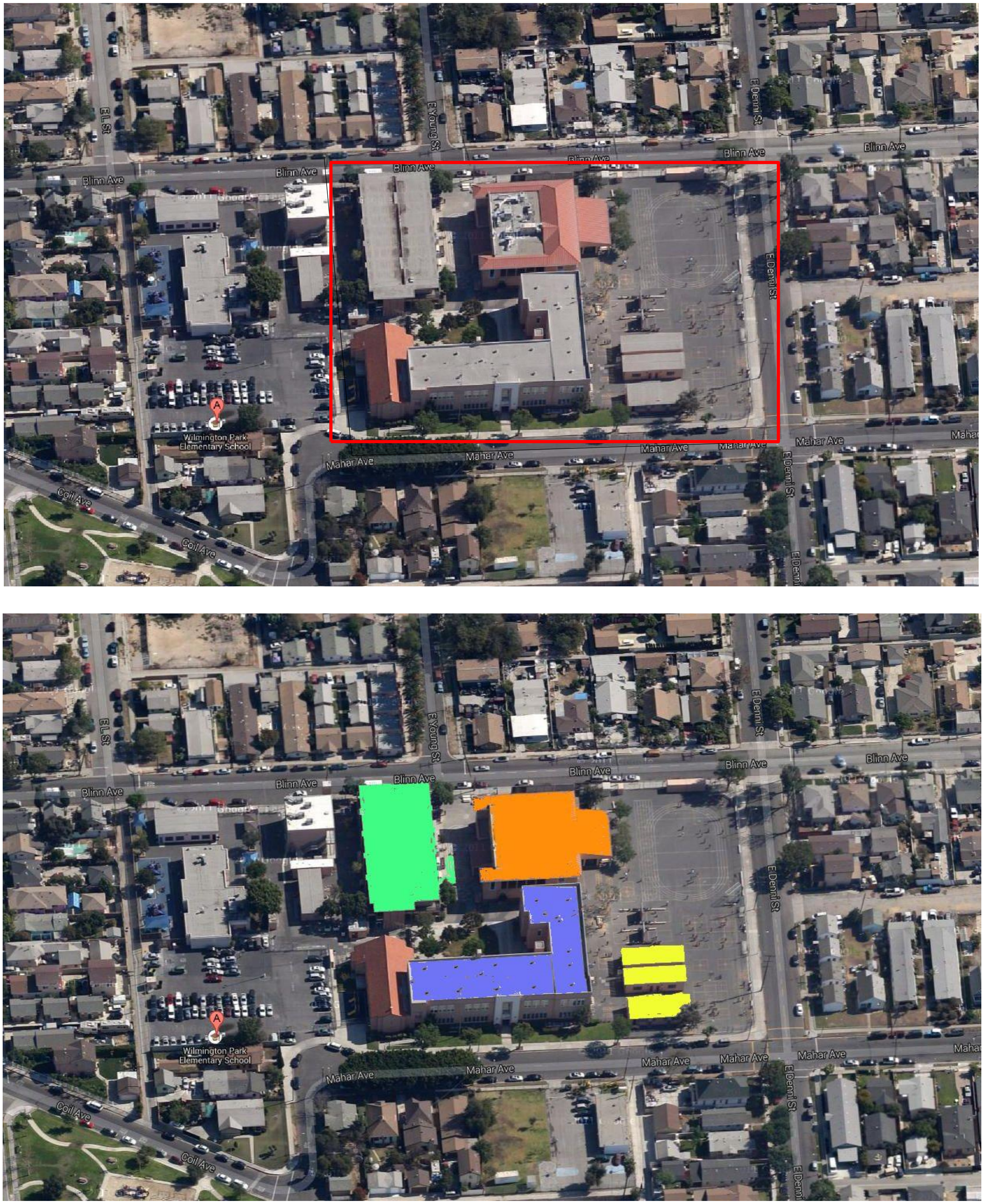
Structure A - The primary structure, and the oldest, is highlighted in blue on Figure 4. The building flanks Mahar Avenue on the west and is a two-story stucco structure with classrooms abutting interior access corridors. The primary window type is wood double-hung. No classrooms have doors that directly access the exterior of the building. Ventilation is provided by a mix of ductless-split and exterior mounted thru-wall systems. Photos of Structure A are included below.



Structure B – The second structure evaluated is highlighted in orange in Figure 4 and flanks Blinn Avenue to the east. The building is a two-story stucco structure with the first floor functioning as teacher’s lounge, cafeteria, and assembly/gym. The second floor consists of classrooms abutting interior access corridors. The primary window type is wood double-hung. No classrooms have doors that directly access the exterior of the building. Ventilation is provided by rooftop mounted ventilation systems. Photos of Structure B are included below.



Figure 4 Wilmington Park School Study Area & Building Configurations



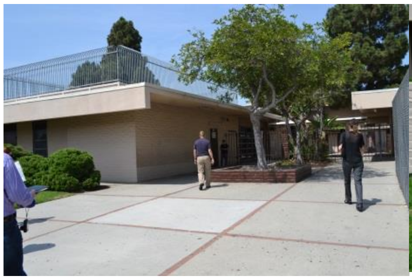
Structure C – The third structure evaluated is highlighted in green in Figure 4 and flanks Blinn Avenue to the east. The building is a two-story stucco structure with classrooms on both floors. All classrooms ingress and egress to exterior access corridors. The primary window type is wood double-hung. All have doors that directly access the exterior of the building. Ventilation is provided by exterior mounted thru-wall systems on first floor, and interior mounted systems on second floor. Photos of Structure C are included below.



Structure Group D – The Structure Group D buildings are highlighted in yellow in Figure 4 and flank Mahar Avenue on the west. The three buildings are single-story stucco structures. All rooms ingress and egress to the exterior. The primary window type is wood double-hung. All have doors that directly access the exterior of the building. Ventilation is provided by exterior mounted thru-wall systems.

Broad Avenue Elementary School – The Broad Avenue Elementary School is located in the Broad Avenue/Oceanside Street Study Area (see Figure 1). The school is part of the Los Angeles Unified School District and is a K-5 configuration. The campus consists of four primary structures and twelve modular structures the confines of which are illustrated in the two aerials in Figure 5.

Structure A - The primary structure fronting Broad Avenue is highlighted in blue on Figure 5. The building is a single-story stucco structure serving the administrative functions of the school. The primary window type is aluminum fixed/awning arrays. Ventilation is provided by rooftop mounted ventilation systems. Photos of Structure A are included below.




Structure Group B - The secondary structures fronting Broad Avenue are highlighted in orange on Figure 5. The buildings are a single-story stucco structures functioning as teacher's lounge, cafeteria, and assembly/gym. The primary window type is aluminum fixed/awning arrays. Ventilation is provided by rooftop mounted ventilation systems. Photos of Structure Group B are included below.

Figure 5 Broad Avenue School Study Area & Building Configurations

Structure Group C – Structure Group C runs perpendicular to E. 249th Street and is highlighted in green on Figure 5. These two structures are two-story classroom buildings clad in stucco. Classrooms abut interior access corridors. The primary window type is aluminum fixed/awning arrays. No classrooms have doors that directly access the exterior of the building. Ventilation is provided by rooftop mounted ventilation systems. Photos of Structure Group C are included below.

Structure Group D – Structure Group D represents the modular structures and is highlighted in yellow. The buildings are single-story stucco structures. All classrooms ingress and egress to the exterior. The primary window type is wood double-hung. All have doors that directly access the exterior of the building. Ventilation is provided by exterior mounted thru-wall systems. Photos of Structure Group D are included below.

Hawaiian Avenue Elementary School – The Hawaiian Avenue Elementary School is located in the Hawaiian Avenue Study Area (see Figure 6). The school is part of the Los Angeles Unified School District and is a K-5 configuration. The campus consists of five primary structures and six modular structures the confines of which are illustrated in the two aerials in Figure 7.

Structure Group A – Structure Group A fronting Hawaiian Avenue is highlighted in orange on Figure 7. The building to the north is a single-story stone veneer and stucco structure serving the administrative functions of the school. The structure to the south is a stucco building and serves as the cafeteria and assembly for the school. The primary window type is aluminum fixed/awning arrays. Ventilation is provided by rooftop mounted ventilation systems. Photos of Structure Group A are included below.



Structure Group B – Structure Group B fronting Hawaiian Avenue to the west and W. F Street to the north and are highlighted in green on Figure 7. The buildings are single-story stucco structures and house classrooms abutting a central access corridor. The primary window type is wood double-hung. Many classrooms have doors that directly access the exterior of the building. Ventilation is provided by thru-wall mounted ventilation systems. Photos of Structure Group B are included below.






Figure 6 Hawaiian Avenue Study Area

Figure 7 Hawaiian Avenue School Study Area & Building Configurations

Structure C – Structure C is located in the northern part of the courtyard and is highlighted in blue on Figure 7. The building is a two-story stucco structure and house classrooms abutting a central access corridor. The primary window type is wood double-hung. Classrooms have doors that directly access the exterior of the building on the first floor. The second floor classrooms egress to an interior access corridor. Ventilation is provided by thru-wall mounted ventilation systems. Photos of Structure Group C are included below.



Structure Group D – Structure Group D represents the modular structures and is highlighted in yellow and red. The red structures are no longer on site and have been removed since the aerial imagery has been taken. The buildings in yellow are single-story stucco structures. All classrooms ingress and egress to the exterior. The primary window type is wood double-hung. All have doors that directly access the exterior of the building. Ventilation is provided by exterior mounted thru-wall systems. Photos of Structure Group D are included below.



Additional key observations about the school inventory are as follows:

1. Schools are not located in the highly-impacted noise areas. In the case of the Hawaiian Avenue Elementary School, they are not even located in the impacted noise area.

2. All campuses have a mix of buildings with a large amount of the classrooms having ingress/egress directly to the exterior.

3. The predominant ventilation condition is thru-wall mounting systems.

4. All properties have modular structures to address lack of classroom space. There is evidence that attendance is down based on the removal of structures at Hawaiian Avenue.

2.3 Residences (Impacted)

It should also be noted that the moderately impacted residential properties were not surveyed as part of this study. However, mitigation concepts for these homes are discussed in Section 6.

3.0 ANALYSIS OF MAJOR ARCHITECTURAL STYLES

The purpose of the windshield survey was to identify the number of noise impacted dwellings, as well as provide a description of component types and typologies of the structures. Elements evaluated to qualify the typologies included form, construction type, building materials, and character. The key analysis questions were:

- What are the housing typologies and what proportion of the overall housing stock do they make up?
- Which homes should be acoustically measured to identify each typologies interior noise conditions?
- What noise mitigation gains are possible within the constraints of individual dwelling typologies?

3.1 Study Area Housing Typologies

The windshield survey identified three basic housing types. Even though the housing components can vary from house to house, the same forms and building materials can be attributed to these three types. In general all homes are stucco wood-framed houses with shingled or tiled roofs. Variations appear in the house typologies as changes in demographics, updates to building regulations, and owner preferences occur.

Housing Type 1 (Ranch Style Homes) - There are several examples of ranch style homes in the target areas. Ranging in build date from the early 1940’s to present, variants within this style group include traditional, contemporary, and Spanish colonial ranches. Common themes in the observed ranch style homes include:

- 1-Story
- Hip or gable roof, often with overhang
- Rectangular, L orientation
- Carport or attached garage
- Minimal or no front porch stoop
- Clapboard, or stucco siding, or a combination
- Roof materials predominantly asphalt shingle
- Sliding glass doors opening onto a patio

Variations in the style include:

- Use & type of wall materials on facades
- Use & type of window styles and materials

- Ornamental details, such as roof materials, porch and carport detailing, landscape walls & planters

Photos of typical Housing Type 1 homes are shown in the following photographs.






Housing Type 2 (Bungalow Style Homes) - There are several examples of bungalow style homes in the target areas. Most examples were built in early 1900's through the 1930's. Variants of this style in the target area include California, and Spanish Revival bungalows. Common themes in the observed bungalow style homes include:

- 1-1½ Stories
- Low pitched roof, often with broad eaves
- Rectangular, L orientation
- No attached garages
- Spacious front porches
- Clapboard or stucco siding
- Spanish-inspired details

Variations in the style include:

- Use & type of wall materials on facades
- Use & type of window styles and materials

- Ornamental details distinguishing California from Spanish revival bungalows, such as parapets, tile roofs, awnings, stucco siding.

Photos of typical Housing Type 2 homes are shown in the following photographs.






Housing Type 3 (Neo-Mediterranean/Spanish Style Homes) - For the purposes of this report we have classified Neo-Mediterranean homes as catch-all that represents a loose interpretation of Spanish style architecture. Most examples have been built from the late 1970's to present. Distinguishing features include stucco walls and red tile roofs. Common themes in the observed Neo-Mediterranean style homes include:

- 2-Stories
- Low-pitched roofs, multiple levels
- Rectangular, L orientation
- Attached garage
- Ornate front porch stoop
- Stucco siding
- Red roof tiles
- Sliding glass doors opening onto a patio

Variations in the style include:

- Use & type of window styles and materials
- Ornamental details, such as shutters, porch overhangs, landscape walls & planters

Photos of typical Housing Type 3 homes are shown in the following photographs.






3.2 Noise Testing Sites

The process of selecting homes for further acoustical evaluation was based on four key factors including typology, noise source, geographic area, and priority ranking. The four key factors are as follows:

1. Homes evaluated should include at least one of each typology.
2. Homes selected should include at least one home impacted by surface truck noise and at least one home impacted by rail.
3. Homes selected would include at least one from each of the study areas identified in Figures 1, 2 and 3.
4. Homes selected would include one from each of the priority areas identified in *Report #2: Criteria and Prioritization Report, Table 9 - Preliminary Residential P_{Score} Priority Ranking by Impact Area*.

Applying these factors to the 280 units surveyed resulted in the following list of ten properties recommended for further evaluation. An additional six alternate properties were also provided to insure the testing sample was complete. Primary and alternate properties are identified in Table 2 below.

Table 2
Properties Recommended for Further Evaluation

Address	Housing Style	Source	Priority Area	Study Area
Primary Properties				
933 McFarland Ave	Bungalow	Rail	McFarland Rail Line	Hyatt Ave/Alameda St
1129 McFarland Ave	Mediterranean			
1248 Hyatt Ave	Ranch			
1419 E Opp St	Ranch	Truck/ Rail	Drumm/Sanford/ Opp St	Hyatt Ave/Alameda St
1535 E Denni St	Bungalow	Rail	Alameda Boulevard	Hyatt Ave/Alameda St
1563 E L St				
1614 E Cruces St	Bungalow	Truck	Drumm/Sanford/ Opp St	Drumm Avenue
823 E 246th St	Ranch	Rail	Northern Rail Line	Broad Ave/ Oceanside St
846 Oceanside St				
24407 Albatross Ave				
Alternate Properties				
1127 McFarland Ave	Mediterranean	Rail	McFarland Rail Line	Hyatt Ave/Alameda St
1425 E Opp St	Ranch	Truck/ Rail	Drumm/Sanford/ Opp St	Hyatt Ave/Alameda St
1559 E O St	Bungalow	Truck		Drumm Avenue
819 E 246th St	Ranch	Rail	Northern Rail Line	Broad Ave/ Oceanside St
840 Oceanside St				
24411 Albatross Ave				

HCBF staff successfully scheduled acoustical testing and surveys for seven properties that took place on August 28th and August 29th, 2013. Homes scheduled met all parameters identified for testing sample.

3.3 Housing Typology Assessments

The following section summarizes some of the main findings from an on-site analysis of the different typologies in relation to noise mitigation strategies. Much of this information was gathered by staff from L&B and JPG while conducting noise measurements at the representative properties on August 28th and August 29th, 2013. This information was assembled at the site visits and compared against the Counties assessor database, the details of which are provided in the following summaries. This information was further developed utilizing data from measured and modeled noise levels expressed in *Table 7, Pre-Modification Acoustical Test Results – Room Summary (Residences)* and *Table 14, Projected Acoustical Conditions - Residences*. It is important to note that the following analysis restricts the discussion to the properties analyzed at the site visits. This analysis will be extrapolated to provide a planning budget and implementation plan once treatment concepts have been reviewed and approved by the HCBF.

1133 McFarland Avenue – Assessment Visit Tuesday 8/27/13 @ 8:10 a.m.

This property was not identified in the primary and alternate lists identified in Table 2. The property is a neighbor of the listed homes and shares the same attributes. The home is in good repair and condition and represents the Neo-Mediterranean Style. It is located on the

McFarland Rail Line and in the Hyatt Avenue/ Alameda Street Study Area. A building photo and site/building attributes are presented below. A building floor plan is presented in Figure 8.

Site Attributes

- Type: Single Family
- Units: 1
- Lot Area: 5920^2
- Zoning: Residential (LARU)
- Title Transfer: April-2010
- Noise Source: Rail
- Noise Impact: Rear

Building Attributes

- Style: Neo-Mediterranean
- Year Built: 2006
- Building Area: 2078^2
- Stories: 2
- Bedrooms: 4

1. **Main characteristics:** This home is wood framed, clad in stucco, with a tiled roof. The main house form is based on a rectangular plan with a gabled roof. The lower floor serves as the living space including the living room, dining room and kitchen. The rear of the home accesses a patio through sliding glass doors. These upper floor rooms contain the sleeping areas of the home. Houses built in this era are typically insulated. The age of the house will likely have a positive impact on the buildings performance given it was built in compliance with more recent code requirements.

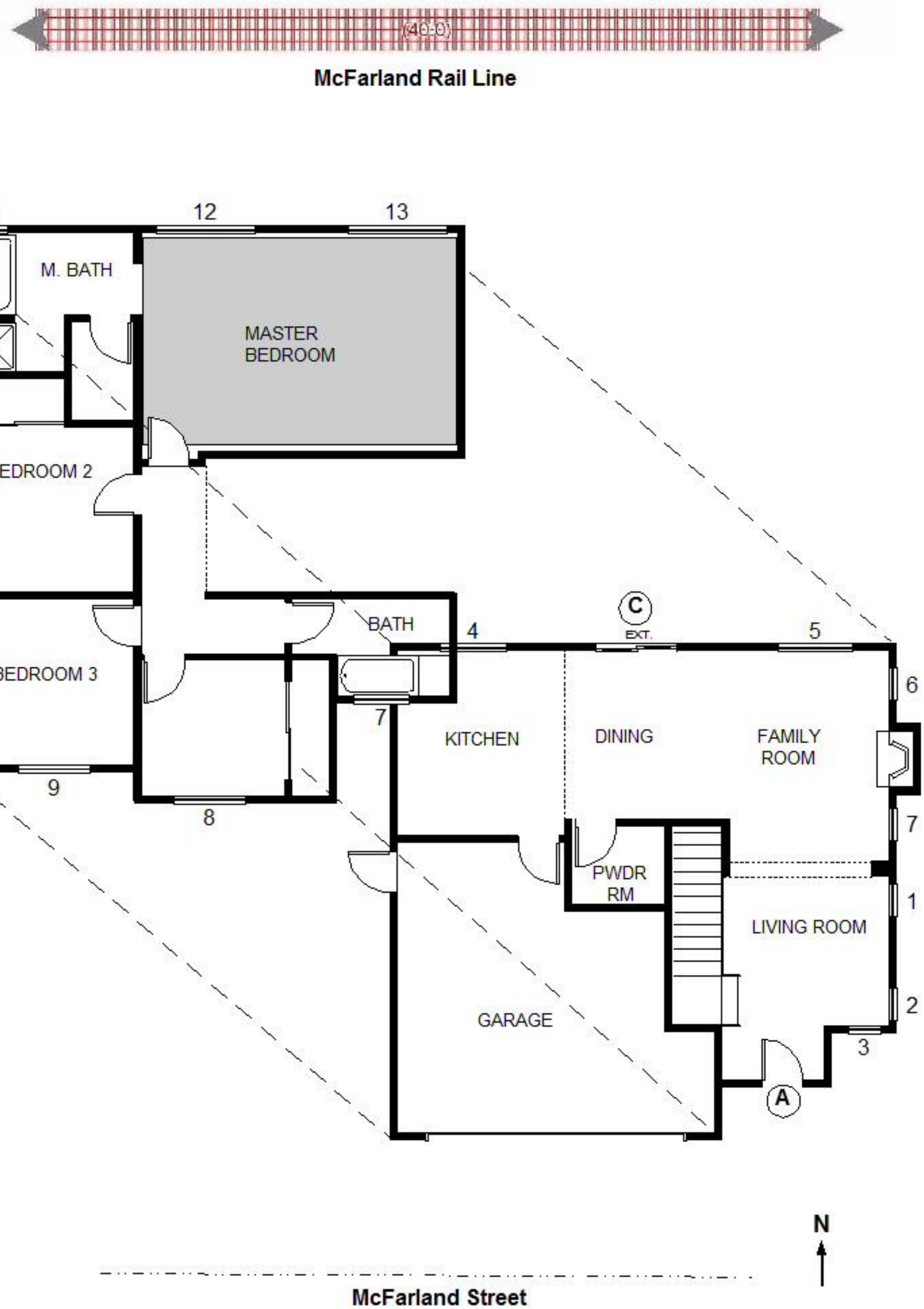
2. **Noise orientation:** This home directly abuts the McFarland Rail Line to the rear of the property. A five-foot high block wall separates the property from the rail line. The first floor living spaces direct line-of-sight to the noise source is obstructed by the masonry wall. However, the second floor has a direct line-of-sight to the noise source from the rear and right of the property. The left elevation has a 6-foot setback from the adjacent property which limits the line of sight to the noise source.

   The homeowner was interviewed about the noise environment. The primary nuisance as defined by homeowner was found to be nighttime rail noise with the main nuisance being the train horn.

3. **Wall system (materials, form, construction and access):** This home is clad in stucco, likely over ½" GSB with 2"x4" wood or aluminum studs. The interior of the wall assembly is finished with ½" wallboard with textured plaster. The walls are likely insulated though there was no access to the wall cavity to verify.

4. **Windows and glazing systems (materials, form and construction)**: Most windows were vinyl double-hung sash windows of a standard size. The upstairs windows were sliders. Glazing in the windows was insulated.

Figure 8 Building Floor Plan – 1133 McFarland Avenue



5. **Ventilation characteristics:** This house relies on windows and/or a forced-air HVAC system for ventilation. The HVAC system provides heating and cooling.

6. **Constructability issues for noise mitigation:** Access to site is not an issue. There is no debris that would prevent a workforce from installing noise mitigation treatments. The home already has a mechanical ventilation system that would allow homeowner to seal up house to take advantage of treatments in comfort. Windows are flanged mounted and set in exterior stucco wall. Replacement would require cutting back siding, adding new waterproofing, patching and painting. The same would be true for the interior surfaces.

933 McFarland Avenue – Assessment Visit Tuesday 8/27/13 @ 9:00 a.m.

The home is in fair repair and condition represents the Bungalow Style. It is located on the McFarland Rail Line and is in the Hyatt Avenue/Alameda Street Study Area. A building photo and site/building attributes are presented below. A building floor plan is presented in Figure 9.

Site Attributes

- Type: Single Family
- Units: 1
- Lot Area: 6751^2
- Zoning: Residential (LAR2)
- Title Transfer: NA
- Noise Source: Rail
- Noise Impact: Rear

Building Attributes

- Style: Bungalow
- Year Built: 1919
- Building Area: 944^2
- Stories: 1
- Bedrooms: 3

1. **Main characteristics:** This home is wood framed, clad in stucco, with an asphalt shingle roof. The main house form is based on a rectangular plan with a gabled roof. A detached garage is located at the rear of the property and a carport abuts the right hand elevation. The sleeping areas are to the right side and rear of the house. The rear of the home accesses a patio through a swinging door off the kitchen. There is a bedroom addition to the rear of the house. Houses built in this era are typically un-insulated. The age of the house will likely have a negative impact on the buildings performance given it was built in an era with less stringent building requirements.

2. **Noise orientation:** This home directly abuts the McFarland Rail Line to the rear of the property. A five-foot high block wall, and a portion of the detached garage, separates the property from the rail line. The living spaces line-of-sight to the noise source is obstructed by the masonry wall and garage.

The homeowner was interviewed about the noise environment. The primary nuisance as defined by homeowner was found to be nighttime rail noise with a particular nuisance to be the train horn.

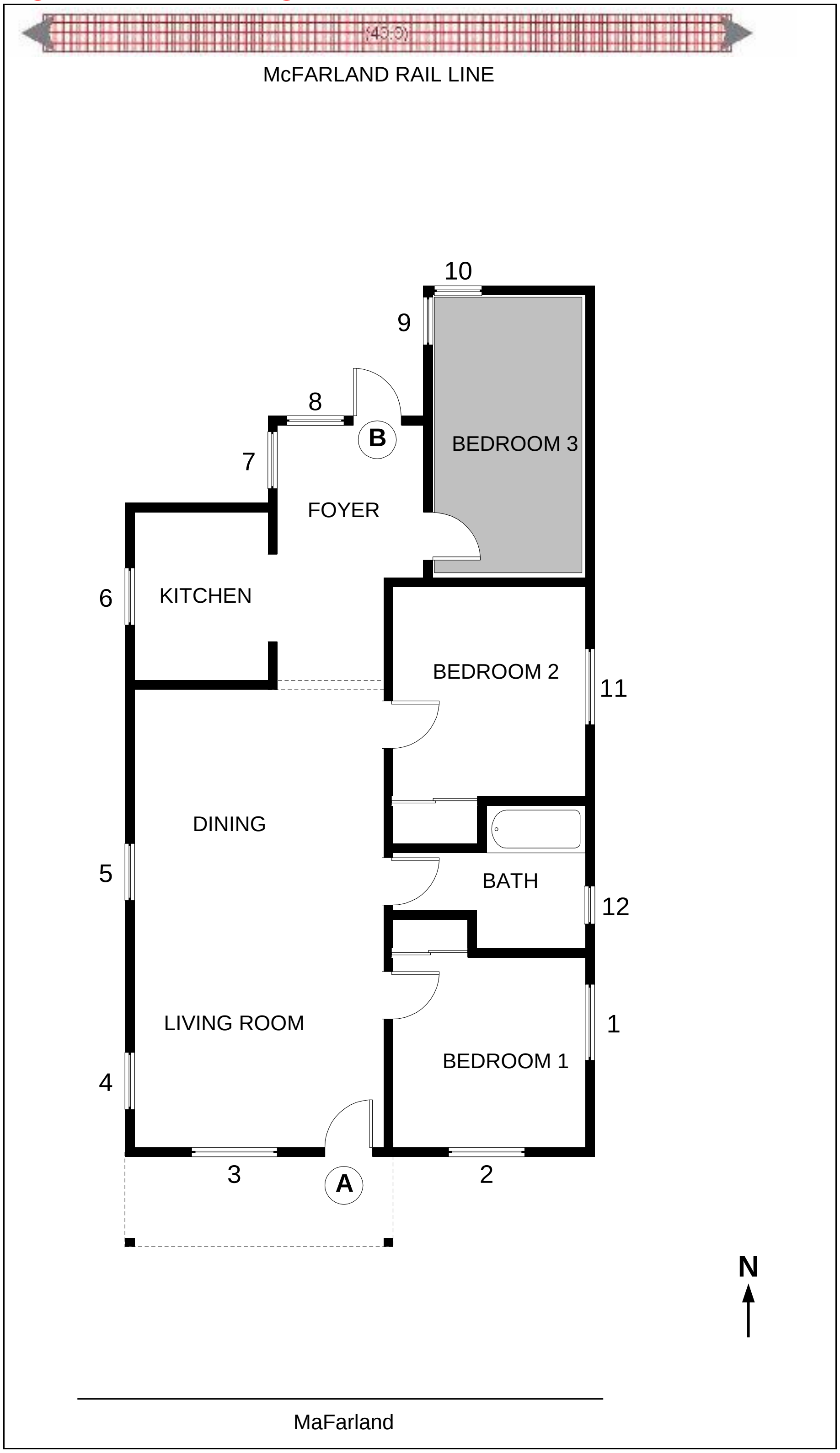
3. **Wall system (materials, form, construction and access):** This home is clad in stucco, likely over ½" board lumber and 2"x4" wood studs. The interior of the wall assembly is finished with textured plaster. The walls are likely insulated though there was no access to the wall cavity to verify.

4. **Windows and glazing systems (materials, form and construction)**: Most windows were metal casement windows of a standard size. Windows were single-glazed.

5. **Ventilation characteristics:** This house relies on windows for ventilation. There is no mechanical means of ventilation at the property.

6. **Constructability issues for noise mitigation:** Access to site is not an issue. There is no debris that would prevent a workforce from installing noise mitigation treatments. The property does not have a mechanical ventilation system that would allow homeowner to seal up house to take advantage of treatments in comfort. Windows are flanged mounted and set in exterior stucco wall. Replacement would require cutting back siding, adding new waterproofing, patching and painting. The same would be true for the interior surfaces. The bedroom addition to the rear of the house barely meets minimum size requirements for habitability required by code.

Figure 9 Building Floor Plan – 933 McFarland Avenue



1563 East L Street – Assessment Visit Tuesday 8/27/13 @ 11:00 a.m.

The home is in fair repair and condition represents the Bungalow Style, and is located on the Alameda Boulevard Rail Line and is in the Hyatt Avenue/ Alameda Street Study Areas. A building photo and site/building attributes are presented below. A building floor plan is presented in Figure 10.

Site Attributes

- Type: Single Family
- Units: 1
- Lot Area: 5200^2
- Zoning: Residential (LAR1)
- Title Transfer: Feb-1998
- Noise Source: Rail/Truck
- Noise Impact: Front & Right Side

Building Attributes

- Style: Bungalow
- Year Built: 1922
- Building Area: 616^2
- Stories: 1
- Bedrooms: 2

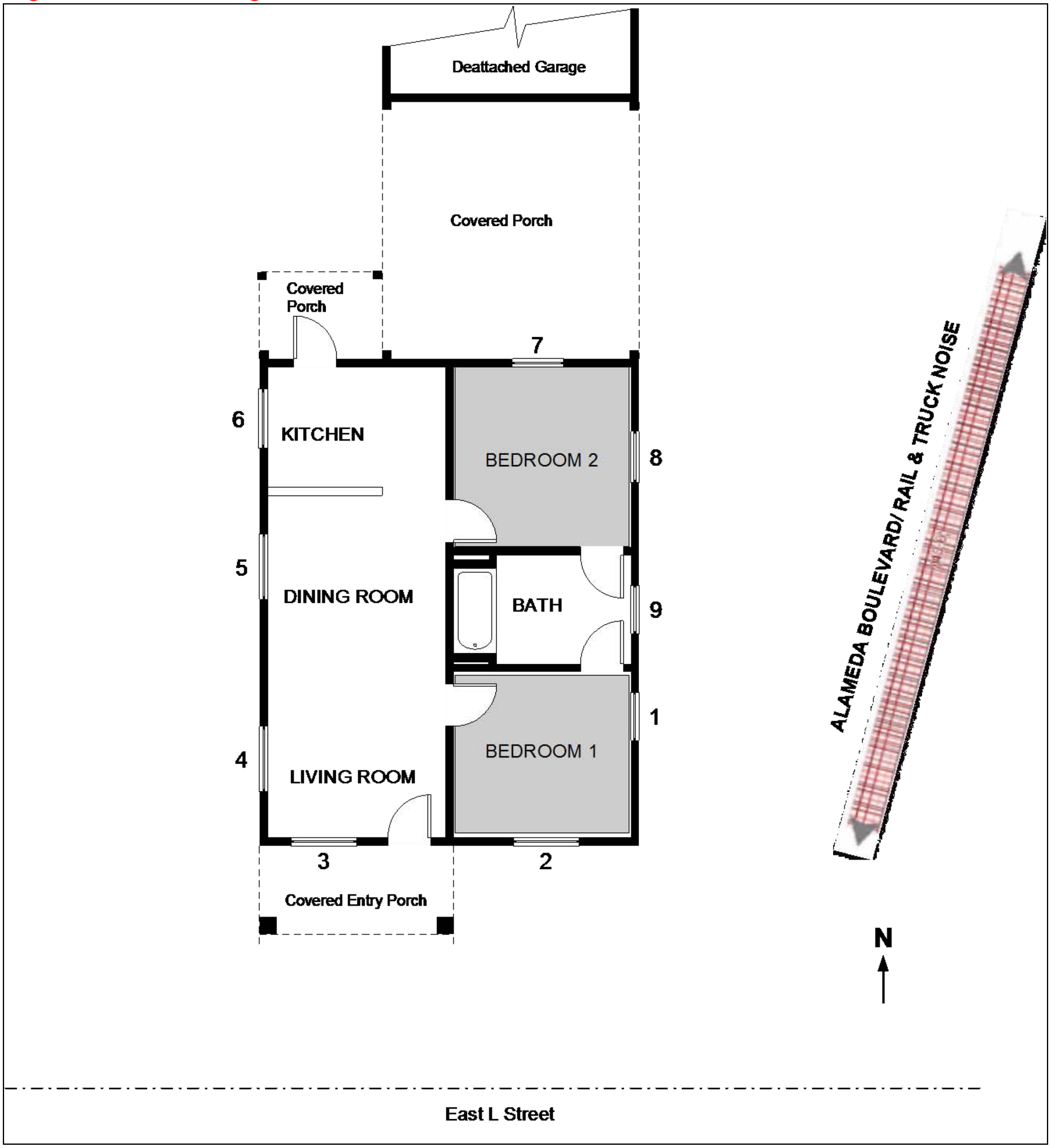
1. **Main characteristics:** This home is wood framed, clad in stucco, with an asphalt shingle roof. The main house form is based on a rectangular plan with a gabled roof. A detached garage is located at the rear of the property and a carport abuts the right hand elevation. The sleeping areas are to the right side of the house. The rear of the home accesses a patio through a swinging door off the kitchen. There is a bedroom addition to the rear of the house. Houses built in this era are typically un-insulated. The age of the house will likely have a negative impact on the buildings performance given it was built in an era with less stringent building requirements.

2. **Noise orientation:** This home flanks the Alameda Boulevard tracks to right of the property. Just beyond the rail line is the truck traffic on South Alameda Street. A chain link fence separates the home from a junk car storage lot. There is no wall that separates the living spaces line of sight to the noise source.

   The homeowner was interviewed about the noise environment. The primary nuisance as defined by homeowner was found to be nighttime rail noise with the train horn being the major nuisance.

3. **Wall system (materials, form, construction and access):** This home is clad in stucco, likely over ½” board lumber and 2”x4” wood studs. The interior of the wall assembly is finished with textured plaster. The walls are likely insulated though there was no access to the wall cavity to verify.

Figure 10 Building Floor Plan – 1563 East L Street



4. **Windows and glazing systems (materials, form and construction)**: Most windows were metal sliding windows of a standard size. Windows were single-glazed.

5. **Ventilation characteristics:** This house relies on windows for ventilation. There is no mechanical means of ventilation at the property.

6. **Constructability issues for noise mitigation:** Access to site is an issue as it is littered with debris and a narrow setback from the junk car lot (see photos below). Furnishings completely fill the bedrooms limiting access to windows from the interior. This limited access would inhibit the installation of noise mitigation treatments. The property does not have a mechanical ventilation system that would allow homeowner to seal up house to take advantage of treatments in comfort. Windows are flanged mounted and set in exterior stucco wall. Replacement would require cutting back siding, adding new waterproofing, patching and painting. The same would be true for the interior surfaces.

846 Oceanside Street – Assessment Visit Tuesday 8/27/13 @ 12:00 noon

The home is in good repair and condition represents the Ranch Style. It is located on the Northern Rail Line and is in the Broad Avenue/Oceanside Street Study Areas. A building photo and site/building attributes are presented below. A building floor plan is presented in Figure 11.

Site Attributes

- Type: Single Family
- Units: 1
- Lot Area: 4996^2
- Zoning: Residential (LAR1)
- Title Transfer: August-2005
- Noise Source: Rail
- Noise Impact: Rear

Building Attributes

- Style: Ranch
- Year Built: 1944
- Building Area: 1003^2
- Stories: 1
- Bedrooms: 3

1. **Main characteristics:** This home is wood framed, clad in stucco, with an asphalt shingle roof. The main house form is based on a rectangular plan with a gabled roof. A detached garage is located at the rear of the property. The sleeping areas are to the left and right sides of the house. The rear of the home accesses a patio through a swinging door off the kitchen. Houses built in this era are typically un-insulated. The age of the house will likely have a negative impact on the buildings performance given it was built in an era with less stringent building requirements.

2. **Noise orientation:** This home flanks the Northern Rail Line to right of the property. A five-foot high block wall, and a portion of the detached garage separate the property from the rail line. The living spaces line-of-sight to the noise source is obstructed by the masonry wall and garage.

   The homeowner was interviewed about the noise environment. The primary nuisance as defined by homeowner was found to be nighttime rail noise, particularly the train horn.

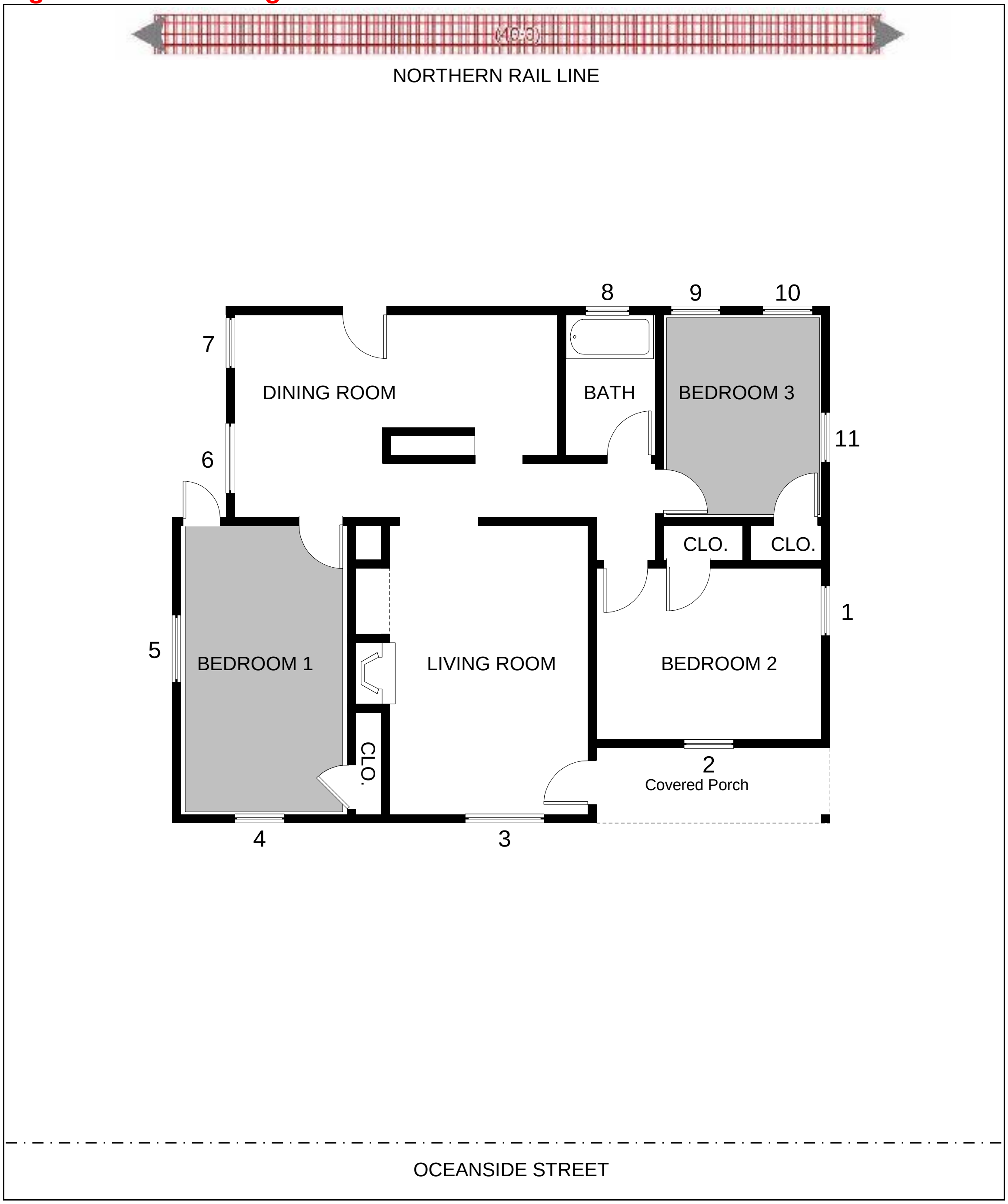
3. **Wall system (materials, form, construction and access):** This home is clad in stucco, likely over ½" plywood and 2"x4" wood studs. The interior of the wall assembly is finished with textured plaster. The walls are likely insulated though there was no access to the wall cavity to verify.

4. **Windows and glazing systems (materials, form and construction)**: Most windows were metal sliding windows of a standard size. Windows were single-glazed.

5. **Ventilation characteristics:** This house relies on windows and/or a forced-air HVAC system for ventilation. The HVAC system provides heating and cooling.

6. **Constructability issues for noise mitigation:** Access to site is not an issue. There is no debris that would prevent a workforce from installing noise mitigation treatments. The home already has a mechanical ventilation system that would allow homeowner to seal up house to take advantage of treatments in comfort. Windows are flanged mounted and set in exterior stucco wall. Replacement would require cutting back siding, adding new waterproofing, patching and painting. The same would be true for the interior surfaces. One bedroom in the home has an abandoned door to the exterior that has been walled over to the interior.

Figure 11 Building Floor Plan – 846 Oceanside Street



1534 East Denni Street – Assessment Visit Tuesday 8/27/13 @ 4:00 p.m.

1535 East Denni Street was the originally targeted home for review, but the homeowner cancelled upon arrival. The field team was approached by the occupant of 1534 E. Denni Street across the street, who stated they would allow our team to assess their home. The alternate property was approved by HCBF staff.

The home is in fair repair and condition represents the Bungalow Style, and is located on the Alameda Boulevard Rail Line and is in the Hyatt Avenue/Alameda Street Study Area. A building photo and site/building attributes are presented below. A building floor plan is presented in Figure 12.

Site Attributes

- Type: Multi-Family
- Units: 3
- Lot Area: 5297^2
- Zoning: Residential (LAR2)
- Title Transfer: Oct-2000
- Noise Source: Rail
- Noise Impact: Left Side

Building Attributes

- Style: Bungalow
- Year Built: 1929
- Bldg Area: 384^2/484^2/484^2
- Stories: 1
- Bedrooms: 1/unit

1. **Main characteristics:** Per the photo below, the unit surveyed (Unit #1) is wood framed, clad in stucco, with an asphalt shingle roof. The main house form is based on a rectangular plan with a gabled roof. There are three units on the property and each of the three units is a separate structure. The site plan on the following page shows the orientation of the three units. Houses built in this era are typically un-insulated. The age of the house will likely have a negative impact on the buildings performance given it was built in an era with less stringent building requirements.

2. **Noise orientation:** This home flanks the Alameda Boulevard Rail Line to the left of the property. Unit #1 has a direct line-of-sight to the noise source. Units #2 and #3 have an obstructed line-of-sight due to flanking buildings.

   The occupants of the property were interviewed about the noise environment. The primary nuisance as defined by occupants was found to be nighttime rail noise, particularly the train horn.

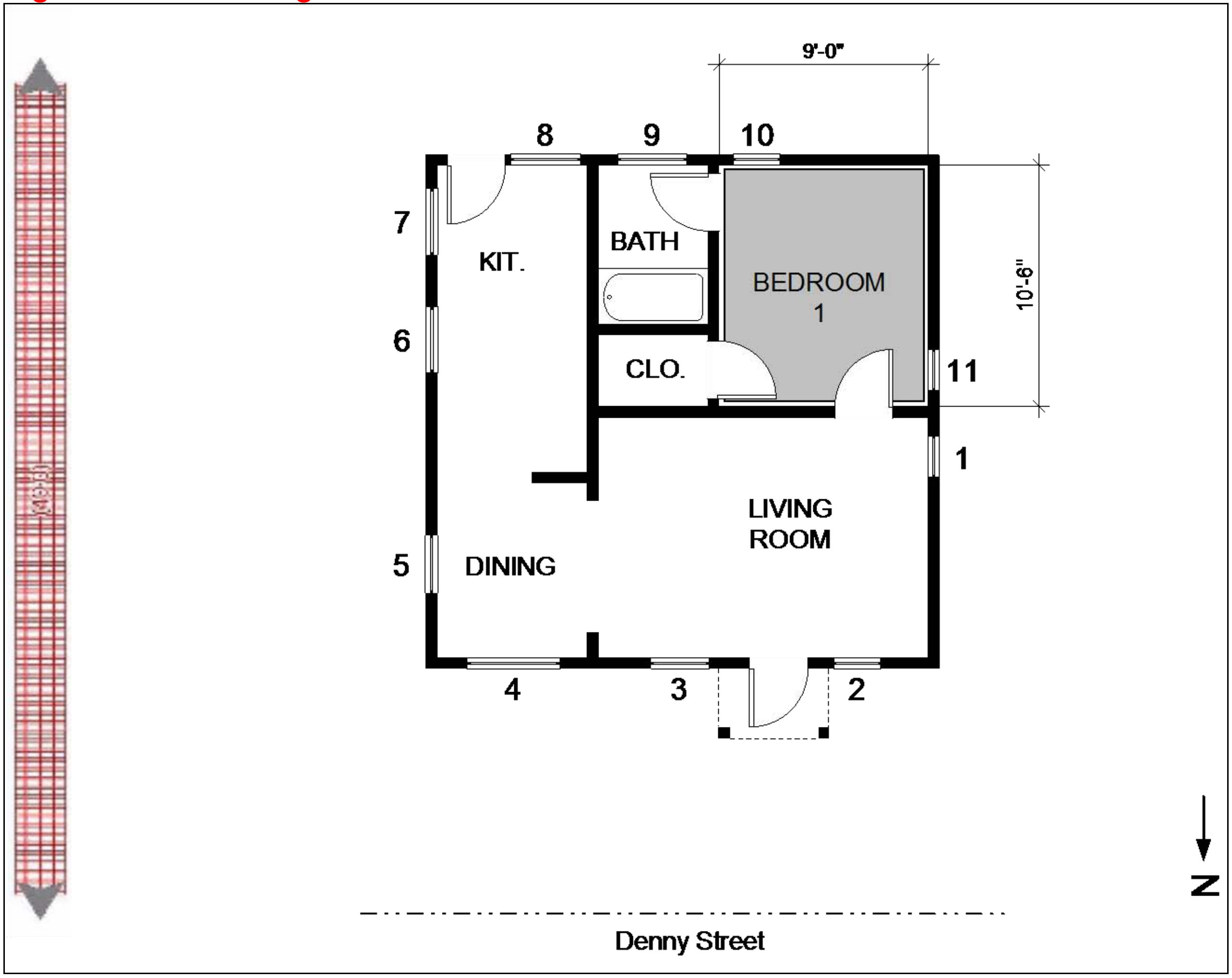
3. **Wall system (materials, form, construction and access):** This home is clad in stucco, likely over ½" board lumber and 2"x4" wood studs. The interior of the wall assembly is finished with textured plaster. The walls are likely insulated though there was no access to the wall cavity to verify.

4. **Windows and glazing systems (materials, form and construction)**: Most windows were vinyl replacement windows of a standard size. Windows were single-glazed.

5. **Ventilation characteristics:** This house relies on windows for ventilation. There is no mechanical means of ventilation at the property.

6. **Constructability issues for noise mitigation:** Access to the site is not an issue. Furnishings completely fill the bedrooms limiting access to windows from the interior. This limited access would inhibit the installation of noise mitigation treatments. The property does not have a mechanical ventilation system that would allow homeowner to seal up house to take advantage of treatments in comfort. Windows are flanged mounted and set in exterior stucco wall. Replacement would require cutting back siding, adding new waterproofing, patching and painting. The same would be true for the interior surfaces. There are signs of occupancy violations in the non-residential structures flanking Alameda Street.

Figure 12 Building Floor Plan – 1534 East Denni Street



<u>1559 East O Street – Assessment Visit Wednesday 8/28/13 @ 8:00 a.m.</u>

The home is in good repair and condition represents the Bungalow Style, and is located on the Drumm Street/Sanford Street/Opp Street truck routes and is in the Drumm Street Study Area. A building photo and site/building attributes are presented below. A building floor plan is presented in Figure 13.

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Site Attributes

- Type: Single Family
- Units: 1
- Lot Area: 6939^2
- Zoning: Residential (LAR1)
- Title Transfer: Jan-2013
- Noise Source: Truck
- Noise Impact: Right Side

Building Attributes

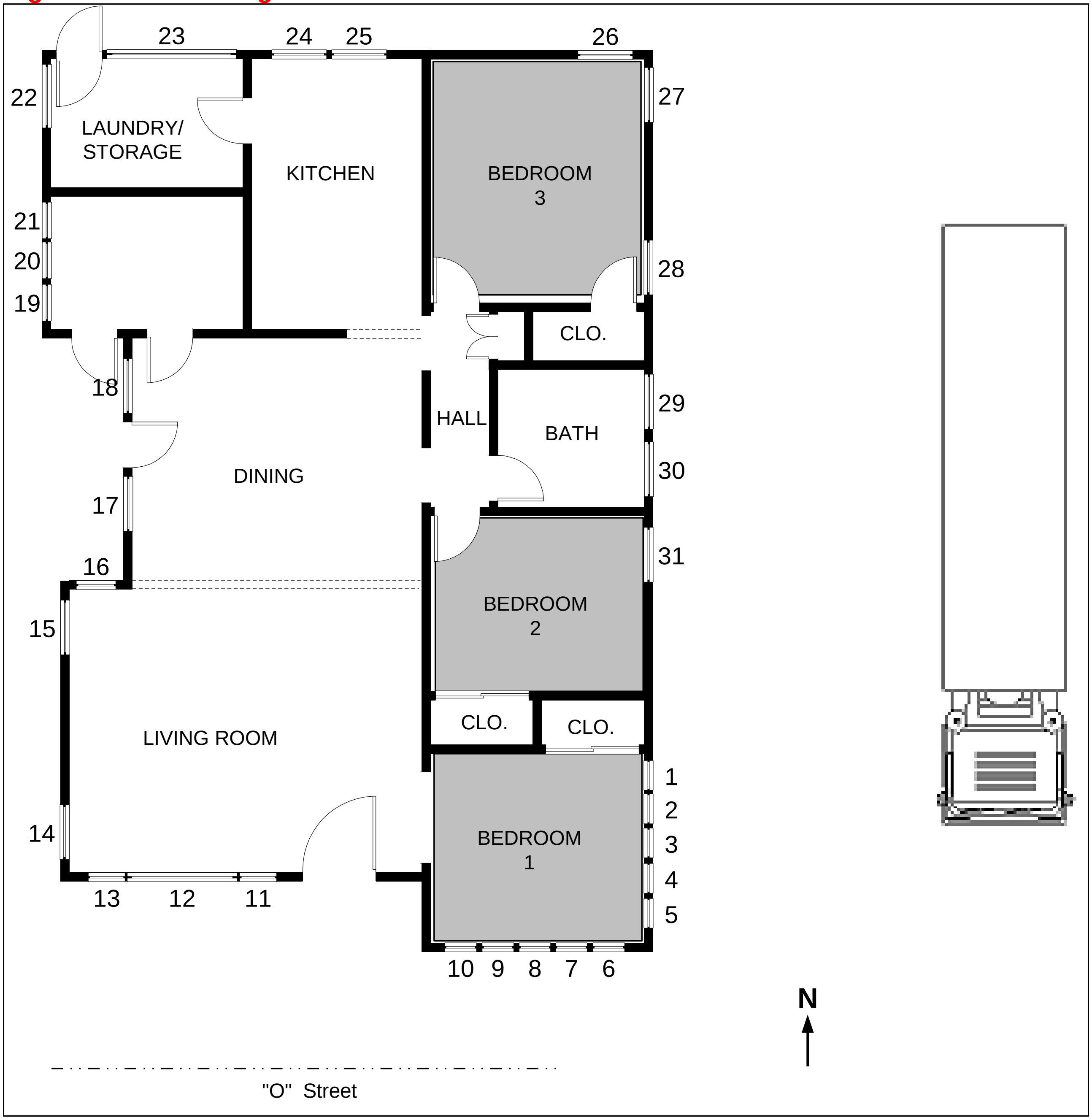
- Style: Bungalow
- Year Built: 1911
- Building Area: 1660^2
- Stories: 1
- Bedrooms: 3

1. **Main characteristics:** This home is wood framed, clad in stucco, with an asphalt shingle roof. The main house form is based on a rectangular plan with a gabled roof. The property is littered with stored vehicles and appliances. The sleeping areas are to the right sides of the house. The rear of the home accesses a patio through a swinging door off the laundry. Houses built in this era are typically un-insulated. The age of the house will likely have a negative impact on the buildings performance given it was built in an era with less stringent building requirements.

2. **Noise orientation:** This home flanks Drumm Avenue to right of the property. Nothing blocks the site from Drumm Avenue truck traffic. The living spaces have a direct line-of-sight to the noise source. Of note, a stop sign is located some 200 feet up the street which complicates noise issue.

   The homeowner was interviewed about the noise environment. The primary nuisance as defined by homeowner was found to be truck traffic 24 hours a day.

Figure 13 Building Floor Plan – 1559 East O Street



3. **Wall system (materials, form, construction and access):** This home is clad in stucco, likely over ½" board lumber and 2"x4" wood studs. The interior of the wall assembly is finished with textured plaster. The walls are likely insulated though there was no access to the wall cavity to verify.

4. **Windows and glazing systems (materials, form and construction)**: Most windows were aluminum double-hung of a standard size. Windows were single-glazed.

5. **Ventilation characteristics:** This house relies on windows for ventilation. There is no mechanical means of ventilation at the property.

6. **Constructability issues for noise mitigation:** Access to the site is an issue. Furnishings completely fill the bedrooms limiting access to windows from the interior. This limited access would inhibit the installation of noise mitigation treatments. The property does not have a mechanical ventilation system that would allow homeowner to seal up house to take advantage of treatments in comfort. Windows are flanged mounted and set in exterior stucco wall. Replacement would require cutting back siding, adding new waterproofing, patching and painting. The same would be true for the interior surfaces.

829 East 246th Street – Assessment Visit Wednesday 8/28/13 @ 9:00 a.m.

819 East 246th Street was the originally targeted home for review, but homeowner cancelled upon arrival. The field team went door to door to gain access to a property to test. The property owner at 829 East 246th granted our team access. The alternate property was approved by HCBF staff.

The home is in good repair and condition represents the Ranch Style. It is located on the Northern Rail Line and is in the Broad Avenue/Oceanside Street Study Areas. A building photo and site/building attributes are presented below. A building floor plan is presented in Figure 14.

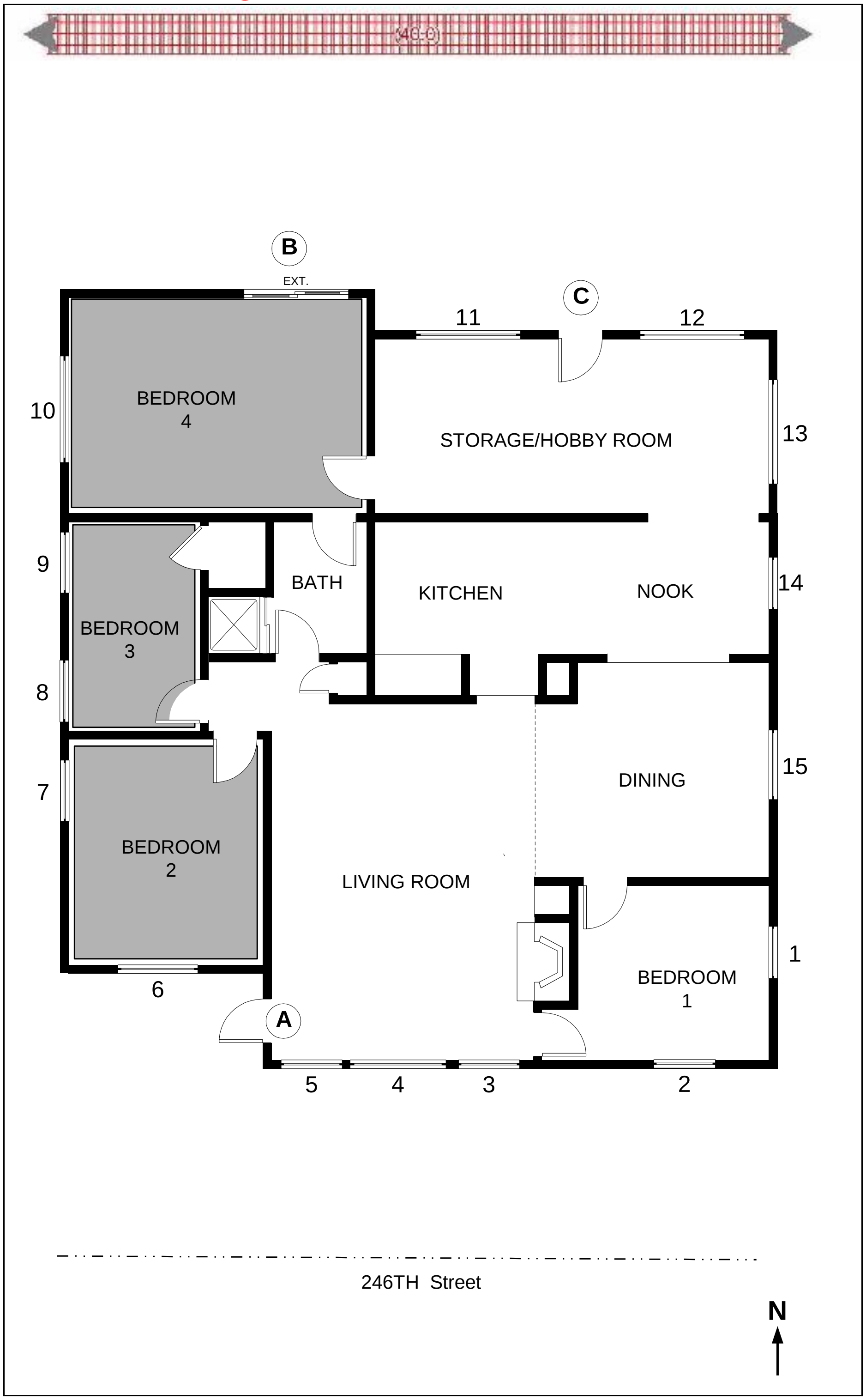
Site Attributes

- Type: Single Family
- Units: 1
- Lot Area: 4999^2
- Zoning: Residential (LAR1)
- Title Transfer: Oct-1980
- Noise Source: Rail
- Noise Impact: Rear

Building Attributes

- Style: Ranch
- Year Built: 1944
- Building Area: 1423^2
- Stories: 1
- Bedrooms: 4

Figure 14 Building Floor Plan – 829 East 246th Street



1. **Main characteristics:** This home is wood framed, clad in stucco, with an asphalt shingle roof. The main house form is based on a rectangular plan with a gabled roof. A detached garage is located at the rear of the property. The sleeping areas are to the left and right sides of the house. The rear of the home accesses a patio through a swinging door off the kitchen. Houses built in this era are typically un-insulated. The age of the house will likely have a negative impact on the buildings performance given it was built in an era with less stringent building requirements.

2. **Noise orientation:** This home flanks the Northern Rail Line to rear of the property. A five-foot high block wall, and a portion of the detached garage separate the property from the rail line. The living spaces line-of-sight to the noise source is obstructed by the masonry wall and garage.

   The homeowner was interviewed about the noise environment. The primary nuisance as defined by homeowner was found to be nighttime rail noise and in particular the train horn.

3. **Wall system (materials, form, construction and access):** This home is clad in stucco, likely over ½" plywood and 2"x4" wood studs. The interior of the wall assembly is finished with textured plaster. The walls are likely insulated though there was no access to the wall cavity to verify.

4. **Windows and glazing systems (materials, form and construction)**: Most windows were metal double-hung windows of a standard size. Windows were single-glazed.

5. **Ventilation characteristics:** This house relies on windows and/or a forced-air HVAC system for ventilation. The HVAC system provides heating and cooling.

6. **Constructability issues for noise mitigation:** Access to site is not an issue. There is no debris that would prevent a workforce from installing noise mitigation treatments. The home already has a mechanical ventilation system that would allow homeowner to seal up house to take advantage of treatments in comfort. Windows are flanged mounted and set in exterior stucco wall. Replacement would require cutting back siding, adding new waterproofing, patching and painting. The same would be true for the interior surfaces. Bedrooms were observed to have exterior locks on every bedroom which suggest home may be functioning as a group home (illegal use).

3.4 Educational Facility Assessments

The following section summarizes some of the main findings from an on-site analysis of the school properties relative to noise mitigation strategies. Much of this information was gathered by staff from L&B and JPG while conducting noise measurements at the representative schools on August 28th and August 29th, 2013. This information was captured through site visits, interviews with Principals, LAUSD school reports, and the Office of Environmental Health and Safety inspection reports, the detail of which is provided in the following summaries. This information was then developed further utilizing data from measured and modeled noise levels expressed in *Table 9, Pre-Modification Acoustical Test Results – Room Summary (Schools)* and *Table 15, Projected Acoustical Conditions - Schools*.

Wilmington Park Elementary School – Assessment Visit Tuesday 8/27/13 @ 5:00 p.m.

The Wilmington Park Elementary School is located at 1140 Mahar Street and is one of 673 elementary schools in Los Angeles Unified School District. It is a public school that serves 973 students in grades K-5. The school resides on a 3.69 acre lot bounded by Young Street to the north, Blinn Avenue to the East, Denni Street to the south, and Mahar Avenue to the west. The school is in good repair and condition and is located in the Hyatt Avenue/Alameda Street Study Area. A building layout and site/building attributes are presented below. Typical classroom layouts are presented in Figure 15.

Site Attributes

- Configuration: K-5
- Permanent Buildings: 3
- Modular Buildings: 3
- Lot Area: 160832^2
- Zoning: (LAPF)
- Noise Source: Rail
- Noise Impact: Level 2
- Noise Direction: East

Building Attributes

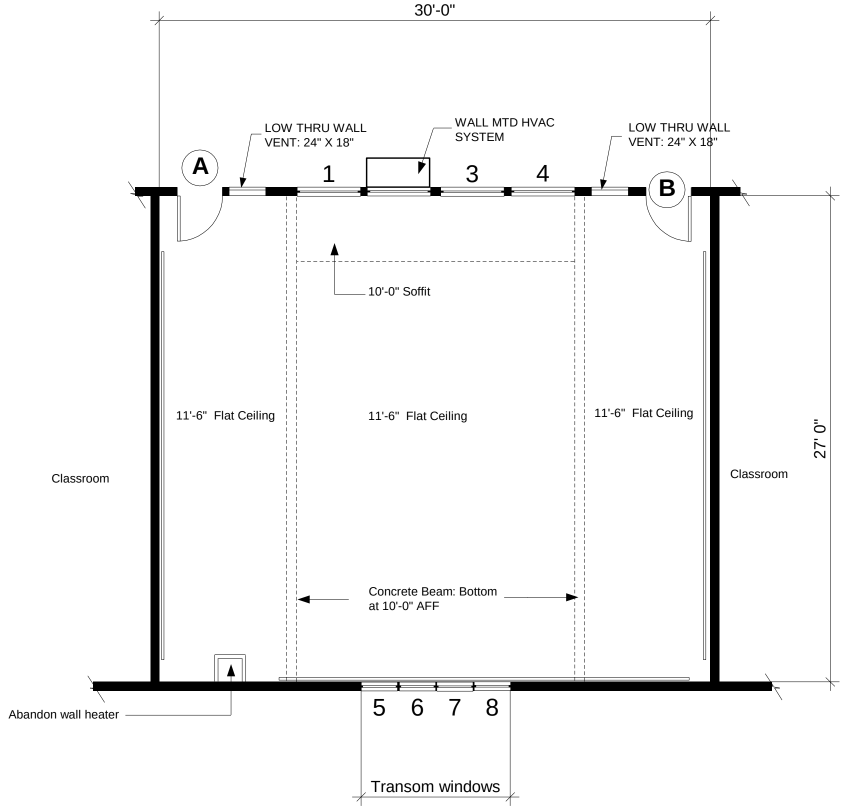
- Current Enrollment: 973
- Total Classrooms: 50
- Total In Use: 44
- Modular Classrooms: 0
- Stories: 1 - 2

1. **Main characteristics:** The Wilmington Park Elementary School consists of three permanent structures and three modular structures. All buildings are clad in stucco with flat or low-pitched roofs. The three main buildings are two-story structures while the modular buildings are single-story.

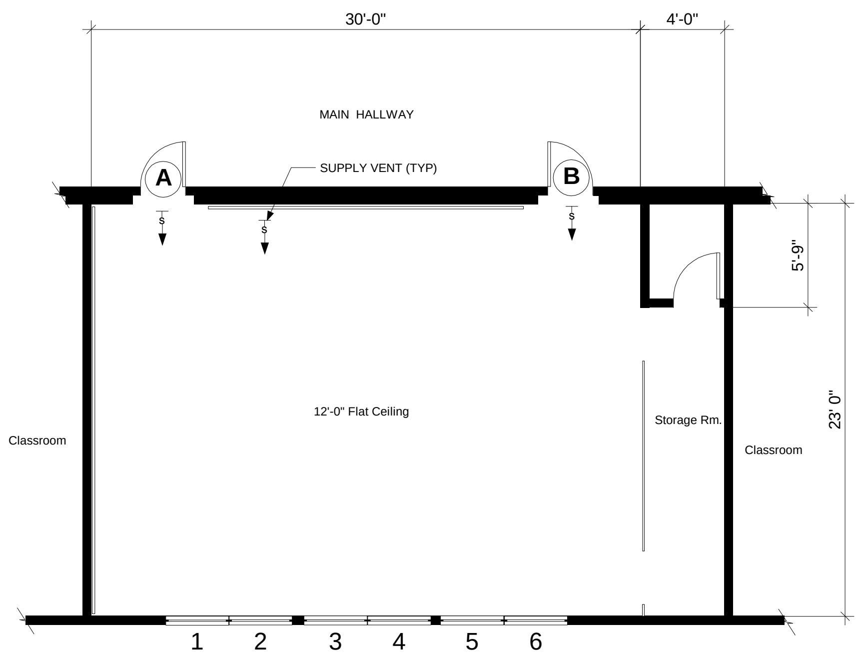
2. **Noise orientation:** The school properties eastern boundaries are located 600 to 700 feet from the Alameda Boulevard Rail Line. Residential housing to the east of the property obstructs the line of site to the noise source. The Principal and teachers were interviewed about the noise environment. Interviews revealed that the rail noise was not considered a nuisance.

3. **Typical classroom wall system (materials, form, construction and access)**: The wall assemblies of all structures are all clad in stucco. The interior of the wall assemblies are finished with sheetrock. All wall cavities are at least 3½”. Determination of insulation in wall cavities was not possible.

Figure 15 Typical Classroom Layouts – Wilmington Park Elementary School



Structure C



Structure A

4. **Typical classroom door/windows and glazing systems (materials, form and construction):** Majority of windows are wood single-glazed double-hung in fair to good condition. Doors to classrooms are wood solid-core.

5. **Typical classroom ventilation characteristics:** Ventilation systems are predominantly exterior wall-mounted heat pumps for classrooms on the ground floor. Second floor systems vary from interior thru-wall mounted units to rooftop mounted units.

   Of note, a study was referenced by IQAir titled "Special Reporting: Classroom Sound Assessment". The study evaluates in-room HVAC system's contribution to the classroom sound levels. Study finds that older in-room HVAC systems can create a noise environment with sound levels exceeding 45 dBA which has a negative impact on learning.

   Constructability issues for noise mitigation: Window and door installations would not require major cutting and patching. Replacement of ventilation systems would trigger the need to perform environmental testing for lead-paint and asbestos. Implementing improvements would require, at minimum, coordination with LAUSD and the Division of the State Architect.

   Of note, a review of an inspection report dated 6/07/13 performed by the Office of Environmental Health and Safety identified ongoing HVAC problems at the facility (deficiency ID 156305). The LAUSD was identified as the responsible party with the status of the issue being identified as open.

Broad Avenue Elementary School – Assessment Visit Wednesday 8/28/13 @ 3:00 p.m.

The Broad Avenue Elementary School is located at 24815 Broad Avenue and is one of 673 elementary schools in Los Angeles Unified School District. It is a public school that serves 826 students in grades K-5. The school resides on a 5.83 acre lot bounded by 245th Street to the north, Broad Street to the East, 249th Street to the south, and an alley to the west. The school is in good repair and condition and is located in the Broad Avenue/Oceanside Street Study Area. A building layout and site/building attributes are presented below. Typical classroom layouts are presented in Figure 16.

1. **Main characteristics:** The Broad Avenue Elementary School consists of four permanent structures and eleven modular structures. All buildings are clad in stucco with flat or low-pitched roofs. The main buildings vary between single- and two-story structures, while the modular buildings are all single-story.

2. **Noise orientation:** The school properties eastern boundaries are located 900 to 1000 feet from the Northern Rail Line. Residential housing to the north and east of the property obstructs the line of site to the noise source.

   The Principal and teachers were interviewed about the noise environment. Interviews revealed that the rail noise was not considered a nuisance.

Site Attributes

- Configuration: K-5
- Permanent Buildings: 4
- Modular Buildings: 11
- Lot Area: 255221[2]
- Zoning: (LAPF)
- Noise Source: Rail
- Noise Impact: Level 2
- Noise Direction: Northeast

Building Attributes

- Current Enrollment: 826
- Total Classrooms: 42
- Total In Use: 37
- Modular Classrooms: 14
- Stories: 1 - 2

3. **Typical classroom wall system (materials, form, construction and access):** The wall assemblies of all structures are all clad in stucco. The interior of the wall assemblies for the main buildings are finished with sheetrock. The modular buildings are finished with ½" fiberboard. All wall cavities are at least 3½". Determination of insulation in wall cavities was not possible.

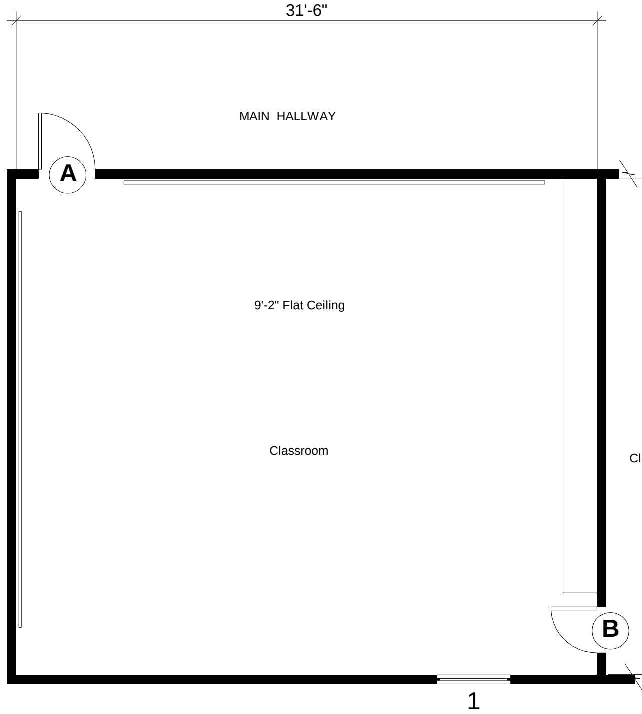
4. **Typical classroom door/windows and glazing systems (materials, form and construction):** Majority of windows are aluminum awnings in the main buildings, and wood single-glazed double-hung in the modular structures. All are in fair to good condition. Doors to classrooms are wood solid-core. Clearstory windows in modular have no glazing and are in-filled with plywood.

5. **Typical classroom ventilation characteristics:** Ventilation systems are predominantly exterior thru-wall mounted heat pumps for classrooms on the ground floor. Second floor systems vary from interior thru-wall mounted units to rooftop mounted units.

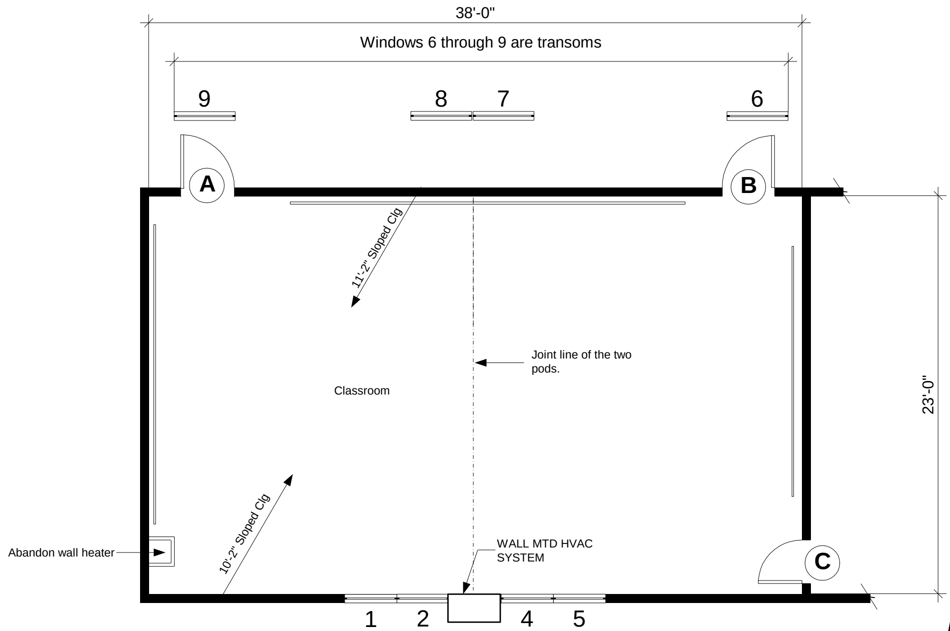
6. **Constructability issues for noise mitigation:** Window and door installations would not require major cutting and patching. Replacement of ventilation systems would trigger the need to perform environmental testing for lead-paint and asbestos. Implementing improvements would require, at minimum, coordination with LAUSD and the Division of the State Architect.

   A review of the Office of Environmental Health and Safety website revealed that there were no recent inspection reports that could be used to determine LAUSD capital planning.

Figure 16 Typical Classroom Layouts – Broad Avenue Elementary School



Structure Group C



Modulars

Hawaiian Avenue Elementary School – Assessment Visit Wednesday 8/28/13 @ 5:00 p.m.

The Hawaiian Avenue Elementary School is located at 540 Hawaiian Avenue and is one of 673 elementary schools in Los Angeles Unified School District. It is a public school that serves 927 students in grades K-5. The school resides on a 4.13 acre lot bounded by West F Street to the north, King Avenue to the East, D Court to the south, and Hawaiian Avenue to the west. The school is in good repair and condition and is located in the Hawaiian Avenue Study Area. A building layout and site/building attributes are presented below. Typical classroom layouts are presented in Figure 17.

Site Attributes

- Configuration: K-5
- Permanent Buildings: 5
- Modular Buildings: 6
- Lot Area: 180225^{2}
- Zoning: (LAPF)
- Noise Source: TraPac
- Noise Impact: None
- Noise Direction: South

Building Attributes

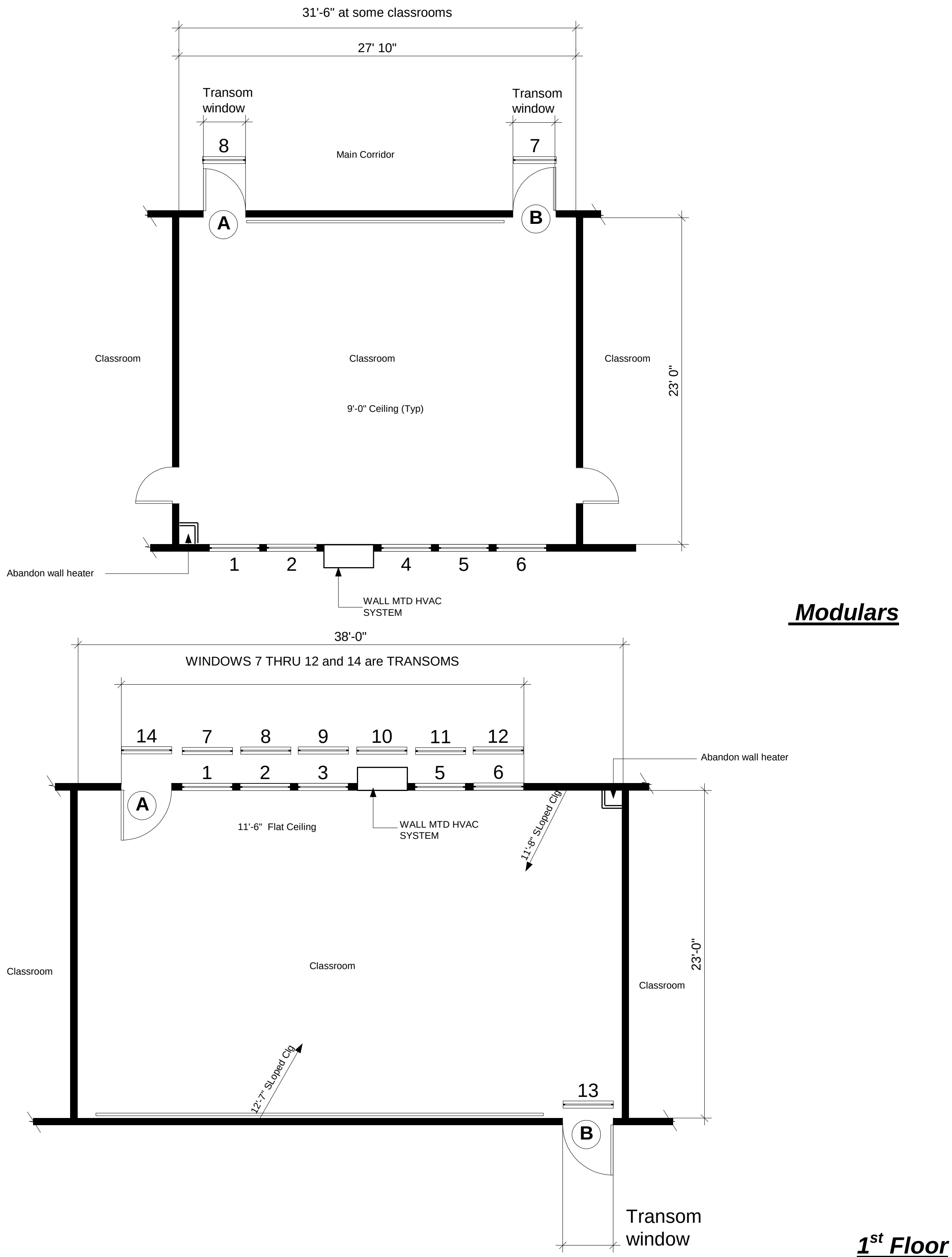
- Current Enrollment: 927
- Total Classrooms: 28
- Total In Use: 28
- Modular Classrooms: 0
- Stories: 1 - 2

1. **Main characteristics**: The Hawaiian Avenue Elementary School consists of five permanent structures and six modular structures. All buildings are clad in stucco with flat or low-pitched roofs. The main buildings vary between single- and two-story structures, while the modular buildings are all single-story.

2. **Noise orientation:** The school properties southern boundaries are located 1600 feet from TraPac operations. Residential housing to the south of the property obstructs the line of site to the noise source.

   The Principal and teachers were interviewed about the noise environment. Interview revealed that the TraPac noise was not considered a nuisance.

Figure 17 Typical Classroom Layouts – Hawaiian Avenue Elementary School



3. **Typical classroom wall system (materials, form, construction and access):** The wall assemblies of all structures are all clad in stucco. The interior of the wall assemblies for the main buildings are finished with sheetrock. All wall cavities are at least 3½”. Determination of insulation in wall cavities was not possible.

4. **Typical classroom door/windows and glazing systems (materials, form and construction):** Majority of windows are wood single-glazed double-hung. All are in fair to good condition. Doors to classrooms are wood solid-core.

5. **Typical classroom ventilation characteristics**: Ventilation systems are predominantly exterior thru-wall mounted heat pumps for classrooms on the ground floor. Second floor systems vary from interior thru-wall mounted units to rooftop mounted units.

6. **Constructability issues for noise mitigation:** Window and door installations would not require major cutting and patching. Replacement of ventilation systems would trigger the need to perform environmental testing for lead-paint and asbestos. Implementing improvements would require, at minimum, coordination with LAUSD and the Division of the State Architect.

   Of note, a review of an inspection report dated 6/14/13 performed by the Office of Environmental Health and Safety with no items listed for ventilation or fenestration improvements.

4.0 ACOUSTICAL MEASUREMENTS

4.1 Introduction

One of the purposes of the windshield survey of the highly-impacted residences and the walk-thru inspection of the schools was to determine the acoustical testing plan. This section presents the testing approach and the results of the acoustical testing.

4.2 Measurement Procedure

For this study, L&B used a sound insulation measurement technique based on the use of an artificial noise source. The use of an artificial noise source was deemed most appropriate for the SAP project as it allows measurements to be made at all of the structures during a brief measurement period, independent from local noise sources. It also allows the collection of data on building elements which assists in the treatments for the acoustical design.

The measurement procedure described herein has been developed to accurately measure outdoor-to-indoor Noise Level Reduction (NLR) of rooms, and to measure the Sound Isolation Effectiveness (SIE) of elements such as doors, windows, walls, and roof structures. The procedures generally follow those outlined in the ASTM Standard E966.[1] The procedures conform to good practice in sound insulation programs and the efficiency and flexibility of the testing procedures are enhanced using methods and theories from other sources such as Leo Beranek's "Noise and Vibration Control". These are applied in addition to the ASTM standard to achieve the same level of accuracy.

L&B used a specialized field monitoring kit that includes a signal generator, amplifier, and an equalizer to produce a noise source of equal energy in each octave band (known in the acoustics field as "pink noise"). The use of pink noise lends to accurately measuring all octave bands of interest. The noise source is relayed to a loudspeaker and the amplified pink noise is directed at the room or element of interest. The loudspeaker was placed on a tripod for measurements exposing the wall facades only. The list of equipment used in this study is as follows:

- Larson Davis 824 Sound Level Meter/One Third Octave Band Analyzer
- McCauley AC95-1 Coaxial Loudspeaker
- Crown XLS 202 Power Amplifier
- Rolls REQ215 31 Band Graphic Equalizer
- Goldline PN3B Noise Generator

[1] American Society for Testing and Materials (ASTM) Standard E966. - "Field Measurement of Airborne Sound Insulation of Building Facades and Facade Elements".

The loudspeaker was directed at the room to be measured, with the goal of having a uniform sound field exposed to all of the surfaces of interest. With the loudspeaker pointed at the room, measurements are made both on the exterior and in the interior of the structure. Exterior and interior octave band sound levels were measured and recorded with the loudspeaker in operation. Exterior and interior octave band sound levels were also measured and recorded without the loudspeaker to provide background or ambient sound levels.

Sound levels using the artificial noise source are used to determine the Outdoor/Indoor Level Reduction (OILR) of rooms and Outdoor/Indoor Transmission Loss (OITL) in accordance with ASTM E966. With the loudspeaker pointed at the room, or element, measurements are made both on the exterior and in the interior of the room. The exterior "near façade" measurements are reduced by 3 dB in each octave band. In some cases such as for roof structures, "near façade" measurements are not practical. In these cases, L&B undertakes "free-field" exterior measurements of the noise source. These measurements are undertaken at a distance from the loudspeaker equal to the distance from the loudspeaker to the façade or element being tested during the period of the interior sound level measurements. Per ASTM E966, the "free-field" measurements require no adjustments to the sound levels. Interior element measurements are adjusted per ASTM E966 based on the angle of incidence of the noise source. Definitions according to ASTM E966 for room NLR measurements and the element measurements are explained in the following sections.

4.3 Noise Calculations

Once the measurements have been completed the OILR of rooms and OITL of elements are calculated from the measured exterior and interior sound levels in each octave band, as outlined in ASTM E966. The OILR values are then used to compute the outdoor to indoor Noise Level Reduction (NLR) of aircraft noise based on A-weighted aircraft noise spectrum. The OITL is similarly used to compute the SIE of the measured building elements.

4.3.1 Noise Level Reduction Calculations for Rooms

NLR is a single number rating used for the comparison of the difference in the outdoor-to-indoor noise levels. This number is typically used to judge the overall effectiveness of sound insulation programs.

The NLR of a room is dependent on the exterior noise source spectrum. For this program, L&B will use a Wilmington-specific A-weighted average noise spectrum for the exterior noise source. This noise spectrum will be based either on a train or a truck pass-by, depending upon the location of the property in the six impact zones. The noise source spectrum is A-weighted to resemble human perception and to be consistent with guidelines for assessing noise in communities. The indoor A-weighted noise source spectrum for each room tested in the program is obtained by subtracting the measured OILR from each octave band of the exterior A-weighted noise source spectrum. The A-weighted sound pressure level is obtained by summing the energies in each octave band. The A-weighted NLR, based the noise spectrum, is the difference between the outdoor and indoor A-weighted sound pressure levels.

4.3.2 Sound Isolation Effectiveness of Elements

Industry-wide various single number ratings have been developed to describe the sound insulating capabilities of elements such as doors, windows, walls, roof structures, etc. L&B measures elements only to provide guidance in providing acoustical support and recommending treatments.

Manufacturers of windows and doors most frequently use the Sound Transmission Class (STC) rating. This rating was developed for rating the sound insulating capabilities of interior building partitions over the frequencies of human speech. The single number rating, SIE, is used by L&B to assess the capability of an element to reduce aircraft noise inside a building. SIE for elements is calculated the same way as the NLR for rooms. For elements, the OITL is subtracted from each octave band of the A-weighted average noise spectrum of the noise source. It should be noted that the SIE will generally be lower than STC because the typical noise source has more energy in the low frequencies than the frequencies of human speech.

4.4 Required Noise Information

The acoustical design of a building is dependent upon three sources of noise data. This information includes the following:

- Exterior Noise Levels;
- Exterior Noise Source Spectrum; and
- Interior Noise Levels.

This information is further explained in the following sections.

4.5 Measured Noise Levels

4.5.1 Exterior Noise Levels (Residences)

For the residences the exterior noise levels are based on the measured noise levels collected during the initial noise measurement program undertaken in June, July and August 2012, as well as information collected during the acoustical testing of residences and schools in August 2013.

Various noise metrics are used in acoustical treatment studies to quantify the exterior acoustical conditions and, ultimately, to determine interior noise levels and to quantify the acoustical goals. During the course of the measurement program, property inventory and acoustical testing residents typically complained about the loud noise events (trains and trucks) that would bother them throughout the day, interfere with evening activities and awaken them in the middle of the night. This message was repeated over and over to the study team. Therefore, the metrics used for the SAP are explained further in the following sections and include:

1. L_{max} – Maximum A-weighted Noise Level (Lmax);
2. SEL – Sound Exposure Level (SEL); and
3. L_{eq} – Equivalent A-Weighted Noise Level (L_{eq}).

L_{max}

The L_{max} metric is the maximum A-weighted noise level. The L_{max} is a typical metric to use in defining speech intelligibility issues for residential structures. This is a typical issue when loud noise events interfere with homeowners undertaking normal daily events such as conversation on a telephone or watching television. It is also typically used to determine issues with sleep disturbance.

SEL

The SEL is the A-weighted Sound Exposure Level. SEL is the accumulation of all the sound energy over the duration of an event, compressed into a one-second time interval. The SEL is another typical metric to use to determine sleep disturbance issues in structures that are primarily residential use. This was a typical issue with homeowners as they most often mentioned the late night train or truck events that awakened them from their sleep in the middle of the night.

L_{eq}

The L_{eq} metric does not include a nighttime component and is a typical metric to use in defining maximum interior noise levels for residences. It is typically used in conjunction with a specific time period, so an $L_{eq(16)}$ is a 16-hour metric used in defining daytime maximum interior noise levels for residential structures, while $L_{eq(8)}$ is a 8-hour metric used in defining nighttime maximum interior noise levels for residential structures. Refer to WHO Guidelines presented in Section 3.1, Table 1 in *Report #2: Criteria and Prioritization Report*.

Summary of Major Noise Sources

Of the seven residential properties measured, Table 3 below summarizes the main source of exterior noise events at each house. It is either train noise, truck noise or a combination of both.

Table 3
Major Noise Sources for Residences Subjected to Acoustical Testing

Building Address	Major Noise Source
1133 McFarland Avenue	Train
933 McFarland Avenue	Train
1563 E. L Street	Train & Truck
846 Oceanside Street	Train
1534 E. Denni Street	Train & Truck
1559 E. O Street	Truck
829 246th Street	Train

Summary of Exterior Noise Conditions

The exterior noise levels as discussed in the previous sections are summarized in Tables 4 and 5 below.

Table 4
Exterior Noise Level Summary – 2012 Measurement Program

Building Address	Major Noise Source	Leq (dBA)		Lmax (dBA)
		Day	Night	Night
1133 McFarland Avenue	McFarland Rail Line	78	75	115
933 McFarland Avenue	McFarland Rail Line	78	75	115
1563 E. L Street	Alameda Rail Line	74	71	108
846 Oceanside Street	Northern Rail Line	78	75	112
1534 E. Denni Street	Alameda Rail Line	74	71	108
1559 E. O Street	Drumm Street Container Trucks	73	68	87
829 246th Street	Northern Rail Line	78	75	112

Table 5
Exterior Noise Level Summary – 2013 Acoustical Testing

Noise Source	Noise Metric	Exterior Noise Level (dBA)
Train	L_{max}	104
	SEL	113
Truck	L_{max}	80
	SEL	89

Report #1: Noise Measurement Report, summarizes the results of 26 noise measurement locations in the study area. Sites #3, #4/4a and #16 details train noise events in the residential areas. Crossing bells created constant noise events around 70 dBA L_{max}, locomotive pass-by's created noise levels between 70 and 77 dBA L_{max} and rail car pass-by's created noise levels around 60 dBA L_{max}. By far, the loudest train events were caused by the train horn near most at-grade rail crossing. Noise events were routinely recorded over 90 dBA and as high as 115 dBA in nearby residential areas.

Table 4 documents the exterior noise levels measured during the 2012 measurement program. Daytime L_{eq} noise levels were as high as 78 dBA along the three rail lines (McFarland, Alameda & Northern). Nighttime L_{eq} noise levels were as high as 75 dBA, while L_{max} noise levels were as high as 115 dBA along the three rail lines. This information was also presented in Section 4.3, Table 9 in *Report #2: Criteria and Prioritization Report*.

During the 2013 acoustical testing of residences, staff did document a 104 dBA train horn event. This information is reported in Table 5 and is consistent with the high maximum noise levels report in Table 4 from the 2012 measurements. A time trace of a similar noise event recorded during the acoustical testing of a residence is presented in Figure 18. As a result, the maximum noise levels at the closest residences were considered to be 115 dBA L_{max} from the train horn.

Sites #2, #22 and #25 details truck noise events in the residential areas. Truck pass-by's routinely created noise events in excess of 70 dBA L_{max} and even up to 80 dBA and sometimes 90 dBA in nearby residential areas.

Table 4 documents the exterior noise levels measured during the 2012 measurement program. Daytime L_{eq} noise levels were as high as 73 dBA along Drumm Avenue from the container trucks. Nighttime L_{eq} noise levels were as high as 68 dBA, while L_{max} noise levels were as high as 87 dBA along Drumm Avenue. This information was also presented in Section 4.3, Table 9 in *Report #2: Criteria and Prioritization Report*.

During the 2013 acoustical testing of residences, staff did document an 80 dBA truck noise event along Drumm Avenue. This information is reported in Table 5 and is consistent with the high maximum noise levels report in Table 4 from the 2012 measurements. A time trace of a similar noise event recorded during the acoustical testing of a residence is presented in Figure 19. As a result, the maximum noise levels at the closest residences were considered to be 87 dBA L_{max} from the truck events.

4.5.2 Exterior Noise Levels (Schools)

For the schools the exterior noise levels are based on the measured noise levels collected during the initial noise measurement program undertaken in June, July and August 2012.

Various noise metrics are used in acoustical treatment studies to quantify the exterior acoustical conditions and, ultimately, to determine interior noise levels and to quantify the acoustical goals. The metrics used for the SAP for schools are explained further in the following sections and include:

1. L_{max} – Maximum A-weighted Noise Level (Lmax); and
2. L_{eq} – Equivalent A-Weighted Noise Level (L_{eq}).

L_{max}

The L_{max} metric is the maximum A-weighted noise level and was explained earlier in Section 4.5.1. The L_{max} is a typical metric to use in defining speech intelligibility issues for schools.

L_{eq}

The L_{eq} metric does not include a nighttime component and is a typical metric to use in defining maximum interior noise levels for schools. It is typically used in conjunction with a specific time period, so a $L_{eq(7)}$ is a 7-hour metric used in defining speech intelligibility issues for classroom hours in schools. Refer to WHO Guidelines presented in Section 3.1, Table 1 in *Report #2: Criteria and Prioritization Report*.

Report #1: Noise Measurement Report summarized the results of noise measurements at only one school location in the study area. Site #18 routinely details local noise events such as neighborhood activities, local traffic, distant aircraft, playground activity, etc. Port noises are not audible or barely audible. Maximum noise levels rarely exceeded the mid-70's dBA L_{max}.

Therefore, L&B took the maximum train horn noise event (115 dBA) and calculated the maximum noise from the train horn (considered a port activity) that is expected to be heard at the three schools. Those levels are reported in Table 6.

Table 6
Major Noise Sources for Residences Subjected to Acoustical Testing

Building Address	Major Train Horn Noise Level (dBA)
Hawaiian Avenue Elementary School	74
Broad Avenue Elementary School	78
Wilmington Park Elementary School	81

4.5.3 Exterior Noise Source Spectrum (Residences & Schools)

The exterior noise source spectrum information is based on measured train or truck noise levels that were undertaken during the acoustical testing. L&B staff spent time in the field collecting spectral data on a representative sample of train and truck pass-by events that occur in the study area. The spectral data from the measured trains and trucks were used to develop an average A-weighted noise spectrum of the typical noise event for the study and is used for determining the NLR of the various rooms measured for this study. Figure 20 shows the exterior source spectrum for a single train event that includes the use of the horn. Figure 21 shows the exterior source spectrum for multiple truck pass-by events. Either the train or truck spectra may be used for the residential analysis, while only the train spectra will be used for the analysis at the schools.

4.5.4 Interior Noise Levels (Residences & Schools)

The interior noise conditions are based on noise measurements that are undertaken at each property and on each building being considered for acoustical treatments.

Personnel from L&B performed acoustical measurements in a representative sample of rooms in the various residential and school buildings. The measurements were performed on Tuesday August 27th and Wednesday August 28th, 2013. The purpose of these measurements was to determine the existing noise level reduction within selected rooms in various buildings and to assess the acoustical performance of elements such as windows, doors, and walls.

Table 7 summarizes the interior acoustical conditions of the sample rooms tested in the various residential buildings. Table 9 summarizes the rooms tested in the various schools. The first and second column describes the building address and the rooms tested. The measured NLR in each room is presented in the third column. The fourth column presents the exterior L_{max} noise levels. The fifth column presents the interior L_{max} noise levels. The interior L_{max} values (column 5) are calculated by subtracting the measured NLR (column 3) from the exterior L_{max} values (column 4).

Table 8 summarizes the acoustical results for the various elements tested in each of the representative rooms tested in the various residential buildings. Table 10 summarizes the elements tested in the various schools. The first and second column in the table describes the building address and the rooms tested. The measured element in each room is presented in the third column. The fourth column presents the measured Sound Isolation Effectiveness (SIE) of the various elements tested.

Figure 18 Time Trace of Train Pass-by Noise Event

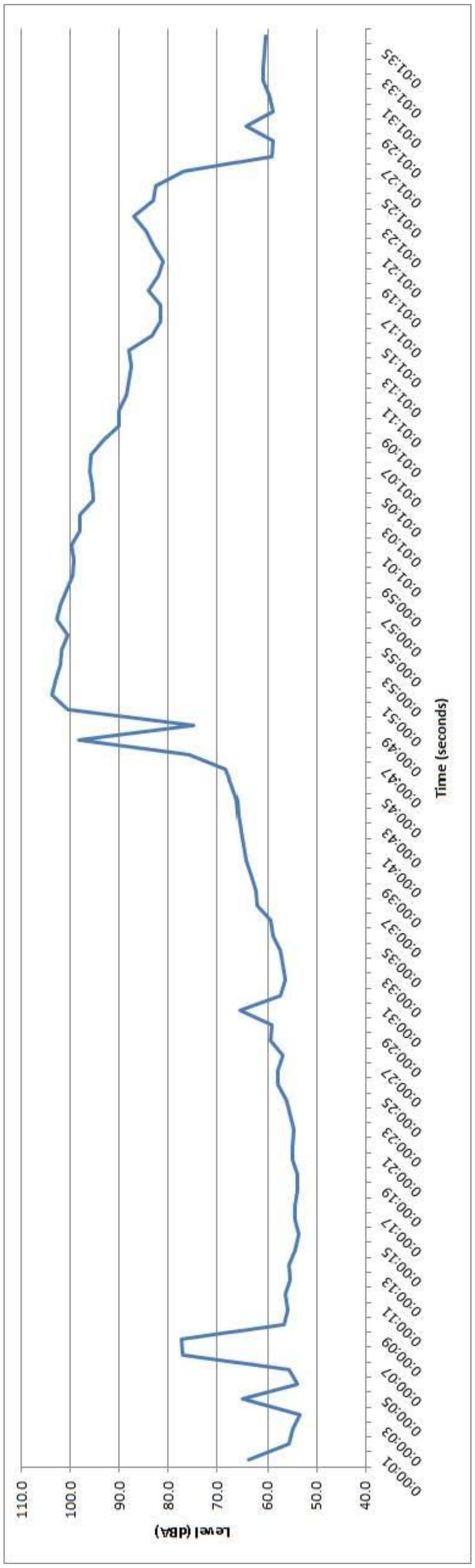


Figure 19 Time Trace of Truck Pass-by Noise Event

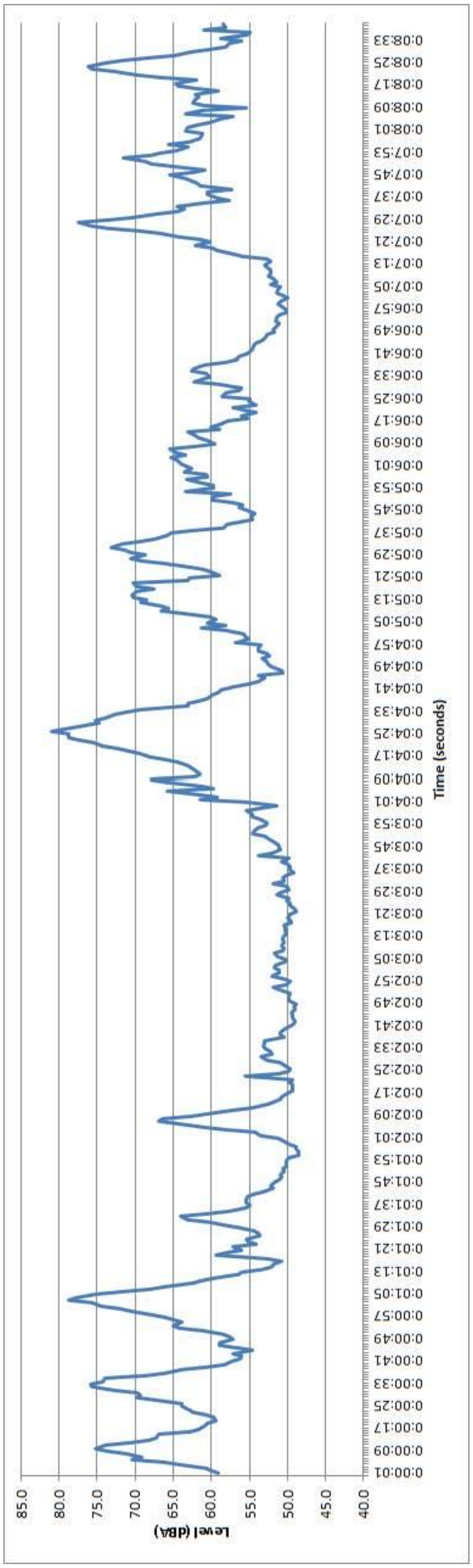


Figure 20 External Train Source Spectrum (Single Train w/ Horn)

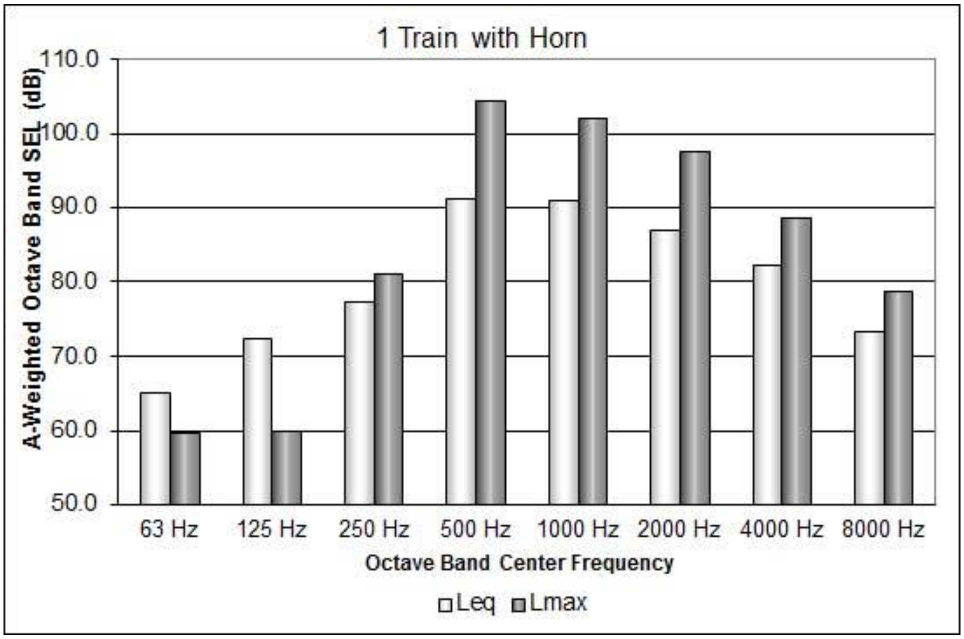


Figure 21 External Truck Source Spectrum (13 Truck Events)

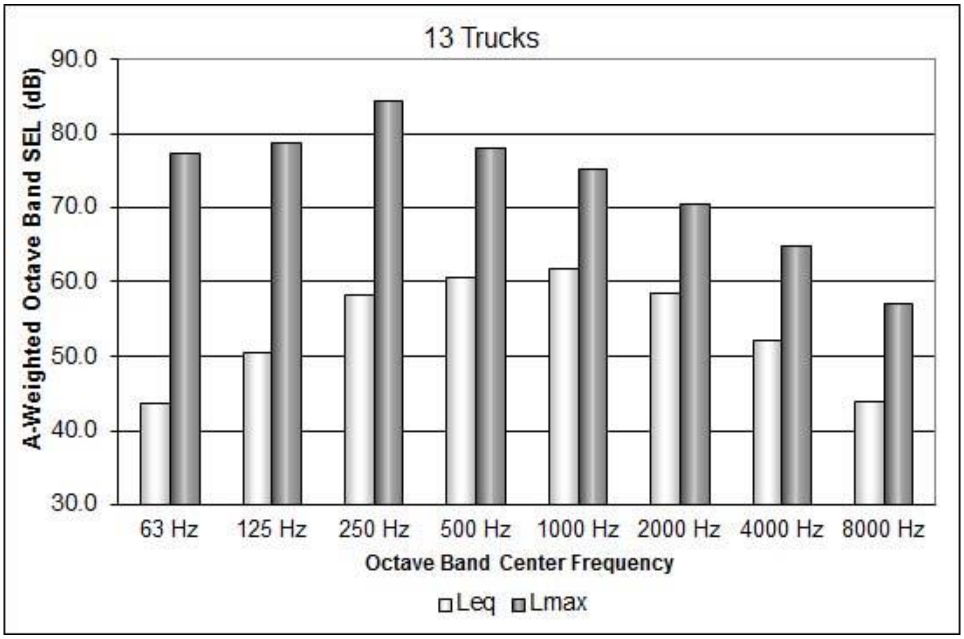


Table 7
Pre-Modification Acoustical Test Results – Room Summary (Residences)

Building Address	Room	Measured NLR (dB)
1133 McFarland Avenue	Family Room	27
	Master Bedroom	29
933 McFarland Avenue	Rear Bedroom	24
1563 E. L Street	Master Bedroom	28
	Living Room	26
846 Oceanside Street	Rear Bedroom	28
	Side Bedroom	22
1534 E. Denni Street	Living/Dining Room	24
	Bedroom	30
1559 E. O Street	Front Bedroom	21
	Rear Bedroom	21
829 246th Street	Rear Bedroom	34

Table 8
Pre-Modification Acoustical Test Results – Element Summary (Residences)

Building Address	Room	Element	Measured SIE (dB)
1133 McFarland Avenue	Family Room	Window Slider	21 26
	Master Bedroom	Window	25
933 McFarland Avenue	Rear Bedroom	Window	20
1563 E. L Street	Master Bedroom	Window	23
	Living Room	Window Door	21 19
846 Oceanside Street	Rear Bedroom	Window	18
	Side Bedroom	Window Door	15 17
1534 E. Denni Street	Living/Dining Room	Window Door	20 23
	Bedroom	Window	23
1559 E. O Street	Front Bedroom	Window	17
	Rear Bedroom	Window	19
829 246th Street	Rear Bedroom	Window Slider	30 29

Table 9
Pre-Modification Acoustical Test Results – Room Summary (Schools)

Building Address	Room	Measured NLR (dB)
Wilmington Park Elementary School 1140 Mahar Avenue	Room 27	23
	Room 35	25
	Room 2	26
Broad Avenue Elementary School 24815 Broad Avenue	Room 26	26
	Room 23	35
Hawaiian Avenue Elementary School 540 Hawaiian Avenue	Room 28	24
	Room 4	25

Table 10
Pre-Modification Acoustical Test Results – Element Summary (Schools)

Building Address	Room	Element	Measured SIE (dB)
Wilmington Park Elementary School 1140 Mahar Avenue	Room 27	Window	15
		Door	16
		HVAC	18
	Room 35	Window	16
		Door	17
		HVAC Vent	9
	Room 2	Window	22
		HVAC Vent	16
Broad Avenue Elementary School 24815 Broad Avenue	Room 26	Window	20
		Door	18
		HVAC	19
	Room 23	Window	23
Hawaiian Avenue Elementary School 540 Hawaiian Avenue	Room 28	Window	16
		HVAC	20
		HVAC Vent	9
	Room 4	Window	21
		HVAC	18

5.0 ACOUSTICAL CRITERIA

Report #2: Criteria and Prioritization Recommendations Report presents information on sleep disturbance and communication interference. The acoustical testing revealed surprisingly high single event noise levels in residential area in the study area. Many of these events occur throughout the day and during all hours of the night. As a result, the noise events would be particularly disturbing to residents. More detailed information on criteria for speech intelligibility and sleep disturbance is provided in this section. These levels will provide guidance when designing the acoustical treatments as discussed in Section 6.

5.1 Speech Intelligibility Criterion

L&B and other acoustical consultants in the industry frequently use additional noise criteria that take into account speech intelligibility. One of the most common effects of noise is speech interference. This may affect a number of common activities, including conversations such as listening to the radio or television in addition to telephone and normal conversations. In the case of school and other similar activity this would include teaching and learning from school classroom activities, quiet time in the library, singing or listening to songs in auditoriums, or conferences/meetings in the administration or other staff buildings.

The degree to which noise may interfere with speech depends not only on the level, frequency, and duration of noise, but also upon other physical factors in the environment such as background noise, the level of the speaker's voice, the distance between the speaker and listener, the activity involved, and room acoustics. In addition, non-physical factors, such as the speaker's enunciation and the listener's interest in and familiarity with the topic, are important.

Figure 22 presents the impacts of noise on speech intelligibility. Noise may mix with desired sounds and under some circumstances can degrade the information that can be extracted from the desired sounds, although people can make adjustments within a certain range. People can extract the desired information from speech in noisy environments even when the speech level is below that of the interfering noise. People usually talk at a level of about 55 to 65 dBA (measured at separations of three feet) in typical environments such as homes and public buildings. If the background sound is higher, people will generally compensate by raising their voices or listening more attentively at background levels up to about 80 dBA.[2] According to the Federal Interagency Committee on Noise, the threshold for speech masking may begin at approximately 60 dBA indoors. This can be a masking of a speakers words or the causing of a speaker to pause. As intrusive indoor levels approach 80 dBA, speech intelligibility may be close to zero. The current Federal Interagency Committee on Aviation Noise (FICAN) supports this finding and the relationship between sentence intelligibility and A-weighted noise levels as proposed by the U.S. Environmental Protection Agency back in 1974. Besides the impact on speech intelligibility, much of the past research has shown that aircraft noise can interfere with classroom learning and that its strongest effect is upon learning.

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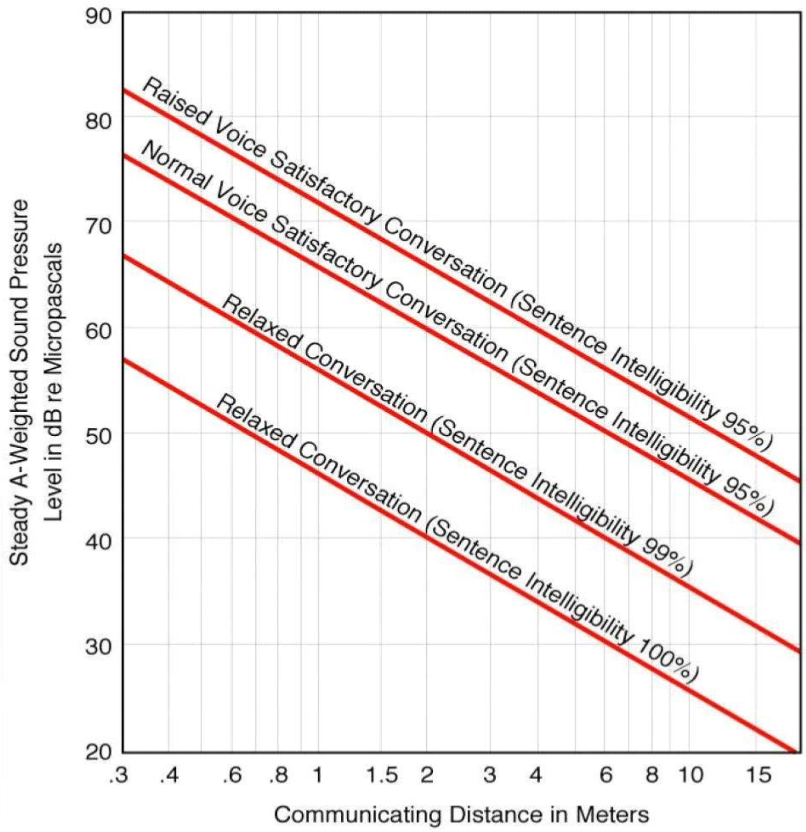
2 *Federal Agency Review of Selected Airport Noise Analysis Issues*, Technical Report, Federal Interagency Committee on Noise (Technical), Volume 2, August 1992, p. 3-7.

Figure 22 Relationship Between Sentence Intelligibility and A-Weighted Noise Level



Source: US EPA, *Information on Levels of Noise Requisite to Protect the Public Health and Welfare with an Adequate Margin of Safety*, March 1974.

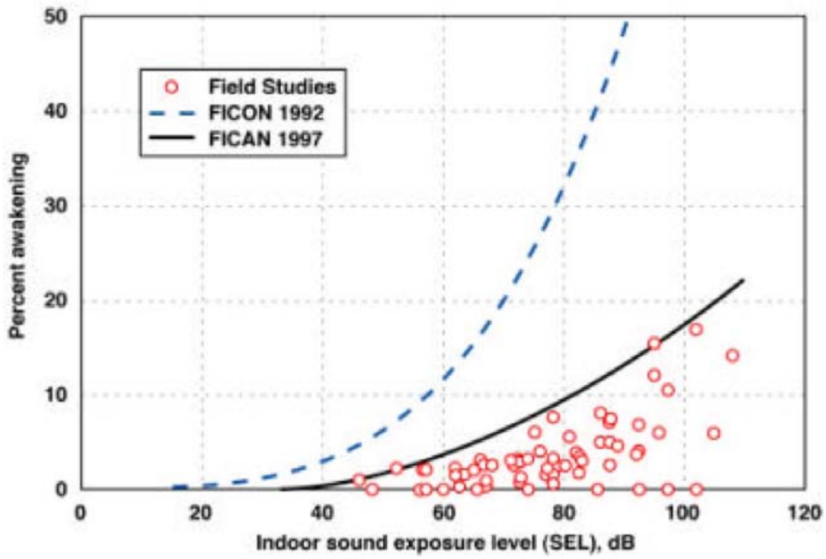
For the purposes of this study, L&B defines an interior listening environment acceptable when 95 percent speech intelligibility is exceeded with a normal voice over a 10-foot (three-meter) distance during a typical exterior noise event. This would be the common noise environment as experienced in a living room with a television playing the background, in a normal classroom environment or in the sanctuary of a church during a Sunday service.

The audible duration of a noise event in the SAP study area would usually occur for less than one minute and the loudest period would normally be within three dB of the L_{max} for less than five seconds. Therefore, based on the information in Figure 22 the interior L_{max} should not exceed 58 dBA. This information is also summarized in Table 11.

5.2 Sleep Disturbance Criterion

FICAN studied the effects of aircraft noise on sleep disturbance in 1997. Although continuing efforts to identify sleep disturbance relationships are being undertaken by standard-setting organizations, FICAN recommends the use of the 1997 curve, presented in Figure 23, FICAN SEL Curve for Assessing Potential Sleep Disturbance Caused by Aircraft Noise for assessing maximum percentage of a number of people that are projected to be awoken in their sleep caused by aircraft noise.

Figure 23 FICAN SEL Curve for Assessing Potential Sleep Disturbance



For the purposes of this study we have selected an indoor SEL criterion of 65 dBA. Events with interior SELs exceeding 65 dBA are projected to awaken not more than five percent of people exposed. Table 11 also summarizes this value.

5.3 WHO Criterion

WHO criterion was also presented earlier in Section 4.3, Table 9 in *Report #2: Criteria and Prioritization Report*.

The acoustical criteria for the treatment of residences and school in the SAP study area are summarized in Table 11.

Table 11
Summary of Acoustical Design Criteria

Criteria	Purpose	Source
	Residential	
Maximum Interior L_{max} of 58 dBA	Speech Intelligibility	U.S. EPA
Maximum Interior SEL of 65 dB	Sleep Disturbance	FICAN
Maximum Interior L_{max} of 45 dBA	Sleep Disturbance	WHO
Maximum Daytime $L_{eq(16)}$ of 35 dBA	Speech Intelligibility/Annoyance	WHO
Maximum Nighttime $L_{eq(8)}$ of 30 dBA	Sleep Disturbance	WHO
	Schools	
Maximum Interior L_{max} of 58 dBA	Speech Intelligibility	U.S. EPA
Maximum Classtime $L_{eq(8)}$ of 35 dBA	Speech Intelligibility	WHO

6.0 RECOMMENDED TREATMENTS

6.1 Treatment Goals

Based on the goals outlined above, L&B conducted an analysis to determine effective treatments for the various buildings to achieve a minimum five dB noise reduction. The minimum five dB noise reduction provides a noticeable reduction in the interior noise levels. For this analysis, L&B looked at a number of representative rooms in the different buildings and identified what structural detail modifications will produce the greatest noise reduction in the interior spaces.

It should be noted that although the design goal is at least five dB, designing for a slightly higher NLR increase as a margin of safety is common practice. In reality, the measured NLR increase after construction typically can vary by two to three dB from projected values. These differences are caused by many factors such as quality of installation, changes in furnishings that affect the interior acoustical conditions and due to the many variations in environmental conditions that result in differences in the acoustical tests in the field. In addition, acoustical projections are based on products that were tested in a laboratory and the actual acoustical performance often differs from the actual product installed in the field.

L&B uses an acoustical model to help determine what treatment protocols are needed to ensure meeting the design goals. This model also shows the noise contributions of each element that enables us to target the treatments. This section discusses sound insulations treatment recommendations and explains the acoustical model, used for this study.

6.2 Modeling Process

The acoustical model that has specifically been developed for sound insulation programs is used as a guide for recommending treatment protocols. This model calculates the NLR of a room based on the noise source, the transmission losses of surfaces that are exposed to the noise source, and the interior acoustics of the room. This model allows calculated results to be compared with measured results at a spectral level, for both the pre-test and post-test data.

6.2.1 Noise Source Input

The NLR depends on the spectrum of the noise source, the spectral data of the noise source is entered into the model. In addition, the exterior L_{max} noise metric is entered in the model to compute the total interior noise levels.

6.2.2 Transmission Loss Input

The exterior surfaces of rooms are comprised of wall facades and roof structures. The wall facades and roof structures are also comprised of various elements such as windows, doors, wall structures, skylights, etc. The NLR for the rooms are dependent on the size and transmission loss of each element of the exposed exterior surfaces, which is entered into the model for each room.

6.2.3 Interior Acoustics Input

The NLR is affected by the amount of absorption in the room and size of the room. All dimensions of interior surfaces and their spectral absorption data are entered into the model.

Also air absorption and furniture information is included in the modeling process. Increasing the absorption in a room will increase the NLR.

6.2.4 Measurements Input

Measured pre-test and post-test data can be entered and compared with computed output. The measured pre-test data is used to validate the model. Measured post-test data can be entered and compared with the projected results to study the performance of the treatments.

6.2.5 Modeling Output

The output of the model is the computation of pre- and post-construction OILR. The interior noise levels are computed from the noise source data and OILR. To project the performance of treatments, the transmission loss spectra of replacement windows, doors, improved roof structure, and other elements are entered, after modeling the non-treated rooms.

6.3 Preliminary Treatment Recommendations

This section discusses preliminary treatment options for the residential and school buildings in the SAP with the goal to provide a minimum of five dB increase in the NLR (5 dB noise reduction). The selected treatments target primarily the “weaker” performing elements such as windows and doors.

The minimum noise reduction goal for all buildings in the SAP is five dB, although we design in a “margin of safety”. As mentioned earlier designing for a slightly higher NLR value as a margin of safety is common practice in sound insulation programs. This is used to account for factors such as quality of installation, changes in room furnishings, variation in environmental conditions, and the actual acoustical performance of the product in the field. Therefore, to ensure at least a five dB NLR increase, L&B designs for an adequate safety margin in the acoustical design.

6.3.1 Residences (Highly-Impacted)

Noise acts like water, if it finds a hole it will leak through. The typical paths of entry for noise into a home include windows, doors, walls, vents, and thru-wall heaters/air conditioners. The principals involved in mitigating how noise enters a home are straightforward:

- The more airtight the product or installation, the more resistant it will be to airborne noise.
- The denser the material, or the more mass it has, the more resistant it will be to airborne noise.
- Decoupling, or the physical isolation of interior and exterior surfaces, reduces the transmission of noise.
- Insulation, in certain cases, will help reduce noise energy by absorption.

These four principles form the basis for our acoustical treatment recommendations. Typical treatment recommendations for residences impacted by noise related to transportation systems include replacement of doors and windows in habitable spaces, provision of adequate ventilation for homeowner comfort and air quality, and baffling of vents, chimneys, and other pores in the building envelope. Depending on the noise source and sponsoring authority, treatments are applied to either the entire building envelope, or to the portions of the building envelope that are within the line-of-sight of the noise source.

The major noise sources in the residential areas are truck pass-by's, train pass-by's and train horns. Residents expressed their concern with the middle of the night noise events that often awakened them. As a result, the main focus of the treatment for the highly-impacted residential structures was to treat bedrooms that have a direct line-of-sight to the source, especially given that there is not nearly enough money to consider whole-house treatments as a mitigation approach. Therefore, the acoustical treatment of the residences focusses on the bedrooms. However, two different treatment options were analyzed.

The key challenge that HCBF faces relative to the noise mitigation of residences in the highly-impacted noise zone is budget. Based on the windshield surveys and targeted house assessments other challenges should be noted:

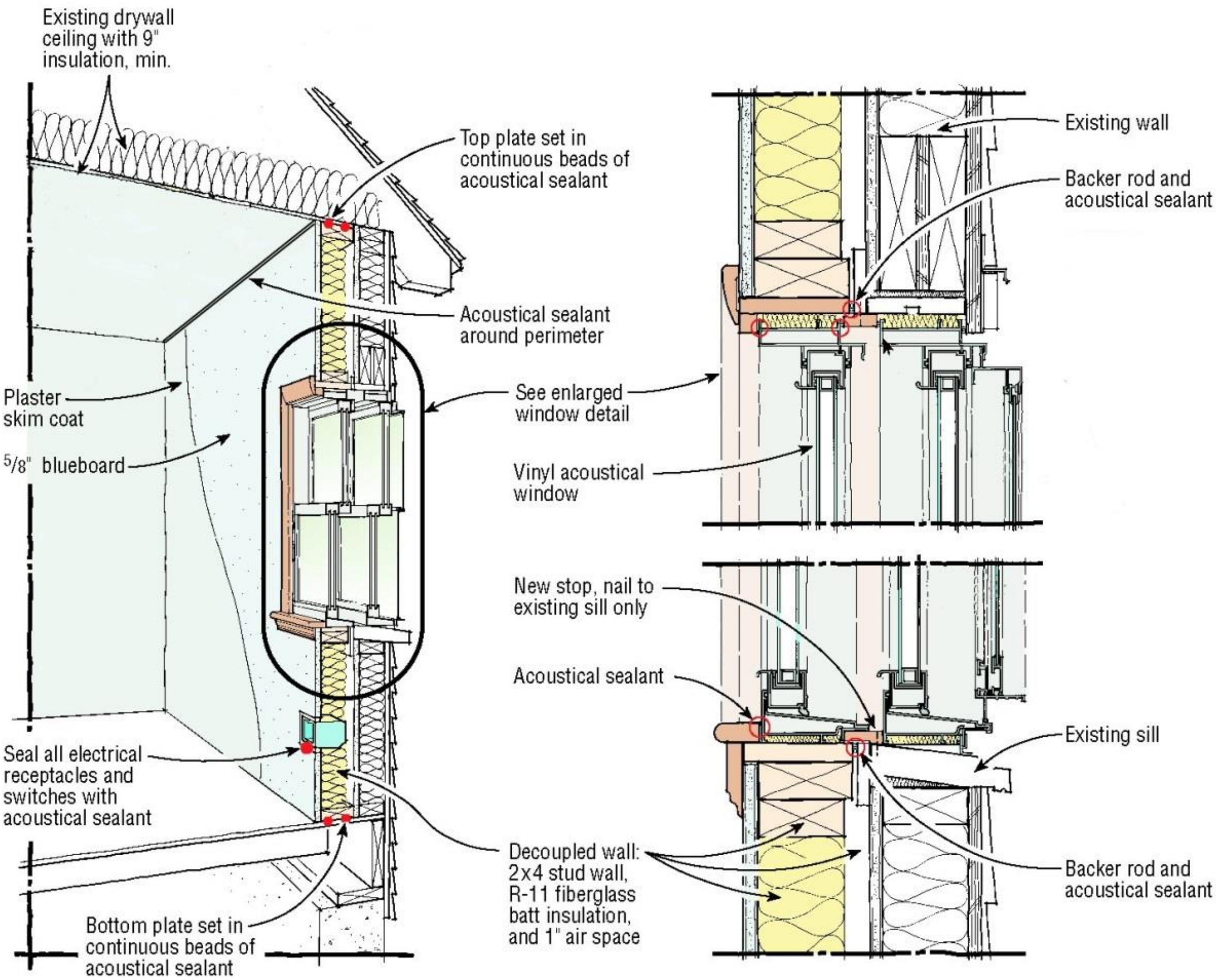
- Majority of homes will require cutting and patching of stucco and interior wall surfaces which can increase costs.
- Many homes could have access issues for noise mitigation treatments due to interior furnishing and/or stored materials on site.
- There will be homes that have permitting, code and occupancy violations that can limit the ability of the program to install noise mitigation treatments.

All of these factors influence our process in determining how to best leverage program funds to address the noise impacted residences. The principals employed in creating our recommended treatment strategy are:

- Limit treatments to rooms with line-of-sight to noise source. This is a typical approach for surface transportation projects (road and rail noise).
- Limit treatments to address primary noise nuisance. All surveyed homeowners noted that primary noise nuisance was at night. Therefore, bedrooms are the primary rooms to be treated.
- Limit the amount of disturbance to the existing construction materials in the homes. This approach can reduce costs of cutting/patching and environmental mitigation (lead paint and asbestos).
- Limit treatments to code compliant structures and/or spaces. Intent of program should not be code enforcement, however if a space is unpermitted or exhibits evidence of code or occupancy issues, it should not be eligible for treatment unless homeowner is willing acknowledge and address the observed violations.
- Unique to this program is to identify treatment options that exceed interior WHO requirements of a 45 dBA (L_{max}), 35 dBA daytime (L_{eq}) and 30 dBA nighttime (L_{eq}).

In acknowledgment of the noise impact criteria, treatment goals, and limited budgets our recommendation for the HCBF sound attenuation program is to offer eligible homeowners an extra measure of sound insulation beyond the typical door and window treatments. The focus of this approach is offering "Quiet Room" treatments to bedrooms that are within the line-of-sight of the noise source. This Quiet Room treatment effectively creates a room within the existing room providing higher levels noise reduction than what is possible with typical treatments. Any wall in the designated bedrooms that has exterior noise exposure will have a second wall installed that is one-inch inside of the existing surfaces. This configuration is presented in Figure 24. This treatment option results in a slight downsizing of the room's dimensions.

Figure 24 Sample Quiet Room Treatment



The treatments elements utilized in this Quiet Room approach include:

1. **Windows -** Windows are a prime source of noise transmission. Most of the homes that are in the treatment area are older, with single-glazed windows. In terms of noise-resistance, these windows amount to little more than a hole in the wall. Window remediation commonly requires complete replacement of the older units. Rather than replace the existing windows, which triggers the potential for additional costs for cutting, patching, and remediation, the Quiet Room window augments the existing window improving on the performance of the replacement and original windows.

2. **Doors -** Doors that lead directly from the exterior to the interior without an intervening air space or vestibule are major noise paths. By focusing our treatments in bedrooms we can diminish the need to treat these locations. Where doors do lead directly from a bedroom to the exterior, a secondary door would be added. The noise-reduction properties of the existing door are significantly enhanced by the addition of this secondary door. The secondary door fits into the secondary or double wall system of the Quiet Room.

3. **Mass –** Normal wood-frame construction (½" drywall, 3½" studs, insulated cavity and ⅝" sheathing with siding/stucco) does not create a noise path that that typically requires treatment. However, given the noise impact of these residences, and the employment of WHO guidelines, it is our recommendation that we should consider adding more mass to the wall assembly to help absorb some of the noise energy. We have implemented this strategy successfully at Boston's Logan International Airport (BOS) offering Quiet Rooms, also known as Rooms of Preference. In this case an additional layer of sheetrock is applied to the secondary wall to increase the mass of the assembly.

4. **Surface Isolation -** Decoupling these rooms works very well. The average tested noise rating of a quiet room at BOS was 40 dB — a 10 dB, or 50%, noise reduction beyond that achieved by normal door and window treatments. For these rooms to be optimally efficient, careful attention to detail is a must. Treatment detailing needs to ensure that no elements bridge the gap between the new and existing walls and/or ceilings, and that seams and holes are tightly sealed. These steps include:

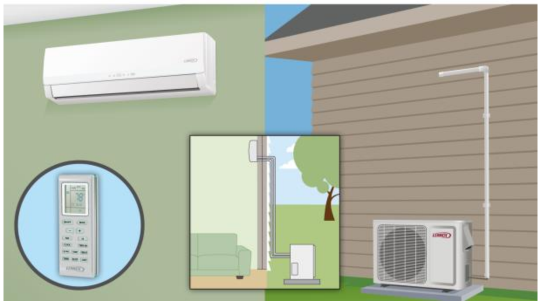
   - Set the new wall plate in acoustical sealant where it is in contact with the floor and ceiling.

   - Seal all electrical wall switches and receptacles with the same sealant.

   - Use the standard elements of a normal 2"x4" wood-framed wall in the double-wall construction, and include R-11 insulation.

5. **Air Quality & Comfort -** In the process of replacing windows and doors and sealing other points of airflow, a home's exterior envelope becomes considerably tighter than it was before. As a consequence indoor air quality and occupant comfort may suffer. Further, in order for a homeowner to benefit from the noise reduction treatments windows and doors to the exterior must be closed. To address these space conditioning issues we recommend that if a bedroom does not have existing central HVAC (heating, ventilating, air-conditioning system), the program provide for cooling and air-change through the use of a ductless mini-split systems.

The main advantages of mini splits (illustration by Lennox) are their small size and flexibility for zoning or heating and cooling individual rooms. Many models can have as many as four indoor air handling units (for four zones or rooms) connected to one outdoor unit. Ductless mini-split systems are easier and more flexible to install than other space conditioning systems.



As mentioned previously, two different treatment options were analyzed. Treatment Option #1 would focus only on window and door treatments to the rooms considered line-of-sight to the noise source. Treatment Option #2 provides a Quiet Room for all bedrooms with a direct line-of-sight to the path of the noise source. Both treatment options are explained in more detail below. The specific treatment options are used in Section 7 to determine the overall noise reduction of the different treatment options.

Treatment Option #1 – This treatment focuses on window and door treatments only. Although this option would result in reduced mitigation costs, constructability issues, as explained earlier, could in fact drive up the overall treatment costs. The noise reduction would also be less than the treatments proposed in Option #2. The treatments for Option #1 are outlined below.

Windows – All windows should be replaced with acoustical product rated a minimum of STC 40.

Doors - All doors in the rooms should be replaced with acoustical product rated a minimum of STC 38.

Treatment Option #2 – This treatment provides a Quiet Room for all bedrooms with a direct line-of-sight to the path of the noise source. Although this option could result in higher mitigation costs, constructability issues are less of an issue and the overall noise reduction would be much higher. A Quiet Room entails the construction of an additional interior wall on all walls that have exterior exposure. The Quiet Room offers homeowners an extra measure of sound insulation beyond the typical door and window treatments. This treatment effectively creates a room within the existing room. Any wall in the bedroom room that has exterior noise exposure will have a second wall constructed one-inch inside of the existing surfaces. The recommended treatments for the Quiet Room in Option #2 are outlined in the following sections.

Walls - All walls with exterior exposure shall have an additional 2"x4" wood stud wall installed 1" from existing wall. The wall shall be filled with 3½" of unfaced insulation and will be faced with ½" gypsum wall board.

Windows - The windows in the new wall should be replaced with acoustical product rated a minimum of STC 44.

Doors - All doors in the rooms should be replaced with acoustical product rated a minimum of STC 44.

Both treatment options would provide for cooling and air-change through the use of ductless mini-split systems for homes do not already such systems.

The acoustical treatment options for the residences are summarized in Table 12.

Table 12
Modeled Treatment Options - Residences

Element	Recommended Treatment (Windows & Doors Only)
Windows	- Replace existing windows with acoustical products rated a minimum STC 40
Doors	- Replace existing exterior doors with acoustical products rated a minimum STC 38
Element	**Recommended Treatment (Quiet Room)**
Wall	- Install 2"x4" wood stud wall, set 1" from existing wall - Install 3½" unfaced insulation in wall cavity - Faced with ½" gypsum wall board
Windows	- Install interior windows with acoustical products rated a minimum STC 44
Doors	- Replace existing exterior doors with acoustical products rated a minimum STC 44

6.3.2 Schools

The principals for developing a treatment approach to schools are no different from those for housing. Their application, however, is quite different. In the case of schools, construction cannot occur during the school year, environmental issues are more challenging, the regulatory environment is more stringent, and the costs of installation are much higher.

The key challenge that HCBF faces relative to the noise mitigation of schools is budget. The fees for A/E services to design, bid, and mitigate one school could easily exceed the entire three year sound attenuation budget. There is not nearly enough money to consider sound attenuating the schools in a traditional manner. A summary of the key considerations influencing our recommended treatment approach are:

- Treatment of any of the three facilities in a traditional design, bid, build approach will trigger the need for environmental assessments for lead and asbestos, DSA reviews, compliance with 2013 Building Energy Efficiency Standards, and may trigger seismic reviews and ADA compliance.
- DSA review cycles can add three- to six-months to program schedules.
- Coordinating the noise mitigation process while accommodating the schedules of school administrators, parent-teacher organizations, teachers and students can be complicated and costly.
- Modular classrooms tend to have wall assemblies that are not equal in mass to primary structures and are not intended to be permanent structures.
- The noise impact driving the need for treatment is less a factor of the environmental noise and more a factor of the acoustic quality of the classroom itself.

- LAUSD may have Capital Improvement Projects programmed to address some of the noise issues that have been identified in the IQAir *"Special Reporting: Classroom Sound Assessment"* dated July 9, 2012.

These considerations are not shared to diminish our focus on the importance of addressing noise when it comes to children and the learning environment. Rather they are being considered to help HCBF prioritize their limited resources in ways that can address the noise issues quicker and in a more cost effective manner. The principals employed in creating our recommended treatment strategy for the schools are as follows:

- Limit treatments to classrooms. Other educational sound attenuation programs have extended treatments to offices and assemblies, but given focus on children, and magnitude of noise impact related to the Port, the classrooms, in our opinion, represent a better use of program funds.

- Limit treatments to the permanent structures. A vast majority of sound attenuation programs do not treat modular buildings due to cost of adding mass to walls and ceilings, as well as potential for structure to be moved off site at some point in the future.

- Maximize the use of local fair-share dollars to fund mitigation treatments to limit impact on HCBF funds.

- Create treatment approaches that are quicker to employ and less expensive to execute.

Two different treatment strategies were analyzed. Treatment Strategy #1 would be for the HCBF to sponsor a special comprehensive study at all three facilities. Treatment Strategy #2 provides a plan to mitigate only the classrooms for each of the schools. Both treatment strategies are explained in more detail below. The specific treatments specified in Treatment Strategy #2 are used in Section 7 to determine the overall noise reduction of the different treatment options.

Treatment Strategy #1 – Given the limited resources available to HCBF, and given the primary issue at the schools appears to be the aging ventilation systems, we recommend HCBF partner with LAUSD to leverage Proposition 39 to fund the necessary improvements at the schools. This program uses revenue from California's General Fund and the Clean Energy Job Creation Fund for eligible projects to improve energy efficiency. Improvements include upgrades to heating and air conditioning systems, and replacement of old windows, among other things. which have a direct correlation to noise mitigation treatments.

Treatment Strategy #2 – If it is determined that funds for the treatment of classrooms should be limited to HCBF budgets, we recommend avoiding the traditional models of designing, bidding and constructing school upgrades. In this case it would be worth exploring the creation of a design manual containing product, equipment, and detailing standards. The standards would be provided to the school district with the funding of the necessary improvements coming from the HCBF. The idea being the program would not need to secure the services of A&E firms to create bid documents that comply with DSA requirements. It may also be possible to save costs of installation if the school district has resources that can perform the work. The key elements of this approach are:

1. **Classrooms –** Treat only the classrooms that are in the permanent structures. Sequence treatments in a way that addresses a few classrooms per year per facility.

The idea is to look for ways to limit triggers that require increased consultant costs and cumbersome and costly reviews.

2. **Windows –** As noted in the residential section windows are a prime source of noise transmission. In the case of the schools remediation should be limited to single-paned windows. This approach complements acoustical and energy strategies.

3. **Doors –** For classrooms where doors lead directly from the exterior to the interior without an intervening air space or vestibule, depending on condition and composition of door, door leafs will be weather-stripped or replaced.

4. **Mass –** No treatments relative to the addition of mass are required for permanent structures, nor are they recommended for modular.

5. **Surface Isolation -** No treatments relative to the surface isolation are required.

6. **Air Quality & Comfort –** Air Quality issue for the schools is being handled under separate contract. Specific to the HVAC systems, the wall mounted heat-pumps represent the greatest area of concern for noise disturbance in the classrooms. For these instances we would recommend replacement with similar self-contained more efficient systems for exterior mounted locations, and where paths of travel prevent exterior installations, the same, or use of split system heat pumps to serve the classrooms.

Treatment Strategy #2 provides mitigation for all classrooms in the permanent structures. The acoustical treatment of the schools focusses entirely on the classrooms. Treatments to offices, libraries, auditoriums and other areas are not considered at this time. Treatments are outlined in the following sections.

Windows - All windows in the classrooms should be replaced with acoustical product rated a minimum of STC 40.

Doors - All doors in the classrooms should be replaced with acoustical product rated a minimum of STC 38.

HVAC – Separate from the issue of the noise generated from the HVAC systems in the classrooms, the acoustical treatment of the classrooms would assume that all exterior HVAC vents would be closed, sealed or otherwise baffled. New mini-split systems or replacement thru-wall units would be provided for cooling and air-change throughout the classrooms.

Acoustical treatments for the schools are summarized in Table 13.

Table 13
Modeled Treatment Options - Schools

Element	Recommended Treatment (Windows & Doors Only)
Windows	- Replace existing windows with acoustical products rated a minimum STC 40
Doors	- Replace existing exterior doors with acoustical products rated a minimum STC 38

Vents	- Close & seal all exterior HVAC vents

6.3.3 Residences (Impacted)

There is no new ground to cover on issues of noise impact or treatment approaches for homes that are noise impacted, but are not located in the highly-impacted zone. The common theme in our recommended approach is to be budget conscious and targeted in our recommendations. We looked to programs with strict budget constraints and lower noise impacts for precedent and point to the Massachusetts Port Authority's (Massport) Bayswater Environmental Program at Logan International Airport. Similar in nature to the HCBF program, Massport made a $4 million contribution to the Bayswater Environmental Fund that provided individual grants of up to $17,000 to help more than 200 homeowners retrofit their homes.

The Program offered specific environmental home improvements for residential properties where homeowners can select from options designed to produce interior noise reduction and/or air quality benefits up to a pre-established maximum grant amount. The program assisted individual homeowners in evaluating and selecting improvement and product options. Homeowners were responsible for soliciting bids from a pre-qualified list of local contractors & subcontractors. Massport offered technical assistance to the homeowners throughout the process with support from local consultants. Massport was also the entity that entered into an agreement with the contractors on the homeowner's behalf. Members of our team helped develop this program as well as implement it. This insight helped us in determining the applicability of this programmatic approach.

The preliminary treatment options for the impacted residential would differ greatly from the proposed treatment approach for the highly-impacted residential. The majority of the highly-impacted residences are impacted by the three rail lines and the properties backup to the railroad right-of-way. This layout typically exposes bedrooms to the impact from the rail lines as these rooms are typically at the rear of the property. The impacted properties are typically across the street from the highly-impacted properties thus exposing the front of the house to the noise from the rail lines or are impacted by truck traffic on local streets which also exposes the front façade of the house to the noise source. As a result, the Quiet Room approach applied to the line-of-slight bedrooms for the highly-impacted property would not be an effective solution in this situation. Therefore, the treatments options offered to the individual homeowners for the HCBF program could include the following options:

- Quiet Room Treatments
- Window Replacement
- Door Replacement
- Installation of ductless mini-splits where there are no existing central air systems
- Air Sealing
- Insulation
- Combustion Appliance Safety Testing
- Energy Audit*

- Energy Improvements identified* in energy audits

**There is the potential to partner with LA County's Energy Upgrade California project. If a successful agreement could be negotiated between the organizations, HCBF could offer the homeowners in the moderately impacted a benefit that leverages a existing programs infrastructure. In this case a homeowner could use a portion of the HCBF grant to join the Energy Upgrade program, secure an audit, and use HCBF grant for treatments that are eligible for both programs.*

Given the number of the impacted properties, the exact shopping list of treatments would be evaluated as some future point following a property survey of the impacted property.

7.0 PROJECTED ACOUSTICAL PERFORMANCE

7.1 Future Noise Levels

Using the two treatment options specified previously in Section 6.3.1, the future improvements in the noise reductions were calculated. This is explained in more detail in the following sections.

7.1.1 Residences (Highly-Impacted)

Table 14 presents the projected improvements of the rooms tested and modeled for all residential properties tested as part of the SAP. These rooms and buildings represent a cross-section of the different styles of structures including in the highly impacted area of Wilmington. The first and second column describes the building address and the rooms modeled. Column three designates whether standard treatments were modeled or if a “Room of Preference” was modeled. The existing measured NLR in each room is presented in the fourth column. The fifth column presents the projected NLR in each room. The sixth column in the table details the projected increase in the NLR (or similarly the noise reduction) after treatments. The projected increase values (column 6) are calculated by subtracting the future projected NLR (column 5) from the existing measured NLR values (column 4). It should be noted that treatments for all rooms were not modeled.

Based on the results presented in Table 14 all rooms would receive between nine (9) and 13 dB of noise reduction with the standard window and door treatments. The median improvement is 10 dB for these rooms. For the same rooms that were modeled with the Quiet Room, all rooms would receive between 14 and 22 dB of noise reduction with the Quiet Room treatments. The median improvement is 18 dB for these rooms.

7.1.2 Schools

Table 15 presents the projected improvements of the rooms tested and modeled for all three schools that are part of the SAP. These rooms and buildings represent a cross-section of the different styles of classroom structures including in the study area of Wilmington. The first and second column describes the building and the rooms modeled. The existing measured NLR in each room is presented in the third column. The fourth column presents the projected NLR in each room. The fifth column in the table details the projected increase in the NLR (or similarly the noise reduction) after treatments. The projected increase values (column 5) are calculated by subtracting the future projected NLR (column 4) from the existing measured NLR values (column 3). It should be noted that treatments for all rooms were not modeled.

Based on the results presented in Table 15 all rooms would receive between seven (7) and 17 dB of noise reduction with the standard window and door treatments. The median improvement is 16 dB for these rooms.

7.1.3 Residences (Impacted)

The impacted residential properties were not included in the property survey discussed in Section 2. As a result, future noise levels were not projected at this time for the impacted residential property.

Table 14
Projected Acoustical Conditions - Residences

Building Address	Room	Room of Preference (Y/N)	NLR (dB) Existing Measured (a)	NLR (dB) Future Projected (b)	NLR (dB) Projected Increase (b-a)
1133 McFarland Avenue	Master Bedroom	N	29	38	9
		Y	29	47	18
	Family Room	(1)	27	(1)	(1)
933 McFarland Avenue	Rear Bedroom	N	24	37	13
		Y	24	46	22
1563 E. L Street	Master Bedroom	N	28	38	10
		Y	28	47	19
	Living Room	(1)	26	(1)	(1)
846 Oceanside Street	Side Bedroom	N	22	34	12
		Y	22	44	22
	Rear Bedroom	(1)	28	(1)	(1)
1534 E. Denni Street	Bedroom	N	30	39	9
		Y	30	47	17
	Living Room	(1)	24	(1)	(1)
1559 E. O Street	Front Bedroom	N	21	34	13
		Y	21	39	18
	Rear Bedroom	N	21	31	10
		Y	21	35	14
829 246th Street	Rear Bedroom	(1)	(1)	(1)	(1)

Notes: (1) Rooms were not modeled.

Table 15
Projected Acoustical Conditions - Schools

Building	Room	NLR (dB)		
		Existing Measured (a)	Future Projected (b)	Projected Increase (b-a)
Wilmington Park Elementary School	Room 27	23	40	17
	Room 35	25	42	17
	Room 2	(1)	(1)	(1)
Broad Avenue Elementary School	Room 26	26	41	15
	Room 23	35	42	7
Hawaiian Avenue Elementary School	Room 28	24	41	17
	Room 4	25	38	13

Notes: (1) Rooms were not modeled.

7.2 Acoustical Impacts

7.2.1 Residences (Highly-Impacted)

Tables 16 and 17 present the existing and projected interior noise levels impacts of the residences that were tested and modeled as part of the SAP. These rooms and buildings represent a cross-section of the different styles of residential structures including in the study area of Wilmington. The first and second column describes the building address and the rooms modeled. The existing measured NLR in each room is presented in the third column. The fourth, fifth and sixth column presents the exterior noise levels ($L_{eq(day)}$, $L_{eq(night)}$ and L_{max}). The seventh, eighth and ninth column in the table presented the existing interior noise level impact ($L_{eq(day)}$, $L_{eq(night)}$ and L_{max}). The interior levels are calculated by subtracting the exterior levels from the existing NLR values (column 3).

The existing maximum interior noise levels in the 12 rooms measured ranged from 44 to 56 dBA $L_{eq(day)}$, 41 to 53 dBA $L_{eq(night)}$ and 66 to 91 dBA L_{max}. All interior noise levels exceed the WHO criteria presented in Table 11. Table 11 recommends maximum interior levels of 35 dBA $L_{eq(day)}$, 30 dBA $L_{eq(night)}$ and 45 dBA L_{max}.

Table 16
Existing Interior Noise Level Impacts – Residences

Building Address	Room	Existing NLR (dB) (a)	Exterior Noise Levels			Interior Noise Levels		
			Leq (dBA)		Lmax (dBA)	Leq (dBA)		Lmax (dBA)
			Day (b)	Night (c)	Night (d)	Day (b-a)	Night (c-a)	Night (d-a)
1133 McFarland Avenue	Family Room	27	78	75	115	**51**	**48**	**88**
	Master Bedroom	29				**49**	**46**	**86**
933 McFarland Avenue	Rear Bedroom	24	78	75	115	**54**	**51**	**91**
1563 E. L Street	Master Bedroom	28	74	71	108	**46**	**43**	**80**
	Living Room	26				**48**	**45**	**72**
846 Oceanside Street	Rear Bedroom	28	78	75	112	**50**	**47**	**84**
	Side Bedroom	22				**56**	**53**	**90**
1534 E. Denni Street	Living/Dining Room	24	74	71	108	**50**	**47**	**84**
	Bedroom	30				**44**	**41**	**78**
1559 E. O Street	Front Bedroom	21	73	68	87	**53**	**47**	**66**
	Rear Bedroom	21				**52**	**47**	**66**
829 246th Street	Rear Bedroom	34	78	75	112	**44**	**41**	**78**

Note: Exceedances of L_{eq}/L_{max} criteria from Table 11 are listed in bold in last three columns.

Table 17 Projected Interior Noise Level Impacts – Residences

Building Address	Room	Quiet Room (Y/N)	Projected NLR (dB) (a)	Exterior Noise Levels Leq (dBA) Day (b)	Exterior Noise Levels Leq (dBA) Night (c)	Exterior Noise Levels Lmax (dBA) Night (d)	Interior Noise Levels Leq (dBA) Day (b-a)	Interior Noise Levels Leq (dBA) Night (c-a)	Interior Noise Levels Lmax (dBA) Night (d-a)
1133 McFarland Avenue	Master Bedroom	N	38	78	75	115	**40**	**37**	**77**
		Y	47				31	28	**68**
933 McFarland Avenue	Rear Bedroom	N	37	78	75	115	**41**	**38**	**78**
		Y	46				32	29	**69**
1563 E. L Street	Master Bedroom	N	38	74	71	108	**36**	**33**	**70**
		Y	47				27	24	**61**
846 Oceanside Street	Side Bedroom	N	34	78	75	112	**44**	**41**	**78**
		Y	44				34	**31**	**68**
1534 E. Denni Street	Bedroom	N	39	74	71	108	35	**32**	**69**
		Y	47				27	24	**61**
1559 E. O Street	Front Bedroom	N	34	73	68	87	**39**	**34**	**53**
		Y	39				34	29	**48**
	Rear Bedroom	N	31				**42**	**37**	**56**
		Y	35				**38**	**33**	**52**

Note: Exceedances of L_{eq}/L_{max} criteria from Table 11 are listed in bold in last three columns.

The projected maximum interior noise levels in the seven (7) rooms, assuming the installation of acoustical treatments, were as follows:

- 35 to 44 dBA $L_{eq(day)}$ (w/ standard acoustical treatments)
- 27 to 38 dBA $L_{eq(day)}$ (w/ Quiet Room acoustical treatments)
- 32 to 41 dBA $L_{eq(night)}$ (w/ standard acoustical treatments)
- 24 to 33 dBA $L_{eq(night)}$ (w/ Quiet Room acoustical treatments)
- 53 to 78 dBA L_{max} (w/ standard acoustical treatments)
- 48 to 69 dBA L_{max} (w/ Quiet Room acoustical treatments)

In general, and with one exception, all projected interior noise levels will exceed the WHO criteria presented in Table 11 using standard acoustical treatments. Table 11 recommends maximum interior levels of 35 dBA $L_{eq(day)}$, 30 dBA $L_{eq(night)}$ and 45 dBA L_{max}.

In general, and with one exception, all projected interior noise levels will meet the WHO criteria presented in Table 11 using the Quiet Room acoustical treatments for both the $L_{eq(day)}$ and $L_{eq(night)}$ criteria. None of the projected interior noise levels will meet the WHO criteria presented in Table 11 using the Quiet Room acoustical treatments for the L_{max} criteria. L_{max} levels would still be from three to 24 dB above the recommended criteria. However, this is a substantial improvement from the existing conditions where the L_{max} levels would be from 21 to 46 dB above the recommended criteria

7.2.2 Schools

Tables 18 and 19 present the existing and projected interior noise levels impacts of the classrooms tested and modeled for all three schools that are part of the SAP. These rooms and buildings represent a cross-section of the different styles of classroom structures including in the study area of Wilmington. The first and second column describes the building and the rooms modeled. The existing measured or future projected NLR in each room is presented in the third column. The fourth and fifth column presents the exterior noise levels ($L_{eq(day)}$ and L_{max}). The sixth and seventh column in the table presented the existing or projected interior noise level impact ($L_{eq(day)}$ and L_{max}). The interior levels are calculated by subtracting the exterior levels from the existing or projected NLR values (column 3).

It should be noted that daytime L_{eq} noise levels during the hours that the schools were in session were not measured or calculated for the three schools. The L_{max} noise events for each school were based on the highest maximum noise level recorded during the measurement phase of this study. That noise event was a train horn with a maximum noise level of 115 dBA (see Table 4). That noise level was then projected at each of the three schools allowing for noise reduction by distance and shielding of intervening structures. The calculated maximum noise level at each of the three schools is presented in Table 6. Based on the maximum exterior noise level, the existing measure and future projected NLR, the maximum interior noise level is calculated and presented in the last column of Tables 18 and 19.

The existing maximum interior noise levels in the seven classrooms measured ranged from 43 to 58 dBA L_{max}. All interior noise levels are at, or below, the speech intelligibility criteria presented in Table 11. The WHO criteria presented in Table 11 recommends maximum interior levels of 58 dBA.

The projected maximum interior noise levels in the six classrooms modeled ranged from 33 to 41 dBA L_{max}. All interior noise levels are well below the WHO-recommended speech intelligibility criteria presented in Table 11 of 58 dBA L_{max}.

Table 18
Existing Interior Noise Level Impacts – Schools

Building	Room	Existing NLR (dB) (a)	Exterior Noise Levels		Interior Noise Levels	
			Leq (dBA)	Lmax (dBA)	Leq (dBA)	Lmax (dBA)
			Day (b)	Day (c)	Day (b-a)	Day (c-a)
Wilmington Park Elementary School	Room 27	23	(1)	81	(1)	58
	Room 35	25			(1)	56
	Room 2	26			(1)	55
Broad Avenue Elementary School	Room 26	26	(1)	78	(1)	52
	Room 23	35			(1)	43
Hawaiian Avenue Elementary School	Room 28	24	(1)	74	(1)	50
	Room 4	25			(1)	49

Note: Exceedances of L_{eq}/L_{max} criteria from Table 9 are listed in bold in last two columns.

Table 19
Projected Interior Noise Level Impacts – Schools

Building	Room	Projected NLR (dB) (a)	Exterior Noise Levels		Interior Noise Levels	
			Leq (dBA)	Lmax (dBA)	Leq (dBA)	Lmax (dBA)
			Day (b)	Day (c)	Day (b-a)	Day (c-a)
Wilmington Park Elementary School	Room 27	40	(1)	81	(1)	41
	Room 35	42			(1)	39
Broad Avenue Elementary School	Room 26	41	(1)	78	(1)	37
	Room 23	42			(1)	36
Hawaiian Avenue Elementary School	Room 28	41	(1)	74	(1)	33
	Room 4	38			(1)	36

Note: Exceedances of L_{eq}/L_{max} criteria from Table 9 are listed in bold in last two columns.

7.2.3 Residences (Impacted)

Future noise level impacts were not quantified for the impacted residential properties since these were not included in the property survey discussed in Section 2.

8.0 COST ESTIMATES

Given the limited funding availability in the foreseeable, the number and size of the schools and number of highly-impacted residences, the cost estimates for the recommended treatment options are being provided on a per-bedroom and per-classroom basis. The cost estimates for the impacted residences are provided on a per-property basis. The scope of work is being quantified based on assumptions that are generated from windshield surveys and site visits.

8.1 Residences (Highly-Impacted)

Based on the results of the windshield survey, a review of the County Assessor's database, and site assessments, we recommend that the program budget for the Quiet Room treatment (Treatment Option #2) of two-bedrooms per residence, each with two walls of noise exposure. Treatment Option #1 would not provide sufficient noise reduction to meet program goals. Specific to HVAC requirements we recommend programming for the use of dual-zone mini-splits for all homes except:

- The Neo-Mediterranean structures on Hyatt Avenue and McFarland Avenue (44 units)
- 50% of the homes on Oceanside Street and 246th Street on the Northern Rail Line (18 units)
- 10% of the remaining housing stock to allow for homeowner improvements (22 units)

8.1.1 Quiet Room Estimate

The elements of the typical Quiet Room would include 16 linear feet of wall, insulation, new finishes, relocated outlets/switches, and a new window in each wall. For the purposes of this cost estimate, Quiet Rooms are being budget at two per residence. Material costs per room are estimated at $2,450 with an additional $3,400 for labor. Factoring in 20% for overhead and profit the average cost per Quiet Room is budgeted at approximately $7,000 per room ($14,000 per residence).

8.1.2 HVAC Cost Estimate

The estimated cost for typical dual-zone mini-split system runs about $6,000 which includes installation, refrigerant line, refrigerant line cover set, and controls. In some cases electrical services will have to be upgrade at the cost of $500 to $1,000 per home. We recommend budgeting for electrical service upgrades at 50% of the homes receiving new mini-split systems.

The estimated treatment costs for the highly impacted residences are summarized in Table 20.

Table 20
Summary of Treatments Costs – (Highly Impacted Residences)

Treatment	Cost per Unit	No. of Units	Total Budget
Quiet Room	$14,000	280	$3,920,000
Ductless Mini-Splits	$6,000	196	$1,176,000
Electrical Service Upgrades	$1,000	98	$98,000
		Subtotal	$5,194,000
Total Cost (including 10% contingency)			**$5,713,400**
Average Treatment Cost per Residence			**$20,405**

The recommended treatment for the highly-impacted homes is estimated to cost just over $5.7 million dollars averaging $20,405 per residences based on treating 280 homes. These budgets do not cover consulting fees which could add 10 to 20 percent to the overall cost depending upon the level of support required. Other factors to consider that will impact budgets are as follows:

- **Escalation -** The longer the program's duration the more important it will be to factor for inflation.
- **Participation Rates –** Most programs do not exceed an 80% participation rate. Participation rates are influenced by condition of housing stock (code or occupancy issues) and homeowner's perception on the value of the program. A participation rate of well under 80% would be expected in the HCBF study area, especially in the early phases of a mitigation program. This would drastically reduce the funding requirements for this program.
- **Environmental Mitigation –** Costs do not account for the need to mitigate for lead and asbestos. It is assumed treatment approach minimizes the potential to need to factor for these costs.

When the cost for the Quiet Room treatments plus HVAC requirements for a dual-zone mini-splits system for the highly-impacted homes is compared to the costs for whole-house treatments related to aviation noise the costs in the area vary widely. At Los Angeles International Airport (LAX) the Cities of El Segundo and Inglewood have on-going sound insulation that has averaged a total cost (staff, consultants, and construction) of between $62,000 and 68,000 per home. For Los Angeles County for the LAX program and at Ontario International Airport (ONT) for the City of Ontario the programs are less costly at $25,000 to $35,000 per home. The variances are due to treatment approaches, services attributed to consultants, and amount of staff dedicated to the program.

The costs for the LAX and ONT programs are far greater than the estimated costs proposed for the Quiet Room and HVAC treatments proposed for the highly-impacted residences. In addition, the treatments proposed for the HCBF attain a much higher level of noise reduction to attenuate the higher noise source levels in the study area.

8.2 Schools

Two approaches were recommended for the school program. Treatment Strategy #1 should budget between $50,000 and $100,000 per report (school). The driving factor in cost will be scope of work and desired product. Treatment Strategy #2 is based on the results of the windshield survey and site assessments and is based on a pre-classroom cost. The summary of total classrooms by school is provided in Table 21. Specific to Strategy #2 treatment would apply only to the classrooms in the permanent structures and would not apply to the classrooms in the modular buildings. We recommend that the program budget the following for each treated classroom:

- 1 Door for 50% of the classrooms
- 4 windows per classroom
- 1 Exterior Mounted Vertical Heat Pump or Ductless Mini-Split System for:

- 100% of the classrooms at Hawaiian Avenue Elementary School
- 50% of the classrooms at Wilmington Park Elementary School
- 0% of the classrooms at Broad Avenue Elementary School

Table 21
Number of Classrooms by School

Building	Permanent Classrooms (Total)	Modular Classrooms (Total)
Wilmington Park Elementary School	50	0
Broad Avenue Elementary School	28	14
Hawaiian Avenue Elementary School	28	8
Total	106	22

8.2.1 Window & Door Estimate

The elements of typical classroom treatments would include new windows and doors. For the purposes of this cost estimate, classrooms are being budget with four windows and one door per classroom. Material costs, labor, overhead and profit are estimated at $17,860 per classroom. The costs do not factor for lead paint or asbestos mitigation.

8.2.2 HVAC Cost Estimate

The estimated cost for the wall-mounted heat pumps is $17,000 including material, labor and profit. The mini-split solutions are budgeted at $17,700 plus an additional $5,000 per classroom to infill and patch the prior location of the thru-wall mounted unit. This would be a total of cost of $22,700 per classroom. For the purposes of this study an average HVAC system cost of $19,850 is assumed for each classroom. Cost does not factor for lead paint or asbestos mitigation.

Section 2.2 summarizes the existing HVAC at each of the three schools. The classroom buildings (Structures A, B & C) at Wilmington Park Elementary School have a mix of roof top units, ductless splits and exterior/interior thru-wall units. For the purposes of this study, it is assumed that 50% of all units will be replaced. The classroom buildings (Structure C) at Broad Avenue Elementary School have roof tops units. For the purposes of this study, it is assumed that none (0%) of the units will be replaced. The classroom buildings (Structures B & C) at Hawaiian Avenue Elementary School have exterior thru-wall units. For the cost estimates it is assumed that 100% of all units will be replaced.

The estimated treatment costs for the schools are summarized in Table 22.

Table 22
Summary of Treatments Costs – (Schools)

Treatment	Cost per Classroom	No. of Classrooms	Total Budget
Windows	$15,360	106	$1,628,160
Doors	$2,500	106	$265,000
HVAC (Average System Cost)	$19,850	53	$1,052,050
		Subtotal	$2,945,210
		Total Cost (including 15% contingency)	$3,386,990
		Subtotal (Wilmington Park Elementary School)	$1,597,640
		Subtotal (Broad Avenue Elementary School)	$575,090
		Subtotal (Hawaiian Avenue Elementary School)	$1,214,260
		Average Treatment Cost per Classroom (All Schools)	$31,950

The recommended treatment for the schools using Treatment Strategy #2 is estimated to cost almost $3.4 million dollars and averaging $31,950 per classroom based on treating 106 classrooms. Some classrooms will require new HVAC systems. The cost is split as follows:

- $1,597,640 for 50 permanent classrooms at Wilmington Park Elementary School - assumes 50% replacement of HVAC units (25 classrooms).
- $575,090 for 28 permanent classrooms at Broad Avenue Elementary School - assumes 0% replacement of HVAC units (0 classrooms).
- $1,214,260 for 28 permanent classrooms at Hawaiian Avenue Elementary School - assumes 100% replacement of HVAC units (28 classrooms).

These budgets do not cover consulting fees which could add 20 to 30 percent to the overall cost if the program utilizes a traditional design, bid, build approach. Other factors that will impact budgets are as follows:

- **Escalation -** The longer the program's duration the more important it will be to factor for inflation.
- **Procurement Methodology –** Costs can be lowered if treatments can be performed as part of LAUSD maintenance.
- **Environmental Mitigation -** It is not known at this time whether or not schools have existing lead paint or asbestos.

8.3 Residences (Impacted)

It is our recommendation to benchmark the grant amount for each home in the impacted area at the average cost of improvements for the LA County Energy Upgrade California program. Note the average cost of improvements for the LA County Energy program is $7,000 per home. The benefit of this approach is that costs are fixed. No other contingencies need to be factored.

The approximate number of residences that are impacted is estimated at around 1,200 units. The exact number will have to be quantified as part of a future property survey. This would be put the mitigation costs for the impacted residences at around $12 million dollars. The total mitigation costs based on the estimated residences in the impacted zone are summarized in Table 23.

Table 23
Summary of Treatments Costs – (Impacted Residences)

Treatment	Cost per Grant	No. of Units	Total Budget
Homeowner Grants	$7,000	1,200	$8,400,000

Appendix A – Database of Highly-Impacted Residential

BROAD AVENUE/OCEANSIDE STREET STUDY AREA (HIGHLY IMPACTED RESIDENTIAL - 74 UNITS)

	Address	Street Name		Type		Height	Style	
1	24700	Seagrove	Avenue	Single-Family	1	Two Story	Ranch Style	Good Condition
2	837	246th	Street	Single-Family	1	Two Story	Ranch Style	Good Condition
3	833	246th	Street	Single-Family	1	Two Story	Ranch Style	Good Condition
4	829	246th	Street	Single-Family	1	Two Story	Ranch Style	Good Condition
5	823	246th	Street	Single-Family	1	Two Story	Ranch Style	Good Condition
6	819	246th	Street	Single-Family	1	Two Story	Ranch Style	Good Condition
7	813	246th	Street	Single-Family	1	Two Story	Ranch Style	Good Condition
8	809	246th	Street	Single-Family	1	Two Story	Ranch Style	Good Condition
9	803	246th	Street	Single-Family	1	Two Story	Ranch Style	Good Condition
10	777	246th	Street	Single-Family	1	Two Story	Ranch Style	Good Condition
11	771	246th	Street	Single-Family	1	Two Story	Ranch Style	Good Condition
12	767	246th	Street	Single-Family	1	Two Story	Ranch Style	Good Condition
13	763	246th	Street	Single-Family	1	Two Story	Ranch Style	Good Condition
14	757	246th	Street	Single-Family	1	Two Story	Ranch Style	Good Condition
15	753	246th	Street	Single-Family	1	Two Story	Ranch Style	Good Condition
16	747	246th	Street	Single-Family	1	Two Story	Ranch Style	Good Condition
					16			
1	806	Oceanside	Street	Single-Family	1	Single Story	Ranch Style	Good Condition
2	810	Oceanside	Street	Single-Family	1	Single Story	Ranch Style	Good Condition
3	816	Oceanside	Street	Single-Family	1	Single Story	Ranch Style	Good Condition
4	820	Oceanside	Street	Single-Family	1	Single Story	Ranch Style	Good Condition
5	826	Oceanside	Street	Single-Family	1	Single Story	Ranch Style	Good Condition
6	830	Oceanside	Street	Single-Family	1	Single Story	Ranch Style	Good Condition
7	836	Oceanside	Street	Single-Family	1	Single Story	Ranch Style	Good Condition
8	840	Oceanside	Street	Single-Family	1	Single Story	Ranch Style	Good Condition
9	846	Oceanside	Street	Single-Family	1	Single Story	Ranch Style	Good Condition
10	850	Oceanside	Street	Single-Family	1	Single Story	Ranch Style	Good Condition
11	856	Oceanside	Street	Single-Family	1	Single Story	Ranch Style	Good Condition
12	860	Oceanside	Street	Single-Family	1	Single Story	Ranch Style	Good Condition
13	866	Oceanside	Street	Single-Family	1	Single Story	Ranch Style	Good Condition
14	870	Oceanside	Street	Single-Family	1	Single Story	Ranch Style	Good Condition

15	876	Oceanside	Street	Single-Family	1	Single Story	Ranch Style	Good Condition
16	880	Oceanside	Street	Single-Family	1	Single Story	Ranch Style	Good Condition
17	886	Oceanside	Street	Single-Family	1	Single Story	Ranch Style	Good Condition
18	890	Oceanside	Street	Single-Family	1	Single Story	Ranch Style	Good Condition
19	894	Oceanside	Street	Single-Family	1	Single Story	Ranch Style	Good Condition
20	24468	Seagrove	Street	Single-Family	1	Single Story	Ranch Style	Good Condition
21	24462	Seagrove	Street	Single-Family	1	Single Story	Ranch Style	Good Condition
					21			
1	24512	Lakme	Avenue	Single-Family	1	Single Story	Ranch Style	Good Condition
2	24506	Lakme	Avenue	Triplex	3	Single Story	Ranch Style	Good Condition
3	24503/24505	Lakme	Avenue	Duplex	2	Single Story	Ranch Style	Good Condition
4	24507	Lakme	Avenue	Single-Family	1	Single Story	Ranch Style	Good Condition
5	24402	Lakme	Avenue	Single-Family	1	Single Story	Spanish Style	Good Condition
6	24401	Lakme	Avenue	Duplex	2	Single Story	Ranch Style	Good Condition
7	24405	Lakme	Avenue	Single-Family	1	Single Story	Spanish Style	Good Condition
					11			
1	24420	Broad	Avenue	Single-Family	1	Single Story	Ranch Style	Good Condition
2	24416	Broad	Avenue	Single-Family	1	Single Story	Ranch Style	Good Condition
3	24412	Broad	Avenue	Single-Family	1	Single Story	Ranch Style	Good Condition
4	24411	Broad	Avenue	Single-Family	1	Single Story	Spanish Style	Good Condition
5	24407	Broad	Avenue	Duplex	2	Single Story	Ranch Style	Good Condition
6	24417	Broad	Avenue	Single-Family	1	Single Story	Spanish Style	Good Condition
					7			
1	24414	Albatross	Avenue	Single-Family	1	Single Story	Ranch Style	Good Condition
2	24408	Albatross	Avenue	Single-Family	1	Single Story	Ranch Style	Good Condition
3	24404	Albatross	Avenue	Single-Family	1	Single Story	Ranch Style	Good Condition
4	24405	Albatross	Avenue	Single-Family	1	Single Story	Ranch Style	Good Condition
5	24406	Albatross	Avenue	Single-Family	1	Single Story	Ranch Style	Good Condition
6	24407	Albatross	Avenue	Single-Family	1	Single Story	Ranch Style	Good Condition
					6			

1	24401	S Avalon	Avenue	Duplex	2	Single Story	Ranch Style	Good Condition
2	24411	S Avalon	Avenue	Duplex	2	Single Story	Ranch Style	Good Condition
3	24412	S Avalon	Avenue	Single-Family	1	Single Story	Ranch Style	Good Condition
4	24415	S Avalon	Avenue	Eight Units	8	Two Story	Ranch Style	Good Condition
					13			

HYATT AVENUE/ALAMEDA STREET STUDY AREA (HIGHLY IMPACTED RESIDENTIAL - 184 UNITS)

	Address	Street Name		Type		Height	Style	
1	1302	Hyatt	Avenue	Single-Family	1	Single Story	Ranch Style	Good Condition
1	1306A-D	Hyatt	Avenue	Multi-Family	4	Single Story	Ranch Style	Good Condition
2	1310 / 1310.5	Hyatt	Avenue	Duplex	2	Two Story	Ranch Style	Good Condition
3	1312 / 1314	Hyatt	Avenue	Duplex	2	Single Story	Ranch Style	Good Condition
4	1320 / 1322	Hyatt	Avenue	Duplex	2	Two Story	Ranch Style	Good Condition
5	1328	Hyatt	Avenue	Single-Family	1	Single Story	Ranch Style	Good Condition
6	1330	Hyatt	Avenue	Single-Family	1	Single Story	Ranch Style	Good Condition
7	1332	Hyatt	Avenue	Single-Family	1	Single Story	Ranch Style	Good Condition
8	1340	Hyatt	Avenue	Single-Family	1	Single Story	Ranch Style	Good Condition
9	1348	Hyatt	Avenue	Single-Family	1	Single Story	Ranch Style	Good Condition
10	1352	Hyatt	Avenue	Single-Family	1	Single Story	Ranch Style	Good Condition
11	1356	Hyatt	Avenue	Single-Family	1	Single Story	Ranch Style	Good Condition
12	1360	Hyatt	Avenue	Duplex	2	Single Story	Ranch Style	Good Condition
13	1366	Hyatt	Avenue	Duplex	2	Single Story	Ranch Style	Good Condition
14	1278/ 1280	Hyatt	Avenue	Duplex	2	Single Story	Ranch Style	Good Condition
15	1272 A-B	Hyatt	Avenue	Duplex	2	Two Story	Ranch Style	Good Condition
16	1264 A-B	Hyatt	Avenue	Duplex	2	Single Story	Ranch Style	Good Condition
17	1262 A-B	Hyatt	Avenue	Duplex	2	Two Story	Ranch Style	Good Condition
18	1260	Hyatt	Avenue	Single-Family	1	Single Story	Ranch Style	Good Condition
19	1254	Hyatt	Avenue	Single-Family	1	Single Story	Ranch Style	Good Condition
20	1248	Hyatt	Avenue	Single-Family	1	Single Story	Ranch Style	Good Condition
21	1240	Hyatt	Avenue	Single-Family	1	Single Story	Ranch Style	Good Condition
22	1238	Hyatt	Avenue	Single-Family	1	Two Story	Apartment	Good Condition
23	1236	Hyatt	Avenue	Single-Family	1	Single Story	Ranch Style	Good Condition
24	1228 / 1230	Hyatt	Avenue	Duplex	2	Single Story	Ranch Style	Good Condition

25	1226	Hyatt	Avenue	Single-Family	1	Two Story	Ranch Style	Good Condition
26	1222	Hyatt	Avenue	Single-Family	1	Single Story	Ranch Style	Good Condition
27	1216	Hyatt	Avenue	Single-Family	1	Single Story	Ranch Style	Good Condition
28	1207	Hyatt	Avenue	Single-Family	1	Single Story	Ranch Style	Good Condition
29	1204	Hyatt	Avenue	Single-Family	1	Two Story	Spanish Style	Good Condition
30	1203	Hyatt	Avenue	Single-Family	1	Single Story	Ranch Style	Good Condition
31	1202	Hyatt	Avenue	Single-Family	1	Two Story	Spanish Style	Good Condition
32	1156	Hyatt	Avenue	Single-Family	1	Two Story	Spanish Style	Good Condition
33	1152	Hyatt	Avenue	Single-Family	1	Single Story	Ranch Style	Good Condition
34	1148	Hyatt	Avenue	Single-Family	1	Two Story	Spanish Style	Good Condition
35	1144	Hyatt	Avenue	Single-Family	1	Two Story	Spanish Style	Good Condition
36	1138	Hyatt	Avenue	Single-Family	1	Single Story	Ranch Style	Good Condition
37	1134	Hyatt	Avenue	Single-Family	1	Two Story	Spanish Style	Good Condition
38	1128	Hyatt	Avenue	Single-Family	1	Two Story	Spanish Style	Good Condition
39	1124	Hyatt	Avenue	Single-Family	1	Single Story	Ranch Style	Good Condition
40	1120	Hyatt	Avenue	Single-Family	1	Two Story	Spanish Style	Good Condition
41	1114	Hyatt	Avenue	Single-Family	1	Single Story	Ranch Style	Good Condition
42	1110	Hyatt	Avenue	Single-Family	1	Two Story	Spanish Style	Good Condition
43	1102	Hyatt	Avenue	Single-Family	1	Two Story	Spanish Style	Good Condition
44	1064	Hyatt	Avenue	Single-Family	1	Single Story	Ranch Style	Good Condition
45	1060	Hyatt	Avenue	Single-Family	1	Single Story	Ranch Style	Good Condition
46	1056	Hyatt	Avenue	Single-Family	1	Two Story	Spanish Style	Good Condition
47	1050	Hyatt	Avenue	Single-Family	1	Two Story	Spanish Style	Good Condition
48	1046	Hyatt	Avenue	Single-Family	1	Two Story	Spanish Style	Good Condition
49	1042	Hyatt	Avenue	Single-Family	1	Two Story	Spanish Style	Good Condition
					63			
1	1165	McFarland	Avenue	Single-Family	1	Two Story	Spanish Style	Good Condition
2	1163	McFarland	Avenue	Single-Family	1	Two Story	Spanish Style	Good Condition
3	1159	McFarland	Avenue	Single-Family	1	Two Story	Spanish Style	Good Condition
4	1157	McFarland	Avenue	Single-Family	1	Two Story	Spanish Style	Good Condition
5	1153	McFarland	Avenue	Single-Family	1	Two Story	Spanish Style	Good Condition
6	1151	McFarland	Avenue	Single-Family	1	Two Story	Spanish Style	Good Condition
7	1147	McFarland	Avenue	Single-Family	1	Two Story	Spanish Style	Good Condition

8	1145	McFarland	Avenue	Single-Family	1	Two Story	Spanish Style	Good Condition
9	1141	McFarland	Avenue	Single-Family	1	Two Story	Spanish Style	Good Condition
10	1139	McFarland	Avenue	Single-Family	1	Two Story	Spanish Style	Good Condition
11	1129	McFarland	Avenue	Single-Family	1	Two Story	Spanish Style	Good Condition
12	1127	McFarland	Avenue	Single-Family	1	Two Story	Spanish Style	Good Condition
13	1121	McFarland	Avenue	Single-Family	1	Single Story	Ranch Style	Good Condition
14	1117	McFarland	Avenue	Single-Family	1	Single Story	Ranch Style	Good Condition
15	1113	McFarland	Avenue	Single-Family	1	Single Story	Ranch Style	Good Condition
16	1107	McFarland	Avenue	Single-Family	1	Single Story	Ranch Style	Good Condition
17	1103	McFarland	Avenue	Single-Family	1	Single Story	Ranch Style	Good Condition
18	1059	McFarland	Avenue	Single-Family	1	Single Story	Ranch Style	Good Condition
19	1051	McFarland	Avenue	Single-Family	1	Single Story	Ranch Style	Good Condition
20	1065	McFarland	Avenue	Single-Family	1	Two Story	Spanish Style	Good Condition
21	1049	McFarland	Avenue	Single-Family	1	Two Story	Spanish Style	Good Condition
22	1047	McFarland	Avenue	Single-Family	1	Two Story	Spanish Style	Good Condition
23	1041	McFarland	Avenue	Single-Family	1	Two Story	Spanish Style	Good Condition
24	947/945	McFarland	Avenue	Duplex	2	Two Story	Spanish Style	Good Condition
25	943	McFarland	Avenue	Duplex	2	Two Story	Spanish Style	Good Condition
26	939/937	McFarland	Avenue	Duplex	2	Two Story	Ranch/ Apt	Good Condition
27	933	McFarland	Avenue	Duplex	2	Single Story	Ranch Style	Good Condition
28	927	McFarland	Avenue	Duplex	2	Single Story	Ranch Style	Good Condition
29	921	McFarland	Avenue	Single-Family	1	Single Story	Ranch Style	Good Condition
30	917	McFarland	Avenue	Duplex	2	Single Story	Ranch Style	Good Condition
31	913	McFarland	Avenue	Duplex	2	Two Story	Apartment	Good Condition
32	907	McFarland	Avenue	Duplex	2	Two Story	Apartment	Good Condition
33	903	McFarland	Avenue	Single-Family	1	Single Story	Ranch Style	Good Condition
34	833	McFarland	Avenue	Single-Family	1	Single Story	Ranch Style	Good Condition
					41			
1	1007	E Mauretania	Street	Single-Family	1	Single Story	Ranch Style	Good Condition
2	1006	E Mauretania	Street	Duplex	2	Single Story	Ranch Style	Good Condition
3	1003	E Mauretania	Street	Single-Family	1	Single Story	Ranch Style	Good Condition
4	1002	E Mauretania	Street	Duplex	2	Two-Story	Spanish Style	Good Condition
					6			

1	629	E M	Street	Single-Family	1	Two-Story	Spanish Style	Good Condition
2	914/912	E M	Street	Duplex	2	Single Story	Ranch Style	Good Condition
3	916	E M	Street	Triplex	3	Single Story	Ranch Style	Good Condition
4	924 A-B	E M	Street	Duplex	2	Single Story	Ranch Style	Good Condition
5	928 A-B	E M	Street	Duplex	2	Single Story	Ranch Style	Good Condition
6	1000	E M	Street	Single-Family	1	Single Story	Ranch Style	Good Condition
7	1004/1006	E M	Street	Duplex	2	Single Story	Ranch Style	Good Condition
8	1005/1007	E M	Street	Duplex	2	Single Story	Bungalow	Good Condition
9	1254	Sanford	Avenue	Duplex	2	Single Story	Bungalow	Good Condition
					17			
1	1622	E Robidoux	Street	Single-Family	1	Single Story	Bungalow	Good Condition
2	1623	E Robidoux	Street	Single-Family	1	Single Story	Bungalow	Good Condition
3	1626	E Robidoux	Street	Duplex	2	Single Story	Bungalow	Good Condition
					4			
1	1563	E L	Street	Single-Family	1	Single Story	Ranch Style	Good Condition
					1			
1	1539	E Young	Street	Triplex	3	Single Story	Ranch Style	Good Condition
2	1548	E Young	Street	Single-Family	1	Single Story	Ranch Style	Good Condition
3	1544	E Young	Street	Single-Family	1	Two Story	Bungalow	Good Condition
4	1538	E Young	Street	Duplex	2	Single Story	Bungalow	Good Condition
					7			
1	1541	E Denni	Street	Duplex	2	Single Story	Bungalow	Good Condition
2	1535	E Denni	Street	Duplex	2	Single Story	Bungalow	Good Condition
3	1531	E Denni	Street	Single Family	1	Single Story	Bungalow	Good Condition
4	1530	E Denni	Street	Triplex	3	Single Story	Bungalow	Good Condition
5	1526	E Denni	Street	Triplex	3	Single Story	Bungalow	Good Condition
					11			
1	1529	E Grant	Street	Single-Family	1	Single Story	Bungalow	Good Condition

2	1527	E Grant	Street	Single-Family	1	Single Story	Bungalow	Good Condition
3	1521	E Grant	Street	Single-Family	1	Single Story	Bungalow	Good Condition
4	1517	E Grant	Street	Single-Family	1	Two Story	Bungalow	Good Condition
					4			
1	1327	E Opp	Street	Duplex	2	Single Story	Ranch Style	Good Condition
2	1333	E Opp	Street	Duplex	2	Single Story	Ranch Style	Good Condition
3	1403	E Opp	Street	Single-Family	1	Single Story	Bungalow	Good Condition
4	1407	E Opp	Street	Single-Family	1	Single Story	Spanish	Good Condition
5	1411	E Opp	Street	Single-Family	1	Single Story	Spanish	Good Condition
6	1415	E Opp	Street	Duplex	2	Single Story	Bungalow	Good Condition
7	1419	E Opp	Street	Single-Family	1	Single Story	Ranch Style	Good Condition
8	1425	E Opp	Street	Single-Family	1	Single Story	Ranch Style	Good Condition
9	1427	E Opp	Street	Triplex	3	Single Story	Ranch Style	Good Condition
10	1431	E Opp	Street	Duplex	2	Single Story	Bungalow	Good Condition
					16			
1	1011	Blinn	Avenue	Single-Family	1	Single Story	Bungalow	Good Condition
2	1007	Blinn	Avenue	Single-Family	1	Single Story	Bungalow	Good Condition
					2			
1	943	Mahar	Avenue	Single-Family	1	Single Story	Ranch Style	Good Condition
2	925	Mahar	Avenue	Duplex	2	Single Story	Ranch Style	Good Condition
3	921	Mahar	Avenue	Single-Family	1	Single Story	Ranch Style	Good Condition
					4			
1	731	Watson	Avenue	Triplex	3	Single Story	Ranch Style	Good Condition
					3			
1	1219	E G	Street	Triplex	3	Single Story	Ranch Style	Good Condition
2	1215	E G	Street	Duplex	2	Single Story	Ranch Style	Good Condition
					5			

DRUMM AVE STUDY AREA (HIGHLY IMPACTED RESIDENTIAL - 21 UNITS)

	Address	Street Name		Type		Height	Style	
1	1630	E Sandison	Street	Multi-Family	4	Two Story	Apartment	Good Condition
2	1626	E Sandison	Street	Single Family	1	Single Story	Ranch Style	Good Condition
					5			
1	1623	E Cruces	Street	Duplex	2	Single Story	Ranch Style	Good Condition
2	1619	E Cruces	Street	Single Family	1	Single Story	Ranch Style	Good Condition
3	1614	E Cruces	Street	Single Family	1	Single Story	Ranch Style	Good Condition
4	1610	E Cruces	Street	Single Family	1	Single Story	Ranch Style	Good Condition
					5			
1	1559	E O	Street	Single Family	1	Single Story	Ranch Style	Good Condition
2	1555	E O	Street	Single Family	1	Single Story	Ranch Style	Good Condition
3	1542	E O	Street	Single Family	1	Single Story	Ranch Style	Good Condition
					3			
1	1535	E Colon	Street	Single-Family	1	Single Story	Bungalow	Good Condition
2	1520	E Colon	Street	Triplex	3	Single Story	Bungalow	Good Condition
					4			
1	1323	Drumm	Avenue	Duplex	2	Single Story	Bungalow	Good Condition
2	1343	Drumm	Avenue	Single-Family	1	Single Story	Bungalow	Good Condition
3	1351	Drumm	Avenue	Single-Family	1	Single Story	Bungalow	Good Condition
					4			