Department of Public Works and Highways
Metro Manila Urban Transport Integration Project
Phase I

Package 4
Marcos Highway

ANNEX 22

Environmental Management Plan for Control of Noise and Air Pollution for the Construction and Operational Phases

Submitted by

PARSONS BRINCKERHOFF in association with TCGI ENGINEERS

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1.0 INTRODUCTION

The Marcos Highway (Package 4) forms a minor component of the Master Plan developed under the 1999 Metro Manila Urban Transport Integration Study (MMUTIS) to achieve an improvement to the ambient air quality in Metro Manila. The proposed improvement includes widening the existing road utilizing its full right-of-way width of 50 meters. It will add one more lane over the two existing lanes in the northern approach, reconstruction of sidewalks, a median island with trees, a bike-lane, and plantings along the outer edge of the sidewalks.

The main construction activities for the Marcos Highway include: excavation and filling, utilities construction, grading and earth movement, roadway base construction; and paving and surface restoration.

The following Environmental Management Plan (EMP) identifies a series of noise and air pollution control measures that will be undertaken to minimize construction related noise and air pollution within construction areas, lay-down areas, and sensitive land uses adjacent to the construction site. It provides a description of the noise and air pollution monitoring programs to assess pollution levels during major construction stages, and to evaluate the effectiveness of the mitigation practices that will be used to minimize impacts; and it describes a field inspection program to verify the implementation of these measures.

While the most significant project impacts on nearby air and noise levels are related to the construction phase of the project, measures to reduce operational impacts are also addressed. Sections 2.0 to 4.0 describe noise pollution control measures, monitoring and field inspection programs; and sections 5.0 to 7.0 describe air and dust pollution control measures and monitoring programs. The estimate cost associated with the recommended mitigation measures can be found in Table 10. A summary of the mitigation measures are provided in Tables 4, 5, 6 and 7.
2.0 NOISE CONTROL PLAN – CONSTRUCTION PHASE

Temporary noise impacts may occur in the local area during project construction, as a consequence of a variety of construction activities, including clearing and grubbing, excavation, and other site preparation and construction work. In addition, noise levels would be anticipated to increase because of noise emitted from construction and delivery vehicles traveling to and from the construction site often through residential areas.

Construction noise sources include both stationary (e.g., compressors, pile drivers, power tools, etc.) and mobile (e.g., trucks, bulldozers, etc.) sources. The impact of these sources depends on their noise emissions levels and the number, location, and duration of their use during the construction period. Pile drivers generally emit the highest noise levels of any construction equipment. Noise levels in the vicinity of the construction site could increase over existing levels. This increase will vary depending on the existing environment. In environments that are dominated by high levels of road traffic noise construction noise would generally be limited to a modest increase over the existing noise.

2.1 Construction Phase Limits and Requirements

Construction noise is regulated by the NPCC Memorandum Circular Order No. 002 (May 12, 1980), which specifies emission standards for construction activities as seen in Table 1.

<table>
<thead>
<tr>
<th>Class of Activity</th>
<th>Maximum Noise Level</th>
<th>Allowable Working Hour</th>
<th>Areas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class 1</td>
<td>90 dBA</td>
<td>7:00 am – 7:00 pm</td>
<td>AA, A, B</td>
</tr>
<tr>
<td>Class 2</td>
<td>85 dBA</td>
<td>7:00 am – 7:00 pm</td>
<td>AA, A, B</td>
</tr>
<tr>
<td>Class 3–4</td>
<td>75 dBA</td>
<td>7:00 am – 9:00 pm</td>
<td>AA, A, B</td>
</tr>
</tbody>
</table>

Source: NPCC Memorandum Circular No. 002 (May 12, 1980)

Certain classifications of activity must meet specified noise emission standards. The four classes of activities are as follows:

Class 1 – work which requires pile drivers (excluding manual type), file extractors, riveting hammers, or combination thereof. This classification does not include work in which pile drivers are used in combination with earth augers.

Class 2 – work which requires rock drills or similar equipment like jack hammers or pavement breakers.

Class 3 – work which requires air compressor (limited to those compressors which use power other than electric motors with a rated output of 16 KW or more excludes air compressors powering rock drills, jack hammers and pavement breakers).

Class 4 – operation involving batching plant (limited to those with a mixer capacity of 0.5 or more cubic meters) and/or asphalt pants (limited to those with mixer capacity or 200 KG or more. Batchimg plants for the making of mortar are excluded.
Construction activities will be limited to the hours of 7:00 AM and 7:00 PM, for Class 1 and Class 2, and 7:00 AM and 9:00 PM, for Class 3 and Class 4. Construction material will be handled and transported in such a manner as not to create unnecessary noise. The construction contractor would be instructed to abide by these requirements. Based on the construction plan for Marcos Highway the project is classified as a Class 2 activity and all construction mitigation associated with the project will follow the applicable guidelines.

2.1.1 Noise Levels From Construction Equipment

Average noise levels for typical construction equipment, shown in Table 2, measured at 15 meters from the construction site, range from 76 dBA for generators and pumps to 89 dBA for asphalt spreaders to 101 dBA for pile drivers. The total hourly energy average dBA noise level, Leq (one-hour), at a distance of 15 meters from the construction site boundary, would be on the order of 85 dBA for all of the construction phases.
### Table 2

**CONSTRUCTION EQUIPMENT NOISE EMISSION LEVELS**

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Typical Noise Level (dBA) 15 m from source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Compressor</td>
<td>81</td>
</tr>
<tr>
<td>Backhoe</td>
<td>80</td>
</tr>
<tr>
<td>Ballast Equalizer</td>
<td>82</td>
</tr>
<tr>
<td>Ballast Tamper</td>
<td>83</td>
</tr>
<tr>
<td>Compactor</td>
<td>82</td>
</tr>
<tr>
<td>Concrete Mixer</td>
<td>85</td>
</tr>
<tr>
<td>Concrete Pump</td>
<td>82</td>
</tr>
<tr>
<td>Concrete Vibrator</td>
<td>76</td>
</tr>
<tr>
<td>Crane, Derrick</td>
<td>88</td>
</tr>
<tr>
<td>Crane, Mobile</td>
<td>83</td>
</tr>
<tr>
<td>Dozer</td>
<td>85</td>
</tr>
<tr>
<td>Generator</td>
<td>81</td>
</tr>
<tr>
<td>Grader</td>
<td>85</td>
</tr>
<tr>
<td>Impact Wrench</td>
<td>85</td>
</tr>
<tr>
<td>Jack Hammer</td>
<td>88</td>
</tr>
<tr>
<td>Loader</td>
<td>85</td>
</tr>
<tr>
<td>Paver</td>
<td>89</td>
</tr>
<tr>
<td>Pile Driver (Impact)</td>
<td>101</td>
</tr>
<tr>
<td>Sonic</td>
<td>96</td>
</tr>
<tr>
<td>Pneumatic Tool</td>
<td>85</td>
</tr>
<tr>
<td>Pump</td>
<td>76</td>
</tr>
<tr>
<td>Rail Saw</td>
<td>90</td>
</tr>
<tr>
<td>Rock Drill</td>
<td>98</td>
</tr>
<tr>
<td>Roller</td>
<td>74</td>
</tr>
<tr>
<td>Saw</td>
<td>76</td>
</tr>
<tr>
<td>Scarifier</td>
<td>83</td>
</tr>
<tr>
<td>Scraper</td>
<td>89</td>
</tr>
<tr>
<td>Shovel</td>
<td>82</td>
</tr>
<tr>
<td>Spike Driver</td>
<td>77</td>
</tr>
<tr>
<td>Tie Cutter</td>
<td>84</td>
</tr>
<tr>
<td>Tie Handler</td>
<td>80</td>
</tr>
<tr>
<td>Tie Inserter</td>
<td>85</td>
</tr>
<tr>
<td>Truck</td>
<td>88</td>
</tr>
</tbody>
</table>


Table 3 lists the construction equipment utilization and quantities associated with the Marcos Highway Project.
TABLE 3  
MARCOS HIGHWAY PROJECT  
CONSTRUCTION EQUIPMENT UTILIZATION

<table>
<thead>
<tr>
<th>Description/Capacity</th>
<th>Total Rqd.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete Mixer, 1 bagger</td>
<td>2</td>
</tr>
<tr>
<td>Concrete Mixer, 2 bagger</td>
<td>2</td>
</tr>
<tr>
<td>Transit Mixer, 6 cu.m. cap.</td>
<td>6</td>
</tr>
<tr>
<td>Bulldozer, from 101 to 150 Hp</td>
<td>2</td>
</tr>
<tr>
<td>Backhoe with Pavement Breaker</td>
<td>2</td>
</tr>
<tr>
<td>Motor Grader, exceeding 120 Hp</td>
<td>2</td>
</tr>
<tr>
<td>Wheel Loader, not exceeding 1.7 cu.m.</td>
<td>4</td>
</tr>
<tr>
<td>Concrete Vibrator</td>
<td>5</td>
</tr>
<tr>
<td>Concrete Saw</td>
<td>3</td>
</tr>
<tr>
<td>Pneumatic Breaker Hand held</td>
<td>2</td>
</tr>
<tr>
<td>Hydraulic Pavement Breaker, 55 kw.</td>
<td>2</td>
</tr>
<tr>
<td>Mobile compressor, with air tank, 250-600 cu.ft./min</td>
<td>2</td>
</tr>
<tr>
<td>Vibratory Plate Compactor, 12 Hp</td>
<td>4</td>
</tr>
<tr>
<td>Vibratory Roller, Self-propelled, 9-11 ton</td>
<td>4</td>
</tr>
<tr>
<td>Pneumatic Roller, Self-propelled, 12 - 16 ton</td>
<td>3</td>
</tr>
<tr>
<td>Pneumatic Roller, Self-propelled, exceeding 16 ton</td>
<td>2</td>
</tr>
<tr>
<td>Water tank truck, capacity 6 to 10 cu.m.</td>
<td>3</td>
</tr>
<tr>
<td>Service Pickup</td>
<td>5</td>
</tr>
<tr>
<td>Stake Truck, 4T - 7T capacity</td>
<td>3</td>
</tr>
<tr>
<td>Dump Truck, 12T - 18T capacity</td>
<td>15</td>
</tr>
<tr>
<td>Dump Truck, 19T and up capacity</td>
<td>10</td>
</tr>
<tr>
<td>Cranes, Crawler Mounted, Standard Boom, 25 tons capacity</td>
<td>4</td>
</tr>
<tr>
<td>Vibratory Pile Driver, Hydraulic Driven 45,000 kg-m.</td>
<td>4</td>
</tr>
</tbody>
</table>

2.2 Measures For Mitigation of Noise Impacts

2.2.1 Noise Reduction Materials And Equipment

A. Noise reduction materials may be new or used. Used materials shall be of a quality and condition to perform their designed function.

B. Noise reduction equipment and materials may include, but not be limited to:

1. Shields, shrouds, or intake and exhaust mufflers.

2. Noise-deadening material to line hoppers, conveyor transfer points, storage bins, or chutes.

3. Noise barriers using materials consistent with the Temporary Noise Barrier materials specified in section 2.2.2 of this document.

4. Noise curtains using materials consistent with the Noise Control Curtains materials specified in section 2.2.4 of this document.
C. All equipment with backup alarms operated during the hours of 10 PM to 7 AM by the Contractor, vendors, suppliers, and subcontractors on the construction site shall be equipped with either audible self-adjusting ambient-sensitive backup alarms or manually adjustable alarms. The ambient-sensitive alarms shall automatically adjust to a maximum of 5 dBA over the surrounding background noise levels. The manually adjustable alarms shall be set at the lowest setting required to be audible above the surrounding noise. Installation and use of the alarms shall be consistent with the performance requirements of the current revisions of Society of Automotive Engineering (SAE) J994, J1446, and OSHA regulations.

D. All equipment used on the construction site, including jackhammers and pavement breakers, shall have exhaust systems and mufflers that have been recommended by the manufacturer as having the lowest associated noise.

E. The local power grid shall be used wherever feasible to limit generator noise. No generators larger than 25 KVA shall be used and, where a generator is necessary, it shall have maximum noise muffling capability and meet the noise emission limits specified in Table 2.

2.2.2 Temporary Noise Barriers

A. Temporary barriers shall be constructed of 20 mm (3/4-inch) Medium Density Overlay (MDO) plywood sheeting, or other material of equivalent utility and appearance having a surface weight of 0.096 KN/m² (2 pounds per square foot or greater. The temporary noise barriers shall have a Sound Transmission Class of STC-30, or greater, based on certified sound transmission loss data taken according to ASTM Test Method E90.

B. The temporary barriers shall be lined on one side with glass fiber, mineral wool, or other similar noise curtain type noise-absorbing material at least 50 mm (2-inches) thick and have a Noise Reduction Coefficient rating of NRC-0.85, or greater, based on certified sound absorption coefficient data taken according to ASTM Test Method C423.

C. The materials used for temporary barriers shall be sufficient to last through the duration of construction for this Contract, and shall be maintained in good repair.

D. Construction Details

1. Barrier panels shall be attached to support frames constructed in sections to provide a moveable barrier utilizing the standard Temporary Precast Concrete Median Barrier (Jersey barrier) or other supports designed to withstand 130 Km/hr (80 mph) wind loads plus a 30 percent gust factor.

2. When barrier units are joined together, the mating surfaces of the barrier sides shall be flush with each other. Gaps between barrier units, and between the bottom edge of the barrier panels and the ground, shall be closed with material that will completely fill the gaps, and be dense enough to attenuate noise.
3. The barrier height shall be designed to break the line-of-sight and provide at least a 5 dBA insertion loss between the noise producing equipment and the upper-most story of the receptor(s) requiring noise mitigation. If for practicality or feasibility reasons, which are subject to the review and approval of the Engineer, a barrier can not be built to provide noise relief to all stories, then it must be built to the tallest achievable height.

F. Prefabricated acoustic barriers are available from various vendors.

2.2.3 Acoustical Barrier Enclosures

A. Materials

1. The acoustical barrier enclosure shall consist of durable, flexible composite material featuring a noise barrier layer bonded to sound-absorptive material on one side.

2. The noise barrier layer shall consist of rugged, impervious material with a surface weight of at least 0.048 KN/m² (one pound per square foot). The sound absorptive material shall include a protective face and be securely attached to one side of the flexible barrier over the entire face.

3. The acoustical material used shall be weather and abuse resistant, and exhibit superior hanging and tear strength during construction. The material shall have a minimum breaking strength of 21 N/mm (120 lb/in) per FTMS 191 A-M5102 and minimum tear strength of 5.25 N/mm (30 lb/in) per ASTM D117. Based on the same test procedures, the absorptive material facing shall have a minimum breaking strength of 17.5 N/mm (100 lb/in) and a minimum tear strength of 1.225 N/mm (7 lb/in).

4. The acoustical material shall be corrosion resistant to most acids, mild alkalies, road salts, oils, and grease.

5. The acoustical material shall be fire retardant and shall also be mildew resistant, vermin proof, and non-hygrosopic.

6. The acoustical material shall have a Sound Transmission Class of STC-25 or greater, based on certified sound transmission loss data taken according to ASTM Test Method E90. It shall also have a Noise Reduction Coefficient rating of NRC-0.70 or greater, based on certified sound absorption coefficient data taken according to ASTM Test Method C423.

7. The Contractor shall submit the name of the manufacturer, properties of the material to be furnished, and two 304.88 mm (one-foot square) samples to the Engineer for review.

- Construction Details
  - The acoustical barrier enclosure shall be designed to have three sides and a top in such as manner as to allow portable placement over a laborer using hand tools or stationary noise producing equipment.
  - The acoustical material shall be installed in vertical and horizontal segments with the vertical segments extending the full enclosure height. All seams and joints shall have a minimum overlap of 50 mm (2 inches) and be sealed using double grommets. Construction details shall be performed according to the manufacturer's recommendations.
- The Contractor shall be responsible for the design, detailing, and adequacy of the framework and supports, ties, attachment methods, and other appurtenances required for the proper construction of the acoustical barrier enclosure.
- The design and details for the acoustical noise barrier enclosure framework and supports shall be prepared and stamped by a Registered Professional Engineer.

2.2.4 Noise Control Curtains

A. Materials

1. The noise control curtain shall consist of durable, flexible composite material featuring a noise barrier layer bonded to sound-absorptive material on one side. The noise barrier layer shall consist of a rugged, impervious material with a surface weight of at least 0.048 KN/mm (one pound per square foot). The sound absorptive material shall include a protective face and be securely attached to one side of the flexible barrier over the entire face.

2. The noise curtain material used shall be weather and abuse resistant, and exhibit superior hanging and tear strength during construction. The curtains noise barrier layer material shall have a minimum breaking strength of 21 N/mm (120 lb/in) per FTMS 191 A-M5102 and minimum tear strength of 5.25 N/mm (30 lb/in) per ASTM D117. Based on the same test procedures, the noise curtain absorptive material facing shall have a minimum breaking strength of 17.5 N/mm (100 lb/in) and a minimum tear strength of 1.225 N/mm (7 lb/in).

3. The noise curtain material shall be corrosion resistant to most acids, mild alkalies, road salts, oils, and grease. It also shall be mildew resistant, vermin proof, and non-hygroscopic.

4. The noise curtain material shall be fire retardant.

5. The noise control curtain shall have a Sound Transmission Class of STC-30 or greater, based on certified sound transmission loss data taken according to ASTM Test Method E90. It shall also have a Noise Reduction Coefficient rating of NRC-0.85 or greater, based on certified sound absorption coefficient data taken according to ASTM Test Method C423.

6. The Contractor shall submit the name of the manufacturer, properties of the material to be furnished, and two 304.88 mm (one-foot square) samples to the Engineer for review.

B. Construction Details

1. The noise control curtains shall be designed in such a manner as to act as a noise barrier. The curtains shall be secured above, at the ground, and at intermediate points by framework and supports designed to withstand 130 Km/hr (80 mph) wind loads plus a 30 percent gust factor.
2. The curtains shall be installed in vertical and horizontal segments with the vertical segments extending the full curtain height to the ground. All seams and joints shall have a minimum overlap of 50 mm (2 inches) and be sealed using Velcro or double grommets spaced 304.80 mm (12 inches) on center. Curtains shall be fastened to framework and guardrails with wire cable 304.80 mm (12 inches) on center. Construction details shall be performed according to the manufacturer's recommendations.

3. The curtain height shall be designed to break the line-of-sight and provide at least a 5 dBA insertion loss between the noise producing equipment and the upper-most story of the receptor(s) requiring noise mitigation. If for practicality or feasibility reasons, which are subject to the review and approval of the Engineer, a curtain system cannot be built to provide noise relief to all stories, then it must be built to the tallest achievable height.

4. The Contractor shall be responsible for the design, detailing, and adequacy of the framework and supports, ties, attachment methods, and other appurtenances required for the proper installation of the noise control curtains.

5. The design and details for the noise control curtains framework and supports shall be prepared and stamped by a Registered Professional Engineer.
3.0 NOISE CONTROL PLAN – OPERATIONAL PHASE

During the operations phase noise impacts would be from increased road traffic as a result of the project. The increase in noise levels is estimated to be on the order of 3 dBA over the existing noise levels. The increase in not considered to be significant though the existing noise levels are already higher than levels specified in the NPCC standards.

3.1 Noise Barriers

Concrete fences around the perimeter of schools and residences affected by excessive noise can consist of concrete post and pre-fabricated concrete panels. The following are some practical design considerations:

- The barrier must break the line-of-sight between the effective noise source and the receiver and block all possible sound propagation paths from the source to the receiver.
- Open areas in the barrier should be avoided as they provide flanking paths for the sound to “short circuit” the barrier.
- The barrier must be constructed of a material that is sufficiently heavy to control the transmission of sound through the barrier. Any material that is sufficiently strong to withstand wind loads and provide structural support will also be sufficiently massive to control sound transmission through the barrier.
- Barriers must block both the direct path and any reflected paths between the source and the receiver.
- The most effective location for the barriers is either closest to the source or closest to the receiver.

3.2 Window Insulation

Institutional buildings such as churches with primarily daytime uses experience higher operational noise levels under the existing conditions and will continue to experience higher noise levels under the build conditions. The most effective acoustical treatment for such buildings is to caulk and seal gaps in the building envelope and to install new windows that are specially designed to meet acoustical transmission loss requirements. Such windows are usually made of multiple layers of glass, usually two layers. Depending on the quality of the original windows, such treatments can provide noise reductions of 5 to 20 decibels. These windows are usually non-operable so that the central ventilation or air conditioning is needed.

A summary of the noise mitigation measures for the construction and operation phases can be found in Table 4 and Table 5, respectively.
4.0 NOISE MONITORING PLAN

The noise monitoring and reporting procedure to be used during construction are described below. Noise generating equipment shall not be operated prior to acceptance of the Noise Monitoring Plan. The Noise Monitoring Plan shall identify and describe the following in detail:

- The receptor locations where noise monitoring will be performed are shown Figure 1.
- The type of noise level measurement equipment.
- The noise monitoring methods and procedures.
- The data reporting method.
- The response procedure and actions to be taken for any lot-line or equipment noise level that exceeds the noise limits specified by NPCC.
- The complaint response and resolution procedures.
Table 4 Mitigation Measures: Construction Phase Noise Levels

<table>
<thead>
<tr>
<th>Sensitive Receptors</th>
<th>Measures</th>
<th>Responsible Agency</th>
<th>Reference Section</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>School Zones</td>
<td>During school hours, work that involves Classes of Activity 1, 2 or 3 will be scheduled to minimize disturbance to school classes, and where possible, will be scheduled outside of school hours. In no case shall work that involves Classes of Activity 1 and 2 commence before 7 am or after 7 pm.</td>
<td>DPWH, Contractor</td>
<td>2.1</td>
<td>Included in the construction contract 10-15 dBA reduction</td>
</tr>
<tr>
<td></td>
<td>Enclosure of work area to contain noise.</td>
<td>Contractor</td>
<td>2.2, 2.2.3</td>
<td>Incluided in the construction contract 10-15 dBA reduction</td>
</tr>
<tr>
<td></td>
<td>Use of attenuators/silencers for construction equipment.</td>
<td>Contractor</td>
<td>-</td>
<td>5 – 10 dBA reduction</td>
</tr>
<tr>
<td>Church Zones</td>
<td>Coordination with administration on scheduling of work hours during non-worship hours/days</td>
<td>DPWH, Contractor</td>
<td>2.1</td>
<td>Included in the construction contract 10-15 dBA reduction</td>
</tr>
<tr>
<td></td>
<td>Enclosure of work area to contain noise.</td>
<td>Contractor</td>
<td>2.2, 2.2.3</td>
<td>Incluided in the construction contract 10-15 dBA reduction</td>
</tr>
<tr>
<td></td>
<td>Use of attenuators/silencers for construction equipment.</td>
<td>Contractor</td>
<td>-</td>
<td>5-10 dBA reduction</td>
</tr>
<tr>
<td>Residential Zones</td>
<td>Schedule of work hours during daytime only and minimizing construction activities at nighttime</td>
<td>DPWH, Contractor</td>
<td>2.1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Use of attenuators/silencers for construction equipment.</td>
<td>Contractor</td>
<td>-</td>
<td>5-10 dBA reduction</td>
</tr>
<tr>
<td></td>
<td>Enclosure of work area to contain noise.</td>
<td>Contractor</td>
<td>2.2, 2.2.3</td>
<td>Incluided in the construction contract 5-10 dBA reduction</td>
</tr>
<tr>
<td>Hospital Zones</td>
<td>Coordination with local officials prior to start of construction.</td>
<td>DPWH, Contractor</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

1 Associated mitigation costs can be found in Table 10 of Annex 22
2 AMA Computer School, Brgy San Roque, Marikina City – School hour is from 0700 to 2000 hours, Monday to Friday. The school has air-conditioned rooms.
3 Sto. Niño The Shepherd School, Brgy Calumpang, Marikina City – School hours from 0700 to 1600 hours, Monday to Friday.
4 San Benildo Integrated Elementary School, Brgy San Isidro, Cainta Rizal – School hours from 0730 to 1630 hours, Monday to Friday and the nearest building is located 3 – 10 meters from road ROW.
5 Sto. Niño de San Antonio Maternity and General Hospital, Brgy dela Paz, Pasig City – Hospital’s rooms are air-conditioned.
<table>
<thead>
<tr>
<th>Operation Stage</th>
<th>Measure</th>
<th>Responsible Agency</th>
<th>Reference Section</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>School Zones</td>
<td>Planting of trees/shrubs in front of school.</td>
<td>DPWH</td>
<td>-</td>
<td>Included in the design</td>
</tr>
<tr>
<td></td>
<td>Provision of concrete fence to serve as noise barrier</td>
<td>DPWH</td>
<td>-</td>
<td>Marginal reduction</td>
</tr>
<tr>
<td></td>
<td>Designation of speed limits and putting up of signages to avoid blowing of horns.</td>
<td>DPWH</td>
<td>3.1</td>
<td>Included in the design 5-7 dBA reduction</td>
</tr>
<tr>
<td>Church Zones</td>
<td>Provision of signages to avoid blowing of horns, jackrabbit start and engine revolution during church service and designation of speed limit</td>
<td>DPWH</td>
<td>-</td>
<td>Included in the design</td>
</tr>
<tr>
<td></td>
<td>Planting of trees within church periphery to serve as barriers.</td>
<td>DPWH</td>
<td>-</td>
<td>Included in the design</td>
</tr>
<tr>
<td>Residential Zones</td>
<td>Provision of trees along the road</td>
<td>DPWH</td>
<td>-</td>
<td>Included in the design</td>
</tr>
<tr>
<td></td>
<td>Provide buffer areas/sidewalk</td>
<td>DPWH</td>
<td>-</td>
<td>Included in the design</td>
</tr>
</tbody>
</table>

*Associated mitigation cost can be found in Table 10 of Annex 22*
4.1 Noise and Monitoring Methods and Procedures

A. All noise measurements shall be performed with an instrument that is in compliance with criteria for a Type 1 (Precision) or Type 2 (General Purpose) Sound Level Meter as defined in the current version ANSI Standard S1.4. A typical Sound Level Meter is shown below in Figure 2.

B. The sound level meter shall be capable of measuring A-weighted noise levels in dBA, and operating on the slow response setting.

C. Sound level meters shall be capable of measuring Leq noise metric over 20 minute intervals and displaying those results in the field without the need for post-processing of data.

D. All sound level meters, microphones, and calibrators shall undergo certified laboratory calibration conformance testing at least once a year. The calibration certificate shall be submitted for inspection.

E. The sound level meter shall be on-site and readily accessible at all times.

4.2 Noise Monitoring Methods And Procedures

A. The sound level meter and the acoustic calibrator shall be calibrated and certified annually by the manufacturer or other independent certified acoustical laboratory. The sound level meter shall be field calibrated using an acoustic calibrator, according to the manufacturer's specifications, prior to and after each measurement.

B. All measurements shall be performed using the A-weighting network and the slow response of the sound level meter.

C. The measurement microphone shall be fitted with an appropriate windscreen, shall be located 1524 mm (5 feet) above the ground, and shall be at least 1524 mm (5 feet) away from the nearest acoustically-reflective surface.
D. Noise monitoring shall not be performed during precipitation or when wind speeds are greater than 24 Km/hr (15 mph), unless the microphone is protected in such a manner as to negate the acoustic effects of rain and high winds.

4.3 Construction Noise Monitoring

- Noise level measurements shall be taken at each noise-sensitive location during ongoing construction activities at least once each week during the applicable daytime, evening, and nighttime period.
- The time period for each noise measurement shall be 20 minutes.
- Construction noise measurements shall coincide with daytime, evening, and nighttime periods of maximum noise-generating construction activity, and shall be performed during the construction phase or activity that has the greatest potential to exceed noise level limitations. Compliance noise measurements for the noise limits in Table 1 shall be performed at a point on a given lot line that is the closest to the construction activity.
- If, in the estimation of the person performing the measurements, outside sources contribute significantly to the measured noise level, the measurements shall be repeated with the same outside source contributions when construction is inactive to determine the ambient noise level contribution.

4.4 Noise Monitoring Data Reporting

A. Provide a sketch or diagram for the exact location of the noise measurement. Include the location and distance of the noise measurement in relationship to the noise monitoring location specified in Figure 1.

B. During construction and complaint response monitoring, all construction equipment operating during the monitoring period shall be identified and the location sketched. The sketch shall include the distance between the noise measurement location and the construction equipment.

C. All activities occurring while performing noise measurements shall be noted in the field notes log. For example, "auger banging on ground to clean soil from threads" or "heavy traffic passing near the sound level meter." In addition, any noise level of 85 dBA or greater requires an explanation.

4.5 Noise Complaint And Response Procedures

A. The objective of the complaint procedure is to ensure that public and agency complaints are addressed and resolved consistently and expeditiously.

B. If the Contractor receives a complaint regarding construction noise, the Contractor shall immediately notify the Engineer.

C. Upon receipt or notification of a noise complaint from the Engineer, the Contractor shall promptly perform noise measurements at the complainant's location during activities representative of the offending operation. The noise measurements shall be performed using equipment and methods as specified listed in section 2.2.1. The complaint response noise measurements shall be immediately submitted to the Engineer.
D. In the event that the measured noise level exceeds allowable limits as specified in Table 2, or is resulting in nuisance conditions, the Contractor shall immediately use noise reduction materials and methods such as, but not limited to, those described in section 2.2.1 to reduce noise levels or to alleviate the nuisance conditions.
5.0 AIR POLLUTION CONTROL PLAN – CONSTRUCTION PHASE

Due to construction activities that will occur near to sensitive land uses (e.g., residential areas, hospitals, and schools), the project will implement a series of measures to reduce dust levels near construction areas.

Air quality impacts from construction activities primarily occur as a result of fugitive dust impacts from earth excavation, grading and removal activities, the handling and transport of material, and emissions from the operation of heavy-duty diesel and gasoline construction equipment. This section specifies the measures that will be undertaken to reduce the amounts of dust, air pollution and odors generated during construction activities. The implementation of these measures will be the responsibility of the contractor.

5.1 Construction Site Dust Control

- Wet suppression, which consists of the application of water or a wetting agent in solution with water, shall be used to provide temporary control of dust. Several applications per day may be necessary to control dust, depending upon meteorological conditions and work activity. Wet suppression equipment shall consist of sprinkler pipelines, tanks, tank trucks, or other devices capable of providing regulated flow, uniform spray, and positive shut-off. The Contractor shall apply wet suppression on a routine basis as necessary to control dust.

- Wind screens and/or wind barriers will be provided in locations where they would be effective in minimizing wind erosion and the spread of dust. The Contractor shall keep wind-screens and/or barriers in good repair for the life of the Contract.

5.2 Public Roadway Dust Control

- Vehicles leaving the construction site shall be washed to remove mud and dirt on the vehicle body or wheels. Temporary wheel-wash stations shall be provided. These stations will consist of a metal grid on a frame where a truck wheels can be washed with a high-pressure hose. The use of crushed stones at construction egress areas can be considered as an adequate alternative to minimize dirt tracking if the logistics of installing wheel wash stations at a specific site prove to be impractical.

- Haul truck cargos during material transport on public roadways shall be covered and secured.

- Vehicle mud and dirt carryout, material spills, and soil wash-out onto public roadways and walkways and other paved areas shall be cleaned up immediately.

The Contractor will be responsible for clean-up of public roadways and walkways affected by Work of this Contract.
5.3 Control of Earthwork Dust

- During batch drop operations (i.e., earthwork with front-end loader, clamshell bucket, or backhoe), the free drop height of excavated or aggregate material shall be reduced, as practical, to minimize the generation of dust.
- To prevent spills during transport, freeboard space shall be maintained between the material load and the top of the truck cargo bed rail.

5.4 Control of Stockpile Dust

- Wet suppression shall be used on active stockpiles to minimize wind erosion, and to minimize dust generation during stockpile load-in, load-out, and maintenance activities.
- If the above methods are not sufficient, stockpiles shall be covered with polyethylene sheeting, and secured with sandbags or an equivalent method to prevent the cover from being dislodged by the wind.

5.5 Control Black Smoke and Nuisance Odors from Diesel Equipment.

- Diesel combustion engines on construction equipment and on dump trucks that are idling while waiting to load or unload material for 5 minutes or more shall be turned off when not in active use.
- Staging zones for trucks that are waiting to load or unload material, and combustion engines such as generators or stationed equipment at the contract areas shall be established in locations where the diesel emissions from the trucks will not be adjacent to public areas such as schools, hospitals and places where the public frequently gathers.
- Truck and traffic circulation routes that minimize interference with abutters, and that are clearly marked by signs in the project area shall be designated.
- Motor-vehicles and diesel equipment shall be properly maintained to minimize excessive exhaust smoke.

5.6 Control of Odors from Excavation.

The following methods should be used by the Contractor to control nuisance odors associated with earthwork excavation where soil composition can result in the release of unpleasant odors.

- Site drainage shall be improved, to the extent practical, standing water in excavated areas shall be minimized, and collected groundwater shall be pumped to sump locations.
- The amount of time that excavated material is exposed to the open atmosphere shall be minimized.
- Excavated and stockpile areas shall be chemically treated, if necessary, with odor suppression materials. Potassium peroxymonosulfate could be utilized in a 5%
solution to treat water control sumps, sedimentation tanks, and/or excavated areas that generate odors.

- The construction site shall be free of trash, garbage, and debris to the extent practically, and excavated material that is deemed odorous shall be cleaned-up and properly disposed.

5.7 Traffic Management

The contractor in coordination with DPWH will prepare a traffic management plan for each one of the eight phases of the project. The plan shall include:

- A provision to keep a minimum of three lanes open to general traffic during the full construction process.
- A provision to allow for bicycle traffic to operate in a safe manner
- A signalization system that will assist the public to clearly identify detours, lanes changes, and closing of road segments.
6.0 AIR POLLUTION CONTROL PLAN – OPERATIONAL PHASE

The measures incorporated into the design and BID documents for the project include:

- Planting of trees as buffers to the residential areas on the median strip and sidewalks.
- Signage for the designation of speed limits to reduce excessive pollution associated with hard accelerations.

These measures will be the responsibility of the Contractor and DPWH.

Measures that are not specifically related to this package but are part of the MMUTIS include:

- The implementation of a Transportation Demand Management Plan, e.g. color coding schemes.
- The implementation of the vehicle inspection and maintenance program.

These measures are not the responsibility of the Contractor and its implementation pertains to DPWH and DENR.

A summary of the air quality mitigation measures for the construction and operation phases can be found in Table 6 and Table 7, respectively.
7.0 AIR POLLUTION MONITORING PLAN

The purpose of the monitoring and inspection programs will be to assess the pollutant levels during major construction stages, and to evaluate the effectiveness of the mitigation practices that will be used to minimize impacts. The monitoring program would utilize portable monitors located in areas where the general public may be exposed. It will be designed to determine, through measured data, air quality levels at the locations where high levels are anticipated before and during major construction activities. The program shall extend through the first year of project operation (i.e., after construction activities are finished).

The responsibility of this program is assigned to a specific Contractor supervised by the DPWH.

7.1 Pollutants of Concern

Of the seven pollutants for which National Ambient air Quality Guideline Values exist, TSP and PM$_{10}$ are the ones whose levels will be most affected by the anticipated construction activities. Elevated TSP and PM$_{10}$ levels in the vicinity of construction areas generally result from fugitive dust released from excavation, grading, and removal activities, and from the handling and transport of material. The impacts of CO emitted from construction equipment on the other hand, will probably be small compared to the emissions from the 74,000 vehicles per day currently using the project area, and increases to ambient CO levels in the project area during construction activities should not be significant.

Fugitive dust in a coastal environment, such as the Manila Metropolitan area, contains soil and sea salt elements. It usually is generated through mechanical processes associated with excavation, demolition, and grinding activities, wind erosion, and the re-suspension of dust particles by wind and/or vehicle movement.

Even though the 24 hour Air Quality Guideline for TSP (230 µg/m$^3$), which include large and small particles (25-50 microns) may be exceeded during construction activities, the smaller particles that constitute PM$_{10}$ (smaller than 10 microns) are of greatest health concern, since they can penetrate into sensitive regions of the respiratory tract. High levels of PM$_{10}$ can be found in urban areas close to large areas of disturbed or exposed soils and/or heavy construction activities. Controlling the sources of fugitive dust from construction activities has proved to significantly reduce PM$_{10}$ levels in these areas.

As a consequence, the construction phase monitoring program will focus only on PM$_{10}$. Currently, the provisional limit promulgated in the Philippine Clean Air act for PM$_{10}$ is 150 µg/m$^3$ for 24-hours. A comparison of recorded PM$_{10}$ levels with the 24-hour limit of 150 µg/m$^3$ should be used to guide the application of mitigation measures to minimize dust impacts near construction sites.
### Table 6- Mitigation Measures: Construction Phase Air Pollution*

<table>
<thead>
<tr>
<th>Sensitive Receptors</th>
<th>Measure</th>
<th>Responsible Agency</th>
</tr>
</thead>
<tbody>
<tr>
<td>School, Hospital, and Residential Zones</td>
<td>Regular application of water to prevent re-suspension of dust particulates in construction areas, stockpiles, and public roads.</td>
<td>DPWH, Contractor</td>
</tr>
<tr>
<td></td>
<td>Use of wind-screens to control wind erosion and dust as necessary.</td>
<td>Contractor</td>
</tr>
<tr>
<td></td>
<td>Installation of temporary wheel wash stations to remove mud from vehicles underbody and wheels before exiting construction areas.</td>
<td>Contractor</td>
</tr>
<tr>
<td></td>
<td>Daily hauling of spoils to avoid accumulation of loose soil that may re-suspend during dry weather conditions.</td>
<td>Contractor</td>
</tr>
<tr>
<td></td>
<td>Coverage with tarps or screens of all haul truck cargos before exiting construction areas.</td>
<td>Contractor</td>
</tr>
<tr>
<td></td>
<td>Removal and immediate clean up of all loose material from public roadways.</td>
<td>Contractor</td>
</tr>
<tr>
<td></td>
<td>Limit idling time of construction vehicles when not in active use.</td>
<td>DPWH, Contractor</td>
</tr>
<tr>
<td></td>
<td>Creation of staging zones for truck loading and unloading away from sensitive areas.</td>
<td>DPWH, Contractor</td>
</tr>
<tr>
<td></td>
<td>Creation of a traffic management plan that will maintain three lanes of traffic open to the public, and allow for the safe circulation of bicycle traffic, including proper signalization of lane changes, detours, and truck operating areas.</td>
<td>DPWH, Contractor</td>
</tr>
<tr>
<td></td>
<td>Maintain proper drainage to reduce standing water.</td>
<td>Contractor</td>
</tr>
<tr>
<td></td>
<td>Removal and/or treatment of material that could generate unpleasant odors.</td>
<td>Contractor</td>
</tr>
</tbody>
</table>

*Associated mitigation cost can be found in Table 10 of Annex 22
<table>
<thead>
<tr>
<th>Sensitive Receptors</th>
<th>Measure</th>
<th>Responsible Agency</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>School, Hospital, and Residential Zones</td>
<td>Planting of trees in median strip and sidewalks to serve as buffers.</td>
<td>DWPH</td>
<td>Included in the design</td>
</tr>
<tr>
<td></td>
<td>Designation of standard speed limits to decrease levels of pollutant emissions from motor vehicles</td>
<td>DPWH</td>
<td>Included in the design</td>
</tr>
<tr>
<td></td>
<td>Transportation Demand Management (TDM) measures, eg. color-coding scheme</td>
<td>MMDA</td>
<td>Not part of scope of work of detailed design.</td>
</tr>
<tr>
<td></td>
<td>Strict implementation of vehicle inspection and maintenance program.</td>
<td>MMDA, LTO</td>
<td>Not part of scope of work of detailed design.</td>
</tr>
</tbody>
</table>

*Associated mitigation cost can be found in Table 10 of Annex 22*
7.2 Plan Concept

The proposed monitoring program was developed to provide adequate coverage of the study area, and was based on the construction activities to be performed and their proximity to sensitive land uses. However, the input of the project proponents, DPWH, and DENR agencies are required before this program can be implemented.

The following are the major aspects of this program:

- The program shall measure daily (24-hour) PM$_{10}$ levels near major construction activities twice a week during the dry season (between the months of December and April). The dry-season is when the highest levels are expected to occur, since wet weather conditions are not conducive to dust generation.
- Measurements shall be taken before large-scale construction activities begin, twice a week for two months during the dry-season to establish baseline conditions. These baseline values will be used to estimate project impacts.
- Measurements shall be performed using portable MiniVOL air samplers. This type of battery-operated equipment has been used by several large-scale projects in the US and in several developing countries over the past several years with very good results. These devices are easy to deploy, since the monitors could be hung from lampposts (or any vertical pole), and have minimum space requirements. One technician could operate and maintain several units simultaneously, and also be responsible for both field and laboratory operations.

7.3 Site Selection

The following criteria shall be used to determine the locations and duration of monitoring activities:

- Schedule (both calendar and daily hours) of major construction activities;
- Types of construction activities that will be undertaken;
- Location of work areas relative to sensitive land uses (i.e., residences, hospitals, schools, and/or areas where the public congregates on a regular basis);
- Types and quantities of construction equipment that will be used during peak construction periods; and
- The estimated number of daily truck trips to and from the work areas.

PM$_{10}$ monitoring sites shall be located in the vicinity of the work areas with the greatest potential impacts at nearby sensitive land uses. Actual sites shall be selected based on a review of the construction sequences for the different contracts that will be performed during a monitoring season. In general, selected monitoring sites shall be located within 10 to 100 meters of construction areas. Site locations should be adjusted as construction activities change and/or are relocated.
7.4 Pre-construction Levels

In order to more accurately estimate project impacts, background levels shall be established. As such, 5 monitoring sites shall be selected for this purpose. These sites should be located outside proposed construction areas. These data shall be used to provide PM$_{10}$ levels at common locations prior and during construction activities.

Recommended sites include locations at the Doña Juana or Doña Aurora Executive Villages; Imelda Ave Intersection; Sto. Niño Hospital; AMA Computer college; and Town & Country or Vermont Executive Villages.

In addition, one site shall be established to provide overall background levels for the project area. This site shall operate prior and during construction activities, and be far enough from construction areas to provide levels that are not directly impacted by construction activities. As significant PM$_{10}$ impacts from construction activities are usually limited to within 200 meters of the emission sources, this site should not only be at least 200 meters from construction zones, and also far away from highways and/or heavily traveled streets (i.e., other potential sources of PM$_{10}$).

The duration of the pre-construction monitoring program should be at least two months during the dry season prior to the beginning of construction activities.

7.5 Monitoring Duration and Schedule

The proposed monitoring period, schedule, and frequency are as follows:

- PM$_{10}$ samples shall be collected twice a week (on working weekdays) on a rotating basis during periods of major construction activities between the months of December and April (dry season).
- The minimum monitoring duration at each site shall be at least three weeks in order to capture construction effects under different meteorological conditions.
- Field inspections of the equipment set-up, filter and battery shall be conducted three times a week and during equipment breakdowns.
- PM$_{10}$ monitoring shall be performed mid-night to mid-night.

The number of monitors to be deployed at any one time will depend on the level of construction activities. Based on the activities and schedule for each one of the eight construction segments (phases), it is expected that the number of simultaneous monitoring sites needed to provide adequate coverage will be between four and six per monitoring season.
7.6 Equipment and Sampling Methodology

The following equipment list includes both portable monitors and a microscale balance to weight the filters. While appropriate equipment is available from several manufacturers, the equipment listed below are those that were used successfully for several years by the PB team on the Central Artery/Tunnel project.

- Portable MiniVOL Samplers
- One microbalance with +/- 1 microgram (ug) resolution used for filter weighing
- Master unit weights and forceps
- Quartz 47mm diameter (micro fibre) filters
- Field calibration unit
- Pole assembly and brackets

The sampling methodology can be divided into three separate tasks -- laboratory work, field sampling, and data processing. The following sub-sections describe the equipment capabilities, cost and tasks involved in the monitoring process. Cost is provided below in Table 8.

Table 8 Cost of Air Quality Sampling Equipment

<table>
<thead>
<tr>
<th>Equipment Description</th>
<th>Unitary Cost</th>
<th>Total Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Portable MiniVOL Sampler</td>
<td>2,500 $US</td>
<td>15,000$US</td>
</tr>
<tr>
<td>Microscale Balance</td>
<td>12,000 $US</td>
<td>12,000 $US</td>
</tr>
<tr>
<td>Micro Fibre Filters</td>
<td>70 $US</td>
<td>1,500$US</td>
</tr>
<tr>
<td>Field Calibration Unit</td>
<td>1,300 $US</td>
<td>1,300 $US</td>
</tr>
<tr>
<td>Pole assembly and brackets</td>
<td>170 $US</td>
<td>1,000 $US</td>
</tr>
<tr>
<td>Master unit weights</td>
<td>300 $US</td>
<td>300 $US</td>
</tr>
</tbody>
</table>

1 Assumes six units
2 Box of 50 filters
3 Assumes 1000 filters

7.6.1 The Portable MiniVOL Samplers

The portable MiniVOL sampler is a gravimetric saturation monitor. It was first developed by Lane Regional Air Pollution Authority, Oregon (with assistance from EPA Region 10) to measure high PM$_{10}$ incidents from slash burning and wood stove burning that occurred in rural Lane County, Oregon. They are currently manufactured, upgraded, and modified by Airmetrics Inc. located in Springfield, Oregon.
The samplers can be mounted on brackets attached to light poles or trees on sidewalks, at an approximately height of ten feet from the ground in order to avoid interference with pedestrian traffic (typical installation is shown in Figures 3 and 4).

![MiniVOL Sampler Mounted on Pole](image)

**Figure 3**

MiniVOL Sampler Mounted on Pole

The sampler has three principal components: A *filter assembly head* consisting of a rain cap, impactor and a standard 47 mm filter holder; a *control unit* in a PVC casing, and consisting of an electronic motherboard, dc motor, twin diaphragm pump, rotameter, clock and programmable timer; and a 12 amp-hour rechargeable *battery pack* also in a PVC casing. It can be used to measure PM$_{10}$ or TSP by changing the impactor at the inlet cap. A full description of the sampler can be found in Airmetrics Users Manuals.
7.6.2 Laboratory work

Laboratory work includes filter handling, and portable sampler calibration and programming. The filters are weighted in the laboratory, where temperatures and relative humidities are maintained within the required range. The measuring sequence shall be as follows:

1) A batch of clean sample filters used as control are stabilized.
2) The filters are stored in petri slides at specified meteorological conditions for 24-hours prior to weighing; and
3) The filters are weighed on a microbalance.

In addition, the portable samplers must be calibrated beginning of the monitoring season and every two weeks to verify the proper flow-rate.

7.6.3 Field Sampling

During field sampling operations, each portable sampler would either be deployed in the field, had batteries and filter assemblies exchanged in the field, or removed and re-deployed to another location. Upon completion of the field sequence, the battery packs and filter assembly heads are taken back to the laboratory, where batteries are recharged, and filters are stabilized for weighting. All information pertaining to each sampler, including day, monitoring start and stop date, site ID, sampler ID, battery ID, and filter assembly ID must be recorded.

7.6.4 Data Collection and Quality Control

Weather conditions, sampling date, season, control filter weights, site ID, sampler ID, filter ID, filter clean weight and filter exposed weight shall be logged, and the PM\(_{10}\) concentrations be corrected to standard temperature and pressure.

During the sampling phase of this monitoring program, a strict quality control (QC) program shall be used to ensure that a high data recovery rate is achieved. The monitoring data shall be reduced to create a PM\(_{10}\) summary sheet, which will includes sample dates, site ID, and PM\(_{10}\) concentrations.

**Manpower requirements:** One experience technician (trained to operate the equipment) with one assistant should be able to carry out the whole monitoring program.

7.7 Data Analysis And Reporting

PM\(_{10}\) data shall be analyzed at each location, and means and ranges should be compared among sampling sites. Data on field observations and daily weather conditions should be used to interpret results and trends. Where differences can be associated for similar activities, those conditions should be described and mitigation practices evaluated.

The construction engineer and the DPWH shall be kept apprised weekly of data results and mitigation recommendations, so that timely changes can be made to dust control practices.
Data reports on recorded PM$_{10}$ concentrations, along with summaries of field observations, and descriptions of recommendations for additional mitigation shall also be provided to the construction engineer, DPWH, and DENR.

In order to determine the effects of construction activities on localized PM$_{10}$ levels, levels measured each day at the background monitor should be subtracted from the levels measured at each construction site for the corresponding day. This procedure assumes that for a given day, the construction effects would be estimated as the difference between the level recorded near a construction site and the background level. However, due to the many sources that could affect PM$_{10}$ levels (i.e., heavily traveled roadways and/or other emission sources), the construction effects should be evaluated using a statistical valid set of data (i.e., mean average and 95% confidence levels) and not individual measurements.

A PM$_{10}$ monitoring report should be produced and distributed to the appropriate parties at the end of each monitoring season. This report should include the measured PM$_{10}$ levels and the effects of construction activities.

### 7.8 Field Inspection Program

A field inspection program, involving direct observation by an environmental inspector during periods of major construction activities, shall be implemented. Observations shall be performed several times per week in the vicinity of the monitored areas. If the inspector is the same individual performing the monitoring, the days can be staggered to allow the inspector handle both activities. The inspector shall record any nuisance dust conditions. The observations, with recommendations for solutions, shall be relayed to construction manager.

In the event of high PM$_{10}$ levels or the non-compliance with the dust control program, the inspector shall review and/or recommend corrective actions through the construction engineer. Procedures to transmit this information to the DPWH and DENR should be developed before this program is implemented.

Table 9 below provides a summary of the proposed equipment, frequency and locations for the air pollution and noise monitoring plans.
<table>
<thead>
<tr>
<th>Module</th>
<th>Phase</th>
<th>Parameter</th>
<th>Sampling/Measurement Method*</th>
<th>Frequency and Number of Sites</th>
<th>Responsible Agency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-construction</td>
<td>PM$_{10}$</td>
<td>Gravimetric – 24-hour levels Portable MiniVol sampler</td>
<td>Twice a week for two months during dry season. Five locations at sensitive receptors. One background location more than 200 meters away.</td>
<td>Contractor-DPWH</td>
<td></td>
</tr>
<tr>
<td>Construction</td>
<td>PM$_{10}$</td>
<td>Gravimetric - 24-hour levels Portable MiniVol sampler</td>
<td>Twice a week during dry season while major construction activities last. Four to six locations at sensitive receptors. Same background location as pre-construction.</td>
<td>Contractor-DPWH</td>
<td></td>
</tr>
<tr>
<td>Operation</td>
<td>PM$_{10}$</td>
<td>Gravimetric - 24-hour levels Portable MiniVol sampler</td>
<td>Twice a week for first year of operation during dry season. Same locations as pre-construction.</td>
<td>DPWH-DENR-LGU-MMDA</td>
<td></td>
</tr>
<tr>
<td>Pre-construction</td>
<td>dBA</td>
<td>Noise meter set to &quot;Slow&quot; response.</td>
<td>Once before commencement of construction for each phase (baseline) at the nearest sensitive receptor to construction site.</td>
<td>DPWH</td>
<td></td>
</tr>
<tr>
<td>Construction</td>
<td>dBA</td>
<td>Noise meter set to “Slow” response.</td>
<td>Hourly measurements for the first seven days of each phase. Hourly measurements during heavy construction activities.</td>
<td>Contractor-DPWH</td>
<td></td>
</tr>
<tr>
<td>Operation</td>
<td>dBA</td>
<td>Installation of noise meter near free flowing traffic segments at known distance from edge of pavement.</td>
<td>Occasional monitoring for operation phase.</td>
<td>DPWH-DENR-LGU-MMDA</td>
<td></td>
</tr>
<tr>
<td>Number</td>
<td></td>
<td></td>
<td>Traffic count of vehicle mix and average speeds at each monitoring station.</td>
<td>MMDA</td>
<td></td>
</tr>
</tbody>
</table>