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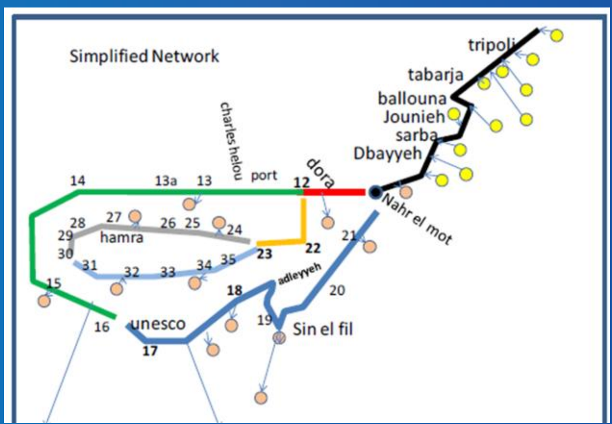


# Council for Development and Reconstruction (CDR)

# Environmental and Social Impact Assessment (ESIA) for the Bus Rapid Transit (BRT) System Between Tabarja and Beirut and Feeders Buses Services

**October 13, 2017**

ELARD

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| Acronym | Definition |
|---|---|
| AAQS | Ambient Air Quality Standard |
| AB | Administrative Beirut |
| ANSI | American National Standards Institute |
| AUB | American University of Beirut |
| BIEL | Beirut International Exhibition and Leisure Center |
| BRT | Bus Rapid Transit |
| CAS | Central Administration of Statistics |
| CBD | Convention on Biological Diversity |
| CCIA | Chamber of Commerce, Industry and Agriculture |
| CDR | Council for Development and Reconstruction |
| CGA | Directorate General of Antiquities |
| CNG | Compressed Natural Gas |
| COM | Council of Ministers |
| dBA | A-weighted decibels |
| DGLMT | Directorate General for Land and Maritime Transport |
| DGRB | Directorate General for Roads and Buildings |
| DGUP | Directorate General of Urban Planning |
| DPF | Diesel Particulate Filter |
| DSTF | Dead Sea Transform Fault |
| EA | Environmental Assessment |
| EBS | Environmental Baseline Summary |
| EEA | European Environment Agency |
| EHS | Environment, Health and Safety |
| EIA | Environmental Impact Assessment |
| ELARD | Earth Link and Advanced Recources Development s.a.l. |
| ELV | Environmental Limit Value |
| EMEP | European Monitoring and Evaluation Programme |
| ESIA | Environmental Social Impact Assessment |
| ESMP | Environmental and Social Management Plan |
| GBUTP | Greater Beirut Urban Transport Project |
| GDP | Gross Domestic Product |
| GHG | Greenhouse Gas |
| GoL | Government of Lebanon |
| GPS | Global Positioning System |
| HDV | Heavy Duty Vehicle |

| | |
|---|---|
| IEE | Initial Environmental Examination |
| IFC | International Finance Corporation |
| ILO | International Labor Organization |
| IPCC | Intergovernmental Panel on Climate Change |
| ISF | Internal Security Forces |
| LARI | Lebanese Agricultural Research Institute |
| LDV | Light Duty Vehicle |
| LMOs | Living Modified Organisms |
| LPG | Liquefied Petroleum Gas |
| MAS | Metropolitan Art Society |
| MoC | Ministry of Culture |
| MoE | Ministry of Environmnet |
| MoEW | Ministry of Energy and Water |
| MoIM | Ministry of Interior and Municipalities |
| MoPWT | Ministry of Public Works and Transport |
| MoSA | Ministry of Social Affairs |
| MV | Mini-van |
| NGO | Non-governmental Organization |
| NMVOC | Non-methane volatile organic compounds |
| NPMPLT | National Physical Master Plan for the Lebanese Territory |
| NSEQ | National Standards for Environmental Quality |
| NSSF | National Social Security Forces |
| OCFTC | Office des Chemins de Fer et des Transports en Commun |
| ODS | Ozone Depleting Substances |
| OP | Operational Policies |
| P&R | Park and Ride |
| PAH | Poly Aromatic Hydrocarbons |
| PC | Passenger Car |
| PME | Powered Mechanical Equipment |
| POPs | Persistent Organic Pollutants |
| PwD | Persons with Disabilities |
| RAP | Resettlement Action Plan |
| RPTA | Railways and Public Transport Authority |
| SCR | Selective Catalytic Reduction |
| SEA | Strategic Environmental Assessment |
| SISSAF | Support Programme for Infrastructure Sector Strategies and Alternative Financing |
| TMO | Traffic and Management Organization |
| TMS | Transportation and Mobility Consultancy |

| | |
|---|---|
| TRU | Transport Regulatory Unit |
| TSP | Total Suspended Particles |
| ULSD | Ultra-low Sulfur Diesel |
| UNDP | United Nations Development Programme |
| UNESCO | United Nations Educational, Scientific and Cultural Organization |
| UNFCCC | United Nations Framework Convention on Climate Change |
| WB | World Bank |
| WC | Water closet |
| WHO | World Health Organization |
| WWTP | Wastewater Treatment Plant |

# EXECUTIVE SUMMARY

Earth Link and Advanced Resources Development s.a.l. (ELARD) (the "ESIA Consultant"), in cooperation with Egis International, was appointed by the Council for Development and Reconstruction (CDR) (the "Project Proponent") to conduct an Environmental and Social Impact Assessment (ESIA) and Resettlement Action Plan (RAP) for the Bus Rapid Transit (BRT) system between Tabarja and Beirut and feeders buses services (the "Project").

The objective of the Project is to improve transport connectivity and mobility on the coastal corridor located to the North of Beirut. This objective will be achieved through:

(i) the construction of a new Bus Rapid Transit (BRT) System between Tabarja and Beirut and within Beirut,

(ii) the establishment of feeder bus services to the trunk BRT line, and

(iii) the establishment of appropriate institutional arrangements for the management, operation and maintenance of the new mass transit system.

The World Bank (WB) prepared the "Pre-feasibility Report for a Bus Rapid Transit System for Greater Beirut" and will be appraising the Project for funding based on the outcomes of the Feasibility Study and Environmental and Social Impact Assessment. When the Project is approved for implementation, the CDR will be responsible for its construction while the operation will be under the jurisdiction of the Railways and Public Transport Authority (RPTA).

Implementation of a Bus Rapid Transit (BRT) System has been identified as one of the potential investments to improve mobility and traffic circulation along the three (3) main entrances to Beirut: Northern, Southern and Eastern entrances. In the first phase, the proposed Project addresses the Northern Entrance. The remaining two (2) entrances will be studied at later stages.

***Project Description***

The Project is thus the implementation of a BRT System for the Northern Corridor of Greater Beirut linking Beirut to Tabarja. In addition, the BRT corridor will continue into the city of Beirut in an Outer Ring and an Inner Ring.

A BRT System is a bus-based mass transit system with large transport capacities and has the following elements:

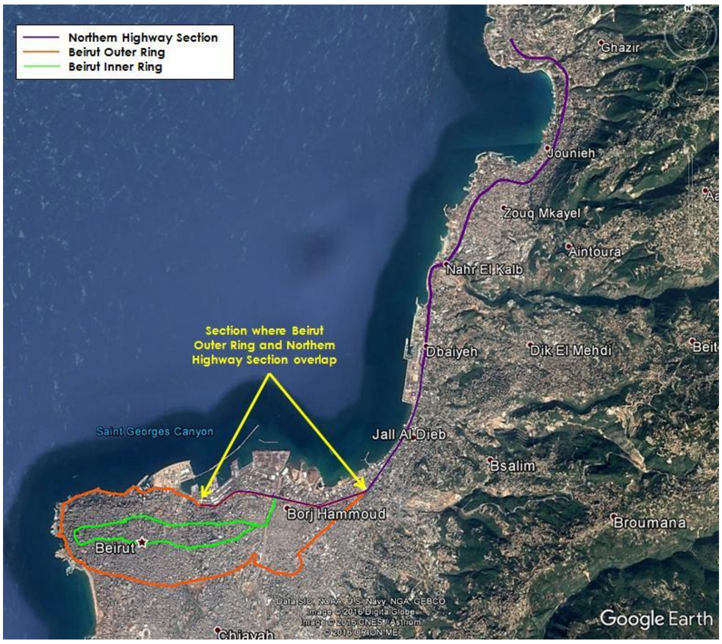
- Alignment in the center of the road with physical separation of the dedicated lane from mixed traffic;
- Stations with off-board fare collection;
- Station platforms level with the bus floor and multiple bus doors for entry; and
- Bus priority at intersections.

The <u>section along the Northern Highway</u> runs from Tabarja to Beirut (Charles Helou) with a length of 24 km and has 28 stations in the median with separating distance of 850 m, connected to either side of the highway by pedestrian bridges, with stairs and elevators.

The <u>Beirut Outer Ring</u> with a length of 18 km follows the Mirna Chalouhi Boulevard - Emile Edde - Jisr El Wati - Corniche Al Mazraa - Corniche Al Baher - Charles Helou - Nahr Al Mot. There will be 21 stations, 700 m apart, and road-level pedestrian crossings.

The Beirut Inner Ring with a length of 16 km stays within the administrative boundaries of the city of Beirut. It passes through the following streets and avenues: Independence, Charles Malek, General Fouad Chehab, Spears, Omar Bin Abdel Aziz, Bani Maarouf, and Algeria. There will be 19 stops on the right hand side of the road, 570 m apart.

The overall BRT alignment is shown in the figure below.




**Overall BRT Alignment**

Along with the BRT service, feeder bus services with specific itineraries are going to be provided to serve as transit, from and to the BRT stations.

The feeder bus lines are based on the "20 bus lines" project prepared by the Ministry of Public Works and Transport (MoPWT). The total service fleet will comprise around 850-900 buses operating on about 20 complementary bus routes outside the main BRT trunk lines.

**Feeder Bus Network**

The third component of the Project is institutional strengthening which includes:

- The delineation of the arrangements for the management, operation and maintenance of the new BRT System; and

- The preparation of required studies to concession BRT operations to a private operator under the supervision of the RPTA.

***Public Consultation***

The BRT System has primarily a general public interest for commuters. Its implementation aims at enhancing public transport thereby easing traffic flows, reducing air pollutants emissions, reducing travel time, and improving road safety conditions. As part of the ESIA Study, a "Stakeholder Engagement and Consultation Plan" was developed to lay out the roadmap on how the ESIA Consultant will facilitate capturing the opinions of stakeholders.

Three (3) main approaches were adopted to inform people about the Project throughout the ESIA study to solicit their opinions:

1. Key Stakeholder Meetings and Interviews,
2. Two Public Consultation Meetings at the Scoping and Draft ESIA Study stages, and
3. Focus Group Meetings.

The most striking and relevant outcomes from the meetings, interviews, public hearings and focus group meetings are summarized as follows:

1- On Project Design: While a reliable and efficient mass transit system is a must, especially that the current system does not meet the expectations of the population on various levels, removing one lane to be dedicated to a busway might lead to more congestion. Furthermore, integration of the BRT bus with the feeder bus network, and P&R facilities is a necessity to create a functioning, integrated system of public transport.

2- On Environmental Matters: There is a need to have clean, low-emission buses that attract the demand of passenger car users to a sufficient level so that they switch from using private vehicles to using the bus.

3- On Social Matters: The current private operators of the common transport system will face competition from the new BRT system – in terms of road space and service provision. Construction of the BRT bus corridors is anticipated to create disruption and heavy congestion along already-saturated roads that have a poor level of service. The project design elements must cater for the needs of all persons: students, women, young adults, professionals, persons with disabilities, the elderly, and should be affordable.

4- On Institutional Matters: Lack of enforcement of the traffic law, illegal parking, traffic rules violations by all road users might be an impediment to achieving the project objectives. Furthermore, there is a general mistrust that the state institutions will succeed in creating and maintaining an operating system of mass transit.

***Policy, Legal and Administrative Framework***

The key institutions spearheading the Project are the CDR, MoPWT and RPTA in terms of design, construction, operation and maintenance. Key stakeholders who have a prominent role in supporting the implementation and ensuring the Project is implemented and operated in line with the rules and regulations are the MoIM through the TMO, the MoE and the MoC, since site preparations will be required. The municipalities are pivotal stakeholders in the implementation, especially for the feeder bus network.

The applicable legislation is the responsibility of all stakeholders and actors to implement, starting with the Traffic Law No. 243/2012, Environmental Protection Law No. 444/2002, Law No. 37/2008 on Cultural Heritage, Law No. 58/1991 on Expropriation, Decree No. 8442/2002 and its amendment Decree No. 3054/2016 on Fuel Standards, and Law No. 220/2000 on the rights of persons with disabilities.

Provided that the Project will be financed through loans from the World Bank, and given the nature of the project that is classed as Category A, two safeguard policies apply, namely OP 4.01 Environmental Assessment and OP 4.12 Involuntary Resettlement.

***Environmental and Social Baseline***

Environmental and socio-economic aspects considered in this ESIA are as follows:

- Physical environment: emissions and air quality, noise, soil and geological setting.
- Landscape and biological environment;
- Socio-economic environment;
- Transport network and traffic; and
- Cultural heritage assets.

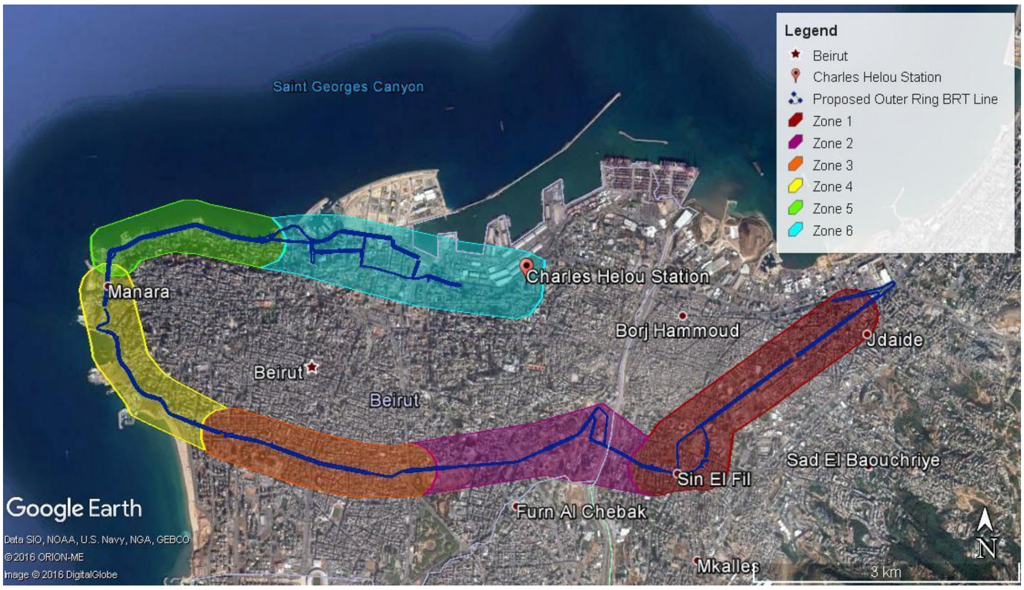
The baseline conditions were analyzed based on 1) a desk study and 2) baseline field investigations. The results of the field and desk surveys were documented in maps, photographs and text describing the existing state of the environment prior to the proposed operation of the BRT System components.

*Overall Environment and Receptors*

For the Northern Highway alignment from Tabarja to Beirut, each station was studied separately. Each of the two Beirut Outer and Inner Rings alignments or corridors was divided into several zones with respect to major avenues/ streets/ areas. In order to define the assessment study area, a walking distance of a 300 m radius buffer area was delineated surrounding each station. Receptors within each zone were identified.

Separate booklets were prepared to compile the findings of the baseline assessment. The descriptions include:

- Physical characteristics of the roads/highway where the BRT buses are planned to pass;
- Detailed GIS and Google Earth maps;
- Photographic records;
- A table providing information about the planned location of each station;
- Environmental, social, cultural and archeological points of interest surrounding the stations;
- General observations; and
- Links with other sites/ towns/ villages/ roads.




**Proposed Beirut Outer Ring BRT Line and Assessment Zones**


**Proposed Beirut Inner Ring BRT Line and Assessment Zones**

*Traffic*

The Project lies in the heavily urbanized and congested area of Greater Beirut. The dense nature of economic activities, housing, commercial, industrial and cultural attract a very large number of commuters on a daily basis.

The AM peak hour traffic volumes on the southbound routes in the Project study area range between 339 on Harissa Highway (feeder service) and 7,024 vehicles entering Beirut at Charles Helou. The PM peak hour traffic volumes on the northbound routes range between 304 on Harissa Highway (feeder service) to 4,797 vehicles on the Jounieh Coastal Highway. Public transport in Greater Beirut is not organized within a comprehensive system and lacks a regulatory approach. Beirut chronically suffers from lack of parking spaces. One of the main reasons that the road network is operating with a bad level of service is the existence of a significant number of double park and illegal on-street parking spaces reducing the capacity of the road and blocking traffic circulation and even the sidewalks, where some cars park.

*Emissions and Air Quality*

The transport sector contributes 99% of the total CO emissions load, 62% of the total NOx load, 4.8% of the total $SO_2$ load and 63% of the NMVOCs load. Passenger cars have the largest contribution to the emissions, since 85% of the Lebanese fleet consists of passenger cars. The road transport sector accounts for 40% of national consumption of fuel and emits 23% of national GHG emissions, contributed through urbanization, negative externalities of air pollution, traffic congestion and the old fleet of passenger vehicles. Privately-owned passenger cars are also the largest contributor to GHG emissions, with 27% of $CO_2$, 0.87% of $CH_4$ and 14.29% of $N_2O$. The annual increases in the contribution of the transport sector to GHG emissions between 1994 and 2011, on the order of 8%, 6% and 15% for $CO_2$, $CH_4$, and $N_2O$ respectively are notable.

In terms of air quality, the ambient concentrations of $NO_2$, $PM_{10}$ and $PM_{2.5}$ exceed the WHO and IFC EHS Ambient Air Quality Guidelines in and around Beirut. Hence, the coastal airshed is regarded as degraded. The coastal areas experience high levels of $PM_{10}$ which are correlated with sea breezes and dust carried over from the African and Arabian deserts. $PM_{2.5}$ which constitutes 61% of $PM_{10}$ concentrations is related to local emissions from traffic congestion.

*Noise*

High population density and large fleet size exacerbate the problem of noise pollution. According to a survey of noise levels in the GBA and the perception of people, the results show elevated noise levels above the national standards all around the city. Transportation noise was perceived as the major source of annoyance by majority of the respondents in the urban setting.

Noise measurements were carried out over 15-minute intervals at 25 locations, as part of this study, reflecting daytime noise levels. Noise levels were measured near residential/commercial buildings and proposed bus stations to acquire baseline noise levels for the entire proposed BRT corridors - Northern Highway, Beirut Outer Ring and Beirut Inner Ring. All noise levels approach or exceed the Lebanese standards and the IFC EHS Guidelines, the existing noise levels throughout the project corridor fluctuate between 67 and 81 dB(A) by location, depending on site characteristics such as proximity to major roadways like Charles Helou Highway, and other noise sources, the relative elevation of roadways and receptors.

*Geology, Soil, Groundwater and Seismicity*

The topography of the area is flat on the coast, where the elevation ranges between 100 and 500 meters from the Mediterranean Sea to the west of the BRT, but becomes mountainous with increasing slopes east of the BRT corridor.

There are eleven (11) geological formations and Quaternary deposits outcropping in the study area. The surface water bodies that are crossed by the proposed BRT Corridor comprise two (2) perennial rivers and three (3) seasonal streams. The major aquifers in the Study Area are the Sannine-Maameltain Limestone formation (C4-C5) and the Miocene

Limestone Formation (mL). Both formations include karstic aquifers with groundwater mostly flowing through fractures and cavities. The general groundwater flow direction is to the west (towards the sea). Almost all the area crossed by the BRT Corridor is characterized by seawater intrusion due to overexploitation of groundwater along the coastal area.

Lebanon is located along the Dead Sea Transform Fault (DSTF) system which has several surface expressions, represented in major faults (Yammouneh, Roum, Hasbaiya, Rachaiya and Serghaya faults) and in uplifts as high mountainous terrain. The activity along the DSTF is evident from the seismic activity record. Recent work categorized the Lebanese section of the DSTF as being a strong seismic activity zone.

*Landscape and Biological Environment*

While the BRT System lies within a heavily urbanized area, some system components such as the Park and Ride (P&R) facilities will be located on empty plots of land that are vegetated, however non-productive.

No areas of special concern (world heritage sites, wetlands, biosphere reserves, or protected areas) are located in the vicinity of the sites or along the median strips. Neither endangered species, nor critical ecosystems/ habitats were recorded during the field visit. The plants observed at the P&R facilities are mostly weeds and signs of degraded habitats such as *Ricinus communis, Chrysanthemum coronarium* and *Notobasis syriaca*.

The existing median strips along the Tabarja-Beirut alignment mainly consist of exotic ornamental plant species such as palm, Washingtonia, eucalyptus, olive trees and others. Those species have no ecological value but have an important positive impact on local air quality and aesthetic value given their presence in congested urban areas.

The median strips along the Beirut Outer Ring mainly consist of exotic ornamental plant species such as palm, Washingtonia trees and other trees, shrubs, and herbs. Those species have no ecological value but have an important positive impact on local air quality in the different areas. Some native coastal plants are observed in the median strip along Corniche Al Baher in Beirut. A highly-regarded vegetated median strip is located on the seaside next to AUB campus in Beirut.

No faunal species or any traces of fauna were observed during the field visit except for pigeons and birds which are adapted to cities. All the sites are situated in urban areas and are not expected to support faunal species.

*Socio-economic and Mobility Aspects*

According to the latest statistics Lebanon's resident population is estimated to be 5.988 million (2016), of which 75.8% is urban population (2.226 million in the capital city of Beirut in 2015). It is important to mention that this number includes refugees, since due to the latest Syrian war crisis, it is assessed that 1.19 million refugees currently reside in Lebanon (mid-2015). The mass influx of Syrian refugees in Lebanon is one of the main challenges that Lebanon is facing today.

The average annual population growth rate is 6.0% (2010-2015) while the urban annual population growth rate in the same period is 3.2%. In spite of the fact that currently there is a positive trend for population growth, future estimates show decelerating and decreasing pattern of population growth. This suggests that by mid-century Lebanon will possibly have an aging population, with larger proportion of the decreasing population (-4.1% between 2015-2050) living in urban areas. Based on the latest national survey in 2009, 10.8% of the population live in Beirut, 27% in the suburbs of Beirut and 15.8% in Mount Lebanon. The governorate of Mount Lebanon accounts for the largest share of the population and the governorate of Beirut is ranked 5th in terms of number of inhabitants, however the city of Beirut being the capital is the major economic pole in the country.

The Lebanese population is young, with 44% of residents below 24 years of age. Statistics show that the households in urban areas are relatively small, with 54.7% in Beirut having members between 1 and 3. In 2014, the national GDP was USD 49,631 million; annual growth rate of 2% and per capita income of USD 8,844. The Services sector is the largest contributor to the national GDP i.e. 73.2% of the Gross Value Added, followed by Industry (23.6%) and Agriculture (3.2%). It is also estimated that 73% of the population have access to the Internet, while 71 per 100 people have mobile-cellular subscriptions.

The traffic conditions in Lebanon are known for facing infrastructure challenges, congestion, and deteriorating quality of already mismanaged public transport services.

Public transport modes are available in Lebanon; however, they are characterized by being unreliable and in most cases improperly distributed over the market. The city of Beirut is over-served compared to the demand, resulting in severe competition among operators, while other cities have shortage of public transport services. The available public transport means are not facilitated with the proper infrastructure to make them accessible by the public; ultimately resulting in the utility of -the only reliable option- private vehicles. According to the RPTA, the approximate number of passengers using public transport in 2014 was 1,213,268, based on 19,112 and 18,033 morning trips and evening trips respectively. The infrastructure and facilities such as bus stations, dedicated taxi-spots and proper scheduling of the available systems are almost absent in Lebanon.

Mobility cost in Lebanon is estimated to be around US¢ 50/veh.km or US¢ 42/pass.km. . It is important to note that the road transport sector in Lebanon is one of the largest energy consumers (27.42% of national energy consumption). This reflects the economic burden of the transport sector not just on the public but also on the national economy. Increase in availability of properly managed public transport systems would tackle the three components of mobility cost through the reduction of pollution, less fuel consumption due to less utility of private cars, and reducing ownership costs. The annual household expenditure on transportation is the third largest (13.11% of total expenses) after Housing expenses (28.36%) and Food (20%).

It is estimated that 40% of the total road fatalities are pedestrians killed in traffic accidents, compared to 10% in developed countries. Statistics show that the number of fatalities is about 600 per year or 17 per 100,000 inhabitants. Absence of sidewalks, expansion of roads at the expense of sidewalks and improper sidewalk arrangements and maintenance are the main reasons causing pedestrian accidents.

In 2011, there were 1.446 million vehicles in Lebanon or 330 vehicles/1,000 population making it the third highest in the region after Kuwait (426 vehicles/1,000 population) and Bahrain (347 vehicles/1,000 population).

The age distribution of the vehicles reflects the old nature of the fleet (i.e. 71% older than 10 years). The size of the fleet and the old nature also impact negatively the public transport. Average age of the shared taxis "service taxis" which are privately owned is about 20 years old, and other public transport vehicles being more than 10 years old. All transport modes of private/public buses, minivans, taxis have low occupancy rate of 1.2 passengers for taxis, 6 for vans and 12 for buses; average of 1.7 for passenger vehicles. These conditions result in high energy demand by the transport sector; 3.08 MJ/pass.km or 15.06 GJ/capita.

Driving patterns and conditions also reflect the efficiency of road transportation. The average speed in GBA is around 18 km/hr and decreases to <10 km/hr in peak traffic conditions.

Currently, there is a functioning, mostly informal mass transit system that consists of private station operators and bus drivers who run one or more buses in the same area of operation of the BRT and its feeder network.

The survey of operators described the routes, fleet sizes, number of roundtrips per day and passengers, along with the fares demanded. A round-up of the surveyed figures shows:

1- 1,414 buses that do 3,501 round trips per day, carrying 136,371 passengers per day, and collecting a gross revenue of 234,316,000 million LBP per day (156,211 USD per day)
2- 2,935 minivans that do 17,088 round trips per day, carrying 372,539 passengers per day, and collecting a gross revenue of 398,354,000 million LBP per day (265,570 USD per day)

The daily turnover of the current mass transit system in the study area is at least 421,780 USD. A back-of-the-envelope calculation of the annual profits of a bus operator that rents a bus, hires a driver, pays for diesel and pays for a stop in an illegal bus station, and the bus would operate for 27 days per month, can reach at least 11,000 USD/year.

The socio-economic inductive study was conducted via an initial opinion survey, focus group meetings to gauge social perceptions, and interviews with key informants.

The purpose of the initial survey that was conducted during the scoping phase was to collect background information about the current modes of transportation and the public's opinions regarding uptake of public transport in the Project area. A total of 60 questionnaires were filled. The opinion census results showed the willingness of the Lebanese population to use public transport and a rather strong awareness of the benefits of a well-managed public transport system.

Four (4) types of focus groups were identified for the focus group meetings as follows:

1- Persons with commercial interests along the BRT routes (northern highway, outer and inner rings) – this branched into two (2) meetings according to geography:
    a. Meeting conducted at the training center of Beirut and Mount Lebanon Chamber of Commerce, Industry and Agriculture (CCIA-BML) with Beirut commercial establishments; and

b. Meeting conducted at ELARD offices with Metn and Kessrouane commercial establishments.

2- Syndicates and Public Transport Unions (meeting conducted at ELARD offices).

3- General public where persons were selected such that they represent the social fabric from all walks of life – women, men, elderly, students, etc. Three (3) focus group meetings were conducted with the general public:

- Focus group meeting with Metn public (meeting conducted at the El Saydeh Church parish in Sin El Fil);
- Focus group meeting with Kessrouane public (meeting conducted at Saydet al-Maounat parish in Haret Sakher); and
- Focus group meeting with Beirut public (meeting conducted at the Municipality of Beirut).

4- Persons with Disabilities (PwDs) (meeting conducted at Arc-en-ciel Non-Governmental Organization (NGO).

NGOs (representing the civil society), mainly working on the public transport sector were invited to the four (4) types of focus groups listed above. A total of seven (7) focus group meetings were held during the months of February, March, April and May 2017.

Due to low turnout of representatives of public transport syndicates and commercial establishments, specific meetings were requested with representatives who agreed to meet and express their views. A third interview was held with an operator in the Dora station to understand the dynamics of the informal mass transit system.

*Land*

The BRT Corridor will occupy the road right of way along its trajectory, and hence there is no change in land use along the corridor. Nonetheless, in some areas along the highway in the northern corridor from Nahr el Kalb to Tabarja there is a need to expropriate approximately 235 $m^2$ of private lands to accommodate the pedestrian infrastructure of the stations along the sidewalks.

The BRT Corridor in the Outer and Inner Rings is entirely located in the right of way, and no land use change or acquisition needs arises.

The P&R facilities will be placed on publicly-available land which have been assessed to have no productive value. One of the P&R facilities in Kfrayassine has five illegal households with a total of 26 persons and some fruit trees.

The bus depot in Safra and bus terminal in Wata Slem, Tabarja will be located on privately-owned plots 14,000 $m^2$ (1 plot) and 6,000 $m^2$ (3 plots and part of a fourth plot). The plots have no productive activities or housing. Nonetheless, the depot and terminal locations are non-built areas, and the creation of transport infrastructure that will become a hub for commuters and a whole fleet of buses might change the land use in the area.

Land acquisition procedures and compensation estimates are fully evaluated in a Resettlement Action Plan (RAP) prepared in line with Law No. 58/1991 and World Bank OP 4.12.

*Cultural Heritage*

Given the richness of the Lebanese territories with archaeological riches and cultural resources, it is important to investigate whether the Project's construction works might adversely affect or unearth archaeological remains with cultural and historical value. Tthe Project's footprint area, available at the time of the study, was shared with the Directorate General of Antiquities (DGA) to advise on potential areas of interest from an archaeological perspective.

The cultural points of interest along the BRT route were highlighted using information from desk research and field surveys to pinpoint the locations of museums, galleries, neighborhoods of cultural value, etc. whose locations might be sought by future system users, and hence the bus route would be used as a means to promote cultural tourism.

***Analysis of Alternatives***

*No Project Alternative*

Without the BRT project, the population of almost 2.2 million residing in Greater Beirut and the larger urban population that commute to Beirut from the northern areas will not benefit from a sustainable, efficient, advanced and safer transport system. The urban population which is in continuous growth (87% of total population in 2050) will continue to suffer from traffic congestion, traffic accident risks, and unreliable public transport systems. The dominant transport mode would continue to be the private passenger car, while contributing to overloading the capacity of existing roads, increasing pollution levels and GHG emissions, and increasing the overall cost of mobility.

Without the dedicated BRT corridor, the buses would be stuck in mixed traffic, without dedicated stations for passengers and regulated timetables. Ultimately, it is expected that there would be no improvement in the level of service that a public transport system would provide, with adverse impacts on quality of life and the environment.

*Elevated BRT Corridors*

BRT corridors running in the median highway can be constructed on separate elevated roads or underground viaducts as an alternative to ground-level structures. Due to the complexity of the underground system and the archaeological potential in Lebanon, only the elevated system is considered as a potential alternative and compared to the current project.

Elevated systems can have relatively high construction costs, due to the additional requirement of raw material and complexity of the engineering, especially in already developed urban settings. Elevated roads are preferred where there are a lot of intersecting roads with the main corridor and the construction area not already developed. No additional lane is gained by having elevated structures since the columns holding the road will be occupying the space, especially in the case of construction at the median section of the road.

Nonetheless, the elevated road option is advocated by the local authorities and municipalities in the Kesserouan area. A feasibility study to evaluate the elevated road option is currently being pursued by the CDR.

*Bus Technology Alternatives*

Most common buses operate on diesel fuel. Advanced models are equipped with Diesel Particulate Filters (DPF) and Selective Catalytic Reduction (SCR) technology. There are other more advanced technologies that operate on biodiesel, compressed natural gas (CNG), diesel-electric (Hybrid), electricity using overhead electric wires (Trolley) or rechargeable batteries, and Hydrogen (Fuel Cell) to name a few.

Trolley buses are not considered in the comparison, since the capital cost of the buses are high and require a high-cost infrastructure of overhead wires and connecting poles in addition to constant electricity supply, which is a challenge in current circumstances in Lebanon. Other fuels also require some sort of requirements but mainly the supply of fuel. Hybrid, Biodiesel and Diesel (with DPF) require similar facilities to provide the fuel. Natural Gas and Fuel Cell buses need specific storage and supply systems that often increase the capital cost of these systems. Since natural gas infrastructure is not realized in Lebanon, buses running on natural gas may not be realistic for the short to medium term.

The choice of diesel buses for the BRT System of this Project stems from the examination of available infrastructure and availability of fuel types in the local market. It is recommended to settle for a known and tested bus technology, provided that new buses are procured that run on energy-efficient engines (Euro V or Euro VI), are equipped with DPF and SCR technology to reduce PM and NOx emissions, and use ultra low sulfur diesel in conformity with the national specified standards.

***Potential Environmental and Social Impacts***

The identification and analysis of impacts consists of appraising the design information submitted by the Project Proponent, in conjunction with the baseline information of the site. A single matrix was developed to summarize the impacts expected during the construction and operation phases. The matrix describes the potential impacts through identifying the sources/activities and the pathways through which these impacts affect receptors (environment/human).

The identified environmental and socio-economic impacts are assessed in terms of their Significance (Low, Moderate or High) based on the Likelihood (Low, Moderate or High) of the impact and its Consequence (Insignificant, Minor, Moderate, Major, Critical and Beneficial). A number of considerations are built into the Impact Consequence Criteria including nature, direction, magnitude, geographical extent, timing, duration and reversibility of the impact as per the MoE Decision No. 261/1/2015.

**Sources of Impacts and Potential Impacts during the Design/Pre-Construction Phase**

| Sources of Impacts during Design/Pre-construction | Potential Environmental and Socio-economic Impacts |
|---|---|
| Poor integration of the BRT System with current public transit services, other public transport systems to be introduced in the future, or the surrounding environment | • Public outcry and frustration from insufficient or disintegrated services that do not meet the long-standing demand for an efficient and reliable public transport system<br>• The current design of stations' separating distances of 850 m on the northern highway, 700 m in the Outer Ring and 500 m in the Inner Ring encourages users within 400 m radius to exercise as they walk to the stations<br>• Poor integration of the infrastructure with the local transit needs and cityscape might lead to poor uptake of the new BRT services, especially if the design of stations, bridges and surrounding infrastructure are not user-friendly for all people, appealing or safe for vulnerable groups such as women, youth, special needs persons and the elderly<br>• Potential visual impact resulting from constructed facilities of the BRT System that do not improve the fabric and aesthetics of the urban space<br>• Non-inclusion or weak integration of the current public transport service providers in the BRT System might create social unrest among operators due to foreseen competition for passengers and road space<br>• If the level of service of BRT feeder buses are sub-standard to the BRT trunk line itself, or if pedestrian infrastructure connecting P&R facilities and stations to neighborhoods and satellite/commuter towns are not upgraded and/or designed to meet the different social needs of users, commuters, especially women, people with special needs or limited mobility, students, the elderly, etc. might be discouraged to undertake journeys in the BRT System<br>• Poor or lack of allocation of sufficient space for commuters who alight from or wish to board other vehicles at stations might lead to tailbacks on the right lanes and reduce the level of service on the road |
| The reserved width of the BRT-dedicated lane on both sides of median of the northern highway between Charles Helou & Tabarja is 8.3 to 11.8 m | • On the medium to long-term, it is anticipated that the BRT System would attract more customers who will make the switch from private vehicles to using the bus, thus contributing to reduced congestion and better level of service along the highway<br>• Decreasing the width of the road which currently witnesses heavy congestion at most times, and not exclusively during peak hours, will lead to public opposition in the short to medium-terms as reduced congestion might only be gradual as private vehicle users switch to using the BRT System |
| Introduction of the BRT System in the section of the northern highway between Nahr el Kalb and Tabarja requires:<br>- Widening of the A1 Highway between Dbayeh and Tabarja to a 3 by 3 lane road | • Widening bridges or constructing new ones are associated with localized impacts on the local environment (debris, construction-related impacts) and the canyons underneath that can however be mitigated, with special attention to the neighboring Roman Bridge<br>• Poor coordination of construction work schedules for A1 Highway widening and BRT-associated construction works along the intersecting sections between Nahr el Kalb & Tabarja would lead to |

| Sources of Impacts during Design/Pre-construction | Potential Environmental and Socio-economic Impacts |
|---|---|
| - Widening of Ghazir and Casino du Liban bridges by 4.6 m | multiple bottlenecks, cause social nuisance and lead to increased noise and air emissions from vehicles idling in standstill traffic<br>• Impacts from widening the A1 Highway are manifold and are examined separately in an EIA and Land Acquisition and Resettlement Plan, prepared by the CDR (www.eib.org/attachments/pipeline/20090635_eia_en.pdf). The impacts from the land acquisition due to widening are addressed in the Expropriation decrees for the A1 highway widening.<br>• The land acquisition and resettlement impacts associated with the BRT pedestrian bridges are analysed in the Resettlement Action Plan document, separate to the ESIA Report. Impacts include partial land expropriation of a total of 235 m² for the road widening without any land fragmentation, approx. 14,000 m² for the depot in Safra, and 8,000 m² for the terminal in Tabarja. All affected lands are non-productive. Some fixed assets such as steel containers and planted trees will be removed and compensated accordingly. Five households illegally occupying state-owned land in one of the P&R facilities in Kfaryassine will be displaced, however compensated in accordance with the provisions of Expropriation Law No. 58/1991. |
| Introduction of the BRT System in the Beirut Outer Ring necessitates that:<br>- 1,200 on-street side parking spaces are axed<br>- Due to road layouts, some sections cannot be dedicated – such as in tunnels from Ain el Tineh to Adlieh, Sin el Fil & Dekwaneh, Dbaibo between Ain el Mreisseh & Raouche<br>- 2 m of the coastal sidewalk (Corniche) be removed<br>- Street furniture, signals, stop signs and traffic lights, and road marking be upgraded to accommodate the BRT System with its stations | • Improvements to road infrastructure is anticipated to enhance road safety. However, since regular buses and taxis will continue to operate on the road lanes next to the BRT lane, continuing to allow passenger-driven road habits of hailing taxis and buses to stop at undesignated locations, as well as pedestrians crossing at unmarked locations through inadequate road design to accommodate different uses and demands, might not bring about the foreseen benefit enhanced road safety. Hence road infrastructure upgrades should solve the cumulative impact from chaotic road usage by addressing the road design of all stretches that the BRT buses and their feeders intend to service<br>• On the medium to long-term, and if public parking lots with limited spaces are made available, it is expected that fewer private vehicle journeys are made into the Greater Beirut Area that is served by the BRT and its feeders, leading to higher parking fares, fewer fuel consumption and pollutant and GHG emissions per commuter<br>• Mixed traffic lanes might lead to bottlenecks and discourage the use of the BRT System for some users, due to increase in journey time, and rise in collision risks in mixed traffic sections<br>• On the short-term, the removal of on-street side parking is anticipated to create social dismay and unacceptance from private vehicle owners, local shops' and business owners, and violations of stricter street parking rules are expected to increase. Enforcement of strict no-parking and no-stopping rules with fines should induce on the medium-term a disincentive to drive private cars into the city for routine journeys, and guarantee free flow on the roads adjacent to the BRT lane<br>• Given the high recreational and amenity value of the seafront promenade, narrowing the sidewalk might induce public opposition to reducing the free, open air public space that is |

| Sources of Impacts during Design/Pre-construction | Potential Environmental and Socio-economic Impacts |
|---|---|
| | revered by the city dwellers, and which is a touristic attraction in its own right |
| Introduction of the BRT System in the Beirut Inner Ring necessitates:<br>- Removal of approx. 1,500 on-street parking spaces on the right hand side, to be replaced with a dedicated BRT bus lane<br>- Only one lane in some stretches remains available for through traffic, and in some stretches the bus would move in mixed traffic<br>- Dedicated lanes not to be physically separated from the rest of the road to enable traffic movement from side streets into and out of residential neighbourhoods, which would however cross-over the dedicated bus lane at numerous points | • The Inner Ring route traverses areas in the heart of the city of Beirut with a marked presence of schools, universities, hospitals, government agencies, social welfare organizations esp. for persons with special needs, cultural centers and museums/galleries, entertainment hubs, shopping areas, restaurants, public parks, etc., hence an improved bus service with marked stops, good level of service roads, with safety features, no on-street parking and upgraded pedestrian infrastructure to residential neighborhoods, commercial areas, educational institutions, etc. should be expected to attract students and inter-city commuters on short journeys, and contribute to less traffic congestion during peak hours<br>• Introducing a bus service within the city might result in less trips demanded from shared taxis, within the zones that the bus and its feeder buses would service<br>• Given the nature of the highly-dense and interwoven inner city streets, the maneuverability impacts from having a dedicated bus lane in the Inner Ring are too restrictive for local traffic, and direct access to residences and small businesses on the right-hand side of the road<br>• While medium to long-term impacts from removing on-street parking spaces are positive for calmer circulation of vehicles on the inner city roads, most parking spaces are used by residents who do not have parking spaces allocated in their residential buildings or neighborhoods, hence, unless alternative public/resident parking garages are made available by the Municipality of Beirut by the time that the BRT bus runs, city dwellers on the Inner Ring route would not have sufficient spaces to park their vehicles<br>• Mixed traffic lanes might lead to bottlenecks and discourage the use of the BRT System for some users, due to increase in journey time, and rise in collision risks in mixed traffic sections |
| Bus fleet and Operability | • Bus size, engine, fuel used, and running frequency influence the assessment of air and noise emissions; which based on the selected technology they will be reduced. The expected reduction in private vehicles trips or trips made in passenger cars is also anticipated to influence the net emissions budget.<br>• The size of the bus, its amenities, frequency of running, operating staff, ticketing system, fares, safety provisions for boarding, disembarking and using the buses by all persons will affect acceptability and take-up. Larger buses within the city of Beirut are expected to be refused by the city dwellers. Low-emission, clean and safe buses that operate on fixed schedules and routes are a key feature that are expected to impact social acceptability and participation. |

**Sources of Impacts and Potential Impacts during the Construction Phase**

| **Sources of Impacts during Construction** | **Potential Impacts during Construction** |
|---|---|
| Site clearance, grading, excavation and paving activities, which involve mobility of personnel and mobilization/ operation/ demobilization of Powered Mechanical Equipment (PME) | • Temporary visual impacts with the presence of equipment, machinery and workers<br>• Increase in air pollution, including Airborne particulates (dust) from soil disturbance<br>• Increase in vibration and sound levels<br>• Soil disturbance and potential impacts on land conditions and groundwater resources (e.g., changes in water drainage, erosion, runoff, sedimentation, grading)<br>• Induced potential secondary development during construction in the surrounding areas<br>• Accidental unearthing/disturbance of archaeological artefacts<br>• No major impacts from construction works are anticipated on species of fauna and flora and their habitats given the primarily urban nature of the project area<br>• Exposure of workers, pedestrians and passengers to potential asphalt odor and hazardous fumes during paving activities |
| Improper handling and storage of construction materials/raw-material as well as accidents: | • If construction works are not properly conducted and managed with safety measures considered, people passing near the construction site could be at risk<br>• Impacts resulting from any dewatering activities<br>• Impact on workers' and pedestrians' safety resulting from improper handling and storage of construction material and construction activities |
| • Traffic accidents<br>• Pipeline and/ or storage tanks fracturing, leakage, as well as explosion and fire hazards<br>• Potential sabotage (risk assessment and emergency response)<br>• Presence of: equipment, materials, soil heaps, and borrow pits, on main existing roads and the highway near commercial and industrial establishments and residential units | • Impact on the public's nuisance, health and safety in the heavily congested and dense corridors of Beirut and the coastal areas in the districts of Metn and Kesseruoan |
| • Potential loss of trees and vegetation in the median strip and highway shoulder | • Poor landscape and visual amenity, and less greenery in the local urban environment |
| Potential use of gensets (combustion of fossil fuel for the operation of the gensets) | • Change in ambient air quality |
| Workers' exposure to noise, dust and occupational | • Increased risks of accidents and health problems |

| Sources of Impacts during Construction | Potential Impacts during Construction |
|---|---|
| hazards | |
| Closing sections of the highway and creating detours to allow construction works and the movement of vehicles to transport people and materials | • Increased peak and off-peak traffic volumes at bottlenecks that will negatively impact people's daily activities (delays to reach destinations, discomfort, increase in noise levels, etc.)<br>• Potential negative impact on businesses (i.e. shops, markets, restaurants, cafes) on the highway resulting from temporary loss of customers or delays |
| Improper storage of chemicals and generated waste on-site | • No major impacts from construction works are anticipated on species of fauna and flora and their habitats given the primarily urban nature of the project area<br>• Chemical and biological contamination of soil and water resources<br>• Impact on workers' and pedestrians' safety resulting from improper handling and storage of chemicals and solid waste generated related to construction activities |
| Accidental spillage of chemicals like fuel, lubricants, oils and other chemicals used for construction works and/or operating the equipment and/or generating power | |
| Inadequate management (handling and disposal) of solid domestic and construction waste (including empty cement bags, piles of sand and dirt due to excavation, etc.), and generated domestic wastewater | |
| Asphalt application during the paving phase of the exclusive BRT lane construction | • Exposure of workers, pedestrians and passengers to potential asphalt odor and hazardous fumes during construction activities |
| Impacts resulting from poor implementation of a Traffic Management Plan during the construction of the BRT system | • Since significant part of the project involves construction on existing traffic routes, the successful or poor implementation traffic management plan will have tangible impacts on the existing traffic and the public using this traffic route |

**Sources of Impacts and Potential Impacts during the Operation Phase**

| Sources of Impacts during Operation | Potential Impacts during Operation |
|---|---|
| Operation and maintenance of the BRT System | • Enhancement of mobility for domestic and international tourists and highlighting of touristic and cultural heritage features along the bus route, which leads to the promotion of landmarks, museums and heritage assets<br>• Enhancement in mobility, road infrastructure and furniture: signage, road markings, signals, crossings<br>• Local small business development around bus stations to serve commuters<br>• Local public transport development around bus stations to further serve commuters (e.g. taxis)<br>• Socio-economic growth in the areas that have access to the BRT system through direct/indirect employment opportunities, increase in land value and attraction of development investments<br>• Short-term to medium-term potential decrease in traffic flow and speeds, and therefore increased congestion due to fewer lanes available for vehicular traffic, in the transition period until commuters switch to using the BRT System and become regular users<br>• Traffic creation at P&R facilities and at bus stations if passages and side road infrastructure within localities are not upgraded<br>• Short-term to medium-term potential increase in fuel demand due to the additional buses added to the fleet in the transition period until commuters switch to using the BRT System and stop using their cars<br>• Resource consumption for the operation of the buses and maintenance activities<br>• Potential soil contamination from accidental spills during maintenance and fueling activities (e.g. fuel, lubricant or oil used for the maintenance)<br>• Increase in noise levels especially during nighttime bus traffic<br>• Hazardous and non-hazardous waste generation from maintenance activities<br>• Solid Waste generation by passengers and operating personnel at stations and P&R facilities |
| Switching to BRT System from other modes of transportation (reduction of number of vehicles) | • Potential reduction in GHG emissions<br>• Potential reduction in emissions of air pollutants (CO, NOx, $PM_{10}$, $SO_2$) and GHGs<br>• Organization of the public transport sector would lead to reduction in traffic incidents thus road fatalities and injuries are reduced<br>• Time and monetary savings for users switching from use of private vehicles to the BRT running on a dedicated lane, with set time schedule and intelligent transportation system |

| Sources of Impacts during Operation | Potential Impacts during Operation |
|---|---|
| | • Higher rates of physical activity for BRT users due to longer walking distances which results in health benefits for BRT users<br>• Reduction in number of passengers using the current buses, thus reduction in passenger turnover and reduced incomes to current bus drivers due to passengers switching to the new BRT System |
| Provision of well-lit stations staffed with security personnel, security cameras on buses and in stations/P&R facilities, and pedestrian-scale lighting around stations | • Creation of a safer environment in the areas served by BRT System<br>• Better road and community safety due to both safer commuting and reduced exposure to road-traffic pollution |

**Given that the Project is at the feasibility stage and the System components will be subject to detailed design, it is imperative that the environmental and socio-economic mitigation and monitoring measures be revisited through site-specific ESIAs (with ESMPs). The site-specific ESIAs for the System components, i.e. BRT Corridors, Feeder Buses, P&R facilities, Depot and Terminal, reflect the final design and provide an update of the assessments and conclusions of this ESIA where needed (including baseline, assessment and mitigation measures) to address any gaps that could arise from the detailed design. The site-specific ESIAs should include:**

a. **Livelihood Restoration Plan (LRP):** Inclusive of a detailed socio-economic baseline of affected bus operators and businesses subject to temporary disruption with detailed measures to mitigate risks and impacts arrived at through consultation with the PAPs.

b. **Physical Cultural Resources (PCR) management plan:** a detailed plan should be prepared as part of the site-specific ESIAs to meet OP 4.11 requirements, in close coordination and consultation with the Directorate General of Antiquities, once the exact physical footprint and excavation depths for all affected plots are determined.

c. **Ambient air quality monitoring program**: Empirical primary data needs to be collected on ambient air quality immediately before and throughout BRT System operation, in order to gauge the anticipated positive environmental benefit.

**Environmental and Social Management Plan for the Design/Pre-Construction Phase**

| Source of Impact | Project Activities | Mitigation Measures |
|---|---|---|
| T.D.1. Impacts resulting from road closures, bottlenecks due to road works to construct the BRT | Design of Project implementation & construction | T. D.1 mitigations include:<br>a. For the northern highway, the construction of the Périphérique, A2 and the implementation of the A1 Highway widening project are crucial to reduce the impact of the BRT construction, which will require the closure of at least one lane of the existing network.<br>b. The bidders for the Construction Tender should be required to submit a Traffic Management Plan for the construction, and the quality of the TMP should be one of the criteria to be considered in the selection process of the contractor. The TMP should be shared with stakeholders and relevant authorities to inform communities when necessary and prevent additional disturbance to already congested traffic flow. The TMP should include the following considerations:<br>i. Ensure the diversion to alternate routes wherever possible will minimize traffic jams and bottlenecks and minimize traffic related accidents;<br>ii. Lane availability and minimization of traffic flows past the works site;<br>iii. Acceptable working hours and constraints, avoiding peak hours or public holidays whenever applicable;<br>iv. Agreement with local authorities on time scale for works and traffic delay requirements;<br>v. Identify road closures and prioritize order;<br>vi. Co-ordination with other planned road works;<br>vii. Establishment of incident management system for the entire duration of the works depending on the location.<br>c. The proposed Construction Management Plan of the selected contractor should show a compact construction phase as much as possible, and night shifts should be included in the construction program.<br>d. For the Outer and Inner Ring BRT lines, providing off-street parking to replace on-street parking is very important before the construction work. However, the time between the completion of these parking spaces and the beginning of the BRT implementation should not exceed one month in each area for residents and the workers not to get used to the high parking availability. |
| ACH.D.1 Potential damage to uncovered archaeological features during excavation | Design of Project implementation & construction | ACH.D.1. The Directorate General of Antiquities (DGA) should be notified of the exact locations where site works will occur and should be involved in the decision-making process during the planning phase of the project (Article 19, Law 166/LR of 1933), impacts on uncovered archaeological features will be reduced. This will allow to:<br>a. Institute the necessary measures that need to be considered in order to alleviate and mitigate any negative impacts on cultural heritage and archaeology;<br>b. Identify sensitive areas prior to starting groundworks, and when possible relocate project components; |

| Source of Impact | Project Activities | Mitigation Measures |
|---|---|---|
| | | c. Guarantee the application of the necessary measures for each project component and location;<br>d. Take into account the possible delays due to archaeological excavation and add them to the BRT construction schedule;<br>e. Determine the needed budgets to conduct any needed archaeological excavation works, studies and publications;<br>f. Set the technical specifications and the tendering procedure. |
| SE.D.1 Impact on other secondary public transport systems | Design of Project implementation & construction | SE.D.1 The preliminary assessment of the project already considered the wider Land Transport Sector Strategy that has been recently developed by the Ministry of Public Works and Transport (MoPWT). Thus reducing the chances for any conflict with future public transport developments |
| SE.D.2 Impact on city aesthetics caused by pedestrian bridges, bus stations, depots, terminals and pedestrian traffic | Design of Project implementation & construction | SE.D.2. Mitigation measures to improve visual amenity include:<br>a. Preserving and maintaining the landscaping of the entire system and promoting tree planting and homogenous visual design (signs, street lights, sidewalks, etc.) with the city design;<br>b. Ensure all future advertisement plans have a protocol and are integrated at different facilities and installed on buses without causing disturbance to commuters;<br>c. Develop a contemporary architectural design for all different components of the project while considering cultural values and the general aesthetics of the GBA. |
| SE.D.3 Land use, land acquisition and resettlement impacts | Design of Project implementation | SE.D.3 Mitigation measures to adequately prepare for change in land use, land acquisition and resettlement impacts include:<br>a. Evaluation of land acquisition procedures and compensation estimates in a Resettlement Action Plan (RAP) prepared in line with Law No. 58/1991 and World Bank OP 4.12<br>b. Assessing the impacts from the anticipated change in land use in the bus depot and terminal areas through a separate SEA study. |
| SE.D.4 Improper system design that does not accommodate persons with special needs and disabilities | Design of Project implementation | SE.D.4 The design of the BRT system both in terms of infrastructure and bus fleet should be in accordance to Law No. 220/2000 and its application Decree No. 7184/2011; relevant articles and design details are discussed in Section 3.2.1.2.9 |
| SE.D.5 Inflexible system design that does not allow future expansion of the system to cover other areas | Design of Project implementation | SE.D.5 The current design of the system serves the areas with high demand should also consider:<br>a. facilitating the integration of the system with existing bus networks that links Tripoli (north), Chtaura (east) and Saida (south);<br>b. facilitating the expansion of the system in terms of road networks with potential demand increase in the future; |

| Source of Impact | Project Activities | Mitigation Measures |
|---|---|---|
| | | c. facilitating the integration with other long term public transport plans (e.g. the railway project;<br>d. operation of the P&R facilities that would help commuters to use their private vehicles to reach to the closest point to the BRT system and continue their journey towards Beirut. |

**Environmental and Social Management Plan for the Construction Phase**

<table>
<tr><th>Source of Impact</th><th>Project Activities</th><th>Mitigation Measures</th></tr>
<tr><td>T.C.1. Increased traffic due to creation of detours during construction</td><td>During various construction activities that require traffic management</td><td>T.C.1 Besides the strict implementation of the measures T.D.1.a & T.D.1.b,<br>a. Management measures should include that any total closure of a road has to be published 2 weeks ahead, and information panels should be placed on the concerned road 1 month in advance. Those closures should be during off peak hours and at night if possible; adequate information signs should be placed 1 km before the closed road or as required on the surrounding road network if it is in the city. The possible detours should be mentioned on the information signs.<br>b. Full cooperation of the Construction contractor with the Internal Security Forces and Traffic police<br>c. Transfer services using water taxis, ferries from sea ports should be considered</td></tr>
<tr><td>AQ.C.1. Airborne particles (dust) from soil disturbance</td><td>Construction works (excavation, grading, movement of trucks, etc.)</td><td rowspan="2">AQ.C.1/AQ.C.2. Control measures for dust emissions:<br>a. Water for any earth moving close to the construction site to prevent visible dust emissions;<br>b. Using water in excavation works and milling (removal) of existing asphalt to suppress dust propagation;<br>c. Continuous application of water of disturbed surfaces that cannot be stabilized;<br>d. Water unpaved roads that is used for vehicular traffic and limit vehicle speed limits;<br>e. If water is not available segregation barriers (easily erectable boards 2.5m) should be applied to separate the construction works from sensitive receptors; specifically, at the median construction sites, the bus depots, P&R facilities;<br>f. Minimize large stockpiles of soil and excavation material, and whenever necessary enclose with side barriers and/or cover when not in use;<br>g. Soil and construction material that are susceptible to dust formation should only be transported in securely covered trucks.<br>AQ.C.2/A.C.3. Control measures for vehicular and equipment emissions:<br>a. Periodically check and conduct maintenance of the construction machinery and vehicles;<br>b. Regularly check engine oil and use engines/machinery/equipment with good efficiency and fuel combustion characteristics;<br>c. Use of catalytic converters and good quality fuels (Low Sulphur);<br>d. Stack height of generators should be at least 3 meters above ground;<br>e. Ensure availability of trained technicians and operators on site<br>f. Air quality monitoring at the project site during construction activities;<br>g. Conduct paving activities during off-peak hours to minimize exposure of receptors to odors, and use advanced application methods and machinery with built in exhausts;</td></tr>
<tr><td>AQ.C.2. Fugitive emissions during constriction works and odors from paving activities</td><td>Construction works (earth works, paving, pilling, machinery, etc.)</td></tr>
</table>

| Source of Impact | Project Activities | Mitigation Measures |
|---|---|---|
| AQ.C.3. Impacts on air quality from generators | Mobile diesel generators | h. Ensure the usage of Personal Protective Equipment (PPEs) (hard hat, gloves, masks, safety glasses, etc.). |
| N.C.1 Increase in vibration and noise levels from general construction activities, and movement of construction vehicles | Heavy machinery and generators operation<br>Transport of raw material, construction waste, workers, and traffic congestion resulting from detours and construction activities | N.C.1. Control measures for noise and vibration propagation:<br>a. Preparation of noise control plan by the contractor depending on the location prior to the commission of activities to take the proper measures based on site characteristics and distance from receptors;<br>b. Install noise barriers where necessary, especially at the median section where there is continuous traffic and movement of potential receptors;<br>c. Ensure periodic monitoring of noise levels during peak construction activities to ensure noise levels are not increased more than 3 dBA;<br>d. Impose speed limits on construction vehicles;<br>e. Using horns should be prohibited by construction vehicles and trucks on the access roads and on construction sites;<br>f. Utility of efficient equipment and less-noisy design alternatives, and ensure maintenance and repair of machinery and equipment;<br>g. Construction works should be limited in time, and based on the location only work during daytime, and restrict use of noise equipment and apply sequential operation schedule to reduce continuous noise generation;<br>h. Whenever possible enclose noisy equipment and generators to reduce noise levels;<br>i. Consultation with sensitive receptors (hospitals, hotels, schools, etc.) and notification during peak construction activities; take maximum noise reduction measures nearby sensitive receptors.<br>j. Restrict noise-generating construction activities to the allowable hours of construction as identified by local jurisdictions where feasible. Construction is generally allowed to start at 7:00 a.m., Monday through Friday. Construction activities should end by 6:00 p.m., Monday through Friday, in most of the communities around the project area. No construction activities should occur on Sundays or holidays. If work is necessary outside of these hours, local jurisdictions shall require the contractor to implement a construction noise monitoring program and, if feasible, provide additional mitigation as necessary (in the form of noise control blankets or other temporary noise barriers, etc.) for affected receptors.<br>k. Limit pile driving to daytime hours only.<br>l. Equip all internal combustion engine driven equipment with intake and exhaust mufflers that are in good condition and appropriate for the equipment.<br>m. Prohibit unnecessary idling of internal combustion engines within 30 meters of residences.<br>n. Locate stationary noise generating equipment as far as possible from sensitive receptors. |

| Source of Impact | Project Activities | Mitigation Measures |
|---|---|---|
| | | o. Utilize "quiet" air compressors and other "quiet" equipment where such technology exists.<br>p. Avoid staging of construction equipment within 65 meters of residences and locate all stationary noise-generating construction equipment, such as air compressors, portable power generators, or self-powered lighting systems as far practical from noise sensitive receptors.<br>q. The contractor shall prepare a detailed construction plan identifying the schedule for major noise-generating construction activities and distribute this plan to adjacent noise-sensitive receptors. The construction plan should also list the construction noise reduction measures identified in this study. |
| SWR.C.1. Site Clearance and demolition activities | Beginning of construction activities and clearance of sites | SWR.C.1. Construction and activities will include excavation works and soil compaction in the immediate vicinity as a result of vehicle and construction equipment operations. However, since most of the BRT path is already along an existing highway in an urbanized area then no valuable soil loss and/or topographic / hydrologic adverse impacts are expected along the project path. Construction will require sourcing of raw materials including aggregates some of which will be sourced from local quarries. Such demand for aggregate materials have a cumulative effect on the adverse impacts resulting from quarries involving geology hydrology and groundwater.<br>The following mitigation measures shall be respected:<br>a. Cover and contain stockpiles to protect them from being carried away by wind and runoff water;<br>b. Source aggregate materials from quarries operated by companies with high Environment, Health and Safety Management standards, with quarry rehabilitation plans in place, and with a reputable history of implementing such rehabilitation plans. |
| SWR.C.2. Accidental spills or leaks of fuel, oil and other chemicals | During various construction phases (grading, paving, installation and building of structures, etc.) | SWR.C.2. Mitigation measures to minimize any potential spills and leaks:<br>a. Store and handle any type of chemical, oil, fuels and lubricants within contained facilities (e.g. bunded areas, leak proof trays) designed to prevent the release of spills/leaks to the soil and groundwater environment;<br>b. Put in place a maintenance schedule as part of the inspection procedures of all equipment/generators/machinery for risk minimization;<br>c. Maintain machines and equipment off-site or onsite in a contained area with impermeable concrete pavement and drainage for vehicle washing and maintenance;<br>d. Oil spill response kits should be available wherever oils are being used/stored;<br>e. Promote awareness among workers on how to handle oil/lubricants;<br>f. Train workers how to clean up small scale spills;<br>g. Promote good housekeeping practices during construction;<br>h. Ensure drip trays are present when re-fueling;<br>i. Prepare a Spill Emergency Plan specific for the project;<br>In case of spill: |

| Source of Impact | Project Activities | Mitigation Measures |
|---|---|---|
| | | j. Immediately report to the company representative in case of any spill;<br>k. Stop the source of spill (close valve, seal pipe, seal hole or as appropriate);<br>l. Check for hazards, flammable matters on site;<br>m. Clean the spill by removing affected top soil layer by trained employees (they should be wearing appropriate PPE);<br>n. Treat the removed soil as hazardous waste;<br>o. Adopt as much as possible dry cleaning techniques to decrease resulting wastewater, and to avoid flushing of spills to deeper soil layers. |
| SWR.C.3. Inadequate storage and disposal of solid wastes | During various construction phases, mainly during clearance and demolition of existing structures | SWR.C.3. The potential impact resulting from Poor Waste Management should be reduced by implementing the following measures:<br>a. Segregate at source domestic waste, construction waste that can be reused, construction waste to be disposed of, etc.<br>b. Sort excavation waste resulting from construction activities:<br>c. Reuse part of the excavation waste in backfilling; and dispose of the rest (if any) in a permitted construction and demolition waste dump designated by the respective Municipality in agreement with the MoE;<br>d. Schedule the works for the dry season if possible;<br>e. Progressively carry out rehabilitation of disturbed areas following completion of work in each area (rehabilitation will include reinstatement of soil, surface leveling, re-vegetation and mulching where applicable);<br>f. Ensure that standards of "good housekeeping" are maintained (i.e., avoiding littering, preventing storage of combustible waste for more than 24 hours to prevent attraction of pests and flies).<br>g. Stockpiles shall be covered and contained to avoid them being transported by wind and rain. |
| SWR.C.4. Inadequate storage and disposal of wastewater generated | Operation of equipment, machinery and workers on site | SWR.C.4. To ensure that no groundwater contamination results from poor wastewater management, the below should be taken into consideration:<br>a. Provide fully impermeable septic/ holding tanks;<br>b. Empty septic/ holding tanks according to an adequate frequency ensuring they are never full;<br>c. Regular inspection of septic/ holding tanks;<br>d. Obtain a permit from the Municipality to transport and discharge the wastewater and sludge in authorized sites;<br>e. Vehicle washing shall be only in contained maintenance areas offsite or onsite with impermeable concrete pavement and proper drainage. |
| SWR.C.5. Potential dewatering activities | During various construction activities | SWR.C.5. Impacts from dewatering shall be alleviated by adopting the following measures:<br>a. Testing of dewatered water should be performed prior to reuse or disposal to ensure the lack of |

| Source of Impact | Project Activities | Mitigation Measures |
|---|---|---|
| | that involve excavation and unearthing | petroleum products in it and oil-water separators shall be used as a minimum prior to disposal at municipality and MoE approved disposal locations.<br>b. Water produced from dewatering, if not contaminated with petroleum products, shall be used for dust suppression as needed or can be discharged in the storm water but only after being settled and filtered from sediments and conditional to approval by local municipalities. |
| ACH.C.1. Accidental unearthing/damage to archaeological findings during excavation | During various construction activities that involve excavation and unearthing | ACH.C.1. By involving the DGA since the planning phase will also be beneficial to the construction phase, if any chance findings were to occur during the construction phase. By applying the following mitigation measures, impacts on archaeology will be reduced:<br>a. Coordinate with the DGA to set a procedure if any chance findings were to occur;<br>b. Stop works immediately;<br>c. Secure the site area;<br>d. Inform the DGA. No actions should be taken prior to the DGA's investigation;<br>e. Construction works can only recommence after permission is given by the DGA. |
| B.C.1. Impacts on biodiversity during site clearance and excavation of P&R facilities, depot and terminal | Construction works involving excavation and clearance at P&R facilities | B.C.1. Based on the description of the biological environment, the anticipated project will not lead to significant negative impacts on biodiversity. The main construction activities having negative results on biodiversity are earth-moving activities, generation of construction waste material and wastewater effluent discharges. Waste resulting from construction works and any other activity should be disposed of in an allocated disposal site in agreement with the Municipality. Littering in the project area and surrounding areas should be prevented.<br>Recommended mitigation measures to minimize or eliminate construction impacts on biodiversity at the proposed location include:<br>a. Adopt a landscape plan that includes native trees, shrubs and herbs (Listed in APPENDIX L) to enhance the visual aspect of the facility and play a role of reintroduction of native plant species to the areas;<br>b. Include *Pancratium maritimum* (APPENDIX L) at P&R6 facility landscape plan since it is coastal plant that grows only on sandy beaches;<br>c. Removal of exotic plants species and weeds;<br>d. Management of landscaping plan to prevent growth of weeds and exotic species and allow propagation and survival of native species;<br>e. Proper disposal of domestic and construction waste and of the waste removed from the current dumpsite;<br>f. Enclosing all fine earth materials during transportation to and from the site to prevent spillage and dusting;<br>g. The transportation of lubricants and fuel to the construction site should only be conducted in the appropriate vehicles and containers, i.e. fuel tankers and sealed drums;<br>h. Proper storage and prompt transportation of construction material to prevent them from being washed |

| Source of Impact | Project Activities | Mitigation Measures |
|---|---|---|
| | | away during rainfall or carried by wind. |
| B.C.2. Site clearance and excavation of Beirut-Tabarja trunk-line and station infrastructure | Construction works involving excavation and clearance on Beirut-Tabarja trunk-line and stations | B.C.2. Proposed mitigation measures for the prevention and minimization of impacts from the removal of vegetation at the median section are:<br>a. Adopt a landscape plan at stations where possible that includes native trees, shrubs, herbs (APPENDIX L) and climbers (*Lonicera etrusca*) which will enhance the visual aspect of the stations and play a role of reintroduction of native plant species to the areas;<br>b. Removal of the very destructive invasive tree *Ailanthus altissima* from sides of streets in Jounieh and Kaslik areas and replacing them with native trees (APPENDIX L);<br>c. Plant a native tree for every tree that is removed. If no place is available on the line or at stations, another place should be found to plant these trees such as sidewalks, abandoned public lands on sides of streets, public gardens;;<br>d. Remove olive trees planted in the median strips to be relocated in different places or sidewalks as mentioned above;<br>e. Avoid removal of the very old tree at the intersection of Charles Helou and George Haddad because it is very big and old and no tree will replace it.<br>f. Proper disposal of domestic and construction waste and of the waste removed from the current dumpsite;<br>g. Enclosing all fine earth materials during transportation to and from the site to prevent spillage and dusting;<br>h. The transportation of lubricants and fuel to the construction site should only be conducted in the appropriate vehicles and containers, i.e. fuel tankers and sealed drums;<br>i. Proper storage and prompt transportation of construction material to prevent them from being washed away during rainfall or carried by wind. |
| B.C.3. Site clearance and excavation of Beirut Outer ring | Construction works involving excavation and clearance on Beirut Outer ring | B.C.3. Proposed mitigation measures for the prevention and minimization of impacts on vegetation at the median section of the Outer Beirut Ring are:<br>a. Adopt a landscape plan at stations where possible that includes native trees, shrubs, herbs (APPENDIX L) and climbers (convolvulus sp.) which will enhance the visual aspect of the stations and play a role of reintroduction of native plant species to the areas;<br>b. Plant and allow to propagate *Matthiola crassifolia*, all Limonium species, *Crithmum maritimum* and *Urginea maritima* in public gardens and spaces along the Beirut sea side strip to compensate for the loss of the green areas at stations. *Matthiola crassifolia* is a native plant species that is endemic to Lebanon and threatened according to the IUCN red list. Its protection and propagation will bring a positive impact for the project on the biodiversity of the area. In addition, there is a need to allow the above mentioned plants to grow along the median strip of the sea side road in Beirut and remove the exotic species gradually; |

| Source of Impact | Project Activities | Mitigation Measures |
|---|---|---|
| | | c. Plant a native tree for every tree that has to be removed. If no place is available on the line or at stations, another place should be found to plant these trees such as sidewalks, abandoned public lands on sides of streets, public gardens such as the public garden under the cola bridge in Beirut;<br>d. Proper disposal of domestic and construction waste and of the waste removed from the current dumpsite;<br>e. Enclosing all fine earth materials during transportation to and from the site to prevent spillage and dusting;<br>f. The transportation of lubricants and fuel to the construction site should only be conducted in the appropriate vehicles and containers, i.e. fuel tankers and sealed drums;<br>g. Proper storage and prompt transportation of construction material to prevent them from being washed away during rainfall or carried by wind. |
| B.C.4. Impacts on biodiversity during site clearance and excavation of P&R facility (8), Safra depot and Tabarja terminal | Construction works involving excavation and clearance of Safra depot, P&R (8) and Tabarja terminal | B.C.4. Recommended mitigation measures to minimize or eliminate construction impacts on biodiversity at the proposed location include:<br>a. Prohibition of unnecessary cutting or damaging of mentioned native trees within or surrounding the proposed sites;<br>b. If removal of certain trees was necessary, plant a native tree for every tree that has to be removed. If no place is available within the site, another place should be found to plant these trees such as sidewalks, abandoned public lands or public gardens;<br>c. Adopt a landscape plan that includes native trees, shrubs and herbs (APPENDIX L) to enhance the visual aspect of the facility and play a role of reintroduction of native plant species to the areas;<br>d. Removal of invasive, exotic plants species and weeds (e.g. *Ailanthus altissima*)<br>e. Management of landscaping plan to prevent growth of weeds and exotic species and allow propagation and survival of native species;<br>f. Proper disposal of domestic and construction waste and of the waste removed from the current dumpsite;<br>g. Enclosing all fine earth materials during transportation to and from the site to prevent spillage and dusting;<br>h. The transportation of lubricants and fuel to the construction site should only be conducted in the appropriate vehicles and containers, i.e. fuel tankers and sealed drums;<br>i. Proper storage and prompt transportation of construction material to prevent them from being washed away during rainfall or carried by wind.<br>j. Prevention of littering in the area. |
| HS.C.1. Impact on | During various | HS.C.1. Mitigation measures of SWR2, SWR3, AQ1 and AQ2 contribute indirectly in reduction of potential |

| Source of Impact | Project Activities | Mitigation Measures |
|---|---|---|
| workers' and pedestrians' safety resulting from improper handling and storage of construction material and construction activities | construction activities that generates waste and requires raw materials | impacts resulting from improper handling and storage of construction materials and construction activities. In addition:<br>a. The contractor should have a clear and detailed safety protocol to be applied at all time and accordingly train all workers and staff of safety procedures;<br>b. The contractor should monitor the application of the safety protocol and ensure the safety of workers, the commuters and traffic in the vicinity of the project site; |
| HS.C.2. Impact on workers' and pedestrians' safety resulting from improper handling and storage of chemicals and waste generated related to construction activities | During various construction activities | HS.C.2. Mitigation measures of SWR2, SWR3, SWR4, AQ1 and AQ2 contribute indirectly in reduction of potential impacts resulting from improper handling and storage of chemicals and waste generated related to construction activities. In addition:<br>a. The contractor should have a clear and detailed safety protocol to be applied at all time and accordingly train all workers and staff of safety procedures;<br>b. The contractor should monitor the application of the safety protocol and ensure the safety of workers, the commuters and traffic in the vicinity of the project site;<br>c. Periodic audits should be conducted for on-site waste management practices, waste disposal contractors and disposal facilities at different construction sites. |
| HS.C.3. Workers exposure to occupational hazards (e.g. noise, air pollution, dust, fire hazards, etc.) and potential for accidents | During various construction activities | HS.C.3 Mitigation measures of AQ1, AQ2, N1, N2, SWR2, SWR3, SWR4 indirectly contribute to mitigating impacts on workers. In addition, there should be detailed safety protocol, and all workers should be trained upon that protocol. The safety should consider:<br>a. Installing proper barricades, signs, providing flags, lights and personnel to control the traffic and separate the construction area from potential receptors;<br>b. Movement of trucks, loading and piling construction or excavation material, and building elevated structures;<br>c. Provide PPEs to workers and personnel on construction sites; assure proper signage of all construction areas (zoning areas) and storage location of hazardous material.<br>d. Emergency plans/ evacuation plans in case of injuries and accidents |

| Source of Impact | Project Activities | Mitigation Measures |
|---|---|---|
| SE.C.1. Induce potential secondary development and impact on utility provision during project construction | During various construction activities | SE.C.1. Some of the mitigation actions that can prevent impacts caused on utility services and secondary developments include:<br>a. Surveying and evaluating the utility infrastructure (water pipes, electricity lines, sewerage networks etc.) and the developments surrounding the construction sites (residential buildings, industries, businesses etc.) prior construction planning;<br>b. Contractors should assess construction locations in advance for potential disruption to services and already executed/planned developments, and identify risks;<br>c. If temporary disruption is unavoidable, the contractors in collaboration with local authorities should develop a construction plan that would minimize the disruption and communicate the dates and duration to respective stakeholders;<br>d. Potential receptors surrounding the construction sites should be informed in advance regarding utility shifts and major constructions that might impact their activities;<br>e. Specific elevated structures such as pedestrian bridges along the BRT line should be studied with utility master plans and construction activities planned accordingly to ensure to existing surroundings and utilities are minimized |
| SE.C.2. Impacts on visual amenity due to landscape change and new constructions | During various construction activities | SE.C.2 Minor visual impacts are expected from the construction activities and installation of work camps, since most of the construction area is already urban, however certain measures can be taken to minimize impact:<br>a. Proper enclosure or the construction camps at different sites, specifically at the median section, where the erected barriers can include the final design of the BRT system, which would motivate commuters and provide positive advertisement for the BRT system;<br>b. Plan the movement of equipment and materials during times of least visual impact (e.g. work day start and end) where applicable;<br>c. Locate piles and topsoil in visually unobtrusive locations where practical;<br>d. Use existing roads and tracks where applicable instead of creating off-road tracks, and minimize length and width of the created road when necessary;<br>e. Minimize construction time near sensitive visual receptors;<br>f. Duration of the construction activities should be optimized to avoid installation of work camps for long periods, and the barriers should be uninstalled in short time following the completion of works/decommissioning;<br>g. Proper landscaping that promotes tree planting and unified visual design (signs, street lights, sidewalks, etc.) |

**Environmental and Social Management Plan for the Operation Phase**

| Source of Impact | Project Activities | Mitigation Measures |
|---|---|---|
| T.O.1. Traffic congestion during the execution of the project and the operation | Beginning of operation and passenger shift to BRT system | T.O.1. An important factor in reducing the grace period and the time for transport mode change is the advertisement of the BRT system. Discounted fares and tickets, promotion of Intelligent Transportation Systems (ITS) can be used to attract commuters and facilitate faster shift from use of private cars to using buses |
| T.O.2. Traffic congestion at P&R facilities and at bus stations if no upgrading of roads and infrastructure takes place | During the operation of the BRT system | T.O.2. Traffic congestion at P&R facilities can be reduced/prevented if rehabilitation of roads is integrated with the BRT project that will ensure serving the demand with the available facilities. Providing facilitates (e.g. auxiliary pedestrian platforms connecting P&R facilities to the stations, traffic management corridors and signage, etc.) that would ease pedestrian and traffic flow would contribute to avoiding traffic and faster interchange between commuter modes |
| SWR.O.1. Fueling and maintenance operation | During relatively deeper excavation works | SWR.O.1 To ensure the minimum contamination of soil and groundwater in case of any spill or leakage, the below shall be implemented:<br>a. Promote awareness among workers on how to handle oil/lubricants;<br>b. Promote good housekeeping practices;<br>c. Put in place a maintenance schedule as part of the inspection procedures of all storage tanks and pipes for risk minimization;<br>d. Use standardized fuel spill prevention system for locomotive fueling, including automatic shut-off systems;<br>e. Storage tanks and components shall meet international standards for structural design integrity and operational performance to avoid catastrophic failures during normal operation and during exposure to natural hazards and to prevent fires and explosions;<br>f. Storage tanks shall have appropriate secondary containment, including procedures for the management of containment systems. Appropriate secondary containment should satisfy the following:<br>i. Consist of berms, dikes, or walls capable of containing the larger of 110 percent of the largest tank or 25% percent of the combined tank volumes in areas with above-ground tanks with a total storage volume equal or greater than 1,000 liters and will be made of impervious, chemically resistant material;<br>ii. Consider means to prevent contact between incompatible materials in the event of a release; |

| Source of Impact | Project Activities | Mitigation Measures |
|---|---|---|
| | | g. Transfer of hazardous materials from vehicle tanks to storage in areas with surfaces sufficiently impervious to avoid loss to the environment and sloped to a collection or a containment structure not connected to municipal wastewater/storm water collection system;<br>h. Leak detection may be used in conjunction with secondary containment, particularly in high-risk locations. Leak detection is especially important in situations where secondary containment is not feasible or practicable, such as in long pipe runs, these include:<br>i. Use of automatic pressure loss detectors on pressurized or long distance piping;<br>ii. Use of approved or certified integrity testing methods on piping or tank systems, at regular intervals.<br>SW6. In case of underground storage tanks; the following shall be applied:<br>i. Assessing local soil corrosion potential, and installing and maintaining rust protection for steel tanks;<br>j. For new installations, installing impermeable liners or structures (e.g., concrete vaults) under and around tanks and lines that direct any leaked product to monitoring ports at the lowest point of the liner or structure;<br>k. Monitoring the surface above any tank for indications of soil movement;<br>l. Reconciling tank contents by measuring the volume in store with the expected volume, given the stored quantity at last stocking, and deliveries to and withdrawals from the store;<br>m. Consider the monitoring groundwater of quality down gradient of underground storage locations, if possible;<br>n. Evaluating the risk of existing underground storage tanks, if any, in newly acquired facilities to determine if upgrades are required or if they should be replaced or abandoned. |
| SWR.O.2. Hazardous and non-hazardous wastes from maintenance activities | Operation and maintenance of equipment and machinery | SWR.O.2. To ensure the minimum contamination of soil and groundwater from wastes generated from maintenance activities, the below should be taken into consideration:<br>For hazardous material:<br>a. Training of operators on release prevention, including drills specific to hazardous materials as part of emergency preparedness response training;<br>b. Use of aqueous detergent cleaning solutions or steam cleaning, or use and recycling of aliphatic cleaning solvents (e.g. 140 solvent);<br>c. Use of water-based paints;<br>For Wastewater:<br>d. Use of ultrafiltration to extend the life of washing solutions for aqueous parts or use of alternatives to water cleaning (e.g. dry cleaning by wire brush or bake oven);<br>e. Plumbing connection of floor drains, if any, in maintenance areas to the wastewater collection and treatment system;<br>f. Prevention of discharge of industrial wastes to septic systems, drain fields, dry wells, cesspools, pits, or separate storm drains or sewers. Keep wastewater from service bays out of storm drains by constructing |

| Source of Impact | Project Activities | Mitigation Measures |
|---|---|---|
| | | berms or other barriers;<br>g. Depending on the volume of contaminants present in the wastewater, and whether the BRT facility is discharging into a municipal system or directly to surface waters, pretreatment of effluents may be necessary to reduce contaminant concentrations. Pretreatment systems typically consist of oil / water separators, biological and chemical treatment, and activated carbon systems.<br>For Waste Management:<br>h. Understanding potential impacts and risks to soil and water resources associated with the management of any generated hazardous waste;<br>i. Establishing waste management priorities at the outset of activities based on an understanding of potential soil and water resources risks and impacts and considering waste generation and its consequences;<br>j. Establishing a waste management hierarchy that considers prevention, reduction, reuse, recovery, recycling, removal and finally disposal of wastes;<br>k. Apply the proper storage and disposal of wastes. |
| SWR.O.3 Solid waste generated from passengers at different facilities | Operation and maintenance of equipment and machinery | SWR.O.3 To ensure the minimum contamination of soil and groundwater from general waste at Park and Ride Facilities, the below should be taken into consideration:<br>a. Instituting a solid waste recycling program, depending on the existence of local facilities, with labeled waste containers in the Park and Ride Facilities for metals, glass, paper, and plastics. Food establishments should segregate compostable and other food waste for recycling as agricultural fertilizer and animal feed;<br>b. Passenger bus operators and cleaning contractors should be encouraged to segregate waste in the buses by separating the collection of newspapers / papers, plastic, and metallic containers. |
| B.O.1. Impacts on biodiversity during regular operation | During operation of the BRT system and utility of different facilities | B.O.1. Recommended mitigation measures to minimize or eliminate the impacts of project operation on biodiversity include:<br>a. Protection of the natural plant species that may grow on sidewalks and median strips along the line such as *Matthiola crassifolia*, *Limonium* sp, *Crithmum maritimum* and *Urginea maritima*;<br>b. Removal and management of weeds and exotic and invasive species;<br>c. Proper management of liquid and solid waste generated by the project;<br>d. Prevention and control spills of fuel and oil. |

| Source of Impact | Project Activities | Mitigation Measures |
|---|---|---|
| SE.O.1. Impact on livelihood of current bus drivers and public transport operators due to passenger shift to BRT | During the execution of the BRT system and long term operation | SE.O.1. The project has considered options and incentives to encourage local operators to join the new BRT and bus concessions. Such incentives include requiring the new concessionaires to buy or rent a number of existing red plates from the small operators, the recruitment and training of drivers, encouraging local operators to join as shareholders and partners into the new concessions, and allowing operators to continue operations along the new bus and BRT lines according to specifications (schedule, bus requirements…) agreed with the concessionaires and public authorities.<br>Since it is expected that the project will contribute to increasing the overall demand for public transportation in Lebanon, new markets are anticipated to be created and new passengers attracted to the system. This will benefit local operators since not all trips and destinations will be covered by the new system and many new passengers will still need an additional public transportation mode to bring them closer to their final destination. The existing local operators are therefore expected to adjust their operations in accordance with the newly generated demand, resulting in complementary systems. |
| SE.O.2. Resource consumption for the operation of buses and for maintenance activities | During the operation of the BRT system buses | SE.O.2. Maintenance and fueling of the BRT buses is necessary. There are negligible to minor impacts related to resource consumption, which can be reduced through maintaining the buses in good conditions and ensuring their operation efficiency. This ultimately contributes to less fuel consumption per trip and reduced requirement for major maintenance works |
| SE.O.3 Frequent bus stops and multiple stations leading to the increase in travel time and discouraging BRT system users | During the operation of the BRT system buses | SE.O.3 The feasibility of the system and the design take into consideration all factors related to passenger demand, size of the fleet, positioning of the stations, the required space, number of stations and the distance between stations to optimize the operation of the system and provide efficient and fast service to the commuters. |
| SE.O.4 Impact on safety due to lack of monitoring, selection of drivers, etc. | During the operation of the BRT system buses | SE.O.4 To ensure public safety and eliminate commuters' unease, the BRT system should:<br>a. Install CCTV system that monitors all activities at the terminals, stations and P&R facilities in addition to the buses;<br>b. Secure access to different facilities through installation of barriers and enclosed fences to allow only commuters with the dedicated passes to access the system;<br>c. Provide security personnel wherever necessary to control the crowd and monitor any suspicious activities;<br>d. Enforce the operators to develop an eligibility criteria for recruiting the drivers and system operators that |

| Source of Impact | Project Activities | Mitigation Measures |
|---|---|---|
| | | are in constant interaction with the commuters, and provide training to ensure efficient and safe operation of the system;<br>e. Include evacuation plans at all facilities and emergency preparedness plans;<br>f. Include proper timetables, traffic signs and directions on all buses and stations accommodating all commuters without any discrimination. |
| SE.O.5 Difficulty in changing the behavior of people to stop using their cars and shift to the BRT system | During the operation of the BRT system buses | SE.O.5 Specifically during the launching of the BRT system and thereafter awareness campaigns should be conducted to encourage people to use the BRT system in addition to incentive schemes. This can be achieved through general media, advertisements, social media, awareness campaigns at different locations tackling various social groups. Proving the efficiency of the system and advertising its advantages play a major role in changing the behavior of the public and encouraging commuters to use the buses instead of their personal vehicles. |

# 1. INTRODUCTION

## 1.1 GENERAL OVERVIEW

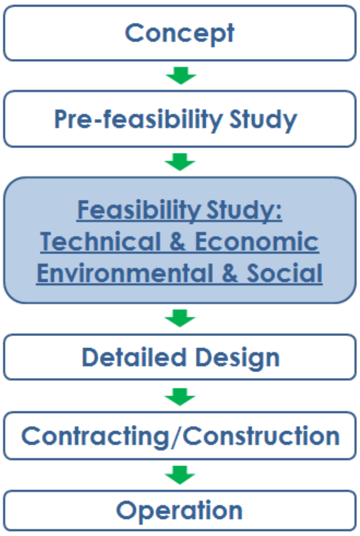
Earth Link and Advanced Resources Development s.a.l. (ELARD) (the "ESIA Consultant"), in cooperation with Egis International, was appointed by the Council for Development and Reconstruction (CDR) (the "Project Proponent") to conduct an Environmental and Social Impact Assessment (ESIA) and Resettlement Action Plan (RAP) for the Bus Rapid Transit (BRT) system between Tabarja and Beirut and feeders buses services (the "Project").

In November 2015, the World Bank (WB) prepared the "Pre-feasibility report for a Bus Rapid Transit system for Greater Beirut". In November 2016 and following the results of the pre-feasibility study, the CDR commissioned Khatib & Alami Engineering Group s.a.l. (the "Engineering Consultant") to prepare the "Feasibility Study for the Greater Beirut Urban Transport Project (GBUTP)". The objective of the GBUTP is to improve transport connectivity and mobility on the coastal corridor located to the North of Beirut. This objective will be achieved through:

(i) the construction of a new Bus Rapid Transit (BRT) system between Tabarja and Beirut and within Beirut,

(ii) the establishment of feeder bus services to the trunk BRT line, and

(iii) the establishment of appropriate institutional arrangements for the management, operation and maintenance of the new mass transit system.




In parallel, the CDR commissioned ELARD to prepare the ESIA and RAP components of the Project. The ESIA aims at identifying and assessing possible environmental and social impacts resulting from the Project and proposing measures to minimize the significance of negative impacts and maximize the benefits of positive ones.

This approach, developing the feasibility and ESIA studies in tandem, will shed the light on environmental and social components to be considered during the feasibility study and will allow for a better integration of environmental and social components in the Project's detailed design phase.

It is to be noted that within the Support Programme for Infrastructure Sector Strategies and Alternative Financing (SISSAF) project a Land Transport Sector Strategy has been recently developed by the Ministry of Public Works and Transport (MoPWT). As shown in Figure 1-1, one of the strategy's programmes is a public transport component and thus the Project falls within the Strategy's objectives.

A Strategic Environmental Assessment (SEA) for the Land Transport Sector Strategy was prepared and is, at the date of preparation of this ESIA Report, undergoing review by the Ministry of Environment (MoE). It is important to note that the Project's ESIA Report is aligned with the SEA's outcomes.

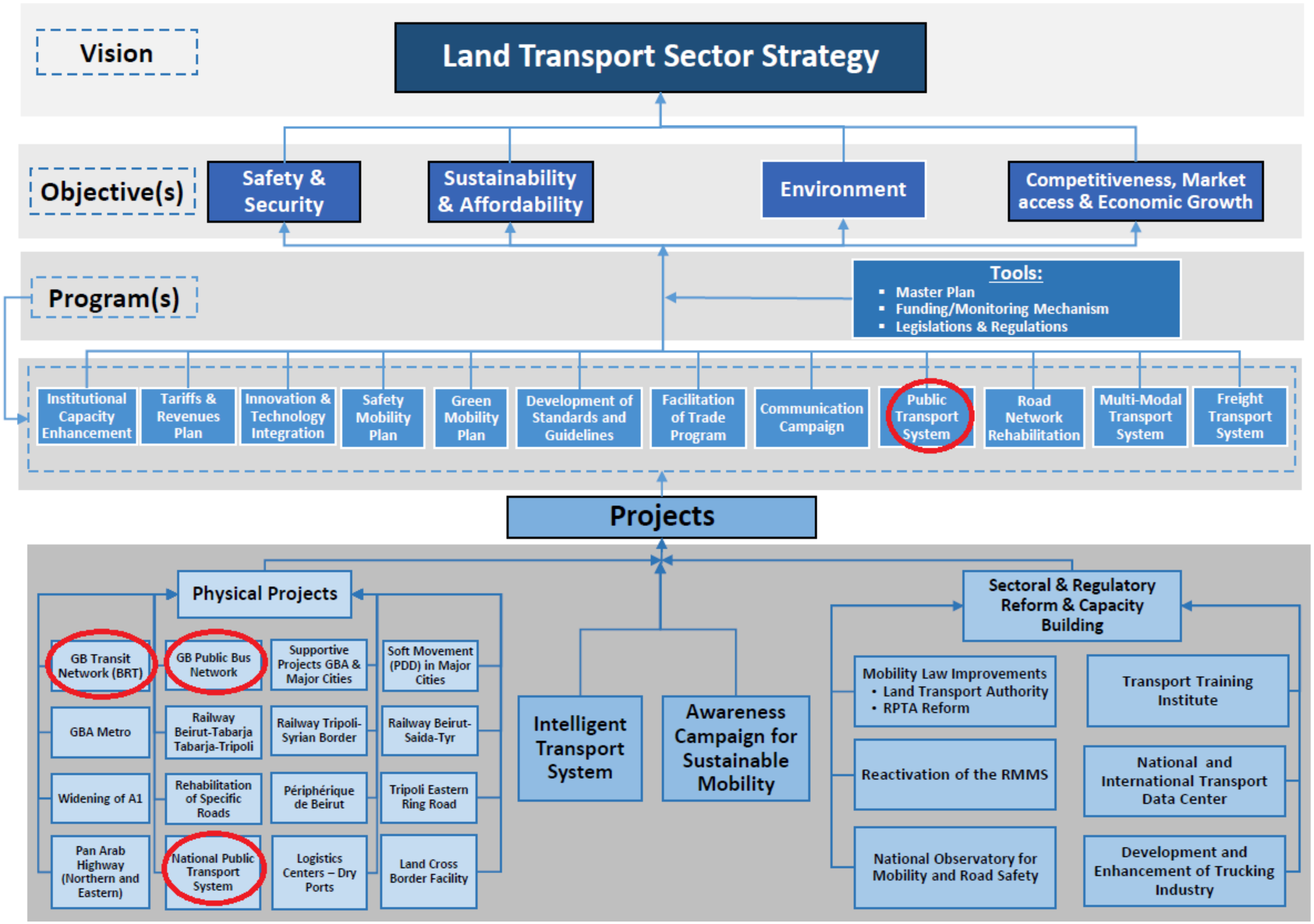



**Figure 1-1. Overview of the Land Transport Strategy and the Public Transport Components**

## 1.2 PROJECT PROPONENT: COUNCIL FOR DEVELOPMENT AND RECONSTRUCTION

The Council for Development and Reconstruction (CDR), established through Decree No. 5/1977, is the Project Proponent and the governing agency responsible for the Project at this stage of its study, which is the technical and economic feasibility assessment.

The World Bank (WB) prepared the "Pre-feasibility Report for a Bus Rapid Transit System for Greater Beirut" and will be appraising the Project for funding based on the outcomes of the Feasibility Study and Environmental and Social Assessments. When the Project is approved for implementation, the CDR will be responsible for its construction while the operation will be under the jurisdiction of the Railways and Public Transport Authority (RPTA).

## 1.3 ESIA PRACTITIONER: ELARD

ELARD s.a.l. is a highly specialized consulting firm that employs professionals in the field of applied earth and environmental sciences, including solid waste management, water resources management and development, water and wastewater treatment, pollution containment and abatement, and environmental policy development and institutional strengthening. ELARD focuses on providing assistance to private developers, industries and public agencies in finding cost effective solutions for highly specialized and complex problems related to the management of natural resources, and the protection of the environment.

Founded in Beirut, Lebanon in 1996, the firm quickly expanded to become one of the leading environment and water resources management consulting firms in the region, offering its services in the Middle East and the Gulf. With established offices in Lebanon, Syria, the United Arab Emirates, Iraq, Libya, and Mozambique, field offices are opened on an as-needed basis, as was the case in Pakistan for an extensive groundwater resource assessment project.

ELARD has accumulated hands-on experience in preparing Environmental Impact Assessments (EIAs) and Environmental Baseline Surveys (EBS) related to the development/construction sector, the industrial sector (power generation, cement manufacturing, Wastewater Treatment Plants (WWTPs), etc.), the transportation sector (highways and parking areas) and the oil and gas sector (onshore seismic, well exploration and drilling operations, oil refining, among others).

ELARD has vast experience in the establishment of objective-oriented, cost-effective and practical Environmental and Social Management Plans/Procedures tailored to the local settings of individual projects, Project Proponent's own health, safety and environmental policies and international guidelines and codes of practice.

## 1.4 ESIA STUDY AND REPORT STRUCTURE

The Environmental and Social Impact Assessment (ESIA) is a decision-making tool to systematically identify the environmental and social impacts of new projects. It aims to evaluate, prevent and mitigate any adverse impacts generated by a project while maximizing its benefits. A list of technical and non-technical references was used to complement and complete the ESIA Study (APPENDIX A). List of all participants in the preparation of the ESIA is attached in APPENDIX B.

According to Appendix 1 of the EIA Decree (Decree No. 8633/2012), the Project requires an EIA (point 6: construction of roads, bridges, railways, and tunnels). As per the required procedure, a screening form was prepared and submitted to the MoE. The MoE's response, provided in APPENDIX C, confirmed that an EIA is required.

The overall role of the ESIA Consultant is to prepare the ESIA Study Report for the Project in order to:

- Help the client identify and abide by the applicable legal framework;
- Identify, evaluate and assess potential positive or negative environmental and social impacts related to the Project's construction and operation;
- Determine appropriate mitigation measures for potential negative impacts;
- Develop monitoring measures to track the implementation of the proposed mitigation measures and environmental compliance;
- Identify and assess Project alternatives and advise on the best alternative; and
- Inform affected stakeholders and the public about the Project and address their concerns in coordination with the Project Proponent.

The first step in the ESIA process is the Scoping Report that was approved by the Ministry of Environment (MoE) in Letter no. 4265/B2016 dated 05 April 2017 as shown in APPENDIX D.

The ESIA report is organized in the following sections:

- Executive Summary;
- Introduction;
- Description of the Proposed Project;
- Policy, Legal, and Administrative Framework;
- Description of the Environment Surrounding the Project – Environmental and Social Baseline Conditions;
- Public Consultation;
- Analysis of Project Alternatives;
- Environmental and Socio-Economic Impact Assessment;
- Environmental and Social Management Plan (ESMP);
- Conclusions; and
- Appendices.

The pledge of the Project Proponent on the implementation of the ESMP described in the current ESIA report will be provided upon final approval of the MoE of the ESIA Study.

# 2. PROJECT DESCRIPTION

## 2.1 PROJECT BACKGROUND AND OBJECTIVES

Lebanon is experiencing a high increase in private car ownership reflected in the traffic congestion facing citizens in their daily trips. The Northern Corridor of Greater Beirut is the most congested road in Lebanon; in terms of the density of population, services, industrial activities, and other trade activities which take place in this area. On a daily basis, about 350,000 vehicles enter Beirut through the Northern Corridor, 225,000 vehicles enter Beirut through the Southern Corridor, and more than 90,000 cars enter Beirut from Bekaa.

The Beirut-Tabarja corridor accounts for more than 24% of employment opportunities across Lebanon, which makes it an important economic pole. This axis also accounts for 25% of the total number of cars in Lebanon, excluding motorcycles, vans, pick-up trucks and/or other conveyances.

In the next 30 years, both the vehicle fleet and the average number of daily motorized trips per person are expected to increase by almost 60%. The expected demographic growth will double the total number of motorized trips. This would severely hamper the mobility of people and goods particularly along the Northern Corridor of the Greater Beirut Area (GBA).

The main challenge for this urban area is to organize the transportation system in order to accommodate the existing demand for road trips and account for the envisaged urbanization and demographic pressures in the northern suburbs of the GBA.

**Figure 2-1. Traffic Congestion along the Northern Corridor of the Greater Beirut Area**

To reduce congestion levels, authorities are investing in public transport. Implementation of a Bus Rapid Transit (BRT) System has been identified as one of the potential investments to improve mobility and traffic circulation along the three (3) main entrances to Beirut: Northern, Southern and Eastern entrances. In the first phase, the proposed Project addresses the Northern Entrance. The remaining two (2) entrances will be studied at later stages.

The Project, subject of this study and report, is thus the implementation of a BRT System for the Northern Corridor of Greater Beirut linking Beirut to Tabarja. In addition, the BRT corridor will continue into the city of Beirut in an Outer Ring and an Inner Ring.

A BRT System is a bus-based mass transit system with large transport capacities that meets certain conditions. To be considered "BRT", buses should operate for a significant part of their journey within a fully dedicated right of way (busway) to avoid traffic congestion. In addition, a BRT System usually has the following elements:

- Alignment in the center of the road (to avoid typical curb-side delays);
- Stations with off-board fare collection (to reduce boarding and alighting delay related to paying the driver);
- Station platforms level with the bus floor and multiple bus doors for entry (to reduce boarding and alighting delay caused by steps and queueing); and
- Bus priority at intersections (to avoid intersection signal delay).

The BRT System is a popular mass transit system because it provides large transport capacities for relatively reasonable investment costs and proven operating techniques.

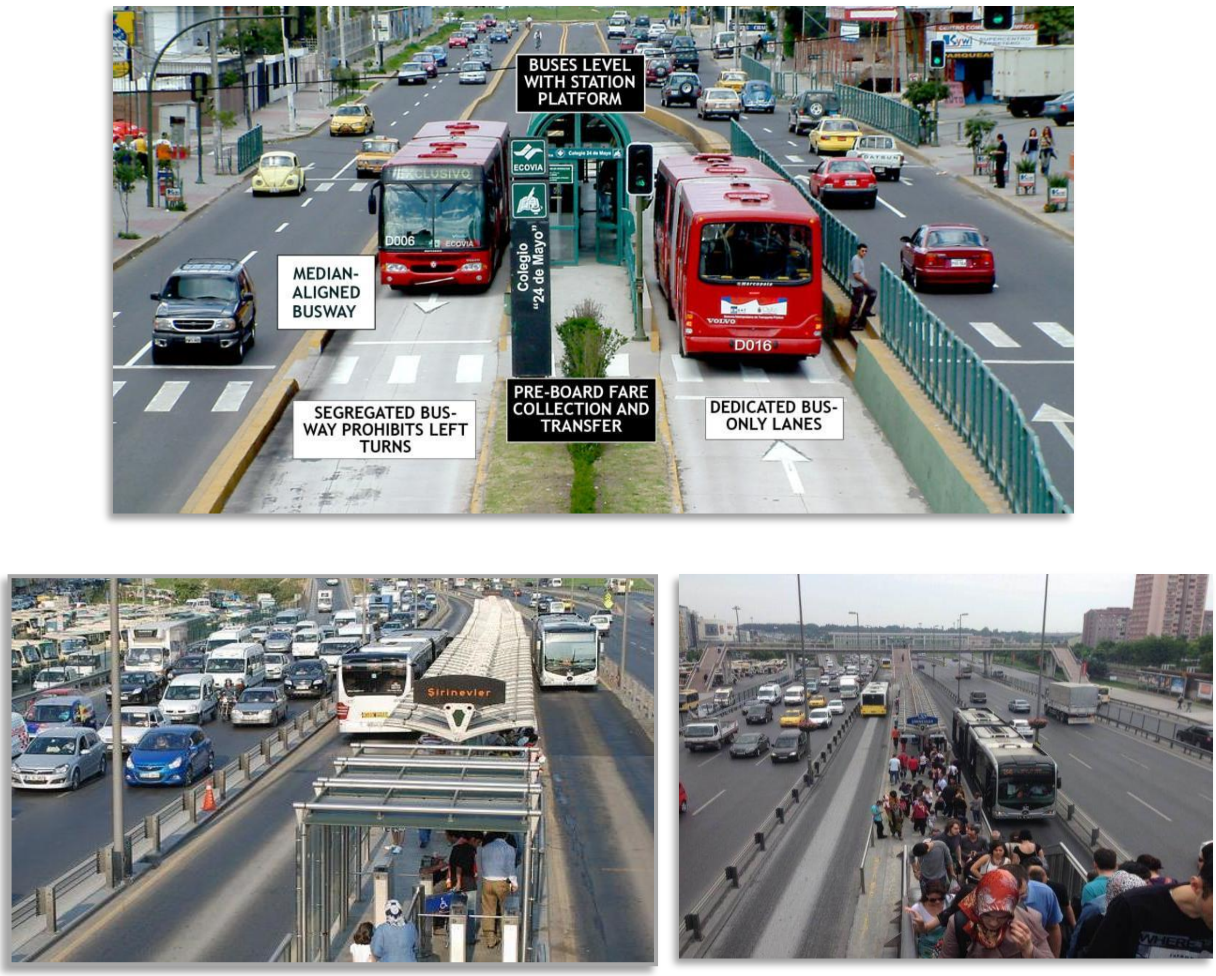



**Figure 2-2. Examples of BRT Systems**

## 2.2 PROJECT LOCATION

The Project is planned for the Northern Highway from Tabarja to Beirut and then continues into the city of Beirut in an Outer Ring and an Inner Ring:

The section along the Northern Highway runs from Tabarja to Beirut (Charles Helou) with a length of 24 km and crosses through the jurisdictions of the municipalities of Tabarja-Kfar Yassine, Ghazir, Adma-Dafne, Jounieh, Zouk Mkayel, Zouk Mosbeh, Dbayeh-Zouk el Khrab-

Mar Youssef-Aoukar, Antelias-Naccache, Jal El Dib-Bkenneya, Zalka-Aamaret Chalhoub, Jdeideh-Bouchrieh-Sadd el Bouchrieh, Bourj Hammoud, Sin el Fil and Beirut.

The Beirut Outer Ring with a length of 18 km follows the Mirna Chalouhi Boulevard: Mirna Chalouhi - Emile Edde - Jisr El Wati - Corniche Al Mazraa - Corniche Al Baher - Charles Helou - Nahr Al Mot. Thus crosses through the jurisdictions of the municipalities of Beirut, Sin Fil, Dekweneh, Jdeideh-Baouchrieh, and Daoura. A section of the Beirut Outer Ring overlaps with the Northern Highway BRT section as shown in Figure 2-3.

The Beirut Inner Ring with a length of 16 km stays within the administrative boundaries of the city of Beirut. It passes through the following streets and avenues: Independence, Charles Malek, General Fouad Chehab, Spears, Omar Bin Abdel Aziz, Bani Maarouf, and Algeria.

The overall BRT alignment is shown in Figure 2-3, and the Beirut Inner and Outer rings alignments are shown in Figure 2-4.

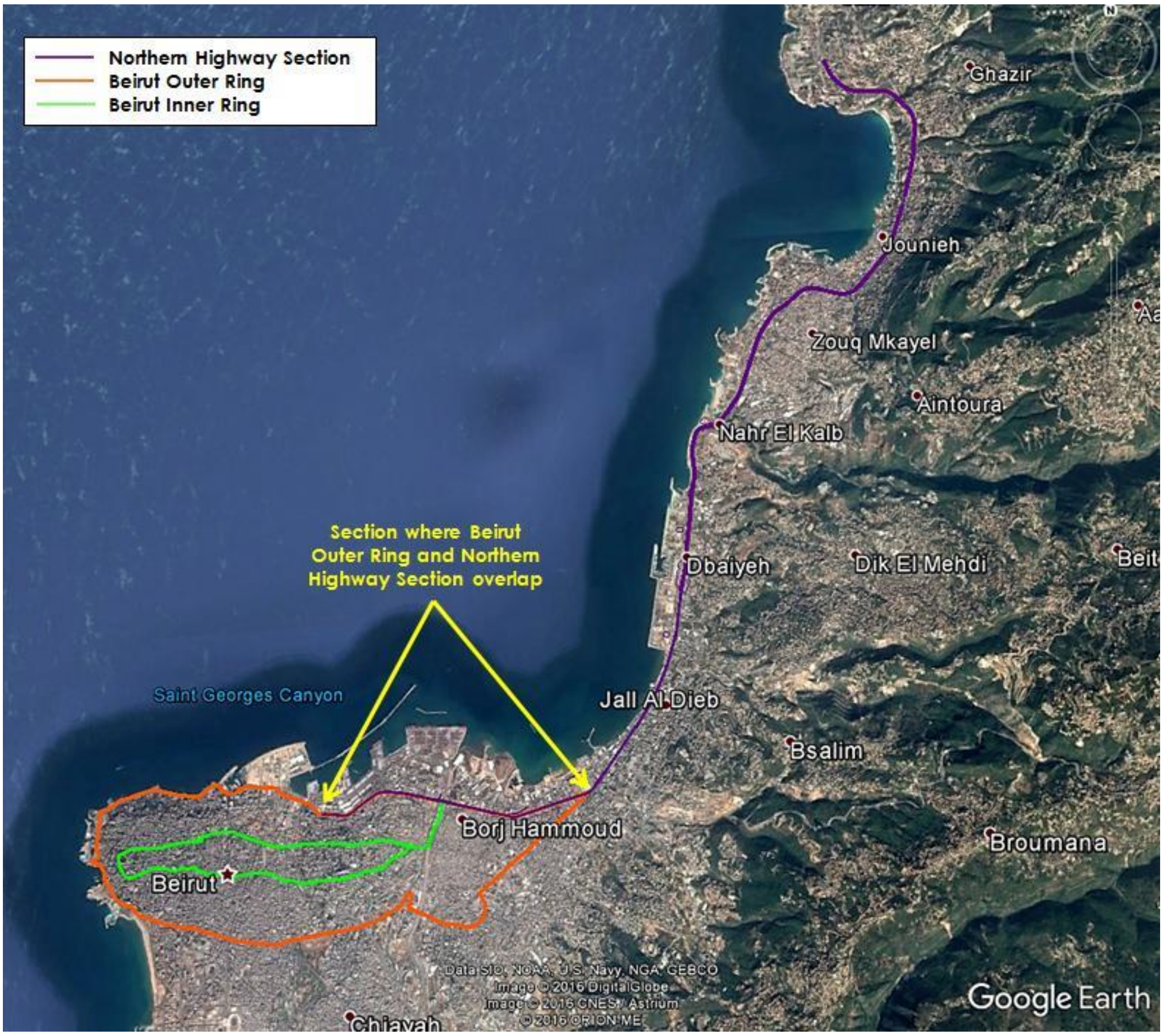



**Figure 2-3. Overall BRT Alignment**


**Figure 2-4. Beirut Inner and Outer BRT Rings**

## 2.3 PROJECT COMPONENTS

The feasibility study covers the following three (3) main components; each component is further detailed in the sub-sections below:

1. The construction of a new Bus Rapid Transit (BRT) System between Tabarja and Beirut and within Beirut;
2. The establishment of feeder bus services to the trunk BRT lines; and
3. The establishment of appropriate institutional arrangements for the management, operation and maintenance of the new mass transit system.

### *2.3.1 The Bus Rapid Transit (BRT) System*

The proposed BRT System consists of three BRT sections and their adjoining facilities. Table 2-1 summarizes the BRT System components as provided by the Project Proponent and Engineering Consultants. The system components include the three (3) BRT sections, the stations, the bus depots & terminals, and the Park and Ride (P&R) facilities.

The linear alignments of the three (3) BRT sections are provided in Figure 2-3 and Figure 2-4. To date, 28 stations between Charles Helou and Tabarja have been identified, 21 station locations in the Beirut Outer Ring and 19 station locations for stations on the Beirut Inner Ring, as indicated in Figure 2-6.

A description of the BRT System components is further detailed in Table 2-1.

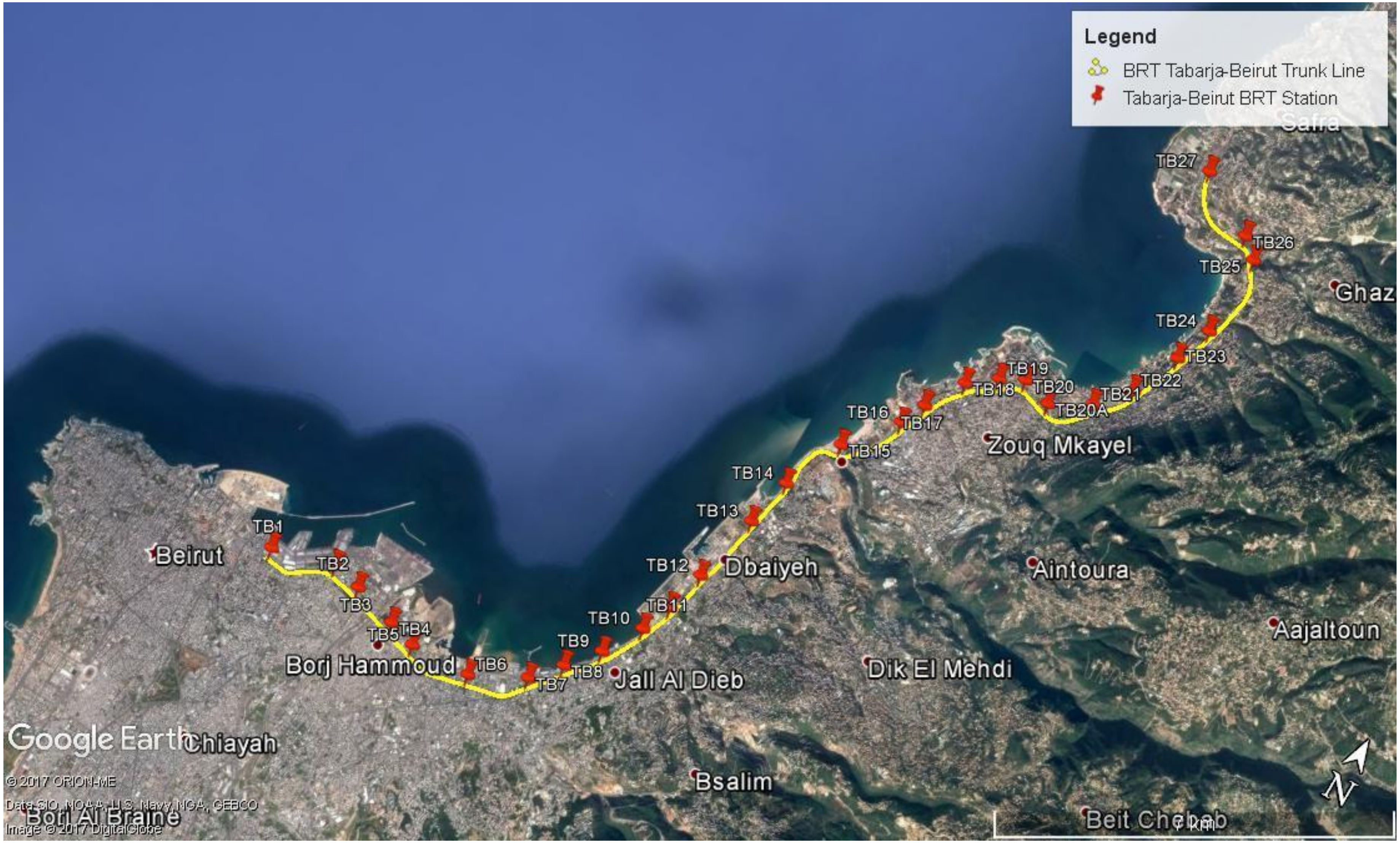



**Figure 2-5. BRT Stations between Charles Helou and Tabarja**

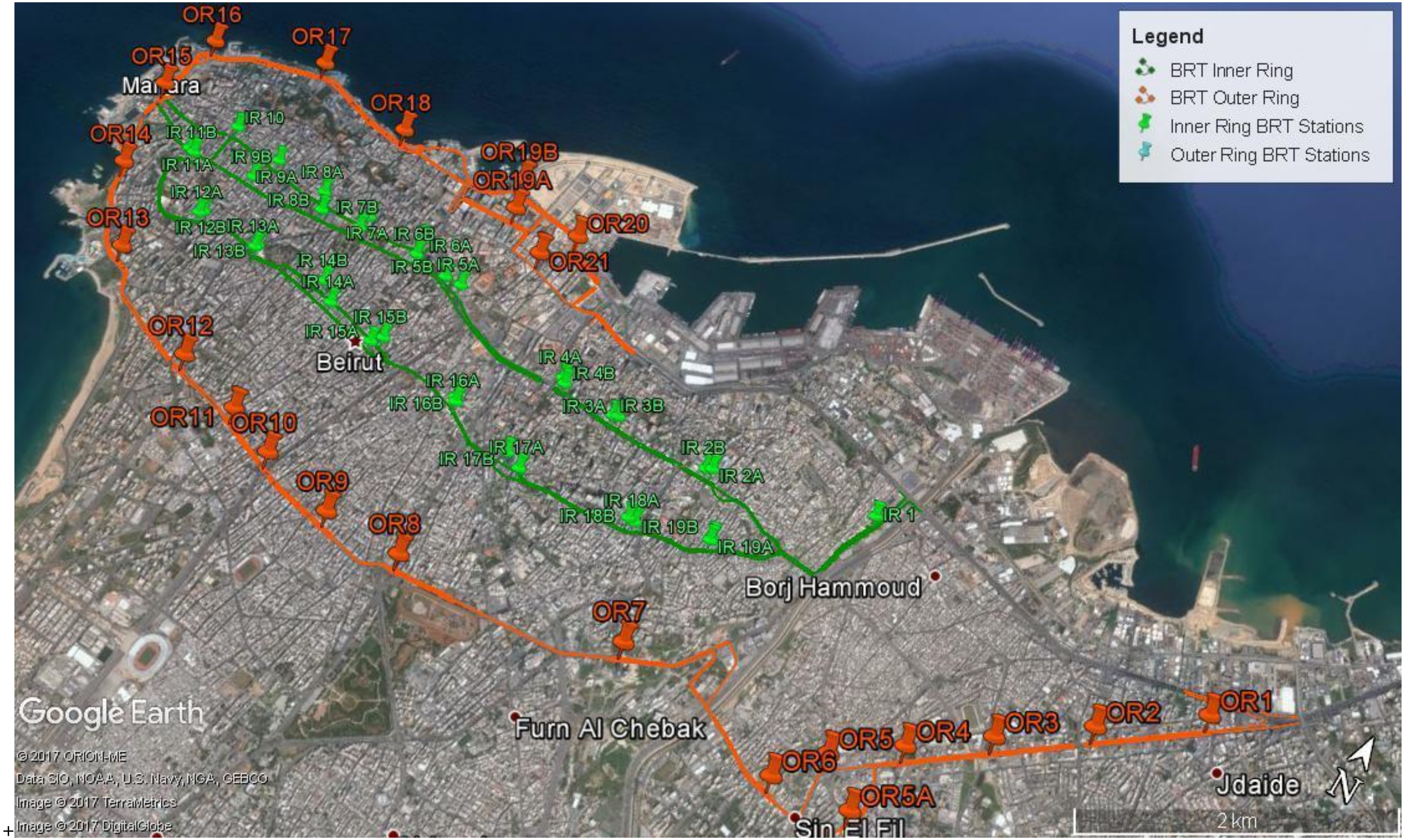
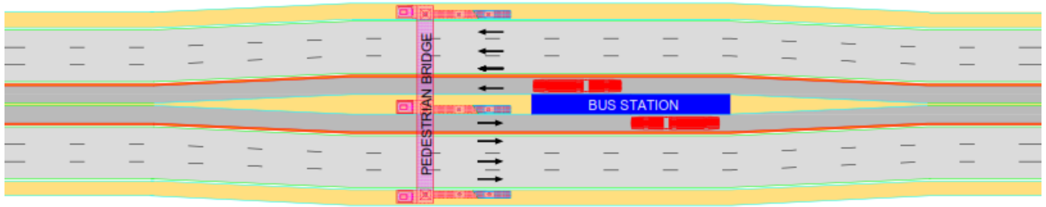
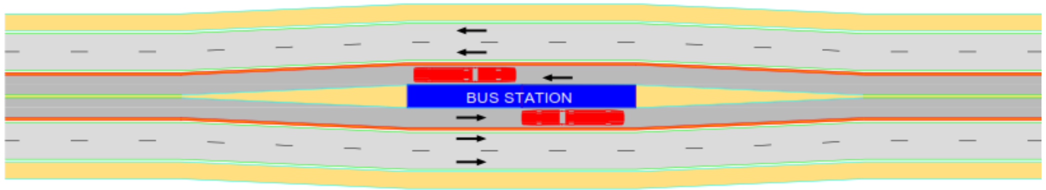
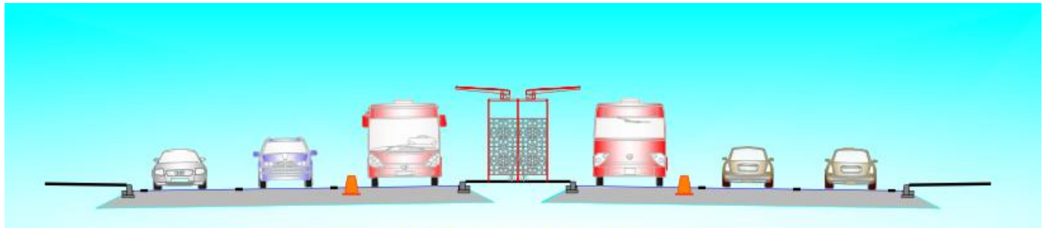
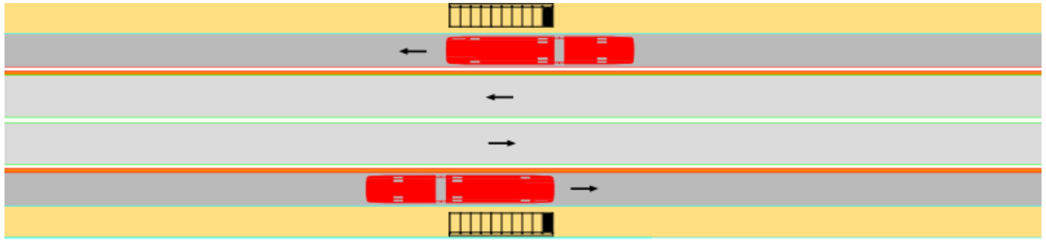
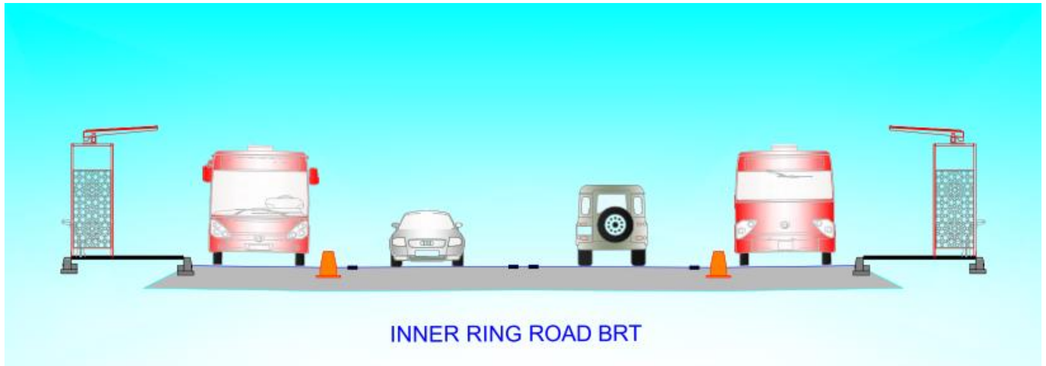



**Figure 2-6. BRT Stations on the Beirut Outer and Inner Rings**

**Table 2-1. Components of the BRT System**

| BRT System Component | Description | Examples |
|---|---|---|
| BRT Trunk Line along the Northern Highway from Tabarja to Beirut (Charles Helou) | A dedicated BRT lane is to be constructed in the middle of the highway (the median).<br>Two BRT lanes will run in parallel, one in each direction (Two-Way Median Busway)<br>The road section would have one BRT lane and at least two, or more, mixed traffic lanes per direction.<br>Physical structures (e.g. concrete barriers or bollards) would separate the dedicated BRT lane from the mixed traffic lanes.<br>28 stations would be established in the median along the BRT trunk line with an average distance between two stations of 850 m.<br>Each station would have a length of 20 m and a width of 4 m.<br>Access to the stations would be via elevated pedestrian bridges; existing bridges will be used where possible. Access to bridges will be through stairs and elevators. |  <br>NORTHERN HIGHWAY BRT TYPICAL BUS STATION LAYOUT PLAN<br> <br>NORTHERN HIGHWAY BRT TYPICAL SECTION AT BUS STATION<br><br>NORTHERN HIGHWAY BRT TYPICAL SECTION AWAY FROM BUS STATION |

| BRT System Component | Description | Examples |
|---|---|---|
| Beirut Outer Ring | A dedicated BRT lane is to be constructed in the middle of the road.<br>The road section would have one BRT lane and at least two or more mixed traffic lanes per direction.<br>Physical structures (e.g. concrete barriers or bollards) would separate the BRT dedicated lane from the mixed traffic lanes.<br>21 station locations would be established with an average of 700 m between each two stations.<br>Access to the stations will be via pedestrian level crossings on the roads coupled with stop lights and road markings. | <br>OUTER RING ROAD TYPICAL BUS STATION LAYOUT PLAN<br><br>OUTER RING ROAD TYPICAL SECTION AT BUS STATION<br><br>OUTER RING ROAD TYPICAL SECTION AWAY FROM BUS STATION |

| BRT System Component | Description | Examples |
| --- | --- | --- |
| Beirut Inner Ring | A dedicated BRT lane is envisaged to be constructed on the right side of the road.<br>The road section would have one BRT lane and two mixed traffic lanes per direction (best case scenario) or one BRT lane and one mixed traffic lane per direction (worst case scenario).<br>Physical structures (e.g. concrete barriers or bollards) would separate the BRT dedicated lane from the mixed traffic lanes.<br>19 bus stop locations would be established with an average of 570 m between each two stations. | <br>INNER RING ROAD BRT<br>TYPICAL BUS STATION LAYOUT PLAN<br><br> |

| **BRT System Component** | **Description** | **Examples** |
|---|---|---|
| Bus Depots and Terminals | Depot is where the buses will be maintained and parked when not operational.<br>Terminal is where buses start or end their journeys as per the schedule.<br>The location of the Beirut bus depot will be in the Mar Mekhayel OCFTC bus depot. The location of the northern bus depot is in Safra.<br>The location of the Beirut BRT terminal will be the Charles Helou bus terminal. The northern bus terminal will be in Wata Slem, Tabarja. |   **Examples of Bus Terminal and Depot** |

| BRT System Component | Description | Examples |
|---|---|---|
| Park and Ride (P&R) Facilities | P&R facilities are parking lots with connections to the BRT stations that allow commuters to park their private vehicles and transfer to BRT stations.<br>P&R facilities along the BRT line from Tabarja to Beirut are shown in the adjacent figure. The lands are empty plots all located in the public domain or are state-owned.<br>P&R facilities are located at a maximum distance of 400 m from BRT stations to minimize the walking distance.<br>From South to North:<br>1- Doura<br>2- Nahr el Mott<br>3- Antelias<br>4- Naccache<br>5- Dbayeh<br>6- Nahr el Kalb<br>7- Jounieh<br>8- Kfar Yassine | <br><br>**Eight Proposed P&R Facilities from Doura to Tabarja** |

### *2.3.2 Feeder Bus Services*

Along with the BRT service, feeder bus services with specific itineraries are going to be provided to serve as transit, from and to the BRT stations.

The feeder bus lines are based on the “20 bus lines” project prepared by the Ministry of Public Works and Transport (MoPWT). The total service fleet will comprise around 850-900 buses operating on about 20 complementary bus routes outside the main BRT trunk lines.

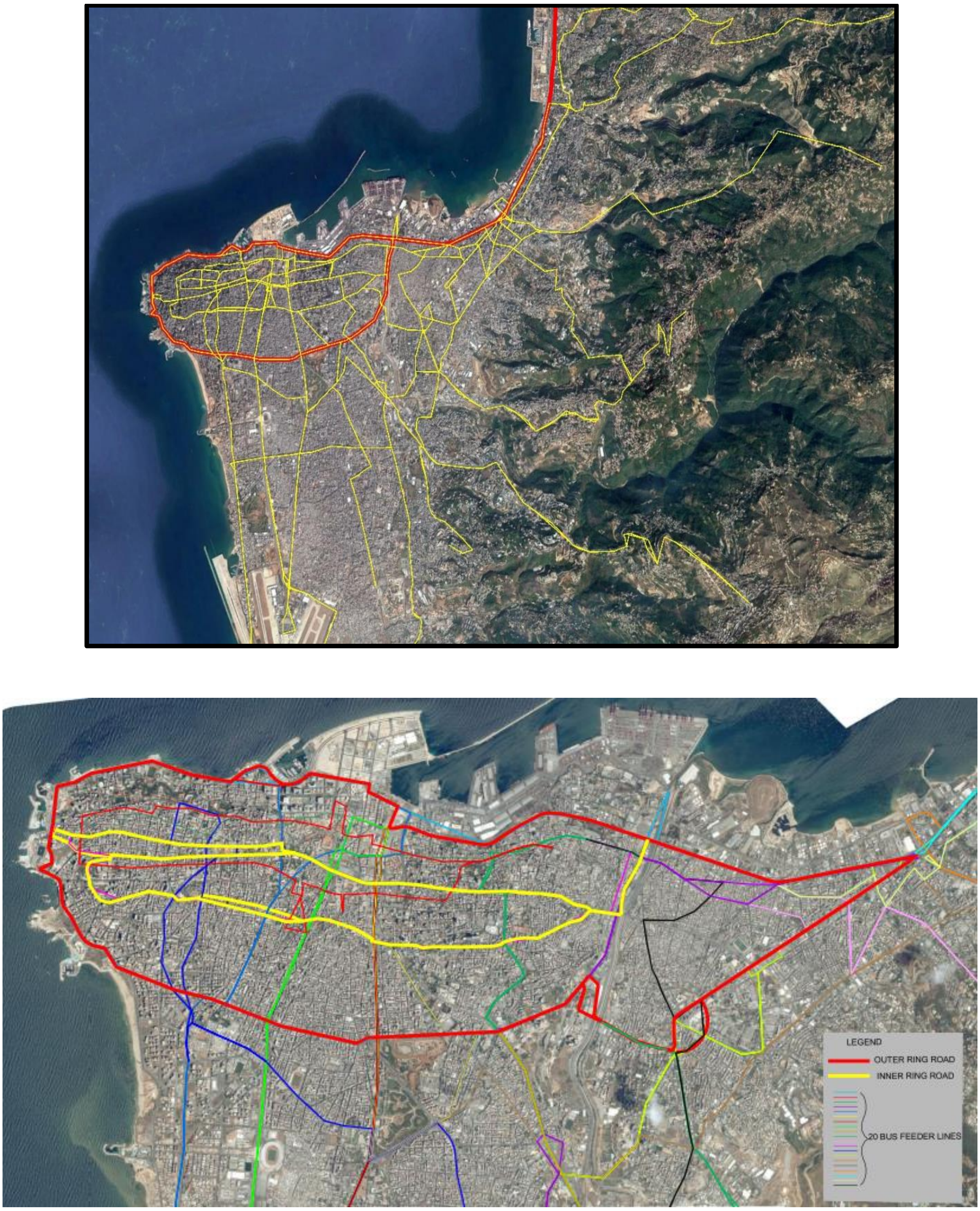



**Figure 2-7. Feeder Bus Network**

### 2.3.3 Institutional Support

The third component of the Project is institutional strengthening which includes:

- The delineation of the arrangements for the management, operation and maintenance of the new BRT System; and
- The preparation of required studies to concession BRT operations to a private operator under the supervision of the Railways and Public Transport Authority (RPTA).

The project anticipates the strengthening of the capacity of the MoPWT and affiliated agencies; namely, the RPTA given that the latter will be responsible for the operational aspects of the project. This component will entail additional studies for further expanding public transport and mass transit coverage in the GBA.

## 2.4 CONSTRUCTION PHASE

### 2.4.1 Construction Activities and Schedule

The construction of the components of the proposed BRT system is estimated to take 5 years (estimated start in 2018 and end in 2023). Since the project is still at the feasibility stage, the construction details such as construction methods, and material and manpower estimations are not available at this stage. Therefore, this section relies on state-of-art and common practices available in international literature, making estimates based on suitability to local conditions and consideration of the pre-feasibility and feasibility studies carried out specifically for this proposed project.

The proposed Project includes the construction of the following structures/ facilities:

- Bus Corridor Infrastructure (road infrastructure and stations, new pedestrian bridges and/or modification of the existing ones);
- Bus Terminals (one in Wata Slem (Tabarja), while a second one in Beirut would use the location of Charles Helou Bus Station);
- Bus Depots (in Mar Mkhayel OCFTC station and a second one in Safra); and
- Park and Ride Facilities (eight proposed locations along the coastal highway).

It is expected that the construction of the BRT System will be divided into three major phases, divided based on the area of service.

1- Phase1: construction of bus terminal and depot, park and ride facilities and the corridor connecting Tabarja and Beirut including the pedestrian bridges and the bus stations;

2- Phase2: construction of bus corridor of Outer Beirut ring, bus stations and respective pedestrian crossings;

3- Phase3: construction of bus corridor of Inner Beirut ring including the modification of the existing road infrastructure and traffic management, and erection of bus stops.

The project construction is expected to have a major impact on the existing traffic through the creation of detours and bottlenecks or road blocks depending on necessity. Hence, each phase is expected to be divided into sub-phases. Each sub-phase of the project would include execution and completion of construction activities on a stretch of the road with the associated access infrastructure. Each phase would have specific sections that require more intensive works and larger area coverage, such as pedestrian bridges and relatively large stations, while other sections would involve the removal/modification of the existing infrastructure and minor construction works such as the removal of the median concrete barriers, paving the exclusive bus lanes and adding separators.

There are multiple components to be constructed in this project, some activities are common between all structures, while others are site specific. The construction works are likely to chronologically entail the following activities:

- Erecting separators around the construction area, which will control:
    - Access of workers and personnel to the construction sites;
    - Security and safety; and
    - Propagation of dust and exposure of the surrounding to construction material and solid waste generated from various construction activities.
- Earth works, including clearing, digging, transportation/relocation and excavation for site preparation, which will involve:
    - Removal and transportation of existing structures, e.g. concrete blocks that separate the median section of the road, and light poles;
    - Demolition of existing structures at different locations;
    - Grubbing out vegetation, such as bushes and trees, or protecting it if not to be removed; and
    - Removal of soil.
- Slab construction, including:
    - Transportation of raw material to site;
    - Concrete mixing on site or transportation of ready mix concrete;
    - Site works/erection;
    - Erection of precast elements (if needed);
    - Beams erection;
    - Repairs;
    - Quality assurance procedures.
- Asphalt paving works, curb and concrete works;
- Plastering, painting and decorating, including:
    - Surface preparation;
    - Primer application;
    - Multiple coatings of paint;
    - Waterproofing.

- Interior works, including:
    - Tilling works;
    - Metal works;
    - Roof cladding works;
    - Assembly of structures (e.g. bus stops, poles);
    - Heating, ventilation and air conditioning (HVAC) works;
    - Electrical works, including passenger amenities (ticket machines, gates, vending machines, etc.);
    - Testing and commissioning.
- Construction and finishing of all public realm takes place in parallel with each sub-phase.

The most critical aspect of the construction besides availability of equipment and materials is the traffic management. The traffic management plan which is envisaged to be developed along with the construction philosophy and management plan by the construction contractor, prior to the physical start of the construction works, will involve local government and non-government stakeholders, such as business owners, functioning in the construction area or impacted by the construction works. Prior communication of the construction phases and timeline will reduce future complication in transporting materials, conducting the construction activities and traffic management in coordination with the traffic police.

#### *2.4.1.1 Infrastructure Construction Works*

Infrastructure construction works include the BRT System structures (bus corridor, P&R facilities, bus stations and pedestrian bridges), roads, pavements, water/wastewater and storm water drainage networks, electrical works, telecommunication systems, landscaping and lighting.

BRT System works will include, but not be limited to:

- Cladding connections;
- Park and Ride Facilities;
- Bus depot and terminal;
- Stairs and supports;
- Elevators and supports;
- Sheltering and shading systems;
- Lights and street lighting;
- Relocation of utilities (drainage systems, electricity and telecommunication); and
- Signage and barriers.

In general, bridges are defined by three parts: the foundation/substructure (abutments and piers), the superstructure (several types: truss, grinder or arch) and the deck. Abutments are constructed to support the ends of the bridge, while the piers provide intermediate support. The bridge deck is then rested on the foundation on top of the bearings. The superstructure in the case of the pedestrian bridges connecting to the median stations will be enclosed or with proper sheltering. The pedestrian bridge works will include the following activities:

- Excavation;
- Earthworks, clearing and burrowing;
- Concrete and steel works to construct the abutments and piers;
- Construction of stairs and other bridge access structures such as elevators and their support structures on the sides of the bridge and the median section which might require grading;
- Construction or installation (pre-cast concrete or metal) of the bridge deck on top of the bears;
- Installation of the top shelter or roof;
- Utility works (e.g. lighting, electricity and drainage);
- Testing and commissioning.

Road works are likely to entail the following activities:

- Asphalt milling, which is the controlled removal and recycling of existing asphalt will take place wherever paved roads exist);
- Excavation;
- Embankment construction (if needed);
- Laying of sub-grade;
- Laying of sub-base;
- Applying prime coat;
- Applying asphalt base course.

If needed, embankments will be constructed, filled and compacted. Before the final laying of new asphalt, sub-grading (compacting materials in layers), sub-base application (the main load-bearing layer) and prime coat application (coat and bind loose material) takes place. The hot-mix asphalt is compacted by vibrator rollers, plate compactors and pneumatic compactors.

Utility works can be summarized by the following:

- Pipeline works: installation of new pipelines or expansion of the existing ones:
    - Storm drainage network;
    - Wastewater collection network;
    - Water supply network;
    - Electrical lines;
    - Telecommunication lines.
- Manholes: to provide access to the underground services, new manholes might be required, especially in the median part of the road;
- Surface preparation and waterproofing: most of the structures of the system are external, therefore waterproofing of concrete structures and exposed utility services will be needed;
- Street lighting: the removed street lighting from median section of the road and other locations should be replaced and new ones installed wherever necessary, this will involve:

- o Installation of streetlight poles;
- o Concrete filling;
- o Backfilling;
- o Fitting of lanterns and accessories, and electrical wiring.

#### 2.4.1.2 Construction Equipment

Provided that the Project is at the stage of feasibility assessment, the high-level information on construction equipment presented herein is based on the current information on System components. This section summarizes the machinery, equipment and vehicles used in road construction projects in three categories: General construction, Road construction, and Traffic Control.

**Table 2-2. Machinery, Equipment and Vehicles for General Construction**

| Construction Activity | Machines |
|---|---|
| Distribution of materials | Articulated dump truck |
| | Dumper |
| | Wheeled excavator |
| | Wheeled loader |
| | Wheeled backhoe loader |
| | Tracked excavator |
| Transporting concrete | Concrete mixer truck |
| | Large lorry concrete mixer |
| | Large concrete mixer |
| Pumping concrete | Concrete pump + cement mixer truck (pumping to higher floors) |
| | Concrete pump + cement mixer truck (idling) |
| | Concrete pump + cement mixer truck (discharging) |
| | Concrete mixer truck |
| | Truck mounted concrete pump + boom arm |
| | Concrete mixer truck + truck mounted concrete pump + boom arm |
| Concreting, other | Poker vibrator |
| | Vibratory tamper |
| | Pump boom + vibrating poker |
| | Concrete placing boom |
| Lifting | Wheeled mobile telescopic crane |
| | Mobile telescopic crane |
| | Tower crane |
| | Tracked mobile crane |
| | Lorry with lifting boom |

| Construction Activity | Machines |
|---|---|
| | Telescopic handler |
| | Wheeled excavator |
| | Lifting platform |
| | Diesel scissor lift |
| | Caged material hoist |
| | Site lift for workers |
| Trenching | Tracked excavator |
| | Wheeled backhoe loader |
| | Mini tracked excavator |
| Core drilling concrete | Core drill (electric) |
| Cutting concrete floor slab | Petrol handheld circular saw |
| Moving equipment | Tractor |
| Cutting concrete blocks | Circular bench saw |
| | Handheld circular saw |
| Sweeping and dust suppression | Road sweeper |
| | Dust suppression unit trailer |
| Pavement marking | Epoxy/Polyurea/Modified Urethane applying trucks |
| | Epoxy/Polyurea/Modified Urethane applying hand-operated machines |
| Miscellaneous | Mounting supports for directional drill |
| | Angle grinder |
| | Petrol generator for handheld grinder |
| | Mobile diesel generator for electricity |
| | Handheld cordless nail gun |
| | Directional drill |

**Table 2-3. Machinery, Equipment and Vehicles for Road Construction**

| Road Construction Activity | Machines |
|---|---|
| Breaking road surface | Backhoe mounted hydraulic breaker |
| | Mini excavator with hydraulic breaker |
| | Road breaker |
| | Compressor for hand-held pneumatic breaker |
| Breaking concrete | Handheld pneumatic breaker |
| Road planing | Road planer / idling |
| | Mini planer / idling |
| Removing broken road surface | Wheeled excavator |
| Spreading chipping / fill | Dozer |
| Earthworks | Bulldozer |

| **Road Construction Activity** | **Machines** |
|---|---|
| | Articulated dump truck |
| | Tracked excavator |
| Rolling and compaction | Road roller |
| | Vibratory roller |
| | Vibratory compacter |
| Paving | Asphalt paver + tipper lorry |
| Trenching | Wheeled excavator |
| | Tracked excavator |
| Cutting concrete slabs | Hand held circular saw |
| Lifting formwork for underpass | Wheeled mobile crane / idle |
| Pumping water | Electric water pump |

**Table 2-4. Devices for Traffic Control**

| **Traffic Control Activity** | **Devices** |
|---|---|
| Speed limits | Work-zone speed limit signs |
| | Paddles, lights or flags to be used by a flagger |
| Traffic management (minimal) | Cones |
| | Tubular markers |
| | Flexible delineators |
| | Plastic drums |
| | Tubular markers |
| Traffic management (major) | Barricades |
| | Arrow boards |
| | Speed limit signs with lights |
| | Mobile traffic lights |
| | Changeable message signs |
| | Truck mounted attenuators |
| | Temporary rumble strips |
| Other | Pedestrian channelizing barricades |

### *2.4.2 Energy Consumption and Power Supply*

Construction of the project will be in phases. The energy consumed on the construction location will include generators for easier mobility and less dependency on the grid, and fuel consumed by construction machinery, trucks and transportations of workers.

### 2.4.3 Manpower, Transportation and Security

During construction it is essential to control the traffic and pedestrian flow to prevent congestion and accidents. Apart from the workers there will be a need for personnel to install proper signs, divert the traffic and manage the movement of equipment at the construction sites. The estimation of manpower needs will be part of the construction management documents that the construction contractor will develop in the later phases of the project.

### 2.4.4 Water Supply

Activities that will require water on construction site will be mainly: water needed for concrete mixing, in case ready-mix concrete is not used, water for workers for use in mobile toilets or temporary offices at larger construction sites, water for suppressing dust, and any other construction activities that would require water. Water can be supplied through the water network or through tankers, depending on the location of the construction and the demand. The estimation of water demand will be part of the construction management documents that the construction contractor will develop in the later phases of the project.

### 2.4.5 Wastewater Generation during Construction

Activities that consume water will often be generating wastewater. The quantities of wastewater generated during construction depend on the number of workers, the number of construction activities requiring water, and the occurrence of leaks and spills from machinery, equipment and vehicles. Wastewater to be generated from the various construction activities will be part of the construction management documents that the construction contractor will develop in the later phases of the project.

### 2.4.6 Raw Materials and Chemicals

The following are key materials that are expected to be used during the construction phase, whose quantities will be further specified in the construction management documents that the construction contractor will develop in the later phases of the project.

- Asphalt (hot-mix);
- Steel/aluminum;
- Metalwork;
- Aggregates and concrete (bags or ready-mix);
- Bricks;
- Fencing materials;
- Paints and solvents;
- Fuel, oils and lubricants;
- Tiles for paving;
- Glass;
- Plastics;
- Wood;
- Roofing and cladding material including insulation;
- Electrical wiring, lighting, conduits and cables.

### *2.4.7 Solid Waste Management during Construction*

Relatively large quantities of solid waste are expected to be generated from construction sites, which should be segregated and managed. The potential activities that would generate solid waste are:

- Excavation works, leveling and clearing;
- Removal of vegetation at certain locations;
- Removal of asphalt;
- Spills during construction activities;
- Solid waste generated from the workers and personnel on site;
- Solid waste generated from equipment, construction material and other packaged material, e.g. cement bags that require unpacking on site, or protective sheets of road furniture.

The construction contractor will elaborate on the types and quantities as well as management methods in the construction management documents that he will develop in the later phases of the project.

## 2.5 OPERATIONAL PHASE

The operational design details of the BRT System are developed at a high-level in the feasibility stage. The following sections shed light on the system components whose design and operability allow for an initial idea on the environmental footprint of the BRT System.

A key design principle of the BRT System and its feeder buses is universal design that caters for all persons and groups such as women, persons with mobility challenges and the elderly. The System design shall be integrated with the urban environment, seek to upgrade the existing road infrastructure, for all road users and especially for pedestrians, and be safe, environment-friendly and sustainable.

### *2.5.1 BRT System Components*

#### *2.5.1.1 BRT Corridors*

As described in Section 2.3.1, the BRT trunk line running between Tabarja and Beirut will be one-lane wide in the median in each direction of the coastal highway. The dedicated lanes will separated by a physical structure from the mixed traffic lanes, with design speed of 80 km/hr between Tabarja and Charles Helou and a design speed of 50 km/hr within Beirut.

The BRT Beirut Outer Ring Corridor is similarly designed to run in the middle lane of two-way roads, separated from mixed traffic, except at road level crossings, and some road sections where current road design (one-way, or major junctions) may not entertain this possibility.

The BRT Beirut Inner Ring corridor is designed to run on the right-hand side of the streets. Most streets in the Inner Ring are one way. The bus lane will be separated with physical structures from the other lanes.

#### *2.5.1.2 Bus Fleet Characteristics*

The BRT buses will be articulated with not more than 40 seats, thus giving more room for standing passengers, and for wheelchairs and baby strollers. The total capacity will be 120 persons/bus. A new fleet of 120 modern low floor left-door articulated buses will be procured for the BRT lines, with engine specifications of Euro V diesel buses, with a requirement to use ultra low sulfur diesel (<15 ppm sulfur), and to be equipped with Diesel Particulate Filters (DPF) to reduce PM emissions, and Selective Catalytic reduction (SCR) technology to reduce NOx emissions, with efficient combustion engines.

The feeder buses operating the 20 lines will have smaller dimensions of 10.5 x 2.5 m and smaller capacities – 80 persons for city buses (30 seated) and 40 seated persons for intercity buses. The feeder buses will integrate with the BRT bus system in one fare structure. They will also be equipped to serve persons with mobility challenges. The buses will be modern, will have screens to announce upcoming stations, a voice service, a GPS system connected to a control center and to bus stops, and air conditioned. The feeder buses will also be specified to use fuel efficient combustion engines, running on ultra low sulfur diesel, with DPF and SCR technology.

#### *2.5.1.3 Bus Stations*

The stations of the BRT System differ in terms of accessibility to the station. The stations on the trunk line of Beirut-Tabarja and Beirut Outer Ring are in the median section of the road, while in the Inner Ring corridor the stations or stops are on the right hand side of the road. Beirut-Tabarja stations will be accessed through elevated bridges. Beirut Outer Ring stations will be accessed through pedestrian level crossings with proper signage and traffic lights. Beirut Inner Ring stations will be accessible from the sidewalk.

Specific dimensions of each bus station/stop can vary according to the local conditions and the desired outcome of transporting passengers in the most convenient way. Platform dimension and structure design have an impact on the construction cost, required material, installation time and maintenance capacity during operation.

##### 2.5.1.3.1 Bus Stations and Stops Design

In general, bus stations/stops can be categorized in four types (Transfort, 2015), which differ in size, the amenities provided and the purpose they serve:

a. Sign Stop
b. Bench Stop
c. Shelter Stop
d. Station Stop

**Sign Stop:** is a bus stop with a bus stop sign and basic accessibility landing surface, without any shelter or bench, which makes it the most basic type of bus stops. It is often used in areas where there is low ridership.


**Figure 2-8. Sign Stops**

**Bench Stop:** is a bus stop with a stop sign and a stand-alone bench on the landing area, without any shelter. In certain cases, it includes bike-parking rack and trash bin. These types of stops are often used in areas with low to mid ridership.


**Figure 2-9. Bench Stops**

**Shelter Stop:** is a bus stop with a shelter as the main feature. This stop type should also include a bus stop sign, at least a bench, a trash bin, bike racks, interior lighting and advertising panels. Shelter stops are used in areas with medium to high ridership, significant number of elderly, youth, disabled and low-income population.


**Figure 2-10. Shelter Stops**

**Station Stop:** is a bus stop that has enhanced passenger amenities: ticket vending machine, real-time LED and/or digital signage, a unique shelter structure, as well as the standard passenger amenities provided in shelter stops.

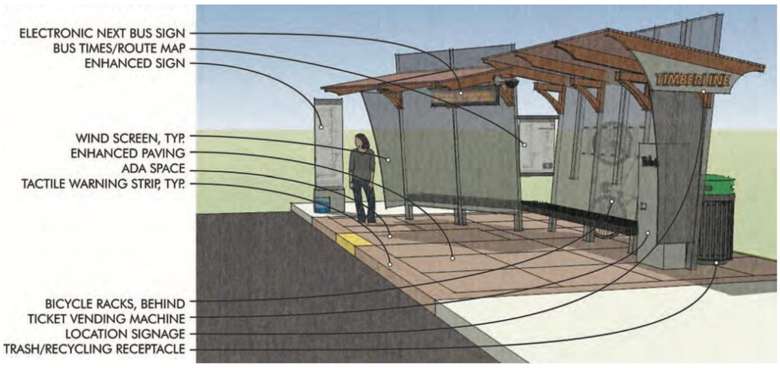



**Figure 2-11. Station Stop**

A summary of the bus stop types and their required, recommended and optional amenities is provided in Table 2-5. Selection of the bus station/stop types for the BRT System and feeder routes takes into account expected ridership and required amenities based on length of waiting times. All stations' designs will be sensitive to and inclusive of most, if not all, users' needs to the extent possible.

**Table 2-5. Bus Stop Types and Amenities**

| Bus Stop Amenities | Sign Stop | Bench Stop | Shelter Stop | Station Stop |
|---|---|---|---|---|
| Bus stop sign | Optional | Optional | Optional | Recommended |
| Solid surface | Optional | Optional | Optional | Optional |
| Landing pad | Optional | Optional | Optional | Optional |
| Connection to adjacent sidewalks | Optional | Optional | Optional | Optional |
| Minimal slope | Optional | Optional | Optional | Optional |
| Bench | | Optional | Optional | Optional |
| Shelter | | | Optional | Recommended |
| Custom shelter | | | | Recommended |
| Bike racks | Required | Optional | Optional | Optional |
| Trash and recycling facilities | Required | Recommended | Optional | Optional |
| Lighting | Required | Required | Recommended | Optional |
| Transit system map | | | Recommended | Recommended |
| Route map/schedules | | | Recommended | Recommended |
| Ticket vending machine | | | | Recommended |
| Digital signage | | | | Recommended |
| Ground mounted tactile | | | | Recommended |
| Paper schedules | | | Required | Required |
| Security cameras and Emergency call-box | | | Required | Recommended |
| Wind screen | | | Recommended | Optional |
| Secure bike parking | | | Required | Required |
| Braille signage | Required | Required | Required | Required |
| Wayfinding signage | | | Required | Required |

(grey): Required Amenity (orange): Recommended Amenity (blue): Optional Amenity
Source: (Transfort, 2015)

#### 2.5.1.3.2 Platform Area

The platform area is the interface for the customer between the station and the BRT vehicle. The platform area in the median of the road will be 20 m in length by 4 m in width. For some stations with high demand, the platform area length is doubled. Attributes that were considered in the platform area design included:

- Efficient flow of pedestrians;
- Availability of passenger amenities;
- Compatibility of the platform with BRT vehicle door configuration;
- Accessibility for people with disabilities;
- Clear and simple signage;
- Fare collection and control system wherever necessary;
- Safety and security; and
- Emergency evacuation procedures.

The total area available at the platform is principally a function of the anticipated passenger load. Stations that are too small can cause congestion and significantly increase passenger wait time.

#### 2.5.1.3.3 Bus Stations between Beirut-Tabarja and on the Beirut Outer Ring Corridor

Since the highest demand is expected to be on the main trunk line and the stations are located in the median, station stops will be employed phase of the project. In addition to amenities and comfortable space for boarding and transfer, these stations will have optimized structures to access the station through the pedestrian bridges with availability of stairs, elevators and/or ramps. As for bus stations and stops in the Beirut Outer Ring, access to these stations would be via marked level crossings.


**Figure 2-12. Median Bus Station**

#### 2.5.1.3.4 Bus Stops on the Beirut Inner Ring Corridor

The BRT will function on the right side of the road in the Beirut Inner Ring. Due to space constraints, construction challenges and operation variables, shelter stops or even bench stops in some cases are the suitable option for this section.

2.5.1.3.5 Bus Stops on the Feeder Routes

The feeder buses will also have assigned bus stops, whose design alternate between sign stops, bench stops and shelter stops depending on the passenger demand and space availability. All stops accommodate information posts to show the timetable and routes information.

### *2.5.1.4 Pedestrian Bridges*

Stations on the Beirut-Tabarja trunkline would be accessed through pedestrian bridges, which would include elevators on both sides and in the middle section lifting passengers from and to the station platform. In addition to the elevators there would be stairs – depending on the availability of space that would enable the movement of passengers.

Accessibility is the key factor determining the design and dimensions of a pedestrian bridge. Therefore, a bridge that connects the sidewalks to the median BRT station should:

- be free of obstacles;
- have a gentle grade stairs in addition to elevators;
- have a smooth connection to the adjoining sidewalk; and
- not have a very large height difference to cross.

Spatial needs of passengers are a prerequisite to constructing stairs. For all pedestrians, including the elderly, the disabled and families with children, the minimum width between the railings should be 1.5 m (preferably 1.8 m) (ipv Delft, 2015).

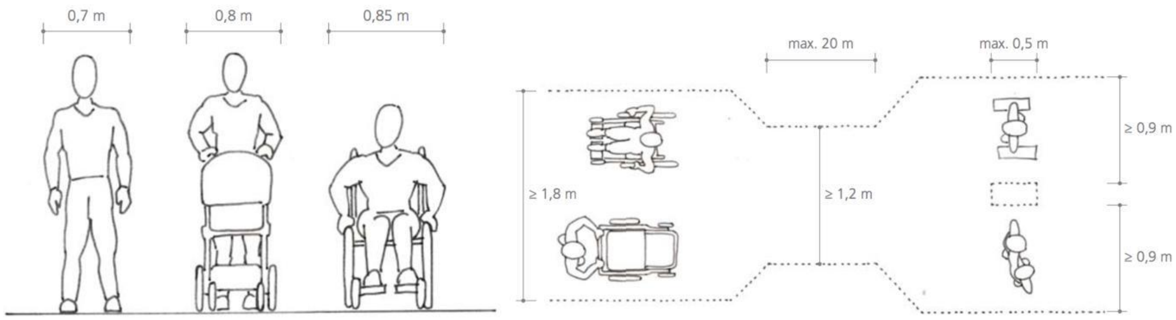



**Figure 2-13. Basic Spatial Needs and Minimal Width for Pedestrians**

### *2.5.1.5 Stairs and Elevators*

To provide safe and well-designed staircases for the comfort of all people, especially those with mobility challenges, the following considerations apply.

- Differences in level should be minimized as much as possible for the comfort of disabled persons and steps should be uniform.
- The minimum width of a two-way stairway should be 1.5 m. For outdoor stairs, the riser should be between 0.12-0.18 m and the tread between 0.28-0.35 m.
- An intermediate landing should be included when the stairs cover more than 2.5 m (refer to Figure 2-14).
- The length of the landing should be at least 1.2 m extending along the full width of the stairs.

- Sharp edges should be avoided and handrails must be installed on both sides. One or more handrails can be included in the middle when stairs are more than 3 m wide.
- A tactile marking strip (at least 0.6 m wide) should be placed at the top and bottom of the stairs, and on the intermediate landings for safety and alerting visually impaired persons as to the location of the stairs.
- Shelter for outdoor stairs to protect people during different weather conditions.

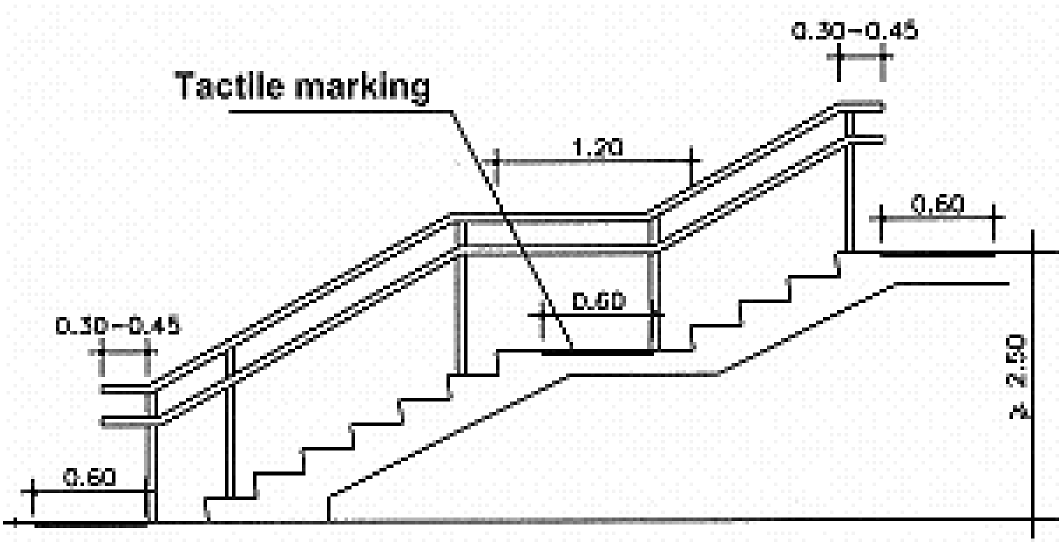



**Figure 2-14. Pedestrian Stairs with Intermediate Landing**

**Figure 2-15. Multiple Configuration of Stairs Transporting Passengers between the Median BRT Station and the Sidewalks via a Pedestrian Bridge**

Ramps are often used when stairs obstruct the free passage of pedestrians, in particular people with mobility challenges and wheelchair users. For the purposes of this project, ramps were not considered for the design due to space limitations, and elevators were selected instead.

Elevators are essential at pedestrian bridges connecting to the median BRT station, facilitating the movement of passengers with mobility challenges. Elevators should be installed with stairs, since elevators require continuous maintenance and electricity and cannot be the only method available for passengers. Elevators can be designed depending on demand and the given limitations of the location (UN, 2004). There are general considerations for elevators:

- For level changes of more than 1.2 m, the elevator should be placed in a closed structure with doors.
- Vertical platform lifts can have different settings for entry and exit as illustrated in Figure 2-16.
- The minimum width of the elevator should be 0.9 m and the minimum length 1.2 m.

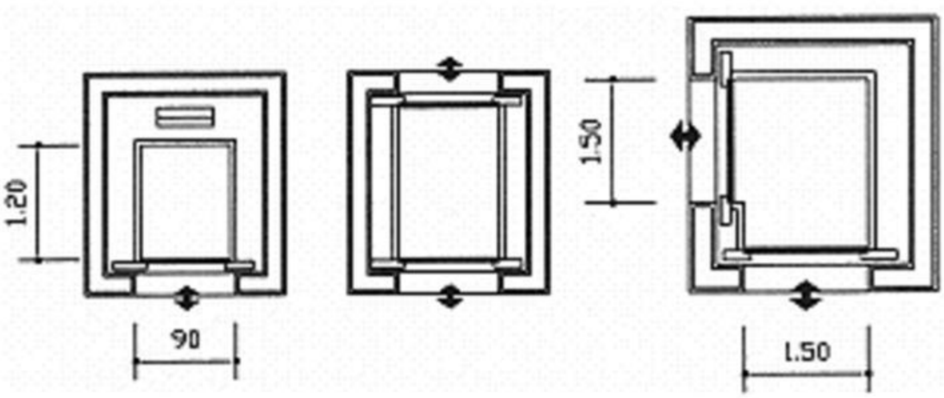



**Figure 2-16. Elevator Dimensions and Entry/Exit Configuration**

*2.5.1.6 <u>Bus Depots</u>*

Bus depot areas serve multiple purposes: bus parking areas, re-fuelling facilities, maintenance areas, and office spaces for bus operators. The ideal location for a bus depot is within the proximity of the actual system, i.e. terminals, to create the ability to:

1. introduce additional buses during peak demand,
2. facilitate re-fueling and maintenance for buses, and
3. avoid dead kilometers, which is additional operational cost, between the depot and the terminals.

The structural design of the depot has the following movement flow: (re-)fueling area, including monitoring operation, parking area in case buses are not needed on-line, and/or followed by exterior and interior cleaning and maintenance area, similar to a repair shop.

2.5.1.6.1 Aesthetic Design

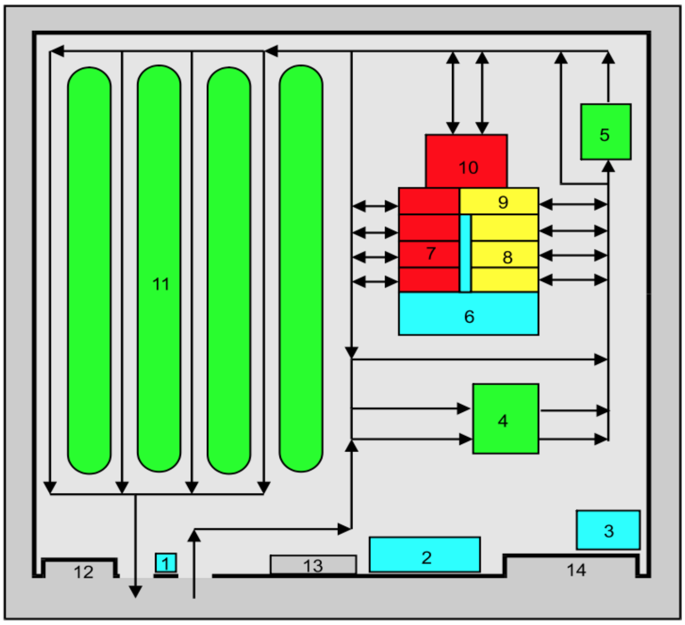
Although depot areas are not accessible to the public, there should be a consideration of the general view of the depot, since it can impact how people perceive the system, specifically the population living nearby. Therefore, a well-designed work environment and creative landscaping is foreseen, i.e. vegetation and trees in balance with concrete structures, to meet the satisfaction of the workers and the public.

2.5.1.6.2 Depots in Beirut and Safra

Bus depot designs consider bus depots as service production areas, with a layout design as shown in Figure 2-17. The product is a bus ready to operate on a daily basis. The majority of the demand is expected from Tabarja to Beirut, therefore land for a depot in Safra was located next to the terminal in Wata Slem. Buses would start from Tabarja in the morning and end at Tabarja in the evening.

Based on the area requirements (refer to Section 2.5.1.6.3), the area that meets the requirements is Mar Mkhayel Station for the Beirut depot, and it is set to be a depot.

The depot keeps spare vehicle to replace the ones that are in maintenance. When buses are new, the number of spare buses is low (5% of the operating fleet). It depends also on good management, capacity building and operations control. The depot infrastructure is expected to last for decades before any major reconstruction is required (World Bank, 2015).




1- Entrance Gate, 2- Administration, 3- Social Area, 4- Fuelling Area, 5- Cleaning area, 6- Spare parts supply area, 7- Corrective maintenance, 8- Preventive maintenance, 9- Lubrication, body repair and painting 11- Parking lot 12- Private parking, 14 Parking area

**Figure 2-17. Bus Depot Design Setting**

2.5.1.6.3 Area Estimations

According to the feasibility study estimations, the bus depot should provide for at least 200 18-m articulated buses. The minimum required area for the bus depot, which considers the operation modes of the BRT is 20,000 $m^2$.

#### *2.5.1.7 Bus Terminals*

Typically, there are terminals at each end of a trunkline corridor. Terminals involve many of the same design challenges as stations. However, given the larger number of passengers and transfer options, terminals obviously require more space. The architectural design of terminals can mimic the style of the system's stations, similar to the example shown in Figure 2-18 for a terminal in Curitiba, Brazil.

Terminal platforms are typically not enclosed within walls since entrance to the terminal site is controlled from a distance, such as the example from Bogota, Colombia shown in Figure 2-19. Terminal facilities in cities such as Bogota, Colombia and Quito, Ecuador have high ceiling designs with modern roof structures, as shown in Figure 2-20. It is important to note that the scale and style of terminal facilities impart an impression of importance to the customer and help to instill the system's professional image.

**Figure 2-18. Bus Terminal in Curitiba, Brazil**

**Figure 2-19. Bus Terminal in Bogota, Colombia**


**Figure 2-20. Bus Terminal in Quito, Ecuador**

The Tabarja-Beirut and Beirut BRT lines will be about 52 km in total and include 87 stations and stops. The operation is highly likely to require terminals and depots near both end-points of the Tabarja-Beirut trunkline to optimize operations and reduce operating cost.

In Beirut, Charles Helou bus station, pictured in Figure 2-21, will be adapted and improved to serve as the Beirut terminal. In Tabarja, a terminal will be located on a 6,000 $m^2$ plot of land.

The preliminary design of the BRT System includes having a fare for the BRT and a fare for the feeder services (at the terminals), both being distance-based fares. Therefore, the space for the transfer between the feeder and the trunklines is to be considered in the construction of the terminals in order to allocate space for fare checks, information kiosks and adequate design to facilitate mobility without causing passenger or bus congestion.

The existing Charles Helou Bus Station will be used as a terminal, however some upgrades and required modifications should be implemented to make the infrastructure ready to receive the buses and passengers. The modifications are to be specified during detailed design. On the other hand, the design of the terminal in Tabarja is assumed to be a large infrastructure including commercial establishments to integrate the transit system with the urban development.


**Figure 2-21. Charles Helou Bus Station, Beirut**

*2.5.1.8 <u>Park and Ride Facilities</u>*

Park and Ride (P&R) facilities are usually developed to integrate private vehicle owners, allowing them to park and use transit bus services to complete their journey. A P&R facility provides a parking lot or a parking garage that is kept secure during the day. To optimally serve their purpose, it is best if P&R facilities are located the closest to the target customers. If private vehicle owners will have to drive long distances before using public transport to reach to their destination, they are less likely to utilize the system. Time and cost of switching are the two main factors that provide incentive or discourage private vehicle owners from using the transit system.

**Figure 2-22. Park and Ride Facility**

Demand for P&R is estimated at 1,473 private vehicles daily in the year 2023, 1,800 daily in the year 2028 and 2,269 daily in the year 2038. The minimum requirement is that parking space be provided for the demand for three hours, which equals to 1,100 cars. Accordingly, there is a need for at least 28,000 $m^2$ for P&R. The currently available land area which can be transformed into P&R areas is upwards of 35,000 $m^2$, and all plots are located on state-owned land or public domain.

Stations TB5, TB11, TB13, TB14, TB15, and TB27 have land available close to the stations. However P&R areas were chosen to be located near the stations that have the highest demand. It is worth to note that some of the already existing plots are already used as parking lots. Similarly, constructed parking areas in the future can serve local parking needs as well.

# 3. POLICY, LEGAL, AND ADMINISTRATIVE FRAMEWORK

This section presents an overview of concerned authorities/ institutions, as well as applicable legislation, policies, standards and international treaties and agreements setting the regulatory environmental requirements associated with the project.

The objective is to ensure compliance in the different phases of the Project from design through pre-construction, construction, operation and decommissioning not only with Lebanese environmental laws and regulations, but also with relevant international agreements of which Lebanon is signatory and to observe non-statutory corporate standards and good practice guidance.

## 3.1 INSTITUTIONAL FRAMEWORK RELEVANT TO THE PROJECT

The main authorities/institutions concerned with the Project along with their roles and mandates are summarized in Table 3-1. The roles of the authorities and institutions listed in Table 3-1 are primarily in the planning, construction, implementation and supervision of operation of the BRT System. The implementing bodies have a responsibility to achieve the objectives of the BRT System in line with the environmental and social rules that are enshrined in Law No. 444/2002 on the Protection of the Environment, and the various social rules such as the Expropriation Law No. 58/1991, Law No. 220/2000 on Persons with Disabilities and Law No. 37/2008 on Cultural Heritage.

The ministries of environment, culture, and social affairs shall be responsible to observe the environmental and social performance of the project. Notwithstanding, the planning authorities (MoPWT, RPTA, CDR, MoIM and MoEW) shall observe the environmental and social rules at the planning, design, construction and operation stages, so that the Project is in compliance and achieves its intended objectives to improve the flow of movement of the residents without jeopardizing the quality of the social and natural environment.

**Table 3-1. Mandates of the Main Concerned Authorities/ Institutions**

| Authority/ Institution | Reference to Legal Text on Organization | Mandate, Role and Responsibilities |
|---|---|---|
| Ministry of Public Works and Transport (MoPWT) - Directorate General for Land & Maritime Transport (DGLMT) | Decree No. 1611/1971 | The DGLMT is in charge of all Maritime and Land Transport affairs, and of controlling ports, harbors and maritime public property as well as of projects and assets of land transport, coordinating, monitoring and setting tariffs. |
| Railway and Public Transport Authority (RPTA) | Decree-Law No. 6479/1961 & Law No. 4/1988 | The RPTA has the mandate for the management and operation of existing and new railways as well as for public transport in Lebanon. |
| Ministry of Interior and Municipalities (MoIM) - Traffic & Vehicles Management Organization (TMO) | Decree No. 11244/2003 | The TMO is in charge of ensuring that regulations related to traffic and registration of vehicles are respected; and of managing and monitoring traffic lights (plans, related data, supervising maintenance contractors, monitoring traffic flow/ video system…), and management of public parking spaces. |

| Authority/ Institution | Reference to Legal Text on Organization | Mandate, Role and Responsibilities |
|---|---|---|
| MoPWT - Directorate General of Roads & Buildings (DGRB) | Decree No. 13379/1998 | The DGRB operates according to the Decree No. 13379/1998, with main tasks including planning for roads infrastructure, environmental assessments for proposed projects, contracting and executing construction works and maintenance. |
| MoIM & Internal Security Forces - Traffic Management Centre (TMC) | Decree No. 4082/2000 | The TMC was formed jointly by the Traffic & Vehicles Management Organization (TMO) and the Internal Security Forces (ISF). The TMC is in charge of the daily operation of the traffic management system, as well as optimizing the network operation and accidents detection/ follow-up. |
| MoPWT - Directorate General of Urban Planning (DGUP) | Decree No. 10490/1997 and amendments (Decree No. 9069/2002 & 16870/2006) | The DGUP is responsible for proposing plans for the development of main projects and infrastructure within a general urban plan, including traffic management and parking spaces. |
| Ministry of Environment (MoE) | Law No. 690/2005 & Decree No. 2275/2009 | The MoE is the national competent authority responsible for the protection of the environment. Responsible for reviewing the Scoping Report and the ESIA report for the Project and for issuing the conditions for approval of the Project. Upon approval of the ESIA Report, MoE is responsible to supervise the implementation of the ESMP. |
| CDR | Decree No. 5/1977 | The responsibilities of the CDR are summarized in three (3) main tasks: 1) developing and implementing a plan and a time schedule for the resumption of reconstruction and of development, 2) guaranteeing the funding of presented projects, and 3) supervising their execution and utilization by contributing to the process of rehabilitation of public institutions; thus enabling these institutions to assume responsibility for the execution of a number of projects under the supervision of the Council of Ministers (CoM).<br>The CDR is the project proponent and the governing agency responsible for the Project. The CDR commissioned Khatib & Alami Engineering Group s.a.l to prepare the "Feasibility Study for the Greater Beirut Urban Transport Project (GBUTP)". In parallel, the CDR commissioned the ESIA Consultant to prepare the ESIA and resettlement studies of the Project.<br>The CDR will be responsible for the construction phase of the BRT System. |

| Authority/ Institution | Reference to Legal Text on Organization | Mandate, Role and Responsibilities |
|---|---|---|
| Ministry of Culture (MoC) - Directorate General of Antiquities (DGA) | Law No. 35/2008 & Law No. 36/2008 | The DGA is the technical unit of the MoC responsible for the protection, promotion and prospecting activities in all sites of national/cultural heritage in Lebanon. |
| Ministry of Energy and Water (MoEW) – Directorate of Petroleum | Decree-Law No. 6821/1973 | The Directorate of Petroleum plays a role in setting fuel standards and regulates the type of fuels imported and used in the country. |
| Ministry of Social Affairs (MoSA) | Law No. 220/2000 | The MoSA implements the program to insure the rights of persons with disabilities including the issuance of personal disability card |

### 3.1.1 Transport and Traffic Planning

Several governmental bodies responsible for traffic and land transport management were established or are suggested to be established:

- Directorate General for Land & Maritime Transport (DGLMT);
- Transport Regulatory Unit (TRU) in the MoPWT.
- Higher Council for Land Transport;
- Railways and Public Transport Authority (RPTA);
- Traffic and Vehicles Management Organization (TMO);
- Environment and Traffic Safety Department in the Directorate General of Roads and Buildings (DGRB); and
- National Center for Road Safety.

#### 3.1.1.1 Directorate General for Land & Maritime Transport (DGLMT)

Decree No. 1611/1971 describes the organization of the DGLMT. The DGLMT assumes all matters of maritime and land transport including the supervision of ports and the public maritime domains. The Department of Land Transport within the DGLMT has the following responsibilities:

- Organizing investment in land transport and coordinating, controlling and defining its tariffs;
- Monitoring the movement of vehicles, studying its impact on the economy, collecting information on land transport movement between Lebanon and abroad, and working on developing it; and
- Tracking the development of rail transport, studying its impact on the economy, collecting information on rail transport movement between Lebanon and abroad, and working on developing it.

#### 3.1.1.2 Transport Regulatory Unit (TRU) in the MoPWT

MoPWT Decision No. 138/1999 calls for the establishment of the Transport Regulatory Unit (TRU) in the MoPWT whose role would be to develop public transport reform and supervise its implementation.

#### *3.1.1.3 Higher Council for Land Transport*

The Higher Council for Land Transport was established according to Decree No. 5540/1966 that was amended by Decrees No. 6181/1994 and No. 4775/1994. The Higher Council for Land Transport has the following responsibilities:

- Studying the economic fundamentals that aim at developing the land transport industry and at regulating the investment in land transport and the coordination and control of land transport;
- Studying the development, density, type and trends of rail transport;
- Studying how to use the roads and the establishment of transport lines, roads, passages, departure stations, parking stations, and arrival stations;
- Studying the issue of public cars plates according to the country's need and public interest;
- Studying the applications to establish companies and institutions to secure land transport, domestic transport and international transport;
- Studying the necessary programs for the training of pedestrians, including students using various means, especially through radio, newspapers and television; and
- Studying the basics of training of traffic supervisors.

#### 3.1.1.4 *Railways and Public Transport Authority*

The Railways and Public Transport Authority was established according to Decree-Law No. 6479/1961, as amended by Law No. 4/1988, and mandated with the following:

- Management and operation of national railways and their associated assets, and
- Management and operation of public transport in the Lebanese territories.

#### *3.1.1.5 Traffic and Vehicles Management Organization (TMO)*

Decree No. 4082/2000 outlines the mandates of the Traffic and Vehicles Management Organization (TMO) and describes it as a public institution that is administratively and financially independent, under the tutelage of the Minister of Interior and Municipalities.

Decree No. 11244/2003 specifies the role and responsibilities of the TMO as follows:

- Ensuring the enforcement of laws and regulations related to traffic and the registration of vehicles;
- Managing and controlling traffic lights;
- Studying traffic engineering for example giving their opinion on traffic impact studies conducted for specific projects listed in the Building Law;
- Operational traffic planning: Developing traffic management strategies and traffic flow plans, analyzing special requirements arising from special events, closing some of the roads to allow works to be done, preparing plans to handle bottlenecks resulting from accidents and events;
- On-street parking management: Working in coordination with municipalities and other competent bodies (Internal Security Forces (ISF), municipal police, and others...) to develop a policy to regulate roadside parking and determining the places where parking is allowed. The TMO is also responsible for the installation and maintenance of park-meters and for controlling violations;

- Informing, guiding and training: Communicating to the public, the media and officials information related to traffic conditions and roads. An advanced system shall be used to guide road users. The TMO shall conduct guiding and informative campaigns on modern traffic management systems for drivers and beneficiaries;
- External services: The TMO is entitled to sell services that include, but are not limited to: statistical information, engineering studies, training, etc. to the public, private and municipal sectors; and
- Support in traffic control and law enforcement: A team of engineers and technicians of the TMO, in cooperation with officers and members of the ISF shall provide support to the field traffic controllers in the different traffic sections in order to enhance their ability to implement the Traffic Law.

#### *3.1.1.6 Environment and Traffic Safety Department in the DGRB*

Decree No. 13379/1998 organizes the Directorate General for Roads and Buildings (DGRB) and Regional Directorates in the MoPWT, and defines the responsibilities of its Environment and Traffic Safety Department. According to Article 21, the responsibilities of the Environment and Traffic Safety Department are the following:

- Developing a plan for the equipment of roads with traffic signs, small lights, barriers, lighting installations and lane demarcation with paint;
- Gathering information and reports on traffic accidents in order to identify dangerous and risky sites and propose appropriate solutions;
- Checking designs prior to approval and reviewing the characteristics of existing roads and evaluating them from a safety point of view;
- Supervising the development of studies and designs related to traffic lights and road lighting and coordinating with the concerned bodies;
- Ensuring a technical control over the manufacturing and installation of traffic lights;
- Evaluating the technical studies that are being developed for road projects especially the impacts on the environment and proposing measures to mitigate the damages and addressing the results.

#### *3.1.1.7 National Center for Road Safety*

Article 356 of Law No. 243/2012 establishes the National Center for Road Safety, and defines its mandates as follows:

- Formulate the general policy of traffic safety and ensure its application;
- Work on the development of the traffic law;
- Development of practical driving tests frameworks and curricula, as amended by Law No. 278/2014;
- Set the qualifications of driving tests examiners and assess their qualifications;
- Prepare a test for driving trainers;
- Prepare education and training curricula to be adopted in driving schools;
- Approve competency courses for traffic accident experience candidates;
- Supervise public and private institutions and departments concerned with traffic affairs;
- Organize and sponsor advertising campaigns related to traffic safety; and

- Issue an annual report on its achievements and what has been achieved in terms of traffic safety, and publish those achievements in the media.

### *3.1.2 Environmental Protection*

Three institutions are responsible to set and oversee the implementation of environmental protection policies, strategies, rules and technical measures. These are the Ministry of Environment, the National Council for the Environment and the Environmental Public Prosecutor.

#### *3.1.2.1 Ministry of Environment*

According to Law No. 690/2005 and its application Decree No. 2275/2009, the MoE is the national competent authority responsible for the protection of the environment. The Law also states that the MoE is responsible for reviewing the Scoping Report and the ESIA report for the Project and for issuing the conditions for approval of the Project. Upon approval of the ESIA Report, MoE is responsible to supervise the implementation of the ESMP.

#### *3.1.2.2 National Council for the Environment*

Decree No. 8157/2012 establishes the National Council for the Environment and assigns its responsibilities as follows:

- In terms of policy and planning, make suggestions related to the following:
  - Environmental policy and strategies set by the Ministry of Environment;
  - Integration of environmental concepts into the policies of all development sectors in order to achieve sustainable development;
  - Integration of environmental concepts in Master Plans; and
  - Performance of follow-up procedures on international and regional treaties, conventions and protocols that are compliant with the general environmental policy and the needs of the country.
- On the technical level, make suggestions related to the following:
  - Evaluation of environmental results of each activity related to natural resources, after the activity has been implemented, as a step to assess the effectiveness of impact assessment studies, initial environmental examination, or the strategic environmental assessment, if any;
  - Revision and renewal of studies and books issued or to be issued by the MoE and proposition of additions and amendments deemed appropriate by the Council.
- On the legislative level, make suggestions related to the following:
  - Preparation of draft laws and regulations to protect the environment and sustain its natural resources;
  - Amendment of the laws and regulations related to the protection of the environment and the sustainability of natural resources to ensure their comprehensiveness, timeliness and applicability; and
  - Preparation of plans, programs and projects necessary to improve compliance with the obligations required in the international and regional treaties, conventions and protocols ratified by Lebanon.
- On the administrative level, make suggestions related to the coordination of the approaches of the institutions and departments concerned with the protection of the environment.
- At the financial level, make suggestions related to the following:

- Activating the National Environmental Fund described in Articles 8 to 11 of the Environment Protection Law No. 444/2002; and
- Development of financial incentives to facilitate environmental compliance by polluting sectors.

#### 3.1.2.3 *Environmental Public Prosecutor*

The control of environmental violations is accomplished through the enforcement of Law No. 251/2014 related to the establishment of an Environmental Public Prosecutor to arbitrate violations of environmental regulations and its application Decree No. 3989/2016 related to the designation of environmental officers to track and report environmental violations.

## 3.2 LEGISLATIVE FRAMEWORK RELEVANT TO THE PROJECT

As per the ESIA Study's Terms of Reference (TOR), the implementation of the ESIA Study must be in compliance with the Operational Policies (OP) of the World Bank (WB) and at the same time compliant with the existing legal framework and the regulations of the Government of Lebanon (GoL).

### 3.2.1 *Legislation and Standards Relevant to the Project*

In this section, the legislative texts and standards that are relevant and applicable to the Project are outlined and explained to set the environmental regulatory context within which the Project should be designed.

#### 3.2.1.1 *Overview of Existing National Legislation Relevant to the Project*

An overview of the main Lebanese legislative texts relevant to the Project is presented in Table 3-2.

**Table 3-2. Overview of the Lebanese Legislative Texts Relevant to the Project**

| Legislative Text | Year | Reference Entity | Relevant Provisions |
|---|---|---|---|
| **Environmental Assessment** | | | |
| Decision 261/1 | 2015 | MoE | Defining the procedures for the review of Scoping and EIA reports. |
| Circular 6/1 | 2015 | MoE | Defining EIA and IEE review fees and bank guarantees. |
| Circular 9/1 | 2014 | MoE | Specifying documents to be submitted with IEE and EIA Scoping Reports. |
| Decree 8633 | 2012 | CoM | Fundamentals of EIA, within the Framework of Environmental Protection Law. It stipulates the EIA procedures and regulations related to development projects that have a potential impact on the environment. |
| Decree 8213 | 2012 | CoM | Strategic Environmental Assessment. |
| **Environmental Controls** | | | |
| Decree 3989 | 2016 | CoM | Environmental Officers to track and report environmental violations. |
| Decree 3277 | 2016 | CoM | Control of Ozone Depleting Substances. |
| Law 251 | 2014 | Parliament | Establishing an Environmental Public Prosecutor to arbitrate violations of environmental regulations. |
| Decree 8157 | 2012 | CoM | Establishment of the National Council for the Environment and assignment of its responsibilities. |
| Integrated Solid Waste Management (ISWM) Draft Law – Decree 8003 | 2012 | -- | Sets the framework for Integrated Solid Waste Management based on the principles of Law 444/2002. |
| Protection of Air Quality Draft Law – Decree 8075 | 2012 | -- | Sets the framework for ambient air quality management and control of sources of emissions to air. |
| Law 444 | 2002 | Parliament | Environment Protection Law. |
| Law 341 | 2001 | Parliament | Lays the legal framework for reducing air pollution from the transport sector and encouraging the use of cleaner sources of fuel. Specifically, the law bans the import of minivans operating on diesel engines, as well as old and new diesel engines for private passenger cars and minivans. Empowers the Government to recall 10,000 public license plates. Amended by Laws 380/2001 & 453/2002 which provide incentives for replacement of public license plate-vehicles operating on diesel engines. |
| Decision 8/1 | 2001 | MoE | Updates/replaces Decision 52/1 by developing the Environmental Limit Values (ELVs) related to air pollutants and liquid waste emitted from classified establishments into receiving water bodies. |

| Legislative Text | Year | Reference Entity | Relevant Provisions |
|---|---|---|---|
| Decision 5/1 | 2001 | MoE | Environmental requirements for permitting the construction and operation of fuel stations. |
| Decision 52/1 | 1996 | MoE | Specifies the NSEQ for Air and Water. Sets the Environmental Quality Standards & Criteria for Air, Noise, Water and Soil. |
| Decree 6603 | 1995 | MoIM & MoE | Sets the standards for operating diesel trucks and buses, as well as the implementation of a monitoring plan and permissible levels of exhaust fumes and exhaust quality. |
| **Fuel Standards** | | | |
| Decree 3054 | 2016 | CoM | Amendment of Decree 8442/2002 on fuel specifications. |
| Decree 119 | 2014 | CoM | Legal endorsement of national standard specifications related to some fuel derivatives, gases and gas canisters (LPG). |
| Decree 8442 | 2002 | CoM | Specifications of unleaded gasoline 92-Octane, 95-Octane and 98-Octane grades, and diesel for use in motor vehicles. |
| **Transport & Traffic Regulations** | | | |
| Law 243 | 2012 | Parliament | Traffic Law organizing the traffic flow, use of public roads, driving licenses and exams, vehicles specifications, and public safety – Amended by Law 278/2014. Establishes the National Center for Road Safety, and defines its mandates. |
| Decision 824 | 2003 | CoM | Clarifications on the application of the Vehicles Inspection System and Procedures. |
| Decree 7577 | 2002 | CoM | Sets the Vehicles Inspection System and Procedures - Mecanique |
| Decree 7858 | 2002 | CoM | - Incentives to renew the vehicle fleet such as exempting certain types of vehicles from import tax, registration, and inspection fees.<br>- Compensation of owners of diesel-engine private cars, public transport cars, and buses who replace the engines with gasoline-operated ones.<br>- Banning the use of private and public cars operated with diesel engines starting from 15/6/2002, and banning the use of private and public transport buses operated with diesel engines starting from 15/7/2002. |
| Decision 9 | 2000 | CoM | Calls for the reform and re-organization of the Land Public Transport Sector in Lebanon and the reduction of the number of public transport vehicles from 39,761 to 27,061. |
| Decision 138 | 1999 | MoPWT | Calls for the establishment of the Transport Regulatory Unit (TRU) in the MoPWT. The TRU is to develop the land public transport reform and supervise its implementation. |
| Decree 6603 | 1995 | MoIM & MoE | Defines the standards for operating diesel trucks and buses, as well as the implementation of a monitoring plan and permissible levels of exhaust fumes and exhaust quality (CO, NOx, HCs and |

| Legislative Text | Year | Reference Entity | Relevant Provisions |
|---|---|---|---|
| | | | TSP). |
| Law 432 | 1995 | Parliament | Amends Law 368/1994. Removes age restriction on imported vehicles for diesel engine vehicles (trucks, buses, and first-aid vehicles) that were purchased or shipped before the promulgation of Law 368/1994. |
| Law 368 | 1994 | Parliament | Allows the import of pick-ups, trucks and buses less than five years old operating on diesel engines. |
| Law 384 | 1994 | Parliament | Permits the MoIM to issue and sell 12,000 license plates for shared-taxi vehicles, 7,000 license plates for trucks, 4,000 license plates for mini-buses (capacity 15 seats or less), and 1,000 license plates for buses. Doubling the existing number of public licenses by issuing one plate for every existing license holder who submits an application within 3 months from law enactment. |
| Decree 84 | 1977 | CoM | Authorizes vehicles owned by public authorities to use diesel engines. |
| Decree 5540 | 1966 | CoM | Establishment of the Higher Council for Land Transport –Amended by Decrees 6181/1994 and 4775/1994. |
| **Land Use** | | | |
| Decree 2366 | 2009 | CoM | National Physical Master Plan for the Lebanese Territory (NPMPLT). |
| Law 58 | 1991 | Parliament | Expropriation Law – Amended by Law issued in 2006. |
| Legislative Decree 45 | 1932 | | Expropriation for the Public Benefit. |
| Decision 144/S | 1925 | High Commissioner | Definition of the Public Domain – amended by Decree-Law 15403/1964. |
| **Cultural Heritage** | | | |
| Decree 3058 | 2016 | CoM | Integration of immovable antiquities in private and public buildings and properties. |
| Decree 3057 | 2016 | CoM | Defines and regulates the procedures followed by the DGA in preventive and rescue excavations. |
| Law 37 | 2008 | Parliament | Defines and regulates the protection and management of cultural properties. |
| Decree in force 1057 | 2007 | Parliament | Protection of heritage buildings. |
| Decision 14 | 1988 | CoM | Regulates the trade in antiquities. |
| Decision 225 | 1934 | High Commissioner | Establishes a system for penalizing violations of laws on ancient monuments and ruins and historical buildings. |

| Legislative Text | Year | Reference Entity | Relevant Provisions |
|---|---|---|---|
| Decision 166 | 1933 | High Commissioner | Sets the regulations for the preservation of antiquities, excavations and trade in antiquities. |
| **Construction Regulations** | | | |
| Decree 8649 | 2012 | CoM | Application of Article 19 of Law 646/2004 related to Parkings. |
| Decree 7964 | 2012 | CoM | Public safety in buildings, facilities, elevators and prevention of fire and earthquake risks. |
| Decree 15874 | 2005 | CoM | Application of the Construction Law 646/2004. |
| Decree 11958 | 2004 | CoM | Protection, prevention and safety in construction. |
| Law 646 | 2004 | Parliament | Construction Law – Amends the Legislative Decree 148/1983. |
| **Persons with Disabilities (PwDs)** | | | |
| Decree 7194 | 2011 | CoM | Application of the provisions of Law 220/2000 related to the rights of PwDs. |
| Law 220 | 2000 | Parliament | Law related to the rights of PwDs. |

#### 3.2.1.2 *Synopsis of the Lebanese Legislative Texts Relevant to the Project*

##### 3.2.1.2.1 Environmental Assessment

The EIA Decree No. 8633/2012 sets specifications and criteria for environmental standards and requirements, principles, and measures necessary to assess the environmental impact of development projects. The EIA Decree addresses the objectives of the regulation, definitions, as well as various stages of the national EIA process such as screening, scoping, implementation, and review of the EIA report, in addition to the period of validity, and the appeal process. The EIA Decree also lists all the activities for which an EIA study or permit conditions are mandatory, and those that require an IEE (refer to Appendices 1, 2 and 3 of the EIA Decree).

According to Appendix 1 of the EIA Decree, the Project requires an EIA (Point 6: construction of roads, bridges, railways, and tunnels).

The main steps of the EIA Implementation Process in Lebanon are summarized in the schematic diagram shown in Figure 3-1 as described in Appendix 9 of the EIA Decree.

The outline adopted for the preparation of the current ESIA report follows that specified in MoE Decision No. 261/1/2015 that defines the procedures for the review of Scoping and EIA reports.

As previously mentioned in Section 1.1, the current ESIA Report is aligned with the outcomes of the Land Transport Sector Strategy SEA that was prepared based on the requirements of the SEA Decree No. 8213/2012.

##### 3.2.1.2.2 Environmental Controls

###### *3.2.1.2.2.1 Environmental Protection*

The Project should be aligned with the overall philosophy of environmental protection in Lebanon as stipulated in the Environment Protection Law No. 444/2002, and which defines the different environmental receptors and resources and proposes means for their protection.

###### *3.2.1.2.2.2 Construction and Operation of Fuel Stations*

MoE Decision No. 5/1/2001 that stipulates the environmental requirements for permitting the construction and operation of fuel stations only applies if fuel stations will be built in bus depots.

Article 1 of the Decision lists the resource inputs and outputs of activities at fuel stations, namely, water consumption to clean vehicles, suspended solids in wastewater from washing of vehicles, residues of cleaning products and organic matters mainly oil and grease, used oils, air pollutants generated from the volatilization of liquid fuels, accidental fuel leakages that could seep to soil and groundwater.

The Decision lists the general environmental conditions required in fuel stations relating to wastewater management, curbing emissions to air, management of used oils, vehicles washing, fuel storage tanks, safety standards, and visual aspects of the fuel stations. The Decision also provides a typical design of a cesspool.

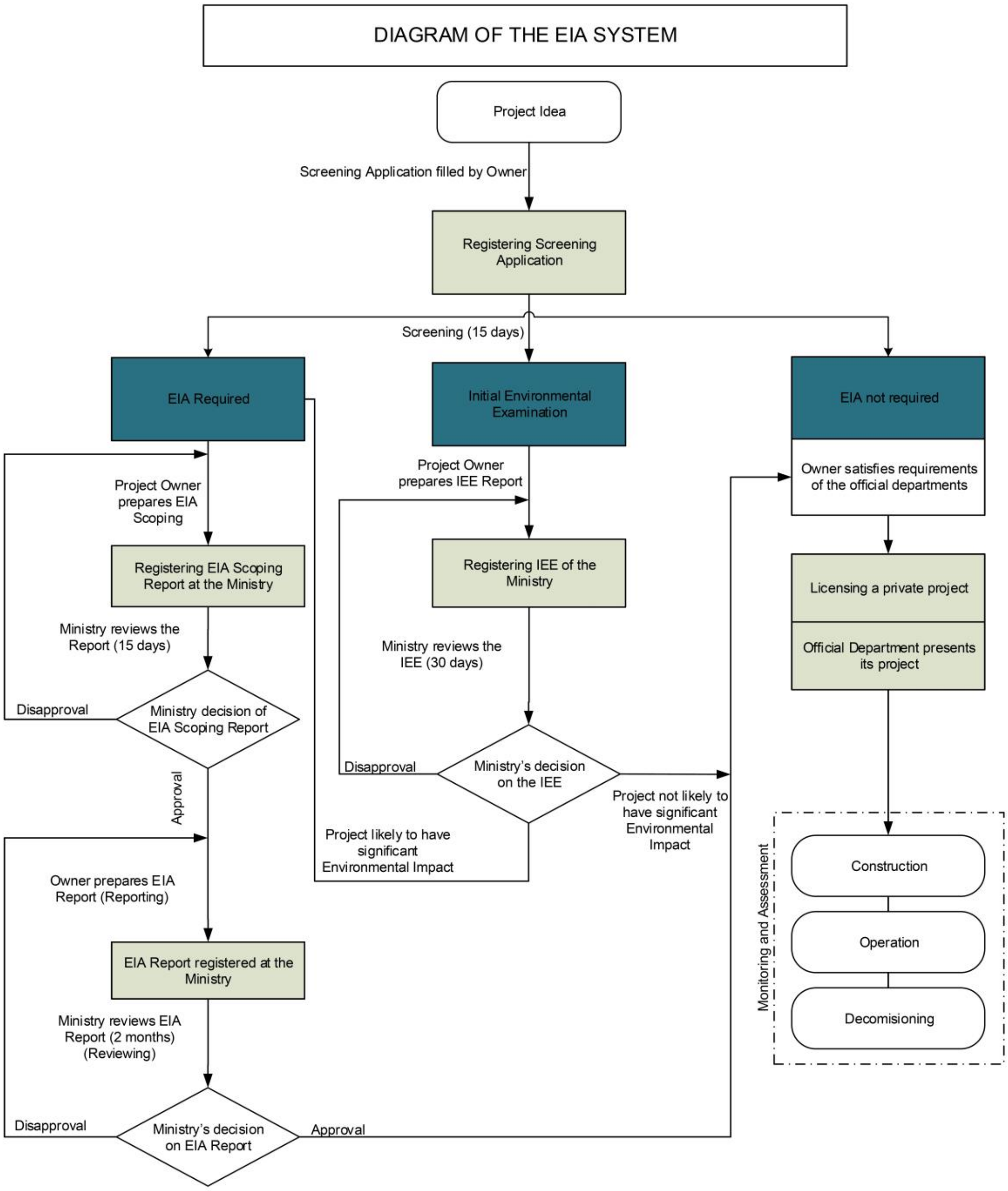



**Figure 3-1. Schematic Diagram of the EIA Licensing Procedure**

The final and obligatory permit conditions are determined according to the location of the station and the pollutants resulting from its daily operation. The MoE reserves the right to impose new environmental conditions when necessary, to conduct periodic monitoring and to suspend the permit in case the required environmental conditions are violated.

*3.2.1.2.2.3 Transport Vehicles*

Several legislations were drafted related to the control on the import of certain types of vehicles; mainly:

- Law No. 368/1994 allows the import of pick-ups, trucks and buses less than five years old operating on diesel engines. Article 2 called for setting the conditions for using pick-ups, trucks and buses operating on diesel engines, monitoring methodologies, the acceptable levels of smoke and smoke quality and which were specified in Decree No. 6603/1995.
- Law No. 384/1994 was enacted in order to control the trade of public license plates. This Law permitted the MoIM to issue and sell 12,000 license plates for shared-taxi vehicles, 7,000 license plates for trucks, 4,000 license plates for mini-buses (capacity 15 seats or less), and 1,000 license plates for buses. The Law also doubles the existing number of public licenses by issuing one plate for every existing license holder who submits an application within three (3) months from law enactment.
- Law No. 432/1995 that amended Law No. 368/1994 removed the age restriction on imported vehicles for diesel engine vehicles (trucks, buses, and first-aid vehicles) that were purchased or shipped before the promulgation of Law No. 368/1994.

By 2000, it was evident that the previous legislation that led to a large increase in public transport vehicles running on diesel-powered engines had undesirable effects on local air quality. The CoM Decision No. 9/2000 called for the reform and re-organization of the Land Public Transport Sector in Lebanon and the reduction of the number of public transport vehicles from 39,761 to 27,061.

The CoM Decision was followed by Law No. 341/2001 which mandated the recall of public license plates and incentives to replace diesel-powered engines with gasoline-powered ones. Pursuant to Law No. 341/2001, Decree No. 7858/2002 was drafted to provide incentives to encourage the renewal of the vehicle fleet and compensation for owners of diesel-engine operated vehicles for the mandatory switch to gasoline-powered engines. The Decree banned the use of private and public transport cars and buses operated with diesel engines.

Also pursuant to Law No. 341/2001, Decree No. 7577/2002 was enacted to set the vehicles inspection system and procedures "mecanique" and its pursuant Decision No. 824/2003 provided clarifications on the application of the vehicles inspection system and procedures.

*3.2.1.2.2.4 Air Quality*

In 1993, Lebanon ratified the Vienna Convention on the Protection of the Ozone Layer and Montreal Protocol on Ozone Depleting Substances (ODS) through Law No. 253/1993, and in 1999 Lebanon ratified the Copenhagen Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer through Law No. 120/1999. An application Decree No. 3277/2016 was promulgated on the control of ODS. This decree aims at controlling the ODS listed in the Annexes of the Montreal Protocol.

Other national legislations also exist for the protection of air quality during construction and operation activities of the proposed project such as the Protection of Air Quality Draft Law of 2012 that sets the framework for ambient air quality management and control of sources of emissions to air and Law No. 341/2001 which is related to the protection of air quality from the transport sector. Law No. 341/2001 lays the legal framework for reducing air pollution from the transport sector and encouraging the use of cleaner sources of fuel. Specifically, the law bans the import of minivans (that can carry no more than 15 passengers other than the driver) operating on diesel engines, as well as old and new diesel engines for private passenger cars and minivans. In addition, the Law prohibits the use of gasoline fuel containing lead in all types of vehicles since 2002. The Law also empowers the Government to recall 10,000 public license plates. This Law was amended by Laws No. 380/2001 & 453/2002, which provide incentives for replacement of public license plate-vehicles operating with diesel engines.

National emission standards were established in the MoE Decision No. 52/1/1996 and later updated in the MoE Decision No. 8/1/2001. Where standards for the assessment are not addressed in the national legislation, international standards will be referred to, particularly those issued by the World Health Organization (WHO), which are also used in the Environmental, Health and Safety (EHS) General Guidelines of the World Bank (IFC, World Bank, 2007), as shown in Table 3-3.

**Table 3-3. Lebanese Ambient Air Quality Standards and WHO Air Quality Guidelines**

| Pollutant | Averaging Period | Source | Concentration |
|---|---|---|---|
| Sulfur dioxide ($SO_2$) | 10 minutes | WHO/EHS AQ Guideline Value | 500 $\mu g \cdot m^{-3}$ |
| | 1 hour | Lebanese AAQS | 350 $\mu g \cdot m^{-3}$ |
| | 24 hours | Lebanese AAQS | 120 $\mu g \cdot m^{-3}$ |
| | | WHO/EHS AQ Guideline Value | 20 $\mu g \cdot m^{-3}$ |
| | 1 year | Lebanese AAQS | 80 $\mu g \cdot m^{-3}$ |
| Nitrogen dioxide ($NO_2$) | 1 hour | Lebanese AAQS / WHO/EHS AQ Guideline Value | 200 $\mu g \cdot m^{-3}$ |
| | 24 hours | Lebanese AAQS | 150 $\mu g \cdot m^{-3}$ |
| | 1 year | Lebanese AAQS | 100 $\mu g \cdot m^{-3}$ |
| | | WHO/EHS AQ Guideline Value | 40 $\mu g \cdot m^{-3}$ |
| Ozone ($O_3$) | 1 hour | Lebanese AAQS | 150 $\mu g \cdot m^{-3}$ |
| | 8 hours | Lebanese AAQS / WHO/EHS AQ Guideline Value | 100 $\mu g \cdot m^{-3}$ |
| Carbon monoxide (CO) | 15 minutes | WHO AQ Guideline Value | 100,000 $\mu g \cdot m^{-3}$ |
| | 30 minutes | WHO AQ Guideline Value | 60,000 $\mu g \cdot m^{-3}$ |
| | 1 hour | Lebanese AAQS / WHO AQ Guideline Value | 30,000 $\mu g \cdot m^{-3}$ |
| | 8 hours | Lebanese AAQS / WHO AQ Guideline Value | 10,000 $\mu g \cdot m^{-3}$ |
| Total suspended particles (TSP) | 24 hours | Lebanese AAQS | 120 $\mu g \cdot m^{-3}$ |
| Particulate matter smaller | 24 hours | Lebanese AAQS | 80 $\mu g \cdot m^{-3}$ |

| Pollutant | Averaging Period | Source | Concentration |
|---|---|---|---|
| than 10 µm ($PM_{10}$) | | WHO/EHS AQ Guideline Value | 50 µg·m$^{-3}$ |
| | 1 year | WHO/EHS AQ Guideline Value | 20 µg·m$^{-3}$ |
| Particulate matter smaller than 2.5 µm ($PM_{2.5}$) | 24 hours | WHO/EHS AQ Guideline Value | 25 µg·m$^{-3}$ |
| | 1 year | WHO/EHS AQ Guideline Value | 10 µg·m$^{-3}$ |
| Lead | 1 year | Lebanese AAQS | 1 µg·m$^{-3}$ |
| | | WHO AQ Guideline Value | 0.5 µg·m$^{-3}$ |
| Benzene | 1 year | Lebanese AAQS | 5 ppb |

Decree No. 6603/1995 only applies if buses will operate on diesel. Article 1 states that before registration, diesel-powered buses are required to install special filters for smoke and dust. Also, the total load of the bus should not exceed the specified load for the bus and the one indicated on its license. Article 2 states the permissible levels of exhaust fumes and exhaust quality should conform to the ones stated in Table 3-4.

**Table 3-4. Permissible levels of Pollutants in Exhaust Fumes of Diesel-powered Buses**

| Pollutant | Permissible Levels |
|---|---|
| CO | 10 mg·m$^{-3}$ |
| $NO_2$ | 0.10 mg·m$^{-3}$ |
| HC | 0.16 mg·m$^{-3}$ |
| Smoke (TSP) | 0.075 mg·m$^{-3}$ |

Also, Article 2 of Decree No. 6603/1995 states that the specifications of the diesel fuel to be used by buses shall be compliant with the following:

1) the amount of sulfur in the diesel fuel used shall not exceed 0.5%,

2) the diesel fuel used shall be lead-free,

3) the diesel fuel used shall not contain any percentage of water, and

4) the diesel fuel used shall not contain any traces of deposits.

The diesel fuel specifications were updated by virtue of Decree No. 8442/2002 and Decree No. 3054/2016. Sulfur content in diesel fuel should not exceed 0.001% by weight (10 ppm).

*3.2.1.2.2.5 Noise*

The national maximum allowable noise levels according to MoE Decision No. 52/1/1996 are presented in Table 3-5 and noise levels according to the World Bank EHS General Guidelines are presented in Table 3-6.

**Table 3-5. Permissible Ambient Noise Levels in Selected Regions**

| Region Type | Limit for Noise Level dB(A) | | |
|---|---|---|---|
| | Day Time (7 a.m. – 6 p.m.) | Evening Time (6 p.m. – 10 p.m.) | Night Time (10 p.m. – 7a.m.) |
| Residential areas with some construction sites or commercial activities or located near a road | 50-60 | 45-55 | 40-50 |

| Region Type | Limit for Noise Level dB(A) | | |
|---|---|---|---|
| | Day Time (7 a.m. – 6 p.m.) | Evening Time (6 p.m. – 10 p.m.) | Night Time (10 p.m. – 7a.m.) |
| Urban residential areas | 45-55 | 40-50 | 35-45 |
| Industrial areas | 60-70 | 55-65 | 50-60 |
| Rural residential areas | 35-45 | 30-40 | 25-35 |

**Table 3-6. EHS General Guidelines for Noise Levels**

| Receptor | One Hour $L_{Aeq}$ (dBA)* | |
|---|---|---|
| | Day Time (7 a.m. – 10 p.m.) | Night Time (10 p.m. – 7 a.m.) |
| Residential; institutional; educational** | 55 | 45 |
| Industrial; commercial | 70 | 70 |

*Guidelines values are for noise levels measured out of doors (Berglun, Lindvall, & Schwela, 1999)
**For acceptable indoor noise levels for residential, institutional, and educational settings, (Berglun, Lindvall, & Schwela, 1999)

3.2.1.2.3 Fuel Standards

Fuel that will be used to operate the BRT buses must comply with the national standard specifications related to some fuel derivatives and gases as set in Decree No. 119/2014 and Decree No. 8442/2002 and its amendment (Decree No. 3054/2016) on the specifications of unleaded gasoline 92-Octane, 95-Octane and 98-Octane grades, and diesel oil for use in motor vehicles. The fuel specifications are listed in Table 3-7 and Table 3-8. The national standard for diesel fuel oil is 10 ppm sulfur by weight, which is considered ultra-low sulfur diesel (ULSD) as per ASTM D975-17 (Standard Specification for Diesel Fuel Oils).

**Table 3-7. National Standards for Fuel**

| Standard Title | National Standard Reference Number |
|---|---|
| Ordinary Leaded Gasoline | NL 252 |
| Leaded Super Gasoline | NL 253 |
| Unleaded Super Gasoline | NL 254 |
| Liquefied Petroleum Gas | NL 257 |

**Table 3-8. Standard Constituents of Unleaded Gasoline 92 Octane, Unleaded Gasoline 95 (Regular) Octane, Unleaded Gasoline 98 (Premium) Octane and Diesel Oil**

| Property | Unleaded Gasoline 92 Octane | Unleaded Gasoline 95 (Regular) Octane | Unleaded Gasoline 98 (Premium) Octane | Diesel Oil |
|---|---|---|---|---|
| Sulfur, Wt % | Max 0.05 | Max. 0.05 | - | Max 0.001 |
| TEL, g/L as Pb | Max. 0.013 | Max. 0.013 | Max. 0.005 | - |
| Benzene, % v/v | - | Max. 5.0 | Max. 5.0 | - |
| Methanol, %v/v | - | Max. 3.0 | Max. 3.0 | - |
| MTBE, %v/v | - | Max. 10.0 | - | - |
| Ethanol, %v/v | - | - | Max. 5.0 | - |

| Property | Unleaded Gasoline 92 Octane | Unleaded Gasoline 95 (Regular) Octane | Unleaded Gasoline 98 (Premium) Octane | Diesel Oil |
|---|---|---|---|---|
| Isopropyl Alcohol, %v/v | - | - | Max. 5.0 | - |
| Tertiary Butyl Alcohol, %v/v | - | - | Max. 7.0 | - |
| Ethers containing five or more C atoms, %v/v | - | - | Max. 10.0 | - |
| Other Organic Oxygenates, %v/v | - | - | Max. 7.0 | - |

3.2.1.2.4 Traffic Rules

The Traffic Law No. 243/2012 organizes the traffic flow, the use of public roads, driving licenses and exams, vehicles specifications, and public safety.

Article 20 of the Law prohibits bus drivers from talking to people (in a way that would distract them while driving), from eating, and from smoking while driving. Article 43 of the Law prohibits buses from stopping and parking in places other than the ones designated for pick-up and drop-off.

Article 22 of the Traffic Law states that outside cities, the safety distance between vehicles or a group of vehicles with a total weight of more than 7.5 tons or exceeding 7 meters in length, moving at the same speed, shall be at least 50 meters. The authority in charge of road facilities may specify a longer safety distance between the vehicles in order to mitigate the risks to these facilities for safety purposes.

Article 24 of the Traffic Law states that the speed limit of equipment used for public works on public roads shall be 30 km/h. The provision of this article shall be respected during the applies to the construction phase of the BRT project.

Article 26 of the Traffic Law states that in case there are no signs specifying the speed limit on local roads, main roads and secondary roads, all drivers must abide with the speed limits as provided in Table 3-9. Custom speed limits can be set in the following cases:

**Table 3-9. Speed Limit for Each Type of Road**

| Type of Road | Speed Limit |
|---|---|
| Highway | 100 km/h |
| Roads outside populated areas | 70 km/h |
| Roads inside populated areas | 50 km/h |

- On unclassified internal roads, the local authority (Municipality, Qa'im maqam, or Governor) can, with the provision of a justification for the decision made, reduce the speed limit in populated areas so as to ensure public safety.
- It is possible with a justified decision by the MoPWT to lower the speed limit on some roads located in populated areas or on part of those roads so as to ensure public safety.

- The speed limit for trucks, public transport vehicles, vehicles transporting dangerous substances, and for new drivers who obtained their driving license less than 3 years ago, when it rains or when the roads are still wet, shall be determined by a decision of the Ministers of Public Works and Transport and Interior and Municipalities.
- When visibility is less 50 meters, the speed limit is reduced to 50 km/h on all roads.

Article 122 of the Law, as amended by Law No. 278/2014, states the special conditions for buses as follows:

- Each bus must have two (2) doors at least at the right side of the bus (current registered buses are exempted from this requirement as long as those buses are in a good condition).
- Each bus shall have sufficient windows and stairs that are easy to use and that are integrated with the bus structure. Curtains can be added to the windows.
- Seats must be firmly anchored to the floor of the bus.
- No changes are allowed to be made to the body of the vehicle, the steering device, or the seat in a way that contradicts the manufacturer's specifications.
- Clear signs and instructions should be placed inside the bus, requiring all passengers not to speak to the bus driver while he is driving so that he does not get distracted.
- Adequate lighting shall be ensured inside the buses.
- Each bus shall be equipped with at least two (2) adequate fire extinguishers that shall be always valid for use. One (1) of the fire extinguishers shall be easily accessible to the bus driver.
- Every bus should be equipped with a first aid kit.
- An identification label shall be posted on the bus in accordance with a decision issued by the Ministers of Public Works and Transport and Interior and Municipalities.

##### 3.2.1.2.5 Land Use

According to Article 1 of Decree No. 2366/2009, the National Physical Master Plan for the Lebanese Territory (NPMPLT) constitutes the general regulatory framework for urban planning and land use in Lebanon. Article 2 of the Decree states that ministries, departments, public institutions, independent parties, municipalities and federations of municipalities are obliged to adopt directives that are consistent with the NPMPLT in every matter related to land use and regulation. The Decree classifies Lebanese lands in accordance with the following categories:

- U: Urban areas
- R: Rural areas
- A: National agricultural areas
- N: National natural areas, distributed as follows:
  - 1N: High Mountainous areas
  - 2N: The Lebanese cedar line and the mountainous orchards
  - 3N: Areas connecting wooded lands, valleys and other natural areas

The Decree identifies the following unique sites:

- P: Major landscape
- S: Historic, archaeological and natural sites distributed as follows:

- 1S: Classified archaeological sites; and
- 2S: Classified natural sites.

Areas prone to natural hazards are referred to as follows:

- F: Areas prone to flooding
- G: Areas exposed to the dangers of soil erosion and landslides
- W: Areas at risk of groundwater contamination

###### 3.2.1.2.6 Land Acquisition

National legislative texts that directly instrument the processes of land acquisition and involuntary resettlement are the Expropriation Law No. 58 dated 29/05/1991 which was amended on 08/12/2006 and the Tenancy Law of year 1991.

The Lebanese Constitution guards and protects the right of private property including landed property and the rights associated with it. The exercise of eminent domain, in Lebanon, for expropriating private property in the public interest, is governed by this Law. This Law is comprehensive and governs many cases.

The State may only expropriate land rights when it is to be declared in the public interest, and against payment of a prior and equitable compensation. All compensation is a financial award through legal assessment. The Expropriation Law establishes general provisions for prior compensation of expropriated assets, and easement fees for other restrictions imposed on property. The mode of payment when compensating for acquisition of land will in practice be in several phases, but no defined time lag exists between taking over of land and final payment.

The decisions of the Expropriation Committee may be appealed to the Appeals Committee by the CDR or the individual property owner and the appellant must be represented by a lawyer. Compensation is determined by an Expropriation Committee set up by a decree according to proposals from the relevant ministers from each Governorate.

The tenancy / rent law was enacted in 1991 and gives the land owner the right to retrieve the property at the end of the contract. Where expropriation causes loss of tenancy, expropriation commissions divide their awards between landlords and tenants according to the economic value of the tenancy, enabling tenants to secure alternative housing by rental or down-payment for the purchase of a housing alternative.

###### 3.2.1.2.7 Cultural Heritage

The Directorate General of Antiquities (DGA) is the technical unit of the Ministry of Culture (MoC) that is responsible for the protection, promotion and excavation activities in all sites of national heritage in Lebanon. Law No. 35/2008 defines the organization and mandates of the MoC.

Several cultural properties were identified in the surroundings of the Project area. Therefore, the project shall comply with the provisions of Law No. 37/2008 that defines and regulates the protection and management of cultural properties. Other legislative texts which may be relevant to the scope of construction works are:

- Decree No. 3058/2016 on the integration of immovable heritage in private and public buildings and properties lays down the different procedures and conditions for in-situ integration and for re-integration of antiquities found when performing excavation activities.
- Decree No. 3057/2016 defines and regulates the procedures followed by the DGA in preventive and rescue excavations.
- Decree in force No. 1057/2007 on the protection of traditional buildings and incentives for owners of these buildings that would discourage their demolition.
- COM Decree No. 14/1988 which considers the illicit trafficking in antiquities or cultural properties a minor crime or a Misdemeanor and not a felony or a major crime. The sanctions range between 9 months to 3 years of imprisonment in addition to a fiscal penalty.
- Decision No. 225/1934 establishes a system for penalizing violations related to laws on ancient monuments and ruins and historical buildings. Article 1 sets the fiscal penalties. Article 2 states that if an archaeological object is seized and confiscated for the benefit of the Lebanese Government, the finder may be rewarded. Article 3 states that the reward shall be equally divided between informants and guardians.
- Law issued by Decision no. 166/1933 sets the regulations for the preservation of antiquities, excavations and trade in antiquities. This decision deals, through its various articles, with the way of licensing, the use of property and ancient monuments while assuring their protection and their conservation.

3.2.1.2.8 Construction Regulations

The construction of the BRT System components shall comply with several legislations mainly:

- Decree No. 7964/2012 on public safety in buildings, facilities, elevators and prevention of fire and earthquake risks;
- Decree No. 15874/ 2005 on the application of the Construction Law No. 646/2004 that amends the Legislative Decree No. 148/1983; and
- Decree No. 11958/2004 on the protection, prevention and safety in construction works, which is applicable to this project through its main requirements:
  - It is the responsibility of the employer to ensure the provision of proper first aid kits and of trained personnel, and to provide the arrangements to ensure the transfer of injured personnel to health care facilities in case of need;
  - A safe means of access to all workplaces shall be provided, maintained in safe conditions and indicated with proper signage;
  - All hazardous materials shall be provided with warning signs and the data sheets indicating their characteristics and instructions for use and storage; and
  - The employer shall provide clean drinking water in the site or within a walking distance.

Given that the Outer Ring and Inner Ring corridors of the BRT System will lead to the removal of on-street parking spots, it is useful to highlight that local authorities have been granted the legal means to provide public parkings by Decree No. 8649/2012 which is an application of Article 19 of Law No. 646/2004 relating to Parkings. According to Article 2 of this Decree, the local authority shall collect parking fees which stand in for parkings that the developer did not construct in his building contrary to his permit. Article 5 of this Decree states that when there is a possibility to secure alternative parkings the local authority shall, after having obtained the approval of the competent technical authority, e.g. DGUP, submit a request to the MoIM to withdraw the funds deposited in the Treasury and shall pledge to ensure the implementation of the parking within one year from the date of refund.

3.2.1.2.9 Persons with Disabilities (PwDs)

Law No. 220/2000 guarantees PwDs equal rights as any other citizen and its application Decree No. 7194/2011 details the provisions that should be made to include the disabled in all facets of social and public life. Section 5 of the Law "Disabled people have the right to mobility, parking and driving licenses" is the most relevant section to the BRT project and is summarized in Table 3-10.

**Table 3-10. Summary of the Relevant Articles of Section 5 of the Law No. 220/2000**

| Articles | Provisions |
|---|---|
| *Article 44* | |
| Paragraph A | MoPWT shall provide buses (or other means of transport) that are properly equipped for PwDs in accordance with international standards of safety as follows:<br>• Sound alerts for the visually impaired;<br>• At least two (2) assistants to accompany every driver (shall be ensured for at least 15% of the total number of each type of transport available at the MoPWT).<br>The Ministry shall enforce the installation of equipment in all new public transport in accordance with the standards mentioned in this Article. |
| Paragraph B | Public transportation that is properly equipped for PwDs shall be made known through:<br>• Placing the international symbol of accessibility on all sides of the transportation vehicle; and<br>• Equipping the transportation vehicle with a special alarm that shall be mandatorily activated by the bus driver whenever he stops and takes off to alert the visually impaired. |
| Paragraph C | The stations of public transportation vehicles that are equipped for PwDs shall be recognized by the international symbol of accessibility placed in different visible areas of the stations. |
| Paragraph D | The CoM shall set up, through a Decree, a joint committee representing the public and private bodies concerned with transport, called the Committee for the Movement of PwDs. |
| *Article 45* | |
| Paragraph A | At least one (1) seat adjacent to the entrance shall be allocated for PwDs in each public transportation vehicle that is not equipped for PwDs. The international symbol of accessibility shall be placed on the allocated seat.<br>Each holder of a disability card has the priority to use this seat and to claim the seat next to him/ her to place the wheelchair or to allow the accompanying person to sit. |
| Paragraph B | The driver or his assistant shall allow the disability card holder to use the nearest door to his/ her seat to get out of the bus if requested. |
| *Articles 46* | |
| Every disability card holder and one person accompanying him/ her (if any) have the right to use public transport vehicles for free. | |
| *Article 47* | |
| Any driver of a transportation vehicle intended for public or joint transportation that refuses to transport | |

| Articles | Provisions |
|---|---|
| a disabled person is considered to have violated the traffic law. The fine for this violation shall be double the fine for parking in a prohibited place. | |
| *Article 48* | |
| Paragraph A | 1.5% of the capacity of every parking of a public building or a building intended for public use shall be allocated to vehicles that transport PwDs in accordance with the criteria adopted in the Construction Law. This ratio is rounded up to calculate the number of places. At least 3.5 m shall be reserved for each car and those spaces shall be the closest to the entrance of the building. |
| Paragraph B | If public buildings do not have parking, parking spaces for vehicles that transport PwDs shall be ensured on public roads (within a maximum distance of 50 m from the entrance of the intended building) provided that it does not impact public safety. |
| *Article 49* | |
| Paragraph B | The Ministry of Social Affairs (MoSA) shall issue a decision on the specifications and conditions for obtaining a special parking card. |
| *Article 50* | |
| Paragraph A | Every person that parks in the parking spot reserved for PwDs must be transporting a person who is a holder of a disability card. This shall be ensured when parking and when departing. The personal disability card shall be placed on the front windscreen (on the inside), where it can be clearly seen. |
| Paragraph B | The traffic police officers and the competent authorities must ensure that the cars parked in the designated places are subject to the conditions mentioned in Paragraph A. Otherwise, it shall be considered a violation of the traffic law. |
| *Article 51* | |
| The MoSA in cooperation with the Ministries of Interior and Municipalities, and Public Works & Transport, shall organize training courses for traffic and municipal police officers, public and private bus drivers, and public vehicles drivers (along with their assistants) to inform them on all applicable laws and measures and on the proper ways to deal with PwDs (related to the time needed for them to get in and out of the vehicle, accompanying persons, etc.). | |

Decree No. 7194/2011 states the purpose of this Decree which is to apply the provisions of Article 34 of Law No. 220/2000 and Article 13 of the Construction Law No. 646/2004. Article 2 of the Decree states that all private and public buildings to be built for public use (Government facilities and institutions, offices, places of worship, commercial establishments with an area that exceeds 150 $m^2$, healthcare facilities, educational and leisure facilities, touristic and sports facilities, banks, ports, airports, and private residential buildings) shall adhere to the standards set forth in this Decree.

Article 3 of the Decree states that in order to obtain a construction permit, the buildings mentioned in Article 2 shall adhere to certain specifications related to various criteria as follows:

- Component 1: Pathways and Ramps
  - Maximum slope: 12%.
  - Resting platforms (length: 140 cm) shall be ensured every 20 m if the slope is < 4%.
  - The maximum length of the ramp in relation to its maximum inclination is shown in Table 3-11.

**Table 3-11. Maximum Length of the Ramp in relation to its Maximum Inclination**

| Inclination (slope) (%) | Maximum Length of the Ramp (m) |
|---|---|
| 4 | 20 |
| 5 | 15 |
| 6 | 10 |
| 7 | 8 |
| 8 | 6 |
| 10 | 4 |
| 12 | 2 |

- o The pathways and ramps shall have a width of at least 180 cm and a free height of 200 cm.
- o If a deviation of more than 20 degrees of the longitudinal axis occurs, a horizontal surface of at least 3 m shall be ensured.

- Component 2: Parking Lots
  - o Length: 5.2 m.
  - o Width: 3.7 m if the parking lot is perpendicular to the road and 3.6 m if the parking lot makes a 45˚ angle with the road (refer to Figure 3-2).

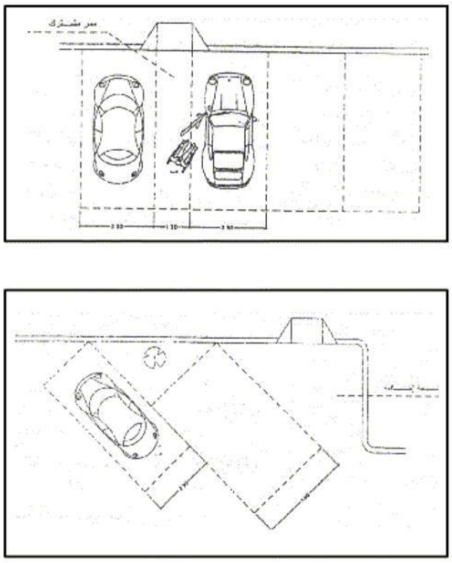


**Figure 3-2. Top Schematic Showing the Case when the Parking Lot is Perpendicular to the Road and Bottom Schematic Showing the Case when the Parking Lot Makes a 45˚ Angle with the Road**

- Component 3: Doors and Entrances
  - o Minimum opening width: 90 cm.
  - o An empty space with the following dimensions: 200 cm x 250 cm shall be ensured in front of main entrances.
- Component 4: Stairs
  - o Maximum stair step height: 16 cm.
  - o Minimum stair step width: 32 cm.

  - Resting platforms with the following dimensions: 140 cm x 150 cm shall be ensured whenever the stairs height exceeds 250 cm.

- Component 5: Elevators
  - Minimum internal elevator dimensions: 110 cm x 140 cm.
  - The door opening should not be less than 80 cm.
  - An empty space with the following dimensions (at least): 140 cm x 180 cm shall be ensured in front of the elevator's door.

- Component 6: WCs (in public buildings)
  - Minimum dimensions: 250 cm x 250 cm

Article 4 states that:

- For buildings intended for public use: at least one (1) bathroom must be secured on each floor to be used by PwDs (women and men) with dimensions not less than 250 cm x 250 cm;
- Stairs that match the dimensions specified above must be ensured unless there are two or more elevators compatible with these conditions that operate around the clock (non-stop);
- Parking: a 1.5% of the total number of cars allowed as per the Construction Law should be secured for PwDs. This percentage shall be rounded up.

Article 6 states that the construction of buildings shall be subject to the criteria set forth in Table 3-12. Construction works can be suspended until the required standards are met.

**Table 3-12. Specifications for Construction that Caters for PwDs**

| Criteria/ Structure | Specifications |
|---|---|
| Ramps | Surface: solid and non-slippery. A protective handrail should be installed along the full length of the ramp. |
| Stairs | A protective handrail should be installed on the entire length of the stairs on both sides. A textural marking strip should be placed at the top and bottom of the stairs and at intermediate landings to alert sightless people as to the location of the stairs. The tactile marking strip should be at least 60 cm wide and should extend over the full width of the stairs. |
| Elevator | • Control panel should be mounted 90 cm from the floor of the elevator. The numerals on the floor selector buttons should be embossed so as to be easily identifiable by touch<br>• Call buttons: For ease of reach, call buttons should be mounted 90 cm from the floor<br>• Tactile numerals should be placed on both sides of the door jambs at an approximate height of 150 cm with prominent figures to help a lone sightless passenger to identify the floor reached<br>• Hall signal should be placed at an approximate height of 180 cm<br>• Audiovisual signals: The elevator should signal arrival at each floor by means of a bell and a light to alert sightless and hearing-impaired passengers simultaneously. The international symbol of accessibility shall be clearly placed<br>• Elevator floor must not be slippery<br>• The color of the elevator door should contrast with the surrounding surface so as to be easily distinguishable by persons with visual impairments |
| WCs | Beams to lean on or grab bars shall be installed in appropriate places at a height ranging between 80 and 90 cm from the floor and with a diameter ranging between 0.30 and 0.40 |

| Criteria/ Structure | Specifications |
|---|---|
| | cm and shall be easily and safely used. The floor material should be non-slippery and easy to clean. WCs shall be equipped with alarms. Accessible rest rooms should be marked with the international symbol of accessibility. |
| Signage indicating accessible facilities for PwDs | Graphic or written directions should be used to indicate clearly the type and location of the available facility. The letters shall be written in bold. Routing signals shall be homogeneous and continuous. Signals and diagrams shall not be excessively placed. Guidelines can be used within the navigation path, identified by the blind via the white stick. Those guidelines shall be different in terms of the quality of the material used. The color to be used shall be prominent in order to be distinguishable by the blind. The described signage shall be placed at the entrances of buildings and traffic routes that comply with the provisions of this Law. |

Article 7 of the Decree states that any violation of the conditions provided in Article 6 of the Decree shall be regarded as a violation of the provisions of the Construction Law and shall be subject to the provisions of Article 24 of the Construction Law.

### *3.2.2 World Bank's Safeguard Policies*

The WB Safeguard Policies are designed to help ensure that projects suggested for financing are environmentally and socially sustainable, and therefore guide the financing decision-making process. The Project triggers the following two WB Safeguard Policies: (i) OP 4.01 on Environmental Assessment, and (ii) OP 4.12 on Involuntary Resettlement.

**Environmental Assessment (OP 4.01)**

For projects to be financed by the WB, environmental screening is conducted according to the potential environmental impacts from implementation of a project. Projects are assigned an environmental category, A, B, C, or FI, with a decreasing order of environmental impact severity. Based on the principles of the OP/BP 4.01, the project is classified as environmental "Category A" given that it is likely to have important adverse environmental and social impacts that are sensitive, diverse, or unprecedented. These impacts may influence an area wider than the sites or facilities subject to physical works. Furthermore, there might be a need for land acquisition and resettlement along some segments of the alignment. Environmental Assessment (EA) for a Category A project inspects the project's possible negative and positive environmental impacts, compares them with those of practicable alternatives and suggests any measures needed to prevent, reduce, mitigate, or compensate for adverse impacts and improve environmental performance. Regarding any Category A project, the borrower is in charge of the preparation of a report, usually an EIA. Category A is comparable to Category I in the Lebanese EIA Decree No. 8633/2012 that includes the list of sub-projects for which a detailed Environment Impact Assessment (EIA) Report is required. Sub-projects falling in this category would have by their magnitude and severity, potential significant adverse social or environmental impacts that are diverse, irreversible, or unprecedented. The draft EIA should be available in a public place accessible to affected groups and local NGOs.

**Involuntary Resettlement (OP 4.12)**

Significant efforts are to be made in the design and screening stages of the construction phase to avoid adverse impacts on people, land, property, including people's access to natural and other economic resources, as far as possible. According to the WB policy on involuntary resettlement:

i. The involuntary resettlement should be avoided where feasible, or minimized, exploring all viable alternative project designs;
ii. Where it is not feasible to avoid resettlement, resettlement activities should be considered and implemented as sustainable development programs, providing enough investment resources to enable the persons displaced by the project to share in project benefits. Displaced persons should be implicitly consulted and should have opportunities to participate in planning and implementing resettlement programs; and
iii. Displaced persons should be assisted in their efforts to improve their livelihoods and standards of living or at least to restore them, in real terms, to pre-displacement levels or to levels prevailing prior to the beginning of project implementation, whichever is higher.

A Resettlement Action Plan (RAP) will be developed as per the Lebanese Law, the WB policy on Involuntary Resettlement (OP 4.12), the procedures adopted by CDR, and other relevant regulations to ensure the adverse impacts resulting from physical and economic displacement are adequately mitigated and the livelihood of Potentially Affected Persons (PAPs) are restored.

### *3.2.3 Relevant International Conventions, Treaties and Protocols*

The main treaties and conventions ratified by Lebanon which are relevant to the proposed Project activities are summarized in Table 3-13.

**Table 3-13. Laws Ratifying the International Conventions of Relevance to the Project**

| Law | Year | Convention/ Declaration/ Protocol/ Amendment | Description/ Objective | Relevance to the Project |
|---|---|---|---|---|
| Law 31 | 2008 | Ratification of the Cartagena Protocol on Biosafety to the Convention on Biological Diversity (CBD) | Regulates the import of Living Modified Organisms (LMOs) | LMOs might be imported for landscaping purposes |
| Law 758 | 2006 | Ratification of the Beijing Declaration on renewed commitment to the protection of the ozone layer | Amends Article 6 of the Montreal Protocol by taking, for example, all appropriate measures to address illegal trade in Ozone-Depleting Substances (ODS) and to safeguard the achievements attained to date | Regulate the use of ODS during all phases of the Project |
| Law 738 | 2006 | Ratification of the Kyoto Protocol to the UN Framework Convention on Climate Change (UNFCCC) | To reduce Greenhouse Gas (GHG) emissions in an effort to prevent anthropogenic climate change | Reduce GHG emissions from construction and operation activities.<br>$CO_2$ and $N_2O$ emissions might occur from the possible use and combustion of fossil fuels to operate the buses. HC emissions might occur from the transportation and use of fossil fuels in fuel stations that may be established in bus depots |
| Law 591 | 2004 | Ratification of the International Labor Organization (ILO) Convention No. 148: Working environment (air pollution, noise and vibration) | Convention concerning the protection of workers against occupational hazards in the working environment due to air pollution, noise and vibration, 1977 | Protect workers' health in the working environment |
| Law 432 | 2002 | Ratification of the Stockholm Convention on Persistent Organic Pollutants (POPs) | Eliminates or restricts the production and use of POPs | Potential use of POPs in construction and road furniture, buses |
| Law 120 | 1999 | Ratification of the Copenhagen Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer | Brings into force the second Amendment, which is based on the principle of preventive action to avoid further damage to the ozone layer and on the scientific and technical data available at the time of its adoption, in order to protect, promote and improve the environment | Regulate the use of ODS during all phases of the Project |
| Law 116 | 1999 | Ratification of the ILO Conventions No. 136 and No. 139 | International Labor Organization Convention No. 136: Benzene Convention concerning protection against | Protect workers' health in the working environment |

| Law | Year | Convention/ Declaration/ Protocol/ Amendment | Description/ Objective | Relevance to the Project |
|---|---|---|---|---|
| | | | hazards of poisoning arising from benzene, 1971<br>International Labor Organization Convention No. 139: Occupational Cancer Convention concerning prevention and control of occupational hazards caused by carcinogenic substances and agents, 1974 | |
| Law 360 | 1994 | Ratification of the CBD | To develop national strategies for the conservation and sustainable use of biological diversity | There might be a need to remove the greenery from the median and from both sides of the highway/ roads where the stations will be established |
| Law 359 | 1994 | Ratification of the UN Framework Convention on Climate Change (UNFCCC) | To achieve stabilization of Greenhouse Gas (GHG) concentrations in the atmosphere in order to prevent dangerous anthropogenic interference with climate system | Reduce GHG emissions from construction and operation activities.<br>$CO_2$ and $N_2O$ emissions might occur from the possible use and combustion of fossil fuel to operate the buses. HC emissions might occur from the transportation and use of fossil fuels in fuel stations that may be established in bus depots |
| Law 253 | 1993 | Ratification of the Vienna Convention for the Protection of the Ozone Layer and the Montreal Protocol on Substances that Deplete the Ozone Layer | To protect human health and the environment from any activity that modifies the ozone layer<br>Adopt measures to control human activities found to have adverse impact on the ozone layer | Regulate the use of ODS during all phases of the Project |
| Legislative Decree 70 | 1977 | Ratification of the ILO Convention No. 120: Hygiene (Commerce and Offices) | Convention concerning hygiene in commerce and offices, 1964 | Protect workers' health and ensure proper sanitation and hygiene in the working environment and offices |

It is important to note that on June 14, 2007, Lebanon signed the UN Convention on the Rights of PwDs but with no formal confirmation, accession or ratification to date.

On April 22, 2016, Lebanon signed the Paris Agreement to the UNFCCC, and it was approved by the CoM in Decree No. 3987/2016, awaiting ratification by the Lebanese Parliament.

# 4. ENVIRONMENTAL AND SOCIAL BASELINE CONDITIONS

## 4.1 INTRODUCTION

This chapter sets the main baseline environmental and socio-economic conditions in the proposed Project area. Environmental and socio-economic aspects considered are as follows:

- Physical environment: emissions and air quality, noise, soil and geological setting (geology, hydrogeology, tectonics and seismicity).
- Landscape and biological environment;
- Socio-economic environment;
- Transport network and traffic; and
- Cultural heritage assets.

The baseline conditions were analyzed based on **1)** a desk study and **2)** baseline field investigations. The results of the field and desk surveys were documented in maps, photographs and text describing the existing state of the environment prior to the proposed operation of the BRT System components.

The **desk study** involved a review of the published literature, research studies, statistical data and available satellite images and cadastral maps of the Project site and surroundings. For this purpose, existing documents were collected, reviewed and analyzed in order to define the characteristics of the existing environment.

Desk study data on the area were verified and supplemented through environmental and socio-economic **baseline field investigations**.

Field surveys included drive-throughs and walk-throughs along the proposed BRT sections, stations, park-and-ride facilities, terminal and depot with an emphasis on the identification of sensitive receptors.

The collected literature information and field data are represented on GIS-based maps, where relevant, covering the ESIA Study area. Photographs are also provided documenting the field survey findings.

## 4.2 DESCRIPTION OF PROJECT SURROUNDINGS AND NEARBY SENSITIVE RECEPTORS

As previously mentioned the Project is planned for the Northern Highway from Tabarja to Beirut and then continues into the city of Beirut in an Outer Ring and an Inner Ring.

Sensitive receptors can either be environmental receptors (biodiversity and abiotic components such as water and soil) or socio-economic receptors (residences, commercial establishments, hospitals, schools, churches, mosques, etc.). The methodology for the identification of sensitive receptors and the identified nearby sensitive receptors are provided in the following sub-sections.

### *4.2.1 Methodology for the Identification of Sensitive Receptors*

In order to assess the current status of the project area, a baseline survey was conducted.

For the Northern Highway alignment from Tabarja to Beirut, each station was studied separately as shown in Figure 2-5 and its surroundings were identified.

For the purpose of analysis and mapping, each of the two Beirut Outer and Inner Rings alignments or corridors was divided into several zones with respect to major avenues/ streets/ areas as shown in the following paragraphs, and indicated in Figure 4-1 and Figure 4-2. Each zone comprised one or more stations.

The Outer Ring was divided into six (6) zones as follows:

- Zone 1: Mirna El Chalouhi Boulevard and Sin El Fil area
- Zone 2: Jisr El Watti Road and Pierre Gemayel Avenue
- Zone 3: Saeb Salam Avenue (Corniche El Mazraa)
- Zone 4: General De Gaulle Avenue (Corniche El Raouche)
- Zone 5: Paris Avenue (Corniche El Raouche)
- Zone 6: Mir Majid Arslan Avenue and Weygand Avenue.

The Inner Ring was divided into eight (8) zones as follows:

- Zone 1: Pierre Gemayel Avenue: Area Between Geitaoui and Bourj Hammoud
- Zone 2: Charles Malek Avenue
- Zone 3: General Fouad Chehab Avenue and Kantari area
- Zone 4: Sanayeh area, Hamra Street and Spears Street
- Zone 5: Badr Demachkieh Avenue, Saqyet EL Janzeer area and Tallet Al Druze area
- Zone 6: Algeria Street, Osman Bin Affan Street and Independence Avenue in Dar Al Fatwa area
- Zone 7: Independence Avenue in Basta Tahta area, Sodeco area and Nasra area
- Zone 8: Independence Avenue in Achrafieh area

In order to define the assessment study area, a walking distance of a 300 m radius buffer area was delineated surrounding each station. Receptors within each zone were identified.

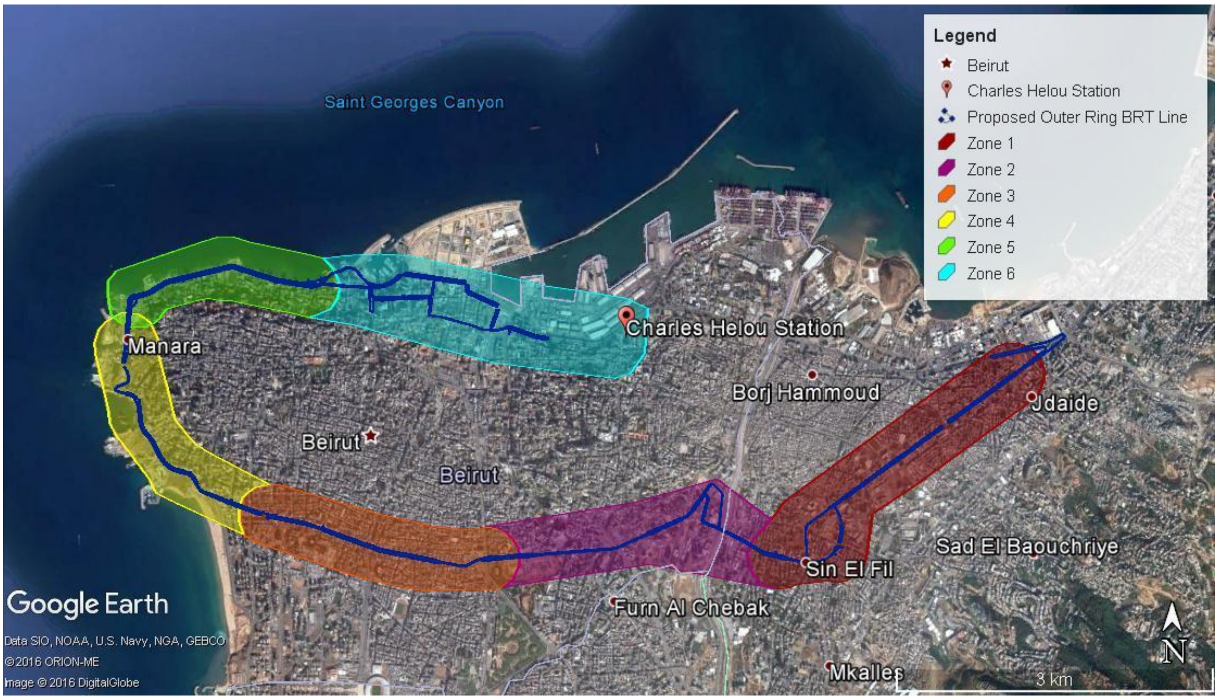



**Figure 4-1. Proposed Beirut Outer Ring BRT Line and Zones**


**Figure 4-2. Proposed Beirut Inner Ring BRT Line and Zones**

### *4.2.2 Findings of the Baseline Assessment*

Separate booklets were prepared to compile the findings of the baseline assessment (refer to APPENDIX E). Those booklets include:

- Physical characteristics of the roads/highway where the BRT buses are planned to pass;
- Detailed GIS and Google Earth maps;
- Photographic records;

- A table providing information about the planned location of each station;
- Environmental, social, cultural and archeological points of interest surrounding the stations;
- General observations; and
- Links with other sites/ towns/ villages/ roads.

The types of sensitive receptors and their relevance to each component of the BRT Project are provided in Table 4-1.

**Table 4-1. Identified Sensitive Receptors and their Relevance to the BRT Project**

| Types of Sensitive Receptors | Project Components | Relevance of the Type of Sensitive Receptors to the BRT Project | | Justification/ Explanation Common to all Components | Justification/ Explanation Specific to Each Component |
|---|---|---|---|---|---|
| | | Yes | No | | |
| Landscape and Biological Environment | BRT System between Tabarja and Beirut | X | | The Project lies within a heavily urbanized area. No ecological sensitive receptors along the proposed BRT path and in the P&R facilities were identified during the site visits. | Some medians along the Tabarja-Beirut and Beirut Outer Ring corridors are landscaped, and are of value to the immediate local environment. |
| | BRT System along the Beirut Outer Ring | X | | | |
| | BRT System along the Beirut Inner Ring | | X | | |
| | Park and Ride (P&R) facilities between Tabarja and Beirut | | X | | |
| | Bus depot | X | | | |
| | Bus terminal | | X | | |
| Surface and Groundwater | BRT System between Tabarja and Beirut | X | | Various aquifers are present in the project area along the BRT Corridors | - |
| | BRT System along the Beirut Outer Ring | X | | | Nahr Beirut crosses the Beirut Outer and Inner Rings |
| | BRT System along the Beirut Inner Ring | X | | | |
| | Park and Ride (P&R) facilities between Tabarja and Beirut | X | | | The activities at the P&R at Nahr El Kelb estuary might affect Nahr El Kelb, however the estuary location is already degraded |
| | Bus depot | X | | | |
| | Bus terminal | x | | | |
| Socio-economy | BRT System between Tabarja and Beirut | X | | Various commercial establishments, residential buildings, educational institutions, public institutions, hospitals, hotels and | - |
| | BRT System along | X | | | |

| Types of Sensitive Receptors | Project Components | Relevance of the Type of Sensitive Receptors to the BRT Project | | Justification/ Explanation Common to all Components | Justification/ Explanation Specific to Each Component |
|---|---|---|---|---|---|
| | the Beirut Outer Ring | | | resorts are located in the vicinity of the Project area (details provided in APPENDIX E | |
| | BRT System along the Beirut Inner Ring | X | | | |
| | Park and Ride (P&R) facilities between Tabarja and Beirut | X | | | |
| | Bus depot | X | | | |
| | Bus terminal | X | | | |
| Culture and Archaeology | BRT System between Tabarja and Beirut | X | | Various cultural and archaeological points of interest are located in the vicinity of the Project area (Details provided in APPENDIX E and section 4.3.8) | - |
| | BRT System along the Beirut Outer Ring | X | | | |
| | BRT System along the Beirut Inner Ring | X | | | |
| | Park and Ride (P&R) facilities between Tabarja and Beirut | X | | | |
| | Bus depot | X | | | |
| | Bus terminal | X | | | |

## 4.3 PHYSICAL ENVIRONMENT

### 4.3.1 Climate and Meteorology

The Climate conditions in the study area are those of a typical eastern Mediterranean climate characterized by hot and dry summers, and mild to cool winters where most of the precipitation is concentrated. Based on 2015 data from Fanar LARI station, rainfall is restricted to the period between September and June. An onshore south-westerly wind from the adjacent Mediterranean Sea affects the area most of the year.

#### 4.3.1.1 Temperature

The Study Area is characterized by warm to hot, dry summers and relatively mild, wet winters. Average minimal and maximal temperatures recorded at the Fanar LARI station between January 2015 and December 2015 are represented in Figure 4-3. Average monthly temperatures ranged between a minimum of 10.01°C in January 2015 and maximum of 33.73°C in August 2015.

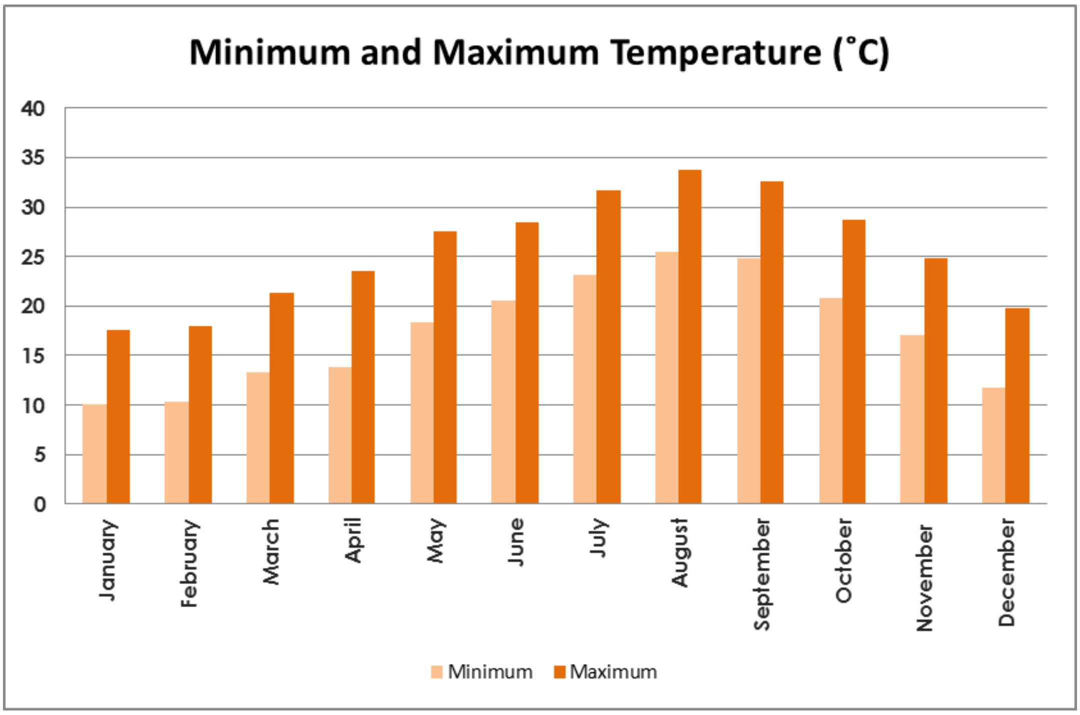



**Figure 4-3. Average Maximum and Minimum Temperatures at Fanar LARI Station (January 2015 – December 2015)**

#### 4.3.1.2 Wind

The maximum wind speed reported at Fanar LARI station for the period between January 2015 and December 2015 ranged between 0.94 m/s in September 2015 and 1.725 m/s in February 2015. The average wind speed ranged between 0.13 m/s in September 2015 and 0.36 m/s in February 2015, as illustrated in Figure 4-4. Prevailing wind is from SSW on the coastal highway and from SW in Beirut as illustrated in Figure 4-5.

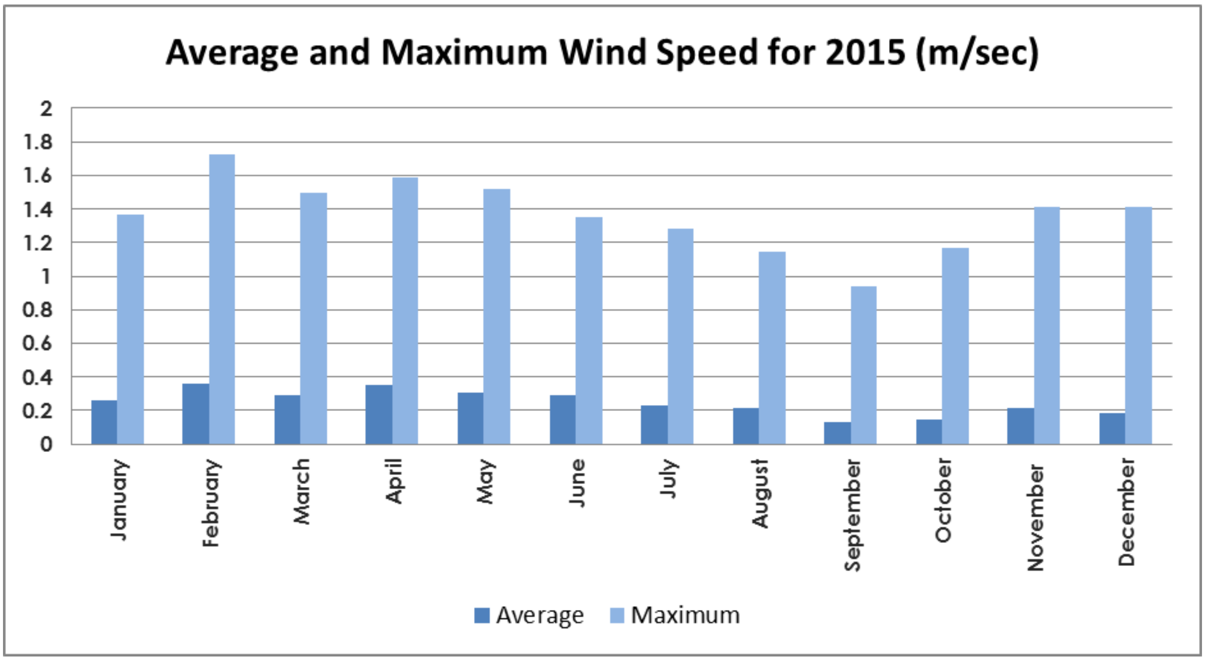



**Figure 4-4. Average and Maximum Wind Speed Data recorded at Fanar LARI Station (January 2015 – December 2015)**

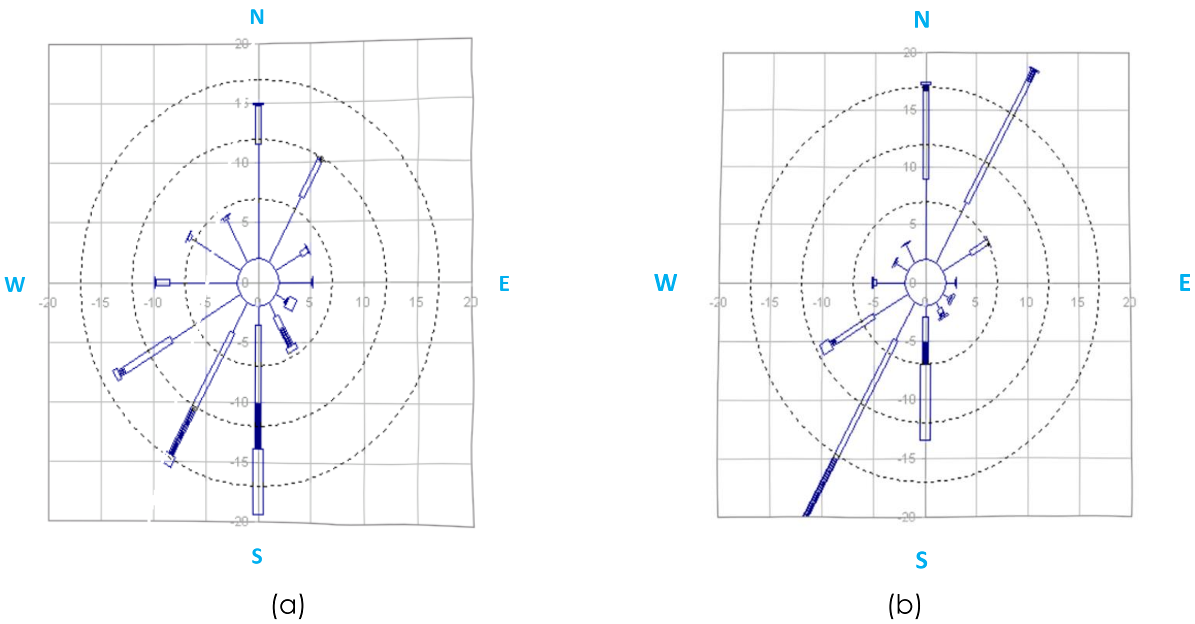



**Figure 4-5. Wind Direction at the Beirut Area (a) and Coastal Highway Area (b)**

*Source:* (MoEW/UNDP/CEDRO, 2011)

#### *4.3.1.3 Precipitation*

The precipitation values recorded at Fanar LARI station for the year 2015 occurred between the months of September and June with the highest value of 202.5 mm documented during the month of January 2015 and the lowest value of 3.6 mm documented during the month of September. A rainfall map of the Study Area is provided in Figure 4-7, showing that average yearly precipitation varies between 700 and 800 mm in the western part of the Beirut Outer and Inner Rings, between 800 and 900 mm in the eastern part of Beirut Outer and Inner Rings and on the Northern Highway (till Jounieh), and between 900 and 1000 mm from Jounieh till Tabarja on the Northern Highway.

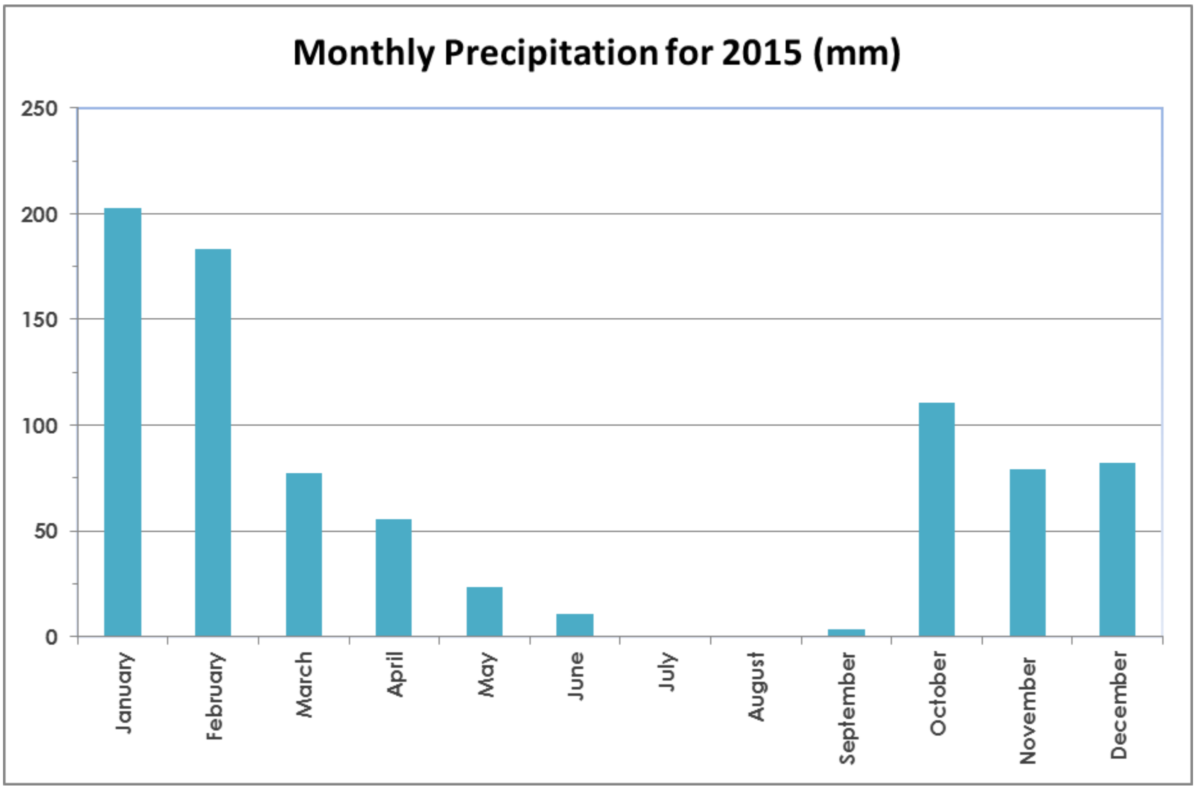



**Figure 4-6. Monthly Precipitation Rates Recorded at Fanar LARI Station for the Year 2015**

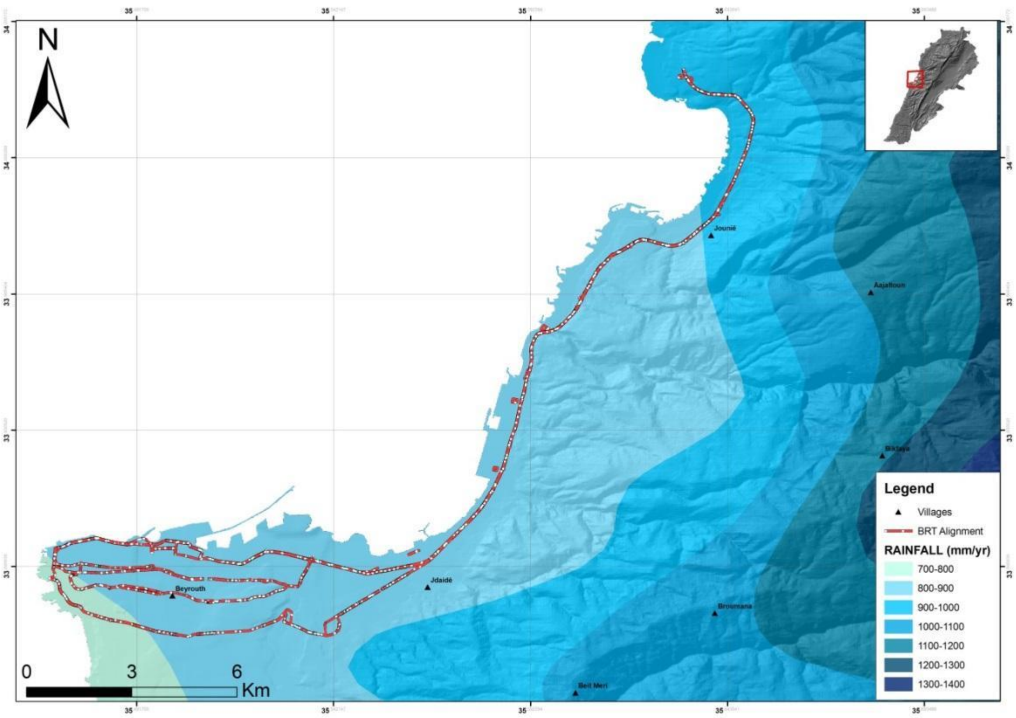



**Figure 4-7. Rainfall Map of the Study Area**

*Source: Plassard, J., 1972*

### *4.3.2 Road Network and Traffic*

The Lebanese land transport sector consists of road-motorized vehicles only, and no appropriate infrastructure for mass transport systems. Mass transport consists of public and private buses, minivans and exclusive and shared ride taxis, all operating on an ad-hoc basis without any coordination, resulting in very poor occupancy rates of about 1.2 passengers per vehicle for taxis, 6 for vans and 12 for buses (MoE/URC/GEF, 2012).

The 2012 vehicle fleet database shows a total of 1.58 million registered vehicles, with 85% passenger cars (PC), 7% Light Duty Vehicles (LDV), 2% Heavy Duty Vehicles (HDV), and 6% Motorcycles (MoE/UNDP/GEF, 2015). The age distribution of passenger cars (public and private) reflects the old nature of the fleet, with 71% older than 10 years (MoE/UNDP/GEF, 2015).

Analysis of the current situation and identification of flows distribution were based on the traffic surveys conducted as part of the feasibility study in Beirut and Mount Lebanon governorates.

#### *4.3.2.1 Network Description*

The BRT System is planned for the Northern Highway from Tabarja to Beirut. The BRT lanes will occupy the middle lane with central stations concept. Bus stops are designed for good quality service for passengers and buses.

It is essential to identify the road network hierarchy along the routes where the BRT System will operate to reflect on the current traffic situation. A definition of the BRT alignment's road type and feeders' itineraries is hereby presented:

- From Naher El Mot to Tabarja: the road is classified as an intercity highway;
- Beirut Outer Ring: the road is classified as an urban highway (Charles El Helou Avenue), and a main urban road (the rest of the ring);
- Beirut Inner Ring: the road is divided into two types: main urban road, and secondary urban road;
- Feeders' itineraries: main urban road, mountainous non-separated primary road, urban highway, flat non-separated secondary road, secondary urban road, mountainous non separated secondary road.

The physical characteristics of the road are presented in Table 4-2 and Table 4-3 below.

**Table 4-2. Roadway Characteristics for Urban Roads**

| Type | On-street Parking | Urban Density | | | | Operation | | | Free flow speed (km/h) | % of transit | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *Very High* | *High* | *Medium* | *Low* | *Controllable Access* | *Traffic Management* | *None* | | *Very High (>40%)* | *High (20% - 40%)* | *Medium (5% - 20%)* | *Low (< 5%)* |
| *Secondary urban road* | Yes | | x | | | | x | | 50 | | | x | x |
| *Main urban road* | Yes | | x | x | | | x | | 50-60 | | | x | |
| *Urban highway* | No | | | x | x | x | | | 80-100 | x | x | | |

**Table 4-3. Roadway Characteristics for Interurban Road**

| Type | Context | | | Level of Traffic | | | Speed (km/h) |
|---|---|---|---|---|---|---|---|
| | *Flat* | *Hilly* | *Mountainous* | *High* | *Medium* | *Low* | |
| *Intercity Highway* | x | | | x | | | 80 |

The following are the major roadways in the study area of the BRT System:

- ***Charles Helou Avenue:*** a two-way arterial road consisting of three moving lanes in each direction separated by a median where on-street parking is prohibited.
- ***Saeb Salem Avenue:*** a two-way arterial road consisting of two to three moving lanes in each direction separated by a median with paid parking on the sides of the road.
- ***Charles Malek Avenue:*** a two-way road consisting of two moving lanes in each direction separated by a median with one paid parking lane on both sides.
- ***Hamra Street:*** a one-way main street consisting of two moving lanes with paid parking on one side of the road.
- ***Badr Demachkieh:*** a two-way road consisting of two moving lanes in each direction separated by a median with parking on both sides of the road.
- ***Independence Avenue:*** a two-way avenue consisting of two moving lanes in each direction separated by a median with paid parking on both sides of the road.
- ***Yerevan Avenue:*** a two-way avenue consisting of two moving lanes in each direction separated by a median without any parking on both sides of the road.
- ***Jisr El Watti:*** a two-way road consisting of two moving lanes in each direction separated by a median with paid parking on both sides of the road on one segment of the street.
- ***Mirna Chalouhi Avenue:*** a two-way avenue consisting of three moving lanes in each direction separated by a median without any parking on both sides of the road.
- ***Daoura-Dbayeh Highway:*** a two-way highway consisting of three moving lanes in each direction separated by a median without any parking on the sides of the road.
- ***Kaslik-Ghazir Highway:*** a two-way highway consisting of two moving lanes in each direction separated by a median without any parking on the sides of the road.

- ***Ghazir-Tabarja Highway:*** a two-way highway consisting of three moving lanes in each direction separated by a median without any parking on the sides of the road.

#### 4.3.2.2 Traffic Survey

Results of the traffic survey conducted specifically for the current feasibility study on the following positions with the AM (09:00-10:00) and PM (15:30-16:30) peaks hours are shown in Table 4-4.

**Table 4-4. Traffic Counts Results at AM and PM Peak Hours**

| Counts Location | Direction | AM Peak hour Traffic Volume | PM Peak hour Traffic Volume |
|---|---|---|---|
| General De Gaulle Road | Northbound | 1,161 | 970 |
| | Southbound | 1,095 | 1,699 |
| Minet El Hosn Road | Northbound | 1,331 | 1,564 |
| | Southbound | 2,783 | 2,777 |
| Charles Helou Road | Eastbound | 3,705 | 4,731 |
| | Westbound | 7,024 | 4,270 |
| Jounieh – Beirut Highway | Eastbound | 6,532 | 6,708 |
| | Westbound | 4,386 | 5,537 |
| Pierre Gemayel Road-1 | Northbound | 2,366 | 2,354 |
| | Southbound | 1,744 | 1,540 |
| Pierre Gemayel Road-2 | Northbound | 2,852 | 2,866 |
| | Southbound | 3,033 | 2,605 |
| Abdallah Elyafi | Eastbound | 2,512 | 2,395 |
| | Westbound | 2,170 | 1,945 |
| Saeb Salem Road | Eastbound | 2,284 | 2,835 |
| | Westbound | 2,378 | 2,490 |
| Spears | Eastbound | 2,738 | 3,815 |
| Michel Chiha Road | Westbound | 1,910 | 1,612 |
| Sagesse Road | Eastbound | 1,156 | 1,136 |
| | Westbound | 1,117 | 1,035 |
| Independence Street-1 | Northbound | 1,273 | 1,495 |
| | Southbound | 1,517 | 1,152 |
| Independence Street-2 | Northbound | 973 | 1,005 |
| | Southbound | 1,036 | 779 |
| Independence Street-3 | Northbound | 2,002 | 1,814 |
| | Southbound | 1,267 | 1,582 |
| Antelias – Bikfaya Road | Northbound | 1,049 | 882 |
| | Southbound | 457 | 548 |

| Counts Location | Direction | AM Peak hour Traffic Volume | PM Peak hour Traffic Volume |
|---|---|---|---|
| Jounieh – Beirut Coastal Highway - 1 | Northbound | 4,409 | 4,750 |
| | Southbound | 3,214 | 3,308 |
| Jounieh – Beirut Coastal Highway - 2 | Northbound | 5,147 | 5,236 |
| | Southbound | 5,728 | 4,797 |
| Jounieh – Beirut Coastal Highway - 3 | Northbound | 4,067 | 3,637 |
| | Southbound | 4,500 | 4,037 |
| Jounieh – Beirut Coastal Highway - 4 | Northbound | 3,808 | 4,209 |
| | Southbound | 3,683 | 3609 |
| Harissa Highway | Northbound | 285 | 428 |
| | Southbound | 339 | 304 |
| Jounieh – Beirut Coastal Highway - 5 | Northbound | 3,799 | 4,694 |
| | Southbound | 4,148 | 3,592 |
| Jounieh – Beirut Coastal Highway - 6 | Northbound | 2,659 | 3,238 |
| | Southbound | 2,454 | 2,312 |
| Zouk Mosbeh-Aajaltoun Road | Eastbound | 2,654 | 3,286 |
| | Westbound | 2,852 | 2,216 |

#### *4.3.2.3 Current Public Transportation*

Public transport in Greater Beirut is not organized within a comprehensive system and lacks a regulatory approach. The current routes on which buses operate are shown in Figure 4-8.

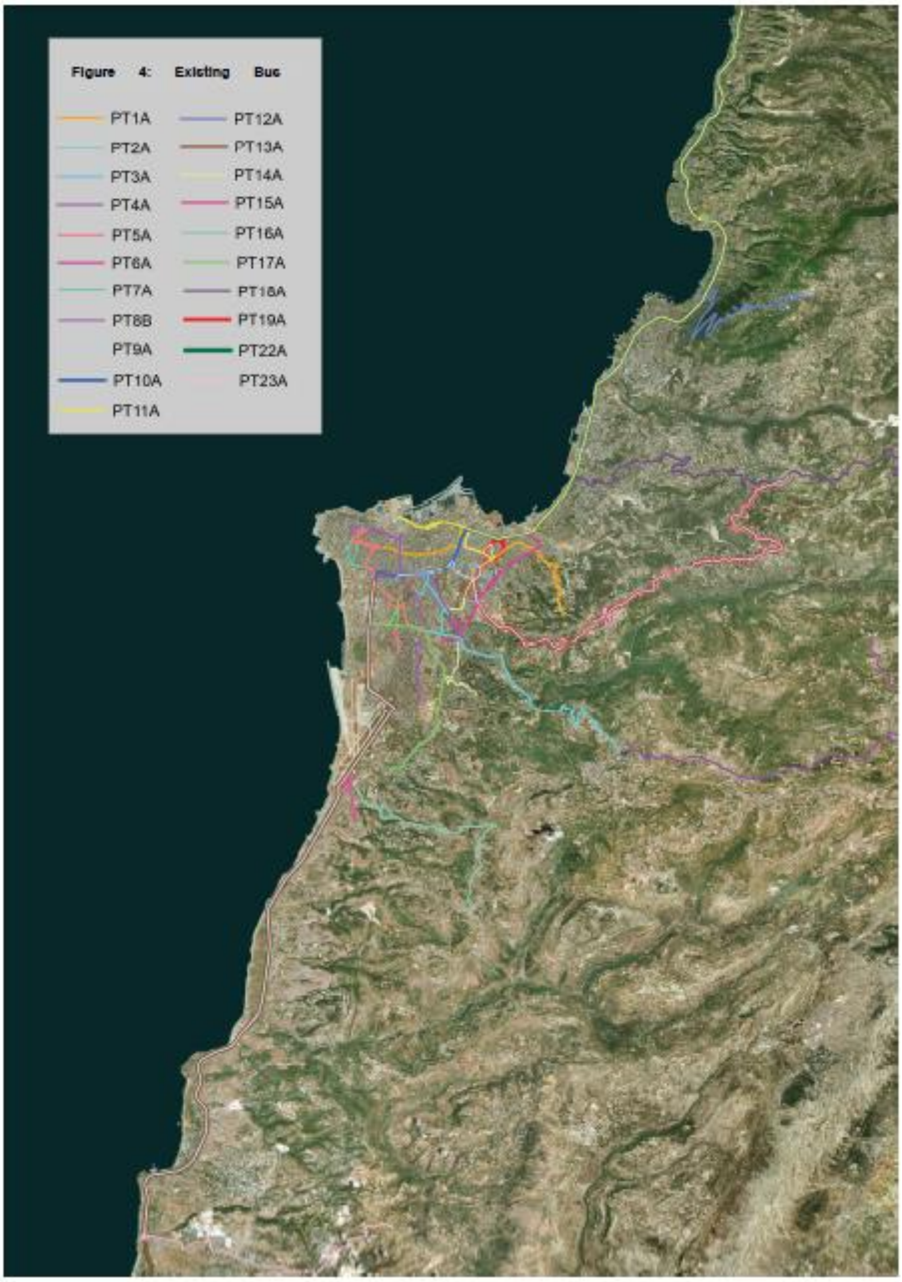



**Figure 4-8. Current Bus Routes**

#### *4.3.2.4 Parking Spaces*

Some on-street parking spaces will be removed in order to have dedicated lanes for the BRT System within the city of Beirut and allow for mixed traffic to circulate along the same roads. The feasibility study identified 1,200 on-street parking spaces which are along the Beirut Outer Ring, and 1,500 on-street parking spaces along the Beirut Inner Ring.

Beirut chronically suffers from lack of parking spaces. One of the main reasons that the road network is operating with a bad level of service is the existence of a significant number of double park and illegal on-street parking spaces reducing the capacity of the road and blocking traffic circulation and even the sidewalks, where some cars park.

### *4.3.3 Air Quality*

The transport sector is globally responsible for the major part of urban air pollution, the death of nearly 185,000 persons directly related to pollution from vehicles, and the emissions of 23% of the world's energy related greenhouse gases each year (World Bank, 2017). Table 4-5 summarizes different types of pollutants generated from motor vehicles and their respective impacts.

**Table 4-5. Types of Pollutants from Vehicles and their Impacts**

| Pollutant | Description | Source | Harmful Effects | Scale |
|---|---|---|---|---|
| Carbon dioxide ($CO_2$) | A product of combustion | Fuel production and tailpipes | Climate Change | Global |
| Carbon monoxide (CO) | A toxic gas caused by incomplete combustion | Tailpipes | Human health, climate change | Very local |
| CFCs and HCFC | A class of durable chemicals | Air conditioners and industrial activities | Ozone depletion, climate change | Global |
| Fine particulates ($PM_{10}$ and $PM_{2.5}$) | Inhalable particles | Tailpipes, brake lining, road dust, etc. | Human heath, aesthetics | Local and Regional |
| Road dust (non-tailpipe particulates) | Dust particles created by vehicle movement | Vehicle use, brake linings, tire wear | Human health, ecological damages | Local |
| Lead | Element used in older fuel additives | Fuel additives and batteries | Human health, ecological damages | Local |
| Methane ($CH_4$) | A flammable gas | Fuel production and tailpipes | Climate change | Global |
| Nitrogen oxides (NOx) and nitrous oxide ($N_2O$) | Various compounds, some are toxic, all contribute to ozone | Tailpipes | Human health, ozone precursor, ecological damage | Local and Regional |
| Ozone ($O_3$) | Major urban secondary air pollutant caused by NOx and VOCs combined in sunlight | NOx and VOCs | Human health, plants, aesthetics | Regional |
| Sulfur oxides (SOx) | Lung irritant and acid rain | Diesel vehicle tailpipes | Human health and ecological damage | Local and Regional |
| VOCs (volatile organic compounds) | Various hydrocarbon (HC) gases | Fuel production, storage & tailpipes | Human health, ozone precursor | Local and Regional |
| Toxics (e.g. benzene) | Toxic and carcinogenic VOCs | Fuel production and tailpipes | Human health risks | Very local |

*Source:* (USEPA, 2000)

The transport sector is the main source of CO and NOx emissions at the national level (Waked et al., 2012). Emissions are localized on main axes and cities (MoE/EU/UNDP, 2014).

A temporally-resolved and spatially-distributed emission inventory was developed by (Waked, Afif, & Seigneura, 2012), which includes 2010 emissions from major anthropogenic and biogenic sources of air pollution in Lebanon. The studied pollutants include CO, NOx, $SO_2$, NMVOC, $NH_3$, $PM_{10}$ and $PM_{2.5}$. Table 4-6 summarizes the results and the major contributing sectors. The spatial distribution show the highest levels of CO being at major urban cities of Beirut and its suburbs, Tripoli and Saida due to high road transport. While the highest levels of $SO_2$ are observed in locations surrounding power plants such as Zouk Mikael and Jieh, which also contribute to NOx and PM emissions. PM levels are the highest in locations where cement production plants operate, such as Chekka.

**Table 4-6. Annual Emissions to Air and their Contributing Sectors (2010)**

| Pollutant | Gg/year | Major Contributor | Percent Contribution of Major Source (%) |
|---|---|---|---|
| CO | 563 | Road Transport | 93 |
| NOx | 75 | Road Transport | 52 |
| $SO_2$ | 62 | Industrial plants | 73 |
| NMVOCs | 83 | Road Transport | 55 |
| $NH_3$ | 4 | Agriculture | 98 |
| $PM_{10}$ | 12 | Industrial plants | 62 |
| $PM_{2.5}$ | 9 | Industrial plants | 59 |

*Source:* (Waked, Afif, & Seigneura, 2012)

It is important to note that some of these pollutants or pollutant categories such as CO, NOx, $SO_2$ and NMVOCs can be involved in creating conditions that contribute to the global warming effect; referred to as indirect GHGs. Transport sector pollutants for the year 2011 are reported in Lebanon's First Biennial Update Report (2015). These pollutants are calculated according to the 1996 Revised IPCC Guidelines – Tier 2 Methodology. Table 4-7 presents the levels for 2005 and 2011 for the road transport sector and the size of the vehicle fleet, which shows a predictable increase. Figure 4-9 shows the contribution of each vehicle type in emitting these pollutants. Passenger cars have the largest contribution among the four pollutants, since 85% of the Lebanese fleet consists of passenger cars.

**Table 4-7. Emissions Load from the Road Transport Sector**

| Year | Estimated Number of Vehicles | CO (Gg) | NOx (Gg) | $SO_2$ (Gg) | NMVOCs (Gg) |
|---|---|---|---|---|---|
| 2005 | 970,803 | 259.75 | 34.76 | 3.18 | 52.39 |
| 2011 | 1,536,919 | 351.91 | 50.59 | 5.18 | 71.05 |
| Share of National Emissions (2011) | | 99% | 62% | 4.8% | 63% |

*Source:* (MoE/UNDP/GEF , 2015)

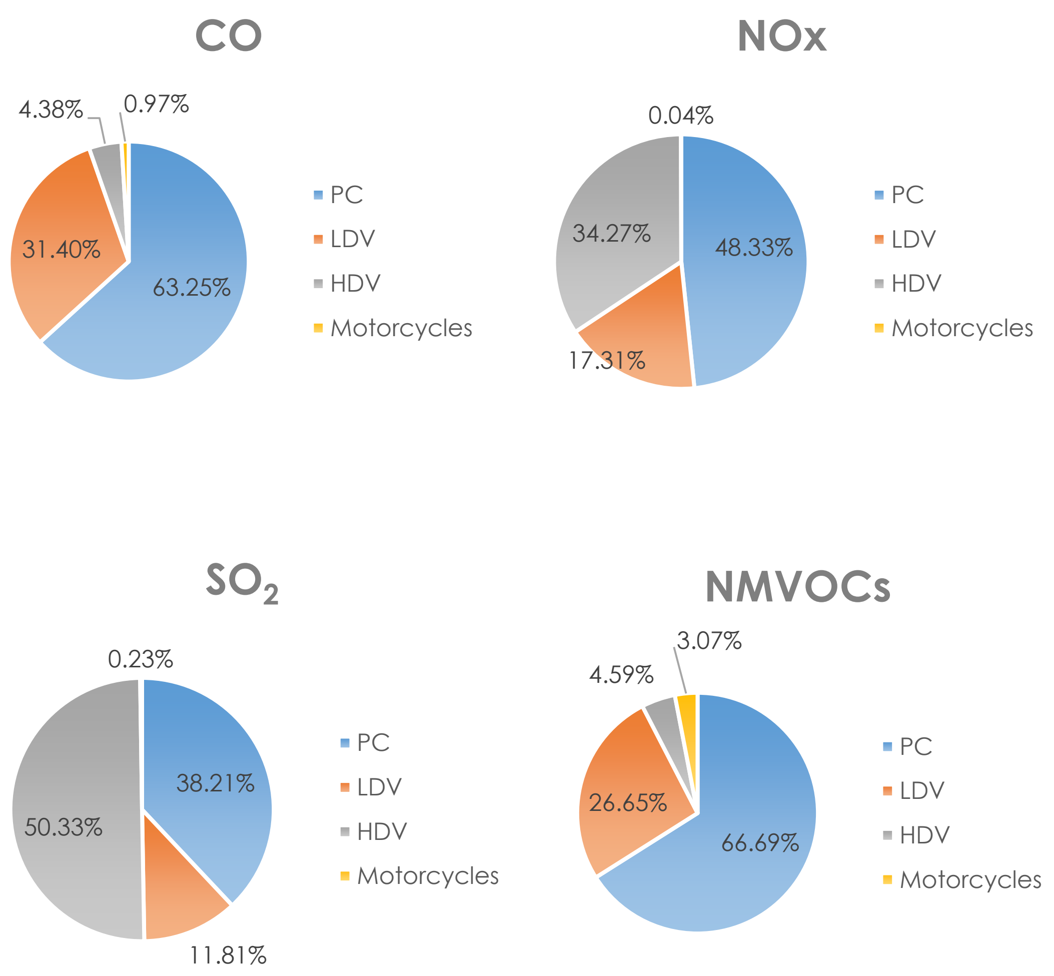



**Figure 4-9. Contribution of Different Vehicle Categories to Emissions of Pollutants with Indirect Global Warming Potential (2011)**

*Source:* (MoE/UNDP/GEF , 2015)

There are multiple references and studies that report pollutant concentrations in Lebanon and in Beirut. This section discusses some of these background concentrations, which are estimated and measured according to distinct methodologies.

Table 4-8 summarizes the available literature that reflect the baseline concentrations of pollutants reported in different periods in the project area. Considering the concentrations In comparison to the IFC EHS General Guidelines of the World Bank and the WHO Ambient Air Quality Guidelines (WHO, 2006), the concentrations of $NO_2$, $PM_{10}$ and $PM_{2.5}$ show exceedance and signify that the project is located in a degraded airshed.

**Table 4-8. Summary of Air Pollutant Concentrations in Lebanon based on the available literature**

| Pollutant | Sampling | Period | Concentrations | WHO Guidelines/ IFC EHS Guidelines | Lebanese AAQSs |
|---|---|---|---|---|---|
| CO | Continuous | Summer | 470±195 μg/m³ | 10,000 μg/m³ (8 | 10,000 μg/m³ |

| Pollutant | Sampling | Period | Concentrations | WHO Guidelines/ IFC EHS Guidelines | Lebanese AAQSs |
|---|---|---|---|---|---|
| | online monitoring at a suburban site in Beirut | 2011 and winter 2012 | and 388±228 $\mu g/m^3$ (Salameh, Sauvage, Afif, Borbon, & Locoge, 2016) | hours) | (8 hours) |
| $NO_2$ | 20 urban sites within Beirut | Two-week sampling period measurements over 41 periods for all sites in 2005 | 66 $\mu g/m^3$ average annual urban background (Afif, et al., 2009) | 40 $\mu g/m^3$ (1 year) | 100 $\mu g/m^3$ (1 year) |
| | Continuous monitoring at the Beirut and Hadat Air Quality Monitoring Stations | 2014 | Annual averages of 50 $\mu g/m^3$ in Hadat and 49 $\mu g/m^3$ in Beirut | | |
| $SO_2$ | Beirut (Four-week sampling period measurements were made over 20 periods for all sites by passive sampling) | December 2004- July 2006 | 8 $\mu g/m^3$ annual average (Afif, et al., 2008) | -- | 80 $\mu g/m^3$ (1 year) |
| | Continuous monitoring at the Hadath Air Quality Monitoring Station | 2014 | 15 $\mu g/m^3$ annual average | | |
| NMVOCs (Benzene) | Suburban site in Beirut | Summer (2-8 July 2011) and winter (28 January 12 February 2012) | Daily average in summer for benzene 2 $\mu g/m^3$ and 1.72 $\mu g/m^3$ during winter (Salameh, et al., 2015) | -- | 5 ppb (15.95 $\mu g/m^3$) (1 year) |
| $PM_{10}$ and $PM_{2.5}$ | Filter sampling at AUB campus | 4 months (February-May in 2004) | Average of 76 $\mu g/m^3$ for $PM_{10}$ and 40 $\mu g/m^3$ for $PM_{2.5}$ (Shaka & Saliba, 2004) | 10 $\mu g/m^3$ for $PM_{2.5}$ (1 year)<br>25 $\mu g/m^3$ for $PM_{2.5}$ (daily) | 80 $\mu g/m^3$ for $PM_{10}$ (daily) |
| | Concentration measurements in Beirut | Hourly measurements in year 2012 | Daily average of 51.3±33.1 $\mu g/m^3$ for $PM_{10}$ and 30.3±19.4 $\mu g/m^3$ $PM_{2.5}$ (Nakhlé, et al., | 20 $\mu g/m^3$ for $PM_{10}$ (1 year)<br>50 $\mu g/m^3$ for $PM_{10}$ (daily) | |

| Pollutant | Sampling | Period | Concentrations | WHO Guidelines/ IFC EHS Guidelines | Lebanese AAQSs |
|---|---|---|---|---|---|
| | | | 2015) | | |
| | Three different sites in the urban city of Beirut | Every sixth day between May 2009 and April 2010 | Annual average of 54.6±10.7; 60.7±12.4; 74.7±16.5 µg/m$^3$ for $PM_{10,}$ and 20.2±1.6; 20.6±2.2; 20.3±2.6 µg/m$^3$ for $PM_{10}$ (Massoud, et al., 2011) | | |

#### 4.3.3.1 Carbon Monoxide (CO)

Carbon monoxide which is mainly emitted from vehicles was continuously measured between 2004 and 2006, without showing exceedance in limits even during peak hours in Beirut (Afif, et al., 2008). Recent studies confirm these findings, where mean concentrations reported were 470±195 µg/m$^3$ and 388±228 µg/m$^3$, in summer 2011 and in winter 2012, respectively (Salameh, Sauvage, Afif, Borbon, & Locoge, 2016).

#### 4.3.3.2 Nitrogen Dioxide ($NO_2$)

Measurements of $NO_2$ were recorded at different locations in Lebanon (Afif, et al., 2008; Afif, et al., 2009; Badaro-Saliba, et al., 2014). Annual average concentrations of 66 µg/m$^3$ (2005), 53 µg/m$^3$ (2010) and 49 µg/m$^3$ (2014) were recorded through the National Air Quality Monitoring Network. These values exceed the WHO guideline value of 40 µg/m$^3$, but are compliant with the national ambient air quality standards of 100 µg/m$^3$. In Beirut, there is a high probability of exposure to 40 µg/m$^3$ (93% of the population having 100% risk of exposure, and 96% having 50% risk of exposure), considering the fact that 76% of the surface area of Beirut exceeds the WHO threshold limit (Badaro-Saliba, et al., 2014).

#### 4.3.3.3 Sulfur Dioxide ($SO_2$)

Results of ground level $SO_2$ measurements in Beirut between December 2004 and July 2006 showed concentrations in the order of 8 µg/m$^3$, which are relatively low and compliant with Lebanese standards (80 µg/m$^3$ annually). It is observed that besides local emissions, long range transport can contribute to $SO_2$ levels in Beirut (around 50%) (Afif, et al., 2008). According to the national air pollution monitoring system, low annual mean concentrations of $SO_2$, in the order of 15 µg/m$^3$, were reported in 2014 in Hadat, next to Beirut.

#### 4.3.3.4 Non-Methane Volatile Organic Compounds (NMVOCs)

According to the study by (Salameh, et al., 2015), measurements of NMVOCs such as benzene in Beirut and its suburbs showed an average of 2 µg/m$^3$ (between 0.25 µg/m$^3$ and 7.83 µg/m$^3$ on an hourly basis) measured during summer 2011 and winter 2012. Although the values are compliant with Lebanese standards (16 µg/m$^3$), long-term exposure can lead to serious health impacts. An occupational pollutant exposure study by (Borgie, et al., 2014) shows higher benzene exposure levels among traffic policemen compared to office-duty policemen. In addition, these levels where higher when compared to exposure levels by traffic policemen in cities such as Prague, Bologna, Ioannina and Bangkok. The prevailing mode of transport using passenger cars increases exposure levels to carcinogens such as benzene, especially in congested areas. About 67% of NMVOCs emissions are considered to originate from the on-road transport sector (Waked, Afif, & Seigneura, 2012).

#### *4.3.3.5 Particulate Matter (PM)*

$PM_{10}$ and $PM_{2.5}$ have been extensively studied in Lebanon. A range of values has been recorded at various sites; 76 µg/m$^3$ for $PM_{10}$ and 40 µg/m$^3$ for $PM_{2.5}$ as an average of four months (Shaka & Saliba, 2004); 51.3±33.1 µg/m$^3$ and 30.3±19.4 µg/m$^3$ for $PM_{10}$ and $PM_{2.5}$ respectively as daily average concentrations (Nakhlé, et al., 2015). The reason behind high levels, higher than the annual WHO guideline values of 20 µg/m$^3$ for $PM_{10}$ and 10 µg/m$^3$ for $PM_{2.5}$, differs from location to another. For example, in coastal areas, high levels of $PM_{10}$ are correlated with sea breezes that carry sea salt particles. While in crowded suburbs such as Bourj Hammoud the high concentrations are related to local emissions from traffic congestion combined with low precipitation and dust outbreaks (Saliba, Kouyoumdjiana, & Roumié, 2007). In certain cases, PM background concentrations are also related to dust episodes coming from both the African and Arabian deserts (Jaafar, et al., 2014). An alarming fact is reported by (Nakhlé, et al., 2015), indicating that in Beirut about 61% of $PM_{10}$ is made of $PM_{2.5}$, which can cause more severe health impacts.

#### *4.3.3.6 Greenhouse Gas (GHG) Emissions*

Besides air pollution, the road transport sector is a major direct contributor to emissions of GHGs (i.e. $CO_2$, $CH_4$, $N_2O$) that cause global warming through the greenhouse gas effect. The road transport sector accounts for 40% of national consumption of fuel and emits 23% of national GHG emissions, contributed through urbanization, negative externalities of air pollution, traffic congestion and the old fleet of passenger vehicles (MoE/UNDP/GEF, 2016). The GHG emissions from the transport sector for 2011 are presented in Table 4-9, with their respective contribution to national emissions. The contribution of each vehicle category to the overall emissions is shown in Figure 4-10; privately-owned passenger cars are evidently the largest contributor to GHG emissions. Domestic aviation emissions are calculated in those emissions, but they are minimal (0.17%) compared to road transport.

**Table 4-9. Direct GHG Emissions from the Road Transport Sector**

| Year | Estimated Number of Vehicles | $CO_2$ (Gg) | $CH_4$ (Gg) | $N_2O$ (Gg) |
|---|---|---|---|---|
| 2005 | 970,803 | 3,504.62 | 0.85 | 0.20 |
| 2011 | 1,536,919 | 5,634.81 | 1.19 | 0.44 |
| Share of National Emissions (2011) | | 27% | 0.87% | 14.29% |

*Source:* (MoE/UNDP/GEF , 2015)

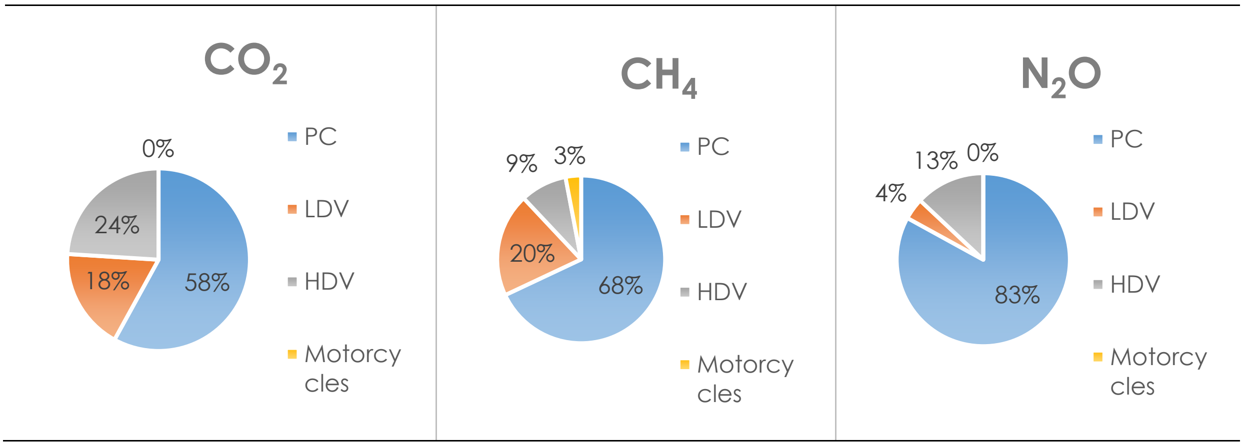



**Figure 4-10. Contribution of Different Vehicle Categories to Direct GHG Emissions (2010)**

*Source:* (MoE/UNDP/GEF , 2015)

The GHG emissions from the transport sector are on a constant increase. The calculated figures for 1994 and 2011 show an increase by 263% for $CO_2$, 158% for $CH_4$ and 979% for $N_2O$, with average annual increase rates of 8%, 6% and 15% respectively[1]. This increase is mainly attributed to the increase in passenger car vehicles and inefficient management of the public transport sector (MoE/UNDP/GEF, 2015).

### *4.3.4 Noise*

Exposure of urban buildings to traffic noise -even at low levels- is associated with annoyance and sleep disturbance, especially in settlements facing streets and main highways (Bluhm, Nordling, & Berglind, 2004). Greater Beirut Area is no exception, where there is limited availability of land, rapid urban sprawl, and where several highways and arterial roads in the city cross through residential and commercial areas.

High population density and large fleet size exacerbate the problem of noise pollution. According to a survey of noise levels in the GBA and the perception of people, the results show elevated noise levels above the national standards all around the city. Transportation noise was perceived the major source of annoyance by majority of the respondents in the urban setting, followed by construction and electricity generators (Korfali & Massoud, 2003). Surveys in other major cities in Lebanon, such as El-Mina in the North showed similar findings with transportation being the major source of noise pollution. Traffic and traffic congestion were cited as the main reason for noise pollution in 86% of the measured locations with levels exceeding 70 dBA (Iaaly-Sankari, Jadayel, & El-Murr, 2007).

A noise survey on a section of the project was conducted under the framework of the EIA Study for the A1 Highway between Tabarja and Dbayeh. Noise levels were recorded at several locations between Nahr El Kalb and Tabarja. The survey showed noise levels exceeding the national standards. Similar results were obtained inside apartments and commercial centers located at first floor level along the highway. A summary of the recorded noise levels are presented in Table 4-10 and Table 4-11.

[1] Calculation made according to 1996 Revised IPCC Guidelines – Tier 2 Methodology

**Table 4-10. Noise Level Measurements on Nahr El Kalb-Tabarja Road at Peak Hours, road level**

| Location | Towards Tripoli Noise Level (dBA) | Towards Beirut Noise Level (dBA) |
|---|---|---|
| Nahr El Kalb Tunnel | 93.7 | 86.4 |
| | 87.4 | 89.2 |
| | 93.1 | 86.7 |
| Zouk Exchange | 97.9 | 85.2 |
| | 84.3 | 83.8 |
| | 95.9 | 88.4 |
| | 99.4 | 84.8 |
| Kaslik Exchage | 94.4 | 89.1 |
| | 94.1 | 83.4 |
| | 97.7 | 81.6 |
| | 82.8 | 79.9 |
| | 76 | 88.4 |
| Sabra Exchange | 78 | 84.8 |
| | 82.3 | 91.6 |
| | 88.2 | 80.2 |
| | 95.8 | 91.2 |
| | 83.9 | 88.2 |
| | 97 | 85.0 |
| | 82.4 | 88.6 |
| Jounieh Exchange | 76.3 | 90.8 |
| | 85.8 | 91.2 |
| | 99.5 | 86.8 |
| | 90.7 | 91.3 |
| | 89.9 | 87.5 |
| Stadium Exchange | 83.8 | 84.6 |
| | 90.4 | 86.1 |
| | 91.1 | 82.6 |
| | 96.3 | 84.1 |
| | 90.2 | 85.9 |
| Adma Exchange | 91.8 | 87.9 |
| | 83.7 | 91.9 |
| | 90.5 | 86.7 |
| Maameltein Exchange | 95.2 | 91.2 |
| | 85.0 | 94.7 |
| Kfarhebab Exchange Casino | 90.9 | 89.8 |
| | 88.6 | 86.7 |
| | 96.9 | 84.2 |
| Tabarja | 91.3 | 83.8 |
| | 98.9 | 90.0 |

*Source: CDR/Gicome (2011, July). Environmental Impact Assessment Study Report for A1 Highway between Tabarja and Dbayeh.*

**Table 4-11. Noise Level Measurements on Nahr El Kalb-Tabarja Road at Peak Hours, taken inside first-floor apartments and commercial centers**

| Location | Towards Tripoli Noise Level (dBA) | Location | Towards Beirut Noise Level (dBA) |
|---|---|---|---|
| Nahr El Kalb (Abi Saab Tools) | 69 | Ghazir (Building) | 53.5 |
| Adonis (Building) | 58 | Jounieh (Shopping Center) | 54.5 |
| Sarba (Showbiz) | 65 | Adonis (McDonalds) | 52.1 |
| Kaslik Exchange | 60 | Zouk (Kozaily) | 75.6 |
| Jounieh Exchange (Wooden Bakery) | 60.2 | Nahr El Kalb (Crepaway) | 60.5 |

*Source: CDR/Gicome (2011, July). Environmental Impact Assessment Study Report for A1 Highway between Tabarja and Dbayeh.*

#### *4.3.4.1 Baseline Survey Methodology*

Noise measurements were carried out on 25 April 2017 and on 27 April 2017 over 15-minute intervals at twenty five (25) locations, reflecting daytime noise levels. Noise levels were measured near residential/commercial buildings and proposed bus stations to acquire baseline noise levels for the entire proposed BRT corridors - Northern Highway, Beirut Outer Ring and Beirut Inner Ring. The Type 1 sound level meter used complies with the latest IEC standards and American National Standards Institute (ANSI). It was factory-calibrated in February 2014. It was also calibrated before and after each set of measurements according to the manufacturer's guidelines.

The noise metric $L_{90}$ was used to characterize the baseline noise as it is thought to be more representative of existing conditions than the equivalent sound level or $L_{eq}$ because of the nature of the noise. The $L_{90}$ is the measured noise level (in A-weighted decibels or dBA) that is exceeded 90 percent of the time during a monitoring event. High noise events, such as a large transport truck passing nearby or a barking dog near the microphone, tend to be excluded in the $L_{90}$ metric. The noise metric $L_{90}$ is generally considered to be representing the background or ambient level of a noise environment.

The monitoring locations for the noise measurements were selected to be representative of the studied area and away from being influenced by interferences such as wind, impulsive sounds and electromagnetic radiation from high voltage transmissions lines. The noise monitoring locations are presented in Figure 4-11 and described in Table 4-12.

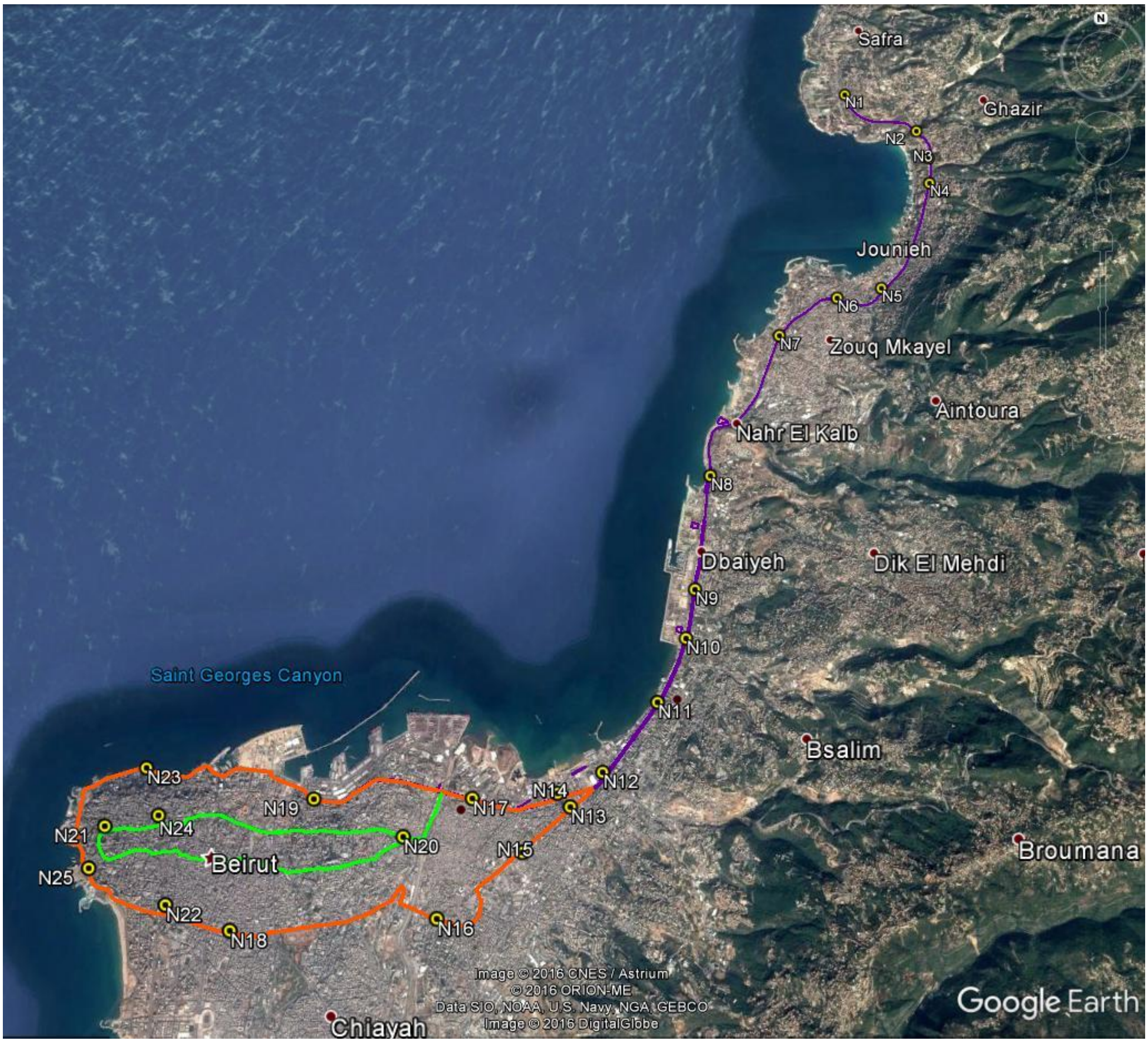


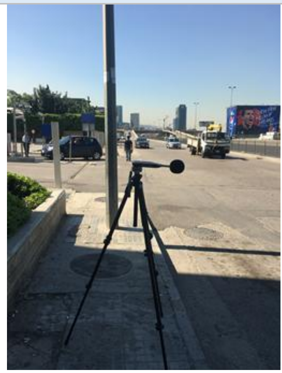

**Figure 4-11. Noise Monitoring Locations**

**Table 4-12. Description of the Noise Monitoring Locations**

| Monitoring Location | Siting Images | Site Description | Notes |
|---|---|---|---|
| **Component 1: Northern Highway: Tabarja - Beirut** | | | |
| N1<br>Tabarja<br><br>34° 1' 18.96"N<br>35° 37' 56.53"E |   | In front of a commercial center on the highway that leads to Tabarja. | Windy weather |
| N2<br>Maameltein, Jounieh<br><br>34° 0' 50.52"N<br>35° 38' 49.76"E |   | After Casino du Liban on the highway from Tabarja to Beirut. In front of a commercial center. | Windy weather |

| Monitoring Location | Siting Images | Site Description | Notes |
|---|---|---|---|
| N3<br>Maameltein, Jounieh<br><br>34° 0' 29.32''N<br>35° 38' 57.73''E |  | On the highway from Tabarja to Beirut in front of a commercial center and residential buildings | Windy weather |
| N4<br>Maameltein, Jounieh<br><br>34° 0' 3.45''N<br>35° 38' 51.53''E |  | In front of a commercial and medical center (Caliprix Supermarket, Crepaway Restaurant, medical clinics, etc.). | - |
| N5<br>Jounieh<br><br>33° 58' 48.63''N<br>35° 38' 1.05''E |   | On the highway leading from Tabarja to Beirut in front of a commercial center in which a store is being built. | - |

| Monitoring Location | Siting Images | | Site Description | Notes |
|---|---|---|---|---|
| N6<br>Jounieh<br><br>33° 58' 44.55"N<br>35° 37' 24.48"E |  |  | In front of a furniture store on the highway that leads to Tabarja. | - |
| N7<br>Zouk<br><br>33° 58' 20.35"N<br>35° 36' 37.88"E |  |  | In front of a commercial center (pharmacy, clothing shop, etc.) on an internal road near the highway. | Municipal works were being conducted near the noise meter (mainly shoveling). |
| N8<br>Dbayeh<br><br>33° 56' 46.31"N<br>35° 35' 36.04"E |  | | Next to Skaff and other commercial establishments on the highway towards Tabarja. The noise meter was placed on the service road leading to Le Royal Hotel. | Very few cars were passing near the noise meter on the service road, whereas, there were many vehicles on the highway towards Tabarja. |

| Monitoring Location | Siting Images | Site Description | Notes |
|---|---|---|---|
| N9<br>Dbayeh<br><br>33° 55' 34.86"N<br>35° 35' 14.43"E |   | In front of ABC Mall on the highway leading to Tabarja. The noise meter was placed right in front of the Mall on the service road. | Only some buses dropping off employees and few cars were passing near the noise meter on the service road whereas, there were many vehicles on the highway towards Tabarja. |
| N10<br>Antelias<br><br>33° 55' 6.61"N<br>35° 35' 5.27"E |  | Facing Antelias bridge. | Few vehicles were passing near the noise meter (mostly buses). |
| N11<br>Jal El Dib<br><br>33° 54' 29.93"N<br>35° 34' 41.54"E |   | On the highway going towards Tabarja. Next to commercial establishments (e.g., Dunkin Donuts) and residential buildings. | The alarm of a car parked near the noise meter was sounding for almost all the noise measurement duration. Hence, the measurement is declared invalid. |

| Monitoring Location | Siting Images | Site Description | Notes |
|---|---|---|---|
| N12<br>Zalka<br><br>33° 53' 54.16"N<br>35° 34' 1.99"E |  | Internal road leading to the highway towards Beirut. A pedestrian bridge is located next to the measurement point. | Some cars were passing directly near the noise meter to access the internal road from the highway that leads to Beirut. |
| N14<br>Dora<br><br>33° 53' 43.35"N<br>35° 33' 30. 92"E |  | - | - |

| Monitoring Location | Siting Images | Site Description | Notes |
|---|---|---|---|
| **Component 2: Beirut Outer Ring** | | | |
| N13<br>Bauchrieh, Sin el Fil Boulevard<br><br>33° 53' 34.46"N<br>35° 33' 38.97"E |     | In front of "Expo One of One" on the road, next to Commercial establishments and residential buildings. | - |
| N15<br>Jdeideh<br><br>33° 53' 13.93"N<br>35° 33' 6.53"E |  | In front of car workshops on the road. | Workshops were operational. Construction works were taking place on the other side of the road (building under construction). |

| Monitoring Location | Siting Images | Site Description | Notes |
|---|---|---|---|
| N16<br>Sin El Fil<br><br>33° 52' 42.28''N<br>35° 32' 11.3''E |  | Facing Sin El Fil Municipality and Bank Audi, in front of Hypco Gas Station, next to Commercial establishments and residential buildings. | - |
| N18<br>Mazraa<br><br>33° 52' 42.77''N<br>35° 29' 56.79''E |   | On the sidewalk, next to Commercial establishments and residential buildings. | Windy weather. |
| N22<br>Mazraa<br><br>33° 52' 57.38''N<br>35° 29' 18.39''E |   | In front of a residential building next to residential buildings. | Very few cars passed near the noise meter. |

| Monitoring Location | Siting Images | Site Description | Notes |
|---|---|---|---|
| N25<br>Raouche<br><br>33° 53' 17.25"N<br>35° 28' 24.059"E |  | On the sidewalk, next to Commercial establishments and residential buildings. | - |
| N23<br>Manara<br><br>33° 54' 8.63"N<br>35° 28' 49.52"E |  | In front of AUB on the sidewalk. | - |
| N19<br>Charles Helou<br><br>33° 53' 47.39"N<br>35° 30' 54.63"E |  | On Charles Helou Bridge sidewalk. | - |

| Monitoring Location | Siting Images | Site Description | Notes |
|---|---|---|---|
| N17<br>Bourj Hammoud<br><br>33° 53' 42.07"N<br>35° 32' 41.22"E |   | In front of BBAC Bank facing the highway, next to Commercial establishments. | - |
| **Component 3: Beirut Inner Ring** | | | |
| N20<br>Achrafieh<br><br>33° 53' 25.33"N<br>35° 31' 48.41"E |  | On Independence Street sidewalk. | - |
| N21<br>Hamra<br><br>33° 53' 38.76"N<br>35° 28' 33.62"E |  | In front of a construction site next to Commercial establishments and residential buildings. | - |

| Monitoring Location | Siting Images | Site Description | Notes |
|---|---|---|---|
| N24<br>Hamra<br><br>33° 53' 43.43"N<br>35° 29' 9.11"E |  | In front of a shop on Hamra Street, next to Commercial establishments and residential buildings. | High flow of vehicles. |

#### *4.3.4.2 Baseline Survey Results*

The measured noise levels were compared to the Lebanese standards for environmental noise as per MoE Decision No. 52/1/1996 (refer to section 3.2.1.2.2.5) and the IFC EHS Guidelines. A summary of noise monitoring results is provided in Table 4-13.

Noting that all noise levels approach or exceed the Lebanese standards and the IFC EHS Guidelines, the existing noise levels throughout the project corridor fluctuate between 67 and 81 dB(A) by location, depending on site characteristics such as proximity to major roadways like Charles Helou Highway, and other noise sources, the relative elevation of roadways and receptors.

**Table 4-13. Summary of Measured Baseline Sound Levels**

| Monitoring Location | Time/ Period | Limit for Ambient Noise Levels dB(A)* | Limit for Ambient Noise Levels db(A)** | Date of Noise Monitoring | Noise Levels in dB(A) | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | LEQ | LMAX | LMIN | L10 | L90 |
| | **Component 1: Northern Highway: Tabarja - Beirut** | | | | | | | | |
| N1 | Day Time (13:24) | 50-60 | 70 | 25-04-2017 | 80.07 | 99.55 | 67.58 | 82.4 | 75.3 |
| N2 | Day Time (14:00) | 50-60 | 70 | 25-04-2017 | 76.68 | 98.28 | 67.35 | 78 | 71.8 |
| N3 | Day Time (14:21) | 50-60 | 70 | 25-04-2017 | 81.75 | 98.76 | 72.06 | 83.9 | 76.8 |
| N4 | Day Time (13:01) | 50-60 | 70 | 25-04-2017 | 79.67 | 101.4 | 68.18 | 81.4 | 73.4 |
| N5 | Day Time (14:50) | 50-60 | 70 | 25-04-2017 | 78.57 | 95.86 | 67.42 | 81.3 | 72.0 |
| N6 | Day Time (11:24) | 50-60 | 70 | 25-04-2017 | 75.14 | 90.36 | 66.05 | 77.7 | 70.5 |
| N7 | Day Time (11:01) | 50-60 | 70 | 25-04-2017 | 75.21 | 95.23 | 67.34 | 77.5 | 69.6 |
| N8 | Day Time (10:33) | 50-60 | 70 | 25-04-2017 | 79 | 90.48 | 71.35 | 80.8 | 76.1 |
| N9 | Day Time (10:02) | 50-60 | 70 | 25-04-2017 | 79.32 | 92.51 | 72.07 | 81.4 | 76.0 |
| N10 | Day Time (09:33) | 50-60 | 70 | 25-04-2017 | 78.48 | 101.55 | 67.39 | 80.2 | 70.7 |
| *N11* | *Day Time (09:07)* | *50-60* | 70 | *25-04-2017* | *79.73* | *99.3* | *71.22* | *82.2* | *74.9* |
| N12 | Day Time (08:38) | 50-60 | 70 | 25-04-2017 | 71 | 91.79 | 62.16 | 72.8 | 66.0 |
| N14 | Day Time (16:39) | 50-60 | 70 | 27-04-2017 | 78.26 | 92.72 | 71.74 | 80.2 | 74.7 |
| | **Component 2: Beirut Outer Ring** | | | | | | | | |
| N13 | Day Time (8:26 | 50-60 | 70 | 27-04-2017 | 73.24 | 98.12 | 59.51 | 75.2 | 64.4 |

| Monitoring Location | Time/ Period | Limit for Ambient Noise Levels dB(A)* | Limit for Ambient Noise Levels db(A)** | Date of Noise Monitoring | Noise Levels in dB(A) | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | LEQ | LMAX | LMIN | L10 | L90 |
| | a.m.) | | | | | | | | |
| N15 | Day Time (9:03 a.m.) | 50-60 | 70 | 27-04-2017 | 72.4 | 92.89 | 58.65 | 74.7 | 63.7 |
| N16 | Day Time (9:39 a.m.) | 50-60 | 70 | 27-04-2017 | 71.76 | 89.96 | 57.74 | 73.2 | 61.8 |
| N18 | Day Time (10:27 a.m.) | 50-60 | 70 | 27-04-2017 | 73.11 | 90.86 | 63.87 | 75.5 | 68.0 |
| N22 | Day Time (11:01 a.m.) | 50-60 | 70 | 27-04-2017 | 66.13 | 90.16 | 49.15 | 68.8 | 53.3 |
| N25 | Day Time (11:31 a.m.) | 50-60 | 70 | 27-04-2017 | 71.86 | 92.12 | 64.34 | 73.7 | 66.5 |
| N23 | Day Time (1:23 p.m.) | 50-60 | 70 | 27-04-2017 | 69.63 | 93.09 | 52.08 | 71 | 59.0 |
| N19 | Day Time (3:00 p.m.) | 50-60 | 70 | 27-04-2017 | 75.09 | 95.04 | 65.14 | 77 | 69.4 |
| N17 | Day Time (4:14 p.m.) | 50-60 | 70 | 27-04-2017 | 75.93 | 95.89 | 66.5 | 77.9 | 70.0 |
| | **Component 3: Beirut Inner Ring** | | | | | | | | |
| N20 | Day Time (3:38 p.m.) | 50-60 | 70 | 27-04-2017 | 73.87 | 95.1 | 65.46 | 75.4 | 68.4 |
| N21 | Day Time (12:00 p.m.) | 50-60 | 70 | 27-04-2017 | 71.53 | 90.47 | 54.11 | 74.8 | 59.6 |
| N24 | Day Time (12:40 p.m.) | 50-60 | 70 | 27-04-2017 | 74.64 | 93.76 | 62.03 | 76.6 | 65.0 |

* Maximum Admissible Sound Levels in Residential areas with some construction sites or commercial activities or located near a road, as per MoE Decision No. 52/1/1996.

** IFC EHS Guidelines: 1 hour exposure during daytime (7 a.m. – 10 p.m.) close to Industrial and commercial settings

### *4.3.5 Geology, Soil, Groundwater and Seismicity*

#### *4.3.5.1 Topography*

The BRT corridor extends over a distance of 56 km on the coastal area from Beirut to Tabarja as shown in Figure 4-12. The topography of the area is flat on the coast, where the elevation ranges between 100 and 500 meters from the Mediterranean Sea to the west of the BRT, but becomes mountainous with increasing slopes east of the BRT corridor.

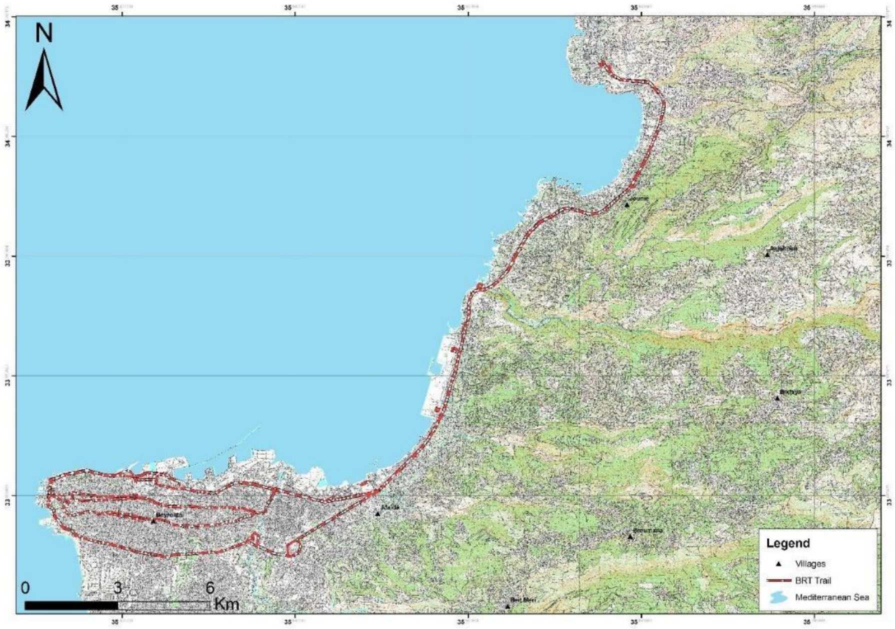



**Figure 4-12. Topographic Map of the BRT Study Area**

*4.3.5.2* *<u>Geology</u>*

a) Lithostratigraphy

There are eleven (11) geological formations and Quaternary deposits outcropping in the study area as shown in Figure 4-13. These formations are shown from youngest to oldest along with their lithological description in Table 4-14 and are described further hereunder.

a.1 Quaternary Deposits (Q)

The Quaternary deposits (Q) mainly outcrop to the west of the corridor along the coast and are mainly composed of sand, silt, moving dunes and decalcified coastal sandstone. The thickness of these deposits reaches up to 50 m in Beirut.

a.2 The Miocene Formation (mcg/ mL)

The Miocene Formation outcrops near the coast. These are sometimes covered by Quaternary Deposits (Q). This formation is composed of cemented conglomerates and Lacustrine Limestone often interbedded with clay and can reach a thickness of 50 m to 100 m.

a.3 The Sannine Formation (C4)

The Sannine Formation (C4) of Cenomanian age outcrops in the western part. The Sannine formation is usually divided into three (3) main units: A lower unit (C4a) and an upper unit (C4c) of relatively similar lithology are separated by a middle unit consisting of marly limestone interbedded with marl (C4b).

The lower and upper units consist of fractured limestone of varying bedding thicknesses, whitish to pale gray color, with some local occurrences of chert nodules in the upper unit. The middle unit (C4b) has a thickness of about 300 m and is predominantly comprised of layers of whitish to gray marls and marly limestone. The total thickness of the Sannine Formations in the region likely exceeds 600 m.

Together with the overlying Maameltein Formation, the combined Sannine-Maameltein sequence constitutes one of the most important aquifers in Lebanon – the Sannine-Maameltein karstic aquifer. Permeability varies across the sequence with the middle C4b having notably lower permeability than the rest of the aquifer with even confining properties in some cases.

a.4 The Maameltain Formation (C5)

The Maameltain Formation (C5) outcrops west of the corridor. This formation is mainly composed of massive to thin bedded whitish gray limestone and marly limestone units which is very similar in lithology to the upper Sannine formation (C4c). The thickness of the Maameltain formation (C5) can reach up to 200 m.

As part of the Sannine-Maameltein aquifer, the Maameltain Formation has similar hydraulic properties to the C4c unit of the Sannine Formation.

a.5 The Abeih Formation (C2a)

The Abeih Formation varies in lithology from fine sands, clays, and sandy limestone at its base to medium beds of limestone interbedded with yellow clay at its top. It has a thickness varying between 65 and 170 m.

**Table 4-14. Main Geological Formations Outcropping within the Study Area**

| Period | Age | Formation Name or Stage / Deposits / Age | Dubertret Alphanumeric Nomenclature | Thickness (m) | Lithology |
|---|---|---|---|---|---|
| ***Quaternary*** | | Quaternary Deposits | Q | Up to 50 | Sand, silt, detrital limestone, conglomerates and alluvial deposits |
| ***Tertiary*** | Neogene | Miocene Formation | Mcg/mL | 50 to 100 | Marls and Lacustrine Limestone (continental succession) and conglomerates |
| ***Cretaceous*** | Senonian | Chekka Formation | C6 | Up to 300 | White chalks, marly chalks with phosphate and chert nodules and bands |
| | Turonian | Maameltein Formation | C5 | Up to 200 | Massive to thin bedded white-gray limestone and marly limestone |
| | Cenomanian | Sannine Formation | C4 | 500 | Pale gray, fractures fine and thick bedded limestone and marly limestone with geodes and |

| Period | Age | Formation Name or Stage / Deposits / Age | Dubertret Alphanumeric Nomenclature | Thickness (m) | Lithology |
|---|---|---|---|---|---|
| | | | | | chert |
| | Albian | Hammana Formation | C3 | 150 | Brown-green marl, marly limestone, and localized basalts |
| | Aptian | Mdairej Formation | C2b | 85 | Massive pale Limestone, highly jointed |
| | Barremian | Abeih | C2a | Up to170 | Brown yellowish limestone, marl, and sandstone |
| | Valanginian/ Hauterivian | Chouf Formation | C1 | Up to 220 | Cross-bedded sandstone |
| ***Jurassic*** | Oxfordian | Bhannes Basalts | BJ5 | 50-100 | Basalts and volcanic tuff accompanied sometimes with marls |
| | Pliensbachian to Callovian | Kesrouane Formation | J4 | 1000 | Massive grey limestone |

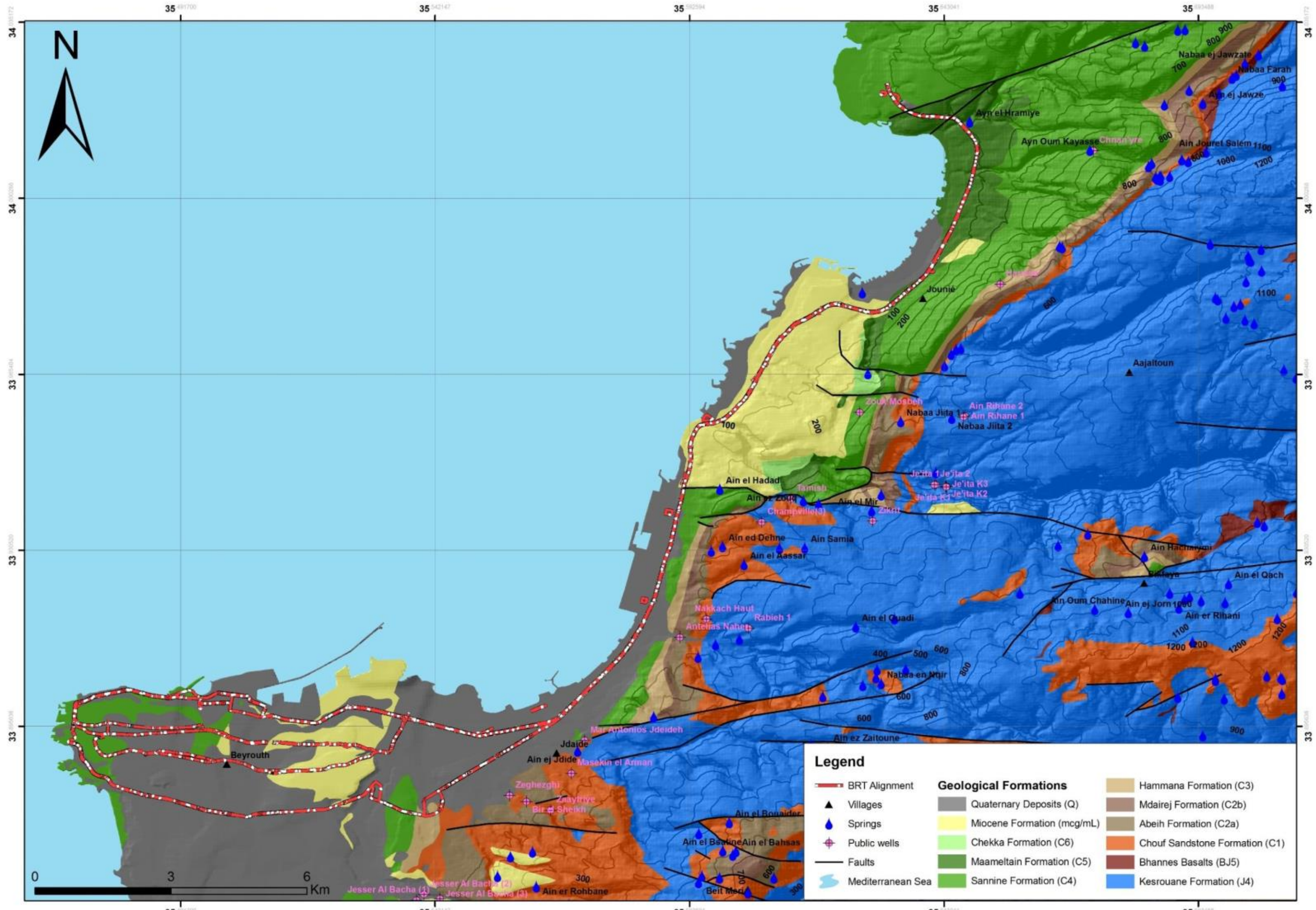



**Figure 4-13. Geological Map of the Study Area along the BRT Corridor**

Source: Dubertret 1/50,000 Map. (1951)

a.6 The Chouf Sandstone Formation (C1)

The Chouf Sandstone Formation (C1) is of Neocomian age, mainly composed of white to ferruginous fine to course grained quartz sands and sandstones, intercalated with horizons and layers (up to few meters thick) of clay, coal, lignite and basalts. The thickness of the Chouf Sandstone Formation in the area is reported to be up to 220 m.

a) Structural Setting

The BRT corridor extends over distance of 56 km between Beirut and Tabarja. It is located west of the Yammouneh fault where it crosses a series of secondary faults trending E-W as shown in Figure 4-14. The Yammouneh Fault is not a single fault, but a fault zone of 1-2 km width that is associated with a variety of structural geological features (e.g. folds, shear fractures and breccia) that are indicative of its sinistral strike-slip nature (Hancock & Atiya, 1979). In addition to the 80 km of lateral displacement, a vertical displacement of more than 800 m is well documented. As for the E-W Trending secondary faults, they are stretching from the Yammouneh fault and are of dextral type fault with a horizontal displacement of up to 3 km and a vertical displacement of 300 m as documented from the vertical displacement.

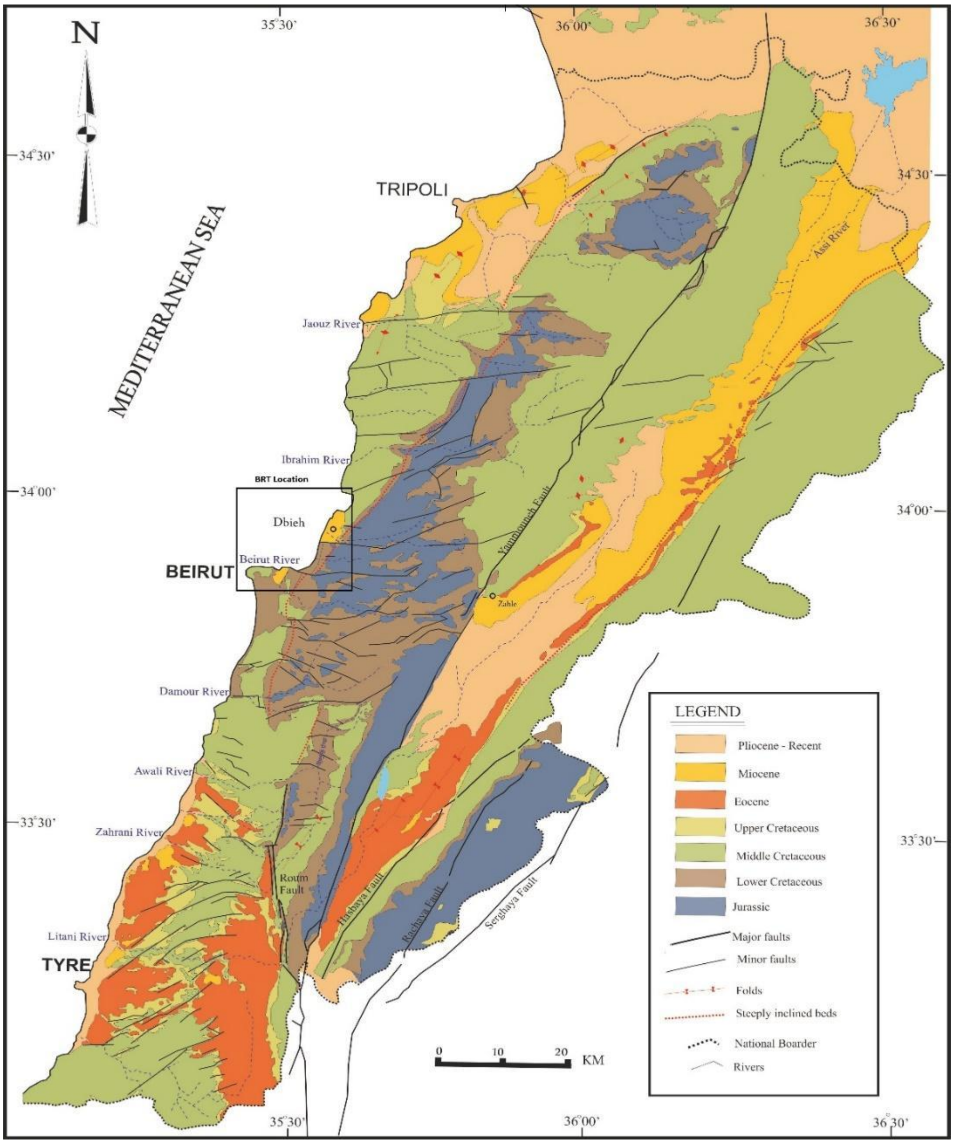



**Figure 4-14. General Geological and Tectonic Map of Lebanon Showing the BRT Location**

b) Springs

There are more than 100 springs in the Study Area as shown in Figure 4-13. With the exception of only one small spring located around 350 meters west of the corridor at an elevation of 11 m (asl) and issuing from the quaternary deposits, located on the Jounieh coast, all other inland springs emerging from the geologic formations crossed by the BRT are considered up gradient to the BRT corridor.

c) Public and Private Wells

There are 27 public wells in the Study Area and are all up gradient of the BRT as shown in Figure 4-13. These wells are tapping the Sannine Maameltain (C4-C5), Keserouane (J4) and Chouf Sanstone (C1) aquifers. The elevation of these wells range from 15 m (asl) to 604 m (asl) and in depth between 45 m (bgl) and 614 m (bgl).

The BRT corridor exhibits a large concentration of private wells particularly in Beirut as shown in Figure 4-15. There are more than 1,500 private wells in Beirut area alone ranging in depths from 15 to 75 m (bgl) tapping the Quaternary deposits and Sannine Maameltain aquifer (C4-C5). Further north, more private wells are present with depths ranging from 15 m (bgl) to 350 m (bgl) tapping the Miocene (mcg) and Sannine Maameltain (C4-C5) aquifers.

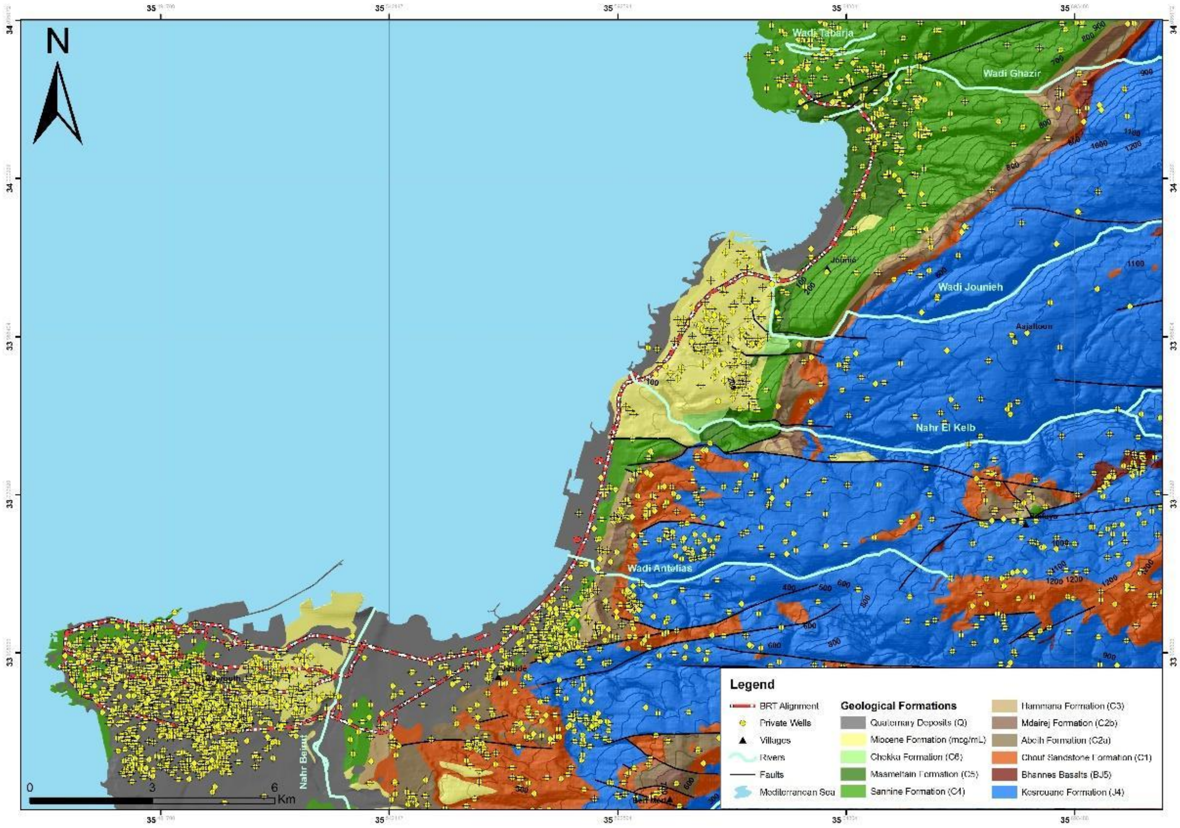



**Figure 4-15. Map Showing the Private Wells along the BRT Corridor**

*4.3.5.3 Surface Water Bodies*

The surface water bodies that are crossed by the proposed BRT Corridor are listed in Table 4-15 and shown in Figure 4-16. They comprise two (2) perennial rivers and three (3) seasonal streams.

**Table 4-15. Surface Water Bodies that are Crossed by the Proposed BRT Corridor**

| Name | Type |
|---|---|
| Naher Beirut | Perennial |
| Nahr El Kelb | Perennial |
| Wadi Antelias | Seasonal |
| Wadi Jounieh | Seasonal |
| Wadi Ghazir | Seasonal |

#### *4.3.5.4 Hydrogeology and Groundwater Flow Conditions*

Each of the geologic formations crossed by the BRT Corridor exhibits unique hydrogeological characteristics. The major aquifers in the Study Area are the Sannine-Maameltain Limestone formation (C4-C5) and the Miocene Limestone Formation (mL). Both formations include karstic aquifers with groundwater mostly flowing through fractures and cavities.

As the BRT Corridor extends over a distance of 56 km along the northern Lebanese coast, groundwater depth changes due to the difference in elevation and geology. Since the BRT Corridor is located along the coast, the groundwater level or piezometric level is often close to sea level but it is protected in the cases of confined aquifers where actual depth to top of aquifer can be deep.

Karstic aquifers are extremely vulnerable to surface pollution. Groundwater depth is not a determining factor in a karstic aquifer such as the Sannine-Maameltain (C4-C5) and Miocene (mL) Aquifer because surface water can percolate through the surface layers and reach several hundred meters of depths in a matter of hours such as through a sinkhole.

The general groundwater flow direction is to the west (towards the sea) as shown in Figure 4-16. It is also worth noting that almost all the area crossed by the BRT Corridor is characterized by seawater intrusion due to overexploitation of groundwater along the coastal area.

#### *4.3.5.5 Tectonics and Seismicity*

Lebanon is located on the eastern coast of the Mediterranean Sea, along the Dead Sea Transform Fault (DSTF) system. The DSTF in Lebanon has several surface expressions, represented in major faults (Yammouneh, Roum, Hasbaiya, Rachaiya and Serghaya faults) and in uplifts as high mountainous terrain (Mount Lebanon and Anti Lebanon) as shown in Figure 4-17. The activity along the DSTF is evident from the seismic activity record. Recent work categorized the Lebanese section of the DSTF as being a strong seismic activity zone (Khair et al., 2000; Huijer *et al.,* 2011).

The BRT Corridor lies to the west of the Yammouneh Fault which is a major fault in Lebanon.

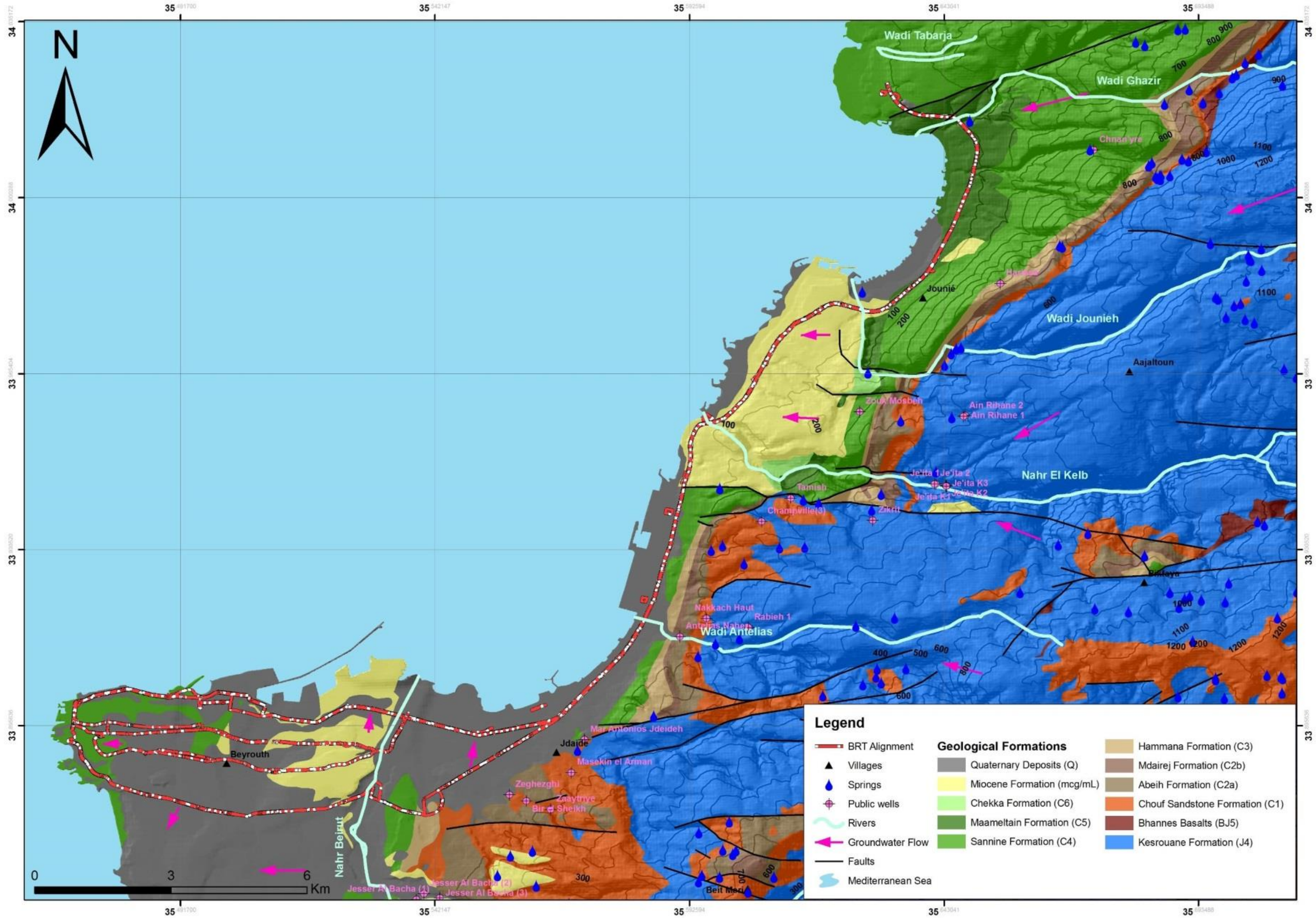



**Figure 4-16. Main Rivers and Streams Crossing the BRT Corridor and Groundwater Flow in the Study Area**


**Figure 4-17. Faults within Lebanon**

AT – Aakkar thrust; DSF – Dead Sea fault; GhF – Ghab fault; MLT – Mt. Lebanon thrust; NT – Niha thrust; RaF – Rachaya fault; RF – Roum fault; SF – Serghaya fault; TT – Tripoli thrust; YF – Yammouneh fault; ZCF – Zrariye-Chabriha fault
Source: Huijer *et al.*, 2011

In terms of seismicity and according to the United States Geological Survey (USGS) , the most recent earthquake that occurred in Lebanon was on June 29, 2016 at around 19 km WSW of Beirut. This earthquake had a magnitude of 3.7 on the Richter scale and occurred at a depth of 13.9 km below the surface (Figure 4-18).

A historical seismicity map and a seismic hazard map of the region are presented in Figure 4-19 and Figure 4-20 respectively. New infrastructure projects should reportedly refer to the recently updated hazard map and implications in terms of construction safety parameters (Figure 4-20) and it is expected that the BRT Project will abide by such directives.

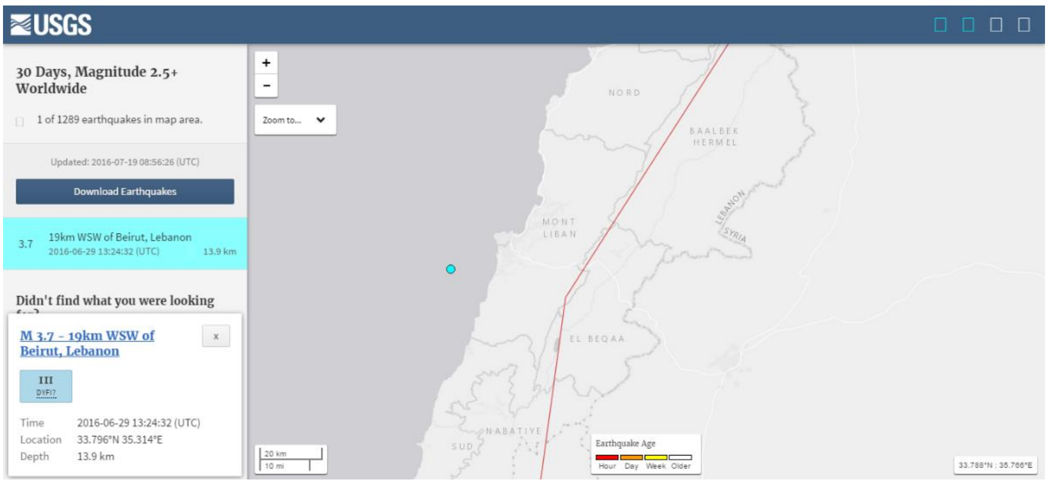



**Figure 4-18. Location of the Most Recent Earthquake in Lebanon**

Source: http://earthquake.usgs.gov/earthquakes/map

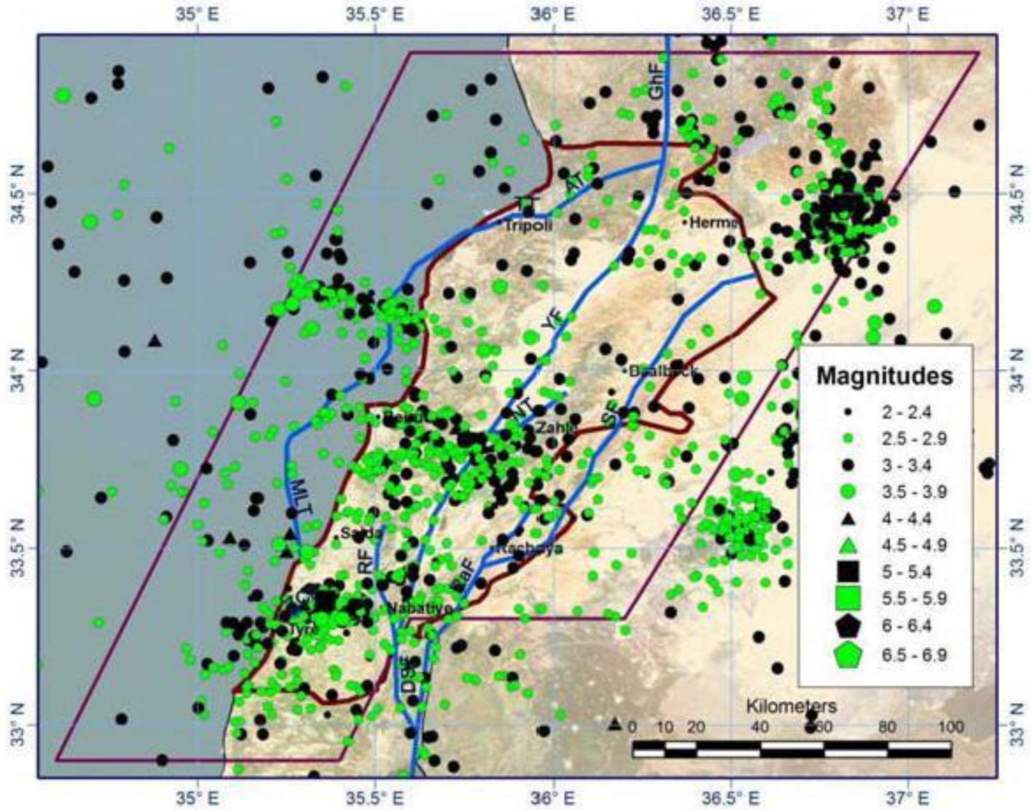



**Figure 4-19. Recorded Earthquake Events in and around Lebanon between 1998 and 2009 with Magnitudes ≥ 2 on the Richter Scale**

Source: Huijer *et al.*, 2011

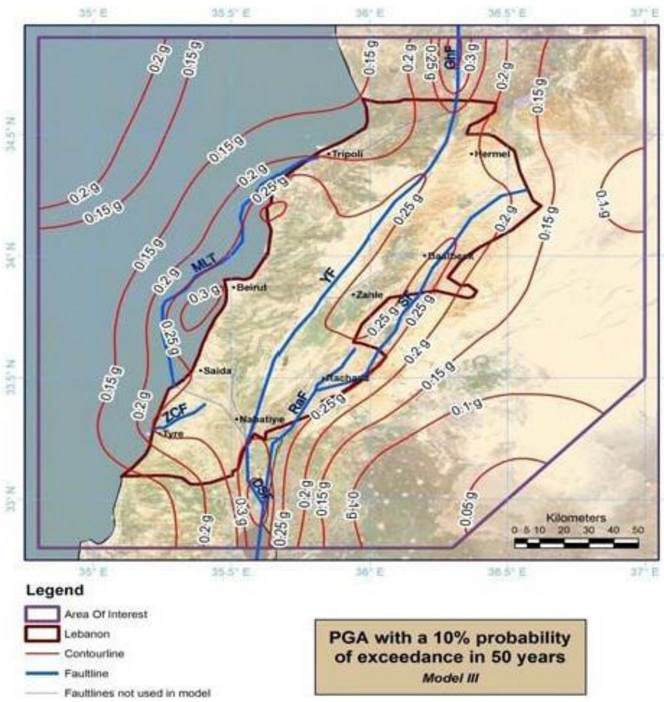



**Figure 4-20. Seismic Hazard Map**

**(contouring of Peak Ground Acceleration with 10% probability of exceedance in 50 years)**

### *4.3.6 Landscape and Biological Environment*

The BRT System lies within a heavily urbanized area, however, some system components such as the Park and Ride (P&R) facilities will be located on empty plots of land that are vegetated. The establishment of pedestrian bridges or the amendment of existing ones might require the removal of green areas at both sides of the road/ highway. In addition, the stations will be located in the median strip, where some of the median strips are vegetated, and hence the baseline survey, through satellite imagery and field observations, documented the vegetated areas that cross with the project's footprint.

#### *4.3.6.1 Baseline Survey Methodology*

A field survey was conducted on 17 April, 2017 and on 29 September 2017, to assess the baseline conditions of the Park & Ride (P&R) Facilities of the BRT System between Tabarja and Beirut, the median strip along the path from Tabarja to Beirut and Beirut Outer Ring, and the depot and terminal sites in Safra and Tabarja.

The site assessment for the terrestrial environment was conducted from a flora and fauna perspective.

#### *4.3.6.2 Baseline Survey Results*

##### 4.3.6.2.1 Flora and Vegetation Cover

A comprehensive assessment of the eight (8) proposed P&R facilities, the Tabarja terminal and the Safra bus depot was conducted during the field visits. A drive through the median strips along the Tabarja-Beirut alignment and Beirut Outer Ring was conducted, along with individual visits to the P&R facilities, depot and terminal sites.

No areas of special concern (world heritage sites, wetlands, biosphere reserves, or protected areas) are located in the vicinity of the sites or along the median strips. Neither endangered species, nor critical ecosystems/ habitats were recorded during the field visit.

###### *4.3.6.2.1.1 P&R Facilities along the Tabarja-Beirut Alignment*

The P&R facilities are located on non-productive land. The plants observed at the P&R facilities are mostly weeds and signs of degraded habitats such as *Ricinus communis, Chrysanthemum coronarium* and *Notobasis syriaca*.

The locations of proposed P&R facilities from a landscape and biological environment point of view are further described in Table 4-16.

**Table 4-16. Description of the Proposed Locations of P&R Facilities**

| P&R Facilities | Current Land Use/ Status and Fauna/ Flora presence | Google Earth Images | Photographic Records from Field Visit |
|---|---|---|---|
| P&R 1 | Closed street and currently used as a parking lot. No flora or fauna were found. |  | - |
| P&R 2 | Currently used as a parking lot. No flora or fauna were found. |  | - |
| P&R 3 | Empty plot in Dbayeh marina. The plot is not a natural habitat and contains weeds on the periphery such as *Ricinus communis* and *Chrysanthemum coronarium*. It has no ecological value. |  |  |

| P&R Facilities | Current Land Use/ Status and Fauna/ Flora presence | Google Earth Images | Photographic Records from Field Visit |
|---|---|---|---|
| P&R 4 | Plot in Dbayeh marina currently occupied by porta cabins, workers' residences, and a water cistern. The plot is not a natural habitat and contains weeds on the periphery such as *Notobasis syriaca* and *Chrysanthemum coronarium*. It has no ecological value. |  |  |
| P&R 5 | Median strip with no ecological value. It is not a natural habitat and contains weeds such as *Inula viscosa* and *Chrysanthemum coronarium* and one exotic tree (*Acacia* sp.) |  |  |

| P&R Facilities | Current Land Use/ Status and Fauna/ Flora presence | Google Earth Images | Photographic Records from Field Visit |
|---|---|---|---|
| P&R 6 | Disturbed land on the coast with no ecological value. The land is used as a site to stock sand extracted from the river and is full of waste with no remaining natural flora or fauna. |  |   |
| P&R 7 | A landscaped area on the highway with observed flora species of *Pinus pinea*, *Olea europea* and *Bougainvillea glabra* (exotic). The pine and olive trees are native species. There are between 40-50 trees on the site. |  |  |

| P&R Facilities | Current Land Use/ Status and Fauna/ Flora presence | Google Earth Images | Photographic Records from Field Visit |
|---|---|---|---|
| P&R 8 | Plot occupied by a house, a parking space, fruit and ornamental exotic trees located next to the house, and a few native plant species (*Chrysanthemum coronarium*, *Papaver* sp., *Rubus* sp.). Those native plant species are very common in degraded and waste lands. |   |  |

*4.3.6.2.1.2 The Median Strips along the Tabarja- Beirut Alignment*

The existing median strips along the Tabarja-Beirut alignment mainly consist of exotic ornamental plant species such as palm, Washingtonia, eucalyptus, olive trees and others (refer to Figure 4-21). Those species have no ecological value but have an important positive impact on local air quality and aesthetic value given their presence in congested urban areas.


**Figure 4-21. Median Strip with Eucalyptus Trees on Jdeideh Highway**

*4.3.6.2.1.3 The Median Strips along the Beirut Outer Ring*

The median strips along the Beirut Outer Ring mainly consist of exotic ornamental plant species such as palm, Washingtonia trees and other trees, shrubs, and herbs. Those species have no ecological value but have an important positive impact on local air quality in the different areas. Some native coastal plants are observed in the median strip along Corniche Al Baher in Beirut. Given that those plants are being confused with weeds, they are being removed by municipality workers.

Vegetated median strips are located along the Beirut Outer Ring Corridor except in Zone 1 as indicated in Figure 4-1, where there are no median strips or no vegetated median strips. A highly-regarded vegetated median strip is located on the seaside next to AUB campus in Beirut and shown in Figure 4-22.


**Figure 4-22. Vegetated Median Strip Next to AUB Campus in Beirut**

*4.3.6.2.1.4 Terminal in Tabarja*

The proposed site in Tabarja consists of 4 plots 530 to 533. Plots 530 and 531 are wastelands and do not present any ecological importance. Plots 532 and 533 consist mainly of agricultural land and partly of native trees such as cypress and pine trees, and also of some exotic trees on the western side of plot 533.

**Figure 4-23. Panoramic view of part of Plot 531 in Tabarja**

**Figure 4-24. West side of Plot 533 dominated by Exotic and Invasive Species**

*4.3.6.2.1.5 Depot in Safra*

The proposed site for the depot in Safra is a big land of 14,000 m$^2$ of surface area (Figure 4-25). It is mostly dominated with wasteland having weeds (*Inula visocosa*, *Rubus* sp., and *Smilax aspera*) or even invasive species (*Ailanthus altissima*) but bordered from the South by very large oak, Pistacia and carob trees, numbering in total 20 trees. Therefore, the plot itself has low ecological value but the native old trees bordering it from the South have a high ecological value and should be protected and not removed during construction and operation of the project.


**Figure 4-25. Aerial view of Safra site and Bordering Native Trees to be Protected**

4.3.6.2.2 Fauna Species

A complete faunal survey of the Study Area was not carried out. No faunal species or any traces of fauna were observed during the field visit except for pigeons and birds which are adapted to cities. All the sites are situated in urban areas and are not expected to support faunal species.

### *4.3.7 Socio-Economic Aspects*

The socio-economic dimension of the Project is an integral part of the ESIA study. The socio-economic dimension includes demographic, social and economic characteristics and features relevant to the Project within the local context. The purpose of this baseline is to present a basis against which potential socio-economic impacts (whether positive or negative) induced by the Project activities can be assessed.

Socio-economic data were obtained from previous studies and official household survey data. Additionally desk reviews of existing studies and readily-available statistics and information provided from relevant sources, such as the Central Administration of Statistics were sought and are summarized in the following sub-sections.

#### *4.3.7.1 Social Demographics*

The following sections provides an overview of the social demographics in Lebanon, while allocating a separate segment to discuss the conditions of mobility in Lebanon and particularly within the project boundaries.

#### 4.3.7.1.1 Population

According to the latest statistics Lebanon's population is estimated to be 5.988 million (2016), of which 75.8% is urban population (2.226 million in the capital city of Beirut in 2015). It is important to mention that this number includes refugees, since due to the latest Syrian war crisis, it is assessed that 1.19 million refugees currently reside in Lebanon (mid-2015). It is important to note that the Syrian crisis which has led to an unexpected mass influx of Syrian refugees in Lebanon is one of the main challenges that Lebanon is facing today. The resident population was estimated at around 3.76 million in 2007, with an additional 260,000 Palestinians (approximately, 2009) living in camps and other migrant workers.

The average annual population growth rate is 6.0% (2010-2015) while the urban annual population growth rate in the same period is 3.2% (UN, 2016). In spite of the fact that currently there is a positive trend for population growth, future estimates show decelerating and decreasing pattern of population growth. This suggests that by mid-century Lebanon will possibly have an aging population, with larger proportion of the decreasing population (-4.1% between 2015-2050) living in urban areas (Table 4-17).

Based on the latest national survey in 2009, 10.8% of the population live in Beirut, 27% in the suburbs of Beirut and 15.8% in Mount Lebanon (CAS, 2015). The governorate of Mount Lebanon accounts for the largest share of the population and the governorate of Beirut is ranked 5th in terms of number of inhabitants (CAS - Yaacoub & Badre, 2012).

With the assumption that average household size in Lebanon is 4.23 members/household (CAS, 2007), the number of households add up to 1.415 million. Statistics show that the households in urban areas are relatively small, with 54.7% in Beirut having members between 1 and 3 (CAS, 2009).

**Table 4-17. Lebanon's Population Forecast**

| Year | Population | Yearly Change % | Median Age | Urban Population % |
|---|---|---|---|---|
| 2015 | 5,850,743 | 6.17 | 29 | 75.8 |
| 2020 | 5,891,495 | 0.14 | 31 | 73.2 |
| 2025 | 5,407,997 | -1.7 | 35 | 83.0 |
| 2030 | 5,291,674 | -0.34 | 38 | 87.6 |
| 2035 | 5,429,369 | -0.52 | 40 | 87.3 |
| 2040 | 5,517,336 | 0.32 | 43 | 87.2 |
| 2045 | 5,572,824 | 0.20 | 45 | 87.1 |
| 2050 | 5,610,145 | 0.13 | 47 | 86.9 |

Source: (UN, 2015)

The Lebanese population is young, with 44% of residents below 24 years of age (CAS - Yaacoub & Badre, 2012) (refer to Figure 4-26). Society is composed of a mixture of religious communities and sects (UNDP, 2015).

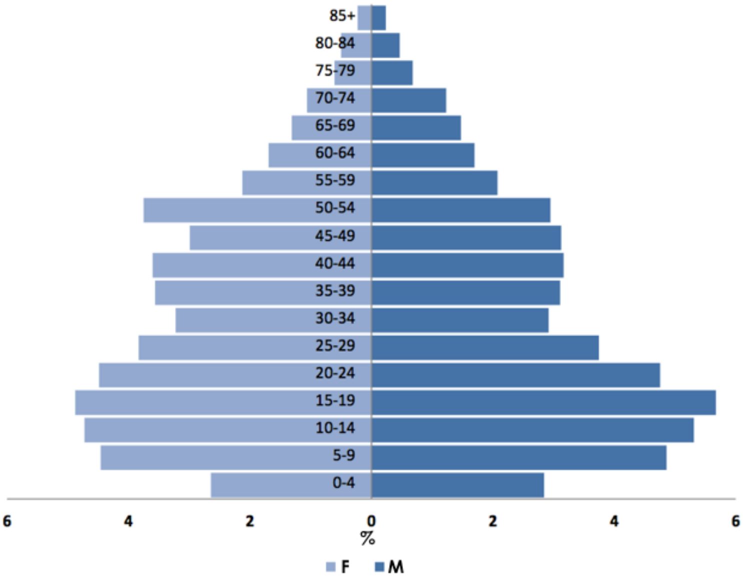



**Figure 4-26. Population Distribution in 2009 according to Age and Sex**

Source: (CAS, 2009)

In 2014, the national GDP was USD 49,631 million; annual growth rate of 2% and per capita income of USD 8,844 (9th rank among the Arab League countries). The Services sector is the largest contributor to the national GDP i.e. 73.2% of the Gross Value Added, followed by Industry (23.6%) and Agriculture (3.2%). It is also estimated that 73% of the population have access to the Internet, while 71 per 100 people have mobile-cellular subscriptions. The former fact can be an asset in optimizing the introduction of Intelligent transportation systems (ITS) and ultimately increasing the utility of public transport, which is further discussed in the following section.

#### 4.3.7.1.2 Socio-economic Profile of the Study Area

A general profile of the Study Area shows the population figures, residential units, commercial establishments, schools, universities and hospitals present in the Study Area, which corroborates the fact that the area that will be served by the BRT is highly dense and a pole of economic activity. The data on the Study Area are summarized in Table 4-18.

**Table 4-18. Socio-Economic Data Relevant to the BRT Project**

| Governorate/ District | Quarter/ Town | Population for the year 2014[2] | Number of Primary Residential Units[3] | Number of Secondary Residential Units[4] | Number of Commercial Establishments[5] | Number of Private and Public Schools[6] | Number of Students per Educational Section | Number of Teachers | Number of Public and Private Universities | Number of Students | Number of Hospitals[7] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Beirut Governorate | Achrafieh | 399,304 | 2,802 | 5 | 327 | Public schools : 60<br>Private schools : 122 | Public:<br>• KGs: 2,776<br>• Elementary: 7,214<br>• Intermediate: 3,872<br>• Secondary: 3,215<br>Private:<br>• KGs: 13,071<br>• Elementary: 26,478<br>• Intermediate: 11,046<br>• Secondary: 10,001<br>Private Technical: 1,821 | 8,716 | | | 13 accredited and 3 not accredited |
| | Bachoura | | 941 | 7 | 81 | | | | | | |
| | Zuqaq al-Blat | | 3,153 | 19 | 83 | | | | | | |
| | Rmeil | | 489 | 489 | 136 | | | | | | |
| | Saifi | | 573 | 37 | 106 | | | | | | |
| | Medawar | | 1,369 | 11 | 103 | | | | | | |
| | Port (Beirut) | | 4 | 2 | 128 | | | | | | |
| | Mazraa (Beirut) | | 3,342 | 84 | 236 | | | | | | |
| | Moussaitbeh | | 6,256 | 94 | 387 | | | | | | |
| | Ras Beirut | | 406 | 56 | 122 | | | | | | |
| | Ain El Mreisse | | 1,013 | 37 | 47 | | | | | | |

[2] Source: MoPH. (2014). Statistical bulletin – Table B.5
[3] Source: CAS. (2004) through letter No. 469 dated 09/03/2017 (found in APPENDIX F)
[4] Source: CAS. (2004) through letter No. 469 dated 09/03/2017 (found in APPENDIX F)
[5] Source: Chamber of Commerce Industry and Agriculture – Beirut and Mount Lebanon (CCIA – BML) through letter No. 785 dated 8/03/2017 (found in APPENDIX F)
[6] Source: Ministry of Education and Higher Education – Center for Educational Research and Development (CERD). (2015 – 2016). Statistical bulletin for the academic year 2015-2016 (In reference to letter In No. 925/M found in APPENDIX F)
[7] Source: MoPH. (2014). Statistical bulletin – Graph H.1

| Governorate/ District | Quarter/ Town | Population for the year 2014[2] | Number of Primary Residential Units[3] | Number of Secondary Residential Units[4] | Number of Commercial Establishments[5] | Number of Private and Public Schools[6] | Number of Students per Educational Section | Number of Teachers | Number of Public and Private Universities | Number of Students | Number of Hospitals[7] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Minet El Hosn | | 42 | 1 | 84 | | Public Technical: 0 | | | | |
| Metn District | Burj Hammoud | 482,535* | 14,908 | 623 | 464 | Public schools: 271<br>Private schools: 622 | Public****:<br>• KGs: 8,081<br>• Elementary: 23,640<br>• Intermediate: 12,163<br>• Secondary: 14,119<br>Private****:<br>• KGs: 67,677<br>• Elementary: 137,181<br>• Intermediate: 57,607<br>• Secondary: 36,210<br>Private Technical****: 15,559<br>Public Technical****: 9,235 | 33,936**** | | | 16 accredited* |
| | Dora | | | | 36 | | | | | | |
| | Jdeideh (El Metn) | | 3,406 | 53 | 288 | | | | | | |
| | Bauchrieh | | 15,720 | 197 | 866 | | | | | | |
| | Sid El Bauchrieh | | | | | | | | | | |
| | Bkenaya | | 919 | - | 27 | | | | | | |
| | Zalka | | 3,006 | 13 | 168 | | | | | | |
| | Dbayeh | | | | 89 | | | | | | |
| | Amaret Chalhoub | | | | 81 | | | | | | |
| | Zouk El Kharab | | 1,856 | 1 | 40 | | | | | | |
| | Jal El Dib | | 2,081 | 77 | 187 | | | | | | |
| | Antelias | | 3,590 | 68 | 195 | | | | | | |
| | Naccache | | 3,306 | 25 | 75 | | | | | | |
| | Nahr El Mot | | | | 27 | | | | | | |
| Kessrouane District | Zouk Mosbeh | 167,039** | | | 324 | | | | | | 4 accredited |

| Governorate/ District | Quarter/ Town | Population for the year 2014[2] | Number of Primary Residential Units[3] | Number of Secondary Residential Units[4] | Number of Commercial Establishments[5] | Number of Private and Public Schools[6] | Number of Students per Educational Section | Number of Teachers | Number of Public and Private Universities | Number of Students | Number of Hospitals[7] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Zouk Mkayel | | | | 203 | | | | | | ** |
| | Tabarja | | 185 | - | 12 | | | | | | |
| | Kfaryasin | | 638 | - | 28 | | | | | | |
| | Adma - Dafneh | | | | 24 | | | | | | |
| | Jounieh - Sarba | | 4,135 | 226 | 49*** | | | | | | |
| | Jounieh – Haret Sakher | | 2,450 | 195 | | | | | | | |
| | Jounieh – Sahel Alma | | 1,469 | 238 | | | | | | | |
| | Ghazir | | 2,424 | 51 | 104 | | | | | | |

*Data for the entire Metn District

**Data for the entire Kessrouane District

***Data for the entire town of Jounieh

****Data for Mount Lebanon

#### *4.3.7.2 Mobility Characteristics*

One of the main socio-economic aspects that is crucial and relevant to this ESIA is the current situation of mobility in Lebanon; in this case, land transport in the Greater Beirut Area and the main highway linking the northern entrance of the capital to Tabarja. In general, the traffic conditions in Lebanon are known for facing infrastructure challenges, congestion, and deteriorating quality of already mismanaged public transport services. For simplicity and for optimal representation of the baseline conditions related to the project, this section is presented based on four different characteristics that describe a road-transport system: Accessibility, Affordability, Safety and Efficiency; considering that the environmental impact is discussed in other sections.

##### *4.3.7.2.1.1 Accessibility*

Public transport modes are available in Lebanon; however, they are characterized by being unreliable and in most cases improperly distributed over the market. The city of Beirut is over-served compared to the demand, resulting in severe competition among operators, while other cities have shortage of public transport services (Choueiri, Choueiri, & Choueiri, 2011). More recent estimates show similar distribution, with mode split of motorized trips in Greater Beirut Area: 71% by private car, 19% by jitney and taxi, and 10% by buses and minibuses (Chalak, Al-Naghi, Irani, & Abou-Zeid, 2016).

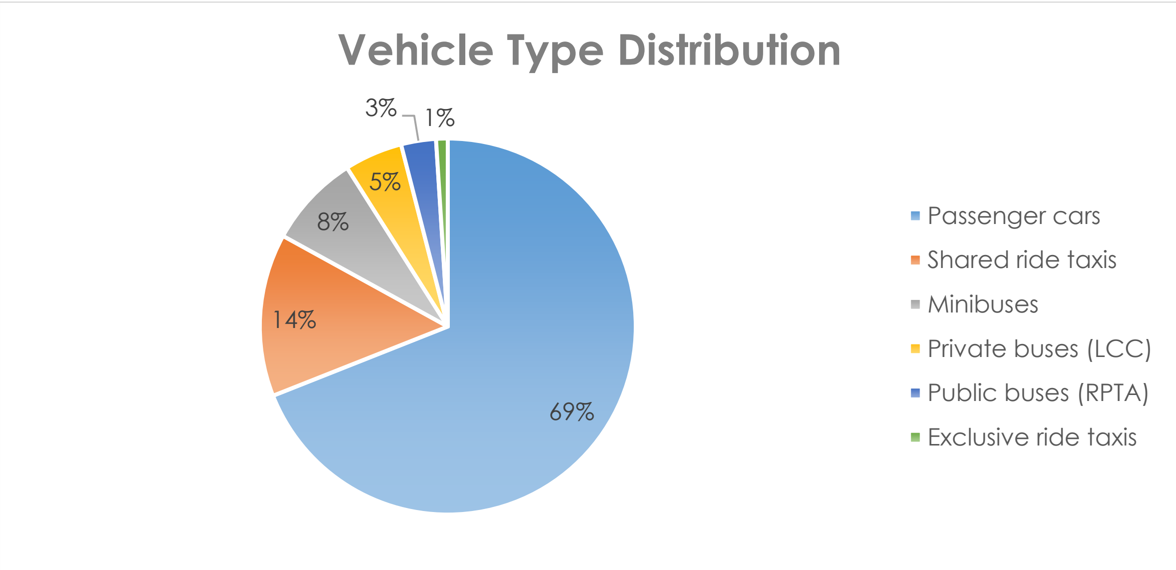



**Figure 4-27. Vehicle Type Distribution in GBA**

Source: (Baaj, 2002)

The available public transport means are not facilitated with the proper infrastructure to make them accessible by the public; ultimately resulting in the utility of -the only reliable option- private vehicles. Both public and private vehicles operate in the GBA. The Lebanese Commuting Company (LCC) operates on six lines with 73 buses and the Railway and Public Transportation Authority (RPTA) operates with 27 buses (World Bank, 2015). The estimated public transport fleet for the GBA and North region is shown in Table 4-19. The private operators carry the majority of the demand. For example, there are mini-bus lines that operate in Beirut, some even transporting around 50,000-60,000 passengers/day, e.g. van number 4, and are reported to have considerable acceptability by the public; however, that is not the general case for all public transport systems (Samaha & Mohtar, 2016). According to the RPTA, the approximate number of passengers using public transport in 2014 was 1,213,268, based on 19,112 and 18,033 morning trips and evening trips respectively.

**Table 4-19. Estimated Public Transportation Fleet in Greater Beirut Area and North Region**

| Type of Vehicle | Number of Legal Vehicles | Illegal Vehicles | Total |
|---|---|---|---|
| Service taxis | 33,000 | 22,000 | 55,000 |
| Minibuses/vans | 4,000 | 12,000 | 16,000 |
| Buses | 2,250 | 1,250 | 3,500 |

Source: (World Bank, 2015)

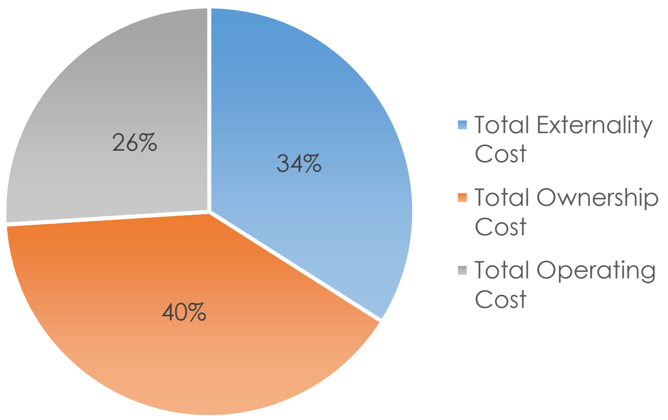
The infrastructure and facilities such as bus stations, dedicated taxi-spots and proper scheduling of the available systems are almost absent in Lebanon. These facilities are pre-requisites for creating more advanced systems that accommodate for the physically disabled, vulnerable community groups, e.g. elderly, pregnant women, school students, or full-day service availability. Both temporal and distance coverage limitations of the Lebanese public transport system make the accessibility to the public a challenging issue, which further feeds into the mismanagement of the entire transport sector.

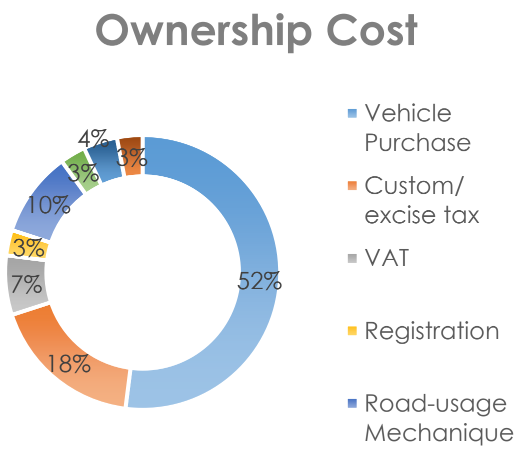
*4.3.7.2.1.2 Affordability*

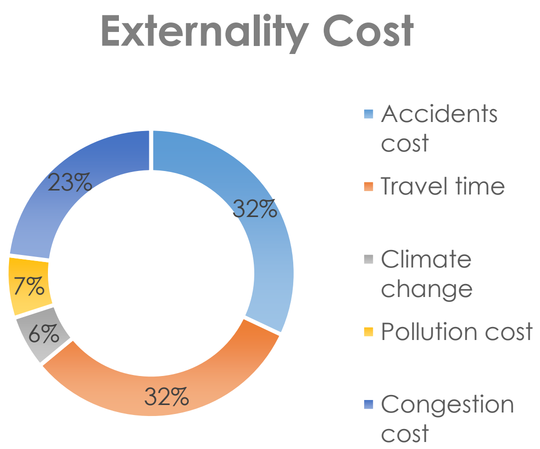
Mobility cost in Lebanon is estimated to be around US¢ 50/veh.km or US¢ 42/pass.km, which includes the operating cost of US¢ 12.7/veh.km or US¢ 10.6/pass.km, the ownership cost of US¢ 19.2/veh.km or US¢ 16/pass.km and the externality cost of US¢ 18/veh.km or US¢ 15.1/pass.km (MoE/UNDP, 2015). Figure 4-28 summarizes the percent division of mobility cost. It is important to note that the road transport sector in Lebanon is one of the largest energy consumers (27.42% of national energy consumption), compared to Jordan (25.27%) and Greece (22.23%) (World Bank, 2011). This reflects the economic burden of the transport sector not just on the public but also on the national economy. Increase in availability of properly managed public transport systems would tackle the three components of mobility cost through the reduction of pollution, less fuel consumption due to less utility of private cars, and reducing ownership costs.

Figure 4-29 and Figure 4-30 show the distribution of different household and individual categories in terms of annual expenditure for transportation. In total, the annual household expenditure on transportation is the third largest (13.11% of total expenses) after Housing expenses[8] (28.36%) and Food (20%) (CAS, 2012).

[8] Housing expenses: water, electricity, gas and other fuels


26%
34%
40%
Total Externality Cost
Total Ownership Cost
Total Operating Cost


Ownership Cost
52%
18%
7%
3%
10%
3%
4%
3%
Vehicle Purchase
Custom/ excise tax
VAT
Registration
Road-usage Mechanique


Externality Cost
32%
32%
6%
7%
23%
Accidents cost
Travel time
Climate change
Pollution cost
Congestion cost

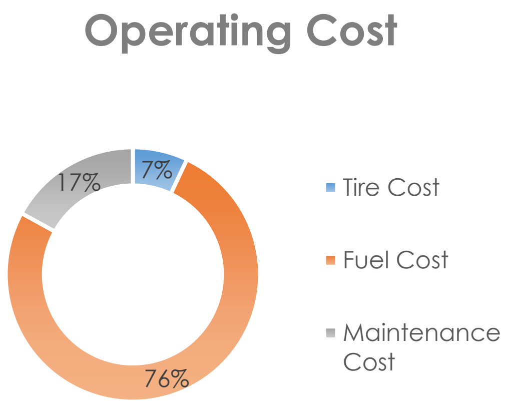

Operating Cost
7%
76%
17%
Tire Cost
Fuel Cost
Maintenance Cost

**Figure 4-28. Mobility Costs Components**

Source: (MoE/UNDP, 2015)

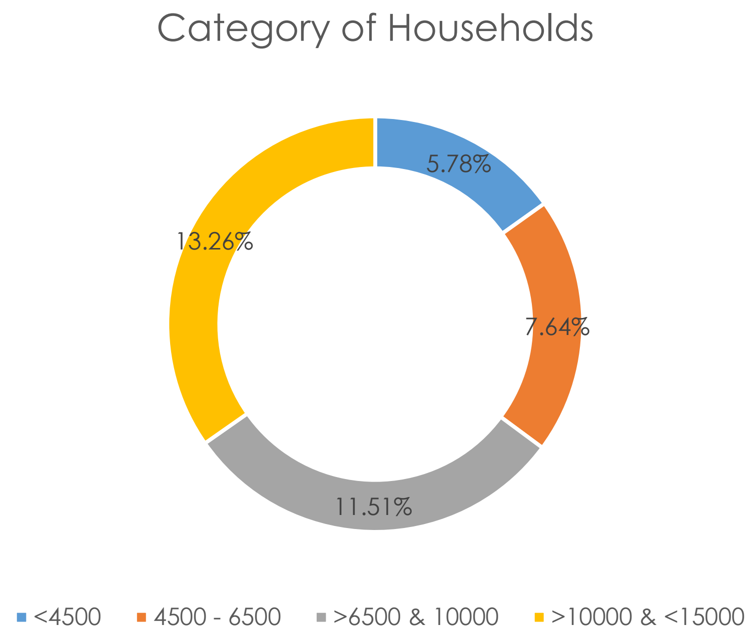



**Figure 4-29. Percentage Distribution of the Annual Expenditure of Households on Transport by Annual Expenditure Category of Household in thousands LBP**

Source: (CAS, 2012)

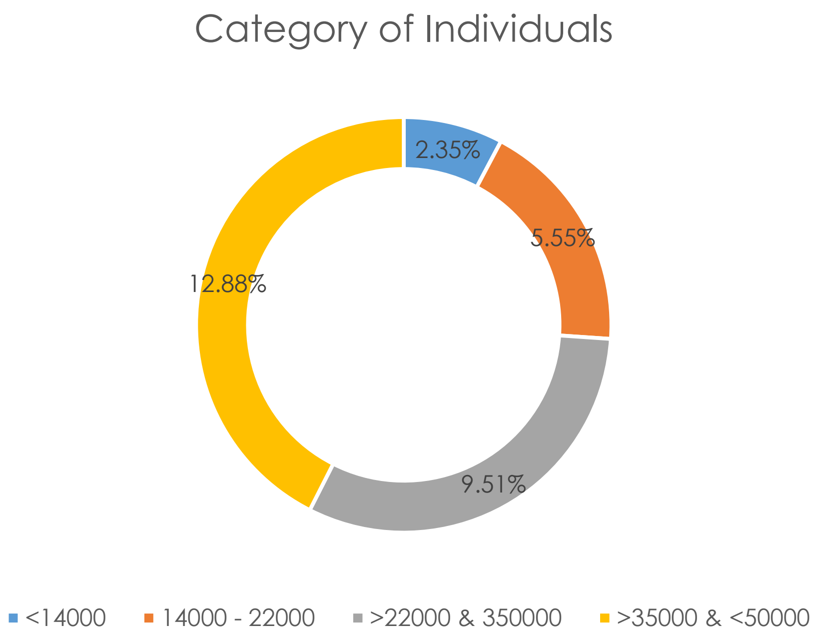



**Figure 4-30. Percentage Distribution of the Annual Expenditure of Individuals on Transport by Annual Expenditure Category of Individual in thousands LBP**

Source: (CAS, 2012)

**Travel Time**: Road travel time cost refers to the monetary value of time spent on transport i.e. waiting time and actual travel. Multiple factors can be considered in travel time cost and can vary significantly. Table 4-20 presents the travel time cost study estimations in GBA by passenger cars and buses in different driving conditions (MoE/UNDP/GEF, 2016).

**Table 4-20. Travel Time Cost under Different Driving Conditions in GBA in US¢/pass·km**

| | Passenger vehicles | Bus system not operating on reserved lanes | Bus system operating on reserved lanes |
|---|---|---|---|
| Paid* | 2.1 | 2.6 | 1.9 |
| Personal, high cost** | 2.8 | 3.4 | 2.5 |
| Personal, medium cost*** | 3.6 | 4.3 | 3.1 |
| Zero-cost travel time**** | 0 | 0 | 0 |
| Travel time cost during peak hours (US¢/pass.km) | 8.5 | 10.2 | 7.5 |
| Travel time cost during off-peak hours (US¢/pass.km) | 3.8 | 4.6 | 4.3 |

* Travel by employees and workers, **travelers experience significant discomfort or frustration, ***travelers experience no discomfort, ****travelers enjoy and so would pay nothing to reduce their travel time

Source: (MoE/URC/GEF, 2012)

**Congestion:** The costs related to congestion can be both internal and external that can result from interference among vehicles during traffic, specifically as traffic volume approaches the capacity threshold of the road. These costs can be translated through incremental delay during traffic, additional fuel consumption, deterioration of vehicle wear, pollution emissions and the cost of passenger discomfort (Hau, 1992). Table 4-21 presents the external costs resulting from congestion[9].

**Table 4-21. Congestion Cost in Urban Settings in US¢/pass.km**

| | Passenger vehicles | Diesel bus operating on dedicated lane | Diesel bus not operating on dedicated lane |
|---|---|---|---|
| Urban peak | 6.73 | 0.1 | 0.67 |
| Urban off-peak | 1.04 | 0.25 | 0.25 |

Source: (MoE/URC/GEF, 2012)

**Crash Costs:** Similar assessments are also done concerning crash costs, which include human injuries (internal costs) in addition to damages imposed by an individual traveling in a vehicle

[9] To prevent double counting, internal congestion costs that are borne by the drivers are not considered here since they have been accounted for under travel time cost, emissions cost, crash cost and vehicle operating cost.

on other travellers (external costs) (MoE/UNDP/GEF, 2016). Due to lack of data, the internal cost for an average car is estimated at US¢ 5.2 and external cost at US¢ 3.4 (Litman, 2011).

**Travel Fees:** On the other hand – specifically for public transport services – fares vary in ranges of LBP 250 by 10 km range for buses and minibuses (Table 4-22). Some regions have higher fare for the same distance, probably related to area accessibility. Future public transport system such as the BRT should consider the affordability of the trips while meeting demand.

**Table 4-22. Fare Structure in LBP**

| Origin | Length (km) | Bus | Mini-bus | Exclusive Taxis | Service Taxis |
|---|---|---|---|---|---|
| Administrative Beirut (AB) | | NA | NA | 8,000 | 2,000 |
| Greater Beirut Area (GBA) | | 1,250 | 1,250 | NA | NA |
| Between AB and GBA | | NA | NA | 9,000 | 2,250 |
| Hadat | 8.2 | 1,250 | 1,250 | 8,000 | 2,000 |
| Antelias | 10 | 1,250 | 1,250 | 8,000 | 2,000 |
| Broumana | 19 | 2,000 | 2,000 | 12,000 | 3,000 |
| Jounieh | 19.1 | 1,500 | 1,500 | 10,000 | 2,500 |

Source: (World Bank, 2015)

*4.3.7.2.1.3 Safety*

There are several factors that define the safety and reliability of road transport system, such as proneness to accidents and injuries, infrastructure conditions, i.e. availability of signage, regular maintenance and monitoring, and exposure to pollutants resulting from exhaust emissions that are usually enhanced during congestion.

**Accidents:** The fatality per capita is relatively equal or lower than neighboring countries, nonetheless 11.3% of trips result in at least one fatality (Haddad, Mansour, & Stephan, 2015). High speed driving and poor implementation of regulations, e.g. wearing seatbelts and abiding by the stop signs, are often the main cause of accidents, in addition to poor road conditions e.g. poor lighting, maintenance, and signage.

It is estimated that 40% of the total road fatalities are pedestrians killed in traffic accidents, compared to 10% in developed countries (Choueiri, Choueiri, & Choueiri, 2012). Statistics that can be further studied in the future show that the number of fatalities is about 600 per year or 17 per 100,000 inhabitants (Choueiri, Choueiri, & Choueiri, 2011). More recent numbers are even higher, over 1000 people are killed every year, one-third being pedestrians and motorcyclists (Choueiri, Choueiri, & Choueiri, 2014); between 962-1,215 deaths were reported by WHO in 2013, i.e. 22.6 per 100,000 population (WHO, 2015). Absence of sidewalks, expansion of roads at the expense of sidewalks and improper sidewalk arrangements and maintenance are the main reasons causing pedestrian accidents. Figure 4-31 summarizes the causes of traffic accidents and traffic accidents types.

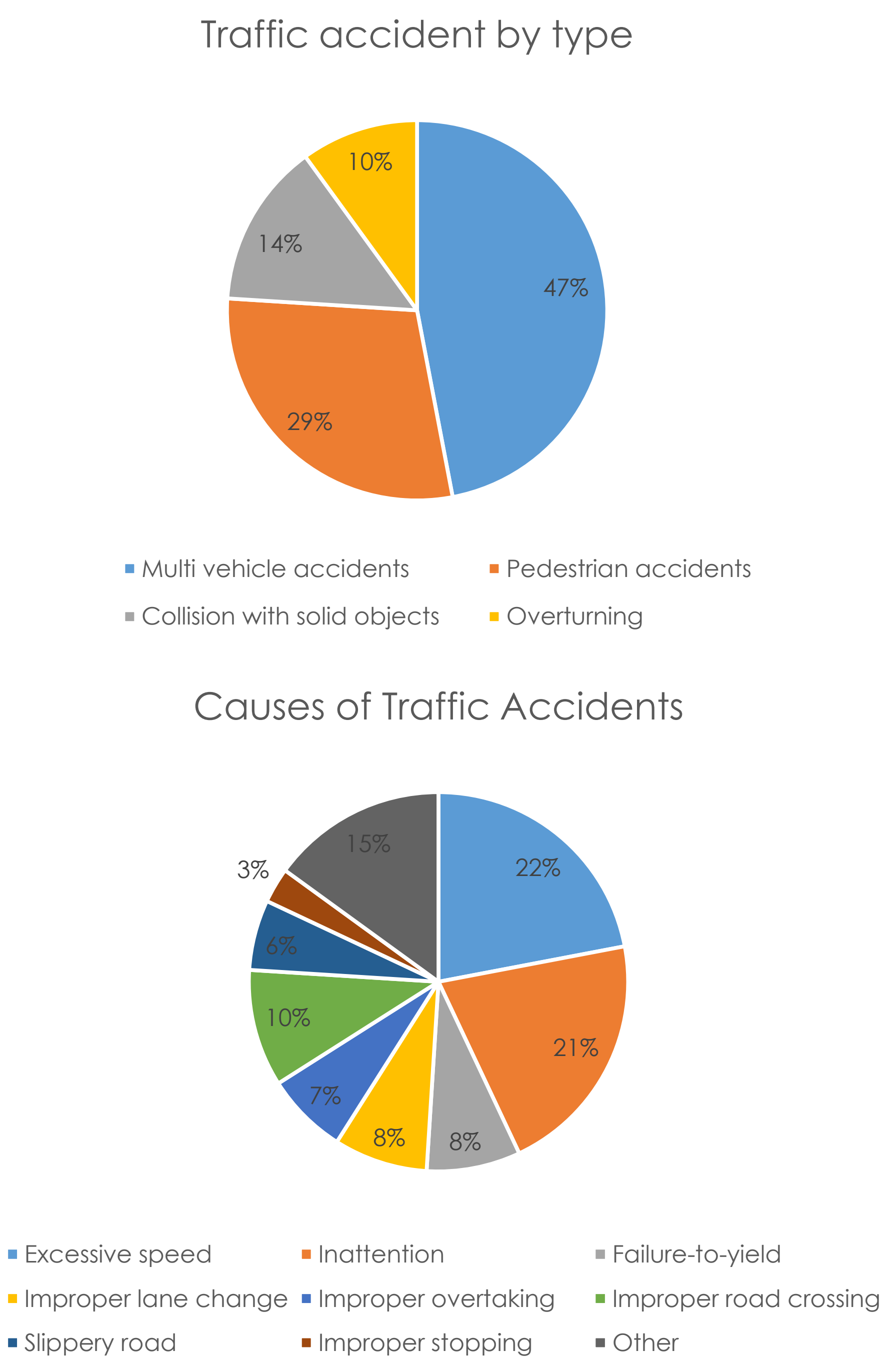



**Figure 4-31. Causes and Types of Traffic Accidents**

Source: (Choueiri, Choueiri, & Choueiri, 2014)

**Pollution Exposure:** Vehicle pollution emissions can have harmful effects not just on the pedestrians but also on the drivers and passengers in the vehicle. There are limited data concerning direct pollution exposure of pedestrians during traffic, however, reported ambient concentrations already provide a preliminary idea of elevated exposure levels. Locally in-vehicle exposure to $PM_{2.5}$ and CO were studied by (Abi-Esber & El-Fadel, 2013) on the coastal highway. The average reported values were higher than the WHO permissible guidelines in all ventilation modes, i.e. one window half-open and air conditioning on, outdoor air intake and recirculation. Although there are multiple factors that impact these concentrations such as atmospheric conditions and in/out-vehicle concentration and which require further analysis, the average concentrations were in general significantly higher compared to developed countries. In-vehicle $PM_{2.5}$ concentrations were higher than those reported in Los Angeles, Beijing and London, while lower than Jakarta. In-vehicle CO concentrations were higher than what is reported in Paris, Milan and London, while lower than in Hanoi, Jakarta and Athens. In another study, (Borgie, et al., 2014) showed higher exposure of traffic-policemen to VOCs such as benzene in Beirut compared to cities like Bangkok and Prague.

These facts show to some extent that reliance on private vehicles as a mode of transport increases the pollution exposure chances of travelers and pedestrians. On the other hand, it can be expected that public transport modes such as the BRT will contribute to reducing emissions of pollutants from vehicular transport and ultimately to reduce the exposure of travelers, thus creating a safer mode of transportation.

*4.3.7.2.1.4 Efficiency*

This section discusses the efficiency of the road-transport system through different indicators. Land transport is the major driving factor of the Lebanese economy, especially in the absence of other modes of transport such as marine ferries or rail services (Haddad, Mansour, & Stephan, 2015). In 2011, there were 1.446 million vehicles in Lebanon or 330 vehicles/1,000 population making it the third highest in the region after Kuwait (426 vehicles/1,000 population) and Bahrain (347 vehicles/1,000 population) (UITP/CTE/RTA, 2016). There are other sources of data that estimate even 434 vehicles/1,000 population (CDR, 2012). In other words, this can also be translated as 2.5 to 3 passengers per vehicle, which is higher than the average of the region (Choueiri, Choueiri, & Choueiri, 2011; Haddad, Mansour, & Stephan, 2015). Privately-owned passenger cars constitute 85% of the fleet (1.58 million registered vehicles in 2012 according to MoIM), with trucks at 8.9%, motorcycles at 5.2% and buses at 0.9% (Haddad, Mansour, & Stephan, 2015). In 2015, there were 107,500 newly registered vehicles, with 70% being private vehicles (CAS, 2015) (Figure 4-32).

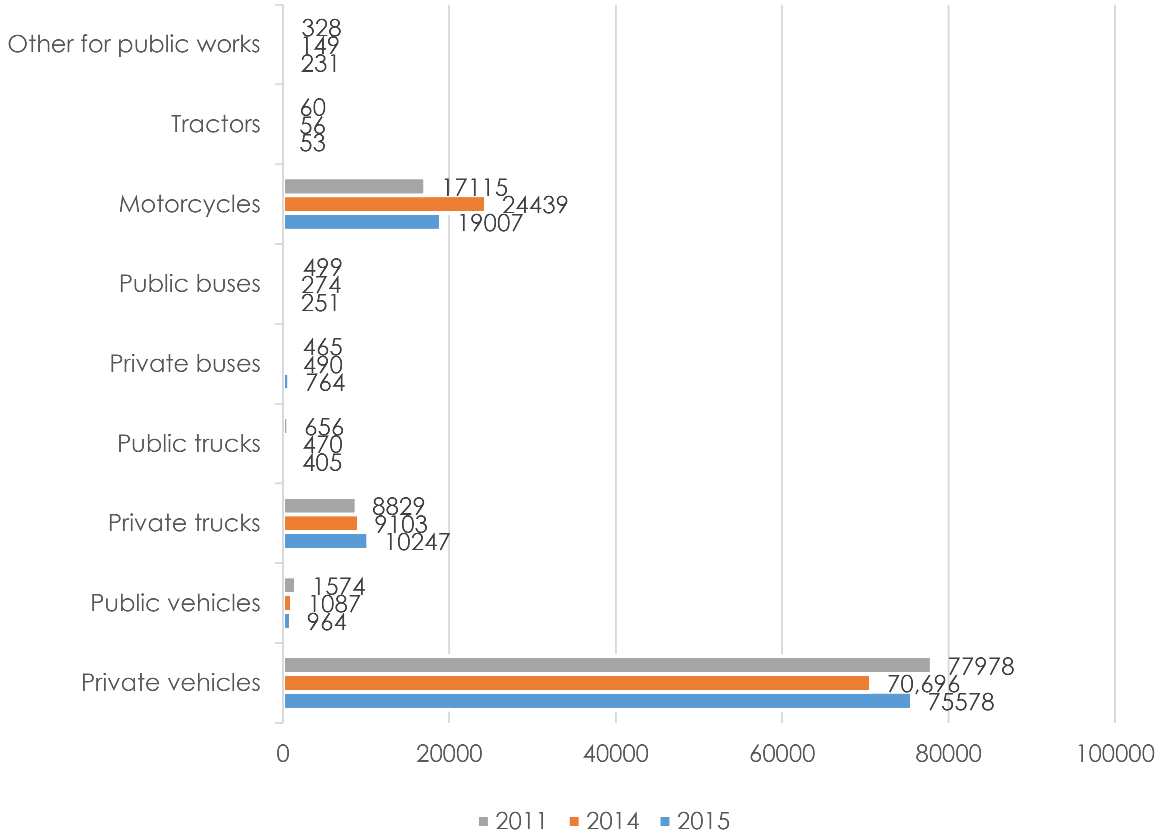



**Figure 4-32. Newly Registered Vehicles by Type (2015)**

Source: (CAS, 2015)

Figure 4-33 shows the age distribution of the vehicles, reflecting the old nature of the fleet (i.e. 71% older than 10 years). The size of the fleet and the old nature also impact negatively the public transport (MoE/URC/GEF, 2012). Average age of the shared taxis "service taxis" which are privately owned is about 20 years old, and other public transport vehicles being more than 10 years old (Choueiri, Choueiri, & Choueiri, 2011). All transport modes of private/public buses, minivans, taxis have low occupancy rate 1.2 passengers for taxis, 6 for vans and 12 for buses; average of 1.7 for passenger vehicles (Chalak, Al-Naghi, Irani, & Abou-Zeid, 2016). Ultimately, the previous conditions result in high energy demand by the transport sector; 3.08 MJ/pass.km or 15.06 GJ/capita. Figure 4-34 compares the energy intensity results for 2007 with international results from 2005. Moreover, results from 2007 show that 60% of the vehicles have engine displacement larger than 2 liters, and only 8% have engine displacements less than 1.4 liters, which further explains the high-energy consumption of the fleet and contributes to further problems of pollution and greenhouse gas emissions (Haddad, Mansour, & Stephan, 2015).

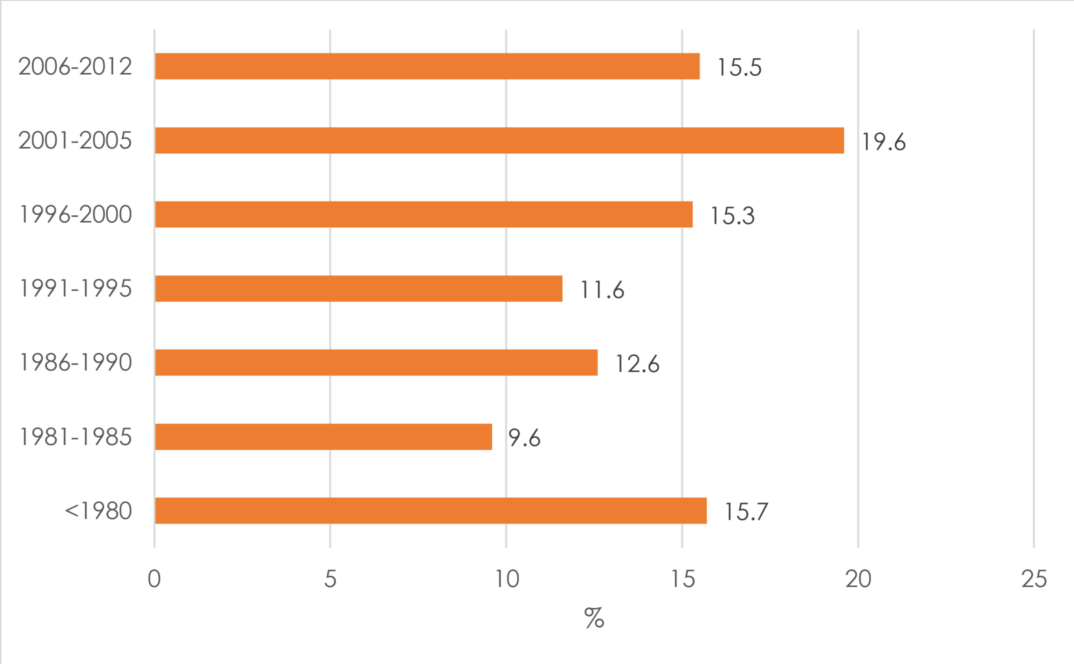



**Figure 4-33. Vehicle Percentage Distribution by Model Year**

Source: (MoE/UNDP/GEF, 2015)

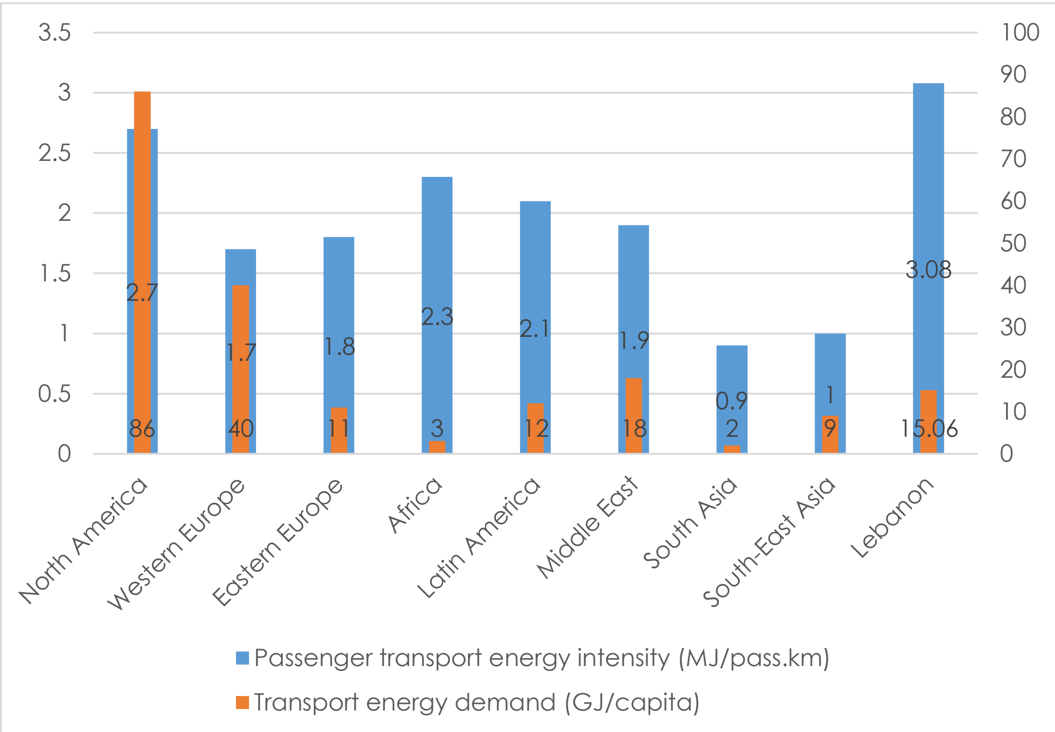



**Figure 4-34. Passenger Transport Energy and Transport Energy Demand**

Source: (Electris, Raskin, Rosen, & Stutz, 2009)

Driving patterns and conditions also reflect the efficiency of road transportation. The average speed in GBA is around 18 km/hr and decreases to <10 km/hr in peak traffic conditions (Figure 4-35). The efficiency of conventional vehicles at these speeds drops by 10% under these conditions. From another perspective, 17.4% of engine losses are wasted during vehicle stop as the engine idles in the urban section, i.e. for 25% of the total duration. Furthermore, the driving patterns are relatively low in the GBA. According to a GPS-guided survey, approximately 50% of trips cover a distance lower than 5 km, 25% of the stops are below two seconds and the cumulative stop-time per trip is more than 15% of the travel time, which reflects the high rate of congestion (Mansour, Zgheib, & Saba, 2011). Other survey results similarly show significant decrease in speed patterns during morning peak hours and at night when people are usually having a trip between home and work (World Bank, 2015).

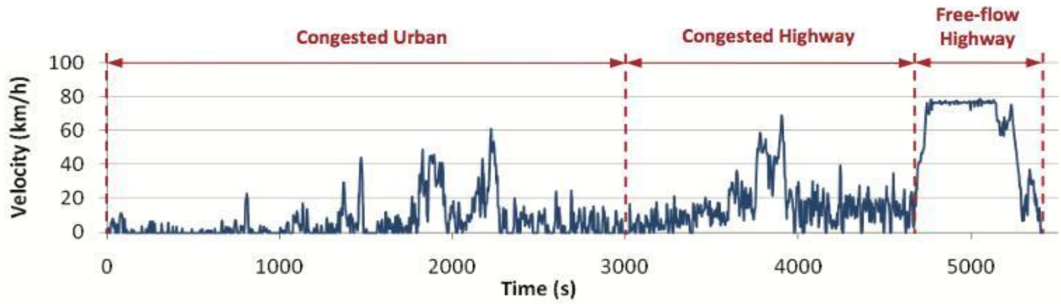



**Figure 4-35. Speed Profile of a Simulated Vehicle in Greater Beirut Area**

Source: (Mansour, Zgheib, & Saba, 2011)

**Table 4-23. Road Speed Survey Measurements**

| Road | From | To | Ext. = km | Measured Speeds (km/h) by period, stretch and direction | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Tabarja to Beirut | | | Beirut to Tabarja | | |
| | | | | 10-Jul | 17-Oct | | 10-Jul | 17-Oct | |
| | | | | AM | Off-peak | PM | AM | Off-peak | PM |
| Northern Highway | Tabarja | Nahr El Mout | 18.0 | 18.4 | 35.4 | 38.6 | 48.4 | 39.9 | 36.0 |
| Northern Highway | Nahr El Mout | Charles Helou | 4.4 | 27.3 | 46.8 | 53.0 | 41.8 | 29.3 | 16.0 |
| South Ring Road | Highway | Kraytem | 7.2 | 21.3 | 18.1 | 10.6 | 21.1 | 15.4 | 12.4 |

Source: (World Bank, 2015); (TMS, 2013)

#### *4.3.7.3 Operators of the Current Public Transport System*

The current operational system of buses in the study area was surveyed for the purpose of the BRT Project in 2017 by MindSETS through interviews with station operators and bus drivers. The findings below are summarized from the survey work.

Currently, there is a functioning, mostly informal mass transit system that consists of private station operators and bus drivers who run one or more buses in the same area of operation of the BRT and its feeder network.

The bus drivers and owners can be categorized as follows:

1- Operators who own multiple buses or mini-vans
2- Operators who own a single bus or mini-van
3- Operators who own and rent multiple buses or mini-vans
4- Operators who rent a fleet of buses or mini-vans

5- Operators who rent a single bus or mini-van

The stations' operators and owners can be categorized as follows:

1- Illegal station operator using the public street
2- Municipality-operated station at a public street
3- Land owner operating a station, or renting the land to an operator of the station

The operating systems of buses and stations are mostly informal, except for the Charles Helou Bus Terminal and the Dora station to a certain extent. The support to the different systems is categorized as follows:

1- Political support for illegal station operators
2- Political/Police support for illegal bus operators
3- Fear of chaos leading to operators coalescing to form an interest group that may or may not belong to a syndicate
4- Legal framework for licensed operators, such as the Connex buses (a formal/licensed operator who owns a fleet of coaches) which begin/end their journeys between Tripoli and Beirut at the Charles Helou Bus Terminal.

It is important to note that the syndicates and the regulatory and enforcement entities consistently voice the need to formalize and regulate the system, since legal operators and rightful owners or leasers of valid red license plates face competition from illegal operators. It is also important to note that there is a general understanding that there is a large number of buses or mini-vans with forged license plates or white plates among the fleet that competes for passengers. The enforcement authorities, i.e. police, have limited means to curb violations and at times the political and group support of illegal operators impedes the enforcement of the road and licensing rules.

The survey of operators described the routes, fleet sizes, number of roundtrips per day and passengers, along with the fares demanded (refer to Table 4-24). A round-up of the surveyed figures shows:

1- 1,414 buses that do 3,501 round trips per day, carrying 136,371 passengers per day, and collecting a gross revenue of 234,316,000 million LBP per day (156,211 USD per day)

2- 2,935 minivans that do 17,088 round trips per day, carrying 372,539 passengers per day, and collecting a gross revenue of 398,354,000 million LBP per day (265,570 USD per day)

Given the informality of the sector, these calculated sums and figures are considered indicative and conservative, and only serve to provide an order of magnitude of the size of the current fleet and operations. The daily turnover of the current mass transit system in the study area is at least 421,780 USD.

A back-of-the-envelope calculation of the annual profits of a bus operator that rents a bus, hires a driver, pays for diesel and pays for a stop in an illegal bus station, and the bus would operate for 27 days per month, can reach at least 11,000 USD/year.

**Table 4-24. Description of Bus Services in the Study Area**

| Bus Service | Station Name/ Bus stop | Origin | Destination | Fleet Size | Number of Round Trips per Day | Total Number of Passengers per Day | Rate/Passenger (LBP) |
|---|---|---|---|---|---|---|---|
| Jbeil-Dora | Dora | Jbeil | Dora | 100 B | 400 | 12,000 | 1,500 |
| No. 10 (previously) | Dora | Dora | Airport | 200 MV | 1,100 | 22,000 | 1,000 |
| Airport-Tiro | | Airport | Tiro | 60 MV | 300 | 6,000 | 1,000 |
| Dora-Mashghara | Dora | Dora | Mashghara | 1 B | 1 | 40 | 8,000 |
| No. 15 | Dora | Dora | Cola | 50 B | 250 | 10,000 | 1,000 |
| Dora-Baskinta | Dora | Dora | Baskinta | 15 B | 45 | 1,800 | 2,500 |
| Dora-Dhour El Shweir | Dora | Dora | Dhour El Shweir | 10 B; 5 MV | 45 | 1,500 | 2,500 |
| Dora-Broummana | Dora | Dora | Broummana | 100 B | 400 | 16,000 | 2,000 |
| Tripoli-Charles Helou | Charles Helou | Tripoli | Charles Helou | 800 B | 1,600 | 33,600 | 2,000 |
| Tripoli-Nahr El Mot | | Tripoli | Nahr El Mot | 800 MV | 1,600 | 16,000 | 2,000 |
| Tripoli-Barbir | | Tripoli | Barbir | 200 B | 400 | 12,000 | 3,000 |
| Zahraa-hay Esselom | Hay Esselom | Zahraa | Hay Esselom | 500 MV | 4,000 | 88,000 | 1,000 |
| Zahraa-Lebanese University | Lebanese University | Zahraa | Lebanese University | 500 MV | 4,000 | 88,000 | 1,000 |
| Zahraa-Al Sahra | Al Zahraa | Al Zahraa | Al Sahra | 500 MV | 4,000 | 88,000 | 1,000 |
| Cola-Bshamoun | Cola | Cola | Bshamoun | 25 B; 14 MV | 117 | 33,900 | 1,500 |
| No. 11 | Cola | Cola | Kfar Matta | | | | 1,000 |
| Cola-Ersal | Cola | Cola | Ersal | | | | 10,000 |
| Cola-Naameh | Cola | Cola | Naameh | | | | 1,000 |
| Cola-Chhim | Cola | Cola | Chhim | 25 B | 25 | 1,500 | 3,000 |
| No. 30 | Cola | Cola | Kayfoun | | | | 2,000 |

| Bus Service | Station Name/ Bus stop | Origin | Destination | Fleet Size | Number of Round Trips per Day | Total Number of Passengers per Day | Rate/Passenger (LBP) |
|---|---|---|---|---|---|---|---|
| Kuwait Embassy-Nabatieh | Kuwait Embassy | Kuwait Embassy | Nabatieh | 5 MV | 10 | 200 | 5,000 |
| Kuwait Embassy-Saida | Kuwait Embassy | Kuwait Embassy | Saida | 7 MV | 21 | 420 | 2,000 |
| Kuwait Embassy-Tyre | Kuwait Embassy | Kuwait Embassy | Tyre | 6 MV | 18 | 360 | 5,000 |
| Kuwait Embassy-Bent Jbeil | Kuwait Embassy | Kuwait Embassy | Bent Jbeil | 2 MV | 2 | 40 | 9,000 |
| Al Rihab-Chtoura/Hermel | Al Rihab | Al Rihab | Chtoura/Hermel | | | | 5,000 / 10,000 |
| Al Rihab-Naameh | Al Rihab | Al Rihab | Naameh | | | | 1,000 |
| Al Rihab-Manara | Al Rihab | Al Rihab | Manara | 12 MV | 60 | 1,200 | 1,000 |
| Al Rihab-Raouche | Al Rihab | Al Rihab | Raouche | 12 MV | 60 | 1,200 | 1,000 |
| Al Rihab-Ramlet El Baida | Al Rihab | Al Rihab | Ramlet El Baida | 12 MV | 60 | 1,200 | 1,000 |
| No. 24 | | Hamra | Barbir | 8 B | 40 | 1,800 | 1,000 |
| No. 12 | | Hamra | Ain El Seke | 20 B | 60 | 1,650 | 1,000 |
| No. 5 | | Hamra | Ain Saadeh | 25 B | 75 | 3,750 | 1,000 |
| No. 2 | | Hamra | Dora | 25 B | 75 | 3,750 | 1,000 |
| No. 4 | Lebanese University | Lebanese University | Hamra | 100 B; 300 MV | 2,400 | 63,000 | 1,000 |

#### 4.3.7.4 *Social Attitudes on Public Transport*

The socio-economic inductive study was conducted via an opinion survey, focus group meetings to gauge social perceptions and interviews with key informants. Two public participation meetings which were conducted as part of the ESIA study are also considered as source of information with regards to socio-economic aspects, and are reported in Section 5.

**A- Initial Survey**

The purpose of the initial survey that was conducted during the scoping phase was to collect background information about the current modes of transportation and the public's opinions regarding uptake of public transport in the Project area. A small questionnaire was developed for the purpose of this initial survey.

A total of 60 questionnaires were filled. Figure 4-36 provides the location where questionnaires were filled along with the age, gender, and professions of interviewees. Three (3) of the interviewees had special needs. The opinion census results showed the willingness of the Lebanese population to use public transport and a rather strong awareness of the benefits of a well-managed public transport system.

The answers to the survey questions showed that 57% of interviewees use private cars, 80% use public transport modes (taxis and buses), and 17% commute on foot[10]. This shows that people use the currently available public and shared transport modes.

When asked about the attributes they would like to have in a public bus transport project implemented by the Government, the answers included:

- Cleanliness and hygiene;
- Timely service and defined stations;
- Reduction in transport cost;
- Reliable service faster than using private cars;
- Accessible to people with disabilities and the elderly; and
- Good organization and security standards.

When asked about their expectations from a Government owned public bus transport project, interviewees mainly mentioned:

- Availability of a sufficient number of buses to accommodate for demand;
- High-standard buses to reduce pollution;
- Reduced fees;
- Accessible to children, elderly, and the disabled;
- Better standards than the current bus services: cleaner, air-conditioned, organized service, well maintained buses, well controlled and secure; and

[10] The numbers do not sum up to 100 since interviewees provided multiple answers to this question.

- To be managed by a private company not the public authorities.

In terms of impact on their life, most respondents considered that such a project could have positive social, environmental, and economic impacts: reduction in transport cost, reduction in pollution levels thus better health conditions, time-savings, less road accidents, and a chance to meet new people.

It can be concluded that this rapid opinion poll is quite representative of the Lebanese reality and the needs of the Lebanese people. It shows a willingness to use public transport and a rather strong awareness of the benefits of a well-managed public transport system.

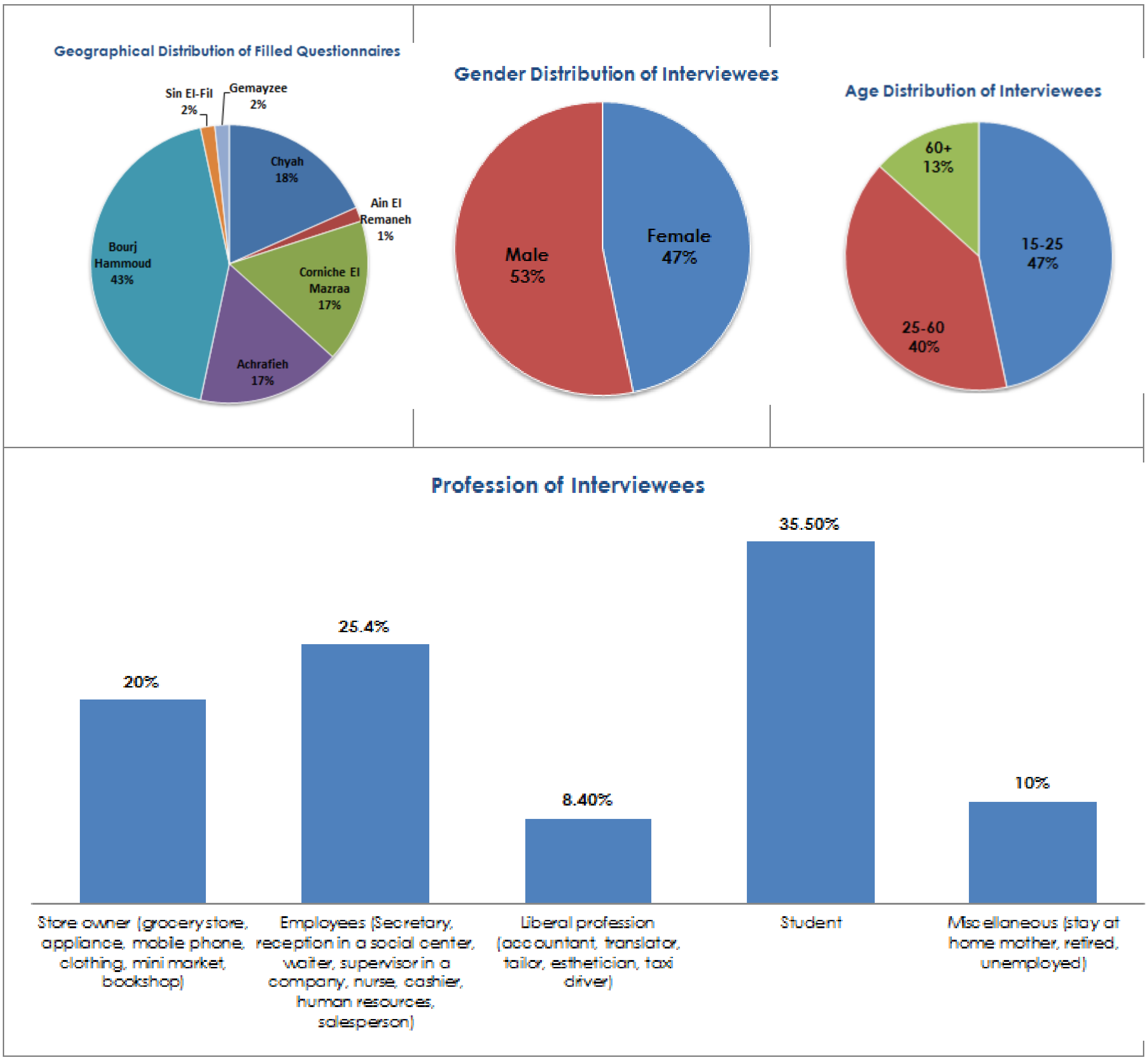



**Figure 4-36. Characteristics of the Initial Social Survey Interviewees**

## B- <u>Focus Group Meetings</u>

The focus group is a special type of group in terms of purpose, size, composition, and procedures. A focus group is typically composed of a group of participants who are selected because they have certain characteristics in common that relate to the topic of the focus group. It is a carefully planned discussion designed to obtain perceptions on a defined area of interest in a permissive, non-threatening environment. Focus groups are used to gather opinions (Krueger, 1994). Focus groups should be small enough to allow for in depth probing and getting into specialized insight, and large enough to provide diverse and rich data.

The main purpose of focus group meetings is to draw upon respondents' attitudes, feelings, beliefs, experiences and reactions in a way in which would not be feasible using other methods, for example observation, one-to-one interviewing, or questionnaire surveys.

Planning for the focus group meetings included the following steps:

- Step 1: Understanding the purpose and outcomes of the BRT Project and their connection to the design and implementation of focus groups;
- Step 2: Deciding on the level of group structure (a) exploratory – non-structured, (b) answering pre-determined specific questions – structured, (c) determining the interview content through the preparation of a well-thought out interview guide comprising a series of open-ended questions which allowed in-depth topic discussions for the targeted focus group meetings;
- Step 3: Selecting and recruiting participants who have a certain degree of commonality (through e-mails, letters, faxes, and phone calls);
- Step 4: Choosing a moderator;
- Step 5: Defining the role of the moderator;
- Step 5: Preparing needed logistics (selecting the location, time and dates of the meeting session and setting-up before the meeting). All meetings were recorded for an improved accuracy of information and written notes were taken.
- Step 6: Preparing brief summaries of key points for every focus group meeting and submitting those small reports to the client so that the outcomes can be taken into consideration during the design phase of the project; and
- Step 7: Analyzing the data.

Four (4) types of <u>focus groups</u> were identified for the focus group meetings as follows:

1- Persons with commercial interests along the BRT routes (northern highway, outer and inner rings) – this branched into two (2) meetings according to geography:

    a. Meeting conducted at the training center of Beirut and Mount Lebanon Chamber of Commerce, Industry and Agriculture (CCIA-BML) with Beirut commercial establishments; and

    b. Meeting conducted at ELARD offices with Metn and Kessrouane commercial establishments.

2- Syndicates and Public Transport Unions (meeting conducted at ELARD offices). The views expressed are reported in Table 4-25.

3- General public where persons were selected such that they represent the social fabric from all walks of life – women, men, elderly, students, etc. Three (3) focus group meetings were conducted with the general public:

- Focus group meeting with Metn public (meeting conducted at the El Saydeh Church parish in Sin El Fil);
- Focus group meeting with Kessrouane public (meeting conducted at Saydet al-Maounat parish in Haret Sakher); and

- Focus group meeting with Beirut public (meeting conducted at the Municipality of Beirut).

4- Persons with Disabilities (PwDs) (meeting conducted at Arc-en-ciel Non-Governmental Organization (NGO)).

NGOs (representing the civil society), mainly working on the public transport sector were invited to the four (4) types of focus groups listed above. A total of seven (7) focus group meetings were held during the months of February, March, April and May 2017; complete summary is attached in (APPENDIX G).

**Table 4-25. Focus Group Meeting Findings: Public Transport Syndicates and Unions**

| | **Public Transport Syndicates and Unions** | **NGOs** |
|---|---|---|
| General view of the BRT Project | Bus stops should be placed on the right-side of the streets.<br>While the project presents an advancement in public infrastructure, pollution control and public image, however it has to be taken into consideration that transport services along this route are a source of income to private operators of minivans and service taxis. | At the stations' locations, around 12 m of road width will be allocated for the BRT service, which means that at those stations, the total equivalent of 4 lanes will be taken from the current width of the roadway.<br>The selection of the stations' locations in relevance to the transportation hubs is questioned: For example, Dora is a major transportation hub, but the BRT would pass on the three-lane by three-lane bridge. Will the BRT bus take the road underneath the bridge to pick up passengers from that major transportation hub, or continue on the bridge? |
| Perceived impact of the project on existing operators of public transport vehicles (buses, minivans, shared taxis) | Many small private operators currently operate their buses and minivans along the same route. What would be the implication of the project on the 250-300 buses which operate on this route?<br>The project is touted to be expanded in all of the country, so what will happen to the existing private operators of buses? There are currently 33,500 taxis. In 1995, 40,000 public license plates were added to the market.<br>If the BRT project would suggest to buy some of the public license plates owned by the drivers, the drivers would not accept this suggestion because the plates are a source of income and provide social security benefits. The current prices of the plates for shared taxi vehicles are 50 million LBP and for plates of buses and minivans it goes up to 75 million LBP. Any scheme of arbitrary or random buy-back would not work. What could work is for the State to buy-back all of the plates, and then the plates would be redistributed and rented out with quotas for each region, allowing for the delineation of the area of service for each vehicle. | The perceived social impacts of the project will follow from the solutions that the project will propose.<br>How will the BRT project and the current public and private transport modes be integrated or brought together? The project should accommodate the "business-as-usual" conditions. |
| Perceived impact or influence on traffic management | There should be designated stops or stations for minivans and service taxis for drop off and pick up on the right hand side of the road to organize the stoppage of these public transport | What strategies will the project use to attract commuters to the use the BRT, since the bus route is along the highway and not within the urban neighbourhoods? The |

| | Public Transport Syndicates and Unions | NGOs |
|---|---|---|
| | vehicles.<br>When these stops are made available, only then can drivers who stop in the middle of the street to drop off and pick up passengers be held accountable. However, it is highly unlikely that these stops will be made available, and stoppages would continue as is given passenger behaviour. There used to be bus stops in Beirut with glass shelters, but they were removed because minivans now stop wherever the passenger is standing.<br>If there were to be created bus stops on the right hand side of the road, the drivers will abide by the rule, however we have to assist them with abiding and prepare them for any changes to come. | stations are located in the middle of a highway, and commuters would pass between the highway pavement and the middle of the highway, which means that the infrastructure is not well integrated with the urban neighbourhood. It is suggested that the pedestrian bridge landing on the sides of the highway be extended to the urban areas and the landing space be meaningfully designed and integrated with the surrounding area. For example, the stair landing could lead to a space where service taxis would be parked, or a pedestrian friendly space where drop-off/pick-up points are marked, or a space that has market stalls. The idea is that having commuters landing on the side of the highway without connecting infrastructure that leads to the urban space might be unsafe and might not be appealing for users. The pedestrian bridges need to be connected with the urban fabric, and should be located in safe and positive locations.<br>It is perceived that having the stair landing of the pedestrian bridge on the side of the highway would provide the opportunity for vehicles to stop on the right side of the road (which usually doesn’t have a shoulder) to drop off or pick up passengers. This would lead to an unsafe road usage practice which also interrupts traffic flow on the right lane.<br>It is suggested that stairs and elevators be replaced with ramps to facilitate movement of as many people with various abilities as reasonably possible (inclusive or universal design).<br>Rightsizing of the streets to allow for 0.5 m from the road to be used for side stops that cater for the existing buses and minivans, and their passengers.<br>The project should be integrated. |
| Perceived impact or influence on transport mode options and modal shifts | It is evident that it is against the interest of the unions to encourage the public to use the BRT.<br>Vehicles with public license plates have the right to transport passengers anywhere within Lebanon, and therefore restricting | Widening roads is not perceived to be a solution to the traffic congestion problems since road widening brings more private vehicles to the streets.<br>Will the same P&R facilities be employed for the BRT and |

| | Public Transport Syndicates and Unions | NGOs |
|---|---|---|
| | their area of operation is not feasible. | railway projects? |
| Perceived role in making the project a success | There are impediments to the implementation of the BRT, where the main impediment is the width of the road.<br>Since the proposed BRT will result in fewer customers for the existing buses and minivans, compensation should be provided to the current operators and drivers such as free fleet renewal, subsidised gasoline, or gasoline coupons, else the BRT project would not bring any benefit to the current operators. | |
| Perceived interest in the project | If a project such as the BRT were to be implemented, services that would improve the work conditions for the affected drivers and operators of buses and minivans should be provided. If the project means that buses and minivans operating along the same street will be moving at lower speeds, it is inevitable that commuters will no longer use the buses and minivans, and hence the current operators will be driven out of work. Services for the existing buses and minivans can be improved through provision of designated stops and pavements to be used by the customers of current buses and minivans.<br>It should be ensured that the drivers are Lebanese and will have valid public driving licenses. It should also be a requirement that the buses have public license plates. Furthermore, the BRT Project should be integrated with the MoPWT's project for the 20 bus lines. | Using the railway's right of way by the BRT is out of the question, because rail transportation should be a fixture in any public transportation plan, and hence the railway right of way should be revived and used to run the trains. The BRT is a very important project, but if it is made to run on the railway right of way then people will get used to the idea and it will be very difficult to restore the railway for running the train.<br>The BRT project's three main trunks should be integrated with one another, and linked to the Karantina area. |
| Strengths of the project | The project would create job opportunities for Lebanese. | |
| Weaknesses of the project | Can the project be implemented if it means that 8.3-12 m of the streets' width will be made exclusive for the BRT? The narrowing of road space for vehicular traffic is expected to create more congestion than is currently the case. | The integration of the three components with one another (i.e. the Tabarja-Beirut trunk line, Beirut Outer Ring and Beirut Inner Ring) needs to be better clarified.<br>The integration of the three components with the 20-bus lines project which the MoPWT has prepared needs to be better clarified. |
| Opportunities that would make the project successful | Why not have the buses run on the existing right of way of the railway? Although there are illegal encroachments, these are mostly reversible. What about using the seaside road? Using the right of way of the railway which is parallel to the highway | |

| | Public Transport Syndicates and Unions | NGOs |
|---|---|---|
| | would ease the congestion and might end up being less costly than the BRT in the middle of the highway.<br>Before implementing this project, the roads should be widened in order to fit the bus.<br>Stopping the import of private cars should contribute to easing traffic congestion. In the 1960s, there were a total of 60,000 vehicles in circulation in Lebanon, while today 70,000 to 80,000 vehicles are imported every year.<br>Removal of 20,000 public license plates to ease congestion.<br>For the BRT project to be successful, the following conditions need to be met:<br>- System has to be integrated, i.e. reaching and connecting all areas;<br>- Incentives to be provided to current operators;<br>- Renewal of current bus fleet;<br>- Road widening;<br>- Use public license plates;<br>- Use Lebanese drivers.<br>If such conditions are met, then the syndicates and unions will promote the BRT project and alleviate any possible opposition from current operators and drivers.<br>Given that such a project requires time to be implemented, there is an opportunity to explain the details and aspects of the project (social, environmental, etc.) to the general public through the media so that the project is better understood, and its advantages and disadvantages clearly explained. | |
| Threats to the success of the project | Many small private operators using the same route.<br>Route is too narrow and insufficient for the current traffic, so by removing a lane the problem will worsen. It is impossible to implement the BRT project without widening the highway.<br>The Lebanese commuters may not be willing to walk for long distances to reach the bus stop. With distances up to 850 m between one station and the other, what will guarantee that commuters will walk to reach their station?<br>There is talk that the State intends to increase the number of | |

| | Public Transport Syndicates and Unions | NGOs |
|---|---|---|
| | public license plates by 15,000.<br>There are 350,000 vehicles entering Beirut from the north, 225,000 vehicles entering Beirut from the south and more than 90,000 vehicles entering Beirut from the direction of Bekaa daily. With around 1 million vehicles in circulation daily, the State derives a large income from having these vehicles on the road (registration fees, gasoline taxes, etc.).<br>There are currently 16,000 public license plates for buses and minivans – 4,000 of which are legal and the rest are fake. | |

**C- Key Informants**

Due to low turnout of representatives of public transport syndicates and commercial establishments, specific meetings were requested with representatives who agreed to meet and express their views. A third interview was held with an operator in the Dora station to understand the dynamics of the informal mass transit system.

***Individual Interview with Representative of Syndicates and Public Transport Unions***

Given that only two (2) presidents of Syndicates and Public Transport Unions attended the focus group meeting that was conducted at ELARD offices and given that syndicates and public transport unions are major stakeholders, ELARD took the decision to set individual meetings with some of their presidents/ representatives who did not show-up. The representative that was met with is Mr. Mansour Sylva (Syndicate of buses and taxis owners and transport offices in Lebanon). A meeting with Mr. Bassam Tleis (President of the Lebanese Union of public drivers) could not be held.

The meeting with Mr. Sylva was conducted in Dora on February 01, 2017 at 9:00 AM. The key points raised by Mr. Sylva are listed as follows:

- The removal of one lane to be dedicated to the bus will lead to more congestion, especially that behavioural change for people using their private vehicle to switch to using the bus is doubted.
- There are 500 buses (24 passengers) operating from Dora (250 buses in each of the directions). There are 400 mini-vans operating on the Cola-Dora-Tripoli line.
- It is important that the BRT project, if implemented, does not make the current situation worse on any front – for drivers, commuters and road users.
- Current owners have no interest in selling their public license plates, because the license plate ownership entitles its holder to social benefits.
- What are the compensation mechanisms for drivers if the BRT system is implemented?
- There will be political pressure to have the BRT System operated by the public entities, but then it is expected that the system will fall into disrepair due to weak maintenance and oversight.
- Currently, public license plates for cars/taxis are valued at 50 million LBP on the market, while those of buses and vans are valued at more than 50 million LBP.

***Individual Interview with Presidents of Beirut Commercial Establishments***

Same as for the Syndicates and Public Transport Unions, only two (2) presidents of Beirut commercial establishments attended the focus group meeting that was conducted at the CCIA-BML training center. Given that Beirut commercial establishments are also major stakeholders, ELARD took the decision to set an individual meeting with the Achrafieh Traders Committee represented by Mr. Antoine Eid, Mr. Paul Salem and Mr. Nabil Choueiri.

The meeting was conducted in Achrafieh on February 23, 2017 at 1:00 PM. The Committee generally welcomed the project and raised the following key points and comments:

- On-street parking should not be removed

- The Beirut Municipality has initiated the building of a multi-storey public parking lot in the Sassine area, which however may not serve the Saydeh area. The project has not seen the light to date.
- The choice of bus technology is of prime concern. Achrafieh is a hilly neighbourhood, but still cleaner technology buses are favoured, as well as smaller-sized buses. Larger buses carrying passengers from the north would stop at Charles Helou and passengers would transfer to smaller buses that would enter Beirut.
- Disincentives to reduce private car use inside Beirut should be introduced.
- Choice of bus over other modes of private transport should be supported with attractive benefits to using the bus over the private car, such as time and monetary savings. In addition, the bus usage experience should be good so that customers favour using the bus over their private cars.
- Incentives to use the bus should include its safety and cleanliness.
- A proposition was suggested to introduce a large bus station at Sin el Fil, where there is a scrapyard for public buses. Another proposition is to introduce small electric buses.
- There is expected to be a general overall benefit from the introduction of the BRT system in particular and public transport in general. If proper and affordable public transportation is provided, the monthly transportation allowance of 200,000 LBP per employee can be cancelled.
- The benefits that could be achieved from introducing the BRT and public transportation by bus are time savings due to higher speeds; neat method of commuting provided the buses are clean, safe and may possibly provide a Wi-Fi service to users; comfortable for users and less expensive than using the private car.
- From the traders' perspective, the introduction of buses will provide better access for customers and time savings for employees who commute to work.
- The main obstacle to growing users of the bus is the mentality and behaviours of the private car users, and therefore it is important to provide a good experience for users as an incentive to keep them using the bus.
- It is expected that by having less cars circulating on the streets due to the bus, then local air pollution might decrease.
- Other obstacles to introduction of the BRT and its dedicated lane in Beirut include the current service taxis and their large number, and who might use the dedicated lane.
- It is perceived that the number of stations may be too many.
- As for the P&R facilities along the Tabarja-Beirut coastal highway, the attendants commented that it may be useful to provide such facilities on the east side of the highway, while the currently proposed locations are almost entirely located to the west of the highway.

***Individual Interview with one of the Owners of the Buses and Vans Operating in Dora Station***

An interview was conducted with one of the owners of the buses and vans operating in Dora Station on April 02, 2017. The purpose of this interview was to gather information about the number of buses and vans operating in Dora station, the fees for using those buses and vans, and the number of passengers using those buses and vans. It is important to note that Dora station is a hub for the BRT project since the buses and vans operate along the northern highway and along the Beirut Inner and Outer rings.

The main points/key information provided by the interviewee are the following:

- There are several bus routes in Beirut;
    - Bus No. 2 & Bus No. 6 to Antelias, Dbayeh, Jounieh and Jbeil
    - Bus No. 12 from Hamra to Burj el Barajneh
    - Van no. 4 from Hamra to Lebanese University in Hadat
- There are several committees responsible for a specific bus route: one in Jounieh, one in Beirut and several in the regions
- There are several companies that own a number of buses and vans and the companies are responsible for the maintenance of the vehicles they own. These companies would employ drivers on fixed salaries – 1,200,000 LBP per month (800 USD). The drivers are enrolled in the National Social Security (NSSF), and receive a per diem of 10,000 LBP.
- At the end of each working day, the driver hands over to the committee in charge the day's revenue.
- Some drivers receive daily wages, set at 60,000 LBP for Lebanese and 30,000 for other nationalities (mainly Syrian).
- There are privately-owned or individual buses operated and maintained by their owners. They pay a rent fee of 50 USD to the municipality.
- Some buses operate on a night schedule, but these are services limited to certain routes and in lower frequencies.

The information provided by the interviewee about the buses and vans operating in Dora Station (number of buses and vans, average number of passengers, number of round/trips per day, areas of operation (origin-destination), fees, and departure schedule) is provided in Table 4-26.

**Table 4-26. Information about Buses and Vans**

| Number of Buses/ Vans | Average Number of Passengers | Number of Trips/ Day (Round-Trip) | Areas of Operation (Origin – Destination) | Fees | Buses/ Vans Departure Schedule |
|---|---|---|---|---|---|
| 400 small buses | 200-250 | 2 to 3 | Route 1: Dora – Tripoli – Dora<br>Route 2: Tripoli – Mazraa – Tripoli<br>Route 3: Dora – Cola – Mazraa – Charles Helou – Airport<br>Route 4: Dora – Jbeil | 5,000 LBP from Beirut to Tripoli<br>Between 1,000 LBP and 2,000 LBP depending on the traveled distance | Every 8 minutes from any bus station (Dora, Tripoli, Cola, etc.) |

| Number of Buses/ Vans | Average Number of Passengers | Number of Trips/ Day (Round-Trip) | Areas of Operation (Origin – Destination) | Fees | Buses/ Vans Departure Schedule |
|---|---|---|---|---|---|
| 250 vans | 200-250 | 4 | Dora – matar (vans) + same trips as buses<br>Dora – Tripoli<br>Dora – Airport<br>Dora – Raouche<br>within Beirut | 5,000 LBP from Beirut to Tripoli<br>Between 1,000 LBP and 2,000 LBP depending on the traveled distance | Every 4 minutes towards the airport |

According to Table 4-26, the minimum number of passengers/ day is 130,000[11] and the maximum number of passengers per day is 162,500[12].

[11] Minimum number of passengers per day x total number of buses and vans (200 x 650 = 130,000)
[12] Maximum number of passengers per day x total number of buses and vans (250 x 650 = 162,500)

### *4.3.8 Land*

The BRT Corridor will occupy the road right of way along its trajectory, and hence there is no change in land use along the corridor. Nonetheless, in some areas along the highway in the northern corridor from Nahr el Kalb to Tabarja there is a need to expropriate approximately 235 $m^2$ of private lands to accommodate the pedestrian infrastructure of the stations along the sidewalks.

The BRT Corridor in the Outer and Inner Rings is entirely located in the right of way, and no land use change or acquisition needs arises.

The P&R facilities will be placed on publicly-available land which have been assessed to have no productive value. One of the P&R facilities in Kfrayassine has five illegal households with a total of 26 persons and some fruit trees.

The bus depot in Safra and bus terminal in Wata Slem, Tabarja will be located on privately-owned plots 14,000 $m^2$ (1 plot) and 6,000 $m^2$ (3 plots and part of a fourth plot). The plots have no productive activities or housing.

Land acquisition procedures and compensation estimates are fully evaluated in a Resettlement Action Plan (RAP) prepared in line with Law No. 58/1991 and World Bank OP 4.12.

### *4.3.9 Cultural Heritage*

Given the richness of the Lebanese territories with archaeological riches and cultural resources, it is important to investigate whether the Project's construction works might adversely affect or unearth archaeological remains with cultural and historical value. Hence, information on the Project's footprint area was shared with the Directorate General of Antiquities (DGA) to advise on potential areas of interest from an archaeological perspective.

Furthermore, the cultural points of interest along the BRT route were highlighted using information from desk research and field surveys to pinpoint the locations of museums, galleries, neighborhoods of cultural value, etc. whose locations might be sought by future system users, and hence the bus route would be used as a means to promote cultural tourism.

#### *4.3.9.1 Area between Beirut and Tabarja*

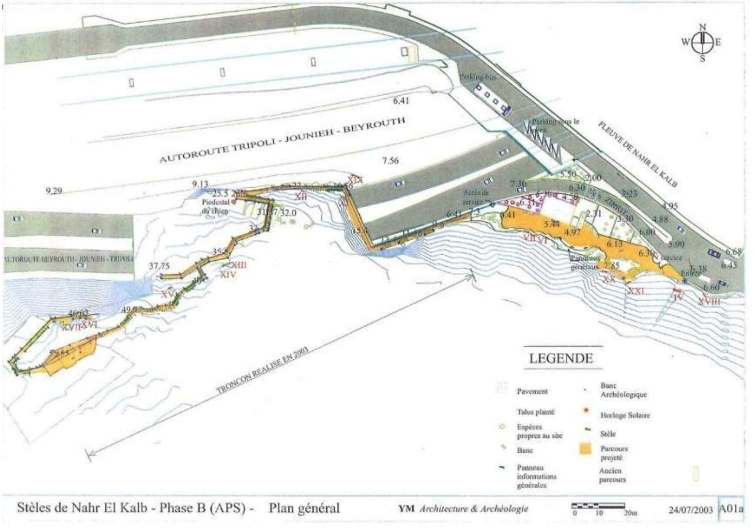
The cultural and archeological points of interest in the different towns along the Northern Highway (from Beirut to Tabarja) are listed and described in Table 4-27.

**Table 4-27. Description of the Points of Interest in the Different Towns along the Northern Highway**

| Cultural and Archaeological Points of Interest | Description | Photos |
|---|---|---|
| **Fanar** | | |
| Sculptor Yousef Ghsoub Museum | Between an art workshop and a museum, it exhibits more than 75 sculptures and a model of Baalbeck's temples, done by the sculptor. |  *Source: https://www.lebarmy.gov.lb/* |
| Ameen Rihani Museum | Located in the Rihani family house in Freikeh, this museum features some of Rihani's manuscripts and letters, his own works of art paintings and portraits, and portraits of Rihani painted by renown artists, among which the ones done by Gibran Khalil Gibran. |  *Source: http://www.ameenrihani.org/* |

| Cultural and Archaeological Points of Interest | Description | Photos |
|---|---|---|
| **Jdeideh** | | |
| Paul Guiragossian Museum for contemporary art | A wide collection of the famous Lebanese artist is presented in the museum: oil paintings, acrylics, watercolors, mixed media, drawings, sketches, and portraits. It also displays works of art made by other Lebanese and international contemporary painters, and is a meeting place for artists. |   *Source: http://www.artreoriented.com/* |
| Wonders of the Sea Museum | This 19th century traditional Lebanese house with its arcades and gardens hosts uncommon guests: a community of marine creatures that directly transports you from land to sea, to discover the richness of the marine fauna and flora. The visit is an instructive and cultural experience which brings sea life to the reach of every visitor. |   *Source: http://www.wondersofthesea.net/* |
| **Zalka** | | |
| Michel Abou Jaoudeh Museum | Dedicated to the well-known columnist of An-Nahar, the museum exhibits his personal objects, all his articles published in An-Nahar newspaper and other various documents. A public library is also included in the museum. | *No photo available.* |

| Cultural and Archaeological Points of Interest | Description | Photos |
|---|---|---|
| **Jal el Dib** | | |
| Edward Nassar Museum | Located in an Ottoman style house, the collection is a reflection of Nassar's life (a wide collection of paintings, stamps, coins, historical books, early bibles, sculptures, etc.) Nassar started to build his collection when he was 25. |  *Source: http://edwardnassarmuseum.com/* |
| **Antelias** | | |
| Cilicia museum | The museum is thought to be the living testimony of the historic journey of the Armenian Church of Cilicia. The objects it houses are rescued treasures of the Catholicosate. The relics, religious art, liturgical vestments and embroideries, manuscripts and scripts take you in a journey back in time, to discover the richness of the Armenian Catholic Church. It also pictures the courage of Monks who were forced to evacuate Cilicia, and had the good sense of packing some of the most important reliquaries of their monasteries. |  *Source: http://www.armenianorthodoxchurch.org/en/museum* |

| **Cultural and Archaeological Points of Interest** | **Description** | **Photos** |
|---|---|---|
| **Nahr el-Kalb** | | |
| Commemorative Stelae of Nahr el-Kalb | Inscribed on the UNESCO Memory of the World register since 2005 and on the World Heritage Sites tentative list since 1996, Nahr el-Kalb summarizes Lebanon's history in one place. More than 20 inscriptions and carved relief are engraved on the limestone rock of the estuary. They evoke the progress of the Pharaonic, Assyro-Babylonian, Greek, Roman, Arab, French and British armies in the Lebanese territory. The general plan of the development project to bring the stelae to prominence is shown in the schematic on the right. | <br>*Source: http://lebanonuntravelled.com/commemorative-stelae-of-nahr-el-kalb/*<br> |

| Cultural and Archaeological Points of Interest | Description | Photos |
|---|---|---|
| **Jeita** | | |
| Hall of Fame | The silicone statues are of local and international celebrities in the political, social and cultural fields. Some of the statues are animated and thus can sing, talk and move. |  *Source: http://www.lebanon-hotels.com/book/visit/?s=HALLOFAME* |
| Jeita Grotto | Located in the Nahr el-Kalb valley, some 5 km from the coastal road, the grotto has become a major touristic attraction. It is one of the longest explored grottos in Lebanon. Both the upper and lower caves are open to the public. The natural formations that can be seen during the visit trigger one's imagination. |  *Source: http://www.jeitagrotto.com/* |
| Lebanese Marine and Wildlife Museum | Just a few meters away from the grotto, the marine and wildlife museum offers an outdoor and indoor exhibition space displaying marine, mammals, birds, reptiles and stones that were or can still be found on ground and below sea level in Lebanon. |  *Source: http://lmwm.org/* |

| Cultural and Archaeological Points of Interest | Description | Photos |
|---|---|---|
| **Zouk** | | |
| Elias Abou Chabke Museum | This Lebanese traditional house is the house of the poet Elias Abou Chabke. Bought by the Municipality of Zouk Mikael, it was not only transformed into a museum but also a gathering place for artists, poets and thus a place where artistic events can be held. | <br>*Source: http://www.zoukmikael.com/museumall.php* |
| Fouad Chehab Museum and Library | The house of former President Fouad Chehab was restored and transformed into a library and museum by the Lebanese Maronite Order. His office and bedroom were kept after restoration, where one can see some of his belongings: his civil status record, medals of Honor, and other belongings related to his life as a normal citizen and his Presidential status. |  <br>Entrance of the museum (left), the office with a statue representing the President (right)<br>*Source: http://www.fouadchehab.com/en/?loc=gall-2016museum* |

| Cultural and Archaeological Points of Interest | Description | Photos |
|---|---|---|
| **Maameltein** | | |
| Cable car leading to Harissa | Located on the coastal road between Jounieh and Tabarja, the cable cars link the coast to the site of our Lady of Lebanon. Pilgrims of different religious communities visit the site on various occasions, and especially during the Holy month of May. The site is also known for the majestic view of the bay of Jounieh that it offers. |  *Source: https://www.touristtube.com/best-travel-images/Green-Teleferique-Cable-Car-on-the-Way-to-Harissa/6xAM72xk* |
| The Roman Bridge | The Roman Bridge that spans the Ghazir river is located to the left of the coastal road leading from Tabarja to Maameltein, just beneath Casino du Liban. The Roman Bridge can be clearly seen from the road. The bridge was once part of the "Via Maris" that followed the Eastern coast of the Mediterranean sea. This massive structure consists of one unique arch built with well-dressed stone. |  *Source: Photo taken during a Field Visit* |
| Juliusz Slowacki Museum | Located in a wing of the Saint Antoine Convent in Ghazir, this museum is dedicated to the polish poet Juliusz Slowacki, a major figure of the Polish Romantic period. In 1836, he travelled to the Middle East, in a journey that led him to write his epic poem "Travel to the Holy Land from Naples". | *No photo available.* |

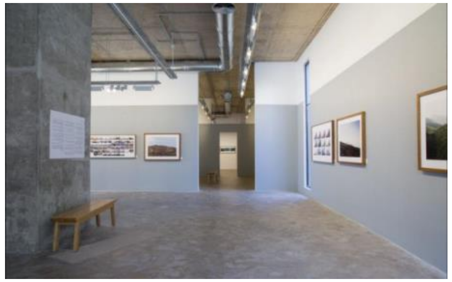
#### *4.3.9.2 Beirut Area (Outer and Inner Rings)*

The historical center of Beirut lies beneath the Beirut Central District, where archaeological excavations have unearthed many features of the diverse represented periods.

As for the modern history of Beirut, the city started its emergence during the mid-19$^{th}$ century, when a range of political transformations changed its status; from a small provincial Ottoman town, it started growing in density and in importance. The Grand Serail's construction started, and in 1888 Beirut became a "wilaya" with an important administrative status. In the neighborhood of the Grand Serail construction of palaces started and in Wadi bou Jmil, middle class residencies were built. Some of the Beirut's Palaces and residences are today transformed into museums and Art Centers.

The development of Beirut went on during the French mandate, and the city spread beyond its municipal boundaries, and absorbed the nearby villages. A description of Beirut districts and of the cultural and archeological points of interest in each district are provided in Table 4-28.

**Table 4-28. Description of Beirut Districts and the Cultural Points of Interest in Each District**

| District Description | Cultural and Archaeological Points of Interest | Description | Photos |
|---|---|---|---|
| Medawar district harbours traditional houses of average social classes, where alleys and streets are connected with staircases climbing uphill. Urbanization started during the 1930s with the French mandate. | Galerie Tanit | The gallery is an open space where artists are promoted. Sculpture and painting exhibitions are held there on regular basis. | <br>*Source: http://www.galerietanit.com/about* |
| | Sfeir Semler Gallery | The gallery is the first white cube space in the Middle East. It represents artists working in the field of conceptual art with a preference on political subjects. Since 2003, Sfeir Semler Gallery has focused on contemporary art from the Arab World. | <br>*Source: http://www.sfeir-semler.com/* |
| In Rmeil district traditional palaces for middle social classes and traditional houses for average social classes can be found adjacently. Palaces are located behind fenced gardens. Staircases climb uphill where numerous villas and palaces can still be found. | Nicolas Ibrahim Sursock Museum | Located in the villa of Nicolas Sursock, it exhibits Lebanese and international art in its permanent displayed collection. Built in the 1920s, the villa itself is an architectural example of Lebanese palaces. | <br>*Source: https://sursock.museum/content/mission* |

| District Description | Cultural and Archaeological Points of Interest | Description | Photos |
|---|---|---|---|
| | Audi Mosaic Museum | Also known as the Villa Audi, the mosaic collection is displayed inside the Villa. Temporary art exhibitions are held on frequent basis in the Villa. |  *Source: http://www.lebanontraveler.com/en/magazine/Lebanon-Traveler-Raymond-Audi?CurrentPage=1* |
| | Atelier Camille Allam Beirut | A real time art studio and gallery of the painter, sculptor and musician Camille Allam. |   *Source: https://www.onefineart.com/artists/sculptors/Camille-Allam* |
| | 392RMEIL393 | Located in what used to be the coach house of the adjacent palace, 392RMEIL393 is a space where various aspects of visual creativity can be exhibited. |   |

| District Description | Cultural and Archaeological Points of Interest | Description | Photos |
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| | | | *Source: http://392rmeil393.com/* |
| Perched on a hill, Achrafieh was inhabited by a limited number of Beiruti families prior to the 1930s. Some of the traditional houses in Achrafieh are still owned by the original families, while others are being purchased in order to be restored and occupied by their new owners. | Mim museum | Located within the Campus of Innovation and Sports (Université Saint Joseph (USJ)), the museum displays a collection of minerals from around the world. A temporary exhibition shows fossils from Lebanon. |   *Source: https://www.crystalclassics.co.uk/news/295/opening-of-the-mim-museum-beirut-lebanon/* |
| | Beit Beirut – Museum and Urban Cultural Center | Also known as the Yellow House and Beit Barakat (the former owners of the house), the building that was established in the 1920s in an Ottoman Revivalist style is dedicated to celebrate the history of Beirut and to serve as a reminder of the civil war history. |  *Source: http://blogbaladi.com/beit-beirut-renovation-finally-underway/* |

| District Description | Cultural and Archaeological Points of Interest | Description | Photos |
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| | Beirut Art Center | Located in an industrial area next to Beirut River, the building was refurbished to include an exhibition space for temporary art, book store and auditorium. |  *Source: https://theculturetrip.com/middle-east/lebanon/articles/10-contemporary-art-galleries-in-beirut-you-should-visit/* |
| | Metropolitan Art Society (MAS) | Located in the renovated 19th century palace of Abdallah Bustros, the MAS showcases modern and contemporary art. Also, temporary exhibitions are held at a frequency of 3-4 each year. |  *Source: https://www.sobeirut.com/the-metropolitan-art-society* |

| District Description | Cultural and Archaeological Points of Interest | Description | Photos |
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| | Ibrahim Najem House of Collectibles | A “bric à brac” of different types of objects collected for more than 25 years by Najem, displayed in his house. |  *Source: Ibrahim Najem House of Collectibles Facebook Page* |
| Mazraa | Beirut National Museum | Built in the 1930s, the museum exhibits a collection of archaeological artifacts that tell the story of people and civilizations that occupied what is known today as the Lebanese territory. |  *Source: https://www.tripadvisor.fi/Attraction_Review-g294005-d1157183-Reviews-National_Museum_of_Beirut-Beirut.html#photos;geo=294005&detail=1157183* |

| District Description | Cultural and Archaeological Points of Interest | Description | Photos |
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| | Beirut Hippodrome* | Officially called Hippodrome du Parc de Beyrouth, Beirut Hippodrome was completed in 1921. National and International horse races are held there, along with other fairs among which are The Garden Show and Spring Festival. |  *Source: https://www.lebanoninapicture.com/pictures/lebanon-beirut-vscocam-beautifuldestinations-dametravel_35* |
| | Pine Palace (Le Palais des Pins)* | The construction of the Pine Palace started in 1916 and was intended to become a casino. In October 1918, after the end of World War I, François Georges-Picot, Commissioner of the Ottoman Territories of Palestine and Syria, settled in the Palace, renamed it Résidence des Pins, and acquired the Palace. In 1920, he declared the State of Greater Lebanon from the porch of the Residence. The Palace is since then property of the French Republic and residence of its Ambassadors. |  *Source: https://en.wikipedia.org/wiki/Pine_Residence* |

| District Description | Cultural and Archaeological Points of Interest | Description | Photos |
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| Mousseitbeh | Art on Spears | Located in an old building, Art on Spears hosts fine art exhibitions of varied artworks and schools. |    *Source: https://www.artonspears.com/* |
| | United Nations Educational, Scientific and Cultural Organization (UNESCO) Palace | As indicated by its name, the UNESCO Palace for Education, Science and Culture holds different types of events (conferences, lectures, exhibitions, live dancing and music performances) both local and international. |  *Source: http://desktop.beiruting.com/Theater/Palais_Unesco* |

| District Description | Cultural and Archaeological Points of Interest | Description | Photos |
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| Saifi | Lebanese Prehistory Museum | Through its collection of stone tools and artifacts, the museum explains Prehistoric Lebanon and the way of living of its inhabitants. |  *Source: http://museums/museum/details/16340/museum-of-lebanese-prehistory* |
| | Theatre Monnot | It is a private theatre that actively participates in the Lebanese cultural life. It aims at promoting young talent, while hosting national and international performances in a wide range of variety: musicals, concerts, conferences and exhibitions. |  Théâtre Monnot *Source: http://www.beirutnightlife.com/video-gallery/ashrafieh-theatrical-play/* |
| | Theatre Gemmayze | One of the objectives being to create hubs and cultural platforms for talented artists, theatre Gemmayze offers a space where local and international theatre productions, one man shows, art and photography exhibitions and dance performance can be held in a freedom of |  |

| District Description | Cultural and Archaeological Points of Interest | Description | Photos |
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| | | expression space. | <br>*Source: http://desktop.beiruting.com/Theater/Theatre_Gemmayze* |
| Until the mid-19th century, Ras Beirut was barely settled with flat-roofed houses surrounded by gardens. In 1866, the founders of the Syrian Protestant College chose this location to establish the College, which was renamed the American University of Beirut (AUB) in 1920. The development of Ras Beirut was encouraged by AUB's founding. Urban villas were first built, followed by low-rise apartment buildings with gardens, and, from the mid-twentieth century, mid-rise buildings. | Lebanese National Library | The Library is still under renovation, books under rehabilitation. | <br>*Source: http://bnl.gov.lb/English/collections.html* |
| | Banque du Liban Museum | Located within the Banque du Liban building, the museum offers a wide variety of banknotes from all over the world, and showcases coins from different historical periods thus taking the visitor in a tour from the beginning of coinage till today's banknotes, and the historical development of the Lebanese pound. |  |

| District Description | Cultural and Archaeological Points of Interest | Description | Photos |
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| | | | *Source: http://www.xibitz.com/creating-engaging-experience/* |
| | DIY Beirut | DIY Beirut is one of the alternative culture and art places in Beirut. It hosts exhibitions, yoga classes, workshops and a flea market. | *No photo could be found* |
| | Al Madina Theater | Masrah al Madina hosts different types of events: theatre and dance performances, music concerts and conferences. |  *Source: http://desktop.beiruting.com/Theater/Al_Madina_Theater* |
| | Babel Theatre | Open to all forms of artistic expressions, the theatre is an open door to fuse and interlace with world cultures and world arts. It produces and hosts drama, dance, exhibitions, poetry readings, and movie screenings, artistic workshops for children and youth as well as cultural seminars. |  BABEL THEATRE |

| District Description | Cultural and Archaeological Points of Interest | Description | Photos |
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| | | | *Source: http://www.momosanno.com/forgotten-rhythms/* |
| In the Bachoura District, and more specifically in its stretch near Downtown Beirut, archaeological excavation works were conducted during the past years on large plots. Publications on the uncovered remains are not yet available. | - | - | - |
| Port | The ancient Tell | The ancient Tell shows the remains of the Beirut's early settlements – 2500 B.C. It constitutes the fortified center of the city during the Canaanite, Phoenician, Persian and Hellenistic periods. |  *Source: http://www.solidere.com/city-center/history-and-culture/archeology* |
| | The Roman Bath | The ruins of the bath were uncovered during the 1960s. The different parts of the bath can be seen: hot rooms, cold rooms, and the surrounding heating systems. |  *Source:* |

| District Description | Cultural and Archaeological Points of Interest | Description | Photos |
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| | | | *https://en.wikipedia.org/wiki/Roman_Baths,_Beirut* |
| | Garden of forgiveness | Surrounded by a number of churches and mosques, Garden of Forgiveness lies close to Martyrs' Square and the wartime Green Line. The area was classified as non aedificandi, "not to be built", in the Master Plan of the Beirut City Center. The garden is envisioned as a place of calm and reflection, of understanding and tolerance. It is surrounded by worship places of different religious communities. The Garden will comprise the uncovered ruins of the diverse civilizations that occupied the city over the centuries. |  *Source: http://www.solidere.com/city-center/history-and-culture/archeology* |
| | Heritage Trail | Heritage trail is an ongoing project that aims to create a path that links the different archaeological sites, historical buildings, public spaces and worship places. | - |
| | Martyrs' Square | The square was initially an open space beyond the city wall. It was called during the 1860s as Cannon Place (Place des Canons), and took the name of Martyrs' Square in 1931, to commemorate the martyrs that were lynched by the Ottomans during the First World War. |  *Source: http://www.solidere.com/city-center/solidere-developments/open-spaces/martyrs%E2%80%99-square* |

| District Description | Cultural and Archaeological Points of Interest | Description | Photos |
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| | BIEL (Beirut International Exhibition and Leisure Center) | BIEL is a large multi-purpose facility. It hosts exhibitions, concerts, conference, book fairs, and other private events. |  *Source: https://en.wikipedia.org/wiki/Beirut_International_Exhibition_%26_Leisure_Center* |
| | Planet Discovery | Through its local, regional and international exhibits, the museum provides interactive fairs, experiences and workshops for children. |  *Source: https://www.beirut.com/l/9444* |

| District Description | Cultural and Archaeological Points of Interest | Description | Photos |
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| During the 19th century, Zokak El Blat was an aristocratic neighborhood, where many palaces were built, of which we can cite the Beyhoum Palace and the Pharaon Palace (today it hosts the Robert Mouawad Private Museum).<br>Zokak El Blat was the first neighborhood in Beirut to have its roads paved by the Ottomans in the 1860s, hence its name. The importance of Zokak El Blat relies on both its architectural patrimony and national cultural and educational role. A study conducted by ALBA has revealed that 41% of the buildings were established during the Ottoman period and the French mandate. The district developed during the Nahda – the Arab Renaissance – and was a pole of intellectual production. | The Grand Serail | The Grand Serail is located within Zokak El Blat district on the Serail hill. It is a majestic Ottoman era building that was constructed in 1853. It is currently the headquarters of the Lebanese Prime Minister. | <br>*Source: https://en.wikipedia.org/wiki/Grand_Serail* |
| | The Ottoman military hospital | The Ottoman military hospital was built in 1860. During the French Mandate it was used as a courthouse. Currently, it houses the Council for Reconstruction and Development (CDR). | <br>*Source: http://www.cdr.gov.lb/eng/profile.asp* |

| District Description | Cultural and Archaeological Points of Interest | Description | Photos |
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| | The Clock Tower | The Clock Tower was erected in 1897 to celebrate the anniversary of Sultan Abdul Hamid II coronation and to make up for the absence of a public clock indicating mandatory Muslim prayer times. |  *Source: https://www.flickr.com/photos/twiga_swala/7427027104* |
| | Robert Mouawad Private Museum | The museum is located in an old palace - the Henry Pharaon Palace - that was restored by its current owner, the jeweler Robert Mouawad. The museum exhibits the collection of art, archaeological objects and other artifacts of different periods and civilizations owned by Henry Pharaon. |  *Source: http://desktop.beiruting.com/Wedding/Robert_Mouawad_Private_Museum* |
| Minet El Hosn | Maghen Abraham Synagogue | Maghen Abraham Synagogue was built in 1925. It is located in Wadi Abu Jmil, the Jewish neighborhood of Beirut. The sector comprises old palaces and houses built in the mid-1800s. |  *Source: https://en.wikipedia.org/wiki/Maghen_Abraham_Synago* |

| District Description | Cultural and Archaeological Points of Interest | Description | Photos |
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| | | | *gue* |
| | Dar El Nimer for Arts and Culture | Dar El Nimer for Arts and Culture is a cultural space dedicated to historical, modern and contemporary cultural productions from Palestine, the Levant and beyond. |  *Source: https://www.sobeirut.com/dar-el-nimer-for-arts-culture* |
| Ain Mreisseh | Archaeological Museum of the American University of Beirut (AUB) | One of the oldest archaeological museums in the Middle East since it was founded in 1868; the museum displays a wide array of antiquities found in Lebanon and in the region. |  Source: https://www.aub.edu.lb/museum_archeo/Pages/index.aspx |

| District Description | Cultural and Archaeological Points of Interest | Description | Photos |
|---|---|---|---|
| | Raoucheh | Avenue de Paris and the Pigeons' Rock constitute a landmark and can be considered as one of Lebanon's emblems. Raoucheh is popular both for Lebanese and tourists. On another note, evidence of prehistoric occupation of the shores near Raoucheh was identified; flints and stone tools collected on the sites are part of the collections of the AUB Archaeological Museum and the Lebanese Prehistory Museum. |  *Source: https://theculturetrip.com/middle-east/lebanon/articles/the-10-best-restaurants-in-raouche-beirut/* |

** The construction of the Beirut hippodrome and the Pine Palace are linked together, since they were commissioned by the Wali of Beirut Azmi Bey, who wanted to build a high-end meeting place for the Beirut's privileged class.*

# 5. PUBLIC CONSULTATION

According to the existing laws and regulations, international conventions and good practice, the public has the right to be properly and timely informed about any type of project that can cause an impact on the environment. Sections below provide details of the public participation conducted during the scoping and the impacts assessment phases.

The BRT System has primarily a general public interest for commuters. Its implementation aims at enhancing public transport thereby easing traffic flows, reducing air pollutants emissions, reducing travel time, and improving road safety conditions. Social, environmental and economic impacts, both beneficial and negative, are expected to be generated from the Project's construction and operation activities; directly or indirectly affecting various stakeholders. As a result, it is crucial to capture the opinion of public, community and private stakeholders concerned with the Project at an early stage.

As part of the ESIA Study, a "Stakeholder Engagement and Consultation Plan" was developed to lay out the roadmap on how the ESIA Consultant will facilitate capturing the opinions of stakeholders. The full document is provided in APPENDIX H and includes details on stakeholders' identification and communication tools.

Overall, three (3) main approaches were adopted to inform people about the Project throughout the ESIA study to solicit their opinions:

4. Key Stakeholder Meetings and Interviews,
5. Two Public Consultation Meetings at the Scoping and Draft ESIA Study stages, and
6. Focus Group Meetings.

The approaches are described in the following sections.

## 5.1 KEY STAKEHOLDER MEETINGS

A number of meetings were carried out during the Scoping and ESIA Phases to inform key stakeholders about the Project and obtain their feedback.

The conducted meetings and a summary of the main points raised and discussed are presented in Table 5-1.

**Table 5-1. Summary of the Meetings and Outcomes**

| Date | Organization / Person | Subject | Main Questions, Comments, and Concerns Raised/Discussed during the Meetings |
|---|---|---|---|
| 06 December 2016 | Council of Beirut Municipality | Introducing the Bus Rapid Transit (BRT) System to Beirut Municipality | • The Council welcomed the project and agreed that shifting the behavior of the Lebanese population towards using public transportation is a need.<br>• The Council is considering converting some streets in Beirut to pedestrian areas (e.g. Jeanne D'Arc); which is consistent with the implementation of a public transport system and reducing traffic congestion within the city.<br>• The Council suggested Jamal Abdel Nasser Square as a potential parking area that could stand-in for the removal of on-street parking in Ain El Mreisseh.<br>• The Council asked about the schedule of construction works to align with the current and pipeline works within Beirut. It was clarified that the Project is currently at the feasibility stage, next step will be detailed design and construction works are not anticipated to start before 2019.<br>• The Council noted that there are streets in Beirut where traffic congestion is severe and public transport introduction in these streets is needed (e.g., Independence and Algeria streets).<br>• The Council questioned the emissions from buses that would enter the city from the north. Low emissions vehicles need to be considered; battery-operated buses inside Beirut were suggested. Smaller buses were proposed to alleviate visual impacts on Beirut's narrow streets. Hybrid buses were also suggested, shifting to cleaner technologies when entering Beirut.<br>• The Council enquired about the aspects that the ESIA will study. The ESIA Consultant explained that the socio-economic aspects of this project will be thoroughly studied, in addition to the environmental aspects which are mainly local air pollution and noise.<br>• The Council commented that a "clean and safe" bus system should be in place in order to attract ridership. Awareness campaigns should be part of the Project's setup to encourage people to use the bus services.<br>• The Council asked about the parties responsible for the Project's financing, construction, and operation. The project's implementation will be funded by the World Bank after appraisal. The CDR will be responsible for the construction phase while the operator will be a private company under the supervision of the RPTA.<br>• The Council raised concern that the RPTA might not be qualified to supervise such a project. It was explained that the WB will provide institutional support in the form of short-term experts to train the RPTA employees who will be in charge of the BRT System. |
| 07 December 2016 | MoE | Scoping Meeting with MoE to introduce the | • The ESIA Study will cover air quality, noise and socio-economic aspects. The ESIA will be developed as per the MoE's regulations.<br>• MoE inquired about bus specifications. The ESIA will include recommendations about bus specifications. |

| Date | Organization / Person | Subject | Main Questions, Comments, and Concerns Raised/Discussed during the Meetings |
|---|---|---|---|
| | | Bus Rapid Transit (BRT) System | CDR explained that bus specifications will be studied in later stages of the Project, emphasizing that the choice of buses will comply with future standards and legislations, at the time of their introduction.<br>• MoE raised a concern about attracting customers for all the transport modes being discussed (namely railway and bus). The ESIA Consultant explained that the study of various modes running together was done and it seems that both projects are feasible. CDR mentioned that alternative modes need to be developed to give commuters options other than using their private vehicles and incentives need to be introduced to encourage people to use public transport; once clean and secure alternatives to private cars are available.<br>• MoE raised a concern about the reaction of the current operators of the public transport vehicles: buses, taxis, etc. CDR explained that there are two options to deal with this concern:<br>▪ Develop standards and ask the current public transport operators to abide by these standards and make them part of the BRT System; and<br>▪ Price the BRT fees higher than the fees of the current public transport modes thus attracting a different clientele.<br>• MoE suggested including the Directorate of Petroleum as a concerned stakeholder given their role in fuel standards setting. |
| 19 December 2016 | Qaim maqam of Metn | Introducing the Bus Rapid Transit (BRT) System and understanding the qaim maqam plans for organizing the buses in Dora area | • A brief description of the 'Dora Bus Station Project' proposed by the Qaim maqam office, its objectives and a brief about the current bus network departing from Dora were provided. There are 500 buses using eleven (11) routes going in different directions. Approximately 20,000 passengers per day use the buses which is equivalent to 1,440 passengers per hour. The parking spaces in Dora are currently leased to the Cooperative for Government Employees.<br>• The percentage of illegal buses departing from Dora ranges between 10% and 40%. The different existing bus routes from Dora and the number of buses that circulate on each route were explained: The only RPTA-owned and operated buses are the ones that traverse from Dora to Tripoli and back with three (3) bus services per day.<br>• From a socio-economic point of view, the Qaim maqam office considered that the operations of 50% of the existing bus network will be impacted by the new BRT System. 70% of the buses are new especially the ones that operate on the coastal road. Those buses can support up to 24 passengers each. Vans operating on the airport road are usually smaller.<br>• The comments raised by the Qa'im maqam of Metn are the following:<br>▪ Due to the lack of a well-organized public transport system in Lebanon, informal bus systems have flourished, and which are not organized or controlled.<br>▪ The buses that currently operate at Dora cannot be driven out of business without finding alternative solutions for current bus operators, as this could lead to social unrest and possible violence.<br>▪ If the buses are kept clean, well-maintained and well-organized people will be encouraged to use the |

| Date | Organization / Person | Subject | Main Questions, Comments, and Concerns Raised/Discussed during the Meetings |
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| | | | BRT System.<br>▪ It is very important to put a staged plan for the long-term, sustainable operations of the BRT System, such as:<br>- Raising the awareness of bus drivers;<br>- Discontinuation of issuing of new public license plates by the MoIM;<br>- Communicating and consulting with all concerned syndicates and stakeholders (e.g., bus operators, etc.); and<br>- Assigning the responsibilities of each concerned public administration.<br>▪ It is important to determine if passengers will have to pay extra fees to switch buses to reach a certain destination. For example, passengers who want to reach Antelias from Bikfaya need to switch buses at Dora. |
| 12 January 2017 | Advisor to the Mayor of the Federation of Municipalities of North Metn - Coastal and Central | Introducing the Bus Rapid Transit (BRT) System | • The following questions were raised:<br>▪ Will the BRT effectively reduce traffic along the highway?<br>▪ What type of fuel will be used to operate the buses?<br>• The ESIA Consultant clarified that the feasibility study and the traffic study for the proposed BRT System are currently under preparation and that the results of the studies will confirm the impacts on traffic. It was also explained that various options for bus specifications will be carefully studied with the aspiration to promote high quality low-emission buses.<br>• The Federation of Municipalities of North Metn - Coastal and Central is ready to provide any clarifications or feedback if needed in the future. |
| 12 January 2017 | Mayor of the Municipality of Jdeideh – Bauchriyeh – Sed El Bauchriyeh | Introducing the Bus Rapid Transit (BRT) System | • The proposed Project was favorably received.<br>• The removal of the landscaped area in the median strip will not be welcome by the public, as the Municipality previously faced public opposition during cleansing activities. Therefore the Project should carefully consider this aspect during the design phase.<br>• The Council is ready to provide further feedback when and if needed. |
| 13 January 2017 | Directorate General for Land & Maritime Transport (DGLMT) | Introducing the Bus Rapid Transit (BRT) System | • CDR explained that here are two (2) possible scenarios for Kesserouane area that are being studied:<br>▪ Scenario1: three (3) lanes open highway; and<br>▪ Scenario 2: Elevated BRT system. The speed of the BRT buses in the case of the elevated BRT system has not been studied yet.<br>• DGLMT emphasized that a Bus Rapid Transit System means that it should ensure high-speed movement. If geometrically there is a constraint on the speed of the BRT, the BRT concept would no longer be respected. Thus, it is important to compare several options and see what is economically more suitable for the context: is it to have priority lanes or dedicated lanes for ordinary buses or to invest in high cost |

| Date | Organization / Person | Subject | Main Questions, Comments, and Concerns Raised/Discussed during the Meetings |
|---|---|---|---|
| | | | infrastructure which may or may not achieve the objective of better mobility? Will the BRT's operation be similar to ordinary buses? If an already existing system is providing the same facilities and services as the BRT System with a lesser investment cost why would we need to implement the BRT System? All of those questions should be answered once the economic feasibility study is completed.<br>• DGLMT enquired whether the identified possible P&R facilities for the BRT System are the same as the ones identified for the railway and whether the lands have been marked to be used as P&R facilities or not. CDR clarified that no action has been taken to date regarding the earmarking of land plots for the P&R facilities.<br>• DGLMT expressed concern regarding the Outer Ring in Beirut. If the BRT System is operated on a dedicated lane, which may be far-fetched, then existing buses can run on the dedicated lane. If the BRT System cannot be operated on a dedicated lane on the Outer Ring, then what makes the BRT different from existing buses if both cannot operate on a dedicated lane? CDR clarified that by January-February 2017, studies will show if a dedicated lane can or cannot be established in the Outer Ring.<br>• CDR & DGLMT both agreed that the feasibility of two (2) concepts/ projects should be carried out. The BRT System on the northern highway from Tabarja to Charles Helou and a different concept for Beirut, such as buses that would operate on a priority lane or if possible on a dedicated lane.<br>• DGLMT expressed concern regarding the removal of on-street parking in Ain el Mreisseh/Corniche El Manara/Raouche and the removal of the vegetated median strip, which is highly regarded by the city residents given that recreational activities take place on the Corniche. CDR stated that the median strip in the Corniche area will not be removed.<br>• DGLMT asked whether after having implemented the BRT System the rest of the lanes would be sufficient and comfortable for the people who do not want to switch to the BRT System. The Engineering Consultant are in the process of answering this question as the traffic model is still underway.<br>• DGLMT stated that the expectation is that the BRT System would not be functional before 2021. In the meantime, why not implement the MoPWT's proposed bus project of 20 bus lines in implementation of the Land Transport Sector Strategy in Greater Beirut Area. The MoPWT-proposed project features buses with advanced specifications (telemetric system, ticketing system, information boards, etc.) that users can reach within a walking distance from residential areas.<br>• DGLMT considers that the railway project must be considered a priority ahead of the BRT System since it is the long-term solution and has a bigger capacity than the BRT System. The railway could be used for passengers movement during the day and freight at night. CDR clarified that the railway would not be implemented before 2031, in the meantime the MoPWT's proposed project for the 20 bus lines should be implemented and should be connected to areas outside Beirut. DGLMT clarified that MoPWT's proposed bus project will link Greater Beirut Area to Tripoli, Saida and Chtaura and will be further expanded at a later stage. |

| Date | Organization / Person | Subject | Main Questions, Comments, and Concerns Raised/Discussed during the Meetings |
|---|---|---|---|
| 13 January 2017 | Railway and Public Transport Authority (RPTA) | Introducing the Bus Rapid Transit (BRT) System | • RPTA enquired about the main issues identified along the BRT alignment. CDR listed the main identified issues/ unresolved matters starting from Tabarja and going towards Beirut:<br>▪ The bridge at Casino du Liban has three (3) lanes in each direction. If one lane of the three in each direction is reserved for the BRT there will be two (2) lanes left in each direction which might create a shortage in road space, which however is to be determined as a result of the traffic modeling.<br>▪ Beirut:<br>- On-street parking on the Outer Ring: In order have the BRT buses running on a dedicated lane along the Outer Ring in Beirut, there are two (2) suggested scenarios:<br>o Scenario 1: removing on-street parking. As a result there will be one (1) lane for the BRT and two (2) vehicular traffic lanes per direction.<br>o Scenario 2: keeping on-street parking. As a result there will be one (1) lane for the BRT, one (1) vehicular traffic lane, and one (1) lane for on-street parking.<br>CDR explained that during the first meeting with the Beirut Municipal Council, Scenario 1 was suggested and the idea of removing on-street parking especially in areas such as Corniche El Mazraa and Raouche was not favoured by Council. CDR noted that the Inner Ring in Beirut has not been studied yet.<br>- Difficulty in operating the BRT in Downtown Beirut (on the way back towards Tabarja), in Raouché (Dbaybo bends which are very steep), and in Sin El Fil (Jisr El Wati-Al-Saydeh road which is very narrow)<br>• RPTA expressed the view that keeping on-street parking is not conducive to the success of the BRT System. Law enforcement should be practiced to ban on-street parking and double parking. The Project itself should set specific requirements to reinforce the requirement for removal of on-street parking so that the BRT System can be implemented.<br>• CDR explained that another meeting will be scheduled at a later stage, when the design is more advanced, with the Beirut Municipal Council to discuss how to handle the issue of on-street parking.<br>• RPTA enquired if P&R facilities have been identified within Beirut. CDR explained that P&R facilities in Beirut are still being studied and that the Beirut Municipal Council asked for an underground parking to be built in Ain El Mreisseh, which might solve part of the problem.<br>• RPTA asked whether the P&R facilities will serve the residents of the area or visitors/shoppers because the way to approach the problem would be different for each case. CDR clarified that the P&R facilities will most likely serve people who are visiting the area. However, at night when business hours are over, the residents of the area could use these facilities to park their cars for free. CDR added that the Beirut Municipality needs to make a decision; either the BRT on a dedicated lane or on-street parking. CDR highlighted that there are plots around Corniche El Mazraa that could potentially be bought by the Municipality of Beirut and used as parking lots.<br>• RPTA enquired about who will be invited to the first public participation meeting and whether the |

| Date | Organization / Person | Subject | Main Questions, Comments, and Concerns Raised/Discussed during the Meetings |
|---|---|---|---|
| | | | Members of Parliament representing the constituents of the concerned areas have been invited. The ESIA Consultant responded that ministries, municipalities, Unions of Municipalities, and NGOs have been invited to the meeting however Members of Parliament were not invited. CDR clarified that the purpose of the meeting is to showcase and discuss the social and technical aspects of the proposed Project, and to show that the proposed Project is not politically affiliated.<br>• RPTA emphasized the importance to link the BRT Project with the Land Transport Sector Strategy (20 bus lines) that has been developed by the MoPWT because the projects are complementary. RPTA added that if the BRT System will not operate on a dedicated lane on the inner and outer rings in Beirut, then there should be a strong recommendation to adopt the MoPWT's proposed bus project (20 bus lines) with minor modifications, so the BRT System is complemented. |
| 23 January 2017 | Parliamentary Committee for Public Works, Transport, Energy and Water | Introducing the Bus Rapid Transit (BRT) System | • MP Mohammad Kabbani stated that he has no comments regarding the alignment from Charles Helou to Tabarja. However, he has concerns for the alignment within Beirut where the citizens' social habits in using public transport means need to be taken into consideration. He added that shared taxis are part of Lebanon's "heritage" and that it is very important to integrate them in the BRT System. Owners of shared taxis would most probably oppose the Project if there interests are negatively affected when the BRT System is in place.<br>• MP Kabbani added that the Corniche which extends from St. Georges Bay to Raouche is a place where people practice recreational activities. There are limited public parks in Beirut, and the Corniche and Horsh Beirut attract large numbers of Beirut residents. If on-street parking were to be removed on the Corniche, where would those people park their cars? It is very important for the Consultants to pay special attention to the social habits of Beirut residents. CDR clarified that there should not be an issue with shared taxis, since shared taxis can still operate on the right hand side of the road, while the BRT in the Outer Ring will operate on the left side next to the median strip. A suggestion from the CDR is to mark/allocate specific stops, most probably at the location of BRT stops, for shared taxis stops. This way people could switch from BRT to shared taxis, at the stops, to continue to their destinations. CDR emphasize that a decision must be made whether to remove the median strip or the on-street parking otherwise the BRT System cannot be implemented. The median strip on the Corniche in the Ain El Mreisseh, Manara and Raouche areas is vegetated, and its removal to make way for the BRT lanes and stops will face opposition.<br>• An expert in traffic matters stated that the new traffic law (Law 243/2012) asserts that shared taxis have to park in specific places. He expressed his view that the BRT System is a very good development for Lebanon in the field of public transportation. He added that with time people will change their habits. |
| 10 August 2017 | Union of Municipalities of Kesserouan | Introducing the Bus Rapid Transit (BRT) | • The Union is not in favour of the widening of the A1 highway in Jounieh given the presence of multiple businesses and urban sprawl. The land and properties acquisition as well as the disruption are regarded as extensive. The Union is of the view that a 2 by 2 elevated road can ease the congestion and provide |

| Date | Organization / Person | Subject | Main Questions, Comments, and Concerns Raised/Discussed during the Meetings |
|---|---|---|---|
| | Al Ftouh | System | the space for the BRT.<br>• CDR clarified that the widening is a pivotal project with objectives that are bigger than the BRT Project. One of the criteria for selecting to place the BRT on the main highway is the urban connection in comparison to placing in on the coastal road. The CDR has commissioned a feasibility study for the elevated road as well the A2 road which is an arterial, inland road connecting the north to Beirut.<br>• The Union representative, Mr. Juan Hobeich, was presented with the plots affected by expropriation due to the BRT Project.<br>• The Union is not in favour of converting the use of the landscaped area opposite Fouad Chehab stadium to a P&R facility, unless it is created beneath the existing landscaped area. |
| 30 August 2017 | Municipality of Tabarja-Kfar Yassine | Introducing the Bus Rapid Transit (BRT) System | • The Municipality is against the project as it will bring a lot of traffic to Tabarja and is thus anticipated that the new infrastructure and associated influx of passengers will burden the local road network, as Tabarja will become a transport hub.<br>• It is suggested that the BRT infrastructure is moved to the coastal road |

## 5.2 PUBLIC CONSULTATION MEETINGS

### *5.2.1 Scoping Phase*

The first public consultation meeting, as part of the Scoping Phase, was conducted on the 19th of January 2017 at the Theatre of the Municipality of Jdeideh – Baouchrieh – Sed El Baouchrieh at 10 am. A total of 52 persons attended the scoping public consultation meeting.

A public announcement was posted along the Project area covering its three (3) sections: Northern Highway and Beirut Inner and Outer Rings. Announcements were also posted on municipalities' boards. The announcement's purpose was to inform the public about the Project and invite them to the Scoping Public Consultation Meeting. Announcements were posted 20 days prior to the Scoping Public Consultation Meeting.

Official invitation letters were sent to concerned Ministries and public administrations, Internal Security Forces (ISF) officials, Governors, Qaimaqams, Federations of Municipalities, and Municipalities. All invitations were sent at least 15 days prior to the meeting's date. In addition, invitations were sent by fax or e-mail to the concerned Syndicates and e-mail invitations were sent to a pool of NGOs, especially the advocacy groups and organisations who support public transport projects and initiatives.

A copy of the announcement, photographic records of the posted announcements, and a list of attendees of the first public consultation meeting are included in APPENDIX I. A sample invitation letter and the list of invitees are also provided in APPENDIX I.

Attendees included public sector officials and ministries' representatives, representatives of the public transport syndicates, civil society representatives, and the general public. A copy of the attendance sheet is provided in APPENDIX I.

After the presentation, questions and discussions lasted for about an hour and a half. The session was closed when none of the attendees had further comments or questions. A summary of the comments raised by the participants and the responses are provided in Table 5-2.

Moreover, at registration, feedback forms were distributed to attendees allowing them to provide the team with their comments in writing. An example of the feedback form is provided in APPENDIX I and a summary of the written comments and concerns is provided in Table 5-3.

Photographic records of the session are provided in Figure 5-1.

**Table 5-2. Questions and Comments Raised by the Participants and Responses**

| Entity | Comments | Reply |
|---|---|---|
| Mr. Jean Matar, Transportation Consultant, Syndicate of Drivers in Northern Metn | • It has been a while (~10 years) since the Government has been asked to provide a proper public transportation system, therefore this a long-awaited project.<br>• The BRT System is not a complete project and is not the only solution for the traffic problem. Other plans and projects need to be implemented in parallel such as decentralization of public services to reduce traffic in urbanized areas.<br>• Many people from sub-urban and rural areas commute to Beirut at various hours of the day to complete transactions or as in the case of Mount Lebanon to complete vehicle inspections, where only one center serves the Mt Lebanon governorate. The centralization of services increases traffic volumes significantly in the Greater Beirut Area.<br>• In order to reduce traffic volumes, an elevated BRT and an elevated highway (above the BRT System) should be implemented.<br>• What about people who live in rural areas or who do not live on a main road and do not own a car? How will they be able to reach the BRT System?<br>• Beneath the road from Solidère – Seaside road – Corniche El Mazraa, there is a high-tension line. This might be problematic for the construction works of the BRT System. | • People who do not own a car can ride in the feeder buses. The 20 bus lines will be integrated with the BRT System.<br>• The BRT System is part of the solution which is not to widen existing roads or create new roads but to organize public transportation and move people not cars.<br>• The Project is still at the feasibility stage. The BRT System's implementation will depend on the outcomes of the study. |
| Ms. Jessica El Chemaly, NAHNOO NGO | • How many people will each bus carry?<br>• The civil society has doubts on the possibility of such projects being implemented or run successfully by the public sector.<br>• Has the MoPWT's strategy for public transportation been approved?<br>• Will there be a need for expropriation?<br>• Who will operate the BRT System? | • It is planned to have a frequent service, such as every 3 to 4 minutes. The bus specifications are not defined yet. It is expected that each bus would have capacity for 50 or more passengers.<br>• There is a very small chance that expropriation will be needed. The highway will be widened with or without the implementation of the BRT System in the Jounieh area (A1 Highway, part of another project).<br>• It is expected that a private company will operate the buses on behalf of the public administration.<br>• It is important to note that since the Project is still at the feasibility stage, there are no definitive answers. |

| **Entity** | **Comments** | **Reply** |
|---|---|---|
| Mr. Ali Muhieddine, Union of Syndicates of Drivers of Public License Vehicles in Lebanon<br>اتحاد نقابات سائقي السيارات العمومية للنقل البري | • There is already a strategy to organize public transport in Lebanon, prepared by the MoPWT, and it is being reviewed by the Council of Ministers (CoM)<br>• The Syndicate wants to see a significant reduction in traffic volumes<br>• It is good that the BRT System is being studied as part of the MoPWT's strategy<br>• The Syndicate requested a copy of the Project under study so that they can review it and present an informed opinion | - |
| Mr. Youssef Merhi, Lebanese Citizen | • The BRT System is a very good idea. However, there are a few questions/comments to highlight:<br>o Why doesn't the BRT System continue to Byblos?<br>o As part of the economic impacts of the project; taxi, vans, and bus drivers currently working along the proposed BRT line need to be integrated in the system. This might even need a separate study.<br>o How well can the BRT System operate without high-tech systems (e.g., creation of an application) especially that high-tech transportation modes already exist such as Uber<br>o How will the removal of a lane from the highway allow the successful implementation of the Project? | • The CDR is currently working on this project as a pilot case. There is a future plan to extend to all Lebanese territories if the pilot project generates positive outcomes.<br>• There is a plan to continue the service to Tripoli. However, between Tabarja and Tripoli, it is envisaged that the buses will not operate on dedicated lanes.<br>• There will be a control room to manage the buses' operations. Timetables will be available at the stations to indicate the arrival and departure times of the buses. |
| Mr. Elias Maalouf, Train/Train Lebanon NGO | • This is not the first time that the BRT System has been suggested. In 2003, an international consultant studied the possibility of implementing the BRT System in Lebanon.<br>• Egis also conducted a study for the implementation of the railway and part of the study was the possibility of implementing a BRT System in Lebanon or an LRT. One of the study's outcomes was that the lifetime of the BRT System would be till 2020.<br>• In order to implement the BRT System, roads will need to be widened and people will be disturbed (e.g., commercial establishments).<br>• Train/Train Lebanon NGO is not against the BRT System. However, previous studies showed that from Beirut to Tabarja, the railway is a better option given that the railway track is already there. Also, | • The BRT System is a medium-term solution. Its implementation does not require heavy infrastructure like the railway. The BRT System will be implemented in the middle of the highway. It will not run on the existing railway track because there is a plan to revive the railway system.<br>• The BRT System and the railway project are both being studied; one does not eliminate the other.<br>• One of the alternatives for Jounieh highway is to create an elevated BRT System. |

| Entity | Comments | Reply |
|---|---|---|
| | widening the Jounieh highway would be very pricey.<br>• It is very important while studying the economic feasibility of the BRT System to set a certain direction and timeline to be followed by the Project owner to ensure the success of the Project<br>• We need to apply pressure on the Government to implement the Project. If we don't, no project will be implemented. | |
| Ms. Marwa Yassine, Ministry of Environment | Will ELARD conduct noise measurements and air quality modelling during the ESIA phase? | Yes, noise measurements will be conducted. As for air quality, the study will be desk-based using background data from MoE's database. |
| Mr. Chadi Faraj, Bus Map Project | • How will the BRT System attract people?<br>• What will become of the currently existing public transportation system?<br>• How will the sustainability of the project be guaranteed? | • The BRT System is a main component of the public transportation strategy and it is a fast track project. Incentives will be studied to encourage people to switch to the BRT System. For example, in Abu Dhabi, in order to encourage people to use public transportation and reduce the use of their cars, parking fees and vehicle inspection fees will be increased. Similar solutions could be studied for Lebanon.<br>• It is proposed to find means to integrate the taxi, vans, and bus drivers currently working on the same routes as the future BRT line with the BRT System. |
| Mr. Jad Baaklini, Bus Map Project | • Have the prices for the BRT System been defined?<br>• Will traffic safety be considered?<br>• How will the BRT System and the MoPWT 20 bus lines operate in parallel? This issue is still not clear | • Not yet.<br>• Yes, through the pedestrian bridges, elevators and safe crossings.<br>• The integration of the 20 bus lines and the BRT System is still being studied. |
| Ms. Rita Hanna, Activist | In order to implement any project in Lebanon changes in the public administration must be made. | - |
| Mr. Karim Jaroudi, Ministry of Environment | Will the BRT System be extended to south of Beirut? | The pressing traffic problem is along the Northern Highway. If the pilot project generates good results, the Project might be extended to all the Lebanese territories. |
| Mr. Elias Abou Mrad, Train/Train Lebanon NGO | • The continuity between the three (3) alignments is not clear.<br>• The highway is a barrier for public transport. How will the bus station in the median strip work? What will be the dimensions of | • In order to ensure continuity between the two (2) sides of the highway (coming into Beirut and leaving Beirut) and accessibility of commuters to the stations |

| Entity | Comments | Reply |
|---|---|---|
| | the pedestrian bridges? Why will the BRT be implemented in the middle of the highway?<br>• How will the pollution from cars moving on the highway affect people waiting in the bus stations for the bus to arrive?<br>• How will construction works affect traffic flow until the BRT System is up and running?<br>• The BRT concept has no value unless an action plan and a timeline are set.<br>• The BRT System should not be a replacement for the railway which is still a better solution. The BRT and the railway should both operate to move people.<br>• Why doesn't the BRT pass inside Jdeideh so that people can directly access the bus and not walk distances?<br>• What will be the type of fuel for the operation of the BRT? | in the median strip, there will be new pedestrian bridges, one for each bus stop to connect both sides of the highway. The BRT dedicated lanes will be in the middle of the highway so that the buses' right of way is not interrupted by traffic movement in and out of side streets and economic activity on the shoulder of the highway.<br>• The dimensions of the pedestrian bridges will be decided according to the population density.<br>• Since it is foreseen to have a bus every 3 to 4 minutes, the passengers' waiting time and therefore exposure time is not foreseen to be of long duration.<br>• The BRT System and the railway project are being studied in parallel.<br>• If the railway moves freight it would significantly reduce traffic from freight trucks.<br>• It is envisaged that there will be feeder buses from neighbouring localities to connect to the bus stations via the pedestrian bridges.<br>• The type of bus technology and thus fuels to be used is still being studied. |
| Mr. Charbel Challita, UNDP-OCFTC | • The BRT System is a good development project.<br>• In order to reach an appropriate solution for public transport, the BRT System and the railway should operate in parallel. | - |
| Mr. Ahmad Osman, Ministry of Environment-EU | • For the Outer and Inner Rings in administrative Beirut, what is the guarantee that vehicles will not encroach on the dedicated bus lane?<br>• What is the guarantee that "Horsh Beirut" will not be affected?<br>• The MoPWT strategy for public transportation cannot be found online. However, the public has the right to have access to it. | • A physical separation will be established to separate the dedicated bus lane from traffic.<br>• The project's geographic footprint is far from "Horsh Beirut". |
| Ms. Dania Turjman, Ministry of Environment | • The BRT alignment from Beirut till Tabarja is clear.<br>• The inner ring is not clear. Will it be considered in the ESIA?<br>• There are already very few green areas in Beirut. Thus, there is a concern for the greenery in the median strip along the Corniche | • The studies for the Inner Ring are at their early stages.<br>• The greenery in the median strip along the Corniche will not be removed. The on-street parking is proposed to be removed to gain a lane for the BRT. |

| Entity | Comments | Reply |
|---|---|---|
| | in Beirut.<br>• The three (3) BRT alignments need to be clearly described in the ESIA report. | The BRT in that area might be operated on the right lane in the space currently reserved for on-street parking. If it is operated in the left lane, the on-street parking on the right will be removed, and the green median strip will not be removed. |
| Mr. Raed Jouni, Citizen | • There is a remarkable absence of civil society members in the meeting<br>• What is the methodology followed to select certain people to attend such meetings?<br>• How will focus groups be selected? | • Public announcements were posted at the boards of the different municipalities where the BRT line will pass through and at different shops and commercial establishments along the BRT alignment to invite the general public. Also, private invitations were sent to public administrations and authorities. Special interest groups and NGOs were notified by e-mail and the public announcement was sent to them.<br>• Focus groups will include: traders, members of the general public (e.g., women of different ages), syndicates of public transportation, and civil society groups.<br>• Questionnaires will be prepared for commuters along the future BRT alignment. |

**Table 5-3. Comments and Concerns Expressed via the Feedback Forms**

| Entity | Comments |
|---|---|
| Mr. Chadi Faraj and Mr. Jad Baaklini, Bus Map Project | As bus riders of existing transit, we would like to be part of the focus groups. |
| Ms. Dania Turjman, Ministry of Environment | • The social and environmental impacts of each BRT alignment must be clearly described.<br>• Mitigation measures for each identified impact must be clearly described.<br>• Indicate whether there will be feeder buses or no as part of this Project and whether BRT buses on dedicated lanes will be implemented in the city of Beirut or not. |
| Mr. Ahmad Osman, Ministry of Environment-EU | • It is very important to ensure a physical separation between the dedicated bus lanes and traffic to prevent cars from encroaching on the dedicated bus lanes. This should also be accounted for in the Inner Ring.<br>• "Horsh Beirut" should not under any circumstances be used as a Park & Ride facility or for any other purposes.<br>• Message to the MoPWT: As a tax-payer, I have the right to access online the strategy for public transportation. |
| Municipality of Tabarja - Kfaryassine | We are against the BRT System because it would increase the traffic to Tabarja and Kfaryassine. The parking lots associated with the Project will take up large areas which would result in additional traffic on the internal roads of Tabarja-Kfaryassine. |
| Mr. Raed Jouni, Citizen | • I am interested in following-up on all the participatory activities that will be organized between local authorities and the public or with entities specialized in studying the urban dimension of the Project.<br>• I am interested in taking part in the focus groups. |
| Mr. Jean Matar, Transportation Consultant, Syndicate of Drivers in Northern Metn | • The BRT System will not resolve the problem 100%<br>• Please consider alternative solutions such as:<br>o Move organizations outside Beirut<br>o Perform mechanical inspections for vehicles outside Beirut<br>o Move industries outside Beirut<br>o Ensure rural development<br>o Improve available means of transportation in terms of fleet development and Customs tax exemption |

**Figure 5-1. Photographic Records of the Scoping Public Consultation Meeting**

One of the special interest groups who attended the meeting are active in the public transport domain and have a website, an online blog, and two pages on social media (Facebook).

They posted about the consultation meeting during and after the event, and published two articles on their blog related to the subject. The first blog article gives a good summary of the meeting proceedings (http://blog.busmap.me/2017/01/20/brt-and-inclusion) while the second blog article focused on the BRT System and integration (http://blog.busmap.me/2017/01/23/brt-and-integration). In general, they portrayed a general positive outlook on the merits of the BRT System and most importantly on the process of engagement of the public in the early stages of the study.



**Figure 5-2. Postings about the Scoping Public Consultation Meeting on Social Media**

### *5.2.2 ESIA Phase*

The second public consultation meeting, as part of the ESIA, was conducted on the 7th of September 2017 at the Municipality of Sin El Fil at 10 am.

Official invitation letters were sent to concerned Ministries and public administrations, Internal Security Forces (ISF) officials, Governors, Qaimaqams, Federations of Municipalities, and Municipalities. All invitations were sent at least 15 days prior to the meeting's date. In addition, invitations were sent by fax or e-mail to the concerned Syndicates and e-mail invitations were sent to a pool of NGOs, especially the advocacy groups and organizations who support public transport projects and initiatives. A sample invitation letter and the list of invitees are provided in APPENDIX J.

A total of 36 persons attended the public consultation session. Attendees included public sector officials and ministries' representatives, representatives of the public transport syndicates, as well as civil society representatives. A copy of the attendance sheet is provided in APPENDIX J.

The presentation started at 10:30 am. The Consultants described the project followed by a presentation of the assessment results related to traffic, emissions to air, noise emissions, biodiversity, archaeology, and socio-economy. A copy of the presentation (in Arabic) is provided in APPENDIX J.

After the presentation, a Q&A session was held and lasted for about an hour. A summary of the comments raised by the participants and the responses are provided in Table 5-4.

Moreover, at registration, feedback forms were distributed to attendees allowing them to provide the team with their comments in writing. An example of the feedback form is provided in APPENDIX J and a summary of the written comments and concerns is provided in Table 5-3.

Photographic records of the session are provided in Figure 5-1.

**Table 5-4. Questions and Comments Raised by the Participants and Responses**

| Entity | Comments | Reply |
|---|---|---|
| Mr. Fadi Sayegh, Lebanese Physical Handicapped Union-Association of Passenger Rights | • The aim of the project is to encourage people to leave their cars and use public transport but the project only covers the northern entrance to Beirut which will prevent it from achieving its goals.<br>• What is the number of parking spaces provided at the eight stations from Tabarja to Beirut? If we are heading to Beirut will we know how many parking are available or will we have to find parking spaces ourselves?<br>• Is there a link between the BRT and the eastern and northern regions of Beirut city? If not, then people will not be willing to give up on using their private cars.<br>• Disabled people were taken into consideration in the socio-economy section, however, in the project description the characteristics of the buses were discussed (Wi-Fi, Air conditioning) but special considerations for disabled and special needs people were not stated. What about safety cameras? If they were not provided, women will not use those buses since they are potentially subject to harassment.<br>• The cameras and the Wi-Fi system can be connected to the operation room to provide safety.<br>• What are the mitigation measures considered at the intersections within Beirut, and how will the private lane be protected from trespassing cars?<br>• How will people on wheelchairs be able to cross from one road to another? Will the buses be equipped with elevators for wheel chairs? | • The stations are equipped with electric elevators.<br>• The buses on the other hand will have the possibility to be lowered to the street level for easy access or will be equipped with elevators.<br>• Buses will have seats designated for disabled people and no one else is allowed to use them.<br>• Sufficient parking spaces are provided in the eight suggested park and ride stations.<br>• A surveillance room is available to monitor the bus path, and the buses will be equipped with cameras inside to monitor passengers on the buses in case of any security breach.<br>• Feeder buses will be provided to link the BRT with Beirut area. Since the project is an integrated system, the operating company will have common standards for the BRT and the feeder buses and therefore, they will both be designed to take into consideration disabled people's needs.<br>• The buses will have priority to cross intersections. Upon the arrival of the bus (moving in its dedicated lane) at the intersection, the traffic light will directly give the way for the bus and this shall encourage people to use it. |
| Elie Andrea, Vice President of Beirut Municipality | • It is very difficult to implement such a project in Beirut.<br>• Beirut is 20 km$^2$ visited by 1.5 million persons and around 1-1.2 million cars per day. The roads in Beirut are saturated with cars.<br>• It is impossible to widen the roads since buildings are on both sides.<br>• The available parking spaces in Beirut are not sufficient enough to accommodate for the number of cars and the situation will become worse if the project is implemented. | • The concerns raised will be taken into consideration. All the factors are still under study and discussions with Beirut Municipality, CDR, World Bank and project design stakeholders.<br>• The project design will try to reduce to the extent possible the impact on the seaside. The lane will require four meters. Those can be divided between each side road and the median strip. Different solutions can be implemented but all are still being |

| Entity | Comments | Reply |
|---|---|---|
| | • Cost of land in Beirut is extremely expensive; the cost of buying a land to be used as a parking lot will cost the municipality at least 15 to 20 million USD.<br>• Utilizing the coastal side and dedicating a lane for the buses will cause visual intrusion and disturb people who visit this area.<br>• Inside Beirut there are many entrances and exits of parking lots that need to be taken into consideration.<br>• It is very difficult to implement the inner and outer rings in Beirut, but Beirut Municipality is discussing the issue with CDR and the World Bank to find a solution.<br>• The traffic study showed a slight improvement in road congestions if the project is implemented. This is a weak point for the project which was supposedly expected to result in great traffic improvement.<br>• Beirut municipality in agreement with the Directorate General of Transport will start implementing a new project (bus stop signs and a public bus system). | debated.<br>• Beirut Municipality has several studies regarding parking locations and solutions. The project can benefit from such studies to solve the parking lots issue.<br>• In the early stages people will face the problem of lacking parking spaces, however with time (a year or two) when people shift from using their personal cars to use the BRT, this issue will be solved.<br>• Implementing a public transport system is the main solution for the traffic problems in Beirut. |
| Engineer Lotf Allah Azar | • Is there a possibility of implementing an elevated path for the project?<br>• Will this project prohibit the current vans from operating? If not, then the traffic issue will be the same. | • A feasibility study was launched by CDR for constructing an elevated bridge for the northern highway from Nahr Kalb to Tabarja. The results will specify whether it is an appropriate alternative or not.<br>• Mechanisms to integrate the current public transport system with the new BRT and feeder bus system are being discussed among the relevant parties. |
| Rachid Otaki, Federation of Keserwan Ftouh Municipalities | • What is the Timetable for the project?<br>• To what extent the project is related to the A1 project? | • The project will require five years to be operational.<br>• The BRT project and A1 will have to be implemented in parallel. The feasibility of the BRT project relies on the implementation of the A1 expansion project or the elevated highway alternative, if considered. |
| Mikel Barbara, MindSETS | • Are the parking spaces discussed in the presentation enough to cover all the passengers?<br>• What will the parking fee be?<br>• Governmental projects are known to last for a year only before being destroyed or damaged. How will this be avoided? | • According to the traffic modelling, the project will require between 9,000 and 10,000 parking spaces.<br>• The parking will not cost any additional fees. They are part of the bus ticket.<br>• The operation of the project will be undertaken between the public sector (Railway and Public |

| Entity | Comments | Reply |
| --- | --- | --- |
| | | Transportation Authority) and the private sector which will be responsible for regular monitoring and maintenance. |
| Amjad Dehman, SETS | • Were impacts on business owners along the path of the inner and outer rings assessed in the socio-economic study especially that the project will replace the parking lane? | • Studies worldwide have shown that most of the people who use the parking spaces in front of the shops or business centers are the employees themselves and not the customers. The project might actually encourage customers to use the BRT system to reach shops that currently do not have parking spaces for visitors.<br>• The ESIA study acknowledges this impact however it is difficult to assess the magnitude and nature of the impact; the impact on the business owners could actually be positive |
| Marline Haddad, Metn Qaimaqam | • Too many studies have been conducted but nothing is being implemented. All governmental institutions and employees have several projects that can be implemented. A lot of governors and Qaimaqams play a role in submitting studies to the international organizations for implementation.<br>• Meetings and discussions are not required anymore, projects should commence. | - |
| Chadi Faraj, Bus map project | • Several focus groups were conducted. How did those meetings affect the study and its design?<br>• The current public transportation system is informal, thus shifting to an organized and formal transportation system is difficult. How will such transition be managed? | • The discussions of the focus groups and the suggestions and concerns raised during the meetings were analyzed and recommendations/mitigation measures are included in the ESIA study and shall be integrated as part of the project design |
| Charbel Challita, UNDP and RPTA | • It is essential to start implementing the BRT project in parallel with A1 project to minimize impacts on local residents during construction. | • This is indeed the government's plan. |

**Table 5-5. Comments and Concerns Expressed via the Feedback Forms**

| Entity | Comments |
|---|---|
| Lotf Allah Azar, Engineer | • What will happen with the current private sector (Vans, buses, cars)? Will this project prohibit their operation or will they keep stopping randomly causing traffic?<br>• An elevated path or similar solutions should be studied. |
| Salwa Al Sabbagh, Urban Designer | • Project duration.<br>• Connect to the South especially that the traffic heading towards the south increases daily.<br>• Connect to the airport. |
| Rachid Otaki, Federation of Keserwan Ftouh Municipalities | • Coordinate with the federation who is currently working on a common transportation plan for all the Caza's municipalities. |


**Figure 5-3. Photographic Records of the ESIA Public Consultation Meeting**

# 6. ANALYSIS OF PROJECT ALTERNATIVES

The discussion and analysis of alternatives should consider practicable alternatives to the proposed ones that would promote the mitigation of negative environmental and social impacts identified. This section is a requirement of the assessment process, and is critical in consideration of the ideal development with minimal environmental and social disturbance.

## 6.1 NO PROJECT ALTERNATIVE

Without the BRT project, the population of almost 2.2 million residing in Greater Beirut and the larger urban population that commute to Beirut from the northern areas will not benefit from a sustainable, efficient, advanced and safer transport system. The urban population which is in continuous growth (87% of total population in 2050) will continue to suffer from traffic congestion, traffic accident risks, and unreliable public transport systems. If a reliable and improved public transport such as the BRT is not introduced, the dominant transport mode will continue to be the private passenger car. The use of private passenger cars would continue to be the preferred option while contributing to overloading the capacity of existing roads, increasing pollution levels and GHG emissions, and increasing the overall cost of mobility.

The BRT services will be designed to be efficient and its buses to operate on dedicated lanes with signage and improved infrastructure. Without the dedicated BRT corridor, the buses would be stuck in mixed traffic, without dedicated stations for passengers and regulated timetables. Ultimately, it is expected that there would be no improvement in the level of service that a public transport system would provide, with adverse impacts on quality of life and the environment. The status quo with sub-standard levels of service in the public transport system would be expected to continue.

A situational analysis showing how having the BRT System in place versus the No Project Alternative is summarized in Table 6-1.

**Table 6-1. BRT System versus No Project Alternative**

| Category | BRT Alternative | No Project Alternative |
|---|---|---|
| **Safety** | ▪ Enhanced passenger safety at P&R facilities, bus stations and terminals (security personnel, security cameras)<br>▪ Reduced injuries and fatalities from accidents<br>▪ Facilitated bus departure and landing at sheltered stations<br>▪ Operation of buses at regulated speed on a dedicated lane with proper signage | ▪ Higher frequency of traffic accidents, injuries and fatalities (pedestrian and car crashes)<br>▪ Exposure to air pollutants during traffic congestion<br>▪ Under-developed infrastructure with improper signage<br>▪ Safety is not prioritized with the existing public transport bus systems |
| **Comfort** | ▪ Intelligent Transportation System (ITS) that facilitates trip planning, up-to-date passenger information and emergency preparedness<br>▪ Sheltered stations with seating that serve persons with impaired mobility | ▪ Public transport modes operate in mixed traffic, with no timetables or scheduled trips<br>▪ No passenger stations, curbside pickup of passengers |

| Category | BRT Alternative | No Project Alternative |
|---|---|---|
| **Travel Time** | ▪ Faster travel-time on a dedicated lane with proper traffic management and scheduled timetables | ▪ Slower travel-time since public transport buses operate in mixed traffic and have no dedicated passenger landing stations (frequent stops) |
| **Cost of Transport** | ▪ Cheaper alternative compared to private vehicle transportation<br>▪ Increase in fares compared to existing public transport buses, which can be explained through improved service and accessibility | ▪ Cheaper alternative compared to private vehicles, but with limited coverage. Fares do not ensure satisfactory service, safety, and travel-time |
| **Air Pollution** | ▪ Reducing air pollution from switching from old vehicles to BRT buses or less usage of private vehicles due to continuation of trip by BRT bus from P&R facilities<br>▪ Efficient performance of new buses, which reduces fuel consumption and ultimately reducing air pollution | ▪ Inefficient operation of buses and old vehicles<br>▪ Dominating mode of transport remains private vehicles, increasing the pollution levels, especially during congestion |
| **GHG Emissions** | ▪ Substitution of multiple low occupancy vehicles with a BRT bus leads to less overall fuel consumption and reduction in GHG emissions<br>▪ Reduction in GHG/passenger due to the switch to BRT buses | ▪ Inefficient operation of buses and old vehicles increases fuel consumption and GHG emissions |
| **Operational Sustainability** | ▪ Continuous maintenance and preservation of the BRT bus fleet and infrastructure ensures the operational sustainability of the system<br>▪ Operation planned based on population and demand growth | ▪ Deteriorating public transport service, with no proper maintenance apart from few initiatives to maintain profit without consideration of the service quality and demand growth |
| **Socio-economic Benefits** | ▪ Creation of job opportunities<br>▪ Increased potential for developments of other public transport services (e.g. taxis) around stations and terminals to further serve commuters | ▪ Service is provided by few operators with little potential for additional jobs due to limited infrastructure and road space to support more buses<br>▪ Absence of a managed infrastructure does not create opportunity for developments around major commuter destinations |
| **Accessibility** | ▪ Distributed coverage and accessibility to areas based on demand<br>▪ Facilitated accessibility for individuals with mobility impairment | ▪ Over-supply of services in certain areas and high competition among few operators, while other areas are under-supplied<br>▪ Accessibility to individuals with mobility impairment is not a priority |
| **Health Benefits** | ▪ Reduced exposure to pollutants due to shorter time travel and more efficient transport system<br>▪ Increase in physical activity of the BRT system users | ▪ Increased exposure to pollutants which is exacerbated during traffic congestion and long-travel time |

## 6.2 ELEVATED BRT CORRIDORS

BRT corridors running in the median highway can be constructed on separate elevated roads or underground viaducts as an alternative to ground-level structures. Due to the complexity of the underground system and the archaeological potential in Lebanon, only the elevated system is considered as a potential alternative and compared to the current project. There are multiple elevated BRT projects operational around the world such as Xiamen (China) (refer to Figure 6-1) and Nagoya (Japan) (refer to Figure 6-2) among others.

Elevated systems can have relatively high construction costs, due to the additional requirement of raw material and complexity of the engineering, especially in already developed urban settings. Elevated roads are preferred where there are a lot of intersecting roads with the main corridor and the construction area is not already developed. No additional lane is gained by having elevated structures since the columns holding the road will be occupying the space, especially in the case of construction at the median section of the road. Table 6-2 reviews different characteristics of the elevated systems compared to road-level systems.

Nonetheless, the elevated road option is advocated by the local authorities and municipalities in the Kesserouan area. A feasibility study to evaluate the elevated road option is currently being pursued by the CDR.

**Table 6-2. Elevated BRT versus Road-level BRT Systems**

| Category | Elevated BRT System | Road-level BRT System |
|---|---|---|
| **Cost** | High cost, due to higher construction requirements in terms of material, space and labour | Relatively low cost, since the current existing infrastructure can be integrated wherever possible, and less construction material, space and labour is needed |
| **Aesthetic view and landscape** | High elevation of the road will obstruct the view of residents on both sides of the road, taking into consideration that the project area already has dense commercial and residential developments on both sides of the road | Good aesthetics since the system is integrated at a location where the paved highway exists. The only elevated structures will be the pedestrian bridges connecting to the stations that do not cause major visual impact, particularly when the design is integrated with the urban setting |
| **Noise and Vibration during construction** | Increasing noise levels during transportation and pilling of construction material, and higher vibration impact resulting from the use of larger excavation machinery and boring equipment | Increasing noise levels during transportation of construction material and less vibration impact resulting from construction activities at ground level |
| **Air pollution during construction** | High impacts of dust and air pollution from demolition, excavation, transportation of material and construction of elevated structures | Medium impacts of dust and air pollution from demolition, excavation, transportation of material and earth works |
| **Waste generation during construction** | Larger quantities of construction waste, since larger quantities of raw material are used and | Less construction waste resulting from shorter periods of construction |

| Category | Elevated BRT System | Road-level BRT System |
|---|---|---|
| | longer construction time | activities |
| **Risk to archeological/ cultural sites** | High risk for accidental damage and unearthing of archaeological heritage, since deeper excavation is required to erect the columns | Lower risk for accidental damage and unearthing of archaeological sites, since minimal excavation and earth work is required to build the infrastructure |
| **Impact on utilities** | Higher risk since major excavation works and pilling is needed | Minimal risk since no deep excavation for pilling will be required |
| **Flexibility and integration with other transportation systems** | Less flexible to integrate and expand with the expansion of the traffic network or conduct major maintenance works | More flexible to integrate and expand with the expansion of the network or conduct major maintenance works, since the infrastructure is more accessible |
| **Operation and capacity** | Fewer stations and longer distance of trips due to the difficulty of building elevated stations and allocating space | Possibility for more frequent stations but with relatively lower capacity with shorter duration of trips |
| **Operational safety** | Increased speeds of buses can increase the scale of accidents or injuries (in case of occurrence); added difficulty during evacuation | Relatively safer to operate and manage accidents (in case of occurrence); easier evacuation plans |
| **Construction safety** | Higher risk of accidents for workers and the surrounding due to construction works at high elevations | Lower risk of accidents for workers and the surrounding due to construction works at road level |

## 6.3 BUS TECHNOLOGY ALTERNATIVES

Most common buses operate on diesel fuel. Advanced models are equipped with Diesel Particulate Filters (DPF) and Selective Catalytic Reduction (SCR) Technology. There are other more advanced technologies that operate on biodiesel, compressed natural gas (CNG), diesel-electric (Hybrid), electricity using overhead electric wires (Trolley) or rechargeable batteries, and Hydrogen (Fuel Cell) to name a few. An overview of the characteristics of different bus technologies and the advantages/disadvantages of each is presented in Table 6-3.

Trolley buses are not considered in the comparison, since the capital cost of the buses are high and require a high-cost infrastructure of overhead wires and connecting poles in addition to constant electricity supply, which is a challenge in current circumstances in Lebanon. Other fuels also require some sort of requirements but mainly the supply of fuel. Hybrid, Biodiesel and Diesel (with DPF) require similar facilities to provide the fuel. Natural Gas and Fuel Cell buses need specific storage and supply systems that often increase the capital cost of these systems. Since natural gas infrastructure is not realized in Lebanon, buses running on natural gas may not be realistic for the short to medium term.

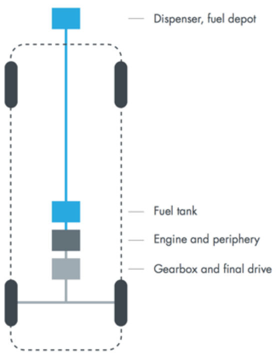
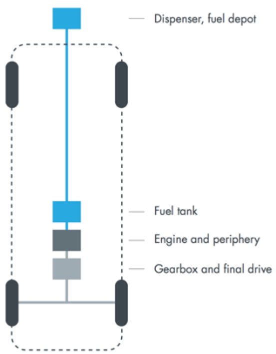
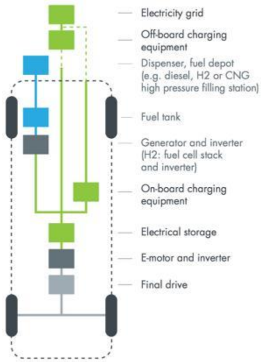
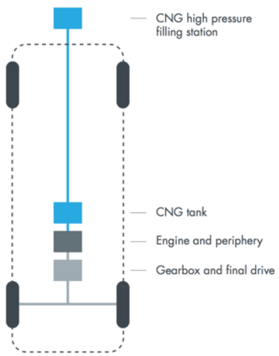
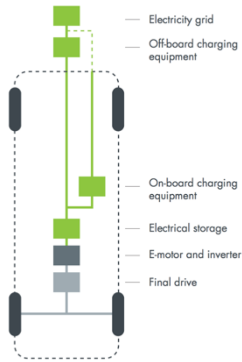
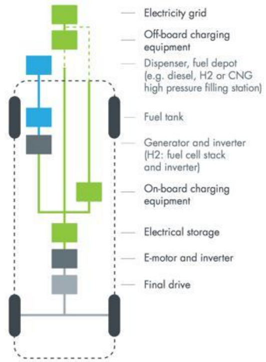
Urban development plans, energy sector projections, demand increase on the BRT System, environmental performance as well as infrastructure readiness to integrate some of the technologies are factors that should be considered with the given characteristics of each alternative fuel buses.

The choice of diesel buses for the BRT System of this Project stems from the examination of available infrastructure and availability of fuel types in the local market. It is recommended to settle for a known and tested bus technology, provided that new buses are procured that run on energy-efficient engines (Euro V or Euro VI), are equipped with DPF and SCR technology to reduce PM and NOx emissions, and use ultra low sulfur diesel in conformity with the national specified standards.

**Figure 6-1. Elevated BRT Corridor and Stations in Xiamen, China**

**Figure 6-2. Elevated BRT Corridor in Nagoya, Japan**

**Table 6-3. Comparison between Different Bus Technologies**

| Category | Diesel (with DPF) | Biodiesel | Hybrid (Diesel-Electric) | Natural Gas | Battery Electric | Fuel Cell |
|---|---|---|---|---|---|---|
| **Description** | Diesel combustion engine is the power source of operation | Combustion engine is the power source of operation, which uses biodiesel fuel instead of pure diesel (e.g. B100 (100% or pure biodiesel), B20 (20% biodiesel and 80% petroleum diesel), B5 or B2) | Combined the conventional combustion engine system with an electric propulsion system | Combustion engine is the source, which uses natural gas either in liquefied form (LNG) or compressed (CNG) | Rechargeable battery is the source of power | Uses hydrogen fuel cell as power source for electrically driven wheels, sometimes improved with a hybrid setting with batteries or a supercapacitor |
| |  |  |  |  |  |  |
| **Capital cost** | USD 250,000 | USD 250,000 | USD 250,000-340,000 | USD 280,000 | USD 360,000-560,000 | USD 900,000 |
| **Maintenance cost** | 0.20-0.31 USD/km | 0.32 USD/km | 0.31 USD/km | 0.44-0.50 USD/km | No information | 0.33-0.50 USD/km |
| **Fuel supply** | Fuel storage and dispensers similar to most common petrol stations | Same filling stations such as diesel for <B7. High blends (B20-B100) require dedicated filing stations and special storage | Same filling stations such as diesel. Plug-in types require a charging infrastructure | Requires a specific filling infrastructure (special compressor and buffer tank for fast filling). Gas is supplied at local depots or through existing gas network | Specific infrastructure (charging points within the bus depot or along the route at bus stops) | Hydrogen requires a specific filling infrastructure that includes a dispenser and supply infrastructure to fuel the vehicle at a regulated pressure |

| Category | Diesel (with DPF) | Biodiesel | Hybrid (Diesel-Electric) | Natural Gas | Battery Electric | Fuel Cell |
|---|---|---|---|---|---|---|
| **Air pollution** | PM: 0.015- 0.68 g/km<br>CO: 0.5-4.4 g/km<br>NOx: 14-18.22 g/km<br>HC: 1.3 g/km | PM: 0.015-0.08g/km<br>CO: 1.5 g/km<br>NOx: 2.82 g/km<br>HC: 1.31 g/km | PM: 0.010-0.015 g/km<br>CO: 0.4 g/km<br>NOx: 0.5-1.1 g/km<br>HC: - | PM: <0.01-0.02 g/km<br>CO: 0.074-0.54 g/km<br>NOx: <1 g/km<br>HC: 9.87 g/km | No direct emissions, indirect emissions depend on energy production | No direct emissions, indirect emissions depend on production method |
| **GHG emissions** | 1,317-1,700 $gCO_2e/km$ | 120-842 $gCO_2e/km$<br>highly variable based on fuel used | 1,054-1,100 $gCO_2e/km$ | 1,277-1,400 $gCO_2e/km$ | No direct emissions, indirect emissions depend on energy production | No direct emissions, indirect emissions depend on production method |
| **Noise** | Standing: 80 dB<br>Passing: 77 dB | Standing: 80 dB<br>Passing: 77 dB | Standing: 69 dB<br>Passing: 73-78 dB | Standing: 78 dB<br>Passing: 78 dB | Lower than diesel | The noise emissions are low and comparable to electric buses |
| **Energy/ Fuel consumption** | 4.1 kWh/km<br>0.50-0.56 l/km | 4.1 kWh/km<br>0.57 l/km | 3.3 kWh/km<br>0.45 l/km | 5.2 kWh/km<br>0.63-0.71 l/km | 1.4 kWh/km<br>- | 3.1 kWh/km<br>1.4 l/km |
| **Fuel cost** | 0.48 USD/km | 0.48 USD/km (B20) | 0.38 USD/km | 0.36-0.42 USD/km | Depend on local electricity production | 0.42 USD /km |
| **Range** | 600-900 km | 570-850 km | 600-900 km | 350-400 km | < 100 km | 200-400 km |
| **Energy efficiency** | 1.5-1.6 km/l | 0.6-0.7 km/l | 2.31 km/l | 1.27-1.45 km/l | 1.6-2.4 km/kWh | 2.79 km/l (diesel equivalent) |
| **Speed** | Max Speed: 100-120 km/h | Max Speed: 100-120 km/h | Max Speed: 60-80 km/h | Max Speed: 80 km/h | Max Speed: 45-80 km/h | Max Speed: 70-80 km/h |
| **Refueling time** | Every second day; 5-10 min | Every second day; 5-10 min | Every second day; 5 min | Every other or second day; 5-10 min | Multiple times a day; 5-10 min | Refueling every day at the end of operation; 10 min |
| **Advantages** | Due to the long tradition of diesel engines, the efficiency, maintenance and exploitation costs of diesel buses are predictable; a fuelling infrastructure is in-place; | Only slight motor modifications of the diesel bus are necessary to use biofuels, and reduce emissions. | Low fuel and energy consumption. | Lower noise and air emissions. | One of the cleanest technologies with negligible direct emissions and lower noise emissions. Electricity can be generated from sustainable sources, | One of the cleanest technologies with negligible direct emissions and lower noise emissions. Electricity can be generated from sustainable sources, |

| Category | Diesel (with DPF) | Biodiesel | Hybrid (Diesel-Electric) | Natural Gas | Battery Electric | Fuel Cell |
|---|---|---|---|---|---|---|
| | these buses can relatively easily be adapted for the usage of biofuels. | | | | and batteries recycled. | and batteries recycled. |
| **Disadvantages** | If emission control measures are not applied and maintained, it results in relatively high emissions;<br>Diesel is a non-renewable source of energy. | For each particular type or blend of biofuel, specific modifications must be performed on the bus engine. | More costly and heavier bus (leading to reduced number of passengers given the same number of axles) | Safety concerns resulting from gas leakage and increased risk of fire;<br>Natural gas is a non-renewable source of energy. | High purchase price and investment in charging infrastructure;<br>Uncertainty about the battery life and costs. | The technology is not mature yet;<br>Safety concerns are associated with high pressure hydrogen storage and fueling;<br>Very high vehicle and infrastructure cost. |

Sources: (CIVITAS, 2016); (traffic21/CMU, 2016); (Berger, 2015); (M.J. Bradley, 2006); (Gwo-Hshiung, Cheng-Wei, & Serafim, 2005)

# 7. ENVIRONMENTAL AND SOCIO-ECONOMIC IMPACT ASSESSMENT

In this section the main potential impacts that could arise from the construction and operation phases of the Project are identified and their significance assessed so that any potentially significant impacts can be properly mitigated. The impact identification and assessment methodology is described in the following sub-sections.

## 7.1 IMPACT IDENTIFICATION AND ASSESSMENT METHODOLOGY

### *7.1.1 Impact Identification*

The identification and analysis of impacts consists of appraising the design information submitted by the Project Proponent, in conjunction with the baseline information of the site. Impacts from similar projects, as cited by literature, and as documented by the Project Proponent for other similar projects conducted elsewhere, are also examined so as to identify potentially significant impacts on the environment and surrounding communities. After identifying the project impacts, the ESIA evaluates their significance and determines mitigation measures to eliminate/minimize these impacts.

Identification of potential environmental and socio-economic impacts and their severity is facilitated by the use of a matrix that shows the main activities and operations anticipated at the project site, the major impacts, and the environmental and socio-economic components affected. Impacts can be induced during the construction phase of the project and later during its operation.

The extent of impacts depends primarily on the various design elements that would be implemented in the construction and operation phases of the Project. Hence, impacts can be anticipated at the design stage of the project, especially given that the BRT System is still at the feasibility stage and will have to undergo conceptual, detailed design and design for construction. The identification or anticipation of potential impacts at this early stage gives credibility to the environmental and socio-economic impact identification and assessment process. The resultant environmental and socio-economic mitigation measures should be integrated in the design of the BRT System to ensure project acceptability and sustainability.

A single matrix was developed to summarize the impacts expected during the construction and operation phases (refer to Table 7-1). The matrix describes the potential impacts through identifying the sources/activities and the pathways through which these impacts affect receptors (environment/human).

**Table 7-1. Impact Identification Matrix for the Construction and Operation Phases of the Project**

| Activity \ Component | Air Quality | Noise | Geology, Hydrogeology, Soil and Groundwater Resources | Ecology | Archaeology and Cultural Heritage | Traffic | Visual Amenity | Socio-economy | Health and Safety | Accidents |
|---|---|---|---|---|---|---|---|---|---|---|
| **Construction** | | | | | | | | | | |
| Mobilization/Operation/Demobilization of Equipment | X | X | X | X | - | X | X | X | X | - |
| Site Clearance, Grading and Excavation Activities | X | X | X | X | X | X | X | X | X | X |
| Construction Activities | X | X | X | X | - | X | X | X | X | X |
| Existing highway widening between Nahr el Kalb & Tabarja | X | X | X | X | X | X | X | X | X | - |
| Construction vehicles movement | X | X | - | X | - | X | - | X | X | X |
| Storage of chemicals / Fuel/ raw materials on site | - | - | X | X | - | - | X | - | X | - |
| Accidental Spills (fuels/chemicals) | X | - | X | X | - | - | X | - | X | - |
| Inadequate waste disposal (solid and liquid) | X | - | X | X | - | - | X | X | X | - |
| **Operation** | | | | | | | | | | |
| Normal Operation | X | X | - | - | - | X | X | X | X | X |
| Maintenance Activities | - | X | X | - | - | - | - | X | X | X |

### *7.1.2 Significance Assessment*

The identified environmental and socio-economic impacts are assessed in terms of their Significance (Low, Moderate or High) based on the Likelihood (Low, Moderate or High) of the impact and its Consequence (Insignificant, Minor, Moderate, Major, Critical and Beneficial). A number of considerations are built into the Impact Consequence Criteria including nature, direction, magnitude, geographical extent, timing, duration and reversibility of the impact as per the MoE Decision No. 261/1/2015. Some basic questions which can be used to address the above considerations are shown in Table 7-2, and the results are filled in Table 7-3.

**Table 7-2. Questions for Addressing Considerations under Impact Consequence Criteria**

| Issue | Question | Criterion | |
|---|---|---|---|
| Nature of impact | What is the nature of the impact? | P: Positive<br>N: Negative | D: Direct<br>I: Indirect |
| Magnitude of the impact | What is the scale of magnitude of the impact on the environmental medium in question? | L: Low<br>M: Medium<br>H: High | |
| Extent of the impact (geographical scale of the impact) | Is the extent of the impact localized or confined to a designated area around the project site, or does it extend regionally/ nationally/ globally? | L: Local - Change or effect only within the project site or extends to areas immediately outside<br>G: Global - Regional, national, or international changes or effects. | |
| Timing of the impact | Is the impact likely to persist for a long or short term? | S: Short term<br>M: Medium term<br>L: Long term | |
| Duration of the impact | Are the consequences likely to be limited to the construction or operation phase? | D: Design/Pre-construction<br>C: During construction<br>O: During operation | |
| Reversibility of the impacted condition (impacted condition can be changed or reversed) | Are the consequences likely to be reversible or irreversible? | R: Reversible<br>I: Irreversible | |

**Table 7-3. Consequence Assessment Criteria Template Table**

| Impact/Source | Nature | Magnitude | Geographical Extent | Timing | Duration | Reversibility | Consequence Rating |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |

### *7.1.3 Impact Assessment Criteria*

Consequence criteria are ranked into six levels of significance based on their rating as listed in Table 7-4.

**Table 7-4. Consequence Assessment Criteria**

| Criteria | Consequence Rating |
|---|---|
| Nature: Negative<br>Magnitude: High<br>Extent: Global (large area of effect that supports sensitive receptors)<br>Timing: Short, medium or long-term<br>Reversibility: Irreversible | 5. Critical |
| Nature: Negative<br>Magnitude: High<br>Extent: Local (area supports a significant proportion of sensitive receptors)<br>Timing: Short, medium or long term<br>Reversibility: Reversible or irreversible | 4. Major |
| Nature: Negative<br>Magnitude: Medium<br>Extent: Local (area of effect encompasses an area that supports either a moderate or minor proportion of sensitive receptors) or global<br>Timing: Short, medium or long term<br>Reversibility: Reversible | 3. Moderate |
| Nature: Negative<br>Magnitude: Low<br>Extent: Local (sensitive receptors located in the immediate vicinity of the source or areas immediately outside)<br>Timing: Medium or long-term (1 – 5 years or > 5 years)<br>Reversibility: Reversible | 2. Minor |
| Nature: Negative<br>Magnitude: Low – unlikely to be noticeable<br>Extent: Local (absence or presence of sensitive receptors located in the immediate vicinity of the source)<br>Timing: Short-term<br>Reversibility: Reversible | 1. Negligible |
| Changes that result in a net positive impact to an ecosystem, environment or population. | B. Beneficial |

The likelihood of the occurrence of the impact is then rated according to the categories outlined in Table 7-5.

**Table 7-5. Likelihood Categories and Rankings Impacts**

| Score | Category | Definition |
|---|---|---|
| H=3 | High | The impact will occur under normal operating conditions |
| M=2 | Moderate | The impact may occur at some time under normal operating conditions |
| L=1 | Low | The impact is unlikely to occur under normal operating conditions but may occur in exceptional circumstances |

Impact significance level is assigned according to the Likelihood of Occurrence cross-tabulated with the Consequence Rating Criteria as shown in Table 7-6.

**Table 7-6. Impact Significance Levels**

| | | Consequence Rating | | | | | |
|---|---|---|---|---|---|---|---|
| | | **Negligible 1** | **Minor 2** | **Moderate 3** | **Major 4** | **Critical 5** | **Beneficial B** |
| **Likelihood Rating** | **Low L=1** | 1 | 2 | 3 | 4 | 5 | + |
| | **Moderate M=2** | 2 | 4 | 6 | 8 | 10 | ++ |
| | **High H=3** | 3 | 6 | 9 | 12 | 15 | +++ |

**Legend**

**Consequence Rating**
1- Negligible
2- Minor
3- Moderate
4- Major
5- Critical
B- Beneficial

**Likelihood**
L- Low (1)
M- Medium (2)
H- High (3)

| **Significance** | |
|---|---|
| + to +++ | Beneficial |
| 1 to 3 | Low |
| 4 to 9 | Medium |
| 10 to 15 | High |

The scoring of impact severity is conducted by different methods: (1) round table scoring exercise by a team of experts, (2) results from analyses and calculations, and (3) scientific predictions based on experience in the field and from similar projects.

### *7.1.4 Management of Impacts*

Residual impacts will be ranked for significance after mitigation measures are applied. The following apply for the different levels of impact significance:

| | |
|---|---|
| Low significance | These impacts are considered to be acceptable. Implementation of mitigation and monitoring measures are required to ensure these impacts remain at low significance. Management of these impacts is the responsibility of the Project Proponent. |
| Medium Significance | It must be demonstrated that the significance of these impacts cannot be reduced further. These impacts must be managed in conjunction with affected stakeholders or population in a manner defined during the ESIA process. |
| High Significance | These impacts are not tolerable. They are likely not to be acceptable to affected populations even with compensation. Measures to reduce the significance of the impacts to Medium or Low need to be identified. This may involve project re-design, consideration of alternatives meeting the same objectives or any other means to reduce the significance of the impact. Final decision on impact acceptability must be made in conjunction |

| | |
|---|---|
| | with affected stakeholders in a manner defined during the ESIA process. |
| Beneficial | These are positive impacts that should be maintained by the Project P, who should demonstrate through the implementation of the monitoring plan that these impacts remain positive and to the extent possible, enhance the benefits through complementary measures. |

## 7.2 POTENTIAL SOURCES OF IMPACTS

Based on a literature review of the impacts of similar projects, international standards and guidelines, in addition to a detailed review of the proposed Project components as described in Section 2, impacts can be induced during the design phase, the construction phase, and later during its operation as shown in Table 7-7, Table 7-8 and Table 7-9.

The extent of impacts depends primarily on the various management practices that would be adopted during the design, construction and operation of the BRT System. The identified impacts should be further studied as the Project's design evolves.

The potential impacts are studied along each geographic alignment separately, taking into account the baseline environmental and socio-economic conditions which are region-specific. The Project components are the three alignments which are the Northern Highway, Beirut Outer Ring and Beirut Inner Ring; the stations along the alignments, the P&R facilities and the bus depots and terminals.

The impacts are addressed in relation to currently-defined design elements, construction and operation activities associated with the Project components, and their geographic locations. Given that the Project is still in the feasibility stage, it is anticipated that the Project design will evolve to take into account the recommendations from this ESIA, as well as operational design elements which will be clearer going forward.

**Table 7-7. Sources of Impacts and Potential Impacts during the Design/Pre-Construction Phase**

| Sources of Impacts during Design/Pre-construction | Potential Environmental and Socio-economic Impacts |
|---|---|
| Poor integration of the BRT System with current public transit services, other public transport systems to be introduced in the future, or the surrounding environment | • Public outcry and frustration from insufficient or disintegrated services that do not meet the long-standing demand for an efficient and reliable public transport system<br>• The current design of stations' separating distances of 850 m on the northern highway, 700 m in the Outer Ring and 500 m in the Inner Ring encourages users within 400 m radius to exercise as they walk to the stations<br>• Poor integration of the infrastructure with the local transit needs and cityscape might lead to poor uptake of the new BRT services, especially if the design of stations, bridges and surrounding infrastructure are not user-friendly for all people, appealing or safe for vulnerable groups such as women, youth, special needs persons and the elderly<br>• Potential visual impact resulting from constructed facilities |

| Sources of Impacts during Design/Pre-construction | Potential Environmental and Socio-economic Impacts |
|---|---|
| | of the BRT System that do not improve the fabric and aesthetics of the urban space<br>• Non-inclusion or weak integration of the current public transport service providers in the BRT System might create social unrest among operators due to foreseen competition for passengers and road space<br>• If the level of service of BRT feeder buses are sub-standard to the BRT trunk line itself, or if pedestrian infrastructure connecting P&R facilities and stations to neighborhoods and satellite/commuter towns are not upgraded and/or designed to meet the different social needs of users, commuters, especially women, people with special needs or limited mobility, students, the elderly, etc. might be discouraged to undertake journeys in the BRT System<br>• Poor or lack of allocation of sufficient space for commuters who alight from or wish to board other vehicles at stations might lead to tailbacks on the right lanes and reduce the level of service on the road |
| The reserved width of the BRT-dedicated lane on both sides of median of the northern highway between Charles Helou & Tabarja is 8.3 to 11.8 m | • On the medium to long-term, it is anticipated that the BRT System would attract more customers who will make the switch from private vehicles to using the bus, thus contributing to reduced congestion and better level of service along the highway<br>• Decreasing the width of the road which currently witnesses heavy congestion at most times, and not exclusively during peak hours, will lead to public opposition in the short to medium-terms as reduced congestion might only be gradual as private vehicle users switch to using the BRT System |
| Introduction of the BRT System in the section of the northern highway between Nahr el Kalb and Tabarja requires:<br>- Widening of the A1 Highway between Dbayeh and Tabarja to a 3 by 3 lane road<br>- Widening of Ghazir and Casino du Liban bridges by 4.6 m | • Widening bridges or constructing new ones are associated with localized impacts on the local environment (debris, construction-related impacts) and the canyons underneath that can however be mitigated, with special attention to the neighboring Roman Bridge<br>• Poor coordination of construction work schedules for A1 Highway widening and BRT-associated construction works along the intersecting sections between Nahr el Kalb & Tabarja would lead to multiple bottlenecks, cause social nuisance and lead to increased noise and air emissions from vehicles idling in standstill traffic<br>• Impacts from widening the A1 Highway are manifold and are examined separately in an EIA and Land Acquisition and Resettlement Plan, prepared by the CDR (www.eib.org/attachments/pipeline/20090635_eia_en.pdf). The impacts from the land acquisition due to widening are addressed in the Expropriation decrees for the A1 highway widening.<br>• The land acquisition and resettlement impacts associated with the BRT pedestrian bridges are analysed in the Resettlement Action Plan document, separate to the ESIA Report. Impacts include partial land expropriation of a total of 235 $m^2$ for the road widening without any land fragmentation, approx. 14,000 $m^2$ for the depot in Safra, and 8,000 $m^2$ for the terminal in Tabarja. All affected lands are non-productive. Some fixed assets such as steel containers and planted trees will be removed and compensated accordingly. Five households illegally |

| Sources of Impacts during Design/Pre-construction | Potential Environmental and Socio-economic Impacts |
|---|---|
| | occupying state-owned land in one of the P&R facilities in Kfaryassine will be displaced, however compensated in accordance with the provisions of Expropriation Law No. 58/1991. |
| Introduction of the BRT System in the Beirut Outer Ring necessitates that:<br>- 1,200 on-street side parking spaces are axed<br>- Due to road layouts, some sections cannot be dedicated – such as in tunnels from Ain el Tineh to Adlieh, Sin el Fil & Dekwaneh, Dbaibo between Ain el Mreisseh & Raouche<br>- 2 m of the coastal sidewalk (Corniche) be removed<br>- Street furniture, signals, stop signs and traffic lights, and road marking be upgraded to accommodate the BRT System with its stations | • Improvements to road infrastructure is anticipated to enhance road safety. However, since regular buses and taxis will continue to operate on the road lanes next to the BRT lane, continuing to allow passenger-driven road habits of hailing taxis and buses to stop at undesignated locations, as well as pedestrians crossing at unmarked locations through inadequate road design to accommodate different uses and demands, might not bring about the foreseen benefit enhanced road safety. Hence road infrastructure upgrades should solve the cumulative impact from chaotic road usage by addressing the road design of all stretches that the BRT buses and their feeders intend to service<br>• On the medium to long-term, and if public parking lots with limited spaces are made available, it is expected that fewer private vehicle journeys are made into the Greater Beirut Area that is served by the BRT and its feeders, leading to higher parking fares, fewer fuel consumption and pollutant and GHG emissions per commuter<br>• Mixed traffic lanes might lead to bottlenecks and discourage the use of the BRT System for some users, due to increase in journey time, and rise in collision risks in mixed traffic sections<br>• On the short-term, the removal of on-street side parking is anticipated to create social dismay and unacceptance from private vehicle owners, local shops' and business owners, and violations of stricter street parking rules are expected to increase. Enforcement of strict no-parking and no-stopping rules with fines should induce on the medium-term a disincentive to drive private cars into the city for routine journeys, and guarantee free flow on the roads adjacent to the BRT lane<br>• Given the high recreational and amenity value of the seafront promenade, narrowing the sidewalk might induce public opposition to reducing the free, open air public space that is revered by the city dwellers, and which is a touristic attraction in its own right |
| Introduction of the BRT System in the Beirut Inner Ring necessitates:<br>- Removal of approx. 1,500 on-street parking spaces on the right hand side, to be replaced with a dedicated BRT bus lane<br>- Only one lane in some stretches remains available for through traffic, and in some stretches the bus would move in mixed traffic<br>- Dedicated lanes not to be physically separated from the rest of the road to enable traffic movement | • The Inner Ring route traverses areas in the heart of the city of Beirut with a marked presence of schools, universities, hospitals, government agencies, social welfare organizations esp. for persons with special needs, cultural centers and museums/galleries, entertainment hubs, shopping areas, restaurants, public parks, etc., hence an improved bus service with marked stops, good level of service roads, with safety features, no on-street parking and upgraded pedestrian infrastructure to residential neighborhoods, commercial areas, educational institutions, etc. should be expected to attract students and inter-city commuters on short journeys, and contribute to less traffic congestion during peak hours<br>• Introducing a bus service within the city might result in less trips demanded from shared taxis, within the zones that the bus and its feeder buses would service |

| Sources of Impacts during Design/Pre-construction | Potential Environmental and Socio-economic Impacts |
|---|---|
| from side streets into and out of residential neighbourhoods, which would however cross-over the dedicated bus lane at numerous points | • Given the nature of the highly-dense and interwoven inner city streets, the maneuverability impacts from having a dedicated bus lane in the Inner Ring are too restrictive for local traffic, and direct access to residences and small businesses on the right-hand side of the road<br>• While medium to long-term impacts from removing on-street parking spaces are positive for calmer circulation of vehicles on the inner city roads, most parking spaces are used by residents who do not have parking spaces allocated in their residential buildings or neighborhoods, hence, unless alternative public/resident parking garages are made available by the Municipality of Beirut by the time that the BRT bus runs, city dwellers on the Inner Ring route would not have sufficient spaces to park their vehicles<br>• Mixed traffic lanes might lead to bottlenecks and discourage the use of the BRT System for some users, due to increase in journey time, and rise in collision risks in mixed traffic sections |
| Bus fleet and Operability | • Bus size, engine, fuel used, and running frequency influence the assessment of air and noise emissions; which based on the selected technology they will be reduced. The expected reduction in private vehicles trips or trips made in passenger cars is also anticipated to influence the net emissions budget.<br>• The size of the bus, its amenities, frequency of running, operating staff, ticketing system, fares, safety provisions for boarding, disembarking and using the buses by all persons will affect acceptability and take-up. Larger buses within the city of Beirut are expected to be refused by the city dwellers. Low-emission, clean and safe buses that operate on fixed schedules and routes are a key feature that are expected to impact social acceptability and participation. |

**Table 7-8. Sources of Impacts and Potential Impacts during the Construction Phase**

| Sources of Impacts during Construction | Potential Impacts during Construction |
|---|---|
| Site clearance, grading, excavation and paving activities, which involve mobility of personnel and mobilization/ operation/ demobilization of Powered Mechanical Equipment (PME) | • Temporary visual impacts with the presence of equipment, machinery and workers<br>• Increase in air pollution, including Airborne particulates (dust) from soil disturbance<br>• Increase in vibration and sound levels<br>• Soil disturbance and potential impacts on land conditions and groundwater resources (e.g., changes in water drainage, erosion, runoff, sedimentation, grading)<br>• Induced potential secondary development during construction in the surrounding areas<br>• Accidental unearthing/disturbance of archaeological artefacts<br>• No major impacts from construction works are anticipated on species of fauna and flora and their habitats given the primarily urban nature of the project area<br>• Exposure of workers, pedestrians and passengers to |

| Sources of Impacts during Construction | Potential Impacts during Construction |
|---|---|
| | potential asphalt odor and hazardous fumes during paving activities |
| Improper handling and storage of construction materials/raw-material as well as accidents: | • If construction works are not properly conducted and managed with safety measures considered, people passing near the construction site could be at risk<br>• Impacts resulting from any dewatering activities<br>• Impact on workers' and pedestrians' safety resulting from improper handling and storage of construction material and construction activities |
| • Traffic accidents<br>• Pipeline and/ or storage tanks fracturing, leakage, as well as explosion and fire hazards<br>• Potential sabotage (risk assessment and emergency response)<br>• Presence of: equipment, materials, soil heaps, and borrow pits, on main existing roads and the highway near commercial and industrial establishments and residential units | • Impact on the public's nuisance, health and safety in the heavily congested and dense corridors of Beirut and the coastal areas in the districts of Metn and Kesseruoan |
| • Potential loss of trees and vegetation in the median strip and highway shoulder | • Poor landscape and visual amenity, and less greenery in the local urban environment |
| Potential use of gensets (combustion of fossil fuel for the operation of the gensets) | • Change in ambient air quality |
| Workers' exposure to noise, dust and occupational hazards | • Increased risks of accidents and health problems |
| Closing sections of the highway and creating detours to allow construction works and the movement of vehicles to transport people and materials | • Increased peak and off-peak traffic volumes at bottlenecks that will negatively impact people's daily activities (delays to reach destinations, discomfort, increase in noise levels, etc.)<br>• Potential negative impact on businesses (i.e. shops, markets, restaurants, cafes) on the highway resulting from temporary loss of customers or delays |
| Improper storage of chemicals and generated waste on-site<br><br>Accidental spillage of chemicals like fuel, lubricants, oils and other chemicals used for construction works and/or operating the equipment and/or generating power<br><br>Inadequate management (handling and disposal) of solid domestic and construction waste (including empty cement bags, piles of sand and dirt due to excavation, etc.), and generated domestic wastewater | • No major impacts from construction works are anticipated on species of fauna and flora and their habitats given the primarily urban nature of the project area<br>• Chemical and biological contamination of soil and water resources<br>• Impact on workers' and pedestrians' safety resulting from improper handling and storage of chemicals and solid waste generated related to construction activities |
| Asphalt application during the paving phase of the exclusive BRT lane construction | • Exposure of workers, pedestrians and passengers to potential asphalt odor and hazardous fumes during construction activities |
| Impacts resulting from poor implementation of a Traffic | • Since significant part of the project involves construction on existing traffic routes, the successful or |

| Sources of Impacts during Construction | Potential Impacts during Construction |
|---|---|
| Management Plan during the construction of the BRT system | poor implementation traffic management plan will have tangible impacts on the existing traffic and the public using this traffic route |

**Table 7-9. Sources of Impacts and Potential Impacts during the Operation Phase**

| Sources of Impacts during Operation | Potential Impacts during Operation |
|---|---|
| Operation and maintenance of the BRT System | • Enhancement of mobility for domestic and international tourists and highlighting of touristic and cultural heritage features along the bus route, which leads to the promotion of landmarks, museums and heritage assets<br>• Enhancement in mobility, road infrastructure and furniture: signage, road markings, signals, crossings<br>• Local small business development around bus stations to serve commuters<br>• Local public transport development around bus stations to further serve commuters (e.g. taxis)<br>• Socio-economic growth in the areas that have access to the BRT system through direct/indirect employment opportunities, increase in land value and attraction of development investments<br>• Short-term to medium-term potential decrease in traffic flow and speeds, and therefore increased congestion due to fewer lanes available for vehicular traffic, in the transition period until commuters switch to using the BRT System and become regular users<br>• Traffic creation at P&R facilities and at bus stations if passages and side road infrastructure within localities are not upgraded<br>• Short-term to medium-term potential increase in fuel demand due to the additional buses added to the fleet in the transition period until commuters switch to using the BRT System and stop using their cars<br>• Resource consumption for the operation of the buses and maintenance activities<br>• Potential soil contamination from accidental spills during maintenance and fueling activities (e.g. fuel, lubricant or oil used for the maintenance)<br>• Increase in noise levels especially during nighttime bus traffic<br>• Hazardous and non-hazardous waste generation from maintenance activities<br>• Solid Waste generation by passengers and operating personnel at stations and P&R facilities |
| Switching to BRT System from other modes of transportation (reduction of number of vehicles) | • Potential reduction in GHG emissions<br>• Potential reduction in emissions of air pollutants (CO, NOx, $PM_{10}$, $SO_2$) and GHGs<br>• Organization of the public transport sector would lead to reduction in traffic incidents thus road fatalities and injuries are reduced<br>• Time and monetary savings for users switching from use of private vehicles to the BRT running on a |

| Sources of Impacts during Operation | Potential Impacts during Operation |
|---|---|
| | dedicated lane, with set time schedule and intelligent transportation system<br>• Higher rates of physical activity for BRT users due to longer walking distances which results in health benefits for BRT users<br>• Reduction in number of passengers using the current buses, thus reduction in passenger turnover and reduced incomes to current bus drivers due to passengers switching to the new BRT System |
| Provision of well-lit stations staffed with security personnel, security cameras on buses and in stations/P&R facilities, and pedestrian-scale lighting around stations | • Creation of a safer environment in the areas served by BRT System<br>• Better road and community safety due to both safer commuting and reduced exposure to road-traffic pollution |

## 7.3 SOURCES OF CUMULATIVE IMPACTS

Potential cumulative sources of impacts around the Project Site include the following:

- The existing urban context where the BRT System will operate is characterized by heavy urbanization and traffic congestion. On-road traffic is already contributing to national air pollution emission levels, ambient air quality and GHG emissions, and elevated noise levels.
- The gains from the BRT System or positive impacts cannot come about if the A1 Highway widening is not widened to at least three by three lane road
- The visual pollution in the urban context and multiplicity of built structures along the roads where the BRT route will run is already at a serious level of unsightliness whether in Beirut or along the northern highway, especially in the Metn area.
- Vehicle ownership is rising, and removing a lane from the current road to be dedicated to the BRT bus may or may not present an incentive for potential car owners to purchase cars.
- Poor safety record on the roads and accident rates are already very high.

Whenever applicable, the effect of these potential cumulative impacts on the different receptors will be taken into consideration as part of the subsequent assessment of project-related impacts.

## 7.4 IMPACTS ON TRAFFIC

The BRT lines were implemented in the EMME model files with their stops as shown in Figure 7-1 below.

**Figure 7-1. BRT Alignment**

Along with the BRT service, feeder services with specific itineraries are provided to serve as transit to and from the BRT stations as shown Figure 7-2 below.

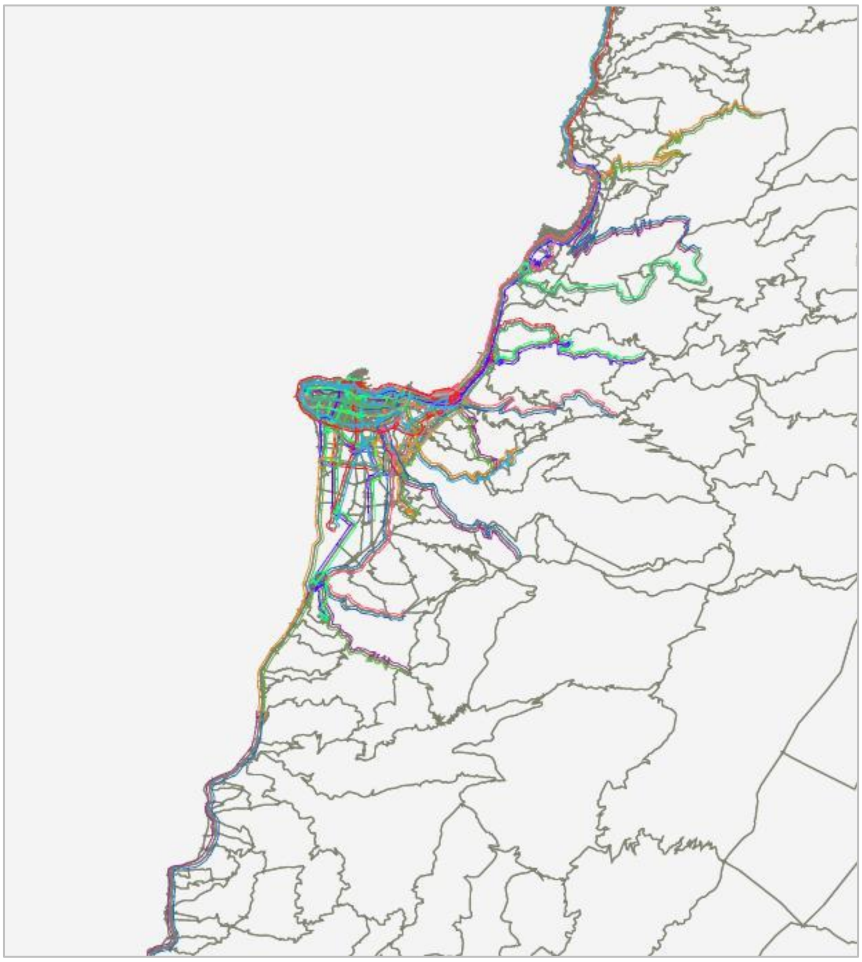


**Figure 7-2. BRT and Feeders Network**

**Table 7-10. Consequence Assessment on Traffic**

| Impact | Nature | Magnitude | Extent | Timing | Duration | Reversibility | Consequence Rating |
|---|---|---|---|---|---|---|---|
| T.D.1. Impacts resulting from road closures, bottlenecks due to road works to construct the BRT | N/D | H | L | M | C | R | Major |
| T.C.1. Increased traffic due to creation of detours during construction | N/D | H | L | M | C | R | Major |
| T.O.1. Traffic congestion during the operation of the project | N | H | L | M | O | R | Major |
| T.O.2. Traffic congestion at P&R facilities and at bus stations if no upgrading of roads and infrastructure takes place | N | H | L | L | O | R | Major |
| T.O.3. Advanced traffic monitoring systems and ease of traffic flow | P | - | - | - | O | - | Beneficial |

### *7.4.1 Traffic Assessment*

The project will generate direct impact on Beirut, Metn and Kesserouan districts and their road network. However, the level of this impact will be variable according to several parameters and it can affect Northern Lebanon as well as Mount Lebanon. The study area is selected as the zone where the influence of the project will be direct and significant. Figure 7-3 and Figure 7-4 below show the selected study area for Beirut and two northern districts in Mount Lebanon.

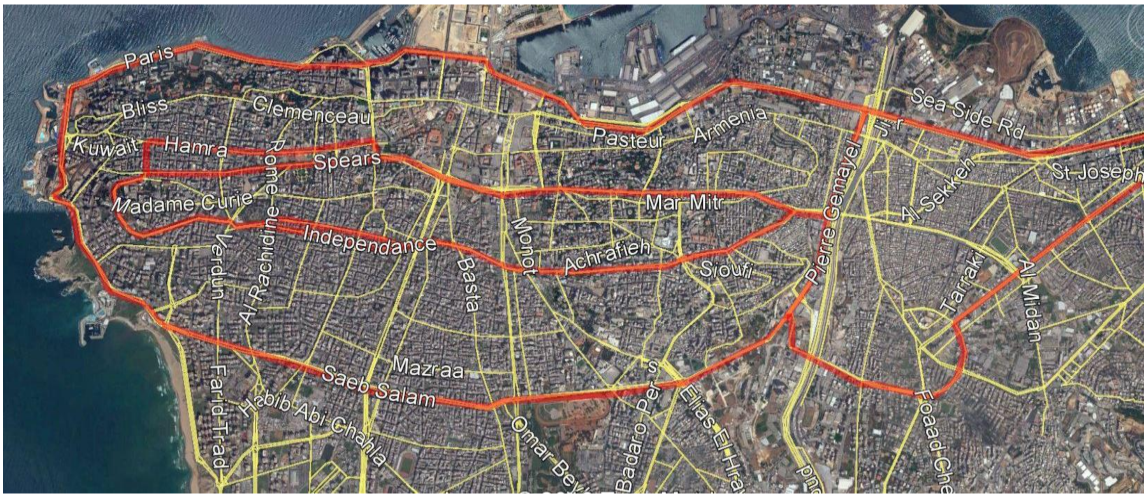



**Figure 7-3. Study Area in Beirut**


**Figure 7-4. Study Area in Mount Lebanon**

The Consultant used the traffic model and all its scenarios that were carried out within the mentioned feasibility study. This model was upgraded and calibrated within the feasibility study based on the Engineering Consultant's counts to provide a reliable estimation of expected passenger volumes, and to provide the ability to assess the BRT System within a comprehensive approach that would allow informed debates among stakeholders, decision makers and the community.

Therefore, the given traffic model was extended from Damour to Tabarja including the main urban and local roads in Beirut and Mount Lebanon networks. Additional projects were also added to the future scenarios: years 2023, 2028 and 2038 with and without the BRT project.

The upgraded Road Network Model provided by the Engineering Consultant is described, in the current situation, by approximately 3,040 nodes, including zones, and 6,400 links. However, several zones were split for future years in order to meet the requirements of the BRT design, which increased the number of nodes to 3,270, in addition to the park and ride zones in the scenarios included in the project.

Parking is an important issue for the success of the BRT project; the removed parking spaces should therefore be compensated by others in the same area.

#### *7.4.1.1 General Approach*

Traffic assessment is based on the existing traffic model of Greater Beirut, which ensures a reliable estimation of traffic volumes gives the ability to assess such infrastructural projects and provides a comprehensive vision allowing relevant discussions among stakeholders, decision makers and the community.

The objective is to identify passengers transported by the BRT, and to appropriately evaluate the project. The main challenge for this Urban Area is to organize the transportation system in order to accommodate future demographic and urban growth in the whole northern suburbs and Beirut.

In the next 30 years, both the vehicle fleet and the average number of daily motorized trips per person are expected to increase by almost 60%. Added to the expected demographic growth, this will double the total number of motorized trips. Such an evolution will lead to infrastructure problems densely located in the Greater Beirut and Mount Lebanon, where the situation could become critical if adequate management solutions or serious alternative public transport are not implemented. Similar problems will arise at entrances and crossings of large cities.

Accordingly, the project will be assessed in order to define conditions of future implementation of public transport facilities such as BRT or dedicated bus lines. It is important to check if the design will allow the circulation of buses or a BRT in the future, taking into consideration the roadway's ability to accommodate such transport modes, and the space on sidewalks for their facilities, such as bus stops and other equipment.

The general approach is illustrated in Figure 7-5.

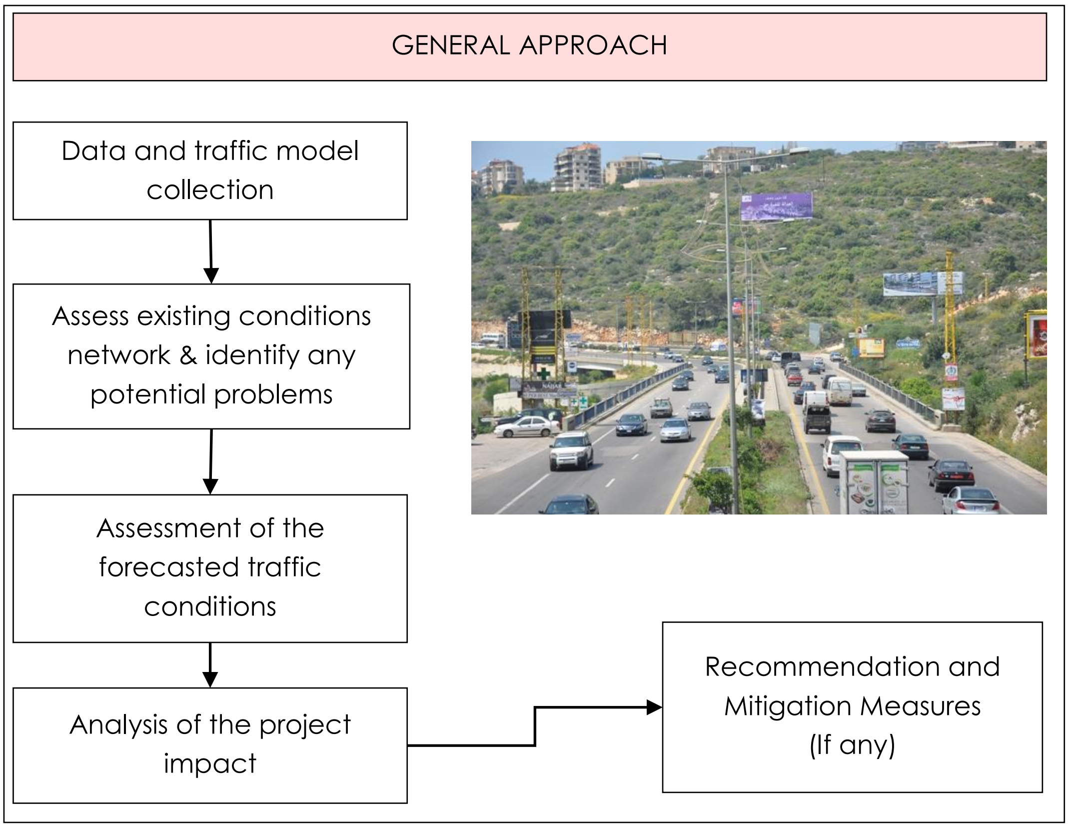



**Figure 7-5. General Approach of the Traffic Impact Assessment**

Traffic assessment is performed as part of the ESIA study. The traffic model is used to examine the Project. Improvements / amendments, recommendations and mitigation measures (if any) are provided after ensuring a reliable estimate of traffic volumes within the district, and level of service assessment for the Project's main corridor, with and without the project, at identified peak hours.

The analysis includes:

1. Analysis and assessment of existing traffic flows and conditions.
2. Assessment of the network's current situation.

3. Analysis of the project impact (carrying out two scenarios: with and without the project).
4. Proposal for mitigation measures and recommendations, if necessary.

*7.4.1.2 Theme-specific Approach*

The approach for determining the significance of traffic impacts is based on changes in traffic flows at peak hours and during the day. The presence of receptors (e.g. built-up areas, schools, hospitals, etc.) is a necessary prerequisite for impacts to occur. The proposed traffic consequence ranking is provided in Table 7-11 for construction phase and Table 7-12 for the operation phase.

During the construction phase, the assessment of the detours is qualitative.

During operation, the consequence ranking is based on calculation of level of service for both situations: with and without the project. Comparison between results from these situations (according to the table) will be used to propose the ranking levels.

**Table 7-11. Ranking of Consequence on Traffic Conditions during Construction**

| Negligible | Minor | Moderate | Major | Critical | Beneficial |
|---|---|---|---|---|---|
| **1** | **2** | **3** | **4** | **5** | **B** |
| Traffic is served at the same performance and no significant changes are noticed | The provided performance are 10% less than the currently available which has a minor effect on the traffic circulation | The provided performance are between 10 and 20% less than the currently available which has a moderate effect on the traffic circulation | The provided performance are between 20 and 40% less than the currently available which has a major effect on the traffic circulation | The provided performance are more than 40% less than the currently available which has a critical effect on the traffic circulation | Traffic are served with a better performance |

**Table 7-12. Ranking of Consequence on Traffic Conditions during Operation**

| Negligible | Minor | Moderate | Major | Critical | Beneficial |
|---|---|---|---|---|---|
| **1** | **2** | **3** | **4** | **5** | **B** |
| | | | | | |

| | | | Status with Project | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Selected criteria: time for 1 km | | <1.2 min | 1.2 to 2 min | 2 to 4 min | 4 to 6 min | 6 to 12 min | >12 min |
| | Origin /Destination Time | Level of Service | A | B | C | D | E | F |
| Without Project | <1.2 min | A | | | | | | |
| | 1.2 to 2 min | B | | | | | | |
| | 2 to 4 min | C | | | | | | |
| | 4 to 6 min | D | | | | | | |
| | 6 to 12 min | E | | | | | | |
| | >12 min | F | | | | | | |

### *7.4.2 Impacts during Construction*

Impacts from the construction phase are linked to road works, closures and detours. The already over saturated road network functions with a critical level of service, and drivers and citizens cannot handle more time spent in transportation.

The construction of bus stations, P&R facilities and widening of roads will require traffic detours and roadblocks at certain locations. These adjustments have the potential for creating traffic congestion and bottlenecks in short to moderate periods in different construction phases of the project. Temporary traffic congestion will slow the fleet movement, increase travel time and cause passenger annoyance especially during peak hours in the morning and the afternoon and holidays. Potential negative impacts may be felt by businesses (i.e. shops, markets, restaurants, cafes) on the affected roads resulting from temporary loss of customers or delays.

Without the adequate planning ahead of time and careful implementation of the mitigation measures during construction, the impact from project construction will have a **Major consequence rating (4)** and **High likelihood of occurrence (H=3)**, thus resulting in a **High Significance Level (4H=12).**

### *7.4.3 Impacts during Operation*

During both the AM and PM peak hour, the New System will attract a high percentage of passengers for the three studied horizons.

**Table 7-13. BRT Results on each Line – AM Peak Hour**

| | | Coastal BRT Tabarja - Beirut | Coastal BRT Beirut - Tabarja | Outer BRT NhrMot - Beirut | Outer BRT Beirut - NhrMot | Inner BRT 1 | Inner BRT 2 |
|---|---|---|---|---|---|---|---|
| Year 2023 | Total Boarding | 12,218 | 7,009 | 10,945 | 6,875 | 4,803 | 3,288 |
| | Max boarding | 3,642 | 4,546 | 2,852 | 1,737 | 1,896 | 1,122 |
| | Avg Boarding | 476 | 418 | 618 | 510 | 419 | 280 |
| | Max Vol on Sections | 7,523 | 7,166 | 5,934 | 3,673 | 2,509 | 1,575 |
| | Avg Vol on Sections | 5,829 | 5,036 | 2,530 | 1,418 | 1,059 | 980 |
| Year 2028 | Total Boarding | 13,448 | 7,434 | 12,476 | 7,238 | 5,173 | 3,549 |
| | Max boarding | 4,190 | 4,906 | 3,287 | 1,880 | 2,022 | 1,254 |
| | Avg Boarding | 522 | 450 | 741 | 591 | 454 | 321 |
| | Max Vol on Sections | 8,510 | 7,637 | 6,882 | 3,763 | 2,738 | 1,702 |
| | Avg Vol on Sections | 6,561 | 5,476 | 2,834 | 1,475 | 1,142 | 1,049 |
| Year 2038 | Total Boarding | 18,669 | 9,097 | 15,187 | 9,853 | 6,483 | 4,758 |
| | Max boarding | 5,601 | 5,338 | 3,457 | 3,047 | 2,466 | 1,600 |
| | Avg Boarding | 718 | 536 | 859 | 758 | 570 | 431 |
| | Max Vol on Sections | 11,593 | 8,530 | 8,035 | 5,175 | 3,400 | 2,276 |
| | Avg Vol on Sections | 8,997 | 6,296 | 3,391 | 2,081 | 1,414 | 1,417 |

**Table 7-14. BRT Results on each Line – PM Peak Hour**

| | | Coastal BRT Tabarja - Beirut | Coastal BRT Beirut - Tabarja | Outer BRT NhrMot - Beirut | Outer BRT Beirut - NhrMot | Inner BRT 1 | Inner BRT 2 |
|---|---|---|---|---|---|---|---|
| Year 2023 | Total Boarding | 7,772 | 9,965 | 9,378 | 6,179 | 3,854 | 7,685 |
| | Max boarding | 2,067 | 2,561 | 2,147 | 2,542 | 1,307 | 1,731 |
| | Avg Boarding | 303 | 433 | 521 | 397 | 315 | 549 |
| | Max Vol on Sections | 5,202 | 6,085 | 4,251 | 3,397 | 1,842 | 3,425 |
| | Avg Vol on Sections | 3,374 | 4,741 | 1,929 | 1,375 | 1,025 | 1,873 |
| Year 2028 | Total Boarding | 8,050 | 10,514 | 10,039 | 5,563 | 4,101 | 8,295 |
| | Max boarding | 2,227 | 3,084 | 2,244 | 1,956 | 1,368 | 1,801 |
| | Avg Boarding | 317 | 463 | 587 | 388 | 335 | 590 |
| | Max Vol on Sections | 5,445 | 6,658 | 4,596 | 2,828 | 1,938 | 3,862 |
| | Avg Vol on Sections | 3,555 | 5,253 | 2,075 | 1,405 | 1,089 | 2,042 |
| Year 2038 | Total Boarding | 9,167 | 13,197 | 12,947 | 6,897 | 4,738 | 9,459 |
| | Max boarding | 2,569 | 4,160 | 2,706 | 2,241 | 1,685 | 2,014 |
| | Avg Boarding | 353 | 587 | 707 | 453 | 360 | 688 |
| | Max Vol on Sections | 6,133 | 8,635 | 6,079 | 3,348 | 2,219 | 4,551 |
| | Avg Vol on Sections | 3,984 | 6,628 | 2,740 | 1,687 | 1,256 | 2,376 |

These figures are calculated for each BRT line. It is important to note that these values are presented without the transfer volumes from one line to another; therefore, there was no double count between lines.

**Table 7-15 Number of Boarding Passengers on each Line**

| | Year 2023 | | | Year 2028 | | | Year 2038 | | |
|---|---|---|---|---|---|---|---|---|---|
| | AM | PM | Daily | AM | PM | Daily | AM | PM | Daily |
| **Coastal BRT Tabarja - Beirut** | 12,218 | 7,772 | **115,945** | 13,448 | 8,050 | **124,685** | 18,669 | 9,167 | **161,449** |
| **Coastal BRT Beirut - Tabarja** | 7,009 | 9,965 | **98,447** | 7,434 | 10,514 | **104,095** | 9,097 | 13,197 | **129,303** |
| **Coastal BRT** | **Sum** | | **214,393** | **Sum** | | **228,780** | **Sum** | | **290,752** |
| **Outer BRT Naher El Mot - Beirut** | 10,945 | 9,378 | **117,877** | 12,476 | 10,039 | **130,584** | 15,187 | 12,947 | **163,177** |
| **Outer BRT Beirut - Naher El Mot** | 6,875 | 6,179 | **75,711** | 7,238 | 5,563 | **74,244** | 9,853 | 6,897 | **97,148** |
| **Outer BRT** | **Sum** | | **193,588** | **Sum** | | **204,828** | **Sum** | | **260,325** |
| **Inner BRT 1** | 4,803 | 3,854 | **50,208** | 5,173 | 4,101 | **53,791** | 6,483 | 4,738 | **65,080** |
| **Inner BRT 2** | 3,288 | 7,685 | **63,642** | 3,549 | 8,295 | **68,698** | 4,758 | 9,459 | **82,454** |
| **Inner BRT** | **Sum** | | **113,850** | **Sum** | | **122,489** | **Sum** | | **147,534** |
| **Grand Total** | | | **521,831** | | | **556,097** | | | **698,611** |

The following tables present volumes on major sections of the coastal highway and Beirut in *pcu*, in both scenarios, with and without BRT, to highlight the effect of the BRT+Feeders project and the physical projects implemented into the model (by horizon).

**Table 7-16. Volumes in PCU on major Sections – AM Peak hour – Tabarja – Beirut Direction**

| Major Sections | 2023 - With BRT | 2023 - Without BRT | 2028 - With BRT | 2028 - Without BRT | 2038 - With BRT | 2038 - Without BRT |
|---|---|---|---|---|---|---|
| **Nahr El Kaleb / Royal Dbayeh** | 5,798 | 6,966 | 4,504 | 5,559 | 5,395 | 6,750 |
| **Dbayeh Marina / Antelias Interchange** | 5,115 | 6,071 | 4,201 | 5,282 | 5,019 | 6,394 |
| **Nahr El Mot Interchange / Daourah** | 5,596 | 6,528 | 4,474 | 5,336 | 5,640 | 6,803 |
| **Forum de Beyrouth / Charles El Helou** | 5,765 | 6,785 | 6,505 | 7,812 | 7,618 | 9,431 |

**Table 7-17. Volumes in PCU on major Sections – PM Peak hour – Tabarja – Beirut Direction**

| Major Sections | 2023 - With BRT | 2023 - Without BRT | 2028 - With BRT | 2028 - Without BRT | 2038 - With BRT | 2038 - Without BRT |
|---|---|---|---|---|---|---|
| **Nahr El Kaleb / Royal Dbayeh** | 4,739 | 5,599 | 3,124 | 3,745 | 3,500 | 4,202 |
| **Dbayeh Marina / Antelias Interchange** | 4,142 | 4,795 | 2,839 | 3,360 | 3,131 | 3,760 |
| **Nahr El Mot Interchange / Daourah** | 3,536 | 3,979 | 2,930 | 3,591 | 3,290 | 4,174 |

| Major Sections | 2023 - With BRT | 2023 - Without BRT | 2028 - With BRT | 2028 - Without BRT | 2038 - With BRT | 2038 - Without BRT |
|---|---|---|---|---|---|---|
| Forum de Beyrouth / Charles El Helou | 3,984 | 4,409 | 4,386 | 4,867 | 5,257 | 5,795 |

**Table 7-18. Passengers shifted on major Sections – Tabarja – Beirut Direction**

| Major Sections | Passengers shifted-AM Peak Hour | | | Passengers shifted-PM Peak Hour | | |
|---|---|---|---|---|---|---|
| | Year 2023 | Year 2028 | Year 2038 | Year 2023 | Year 2028 | Year 2038 |
| Nahr El Kaleb / Royal Dbayeh | 17% | 19% | 20% | 15% | 17% | 17% |
| Dbayeh Marina / Antelias Interchange | 16% | 20% | 22% | 14% | 16% | 17% |
| Nahr El Mot Interchange / Daourah | 14% | 16% | 17% | 11% | 18% | 21% |
| Forum de Beyrouth / Charles El Helou | 15% | 17% | 19% | 10% | 10% | 9% |

From Tabarja to Beirut, an important percentage of passengers shift from the Highway to the New System (BRT+Feeders), thus liberating the road network by a minimum of 10% and a maximum of 17% for year 2023.

**Table 7-19. Volumes in PCU on major Sections – PM Peak hour – Beirut - Tabarja Direction**

| Major Sections | 2023 - With BRT | 2023 - Without BRT | 2028 - With BRT | 2028 - Without BRT | 2038 - With BRT | 2038 - Without BRT |
|---|---|---|---|---|---|---|
| Charles El Helou / Forum de Beyrouth | 7460 | 8033 | 8715 | 8821 | 10452 | 10467 |
| Daourah / Nahr El Mot Interchange | 6431 | 6987 | 5831 | 6597 | 7373 | 8105 |
| Royal Dbayeh / Nahr El Kaleb | 5730 | 6806 | 4474 | 5335 | 5487 | 6501 |
| Aajaltoun Interchange / Kaslik | 5117 | 5470 | 3726 | 4335 | 4309 | 4980 |

**Table 7-20. Volumes in PCU on major Sections – AM Peak hour – Beirut - Tabarja Direction**

| Major Sections | 2023 - With BRT | 2023 - Without BRT | 2028 - With BRT | 2028 - Without BRT | 2038 - With BRT | 2038 - Without BRT |
|---|---|---|---|---|---|---|
| Charles El Helou / Forum de Beyrouth | 4825 | 5893 | 5351 | 6411 | 6233 | 7547 |
| Daourah / Nahr El Mot Interchange | 5716 | 6801 | 4294 | 5430 | 4961 | 6239 |
| Royal Dbayeh / Nahr El Kaleb | 5157 | 5960 | 4244 | 4910 | 4605 | 5467 |
| Aajaltoun Interchange / Kaslik | 4799 | 5718 | 3452 | 3912 | 3713 | 4277 |

**Table 7-21. Passengers shifted on major Sections – Beirut - Tabarja Direction**

| Major Sections | Passengers shifted-AM Peak Hour | | | Passengers shifted-PM Peak Hour | | |
|---|---|---|---|---|---|---|
| | Year 2023 | Year 2028 | Year 2038 | Year 2023 | Year 2028 | Year 2038 |
| Charles El Helou / Forum de | 18% | 17% | 17% | 7% | 1% | 0% |

| Major Sections | Passengers shifted-AM Peak Hour | | | Passengers shifted-PM Peak Hour | | |
|---|---|---|---|---|---|---|
| | Year 2023 | Year 2028 | Year 2038 | Year 2023 | Year 2028 | Year 2038 |
| **Beyrouth** | | | | | | |
| **Daourah / Nahr El Mot Interchange** | 16% | 21% | 20% | 8% | 12% | 9% |
| **Royal Dbayeh / Nahr El Kaleb** | 13% | 14% | 16% | 16% | 16% | 16% |
| **Aajaltoun Interchange / Kaslik** | 16% | 12% | 13% | 6% | 14% | 13% |

From Beirut to Tabarja, an important percentage of passengers also shift to the New System, with a minimum of 6% at the PM peak hour, and a maximum of 18% for the morning peak hour.

The northern corridor is currently very congested; its infrastructure operates with a critical level of service, reaching over-saturation. The BRT and Feeder lines can attract a considerable part of the demand, which will increase the supply capacity to accommodate the expected traffic growth. In the years 2023-2028, the new proposed system will improve the level of service on the northern highway, but it will reach its maximum capacity in 2028 and function over capacity in year 2038.

Comparing the scenarios with and without project will determine the project's impact on the existing road network. As the road capacity will be reduced on some sections of the corridor, the evaluation of the project will not be simple; therefore the time spent from an Origin A to a Destination B is the most suitable method to evaluate the Project's impact. The table below shows the Level of Service based on the average time for ODs in the scenarios with and without the Project. The color of the cell represents the impact as described in the section above.

| **Without Project** | **With Project** |
|---|---|

**Table 7-22. Impact of the Project for AM year 2023**

| | **Beirut** | **North Mount Lebanon** | **South Mount Lebanon** |
|---|---|---|---|
| **Beirut** | E D | F D | F D |
| **North Mount Lebanon** | F D | D D | F D |
| **South Mount Lebanon** | F E | F D | F F |

**Table 7-23. Impact of the Project for PM year 2023**

| | Beirut | North Mount Lebanon | South Mount Lebanon |
|---|---|---|---|
| **Beirut** | E / D | F / E | F / E |
| **North Mount Lebanon** | E / D | D / D | F / D |
| **South Mount Lebanon** | E / D | E / D | E / E |

During operation, for the AM and the PM peak hours, the project is beneficial; and for a few ODs, the impact is negligible. The project construction is not beneficial but does not have a bad impact. In general, the trip time from origin to destination is improved.

After implementation of the BRT system, there will be a grace period of 6 to 9 months for passengers to get used to it and become frequent users. The BRT system needs 1 year to be considered fully operational. During that time, traffic congestion is expected since certain roads will still have reduced capacities due to the median BRT lane, and flows will be high because people would still be using their private vehicles. Passenger integration into the BRT system will require time; appropriate measures should be taken to facilitate the process and maximize the advertisement of the BRT system.

Without the implementation of any mitigation measures and facilitated integration, the impact from construction activities will have a **Major consequence rating (4)** and **High likelihood** of occurrence, thus resulting in a **High Impact Significance Level (4H=12).**

Major sub-component of the project is the P&R facilities which are expected to be constructed at location where there is significant demand from private car users. P&R facilities also have the potential for serving as general parking stations during off-operation periods. If not proper integration (signage, road alignments and restoration) with the existing road infrastructure (old and over-used), traffic congestion can be anticipated surrounding these facilities, especially when demand is larger than the available capacity or traffic management is not planned in advance. This can also inhibit the utility of the BRT system, since it will be less attractive for passenger to park their cars and continue their journey with a bus if it takes long time for them to interchange.

Without the implementation of any mitigation measures and facilitated integration, the impact from construction activities will have a **Major consequence rating (4)** and **Moderate likelihood** of occurrence, thus resulting in a **Medium Impact Significance Level (4M=8).**

## 7.5 IMPACTS ON EMISSIONS AND AIR QUALITY

The primary sources of air pollutants from the various Project activities and the impacts associated with the sources, along with their consequence assessment are summarized in Table 7-24.

**Table 7-24. Consequence Assessment on Emissions and Air Quality**

| Impact | Nature | Magnitude | Extent | Timing | Duration | Reversibility | Consequence Rating |
|---|---|---|---|---|---|---|---|
| AQ.C.1. Airborne particles (dust) from soil disturbance | N/D | M | L | S | C | R | Moderate |
| AQ.C.2. Fugitive emissions during construction works and odors from paving activities | N/D | M | L | S | C | R | Moderate |
| AQ.C.3. Impacts on air quality from generators | N/D | M | L | S | C | R | Moderate |
| AQ.O.1. Change in overall atmospheric pollutant emissions | P/D | H | L | L | O | R | Beneficial |
| AQ.O.2. Change in GHG emissions | P/D | H | L/G | L | O | R | Beneficial |

### *7.5.1 Emissions Assessment*

The emissions assessment studied the different atmospheric emissions resulting from the operation of the transportation fleet with and without the BRT System for the year 2023. The comparison of the two scenarios resulted in the net emissions budget.

The exercise consisted of assessing the future incremental emissions due to the project while taking into consideration the anticipated change in traffic circulation and modal shares due to the operation of the BRT System.

For this purpose, the “With BRT” or Scenario S1 should be compared to “Without BRT” or Scenario S2 for the same future year in terms of emissions. Scenario S1 comprises the emissions from the whole fleets when the BRT System is in operation (designated as New System – NS) which includes the new buses and induced traffic (passenger cars, taxis, and trucks). Scenario S2 comprises the emissions of the present Public Transport system (PT) and the induced traffic (passenger cars, taxis, and trucks) in the absence of the BRT System. The comparison is undertaken for the year 2023 for CO, $NO_x$, $PM_{10}$, $SO_2$ and GHGs. Emissions are calculated based on EMEP/EEA 2016 methodology using Tier 3 methodology (EMEP/EEA, 2016). GHG emissions are estimated using the IPCC Tier 2 methodology. Table 7-25 below details the results obtained.

The volume of vehicles (PC and Taxis) is lower in S1 than in S2. This results in lower emissions for PC, taxis, and trucks in the area where the BRT System will operate in Beirut and from Beirut till Tabarja. The New System comprises a lower number of Buses with higher occupancy than the Public Transport in Scenario S2. Even with higher emission factors due to the presence of bigger Buses in S1, the lower number of buses counteracts the emissions per km from the NS resulting in lower emissions for the New System. In conclusion, for the four pollutants considered, the implementation of the BRT System will decrease the emissions in the area of interest where the system will be present.

**Table 7-25. Emissions of the Different Pollutants per Scenario**

| | Scenario S1 | | Scenario S2 | | Net emissions budget (S1 minus S2) |
|---|---|---|---|---|---|
| | PC, Taxis and Trucks | New System | PC, Taxis and Trucks | Public Transport | |
| CO (kg/day) | 20,012 | 110 | 23,253 | 455 | -3,376 |
| NOx (kg/day) | 6,202 | 319 | 7,030 | 1,249 | -1,759 |
| $PM_{10}$ (kg/day) | 210 | 19 | 244 | 81 | -98 |
| $SO_2$ (kg/day) | 624.2 | 0.4 | 719.7 | 1.5 | -96.6 |

For the year 2023, the annual emissions reduction in the project area would be of 1,232.39 t/yr, 641.89 t/yr, 35.26 t/yr, and 35.63 t/yr for CO, NOx, $SO_2$, and $PM_{10}$ respectively.

The maps shown in Figure 7-6 present the percentage variation in emissions if the BRT System is implemented when compared to the Scenario S2 for the four pollutants of interest. The maps show that no increase in the emission of any pollutant is observed in any locality that will be served by the BRT System.

As for GHG emissions, Table 7-26 summarizes the emissions for both scenarios. The results show that the shift in the mass transport system from the current Public Transport to the New System will reduce GHG emissions in 2023 of around 590 Gg/yr of $CO_2$eq in Lebanon which is higher than the impact of the implementation of the BRT System on the emissions reduced from the PC, Taxis and trucks. When all categories are considered, a total of 713.67 Gg/yr of $CO_2$eq. are reduced in 2023.

**Table 7-26. Emissions of GHG for S1 and S2 Scenarios**

| | Scenario S1 PC, Taxis and Trucks | Scenario S2 PC, Taxis and Trucks | Scenario S1 Buses NS | Scenario S2 Buses PT |
|---|---|---|---|---|
| $CO_2$ (t/d) | 4,341.6 | 4,660.9 | 304.5 | 1,899.4 |
| $CH_4$ (t/d) | 0.74 | 0.80 | 0.02 | 0.15 |
| $N_2O$ (t/d) | 0.77 | 0.82 | 0.01 | 0.07 |
| $CO_{2\,eq}$ (t/d) | 4,594.73 | 4,933.30 | 308.72 | 1,925.41 |
| $CO_{2\,eq}$ (Gg/yr) | 1,677.08 | 1,800.65 | 112.68 | 702.77 |

Current results show that no increments of CO, NOx, PM10, and SO2 will be observed; on the contrary traffic emissions in the project domain will decrease. On the other hand, the GHG emissions will also decrease. The impact of the BRT project is beneficial for CO, PM10, NOx, SO2, and GHGs.

The complete Emissions Assessment Study including the methodology, assumptions, and calculations is included in APPENDIX K.

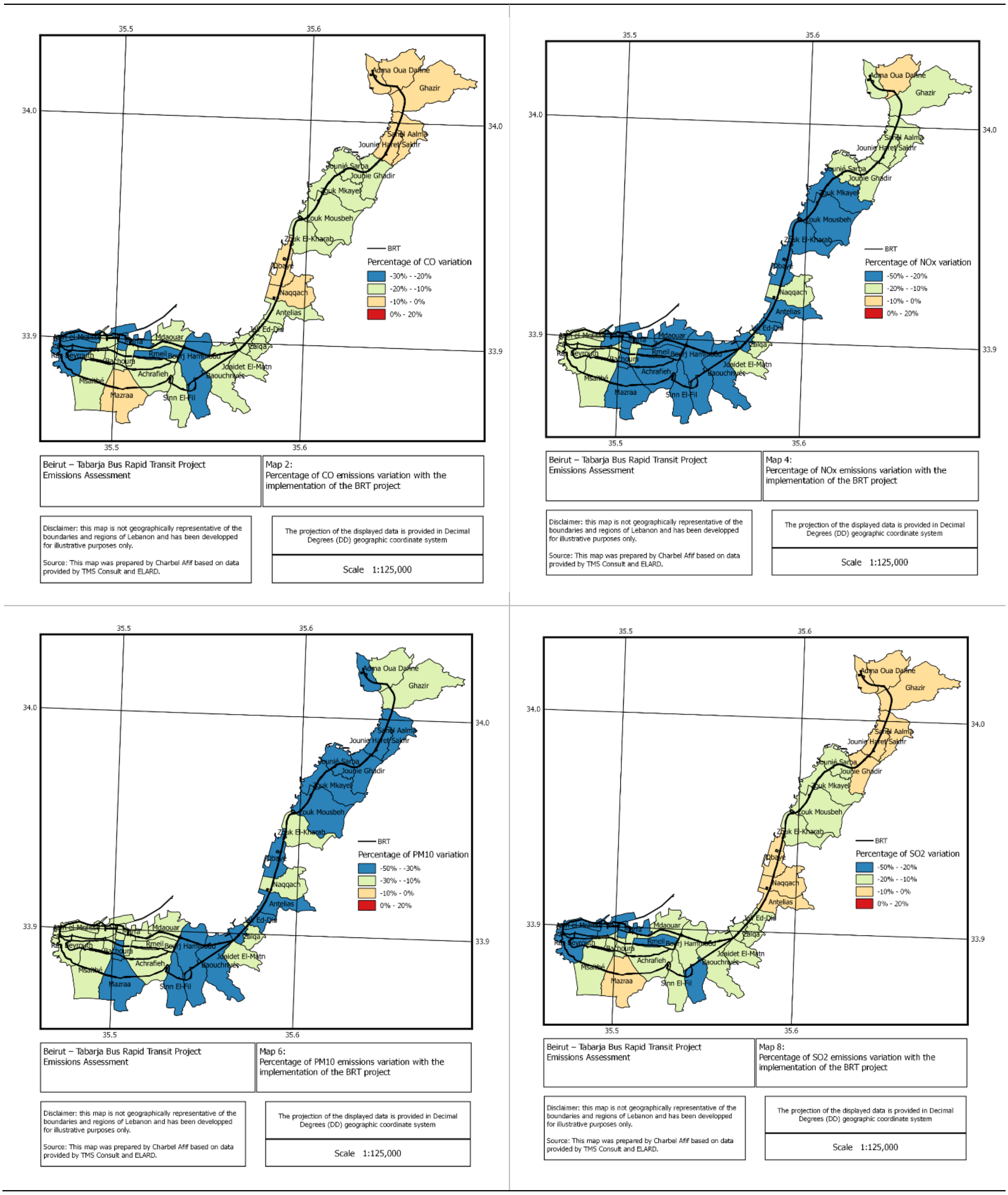



**Figure 7-6. Percentage of Variation in Emissions of CO, NOx, $PM_{10}$ and $SO_2$ with the Implementation of the BRT System**

### *7.5.2 Impacts during Construction*

In general there are moderate impacts on air emissions resulting during the construction phase of the project, which through the application of minor mitigation measures they can be mitigated. The construction activities involve the transport of raw material, operation of machinery and gensets at construction sites that are necessary and inevitable.

### 7.5.3 Impacts during Operation

The BRT System impact on CO, NOx, $PM_{10}$, $SO_2$, and GHG emissions is anticipated to be of Beneficial consequence and High likelihood, giving an overall Beneficial impact significance level (BH=+++) on air quality and climate change.

## 7.6 IMPACTS ON NOISE

The sources or activities that contribute to the elevation of noise and vibration levels and the impacts associated with the sources, along with their consequence assessment are summarized in Table 7-27.

**Table 7-27. Consequence Assessment on Noise**

| Impacts | Nature | Magnitude | Extent | Timing | Duration | Reversibility | Consequence Rating |
|---|---|---|---|---|---|---|---|
| N.C.1. Change in vibration and noise levels from general construction activities, and movement of construction vehicles | N/D | H | L | S | C | R | Major |
| N.O.1. Change in noise levels from normal operation of the BRT System | P/D | - | - | - | O | - | Beneficial |

### 7.6.1 Noise Assessment

A qualitative assessment for the construction phase was conducted based on average noise levels resulting from the operation of equipment and machinery during construction.

A qualitative assessment for the operation phase was conducted based on the traffic study outputs and expected number of passenger cars, buses and trucks.

The assessment of the magnitude of the impact from activities on noise is provided in Table 7-28 below.

**Table 7-28. Evaluation Criteria for the Magnitude of Impact on Noise Levels**

| Type of Impact[1] | Ranking | | | |
|---|---|---|---|---|
| | Low | Moderate | High | Beneficial |
| Impact on noise | Ambient noise level ($L_{Aeq}$) increased at receptor by less than 3 dB(A) | Ambient noise level ($L_{Aeq}$) increased at receptor by more than 3 dB(A) and less than 5 dB(A) | Ambient noise level ($L_{Aeq}$) increased at receptor by more than 5 dB(A) | Noise emissions decrease in the study area |

The primary sources of impacts on noise from the various Project activities are shown in Table 7-27.

### *7.6.2 Impacts during Construction*

Noise generated by project-related construction activities would be a function of the noise levels generated by individual pieces of construction equipment, the type and amount of equipment operating at any given time, the timing and duration of construction activities, the proximity of nearby sensitive receptors, and the presence or lack of shielding at these sensitive receivers. Construction noise levels would vary on a day-to-day basis during each phase of construction depending on the specific task being completed. In general, noise levels at receptors nearest the proposed project would not be substantially higher than ambient noise levels during the day or night. However, certain construction techniques such as pile driving would generate high, impulsive noise levels that would be substantially higher than existing noise levels and would exceed the absolute noise level limits established by local jurisdictions.

Construction activities anticipated with the project would include demolition of existing structures, earthwork, granular bases preparation, bituminous construction, concrete and structures construction, drainage, sewer and water supply networks provision and construction etc. Each construction phase would require a different combination of construction equipment necessary to complete the task and different usage factors for such equipment.

Construction noise would primarily result from the operation of heavy construction equipment and arrival and departure of heavy-duty trucks. The highest maximum instantaneous noise levels would result from special impact tools such as impact pile drivers used to install the piles that would support concrete pedestrian bridges or ramps, overhead signs at P&R facilities, or, of the elevated BRT route is chosen, the overpass road. The construction noise levels calculated for each major phase of the project at a distance of 30 meters from the noise source are presented in Table 7-29.

In some instances, maximum instantaneous noise levels are calculated to be slightly lower than hourly average noise levels. This occurs because maximum instantaneous noise levels generated by multiple pieces of construction equipment are not likely to occur at the same time. Hourly average noise levels resulting from multiple pieces of construction equipment would be additive resulting in slightly higher calculated noise levels. Noise generated by construction equipment drops off at a rate of 6 dB per doubling of distance.

**Table 7-29. Construction Equipment Noise Levels at 30 meters**

| Construction Phase | Maximum Noise Level ($L_{max}$, dBA) | Hourly Average Noise Level ($L_{eq[h]}$, dBA) |
|---|---|---|
| Demolition | 84 | 78 |
| Earthworks | 76 | 78 |
| Paving | 79 | 79 |
| Structures (with Pile Driving) | 95 | 89 |

| | | |
|---|---|---|
| Structures (without Pile Driving) | 77 | 78 |

The proposed construction activities typically occur for relatively short periods of time as construction proceeds along the project's alignment. Construction noise would mostly be of concern in areas where impulse-related noise levels from construction activities would be concentrated for extended periods of time, where noise levels from individual pieces of equipment are substantially higher than ambient conditions, or when construction activities would occur during noise-sensitive hours, such as early morning, evening, or nighttime.

In the absence of mitigation measures, the impact cannot be avoided. The likelihood of the impact will be **High (3)** with a **Major (4)** consequence giving overall a **High significance (4H=12)**.

If the set of mitigation measures identified for N.C.1. in Table 8-2 are taken into consideration and noting that baseline results were high and exceeded 70 dB(A) at all locations, the rating of potential impacts from construction activities would be reduced to **Moderate (3)** consequence with **High (3)** likelihood of occurrence, as such the significance level will then be a **Medium (3H=9)**.

### *7.6.3 Impacts during Operation*

In general, the efficiency and type of buses determine the generated noise levels during travel. Diesel and CNG buses have maximum noise levels of 80 dBA at the normal travel speed between 40-60 km/h. While Hybrid buses have slightly lower records of 75 dBA. Due to the absence of combustion, electric buses have a lower noise emissions level of 60 dBA that increases with the increase of speed (Ross & Staiano, 2007).

Based on the traffic study outputs, the proposed project will reduce the number of vehicles on the streets thus reduce traffic-related noise. The project will somehow help in maintaining constant vehicles flow which will reduce the stop-and-go traffic related noise.

Without any mitigation measure in place, the rating of potential impacts from operation activities would be **Beneficial (B)** with **High Likelihood of occurrence (3)**; as such the significance level will then be **Beneficial (+++)**.

## 7.7 IMPACTS ON SOIL AND WATER RESOURCES

The main sources of impact on soil and water bodies (groundwater) during construction and operation, along with their consequence ratings, are discussed in the below sections and shown in Table 7-30.

**Table 7-30. Consequence Assessment on Soil and Water Resources**

| Impact/Source | Nature | Magnitude | Extent | Timing | Duration | Reversibility | Consequence Rating |
|---|---|---|---|---|---|---|---|
| SWR.C.1. Site clearance and demolition activities | N/D | L | S | L | C | R | Negligible |
| SWR.C.2. Accidental spills or leaks of fuel, oil and other chemicals | N/D | H | G | M | C | R | Major |
| SWR.C.3. Inadequate storage and disposal of solid wastes | N/D | M | L | L | C | R | Moderate |
| SWR.C.4. Inadequate storage and disposal of wastewater generated | N/D | H | G | M | C | R | Major |
| SWR.C.5. Potential dewatering activities | N/D | M | G | M | C | R | Moderate |
| SWR.O.1. Fueling and maintenance operation | N/D | H | G | L | O | R | Major |
| SWR.O.2. Hazardous and non-hazardous wastes from maintenance activities | N/D | H | L | L | O | R | Major |
| SWR.O.3. Solid waste generated from passengers at different facilities | N/D | L | L | L | O | R | Minor |

### *7.7.1 Impacts during Construction*

The major potential sources of accidental spills include chemicals (paint, etc.), diesel supplies, lubricating oil as part of routine equipment and generators operations, and maintenance during the construction phase.

These spills may contain BTEX such as benzene and toluene and methyl tertiary butyl ether (MTBE). These monocyclic aromatic hydrocarbons tend to readily evaporate from surface spills and biodegrade under aerobic and anaerobic conditions given their relatively good solubility and volatility, particularly MTBE and benzene. Spills consisting of BTEX; Poly Aromatic Hydrocarbons (PAH), chlorinated hydrocarbons, as well as heavy metals such as Nickel, Copper, Chromium and Zinc persist in the receiving environment, and when mixed with soil, they tend to adhere and accumulate due to their low evaporation and biodegradability.

If maintenance of machines/equipment is to take place on-site by the responsible parties, which are the suppliers in this case, a high risk of accidental spills during maintenance is expected if no precautionary measures are in place. Therefore, and due to the geological units exposed within the working site, soil and groundwater pollution will be at risk especially that either groundwater is expected to be shallow or percolation and pollution transport due to secondary porosity to be easy along the BRT path.

The main rivers running east-west and passing under the BRT path are the main nearby receptor to surface water pollution from the BRT.

Impacts from potential accidental spills or leaks are expected to have a **Major consequence rating (4)** and **Moderate likelihood of occurrence (M)**, thus resulting in a **Medium Impact Significance Level (4M=8).**

Construction of the BRT will require a large number of construction workers including temporary site offices. Such activities and facilities will require temporary and portable lavatories that are usually provided by contractors and consultants commissioned for the construction phase. f such lavatories are insufficiently supplied or are leaking, pollution to soil and groundwater may occur.

The impacts from inadequate storage and disposal of wastewater in the context of the BRT project during construction will have a **Major consequence impact (4)** with **Moderate likelihood** without any mitigation in place, resulting in a **Medium Impact Significance Level (4M=8).**

### *7.7.2 Impacts during Operation*

BRT operations with engines depend on fueling stations located in Beirut and Safra. Fueling stations typically include aboveground storage tanks, piping and filling equipment with a major impact on soil and groundwater in case of any leakage or spill.

Without the implementation of any mitigation measure, the impacts from the fueling and maintenance operations will have a **Major Consequence impact (4)** with **Moderate likelihood**, resulting in a **Medium Impact Significance Level (4M=8).**

The operation and maintenance of the BRT Buses will result in different hazardous and non-hazardous wastes. These activities will most likely take place in Beirut and Tabarja terminals and bus depots only. These wastes can be divided into three types:

- Hazardous wastes including solvents, coolants, acids and alkalis may be used in bus maintenance.
- Wastewater from the Bus maintenance and refurbishment which usually includes high-pressure water wash which may contain residues from transport material, paint, oil and grease and other contaminants. Moreover the use of coolants is usually water-based with corrosion inhibitor additives that might be a source of soil and groundwater contamination.

Without the implementation of any mitigation measures, the impact from hazardous and non-hazardous wastes from maintenance activities will have a **Major consequence rating (4)** and **Moderate likelihood** of occurrence, thus resulting in a **Medium Impact Significance Level (4M=8).**

## 7.8 IMPACTS ON ARCHAEOLOGICAL AND CULTURAL HERITAGE

Impacts on archaeological features from any project that involves construction works in Lebanon are always a possibility due to the rich history of the country. Any site works will involve excavation to some degree, whether along the BRT corridor or in the preparation of the P&R facilities, bus terminal or bus depot. Hence, incidental finds of buried archaeological artefacts might occur during construction phase. The DGA has clear procedures for the handling of chance finds.

Table 7-31 reviews the potential impacts on archaeology during excavation works and benefits during operation phase of the project.

**Table 7-31. Consequence Assessment on Archaeological and Cultural Heritage**

| Impact/Source | Nature | Magnitude | Extent | Timing | Duration | Reversibility | Consequence Rating |
|---|---|---|---|---|---|---|---|
| ACH.D.1. Potential damage to uncovered archaeological features that could be unearthed during excavation | N/D | H | L | L | D | R | Major |
| ACH.C.1. Accidental unearthing/damage to unidentified archaeological features during excavation | N/I | M | L | L | C | R | Moderate |
| ACH.O.1. Promotion of archaeology, museums, and heritage assets | P/I | - | - | - | O | - | Beneficial |

The BRT project covers a large area with a high potential of archaeological remains, whether on the Tabarja-Beirut course or within Beirut. Beirut is classified as a very sensitive archaeological and historical area.

The letter sent to the Directorate General of Antiquities allowed confirming the likelihood of findings during excavation works. Tabarja, Maameltein, Nahr el-Kalb, Dbayeh, Antelias and Charles Helou have revealed archaeological features during previous excavation work. As for Beirut, archaeological findings have been discovered in most of the areas where the rings are planned. Impacts on archaeological features will be reduced during construction if the proper mitigation measures are applied during the planning phase.

Thus the DGA stresses on the necessity to be handed all relevant maps, construction details and excavation depth in order to direct the necessary archaeological works, and alleviate the project's impacts on archaeology.

Assuming no mitigation measures are taken, the likelihood of the impact will be **High** with a **Major (4)** consequence, resulting in a **High Impact Significance Level (4H=12)**.

During operation, the introduction of the bus is anticipated to generate interest in cultural and touristic landmarks that are present along the way. The richness of these landmarks is explored in Section 4.3.9.

## 7.9 IMPACTS ON BIODIVERSITY

The study is to assess the potential impacts of the project during the construction and operation phases on local biodiversity and habitats, and recommend mitigation measures to minimize or eliminate these impacts.

The project lies within a heavily urbanized area, however, some project components such as the P&R facilities will be located on empty plots that are vegetated. Similarly, the stations will be located in the median strip, where some of the median strips are vegetated. reviews the potential impacts on biodiversity during construction at different locations and during operation.

**Table 7-32. Consequence Assessment on Biodiversity**

| Impact/Source | Nature | Magnitude | Extent | Timing | Duration | Reversibility | Consequence Rating |
|---|---|---|---|---|---|---|---|
| B.C.1. Impacts on biodiversity during site clearance and excavation of P&R facilities (1-6 and 8) | N/D | L | L | S | C | R | Negligible |
| B.C.2. Impacts on biodiversity during site clearance and excavation of Beirut-Tabarja trunk-line and station infrastructure | N/D | M | L | S | C | R | Minor |
| B.C.3. Impacts on biodiversity during site clearance and excavation of Beirut Outer ring | N/D | M | L | S | C | R | Minor |
| B.C.4. Impacts on biodiversity during site clearance and excavation of P&R facility (8), Safra depot and Tabarja terminal | N/D | M | L | S | C | R | Moderate |
| B.O.1. Impacts on biodiversity during regular operation | N/D | L | L | S | O | R | Negligible |

Based on the description of the biological environment, the anticipated project will lead to moderate negative impacts on biodiversity at the P&R facility (8), the bus depot at Safra and the Tabarja terminal. The main construction activities having negative results on biodiversity are removal of trees, earth-moving activities, generation of construction waste material and wastewater effluent discharges. Waste resulting from construction works and any other activity should be disposed of in an allocated disposal site in agreement with the Municipality. Littering in the project area and surrounding areas should be prevented.

The potential impact of construction activities of P&R facilities on biodiversity is considered of **High Likelihood** and **Moderate consequence** rating, resulting in **Medium impact significance (3H=9).**

## 7.10 IMPACTS ON HEALTH AND SAFETY

The sources of health and safety impacts from the various project activities, along with their consequence assessment are listed in Table 7-33.

**Table 7-33. Consequence Assessment on Health and Safety**

| Impact/Source | Nature | Magnitude | Extent | Timing | Duration | Reversibility | Consequence Rating |
|---|---|---|---|---|---|---|---|
| HS.C.1. Impact on workers' and pedestrians' safety resulting from improper handling and storage of construction material and construction activities | N/D | H | L | S | C | R | Major |
| HS.C.2. Impact on workers' and pedestrians' safety resulting from improper handling and storage of chemicals and solid waste generated related to construction activities | N | M | L | S | C | R | Moderate |
| HS.C.3. Workers exposure to occupational hazards (e.g. noise, air pollution, dust, fire hazards, etc.) and potential for accidents | N | H | L | S | C | R | Major |
| HS.O.1. Higher rates of physical activity for BRT system users | B | - | - | - | O | - | Beneficial |
| HS.O.2. Creation of safer environment in areas served by BRT system | B | - | - | - | O | - | Beneficial |
| HS.O.3. Improved mobility, road and community safety due to improved infrastructure and reduced exposure to pollutants | B | - | - | - | O | - | Beneficial |

### *7.10.1 Impacts during Construction*

There are various sources of fugitive emissions during construction activities:

- Earth excavation and moving
- Disturbed surface areas
- Unpaved roads
- Open storage piles
- Paving and application of asphalt
- Machinery and vehicles

Workers and personnel at construction sites will be in direct contact with fugitive emissions such as dust, air pollutants (SOx, NOx, CO and VOCs) from the operation of different machinery and the vehicles passing nearby, especially during the construction activities on the trunk-line. In addition, there are direct emissions resulting from equipment such as the diesel generators and heavy-weight vehicles operating at the construction sites. Exposure to air emissions have both acute (respiratory problems) and chronic impacts (cancer), therefore mitigation measures are necessary to eliminate or reduce the propagation of fugitive and direct emissions.

Without the implementation of any mitigation measures, the impact on workers' and pedestrians' safety resulting from improper handling and storage of construction material and construction activities will have a **Major consequence rating (4)** and **Moderate likelihood of occurrence (M)**, thus resulting in a **Medium Impact Significance Level (4M=8).**

Workers on the trunk-line and construction sites of different facilities of P&R, bus depots and terminals will be continuously exposed to potential sources of hazards if construction activities were not managed properly. Adjacent traffic, heavy machinery noise, vibration and emissions, construction activities that involve excavation, storage of hazardous raw material and waste, etc. are examples of potential sources of hazards that are in direct contact with workers. In addition to workers, there will be engineers, monitoring personnel and other personnel that might also be exposed to these hazards. Moreover, On the Inner/Outer-Beirut lines installations and construction works will take place in crowded urban locations that involve heavy traffic and pedestrian movement, therefore increasing the chances for accidents and limiting the space for construction activities.

Without the implementation of any mitigation measures, the impact from workers' exposure to occupational hazards and potential for accidents will have a **Major consequence rating (4)** and **High likelihood of occurrence (H)**, thus resulting in a **High Impact Significance Level (4H=12)**.

## 7.11 IMPACTS ON SOCIO-ECONOMIC ASPECTS

The project has various negative and positive impacts during construction and operation phases that might impact directly/indirectly the socio-economic status of the residents adjacent to the project and the nation on larger scale. The initial opinion survey, focus group meetings, interviews with key informants, key stakeholder meetings, and the two public consultation meetings were crucial in the compilation and analysis of various socio-economic impacts. Table 7-34 lists the potential impacts and their respective consequence assessments.

**Table 7-34. Consequence Assessment on Socio-Economic Aspects**

| Impact/Source | Nature | Magnitude | Extent | Timing | Duration | Reversibility | Consequence Rating |
|---|---|---|---|---|---|---|---|
| SE.D.1 Impact on other secondary public transport systems | N | M | L | L | D | R | Moderate |
| SE.D.2 Impact on city aesthetics caused by pedestrian bridges, bus stations, depots, terminals and pedestrian traffic | N | M | L | M | D | R | Moderate |
| SE.D.3 Land use, land acquisition and resettlement impacts | N | H | L | L | D | R | Major |
| SE.D.4 Improper system design that does not accommodate persons with special needs and disabilities | N | H | L | L | D | R | Major |
| SE.D.5 Inflexible system design that does not allow future expansion of the system to cover other areas | N | H | L | L | D | R | Major |
| SE.C.1. Induce potential secondary development and impact on utility provision during project construction | N/I | M | L | S | C | R | Moderate |
| SE.C.2. Impacts on visual amenity due to landscape change and new constructions | N | L | L | M | C | R | Minor |
| SE.C.3 Improvements in road conditions and traffic management infrastructure | P | - | - | - | C | - | Beneficial |
| SE.O.1. Impact on livelihood of current bus drivers and public transport operators due to passenger shift to BRT | N | H | G | L | O | I | Critical |
| SE.O.2. Resource consumption for the operation of buses and for maintenance activities | N | L | L | L | O | R | Minor |
| SE.O.3 Frequent bus stops and multiple stations leading to the increase in travel time and discouraging BRT system users | N | M | L | L | O | R | Moderate |
| SE.O.4 Impact on safety due to lack of monitoring, selection of drivers, etc. | N | H | L | L | O | R | Major |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| SE.O.5 Difficulty in changing the behavior of people to stop using their cars and shift to the BRT system | N | M | G | L | O | R | Moderate |
| SE.O.6. Creation of job opportunities including personnel with limited skills | P | - | - | - | O | - | Beneficial |
| SE.O.7. Increased attraction to local touristic and cultural areas due to better mobility to these locations by tourists and locals | P | - | - | - | O | - | Beneficial |
| SE.O.8. Increased physical activity of BRT users | P | - | - | - | O | - | Beneficial |
| SE.O.9. Time and monetary savings by BRT users from all social classes due to switching from private vehicles | P | - | - | - | O | - | Beneficial |
| SE.O.10. Local public transport development around bus stations to further serve commuters | P | - | - | - | O | - | Beneficial |
| SE.O.11. Socio-economic growth at the areas that have access to the BRT system through direct/indirect employment opportunities, increase in land value and attraction of development investments | P | - | - | - | O | - | Beneficial |

### *7.11.1 Impacts during Construction*

The detailed design of the project should confirm the identified civil works and lands affected. The BRT Corridor will occupy the road right of way along its trajectory, and hence there is no change in land use along the corridor. Nonetheless, in some areas along the highway in the northern corridor from Nahr el Kalb to Tabarja there is a need to expropriate approximately 235 $m^2$ of private lands to accommodate the pedestrian infrastructure of the stations along the sidewalks.

The BRT Corridor in the Outer and Inner Rings is entirely located in the right of way, and no land use change or acquisition needs arises.

The P&R facilities will be placed on publicly-available land which have been assessed to have no productive value. One of the P&R facilities in Kfrayassine has five illegal households with a total of 26 persons and some fruit trees.

The bus depot in Safra and bus terminal in Wata Slem, Tabarja will be located on privately-owned plots 14,000 $m^2$ (1 plot) and 6,000 $m^2$ (3 plots and part of a fourth plot). The plots have no productive activities or housing. Nonetheless, the depot and terminal locations are non-built areas, and the creation of transport infrastructure that will become a hub for commuters and a whole fleet of buses might change the land use in the area.

Land acquisition procedures and compensation estimates are fully evaluated in a Resettlement Action Plan (RAP) prepared in line with Law No. 58/1991 and World Bank OP 4.12.

Without the implementation of any mitigation measures and adequate planning, the impact from the project design on land use, land acquisition and resettlement will have a **Major consequence rating (4)** and **High likelihood of occurrence (H)**, thus resulting in a **High Significance Level (5H=12)**.

### *7.11.2 Impacts during Operation*

Currently, the public transport system in Lebanon is not regulated, where various buses, mini-vans and taxis serve the demand in a random manner in most cases. The existing public transport modes is a source of livelihood for many individuals and source of profit to private operators. The introduction of the BRT system will impact the existing services through the shift of passengers to a more regulated, faster and comfortable system. Hence, there will be a significant impact on the income and livelihood of the existing operators.

Without the implementation of any mitigation measures and facilitated integration, the impact of the BRT on livelihood of current bus drivers and public transport operators will have a **Critical consequence rating (5)** and **High likelihood of occurrence (H)**, thus resulting in a **High Impact Significance Level (5H=15).**

## 7.12 SUMMARY OF ENVIRONMENTAL IMPACTS BEFORE AND AFTER IMPLEMENTATION OF MITIGATION MEASURES

A summary of environmental impacts before and after the implementation of mitigation measures during the design, construction and operation phases are provided in Table 7-35 and Table 7-37 respectively.

**Table 7-35. Summary of Environmental Impact Assessment (Before and After Mitigation) during Design/Pre-construction Phase**

| Impact/Source | | Nature | Magnitude | Extent | Timing | Duration | Reversibility | Consequence Rating |
|---|---|---|---|---|---|---|---|---|
| T.D.1. Impacts resulting from road closures, bottlenecks due to road works to construct the BRT | Before Mitigation | N/D | H | L | M | C | R | Major |
| | After Mitigation | N/D | M | L | M | C | R | Moderate |
| ACH.D.1 Potential damage to uncovered archaeological features during excavation | Before Mitigation | N/D | H | L | L | D | R | Major |
| | After Mitigation | N/I | L | L | L | C | R | Minor |
| SE.D.1. Impact on other secondary public transport systems | Before Mitigation | N | M | L | L | D | R | Moderate |
| | After Mitigation | N | L | L | M | D | R | Minor |
| SE.D.2. Impact on city aesthetics caused by pedestrian bridges, bus stations, depots, terminals and pedestrian traffic | Before Mitigation | N | M | L | M | D | R | Moderate |
| | After Mitigation | N | L | L | M | D | R | Minor |
| SE.D.3. Land use, land acquisition and resettlement impacts | Before Mitigation | N | H | L | L | D | R | Major |
| | After Mitigation | N | M | L | M | D | R | Moderate |
| SE.D.4 Improper system | Before Mitigation | N | H | L | L | D | R | Major |

| Impact/Source | | Nature | Magnitude | Extent | Timing | Duration | Reversibility | Consequence Rating |
|---|---|---|---|---|---|---|---|---|
| design that does not accommodate persons with special needs and disabilities | After Mitigation | N | L | L | L | D | R | Minor |
| SE.D.5 Inflexible system design that does not allow future expansion of the system to cover other areas | Before Mitigation | N | H | L | L | D | R | Major |
| | After Mitigation | N | M | L | L | D | R | Minor |

**Table 7-36. Summary of Environmental Impact Assessment (Before and After Mitigation) during Construction Phase**

| Impact/Source | | Nature | Magnitude | Extent | Timing | Duration | Reversibility | Consequence Rating |
|---|---|---|---|---|---|---|---|---|
| T.C.1. Increased traffic due to creation of detours during construction | Before Mitigation | N/D | H | L | M | C | R | Major |
| | After Mitigation | N/D | M | L | S | C | R | Moderate |
| AQ.C.1. Airborne particles (dust) from soil disturbance | Before Mitigation | N/D | M | L | S | C | R | Moderate |
| | After Mitigation | N/D | L | L | S | C | R | Minor |
| AQ.C.2. Fugitive emissions during constriction works and odors from paving activities | Before Mitigation | N/D | M | L | S | C | R | Moderate |
| | After Mitigation | N/D | L | L | S | C | R | Minor |
| AQ.C.3. Impacts on air quality from generators | Before Mitigation | N/D | M | L | S | C | R | Moderate |
| | After Mitigation | N/D | L | L | S | C | R | Minor |
| N.C.1 Change in vibration and noise levels from general construction activities, and movement of construction vehicles | Before Mitigation | N/D | H | L | S | C | R | Major |
| | After Mitigation | N/D | M | L | S | C | R | Moderate |
| SWR.C.1. Site Clearance and demolition activities | Before Mitigation | N/D | L | S | L | C | R | Negligible |
| | After Mitigation | N/D | L | L | L | C | R | Negligible |
| SWR.C.2. Accidental spills or leaks of fuel, oil and other chemicals | Before Mitigation | N/D | H | G | M | C | R | Major |
| | After Mitigation | N/D | L | L | M | C | R | Minor |
| SWR.C.3. Inadequate storage and disposal of solid wastes | Before Mitigation | N/D | M | L | L | C | R | Moderate |
| | After Mitigation | N/D | L | L | L | C | R | Minor |
| SWR.C.4. Inadequate storage and disposal of wastewater generated | Before Mitigation | N/D | H | G | M | C | R | Major |
| | After Mitigation | ND | L | L | S | C | R | Minor |
| SWR.C.5. Potential dewatering activities | Before Mitigation | N/D | M | G | M | C | R | Moderate |
| | After Mitigation | ND | L | G | S | C | R | Minor |

| Impact/Source | | Nature | Magnitude | Extent | Timing | Duration | Reversibility | Consequence Rating |
|---|---|---|---|---|---|---|---|---|
| ACH.C.1. Accidental unearthing/damage to archaeological findings during excavation | Before Mitigation | N/I | M | L | L | C | R | Moderate |
| | After Mitigation | N/I | L | L | L | C | R | Minor |
| B.C1. Impacts on biodiversity during site clearance and excavation of P&R facilities | Before Mitigation | N/D | L | L | S | C | R | Negligible |
| | After Mitigation | P | - | - | - | C | - | Beneficial |
| B.C.2. Impacts on biodiversity during site clearance and excavation of Beirut-Tabarja trunk-line and station infrastructure | Before Mitigation | N/D | M | L | S | C | R | Minor |
| | After Mitigation | P | - | - | - | C | - | Beneficial |
| B.C.3. Impacts on biodiversity during site clearance and excavation of Beirut Outer ring | Before Mitigation | N/D | M | L | S | C | R | Minor |
| | After Mitigation | P | - | - | - | C | - | Beneficial |
| B.C.4. Impacts on biodiversity during site clearance and excavation of P&R facility (8), Safra depot and Tabarja terminal | Before Mitigation | N/D | M | L | S | C | R | Moderate |
| | After Mitigation | N/D | L | L | S | C | R | Negligible |
| HS.C.1. Impact on workers' and pedestrians' safety resulting from improper handling and storage of construction material and construction activities | Before Mitigation | N/D | H | L | S | C | R | Major |
| | After Mitigation | N/I | L | L | S | C | R | Negligible |
| HS.C.2. Impact on workers' and pedestrians' safety resulting from improper handling and storage of chemicals and solid waste generated related to construction activities | Before Mitigation | N | M | L | S | C | R | Moderate |
| | After Mitigation | N/I | S | L | S | C | R | Minor |
| HS.C.3. Workers exposure to occupational hazards (e.g. noise, air pollution, dust, fire hazards, etc.) and potential for accidents | Before Mitigation | N | H | L | S | C | R | Major |
| | After Mitigation | N | L | L | S | C | R | Minor |
| SE.C.1. Induce potential secondary development during project construction | Before Mitigation | N/I | M | L | S | C | R | Moderate |
| | After Mitigation | N/I | L | L | S | C | R | Negligible |
| SE.C.2. Impacts on visual amenity due to landscape change and new constructions | Before Mitigation | N | L | L | M | C | R | Minor |
| | After Mitigation | N | L | L | S | C | R | Negligible |

| Impact/Source | | Nature | Magnitude | Extent | Timing | Duration | Reversibility | Consequence Rating |
|---|---|---|---|---|---|---|---|---|
| SE.C.3. Improvements in road conditions and traffic management infrastructure | Before Mitigation | P | - | - | - | C | - | Beneficial |
| | After Mitigation | - | - | - | - | - | - | - |

**Table 7-37. Summary of Environmental Impact Assessment (Before and After Mitigation) during Operation Phase**

| Impact/Source | | Nature | Magnitude | Extent | Timing | Duration | Reversibility | Consequence Rating |
|---|---|---|---|---|---|---|---|---|
| T.O.1. Traffic congestion during the operation of the project | Before Mitigation | N | H | L | M | O | R | Major |
| | After Mitigation | N | M | L | S | O | R | Moderate |
| T.O.2. Traffic congestion at P&R facilities and at bus stations if no upgrading of roads and infrastructure takes place | Before Mitigation | N | H | L | L | O | R | Major |
| | After Mitigation | N | L | L | L | O | R | Minor |
| T.O.3. Advanced traffic monitoring systems and ease of traffic flow | After Mitigation | P | - | - | - | O | - | Beneficial |
| | Before Mitigation | | - | - | - | - | - | - |
| AQ.O.1. Change in overall atmospheric pollutant emissions | Before Mitigation | P/D | H | L | L | O | R | Beneficial |
| | After Mitigation | - | - | - | - | - | - | - |
| AQ.O.2. Change in GHG emissions | Before Mitigation | P/D | H | L/G | L | O | R | Beneficial |
| | After Mitigation | - | - | - | - | - | - | - |
| N.O.1. Change in noise levels from normal operation of the BRT System | Before Mitigation | P/D | - | - | - | O | - | Beneficial |
| | After Mitigation | P/D | - | - | - | - | - | - |
| SWR.O1. Fuelling and maintenance operation | Before Mitigation | N/D | H | G | L | O | R | Major |
| | After Mitigation | ND | L | L | L | O | R | Minor |
| SWR.O.2. Hazardous and non-hazardous wastes from maintenance activities | Before Mitigation | N/D | H | L | L | O | R | Major |
| | After Mitigation | N/D | L | L | L | O | R | Minor |
| SWR.O.3. Solid waste generated from passengers at different facilities | Before Mitigation | N/D | L | L | L | O | R | Minor |
| | After Mitigation | N/D | L | L | S | O | R | Negligible |
| ACH.O.1. Promotion of archaeology, museums, and heritage assets. | Before Mitigation | P/I | - | - | - | O | - | Beneficial |
| | After Mitigation | - | - | - | - | - | - | - |
| B.O.1. Impacts on biodiversity during regular operation | Before Mitigation | N/D | L | L | S | O | R | Negligible |
| | After Mitigation | P | - | - | - | O | R | Beneficial |
| HS.O.1. Higher rates of | Before Mitigation | B | - | - | - | O | - | Beneficial |

| Impact/Source | | Nature | Magnitude | Extent | Timing | Duration | Reversibility | Consequence Rating |
|---|---|---|---|---|---|---|---|---|
| physical activity for BRT system users | After Mitigation | - | - | - | - | - | - | - |
| HS.O.2. Creation of safer environment in areas served by BRT system | Before Mitigation | B | - | - | - | O | - | Beneficial |
| | After Mitigation | - | - | - | - | - | - | - |
| HS.O.3. Improved mobility, road and community safety due to improved infrastructure and reduced exposure to pollutants | Before Mitigation | B | - | - | - | O | - | Beneficial |
| | After Mitigation | - | - | - | - | - | - | - |
| SE.O.1. Impact on livelihood of current bus drivers and public transport operators due to passenger shift to BRT | Before Mitigation | N | H | G | L | O | I | Critical |
| | After Mitigation | N | L | L | L | O | R | Minor |
| SE.O.2. Resource consumption for the operation of buses and for maintenance activities | Before Mitigation | N | L | L | L | O | R | Minor |
| | After Mitigation | N | L | L | L | O | R | Negligible |
| SE.O.3 Frequent bus stops and multiple stations leading to the increase in travel time and discouraging BRT system users | Before Mitigation | N | M | L | L | O | R | Moderate |
| | After Mitigation | N | L | L | L | O | R | Minor |
| SE.O.4 Impact on safety due to lack of monitoring, selection of drivers, etc. | Before Mitigation | N | H | L | L | O | R | Major |
| | After Mitigation | N | L | L | M | O | R | Minor |
| SE.O.5 Difficulty in changing the behavior of people to stop using their cars and shift to the BRT system | Before Mitigation | N | M | G | L | O | R | Moderate |
| | After Mitigation | N | L | L | L | O | R | Minor |
| SE.O.6. Creation of job opportunities including personnel with limited skills | Before Mitigation | P | - | - | - | O | | Beneficial |
| | After Mitigation | - | - | - | - | - | - | - |
| SE.O.7. Increased attraction to local touristic and cultural areas due to better mobility to these locations by tourists and locals | Before Mitigation | P | - | - | - | O | - | Beneficial |
| | After Mitigation | - | - | - | - | - | - | - |
| SE.O.8. Increased physical activity of BRT users | Before Mitigation | P | - | - | - | O | - | Beneficial |
| | After Mitigation | - | - | - | - | - | - | - |
| SE.O.9. Time and monetary savings by BRT users from all social classes due to switching from private vehicles | Before Mitigation | P | - | - | - | O | - | Beneficial |
| | After Mitigation | - | - | - | - | - | - | - |
| SE.O.10. Local public transport development around bus stations to | Before Mitigation | P | - | - | - | O | - | Beneficial |
| | After Mitigation | - | - | - | - | - | - | - |

| **Impact/Source** | | **Nature** | **Magnitude** | **Extent** | **Timing** | **Duration** | **Reversibility** | **Consequence Rating** |
|---|---|---|---|---|---|---|---|---|
| further serve commuters | | | | | | | | |
| SE.O.11. Socio-economic growth at the areas that have access to the BRT system through direct/indirect employment opportunities, increase in land value and attraction of development investments | Before Mitigation | P | - | - | - | O | - | Beneficial |
| | After Mitigation | - | - | - | - | - | - | - |

# 8. MITIGATION AND MONITORING PLAN

## 8.1 INTRODUCTION

This chapter presents the proposed ESMP for the BRT Project. This ESMP addresses the main impacts that were identified in the Impact Assessment, and proposes the following:

- Mitigation measures to be implemented during the construction and operation phases of the project, where these measures should be integrated in the detailed design phase to ensure that the design accounts for the environmental and socio-economic impacts of the Project;
- References to control guidelines and standards;
- Responsibilities for the implementation of the plan;
- Verification, monitoring and training requirements;
- Reporting requirements; and
- Overall cost estimates for mitigation measures and monitoring.

The overall objectives of the ESMP are to ensure Project compliance with environmental legislation and Proponent's requirements, and to provide the Project Proponent with clear and specific guidelines to undertake the appropriate monitoring activities and compliance inspection programs. The ESMP may be subject to updates and modifications throughout the Project lifetime by the Project Proponent.

**Given that the Project is at the feasibility stage and the System components will be subject to detailed design, it is imperative that the environmental and socio-economic mitigation and monitoring measures be revisited through site-specific ESIAs (with ESMPs). The site-specific ESIAs for the System components, i.e. BRT Corridors, Feeder Buses, P&R facilities, Depot and Terminal, reflect the final design and provide an update of the assessments and conclusions of this ESIA where needed (including baseline, assessment and mitigation measures) to address any gaps that could arise from the detailed design. The site-specific ESIAs should include:**

d. **Livelihood Restoration Plan (LRP):** Inclusive of a detailed socio-economic baseline of affected bus operators and businesses subject to temporary disruption with detailed measures to mitigate risks and impacts arrived at through consultation with the PAPs.

e. **Physical Cultural Resources (PCR) management plan:** a detailed plan should be prepared as part of the site-specific ESIAs to meet OP 4.11 requirements, in close coordination and consultation with the Directorate General of Antiquities, once the exact physical footprint and excavation depths for all affected plots are determined.

f. **Ambient air quality monitoring program**: Empirical primary data needs to be collected on ambient air quality immediately before and throughout BRT System operation, in order to gauge the anticipated positive environmental benefit.

## 8.1 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

Mitigation measures for the negative impacts identified in the impact analysis shall be summarized in this section of the ESIA report. The mitigation plan will be based on a source and sensitivities approach, allowing the identification and proposition of protective measures for tackling the problems facing each. Proposed mitigation measures for design, construction and operation impacts are summarized in Table 8-1, Table 8-2 and Table 8-3.

**Table 8-1. Environmental and Social Management Plan for the Design/Pre-Construction Phase**

| Source of Impact | Project Activities | Evaluation of Impact[13] | | | | | | | | Mitigation Measures | Residual Impacts[14] | Institutional Responsibility | Indicative Cost Estimation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | N | M | E | T | D | R | L | S | | | | |
| T.D.1. Impacts resulting from road closures, bottlenecks due to road works to construct the BRT | Design of Project implementation & construction | N/D | H | L | M | C | R | H | H | T. D.1 mitigations include:<br>a. For the northern highway, the construction of the Périphérique, A2 and the implementation of the A1 Highway widening project are crucial to reduce the impact of the BRT construction, which will require the closure of at least one lane of the existing network.<br>b. The bidders for the Construction Tender should be required to submit a Traffic Management Plan for the construction, and the quality of the TMP should be one of the criteria to be considered in the selection process of the contractor. The TMP should be shared with stakeholders and relevant authorities to inform communities when necessary and prevent additional disturbance to | Residual impacts should be evaluated during Construction and should follow careful implementation of the TMP | CDR | 100,000 USD (except T.D.1. & T.D.4. which are major infrastructure projects) |

[13] The proposed categories for each of the evaluation criteria:
**N (Nature):** P (Positive), N (Negative), D (Direct), I (Indirect);
**M (Magnitude):** L (Low), M (Moderate), H (High);
**E (Extent):** L (Local), G (Global);
**T (Timing):** S (Short-term), M (Medium-term), L (Long-term);
**D (Duration):** C (During Construction), O (During Operation), D (During Design);
**R (Reversibility):** R (Reversible), I (Irreversible);
**L (Likelihood of Occurrence):** L (Low), M (Moderate), H (High);
**S (Significance):** L (Low), M (Moderate), H (High).

[14] Includes a list of remaining environmental impacts (if any) following the implementation of the mitigation plan.

| Source of Impact | Project Activities | Evaluation of Impact[13] | | | | | | | | Mitigation Measures | Residual Impacts[14] | Institutional Responsibility | Indicative Cost Estimation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | already congested traffic flow. The TMP should include the following considerations:<br>i. Ensure the diversion to alternate routes wherever possible will minimize traffic jams and bottlenecks and minimize traffic related accidents;<br>ii. Lane availability and minimization of traffic flows past the works site;<br>iii. Acceptable working hours and constraints, avoiding peak hours or public holidays whenever applicable;<br>iv. Agreement with local authorities on time scale for works and traffic delay requirements;<br>v. Identify road closures and prioritize order;<br>vi. Co-ordination with other planned road works;<br>vii. Establishment of incident management system for the entire duration of the works depending on the location.<br><br>c. The proposed Construction Management Plan of the selected contractor should show a compact construction phase as much as possible, and night shifts should be included in the construction program.<br><br>d. For the Outer and Inner Ring BRT lines, | | | |

| Source of Impact | Project Activities | Evaluation of Impact[13] | | | | | | | | Mitigation Measures | Residual Impacts[14] | Institutional Responsibility | Indicative Cost Estimation |
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| | | | | | | | | | | providing off-street parking to replace on-street parking is very important before the construction work. However, the time between the completion of these parking spaces and the beginning of the BRT implementation should not exceed one month in each area for residents and the workers not to get used to the high parking availability. | | | |
| ACH.D.1 Potential damage to uncovered archaeological features during excavation | Design of Project implementation & construction | N/D | H | L | L | D | R | H | H | ACH.D.1. The Directorate General of Antiquities (DGA) should be notified of the exact locations where site works will occur and should be involved in the decision-making process during the planning phase of the project (Article 19, Law 166/LR of 1933), impacts on uncovered archaeological features will be reduced. This will allow to:<br>a. Institute the necessary measures that need to be considered in order to alleviate and mitigate any negative impacts on cultural heritage and archaeology;<br>b. Identify sensitive areas prior to starting groundworks, and when possible relocate project components;<br>c. Guarantee the application of the necessary measures for each project component and location;<br>d. Take into account the possible delays due to archaeological excavation and add them to the BRT construction schedule;<br>e. Determine the needed budgets to conduct any needed archaeological | Coordination with DGA at an early stage, by providing maps of project physical footprint should be adequate to mitigate the potential impact. | CDR & Design Engineer | - |

| Source of Impact | Project Activities | Evaluation of Impact[13] | | | | | | | | Mitigation Measures | Residual Impacts[14] | Institutional Responsibility | Indicative Cost Estimation |
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| | | | | | | | | | | excavation works, studies and publications;<br>f. Set the technical specifications and the tendering procedure. | | | |
| SE.D.1 Impact on other secondary public transport systems | Design of Project implementation | N | M | L | L | D | R | M | M | SE.D.1 The preliminary assessment of the project already considered the wider Land Transport Sector Strategy that has been recently developed by the Ministry of Public Works and Transport (MoPWT). Thus reducing the chances for any conflict with future public transport developments | - | CDR / MoPWT / RPTA | - |
| SE.D.2 Impact on city aesthetics caused by pedestrian bridges, bus stations, depots, terminals and pedestrian traffic | Design of Project implementation & construction | N | M | L | M | D | R | M | M | SE.D.2. Mitigation measures to improve visual amenity include:<br>a. Preserving and maintaining the landscaping of the entire system and promoting tree planting and homogenous visual design (signs, street lights, sidewalks, etc.) with the city design;<br>b. Ensure all future advertisement plans have a protocol and are integrated at different facilities and installed on buses without causing disturbance to commuters;<br>c. Develop a contemporary architectural design for all different components of the project while considering cultural values and the general aesthetics of the GBA. | Positive residual impacts if mitigation measures are applied with genuine intent to improving the urban aesthetics | CDR / Design Engineer / Municipalities | 75,000 USD (landscape plan & aesthetic design) |
| SE.D.3 Land use, land acquisition and resettlement impacts | Design of Project implementation | N | H | L | L | D | R | H | H | SE.D.3 Mitigation measures to adequately prepare for change in land use, land acquisition and resettlement impacts include:<br>a. Evaluation of land acquisition | Land use changes | CDR / DGUP / Municipalities | 20 million USD (land acquisition and resettleme |

| Source of Impact | Project Activities | Evaluation of Impact[13] | | | | | | | | Mitigation Measures | Residual Impacts[14] | Institutional Responsibility | Indicative Cost Estimation |
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| | | | | | | | | | | procedures and compensation estimates in a Resettlement Action Plan (RAP) prepared in line with Law No. 58/1991 and World Bank OP 4.12<br>b. Assessing the impacts from the anticipated change in land use in the bus depot and terminal areas through a separate SEA study. | | | nt) |
| SE.D.4 Improper system design that does not accommodate persons with special needs and disabilities | Design of Project impleme ntation | N | H | L | L | D | R | L | M | SE.D.4 The design of the BRT system both in terms of infrastructure and bus fleet should be in accordance to Law No. 220/2000 and its application Decree No. 7184/2011; relevant articles and design details are discussed in Section 3.2.1.2.9 | None if inclusive and universal design principles are applied | CDR / Design Engineer | - |
| SE.D.5 Inflexible system design that does not allow future expansion of the system to cover other areas | Design of Project impleme ntation | N | H | L | L | D | R | M | M | SE.D.5 The current design of the system serves the areas with high demand should also consider:<br>a. facilitating the integration of the system with existing bus networks that links Tripoli (north), Chtaura (east) and Saida (south);<br>b. facilitating the expansion of the system in terms of road networks with potential demand increase in the future;<br>c. facilitating the integration with other long term public transport plans (e.g. the railway project;<br>d. operation of the P&R facilities that would help commuters to use their private vehicles to reach to the closest point to the BRT system and continue their journey towards Beirut. | - | CDR / MoPWT / RPTA | Not possible to estimate at this stage the cost of expansion of BRT |

**Table 8-2. Environmental and Social Management Plan for the Construction Phase**

| Source of Impact | Project Activities | Evaluation of Impact[15] | | | | | | | | Mitigation Measures | Residual Impacts[16] | Institutional Responsibility | Indicative Cost Estimation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | N | M | E | T | D | R | L | S | | | | |
| T.C.1. Increased traffic due to creation of detours during construction | During various construction activities that require traffic management | N/D | H | L | M | C | R | H | H | T.C.1 Besides the strict implementation of the measures T.D.1.a & T.D.1.b,<br>a. Management measures should include that any total closure of a road has to be published 2 weeks ahead, and information panels should be placed on the concerned road 1 month in advance. Those closures should be during off peak hours and at night if possible; adequate information signs should be placed 1 km before the closed road or as required on the surrounding road network if it is in the city. The possible detours should be mentioned on the information signs.<br>b. Full cooperation of the Construction contractor with the Internal Security Forces and Traffic police<br>c. Transfer services using water taxis, | Congestion is still expected to form, however there should not be deadlocks and standstill traffic | ISF / CDR / Construction Contractor (HSE) | 200,000 USD |

[15] The proposed categories for each of the evaluation criteria:
**N (Nature):** P (Positive), N (Negative), D (Direct), I (Indirect);
**M (Magnitude):** L (Low), M (Moderate), H (High);
**E (Extent):** L (Local), G (Global);
**T (Timing):** S (Short-term), M (Medium-term), L (Long-term);
**D (Duration):** C (During Construction), O (During Operation);
**R (Reversibility):** R (Reversible), I (Irreversible);
**L (Likelihood of Occurrence):** L (Low), M (Moderate), H (High);
**S (Significance):** L (Low), M (Moderate), H (High).

[16] Includes a list of remaining environmental impacts (if any) following the implementation of the mitigation plan.

| Source of Impact | Project Activities | Evaluation of Impact[15] | | | | | | | | Mitigation Measures | Residual Impacts[16] | Institutional Respons | Indicative Cost Estimation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | ferries from sea ports should be considered | | | |
| AQ.C.1. Airborne particles (dust) from soil disturbance | Construction works (excavation, grading, movement of trucks, etc.) | N/D | M | L | S | C | R | H | M | AQ.C.1/AQ.C.2. Control measures for dust emissions:<br>a. Water for any earth moving close to the construction site to prevent visible dust emissions;<br>b. Using water in excavation works and milling (removal) of existing asphalt to suppress dust propagation;<br>c. Continuous application of water of disturbed surfaces that cannot be stabilized;<br>d. Water unpaved roads that is used for vehicular traffic and limit vehicle speed limits;<br>e. If water is not available segregation barriers (easily erectable boards 2.5m) should be applied to separate the construction works from sensitive receptors; specifically, at the median construction sites, the bus depots, P&R facilities;<br>f. Minimize large stockpiles of soil and excavation material, and whenever necessary enclose with side barriers and/or cover when not in use;<br>g. Soil and construction material that are susceptible to dust formation should only be transported in securely covered trucks.<br>AQ.C.2/A.C.3. Control measures for vehicular and equipment emissions:<br>h. Periodically check and conduct maintenance of the construction | Short-term impacts | CDR/ Construction contractor (HSE) | 20,000 USD |
| AQ.C.2. Fugitive emissions during constriction works and odors from paving activities | Construction works (earth works, paving, pilling, machinery, etc.) | N/D | M | L | M | C | R | H | M | | | | |
| AQ.C.3. Impacts on air quality from generators | Mobile diesel generators | N/D | M | L | M | C | R | H | M | | | | |

| Source of Impact | Project Activities | Evaluation of Impact[15] | | | | | | | | Mitigation Measures | Residual Impacts[16] | Institutional Respons | Indicative Cost Estimation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | machinery and vehicles;<br>i. Regularly check engine oil and use engines/machinery/equipment with good efficiency and fuel combustion characteristics;<br>j. Use of catalytic converters and good quality fuels (Low Sulphur);<br>k. Stack height of generators should be at least 3 meters above ground;<br>l. Ensure availability of trained technicians and operators on site<br>m. Air quality monitoring at the project site during construction activities;<br>n. Conduct paving activities during off-peak hours to minimize exposure of receptors to odors, and use advanced application methods and machinery with built in exhausts;<br>o. Ensure the usage of Personal Protective Equipment (PPEs) (hard hat, gloves, masks, safety glasses, etc.). | | | |
| N.C.1 Increase in vibration and noise levels from general construction activities, and movement of construction vehicles | Heavy machinery and generators operation<br>Transport of raw material, construction waste, workers, and traffic congestion resulting from detours and construction | N/D | H | L | S | C | R | H | 12 | N.C.1. Control measures for noise and vibration propagation:<br>a. Preparation of noise control plan by the contractor depending on the location prior to the commission of activities to take the proper measures based on site characteristics and distance from receptors;<br>b. Install noise barriers where necessary, especially at the median section where there is continuous traffic and movement of potential receptors;<br>c. Ensure periodic monitoring of noise levels during peak construction activities to ensure noise levels are not | Short-term impacts | CDR / Construction Contractor (HSE) | 30,000 USD |

| Source of Impact | Project Activities | Evaluation of Impact[15] | | | | | | | | Mitigation Measures | Residual Impacts[16] | Institutional Respons | Indicative Cost Estimation |
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| | activities | | | | | | | | | increased more than 3 dBA;<br>d. Impose speed limits on construction vehicles;<br>e. Using horns should be prohibited by construction vehicles and trucks on the access roads and on construction sites;<br>f. Utility of efficient equipment and less-noisy design alternatives, and ensure maintenance and repair of machinery and equipment;<br>g. Construction works should be limited in time, and based on the location only work during daytime, and restrict use of noise equipment and apply sequential operation schedule to reduce continuous noise generation;<br>h. Whenever possible enclose noisy equipment and generators to reduce noise levels;<br>i. Consultation with sensitive receptors (hospitals, hotels, schools, etc.) and notification during peak construction activities; take maximum noise reduction measures nearby sensitive receptors.<br>j. Restrict noise-generating construction activities to the allowable hours of construction as identified by local jurisdictions where feasible. Construction is generally allowed to start at 7:00 a.m., Monday through Friday. Construction activities should end by 6:00 p.m., Monday through Friday, in most of the communities around the project area. No | | | |

| Source of Impact | Project Activities | Evaluation of Impact[15] | | | | | | | | Mitigation Measures | Residual Impacts[16] | Institutional Respons | Indicative Cost Estimation |
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| | | | | | | | | | | construction activities should occur on Sundays or holidays. If work is necessary outside of these hours, local jurisdictions shall require the contractor to implement a construction noise monitoring program and, if feasible, provide additional mitigation as necessary (in the form of noise control blankets or other temporary noise barriers, etc.) for affected receptors.<br>k. Limit pile driving to daytime hours only.<br>l. Equip all internal combustion engine driven equipment with intake and exhaust mufflers that are in good condition and appropriate for the equipment.<br>m. Prohibit unnecessary idling of internal combustion engines within 30 meters of residences.<br>n. Locate stationary noise generating equipment as far as possible from sensitive receptors.<br>o. Utilize "quiet" air compressors and other "quiet" equipment where such technology exists.<br>p. Avoid staging of construction equipment within 65 meters of residences and locate all stationary noise-generating construction equipment, such as air compressors, portable power generators, or self-powered lighting systems as far practical from noise sensitive receptors.<br>q. The contractor shall prepare a detailed construction plan identifying the | | | |

| Source of Impact | Project Activities | Evaluation of Impact[15] | | | | | | | | Mitigation Measures | Residual Impacts[16] | Institutional Respons | Indicative Cost Estimation |
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| | | | | | | | | | | schedule for major noise-generating construction activities and distribute this plan to adjacent noise-sensitive receptors. The construction plan should also list the construction noise reduction measures identified in this study. | | | |
| SWR.C.1. Site Clearance and demolition activities | Beginning of construction activities and clearance of sites | N/D | L | S | L | C | R | H | L | SWR.C.1. Construction and activities will include excavation works and soil compaction in the immediate vicinity as a result of vehicle and construction equipment operations. However, since most of the BRT path is already along an existing highway in an urbanized area then no valuable soil loss and/or topographic / hydrologic adverse impacts are expected along the project path. Construction will require sourcing of raw materials including aggregates some of which will be sourced from local quarries. Such demand for aggregate materials have a cumulative effect on the adverse impacts resulting from quarries involving geology hydrology and groundwater.<br>The following mitigation measures shall be respected:<br>a. Cover and contain stockpiles to protect them from being carried away by wind and runoff water;<br>b. Source aggregate materials from quarries operated by companies with high Environment, Health and Safety Management standards, with quarry rehabilitation plans in place, and with a reputable history of implementing such rehabilitation plans. | Short-term impacts | CDR / Construction Contractor (HSE) | 10,000 USD |

| Source of Impact | Project Activities | Evaluation of Impact[15] | | | | | | | | Mitigation Measures | Residual Impacts[16] | Institutional Respons | Indicative Cost Estimation |
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| SWR.C.2. Accidental spills or leaks of fuel, oil and other chemicals | During various construction phases (grading, paving, installation and building of structures, etc.) | N/D | H | G | M | C | R | M | M | SWR.C.2. Mitigation measures to minimize any potential spills and leaks:<br>a. Store and handle any type of chemical, oil, fuels and lubricants within contained facilities (e.g. bunded areas, leak proof trays) designed to prevent the release of spills/leaks to the soil and groundwater environment;<br>b. Put in place a maintenance schedule as part of the inspection procedures of all equipment/generators/machinery for risk minimization;<br>c. Maintain machines and equipment off-site or onsite in a contained area with impermeable concrete pavement and drainage for vehicle washing and maintenance;<br>d. Oil spill response kits should be available wherever oils are being used/stored;<br>e. Promote awareness among workers on how to handle oil/lubricants;<br>f. Train workers how to clean up small scale spills;<br>g. Promote good housekeeping practices during construction;<br>h. Ensure drip trays are present when re-fueling;<br>i. Prepare a Spill Emergency Plan specific for the project;<br>In case of spill:<br>j. Immediately report to the company representative in case of any spill;<br>k. Stop the source of spill (close valve, seal pipe, seal hole or as appropriate); | Short-term impacts if contained properly or avoided completely | CDR / Construction Contractor (HSE) | 10,000 USD |

| Source of Impact | Project Activities | Evaluation of Impact[15] | | | | | | | | Mitigation Measures | Residual Impacts[16] | Institutional Respons | Indicative Cost Estimation |
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| | | | | | | | | | | l. Check for hazards, flammable matters on site;<br>m. Clean the spill by removing affected top soil layer by trained employees (they should be wearing appropriate PPE);<br>n. Treat the removed soil as hazardous waste;<br>o. Adopt as much as possible dry cleaning techniques to decrease resulting wastewater, and to avoid flushing of spills to deeper soil layers. | | | |
| SWR.C.3. Inadequate storage and disposal of solid wastes | During various construction phases, mainly during clearance and demolition of existing structures | N/D | M | L | L | C | R | M | M | SWR.C.3. The potential impact resulting from Poor Waste Management should be reduced by implementing the following measures:<br>a. Segregate at source domestic waste, construction waste that can be reused, construction waste to be disposed of, etc.<br>b. Sort excavation waste resulting from construction activities:<br>c. Reuse part of the excavation waste in backfilling; and dispose of the rest (if any) in a permitted construction and demolition waste dump designated by the respective Municipality in agreement with the MoE;<br>d. Schedule the works for the dry season if possible;<br>e. Progressively carry out rehabilitation of disturbed areas following completion of work in each area (rehabilitation will include reinstatement of soil, surface leveling, re-vegetation and mulching where applicable); | - | CDR / Construction Contractor (HSE) | 20,000 USD |

| Source of Impact | Project Activities | Evaluation of Impact[15] | | | | | | | | Mitigation Measures | Residual Impacts[16] | Institutional Respons | Indicative Cost Estimation |
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| | | | | | | | | | | f. Ensure that standards of "good housekeeping" are maintained (i.e., avoiding littering, preventing storage of combustible waste for more than 24 hours to prevent attraction of pests and flies).<br>g. Stockpiles shall be covered and contained to avoid them being transported by wind and rain. | | | |
| SWR.C.4. Inadequate storage and disposal of wastewater generated | Operation of equipment, machinery and workers on site | N/D | H | G | M | C | R | M | M | SWR.C.4. To ensure that no groundwater contamination results from poor wastewater management, the below should be taken into consideration:<br>a. Provide fully impermeable septic/ holding tanks;<br>b. Empty septic/ holding tanks according to an adequate frequency ensuring they are never full;<br>c. Regular inspection of septic/ holding tanks;<br>d. Obtain a permit from the Municipality to transport and discharge the wastewater and sludge in authorized sites;<br>e. Vehicle washing shall be only in contained maintenance areas offsite or onsite with impermeable concrete pavement and proper drainage. | Short-term impacts or none at all if contained properly | CDR / Construction Contractor (HSE) | 10,000 USD |
| SWR.C.5. Potential dewatering activities | During various construction activities that involve excavation and | N/D | M | G | M | C | R | M | M | SWR.C.5. Impacts from dewatering shall be alleviated by adopting the following measures:<br>a. Testing of dewatered water should be performed prior to reuse or disposal to ensure the lack of petroleum products in it and oil-water separators shall be | - | CDR / Construction Contractor (HSE) | 10,000 USD |

| Source of Impact | Project Activities | Evaluation of Impact[15] | | | | | | | | Mitigation Measures | Residual Impacts[16] | Institutional Respons | Indicative Cost Estimation |
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| | unearthing | | | | | | | | | used as a minimum prior to disposal at municipality and MoE approved disposal locations.<br>b. Water produced from dewatering, if not contaminated with petroleum products, shall be used for dust suppression as needed or can be discharged in the storm water but only after being settled and filtered from sediments and conditional to approval by local municipalities. | | | |
| ACH.C.1. Accidental unearthing/damage to archaeological findings during excavation | During various construction activities that involve excavation and unearthing | N/D | H | L | L | C | R | M | H | ACH.C.1. By involving the DGA since the planning phase will also be beneficial to the construction phase, if any chance findings were to occur during the construction phase. By applying the following mitigation measures, impacts on archaeology will be reduced:<br>a. Coordinate with the DGA to set a procedure if any chance findings were to occur;<br>b. Stop works immediately;<br>c. Secure the site area;<br>d. Inform the DGA. No actions should be taken prior to the DGA's investigation;<br>e. Construction works can only recommence after permission is given by the DGA. | Scheduling delays if chance finds materialism. Hence, coordination with DGA at early design stages is pivotal | CDR /DGA | Cannot be estimated |
| B.C.1. Impacts on biodiversity during site clearance and excavation of P&R facilities, depot and terminal | Construction works involving excavation and clearance at P&R facilities, | N/D | L | L | S | C | R | M | L | B.C.1. Based on the description of the biological environment, the anticipated project will not lead to significant negative impacts on biodiversity. The main construction activities having negative results on biodiversity are earth-moving activities, generation of construction waste | Positive impacts if mitigation measures are applied | CDR / Construction Contractor (HSE) | 20,000 USD |

| Source of Impact | Project Activities | Evaluation of Impact[15] | | | | | | | | Mitigation Measures | Residual Impacts[16] | Institutional Respons | Indicative Cost Estimation |
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| | depot and terminal | | | | | | | | | material and wastewater effluent discharges. Waste resulting from construction works and any other activity should be disposed of in an allocated disposal site in agreement with the Municipality. Littering in the project area and surrounding areas should be prevented.<br>Recommended mitigation measures to minimize or eliminate construction impacts on biodiversity at the proposed location include:<br>a. Adopt a landscape plan that includes native trees, shrubs and herbs (Listed in APPENDIX L) to enhance the visual aspect of the facility and play a role of reintroduction of native plant species to the areas;<br>b. Include *Pancratium maritimum* (APPENDIX L) at P&R6 facility landscape plan since it is coastal plant that grows only on sandy beaches;<br>c. Removal of exotic plants species and weeds;<br>d. Management of landscaping plan to prevent growth of weeds and exotic species and allow propagation and survival of native species;<br>e. Proper disposal of domestic and construction waste and of the waste removed from the current dumpsite;<br>f. Enclosing all fine earth materials during transportation to and from the site to prevent spillage and dusting;<br>g. The transportation of lubricants and fuel to the construction site should only be conducted in the appropriate | | | |

| Source of Impact | Project Activities | Evaluation of Impact[15] | | | | | | | | Mitigation Measures | Residual Impacts[16] | Institutional Respons | Indicative Cost Estimation |
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| | | | | | | | | | | vehicles and containers, i.e. fuel tankers and sealed drums;<br>h. Proper storage and prompt transportation of construction material to prevent them from being washed away during rainfall or carried by wind. | | | |
| B.C.2. Site clearance and excavation of Beirut-Tabarja trunk-line and station infrastructure | Construction works involving excavation and clearance on Beirut-Tabarja trunk-line and stations | N/D | M | L | S | C | R | H | M | B.C.2. Proposed mitigation measures for the prevention and minimization of impacts from the removal of vegetation at the median section are:<br>a. Adopt a landscape plan at stations where possible that includes native trees, shrubs, herbs (APPENDIX L) and climbers (*Lonicera etrusca*) which will enhance the visual aspect of the stations and play a role of reintroduction of native plant species to the areas;<br>b. Removal of the very destructive invasive tree *Ailanthus altissima* from sides of streets in Jounieh and Kaslik areas and replacing them with native trees (APPENDIX L);<br>c. Plant a native tree for every tree that is removed. If no place is available on the line or at stations, another place should be found to plant these trees such as sidewalks, abandoned public lands on sides of streets, public gardens;;<br>d. Remove olive trees planted in the median strips to be relocated in different places or sidewalks as mentioned above;<br>e. Avoid removal of the very old tree at the intersection of Charles Helou and | Positive impacts if mitigation measures are applied | CDR / Construction Contractor (HSE) | 20,000 USD |

| Source of Impact | Project Activities | Evaluation of Impact[15] | | | | | | | | Mitigation Measures | Residual Impacts[16] | Institutional Respons | Indicative Cost Estimation |
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| | | | | | | | | | | George Haddad because it is very big and old and no tree will replace it.<br>f. Proper disposal of domestic and construction waste and of the waste removed from the current dumpsite;<br>g. Enclosing all fine earth materials during transportation to and from the site to prevent spillage and dusting;<br>h. The transportation of lubricants and fuel to the construction site should only be conducted in the appropriate vehicles and containers, i.e. fuel tankers and sealed drums;<br>i. Proper storage and prompt transportation of construction material to prevent them from being washed away during rainfall or carried by wind. | | | |
| B.C.3. Site clearance and excavation of Beirut Outer ring | Construction works involving excavation and clearance on Beirut Outer ring | N/D | M | L | S | C | R | H | M | B.C.3. Proposed mitigation measures for the prevention and minimization of impacts on vegetation at the median section of the Outer Beirut Ring are:<br>h. Adopt a landscape plan at stations where possible that includes native trees, shrubs, herbs (APPENDIX L) and climbers (convolvulus sp.) which will enhance the visual aspect of the stations and play a role of reintroduction of native plant species to the areas;<br>i. Plant and allow to propagate *Matthiola crassifolia*, all Limonium species, *Crithmum maritimum* and *Urginea maritima* in public gardens and spaces along the Beirut sea side strip to compensate for the loss of the green areas at stations. *Matthiola* | Positive impacts if mitigation measures are applied | CDR / Construction Contractor (HSE) | 20,000 USD |

| Source of Impact | Project Activities | Evaluation of Impact[15] | | | | | | | | Mitigation Measures | Residual Impacts[16] | Institutional Respons | Indicative Cost Estimation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | *crassifolia* is a native plant species that is endemic to Lebanon and threatened according to the IUCN red list. Its protection and propagation will bring a positive impact for the project on the biodiversity of the area. In addition, there is a need to allow the above mentioned plants to grow along the median strip of the sea side road in Beirut and remove the exotic species gradually;<br>j. Plant a native tree for every tree that has to be removed. If no place is available on the line or at stations, another place should be found to plant these trees such as sidewalks, abandoned public lands on sides of streets, public gardens such as the public garden under the cola bridge in Beirut;<br>k. Proper disposal of domestic and construction waste and of the waste removed from the current dumpsite;<br>l. Enclosing all fine earth materials during transportation to and from the site to prevent spillage and dusting;<br>m. The transportation of lubricants and fuel to the construction site should only be conducted in the appropriate vehicles and containers, i.e. fuel tankers and sealed drums;<br>n. Proper storage and prompt transportation of construction material to prevent them from being washed away during rainfall or carried by wind. | | | |
| B.C.4. Impacts on | Construction | N/D | M | L | S | C | R | H | M | B.C.4. Recommended mitigation measures | Positive | CDR / | 20,000 USD |

| Source of Impact | Project Activities | Evaluation of Impact[15] | | | | | | | | Mitigation Measures | Residual Impacts[16] | Institutional Respons | Indicative Cost Estimation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| biodiversity during site clearance and excavation of P&R facility (8), Safra depot and Tabarja terminal | works involving excavation and clearance of Safra depot, P&R (8) and Tabarja terminal | | | | | | | | | to minimize or eliminate construction impacts on biodiversity at the proposed location include:<br>a. Prohibition of unnecessary cutting or damaging of mentioned native trees within or surrounding the proposed sites;<br>b. If removal of certain trees was necessary, plant a native tree for every tree that has to be removed. If no place is available within the site, another place should be found to plant these trees such as sidewalks, abandoned public lands or public gardens;<br>c. Adopt a landscape plan that includes native trees, shrubs and herbs (APPENDIX L) to enhance the visual aspect of the facility and play a role of reintroduction of native plant species to the areas;<br>d. Removal of invasive, exotic plants species and weeds (e.g. *Ailanthus altissima*)<br>e. Management of landscaping plan to prevent growth of weeds and exotic species and allow propagation and survival of native species;<br>f. Proper disposal of domestic and construction waste and of the waste removed from the current dumpsite;<br>g. Enclosing all fine earth materials during transportation to and from the site to prevent spillage and dusting;<br>h. The transportation of lubricants and | impacts if mitigation measures are applied | Construction Contractor (HSE) | |

| Source of Impact | Project Activities | Evaluation of Impact[15] | | | | | | | | Mitigation Measures | Residual Impacts[16] | Institutional Respons | Indicative Cost Estimation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | fuel to the construction site should only be conducted in the appropriate vehicles and containers, i.e. fuel tankers and sealed drums;<br>i. Proper storage and prompt transportation of construction material to prevent them from being washed away during rainfall or carried by wind.<br>j. Prevention of littering in the area. | | | |
| HS.C.1. Impact on workers' and pedestrians' safety resulting from improper handling and storage of construction material and construction activities | During various construction activities that generates waste and requires raw materials | N/D | H | L | S | C | R | M | M | HS.C.1. Mitigation measures of SWR2, SWR3, AQ1 and AQ2 contribute indirectly in reduction of potential impacts resulting from improper handling and storage of construction materials and construction activities. In addition:<br>a. The contractor should have a clear and detailed safety protocol to be applied at all time and accordingly train all workers and staff of safety procedures;<br>b. The contractor should monitor the application of the safety protocol and ensure the safety of workers, the commuters and traffic in the vicinity of the project site; | No injuries | CDR / Construction Contractor (HSE) | 10,000 USD |
| HS.C.2. Impact on workers' and pedestrians' safety resulting from improper handling and storage of chemicals and waste generated related to construction | During various construction activities | N | M | L | S | C | R | M | M | HS.C.2. Mitigation measures of SWR2, SWR3, SWR4, AQ1 and AQ2 contribute indirectly in reduction of potential impacts resulting from improper handling and storage of chemicals and waste generated related to construction activities. In addition:<br>a. The contractor should have a clear and detailed safety protocol to be applied at all time and accordingly train all workers and staff of safety | No injuries or risk to safety and health | CDR / Construction Contractor (HSE) | 20,000 USD |

| Source of Impact | Project Activities | Evaluation of Impact[15] | | | | | | | | Mitigation Measures | Residual Impacts[16] | Institutional Respons | Indicative Cost Estimation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| activities | | | | | | | | | | procedures;<br>b. The contractor should monitor the application of the safety protocol and ensure the safety of workers, the commuters and traffic in the vicinity of the project site;<br>c. Periodic audits should be conducted for on-site waste management practices, waste disposal contractors and disposal facilities at different construction sites. | | | |
| HS.C.3. Workers exposure to occupational hazards (e.g. noise, air pollution, dust, fire hazards, etc.) and potential for accidents | During various construction activities | N | H | L | S | C | R | H | H | HS.C.3 Mitigation measures of AQ1, AQ2, N1, N2, SWR2, SWR3, SWR4 indirectly contribute to mitigating impacts on workers. In addition, there should be detailed safety protocol, and all workers should be trained upon that protocol. The safety should consider:<br>a. Installing proper barricades, signs, providing flags, lights and personnel to control the traffic and separate the construction area from potential receptors;<br>b. Movement of trucks, loading and piling construction or excavation material, and building elevated structures;<br>c. Provide PPEs to workers and personnel on construction sites; assure proper signage of all construction areas (zoning areas) and storage location of hazardous material.<br>d. Emergency plans/ evacuation plans in case of injuries and accidents | No injuries or risk to safety and health | CDR / Construction Contractor (HSE) | 20,000 USD |
| SE.C.1. Induce potential secondary development and | During various construction | N/I | M | L | S | C | R | M | M | SE.C.1. Some of the mitigation actions that can prevent impacts caused on utility services and secondary developments | Short-term impacts from | CDR / Construction | 20,000 USD |

| Source of Impact | Project Activities | Evaluation of Impact[15] | | | | | | | | Mitigation Measures | Residual Impacts[16] | Institutional Respons | Indicative Cost Estimation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| impact on utility provision during project construction | activities | | | | | | | | | include:<br>a. Surveying and evaluating the utility infrastructure (water pipes, electricity lines, sewerage networks etc.) and the developments surrounding the construction sites (residential buildings, industries, businesses etc.) prior construction planning;<br>b. Contractors should assess construction locations in advance for potential disruption to services and already executed/planned developments, and identify risks;<br>c. If temporary disruption is unavoidable, the contractors in collaboration with local authorities should develop a construction plan that would minimize the disruption and communicate the dates and duration to respective stakeholders;<br>d. Potential receptors surrounding the construction sites should be informed in advance regarding utility shifts and major constructions that might impact their activities;<br>e. Specific elevated structures such as pedestrian bridges along the BRT line should be studied with utility master plans and construction activities planned accordingly to ensure to existing surroundings and utilities are minimized | accidents, however with adwequate surveying, the Contractor should be ready to mitigate immediately | Contractor (HSE) | |
| SE.C.2. Impacts on visual amenity due to landscape change and new | During various construction activities | N | L | L | M | C | R | M | M | SE.C.2 Minor visual impacts are expected from the construction activities, since most of the construction area is already urban, however certain measures can be taken to | Short-term impacts | CDR / Construction Contrac | 20,000 USD |

| Source of Impact | Project Activities | Evaluation of Impact[15] | | | | | | | | Mitigation Measures | Residual Impacts[16] | Institutional Respons | Indicative Cost Estimation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| constructions | | | | | | | | | | minimize impact: a. Proper enclosure of construction sites or areas, specifically at the median section, where the erected barriers can include the final design of the BRT system, which would motivate commuters and provide positive advertisement for the BRT system; b. Plan the movement of equipment and materials during times of least visual impact (e.g. work day start and end) where applicable; c. Locate piles and topsoil in visually unobtrusive locations where practical; d. Use existing roads and tracks where applicable instead of creating off-road tracks, and minimize length and width of the created road when necessary; e. Minimize construction time near sensitive visual receptors; f. Duration of the construction activities should be optimized, and the barriers should be uninstalled in short time following the completion of works/decommissioning; g. Proper landscaping that promotes tree planting and unified visual design (signs, street lights, sidewalks, etc.) | | tor (HSE) | |

**Table 8-3. Environmental and Social Management Plan for the Operation Phase**

| Source of Impact | Project Activities | Evaluation of Impact[17] | | | | | | | | Mitigation Measures | Residual Impacts[18] | Institutional Responsibility | Indicative Cost Estimation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | N | M | E | T | D | R | L | S | | | | |
| T.O.1. Traffic congestion during the execution of the project and the operation | Beginning of operation and passenger shift to BRT system | N | H | L | M | O | R | H | H | T.O.1. An important factor in reducing the grace period and the time for transport mode change is the advertisement of the BRT system. Discounted fares and tickets, promotion of Intelligent Transportation Systems (ITS) can be used to attract commuters and facilitate faster shift from use of private cars to using buses | - | Operator/ RPTA | 300,000 USD |

[17] The proposed categories for each of the evaluation criteria:
**N (Nature):** P (Positive), N (Negative), D (Direct), I (Indirect);
**M (Magnitude):** L (Low), M (Moderate), H (High);
**E (Extent):** L (Local), G (Global);
**T (Timing):** S (Short-term), M (Medium-term), L (Long-term);
**D (Duration):** C (During Construction), O (During Operation);
**R (Reversibility):** R (Reversible), I (Irreversible);
**L (Likelihood of Occurrence):** L (Low), M (Moderate), H (High);
**S (Significance):** L (Low), M (Medium), H (High), Beneficial (B).

[18] Includes a list of remaining environmental impacts (if any) following the implementation of the mitigation plan.

| Source of Impact | Project Activities | Evaluation of Impact[17] | | | | | | | | Mitigation Measures | Residual Impacts[18] | Institutional Responsibility | Indicative Cost Estimation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| T.O.2. Traffic congestion at P&R facilities and at bus stations if no upgrading of roads and infrastructure takes place | During the operation of the BRT system | N | H | L | L | O | R | M | M | T.O.2. Traffic congestion at P&R facilities can be reduced/prevented if rehabilitation of roads is integrated with the BRT project that will ensure serving the demand with the available facilities. Providing facilitates (e.g. auxiliary pedestrian platforms connecting P&R facilities to the stations, traffic management corridors and signage, etc.) that would ease pedestrian and traffic flow would contribute to avoiding traffic and faster interchange between commuter modes | Positive | CDR / Design Engineer | - |
| SWR.O.1. Fueling and maintenance operation | During relatively deeper excavation works | N/D | H | G | L | O | R | M | M | SWR.O.1 To ensure the minimum contamination of soil and groundwater in case of any spill or leakage, the below shall be implemented:<br>a. Promote awareness among workers on how to handle oil/lubricants;<br>b. Promote good housekeeping practices;<br>c. Put in place a maintenance schedule as part of the inspection procedures of all storage tanks and pipes for risk minimization;<br>d. Use standardized fuel spill prevention system for locomotive fueling, including automatic shut-off systems;<br>e. Storage tanks and components shall meet international standards for structural design integrity and operational performance to avoid catastrophic failures during normal | Impacts can be mitigated with regular maintenance and inspection | Operator of auxiliary facilities (HSE) | - |

| Source of Impact | Project Activities | Evaluation of Impact[17] | | | | | | | | Mitigation Measures | Residual Impacts[18] | Institutional Responsibility | Indicative Cost Estimation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | operation and during exposure to natural hazards and to prevent fires and explosions;<br>f. Storage tanks shall have appropriate secondary containment, including procedures for the management of containment systems. Appropriate secondary containment should satisfy the following:<br>i. Consist of berms, dikes, or walls capable of containing the larger of 110 percent of the largest tank or 25% percent of the combined tank volumes in areas with above-ground tanks with a total storage volume equal or greater than 1,000 liters and will be made of impervious, chemically resistant material;<br>ii. Consider means to prevent contact between incompatible materials in the event of a release;<br>g. Transfer of hazardous materials from vehicle tanks to storage in areas with surfaces sufficiently impervious to avoid loss to the environment and sloped to a collection or a containment structure not connected to municipal wastewater/storm water collection system;<br>h. Leak detection may be used in conjunction with secondary containment, particularly in high- | | | |

| Source of Impact | Project Activities | Evaluation of Impact[17] | | | | | | | | Mitigation Measures | Residual Impacts[18] | Institutional Responsibility | Indicative Cost Estimation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | risk locations. Leak detection is especially important in situations where secondary containment is not feasible or practicable, such as in long pipe runs, these include:<br>i. Use of automatic pressure loss detectors on pressurized or long distance piping;<br>ii. Use of approved or certified integrity testing methods on piping or tank systems, at regular intervals.<br>SW6. In case of underground storage tanks; the following shall be applied:<br>i. Assessing local soil corrosion potential, and installing and maintaining rust protection for steel tanks;<br>j. For new installations, installing impermeable liners or structures (e.g., concrete vaults) under and around tanks and lines that direct any leaked product to monitoring ports at the lowest point of the liner or structure;<br>k. Monitoring the surface above any tank for indications of soil movement;<br>l. Reconciling tank contents by measuring the volume in store with the expected volume, given the stored quantity at last stocking, and deliveries to and withdrawals from the store;<br>m. Consider the monitoring groundwater of quality down gradient of underground storage | | | |

| Source of Impact | Project Activities | Evaluation of Impact[17] | | | | | | | | Mitigation Measures | Residual Impacts[18] | Institutional Responsibility | Indicative Cost Estimation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | locations, if possible;<br>n. Evaluating the risk of existing underground storage tanks, if any, in newly acquired facilities to determine if upgrades are required or if they should be replaced or abandoned. | | | |
| SWR.O.2. Hazardous and non-hazardous wastes from maintenance activities | Operation and maintenance of equipment and machinery | N/D | H | L | L | O | R | M | M | SWR.O.2. To ensure the minimum contamination of soil and groundwater from wastes generated from maintenance activities, the below should be taken into consideration:<br>For hazardous material:<br>a. Training of operators on release prevention, including drills specific to hazardous materials as part of emergency preparedness response training;<br>b. Use of aqueous detergent cleaning solutions or steam cleaning, or use and recycling of aliphatic cleaning solvents (e.g. 140 solvent);<br>c. Use of water-based paints;<br>For Wastewater:<br>d. Use of ultrafiltration to extend the life of washing solutions for aqueous parts or use of alternatives to water cleaning (e.g. dry cleaning by wire brush or bake oven); | Impacts can be mitigated with regular maintenance and inspection, and following protocols, as set by HSE | Operator of auxiliary facilities (HSE) | - |

| Source of Impact | Project Activities | Evaluation of Impact[17] | | | | | | | | Mitigation Measures | Residual Impacts[18] | Institutional Responsibility | Indicative Cost Estimation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | e. Plumbing connection of floor drains, if any, in maintenance areas to the wastewater collection and treatment system;<br>f. Prevention of discharge of industrial wastes to septic systems, drain fields, dry wells, cesspools, pits, or separate storm drains or sewers. Keep wastewater from service bays out of storm drains by constructing berms or other barriers;<br>g. Depending on the volume of contaminants present in the wastewater, and whether the BRT facility is discharging into a municipal system or directly to surface waters, pretreatment of effluents may be necessary to reduce contaminant concentrations. Pretreatment systems typically consist of oil / water separators, biological and chemical treatment, and activated carbon systems.<br>For Waste Management:<br>h. Understanding potential impacts and risks to soil and water resources associated with the management of any generated hazardous waste;<br>i. Establishing waste management priorities at the outset of activities based on an understanding of potential soil and water resources risks and impacts and considering waste generation and its consequences; | | | |

| Source of Impact | Project Activities | Evaluation of Impact[17] | | | | | | | | Mitigation Measures | Residual Impacts[18] | Institutional Responsibility | Indicative Cost Estimation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | j. Establishing a waste management hierarchy that considers prevention, reduction, reuse, recovery, recycling, removal and finally disposal of wastes;<br>k. Apply the proper storage and disposal of wastes. | | | |
| SWR.O.3 Solid waste generated from passengers at different facilities | Operation and maintenance of equipment and machinery | N/D | L | L | L | O | R | M | M | SWR.O.3 To ensure the minimum contamination of soil and groundwater from general waste at Park and Ride Facilities, the below should be taken into consideration:<br>a. Instituting a solid waste recycling program, depending on the existence of local facilities, with labeled waste containers in the Park and Ride Facilities for metals, glass, paper, and plastics. Food establishments should segregate compostable and other food waste for recycling as agricultural fertilizer and animal feed;<br>b. Passenger bus operators and cleaning contractors should be encouraged to segregate waste in the buses by separating the collection of newspapers / papers, plastic, and metallic containers. | Impacts can be mitigated with regular maintenance and inspection, and following protocols, as set by HSE | Operator of auxiliary facilities (HSE) | - |

| Source of Impact | Project Activities | Evaluation of Impact[17] | | | | | | | | Mitigation Measures | Residual Impacts[18] | Institutional Responsibility | Indicative Cost Estimation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| B.O.1. Impacts on biodiversity during regular operation | During operation of the BRT system and utility of different facilities | N/D | L | L | S | O | R | L | L | B.O.1. Recommended mitigation measures to minimize or eliminate the impacts of project operation on biodiversity include:<br>e. Protection of the natural plant species that may grow on sidewalks and median strips along the line such as *Matthiola crassifolia*, *Limonium* sp, *Crithmum maritimum* and *Urginea maritima*;<br>f. Removal and management of weeds and exotic and invasive species;<br>g. Proper management of liquid and solid waste generated by the project;<br>h. Prevention and control spills of fuel and oil. | Impacts can be mitigated with regular maintenance and inspection, and following protocols, as set by HSE | Operator of auxiliary facilities (HSE) | - |
| SE.O.1. Impact on livelihood of current bus drivers and public transport operators due to passenger shift to BRT | During the execution of the BRT system and long term operation | N | H | G | L | O | I | H | H | SE.O.1. The project has considered options and incentives to encourage local operators to join the new BRT and bus concessions. Such incentives include requiring the new concessionaires to buy or rent a number of existing red plates from the small operators, the recruitment and training of drivers, encouraging local operators to join as shareholders and partners into the new concessions, and allowing operators to continue operations along the new bus and BRT lines according to specifications (schedule, bus requirements…) agreed with the concessionaires and public authorities.<br>Since it is expected that the project will | The integration options should undergo further negotiations with political entities and syndicates and unions | MoPWT | - |

| Source of Impact | Project Activities | Evaluation of Impact[17] | | | | | | | | Mitigation Measures | Residual Impacts[18] | Institutional Responsibility | Indicative Cost Estimation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | contribute to increasing the overall demand for public transportation in Lebanon, new markets are anticipated to be created and new passengers attracted to the system. This will benefit local operators since not all trips and destinations will be covered by the new system and many new passengers will still need an additional public transportation mode to bring them closer to their final destination. The existing local operators are therefore expected to adjust their operations in accordance with the newly generated demand, resulting in complementary systems. | | | |
| SE.O.2. Resource consumption for the operation of buses and for maintenance activities | During the operation of the BRT system buses | N | L | L | L | O | R | M | M | SE.O.2. Maintenance and fueling of the BRT buses is necessary. There are negligible to minor impacts related to resource consumption, which can be reduced through maintaining the buses in good conditions and ensuring their operation efficiency. This ultimately contributes to less fuel consumption per trip and reduced requirement for major maintenance works | Impacts can be mitigated with regular maintenance and inspection, and following protocols, as set by HSE | Operator of BRT System (HSE) | - |
| SE.O.3 Frequent bus stops and multiple stations leading to the increase in travel time and | During the operation of the BRT system buses | N | M | L | L | O | R | L | L | SE.O.3 The feasibility of the system and the design take into consideration all factors related to passenger demand, size of the fleet, positioning of the stations, the required space, number of stations and the distance between stations to optimize the operation of the system and provide efficient and fast service to the commuters. | Design can be amended to better serve anticipated demand, in the Detailed Design Phase | CDR / Design Engineer | - |

| Source of Impact | Project Activities | Evaluation of Impact[17] | | | | | | | | Mitigation Measures | Residual Impacts[18] | Institutional Responsibility | Indicative Cost Estimation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| discouraging BRT system users | | | | | | | | | | | | | |
| SE.O.4 Impact on safety due to lack of monitoring, selection of drivers, etc. | During the operation of the BRT system buses | N | H | L | L | O | R | M | M | SE.O.4 To ensure public safety and eliminate commuters' unease, the BRT system should:<br>g. Install CCTV system that monitors all activities at the terminals, stations and P&R facilities in addition to the buses;<br>h. Secure access to different facilities through installation of barriers and enclosed fences to allow only commuters with the dedicated passes to access the system;<br>i. Provide security personnel wherever necessary to control the crowd and monitor any suspicious activities;<br>j. Enforce the operators to develop an eligibility criteria for recruiting the drivers and system operators that are in constant interaction with the commuters, and provide training to ensure efficient and safe operation of the system;<br>k. Include evacuation plans at all facilities and emergency preparedness plans;<br>l. Include proper timetables, traffic signs and directions on all buses | - | ISF / MoPWT / Design Engineer / Operator | - |

| Source of Impact | Project Activities | Evaluation of Impact[17] | | | | | | | | Mitigation Measures | Residual Impacts[18] | Institutional Responsibility | Indicative Cost Estimation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | and stations accommodating all commuters without any discrimination. | | | |
| SE.O.5 Difficulty in changing the behavior of people to stop using their cars and shift to the BRT system | During the operation of the BRT system buses | N | M | G | L | O | R | M | M | SE.O.5 Specifically during the launching of the BRT system and thereafter awareness campaigns should be conducted to encourage people to use the BRT system in addition to incentive schemes. This can be achieved through general media, advertisements, social media, awareness campaigns at different locations tackling various social groups. Proving the efficiency of the system and advertising its advantages play a major role in changing the behavior of the public and encouraging commuters to use the buses instead of their personal vehicles. | - | MoPWT / Design Engineer / Operator | - |

## 8.2 ENVIRONMENTAL AND SOCIAL IMPACTS MONITORING PLAN

**Table 8-4. Construction Phase Monitoring**

| Project Activity / Potential Impact | Parameters | Measurements | Location | Frequency | Responsibility |
|---|---|---|---|---|---|
| **T.C.1**<br>Increased traffic due to creation of detours during construction | Number of traffic congestion events/ traffic delays | Visual inspection | Construction sites of all project components | Daily | Contractor's management |
| **AQ.C.1/AQ.C.2**<br>Dust and fugitive air pollution emissions from construction activities | Total Suspended Particles (TSP), $PM_{10}$, $PM_{2.5}$ (wherever feasible), SOx, NOx and CO | 1-hr and 24-hr measurements, and visual observation of dust dispersion (scale and direction) | At key receptor locations at different project component construction sites | Weekly | Contractor's Health Safety, Environment(HSE) Officer/Department |
| **AQ.C.3**<br>Emissions from the generators on construction sites | TSP, $PM_{10}$, $PM_{2.5}$, SOx, NOx and CO | Single emission measurement | Stacks of the operating generators | Monthly | Contractor's HSE Officer/Department |
| **N.C.1**<br>Elevation of noise levels due to construction activities | Lea, Lmin and Lmax | Single sample per location (average 1hr reading-15min intervals) during morning (7-8am), evening (1-2pm) and night (4-5pm) | Near loud machinery, equipment and vehicles, and major construction activities | Weekly | Contractor's HSE Officer/Department |
| **SWR.C.2**<br>Soil contamination from accidental spills and leaks | Number of incidents of fuel, oil, lubricant or other chemical spills/leaks; | Visual inspection | At construction sites and vehicle refueling, maintenance and packing areas | Weekly | Contractor's HSE Officer/Department |

| Project Activity / Potential Impact | Parameters | Measurements | Location | Frequency | Responsibility |
|---|---|---|---|---|---|
| **SWR.C.3/SW.C.4**<br>Improper waste storage and disposal | Implementation of waste management system | Visual inspection | At construction sites: waste(solid/liquid) generation, collection, segregation, storage, transportation and disposal; and at lavatories on site | Weekly | Contractor's HSE Officer/Department and/or Waste management contractor |
| **ACH.C.1**<br>Accidental unearthing of archeological/cultural findings | Implementation of the procedures agreed with the DGA for the protection of archeological findings during construction | Visual Inspection | Construction sites of all project components during excavation and earth works | Continuous | Dedicated personnel from the DGA |
| **HS.C.1/HS.C.2/HS.C.3**<br>Health and safety concerns of workers and general public | Implementation of the Health and Safety Protocol (yes/no)<br>and<br>Number of near miss events and accidents taking place | Visual Inspection | Construction sites of all project component; workers and personnel on site | Continuous | Contractor's HSE Officer/Department |
| **SE.C.1**<br>Induced secondary developments | Number of secondary developments impacted | Visual inspection | At construction sites of all project components that have potential nearby construction works, and main used roads by construction sites | Continuous | Contractor's management |

**Table 8-5. Operation Phase Monitoring**

| Project Activity / Potential Impact | Parameters | Measurements | Location | Frequency | Responsibility |
|---|---|---|---|---|---|
| **T.O.1/T.O.2**<br>Traffic congestion during the execution of the project and the operation / Traffic congestion at P&R facilities and at bus stations if no upgrading of roads and infrastructure takes place | Traffic load change (number of cars on major highways where he BRT operates) | Traffic surveys on highways and major roads along the BRT system operation area | At P&R facilities, nearby bus stations and terminals and major highways that potentially should have reduced traffic due to the BRT | Monthly | BRT System Operators' traffic consultants/auditors; Trucks and Vehicles Management Authority |
| **N.O.1**<br>Elevation of noise levels due to bus operation and at stations/terminals | Lea, Lmin and Lmax | Single sample per location (average 1hr reading-15min intervals) during morning (7-8am), evening (1-2pm) and night (4-5pm) | Along the BRT line, main stations, terminals and near sensitive receptors | Annually | BRT System Operators |
| **SWR.O.1/SWR.O.2**<br>Fueling and maintenance operation;<br>Hazardous and non-hazardous wastes from maintenance activities | Number of incidents of fuel, oil, lubricant or other chemical spills/leaks; and improper storage/management of waste generated at bus maintenance areas | Visual inspection, and records of amounts of hazardous and non-hazardous waste generated from maintenance activities | At bus deports and where maintenance works take place | Monthly | BRT System Operators |
| **SWR.O.3**<br>Solid waste generated from passengers at different facilities | Implementation of waste management system (yes/no) | Visual inspection, and records of amount of solid waste generated during the operation of the system | At bus stations, terminals, depots where cleaning of buses take place | Daily, Monthly reporting | BRT System Operators |
| **SE.O.1**<br>Impact on livelihood of current bus drivers and public transport operators due to passenger shift to | Number of public transport operators | Surveys of bus operators, taxis, mini-buses, etc. | At areas impacted by the BRT service | Monthly | Ministry of Public Works and Transport/ Traffic, Trucks and Vehicles Management |

| Project Activity / Potential Impact | Parameters | Measurements | Location | Frequency | Responsibility |
|---|---|---|---|---|---|
| BRT | | | | | Authority |
| **SE.O.2**<br>Resource consumption for the operation of buses and for maintenance activities | Fuel consumption, spare parts and maintenance requirements of buses and different facilities (including back-up generators used to operate the system) | Record keeping of all fueling and maintenance activities | BRT system | Annually | BRT System Operators |

**Table 8-6. Sustainability Monitoring**

| Category | Indicator (Parameter) | Description | Baseline Value | Methodology | Frequency |
|---|---|---|---|---|---|
| **Economic** | Annual income from public transport (USD) | Income made by the public transport operators | - | Survey of public transport operators | Annually |
| | Cost of transport per capita (USD/capita.km) | transport cost paid by the commuter using a transport mode per distance traveled or time-period | US¢ 50/veh.km | Household survey | Annually |
| | Cost of public transport per capita (USD/capita) | Public transport cost paid by the commuter using a public transport mode | LBP 250 by 10 km range for buses and minibuses | Household survey | Annually |
| | Cost of transport per household (USD/Household) or (%/total expenses) | transport cost paid by the household using a transport mode per distance or time | 13.11% of total expenses (CAS, 2012) | Household survey | Annually |
| | Cost of system maintenance (USD) | Maintenance expenditure by public transport system operator | - | Data collection from public transport operators | Annually |

| Category | Indicator (Parameter) | Description | Baseline Value | Methodology | Frequency |
|---|---|---|---|---|---|
| | Cost of public transport as percentage of total transport cost (% of transportation cost) | Public transport cost paid by the commuter as part of the total cost of transport | 421,780 USD as daily turnover rate of the mass transit system in the study area | Household survey | Annually |
| | Average fuel price (USD/L) | | 800 LBP/l (for diesel)<br>1140 LBP/l (for Gasoline) | Data from major fuel importers, Ministry of Energy and Water | Monthly |
| | Number of paved roads (km) | | 84.9% of total roads (World Bank, 1999) | Data from Ministry of Interior and Municipalities and Ministry of Public Works and Transport | Annually |
| Social | Transport mode split (% of each mode type) | Percentage distribution of transport modes (e.g. bus, taxi, private vehicles, etc.) | 85% passenger cars; 8.9% trucks; 5.2% motorcycles; 0.9% buses (Haddad, Mansour, & Stephan, 2015) | Data from Ministry of Public Works and Transport | Annually |
| | Per capita mobility (km/day) | Distance traveled per commuter per time-period | The average speed in GBA is around 18 km/hr and decreases to <10 km/hr in peak traffic conditions (Mansour, Zgheib, & Saba, 2011) | Household survey and data from public transport operators | Annually |
| | Average travel time (hours, hours/trip) | Average time spent commuting (on-road) | - | Household survey and data from public transport operators | Annually |
| | Average distance travelled (km, km/trip) | | Approximately 50% of trips cover a distance lower than 5 km (Mansour, Zgheib, & Saba, 2011) | Household survey and data from public transport operators | Annually |
| | Accidents and fatalities (number of accidents, injuries, deaths) | | 600 fatalities per year or 17 per 100,000 inhabitants (Choueiri, Choueiri, & Choueiri, 2011) | Directorate General of the Internal Security Forces | Monthly |
| | Number of journeys per mode of transport | | - | Household survey and data from public transport operators | Annually |

| Category | Indicator (Parameter) | Description | Baseline Value | Methodology | Frequency |
|---|---|---|---|---|---|
| | (trips/mode) | | | | |
| | Occupancy rate | | 1.2 passengers for taxis, 6 for vans and 12 for buses; average of 1.7 for passenger vehicles (Chalak, Al-Naghi, Irani, & Abou-Zeid, 2016) | Household survey | Annually |
| | Affordability (total transportation expenditure relative to income) | Individual or household expenditure on transportation relative to total income | 13.11% of total expenses for households (CAS, 2012) | Household and/or passenger survey | Annually |
| | Consumer satisfaction rating of public transportation (1-5 scale) | | - | Household and/or passenger survey | Annually |
| | Bus stations that have accessibility to people with disadvantaged mobility | | - | Physical mapping | Annually |
| **Environmental** | Per capita consumption of fuel for transportation (L/capita) | | Transport energy demand 15.06 (GJ/capita) (Electris, Raskin, Rosen, & Stutz, 2009) | Data from Ministry of Public Works and Transport, Ministry of Energy and Water; household survey | Annually |
| | Transport sector fuel consumption (tonnes) | | 27.42% of national energy consumption (World Bank, 2011) | Data from Ministry of Energy and Water | Annually |
| | Average age per mode of transport | | 71% of the entire fleet older than 10 years (MoE/URC/GEF, 2012) | Data from Ministry of Public Works and Transport | Annually |
| | GHG emissions of transport sector (tonnes per GHG: $CO_2$, $CH_4$, $N_2O$ and total $CO_2eq$) | | $CO_2$: 5,634.81 Gg<br>$CH_4$: 1.19 Gg<br>$N_2O$: 0.44 Gg | Fuel consumption data and emission factors | Annually |

| Category | Indicator (Parameter) | Description | Baseline Value | Methodology | Frequency |
|---|---|---|---|---|---|
| | | | For year 2011<br>(MoE/UNDP/GEF , 2015) | | |
| | GHG emissions from public transport (tonnes per GHG: $CO_2$, $CH_4$, $N_2O$ and total $CO_2$eq) | | | Fuel consumption data and emission factors | Annually |
| | Air pollution emissions of transport sector (tonnes per pollutant: $NO_x$, CO, $PM_{2.5}$, $PM_{10}$, NMVOCs and $SO_x$) | | CO: 551.91 Gg<br>NOx: 50.59 Gg<br>$SO_2$: 5.18 Gg<br>NMVOCs: 71.05 Gg<br>For year 2011<br>(MoE/UNDP/GEF , 2015)<br>$PM_{10}$: 12 Gg/year<br>$PM_{2.5}$: 9 Gg/year<br>(Waked, Afif, & Seigneura, 2012) | Fuel consumption data and emission factors | Annually |
| | Air pollution emissions of public transport (tonnes per pollutant: $NO_x$, CO, $PM_{2.5}$, $PM_{10}$, NMVOCs and $SO_x$) | | | Fuel consumption data and emission factors | Annually |
| | Per capita consumption of fuel for transportation (L/capita) | | Transport energy demand 15.06 (GJ/capita) (Electris, Raskin, Rosen, & Stutz, 2009) | Data from Ministry of Public Works and Transport, Ministry of Energy and Water; household survey | Annually |

Source: Indicators adopted from (Buzasi & Csete, 2014) and (IFI/FESLB, 2017); * The latest available value, some indicators have an alternative unit of measurement or have no value, which suggests the collection/measurement of these values prior to the commencement of the construction activities

# 9. CONCLUSION

The environmental and social impact assessment of the BRT System between Tabarja and Beirut and within Beirut, along with the feeder bus network is a vital public transport project for Lebanon which will serve the most dense urban area in Lebanon. The assessment concludes that the implementation of the Project will improve transport connectivity and mobility on the coastal corridor located to the North of Beirut.

The BRT System has primarily a general public interest for commuters. Its implementation aims at enhancing public transport thereby easing traffic flows, reducing air pollutants emissions, reducing travel time, and improving road safety conditions. The BRT System is anticipated to contribute to achieving some of the objectives of the Land Transport Strategy and in the application of the Traffic Law.

The ESIA Study has been prepared at the Feasibility Study stage of the Project. The ESIA was conducted against broad design elements which however provided key information for the assessment of the project's physical, natural and social footprint.

On the physical aspects, the project runs in a heavily urbanized region within a degraded airshed. The organization of the public transport system through the BRT, and its new bus fleet of modern, fuel-efficient, clean technology engines has been assessed to contribute to decreased air pollution and GHG emissions from the vehicle fleet on the overall when it starts operation in 2023. The traffic assessment showed that a large number of private car passengers will switch to using the BRT System. Noise impacts are also anticipated to be low.

Given its presence in an urban, heavily built up area, the facilities of the BRT System, such as P&R facilities, depot and terminal, are not anticipated to result in negative impacts on the natural environment. Nonetheless, the infrastructure works should realize a landscape plan to create an opportunity to upgrade the urban aesthetics, and reduce visual amenity impacts from introducing new concrete structures – pedestrian bridges, terminal, depot, etc.

The land impacts from the BRT System are also anticipated to be low, given that the majority of structures are located on the right of way, or on state-owned lands, or on public domain. The depot and terminal are located on private lands. A Resettlement Action Plan has been prepared accordingly in line with the Expropriation Law and WB OP 4.12.

The social impacts from the Project are the widest in breadth and depth, and they range from beneficial to the overall public to sensitive to the current operators of the informal public transport system. The beneficial impacts from implementing the Project will ultimately be realized and noticed through reduced travel time and lower overall mobility costs. There is a serious call from all social groups consulted as part of this ESIA study to implement a solution for public transport, where the system should respond to the needs of all groups – women, elderly, persons with mobility challenges, students, professionals, etc. The quality of the services of the BRT System is also of primary interest to all stakeholders. The need to have the public transport system organized and the level of services to be improved is a call to improve the quality of life of commuters on the overall. The integration of current operators in the new setup that will operate the BRT System is a vital strategy to reduce livelihood impacts from the competition that the new system will create.

All the environmental and social impacts assessed in this ESIA Study can be mitigated if negative and enhanced if positive through inclusive and universal design, through responsible implementation, and through serious operation, maintenance and follow-up from the concerned institutions. Above all, there is a great need for more consultation and coordination among institutions and municipalities to realize the social and environmental benefits that this project is anticipated to bring.

This ESIA Study has shed light on core environmental and, especially social, matters that influence the design of the project, which have largely been taken from the extensive consultations and meetings with stakeholders and community groups. It is essential that the Environmental and Social Management Plan is taken up by the Detailed Design Engineer, to create a design that elevates the road infrastructure and public transport services in Lebanon to the expectations of the resident population.

# 10. APPENDICES

# APPENDIX A – LIST OF TECHNICAL AND NON-TECHNICAL REFERENCES

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# APPENDIX B – LIST OF ESIA PREPARERS

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| Tarek MASHTOUB | Geologist |
| **Companies** | |
| TMS Consult | Transportation and Mobility Consultancy |
| Khatib and Alami | Engineering Design Services |

## APPENDIX C – MOE RESPONSE ON SCREENING

## APPENDIX D – MOE APPROVAL OF SCOPING REPORT

# APPENDIX E – BOOKLET FOR THE BASELINE ASSESSMENT

## APPENDIX F – LETTERS FROM PUBLIC ADMINISTRATIONS

# APPENDIX G – FOCUS GROUP MEETINGS

# APPENDIX H – STAKEHOLDER ENGAGEMENT AND CONSULTATION PLAN

## APPENDIX I – PUBLIC CONSULTATION AT THE SCOPING PHASE

## APPENDIX J – PUBLIC CONSULTATION AT THE ESIA PHASE

## APPENDIX K – EMISSION ASSESSMENT STUDY

## APPENDIX L – LIST OF NATIVE TREES, SHRUBS AND HERBS TO ENHANCE THE VISUAL ASPECT OF THE FACILITY AND PLAY A ROLE IN REINTRODUCING NATIVE PLANT SPECIES TO DIFFERENT AREAS

| Name | Type |
|---|---|
| *Tamarix* | Shrub |
| *Cercis siliquatrum* | Tree |
| *Punica granatum* | Tree |
| *Pinus pinea* | Tree |
| *Acer syriacum* | Tree |
| *Quercus calliprinos* | Tree |
| *Laurus nobilis* | Tree |
| *Vitex agnus-castus* | Tree |
| *Vitex agnis-castus* | Shrub |
| *Lonicera etrusca* | Climber |
| *Ceratonia ciliqua* | Tree |
| *Pistacia lentiscus* | Shrub |
| *Arbutus andrachne* | Tree |
| *Creteagus monogyna* | Small Tree |
| *Fraxinus ornus* | Tree |
| *Myrtus communis* | Shrub |
| *Styrac officinalis* | Tree |
| *Capparis spinose* | |
| *Matthiola crassifolia* | |
| *Matthiola tricuspidata* | |
| *Crithmum maritimum* | |
| *Urginea maritima* | |
| *Alcea setosa* | |
| *Limonium sinuatum* | |
| *Pancratium maritimum* | |