Environmental Assessment Report

Initial Environmental Examination
Tbilisi University Metro Extension
Project Number: 42414
May 2010

Proposed Multitranche Financing Facility
Georgia: Georgia Sustainable Urban Transport Investment Program

ABBREVIATIONS

ADB	–	Asian Development Bank
CC	–	Construction Contractor
GDP	–	Gross Domestic Product
GOG	–	Government of Georgia
GRP	–	Grivance Redress Procedure
GWP	–	Georgian Water and Power
EE	–	Ecological Expertise
EIA	–	environmental impact assessment
EIP	–	environmental impact permit
EMP	–	environmental management plan
EP	–	Environmental Permity
FI	–	Financial Intermediary
H&S	–	Health and Safety
IDP	–	Internally Displaced Persons
IEE	–	Initial Environmental Examination
IUCN	–	International Union for Conservation of Nature
MDF	–	Municipal Development Fund
MoE	–	Ministry of Environmental Protection and Natural Resources of Georgia
MPL	–	Maximum Permissible Level (of concentrations of pollutants)
MRDI	–	Ministry of Regional Development and nfrastructure of Georgia
NGO	–	Non-Government Organization
O&M	–	Operations and Maintenance
PIU	–	Project Implementation Unit
PME	–	Powered Mechanical Equipment
PPE	–	Personal Protecting Equipment
REA	–	Rapid Environmental Assessment
SC	–	Supervision Consultant
TA	–	Technical Assistance
TBM	–	Tunnel Boring Machine
TCS	–	Traction Control System
TOR	–	Terms of Reference
TSU	–	Tbilisi State University

CURRENCY EQUIVALENTS

(as of 25 March 2010)
Currency Unit – lari (GEL)
GEL1.00 = US$0.58
US$1.00 = GEL1.735

Note:
This environmental impact assessment report is a document of the borrower. The views expressed herein do not necessarily represent those of ADB's Board of Directors, Management, or staff, and may be preliminary in nature.

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EXECUTIVE SUMMARY

1. **Introduction.** With 1.34 million people, the City of Tbilisi houses more than 25% of Georgia's population and generates nearly 50% of Georgian GDP. Challenges in the urban sector are key priorities in the economic recovery policy for Government. Tbilisi suffers from traffic congestion and air and noise pollution, loss of green areas and degradation of historical buildings and monuments. ADB has been requested to support an urgent program of investments in Tbilisi municipal transport systems, including roads, traffic management and public transport.

2. Serving 250,000 passengers daily, the Metro is playing a significant role in the urban transport system and can serve as the backbone of the city's network. Tbilisi Municipality is now exploring options for expanding the network. A first phase is planned to extend the line to the station "University" at Saburtalo district, where there is a large population, significant number of students and high traffic flow.

3. The construction of the "Delisi-University" section of the metro started in 1985 but ceased in 1993 for financial and technical reasons. In 1998 construction resumed and half of "Vaja Pshavela" station was opened in 2000 with only one way in operation. The remaining tunnel has been bored up to the university station, including the station shell, escalator shaft and the exits. This Project aims to resume and complete the construction of the metro tunnel along Vaja Pshavela Avenue of a total length of 1,521 m and the "University" subway station, to benefit more that 150,000 people and increase ridership of the metro network.

4. The Consultant prepared this IEE as part of the Project on the basis of review of proposed engineering works, field investigations, primary and secondary data collection, desk study and screening of baseline environmental parameters, stakeholder consultation and review of other similar metro projects. The IEE includes an overview of the general environmental profile of the Project area, assesses potential environmental impacts and their magnitude, and proposes necessary mitigation measures and environmental management plan for each of the identified impacts.

5. **Chapter II "Policy, Legal and Administrative Framework"** of the IEE describes the environmental policy and legislation of Georgia, the environmental permitting process, ADB environmental requirements and public consultation procedures.

6. According to the Law of Georgia on Environmental Impact Permits (2008), the metro construction in general is subject to EIA and Environmental Permit (Chapter II, Article 4, Paragraph 1, point "n"), but at the same time particular activities to be financed under the proposed Project (such as building development within urban area, underground pedestrians passages, installation of railway superstructure, installation of metro systems, station interior finishing) are not subject to the state Ecological Examination (EE) and Environmental Permitting process (EP). Georgian legislation does not consider screening procedures to define project category and scoping procedure to determine EIA extent. Simply the project is considered as subject to EIA, EE procedure and Environmental Permit if the activities planned or considered by the project are listed in the Law on Environmental Permits (Chapter II, Article 4, Paragraph 1).

7. However, the Construction Permit procedure, according to the Law of Georgia on Construction Permit (2004), considers approval of an environmental component that may contain environmental management planning for the construction and operation period, including waste management, pollution prevention, etc. Prior to commencement of activity, the contractor is required to prepare a site plan with detailed information on the location of staging and parking areas; arrangements for water supply, sanitation, vehicle and machinery servicing; storage of construction materials and waste; final disposal of waste; etc. During the whole process of implementing the works the contractor will be responsible for ensuring

compliance of the works with environmental management and monitoring plans through application of internal environmental supervision and quality control systems.

8. ADB uses a classification system to reflect the significance of a project's potential environmental impacts and determine the approach to environmental assessment. A project's category is determined by the category of its most environmentally sensitive component, including direct, indirect, cumulative, and induced impacts in the project's area of influence. Each proposed project is scrutinized as to its type, location, scale, and sensitivity and the magnitude of its potential environmental impacts. Projects are assigned to one of the following four categories:

(i) **Category A.** A proposed project is classified as category A if it is likely to have significant adverse environmental impacts that are irreversible, diverse, or unprecedented. These impacts may affect an area larger than the sites or facilities subject to physical works. An environmental impact assessment (EIA) is required.
(ii) **Category B.** A proposed project is classified as category B if its potential adverse environmental impacts are less adverse than those of category A projects. These impacts are site-specific, few if any of them are irreversible, and in most cases mitigation measures can be designed more readily than for category A projects. An initial environmental examination (IEE) is required.
(iii) **Category C.** A proposed project is classified as category C if it is likely to haveminimal or no adverse environmental impacts. No environmental assessment is required although environmental implications need to be reviewed.
(iv) **Category FI.** A proposed project is classified as category FI if it involves
(v) investment of ADB funds to or through a Financial Intermediary (FI).

9. Based on categorization procedure undertaken by the ADB, and the Rapid Environmental Assessment (REA) screening checklist, the metro extension project has been classified as Category B, requiring Initial Environmental Assessment (IEE). This IEE has been prepared in accordance with the ADB Safeguard Policy Statement (ADB, June 2009), Appendix 1 "Safeguard Requirements 1: Environment".

10. ADB will require borrowers/clients to submit to ADB the final IEE for disclosure and to engage with communities, groups, or people affected by proposed projects, and with civil society through information disclosure, consultation, and informed participation in a manner commensurate with the risks to and impacts on affected communities.

11. **Chapter III "Description of the Project"** of the IEE describes the background and current situation of the Project, the remaining civil works, the metro systems to be installed, alternatives for the metro station "University" building, and the operations and maintenance phases of the Project.

12. Line-2 of Tbilisi Metro, also called Saburtalo Line, opened in 1979. At this time, the line was running from "Vagzlis Moedani" (Tbilisi Central Railway Station) to "Delisi" (at Saburtalo District), with a total length of 5.5km. The initial plan considered an extension of Line-2 to the University, with 2 additional stations: "Vaja-Pshavela" and "University". The line construction was stopped in 1993, due to financial and technical problems. In 2000 the section between "Delisi" and "Vazha-Pshavela" was opened, adding 1.2km, with only one tunnel.

13. The Saburtalo Metro Line currently ends at "Vaja Pshavela" station with limited operations between "Delisi" and "Vaja Pshavela". Therefore most passengers continuing on the western parts of Saburtalo – especially the Tbilisi University buildings - have to transfer at "Delisi" station to buses and microbus-taxes due to the fact that Delisi area is the most busy

area within Saburtalo District, with developed commercial and transport infrastructure, and almost all buses and minibus-taxis lines currently end/start/stop at metro “Delisi”.

14. The current situation with the metro station “University” is as follows: the tunnels are built along the entire length of the constructing section; the upper entrance hall of the station “University” is partially constructed, and underground passes are constructed; the moving staircase tunnel is constructed.

15. The broader scope of work of the Project considers the completion of the Metro extension till “University” station (1521m). It includes:

(i) Completion of civil works (completion of the station with platform and technological premises, tunneling of railway dead-end siding or “blind alleys” with crossover, completion of passage tunnel with sealing the exterior by pumping in concrete, and construction of railway superstructure for the installation of track.)
(ii) The installation of metro systems (track, escalators, ventilation, dewatering, power supply, signaling, control, telecommunications, automatic fare collection)
(iii) The creation of “University” station (alternatives for standard design, new design, or with commercial space).

16. The definitive alternative for station design needs to be chosen by Tbilisi Municipality and Metro Company. The base alternative will only require the construction of a ticket hall at the top of the station. The two other alternatives will add specific construction which has to be defined. However, there is not sufficient information to undertake environmental analysis of alternatives for the creation of the Station. The present IEE therefore covers the base alternative considered by the current design of Metro station.

17. The objective is to put the section in operation in 2013. The main benefits expected from the metro extension are to:

(i) Significantly decrease travel time to access the western Saburtalo area from the city centre and the left bank of the river using the Metro.
(ii) Reduce the number of buses and minibus-taxis in the area since many passengers will not need to transfer any more.

18. At the operations phase, when the metro extension is functioning, the Project proposes continuous monitoring of the issues/topics that may generate adverse impact on environment. These issues are related to the proper maintenance of the drainage system, monitoring of dewatering effects, vibration effects, pollution prevention measures via O&M procedures, waste management and other components of the routine environmental management as proposed in the Operational Phase Environmental Management and Monitoring Program.

19. **Chapter IV “Description of the Environment”** of the IEE describes baseline data of the following resources in the area affected by the Project: *physical resources* (climate, topography and soils, surface water, geology, ground water, seismology, ambient air quality, noise and radiation); *ecological resources* (rare or endangered species); *economic development* (industries and infrastructure, transportation, power sources and transmission, land use); *social and cultural resources* (population and communities, healthcare and education facilities, socio-economic conditions, cultural resources and archaeological sites).

20. Tbilisi is located in the South Caucasus at 41° 43' North and 44° 47' East Longitude. The city is situated in East Georgia on both banks of the Mt'k'vari River. The elevation of the city ranges from 380-770 meters above sea level and possesses the shape of an amphitheatre surrounded by mountains on three sides. The **climate** of Tbilisi is transitory from moderate continental to a moderate humid subtropical. The city's climate is influenced

both by dry (Central Asian/Siberian) air masses from the east and humid subtropical (Atlantic/Black Sea) air masses from the west. Tbilisi experiences relatively cold winters and hot summers. The proximity to large bodies of water (Black and Caspian Seas) and the fact that the Greater Caucasus Mountain Range blocks the intrusion of cold air masses from North, determines that Tbilisi has a relatively mild micro-climate compared to other cities along the same latitudes.

21. The diversity of Tbilisi **topography** and relief is the result of its geo-morphological structure. Tbilisi is located between two folded mountain systems, in particular, the foot of an intensely dislocated southern slope of the Central Caucasus in the north and the folded system of Ajara-Trialeti in the south. Its tectonomorphic structure means that the topography mirrors the underlying structure. Among natural-tectonic events and processes are landslides, mudflow, erosion and floods. The project area is located in a slight depression among the two hilly areas. The relief is slightly inclined to the East. The hills provide a local drainage boundary (watershed), so surface and groundwater are drained to the East, towards the river Mtkvari. Distance from the project area to the river Mtkvari is about 4 km. The **soil** filling is of non-uniform loam mass with (0 – 4,5m). Dark brownish loamy soil with dense sand bends and 10-15% of boulder-like inclusions, with gruss, broken stone and clusters of rocks.

22. There are no **surface water** resources at the territories adjacent to the Project site. Mtkvari is the main river within Tbilisi city limits. Distance from the Project site to the r.Mtkvari is about 4 km, the distance to the small r. Vere (r. Mtkvari right tributary) is about 2 km. Topographically the riv. Vere gorge is separated from the project area by watershed hills, so surface water, as well as shallow groundwater from the project area is not drained to the riv. Vere. The Lisi lake and Kus-tba lake (Tortoise lake) are located respectively 100m and 170m above the level of project area, at a distance of 2,2km and 3,5km.

23. The Project area **geology** is composed of the Middle Eocene (rubble with boulders inclusions, gravel and sand filler, sand stone with mudstone and clay layers) tufogenic formations. These rocks are covered with the continental deposits of rocks, boulders and sandy clays crushed stone. Out of the modern Quaternary deposits, the rocks of an eluvial (clay and sand, colluvial-deluvial boulders and sandy clays) genesis are spread over the Project territory and its adjacent area and are covered with the fill of a different thickness here and there. In a lithological respect, the given deposits are presented by tufogenic rock blocks, detritus and gravel with loamy filler. The diluvia soils are dominant, which have different thicknesses, varying between 10 and 15 m in some places. They are mostly represented by loams and clays with conglomerates and gravel admixtures. The preconditions forming geotechnical characteristics in the Project area are soil type, the proximity and mineralized nature of near-surface (shallow) groundwater, changes of the groundwater level due to cuts, or leakages from malfunctioning water supply, wastewater and storm water drainage systems.

24. According to the hydrogeological zoning of Georgia (Buachidze I., 1970), the Project site and its adjacent territory are located within the area with the fissure and fissure-karst **ground water** of Tbilisi artesian basin. The feeding area of the ground waters of Tbilisi is mostly located beyond the city borders. On the right bank of the Mtkvari, which is characterized by strongly inclined slopes and little vegetation cover, during abundant rainfall the water infiltration into the grounds is complicated and therefore, the constituent rocks of the Project area are less water-infused than other areas of the city. Rainfall is drained down into the r. Mtkvari mainly as surface water. The fault zones contain chemically aggressive sulphate-rich thermal water circulating under pressure. In particular, these waters have adversely affected the Tbilisi Metro (G.Buachidze, G.Chokhonelidze,) by damaging tunnel lining, ceilings, stone and paint finishing, etc.

25. Georgia is a part of the seismically active region of the Caucasus. It belongs to the Mediterranean **seismic** belt. Its tectonic movement and activity is connected with the movement of the neighboring Europe-Asian and Africa-Arabian plates. According to the corrected scheme of zoning of the territory of Georgia, the study territory is included in the point 8 earthquake zone. The intensity of tectonic zones are calculated for 2% probability (expectation time 50 years) according to the Richter Scale. The risk of activation of exogenous processes on the territory of Tbilisi has significantly increased after the earthquakes of April 25, 2002 weakening the stability of the landslide-gravitational slopes to the critical tension and areas structured with weak erosive-settling grounds.

26. Until 1991, **ambient air quality** monitoring was carried out regularly and systematically in Georgia in 11 cities, including Tbilisi. Dust, CO, NO_2 and SO_2 were measured continuously 3 times a day. The latest available air quality monitoring (from 1995 to 2004). The average yearly concentrations of dust, sulfur dioxide and nitrogen dioxide in the center of Tbilisi slightly exceeded norms. The maximal dust concentration exceeded MPL 1.2 times. In the later years of the data, the concentration of nitrogen dioxide increased substantially due to increased traffic, while the level of hydrogen sulfide pollution decreased with reduction of industrial activity.

27. No data on background **noise** corresponding to the recent years is available. Instant measurements of noise were carried out at the Project site to assess the background noise level. The measurements were taken on the field within the Project area. Comparison of the measurement data with the values determined under the statutory shows that the background noise on the site is slightly higher than the maximum permissible level. The main source of noise is traffic.

28. Preliminary studies of the background **radiation** were carried out near Metro station V-Pshavela (point1), construction site 1 (point2) and construction site 2 (point3). The need for such assessment is determined by following reasons: a) The Georgian EIA regulations require providing information about baseline radiation values. b) the project site is in the vicinity of the Institute of Isotopes (250m). c) baseline radiation in some residential houses varies in a range of 8 – 16 milliroentgen/hour. The reason for that may be radiation of certain construction materials. The background radiation is acceptable for urban areas.

29. Among the protected species, only bats have a habitat in the city, and particularly in the metro tunnel of the Project. A survey has been conducted to determine the following: a) to what extent do bats really use the tunnel; b) which bat species exactly dwell in the tunnel. As a result of investigation the **Greater Horseshoe Bat** (*Rhinolophus ferrumequinum*) wintering colony consisting up to 500 individuals was found, using a standard photo-counting approach. This colony is probably biggest wintering colony of this species in the city. However, investigation of the tunnel in the project area revealed only colony of the one specie.

30. Construction **industry**, transport and telecommunications compose the economic foundation of Tbilisi. Much more than half of the products produced in Tbilisi come on these fields. Only few of industrial or business enterprises are located in the project area: National Center of High Technologies - Institute of Isotopes, MAGTICOM – cellular phone operator, Market of Construction Materials, Zonal Experimental Scientific Design Institute TBILZNIEP.

31. There is well developed **infrastructure** in the Project area that includes water supply, power supply, gas supply, communication cables (telephone, internet, cable TV). Most significant of utilities - ”Georgian Water and Power” (GWP) delivers 21 m^3/sec. of drinking water to Tbilisi and its neighborhood. Tbilisi **water supply** system uses both – groundwater and surface water resources. The intake of underground waters takes place in Aragvi Gorge (about 40 km from Tbilisi), and surface water intake is carried out from Tbilisi Sea. The residential districts adjacent to the construction site are supplied with drinking water with 300

and 600-mm-diameter steel pipes. The system pressure reaches 6 atmospheres. The system is amortized and needs replacement. At present, there are no visible leakages on the study territory.

32. Tbilisi **storm water drainage system** components with the diameter of 150- 1200 mm are built with brick, arch, concrete, reinforced concrete, ceramic, cast iron, asbestos cement and polyethylene pipes. The drainage system is self-flowing. The total length of the network system is 1600 km. The length of the main trunk **wastewater sewer** is 72 km. The waste water flows through the sewer to Gardabani Treatment Plant. There are 42 separating chambers on the main sewer. The capacity of Gardabani Treatment Plant is 1, 0 million cubic meters/day. The water-drainage system is amortized, but is in the working condition, mainly consisting of 800-mm-diameter cast iron pipes.

33. Tbilisi **transportation** network includes metro, buses and microbuses. The construction site is crossed by the routes of 9 **buses** and 9 fixed-run **microbus-taxis.** Most of the buses and microbuses run on diesel fuel and as usual are not in a good technical condition, so the pollution from emissions exceeds the maximum permissible concentration. After the metro station is put into operation, presumably the emissions of harmful substances into the atmosphere by the public transport will be reduced. Tbilisi **Metro** is a rapid transit system in Tbilisi, it was opened in 1966. Presently the system consists of two lines, 22 stations on 26.4 kilometers of track. 20 stations are below ground and two are at surface level. Of the subterranean stations 16 are deep level and 4 shallow.

34. Currently 24 hour uninterrupted **power supply** of the residential houses, public buildings, industry, transport sector and commercial entities in Tbilisi is ensured by the power generation and distribution system. Tbilisi Metro is considered as one of the major consumers of electrical energy, it uses 62.000 MWt/h of electricity. Power supply for the residential districts adjacent to the Project site comes through 600-KV sub-station “Saburtalo-2” located within 280m from the site, at the beginning of Jikia Street. Electricity is supplied to 7330 subscribers, which use about 1,7 MW/hour of electricity in winter period and 1,3 MW/hour of electricity in the summer period.

35. The Project site is located in a part of Tbilisi urban area, that was developed in the 1960`s mostly by residential blocks. The area located west of the site is more business and industrial. Therefore the urban **landuse** has about half century history and the area is completely urbanized. The existing land-take for metro construction within the Vaja Pshavela streetscape is intended to be temporary (for almost 3 decades now). There are two suspended constructions of residential buildings in the vicinity of the Project, which might be resumed within the Project period. Tbilisi Municipality estimates that the completion of the metro extension with the University station, due to improved access to Jikia street businesses, and the relatively remote Nutsubidze Plateau 1st District, will extend residential and commercial development in the area, with creation of additional jobs.

36. The number of the regular **population** of Tbilisi is about 1.1 mln (data provided by Department of Statistics). In fact the population living in the city is 300 thousand more than the given data, because of inflow of the refugees (IDPs), students, workers and other people from the regions of Georgia, temporarily living in Tbilisi. City still attracts people providing more employment opportunities, therefore the loads on city transport are increasing. Tbilisi **communities** have always been multi-ethnic. The Kurds, Armenians, Jewish, Azeri, Russians, Greek and others have been living side by side with the Georgians. At present, 20% of the city population are not Georgians in the ethnic respect. 85% of the city population is Orthodox Christians. The city is historically known for its religious tolerance. This is particularly well seen in Old Tbilisi, which is rich in churches and chapels of different confessions.

37. The metro system is used mainly by patients of the primary **healthcare facilities** and specific medical and diagnostic centers. Three of primary facilities are located in the project area. Some of the specific hospitals, medical and diagnostic centers are located close to the metro line and could be used by patients. In regards of **education facilities** - the following universities (out of about 20) are located in the Project area: Tbilisi Iv.Javakhishvili State University (1 University St), Tbilisi State Medical University (33 Vazha-Pshavela Ave); European School of Management (ESM; 40 Vazha-Pshavela Ave). There are approximately 200 municipal and private schools in Tbilisi, out of which 7 are in the Project area. Most students of secondary schools are living in the vicinity of their schools. However, certain part of students is using municipal transport for reaching their schools.

38. In Tbilisi **socio-economic conditions** are better than in the rest of the country but the employment level is quite low due to economic crisis and war of 2008. Level of unemployment in Tbilisi has varied between 29 and 30.5% in recent years.

39. Archeological studies have demonstrated that territories of Tbilisi have been populated since the ancient age (5^{th}-6^{th} cc. B.C.) through the Late Feudal Age. There are over 150 **archeological monuments** of different periods found at present. During the metro earthworks at Vaja Pshavela avenue in 2001 there were several chance findings identified as artifacts of the Antique Age. The archeological excavations carried out later have shown that the metro earthworks in 2001 had damaged several tombs of the Late Bronze and Antique Ages. There are several archeological sites (Tombs No.1, 2, 9, 10, 11) already identified/known in the Project area as burial place Namgala Mitsa.

40. **Chapter V "Anticipated Environmental Impacts and Mitigation Measures"** of the IEE describes potential environmental effects of the proposed Project during the construction and operational phases, having regard to the characteristics of the local environment. It also evaluates the magnitude and significance of the impacts and proposes appropriate measures to mitigate adverse impacts.

41. An initial desk study was carried out to identify potential adverse effects associated with development of metro schemes and construction of metro stations similar to the Project. Potential environmental impacts associated with the construction and operations of the Project have been identified based on the screening of baseline environment, review of preliminary design information and proposed scope of works for the completion of the metro station "University" in Tbilisi.

42. The majority of the remaining works will mostly be done underground, and the main interactions with the surface environment will be at the existing construction sites at Vaja Pshavela station and University station. Most of materials will be loaded into special railway wagons at the existing open-air sections of Tbilisi metro (in Didube area) for transportation to the site.

43. The likely environmental impacts of the proposed works that may arise during both construction and operation phases are presented in four groups:.

(i) Impact on Physical Environment: geology and soil, groundwater and surface
(ii) water, noise, vibration, air quality;
(iii) Impact on Biological Environment: flora and fauna, rare and endangered species;
(iv) Impact on Socioeconomic Environment: landuse, utilities, socio-economics (employment, local businesses, property, etc.), transport and traffic, cultural heritage (archeology, architecture, etc.)
(v) Cumulative Impacts.

44. This chapter analyses each of the above impacts in detail for both construction and operation phases and proposes respective mitigation measures.

45. The principal source of construction impacts on **geology and soils** for this particular Project is related to the **groundwater**. The tunnel is lined but unsealed and groundwater enters through the walls and is continuously removed by pumping to the surface. This has been done for many years, and may have caused groundwater flow alterations and the groundwater lowering. The groundwater table lowering, in turn, may have adversely affected the geo-technical characteristics of the geological formations resulting in reduction of bearing capacity of the foundation soils under the neighboring buildings. That reduction might be gradual (for instance building load plus vibration) or immediate (of seismic nature). It is therefore advisable for Tbilisi Metro Authority to undertake a geo-technical survey of the changes in local aquifer and groundwater table in order to evaluate the risk of negative impact on the geotechnical characteristics and therefore, the foundations of neighboring buildings.

46. The construction phase for the “University” metro extension has been suspended for several years with tunnels not concreted. The completion of the concrete works and proper finishing of water tight tunnel by this project, may represent, in itself, the major mitigation measure to prevent further groundwater lowering and restore the water table to its natural level and thus avoid negative impact on geo-technical characteristics.

47. The key **airborne noise** is likely to be generated during the construction phase. Noise impacts due to the use of powered mechanical equipment (PME) at noise sensitive receivers (mostly residential blocks along Vaja Pshavela Avenue) close to the Project area are expected. Not all of the tunneling and other major work in the tunnel, station area and entrances has been completed so there will be some more tunneling, drilling and excavation works as well as significant quantities of concreting works involving concrete pumps, compressors, etc. There will also be large components of equipment delivered by heavy vehicles to the open-air loading site on the existing line, and transferred to railway wagons by crane for delivery to the site. Some materials like reinforcing rods, sand and cement will also be delivered to the station entrance. Commonly used direct mitigation measures such as quieter powered mechanical equipment (PME), quieter alternative construction method (e.g. use of concrete crushers in lieu of conventional noisy excavator mounted breaker) and other good site practices will be necessary to alleviate airborne construction noise impacts.

48. As the above ground and below ground works will be of limited scope and time period, and taking into consideration the limited use of powered mechanical equipment (hummer drills, small soil compactors, concrete vibrators) it is concluded that **vibration** will not have a significant impact on nearby structures during the construction period. Due to its location (more than 800m from the site), vibration should not affect sensitive equipment in the hospital located at Kavtaradze street (see Section III – Baseline Environment). Two principal methods of mitigation are available for the tunnel boring/drilling. The first is to limit hours of operation to avoid the more sensitive night period. The second method is optimization of boring machine or drills characteristics including face pressure and selection of cutters and teeth. Both methods should be applied by the Contractors in order to minimize impact from vibration.

49. In the operations phase the metro rail vibration may give rise to potential impacts on dwellings adjacent to the extension section. Early morning (before 08:00 hours) and night-time (after 22:00 hours) train movements may present a potential issue. In quiet hours the passage of trains in the tunnel has the potential to cause ground-borne noise and vibration. Potential **vibration impacts** in general should be mitigated by the appropriate selection of track form and use of welded rails in the tunneled areas (at the design phase) and by reducing the train speed limits (at operations phase).

50. The construction phase of the metro extension will have a greater impact on **air quality** than the operational phase. Construction activities have the potential to generate dust, as well as soot and other emissions from construction machinery/vehicles, so air quality is likely to be somewhat degraded throughout the construction period. This is unlikely to be a major impact as residential areas are located 50m or more from the construction sites. Mitigation measures (such as dust control, emissions minimization) should nevertheless be implemented to reduce the impact on about 5-7 thousands residents in the residential blocks along both front lines of Vaja Pshavela Avenue, neighboring shafts construction sites and the station entrances construction site. Once operational, the proposed metro station would not have much potential for changing the air quality as the metro train would emit no pollutants due to having electric motors. Due to reduction of number of buses and minibus-taxis a small reduction in emissions of carbon dioxide from traffic is expected, when the metro extension becomes operational.

51. The proposed Project site is located within a busy urban environment, where urban habitats are largely of low local nature conservation value. The Project does not involve temporary or permanent loss of habitat along the new extension and at the metro station entrances including the construction phase. Some temporary disturbance to a range of common urban fauna species (mostly birds) will occur, but the impacts are not predicted to be significant. Once operational, the proposed Project of metro extension will have no significant impacts on **habitats and surrounding wildlife** due to two reasons: a) almost no wildlife is present and the low ecological value of habitats; and b) no emissions/pollution, no further land-takes or any other direct impacts on habitats are generated by the Project at operations stage.

52. One exception is the **Greater Horseshoe Bat** (*Rhinolophus ferrumequinum*) wintering colony consisting of up to 500 individuals, which was found in the tunnel, from University station side. This species is under protection of the Convention on Migratory Species (CMS) and its Agreement on the Conservation of Populations of European Bats (EUROBATS, 1994) to which Georgia is a contracting Party (since February 2009). To avoid negative impact of construction works on protected species (torcreting works, finishing works, noise etc.) it is recommended to emloy experts to undertake moving/excluding the colony before construction starts and before winter time (November-March period). Timing is critical for excluding bats from the tunnel. In the spring and summer, if a maternity colony has taken up residence, the contractor would need to delay excluding the bats until August when the young are able to fly.

53. The proposed Project will not have significant direct impact on current **land use**, as well as on the ownership and rights over land and property within the Project area because no major land-takes/acquisition is required. There may possibly be indirect impact on future land use as a result of the completion and operations of the metro station “University” - such as new commercial and residential development/redevelopment projects conditioned by better access to the area due to new metro station.

54. The implementation of mitigation measures for environmental issues (noise, vibration, air quality, traffic, etc.) will be important in minimizing and managing potential negative **socio-economic impacts** during the construction process. In summary, these construction-based mitigation measures are all designed to minimize unnecessary disruption, nuisance impacts and temporary delays that might arise during construction. The proposed Project will result in a range of significant positive socio-economic impacts. It will provide a high-quality, rapid and frequent transport option for existing and future passengers from University and Jikia Street area to Tbilisi center. In comparison to current public transport options, the proposed Project will provide improvement in commuting, thereby resulting in significant reductions in journey time and congestion. There will also be socio-economic benefits during construction phase as some local people will be employed in the workforce.

55. There are still some tunneling works remained for the blind alleys, passages, etc. and although no significant impact on **utility infrastructure** is expected, all utilities along the remaining excavation/tunneling alignments should be assessed during the preconstruction (precondition) survey undertaken by the Contractor.

56. Mitigation measures will be required to reduce the impact on **traffic** during the construction phase. The plan for any traffic diversions or detours (if necessary) should be developed jointly with the local authorities, public transport operators and other relevant stakeholders (in cooperation with Contractor, Tbilisi Municipality, Traffic Police, etc.). The construction vehicle management should be in correspondence with contractor's construction program to reduce the impact of construction traffic on the road network. During the construction period, there may be a reduction in average traffic speeds throughout the Vaja Pshavela Avenue.

57. The principal risk of construction **archeological and cultural heritage** is ground disturbance. According to the outcome of the baseline study, certain archeological sites, particularly tombs of the Late Bronze and Antique Ages, are located in the Project area (tomb No.9 and tomb No.10 of Namgala Mitsa). Potentially some other tombs may be located in the area that will be affected by the construction (tunneling) of University station blind alleys. Considering these remaining tunneling and excavation works, the Chance Finding Procedure should be developed by the Contractors as a part of Cultural Heritage Management Plan to ensure that any historical material discovered is properly recognized, recorded and conserved if necessary.

58. The **cumulative impact** of the groundwater lowering in combination with the operational vibrations may affect engineering characteristics (in particular bearing capacity) of foundation soils close to the Project area. It is recommended to undertake a new geology/hydrogeology survey of the changes in local aquifer and groundwater lowering (if any) in order to evaluate risk of negative impact on the engineering characteristics of the foundation soils (under the neighboring buildings), especially considering its potential cumulative effect in combination with the vibration impact from metro operations. The cumulative environmental impacts of the proposed Project can be mitigated by set of measures comprising the following:

(i) good pre-construction surveys (including geo-technical);
(ii) careful planning of construction works and coordination with other projects and construction activities in the area;
(iii) adequate provision of environmental clauses in work contracts;
(iv) proper development and implementation of the site-specific detailed environmental management plans (based on this IEE and EMP); and
(v) efficient contract management.

59. **Chapter VI "Analysis of Alternatives"** of the IEE describes the existing alternatives for the Project. From the beginning of this Project there was no alternative to the extension scheme and alignment, as any alternatives would have been considered and dismissed long ago in 1980-ies, when the Tbilisi Metro extension scheme has been planned, designed and started. Today the tunnels from the Vaja Pshavela Station to University Station are actually built.

60. At the feasibility stage in the process of preparation of this IEE, the only one alternative could be considered for the Project. It is the "no project" alternative: to leave the uncompleted metro construction as it is, with the risk of groundwater lowering, disturbance to the Saburtalo residential area, impact from exposed soils at the existing construction sites, lost investments and incremental costs of conservation.

61. Two most important criteria for the comparative analysis of "with project" and "without project" alternatives are: a) minimizing environmental impacts and b) optimizing capital and

operational costs. The Project reduces impact on environment (including geology and groundwater) and optimizes (actually rescues) the initial capital investments. The major positive impact of the “with project” alternative will be completion of a major construction project that has been suspended for many years, and as a result there should be: less disturbance to the Saburtalo landscape and district community; less risk of groundwater lowering; less air pollution and dust; less congestion due to reduction in usage of vehicles.

62. **Chapter VII “Information Disclosure, Consultation and Participation”** of the IEE describes the consultations process for the Project, IEE disclosure procedure and public participation.

63. Consultations with most of stakeholders were held during monthly project meetings. Discussions were also held on site with people and communities who could be affected by the subprojects, so that views could be expressed in a less formal setting. These were also considered in preparing the IEE.

64. Public consultation meeting is planned to take place in MDF office in April 2010. Following the information disclosure procedure, the electronic version of the draft IEE will be placed on the MDF web-site. Hard copy of the IEE and Executive Summary will be available for review in MDF office. Announcement will be made in central newspapers and CENN (Caucasus Environmental NGOs Network) mailing network about the planned public consultation meeting.

65. Representatives of primary and secondary stakeholders will be invited. Attendees will be informed about the aim of the Metro Extension Project and the benefits it would bring, together with Project likely impacts and the ways in which they would be mitigated. Participants will be invited to discuss their views and concerns. A summary of the meeting will be added to the report as an Appendix.

66. **Chapter VIII “Grievance Redress Mechanism”** of the IEE describes the grievance redress framework setting out the time frame and mechanisms for resolving complaints about environmental performance. The MDF has overall responsibility for project implementation and environmental compliance. The administrative bodies responsible for environmental protection are MoE and Tbilisi Municipality. The affected population and stakeholders may send their grievances, related to the project-induced environmental impacts and nuisance to the Project Implementation Unit (PIU) or directly to the administrative bodies responsible for environmental protection.

67. The PIU will facilitate the response by implementing a project-specific GRP (Grivance Redress Procedure). During the public consultation process, the PIU will inform stakeholders and the public that the PIU is responsible for environmental compliance and grievance redress. The PIU will provide at the public consultation meetings and disclose on the MDF web-site the contact details of the persons responsible for grievance collection and response.

68. **Chapter IX “Environmental Management Plan”** of the IEE describes the Environmental Management Plan (EMP) for the Project, prepared based on the environmental impacts and respective mitigation measures proposed in Chapter V.

69. The EMP will be included in the contract documents to ensure the contractors comply with the EMP. The EMP defines the:

(i) responsibilities of the Municipality, Contractor and Supervision Consultant, in accordance with the three Project phases (pre-construction, construction and operation);
(ii) framework of the mitigation measures by providing the technical details of each Project impact, recommended mitigation and proposing implementation arrangements;

(iii) monitoring mechanism, with monitoring parameters to ensure that all proposed mitigation measures are completely and effectively implemented;

70. The environmental impacts and respective mitigation measures are presented in the form of table. The Contractor should prepare a Construction Phase EMP discussing the action he will take to provide each of the mitigation measures he is responsible for. The metro scheme operator (Tbilisi Metro Company), in turn, should prepare and implement an Operational Phase EMP. These EMPs would be based on the EMP presented in this IEE, but in each case describe the actions in more details. The Construction Phase EMP should contain site-specific method statements and management plans that have to be prepared and submitted by the Contractor to the Municipality and/or its Construction Supervisor for approval, prior to initiation of any construction works by the Contractor. These documents should comprise (but not be limited to) the following:

(i) Pre-construction (pre-condition) Survey Plan;
(ii) Health and Safety Management Plan;
(iii) Community Liaison and Community Safety Plan;
(iv) Utilities Infrastructure Management Plan;
(v) Traffic Management Plan;
(vi) Pollution Prevention and Abatement Plan;
(vii) Waste Management Plan;
(viii) Emergency Response Plan;
(ix) Cultural Heritage Management Plan (with Chance Finds Procedure);
(x) Reinstatement Management Plan;
(xi) method statements per each category of work (tailored to site-specific conditions and containing an environmental component with mitigation measures);
(xii) other, as required.

71. The contract documents should contain a listing of all required mitigation measures and a time frame for the compliance monitoring of these activities. The EMP of the IEE should be included in contract documents. The monitoring will comprise: a) surveillance by executing agency (presumably Municipal Development Fund) to check whether the contractor is meeting the provisions of the contract during construction and b) surveillance by Project Operator (presumably Tbilisi Metro Company) during the operations. Tbilisi Municipality or ADB may also require the executing agency to undertake impact monitoring.

72. Most of the monitoring conducted by the executing agency directly or through contracted Supervision Consultant (SC) will involve periodically checking the activities conducted by the contractor, during regular site inspections, which the SC will conduct on a daily, weekly and monthly basis. These checks will be mainly visual, but some will require review of documents, records, reports and drawings, as specified in the monitoring plan. Any deficiencies will be reported to SC management, who, where necessary, will instruct the Contractor to take remedial action. Regular written accounts will be given to Client/Borrower (Tbilisi Municipality) as part of the normal procedure through which SC reports on progress of the construction process.

73. **Chapter X "Conclusions and Recommendations"** of the IEE states the following: The major positive impact of the Project will be completion of a major construction project that has been suspended for many years. This will produce a number of benefits, including: less disturbance to the Saburtalo landscape and district community; less risk of groundwater lowering; less air pollution and dust; less road congestion due to reduction in usage of vehicles; improved accessibility to affordable and comfortable transport; and improved traffic safety at Vaja Pshavela Avenue. The Project will deliver good quality transport integration and generate social and economic benefits, such as potential growth in the economy of the district, substantial income and employment opportunities, improved living conditions.

74. Recommendations are made to mitigate expected negative environmental impacts with adequate funds provided to cover environmental mitigation and monitoring cost.

(i) The most important and practical recommendation for the Project implementation process is to follow the environmental mitigation and monitoring measures proposed by this IEE.

(ii) It is also recommended to undertake a new geology/hydrogeology survey of the changes in local aquifer and groundwater lowering (if any) in order to properly evaluate the risk of negative impact on the engineering characteristics of the foundation soils (under the neighboring buildings), especially considering its potential cumulative effect in combination with the vibration impact from metro operations.

(iii) It is also recommended that the environmental and social management training of Municipality and Metro officials is provided to enable them to carry out environmental and social monitoring and implementation of Environmental Management Plan.

(iv) Finally, it is recommended that an updated IEE and EMP is produced based on detailed engineering design and the results of the geo-technical survey, so that any impacts that may have been overlooked by this IEE (conducted early in the feasibility study) may be recognized, assessed and mitigated.

I. INTRODUCTION

A. Project Background

1. In Georgia as elsewhere, urban transport plays a major role in improving access to businesses and communities, attracting investments and enabling citizens to tap economic and social opportunities. With 1.34 million people, the capital city of Tbilisi houses more than 25% of Georgia's population and generates nearly 50% of Georgian GDP. Challenges in the urban sector are key priorities in the economic recovery policy for Government. Tbilisi suffers from traffic congestion and resulting air and noise pollution, loss of green areas and degradation of historical buildings and monuments.

2. This situation has highlighted the need to act with a more global point of view, focusing on each component of the urban transport system. ADB has therefore been requested to support an urgent program of investments in Tbilisi municipal transport systems, including roads, traffic management and public transport. Improving municipal infrastructure and reducing road transportation constraints on economic activity are direct objectives of the ADB Country Partnership Strategy (ADB Country Partnership Strategy Guidelines, January 2007). The proposed ADB Tbilisi Sustainable Urban Transport Program will promote efficient and effective urban transport services with incentives and capacity to improve quality, reliability, accessibility, affordability, integration and coverage of transport services. These investments will help resolve heavy traffic congestion and air and noise pollution, caused by increased private car ownership.

3. Today, Tbilisi's urban transport network comprises a two line metro system, 123 bus routes and over 60 microbus routes operated by public and private companies (data provided by Tbilisi Municipality, Division of Urban Transportation, 2009). Microbuses convey the bulk of daily passengers, holding 60% market share, while the balance is split evenly between public buses and the metro system. Tbilisi Municipality is pursuing a number of initiatives to improve urban transport, road and traffic management. It is now exploring options for expanding an existing asset, the Metro network.

4. Serving 250,000 passengers daily, the Metro plays a strong role in the urban transport system and can serve as the backbone of the city's network. A first phase is planned to extend the line to the station "University" at Saburtalo district, where there is a large population, a significant number of students and high traffic flow. The construction of the "Delisi-University" section of the metro started in 1985 but ceased in 1993 for financial and technical reasons. In 1998 construction resumed and half of "Vaja Pshavela" station was opened in 2000 with only one way in operation. The remaining tunnel has been bored up to the university station, including the station shell, escalator shaft and the exits.

5. This Project aims to resume and complete the construction of the metro tunnel below Vaja Pshavela Avenue of a total length of 1,521m and complete the "University" subway station, to benefit more that 150,000 people and increase ridership of the metro network.

B. Environmental Assessment

6. The Consultant prepared this IEE as part of the Feasibility Study (FS) for completion of the Metro extension on the basis of a review of proposed engineering works, field investigations, primary and secondary data collection, desk study and screening of baseline environmental parameters, stakeholder consultation and review of other similar metro projects. The study was conducted during February – March, 2010. The IEE covers the general environmental profile of the Project area including physical, ecological, environmental, social, cultural and economic resources. The IEE includes an assessment of

the potential environmental impacts and their magnitude, and proposes necessary mitigation measures and an environmental management plan for each of the identified impacts.

II. POLICY, LEGAL, AND ADMINISTRATIVE FRAMEWORK

A. Environmental Policy and Legislation of Georgia

7. According to Georgian legislation, during the planning and implementation process of a project the investor/proponent is obliged to take adequate measures for reduction or elimination of the expected negative impacts on the environment and human health. Below is a brief overview of Georgia's environmental legislation as it pertains to the proposed project.

8. *The Law of Georgia on Environmental Protection* (1996) is a framework law that regulates the legal relationship between the bodies of the state authority and the physical persons or legal entities in the scope of environmental protection and in the use of nature. It applies to all of Georgia including its territorial waters, airspace, continental shelf and special economic zone. The Law discusses the aspects of environmental education and environmental management; describes the economic sanctions, licensing, standards and results of Environmental Impact Assessment (EIA); it also discusses the various aspects of protection of natural ecosystems, habitats to be protected, the issues of global and regional management, protection of the ozone layer, protection of biodiversity, protection of the Black Sea, and aspects of regional cooperation.

9. On December 14, 2004 a number of changes were introduced into this Law. According to Article 35, the term "environmental permit" has been changed to "environmental impact permit" and therefore the new version of Article 37 of the Law says: Environmental Impact Assessment shall be carried out prior to issuing an environmental impact permit for the proposed activity to prevent or minimize the harmful impact on the environment.

10. *The Law of Georgia on Environmental Impact Permits* (2008) was prepared on the basis of changes introduced into the Law of Georgia on Environmental Protection. The Law establishes the procedure of obtaining environmental impact permits. In particular, Article 4 deals with the activities subject to ecological expertise (EE, see below) and bodies authorized for granting rights on implementation of the activities. The Article describes the procedure for obtaining environmental impact permits, including: public discussion of the EIA report; rules for documenting the results of public discussion of the EIA report; the list of documents required for obtaining permits; the rule of issuing permits; the EIA procedure and the requirements for the content of the EIA report; exemption of certain activities from EIA; duties and responsibilities of the project proponent; duties and responsibilities of the permit issuing authority; etc.

11. *The Law of Georgia on Ecological Expertise* (2008) replaced the Law on State Ecological Expertise. It defines the basic principles of ecological expertise; identifies the authority responsible; establishes the rules for conducting ecological expertise; determines the role of independent experts; determines the conclusion of ecological expertise; establishes the duties and responsibilities of those involved in the process; etc. Ecological expertise is a review of the EIA or other documents, submitted in support of an environmental permit application and is undertaken by a commission composed of independent experts for different impacts/disciplines related to the project profile. After submission of an EIA report by the project proponent, the experts review/examine the data presented, impacts identified and mitigation proposed. A positive Ecological Expertise Conclusion is a prerequisite for issuing the Environmental Permit, and the recommendations made by the experts are usually attached to the environmental permit as Conditions.

12. *The Law of Georgia on Protection of Atmospheric Air* (1999) regulates protection of ambient air from harmful anthropogenic impact. The purpose of this Law is to preserve and improve air quality and prevent and decrease chemical, physical, biological and other impacts on air that cause harm to human health, the national economy and the flora and fauna of the country. The role of the State in the sphere of air protection is: (a) to develop ambient air quality standards and regulations for an emission inventory; (b) to establish state control and enforcement mechanisms. The measures for improvement of ambient air quality are stipulated by the state plans of economic and social development. The norms of maximum allowable limits of concentration of pollutants and the norms of harmful impact rates are established for the assessment of the ambient air quality.

13. *The Law of Georgia on Water* (1997) regulates the use of water resources; determines the rights and responsibilities of water users; establishes the types and rules of licensing on water use, describes the conditions and rules for issuing licenses; determines the conditions for their suspension, cancellation, withdrawal and change; and regulates water discharges.

B. Environmental Permitting

14. Paragraph 1 of Article 4 of Chapter II of the Law of Georgia on Environmental Impact Permits determines activities subject to ecological expertise, which require obtaining environmental impact permit, issued by the Ministry of Environmental Protection and Natural Resources (MoE).

15. According to the legislation, a project proponent is required to prepare and submit an EIA report to obtain the environmental impact permit. EIA is defined in the law as the study and investigation of the planned activity aimed at the protection of certain elements of the environment, people, landscape and cultural heritage. EIA identifies and describes the direct and indirect impacts on human health and safety, flora and fauna, soil, air, water, climate, landscape, ecosystems and historical monuments or combination of the above-listed factors, including the impact of these factors on cultural values (heritage) and social and economical factors (for infrastructure projects). Development of mitigation measures for the above-listed impacts, as well as preparation of environmental management and monitoring plans is an essential element of the EIA process. Thus, if the proposed activity requires an environmental impact permit, the EIA report shall be presented to enable MoE to make a decision on permitting.

16. Environmental Impact Permits are issued by the MoE (competent authority) under a procedure that includes (i) An Environmental Impact Assessment (EIA) Report, (ii) Ecological Expertise (EE) and (iii) Public Participation. The steps included in securing the Environmental Impact Permit are:

(i) The proponent will conduct an environmental assessment study and prepare an EIA report;
(ii) The proponent will arrange a public hearing on the EIA. The procedure involved in public consultation is:
(iii) one week before submitting draft EIA reports to MoE and the Ministry of Regional Development and Infrastructure (MRDI[1]), the proponent issues an advertisement in regional and national newspapers about the project, and the date, time and place of public consultations; and sends written invitations to the local government, MoE and MRDI; and
(iv) The proponent must then arrange consultations within 50 to 60 days after publishing the advertisement in the newspaper;

[1] Ministry of Regional Development and Infrastructure (MRDI) recently separated from the Ministry of Economic Development, in charge of issuing construction permits for all infrastructure projects in Georgia.

(v) The proponent will submit an application for an Environmental Impact Permit (EIP) with the EIA report, minutes of meetings of public hearing and other required documents to MoE and MRDI; and

(vi) MoE will carry out Ecological Expertise on the EIA report and issue an EE Conclusion (EEC). If the conclusion is positive, MoE will issue the Environmental Impact Permit.

17. For projects requiring a Construction Permit (almost all new construction projects plus those rehabilitation projects that require major reconstruction or major change in technology), no special permit is issued by MoE (according to the "one window principle", only one permit shall be issued for each activity). The Construction Permit is issued by MRDI, subject to the consent of MoE and other institutions relevant to the project profile. Consent of the MoE in such cases is issued according to the same procedures (EIA; public consultations; SEE etc.) as for issuing an Environmental Permit. As an administrative body issuing a permit, MRDI ensures the involvement of MoE as a different administrative body in the proceedings initiated for the purpose of permit issuance, in accordance with Georgia's Law on Licenses and Permits (2005).

18. According to the Law of Georgia on Environmental Impact Permits, the metro construction in general is subject to EIA and Environmental Permit (Chapter II, Article 4, Paragraph 1, point "n"), but at the same time particular activities to be financed under the proposed Project (such as building development within urban area, underground pedestrians passages, installation of railway superstructure, installation of metro systems, station interior finishing) are not subject to the State Ecological Examination and Environmental Permitting. Georgian legislation does not specify screening procedures to define project category or a scoping procedure to determine EIA extent. Simply the project is considered as subject to EIA, EE procedure and Environmental Permit if the activities planned or considered by the project are listed in the Law on Environmental Permits (Chapter II, Article 4, Paragraph 1).

19. However, the Construction Permit procedure, according to the Law of Georgia on Construction Permit (2004), considers approval of an environmental component that may contain environmental management planning for the construction and operation period, including waste management, pollution prevention, reinstatement, etc. Prior to commencement of construction, the contractor is required to prepare a site plan with detailed information on: the location of staging and parking areas; arrangements for water supply, sanitation, vehicle and machinery servicing; and storage of construction materials and waste; final disposal of waste; etc. During the whole process of implementing the works the contractor will be responsible for ensuring compliance of works with environmental management and monitoring plans through application of internal environmental supervision and quality control systems.

C. ADB Environmental Requirements

20. The ADB requirements for Environmental Impact Assessments are set out in the ADB Safeguard Policy Statement (ADB, June 2009), Appendix 1 "Safeguard Requirements 1: Environment".

21. As stated in Paragraph 9:

…"Depending on the significance of project impacts and risks, the assessment may comprise a full-scale environmental impact assessment (EIA) for category A projects, an initial environmental examination (IEE) or equivalent process for category B projects (see below), or a desk review. An EIA report includes the following major elements: (i) executive summary, (ii) policy, legal and administrative framework, (iii) description of the project, (iv) description of the environment (baseline data), (v) anticipated environmental impacts and mitigation measures, (vi) analysis of alternatives, (vii) consultation and information disclosure, (viii) grievance redress, (ix) environmental management plan and (x) conclusion

and recommendations. An IEE, with its narrower scope, may be conducted for projects with limited impacts that are few in number, generally site-specific, largely reversible, and readily addressed through mitigation measures"…

22. The Project Screening and Categorization requirements are presented in ADB Operation Manual OM Section F1 OP (2006) "Environmental Considerations in ADB Operations". ADB carries out project screening and categorization at the earliest stage of project preparation when sufficient information is available for this purpose. Screening and categorization is undertaken to (i) reflect the significance of potential impacts or risks that a project might present; (ii) identify the level of assessment and institutional resources required for the safeguard measures; and (iii) determine disclosure requirements.

23. The process of determining a project's environment category involves a Rapid Environmental Assessment (REA), and completion of an environmental categorization form prior to project initiation. REA uses a sector-specific screening checklist, taking into account: the type, size, and location of the proposed project; sensitivity and vulnerability of environmental resources in the project area; and the potential for the project to cause significant adverse environmental impacts.

24. ADB uses a classification system to reflect the significance of a project's potential environmental impacts. A project's category is determined by the category of its most environmentally sensitive component, including direct, indirect, cumulative, and induced impacts in the project's area of influence. Each proposed project is scrutinized as to its type, location, scale, and sensitivity and the magnitude of its potential environmental impacts, based on the completed REA checklist. Projects are assigned to one of the following four categories:

(i) **Category A.** A proposed project is classified as category A if it is likely to have significant adverse environmental impacts that are irreversible, diverse, or unprecedented. These impacts may affect an area larger than the sites or facilities subject to physical works. An environmental impact assessment (EIA) is required.

(ii) **Category B.** A proposed project is classified as category B if its potential adverse environmental impacts are less adverse than those of category A projects. These impacts are site-specific, few if any of them are irreversible, and in most cases mitigation measures can be designed more readily than for category A projects. An initial environmental examination (IEE) is required.

(iii) **Category C.** A proposed project is classified as category C if it is likely to have minimal or no adverse environmental impacts. No environmental assessment is required although environmental implications need to be reviewed.

(iv) **Category FI.** A proposed project is classified as category FI if it involves investment of ADB funds to or through a Financial Intermediary (FI).

25. Based on the screening procedure, the metro extension project has been classified as Category B Project.

26. In line with ADB's Public Communications Policy (January 2010), ADB is committed to working with the borrower/client to ensure that stakeholders, including the general public, can provide meaningful inputs into project design and implementation. To provide information to aid this process ADB will post the following safeguard documents on its website:

(i) For environment category A projects, draft EIA reports at least 120 days before consideration by the ADB Board of Directors;

(ii) Draft environmental assessment and review framework, draft resettlement frameworks and/or plans, and draft Indigenous Peoples planning frameworks and/or plans before project appraisal;

(iii) Final or updated EIA or IEE, resettlement plans, and Indigenous Peoples plans upon receipt;

(iv) Environmental, involuntary resettlement, and Indigenous Peoples monitoring reports submitted by borrowers/clients during project implementation upon receipt.

27. This IEE has been prepared in accordance with the ADB Safeguard Policy Statement (ADB, June 2009), Appendix 1 ”Safeguard Requirements 1: Environment” and the Law of Georgia on Environmental Permits (2008).

D. Public Consultations

28. The Law of Georgia on Environmental Impact Permit determines the timeframes and participation procedures for public consultations on the EIA only for the activities/projects that are subject to Ecological Examination and Environmental Permit (listed in Chapter II, Article 4, Paragraph 1 – see Appendix A). In particular, the project proponent is required:

(i) To carry out public consultations prior to submitting the EIA report to the permitting authority;
(ii) For the purpose of public discussion of the EIA report, publish information about the proposed activity in central newspapers, as well as in printed media of the self-governed administrative unit where the activity is to be implemented;
(iii) Submit hard and electronic copies of the EIA report to the permitting authority within 1 week after publication of information on proposed activity in printed media;
(iv) Receive and discuss written comments and suggestions of the general public within 45 days after publication of information on the proposed activity in printed media;
(v) Carry out public consultation on the proposed activity not earlier than 50 days and not later than 60 days after publication of information on the proposed activity in printed media.

29. Representatives of the general public have the right to attend the EIA public consultation. This has to be organized in the administrative centre of that self-governed unit where the proposed activity is to be implemented.

30. ADB safeguards policy states that ADB is committed to working with borrowers/clients to put meaningful consultation processes into practice. This is a process that:

(i) Begins early in the project preparation stage and is carried out on an ongoing basis throughout the project cycle;
(ii) Provides timely disclosure of relevant and adequate information that is understandable and readily accessible to affected people;
(iii) Is undertaken in an atmosphere free of intimidation or coercion;
(iv) Is gender inclusive and responsive, and tailored to the needs of disadvantaged and vulnerable groups; and
(v) Enables the incorporation of all relevant views of affected people and other stakeholders into decision making, such as project design, mitigation measures, the sharing of development benefits and opportunities, and implementation issues.

31. ADB requires borrowers/clients to submit to ADB the final IEE for disclosure and to engage with communities, groups, or people affected by proposed projects, and with civil society through information disclosure, consultation, and informed participation in a manner commensurate with the risks to and impacts on affected communities.

III. DESCRIPTION OF THE PROJECT

A. Background and Current Situation

32. Line-2 of Tbilisi Metro, also called Saburtalo Line, opened in 1979 (Figure 3-1). At that time, the line ran from "Vagzlis Moedani" (Tbilisi Central Railway Station) to "Delisi" (at Saburtalo District), with a total length of 5.5km. Plans were then developed for an extension of Line-2 to the Tbilisi University area, with 2 additional stations: "Vaja-Pshavela" and "University". Construction began in 1985, but ceased in 1993, due to financial and technical problems. Construction recommenced in 1998 and in 2000 the section between "Delisi" and "Vazha-Pshavela" was opened, adding 1.2km, with only one tunnel, operating in one direction only.

33. The Saburtalo Metro Line currently ends at "Vaja Pshavela" station with limited operations between "Delisi" and "Vaja Pshavela". Most passengers traveling to the western parts of Saburtalo (especially the Tbilisi University buildings) therefore have to transfer at "Delisi" station to buses and microbus-taxis. Largely as a result of this, Delisi is one of the busiest parts of Saburtalo District, with well developed commercial and transport infrastructure operating in the vicinity of the Metro station.

Fig.3.1 Current situation at metro University

34. The current situation with the metro station "University" is as follows:

- The tunnels are built along the entire length of the new section;
- The upper entrance hall of the station "University" is partially constructed (see Photo 3-1);
- Underground pedestrian passes to the station are constructed;
- Moving staircase tunnel is constructed.

35. The scope of work of the Project involves a study of the feasibility of completing the Metro extension (1521 m) and the "University" station. This will include:

(i) Completion of civil works (station, blind alleys[2], tunnel, and railway superstructure[3])

(ii) Installation of metro systems (track, escalators, ventilation, dewatering, power supply, signaling, control, telecommunications, automatic fare collection)

(iii) Creation of the surface structure of the "University" station (alternatives for standard design, new design, or with commercial space). As the tunnel is already built, there is no alternative in terms of layout/alignment for the metro extension, except the alternatives of completing the project ("with project") or allowing the present situation to continue ("no project".

36. The objective is to put the section into operation in 2013. The main benefits are expected to be:

- A significant decrease in travel time to access the western Saburtalo area from the city centre and the left bank of the river using the Metro.
- Reduced numbers of buses and minibus-taxis in the Delisi area as many passengers will no longer need to use these modes to complete or begin their journeys.

37. A plan and schematic view of the proposed infrastructure are shown on Figure 3-2.

[2] blind alley - railway dead-end siding with crossover, for changing track and train direction
[3] superstructure – civil works for arranging layers of sub-base, base and sleepers under the railway track/rails

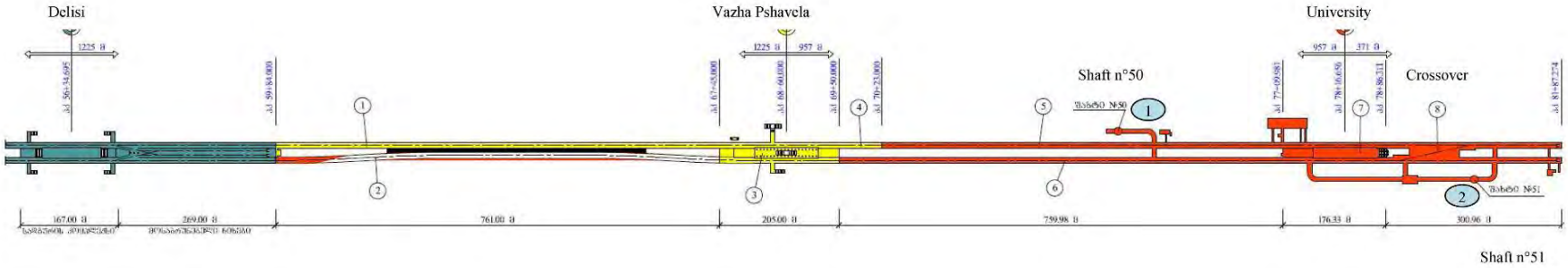

Fig.3.2: Layout plan of metro scheme for the sections Delisi - Vaja Pshavela - University **▼North**

▲North

Fig.3.3 (below): Metro line in Saburtalo District

B. Completion of Civil Works

38. The completion of civil works will involve construction of:
- (i) The University station complex and facilities (above and below ground);
- (ii) Blind alleys behind University station (railway dead-end siding with crossover, for changing track and train direction)
- (iii) Remaining part of passage tunnel from Vazha-Pshavela to University station;
- (iv) railway superstructure (arranged under/for the rail track)

39. Data provided by Tbilisis Metropoliteni (Tbilisi Metro Company, owned by Tbilisi Municipality) does not cover the architectural design of the University station building (space, area, floors, entrances, passages, etc) as reportedly these will be determined later, separately (see Section III-D below).

40. Platform reconstruction includes arrangements of water-proof “umbrellas”, completion of railway side walls, other concrete structure elements (including monolith concrete works, reinforced concrete works, concrete pumping/injecting, other).

41. Construction of technological premises (two floors structure at the beginning of the platform) involves installation of monolith reinforced concrete structure (including monolith concrete works, reinforced concrete works, concrete pumping/injecting, arrangements of water-proof “umbrellas”, finishing works, plumbing and sanitary works).

42. Vestibule structure comprises three spans reinforced concrete frame and should be protected from ground waters by several layers of fiberglass hydro-insulation. Vestibule underground passage structure is combined of monolith concrete walls with prefabricated (precast) reinforced concrete slabs. Underground passage hydro-insulation should be similar to vestibule. Mechanical chamber should be covered by monolith slab. Open construction method (constructing from above ground) will be used for vestibule structure components. Underground passages (underpasses) and entrances are to be constructed. Vestibule covering works shall be coordinated with escalator installation works and the construction of entire building (if/when design is approved).

43. For the escalators incline tunnel the D=7.5m cast iron tubes are considered for installation of “Soviet/Russian-type” triple-stripe escalator with elevation 45.2m. Construction includes some earthworks, hydro-insulation works, arch finishing by cement torcreting, concrete pumping/injecting, arrangements of water-proof “umbrellas”.

44. Blind alleys behind station “University” (railway dead-end siding with crossover, for changing track and train direction, with length 300m) includes construction of concrete chambers #1, #2, #3, #4, passage tunnels, main drainage pumping and additional ventilation shafts. Construction includes excavation/earthworks, drilling/boring, monolith concrete works, reinforced concrete works, concrete pumping/injecting, arrangements of water-proof “umbrellas”, finishing works, other.

45. For the construction and completion of passage tunnels the cast iron tubing and pre-cast concrete blocks are used as fastening structure, and the monolith reinforced concrete will be used where there is minor deepened section. Construction involves boring/drilling works, earthworks, tunnel lining fastening, monolith concrete works, reinforced concrete works, concrete pumping/injecting, torcreting, finishing, and hydro-insulation)

46. Works at combined mining facility include excavation and other earthworks, arch finishing by cement torcreting, concrete injecting between back of arch and tunnel ground wall, arrangements of water-proof “umbrellas”.

47. For the #51 Mining Shaft and the access shafts D_g=6.0 m cast iron tubing is used as permanent fastening structure of monolith concrete. Later, at operations stage, shafts will be used for ventilation and connected to ventilation chamber (length 24m). Works include construction of ventilation chamber, metal ladders, drainage, water-proof umbrellas (involving monolith concrete works, reinforced concrete works, concrete pumping/injecting, arrangements of water-proof "umbrellas", etc).

C. Installation of Metro Systems

48. Based on the field visit made by the systems expert, the systems to be provided are the following:

(i) Rail track (contact rail)
(ii) Electro-mechanical, including escalators, ventilation and dewatering
(iii) Power supply, traction control system (TCS), lighting and low voltages.
(iv) Signalling,
(v) Centralised Control,
(vi) Telecommunications, including radio, administrative telephone, direct telephone,
(vii) data transmission, CCTV, public address, access control and chronometry.
(viii) Automatic Fare Collection, using current technology (tokens and magnetic ticket)

D. Station "University" Building

49. The station "University" needs to be created. For this part of the scope, 3 alternatives can be proposed:

(i) Create the station based on the current design of Tbilisi metro stations
(ii) Create the station with a new specific design
(iii) Create the station with a specific design and adding some facilities to provide areas dedicated for commercial use.

50. The definitive alternative needs to be chosen by Tbilisi Municipality and Metro Company. The base alternative will only require the construction of a ticket hall at the top of the station. The two other alternatives will add specific construction which has to be defined. So there is not sufficient information to undertake environmental analysis of alternatives for the creation of the Station. The present IEE therefore covers the base alternative considered by the current design of Metro station.

E. Operations and Maintenance Phase

51. When the Project reaches the operational stage and the Client/Borrower or another agency (Tbilisi Metro Company in this case) takes over responsibility for its functioning, it is important to maintain the new length of tunnels and the station facilities in working order and monitor issues/activities that may generate adverse impact on environment. These issues/activities are: the proper maintenance of the drainage system, monitoring of dewatering effects, vibration effects, pollution prevention measures, waste management and other necessary routine environmental management components as proposed in Environmental Management and Monitoring Program (see section VI of this report).

52. The O&M procedures will consist of checking, maintenance and repair and replacement if necessary of the track, drainage system, power supply system, signalling, lighting, etc. The existing O&M procedures of the Tbilisi Metro Company describe what will be done during the routine maintenance or emergency situations, how it will be done, and what workers, equipment and machinery will be involved.

IV. DESCRIPTION OF THE ENVIRONMENT (BASELINE DATA)

A. Physical Resources

1. Climate

53. The climate of Tbilisi can be classified as being transitory from moderate continental to a moderate humid subtropical. The city's climate is influenced both by dry (Central Asian/Siberian) air masses from the east and humid subtropical (Atlantic/Black Sea) air masses from the west. Tbilisi experiences relatively cold winters and hot summers. The proximity to large bodies of water (Black and Caspian Seas) and the fact that the Greater Caucasus Mountain Range (to the north) blocks the intrusion of cold air masses from North, determines that Tbilisi has a relatively mild micro-climate compared to other cities along the same latitudes.

54. The average annual temperature in Tbilisi is 12.7 °C. January is the coldest month with an average temperature of 0.9 °C. July is the hottest month with an average temperature of 24.4 °C. The absolute minimum recorded temperature is −24.4 °C and the absolute maximum is 40.3 °C. Average annual precipitation is 498 mm. May is the wettest month (78 mm) while January is the driest (19 mm). Snow may fall on average for 15–25 days per year.

55. North and Northwesterly winds dominate in most parts of Tbilisi throughout the year (26% and 28%), because Tbilisi is located between two folded mountain systems: southern slope of the Central Caucasus in the North and the folded system of Ajara-Trialeti in the South, creating a relief corridor from North-West to South-East. Southeasterly winds are also common (25%). The average annual wind speed Tbilisi is 2.1 m/sec with maximum 4.8 m/sec during February.

2. Topography and Soils

56. Tbilisi is located in the South Caucasus at 41° 43' North and 44° 47' East Longitude. The city is situated in East Georgia on both banks of the Mt'k'vari River. The elevation of the city ranges from 380-770 meters above sea level and possesses the shape of an amphitheatre surrounded by mountains on three sides. To the north, Tbilisi is bounded by the Saguramo Range, to the east and south-east by the Iori Plain, to the south and west by various slopes (sub-ranges) of the Trialeti Range.

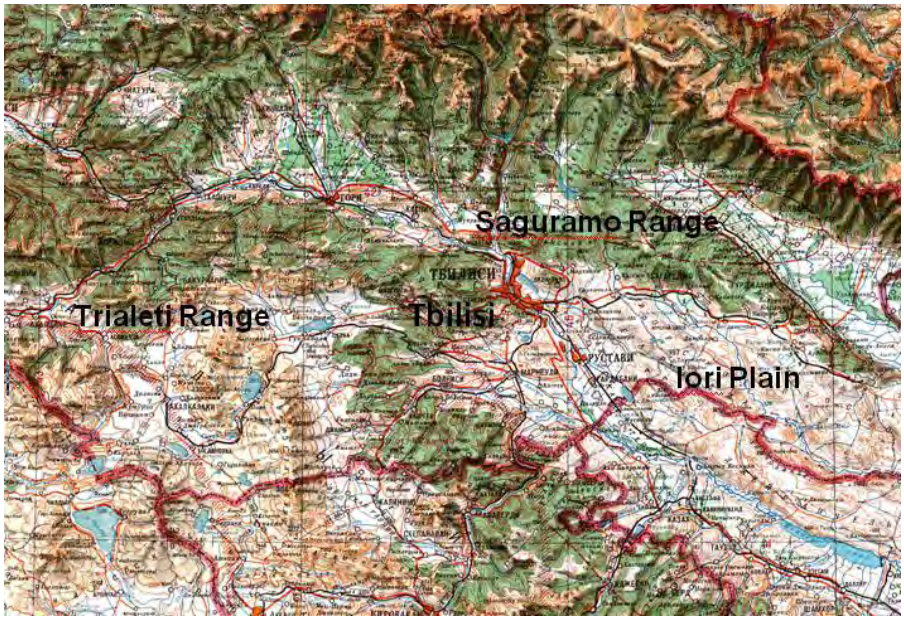

Fig. 4.1: Topography map of Tbilisi area

57. The diversity of Tbilisi relief is the result of its geo-morphological structure. Tbilisi is located between two folded mountain systems, in particular, the foot of an intensely dislocated southern slope of the Central Caucasus in the north and the folded system of Ajara-Trialeti in the south. Its tectonomorphic structure means that the topography mirrors the underlying structure, when anticlines[4] form ridges, while synclines[5] produce depressions. Paleogene-Neogene alluvio-volcanic and terrigenous deposits are covered in many places by thick Quaternary formations.

58. The relief has been strongly transformed under the anthropogenic impact over the centuries. Among natural-tectonic events and processes are landslides, mudflow, erosion and floods. The principal factors hampering the development of Tbilisi and damaging city infrastructure are landslide-gravitational events and mudflows, historically taking place on the basin slopes.

59. The project area is located in a slight depression among the two hilly areas spread from West to East. The relief is slightly inclined to the East. The hills provide a local drainage boundary (catchment), so that from the construction sites, surface and groundwater are drained to the East, towards the river Mtkvari. Distance from the project area to the river Mtkvari is about 4 km.

60. Filling is of non-uniform loam mass with (0 – 4,5m). Dark brownish loamy soil with dense sand bends and 10-15% of boulder-like inclusions, with gruss, broken stone and clusters of rocks.

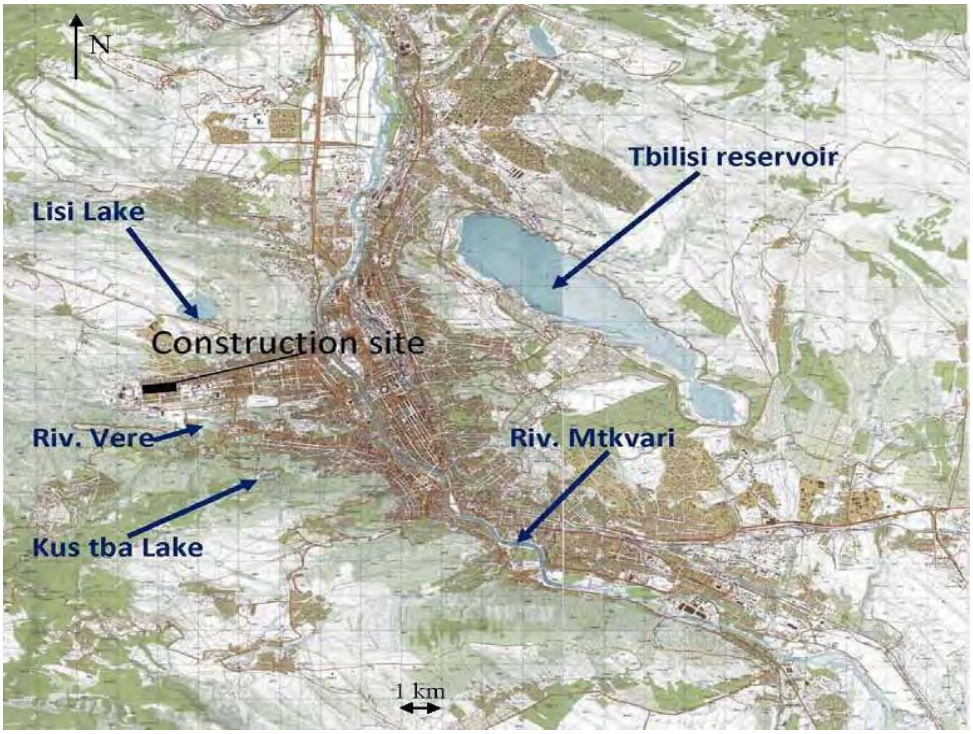

Fig. 4.2: Tbilisi Topographic Map with Indication of the Project Site and Surface Water Resources

[4] anticlines – fold of geological formation with swelling or arch (saddle) form directed upward, where the oldest geological deposits are located in the central (nuclear) part

[2] synclines - synclinal basin, fold of geological formation with depression form (saddle) directed downward

3. Surface Water

61. There are no surface water resources at the territories adjacent to the Project site. Mtkvari is the main river within Tbilisi city limits. Distance from the Project site to the r.Mtkvari is about 4 km, the distance to the small r. Vere (r. Mtkvari right tributary) is about 2 km. Topographically the riv. Vere gorge is separated from the project area by watershed hills, so surface water, as well as shallow groundwater from the project area is not drained to the riv. Vere. The Lisi lake and Kus-tba lake (Tortoise lake) are located respectively 100m and 170m above the level of project area, at a distance of 2,2km and 3,5km.

62. Generally, pollution of the water resources in the city is mostly the result of deficient operation of the water-supply and drainage systems. Mtkvari water is used for industry, agriculture, hydropower and thermal power plants. Bio-chemical studies show that Mtkvari water does not experience sharp changes. Bacteriological studies show the growing pollution with domestic and fecal discharges.

Fig 4.3: Surface Water and Shallow Groundwater Drainage Direction

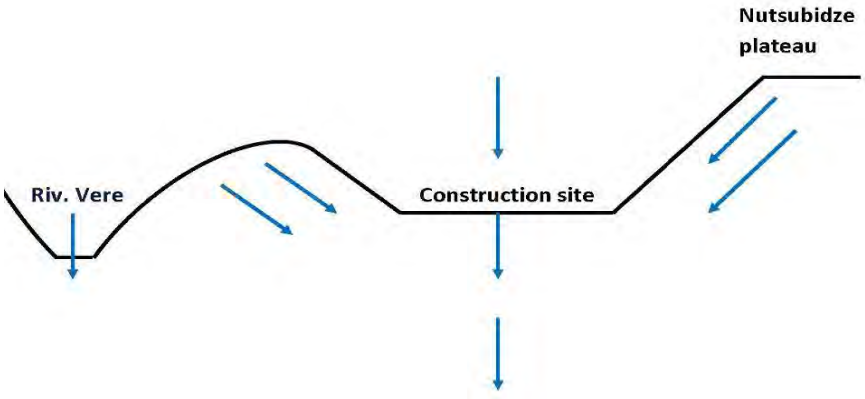

Fig. 4.4: Shallow Groundwater and Surface Water Drainage Cross-section

4. Geology

63. Oligocene-Lower Miocene Terrigenous Deposits(clay with mudstones layers) are widespread in Tbilisi, and outcrop in the troughs of Saburtalo (Project district) syncline. Quaternary deposits are common both in the intermontane basins[6] and on the piedmont slopes[7]. They include gravels in six alluvial river terrace levels above the Mtkvari River floodplain on which rests most of the city's buildings. Clayey and sandy lacustrine sediments[8] and alluvial sandy silts are also present. The terrace gravels above the floodplain are of low permeability and present a secure foundation for industrial and civil structures.

64. Manmade (anthropogenic) deposits, filling old ravines and depressions, are characterized by poor engineering properties. The main causes of the deformation of the buildings in Tbilisi are soil type, the proximity and mineralized nature of near-surface (shallow) groundwater and leakages from depreciated water supply, wastewater and storm water drainage systems. From a geotechnical point of view, the rocks are remarkably strong and represent a secure foundation for both surface and underground structures.

65. The Project area and its environs are composed of the Middle Eocene (rubble with boulders inclusions, gravel and sand filler, sand stone with mudstone and clay layers) (P_2^2) tufogenic formations. These rocks are covered with the continental deposits[9] of variable thicknesses, which comprise the rocks of a colluvial-deluvial[10] and proluvial-deluvial[11] (boulders and sandy clays crushed stone) genesis. Out of the modern Quaternary deposits, the rocks of an eluvial (clay and sand, colluvial-deluvial boulders and sandy clays) genesis are spread over the Project territory and its adjacent area and are covered with the fill of a different thickness here and there. In a lithological respect, the given deposits are presented by tufogenic rock blocks, detritus and gravel with loamy filler.

Tab 4.1: Lithological cross section of Vaja Pshavela Ave and Asatiani St ("Sojuzburgaz" Report. 1985).

Interval m.	Lithological column	Geological description
0.0-4.5		Loose material, conglomerates
4.5-8.5		Dark brownish loamy soil with dense sand bends and 10-15% of boulder-like inclusions
8.5-10.5		Heavy weathered alternation of quartz-sandstones and argillites. Water table at 10.5 m
10.5-20.0		Alternation of quartz-sandstones and argillites

66. Out of the deposits of the mentioned genesis, the deluvial (slope) grounds are dominant, which have different thicknesses, varying between 10 and 15 m at some places. They are mostly presented by loams and clays with conglomerates and gravel admixtures. Schematic lithological cross-section is given on fig X p.5 "Grondwater". Lithological cross-section of the site

[6] intermontane basins – accumulative basin located within the intermountain (synclinal) depression
[7] piedmont slopes – slopes at the foot of mountain
[8] lacustrine sediments – sediments formed by conglomerates, shingles, gravels, sand, clay or organogenic materials and accumulated at the lake bottom.
[9] continental deposits – totality of all overland formed sediments as opposition to the marine sediments
[10] colluvial material – coarse rubbly talus deposits accumulated at the foots of steep slopes,
[11] proluvial – alluvial fan deposits washed out by temporary watercourses (alluvial – by continuous, permanent watercourse)

at the Vaja Pshavela Ave corner with Asatiani street located at a distance of 2.3 km from the construction site, within the same drainage area, is given below.

5. Groundwater

67. According to the hydrogeological zoning of Georgia (Buachidze I., 1970), the Project site and its adjacent territory are located within the area with the fissure and fissure-karst[12] waters of Tbilisi artesian basin[13]. The feeding area of the underground waters of Tbilisi is mostly located beyond the city borders. The relief of the city, in particular, the lithological content of the constituent rocks and their bedding elements, negative humidity balance and other conditions, do not support the feeding of the underground waters.

68. On the right bank of the Mtkvari, which is characterized by strongly inclined slopes and little vegetation cover, during abundant rainfall, the water infiltration into the grounds is complicated and therefore, the constituent rocks of the Project area are less water-infused than other areas of the city. Rainfall is drained down into the r. Mtkvari mainly as surface water.The fault zones contain chemically aggressive sulphate-rich thermal water circulating under pressure. In particular, these waters have adversely affected the Tbilisi Metro (G.Buachidze, G.Chokhonelidze,) by damaging tunnel lining, ceilings, stone and paint finishing, etc.

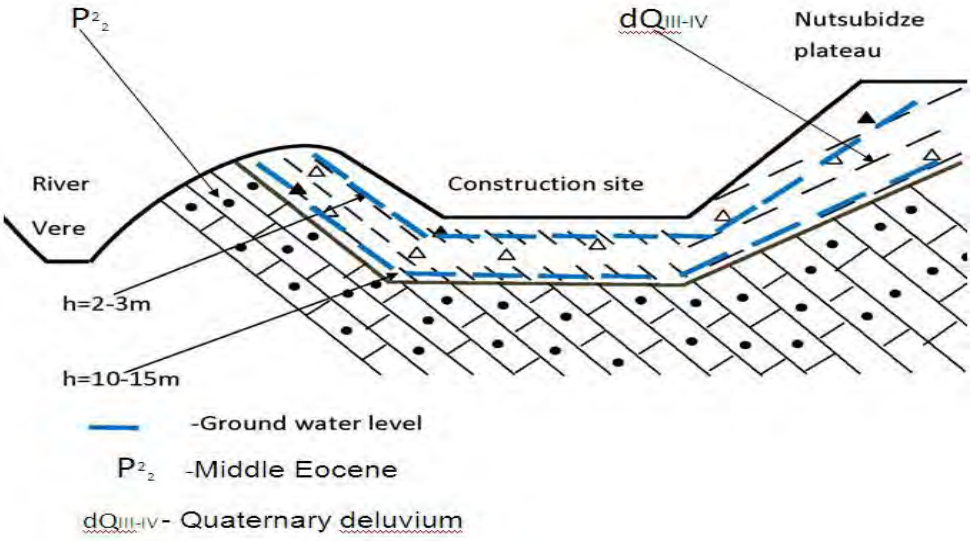

Fig. 4.5: Schematic drawing of lithological cross-section of aquifers in the project area

69. The underground waters of a deep circulation of the Middle Eocene are characterized by a high content of hydrocarbon of up to 12 g/l. These waters also contain up to 19.28-22% of methane and nitrogen. The underground waters are characterized by high flow rate. Their circulation is associated with the fissures of the constituent rocks (sandstones). As for the mudstones, they present an almost water-proof stratum. Within the project area there are significant flows of ground waters formed in the Quaternary deposits of the eluvial-deluvial genesis[14] (sandy clay with gravel inclusions), as shown on a fig. 5.1

6. Seismology

70. Georgia is a part of the seismically active region of the Caucasus. It belongs to the Mediterranean seismic belt. Its tectonic movement and activity is connected with the movement of the neighboring Europe-Asian and Africa-Arabian plates. In a tectonic respect, the Project area and its adjacent territory are included in Aspindza-Manglisi sub-zone of Ajara-Trialeti

[12] fissure-karst waters - type of groundwater that circulates in the karst structures (cavities, channels, fissures) formed due to washing out of soluble materials of the rock formations
[13] artesian basin – basin of pressurized (confined) groundwater

folded system where there are large folds identified, with the length of several tens of kilometers each. One of such folds in the city is the arched portion of Tabori (Seidabadi) anticline. The techtonic fault is shown on the geological map (fig 5.3, red line). The seismic intensity map of Georgia is shown on Figure.

71. After the principal impact of the (7-point) earthquake of 2002, the repeated seismic impacts still continued in the zone of the epicenter. On 27.04.2002, the national seismological office of Armenia registered 8 aftershocks Tbilisi within the period of April 25- May 3, 2002. As a result of the analysis of Tbilisi earthquake of 25.04.2002, proper schedules were drafted for the seismic regime.

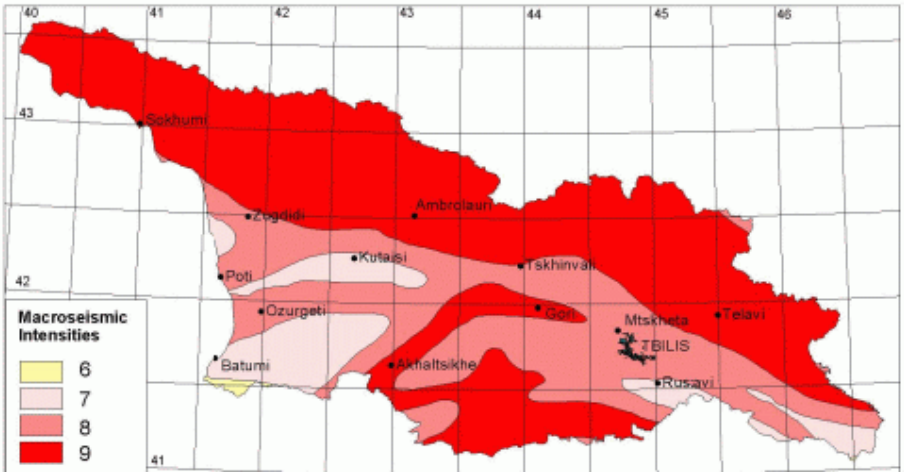

Fig. 4.6: Seismic Intensity Map of Georgia

Source: Georgian Geophysical Society, 2002

72. According to the corrected scheme of zoning of the territory of Georgia, the study territory is included in the point 8 earthquake zone (Decree No. 1-1/2284 of October 7, 2009 (Tbilisi) of the Minister of Economic Development of Georgia about standards “Seismically stable construction (PN 01.01-09)). The intensity of tectonic zones are calculated for 2% probability (expectation time 50 years) according to the Richter Scale. The risk of activation of exogenous processes on the territory of Tbilisi has significantly increased after the earthquakes of April 25, 2002 weakening the stability of the landslide-gravitational slopes to the critical tension and areas structured with weak erosive-settling grounds.

7. Ambient Air Quality, Noise and Radiation

73. Until 1991, **ambient air quality** monitoring was carried out regularly and systematically in Georgia in 11 cities, including Tbilisi. Dust, CO, NO_2 and SO_2 were measured continuously 3 times a day. The latest available air quality monitoring (from 1995 to 2004). The average yearly concentrations of dust, sulfur dioxide and nitrogen dioxide in the center of Tbilisi slightly exceeded norms. The maximal dust concentration exceeded MPL 1.2 times. In the later years of the data, the concentration of nitrogen dioxide increased substantially due to increased traffic, while the level of hydrogen sulfide pollution decreased with reduction of industrial activity.

Table 4.2: Air Pollutant Concentrations in Tbilisi and Maximum Permissible Levels in Georgia (Data of center of monitoring of MoE of Georgia, 2006)

Pollutant	Concentrations in Tbilisi, mg/m^3	MPL of Concentrations in Georgia, mg/m^3
Dust	0.2	0.5
Soot		0.15
SO2	0.196	0.5
CO	3.9	5.0
NO2	0.049	0.085
NO	0.07	0.4
Phenol	0.013	0.01
Formaldehyde	0.024	0.035

74. No data on background **noise** corresponding to the recent years is available. Instant measurements of noise were carried out at the Project site to assess the background noise level.

75. The measurements were taken on February 18, 2010 at 10.00AM, 14.00PM and 18.00PM using the standard certified Russian device - “Shum 1M30”. The map for the sampling sites and average results of measurement are provided on fig 2.1. and table 2.2 below. Comparison of the measurement data with the values determined under the statutory shows that the background noise on the site is higher than the maximum permissible level. The main source of noise is traffic.

Table 4.3 Average Noise Level (L_{Aeq}) at the Project Area (Mid Vaja Pshavela Ave)

No	Hours	10:00	14:00	18:00	Noise Standards of Georgia (dBA) 7 am-11 pm	
					LAeq	Maximum
1	Noise, Dba	76	75	79.1	55	70
2		72.0	72.6	73.1	55	70
3		70.9	72.3	72.3	55	70

Fig. 4.7: Points 1,2 and 3 - noise and radiation measurment locations

76. Preliminary studies of the background **radiation** were carried out near Metro station V-Pshavela (point1), construction site 1 (point2) and construction site 2 (point3). The need for such assessment is determined by following reasons: a) The Georgian EIA regulations require providing information about baseline radiation values. b) the project site is in the vicinity of the Institute of Isotopes (250m). c) Baseline radiation in some residential houses varies in a range of 8 – 16 milliroentgen/hour. The reason for that may be radiation of certain construction materials.

77. The measurements were carried out on February 18, 2010 using the standard certified Russian device – “SRP 6801”. The sampling points were the same as for noise assessment. The results are provided on table 2.3 below. The background radiation is acceptable for urban areas.

Table 4.4: Radiation Level at the Project Area (Mid Vaja Pshavela Ave)

Sampling point No	Radiation, mr/h	Maximum permissible level mr/h
1	10	12
2	10	
3	10	

B. Ecological Resources

78. The Project site is located in a part of Tbilisi urban area, that was developed in the 1960`s. In the North, East and South the site is surrounded by residential blocks of various densities with 5- to12-storey houses. The area located west of the site is industrial and building complexes of scientific-research institutes, offices, laboratories, mechanical workshops, technical headquarters of cellular communication providers, etc. Therefore the anthropological impact on the ecological resources has about half century history and the area is completely urbanized. There are no protected areas or water bodies close to the Project site.

79. The trees, bushes and adjacent houses provide the habitat for synanthropic[15] species, but from the faunistic point of view, these sites are not important. Only 55 bird species out of 390 registered in Georgia are included into the Red List. None of the bird species protected by the law dwell adjacent to the Project site. The birds wintering in Tbilisi are not protected by law and there is no stop-over adjacent to the Project site for the birds protected by law.

1. Rare or Endangered Species.

80. Regarding the wildlife (A. Kandaurov, 2004) - 26 mammals of the 109 species in Georgia are protected by the law. Among the protected species, only bats have a habitat in the city, and particularly in the metro tunnel of the Project. There are 16 bat species dwelling in Tbilisi, with 5 of them protected. These species are under protection of the Convention on Migratory Species (CMS) and its Agreement on the Conservation of Populations of European Bats (EUROBATS, 1994) to which Georgia is a contracting Party (since February 2009).

81. An additional survey has been conducted to determine the following: a) to what extent do bats really use the tunnel; b) which bat species exactly dwell in the tunnel;

Fig. 4.8: Bat colony wintering in the metro tunnel of Project area

82. As a result of investigation the Greater Horseshoe Bat (*Rhinolophus ferrumequinum*) wintering colony consisting up to 500 individuals was found, using a standard photo-counting

[15] synanthropic – ecologically connected to the areas of anthropogenic activity (urban and rural areas)

approach. This colony is probably biggest wintering colony of this species in the city. However, investigation of the tunnel in the project area revealed only colony of the one specie.

C. Economic Development

1. Industries and Infrastructure

83. The events of the 1990s in Georgia and its capital as well as the economic developments brought Tbilisi infrastructure and social-economic system to the brink of collapse. The main economic parameters started to improve as of 2001. As a result of comprehensive social and economic reforms of the new Government the Gross Domestic Product (GDP) started to increase in 2003. A significant share of the economic growth comes from the economic activities in Tbilisi.

84. Construction **industry**, transport and telecommunications compose the economic foundation of Tbilisi. Much more than half of the products produced in Tbilisi come on these fields. Only few of industrial or business enterprises are located in the project area:

(i) National Center of High Technologies - Institute of Isotopes (21 Kavtaradze str.)
(ii) MAGTICOM – cellular phone operator (5 Politkovskaia str.)
(iii) Market of Construction Materials (Kavtaradze str.)
(iv) Zonal Experimental Scientific Design Institute TBILZNIEP (5A Sandro Euli str.)

Development of the new branch of metro will have certain positive impact providing more possibilities and choices for the employees of the mentioned entities.

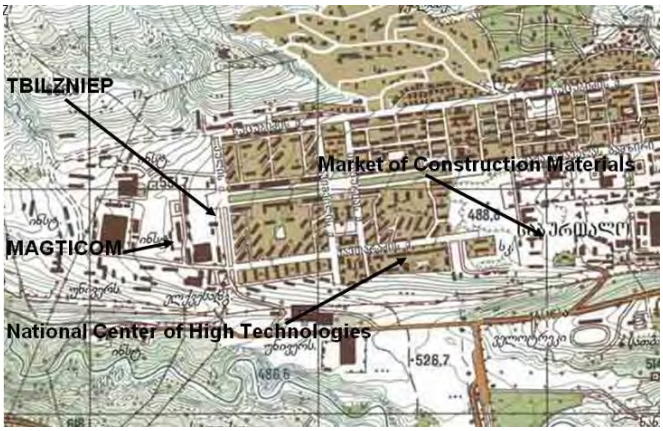

Fig. 4.9: industrial and business enterprises in the project area

85. There is well developed **infrastructure** in the Project area that includes water supply, power supply, gas supply, communication cables (telephone, internet, cable TV). Most significant of utilities - "Georgian Water and Power" (GWP) delivers 21 m^3/sec. of drinking water to Tbilisi and its neighborhood. Tbilisi **water supply** system uses both – groundwater and surface water resources. The intake of underground waters takes place in Aragvi Gorge (about 40 km from Tbilisi), and surface water intake is carried out from Tbilisi Sea through Grmagele and Samgori treatment facilities. The residential districts adjacent to the construction site are supplied with drinking water with 300 and 600-mm-diameter steel pipes. The system pressure reaches 6 atmosphere. The system is amortized and needs replacement. At present, there are no visible leakages on the study territory. During the metro operation, the damage to the already amortized system is not excluded because of vibration.

86. Construction of the **storm water drainage system** of Tbilisi started in 1835. Brick sewers in which utility and sanitary waters as well as rainfalls flowed and empted in the river Mtkvari. At present Tbilisi drainage systems with the diameter of 150- 1200 mm are built with brick, arch, concrete, reinforced concrete, ceramic, cast iron, asbestos cement and polyethylene pipes. The drainage system is self-flowing. The total length of the network system is 1600 km.

The length of the main trunk **wastewater sewer** is 72 km. The waste water flows through the sewer to Gardabani Treatment Plant. There are 42 separating chambers on the main sewer. The capacity of Gardabani Treatment Plant is 1, 0 million cubic meters/day. The water-drainage system is amortized, but is in the working condition, mainly consisting of 800-mm-diameter cast iron pipes.

2. Transportation

87. Tbilisi transport network includes metro, buses and microbuses. The construction site is crossed by the routes of 9 **buses** (13, 21, 25, 44, 55, 71, 92, 115, 125) and 9 fixed-run **microbus-taxis** (19, 75, 88, 137, 147, 149, 184, 200, 201). Most of the buses and microbuses run on diesel fuel and as usual are not in a good technical condition, so the pollution from emissions exceeds the maximum permissible concentration. After the metro station is put into operation, presumably the emissions of harmful substances into the atmosphere by the public transport will be reduced.

88. The Tbilisi **Metro** is a rapid transit system in Tbilisi. Opened in 1966 it became the fourth Metro system in the former Soviet Union. Like most ex-Soviet Metros, most of the stations are very deep and vividly decorated.

Fig. 4.10: Metro Station Tsereteli

89. Presently the system consists of two lines, 22 stations on 26.4 kilometers of track. 20 stations are below ground and two are at surface level. Of the subterranean stations 16 are deep level and 4 shallow. The former comprise 6 pylon stations, 5 column and 5 single vaults (built to the Leningrad Technology). The shallow stations consist of three pillar-trispans and one single vault (Kharkov Technology). Due to Tbilisi's uneven landscape, the metro, particularly the Gldani-Varketili line, in two cases goes above ground.

90. In 2005 it was estimated that a total of 105.6 million people used the Metro annually[1]. Carrying them are a fleet of 186 metro cars from two depots. Although the platforms are accommodated for five-carriage trains currently four and three carriage trains are used on lines 1 and 2 respectively. The car models are identical to those of other ex-Soviet Metros. The cost per token is 40 tetris, and remains valid for the whole duration. Trains run from 6:00 a.m. till 1:00 a.m. with intervals ranging between 4 minutes and 2.5 during peak times. Trains run between 60 km/h - 90 km/h.

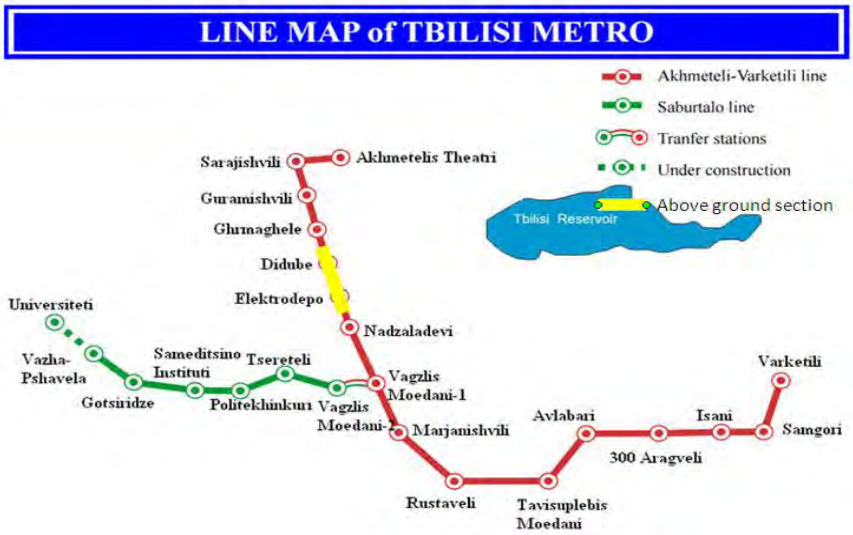

Fig 4.11: Line Map of Tbilisi metro

3. Power Sources and Transmission

91. Currently 24 hour uninterrupted power supply of the residential houses, public buildings, industry, transport sector and commercial entities in Tbilisi is ensured by the power generation and distribution system. Tbilisi Metro is considered as one of the major consumers of electrical energy, it uses 62.000 MWt/h of electricity.

92. Power supply for the residential districts adjacent to the Project site comes through 600-KV sub-station “Saburtalo-2” located within 280m from the site, at the beginning of Jikia Street. Electricity is supplied to 7330 subscribers, which use about 1,7 MW/hour of electricity in winter period and 1,3 MW/hour of electricity in the summer period.

4. Land Use

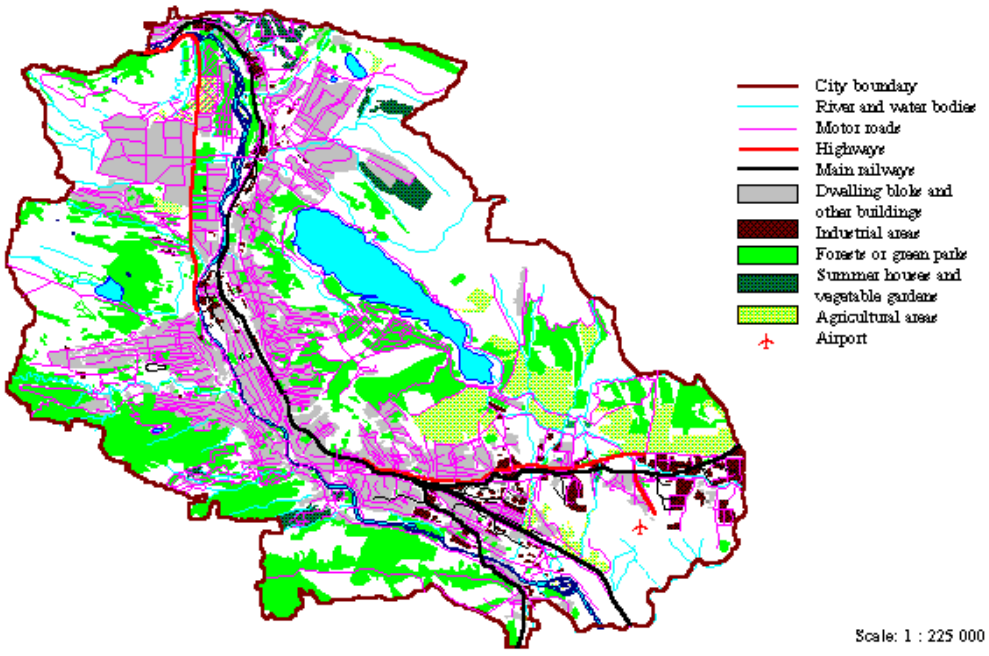

Fig. 4.12: Tbilisi land use map

93. The Project site is located in a part of Tbilisi urban area, that was developed in the 1960`s. In the North, East and South the site is surrounded by residential blocks of various densities with 5- to12-storey houses. The area located west of the site is industrial and building complexes of scientific-research institutes, offices, laboratories, mechanical workshops, technical headquarters of cellular communication providers, etc. Therefore the urban landuse has about half century history and the area is completely urbanized. The existing land-take for metro construction within the Vaja Pshavela streetscape is intended to be temporary (for almost 3 decades now). There are two suspended constructions of residential buildings started during "construction boom" of 2007-2008 (before 2008 crisis) in the vicinity of the Project, that might be resumed within the Project period. Tbilisi Municipality estimates (according to Tbilisi Master-Plan) that the completion of the metro extension with the University station, in addition to improving access to Tbilisi University facilities, Jikia street businesses, and the relatively remote Nutsubidze Plateau 1st District, will also extend residential and commercial development in the area, with creation of additional jobs.

Fig.4.13 Shaft No.50 construction site

Fig.4.14 Shaft No.51 construction site

Fig.4.15 Park in the center of Vaja Pshavela Ave.

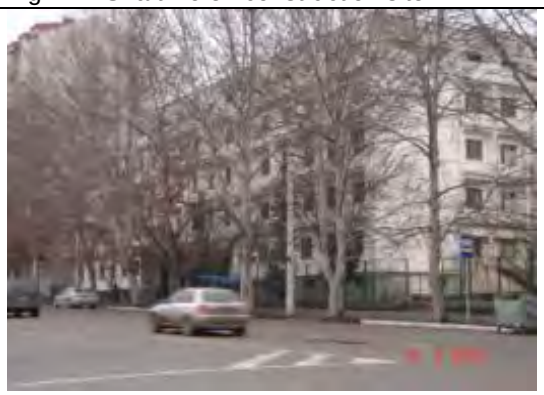

Fig.4.16: Medical center at Vaja Pshavela Ave

Fig.4.17: Power supply substation at Jikia St

Fig.4.18: Groundwater in the tunnel

D. Social and Cultural Resources

1. Population and Communities

94. The data below show the number of the regular population of Tbilisi. However, in fact the population living in the city is 300 thousand more than the given data, because of inflow of the refugees (IDPs), students, workers and other people from the regions of Georgia, temporarily living in Tbilisi. The employment level is quite low due to economic crisis and war of 2008. However, city still attracts people providing more employment opportunities than countryside, and the loads on city transport are increasing.

Table 4.5: Changes in Tbilisi population for the last 10 years

2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1097.5	1088.5	1081.7	1079.1	1078.2	1079.7	1103.3	1101.1	1106.7	1106.7

95. The population of Tbilisi has always been multi-ethnic. The Kurds, Armenians, Jewish, Azeri, Russians, Greek and others have been living side by side with the Georgians. At present, 20% of the city population are not Georgians in the ethnic respect. 85% of the city population is Orthodox Christians. The followers of the Russian Orthodox Church and Armenian Apostolic Church are quite large in number. The Catholics, Lutherans, Baptists and other Christian denominations are in a minority. The Islam followers are 8%. Approximately 2% of the Tbilisians are Hebrew. The city is historically known for its religious tolerance. This is particularly well seen in Old Tbilisi, which is rich in churches and chapels of different confessions.

2. Health Facilities

96. The following types of facilities make up the core of the primary healthcare in Georgia: polyclinics, dispensaries, health centers, women consultation clinics, doctor ambulatories and hospitals (inpatient healthcare). In 2007, there were 265 inpatient healthcare facilities in Georgia. These facilities provided 14,565 hospital beds. This is a substantial decrease in bed provision from 1991 when there were 53,122 beds in 390 hospitals. However, despite these reductions, numbers remain high compared to other countries and, in 2007, there were approximately 331.9 beds per 100,000 population. Occupancy rates dropped from 73% in 1980 to 40 % in 2007.

97. In the following tables specific data of the healthcare network in Georgia are summarized. All information are taken from the Health and Health Care Statistical Yearbook 2007 – 2008 Georgia (National Center for Disease Control).

Table 4.6: Primary healthcare facilities network in Georgia, and in Project Area; 2007

Region	Polyclinics	Dispensaries	Health centres	Women consultancies	Doctor ambulatories
Tbilisi	34	13	20	8	0
Project Area	1	0	0	2	0

98. The metro system is used mainly by patients of the primary healthcare facilities and specific medical and diagnostic centers. Three of primary facilities are located in the project area. Some of the specific hospitals, medical and diagnostic centers are located close to the metro line and could be used by patients. Particularly, along the Vaja-Pshavela line - the Republic Infectious Disease Clinic, Republic Central Clinical Hospital, Septic Center, AIDS

center, children policlinics and policlinics No 26, Diagnostic center “Limbach Group” and Children Diagnostic Center are located in the vicinity of metro station “Medical University”. The research Institute of Hematology and Transfusion, National Center for Disease Control, Research Institute of Psychology, Research Institute of Narcology are located near the metro station Delisi. Republic Clinic No 2 – Medical center integrating several clinics (16 Kavtaradze str. 300m from the project site), Cardio-diagnostic center and Family Medicine Center No 1 (15m from project site) are located in the vicinity of metro station Vaja Pshavela.

3. Education Facilities

99. There are state and private Universities in Tbilisi that provide undergraduate and postgraduate education. The largest university is Ivane Javakhishvili State university, established in 1918 which offers number of faculties and degrees. It has 5 subsidiaries in different regions of Georgia, six faculties, over 60 scientific-research labs. TSU (Tbilisi State University) has close interactions with many universities and centers of various countries of the globe.

100. The following **universities** are located in the Project area: Tbilisi Iv.Javakhishvili State University (1 University St), Tbilisi State Medical University (33 Vazha-Pshavela Ave); European School of Management (ESM; 40 Vazha-Pshavela Ave). Development of the new branch of metro connecting the network with the University area will have benefit for the University students, providing them additional choice. Metro is more expensive than bus transport, but cheaper and more reliable than minibus and taxi transportation.

101. There are approximately 200 municipal and private **schools** in Tbilisi, out of which the following are in the Project area:

1. Physical - Mathematical school in name of Komarov
2. Secondary school No 126,
3. Secondary school No 128
4. German secondary school in name of Waldorf
5. Experimental school No 1
6. Sports School No 35
7. Sports school “Olympus”

102. Most students of secondary schools are living in the vicinity of their schools. However, certain part of students is using municipal transport for reaching their schools. For this segment of students the development of new branch of metro may provide some choice for the safe and reliable transport means. However, this positive impact should not be considered as significant benefit.

4. Socio-economic Conditions

103. The level of unemployment in Tbilisi is quite high and has varied between 29 and 30.5% in recent years.

Table 4.7: Proportions of 15-year-old and older population according to their economic activity

	2005	2006	2007	2008
Total of active population (labor force)	429.8	434.7	480.7	430.1
Employed	305.0	303.6	346.1	302.1
Hired	248.9	248.8	291.0	240.6
Self-employed	55.6	53.8	55.2	61.4
Unknown	0.5	1.0	0.0	0.1
Unemployed	124.8	131.1	134.6	128.0
Level of unemployment, %	**29.0**	**30.2**	**28.0**	**29.8**
Level of activity, %	**54.4**	**52.9**	**55.3**	**52.4**
Level of employment, %	**38.6**	**37.0**	**39.8**	**36.8**

5. Cultural Resources and Archaeological Sites

104. Archeological studies have demonstrated that territories of Tbilisi have been populated since the ancient age (5^{th}-6^{th} cc. B.C.) through the Late Feudal Age. There are over 150 archeological monuments of different periods found at present, including: Delisi site of ancient settlement in Vazha-Pshavela avenue (V-IV cc. B.C.), sites of ancient settlement and tombs of the Early and Middle Bronze Ages (IV-II cc. B.C.) in Digomi, Saburtalo, Vashlijvari, etc.

105. The territory of Tbilisi was particularly densely populated in the Late Bronze and Early Iron Ages (XIV-VII cc. B.C.). The sites of ancient settlements and burials of this period have been found in Avlabari, Ortachala, Saburtalo, Didube, Digomi, Mtatsminda slope, Nadzaladevi, Avchala and in other places. The monuments of the Antique Age (VI c. BC – II-IV c. AD) were found in Avlabari, Mtatsminda slope, Tavisupleba Square, Agmashenebeli Avenue, Digomi, Saburtalo, Gldani, Vake, Didube, Nadzaladevi, Ortachala, Grmagele, etc.

106. During the metro earthworks at Vaja Pshavela avenue in 2001 there were several chance findings identified as artifacts of the Antique Age. The ordinary citizen of Tbilisi brought the artifacts he found at Vaja Pshavela open cuts to Tbilisi archeological museum. These are a **bronze lion** and **gladiator statuette** dated by the I-III cc. and a silver bowl with the Phalaurian inscription. The archeological excavations carried out later have shown that the metro earthworks in 2001 had damaged several tombs of the Late Bronze and Antique Ages. There are several archeological sites (Tombs No.1, 2, 9, 10, 11) already identified/known in the Project area as burial place Namgala Mitsa.

V. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

A. Introduction

107. The objectives of Environmental Impact Assessment include: a) Identification of the likely significant environmental impacts of the proposed Project during the construction and operational phases, having regard to the characteristics of the local environment; b) Evaluation of the magnitude and significance of the impacts and derivation of appropriate measures to mitigate adverse impacts; and c) Preparation of an EMP specifying how each mitigation measure will be provided and monitoring to be conducted to ensure mitigation is provided and functions as intended.

108. An initial desk study was carried out to identify potential adverse effects associated with development of metro schemes and construction of metro stations similar to the Project. Potential environmental impacts associated with the construction and operations of the Project have been identified based on the screening of baseline environment, review of preliminary design information and proposed scope of works for the completion of the metro station "University" in Tbilisi.

109. Completion of the infrastructure is expected to take 30 months and will not involve major construction as the tunnel and most of the basic structure of the underground station has already been built. The remaining work consists of: completion of tunnels and shafts; injection of concrete to seal the exterior tunnel lining; shafts lining; construction of railway superstructure; completion of the reinforced concrete floors in tunnels and the platform; construction of 2-stores technological building at the beginning of the platform (for systems control, service facilities, personnel, toilets, etc.); completion of the station structure; finishing works; installation of equipment and system components including rails, escalators, electrical fittings, etc.

110. The majority of the remaining works will mostly be done underground, and the main interactions with the surface environment will be at the existing construction sites at Vaja Pshavela station and University station. Most of materials will be loaded into special railway wagons at the existing open-air sections of Tbilisi metro (in Didube area) for transportation to the site.

111. Impacts of the construction works are expected to be mainly temporary and relatively minor because both locations are a good distance from surrounding houses, and there are no other especially sensitive features nearby. Disturbance can be reduced by commonly used mitigation measures (traffic planning, noise screening, spraying to reduce dust, etc) and there is no requirement for land acquisition or relocation of people and there should be no economic displacement. Noise and vibration may be an issue when the metro extension is operating.

112. These and other environmental impacts of the proposed works that may arise during both construction and operation phases are presented in four groups:

(i) Impact on Physical Environment: geology and soil, groundwater and surface water, noise, vibration, air quality;
(ii) Impact on Biological Environment: flora and fauna, rare and endangered species;
(iii) Impact on Socioeconomic Environment: land use, utilities, socio-economics (employment, local businesses, etc.), traffic, cultural heritage (archeology, architecture, etc.)
(iv) Cumulative Impacts.

This chapter analyses each of the above impacts in detail for both construction and operation phases and proposes respective mitigation measures.

B. Geology and Soil

113. The baseline assessment included a desk study of the relevant technical data and review of geo-technical reports provided by metro authority (not updated recently). In the Project

area the deposits are mainly tufogenic rock blocks, detritus and gravel with loamy filler. The diluvia soils are dominant, which have different thicknesses, varying between 10 and 15 m in some places. They are mostly represented by loams and clays with conglomerates and gravel admixtures. The preconditions forming geotechnical characteristics in the Project area are soil type, the proximity and mineralized nature of near-surface (shallow) groundwater, changes of the groundwater level due to cuts, or leakages from malfunctioning water supply, wastewater and storm water drainage systems.

1. Impacts and Mitigation - Construction Phase

114. The principal source of construction impacts on geology and soils for this particular Project is related to the groundwater. Throughout the long existence of the tunnel, groundwater has drained into the tunnel void through the unsealed walls, and this has been removed continuously by pumping to the surface and discharging through roadside drains into the River Mtkvari. The resulting lowering of the groundwater table, in its turn, may have adversely affected the geo-technical characteristics of the geological formations resulting in reduction of bearing capacity of the foundation soils under the neighboring buildings. That reduction might be gradual (for instance building load plus vibration) or immediate (of seismic nature).

115. The proposed Project scope for the metro station “University” in Tbilisi does not involve significant volumes of tunneling earthworks and requires only completion/finishing of the existing passage tunnel, creation of tunnel for blind alleys behind station “University” (railway dead-end siding with crossover), and application of pumped concrete to seal the exterior tunnel lining, as well as construction of the station with entrances. Nevertheless, it is advisable for Tbilisi Metro Company to undertake a geo-technical survey of the changes in the local aquifer and groundwater table to evaluate the risk of negative impact on the geotechnical characteristics and therefore, the foundations of neighboring buildings, given the associated risk to human health and safety.

116. The construction phase for the “University” metro extension has been suspended for several years with tunnels not concreted. The completion of the concrete works and proper finishing of water tight tunnel, may therefore represent, in itself, the major mitigation measure to prevent lowering of water table and avoid negative impact on geo-technical characteristics, as this will greatly reduce the volume of water entering the tunnel, allowing the water table to return to its “natural” level.

117. Another common mitigation measure to reduce impact on soils and geology is the minimization of the exposed areas during construction works. For this particular Project the significance of the residual impacts are low to very low as the majority of the proposed works is under ground, with minimum exposed soil, and through already disturbed urban areas of Saburtalo District that are already paved along Vaja Pshavela Avenue.

2. Impacts and Mitigation - Operation Phase

118. The principal sources of operational impacts on geology and soils are related to a) vibration (as it is described in Section E); and b) contamination of soils from tunnel. The vibration impact on geology and foundation soils can be mitigated by use of welded rail and speed limits for the trains. This should help ensure that the impact of the vibration on geology and soils will be of low significance. Mitigation measures for potential contamination of the soil from tunnels, which is very low due to absence of depot related services, should include proper drainage and treatment, control of wastewater discharge, in addition to the routine inspections and proper housekeeping practices.

C. Groundwater and Surface Water

119. Various elements of both the construction and operational phases have the potential to impact on the groundwater environment.

1. Impacts and Mitigation - Construction Phase

120. Although the Project will involve only very limited tunneling/drilling works, it should be noted that a potential common impact from construction of metro tunnels includes localized alteration of the direction of groundwater flow due to tunneling operations, requiring dewatering, which may in turn result in temporary or permanent lowering of the water table. This impact may cause changes in geological characteristics and is discussed in the previous section “Geology and Soils”.

121. There is also the potential that the underlying groundwater quality may be affected during the construction phase (from both underground and above-ground works) due to poor control/treatment of concrete wash waters, leakage of fuel from construction vehicles/equipment, oil spillages during refueling or equipment maintenance operations, leakage from chemical storage areas and inappropriate disposal of chemicals (paints, oils, glues etc.). Surface contaminants can then migrate towards underlying groundwater sources.

122. All of the potential risks to ground - and surface- water in the construction phase are considered likely to be of low significance. This is mainly because contractors will be required by their contracts to operate good housekeeping practices to prevent leaks and spills (as described below), which should protect the surrounding groundwater. Nevertheless, groundwater generated by natural inflow into tunnels during the construction phase, should be collected through on-site drainage and tested and treated prior to being pumped out and discharged to the surface water drain. The treatment of surface water runoff and groundwater should include the use of silt/sediment traps and oil interceptors prior to release to surface water drains, as these ultimately discharge to the River Mtkvari.

123. The main method for preventing pollution of surface- and ground-water will be a pollution prevention and abatement plan and an emergency response plan, which contractors will be required to prepare and implement. These will specify containment measures for pollution incidents, a list of appropriate clean-up materials and equipment, details of staff responsibilities and trained personnel, and contact details for pollution clean-up teams, relevant local authorities and emergency services.

124. Contractors will be required to include in the plans and enforce on site a variety of pollution prevention and control measures. Oil and fuel storage tanks will be held in designated bunded areas within the construction compounds and filling and draw-off points will be located entirely within the bunded area(s). Drainage from the bunded area(s) will be diverted for collection and safe disposal off site by an appropriately licensed contractor. All storage tanks should have secondary containment with concrete bunds and floors and with volumes that must exceed the volume of stored liquids. Their integrity will be regularly checked and maintained and tank level gauges will be checked regularly to detect leakage at an early stage.

125. Refueling of construction vehicles and the addition of hydraulic oils or lubricants to vehicles, must take place in a designated bunded area of the construction compound. The refueling area should not be situated close to any surface water drain. If it is not possible to bring a machine to the refueling point, fuel will be delivered in a double skinned mobile fuel bowser.

126. A drip tray shall be used beneath the fill point during refueling operations in order to contain any spillages that may occur. Spill-kits and hydrocarbon absorbent packs must be stored in this area and operators will be fully trained in the use of this equipment. Spill-kits and drip trays should be used to contain any spillages that may occur. Where concrete mixing is required this will only take place at a designated area at the construction compound, which will not be located next to a surface water drain.

127. The washing of concrete mixing vehicles must take place in a hard-standing bunded designated area. Disposal of waste water from ready mixed concrete operations is a great concern because in Tbilisi it is usually discharged directly to surface water drains and goes to riv.Mtkvari without treatment. Alternative solution is to recycle the waste water and use it as batch water to make fresh concrete. Performance of concrete is not affected by the use of recycled water, also new stabilizing admixtures are being used to reduce wastes from batch plant operations.

128. The emergency response plan will be implemented in the event of concrete spillages during pouring operations. All associated hazardous waste residuals, such as oil, solvent, material used in oil spill cleanups, together with glue and solvent based paint containers, should be stored within appropriately covered skips prior to removal by the municipal authority or a suitable licensed waste management contractor for off-site treatment/recycling/disposal. Any other construction waste should be disposed of to on-site skips for removal by an approved waste management contractor.

2. Impacts and Mitigation - Operation Phase

129. During the operational phase, there is very minor potential for the migration of contaminants into groundwater, from the surface or operations in the tunnel. This is because after completion the tunnel will comprise an almost sealed watertight concrete structure, with a proper water drainage, treatment and discharge system for the limited quantities of water that will enter the tunnel, so the potential for contamination from the underground section should be very low. To protect surface water and particularly the River Mtkvari, the metro operator (Tbilisi Metro Company) should regularly monitor the quality of water removed from the tunnel prior to discharge to surface water drains, so that treatment can be applied if found to be necessary.

130. There is almost no potential for the release of chemical substances such as oils/lubricants or solvents into the underlying groundmass, because there is no train technical maintenance services envisaged at the Project area during the operations. Any leaks that occur from trains or carriages should be very small and should not require any special treatment before being removed in the drainage water. The metro operator should however still be required to prepare and implement a pollution prevention and abatement plan as this should then ensure appropriate action in the unlikely event of a significant spillage in the tunnel, such as could occur if there were an accident for example.

131. Power supply transformers should be regularly checked and maintained to minimize the potential for leakage of transformer oil, and transformers must be located on areas of hard-standing. Waste material generated at the station and along this section of the route should be stored in appropriate containers in a suitably designed waste storage area and collected on a regular basis by a suitably licensed municipal waste collection contractor for disposal at an appropriately licensed municipal landfill. The waste storage area must be regularly and appropriately cleaned.

D. Noise

1. Impacts and Mitigation - Construction Phase

132. The key airborne noise is likely to be generated during the construction phase when some noise impacts due to the use of powered mechanical equipment (PME) at noise sensitive receivers (mostly residential blocks along Vaja Pshavela Avenue) are expected. Not all of the tunneling and other major work in the tunnel, station area and entrances has been completed so there will be some more tunneling, drilling and excavation works as well as significant concreting works involving concrete pumps, compressors, etc. There will be large components of equipment delivered by heavy vehicles to the open-air loading site on the existing line (in Didube area), and transferred to railway wagons by crane for delivery to the site. Some

materials like reinforcing rods, sand and cement, some equipment will be delivered and unloaded at the station entrance.

133. Commonly used direct mitigation measures such as quieter mechanical equipment and alternative construction methods (e.g. use of concrete crushers in lieu of a conventional noisy excavator mounted breaker “jet-hummer”) and other good site practices would be necessary to alleviate airborne construction noise impacts. The significant noise levels are expected, therefore purpose-built barriers or enclosures should be used by the Contractor to further alleviate the impacts on neighboring residential areas to acceptable levels.

134. There could also be noise impacts along routes used by heavy vehicles bringing equipment and materials to site. Access routes to both sites should therefore be planned with the objective of avoiding any buildings or locations that may be vulnerable to noise disturbance (schools, hospitals, etc). There will only be limited access to both underground and above-ground work, so the amount of construction plant to be employed will be restricted so the magnitude/extent of the construction works will be limited, which will further reduce surface noise.

135. All noise impacts generated from the proposed works are expected to be short-term. Noise impacts will be adverse, but temporary and of medium significance only (as there will be no or limited explosions, no percussive piling, and no massive breakers). To control noise impacts the following mitigation actions are recommended:

(i) Discussions with Tbilisi Municipality to decide whether there is any need for possible restrictions on hours of working on week days (night-time working), Saturdays and Sundays and public holidays;
(ii) Use of up-to-date equipment that meets national standards or ‘best accepted practice’ in terms of sound power output;
(iii) Use of silencers, mufflers and acoustic shields on plant and equipment;
(iv) Erection of noise barriers at the University station open site;
(v) Regular maintenance of machinery to ensure sound power output is minimized;
(vi) Limits on the number of machines used at any one time;

2. Impacts and Mitigation - Operation Phase

136. Baseline noise levels along the Vaja Pshavela Avenue during the day are already quite high (see Section IV) and the environment is generally dominated by urban traffic. There might therefore be a small reduction in noise when the metro extension is operating, as traffic volumes are expected to decrease. Nevertheless noise attenuation measures should be incorporated into those facilities that could produce surface noise, including electricity substations and ventilation chambers and shafts to control/reduce noise emission to acceptable levels. With proper design of the vent shaft, potential noise impact should comply with the legal limits discussed in Chapter IV. No significant ground-borne noise is expected from the train movement as well. In silent hours (before 08:00 and after 22:00) it can be mitigated by reducing the train speed limits.

E. Vibration

1. Impacts and Mitigation - Construction Phase

137. Vibration and ground-borne noise are aspects of the same phenomenon, perceived differently or conveyed in different media. Vibration is movement of a surface or structure perceived by humans by the tactile sense; ground-borne noise is vibration of a surface or structure perceived by humans as sound.

138. There will be certain potential vibration sources in the construction phase. According to the project design scope, the use of a large TBM (Tunnel Boring Machine) is not considered because the majority of tunneling works have been completed. Minor boring, very limited blasting and drilling is envisaged at the construction phase for completion of the passage tunnels (from Vaja Pshavela station to University station) as well as for the blind alleys at University station and completion of technological shafts No.50 and No.51 (see Fig. 3.1)

139. Vibration from blasting (if any) will necessarily be controlled by specification to ensure that thresholds for significant effects on people in occupied buildings, or on the structure of buildings are not exceeded. The achievement of the specified limits will be by limitation on explosive charge weight, with the consideration of geological formations, and any blasting would be planned and performed by fully qualified, experienced and licensed operatives.

140. For the tunnel boring/drilling two principal methods of mitigation are available. The first is to limit hours of operation to avoid the more sensitive night period. The second method is optimization of boring machine or drills characteristics including face pressure and selection of cutters and teeth. Both methods should be applied by the Contractors in order to minimize impact from vibration

141. As the above ground and below ground works will be of limited scope and time period, and taking into consideration the limited use of powered mechanical equipment (hammer drills, small soil compactors, concrete vibrators) it is concluded that vibrations should not have a significant impact on nearby structures. Furthermore, as most buildings are more than 50 m from the tunnel (which is located below the centre of a wide road) and most work will be conducted 20-40 m below ground, vibration should generally not be noticeable at the surface. One especially sensitive receptor is the hospital located at Kavtaradze street (see Section III – Baseline Environment), and as this is over 800 m away, vibration should not affect patients or sensitive equipment in this facility.

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2. Impacts and Mitigation - Operational Phase

142. When the metro is operating, rail vibration may give rise to potential impacts on dwellings adjacent to the extension section. In quiet hours the passage of trains in the tunnel has the potential to cause ground-borne noise and vibration. Early morning (before 08:00 hours) and night-time (after 22:00 hours) train movements may thus present a potential issue.

143. Considering the potential cumulative effect of the impact of the groundwater lowering (if any) on geological conditions, in combination with vibration from metro operations, there is a risk of negative impact on the engineering characteristics of the foundation soils under the neighboring buildings. (see Section IV). That risk should be assessed properly based on the outcome of a special geo-technical survey to be organized by the metro authority.

144. Potential vibration impacts in general should be mitigated by the appropriate selection of track form and use of welded rails in the tunneled areas (at the design phase) and by limiting train speeds in the operations phase if found to be necessary.

F. Air Quality

145. The project will extend the Western Line from the city centre (Tbilisi Railway Station) out to Saburtalo district. It starts at areas where airborne concentrations of pollutants such as nitrogen dioxide and particulate matter are at their highest in Tbilisi. In some places in Tbilisi center, near roads with heavy traffic flows, current concentrations are in excess of those defined by air quality standards. In contrast, most areas adjacent to the Project site currently experience air quality that is compliant with air quality standards.

1. Impacts and Mitigation - Construction Phase

146. The construction phase of the metro extension will have a greater impact on air quality than the operational phase. Construction activities have the potential to generate dust, as well as soot and other emissions from construction machinery/vehicles, so air quality is likely to be degraded to an extent during the construction period.

147. Dust is likely to be the main issue, produced in and around the surface construction sites by construction activities and heavy vehicles, and along transportation routes. Exhaust emissions will also contribute to a general lowering of air quality in these areas, but this will not be a major issue because houses and flats are located some distance from the sites and wind dispersion is generally good in Saburtalo area.

148. It is not possible to eliminate the emission of dust from a construction sites entirely; nevertheless, mitigation measures should be implemented to reduce the impact on about 5-7 thousands residents in the residential blocks along both front lines of Vaja Pshavela Avenue, neighboring the shafts construction sites and the station construction site.

149. In order to mitigate these, the following should be implemented:

(i) Construction equipment (concrete pumps, bulldozers, loaders, trucks, and other vehicles with diesel engines) should be maintained to a good standard and idling of engines should be discouraged. Machinery causing excessive pollution (e.g. visible smoke) should be banned from construction sites;

(ii) Prior to construction the contractor must be required to submit a dust suppression program to Supervision Consultant for approval. The program should detail actions to be taken to minimize dust generation (e.g., properly stored materials, spraying of sites with water, cover the trucks transporting the materials, etc.), and should identify equipment to be used;

(iii) Construction materials should be stored away from the residential areas and must be properly covered;

(iv) Concrete production plants shall be located more than 300m away from the residential buildings to avoid direct impact of emissions (government Decree # 234n by Ministry of Health and Social Welfare of Georgia, 2003). The construction machinery/vehicles used during the construction shall comply with national environmental requirements with respect to emission and noise pollution.

150. Considering that majority of works will be below ground, the construction phase is unlikely to require significant route diversions and this should therefore not affect road traffic flows on the road network within Saburtalo district, resulting in spatial concentrations of emissions.

151. It is also important to consider the issue of air quality inside the tunnel, where vehicles and machines will be working in a confined space, where there are not sufficient ventilation shafts completed and functioning at present. Exhaust gases in particular, but also dust could be a danger to the health of workers. This can probably be mitigated quite easily by putting in ventilations shafts before work begins, but then it is important to ensure that ventilation shafts

are equipped with filters so that they do not become point sources for the liberation of air pollution at the surface.

2. Impacts and Mitigation - Operation Phase

152. Once operational, the proposed metro station will not have much potential for directly changing the air quality as the metro train will emit no pollutants due to having electric motors. Any changes in local air quality would be associated with changes in traffic flows on the whole of Tbilisi and Saburtalo district in particular and should be generally beneficial as vehicle numbers are expected to decline. On the other hand however, there could be an increase in the number of buses, micro-buses and taxis serving passengers at the new University station, which could cause a slight deterioration in local air quality, although this is unlikely to be of major significance as the open aspect of the area and frequent incidence of wind should mean that pollutants are dispersed quite effectively. Mitigation should therefore not be required.

G. Flora and Fauna

153. The proposed Project site is located within a busy urban environment, where available animal and plant habitats are largely of low local nature conservation value. The Project does not involve temporary or permanent loss of habitat along the new extension or at the metro station entrances during construction or operation phases.

154. Some temporary disturbance to a range of common urban fauna species (mostly birds) will occur, but the impacts are unlikely to be significant. The habitats that might be affected by dust and emissions from construction machinery/vehicles are largely common and widespread including those typical in urban locations, such as street trees and the parkland/green recreation area in the middle of Vaja Pshavela (see Fig.4.15), which is more important for its social value than for nature conservation.

155. A colony of bats in the existing tunnel may be directly affected by construction works and this impact and proposed mitigation is discussed below.

156. Small areas of permanent habitat loss will occur to accommodate above ground structures such as air vents and emergency accesses, however, such losses will be small so the effects on habitats and species are not expected to be significant.

157. Once operational, the metro extension will have no significant impacts on habitats and surrounding wildlife due to two reasons: a) almost no wildlife will come into contact with the metro system, and most urban habitats are of low ecological value; and b) there should be no emissions/pollution, no further land-take or any other direct impacts on habitats as a result of the Project at operations stage.

H. Rare and Endangered Species - Bats

158. Vaja Pshavela Avenue is an urban area and as explained above there are very few remaining natural habitats in the town. Flora is mostly limited to artificially planted trees and shrubs, and the fauna comprises species able to live in the cities (urban birds, rodents and some insects). Of the amphibians - only *Bufo viridis* (the European green toad, which is not protected by law) dwells in the vicinity of the Project site. There are no rare species in this area except the bats that are wintering in the incomplete metro tunnel.

159. As explained in Chapter IV above, a wintering colony of the Greater Horseshoe Bat (*Rhinolophus ferrumequinum*) consisting of up to 500 individuals was found in the tunnel, from the University station side. This species is under protection of the Convention on Migratory Species (CMS) and its Agreement on the Conservation of Populations of European Bats (EUROBATS, 1994) to which Georgia is a contracting Party. In 2008 the status of bat species

was re-assessed according to IUCN criteria and the Greater Horseshoe Bat was evaluated as under category VU (vulnerable) (Bats Conservation Action Plan for the Caucasus, 2008).

160. To avoid negative impact of construction works on this protected species (torcreting, finishing works, noise etc.) it is recommended that experts approved by MoE are engaged to undertake moving/excluding the colony before construction starts and before winter time (November-March). Timing is critical for this exercise because in the spring and summer, if a maternity colony has taken up residence, the contractor would need to delay excluding the bats until August when the young are able to fly. The operation must use MoE approved humane exclusion and collection methods to ensure safe transfer of the colony to an appropriate alternative habitat.

161. It is important to take further action to prevent recolonisation of the tunnel. This will require use of meshes to protect shafts access points, checking of underground tunnels and cavities by the use of bat-detector tools to find routes, etc. to implement other preventative measures. It is also recommended to keep the permanent consultations and cooperation with the bats specialists and follow their guidance/instructions.

I. Land Use

162. The proposed Project of the metro extension will not have a significant direct impact on current land use, or on the ownership and rights over land and property within the Project area because no major land-take/acquisition is required. No cut and cover works are planned, so none of the traffic lanes are planned be closed resulting in disturbances of traffic. There may possibly be indirect impact on future land use as a result of the completion and operations of the metro station “University” - such as new commercial and residential development/redevelopment projects conditioned by better access to the area due to new metro station.

163. The existing land-take for metro construction within the Vaja Pshavela streetscape is intended to be temporary (for almost 3 decades now). To minimize further land take the construction compounds for the completion works should be placed within already allocated areas with no or minimum extension, and designed in a manner that minimizes impacts in the surrounding areas. Any such areas should be reinstated to their original use after project completion. Some temporary land-take will occur around the areas permanently taken to accommodate metro entrances. However, residential properties will remain accessible throughout the construction period and the unaffected area of green public recreation zone in the middle of Vaja Pshavela Avenue will also remain accessible and useable at all times.

164. The Contractor should submit to Supervision Consultant and Tbilisi Municipality the layout plan of construction compounds with a list of all proposed temporary structures and activities for approval. Pollution prevention, waste management and reinstatement measures at the construction compounds should be included in the Contractor’s site-specific Pollution Prevention and Waste Management Plans and in the Reinstatement Management Plan.

J. Socio-Economics

165. One of the key socio-economic characteristics that emerges from the baseline data discussed in Chapter IV is that population is increasing in Saburtalo district, especially around the Project area. Of further note is the low level of employment in Georgia and Tbilsi , a reflection of the long-term social challenges in the country.

166. In relation to travel to work data, because of limited car ownership amongst the less well off, commuting via non-car modes of transport is quite high in Tbilisi including Saburtalo district. Higher proportions of the working population are employed in commerce and trade (small traders, street vendors, market/shops sellers, merchants) building and construction,

manufacturing industries, and transport and communication, than in the public sector (administration, schools, police and army), and professional services.

167. Tbilisi Municipality estimates that the completion of the metro extension with the University station, in addition to improving access to Tbilisi University facilities, Jikia street businesses, and the relatively remote Nutsubidze Plateau 1st District, will also extend residential and commercial development in the area, with creation of additional jobs.

168. The long and unfinished construction of the metro extension project over recent decades has already resulted in some negative socio-economic impacts (visual discomfort, geotechnical risks to buildings, dust from sites, etc.). The implementation of the proposed Project will put an end to these negative impacts and perceptions and in addition will improve transport, economy, employment and access to work.

1. Impacts and Mitigation - Construction phase

169. The implementation of mitigation measures for other environmental issues (noise and vibration, air quality, landscape and visual, traffic etc.) will also be important in minimizing and managing potential negative socio-economic impacts during the construction process. This is because these construction-based mitigation measures are all designed to minimize unnecessary disruption, nuisance impacts and temporary delays that might arise during construction.

170. In the construction phase the proposed Project will result in positive impacts due to certain employment creation. Furthermore, a certain portion of construction workers' wages will be spent in the district economy of Saburtalo over the approximately two-year construction period, thereby resulting in indirect/secondary economic benefits. To maximize direct socio-economic benefits amongst communities most likely to be directly affected by any negative impacts from the project, contractors should be required to employ at least 50% of their workforce from people living in the vicinity of Vaja Pshavela Avenue.

2. Impacts and Mitigation - Operations phase

171. The completed Project should result in a range of significant positive socio-economic impacts. It will provide a high-quality, rapid and frequent transport option for existing and future passengers from the University and Jikia Street area to Tbilisi center. In comparison to current public transport options, the proposed Project will greatly improve the commuting experience by providing significant reductions in journey time and congestion.

172. The metro extension will also increase access to employment across Saburtalo area by linking the district with some of the key employment destinations in Tbilsi (like Central Railway Station, Dynamo and Eliava market area at station "Tsereteli", Tbilisi Technical University, Tbilisi Medical University, etc.), and integrating this route as part of the wider Tbilisi metro network.

173. The Project will also assist with increasing overall accessibility to a range of social and community facilities along the line, and (via the wider metro network) across Tbilisi. Examples include town centre facilities, such as railway station, post offices, local shops, professional services, medical facilities, education facilities and key retail and commercial areas.

174. In the long-term, the Project will permit the optimization of future planning and development (and thus future land-use) along the extension and the University station, taking advantage of the benefits provided by the completion of metro line in Saburtalo. In the long-term, the operation of the proposed metro extension should result in some localized improvements across the traffic network (such as relieve congestions at Delisi area, including Kazbegi Ave and Tamarashvili St junction, better access to transport from Nutsubidze #1 Microdistrict and Jikia St.).

175. As the majority of the socio-economic impacts described above are positive, there are no specific mitigation measures required.

K. Utilities/infrastructure

176. There is not a significant amount of earthworks required by the Project, because the main tunneling, cut and cover, and mining works were completed some years ago, and this included relocation of utility infrastructure (water supply, wastewater/sewer, storm water systems, power and communication cables, natural gas). There is however still some tunneling works remaining for the blind alleys, passages, etc. and although no significant impact on utility infrastructure is expected, all utilities along the remaining excavation and tunneling alignments should be assessed during the preconstruction survey undertaken by the Contractor. Consultation should take place with all relevant utility companies and authorities to ensure that all services that are needed to provide continuity of supply are known, and that appropriate action is taken to re-route these facilities if necessary.

177. Tbilisi Municipality should recognize the importance of ensuring that disruption to any utility service should be minimized and, where necessary, alternative measures must be taken to ensure continuity of the service whilst diverted. A schedule of proposed utility diversions (if any) should be prepared, which identifies infrastructure requiring diversion and includes information on the type and size of each utility infrastructure. This schedule (or method statement) should also identify the necessary mitigation measures required by the utility company and the contractor to facilitate the implementation of works (pollution prevention, waste management, noise reduction, etc.).

178. All such measures will be taken in the construction period, so no mitigation measures are required with respect to the operational phase of the Project.

L. Traffic

179. Implementation of the Project will improve and transform public transport availability in the Project area, which should have benefits for all forms of traffic movement. The introduction of quality public transport links will increase public transport use and reduce the use of minibus-taxis and car dependency.

180. There will be a minor reduction in traffic capacity during the construction phase which will have an insignificant impact on road transportation modes. Rapid transportation analysis has been undertaken to assess the likely impact during the construction and operational phases of the proposed Project.

1. Impacts and Mitigation - Construction phase

181. It is generally accepted that there will be some negative traffic impact during the construction phase in certain places. The main impact is likely to arise when/if there is a requirement to temporarily occupy road space for construction works, resulting in partial short term closure of Vaja Pshavela Avenue. Local traffic will also be disrupted by more routine construction traffic, in particular trucks visiting the sites to deliver materials or remove waste.

182. Mitigation measures will be required to reduce the impact on traffic during the construction phase. A traffic management plan should be developed in consultation with local authorities, public transport operators and other relevant stakeholders (in cooperation with Contractor, Tbilisi Municipality, Traffic Police, etc.). This should include details of any required diversions and should plan all such routes carefully to avoid sensitive areas and maximize safety and convenience for the motorist. The plan should also consider whether, during the construction period, there may be a reduction in average traffic speeds throughout Vaja Pshavela Avenue.

183. In locations where construction is at street level, there may be an additional minor impact on the pedestrian environment, especially where new metro entrances are located. Temporary footpaths and/or pedestrian crossings should be provided at certain locations to mitigate these impacts.

2. Impacts and Mitigation - Operations phase

184. The most notable negative impact on transport during the operational period might arise from increased levels of pedestrian activity at and near the new metro station. The metro extension will carry a significant volume of passengers, most of whom will walk to and from the station. To mitigate for the increases in pedestrian activity, additional pedestrian infrastructure should be provided around the station entrances as part of the project design (maybe new signalized pedestrian crossings or footpaths should be introduced).

185. The major impacts of the operating scheme on transport will be highly beneficial. When operational, the new metro station will allow people within its walking and bus interchange distance to use a quality public transport service. As a result it is expected that there will be significant reductions in vehicular traffic on the surrounding road network as people transfer from car to public transport.

M. Cultural Heritage and Archaeology

186. The baseline assessment included a desktop study of the history and archaeology of the Saburtalo area. No sites of archaeological, architectural or cultural significance have been identified in the Project area, apart of Vaja Pshavela Monument.

1. Impacts and Mitigation - Construction phase

187. The principal risk of construction impacts on archeology and cultural heritage is from ground disturbance during the remaining excavation. According to the outcome of the baseline study, certain archeological sites, particularly tombs of the Late Bronze and Antique Ages, are located in the Project area (tomb No.9 and tomb No.10 of Namgala Mitsa – see Chapter IV). It is possible therefore that some other tombs may be located in the area that will be affected by the construction (tunneling) of station University blind alleys.

188. In view of this risk, a Chance Finds Procedure should be developed by the Contractors as a part of Cultural Heritage Management Plan, to ensure that any important archaeological material is properly recognized, recorded and preserved if necessary. Should any archeological deposits be found, a full measured, drawn and photographic survey should take place prior to any further works. Additional mitigation measures should be agreed with the Department of Historical Monuments under the Ministry of Culture of Georgia.

189. If, as a result of the work method statement developed by the Contractor, there is a possible impact on Vaja Pshavela Monument, this impact should be avoided and the method statement revised. In the unlikely event that impact is genuinely unavoidable, further mitigation measures should be agreed with the Department of Historical Monuments under the Ministry of Culture of Georgia.

2. Impacts and Mitigation - Operations phase

190. Impacts on cultural heritage during the operations phase of the Project should be of Low significance. This will principally be a moderate visual impact that the new above ground structure of the station entrance will have on the existing environment, including landscape and architecture. Such visual impacts should be mitigated through careful architectural and landscaping design that is appropriate to the visual context of the area at present. Almost no potential vibration impact is expected on Vaja Pshavela Monument from the running of the

metro trains, due to reliable foundation structure and as it is located around 50m from the tunnel.

N. Cumulative Impacts

191. Cumulative impacts occur when the addition of single impacts from a number of individual events results in a compounding effect. Although each impact may not be significant alone, cumulatively, these impacts may be significant if they occur close together in terms of location and time, resulting in incremental, widespread, often slow change of environmental conditions.

192. The cumulative impact of the groundwater lowering in combination with the operational vibrations may affect engineering characteristics (in particular bearing capacity) of foundation soils close to the Project area. It is recommended to undertake a new geology/hydrogeology survey of the changes in local aquifer and groundwater lowering (if any) in order to evaluate the risk of negative impact on the engineering characteristics of the foundation soils (under the neighboring buildings), especially considering its cumulative effect in combination with the vibration impact from metro operations. Specific mitigation, such as strengthening any particularly vulnerable buildings, could then be developed, if found to be necessary.

193. The combination of construction effects such as dust, noise, visual impact (although the two construction compounds have been surrounded by fences for more than two decades), is likely to heighten any overall sense of disruption felt by those living and working close to the Project area. This would be exacerbated by other commercial or residential development together with infrastructure or utility developments in the vicinity. During the construction phase of the Project, other development projects may take place within the study area. There are already two suspended constructions of residential buildings that might be resumed within the Project period. The “Tbilisi Water” utility company also has active rehabilitation projects in Saburtalo area. The Contractor should coordinate activities with development projects neighboring the Project area by agreeing plans/schedules for major construction processes.

194. Given the urban location of the proposed Project, cumulative impacts arising due to other major construction projects are inevitable. Impacts of this nature should be assessed where possible and must be considered by the planning authority in exercising their development control function for future developments in the local area.

195. The cumulative environmental impacts of the proposed Project can be mitigated by set of measures comprising the following:

(i) Good pre-construction surveys (including geo-technical) to devise specific mitigation where possible/appropriate;
(ii) Careful planning of construction works and coordination with other projects and construction activities in the area;
(iii) Adequate provision of environmental mitigation via clauses in work contracts;
(iv) Proper development and implementation of site-specific detailed environmental management plans (based on this IEE and EMP – see below); and
(v) Efficient contract management.

196. A common problem encountered during implementation of environmental management plans of such projects is lack of environmental awareness among engineers and managers concerned with day to day construction activities, which can be solved through regular internal environmental training, proper supervision and monitoring.

197. The issue of air quality and noise inside the tunnel, where vehicles and machines will be working in a confined space, may also present a combination of construction effects causing negative cumulative impact on the health and safety of workers (occupational H&S). Exhaust gases, noise and dust could be a danger to the health of workers. This should be mitigated by proper obligatory use of PPE (Personal Protecting Equipment) and arrangement of proper

ventilation. It is important to ensure that ventilation shafts are equipped with filters so that they do not become point sources for the liberation of air pollution at the surface

VI. ANALYSIS OF ALTERNATIVES

198. The ADB Safeguards require that an Initial Environmental Examination (IEE) contains an outline of the main alternatives studied by the beneficiary and an indication of the main reasons for its chosen option, taking into account the environmental effects. Usually this section examines alternatives to the proposed project site, technology, design, and operation—including the no project alternative—in terms of their potential environmental impacts.

199. From the beginning of this Project there was no alternative to the extension scheme and alignment, as any alternatives would have been considered and dismissed long ago in 1980-ies, when the Tbilisi Metro extension scheme has been planned, designed and started. Today the tunnels from the Vaja Pshavela Station to University Station are actually built.

200. There are some alternatives for the design and function of the University station building only. The alternative needs to be chosen by Tbilisi Municipality and Metro Company. The base alternative will only require the construction of a ticket hall at the top of the station. The two other alternatives will add specific construction which has to be defined. So there is not sufficient information to undertake environmental analysis of alternatives for the creation of the University Station building. The present IEE therefore covers the base alternative considered by the current basic design of University station.

201. At the feasibility stage in the process of preparation of this IEE, the only one alternative could be considered for the Project. It is the “no project” alternative: to leave the uncompleted metro construction as it is, with the risk of groundwater lowering, disturbance to the Saburtalo residential area, impact from exposed soils at the existing construction sites, lost investments and incremental costs of conservation.

202. Usually, following the methodology for the evaluation, the main alternatives considered for the metro schemes are evaluated using a multi-criteria analysis. The criteria and objectives with respect to the proposed Project are:

(i) Compliance with transport and landuse (Tbilisi Masterplan) strategy;
(ii) Minimizing environmental impacts (geology and groundwater, congestion and associated pollution, disturbance to landscape and community, other);
(iii) Generating social and economic benefits;
(iv) Delivering good quality transport integration;
(v) Optimizing capital and operating costs;
(vi) Delivering a safe and operationally efficient system;
(vii) Achieving efficiency and minimizing risk during construction.

203. For the above criteria, even not presenting it in the comparison table, is clear that all answers for the “With Project” alternative will be positive (“yes”) and the answers for the “Without Project” alternative will be negative (“no”). Two most important criteria for this particular analysis are “minimizing environmental impacts” and “optimizing capital and operational costs”, where the Project reduces impact on environment (including geology and groundwater) and optimizes (actually rescues) the initial capital investments.

204. The major positive impact of the “with project” alternative will be completion of a major construction project that has been suspended for many years, and as a result there should be: less disturbance to the Saburtalo landscape and district community; less risk of groundwater lowering; less air pollution and dust; less congestion due to reduction in usage of vehicles; increased accessibility to affordable and comfortable transport; and improved traffic safety at Vaja Pshavela Avenue.

VII. INFORMATION DISCLOSURE, CONSULTATION AND PARTICIPATION

205. During preparation of the IEE main stakeholders have been identified and consulted, and any others that are identified during Project implementation will be brought into the process in the future. Primary stakeholders are:

(i) People who live and work in the vicinity of the construction site;
(ii) Municipal and metro authorities;

Secondary stakeholders are:

(i) MDF (Municipal Development Fund) as the Executing Agency;
(ii) Other government institutions whose responsibility includes areas or issues affected by the project (Ministry of Environment, municipal and district planning authorities, Ministry of Regional Development and Infrastructure, Department of Protection of Historical Monuments under Ministry of Culture, municipal utility authorities, etc);
(iii) Beneficiary community, NGOs and other representatives of affected communities; and
(iv) The ADB.

206. Consultations with most of stakeholders were held during monthly project meetings. Discussions were also held on site with people and communities who could be affected by the subprojects, so that views could be expressed in a less formal setting. These were also considered in preparing the IEE.

207. Public consultation meeting is planned to take place in MDF office in April 2010. Following the information disclosure procedure, the electronic version of the draft IEE will be placed on the MDF web-site on …….2010. Hard copy of the IEE and Executive Summary will be available for review in MDF office.

208. Announcement will be made in central newspapers and CENN (Caucasus Environmental NGOs Network) mailing network about the planned public consultation meeting. The note will contain information explaining where the disclosed reports could be observed, time and place of the planned consultation meeting, contact persons for submission of comments. Contact person for grievance and comment collection is Environmental and Social Specialist of MDF Medgar Tchelidze, E-mail : mchelidze@mdf.org.ge , phone: 8.99.162221.

209. Representatives of primary and secondary stakeholders will be invited. Attendees will be informed about the aim of the Metro Extension Project and the benefits it would bring, together with Project likely impacts and the ways in which they would be mitigated. Participants will be invited to discuss their views and concerns. A summary of the meeting will be added to the report as an Appendix. This will record a)meeting date, time and location, b) list of attendees and their affiliations, c) copy of the presentation, d) table showing each comment made, the speaker, the response given and the manner in which the comment was addressed in the design and/or this IEE.

210. Public information campaigns (via newspaper, TV and radio) will be organized to explain the project to the wider city population and prepare them for disruption they may experience once the construction is underway.

VIII. GRIEVANCE REDRESS MECHANISM

211. All efforts will be made to avoid dissatisfaction by stakeholders (in particular persons affected directly by the project) by sensitive planning of design and construction works, effective consultation and disclosure as described above, and by responding promptly and appropriately to stakeholder concerns. Stakeholders may still wish to raise concerns and complaints about the project's environmental performance, so MDF has established a grievance redress procedure (GRP) to enable them to do so.

212. MDF has overall responsibility for project implementation and environmental compliance. The administrative bodies responsible for environmental protection are MoE and Tbilisi City Hall. The affected population and stakeholders may send their grievances, related to the project-induced environmental impacts and nuisance to the Project Implementation Unit (PIU) or directly to the administrative bodies responsible for environmental protection.

213. MoE and City Hall are obliged to respond to the grievances that have been received from population or other interested parties in accordance with the requirements of the Administrative Code of Georgia. The PIU will facilitate the response by implementing a project-specific GRP. During the public consultation process, the PIU will inform stakeholders and the public that the PIU is responsible for environmental compliance and grievance redress. The PIU will provide at the public consultation meetings and disclose on the MDF web-site the contact details of the persons responsible for grievance collection and response. Upon receiving a grievance (in written or oral communication) the PIU will execute following actions:

(i) Send its representatives to check the claims and monitor the situation;
(ii) Involve MoE and City Hall when and where appropriate;
(iii) Receive experts' conclusion (from MDF personnel, independent experts and/ or MoE/City Hall experts);
(iv) Submit to the constructing company and operator an instruction regarding corrective measures;
(v) During 10 days after receiving the grievance, inform the affected person or persons about the expert's decision and applied corrective measures;
(vi) If the complainant is dissatisfied with the decision, they may present further information in support of their case. After considering the appeal and the supporting new information, the subsequent decision of the PIU/MoE and participating municipality is considered final.

214. At the conclusion of this process, if the affected stakeholder or person is not satisfied by the response of PIU or administrative bodies, the grievance may then be directed to the court.

IX. ENVIRONMENTAL MANAGEMENT PLAN

215. The IEE assessed the potential environmental impacts on physical, ecological, socio-economic and cultural resources that could be anticipated from implementation of the Project and grouped these impacts into pre-construction, construction and operation phases. The anticipated impacts and proposed mitigation measures of all these three phases of the Project are explained in Chapter 5 and are summarized in Table 6.1.

A. Environmental Management

216. Based on the environmental impacts and respective mitigation measures proposed in Chapter V, an Environmental Management Plan (EMP) for the Project has been prepared. The EMP will help the Tbilisi Municipality (or the Municipal Development Fund, as project implementation agency) to address the foreseen adverse environmental impacts of the Project, enhance the Project's overall benefits and introduce standards of good environmental practice. The EMP will be included in the contract documents to ensure the contractors comply with the EMP. The EMP defines the:

(i) Responsibilities of the Municipality, Contractor and Supervision Consultant, in accordance with the three Project phases (pre-construction, construction and operation);
(ii) Framework of the mitigation measures by providing the technical details of each Project impact and proposing implementation arrangements;

(iii) Monitoring mechanism, with monitoring parameters ensuring that all proposed mitigation measures are completely and effectively implemented and that they protect the environment as intended.

217. The environmental impacts and respective mitigation measures are presented in Table 6.1. To increase contractors' environmental awareness and ensure that they consider carefully and plan the implementation of each mitigation measure that is their responsibility, contractors will be required to prepare their own construction-phase EMP describing in detail the action they will take to provide each measure. This may use the EMP below as a template, but should describe implementation of each measure (and monitoring) in more detail. The contractor's EMP should be further supported by site-specific method statements and management plans that have to be prepared and submitted by the Contractor to the Municipality and its Construction Supervisor for approval, prior to initiation of any construction works. These documents should comprise (but not be limited to) the following:

(i) Pre-construction (pre-condition) Survey Plan;
(ii) Health and Safety Management Plan;
(iii) Community Liaison and Community Safety Plan;
(iv) Utilities Infrastructure Management Plan;
(v) Traffic Management Plan;
(vi) Pollution Prevention and Abatement Plan;
(vii) Waste Management Plan;
(viii) Emergency Response Plan;
(ix) Cultural Heritage Management Plan (with Chance Finds Procedure);
(x) Reinstatement Management Plan;
(xi) Method statements per each category of work (tailored to site-specific conditions and containing environmental component with mitigation measures);
(xii) Other, as required.

218. Environmental monitoring is a very important component of environmental management to safeguard the protection of environment at both construction and operation stages of the Project. In response to environmental impacts identified during this IEE study, an Environmental Monitoring Program has been developed as an integrated part of Environmental Management Plan and is also presented in Table 6.1.

219. The contract documents should contain a listing of all required mitigation measures and a time frame for the compliance monitoring of these activities. The EMP of the IEE should be included in tender and contract documents so that the contractor is fully aware at bidding stage of what is expected of him in terms of environmental stewardship and can build the necessary costs into his tender pricing. The monitoring will comprise surveillance to check whether the contractor is meeting the provisions of the contract during construction and the executing agency during the operation of the Project. Municipality or ADB may also require the agency to undertake the impact monitoring.

220. Once the project is operating, responsibility for environmental management will pass to Tbilisi Metro Company as the operator of the scheme and they should produce their own operational-phase EMP describing how they will provide the mitigation allocated to them in Table 6.1. Alternatively they may engage a consultant to prepare the operational phase EMP. Although major negative impacts are not expected during operation of the scheme, it would be beneficial for a small proportion of the project budget to be allocated to institutional strengthening, to allow Tbilisi Metro Company to employ an environmental specialist to set up and implement their mitigation measures and other environmental procedures in the operational phase, and to provide the environmental specialist with training and support.

B. Environmental Monitoring

221. Environmental monitoring is conducted throughout all phases of project development and implementation, with the aim of:

(i) Ensuring that action necessary to provide the required mitigation is taken;

(ii) Ensuring that the mitigation protects the environment as intended; and

(iii) Determining the actual environmental and social impacts that occur once mitigation has been applied, to establish whether there are any residual or unexpected impacts that require further action.

222. Two last columns of Table 6.1 show the proposed Environmental Monitoring Program for Project implementation. This indicates the type/method/frequency of monitoring that should be conducted to ensure that the mitigation is provided. The table also indicates who should be responsible for the monitoring. Construction monitoring normally involves three main elements:

(i) Monitoring the work of the construction contractors (CC) to ensure that they provide the mitigation measures required by their contracts and do not cause additional environmental damage in conducting construction activities;

(ii) Liaising with other parties involved in the construction process (including the Design Consultant and Client) to ensure that they also fulfill their environmental and social responsibilities and provide the mitigation that is their responsibility;

(iii) Conducting additional monitoring activities to ensure that all parties (client, consultants and contractors) comply with any additional requirements imposed by the Environmental Permit or other documents and licenses issued by the national environmental regulator (MoE in this case).

223. Most of the monitoring conducted by the Supervision Consultant (SC) will involve periodically checking the activities conducted by the contractor, during regular site inspections, which the SC will conduct on a daily, weekly and monthly basis. These checks will be mainly visual, but some will require review of documents, records, reports and drawings, as specified in Table 6.1. Any deficiencies will be reported to SC management, who, where necessary, will instruct the Contractor to take remedial action. Regular written accounts will be given to the Client/Borrower (Tbilisi Municipality) as part of the normal procedure through which the SC reports on progress of the construction process.

224. The Environmental Monitoring Program also places responsibility for conducting specific elements of environmental monitoring on the Contractor, to raise their awareness of the impacts of their activities through implementing internal Environmental Supervision as part of their own internal Environmental Management System. The SC will ensure that the internal Environmental Supervision is carried out by the contractor, and will review the results.

225. When the Project reaches the operational stage and the Client/Borrower or another agency (Tbilisi Metro Company in this case) takes over responsibility for its functioning, it is important that the agency will manage and/or implement the activities necessary to maintain the scheme in working order and will monitor those activities to the extent necessary. To assist Tbilisi Metro Company in fulfilling their environmental responsibilities, institutional strengthening should be provided as recommended above.

Table 9.1: Environmental Impacts, Mitigation and Monitoring

Potential Negative Impact	Sign*	Dur**	Mitigation Activity and Method	Resp.***	Location	Monitoring Method	Resp***
PRE-CONSTRUCTION PHASE – DETAILED DESIGN							
Groundwater flow alterations and the groundwater lowering as a result of long-term drainage and removal of water from the tunnel may adversely affect the **geo-technical characteristics** of the geological formations, weakening and possibly damaging building foundations and structure.	H	T	- Geotechnical survey of changes in local aquifer and groundwater table to a) evaluate risk of negative impact on the geotechnical characteristics and b) design mitigation measures. - A structural survey of affected buildings may also be needed. - The design for tunnel should comprise maximally watertight structure, to minimize groundwater inflow.	TM	Tunnel and surrounding areas	Review survey TOR. Conduct observations during survey. Review reports: confirm findings are included.	SC TM
Migration of **contaminants** from surface and from tunnel towards the underlying groundwater sources due to leaks and spills of fuel, oil and other potentially toxic materials.	M	P	- All underground drainage system should include appropriate containment & evacuation/treatment measures (such as separator or interceptor prior to discharging into storm-water drain), to minimize the potential for contamination from underground tunnel section.	DC	Tunnel	Review design reports and drawings	SC
Negative effects due to vibration and ground-borne noise	S	P	- Modern railways incorporate specific track forms and continuously welded rails, which allows to avoid significant effects due to vibration and groundborne noise, provided that an adequate maintenance regime is followed. These track forms should be designed and considered, if technically possible.	DC	Rail Line	Review design reports and drawings.	SC

***Sign – Potential Significance (H – Highly Significant; S – Significant; M – Moderate; NS – Not Significant)**
****Dur – Duration (T – Temporary; P – Permanent)**
*****Resp – Responsible Entity**
Metro – Tbilisi Metropolitan Company TM - Tbilisi Municipality
DC – Design Consultant SC – Supervision Consultant CC – Construction Contractor

CONSTRUCTION PHASE							
Groundwater flow alterations and the groundwater lowering may adversely affect the **soils and geology** resulting in damage to buildings foundations and structure.	H	T	- Implement measures recommended as an outcome of the geotechnical survey in order to a) minimize negative impact on the foundation soils, and b) reinforce potentially affected buildings, if any.	CC	Tunnel, Project area	Review geotechnical survey reports: confirm findings included. Review mitigation measures design. Observe implementation.	SC TM
Negative impact on underlying **groundwater quality** due to poor control/treatment of concrete wash waters, leakage of fuel from construction vehicles, oil spillages during refueling or vehicle maintenance operations, leakage from chemical storage areas and inappropriate disposal of chemicals (paints, oils, glues etc.)	M	T	Submit site specific Pollution Prevention and Abatement Plan and Waste Management Plan to be agreed with TM and SC. The Plans should contain (but not limited to) the following mitigation measures and procedures: - collection and treatment of surface water runoff and groundwater generated during construction (silt/sediment traps and oil interceptors prior to the release to surface water drains) - Emergency Response Plan for pollution incidents should be established by the contractor and regularly updated (containment measures, clean-up materials and equipment, staff responsibilities, trained personnel and contact details for emergency teams, local authorities and emergency services. - drainage from the oil and fuel storages bunded area(s) is to be diverted for collection and safe disposal off site by an appropriately licensed contractor, all storage tanks should have secondary containment.	CC	Construction sites in tunnel and the station. Construction compounds	Review Pollution Prevention and Abatement Plan, Emergency Response Plan, Waste Management Plan submitted by Contractor. Conduct observations of drainage system on site. Observe site drainage during rainfall. Conduct observations of vehicle maintenance/repair and refueling on site Observe waste and hazardous waste collection, transportation and disposal. Check oil and fuel storage bunded areas, integrity and level gauges of the fuel tanks. Observe concrete mixing operations and pumping/concreting operations	SC

			- use drip trays beneath the fill point during refueling operations; use spill-kits and drip trays to contain any spillages, which may occur. - concrete mixing operations only at a designated area at the construction compound, not located next to a surface water drain. The washing of concrete mixing vehicles only at hardstanding bunded designated area; an emergency response plan should be implemented in the event of concrete spillages during pumping/concreting operations. - all hazardous waste, such as oil, solvent, absorbents, glue and solvent based paint containers should be stored within appropriately covered skips prior to removal by municipal authority or a suitable licensed waste management contractor for treatment /recycling/ /disposal. Any other construction waste should be disposed of to on-site skips for removal by an approved waste management contractor.				
Noise impacts due to the use of powered mechanical equipment, if noise sensitive receivers (mostly residential blocks) close to the Project area.	S	T	To control noise impacts the following mitigation actions are recommended: - No or limited night-time working; - Use of up-to-date equipment that meets national standards or 'best accepted practice' in terms of sound power output; - Use of silencers, mufflers and acoustic shields on plant and	CC	Construction sites in tunnel and the station. Construction compounds. Access roads	Conduct observations and measurements on site. Check Contractor's schedule and records of vehicle and equipment servicing and repair.	SC

			equipment; - Erection of noise barriers at the University station open site; - Adequate regular maintenance of machinery to ensure that sound power output is minimized; - Reduction in number of machines used at any one time;				
Negative impact of **vibration** at the construction phase (from tunnel drilling or torcreting, or from concrete vibrators, rollers, etc.)	M	T	To control vibration impacts the following mitigation actions are recommended: - If/when blasting - apply limitation on explosive charge weight, with the consideration of geology. Any blasting would be planned and performed by fully qualified, experienced and licensed operatives; - For tunneling works – provide optimization of boring machine or drills characteristics including face pressure and adequate selection of cutters and teeth; - No or limited night-time working; - Use of up-to-date equipment that meets national standards or 'best accepted practice' in terms of sound power output; - Reduction in number of machines used at any one time;	CC	Tunnels, Blind Alleys, Shafts All other Project sites	Conduct observations and measurements on site. Check Contractor's schedule and records of vehicle and equipment servicing and repair. Check licenses of blasting sub-contractors. Check drilling/boring characteristics	SC
Air quality degradation by exhaust emissions from the construction machinery, remaining mining operations; exhaust emissions and dust from concrete plants and pumps; dust generated by vehicles, construction activity and grinding	M	T	The site-specific Pollution Prevention and Abatement Plan submitted by Contractor should contain the following mitigation actions to reduce air pollution: - Maintain Construction equipment to	CC	All construction sites and Project area	Review the emission reduction and air pollution prevention measures in Contractor's Pollution Prevention and Abatement Management Plan. Conduct observations and measurements on site.	SC

works, etc.			a good standard; idling of engines should be discouraged. Machinery causing excessive pollution (e.g., visible smoke) should be banned from construction sites. - The contractor submits a dust suppression program prior to construction. The plan should detail actions to minimize dust generation (e.g., properly stored materials, spraying of sites with water, cover the trucks transporting the materials, etc.), and should identify equipment to be used. - Construction materials should be stored away from the residential areas and will be properly covered. - The concrete production plants shall be located more than 300m away from the residential buildings.			Check Contractor's schedule and records of vehicle and equipment servicing and repair. Observe implementation of dust suppression program. Observe concrete mixing operations.	
The **colony of bats** (Greater horseshoe bat - *Rhinolophus ferrumequinum)* in the existing tunnel may be directly affected by construction works	S	T	Timing is critical for excluding bats from the tunnel. It is strongly recommended to do it a) before wintering period (November-March); b) prior to start of construction works; c) hiring bats exclusion specialists who will follow rules and procedures to ensure safe transfer of the bats colony to the relevant habitat.	CC, Sub-contractd Experts	Tunnel from University side	Review TOR for bats survey and exclusion plan. Conduct observations during survey. Review reports. Conduct observations during bats exclusion and/or transfer procedures.	SC TM MoE
Impact on **land use** due to land-take for construction compounds and metro entrances.	NS	T	The Contractor should submit to Supervision Consultant and Tbilisi Municipality the layout plan of construction compounds with a list of all proposed temporary structures and activities for approval. The construction of any new compounds for the completion works	CC	Construction compounds, station University entrances	Review Contractor's plans. Conduct observations during new installation or extension process – to ensure compliance with permit and cadastre plans	SC TM

			or any extension of existing compounds should be performed in a manner that: - minimizes the area of any new land-take temporarily required; - minimizes duration of land-take; - provides measures to reinstate the lands to their original use, when construction is over.				
The construction phase will result in some positive **socio-economic** impact due to certain employment creation; also certain portion of construction workers' wages may be spent in the district economy of Saburtalo	Posi-tive, NS	T	Contractors should be required to employ at least 50% of their workforce from people living in the vicinity of Vaja Pshavela Avenue. Provide incentives and stimulate purchase of products from local businesses.	CC TM	Project area	Review Contractor's recruitment plans. Check commitment to employment of locals during the construction period	SC TM
Impact on **utilities infrastructure** by constructing/tunneling of blind alleys behind University station, completion of the station, completion of technological shafts.	M	T	- All utilities that may be affected by new tunnel sections/alleys or the construction of station entrances or shafts should be protected or lowered, relocated or diverted as necessary and spare capacity may be provided for future maintenance or expansion. - A schedule of proposed utility diversions (if any) should be prepared, which identifies infrastructure requiring diversion and includes information on the type and size of each utility, as well as necessary mitigation measures. - All works should be carried out in ongoing consultation with the relevant statutory undertakers and local authority representatives and should be in compliance with their requirements (including health and safety) and relevant codes of	CC	Station University, blind alleys, technological shafts	Review design reports and drawings. Conduct site observations to confirm if/where impact on infrastructure.	SC TM

			practice. Agreement should be reached prior to any works taking place and relevant design documentations prepared.				
Reduction in **traffic** capacity during the construction phase, impact on road transportation modes. Where construction is at street level, there may be **impact on the pedestrian** environment, especially where new metro entrances are located.	M	T	- The plan for any traffic diversions or detours (if necessary) should be developed jointly with the local authorities, public transport operators and other relevant stakeholders (in cooperation with Contractor, Tbilisi Municipality, Traffic Police, etc.). - The construction vehicle management should be in correspondence with contractor's construction program to reduce the impact of construction traffic on the road network. - Temporary footpaths and/or pedestrian crossings should be provided at metro entrances and certain locations to mitigate impacts on pedestrians.	CC TM	Construction compounds at Vaja Pshavela and Station University. Station entrances	Review Contractor's Construction Vehicle Management plan. Check that procedure includes all elements listed in the Plan Observe traffic management at several locations within and adjacent to Project area.	SC TM
Impact on **cultural heritage** includes potential risk of construction impacts on tombs of the Late Bronze and Antique Ages; and impact on Vaja Pshavela Monument.	NS	T	The Chance Finding Procedure should be developed by the Contractor in case if any archeological deposits are discovered during the remaining excavation or tunneling works. If such is found, a full measured, drawn and photographic survey should take place prior to any further works. Additional mitigation should be agreed with the Department of Historical Monuments under the Ministry of Culture of Georgia	CC	Blind alleys, Vaja Pshavela monument	Review Contractor's Chance Finding Procedure. Observe sites and review reports to ensure findings recorded as specified and identified sites (if any) protected.	

Cumulative impact resulted from combination of Project construction effects with the impacts from other commercial/residential, infrastructure or utility development in the vicinity. Combination of air quality and noise impacts on occupational H&S inside the tunnel.	M	T	The cumulative environmental impacts at construction phase should be mitigated by Contractor through the following measures: - Good pre-construction surveys (including geo-technical) to devise specific mitigation where possible/appropriate; - Careful planning of construction works and coordination with other projects and construction activities in the area; - Adequate provision of environ-mental mitigation via clauses in work contracts; - Proper development and imple-mentation of site-specific detailed environmental management plans (based on this IEE and EMP); and - Efficient contract management. - Regular internal environmental training, proper supervision and monitoring. - For H&S inside tunnel Contractor should ensure proper obligatory use of PPE (Personal Protecting Equipment) and arrangement of proper ventilation.	CC SC TM	Project area	Participate in Contractor's pre-construction survey. Review Contractor's method statements and work plans. Review contract clauses related to environmental mitigation. Check compliance with EMPs Oversee internal trainings. Check use of PPE and the ventilation arrangements in the tunnel	SC TM
OPERATIONS PHASE							
Impact on the **groundwater**	M	P	Treatment, the use of hydrocarbon	Metro	Tunnels,	Review O&M plans. Conduct	TM

environment and geology due to bad maintenance of the drainage system, or bad maintenance of water treatment interceptors, resulting in migration of surface **contaminants** towards the underlying groundwater sources			interceptors and grit chambers, the inspection of bunded waste storage areas and substations, in addition to the control of wastewater discharge. The good maintenance, waste management and housekeeping practices should be implemented in order to prevent pollution and ensure protection of the surrounding groundwater sources.		shafts and station	observations and inspections as required. (2 technicians, once a week or after the rainfalls). Review Pollution Prevention and Waste Management Plan, developed for O&M phase. Check procedures. Examine personnel and review training program. Check inspection procedures by personnel. Observe drainage system and compliance with Plan on site.	
Increased levels of **pedestrian** activity at and near the metro "University" station	M	P	To mitigate for the increases in pedestrian activity, additional pedestrian infrastructure should be provided around the metro "University" entrances. New signalized pedestrian crossings should be introduced and footpaths should be upgraded.	TM Traffic Police	University Station entrances	Review design, ensure that design agreed and complies with safety requirements.	TM
The **cumulative impact** of the groundwater lowering in combination with the operational vibrations may affect foundation soils close to the Project area.	S	P	Permanent monitoring of the changes in local aquifer and groundwater lowering (if any). Permanent monitoring of the engineering characteristics of the foundation soils (under the neighboring buildings), especially considering vibration impact from metro operations.	Metro	Project area	Review monitoring reports in consultation with geology, seismology and building structure expert	TM

X. CONCLUSIONS AND RECOMMENDATIONS

A. Conclusions

226. This IEE demonstrates that there will be both negative and positive impacts due to the construction completion and normal operations of the Tbilisi metro extension to the station "University". Recommendations are made to mitigate expected negative environmental impacts with adequate funds provided to cover environmental mitigation and monitoring cost.

227. The major positive impact of the Project will be completion of a major construction project that has been suspended for many years, and as a result there should be: less disturbance to the Saburtalo landscape and district community; less risk of groundwater lowering; less air pollution and dust; less congestion due to reduction in usage of vehicles; increased accessibility to affordable and comfortable transport; and improved traffic safety at Vaja Pshavela Avenue. The Project will deliver good quality transport integration and generate social and economic benefits, such as potential growth in the economy of the district, increased income and employment opportunities, and improved living conditions.

228. There will be some negative impacts in the construction phase, including: increased air emission, noise and vibration produced by construction machinery and equipment; potential pollution, including groundwater pollution; disturbance of a colony of bats; and more small-scale impacts on infrastructure, land-use, traffic and pedestrians. A certain level of impact from vibration and ground-borne noise is expected at the operations phase. The cumulative impact of the groundwater lowering and operational vibrations may affect engineering characteristics (in particular bearing capacity) of foundation soils close to Project area, and a survey to assess the significance of this issue and plan remediation if necessary is recommended in the detailed design stage.

229. An environmental management and monitoring program is provided for preconstruction, construction and operation stages of the Project. Implementation of the recommended set of environmental management plans and mitigation measures during the various phases should minimize the negative impacts of the Project to acceptable levels, providing all action is provided as set out in this report. To ensure that these plans and mitigation measures are implemented and negative impacts avoided, the EMP will be included in the contract documents of the Project.

B. Recommendations

230. 1. The most important and practical recommendation for providing an appropriate degree of environmental protection during the Project implementation process is to follow the environmental mitigation and monitoring measures proposed by this IEE.

231. 2. It is also recommended to undertake a new geology/hydrogeology survey of the changes in local aquifer and groundwater lowering (if any) in order to evaluate the risk of negative impact on the engineering characteristics of the foundation soils (under the neighboring buildings), especially considering its cumulative effect in combination with the vibration impact from metro operations. Mitigation can then be designed if required.

232. 3. It is also recommended that environmental and social management training of Municipality and Metro officials is provided to enable them to carry out environmental and social monitoring and implementation of the Environmental Management Plan.

233. 4. It is recommended that the IEE and EMP are updated based on detailed engineering design and results of the geo-technical survey, so that any impacts that may have been overlooked due to an insufficiency of information when the IEE was prepared, can be recognized, assessed and mitigated.