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Report No: PAD1807

INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT

PROJECT PAPER

ON A

PROPOSED ADDITIONAL LOAN

IN THE AMOUNT OF US$230 MILLION

TO THE

MUNICIPALITY OF THE METROPOLITAN DISTRICT OF QUITO
WITH GUARANTEE OF THE REPUBLIC OF ECUADOR

FOR THE

QUITO METRO LINE ONE PROJECT

June 1, 2018

Transport & ICT Global Practice
Latin America and the Caribbean Region

The World Bank

CURRENCY EQUIVALENTS

(The U.S. dollar is the official currency of Ecuador, effective January 2000)

Currency Unit = U.S. Dollar
US$1 = US$1

FISCAL YEAR
January 1 – December 31

ABBREVIATIONS AND ACRONYMS

ACG	Anti-Corruption Guidelines
BIESS	*Banco del Instituto Ecuatoriano del Seguro Social* (Bank of the Ecuadorean Social Security Institute)
BNDES	*Banco Nacional do Desenvolvimento Econômico e Social* (Brazilian Economic and Social Development Bank)
BP	Bank Procedures
BRT	Bus Rapid Transit
CAF	*Corporación Andina de Fomento* (Andean Development Corporation)
CBA	Cost–Benefit Analysis
CHQ	*Centro Histórico de Quito* (Historical Center of Quito)
COOTAD	*Código Orgánico Territorial, Autonomía y Descentralización* (Organic Territorial Autonomy and Decentralization Code)
CQS	Consultant Qualifications Selection
EIA	Environmental Impact Assessment
EIB	European Investment Bank
EIRR	Economic Internal Rate of Return
EMGIRS	*Empresa Municipal de Gestión Integral de Residuos Sólidos* (Municipal Company for Integrated Management of Solid Waste)
EMP	Environmental Management Plan
EPMMQ	*Empresa Pública Metropolitana Metro de Quito* (Quito Metropolitan Public Metro Company)
ESHS	Environmental, Social and Health and Safety
ESM	Environmental and Social Management
F&C	Fraud & Corruption
FIDIC	*Fédération Internationale des Ingénieurs Conseils* (International Federation of Consulting Engineers)
FIEM	*Fondo para la Internacionalización de la Empresa* (Spanish Fund for Corporate Internationalization)
FM	Financial Management

GoE	Government of Ecuador
GHG	Greenhouse Gas
GIF	Global Infrastructure Facility
GMQ	*Gerenciadora Metro de Quito* (Quito Metro Management Company)
GRM	Grievance Redress Mechanism
IADB	Inter-American Development Bank
ICT	Information and Communication Technologies
IFR	Interim Financial Report
ISN	Interim Strategy Note
KPH	Kilometers per hour
LAC	Latin America and the Caribbean Region
LCS	Least Cost Selection
MDB	Multilateral Development Bank
MFD	Maximizing Finance for Development
MDMQ	*Municipio del Distrito Metropolitano de Quito* (Municipality of the Metropolitan District of Quito)
MPTA	Municipal Planning Transport Authority
NAIQ	*Nuevo Aeropuerto Internacional de Quito* (New Quito International Airport)
NPV	Net Present Value
O&M	Operation and Maintenance
OHS	Occupational Health and Safety
OP	Operational Policy
PAC	*Plan de Acción Correctiva* (Corrective Action Plan)
PDO	Project Development Objective
PGASSH	*Plan de Gestión Ambiental, Social, de Seguridad Industrial y Salud Ocupacional* (Integrated Environmental, Social, Industrial and Occupational Safety and Health Management Plan)
PLMQ	*Primera Linea Metro de Quito* (Quito Metro Line One Project)
PP	Project Paper
PPD	Passengers per Day
PPHPD	Passengers per hour per direction
PPSD	Project Procurement Strategy for Development
PQ	Prequalification
RAP	Resettlement Action Plan
SITP	*Sistema Integrado de Transporte de Pasajeros* (Integrated Mass Transit System)
RPF	Resettlement Policy Framework
TA	Technical Assistance
TBM	Tunnel Boring Machine
VAT	Value Added Tax

Vice President:	Jorge Familiar
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REPUBLIC OF ECUADOR
ADDITIONAL FINANCING FOR QUITO METRO LINE ONE PROJECT (P158756)

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ADDITIONAL FINANCING DATA SHEET

Ecuador

Additional Financing Quito Metro Line One Project (P158756)

LATIN AMERICA AND CARIBBEAN

GTI04

Basic Information – Parent			
Parent Project ID:	P144489	Original EA Category:	A - Full Assessment
Current Closing Date:	31-Dec-2018		

Basic Information – Additional Financing (AF)			
Project ID:	P158756	Additional Financing Type (from AUS):	Cost Overrun, Restructuring, Scale Up
Regional Vice President:	Jorge Familiar Calderon	Proposed EA Category:	A - Full Assessment
Country Director:	Alberto Rodriguez	Expected Effectiveness Date:	15-August-2018
Senior Global Practice Director:	Jose Luis Irigoyen	Expected Closing Date:	31-Dec-2020
Practice Manager/Manager:	Shomik Raj Mehndiratta	Report No:	PAD1807
Team Leader(s):	Bianca Bianchi Alves, Alejandro Hoyos Guerrero		

Borrower				
Organization Name	Contact	Title	Telephone	Email
Municipality of Quito	Miguel Davila	Administrador General, Municipio Metropolitano de Quito	5932571875	
Municipio del Distrito Metropolitano de Quito	Carla Arellano	Mobility Advisor to the Mayor of Quito	5913952-300	carla.arellano@quito.gob.ec

Project Financing Data - Parent (Quito Metro Line One-P144489) (in USD Million)

Key Dates

Project	Ln/Cr/TF	Status	Approval Date	Signing Date	Effectiveness Date	Original Closing Date	Revised Closing Date
P144489	IBRD-82850	Effective	25-Jul-2013	11-Nov-2013	25-Sep-2015	31-Dec-2018	31-Dec-2018

Disbursements

Project	Ln/Cr/TF	Status	Currency	Original	Revised	Cancelled	Disbursed	Undisbursed	% Disbursed
P144489	IBRD-82850	Effective	USD	205.00	205.00	0.00	200.15	4.85	97.63

Project Financing Data - Additional Financing Additional Financing Quito Metro Line One Project (P158756) (in USD Million)					
[X] Loan	[ ] Grant	[ ] IDA Grant			
[ ] Credit	[ ] Guarantee	[ ] Other			
Total Project Cost:	632.20		Total Bank Financing:	230.00	
Financing Gap:	0.00				

Financing Source – Additional Financing (AF)	Amount
International Bank for Reconstruction and Development	230.00
Development Bank of Latin America (CAF)	152.20
Inter-American Development Bank	250.00
Financing Gap	0.00
Total	632.20

Policy Waivers

Does the project depart from the CAS in content or in other significant respects?	No
Explanation	
Does the project require any policy waiver(s)?	Yes

Explanation

When the original loan of US$205 million for the project was approved in 2013, the Board approved a waiver of OP11.00 (today replaced by the Bank Policy, Procurement in Investment Project Financing [IPF] and Other Operational Procurement Matters) and the Procurement Guidelines for the use of the IADB Procurement Rules for the main civil works contract (Part 2), with a carve-out for eligibility, the Bank's anticorruption guidelines, and sanctions regime and misprocurement. The TA component (Part 5) remained under the Bank's Procurement/Consultants Guidelines.

The proposed Additional Financing would be used for two components, further funding for the main civil works contract (Part 2), as well as new consulting activities under the TA component (Part 5). A waiver was approved by Bank management on May 3, 2018 to extend this procurement arrangement under the proposed additional loan, so that the civil works contract under Part 2 of the Project would be exempt from the application of the Procurement Regulations. This waiver allows the Bank to maintain the same implementation arrangements set forth for under the initial loan (i.e. use of IADB's procurement rules for the civil works contract under Part 2 of the Project). The additional financing for the construction contract does not include or foresee any new procurement activities or new works (beyond ongoing contract management) and will thus continue to be regulated by the IADB's Procurement Rules.

Additionally, under this arrangement, the 2016 version of the Bank's Anti-Corruption Guidelines (ACG) will apply to both components. However, the civil works contract under Part 2 will remain for now unchanged (i.e. including references from the ACG's policy in force in 2013, when the contract was signed). If there is a need for any amendment to the civil works contract, at that time, references to the new ACG's will be introduced.

Has the waiver(s) been endorsed or approved by Bank Management?	Yes
Explanation	

Team Composition				
Bank Staff				
Name	**Role**	**Title**	**Specialization**	**Unit**
Bianca Bianchi Alves	Team Leader (ADM Responsible)	Senior Urban Transport Specialist	Senior Urban Transport Specialist	GTD04
Alejandro Hoyos Guerrero	Team Leader	Transport Specialist	Transport Specialist	GTD04
Alvaro Larrea	Procurement Specialist (ADM Responsible)	Lead Procurement Specialist	Lead Procurement Specialist	GGOPL
Fatima Arroyo Arroyo	Transport Specialist	Urban Transport Specialist	Urban Transport Specialist	GTD07
Ana Lucia Jimenez Nieto	Financial Management Specialist	Financial Management Specialist	Financial Management Specialist	GGOLF
Arturo Ardila Gomez	Team Member	Lead Transport Economist	Lead Transport Economist	GTD10
Carlos Tomas Perez-Brito	Social Safeguards Specialist	Senior Social Development Specialist	Senior Social Development Specialist	GSU04
Catarina Isabel Portelo	Counsel	Senior Counsel	Senior Counsel	LEGLE
Claudia Lopez Rodriguez	Team Member	Consultant	Consultant	GTD04
Daniel Pulido	Team Member	Senior Infrastructure Specialist	Senior Infrastructure Specialist	GTD04
Javier Escudero Marroquin	Team Member	Transport Analyst	Transport Analyst	GTD04
Juan Carlos Serrano-Machorro	Team Member	Senior Financial Management Specialist	Senior Financial Management Specialist	GGOLF
Maria Virginia Hormazabal	Team Member	Finance Officer	Finance Officer	WFACS
Robert H. Montgomery	Environmental Safeguards Specialist	Lead Environment Specialist	Lead Environment Specialist	GEN04
Sandra Monica Tambucho Perez	Team Member	Senior Finance Officer	Senior Finance Officer	WFALA
Licette Moncayo	Team Member	Program Assistant	Program Assistant	GTD04
Locations				

Country	First Administrative Division	Location	Planned	Actual	Comments
Ecuador	Pichincha	Quito		X	

Institutional Data
Parent (Quito Metro Line One-P14448)
Practice Area (Lead)
Transport & Digital Development
Contributing Practice Areas
Additional Financing Additional Financing Quito Metro Line One Project (P158756)
Practice Area (Lead)
Transport & Digital Development
Contributing Practice Areas

Consultants (Will be disclosed in the Monthly Operational Summary)
Consultants Required? Consulting services to be determined.

I. INTRODUCTION

1. This Project Paper (PP) seeks the approval of the Executive Directors to provide an additional loan in the amount of US$230 million to the Municipality of the Metropolitan District of Quito (Municipio del Distrito Metropolitano de Quito- MDMQ), with a sovereign guarantee from the Republic of Ecuador, to support the implementation of the Quito Metro Line One Project (Primera Linea del Metro de Quito, PLMQ).

2. **This Additional Financing (AF) seeks to: (a) partially cover a financing gap; and (b) scale up the project's Technical Assistance (TA) component.** The AF will cover part of the US$632 million financing gap. The gap was due to a combination of higher-than-estimated project costs and financial sources (US$80M from Quito Airport revenue securitization and Banco del Estado (BdE) (US$152.2 million loan) that did not materialize. Scaling up the TA component will allow for further support to the implementation of the Metro and the Integrated Mass Transit System (Sistema Integrado de Transporte de Pasajeros, SITP). The AF involves new activities and TA assistance to support implementation, but does not involve any changes in the project design.

3. **This AF includes a Level II restructuring.** The restructuring introduces the following changes: (a) a two-year extension of the current loan closing date to December 31, 2020; (b) a restructuring of the TA component (Component 5) to introduce new activities to support environmental and social risk mitigation efforts; (c) the application of the current Procurement Framework;[1] and (d) an update of the Results Framework.

4. **Three other Multilateral Development Banks (MDBs) jointly co-finance the project.** The Inter-American Development Bank (IADB), the Andean Development Corporation–Development Bank of Latin America (CAF), and the European Investment Bank (EIB) are co-financing the project through loans provided to the Republic of Ecuador. Approved in 2012, these loans finance the national government's investment in the project.[2] In 2016, the EIB approved an additional loan of US$44.2 million to cover part of the abovementioned financing gap. The IADB has approved an additional loan to the MDMQ of US$250 million and CAF is preparing a new loan US$152.2 million. This CAF loan is expected to be approved by their board before the end of FY18. Together with the proposed AF, the IADB and CAF loans are expected to completely close the project's financing gap.

[1] Procurement in IPF and Other Operational Procurement Matters (revised on November 2, 2017). Applicable to all loans approved after July 2016.

[2] The EIB's financing of US$259.3 million was approved by its Board on July 27, 2012; CAF's financing of US$250 million was approved by its Board through Resolution No. 2004/2012 of November 27, 2012 (Document number: D.CXLVI.D.7/2012); The IADB's financing of US$200 million was approved on December 5, 2012 (Approval number: 2882/OC-EC).

II. BACKGROUND AND RATIONALE FOR ADDITIONAL FINANCING

Sector Context

5. **To address the increased transport demand in Quito due to growing population and suburbanization, the MDMQ commissioned in 2009 comprehensive planning studies that recommended the creation of a city-wide** Integrated Mass Transit System**, SITP.** Initiated in March 2012, the SITP[3] is intended to provide high-quality urban transport services by integrating mass transit systems (bus and rail-based) and allowing passengers to transfer more easily between different modes. The SITP has four components: (i) the currently operational Metrobus-Q bus medium-capacity rapid transit system, the Bus Rapid Transit (BRT)[4] network; (ii) the conventional buses that operate in mixed traffic with other vehicles; (iii) the Quito Cable Cars; and (iv) the PLMQ as a high-capacity metro system that would serve as the backbone of the SITP.

6. **The BRT network encompasses three trunk lines with a total length of 83.8 km, one of the largest networks in Latin America.** First, the Central Trunk *Trole* (trolleybus) corridor opened in 1995 and reaches the narrow streets of the Historical Center of Quito (*Centro Histórico de Quito,* CHQ). Quito subsequently expanded its BRT network with the East Trunk (2002) and the Southeast Corridor in 2010. The West Trunk corridor includes the Central North Corridor (2004) and the Southwest Corridor (2012). The expansion of this network, together with significant investments in the existing facilities and bus fleet, resulted in a jump in demand from 400,000 to 828,000 passengers per day from 2010 to 2012. Conventional buses complement and serve as feeders to the future Metro and the Metrobus-Q. A fleet of approximately 2,500 privately owned buses operating in mixed traffic handles 1.8 million daily trips. The lack of dedicated lanes for these conventional buses results in lengthy travel times that particularly affect the poorest people living in the southern part of Quito. However, extending the BRT network is not possible due to lack of physical space. The PLMQ will solve this bottleneck by becoming the high-capacity backbone of the SITP—allowing Quito to expand the reach of the BRT network.

Project Description

7. **The original loan of US$205 million (IBRD 8285-EC) was signed on November 22, 2013 and was declared effective on September 25, 2015.** The Project Development Objective (PDO) is to improve urban mobility in the city of Quito, serving the growing demand for public transport. The project will reduce travel time, decrease operational costs of the transport service, improve connectivity, security and comfort of the current system, and reduce emissions of pollutants and greenhouse gases.

8. **The Borrower is the MDMQ, which has officially delegated implementation of the PLMQ to the Quito Metropolitan Public Metro Company (*Empresa Pública Metropolitana Metro de Quito,* EPMMQ), a city-owned enterprise created in April 2012.** The EPMMQ manages all project implementation aspects, such as safeguards, reporting, and supervision of construction contracts. Financial management (FM) responsibilities are assigned to both the MDMQ and EPMMQ. Likewise,

[3] Ecuador, *Ordenanza Metropolitana* 194, March 13, 2012, established the creation of the SITP.

[4] In 2013, the Trole corridor (one of the BRT corridors) had peaks of 14,000 passengers per hour per direction (ppdpd). Demand analyses shows that ridership on the Trole corridor at the CHQ would be 18,500 by 2016 and 23,000 ppdpd by 2020.

while the EPMMQ is responsible for procurement arrangements and processes, the MDMQ pays the contractors and is the official counterpart in the contracts.

9. **The PLMQ is a fully underground 23-km metro line with 15 stations, six of which are physically integrated with the Metrobus-Q.** The PMLQ extends along a north–south axis from El Labrador (located at the southern tip of the decommissioned Quito Mariscal Sucre Airport) to the inter-municipal bus transport terminal in the Quitumbe district (part of the Metrobus-Q). Table 1 provides the key characteristics of the PLMQ.

Table 1. Quito Metro Line One Project Characteristics

Length	23 km underground (Quitumbe–El Labrador) including a yard at grade and maintenance shops in Quitumbe
Average travel time between end-stations	34.5 minutes
Average commercial speed	37.5 km/h
Stations	15 operating and 5 areas in reserve with universal accessibility
Rolling stock	18 electric trains with 6 cars each, of which 2 are motorized, with a maximum capacity of 1,270 passengers each (six passengers per square meter [m^2])
Power	Fixed Catenary 1500 V dc
Signaling	ATP/ATO, track-train, ATS
Estimated Ridership in first year	369,000 passengers/work day
Integrated Mass Transport System (*Sistema Integrado de Transporte Masivo,* SITM)	Metro will be the backbone with intermodal integration with the main existing BRT, Trolleybus and inter-municipal bus terminals. The MQ will have an automated ticketing system.

10. The project has five components: one that has been completely executed and the other four currently under implementation. The World Bank cofinances Component 2 and finances Component 5 solely. Project components are as follows:

i. *Component 1. Construction of La Magdalena and El Labrador Metro Stations (Original: US$83.9 million; Revised: US$124.0 million).*[5] The Government of Ecuador (GoE) and MDMQ jointly financed this component without MDB financing. The firm Acciona Construcción S.A. carried out the construction of these two stations, which were delivered in April 2015 with some delays due to changes in the original designs and additions to the original scope. Through the execution of this component, the EPMMQ gained implementation experience and a better understanding of soil characteristics. This component has been completed.

ii. *Component 2. Infrastructure and Equipment Investment for the PLMQ (Original: US$1.097 billion)*: This component includes the delivery of civil works (23-km tunnel, 13 stations, rail yard and maintenance shops) and the provision and installation of the facilities and equipment required

[5] This value includes project management and supervision.

for the system's operation. The IBRD, IADB, EIB and CAF jointly finance this component, with counterpart funds provided by the GoE and MDMQ. The delivery of this component is through a single contract awarded to a consortium named Consorcio Línea 1 Metro de Quito Acciona Odebrecht (CL1). Procurement of this contract was conducted under IADB guidelines, which are in line with World Bank guidelines. Contract execution is currently under way with physical progress of 54.13 percent (as of March 2018). The four co-financiers consider contract execution progress to be Satisfactory (S). In the absence of delays, the contract would be completed by October 2019.

iii. *Component 3. Provision of Train Sets to operate in the PLMQ (Original: US$192.8 million).* This component comprises the delivery of 18 six-car train sets, with a total of 108 rail cars. The MDMQ used local procurement rules to hold an international competitive bidding process that resulted in the awarding of the contract to Construcciones y Auxiliar de Ferrocariles (CAF S.A.). The MDMQ is financing this contract in its entirety through an export promotion loan from the Spanish Fund for Corporate Internationalization (*Fondo para la Internacionalización de la Empresa*, FIEM). Trains will be delivered progressively starting in October 2018 and ending in March 2019.

iv. *Component 4. Project Management (Original: US$47.2 million)*: This component comprises the provision of consulting services to strategically manage and supervise the execution of Component 2. The IADB and CAF co-finance this component, with counterpart funds provided by the GoE and the MDMQ. The EPMMQ hired a supervisor for the contract to deliver Component 2: the joint venture Metro Alianza Consorcio. In alignment with international best practices, the EPMMQ has also hired a project management consultant: Consorcio Gerencia Metro de Quito (GMQ). The project management consultant supported the EPMMQ throughout the negotiations with the lowest-evaluated bidder (LEB) and led the value-engineering exercises[6] to optimize the designs of the works in Component 2.

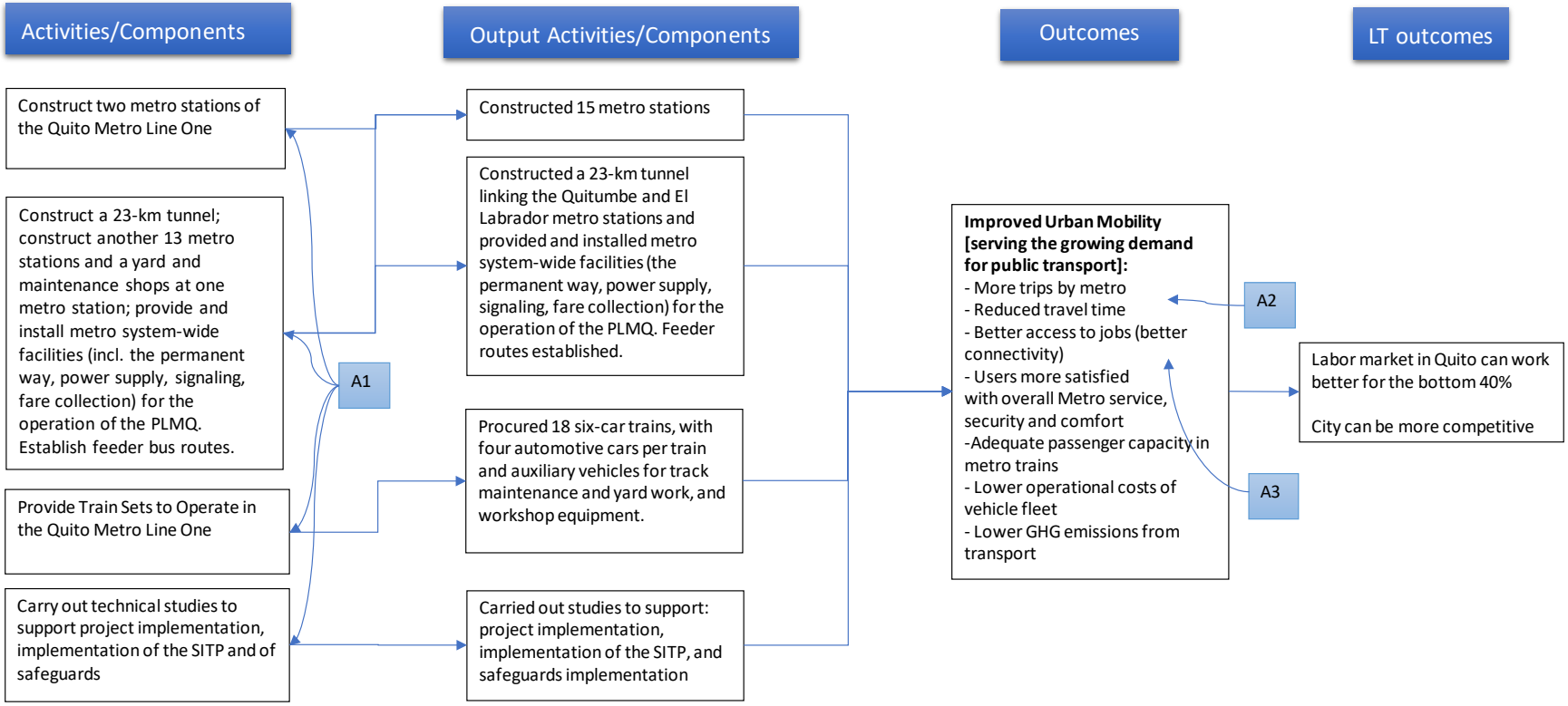
v. *Component 5. Technical Studies to Support Project Implementation (Original: US$5 million):* This component provides technical support to the MDMQ on decisions related to Quito Metro implementation and Quito´s transport system integration. It initially included a study of the financial arrangements for the SITP to support balancing operational costs and tariff revenues, and a study to define the technical characteristics of the fare collection for the SITP, compatible with the electronic fare-collection system installed for the PLMQ. Later, different studies were incorporated into this component, such as technical support to management of FIDIC contracts, gender studies, and additional studies for the SITP. (For a full table of current studies, refer to Annex 2.)

11. The figure below presents the Theory of Change (ToC) for the project. In the long term, the PLMQ will help Quito improve labor market because will enhance accessibility to jobs and other opportunities, especially to the bottom 40 percent of the income distribution. The PLMQ will also make Quito more competitive, not only because of a more efficient labor market, but also because a faster public transport service such as metros allows users to undertake more activities in a day (e.g. run errands). Because of the long-term nature of the expected results, the results framework (RF) does not

[6] Value engineering is a conscious and explicit set of disciplined procedures designed to seek optimum value for both initial and long-term investment; it analyzes the requirements of a project for the purpose of achieving the essential functions at the lowest total costs (capital, staffing, energy, maintenance) over the life of the project. The use of this term in this Project Paper does not correspond to the definition of Value Engineering as per the FIDIC civil works contract (changes proposed by the contractor that generate savings).

capture the whole spectrum of impacts. The impact that is captured by the RF is the improvement in mobility that the PLMQ will bring about, which is measured by a series of indicators that the reflect use of the PLMQ, such as user satisfaction and improvements in accessibility to opportunities. The “output/activities components” and the “activities/components” columns of the ToC reflect the components that constitute the project. Only if these activities are carried out as expected will the project meet its objective of improving mobility.

THEORY OF CHANGE



Critical Assumptions	
A1	Financing from co-financiers and counterpart needs to materialize in time.
A2	Fare collection for metro is integrated with city-wide fare collection. Bus routes are restructured and PLMQ has feeder buses. SITP is established.
A3	A capable operator for the metro is in place, be it private or public.

Implementation Progress

12. **The project's PDO and overall implementation progress ratings are currently assessed as Satisfactory (S).** The PDO is aligned with Ecuador's National Development Plan[7] and Country Engagement Note (CEN),[8] which propose to enhance access to basic services and improve their quality, especially among the poorest populations, by improving accessibility and efficiency in public transport. The project is advancing well, with physical progress in the ongoing civil works contract of 54.13 percent and financial progress of 53.32 percent as of March 2018. In accordance with the current implementation schedule, the contract will be completed by October 2019. The original loan is 98 percent disbursed and the portion of the loan available for the infrastructure and equipment component (the component with the financing gap) has now been fully disbursed. The remaining balance of US$4.8 million corresponds to the project's TA component. The Borrower is complying with the covenants in the existing loan agreement.

13. **The project's safeguards performance rating is MS.** This relates mainly to social aspects associated with economic displacement and delays in the implementation of certain aspects of the project's Integrated Environmental, Social, Industrial and Occupational Safety Management Plan (*Plan de Gestión Ambiental, Social, de Seguridad Industrial y Salud Ocupacional,* PGASSH), including institutional strengthening measures. The Borrower has agreed to implement a Corrective Action Plan (*Plan de Acción Correctiva,* PAC), incorporated in the PGASSH, to better manage various issues related to mitigation and compensation of social impacts and limited economic displacement, which are reflected in the Moderately Satisfactory (MS) Environmental and Social Risk rating.

14. **Fiduciary arrangements have performed well and have provided the transparency required for project implementation, oversight, and control.** Regarding FM, there are no overdue financial statement audits or relevant audit issues. The project's FM performance has been affected by issues related to staff rotation, delays and quality gaps in interim financial reports (IFRs), accounting reconciliation, and delays in documenting expenditures to the Bank. Because of these issues, the project's FM rating was Unsatisfactory (U) until May 2017, when the rating was upgraded to Moderately Satisfactory (MS) after the Borrower agreed on an action plan to correct the issues. The action plan is under implementation. Further details are available in Annex 6. On the procurement arrangements, the Principles of Collaboration agreed among the banks have allowed for coordination, close supervision and appropriate management of issues arising during implementation. The procurement rating has been Satisfactory (S) rating since 2013.

Implementation Issues

15. **The project presented a financing gap.** The project has reached a financing gap mainly due to the higher-than-estimated cost and the need to replace some of the originally contemplated financing sources that did not materialize. The original project cost estimate of US$1,499 million had to be revised to US$2,014 million (amounts exclude Value Added Tax [VAT], except for Component 1[9]). Out of US$2,014 million, about US$750 million were to be provided by the GoE and the remaining US$1,259 million by the MDMQ. Both the GoE and the MDMQ are financing

[7] National Development Plan (*Plan Nacional de Desarrollo* 2017–2021), Gobierno de Ecuador.
[8] "Ecuador–Country Engagement Note", The World Bank Group, March 2016
[9] Component 1 was procured by the EPMMQ which, unlike the MDMQ, is subject to the VAT.

their investments in the project with various loans from multi- and bilateral sources and with their own funds. The main source of this US$509.9 million increase in project costs was a higher-than-expected price for the delivery of Component 2, for the civil works contract. In addition, some of the financing sources that had been committed at the time of project appraisal did not ultimately materialize and could not be replaced by alternative sources. When considered together, these two situations result in a financing gap of US$632.2 million, net of increased contributions of own resources from MDMQ. Annex 3 provides more details about the costs and financing sources.

16. **While implementation of the civil works contract under Component 2 advances at good pace, it started later than expected.** The higher-than-estimated cost of Component 2 generated delays for three main reasons: a) the Borrower conducted negotiations and a value engineering exercise to reduce costs, which added a few months to the project; b) the Borrower had to undertake a study to review the reference budget and assess whether the new proposal was within-range of market prices for this kind of projects; and c) the Borrower had to search for additional financing sources, which delayed the process further.

17. **Reconfiguration of the civil works contractor.** The civil works contract was awarded to Consorcio Línea 1 Metro de Quito Acciona Odebrecht (CL1), comprising Construtora Norberto Odebrecht (CNO) and Acciona Construcción (Acciona). In September 2016 the CL1 asked the EPMMQ and MDMQ to authorize the exit of CNO and allow two other firms to join the consortium: Acciona México and Acciona Industrial. The consortium's reformulation was achieved in December 2017 after the co-financiers provided a no-objection to this change.

18. **The project experienced delays in the definition and implementation of decisions related to planning for the operation and maintenance (O&M) phase and integration with the existing public transport system.** These decisions require strong inter-institutional coordination between the MDMQ and EPMMQ. In terms of O&M contract, the Banks are supporting structuring an integral contract for a private operation of the metro. Regarding the integration with the existing public transport system, while physical-node integration is adequate with six intermodal integration stations, there are still delays in the implementation of the physical-route integration with the bus system. The Banks are also supporting EPMMQ for the acquisition of fare collection systems for the Metro, which would be eventually integrated with the rest of the system. While there is a consistent long-term action plan for the implementation of the integrated fare collection and physical-route integration, the completion of this plan will require strong institutional and political support given the tight schedule.

19. **Disposal of extracted soil material.** The project's two available sites for disposal of soil material extracted from the construction of the tunnel and stations were Troje IV (a municipal landfill) and Bicentenario Park (a former airport that will reuse soil material produced by the Metro to create a public park). In December 2016, due to limitations on expanding Bicentenario's capacity, the project began to look for an additional landfill. The client started using a public landfill in Oyacoto in March 2017 without prior agreement from the banks, which were informed in May 2017. The use of Oyacoto stopped in October 2017 after a request from the banks. The client is currently implementing an agreed action plan to mitigate the social and environmental impacts of using the Oyacoto landfill (see Social Analysis and Environmental Analysis sections below for details). A number of possible alternative sites were considered to replace Oyacoto and Troje IV. After careful analysis, the site Casantopamba was selected as the best option. The

EPMMQ has complied with the local regulations and the criteria specified in the PGAHSS in regard to the environmental and social safeguards policies of the Banks. Based on that information, the Banks issued the no-objections for the use of the site.

20. **Occupational Health and Safety (OHS).** The project has developed and implemented strong occupational management systems. The EPMMQ is supervising the project through (a) the project supervision firm, (b) inspection from the national Ministry of Labor, and (c) a quarterly environmental and social audit by an independent company. Nevertheless, six deaths have been directly or indirectly associated with the project (with four from November 2017 to February 2018): four related to truck transit (e.g., movement of materials or extracted materials to/from project construction sites), one associated with a Tunnel Boring Machine (TBM) operation, and one due to a slope failure at Troje IV. In December 2017, the Bank, working with the EPMMQ, CL1 and the contracted supervision company, developed an OHS Action Plan to assess the situation, implement actions to help reduce similar future incidents, and provide follow-up on individual worker fatality incidents. The action plan included specific measures on road safety (detailed in Annex 10) that reflect the importance of this critical and complex development challenge for the Quito Municipality. As of March 2018, most of the actions agreed in the augmented OHS Action Plan were being complied with (96.7% progress), and the remaining actions were close to full implementation.

21. **Procedural shortcomings with land acquisition processes.** The project design has not caused physical resettlement and has minimized economic displacement, which is commendable for such a megaproject in an urban area. Some land expropriations were carried out before the World Bank became involved in the project. Due diligence carried out at the time of appraisal of the original loan considered these expropriations to be in compliance with Bank OP 4.12 Involuntary Resettlement. The client prepared a Resettlement Policy Framework (RPF) and agreed to use it to prepare a Resettlement Action Plan (RAP) for any future land acquisition and resettlement. However, due to internal coordination problems, the project expropriated three properties (pieces of land) without preparing the required RAPs. Therefore, the Bank recommended that a third-party assessment of land acquisition be prepared for these three properties that were acquired without RAPs. The land acquisition assessment determined that the amount paid was sufficient to replace the expropriated properties. Because RAPs were not prepared at the time of the expropriations, the Bank agreed with the Borrower to undertake additional due diligence by requiring the Borrower to engage in consultations with the affected owners to fully ascertain that the outcomes of these expropriations are aligned with the principles of OP 4.12, and to undertake corrective actions if necessary. These consultations, including any corrective actions, will be reflected in a time-bound action plan, acceptable to the Bank, to be prepared by the Borrower no later than two months after the effectiveness date of the proposed additional loan, and included as a covenant in the loan agreement. The client has also updated the RPF, which was disclosed by the client on the client project's website[10] on May 6, 2018 and by the Bank on its external webpage on May 7, 2018. The Client has also prepared RAPs (RAP was disclosed by the client on May 6, 2018 and by the Bank on May 7, 2018) for four new properties that will be subject to expropriation. Loan proceeds will be available for the Borrower to cover any expenditure related to involuntary resettlement.

[10] https://www.metrodequito.gob.ec/el-proyecto/estudios/

Rationale for Additional Financing

22. **The rationale for the AF and project restructuring is to address the implementation issues described above, as well as to incorporate the Procurement Framework for Component 5.** This includes bridging the financing gap of US$632.2 million resulting from the higher costs in Component 2 and scaling up activities in Component 5 to address the issues of institutional coordination and limited technical capacity and resources to implement safeguards measures. Component 5 will now support the implementation of critical measures to ensure that the Metro is ready for O&M, and to ease integration with the public transport system. Furthermore, the new activities will support the EPMMQ's capacity to mitigate environmental and social risks and implement the activities agreed on in the PAC, including any expenditures related to involuntary resettlement. Updating the implementation schedule will reflect that the project will begin operations by the end of 2019. Annex 2 presents the detailed list of studies incorporated in Component 5. The World Bank finances this component in its entirety and its Procurement Framework applies to the contracting of services under this component. The project restructuring includes an updating of the M&E framework, now consistent with the implementation schedule, and improves the definition of some indicators. Incorporating the Procurement Framework will enable the incorporation of a Project Procurement Strategy for Development (PPSD).

23. **Despite the higher-than-estimated costs, the project is still at the lower end of similar projects' cost range.** The four co-financiers conducted a detailed analysis to explain the increase in Component 2 costs with respect to the original estimate. Their conclusion was that the original estimate underappreciated project indirect costs, particularly the cost of doing business in Ecuador, administrative expenses, and allowances to compensate for perceived risks. Nevertheless, the awarded contract results in a cost of US$88.7 million/km (net of VAT), including rolling stock. This cost is lower than the cost per kilometer of most metro lines in Brazil and Europe (except for some lines in Spain) and is comparable to the costs of Lines 3 and 6 in Santiago and of recent Chinese metros. See Annex 3 for detailed information on cost increases and financing sources that did not materialize.

Alternatives to the Additional Financing: Maximizing Finance for Development (MFD)

24. **The Bank considered different alternatives for leveraging commercial financing while optimizing the use of scarce public resources for the delivery of the AF.** In particular, the Bank discussed with the client the possibility of providing an IBRD partial guarantee (or a combination of a loan and a guarantee) that would enable commercial financing. The Bank's Financial Solutions team explored the use of commercial financing through market consultation. MIGA also expressed preliminary interest in participating in such a structure. This exercise indicated interest of international commercial banks, but raised the need to address several areas such as the Municipality of Quito's creditworthiness and revenue-generation capacity. In addition, commercial banks would also ask for a sovereign guarantee, thus increasing the borrowing cost. Finally, there was some uncertainty about bankability and an urgent need for financing. In this sense, the MDMQ expressed preference for a traditional loan approach.

25. **The use of public resources through an IBRD loan proved necessary to absorb risks that lenders were not willing to take.** IBRD resources, together with other MDB lending, will allow the conclusion of the civil works for the Quito Metro Project and will likely deploy a private

concession for the operation. This new IBRD engagement allows the team to continue improving the project by reinforcing the TA component and providing further support to the implementation of the project, the SITP, and safeguards-related risk management.

26. **The MDMQ is interested in implementing a private-sector solution for the PLMQ's O&M, which the Bank is supporting.** The EPMMQ contracted a study to evaluate business-model alternatives for the delivery of the PLMQ's O&M: "*Evaluación de alternativas y diseño del modelo de explotación de la Primera Línea del Metro de Quito*." The study recommended a performance-based agreement with a private operator, incorporating incentives as the preferred business model for the PLMQ's O&M. The EPMMQ is currently evaluating the study and is following up on the next steps to implement the concession. The Bank is implementing resources from the GIF to support the definition and pre-structuring of the future concession for the PLMQ's O&M.

Corporate Priorities

Climate change mitigation

27. Over the next 30 years, the PLMQ will cut CO_2 emissions by 2.5 million tons. The decrease in travel times in the corridor when using the Metro will attract private vehicle users to the system. The project design estimates that 10 percent of future Metro users will come from current private vehicle users. In addition, 85 percent of future Metro users currently use existing bus system, which is significantly more pollutant than the Metro. Given that the project promotes transport mode shift to cleaner technologies, the project is considered to generate high levels of co-benefits.

Gender Analysis and Actions

28. **Women in Ecuador have lower participation in the labor force and higher rates of unemployment, and sexual harassment is a barrier to their participation in the economy.** Limited access to and lack of safety in transport are estimated to be the greatest material obstacles to women's participation in the labor market in developing countries. Despite their higher presence in public transport, 91 percent of women in Quito have experienced verbal and physical harassment in public spaces. The project will provide safer access to and from public transport for women, through the incorporation of a reporting mechanism for cases of violence against women and girls in public transport. The satisfaction level of Metro users (with specific questions on sexual harassment and mobility) will be assessed through surveys, with data classified by gender. This plan is coordinated with a World Bank-financed study that seeks to strengthen women's skills to prevent and report harassment. The study will implement communication and education campaigns to change behavior patterns and promote the use of tools and mechanisms to prevent and report sexual violence in the SITP.

29. **Women's low employment participation in the transport sector**. According to the ILOSTAT[11] database, in the transport sector jobs database, only 11 percent are women. Statistics also show that in the construction sector, only 5.3 percent of employees are women. These data

[11] International Labor Organization, the world's leading source on labor statistics.

indicate very low participation of women in both sectors directly related to the project. The EPMMQ will implement a strategy to increase (to 20 percent) the participation of women directly employed by the company that will operate the Metro, facilitated by gender-sensitive recruitment procedures.

III. PROPOSED CHANGES AND APPRAISAL SUMMARY

Summary of Proposed Changes

The proposed changes are: (a) an extension of the closing date to December 31, 2020, to accommodate delays in the start of the project and in the commencement of the civil works contract under Component 2; (b) the restructuring of Component 5 "Technical Studies to Support Implementation," to include additional activities and redefine the studies needed to implement the project successfully, which warrant a change in the description of this component in the legal agreement; (c) the scale-up of Component 5 to provide further support to project implementation and integration with the existing transportation system; (d) the updating of the M&E Framework due to the new implementation timeline and improved description of the indicators to reflect state-of-the-art practices; and (e) following current operational policies, a change in procurement to include the use of the Procurement Regulations for IPF Borrowers (November 2017) for the procurement of goods, non-consultant services and the selection of consultants (firms and individuals) for the new activities included as part of the scale-up of the project's TA component, replacing the former Procurement and Consultant Guidelines.

Change in Implementing Agency	Yes [ ] No [X]
Change in Project's Development Objectives	Yes [ ] No [X]
Change in Results Framework	Yes [X] No [ ]
Change in Safeguard Policies Triggered	Yes [X] No [ ]
Change of EA category	Yes [ ] No [X]
Other Changes to Safeguards	Yes [X] No [ ]
Change in Legal Covenants	Yes [X] No [ ]
Change in Loan Closing Date(s)	Yes [X] No [ ]
Cancellations Proposed	Yes [ ] No [X]
Change in Disbursement Arrangements	Yes [ ] No [X]
Reallocation between Disbursement Categories	Yes [ ] No [X]
Change in Disbursement Estimates	Yes [ ] No [X]
Change to Components and Cost	Yes [X] No [ ]
Change in Institutional Arrangements	Yes [ ] No [X]
Change in Financial Management	Yes [ ] No [X]
Change in Procurement	Yes [X] No [ ]

Change in Implementation Schedule	Yes [X] No [ ]
Other Change(s)	Yes [ ] No [X]

Development Objective/Results

Project's Development Objectives

Original PDO

The proposed Project development objective (PDO) is to improve urban mobility in the city of Quito serving the growing demand for public transport. The Project will reduce travel times, decrease operational costs of the transport service, improve connectivity, security and comfort of the current system and reduce emissions of pollutants and greenhouse gases.

Change in Results Framework

Explanation:

As explained in the original PAD for this project, the PDO is the same one that the IADB, one of the co-financiers, uses for the project. The outcome indicators are also the same. This approach lowers the transaction costs for the client.

Once in operation, the PLMQ will improve urban mobility in the city of Quito: this is the expected outcome that will be assessed. Improved mobility will allow people to reach more opportunities—employment, education, health—in less time. People will be able to make more trips per day. The PLMQ will also serve the growing demand for public transport in Quito: the reason for designing the metro project. The PLMQ resolves the bottleneck that Quito's BRT network faces: it is impossible to build more BRT lines in the World Heritage Center of Quito. BRT lines operate at or above capacity, making travel uncomfortable due to overcrowding. Travel is also unreliable because people cannot board a bus during rush hour. The PLMQ will resolve this bottleneck because it is a high-capacity mode and is physically integrated with the BRT network at six stations. The PLMQ will also have feeder buses at the remaining nine stations. Tariffs will be integrated to facilitate transfers among buses, BRT and Metro. Once the Metro is operational, Quito will have a higher-capacity public transport system, the SITP—able to serve a demand for public transport that is expected to grow. Furthermore, thanks to the PLMQ, Quito will be able to expand the SITP, particularly the BRT portion. The operating cost of Quito's vehicle fleet will be reduced compared to the without-Metro situation or business-as-usual (BAU) scenario. The carbon footprint from transport in the MDMQ will also be lower than in the BAU scenario.

The final part of the PDO statement states: "The project will reduce travel times, decrease operational costs of the transport service, improve connectivity, security and comfort of the current system and reduce emissions of pollutants and greenhouse gases." These parts of the PDO statement describe different features of improved urban mobility. They are measured through a number of outcome-level indicators in the project's Results Framework (RF).

A new outcome indicator was added to the RF: "Percentage of jobs accessible within 60 minutes of travel." The indicator measures the improvement of urban mobility by improving the connectivity, because the PLMQ will be the backbone of Quito's SITP.

A second change to the RF was to improve the description of each indicator and its relationship with the PDO as well as the methodological descriptions. A third change was to make the RF consistent with the new closing date. The end-target year is now 2021, when the Metro will be in commercial operation. The Metro is expected to begin operations in the second half of 2020. A fourth change was introduced as three intermediate indicators were added. The first reflects the progress in the installation of the permanent way

(tracks), which had been omitted from the original RF. The next two will capture gender-related aspects of the project. One measures the implementation of reporting mechanism for cases of violence against women and girls in the PLMQ. The final intermediate indicator measures the percentage of total women staff directly employed by the operator of the PLMQ.

Compliance

Change in Safeguard Policies Triggered

Explanation:

Indigenous Peoples (IPs) are present in the Oyacoto landfill. While the Oyacoto landfill site is not in use for the project anymore, given the risks of finding IPs on new selected landfills, OP 4.10 was triggered. OP 4.09 was triggered given the need of pest management during the operations phase of the metro.

Current and Proposed Safeguard Policies Triggered:	Current (from Current Parent ISDS)	Proposed (from Additional Financing ISDS)
Environmental Assessment (OP) (BP 4.01)	Yes	Yes
Natural Habitats (OP) (BP 4.04)	No	No
Forests (OP) (BP 4.36)	No	No
Pest Management (OP 4.09)	No	Yes
Physical Cultural Resources (OP) (BP 4.11)	Yes	Yes
Indigenous Peoples (OP) (BP 4.10)	No	Yes
Involuntary Resettlement (OP) (BP 4.12)	Yes	Yes
Safety of Dams (OP) (BP 4.37)	No	No
Projects on International Waterways (OP) (BP 7.50)	No	No
Projects in Disputed Areas (OP) (BP 7.60)	No	No
Performance Standards for Private Sector Activities OP/BP 4.03	No	No

Other Changes to Safeguards

Two new policies were triggered under the AF; the Pest Management OP 4.09 and Indigenous Peoples OP/BP 4.10. While the project does not involve the purchase, or use of significant quantities of pesticides, OP 4.09 is triggered since, during operation phase, the project may require the limited use of regularly available pesticides for pest control (e.g. rodents, etc.) in the tunnels. OP 4.10 was triggered as Indigenous Peoples (IPs) were identified in the area of Oyacoto, a site temporarily used as a landfill to dispose soil waste from the project. Although the site is now not being used for the project, the policy was triggered preventatively because of the possibility of indigenous peoples being present in new landfills that might be identified in the future.

Covenants - Additional Financing (Additional Financing Quito Metro Line One Project - P158756)						
Source of Funds	**Finance Agreement Reference**	**Description of Covenants**	**Date Due**	**Recurrent**	**Frequency**	**Action**
IBRD	Schedule 2, Section I.A.1	The Borrower shall cause the EPMMQ to maintain, throughout the implementation of the Project, key staff for the Project, including without limitation, a Project coordinator, a procurement specialist, a financial management specialist, an environmental specialist, a social specialist, a physical cultural resources specialist and a health and safety specialist, all with terms of reference, and qualifications and experience satisfactory to the Bank.		☒	CONTINUOUS	New
IBRD	Schedule 2, Section I. B.1	The Borrower shall, and shall cause the EPMMQ to: (a) update the ROP to include the arrangements for the process and procedures for control, approve and monitor cash and in-kind compensations for Resettlement Expenditures, under terms and conditions satisfactory to the Bank**;** and (b) immediately thereafter carry out the Project in accordance with the provisions of the ROP.		☒	CONTINUOUS	New
IBRD	Schedule 2, Section I. D. 1	The Borrower shall, and shall cause EPMMQ to, ensure that the Project is carried out in accordance with the provisions of the Environmental Impact Assessment (including the EMP), the PGASS-H (including the PAC and the PAC Health and Safety), the RPF, the RAPs, the IPPF and any applicable IPPs.		☒	CONTINUOUS	New
IBRD	Schedule 2, Section I. D. 2 (a)	For each activity which involves works under the Project for which the RPF provides for the preparation of a RAP, (i) prior to the carry out of any said works,		☒	CONTINUOUS	New

		such RAP is prepared and disclosed in accordance with the RPF, adequately consulted with Affected Persons as per the RPF, and furnished to the Bank for review and approval; and (ii) thereafter the RAP is adopted and implemented in accordance with its terms and in a manner satisfactory to the Bank				
IBRD	Schedule 2, Section I. D. 2 (b)	For each activity under the Project for which the IPPF provides for the preparation of an IPP: (i) prior to the carry out of any said activity, such IPP is prepared and disclosed in accordance with the IPPF, adequately consulted upon and furnished to the Bank for review and approval; and (ii) thereafter the IPP is adopted and implemented in accordance with its terms and in a manner satisfactory to the Bank.		☒	CONTINUOUS	New
IBRD	Schedule 2, Section I. D. 3	The Borrower shall cause the EPMMQ to establish and maintain throughout Project implementation an adequate institutional capacity, including staffing, and systems acceptable to the Bank, as shall be necessary to fully implement, manage, coordinate, and monitor the implementation of the Safeguard Instruments.		☒	CONTINUOUS	New
IBRD	Schedule 2, Section I. D. 4	The Borrower shall, and shall cause EPMMQ to: (a) maintain and publicize the availability of the grievance redress mechanism set forth in the PGASS-H for purposes of listening to complaints raised in relation with the implementation of the Project; and (b) thereafter take all measures necessary to implement the decisions made by the Borrower and EPMMQ under such grievance redress mechanism, all in accordance with the Safeguard Instruments and in manner acceptable to the Bank.		☒	CONTINUOUS	New
IBRD	Schedule 2, Section I. D. 5	The Borrower shall ensure, and cause EPMMQ to ensure, that all contractors and subcontractors (which contracts were awarded pursuant to the terms of Original Loan Agreement): (i) comply with the		☒	CONTINUOUS	New

		obligations under the applicable Safeguard Instruments; and (ii) comply with the Code of Conduct that should be provided to and signed by all workers; all in a manner satisfactory to the Bank and as applicable to such civil works commissioned or carried out pursuant to said contracts.				
IBRD	Schedule 2, Section I. D. 6 (i)	The Borrower shall ensure, and cause EPMMQ to ensure, that all bidding documents and contracts for civil works to be awarded pursuant to the terms of this Agreement shall include the obligation of the relevant contractors and subcontractors to: (i) comply with the obligations under the applicable Safeguard Instruments.		☒	CONTINUOUS	New
IBRD	Schedule 2, Section I. D. 6 (ii)	The Borrower shall ensure, and cause EPMMQ to ensure, that all bidding documents and contracts for civil works to be awarded pursuant to the terms of this Agreement shall include the obligation of the relevant contractors and subcontractors to: ii) adopt and enforce code of conducts that should be provided to and signed by all workers.		☒	CONTINUOUS	New
IBRD	Schedule 2, Section I. D. 7	The Borrower shall provide, and/or cause to be provided, all the funds necessary or appropriate to perform its obligations under the Project, including, as applicable, all the funds required to implement the pertinent RAPs, in a manner satisfactory to the Bank.		☒	CONTINUOUS	New
IBRD	Schedule 2, Section I. D. 8 (a)	For purposes of carrying out a land acquisition review of the properties identified in the PAC, the Borrower shall: (a) cause EPMMQ to not later than forty-five (45) business days after the Effective Date, prepare and furnish to the Bank, a time-bound action plan, acceptable to the Bank.	21-Oct-2018	☐		New
IBRD	Schedule 2, Section I. D. 8 (b)	The Borrower shall implement, and cause EPMMQ to implement (as the case may be), said time-bound action plan (including any corrective action, as		☒	CONTINUOUS	New

		determined and approved by the Bank), all in accordance with its terms and in a manner acceptable to the Bank.				
IBRD	Schedule 2, Section II	The Borrower shall cause EPMMQ to furnish to the Bank each Project Report not later than forty-five days after the end of each calendar semester, covering the calendar semester.		☒	Semiannual	New

Covenants - Parent (Quito Metro Line One - P144489)							
Ln/Cr/TF	**Finance Agreement Reference**	**Description of Covenants**	**Date Due**	**Status**	**Recurrent**	**Frequency**	**Action**
IBRD-8285	Section I. E.2(b)of Original Loan Agreement	The Borrower shall, and shall cause EPMMQ to, ensure that: (...)for each activity under the Project for which the IPPF provides for the preparation of an IPP: (i) prior to the carryout out of any said activity, such IPP is prepared and disclosed in accordance with the IPPF, adequately consulted upon and furnished to the Bank for review and approval; and (ii) thereafter the IPP is adopted and implemented in accordance with its terms and in a manner satisfactory to the Bank.		Complied with	☒	CONTINUOUS	New
IBRD-8285	Section I. E.5 of Original Loan Agreement	The Borrower shall ensure, and cause EPMMQ to ensure, that all contractors and subcontractors (which contracts were awarded pursuant to the terms of this Agreement): (i) comply with the obligations under the applicable Safeguard Instruments; and (ii) comply with the Code of Conduct that should be provided to and signed by all workers; all in a manner satisfactory to the Bank and as applicable to such civil works commissioned or carried out pursuant to said contracts.		Complied with	☒	CONTINUOUS	New
IBRD-8285	Section I. E.6 of Original Loan Agreement	The Borrower shall ensure, and cause EPMMQ to ensure, that all bidding documents and contracts for civil works to be awarded pursuant to the terms of this Agreement shall include the obligation of the relevant contractors and subcontractors to: (i) comply with the obligations		Complied with	☒	CONTINUOUS	New

		under the applicable Safeguard Instruments; and (ii) adopt and enforce code of conducts that should be provided to and signed by all workers; all in a manner satisfactory to the Bank and as applicable to such civil works commissioned or carried out pursuant to said contracts.					
IBRD-8285	Section I. E.7 of Original Loan Agreement	Without limitation to the provisions of Section 5.03 of the General Conditions, the Borrower shall provide, and/or cause to be provided, all the funds necessary or appropriate to perform its obligations under the Project, including, as applicable, all the funds required to implement the pertinent RAPs, in a manner satisfactory to the Bank.		Complied with	☒	CONTINUOUS	New
IBRD-8285	Schedule 4. 3, reference to Section III. 3 of Original Loan Agreement	**Goods, Works, Non-consulting Services and Consulting Services for Part V.** All goods, works, and services required for Part V of the Project and to be financed out of the proceeds of the Loan shall be procured in accordance with the requirements set forth or referred to in the Procurement Regulations and the provisions of the Procurement Plan.		Complied with	☒	CONTINUOUS	New
IBRD-8285	Schedule 4. 3, reference to Section III.1 of Original Loan Agreement	The Borrower shall and shall cause the EPMMQ ensure that all goods, works, non-consulting services and consultants' services required for the Project and to be financed out of the proceeds of the Loan are procured in compliance with the standard of economy and efficiency set forth in the Bank?s Articles of Agreement.		Complied with	☐	CONTINUOUS	Revised
IBRD-8285	Schedule 4. 3, reference to Section I.E 5. of	The Borrower shall ensure, and cause EPMMQ to ensure, that all contractors and subcontractors (which contracts were awarded pursuant to the terms of Original Loan Agreement): (i) comply		Complied with	☒	CONTINUOUS	Propose d

	Original Loan Agreement	with the obligations under the applicable Safeguard Instruments; and (ii) comply with the Code of Conduct that should be provided to and signed by all workers; all in a manner satisfactory to the Bank and as applicable to such civil works commissioned or carried out pursuant to said contracts.					
IBRD-8285	Schedule 4. 3, reference to Section III. 2 of Original Loan Agreement	**Goods, Works and Non-consulting Services.** Notwithstanding the provision mentioned in paragraph (a) above, all goods, works and non-consulting services required for Part II of the Project and to be financed out of the proceeds of the Loan shall be procured by the Borrower: (a) in accordance with the provisions set forth in paragraphs 3.21, 3.23 (e), 3.24, 3.25, 3.32 of the Procurement Regulations; and (b) otherwise also in accordance with the IADB Procurement Rules.		Complied with	☒	CONTINUOUS	Proposed
IBRD-8285	Schedule 4. 3, reference to Section III. 1 of Original Loan Agreement	The Borrower shall, and shall cause EPMMQ to, ensure that all goods, works and services required for the Project, and to be financed out of the proceeds of the Loan are procured under procedures consistent with the Bank's Core Procurement Principles set forth in the Procurement Regulations.		Complied with	☒	CONTINUOUS	Proposed
IBRD-8285	Schedule 2. Section I. E. 5	The Borrower shall, and shall cause EPMMQ to: (a) maintain and publicize the availability of the grievance procedures set forth in the PEGASHS for purposes of listening to complaints raised in relation with the implementation of the Project; and (b) implement the decisions made by the		Complied with	☐		Marked for Deletion

		Borrower and EPMMQ under such grievance procedures, in a manner acceptable to the Bank.					
IBRD-8285	Section I. E.4 of Original Loan Agreement	Without limitation to the provisions of this Section, the Borrower shall, and shall cause EPMMQ to: (a) maintain and publicize the availability of the grievance redress mechanism set forth in the PGASS-H for purposes of listening to complaints raised in relation with the implementation of the Project; and (b) thereafter take all measures necessary to implement the decisions made by the Borrower and EPMMQ under such grievance redress mechanism, all in accordance with the Safeguard Instruments and in manner acceptable to the Bank.		Complied with	☒	CONTINUOUS	Proposed
IBRD-8285		Finance Agreement: Safeguards (Resettlement) | Description: Schedule 2. Section I. E.2. If Resettlement is involved, the Borrower shall: (a) prior to carrying out of any said works cause the EPMMQ to prepare and submit to the Bank for its approval the RAP satisfactory to the Bank; and (b) implement and/or cause the EPMMQ to implement the pertinent RAP | Frequency: Yearly		Complied with	☐		Revised
IBRD-8285	Section I. E.2(a)of Original Loan Agreement	Without limitation to paragraph 1 above, the Borrower shall, and shall cause EPMMQ to, ensure that: (a) for each activity which involves works under the Project for which the RPF provides for the preparation of a RAP, (i) prior to the carry out of any said works, such RAP is prepared and disclosed in accordance with the RPF, adequately consulted with Affected Persons as per the RPF, and furnished to the Bank for review and approval; and (ii) thereafter the RAP is adopted and implemented in accordance with its terms and in a manner satisfactory to the Bank; and		Complied with	☒	CONTINUOUS	Proposed

IBRD-8285		Finance Agreement: Safeguards (General) | Description: Schedule 2. Section I. E.1 The Borrower shall, and shall cause EPMMQ to, ensure that the Project is carried out in accordance with the provisions of the Environmental Impact Assessment (including the EMP), the PEGASHS, the Resettlement Policy Framework and any RAP, if applicable. | Frequency: Yearly		Complied with	☐		Revised
IBRD-8285	Section I. E.1 of Original Loan Agreement	The Borrower shall, and shall cause EPMMQ to, ensure that the Project is carried out in accordance with the provisions of the Environmental Impact Assessment (including the EMP), the PGASS-H (including the PAC and the PAC Health and Safety), the RPF, the RAPs, the IPPF and any applicable IPPs.		Complied with	☒	CONTINUOUS	Proposed
IBRD-8285		Finance Agreement: Subsidiary Agreement | Description: Schedule 2. Section I. C. The Borrower shall enter into an agreement with the EPMMQ, under terms and conditions satisfactory to the Bank. | Frequency: Yearly		Complied with	☐		No Change
IBRD-8285		Finance Agreement: Operational Manual | Description: Schedule 2. Section I. B. The Borrower shall, and shall cause the EPMMQ to, carry out the Project in accordance with the provisions of the ROP, which sets forth the rules and procedures for the carrying out of the Project | Frequency: Yearly		Complied with	☐		No Change
IBRD-8285		Finance Agreement: Institutional Arrangements | Description: Schedule 2. Section I. A. The Borrower shall cause the EPMMQ to maintain, throughout the implementation of the Project, key staff for the Project including without limitation, a		Complied with	☐		No Change

		Project coordinator, a procurement specialist, a financial management specialist, an environmental specialist, a social specialist, a physical cultural resources specialist and a health and safety specialist. | Frequency: Yearly					

Conditions

Source of Fund	Name	Type
IBRD	Update Subsidiary Agreement	Effectiveness

Description of Condition

The Subsidiary Agreement has been updated in a manner satisfactory to the Bank.

Source of Fund	Name	Type
IBRD	ROP updated for resettlement expenditures	Disbursement

Description of Condition

No withdrawal shall be made for payments under Category (3) of eligible expenditures, until the ROP has been updated to include the arrangements for the process and procedures for control, approve and monitor cash and in-kind compensations for Resettlement Expenditures, under terms and conditions satisfactory to the Bank.

Source of Fund	Name	Type
IBRD	Provision for Retroactive Financing	Disbursement

Description of Condition

No withdrawal shall be made for payments made prior to the Signature Date, except that withdrawals up to an aggregate amount not to exceed $ 46,000,000 equivalent may be made for payments made twelve months prior to this date, for Eligible Expenditures under Category (1) and Category (2).

Risk

Risk Category	Rating (H, S, M, L)
1. Political and Governance	Substantial
2. Macroeconomic	High
3. Sector Strategies and Policies	Substantial
4. Technical Design of Project or Program	Moderate
5. Institutional Capacity for Implementation and Sustainability	Substantial
6. Fiduciary	High
7. Environment and Social	High
8. Stakeholders	High
9. Other	High
OVERALL	High

Finance

Loan Closing Date - Additional Financing (Additional Financing Quito Metro Line One Project - P158756)

Source of Funds	Proposed Additional Financing Loan Closing Date

International Bank for Reconstruction and Development	31-Dec-2020

Loan Closing Date(s) - Parent (Quito Metro Line One - P144489)

Explanation:

The closing date of the Original Financing would be extended from December 31, 2018 to December 31, 2020 to match the closing date of the Additional Financing.

Ln/Cr/TF	Status	Original Closing Date	Current Closing Date	Proposed Closing Date	Previous Closing Date(s)
IBRD-82850	Effective	31-Dec-2018	31-Dec-2018	31-Dec-2020	

Allocations - Additional Financing (Additional Financing Quito Metro Line One Project - P158756)

Source of Fund	Currency	Category of Expenditure	Allocation	Disbursement %(Type Total)
			Proposed	Proposed
IADB	USD	Part 2 of the project	250,000,000.00	39.54
		Total:	250,000,000.00	
IBRD	USD	Works, goods, and non-consulting services under Part 2 of the project	225,000,000.00	35.59
IBRD	USD	Works, goods, and non-consulting services, consulting services and training under Part 5 of the Project	3,850,000.00	0.61
IBRD	USD	Resettlement expenditures	1,150,000.00	0.18
		Total:	230,000,000.00	
CAFL	USD	Part 2 of the project	152,200,000.00	24.07
		Total:	152,200,000.00	
		Total:	632,200,000.00	100.00

Components

Change to Components and Cost

Explanation:

Change to Costs of Components 1, 2, 3 and 4
Higher than estimated costs total US$509.9 million. The main causes of the cost changes are higher costs of Component 2 than those estimated at appraisal. Following cost optimizations and renegotiation, the final contract price was US$440.9 million higher than originally estimated. The remaining gap of US$69 million refers to additional works, minor adjustments in prices, and small changes in expropriation expenditures. In

addition, some of the financing sources that had been committed at the time of project appraisal did not ultimately materialize and could not be replaced by alternative sources. Annex 3 includes a more detailed explanation of this change in cost.

Restructuring and Scaling up Component 5
Component 5 will be restructured to implement new/modified activities in line with the PDO and to scale up to incorporate additional activities to support environmental and social safeguards activities, with an increase in financing from US$5 million to US$10 million. As shown in Annex 2, Component 5 will include activities under three categories: (i) technical assistance to support project implementation; (ii) technical assistance studies to support the implementation of the SITP; and (iii) implementation of social and environmental safeguards (ESS) measures and technical assistance to support implementation of these measures, including compensations related to resettlement expenditures. Annex 2 presents the final list of activities under Component 5.

Among key activities currently financed in Component 5 there are consulting services, such as the studies to update project demand forecasts, support the management of the FIDIC contract (the type of contract used for Component 2), studies to incorporate a gender perspective in the SITP, and studies to support project implementation and integration with the public transport network. New activities will now be incorporated to address arising needs on readiness for O&M and integration with the existing transport system. These activities will strengthen the EPMMQ's capacity to address the main institutional and operational challenges related to the launch of the transport service, such as coordination and integration with other transport modes, and management of O&M contractors.

Component 5 will also finance the required ESM activities for 2018 and 2019, which will allow the EPMMQ to further mitigate and compensate social impacts. They include those resulting from project execution, such as those related to involuntary resettlement, economic displacement, and cultural heritage. The also include activities to improve environmental health and safety management (including traffic management, occupational health and safety).

The AF will bring additional resources in the amount of US$5 million, resulting in total of US$10 million for Component 5. Following restructuring, Component 5 will be renamed as Institutional Studies, Safeguards and Project Implementation Supporting Activities. In addition, the Loan Agreement for the AF will incorporate new expenditure categories for Component 5 to accommodate new types of activities beyond consulting services such as works and resettlement-related expenditures.

Current Component Name	**Proposed Component Name**	**Current Cost (US$M)**	**Proposed Cost (US$M)**	**Action**
1. Construction of Two Metro Stations of the Quito Metro Line One	1. Construction of Two Metro Stations of the Quito Metro Line One	83.91	124.00	Revised
2. Infrastructure and Equipment Investment for the Quito Metro Line One	2. Infrastructure and Equipment Investment for the Quito Metro Line One	1175.96	1650.20	Revised
3. Provision of Train Sets to Operate in the Quito Metro Line One	3. Provision of Train Sets to Operate in the Quito Metro Line One	192.82	183.60	Revised

4: Project Management	4. Project Management	47.25	47.00	Revised
5: Technical Studies to Support Project Implementation	5: Institutional Studies, Safeguards and Project Implementation Supporting Activities	5.60	10.00	Revised
	Total:	1,505.54	2,014.80	

Other Change(s)

Change in Procurement

Explanation:

The additional funding for the civil works contract under Component 2 does not result in any new procurement activities or new works (beyond ongoing contract management) and will continue to be regulated by the IADB's Procurement Rules, approved at the time of appraisal. However, Component 5 will have new activities to be procured. These activities will be covered under World Bank Procurement Regulations for Borrowers under Investment Project Financing (IPF), dated November 2017. They are applicable to the procurement of goods, works, non-consulting services and consulting services for IPF operations of all loans approved after July 2016, in accordance with the provisions of paragraph 2.1 of the Regulations.

The Borrower has prepared Project Procurement Strategy for Development (PPSD) and a Procurement Plan. The new activities that will be procured are expected to be small-value procurement of goods, non-consultancy services, and consultancy services to support project implementation and to strengthen project management capacity, including ESS activities, under Component 5. Because these are expected to be low-risk and low-value activities, they will be defined in the agreed Procurement Plan using the current procurement thresholds, which are found to be fully applicable to the type of activities to be procured. Any changes to these conditions will be reflected in the PPSD and the Procurement Plan throughout the duration of this AF.

Change in Implementation Schedule

Explanation:

The implementation schedule was revised to reflect the new closing date of December 31, 2020. The closing date is extended to accommodate delays given that the higher-than-estimated project costs generated the need to conduct contract negotiations, to review the reference budget to assess the benchmark of similar projects and to search for additional financing sources to cover the gap.

Appraisal Summary

Economic and Financial Analysis

Explanation:

Economic analysis
An update of the project' economic analysis shows that it remains economically viable, even after the cost increase. The lowest bid for Component 2 was 44.7 percent higher than estimated at appraisal. Under conservative assumptions, the project's updated net present value (NPV) is US$4.315 billion, with an economic internal rate of return (EIRR) of 12.09 percent for a 35-year evaluation period (including five years of construction and 30 of operation). A sensitivity analysis shows that the results are robust. The main risks for economic viability are cost overruns and decreased demand.
The use of World Bank resources remains justified because of four interrelated factors. First, the project is

economically viable. Second, the project's expected outcomes and potential impact on poor and vulnerable groups are aligned with the three pillars of the Bank's CEN for Ecuador. Third, due to its global experience, the Bank adds value both supporting the construction as well as at a policy level. Fourth, the Bank's flexible loan conditions mitigate the project's fiscal impact on municipal finances.

Public-sector provision is justified because of positive externalities. The analysis shows that public-sector investment is justified because of the large initial costs that cannot be recovered through tariffs alone. Nevertheless, the economic benefits outweigh costs because of positive externalities that justify public sector provision.

In addition, the team is aligning the CBA methodology with World Bank guidelines and including best practices, including updated social discount rate, improved definition of value of time and improved definition of CO2 shadow pricing. See Annex 4 for further details on methodology, assumptions and results.

Fiscal impact analysis
The Bank has conducted due diligence to evaluate the financial projections presented by the MDMQ. This analysis has been carried out with the support of an external firm: Ernst and Young (EY) Peru and Ecuador.

Despite increased costs and the changing macroeconomic situation, the fiscal impact analysis update shows that the MDMQ can continue to afford the project. However, the MDMQ's capacity to develop new capital projects will be very limited going forward. In addition, a negative shock such as Quito Metro cost overruns, or lower-than-expected central government transfers, may cause the legal indebtedness limits to be exceeded unless the MDMQ takes actions to avoid them.

Table 1. Indebtedness indicators, 2017–2022

Indicator	2017	2018	2019	2020	2021	2022	Max. allowed by Law
Debt stock/income	56.6%	163.3%	188.3%	182.6%	169.4%	157.0%	200%
Debt service/revenue	5.8%	13.1%	14.9%	18.6%	16.0%	14.9%	25%

Source: Final analysis, EY

The MDMQ has made an adjustment to capital expenditure, prioritizing the PLMQ over other investments. The project's high capital requirements, combined with the realization of a pessimistic scenario, have hindered the MDMQ's ability to take on more debt. In turn, the city has reviewed its investment priorities and reduced or delayed its capital spending, as necessary. The MDMQ reduced its expenditures in public works, personnel spending for investments, and transfers to municipal companies (transfers and grants for investment) in 2017. The MDMQ is committed to strongly decreasing capital expenditure to accommodate the project's development.
See Annex 5 for a more detailed explanation of the study of the reference.

Technical Analysis

Explanation:

The project's physical implementation is advancing satisfactorily and demonstrating several best practices that are keeping execution within time and budget. Component 2 had a physical progress of 54.13 percent and a financial progress of 53.32 percent as of March 2018. In total, 34.54 percent of the tunnel has been built, as well as 54.61 percent of the stations, 40.16 percent of the yards and depots, and 38.5 percent of the

power supply and other systems. Good practices include: (a) the high level of detail in project engineering designs; (b) a good project management firm that has been very proactive and key in value-engineering processes and negotiations; and (c) the conduction of a small first phase of the civil works before embarking on the larger contract, which made it possible to increase implementation capacity and knowledge about local conditions. On Component 3, the rolling stock contract is advancing well, with physical progress of 11.3 percent. The first train is expected to be received in October 2018; the last train (No. 18) is expected in March 2019.

However, there are some challenges to ensure implementation readiness and timely achievement of the project's full potential benefits. These include: (a) delays in the implementation of the fare-collection system; (b) delays in the final definition and implementation of the business model for the delivery of O&M services; (c) delays in the planning and implementation of the operational integration and restructuring of BRT and conventional bus routes; and (d) the need to set up the institutional framework (public transport authority) to regulate, oversee and plan an integrated system in the medium and long terms. Although these challenges do not jeopardize project viability, they can cause delays in project implementation and reduce the project's potential benefits. In particular, the lack of proper integration with other modes can cause a 20 to 30 percent reduction in demand for the Metro, the most efficient mode.

Further details on the technical analysis are presented in Annex 3.

Social Analysis

Explanation:

The client has recently updated different social safeguards instruments and developed new analyses, assessments and audits to address compliance issues identified during several supervision missions. The Banks and the client agreed on a Remedial Action Plan (Plan de Acción Correctivo, PAC) between June and November 2017. As of March 2018, the EPMMQ has completed 95 percent of the actions. In accordance with the PAC, the EPMMQ has prepared several studies and assessments. The World Bank and the IADB hired a local firm to help the EPMMQ conduct six studies: (i) a land acquisition assessment; (ii) a social and environmental study of the Oyacoto landfill; (iii) an update the resettlement framework for the entire project and a resettlement plan for ongoing land acquisition; (iv) an analysis of impacts on street vendors located near El Ejido Park and Station; (v) an Indigenous Peoples Planning Framework (IPPF), following OP4.10, to prepare for potential landfills that might include indigenous peoples in their area of influence, the client disclosed the IPPF on May 6, 2018 and the Bank on May 7, 2018 on the client project's website and the Bank's external website respectively; and (vi) an update of the baseline and drafting of a methodology to prepare a livelihood restoration plan for any economic displacement of businesses in the area of direct influence of Metro stations.

An assessment of land acquisition to date was prepared for the three properties that were acquired without RAPs. The land acquisition assessment determined that that the amount paid had been sufficient to replace the properties that were expropriated. Because RAPs were not prepared at the time of the expropriations, the Bank will undertake the additional due-diligence measure of requiring the Borrower to engage in consultations with the affected owners, to fully ascertain that the outcomes of these expropriations are aligned with the principles of OP 4.12, and to undertake corrective actions as needed. These consultations, including any corrective action, will be reflected in a time-bound action plan, acceptable to the Bank, to be prepared by the Borrower no later than two months after the effectiveness date of the proposed additional loan, and included as a covenant in the loan agreement.

The analysis of the Oyacoto landfill confirmed that Oyacoto is a community where indigenous peoples are present, and has identified impacts and potential compensation mechanisms. Oyacoto is managed by the municipal waste management company (Empresa Municipal de Gestión Integral de Residuos Sólidos,

EMGIRS). EMGIRS and the project used this landfill from March to October 2017 without a no-objection from the banks. The study also concluded that the road through the community was not widened to serve the needs of the Metro, but that the use of these roads by construction-related trucks resulted in some social impacts, particularly damages to four houses due to vibrations caused by heavy trucks going through the community, and economic impacts on a group of 24 waste pickers, mostly women. The waste pickers reduced their recycling activities, particularly during six months in which activity in the landfill increased. The report identified that damages to the houses were adequately repaired. The report suggested a compensation mechanism to the waste pickers, to be funded by IADB's additional financing, according to an agreed timeline.

The EPMMQ has updated the original Resettlement Policy Framework. The framework covers potential future land acquisitions, economic displacement resulting from any land expropriations, and the needs of new land acquisition in the future due to value engineering or changes to or variations in the construction plans. The EPMMQ will bridge any gap between the compensation provided following the national system, and full replacement value as estimated by an independent appraiser, using funds from the loan. In addition, a RAP has been prepared to address the ongoing acquisition of properties, and any gaps resulting from the differences between national system and OP 4.12 as estimated by independent appraiser will be bridged with loan proceeds. This RAP also documents the temporary relocation of 30 street vendors within the same area of El Ejido Station. In addition, the Bank has agreed with the EPMMQ to prepare a proposal for the reintegration of vendors to the original site once the station is completed. The RAP was disclosed by the client on May 6, 2018 and by the Bank on May 7, 2018.

Regarding economic displacement attributed to the project, the construction has limited the access to households and formal and informal business in five work sites. This limited access has resulted in temporary economic impacts not associated with land expropriations. The EPMMQ has commissioned a new study to develop a Livelihood Restoration Plan, which will be ready by June 2018. This study will update the business and household census to better identify current and future economic impacts. It will also define a specific methodology to measure, mitigate and compensate residual economic impacts beyond cash compensations already in place.

Environmental Analysis

Explanation:

The project is classified as Category A. The AF does not entail any new project works or any new environmental impacts and risks that were not already considered in the original financing. The AF addresses a financing gap generated by a higher-than-estimated project cost and scale-up of the project's TA component to further strengthen the implementing agency's capacity and support project execution, including issues related to environmental health and safety management.

The project's environmental, health and safety plans (e.g., ESIA, PGASSH) are being implemented. The PGASSH was developed and implemented by the EPMMQ to provide an Integrated Environmental, and Social, and Health and Safety Management Plan (PGASSH) that incorporates all aspects of the project's ESIA/ESMP and further develops various environmental, social, health and safety aspects. The PGASSH is being updated, in association with the AF. The construction consortium (CL1) has implemented an Environmental Management System and a Health and Safety Management System. The independent consortium supervising the construction contract has implemented various supervision and reporting measures related to environment, health and safety. The EPMMQ has contracted an additional environmental and social auditor to supplement its own works supervision.

The only material change in the original project design is the location of the 2.6 km line section from the Quitumbe Station. The new location, which runs slightly to the west, significantly reduced potential

environmental and social impacts by avoiding cut–cover excavations in a small river and housing area. An ESIA was prepared for this new alignment, was disclosed to the public, and has been approved by the Ministry of Environment. The client disclosed the ESIA document on March 24, 2017 on client project's website, which was reviewed by the Bank and disclosed on the Bank's website on November 21, 2017.

No significant unmitigated environmental impacts or material environmental regulatory or contractual non-compliance requirements have occurred. However, specific management plans have been developed to manage soil and groundwater contamination at La Pradera Station, caused by leaks from an existing gasoline station's underground tanks (note: the PGASSH included a process for development of such plans should contamination be detected). The Ministry of Environment has approved these plans. The treatment is under implementation. The project design has incorporated various measures to minimize and mitigate potential impacts and risks. Studies of the types of soils along the route have confirmed that there is limited risk to liquefaction or collapse. A sequential method will be used for tunnel construction that provides greater safety during works and reduces the possibility of subsidence. Tunnel protection systems will be used to minimize risks of subsidence and impact on groundwater flow.

Significant works were completed for archeological collection and removal at the San Francisco Station. The archaeological campaign included, in addition to exhaustive documentation, the consolidation and extraction of some of the architectural structures, as well as such materials as ceramics, metals and bones, currently under the custody of the Municipal Institute of Heritage (Instituto Municipal de Patrimonio, IMP). The IMP, together with the National Institute of Cultural Heritage (Instituto Nacional de Patrimonio Cultural, INPC) and EPMMQ, are collaborating in the design and development of the archaeological display in the future San Francisco Metro Station, including the abovementioned structures, artifacts exhibition, and informative panels and photographs about the history and evolution of the square (Plaza de San Francisco). On the surface, the historic cobblestones were reinstalled, achieving the UNESCO mandate to keep the integrity of the square as it was prior the Metro works. The IMP is following up with UNESCO and ICOMOS on the World Heritage Committee resolutions, including the development of the mandatory State of Conservation reports (SOC).

The project had been using the Troje IV landfill (operated by EMGIRS) for disposal of excavated materials. Troje IV had received an environmental authorization from the Ministry of Environment and was receiving waste materials from a variety of sources (non-project related), operated by a firm contracted by EMGIRS. The dumpsite was legally in operation since 2015, also in agreement with the Banks. In December 2017 a significant slope failure occurred at the landfill, which resulted in the fatality of a landfill worker, and the site is presently closed. A government investigation is being undertaken to confirm the cause of the slope failure and define necessary remedial actions. At the present time, it is unclear whether the Troje IV landfill will re-open or remain closed. Based on the government's final decision, the appropriate plans (e.g., engineering, O&M, closure, EHS management, etc.) will be needed. Due to the closure of Troje IV, all project-extracted soil materials are being disposed at Bicentenario Park. However, the availability of Bicentenario Park is limited in terms of capacity and types of materials.

Due to logistical problems at Bicentenario Park, the extracted soil disposal destined for re-use at Bicentenario Park was stopped and some materials were disposed at the Oyacoto landfill. Oyacoto is a public landfill, managed by EMGIRS, and services the Quito metropolitan area. While the Oyacoto landfill is reportedly authorized by the Ministry of Environment, some social and environmental issues were identified by the Bank and formalized as part of an Environmental and Social Audit conducted under the auspices of the EPMMQ and the banks. Regarding the environmental aspects, the audit identified a potential risk for slope instability in the area at the top of a slope where project soils were disposed along with materials from other sources. The EPMMQ and EMGIRS have agreed to conduct a specific soil-stability analysis of the areas where project materials were disposed on the top of the slope, and EMGIRS

(in a study estimated to be completed by June 2018) will implement immediate actions to mark the area (i.e., identifying of potential risks, restrictions) and provide information to workers and others in the site (including waste pickers) of the potential risk and limitations/restrictions (measures estimated to be implemented by end-April 2018). The use of the Oyacoto landfill was stopped and materials are again being disposed at Bicentenario Park. The EPMMQ has confirmed in writing that Oyacoto will not be used again by the project. The updated PGASSH defines a strategy and process to assess other potential sites for project soil disposal. The PGASSH was disclosed by the client on May 15, 2018 and by the Bank on May 14, 2018, on the client project's website and Bank's external website respectively.

A number of possible alternative sites were considered to replace Oyacoto and Troje IV. After careful analysis, the site Casantopamba was selected as the best option. The EPMMQ has complied with the local regulations and the criteria specified in the PGAHSS in regard to the environmental and social safeguards policies of the Banks. Based on that information, the Banks issued the no-objections for the use of the site. The construction company (CL1) has developed and implemented a comprehensive Occupation Health and Safety Management System, which, based on project supervision and monitoring reports, has demonstrated strong performance (e.g., extensive procedures, large-scale OHS staffing, low accident rates, high levels of training, good supervision, etc.). The EPMMQ has an OHS management system component in the PGASSH. Despite these, there have been six deaths directly or indirectly associated with the project (four in November and December 2017, one in February 2018). Four are related to truck transit (e.g., movement of materials or extracted materials to/from project construction sites), one associated with a Tunnel Boring Machine (TBM) operation, and one due to the slope failure at Troje IV. The unfortunate recent fatalities in a short time period represented a significant concern and required an assessment and OHS action. In December 2017, the Bank, working with the EPMMQ, CL1 and the contracted supervision company, developed an OHS Action Plan to more completely assess the situation, define and implement actions to help reduce similar future accidents, and provide follow-up on the individual worker fatality incidents. Example actions in the plan include improving the process/procedure for fatality assessment and reporting, reviewing and updating (as needed) driver procedures and training, and reviewing and reassessing truck routes (including identification of specific risks). Annex 10 presents further details on this action plan. Significant progress has been made on the action plan. During a Bank mission in February 2018, additional follow-up measures were identified, including various measures related to road safety (e.g., installation of GPS in all trucks, etc.). No systemic issue or significant non-compliance has been id entified in relation to the fatalities. Continued follow-up work will be conducted by various parties related to the OHS Action Plan and OHS management in the project as related to fatalities. Further details on the road safety action plan have been included in Annex 10.

In order to consolidate the various environmental, social, health and safety issues identified (e.g., through Bank missions and Aide-Mémoires, environmental and social performance reports, supervision and audits) and assess overall compliance associated with the request for Additional Financing to various banks, an Environmental and Social Corrective Action Plan (PAC, the initial version of which was developed in the third and fourth quarters of 2017) was contracted by the IADB. The EPMMQ and the project have been working diligently to implement the PAC, and as of April 2018 approximately 96.7 percent of the recommended actions have been completed. The PAC was disclosed by the client on their external website on May 6, 2018 and by the Bank on its external website on May 10, 2018.

The environmental risk remains high due to the magnitude of project construction works, potential environmental health and safety impacts and risks, and the range of their associated mitigation and monitoring measures. Some key issues continue to exist: ongoing management and EHS performance of all contractors and sub-contractors due to numerous work locations/sites and workers; safe and environmentally correct construction at La Pradera Station due to existing contamination; limited resources available for the EPMMQ's Department of Social Responsibility; resolution of issues associated with

extracted soil management, including area(s) for the remaining project soils and resolution of the Troje IV situation; and implementing actions to address recent project-related worker fatalities. These issues have been identified during Bank missions and as part of the AF preparation, and have been added to the project's requirements.

The proposed AF (Component 5) provides specific additional resources to assist in enhancing institutional capacity, including the hiring of consultants to provide additional technical support, training and execution of technical studies.

Risk

Explanation:

All risks remain the same as in the parent project, except for the macroeconomic risk rating, which increases from Substantial to High, and the stakeholder risk, which increases from Moderate to High.

Macroeconomic risk rating increases to High. Since the appraisal of the original loan, the Municipality of Quito's financial position has been exposed to high macroeconomic volatility. Quito's municipal finances are highly dependent on central government transfers, which in turn have been affected by low international oil prices, the availability of external financing, and volatile economic growth. Although the economy started to grow in recent quarters, it is still highly dependent on external debt to finance a large fiscal deficit and to keep the money supply growing. The government's goal of gradual fiscal consolidation is also exposed to the availability of external financing that could be undermined by increasing international interest rates and lack of a comprehensive medium-term macroeconomic management program. In addition, the policy space to deal with a new external shock is constrained by the Central Bank's low level of liquid assets and the exchange rigidity resulting from dollarization. In this context, a decrease in external financing may reduce the fiscal space for investment. A decrease in external financing may cause a deceleration in economic growth, which in turn may curb the demand for Metro's services, to the detriment of assumed benefits. On the other hand, although a negative shock could reduce the Central Government's transfers to the municipality, the risk of inadequate maintenance of transport infrastructure is not high, according to the Municipal Finance Assessment. Similarly, the government's efforts to prevent dollar outflows by constraining imports may have limited impact on the availability or cost of imported inputs because, according to the institutional arrangements in place, the municipality undertakes imports on behalf of the contractor. As a result, the macroeconomic risk rating was increased from Substantial to High.

Stakeholder risk rating increases to High. The project has had a significant impact during construction that so far has been adequately managed. Inappropriate management of these impacts can place project implementation progress at risk. Given the potential environmental and social liability issues from the use of the Oyacoto dumping site (managed by EMGIRS), as well as the potential impacts on businesses around the corridor, the rating increases to High, to reflect the need to address and mitigate such risks.

Political and governance risk is rated Substantial. The project requires a high level of inter-institutional coordination for implementation. Although coordination between the central and municipal governments has improved, the project remains subject to political and governance risks.

Sector strategies and policies risks are still rated Substantial. Urban transport policies are highly relevant for the project to develop its maximum potential benefits. Proper multimodal integration would ensure system-level efficiency. Without integration, the Metro (the most efficient mode) would carry from 20 to 30 percent fewer passengers per day. Coordination of transport and urban planning policies can also help achieve long-term benefits. The city of Quito is making an effort to ensure this coordination at a system level, as well as at specific locations.

The risk rating for the project's technical design continues to be Moderate. Because the Borrower has commissioned detailed project designs, and works implementation has progressed to date, there is less risk that unexpected issues will arise. Despite an underestimation of indirect costs, direct costs were reasonably estimated. The project is so far not experiencing cost overruns during implementation and remains at the lower end of international benchmark prices for underground metros.

Institutional capacity for implementation and sustainability risks is still considered Substantial. The EPPMQ's budget has been reduced as a result of city-wide budget cuts. The EPMMQ continues to depend on the hiring of specialized advisors, such as the strategic project management consultant, in order to be able to adequately manage the civil works contract. As the project transitions into the operational phase, the EPMMQ will continue to require specialized external support. To date, the project management consultant has performed well and has mitigated institutional capacity risks. The MDMQ is still evaluating the business model for the Metro system's O&M. Although the MDMQ has opted for a private participation model, the specifics of the transaction structure are still being defined. A delay in the implementation of this model would negatively affect the launch of project operations.

The fiduciary risk rating remains High because of the limited experience of the implementing agency, EPMMQ. This risk is heightened by implementation arrangements that require close coordination between the EPMMQ and MDMQ and by the use of different sources of funding and bank accounts.

Environmental and social risks remain High (see environmental and social appraisal summaries).

The environmental and social risk remains High due to the magnitude of project construction work, environmental health and safety impacts and risks, and the range of associated mitigation and monitoring measures. Some key issues continue to exist: ongoing management and EHS performance of all contractors and sub-contractors due to numerous work fronts/sites and workers; continued and complete implementation of all environmental, social, and health and safety required actions (e.g., in the PAC, Oyacoto Environmental and Social Audit Report, Occupational Health and Safety Action Plan); safe and environmentally correct construction at La Pradera Station due to existing soil and groundwater contamination; resolution of issues associated with extracted soil management, including area(s) for the remaining project soils and resolution of the Troje IV situation; resolution of the existing limited resources available for the EPMMQ's Department of Social Responsibility (GRS) due to overall budget reductions in the EPMMQ, which have led to some issues with the overall EHS management and PGASSH implementation; and implementation of actions to address recent project-related worker fatalities.

IV. WORLD BANK GRIEVANCE REDRESS MECHANISMS

30. **Communities and individuals who believe that they are adversely affected by a World Bank- (WB) supported project may submit complaints to existing project-level grievance redress mechanisms or the WB's Grievance Redress Service (GRS).** The GRS ensures that complaints received are reviewed promptly in order to address project-related concerns. Project-affected communities and individuals may submit their complaint to the WB's independent Inspection Panel which determines whether harm occurred, or could occur, as a result of WB non-compliance with its policies and procedures. Complaints may be submitted at any time after concerns have been brought directly to the World Bank's attention, and Bank Management has been given an opportunity to respond. For information on how to submit complaints to the World Bank's corporate Grievance Redress Service

(GRS), please visit http://www.worldbank.org/GRS. For information on how to submit complaints to the World Bank Inspection Panel, please visit www.inspectionpanel.org.

The World Bank

ANNEX 1: RESULTS FRAMEWORK AND MONITORING

Country: Ecuador

Project Name: Quito Metro Line One (P144489)

Results Framework

Project Development Objectives

PDO Statement

The proposed Project Development Objective (PDO) is to improve urban mobility in the city of Quito by serving the growing demand for public transport. The project will reduce travel times, decrease operational costs of the transport service, improve the current system's connectivity, security and comfort, and reduce emissions of pollutants and greenhouse gases (GHGs).

These results are at	Project Level

Project Development Objective Indicators

Indicator Name	Baseline	Cumulative Target Values								
		YR1 2013	YR2 2014	YR3 2015	YR4 2016	YR5 2017	YR6 2018	YR7 2019	YR8 2020	End Target (2021)
1. Passengers per day in PLMQ (number)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	295999.00	295999.00
2. Travel time for public transportation users (minutes)	38.50	38.50	38.50	38.50	38.50	38.50	38.50	38.50	23.10	23.10
3. Operating costs of Quito's vehicle fleet (amount [USD])	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-59400000.00	-59400000.00
4. GHG emissions from transport in MDMQ (tons/year)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-58170.00	-58170.00
5. Adequate passenger capacity is provided by PLMQ (Yes/No)	No	No	No	No	No	No	No	No	Yes	Yes

6. Percentage of users satisfied with overall Metro service, its security and comfort, differentiated by gender and income (percentage)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	65.00	65.00
6.1 Percentage of female users satisfied with overall Metro service, its security and comfort (percentage)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	65.00	65.00
6.2 Percentage of low-income users satisfied with overall Metro service, its security and comfort (percentage)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	65.00	65.00
7. Percentage of jobs accessible in 60 minutes of travel time (percentage)	45.3	45.3	45.3	45.3	45.3	45.3	45.3	45.3	50.8	50.8

Intermediate Results Indicators

Indicator Name	Baseline	Cumulative Target Values								
		YR1 2013	YR2 2014	YR3 2015	YR4 2016	YR5 2017	YR6 2018	YR7 2019	YR8 2020	End Target (2021)
% of physical work progress in civil works other than stations (percentage)	0.00	0.00	0.00	0.00	4.17	34.54	70.00	100.00	100.00	100.00
% of physical work progress in stations and universal access (percentage)	0.00	0.00	0.00	0.00	5.08	54.61	75.00	95.00	100.00	100.00
% of physical work progress in rail yard (percentage)	0.00	0.00	0.00	0.00	1.26	40.16	70.00	100.00	100.00	100.00
% of progress in installation of power supply, auxiliary, signaling and telecom systems (percentage)	0.00	0.00	0.00	0.00	0.00	11.26	50.00	80.00	100.00	100.00
% of rolling stock completed (percentage)	0.00	0.00	0.00	0.00	0.00	11.12	20.00	100.00	100.00	100.00

% of fare-collection system installed (percentage)	0.00	0.00	0.00	0.00	0.00	0.00	10.00	60.00	100.00	100.00
% of Metro feeder routes in operation (percentage)	0.00	0.00	0.00	0.00	0.00	0.00	0	10.00	15.00	15.00
% of MDMQ bus fleet under unified fare-collection system (percentage)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00	25.00	25.00
% of progress in installation of permanent way (percentage)	0.00	0.00	0.00	0.00				80.00	100.00	100.00
Implementation of a reporting mechanism for cases of violence against women and girls in the PLMQ (Yes/No)	No	No	No	No	No	No	No	No	Yes	Yes
Percentage of technical and professional staff, directly employed by the operator of the PLMQ, that is female.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20.00	20.00

ANNEX 2: DETAILED DESCRIPTION OF COMPONENT 5

Country: Ecuador

Project Name: Quito Metro Line One (P144489)

1. The table below includes the current studies and activities that were envisioned under Component 5 of original loan and that were added to the scaled-up Component 5. The table is classified in three categories: (i) technical assistance to support project implementation; (ii) technical assistance studies to support the implementation of the SITP; and (iii) implementation of social and environmental safeguards (ESS) measures and technical assistance to support the implementation of these measures.

Table 2.1: Studies and Activities to be procured under Component 5

#	ACTIVITY NAME	ESTIMATED BUDGET	START DATE	END DATE
Activities envisioned under original loan				
I. Technical assistance studies to support project management				
1	Quito Metro business model and structuring of Metropolitan Public Company Metro de Quito. It includes a study of the model of development, management and administration of the PLMQ's non-tariff revenues	$1,895,000	6/7/2018	22/10/19
2	FIDIC Advisory Contract	$30,000	10/10/2017	25/02/18
3	Study of the development of the control system and asset management for the PLMQ	$195,000	15/06/18	25/03/19
	SUBTOTAL	**$2,120,000**		
II. Technical assistance studies to support the implementation of the SITP				
4	Update of the demand model for the PLMQ	$200,000	31/10/17	18/04/18
5	Urban Development Study related to the PLMQ and Public Transport System.	$550,000	25/07/2018	25/11/2019
6	Study of intermodality and promotion of public transport	$250,000	1/6/2018	11/12/2019
7	Development of the strategy for the promotion of Metro culture	$300,000	21/5/2018	29/05/19
8	Incorporation of the gender perspective in the Integrated Public Transport System of the Quito Metropolitan District	$178,000	14/02/18	14/02/19
9	Implementation of prevention mechanisms for addressing and reporting violence and sexual harassment against women and girls in the Integrated Public Transportation System of the Quito Metropolitan District	$100,000	30/06/18	27/12/18
	SUBTOTAL	**$1,578,000**		
III. Implementation of social and environmental safeguards (ESS) measures and TA				
10	Monitoring	$500,000	18/06/18	15/06/19
11	Remediation of environmental liabilities at Oyacoto site (PAC)	$150,000	4/6/2018	2/6/2019
12	Updating of value of archeological finds in Plaza San Francisco	$50,000	5/7/2018	3/9/2018

13	Annual hazardous waste statement (2017)	$30,000	28/02/18	29/04/18
14	Annual hazardous waste statement (2018)	$30,000	4/10/2018	3/12/2018
15	Technical support for implementation of Component 5	$34,000	9/3/2018	29/03/18
16	Update of the EI assessment for the operation of the PLMQ	$300,000	6/10/2018	4/4/2019
17	Contingency for the ESS measures	$208,000	15/10/18	15/10/19
	SUBTOTAL	**$1,302,000**		
	Total activities Comp 5 (original loan)	**$5,000,000**		

Activities added for the scale up under AF

III. Implementation of social and environmental safeguards (ESS) measures and TA				
1	Support for supervision of safeguards in project plans	$100,000	1/3/2018	1/5/2019
2	Soil and water remediation outside La Pradera Station	$1,500,000	1/1/2019	15/05/19
3	Support for occupational, health and safety management	$250,000	15/04/18	15/05/19
4	Contingency for land expropriations	$1,150,000	15/10/18	15/010/19
5	Contingency for extracted soil management activities	$2,000,000	15/10/18	15/10/19
	SUBTOTAL	**$5,000,000**		
	Total activities Comp 5 (AF)	**5,000,000**		
	Total activities Comp. 5 (original + AF)	**$10,000,000**		

2. The World Bank is currently working with the client on grouping some of the studies under each of the categories, to expedite the implementation of procurement processes and facilitate the management and supervision of these activities. Given the recent updates in the PAC and its activities, the EPPMQ decided that a contingency plan would be necessary. This contingency plan includes continued implementation support until the closure of the project, and unforeseeable needs that might arise. This contingency brings Component 5 from the current US$5 million to US$10 million (an increase of US$5 million).

3. Other project co-financiers, mainly the IADB and CAF, are also financing complementary technical studies and institutional strengthening activities. According to the Principles of Collaboration, the World Bank has coordinated with the EPMMQ and the co-financiers in the definition and implementation of these activities to increase effectiveness and value. Co-financiers are working together with a contact point established by the MDMQ to ensure that these activities are coordinated.

4. In addition to the TA executed by the client under Component 5, the World Bank is providing strategic additional analytical support financed by trust funds and is assisting the Borrower with advice provided by the Urban Mobility Global Solutions Group (UM GSG), including:

a) *Seismic and Hydrologic Risk Management*. The World Bank conducted an analysis of the project's resilience to seismic and hydrologic risk, funded by the Global Facility for Disaster and Recovery (GFDRR). Annex 7 summarizes the results of this activity.

b) *Transit-Oriented Development (TOD):* This activity seeks to identify the most important accessibility nodes—stations or groups of stations—in Quito's Hierarchically Integrated Transit System (HITS). A key element of the HITS in Quito is the extensive Bus Rapid Transit (BRT) system (Metrobus-Q). Once operational, the Quito Metro Line One Project will become the backbone of the HITS. Progress has been made in improving the TORs for the TOD/Land Value Capture (LVC) studies under the original loan. The team decided to merge both TORs into a single study that will cover three topics: (i) a more top-down approach; (ii) a more bottom-up approach; and (iii) an institutional vehicle/framework for implementation. This activity is financed by the Quality Infrastructure Trust Fund (QII).

c) *Private participation in the O&M of the Quito Metro Project*. This TA activity comprises the definition of a business case for the private O&M of the Metro Project. This activity is being financed by the Global Infrastructure Facility (GIF).

d) *Other areas of support*: The Bank has provided support in other areas such as: (a) the grievance and redress mechanism (GRM); (b) accessibility analysis (see Annex 6); (c) sustainable municipal financing (see Annex 5); (d) diagnosis and restructuring options for the Metrobus-Q; and (e) a study tour to strengthen institutional coordination and the implementation of the SITP, as it is known locally or HITS as referred to above.

The table below summarizes the analytical support provided by the World Bank.

Table 2.2: Analytical support provided by the World Bank

	TECHNICAL STUDY	FINANCING SOURCE
1	Metro Technical Assistance (operational model, institutional restructuring and capacity building for the EPMMQ)	GIF
2	Modal choice model for the Metropolitan District of Quito's transportation model	IBRD BB
3	Seismic risk management	GFDRR
4	Transit-Oriented Development (TOD)	QII
5	Business model for the Metro's operational phase and support to feasibility studies for the use of an IBRD guarantee to enable commercial bank financing for the MDMQ	GIF
6	Grievance and redress mechanism (GRM)	Bank Budget
7	Accessibility analysis	Bank Budget
8	Sustainable municipal financing	Bank Budget
9	Restructuring of the Metrobus-Q	PPIAF
10	Studies of municipal financing	PPIAF
11	Study-tour activities on transport integration	SSKE

ANNEX 3: TECHNICAL ANALYSIS
Country: Ecuador
Project Name: Quito Metro Line One (P144489)

1. **The three sections of this annex describe the project's most relevant technical aspects that justify the AF.** The first section describes the project implementation status as of March 2018, including main challenges and technical risks. It concludes that the project remains technically viable. The second section summarizes the analysis of the original higher than estimated cost that motivate the AF. It explains the main reasons for higher than estimated cost when compared to the original project cost estimates made by the project design consultant and used in the appraisals of the four banks. It also shows that despite the higher than estimated cost, the project is at the lower end of international benchmark prices for underground metros and continues to be technically viable and cost efficient. The third section briefly summarizes main institutional features and topics.

Project implementation

2. Despite implementation challenges, project implementation is advancing well and the project remains technically viable.

3. **Civil Works**. Component 1, which comprises the construction of two intermodal stations, was delivered on April 30, 2015. Implementation of this component allowed the EPMMQ to gain experience and provided additional information on Quito's soils. As of March 2018, physical progress for the Component 2 civil works contract was 54.13 percent of the planned scope and financial progress was 53.32 percent of the planned cost as of that date. In total, 34.54 percent of the tunnel, 54.61 percent of the stations, 40.16 percent of the train yard and shops, and 11.26 percent of the trains have been completed. The works are advancing very well with the three Tunnel Boring Machines (TBMs) setting world records. For example, the Guaragua TBM is drilling an average of 54 m/day which is no doubt a world record. This will compensate for some initial stoppages that were due to unidentified utilities' interferences (Santa Maria water main), hydrostatic pressure at the Solanda Station that had not been caught in original surveys, and the contamination of the La Pradera Station area due to fuel spills.

4. The EPMMQ is successfully addressing the main technical implementation challenges in the civil works contract: (a) contaminated soils in La Pradera Station, and (b) availability of sites to dispose of extracted soil material. Soils and groundwater contaminated with gasoline products (including volatile components) create the risk of potential explosion during construction around La Pradera Station, in addition to the environmental liability of contaminated soils and groundwater management and disposal. The EPMMQ is successfully addressing the problem by cleaning up the contaminated right-of way area and treating the terrain to allow the TBM to pass through and the station works to continue. These activities are being conducted in consultation with the Quito Secretariat of Environment and with its approval.

5. In terms of the availability of disposal sites, the city will use Bicentenario Park, at the north terminal of the Metro Line, to accommodate non-contaminated excavation materials. Bicentenario Park is in the decommissioned Mariscal Sucre Airport and will be transformed into a green area that will serve the surrounding neighborhoods. After the Troje IV landfill was closed due to a mudslide (slope failure), the EPMMQ managed to increase Bicentenario Park's capacity to handle excavation material, and is

assessing the need for other sites. The EPMMQ is working jointly with the Bank's safeguards team to find a suitable solution to soil disposal that complies with all requirements. number of possible alternative sites were considered to replace Oyacoto and Troje IV. After careful analysis, the site Casantopamba was selected as the best option. The EPMMQ has complied with the local regulations and the criteria specified in the PGAHSS in regard to the environmental and social safeguards policies of the Banks. Based on that information, the Banks issued the no-objections for the use of the site.

6. It is important to highlight several best practices that are keeping the civil works within budget and mitigating risks: (a) the original project designs have a good level of detail, which would have been even better if more money for soil surveys and a value-engineering exercise had been made available before the bidding process; this could have partially prevented the higher than estimated cost at the bidding stage; (b) the existence of an experienced project management consultant in charge of project management oversight, design review and optimization; (c) a strong supervision consultant; (d) the experience gained with the implementation of Component 1, prior to embarking on the larger contract for Component 2; and (e) a well-thought project alignment at the design stage that minimized social and environmental impacts during construction (all stations are in public spaces) without compromising system efficiency from a demand standpoint. The good level of detail in project engineering designs and equipment specifications is a good practice to be emulated in the region and has proved useful because after the contract was awarded, the costs are not increasing during project implementation. The project management and supervision firms have been crucial in keeping the project going because the EPMMQ is a nascent organization that needs their support and advice to effectively manage the project. The management consultant is actively supporting implementation by proposing solutions to emerging problems, devising alternatives, and participating in value-engineering processes and optimization negotiations. This is another best practice to be emulated in future metro projects. Quito conducted an initial phase of the civil works, comprising the construction of two intermodal stations (La Magdalena and El Labrador). This phase amounted to less than 10 percent of the value of the second phase. It allowed the EPMMQ to gain experience in conducting a bidding process and coordinating with public and private agencies. The well-thought alignment has reduced social risks associated with land acquisition while allowing for efficient physical integration and network planning.

7. **Rolling Stock:** The rolling stock contract is advancing well, with physical progress of 11.2 percent. The Municipality of Quito used local procurement rules to conduct an international competitive bidding process that resulted in the award of a US$183.6 million contract to Spanish manufacturer CAF for 18 six-car trains (a total of 108 cars). The advance payment was issued in December 2016, receipt of the first train is expected to take place in October 2018, and the final train delivery is scheduled for March 2019. The EPMMQ hired the firm INECO to supervise the train manufacturing. Because the rolling stock is not included in the main contract for civil works and systems, the banks have advised the EPMMQ to include in the project management consultancy a number of specialized consultants who will guarantee the proper integration among civil works, systems and rolling stock. The rolling stock contractor is working with the civil works and systems contractor to make the necessary adaptations to the main yard and shops required to receive the train fleet, test it, and properly provide the equipment and installations to maintain it.

8. **Systems:** The project's systems *(instalaciones)* subcomponent, which includes signaling, telecom, electrification, operations control center, distribution of energy, fire control, stairways, ventilation, and auxiliary systems, is at 11.26 percent completion as compared to the planned 12.35

percent. This means that most of this subcomponent is at the design stage. Most systems need to wait for the completion of civil works to be installed. The municipality is responsible for managing imports on behalf of the contractor. The management company is doing its best to ensure that the EPMMQ, through the municipality, approves supply orders to manufacturers so that they can begin the process and deliver the main components on time. So far none of these systems is on the critical path for completion, but during recent missions the project team has emphasized the importance of fast response on supply orders by the EPMMQ. There is also a clear need to quickly make available the operating and signaling plans, and the GMQ is now staffed with appropriate personnel to handle these tasks.

9. **Operating Model:** The EPMMQ has indicated its preference for private=sector operation of Line 1 because it recognizes that this model will reduce the size of its staff and the financial burden on the municipality. To evaluate the feasibility of a public–private partnership (PPP) for the operation and maintenance of Line 1, an EPMMQ study evaluated several options that are now being fine-tuned by a subsequent study financed through a Global Infrastructure Facility (GIF) grant and executed by the Bank. This subsequent study will be ready by April 2018 and, in case a PPP is considered viable, the Metro will proceed to the transaction structuring stage. In parallel, an option for a public-sector operation, such as the one undertaken in Panama's Line 1, is being studied in case the PPP is not considered viable. The project team is urging the EPMMQ to speed up this process because the definition of the operating model is crucial for other subcomponents.

10. **Fare Collection**. The EPMMQ is working on the bidding documents for the Metro's fare-collection system. In parallel, the city is planning a concession for the entire fare-collection system, which will serve the BRT network, the future Metro, the cable-car system, and eventually the conventional bus system. The procurement of a sector-wide ticketing system became the responsibility of the Secretariat of Mobility, which was advised by a specialized fare-collection consultant. The original recommendation was to call for bids for a concessionaire to be in charge of financing and installing fare-collection systems in all modes and act as a clearing house. However, due to delays in the study, Metro would procure its own fare-collection equipment following the inter-operability guidelines issued by the Secretariat of Mobility. Alternatively, the O&M company for the Metro could provide the fare-collection system.

11. **Integrated Public Transport System (*Sistema Integrado de Transporte de Pasajeros,* SITP).** In addition to designing a project that maximizes the physical integration between the city's bus- and rail-based mass transit modes, the MDMQ has issued regulations to enforce the creation of the SITP, intended to be a Hierarchically Integrated Transport System (HITS). Municipal Ordinance *(Ordenanza Metropolitana)* 194, dated March 13, 2012, defined the SITP, also known as the Metropolitan Public Transport System, as all the interrelated constituent parts that enable the provision of public transport services with optimum quality. The principle of integration calls for system participants to progressively achieve physical, operational and financial integration. This principle is stated in Article 4 of the *Ordenanza*, which goes beyond the obligation set forth by national regulations: mandate transport cooperatives to implement a single fare-box collection system with an integrated fare. Although Quito has commissioned studies to restructure different modes, some analyses remain pending and implementation will be challenging.

12. **Despite strong policy decisions that support effective physical and tariff integration, the city still needs to improve coordination of the different bodies in charge of public transportation.**

Lack of modal and tariff integration would significantly reduce project benefits because Metro demand would likely drop 20 to 30 percent. Even in a suboptimal scenario without integration, the project would still be economically viable, as shown in the CBA analysis (see Annex 4). The project team has been working with Metro and the Secretariat of Mobility to ensure that all steps needed to produce a firm physical and tariff modal integration plan are taken and in place before Metro begins operations. The objective is to first integrate Metro and BRTs and then gradually integrate the conventional owner-operated bus system.

Financing gap

Original and Proposed Financing Structure

13. **Table 3.1 summarizes cost changes.** Net higher than estimated costs total US$509.9 million. The main causes of the cost changes are higher costs of Component 2 than those estimated at appraisal. Following cost optimizations and renegotiation, the final contract price was US$440.9 million higher than originally estimated. The remaining gap of US$69 million refers to additional works, minor adjustments in prices, and small changes in environmental and social mitigation activities related expenditures, as shown in the table.

Table 3.1. Changes in project costs (US$ millions) (excluding Component 5)

Item	Amount
Original total project cost	1,499.94*
Financing gap from Phase 2 civil work contract	440.94
Adjustments to project cost estimate (after original project cost calculation, before bidding process	34.57
Adjustments to expropriation costs	0.27
Phase 1 additional works (Isaac Albeniz and cul-de-sac)	14.40
Phase 1 VAT	11.30
Adjustments to estimated TA costs	7.31
Net budget reduction form actual rolling stock cost	(4.52)
Dumping-site' related costs reduction from institutional arrangements	(7.88)
Adjustments to contingency fund	13.50
Revised total project cost	2,009.82

*The original and revised total project costs of US$1,499 and US$2,009.82 excluded the US$5 million related to TA under component 5

14. **Original funding sources that did not materialize.** In addition to the US$509.9 million higher-than-expected costs, two of the financing sources that were part of the project's original sources of funds have not been carried out: (i) a US$80 million financing involving the securitization of revenues accruing to the MDMQ from the concession of Quito's New International Airport (NAIQ); and (ii) a US$157.15 million loan from the publicly owned Bank of the Ecuadorean Social Security Institute (*Banco del Instituto Ecuatoriano de Seguridad Social*, BIESS). The MDMQ decided not to pursue the securitization of the NAIQ's revenues because the quantum of financing that could be raised and the price and tenor that could be obtained in the local market were not sufficiently attractive. Given these suboptimal prospects and the transaction cost associated with securitization, the Bank that airport concession

revenues be applied to the project's execution; this has not materialized. The application of these funds to the project depends on the reconfiguration of the trust fund that was established to administer these resources. On the other hand, the BIESS loan was not pursued. Instead, it was replaced by a *Banco del Estado* (BdE) US$152.2 million loan, which was approved by that institution's board of directors in August 2013. However, this replacement loan never materialized due to funding issues. Considering the unreliability of local sources of financing, the MDMQ increased the amount of own resources. The final gap totaled US$632.2 million, which the MDMQ will fill with loans from the existing project financiers.

15. **Table 3.2 below explains the financing gap per component and the sources of funds that the MDMQ plans to use to cover the financing gap, and compares them with the original costs and financing structure.** Rows in Table 3.2 refer to the cost of project components, and columns differentiate by source of financing. The financing gap, stemming from the additional costs and the need to replace sources of finance that have not materialized, totals US$632.2 million. The table shows figures excluding VAT because the national government is obliged to reimburse the VAT paid by the MDMQ, except for Component 1, which was procured by the EPMMQ and is subject to VAT.

Table 3.2: Sources and uses of funds (assuming an AF of US$230 million)

Amounts in US$ millions

	Source of Financing	Status	C1: Civil Works Phase I	C2: Civil Works Phase II	C3: Rolling Stock	C4: Project Mgt.	C5: TA	Total Project Cost
	Original project cost		83.91	1175.96	192.82	47.25	5	1504.94
A	**TOTAL REVISED PROJECT COST:**		**124**	**1650.2**	**183.59**	**47.03**	**10**	**2014.82**
B	**Total Committed Funding**		**124**	**1023**	**183.59**	**47.03**	**5**	**1382.62**
B1	**Gov. of Ecuador**		**40.69**	**690.28**	**0**	**19**	**0**	**749.97**
B11	Own Resources	Confirmed	40.69					40.69
B12	EIB	Confirmed		259.28				259.28
B13	IADB	Confirmed		186		14		200
B14	CAF	Confirmed		245		5		250
B2	**Municipality of Quito (MDMQ)**		**83.31**	**332.72**	**183.59**	**28.03**	**5**	**632.65**
B21	Own Resources	Confirmed	83.31	88.57		28.03		199.91
B22	FIEM Rolling stock	Confirmed			183.59			183.59
B23	World Bank (original loan)	Confirmed		200			5	205
B24	EIB (AF)	Confirmed		44.15				44.15
B25	*Banco del Estado (BdE)*	*Cancelled*						157.15
B26	*BNDES*	*Cancelled*	*Initially planned US$250.94 million to close the financing gap*					0
B27	*Securitization of NAIQ*	*Cancelled*						80
C (A-B)	**MDMQ total financing gap**		**0**	**627.2**	**0**	**0**	**5**	**632.2**
D	**Financing sources identified or in preparation**							**632.2**
D1	CAF (AF)	In preparation						152.2
D2	IADB (AF)	In preparation						250
D4	IBRD (AF)	In preparation						230
E (C-D)	**Remaining Financing needs**							**0**

Cause of higher-than-estimated costs in Component 2 contract

16. **The four banks undertook due diligence[12] that identified the incorrect estimation of indirect costs in the reference budget as the main cause of the higher-than-estimated costs.** Indirect cost estimates were 52 percent lower than the average for the bids. Differences in the indirect costs explain more than half of the higher than estimated cost in the two lowest-evaluated bids. In addition, the Ecuadorean market shows that indirect costs can be as much as 70 percent higher[13] than the level seen for projects in other regions. Possible causes for this underestimation are: (a) the high cost of doing business in Ecuador; (b) a potentially higher political-risk perception on the part of bidders, resulting from the change in the city's administration that occurred prior to bid submission; (c) geological and other project risks for which bidders likely built cost allowances into their proposals; and (d) different profit structures.

17. **The analysis did not identify any substantial miscalculation of direct costs.** The analysis identified several patterns that suggested inaccuracies in unit-price estimation. However, none of these possible inaccuracies was substantial or explains a significant percentage of the higher than estimated cost. The analysis identified several items that showed a pattern in terms of deviations among bids relative to the estimated cost. These deviations corresponded to cost over- and under-estimations. However, they had no significant impact on the total direct cost estimation. The estimated direct cost was 22 percent lower than the average direct costs in the bids. This is consistent with the level of detail of the designs prepared by Quito Metro, which prevented a greater deviation from the reference budget.

18. **Reasons for the underestimation of direct costs.** The factors that bidders take into account to calculate prices appear to have been different from those of the project designer. These factors include: different and more risk-averse cash-flow considerations (factors of implementation schedule, competitive advantages, agreements among the different companies forming the consortium); different levels of risk tolerance (a risk-averse bidder may prefer to increase the weight of less volatile items in its proposal); and different construction strategies. Because this is the first project of this type in Ecuador and the largest civil works project in the country to date, it is possible that project designers did not have the proper reference to properly estimate the cost of doing business in the country and followed strategies that are more common in Europe where the degree of competitiveness is higher and the risk and profit margin is lower.

19. **The analysis also showed that, despite the differences in indirect costs, the price of the lowest-evaluated bid was within the lower range in the market for recent metro projects**. The per-kilometer cost of the Quito Metro Line 1 Project is still one of the lowest in the world, as shown in the table 3.3 below.

[12] A full report is available in WBDocs.
[13] We analyzed eight infrastructure projects in Ecuador and found indirect cost values ranging from 30 to 40 percent, and averaging 34.2 percent.

Table 3.3: Comparison[14] of similar metros' cost/km

Metro	Km	% Tunnel	Cost/Km (US$ Million)	Comments
Santiago Metro Line 6	15.3	100	67.7	98%; bidding completed 2014
Santiago Metro Line 3	22.0	100	78.3	98%; bidding completed 2014
Lima Metro Line 2	34.5	100	131.3	Bidding completed 2014 (now should be closer to 160)
Quito Metro Line 1	22.7	100	88.0	Estimated rolling-stock costs included
São Paulo Metro Line 5 (Phase 2)	12.0	100	261.1	Bidding completed 2009; construction underway
São Paulo Metro Line 4)	14.0	100	120.0	Only Phase 1, 2002
Panama Metro Line 1	13.5	53.2	138.7	Bidding completed 2009
Kunming Line 3 (China)	19.54	100	87.6	Bidding completed 2011
Nanchang Line 2 (China)	23.78	100	108	2013
Madrid (Lines 1, 2, 3, 4, 5, 7, 10, 11)	53.13	100	90.24	2003–2007

Source: Jorge Rebelo, international rail infrastructure consultant

EPMMQ response

20. **The EPMMQ transferred some components to other agencies and conducted a value-engineering exercise to reduce costs**. In response to the cost increase, the EPMMQ engaged in negotiations with the municipality and the national management consultant undertook a value-engineering exercise to evaluate whether some of the civil works and systems could be optimized. These measures reduced the contract's higher than estimated cost to US$440.9 million and created an initial US$75 million contingency reserve for potential cost overruns and complementary soil surveys necessary to complement the original campaign which had budget restrictions. For example, this contingency reserve allowed the continuation of the value-engineering exercise and several additional borings to test the hydrostatic pressure at Solanda and other stations. It also enables a better knowledge of the contamination at La Pradera Station.

21. **The EPMMQ first achieved a reduction of US$49.2 million by transferring the implementation of two items from the original contract: (i) the fare-collection system for the entire public transport network, and (ii) an electrical substation**. In recognition of the fact that the fare-collection system benefited not only the Metro, but also other transport systems in the city (bus, BRT and cable cars), the EPMMQ transferred responsibility for its implementation to the municipality's Secretariat of Mobility. This lowered the price by US$31.2 million. The EPMMQ also transferred the development of the Bicentenario electrical substation to the Quito Energy company, which will use it for the Metro and other purposes. The removal of this substation lowered the price by US$18 million. As explained above, it is possible that the Metro portion of the fare-collection system may be returned to the project due to delays by the Secretariat of Mobility in the bidding for the overall fare-collection system.

[14] Note: This cost comparison is general in nature. Costs have not been normalized to account for differences in project characteristics and components. Comparison is only intended to provide a general idea of the costs that other cities have incurred in the development of metro projects.

22. **Optimizations resulted in a US$75 million additional contingency budget**. The main optimizations stemming from the value-engineering exercise include: (a) adding a third TBM, which allowed for greater flexibility in the implementation schedule; (b) reducing construction costs by using a TBM for tunneling in the old city center instead of the originally contemplated New Austrian Tunneling Method (NATM); and (c) slightly changing the horizontal and/or vertical location of some of the stations to make them safer, less expensive, and more environmentally friendly. As part of the optimization exercise, the EPMMQ also undertook additional borings and hydrostatic pressure tests to better identify areas where costs could be saved. This exercise resulted in savings of US$75 million, or five percent of project cost, after the transfer of the abovementioned components. Of these US$75 million, as of November 2017, US$73 million were still available in the contingency reserve, which could be used to cover some of the variation orders, additional borings and tests if so required. The question also is whether there will be additional costs for items not considered in the original project due to budget restrictions. These items include civil works not contemplated in the original proposal but considered important to strengthen the project and also claims by the contractor due to idle equipment for reasons related to unidentified public utilities' interferences and/or events such as the decontamination of La Pradera.

Institutional Framework

23. **At a city level, the Secretariat of Mobility, which is subordinate to the mayor's office, heads the structure of the transport sector in the MDMQ.** The Municipal Public Company for Passenger Transport (*Empresa Pública Metropolitana de Transporte de Pasajeros,* EPMTP[15]) oversees the operation of the surface mass transit system Metrobus-Q. The new EPMMQ[16] is accountable for the development, implementation and management of the future PLMQ. The Public Company for Mobility and Public Works (*Empresa Pública Metropolitana de Movilidad y Obras Públicas,* EPMMOP[17]) oversees the development of transport infrastructure but also proposes policies, and regulates and enforces the regulation on mobility.

24. **Lack of definition by the Secretariat of Mobility of its modal and tariff policy related to Quito Metro, and the lack of coordination among the several studies financed by multilateral grants, are major concerns in project implementation.** This lack of definition causes delays in planning and setting up the fare-collection system, without which modal integration will delay integration and its associated benefits in terms of the efficiency and efficacy of the entire public transport network.

25. **At project level, the EPMMQ is responsible for project implementation, acting together with the project management consultant and the project supervision consultant in contract management activities.** The three entities share the role of "engineer" in accordance with the FIDIC works contract. The figure below represents the EPMMQ's organic structure.

[16] *Empresa Pública Metropolitana del Metro de Quito.* Ecuador, *Ordenanza Metropolitana 237.* April 27, 2012
[17] *Empresa Pública Metropolitana de Movilidad y Obras Públicas.* Ecuador, *Ordenanza Metropolitana 251*. June 9, 2008 and *Ordenanza Metropolitana* 309, April 19, 2010.

26. **The main institutional concerns** are also related to: (a) quickly deciding on the operating model, whether private or public; (b) starting the training of Quito Metro senior staff because it does not depend on the operating model; (c) if the operation is by management contract, hiring advisors to take care of it as soon as possible so they can monitor the two last years of work/system installation; (d) ensuring that the Secretariat of Mobility provides a firm modal integration map showing the dates when the integration will begin at each station; (e) ensuring that a fare schedule is approved and an estimate of the operating subsidy is presented; (f) beginning as soon as possible the acquisition and installation of the Metro's fare-collection system; and (g) mitigating interphase risks by having the project management consultant support the integration process.

ANNEX 4: ECONOMIC ANALYSIS
Country: Ecuador
Project Name: Quito Metro Line One (P144489)

Introduction

1. The objective of this document is to update the economic analysis of PLMQ to account for changes since the original loan appraisal. The analysis also seeks to incorporate the latest guidance and methodologies recommended by the World Bank Group for economic analysis of transport projects.[18,19] The updated economic analysis confirms that the project remains viable.

2. The incremental cost-benefit analysis (CBA) used to reach this conclusion is based on time savings, decreased vehicle operating costs (VOCs), reduction of CO_2 emissions, as well as other measurable and unmeasurable benefits. Under conservative assumptions, the project's updated net present value (NPV) is US$4.315 billion, with an economic internal rate of return (EIRR) of 12.09 percent for a 35-year evaluation period (including five years of construction and 30 years of operation). The results show that the NPV for the project remains positive at a 4.65 percent discount rate, with a conservatively adjusted average value of time of US$1.32 per hour for public transport and US$3.24 per hour for private transport.

CBA Methodology and Assumptions

3. **The CBA for the PLMQ was updated to incorporate the increased civil works costs.** The bidding process for Component 2 civil works resulted in a lowest-evaluated bid with a price 44.68 percent higher than estimated at appraisal. After negotiations and optimizations, this resulted in increased cost of US$440.9 million. The CBA was updated to include actual expected disbursements calculated by Gerenciadora Metro de Quito (GMQ), which incorporates the increase in civil works costs. The updated CBA does not include all potential cost overruns resulting from delays in the implementation schedule or potential additional expenses for the PLMQ's implementation and operations. Based on international experience, there is a 30 to 50 percent probability that the costs estimated in July 2017 have been underestimated by US$75 to US$100 million; these are contemplated in the sensitivity analysis.

4. **The updated CBA methodology includes an alignment with World Bank guidelines**. The main changes are: (a) the updated project cost to reflect the higher-than-estimated cost; (b) the improved definition and justification of a new discount rate; (c) the improved estimate of a new social value of time; and (d) the updated CO_2 price.

5. **The analysis follows the original's standard incremental CBA methodology, in compliance with Operational Policy (OP) 10.04.** For each benefit the analysis compares likely outcomes with and without project. It then calculates the social NPV of estimated net costs and benefits and the ERR, defined as the rate at which the discounted costs and benefits over the life of the project are equal. Shadow prices are used to calculate the economic value of costs and benefits. To do so, the analysis adjusts market prices and eliminates taxes, subsidies and any other factors that distort the actual value for society as a whole. Data limitations made it necessary to apply several conservative adjustments that

[18] "Discounting Costs and Benefits in Economic Analysis of World Bank Projects", The World Bank, 2016
[19] "Investment Project Financing Economic Analysis Guidance Note", The World Bank, 2014

may underestimate the project's potential benefits. In this update, the same factor used to calculate the increase in costs has been considered for shadow prices. Even at the low end of the range, the project provides acceptable net benefits.

6. **To update the assessment of the project's economic viability, the team reviewed and adjusted the original analyses.** The Bank reviewed the analyses conducted by the Borrower. It has also adjusted assumptions and parameters, and has standardized the existing analyses to the extent possible in order to better meet the Bank's recommendations. The main modifications are: the calculation of a new social discount rate to incorporate the Bank's latest guidance and the adjustment of the evaluation horizon. Except for the use of a lower discount rate, the team has adjusted the models in a conservative manner with the objective of increasing the robustness of the economic viability conclusions:

a. **The analysis uses a social discount rate of 4.65 percent, which is based on one of three elements: (i) estimated economic growth (g); (ii) elasticity of marginal utility (θ); and (iii) rate of time preference (ρ).** The three elements correspond to the components of the Ramsey equation,[20] as recommended by the Bank's latest guidance on the social discount rate.[21] Economic growth is included to represent the facts that beneficiaries will be richer in the future and that the marginal utility of an additional dollar will decrease. The estimated value of economic growth of 3.1 percent corresponds to the average household's final expenditure growth in the last 20 years (see Figure 1). The elasticity of marginal utility (θ) represents how much the marginal utility decreases as beneficiaries become richer: usually considered between 1 and 2, here defined as 1.5. The last element, of intertemporal preference, is usually defined between 0 and 0.2. For purposes of calculating the discount rate, the analysis considers 0, which reflects equal preference for current and future benefits.

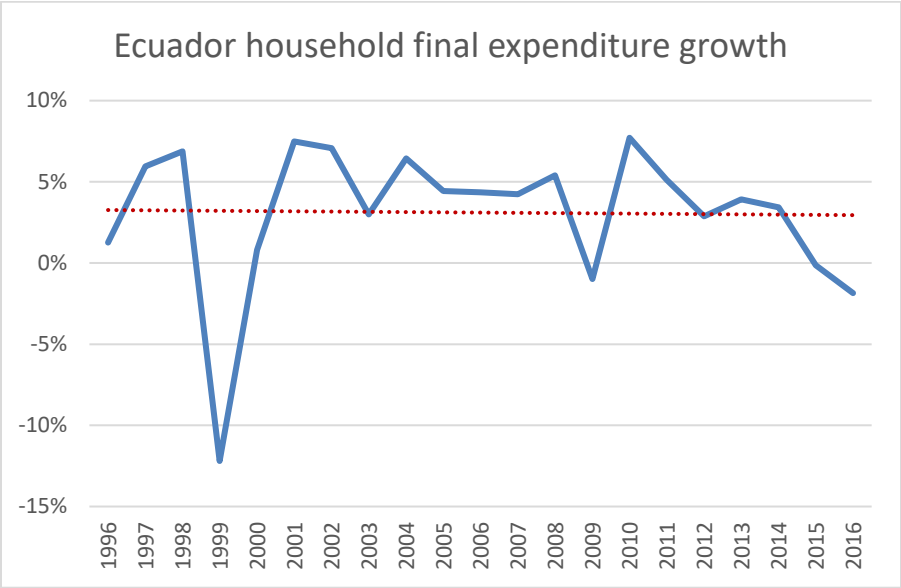
Table 4.1. Ramsey equation

$$ERR = \rho + \theta\, g = 0 + 1.5 \times 0.031 = 0.0465$$

ρ: Intertemporal preference = 0
θ: Elasticity of marginal utility = 1.5
g: Growth rate = 0.031

[20] "A Mathematical Theory of Saving", Frank Ramsey, 1928
[21] "Discounting Costs and Benefits in Economic Analysis of World Bank Projects", March 2016

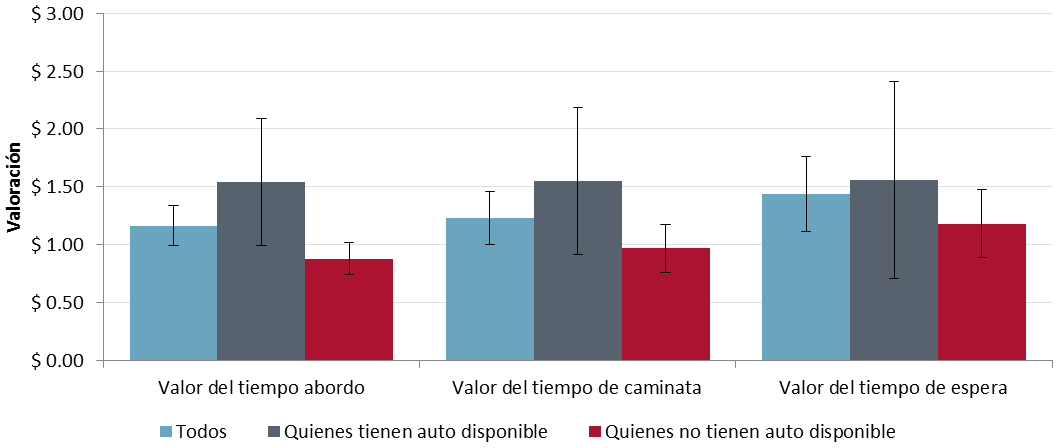
Figure 4.1. Ecuador household final expenditure growth



b. **The reviewed CBA conservatively considers a lower time value than that in the original analysis.** The analysis incorporates an improved estimation of the value of time for beneficiaries, which averages US$1.32 per hour for public transport users and US$3.24 per hour for private transport users, in accordance with the results of a recent study commissioned by the Bank for this project in 2016.[22] This analysis includes an update of (a) the size of the network considered; (b) the model's decision parameters; and (c) the new demand estimates. For the 2016 study, the methodology was based on the results from stated-preference surveys. The study calculates these values using a nested logit model. The study analyzes the information collected by grouping various variables, including household income, gender, main reason for the trip, urban or inter-urban trip, private car availability or informal vehicle availability, and the methodology for data collection. In previous studies, neither the segregation of the sample in socioeconomic stratification nor the level of income was considered; instead, ranges of variations of value of time (VOT) were established for the total population. The analysis uses the results from the stated preferences surveys results from the 2016 study, as recommended by Gwilliam (1997)[23]. The analysis estimates the value of leisure time for those with a monthly income over US$800 (calculated as US$1.81 per hour) and for those under US$800 (calculated as US$0.83 per hour). [24] Regarding business trips, the analysis also uses Gwilliam recommendations and estimates it as 1.3 times the wage per hour. Table 2 summarizes the results obtained by differentiating VOT for those with and without private vehicle availability.

[22] "Modelo de Elección Modal para el Metro de Quito", Steer Davies Gleave, July 2016
[23] Gwilliam, K M (1997) The Value of Time in Economic Evaluation of Transport Projects, Infrastructure Note OT-5, World Bank, Washington DC, USA.
[24] For the purposes of calculating leisure travel time, the team assumed the VOT for those with a monthly income over US$800 as the value of private transport users; and the VOT for those with a monthly income under US$800 as the value of public transport users.

Figure 4.2. Value of time for nested models, differentiating between those with private vehicle availability (gray) and those without private vehicle (red)



c. **The analysis considers an update of the demand forecast estimates**. On the one hand, the analysis is conservative because, in absence of an update of the model,[25] there is no consideration growth in demand during four years (from 2016 to 2020); the demand is set to 369,714 passengers per day. On the other hand, the original demand estimates for the project assume the implementation of a Hierarchically Integrated Transit System (HITS), which blends efficient technologies such as BRT and metros. This means that passengers could transfer seamlessly in physical, fare and scheduling terms. Without the HITS, demand can decrease by 20 to 30 percent. The sensitivity analysis shows that, *ceteris paribus*, the project remains viable even without the implementation of the HITS.

Summary of CBA results

7. **The updated economic analysis confirms that the project remains economically viable.** Under conservative assumptions, the project's updated NPV is US$4.315 billion, with an EIRR of 12.09 percent for a 35-year evaluation period (including five years of construction and 30 years of operation). The results show that the NPV for the project remains positive at a 4.65 percent discount rate, with an adjusted VOT of US$1.32 per hour for public transport users and US$3.24 per hour for private transport users. Table 3 below summarizes the combined results.

8. **Benefits and cost composition.** The main costs considered are investment costs, O&M costs, and impacts of works during construction, while the salvage value is considered a negative cost. Initial investment accounts for more than 80 percent of total costs. These include civil works, expropriations, installations, and rolling stock. The bidding process for most the works resulted in a lowest-evaluated bid with a price that was 44.68 percent higher than estimated at appraisal, as reflected in the updated costs. The updated model incorporates the increased civil works costs and the same shadow price factor of 1.027 to convert financial costs into economic costs.

[25] An update of the model is currently under way and will likely provide initial results by June 2018.

9. **O&M** represents 27.84 percent of costs and includes system operation, infrastructure maintenance, rolling stock, and the operator's management costs. Shadow prices do not factor into fuel and electricity subsidies.[26] Remaining expenses involve needed investments during the project's life and impacts of works during construction.

10. Some activities will require temporary closure of public access, affecting mobility,[27] included as costs totaling US$24 million.

11. Salvage value accounts for -4.98 percent of investments, including rolling stock, in 2050.[28]

12. VOC reductions represent 23.7 percent of benefits. Public transit lowers VOCs by reducing vehicle use—including O&M and fuel costs—of both public and private surface vehicles.

13. Over the next 30 years, the PLMQ would cut CO_2 emissions by 0.6 percent. The CO_2 price was updated to US$30 per ton with an annual growth rate to reach 50 in 2050, in accordance with the World Bank Guidance Note on this matter.[29] According to this note, the shadow price of carbon can be derived from three different measures: (i) social cost of carbon; (ii) marginal abatement costs; and (iii) carbon market prices. The World Bank Guidance Note recommends that projects with carbon-reduction externalities should undertake the economic analysis with and without the carbon benefit, and that projects should use a base-case carbon price starting at US$30 in 2015 and increasing to US$80 in real terms by 2050.

[26] Fuel subsidies account for 50 percent of the cost. Due to electricity generation and distribution costs in Quito, the electricity subsidy is estimated to be 68 percent of the cost.
[27] Impacts of works are underestimated. To calculate them, the analysis assumes a homogeneous density within the city (91 inhabitants per hectare) and, given an average affected area of 7.07 ha per station and 15 stations, provides the number of inhabitants affected regardless of the fact that the stations would be placed in the city's main transport corridors. Then the analysis assumes losses of one hour per day per inhabitant and calculates the losses by assigning an average value of time for the time lost by affected people.
[28] The model assumes a linear depreciation period of 50 years for works, 17 for systems, and 30 for rolling stock.
[29] "Social cost of carbon in project appraisal", Guidance Note to World Bank Group staff, May 16, 2014.

Table 4.2. CBA summary with updated costs and 4.65% discount rate

BENEFITS		100%	$7,230,328,633
Gains in Productivity	Benefits from time savings	82.59%	**$5,971,569,607**
Metro Users	Metro users' time savings	47.06%	$3,402,730,147
Generated Trips	New users' time savings (not included in Metro users)	0.99%	$71,364,012
Improvement in system reliability	Time savings of Metro users due to less waiting and transfer time (not included in metro users)	3.90%	$282,007,172
Surface traffic congestion reduction	Time savings due to less traffic congestion on surface	36.49%	$2,638,479,033
Access and Dispersion	Fewer savings due to time spent in reaching the stations (dispersion) and accessing the Metro within the station (access).	-5.85%	($423,010,758)
VOC reduction	Less VOCs due to lowered vehicle use including fuel use.	16.81%	**$1,215,687,539**
CO_2 emissions reduction	Savings from lowering CO_2 emissions	0.60%	**$43,071,487**

COSTS		100%	($2,988,220,767)
Initial investment cost	Studies, civil works and procurement of rolling stock	65.69%	**($1,962,897,211)**
Reinvestment	New equipment needs throughout project life	5.02%	**($149,987,229)**
O&M	Cost of operating and maintaining the project with the required quality level	27.84%	**($831,817,123)**
Impact while conducting civil works	Impacts of the civil works	1.46%	**($43,519,204)**

Salvage value	Less cost derived from the residual value of project assets	-2.45%	**$73,196,564**

BENEFITS–COST	$4,315,304,429
SIRR	12.09%

Sensitivity analysis

14. **The sensitivity analysis shows that the results are robust**. The sensitivity analysis for the updated model calculates the switching values for demand decrease and cost overruns, in accordance with results in Table 3. Switching values are the threshold values of the analyzed variables that make the IRR equal the discount rate or the NPV equal zero. The sensitivity analysis shows that the investment would be profitable with an additional increase of the investments costs up to 220 percent, while potential cost overruns are not expected to exceed 10 percent. On the other hand, the project would still be viable if there is a decrease in the demand up to 61 percent (double the expected negative effect of lack of effective integration of the Metro with other public transport modes). Similarly, the project would remain viable with a combined 150 percent cost increase and a 20 percent demand decrease. Cost overruns are estimated to be far below the values used for the sensitivity analysis.

Table 4.3. Sensitivity Analysis

IRR		Metro Demand (decrease)					
		0%	10%	20%	40%	61%	80%
Investment costs (increase)	0%	12.09%	11.19%	10.20%	7.92%	**4.66%**	0.05%
	50%	9.20%	8.42%	7.58%	5.60%	2.74%	-1.40%
	100%	7.37%	6.67%	5.90%	4.10%	1.45%	-2.41%
	150%	6.05%	5.40%	**4.69%**	2.99%	0.49%	-3.18%
	200%	5.04%	4.42%	3.74%	2.12%	-0.27%	-3.81%
	220%	**4.69%**	4.08%	3.41%	1.82%	-0.54%	-4.02%

15. **In conclusion, the updated CBA and sensitivity analysis for the Quito Metro Line 1 Project show that the project is economically viable at a 4.65 percent discount rate, because its benefits are greater than its costs.** The NPV is positive. The project will benefit the Ecuadorean economy. Should the Bank agree to begin preparing an AF to cover part of the financing gap generated by higher-than-expected construction costs, the updated CBA shows that the decision is justified on economic grounds.

ANNEX 5 : MUNICIPAL FINANCE ANALYSIS
Country: Ecuador
Project Name: Quito Metro Line One (P144489)

Introduction

1. **The Municipality of the Metropolitan Area of Quito (MDMQ) has commissioned, with World Bank's support, a due diligence analysis evaluating its financial capacity to carry through the metro project**. This due diligence analysis, carried out by Ernst and Young (EY), includes base case scenarios as well as stress-tests for key risks. This Annex summarizes the preliminary findings of this due diligence.

2. **From a pure solvency point of view, the fiscal sustainability of MDMQ relates to its capacity to command sufficient resources in the future to service debts incurred in the past, including for the PLMQ**. Solvency requires that the current value of expenditure flows plus net debt does not exceed the current value of future revenues under the current tax and fiscal transfer structures.[30] If this condition is satisfied, all debt, external or internal, can be serviced. External sustainability for the case of the City can be subsumed to the question of fiscal sustainability. A wedge between fiscal sustainability and external creditworthiness could emerge if there is insolvency, but external debt (e.g., with bilateral or multilateral institutions) is considered senior to (loosely spoken, more important than) internal debt (e.g., with the country's development bank). In that case, even a situation of fiscal unsustainability could be compatible with external creditworthiness.

3. **Conceptually, a bigger wedge between fiscal sustainability and external creditworthiness appears when willingness to pay is introduced**. A government may be able to raise sufficient resources to finance its debt service, but may simply not be willing to do so – i.e., governments could default before they hit the fiscal sustainability condition. A third issue has to do with foreign exchange availability: a city could be able to produce sufficiently high surpluses to service all its debt, but might not be able to transform this surplus in externally usable assets if the country's foreign exchange reserves are low.

4. **The due diligence prepared by EY, and this annex, doesn't take into consideration issues of external creditworthiness and willingness to pay, focusing instead on evaluating MDMQ's ability to comply with its legal indebtedness limits, and its indicative financial capacity**. Legal limits are imposed on the Debt Stock to Income Ratio, which should remain below 200 percent; and the Debt Service to Income Ratio, which should remain below 25 percent. This annex summarizes the projected dynamics of these two ratios under the MDMQ's envisaged fiscal framework, and a more pessimistic scenario designed by EY. Stress-test is conducted with respect to two key assumptions: (i) the level of transfers from the central government, and (ii) the PLMQ potentially incurring further (and significant) cost overruns. The analysis (and particularly EY's scenario) assumes that the city ability to reduce capital expenditure is limited by the need to maintain a minimum level of investments in water, transport, parks, and other basic services.[31]

[30] Note that the city does not need to reduce the balance of its debt to remain solvent (in dynamic terms, solvency requires that the City's debt grow at a rate less than the rate of interest it is expected to pay).
[31] The MDMQ plans to borrow about $145m in 2018 to cover some of these investment needs.

5. **The financial assessment undertaken by the MDMQ and EY shows that the PLMQ project will impact its finances significantly**. Under the MDMQ and EY's assumptions, the city is likely to manage the debt incurred to complete the PLMQ. However, a compounded negative shock of lower transfers from the central government and additional cost overruns of the PLMQ will significantly worsen MDMQ's overall debt-carrying capacity. Such as situation might render the city's debt levels unsustainable. As discussed earlier, the city's debt carrying capacity could be undermined by "willingness" to pay consideration and foreign exchange availability issues, even before the sustainability thresholds presented here are reached.

Quito's finances: Context

6. **Prior to starting the PLMQ[32], the MDMQ ran small deficits resulting in moderate levels of indebtedness.** As shown in Table Annex 5.1 below, between 2012 and 2015, overall deficits amounted to US$41 million and the city's overall debt levels had reached US$429 million in 2015 (or about 65 percent of its 2015 revenue; well below the 200 percent threshold). During this period, overall revenues averaged $589 million, including collection of property taxes and fees for about $209 million on average, and transfers from the central government for US$364 million on average. The bulk of the transfers from the central government came from Ecuador's Fiscal Decentralization Code that obliges the central government to allocate 21 percent of the "permanent" revenue and 10 percent of the "transitory" revenue of the country to the MDMQ.[33]

7. **Prior to initiating the metro, the MDMQ spent mainly on investment carried out by municipal state-owned enterprises (SOEs)**. Between 2012 and 2015, total spending averaged $630 million, of which about half were transferred to SOE to fund improvements in transport, water, and other municipal infrastructure and services[34]. An additional 7 percent were invested directly the city in gardens, pedestrian walkways, and the like. The city's wage bill accounted for about 22 percent of total spending (including remunerations associated with workers in social sectors and capital projects). Finally, about 11 percent of total spending went for purchases of goods and services (including those associated with capital projects). It should be noted that in Table 5.1, we have manually rearranged spending categories to ensure the MDMQ fiscal accounts resemble international standards.

8. **It is estimated that the MDMQ's debt stock reached US$ 544 million at the end of 2017.** This stock is projected to have increased by 26 percent between 2016 and 2017 mainly due to the financing of the Metro project. The composition of debt is as follows: (i) internal debts for US$64 million (11 percent of the total), mainly with the Development Bank of Ecuador; (ii) external debt for US$215 million (40 percent of the total) associated with projects other than the metro and owed to multilateral banks (IADB, CAF, and China EXIMBANK); and (iii) external financing of the metro project for US$264 million as explained in other sections of this document (49 percent of the total) (IBRD, EIB, FIEM).

[32] The first phase of the Metro project, was delivered in April 2015. The main civil works contract commenced in April 2016.
[33] In Ecuador "permanent" revenue is defined as predictable income sources that last a period (i.e. VAT, income taxes), and "transitory" revenue as non-predictable income sources (i.e. oil sales, sale of assets, loan disbursements). In the past these two concepts have been defined with discretion by the government and, thus, might fluctuate by more than the fluctuations in oil revenues.
[34] This analysis does not cover the fiscal or quasi-fiscal liabilities MDMQ might be incurring through financial operations carried out by its SOEs (with or without sovereign or sub sovereign guarantee), or trough contingencies incorporated in the balance sheet of MDMQ's or any of its SOEs.

Table 5.1: MDNQ Finances, 2012-15
(in millions of US dollars unless indicated otherwise)

	2012 Act.	2013 Act.	2014 Act.	2015 Act.	12-15 Avg.	12-15 Comp.%	2016 Act.	2017 Proj. MDMQ
Total Revenue, of which	501	594	598	664	589	100.0	906	909
Taxes	131	152	164	184	158	26.8	173	190
Fees	37	53	57	58	51	8.7	47	57
Other current revenue	18	13	14	22	17	2.9	40	51
Airport royalties	-	-	-	-	-	-	-	-
Transfers, of which	314	376	364	400	364	61.7	646	611
Fixed transfers (COOTAD)	259	259	259	259	259	43.9	259	259
Other capital transfers CG	56	117	105	137	104	17.6	94	121
CG contribution to metro project	-	-	-	4	1	0.2	293	231
Total Expenditure, of which	591	662	597	670	630	100.0	839	1,069
Personnel (including for projects)	127	135	124	169	139	22.1	173	172
Goods and services (including for projects	61	66	67	86	70	11.1	89	79
Interest payments	12	14	15	18	15	2.3	18	19
Current transfers	8	9	7	11	9	1.4	15	18
Capital spending, of which	383	437	384	386	397	63.1	543	781
Public works	51	59	23	33	42	6.6	35	37
Metro project	-	-	-	6	1	0.2	132	492
Transfers to SOEs	305	354	334	300	323	51.3	312	226
Others	27	23	27	47	31	4.9	65	26
Overall Balance	(90)	(68)	1	(5)	(41)	100.0	67	(160)
Memo: primary balance	(78)	(54)	16	12	(26)	64.1	85	(142)
Overall Financing	90	68	(1)	5	41	(100.0)	(67)	160
Long-term loans, disbursements	80	120	69	124	98	(241.6)	51	152
Long-term loans, repayments	30	30	38	47	36	(89.2)	47	42
ST financing, net	43	18	43	-	26	(64.1)	-	-
Change in balances	(2)	(40)	(75)	(71)	(47)	116.4	(71)	50
Memoramdum items:								
Total debt	231	321	352	429	333	-	433	544
Debt to revenue ratio, %	46	54	59	65	56	-	48	60
Debt service to revenue ratio, %	8	7	9	10	9	-	7	7
Debt to GDP, %	-	-	-	-	-	-	2	2

Source: EY estimates based on MDMQ data, and WB staff reclassification and calculations.

Debt Sustainability Scenario

9. Two set of assumptions are considered to estimate future revenues and expenditures: (i) the MDMQ's own projections; and (ii) EY's projections, which are slightly more pessimistic than those of MDMQ for both revenues and expenditures, because of the following:

i. Tax and current income growth is expected to be equal or less than the one observed during the 2012-17 period – a level that could still render a stream higher than expected if revenue were to perform at the country's future nominal GDP growth;
ii. Transfers from the central government are also adjusted slightly down relative to MDMQ's projections;

iii. The period for VAT recovery (associated to the city's airport) from the central government is extended from 2018-19 to 2018-23;
iv. The city is expected to accumulate treasury balances to at least cover one month of current spending (MDMQ assumes cash balances increase only at the pace of inflation);
v. Personnel expenses are adjusted to ensure the ratio of the wage bill to income is constant at the levels observed during the 2012-17 period, or about 25 percent. (note this is not a legally binding rule for the City);
vi. Transfers to SOEs are kept at a minimum of US$226 million (the amount registered in 2017) adjusted by annual inflation, but a ceiling is imposed if the municipality runs a deficit (this is also a non-legally binding rule for the city); and
vii. Deficits above those incurred due to the construction of the metro (without taking into accounts additional cost overruns) are assumed to be financed by a working capital loan at 8 percent interest and maximum 10 years of maturity (slightly higher than the 6 percent initial expectations MDMQ had for commercial borrowing terms).

10. **An additional important assumption, related to point (ii) above, is the amount of the metro that will be subsidized by the central government.** The total project costs (excluding World Bank´s component for technical assistance) totals about US$2 billion. The central government committed to subsidize the capital investment with US$ 750 million, which corresponds to 37 percent of the total cost.

11. **Financing for the MDMQ's is expected to be associated mainly with the finalization of the metro, but the city expects to mobilize commercial debt to fund other projects**. MDMQ plans to take commercial debt in the amount of $145 million securitizing about 60 percent of the revenue flows coming from the existing concession of the International Quito Airport. This loan, which is still under negotiation, is expected to have a 6.5 percent interest and a maturity of 10 years through 2037. The EY's analysis stresses the condition of this loan to match previous rates at 8 percent. As mentioned earlier, deficits above those generated by the Metro are expected to be financed at commercial terms (like the above described loan).

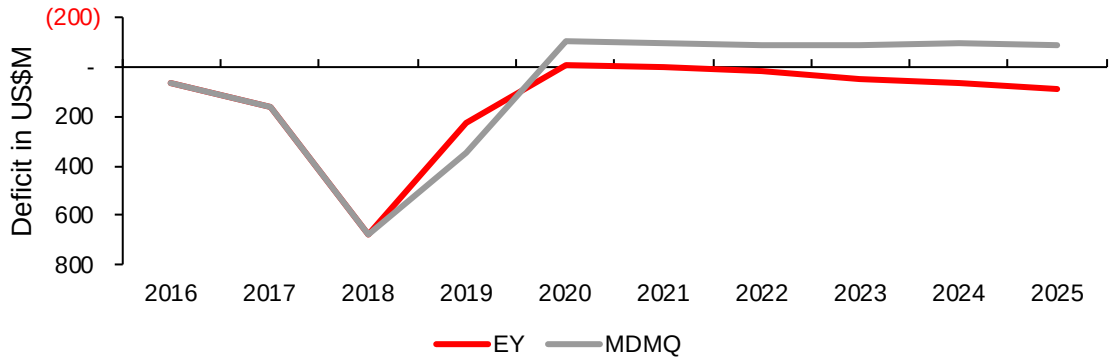
12. **Under the MDMQ, the city is expected to run overall surpluses during the 2020-25 period once the PLMQ is completed – but the EY's scenario assumes that the city runs deficits for this latter period as well**. In a nutshell:

- *The MDMQ scenario* foresees a stock of debt increasing from US$544 million in 2017 to a peak of US$1,572 million in 2019 before receding back to US$1,008 million by 2025. The "hump" shape in debt projections is the result of deficits driven by the completion of the metro during 2018 and 2019 (US$677 million and US$351 million, respectively); followed by surpluses averaging US$94 million per year between 2020 and 2025; and

- *The EY scenario* foresees a continuously increasing level of debt that would reach US$1,651 million by 2025. The debt dynamics under this scenario are strikingly different despite similar expectations for the 2018 and 2019 deficits (US$677 million and US$226 million, respectively); they are driven the projection of continued deficits that although small on average per year (i.e., US$34 million) are sustained through 2025.

13. **These two scenarios illustrate well the financial risks faced by MDMQ**. First, they show that small changes in the assumptions can result in very different financial outcomes. Second, they also illustrate the need for future administration of Quito to "save" both, to maintain the key financial ratios below legal limits, and to prepare the city for a period of significant debt repayments between 2028 and 2033. See Figure 5.1.

Figure 5.1: MDMQ's Projected Overall Balance, 2016-25, in millions of US$



Source: EY's model and WB staff calculations

14. **Based on the assumptions, and resulting deficits and debt levels described above, two different analyses are conducted.** The first analysis is on the two key ratios imposed by *the Legal Indebtedness Limit*. The second analysis, an *Indicative Indebtedness Capacity*, is based on future unlevered cash flow and calculates the indicative maximum amount of debt that the municipality would be able to repay in each period and the associated cost of capital (i.e., interest).

Legal Indebtedness Limit

15. **The Legal Indebtments Limit analysis focuses on two MDMQ's key financial ratios beyond which the central government could intervene the accounts of the City:**

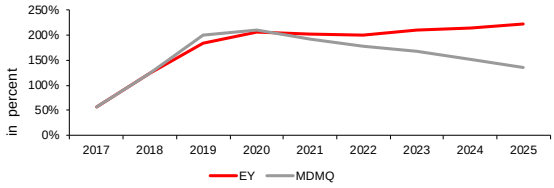
- **The Debt Stock to Income Ratio –** which is to remain below 200 percent under the existing subnational fiscal rules.
- **The Debt Service to Income Ratio –** which is to remain below 25 percent under the existing subnational fiscal rules.

16. **As the construction of the metro progresses, the associated financing stresses the financial situation of the MDMQ, particularly in 2019.** The MDMQ's debt capacity deteriorates significantly starting this year, with the most critical period being in 2019 when the metro is expected to be largely completed. A year later, in 2020, the Debt Stock to Income Ratio reaches a peak of 209 percent under MDMQ's scenario, and a 205 percent level under EY's. As shown in the Figure 2a below, under the MDMQ's scenario, this ratio not only stabilizes, but falls to 136 percent by 2025. However, under EY's scenario, the ratio continues to increase and reaches 222 percent, driven by the projected deficits, which are in turn explained by the modifications to the financial assumptions explained earlier.

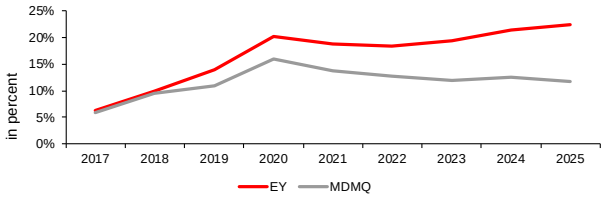
17. **The Debt Service (amortizations and interests) to Income Ratio is projected to remain below the 25 percent legal threshold during the entire projection period and under both set of assumptions.** Under the MDMQ's scenario it peaks at 16 percent in 2020, while under EY's assumptions it is expected to peak in 2020 at 20 percent, and then again in 2025 at 22 percent (Figure 5.2.b).

Figure 5.2: Evolution of key financial ratios under MDMQ and EY's projections

a. Stock of Debt to Income ratio, %



b. Debt Service to Income Ratio, %



Source: WB staff calculations based on EY's report.

Indicative Indebtedness Capacity

18. **Indicative indebtedness capacity is the maximum amount of debt that the municipality could, notionally, repay over a given period and with the cost of capital.** This is estimated as the net present value (NPV) of the municipality's future unlevered cash flow. For purposes of the analysis, eight percent is used as the cost of capital. This is because the weighted average cost of capital is not known; this would be a better proxy of the cost of capital. However, eight percent is a conservative assumption because it is probably above the average cost of capital for Quito. Because the municipality's principal lenders are public and multilateral banks, indicative indebtedness capacity is not as important as if the municipality had to borrow from commercial banks. Quito may have access to public or multilateral financing. Indicative indebtedness capacity does not necessarily reflect the municipality's real indebtedness capacity, but it serves as a reference for the impact of loans on Quito's finances.

19. **An analysis of the municipality's indicative indebtedness capacity shows that PMLQ will have a significant impact on the city's indebtedness capacity over the next 30 years, but the municipality can afford the debt for the Metro.** Using an eight percent discount rate, the NPV of total unleveraged cash flow in Quito is higher than the required debt service of Metro-related loans over the next 30 years, and is higher than the NPV of the total debt service of municipal loans required for the project.

Sensitivity Analysis

20. **As mentioned earlier, the above scenarios are subject to substantial downside risks.** These risks include: (i) lower than expected central government transfers (or lower collection of own revenues); (ii) additional cost overruns of the PLMQ investment (or additional investments or recurrent spending, whether or not related to PLMQ); (iii) harder than expected financial conditions. Sensitivity analysis for the first two risks are included in the table 2 below for the set of projections made by EY. In other words, the simulation uses as baseline EY's less optimistic projections relative to those of MDMQ.

21. **The stress-test show that the Debt to Income Ratio is highly sensitive to relatively minor changes in the assumptions, while the Debt Service to Income Ratio is less sensitive**. The Debt to Income Ratio, which started already above 200 percent in the baseline for these simulations reaches up to 400 percent if the MDCM overruns by fifty percent and the central government transfers fall by 5 percent. The Debt Service to Income Ratio only jumps above 26 percent if the MDCM cost overruns are higher than 20 percent -- irrespectively on the level of central government transfers. The relative resilience of the Debt Service to Income Ratio to shocks is due to the favorable financial conditions of multilateral loans, which include periods of grace for the most critical months faced by the MDCM (i.e., during the 2018-2020 period).

Table 5.3: Sensitivity Analysis to Reduced Transfers and Increased PLMQ's Costs

Debt to income ratio in 2025, %

Changes in PLMQ investment cost \ Changes in central government transfers	-5.0%	-2.0%	0.0%	3.0%	5.0%
0.0%	243%	231%	222%	208%	200%
5.0%	247%	235%	227%	213%	205%
10.0%	259%	244%	234%	219%	210%
20.0%	294%	278%	268%	253%	243%
30.0%	329%	313%	303%	287%	277%
50.0%	399%	382%	371%	355%	344%

Debt service to income ratio 2025, %

Changes in PLMQ investment cost \ Changes in central government transfers	-5.0%	-2.0%	0.0%	3.0%	5.0%
0.0%	24%	23%	22%	20%	20%
5.0%	25%	24%	23%	22%	20%
10.0%	26%	24%	23%	22%	21%
20.0%	29%	29%	27%	25%	25%
30.0%	33%	31%	30%	29%	28%
50.0%	40%	38%	37%	36%	35%

Note: The table above shows the sensitivity of the debt to income and debt service to income rations in the year they reach their maximum (2025) to a combined changed in PLMQ investment cost and central government transfers.
Source: EY's draft report.

Conclusions

22. **The financial assessment shows that the MDMQ's finances will be significantly stressed by the PLMQ.** While MDMQ can be expected to manage such as financial stress under relatively optimistic assumptions (i.e., those of MDMQ), changes in these assumptions (i.e., those of EY) can lead to a quick deterioration of city's finances. Furthermore, stress-test ran on EY's assumption about transfers from the central government and the expected cost of PLMQ illustrate the fragility of the city's finances to changes in these external/internal conditions.

23. **The simulations suggest the financial management of MDMQ would need to be extra conservative starting this year and throughout at least 2025**. The most critical period for the MDMQ is expected to occur by the end of 2020 when most financing would have been disbursed to support the last stretch of the PLMQ construction. Thereafter, the debt capacity of MDMQ will improve, but only if it is able to generate enough fiscal savings (surpluses) to repay the debt associated with the PLMQ and all other projects.

24. **The following actions will be particularly important for MDMQ to maintain healthy finances**:

i. Revenue management recommendations:
- Continue to improve the administration of property taxes and fees, including updating valuation (e.g., that induced by the MDMQ currently known in Ecuador

as “plusvalia” tax), ease compliance (e.g., through introducing payments through supermarkets or cell phones).

- Find alternative sources of financing (e.g., new or increased levels of city’s taxation) in case Central Government transfers are reduced due to external factors (e.g., further drop in oil prices).

ii. Expenditure management recommendations:

- Maintain recurrent spending in check via improving the efficiency of the city’s key service provision (ideally the wage bill will be kept at below 25 percent of total revenues or less).
- Ensure that capital outlays (unrelated to the MDMQ) do not significantly increase, while improving coverage and quality of the City’s basic services.
- Increasing the efficiency of public investments including both, that undertaken directly by the city and well as the ones implemented by state-owned enterprises. In this respect, modernizing the City’s SOEs is key, to ensure they fully comply with OECD principles is crucial in this respect.

iii. Debt management recommendations:

- Initiate efforts to lengthen maturities and reduced average cost of the city’s borrowing – in close coordination with the improvements that the sovereign might do in this same respect (e.g., countries in the Pacific Alliance are able to access financial markets at terms that are often better to those offered by multilaterals).
- Ensure the city puts in place a system to manage guarantees and contingent liabilities that might emerge as it launches program of Public-Private Partnerships directly or through its SOEs.

ANNEX 6: REVISED IMPLEMENTATION ARRANGEMENTS AND SUPPORT FOR FINANCIAL MANAGEMENT

Country: Ecuador

Project Name: Quito Metro Line One (P144489)

1. **Financial Management (FM).** From the FM standpoint the project risk is still considered high. The Project entails complex implementation arrangements. The generation of reliable financial information which promotes project accountability will be complex considering the challenges faced in the past in the FM project performance; however, the Bank's FM team has worked with MDMQ and EPMMQ in order to improve the current financial reporting mechanisms for financial management and disbursement purposes and the importance to maintain an effective coordination between MDMQ and EPMMQ to prepare, approve and submit timely project financial reports. Financial management and disbursement arrangements are being adequately reflected in the Project Operational Manual. It has been agreed that disbursements under category 3 will initiate, until the operational manual (*Reglamento Operativo del Proyecto*, ROP) has been updated to include process and procedures for control, approve and monitor cash and in-kind compensations for resettlement expenditures. The signing of updated Subsidiary Agreement that includes clear roles and responsibilities for MDMQ and EPMMQ (under the AF) has been established as an effectiveness condition. On such basis and subject to the signing of such agreements, the proposed FM arrangements meet the Bank's minimum FM requirements.

Summary of financial management arrangements for the AF:

2. ***Organization and staffing.*** Project staff is qualified and experienced. Moreover, they are better acquainted with Bank policies and procedures considering the experience gained under the parent project. Nonetheless, during implementation of the parent project either MDMQ and EPMMQ have experienced staff rotation. Thus, continuity of UGP's staff is a key factor to ensure that both entities are able to effectively support the implementation of the additional financing as well as to ensure suitable coordination between MDMQ and EPMMQ.

3. ***Budgeting.*** Budget policies and procedures applied by MDMQ and EPMMQ to manage and monitor project implementation are considered acceptable and will continue in place for the AF. Budget allocations are controlled and monitored through an Enterprise Resource Management system (SAP). The proposed expansion of activities to be financed under Component 5 required some adjustments to the budgeting codes (partidas presupuestarias) and corresponding chart of accounts, so as to allow their systems to generate automated project financial information by financing source. These definitions are reflected in the matrix of budgeting structure classification which is part of the FM section of the Operational Manual.

4. ***Financial reporting.*** MDMQ and EPMMQ will continue using their FM information systems SAP and CGWeb respectively. MDMQ will continue to record project financial information following a segregated level without differentiating every external financing source. In contrast, MDQM has committed to record project financial information following a cost center practice to track expenditures by financing source. Semiannual IFRs will continue to be prepared and submitted to the Bank within 45 days following the end of each calendar semester. The core content of IFRs (including the AF) have been reviewed, agreed with MDMQ and EPMMQ and reflected in the Project Operational Manual.

5. ***Internal control and internal audit***. MDMQ and EPMMQ have to comply with the internal control standards issued by the Country's Supreme Audit Institution (Contraloria General del Estado - CGE, by its name in Spanish). Moreover, the internal audit unit of both entities report to the CGE. Under the parent project, it was agreed that project's transactions would be subject to internal reviews as required by those oversight entities, and the reports resulting from those reviews should be made available to the Bank as appropriate. This practice will continue during the AF.

6. The internal control framework for the parent project also included specific procedures for the approval of civil works progress certificates, which involved: i) external supervision exercised by a consulting firm including physical inspection of works; and ii) a specialized technical unit created within the EPMMQ, (Gerencia Técnica) who is responsible for reviewing and approving such certificates from the technical perspective. It is expected that these controls will also continue in place during the implementation of the AF. Regarding the project Operational Manual, it reflects financial management arrangements designed for the AF and will be complemented by payments processes followed for resettlement processes. Updated version of Subsidiary Agreement between MDMQ and EPMMQ will be considered as an effectiveness condition.

7. ***External Audit***. Audit of annual financial statements of the project will be conducted in accordance with International Standards on Auditing (ISAs) issued by the International Federation of Accountants (IFAC). Each audit of the project financial statements will cover the fiscal year of the Borrower or any other period agreed with the Bank. Auditors should submit: (i) an opinion on the project financial statements; and (ii) management letter. Audit costs will continue to be financed out of local counterpart funds from EPMMQ. In accordance with the World Bank's Access to Information Policy, the annual audited financial statements of the project will be made publicly available by the Bank upon receipt. The audit report shall be submitted to the Bank within four months of the end of the Borrower's fiscal year per previous arrangements harmonized with the other project's co-financers. In addition to this, EPMMQ in coordination with MDMQ will directly carry out selection and appointment of acceptable audit firm, based on the list of eligible audit firms acceptable for all co-financers; based on a harmonized set of audit terms of reference; and preparing annual audit reports.

8. The audit report for calendar year 2016 for the parent project arrived on time and was considered acceptable to the Bank despite the fact the auditors issued qualified opinions on the project's financial statements. According to the Principles of Collaboration Agreement signed by project co-financiers, the IADB was designated responsible for consolidating and communication the results of the review of the audit report to the Government, and this arrangement will likely continue under the AF.

9. ***Flow of funds and disbursement arrangements.*** As in the parent project, administration of loan proceeds remains with the project implementing entity MDMQ. Under AF, MDMQ will be the main responsible for payment processing of project expenditures, while EPMMQ will collect and review supporting documentation and prepare payment requests for MDMQ's approval. The same disbursement methods established under the original loan will be used, namely advances, reimbursements and direct payments.

10. Under the advance method, MDMQ will open in the Central Bank (Banco Central del Ecuador) a new Segregated Designated Account (DA) in US dollars to manage AF loan proceeds. Funds deposited into the DA as advances, will follow Bank's disbursement policies and procedures as described in the Disbursement and Financial Information Letter (DFIL). According to funds flow arrangements for subnational governments, the DA is not part of the Single Treasury Account and therefore no transfers to the STA are expected. It is important to mention that the FM team has been monitoring funds flow

arrangements in order to ensure loan proceeds are used only for the intended purposes of the project, as part of the project supervision missions and regular reviews of DA reconciliation carried out on a quarterly basis.

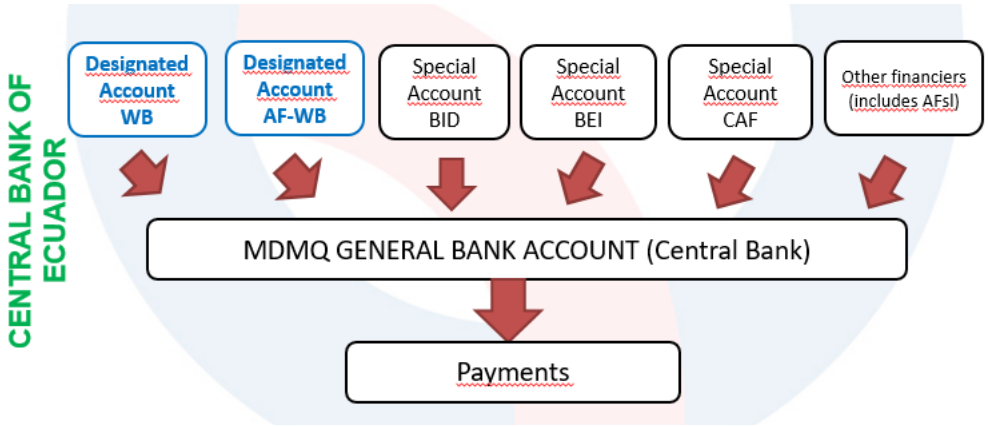
11. The project involves co-financing from IADB, BEI, CAF, FIEM and local counterpart funding. Most of the funds provided by such financiers (including IBRD) will finance activities under Component 2. FIEM will finance Component 3, while IADB, CAF and local counterpart will finance Component 4. Component 5 will be mostly financed by IBRD including gaps determined between compensations paid under national expropriation processes and OP 4.12, in past and future land acquisitions. Other compensation related expenditures would be financed IADB's AF. The Value Added Tax (VAT) will be financed out of local counterpart funds.

12. To process payments, MDMQ will be able to withdraw the required amount from the DA to the MDMQ general bank account (maintained in the Central Bank of Ecuador) from which payments would be made immediately to contractors, consultants and suppliers based on a financial programming and considering Bank disbursement policies. Payments of taxes will be carried out from MDMQ general bank account. EPMMQ will continue financing with its own resources audit fees. All payments will be processed through the Interbank Payment System (SPI) of the Central Bank, which allows cash transfers to beneficiaries' bank accounts.

13. The ceiling for advances to be made into the DA will continue to be based on a three-months forecast which will need to be approved by TTL. The minimum value of applications for direct payment and reimbursement, will be established in the DFIL. Similarly, supporting documentation to document project expenditures under advances, reimbursement and direct payments will also remain the same. The frequency for reporting eligible expenditures will be on a quarterly basis or more often as required. Current harmonized report for disbursement purposes will include the Additional Financing.

14. ***Retroactive Financing***. Component 2 and 5 may require retroactive financing up to 20 percent of the total project amount which is US$46 million. The MDMQ would pre-finance the activities with its own fiscal resources, requesting retroactive financing of the payments made before the signing date of the loan agreement against adequate documentation. The Borrower will be reimbursed from the loan proceeds for payments corresponding to eligible expenditures agreed with the Bank - and in accordance with the provisions detailed in the loan agreement. After effectiveness, MDMQ will prepare a SOE summarizing eligible expenditures incurred before the date of signature of the loan agreement, then submit it for reimbursement to the Bank.

Chart 6.1: Funds Flow



15. Loan proceeds under AF would be disbursed against the following expenditures categories:

Table 6.1. of Loan Proceeds		
Category	Amount of the Loan Allocated (expressed in US dollars)	Percentage of Expenditures to be financed (exclusive of taxes)
1. Works, goods and non-consulting services under Part 2 of the project	225,000,000	100%
2. Works, goods, and non-consulting services, consulting services and training under Part 5 of the project	3,850,000	100%
3. Compensations and resettlement assistance associated with involuntary resettlement resulting from the project[35]	1,150,000	100%
	230,000,000	

[35] Disbursements under Category (3) will not initiate until the ROP has been updated to include the arrangements for the process and procedures for control, approve and monitor cash and in-kind compensations for Resettlement Expenditures, under terms and conditions satisfactory to the Bank.

ANNEX 7: EMPLOYMENT ACCESSIBILITY EFFECTS OF THE PROJECT

Country: Ecuador

Project Name: Quito Metro Line One (P144489)

Introduction

1. This annex discusses the use of urban accessibility as an outcome indicator for the operations' Results Framework and summarizes the results of a larger accessibility analysis developed to inform the project.

Accessibility

2. In urban transportation, "accessibility" refers to the ease with which an individual can access opportunities (e.g., employment, health or education services), given the city's spatial distribution (land use), the transportation infrastructure and services available (transportation supply), the temporal constraints of individuals and activities, and the individual characteristics of people.

3. Accessibility offers a powerful lens to assess how proposed changes in the transportation system will serve the city. We can reframe the efficiency of urban transport systems in terms of their ability to connect people with opportunities.

4. For the scope of this project, the outcome indicator focuses on employment opportunities that are accessible within a 60-minute commute using public transportation. Accessibility is therefore defined as: *Average percentage of jobs accessible within a 60-minute commute using non-private transport (public transportation and walking).*

5. In order to estimate the accessibility indicator for the study area, a weighted average of accessibility is created based on population.

Urban Accessibility (UA) Tool

6. In order to calculate access, we use the Urban Accessibility (UA) Tool (Tool and User Guide), an open-source web-based tool. This tool combines estimated travel times and job location data to calculate the accessibility of every point in the city, for different travel modes (automobile, transit, walking and biking). The tool facilitates the calculation of the accessibility measure, although it is not the only way to calculate this indicator, and can be calculated with travel time matrixes (outputs from a four-step transport model) and distribution of opportunities in a geographic information system (GIS) platform or database manager.

7. The tool models the travel times of a ubiquitous person in the city, starting from all possible origins and reaching all possible destinations. A potential destination is considered as accessible from any given origin if it is within a total travel time of 60 minutes (this includes time to the station, wait time for a service, in-vehicle time, transfer time [both transfer wait time and in-vehicle time, if necessary], and egress time). The employment opportunities in these accessible destinations are aggregated to determine the accessibility for each location.

8. The Accessibility Tool allows us to calculate accessibility with different transport networks. In this case, we ran two models—baseline and with project—and compared the results. The regional analysis was used to calculate the accessibility indicator, as previously defined. See below for definitions of reach.

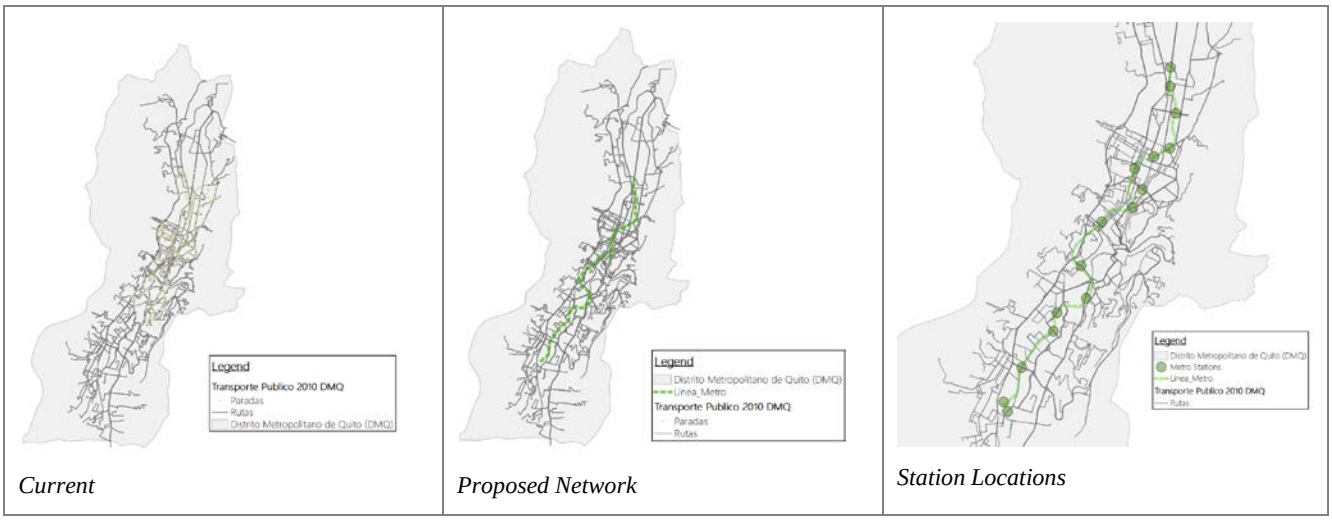
Outcome indicator: Accessibility

9. Baseline: The baseline scenario includes the existing transport system, including BRT lines and feeder services that are currently in service. The operating schedule is derived from the data collected for the TransCad four-step model developed by Taryet-ETT for Metro de Madrid.

10. Target: The target models the functioning system with the completed project. This includes having the fully operational Metro system, 21 km of Metro service and 15 stations, six of them physically integrated with BRT. All 15 stations will have feeder buses. The alignment and operating schedule is derived from the abovementioned TransCad model. Therefore, this outcome represents the situation when the Metro is operational.

11. Study Area: The study area is the Quito Metropolitan District.

Figure 7.1: Public Transportation Network



Current | *Proposed Network* | *Station Locations*

	Scenario	
Indicator	**Baseline**	**Target (change)**
Employment accessibility: percentage of jobs accessible within a 60-minute commute using non-private transport	45.3%	50.8% (+5.5%)

Source: own elaboration using Open Trip Planner Analyst.

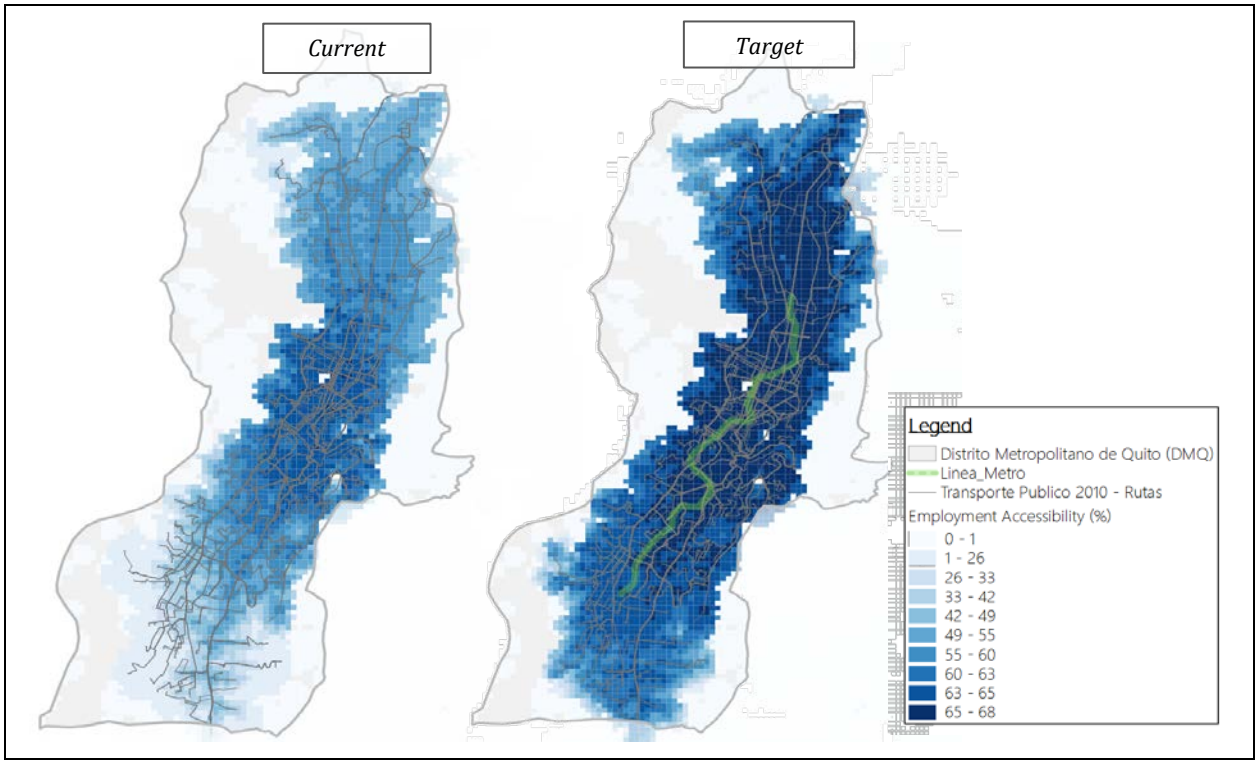
Accessibility-informed project

12. As part of the PLMQ's preparation, various accessibility analyses were conducted to identify ways to further improve access and to inform the project's design. The analysis shows that the alignment provides large gains in terms of accessibility because of the PLMQ's physical integration with BRT stations and feeder bus routes in 100 percent of the stations.

13. From this analysis, it is evident that the current system provides employment accessibility primarily to people living in the center of the city, and then tapers off quickly to the south and north.

14. The addition of the Metro increases the city's overall employment accessibility. While the city center continues to be a location of high accessibility, the city continues to provide high levels of access, primarily in the northern corridor.

Figure 7.2: Employment Accessibility Before and After Metro, with full operational integration



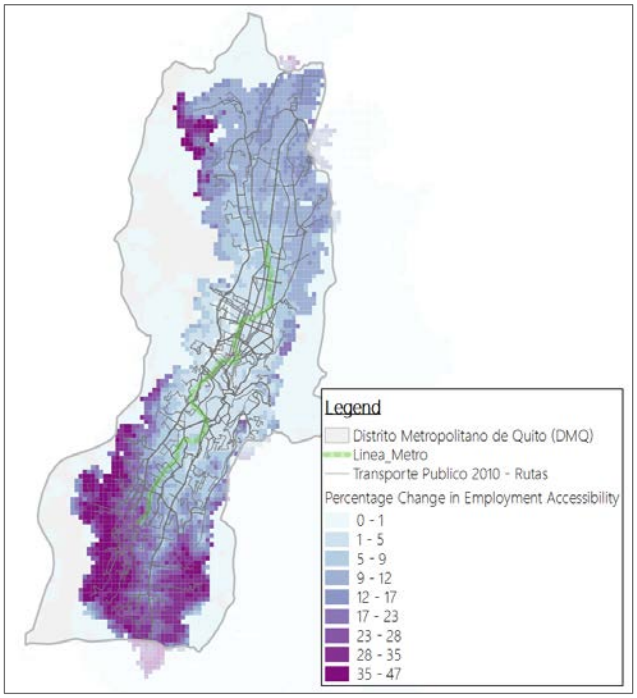
Source: own elaboration using Open Trip Planner Analyst.

15. One element of particular importance in the design of the proposed Metro alignment is the location of the Metro stations. As seen in the figure below, the location of the Metro and stations was designed to maximize the integration between the Metro and the current bus and BRT network. This has the potential to encourage intermodal transfers within the different public transport sub-systems.

16. Furthermore, although the absolute value of accessibility increases mostly in the city's northern and central corridors, peripheral areas tend to have the largest gains in terms of percentage-change increase in accessibility. These areas also have the highest incidence of poverty.[36] As seen in the figure below, the areas on the city's southern border have the largest percentage gain in employment accessibility, increasing by as much as 47 percent.

[36] Carrion, D. & J. Vasconez. UN-Habitat (2003) Global Report on Human Settlements 2003, The Challenge of Slums: The case of Quito, Ecuador

Figure 7.3: Changes in accessibility with full Metro integration



Source: own elaboration using Open Trip Planner Analyst.

17. The physical integration of transit stations provides a useful opportunity to increase accessibility overall by minimizing transfer time and encouraging intra-modality. The PLMQ is expected to increase overall employment accessibility by 5.5 percent, from 45.3 percent to 50.8 percent.

18. The Municipality of Quito should seek a more aggressive operational coordination of transport services. This means coordinating the timing of feeder services to arrive in coordination with trunk services as well as integrating fares in different services. Pursuing this stronger operational multimodal integration can improve overall city employment accessibility to 56.1 percent.

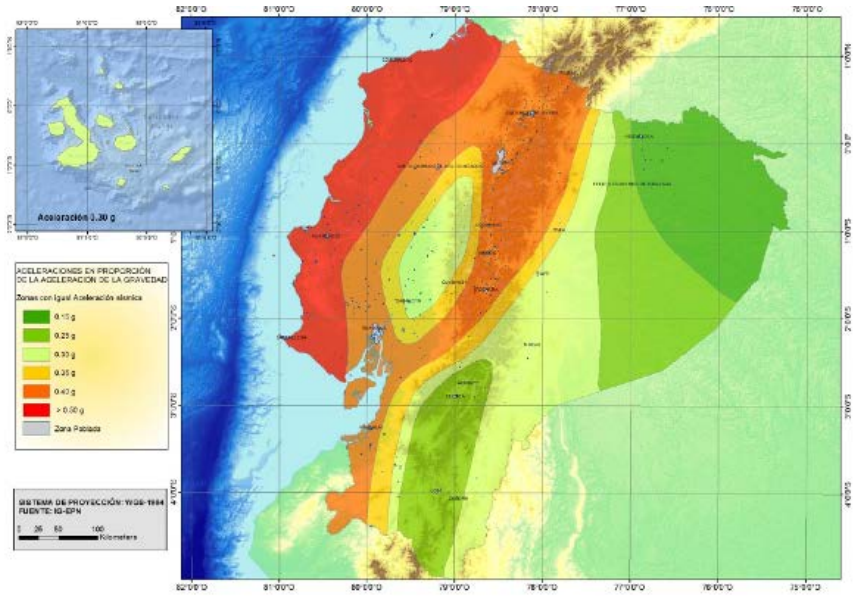
ANNEX 8: CLIMATE AND DISASTER RISKS
Country: Ecuador
Project Name: Quito Metro Line One (P144489)

1. The team carried out a climate and disaster risk screening[37] that identified seismic risk as the only high risk for the project. Given the project's characteristics, hydrological risk may have an impact if not mitigated properly. In this sense, this annex describes the bases for the seismic and hydrological design of Quito Metro Line One (*Primera Línea del Metro de Quito,* PLMQ).

Seismic Design

2. **Ecuador is a country with significant seismic activity.** It lies above the plate boundary where the Nazca Plate subducts beneath the South American Plate. The level of seismic activity in Ecuador is relatively high. Earthquakes with magnitudes greater than 5.0 on the Richter scale, which are considered moderate, are frequent. In the twentieth century, Ecuador registered seven earthquakes with magnitudes greater than 7.5.[38]

Figure 8.1. Map of seismic design



Source: Ecuadorean Construction Standard 2011 (Normativa ecuatoriana de la construcción, Capítulo 2. Peligro Sísmico. Requisitos de diseño sismo resistente).

3. **Quito is located in one of Ecuador's highest seismic-risk areas.**[39] Ecuadorean Construction Standard NEC-11 (2011) classify the country in six seismic zones (Figure 1). Each of these zones has an associated maximum design acceleration. The coastal area, closer to the plate boundary, has the

[37] The analysis is available in WBDocs http://wbdocs.worldbank.org/wbdocs/drl/objectId/090224b0855e8fcc
[38] Geophysical Institute *(Instituto Geofísico)* of Ecuador.
[39] "Últimos avances en la evaluación del riesgo sísmico de Quito y futuros proyectos de mitigación," Fabricio Yépez Moya.

highest peak ground acceleration (PGA).[40] The seismic risk in Quito is one of the highest in the country. The city is located within seismic Zone V whose PGA for the design earthquake is 0.40*g. This seismic risk translates into the significant relevance of the seismic design.

4. **Technical support studies defined accurate ground-motion parameters, which were used in the detailed engineering design.** Prior to the detailed design of the PLMQ, Metro de Quito ordered technical support studies that made it possible to understand and interpret conditions in the PLMQ's area of influence. These studies set a solid basis for the seismic engineering design. The technical support studies that are relevant for the seismic design included: (a) geotechnical: study of geology and geodynamics of the terrain to obtain parameters for structural design; the study included state-of-the-art methods such as down-hole testing; (b) passive seismic monitoring: study of geological sampling to obtain seismic parameters of the stratigraphy in the project's area of influence, using seismic refraction micro-tremors; and (c) seismic and neo-tectonic monitoring: study of the resonance frequency of the terrain in the project's area of influence.

5. **The PLMQ's seismic design uses both Ecuadorean Standards and International Standards applicable to Ecuador**. The standards used for the design of tunnels and structures are: (a) Ecuadorean Standards: Ecuadorean Construction Standard NEC-11 (2011);[41] *Código de Práctica Ecuatoriano 5: Código Ecuatoriano de la Construcción; Guía Popular de Construcción Sismo Resistente* and *Especificaciones Generales para la Construcción de Caminos y Puentes MPO-001-F*; and (b) International Standards applicable to Ecuador: AASHTO LRFD Bridge Design Specifications; ACI 318S-08 on Seismic Design of Structures; Technical Manual for Design and Construction of Road Tunnels. Civil Elements. FHWA-NHI-10-0.34 2009, Seismic Design of Tunnels. A simple state-of-the-art design approach. Jaw-Nan Wang (1993); Eurocode 8; and *Instrucción sobre las acciones a considerar en el proyecto de puentes de carreteras* (IAP Spain).

6. **The detailed design considers the PLMQ as a special construction, following Ecuadorean Construction Standard NEC-11** (2011).[42] The occupancy importance factor for special constructions, which weighs seismic design action, is 1.3, in accordance with NEC-11. This factor is in line with or higher than other national standards of countries with highly seismic areas. For instance, the occupancy importance factors for high- and special-occupancy constructions are: (a) 1.25 in Chilean Seismic Standard NCh433.Of96; (b) 1.25 in United States Standard ASCE/SEI 7-10; (c) 1.2 in Eurocode 8; and (d) 1.3 in Peruvian Standards E-030.

7. **As a special construction, Quito Metro uses higher earthquake verification levels in order to comply with applicable standards.** The guiding philosophy of earthquake design for the PLMQ is

[40] Peak ground acceleration (PGA) is equal to the maximum ground acceleration that occurred during earthquake shaking at a location. PGA is equal to the amplitude of the largest absolute acceleration recorded on an accelerogram at a site during a particular earthquake. Earthquake shaking generally occurs in all directions (horizontal and vertical). Therefore, PGA is often split into horizontal and vertical components. Horizontal PGAs are generally larger than those in the vertical direction but this is not always true, especially close to large earthquakes. PGA is an important parameter (also known as an intensity measure) for earthquake engineering. The design-basis earthquake ground motion (DBEGM) is often defined in terms of PGA. Source: https://en.wikipedia.org/wiki/Peak_ground_acceleration. PGA is equal to the maximum ground acceleration that occurred during earthquake shaking at a location.

[41] Ecuador enacted new construction standards in 2015. The PLMQ's design uses the previous Ecuadoran Construction Standard NEC-11 (2011).

[42] NEC-11 includes the following under its Special Construction category: museums, churches, schools and other educational or sports centers with the capacity for more than 300 people, all structures with the capacity for more than 5000 people, and public buildings that need to operate continuously.

to provide a high level of assurance that (a) the overall system will continue operating during and after an Operating Design Earthquake (ODE) with a return period of 475 years (annual probability of occurrence 0.2 percent),[43] and (b) the system's design provides a high level of assurance that public safety will be maintained (non-collapse) during and after a Maximum Design Earthquake (MDE) with a return period of 2500 years (annual probability of occurrence 0.04 percent). Comparing with other metros in seismic areas, in the case of the Los Angeles Metro the seismic design considers an ODE with a return period of 150 years (probability of annual occurrence of 0.67 percent) and an MDE with a return period of 2500 years (annual probability of occurrence 0.04 percent).[44] In the design of the Kadikoy–Kartal Metro Line in Istanbul, the seismic design considers an ODE with a return period of 73 years (probability of annual occurrence of 1.4 percent) and an MDE with a return period of 2500 years (annual probability of occurrence 0.04 percent).[45]

8. **The seismic design verifies not only the completed structure but also the structures during construction.** The resistance of structures during construction can be less favorable to seismic effects than that of the final structure. This fact justifies the additional calculation of the structures during construction. The seismic actions during construction for the PLMQ are calculated following the recommendations of International Standards applicable to Ecuador (Eurocode 8 and the Spanish standard on actions to be considered in the design of highway bridges: *Instrucción sobre las acciones a considerar en el proyecto de puentes de carreteras*).

9. **Complex numerical models are used to study the seismic soil-structure interaction, following the ground deformation approach.**[46] After obtaining the seismic design action (using Ecuadorean Construction Standard NEC-11, Eurocode 8 and the Spanish standard on actions to be considered in the design of highway bridges; see the two previous paragraphs), the seismic analysis contains complex numerical models to evaluate how the tunnel and structures accommodate the deformations imposed by the ground. The ground deformation approach follows the Technical Manual for Design and Construction of Road Tunnels FHWA-NHI-10-0.34 2009 of the US Federal Highway Administration.

10. **In conclusion, the PLMQ's seismic design follows international best practices and provides a high level of assurance that the overall Metro system will continue operating following an earthquake with a return period of 450 years and will not collapse following an earthquake with a return period of 2500 years.** First, the PLMQ includes an accurate estimate of the ground-motion parameters under site conditions, which are essential for a solid, detailed engineering design. Second, the design follows local and international standards and international recommendations in the seismic

[43] The relationship between return period and probability of exceeding a certain earthquake is $T = 1/\left(1-(1-p)^{1/n}\right)$, where T is the return period and p is the probability of exceeding in n years. For a return period of 475 years, the probability of exceeding in one year is p=0.2%.
[44] Metro Rail Design Criteria, Section 5. Los Angeles
[45] Design of underground structures under seismic conditions: a long deep tunnel and a metro tunnel. Moreno Pescara, Giuseppe Maria Gaspari, Luca Repetto Geodata Engineering SpA, Torino, Italy, 2011
[46] Ground deformation approach (as opposed to the inertial force approach); i.e., the structures should be designed to accommodate the deformations imposed by the ground. Source: Technical Manual for Design and Construction of Road Tunnels FHWA-NHI-10-0.34 2009 of the US Federal Highway Administration.

design.[47] Third, the seismic calculation is limited not only to the final structures but also to the structures during construction.

11. **Finally, it is recommended that an inspection protocol is developed for the PLMQ after earthquakes occur.** The PLMQ should be capable of being placed immediately back in service after earthquakes, always after an inspection to evaluate possible damage to the infrastructure. It is also recommended that an inspection protocol be designed, the main objective of which is to evaluate the extent of damage and conclude whether the structure poses potential safety risks. Another recommendation is to prepare equipment, tools and checklists in advance. Effective post-earthquake inspections also require preparation and training of the team evaluating the structures.

Hydrological Design

12. **Ecuador is one of the countries most directly affected by El Niño Southern Oscillation (ENSO).**[48] This phenomenon has an impact on ocean temperatures, shifting global weather from Australia to South America and causing flooding in some areas and droughts in others.[49] In Ecuador El Niño usually creates wet and warm weather from December to February and dry and warm weather from June to August. La Niña generates dry and cool weather from December to February and wet and cool weather from June to August. The wet periods often cause flooding in the country. ENSO severity is especially strong in Ecuador and Peru. Ecuador, for example, experienced an extremely severe El Niño effect in 1997–1998, causing flooding which cost the lives of at least 286 people and left some 30,000 homeless.[50] El Niño and La Niña events occur in irregular cycles at two- to seven-year intervals.

13. **Climate change in Ecuador and its impact on flooding.** Quito has experienced climatological changes in recent years, with an increase in the number of days classified as very humid or extremely humid, as well as an increase in the number of very dry consecutive days.[51] This fact leads to a higher flooding risk due to an increase in rainfall intensity despite a decrease in rainy days.

14. **The PLMQ's hydrological design takes into consideration the impact of climate change and ENSO.** The detailed design includes a detailed assessment of climatology, weather conditions, hydrology, hydrogeology and drainage for the PLMQ. The project identifies flood risk and adapts the design to mitigate this risk following international best practices, including source control, flood storage, construction of higher-capacity drains, better drain maintenance, and construction and operation of barriers to prevent water ingress to stations.[52]

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[47] For reference on the seismic design of underground structures, see: Seismic design and analysis of underground structures, Youssef M.A. Hashasha, Jeffrey J. Hooka, Birger Schmidtb, John I-Chiang Yao, 2011; and Seismic Design of Tunnels, A Simple State-of-the-Art Design Approach, Jaw-Nan Wang, Parsons Brinckerhoff Quade & Douglas, Inc, 1993

[48] The El Niño-Southern Oscillation (ENSO) is a naturally occurring phenomenon that involves fluctuating ocean temperatures in the equatorial Pacific. The warmer waters essentially slosh, or oscillate, back and forth across the Pacific, much like water in a bathtub. The phenomenon is known as a dominant force causing variations in regional climate patterns. The pattern generally fluctuates between two states: warmer than normal central and eastern equatorial Pacific SSTs (El Niño) and cooler than normal central and eastern equatorial Pacific SSTs (La Niña). Souce: http://climate.ncsu.edu/climate/patterns/ENSO.html

[49] National Geographic. http://nationalgeographic.org/encyclopedia/el-nino/

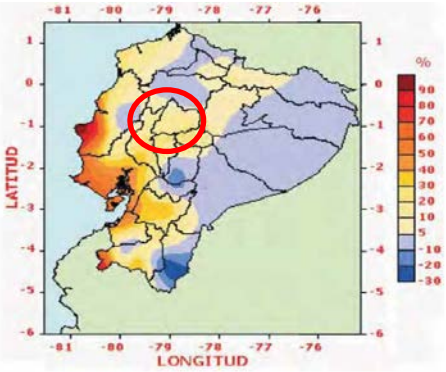
[50] Economic and Social Effects of El Niño in Ecuador, 1997–1998. Inter-American Development Bank. 1999.

[51] National Institute of Meteorology and Hydrology (*Instituto Nacional de Meteorología e Hidrología,* INAMHI).

[52] Impacts of Climate Change on London's Transport Systems. B.P. Arkell, G.J.C. Darch, Atkins Ltd., Design and Engineering Solutions–Water and Environment: e.g.,

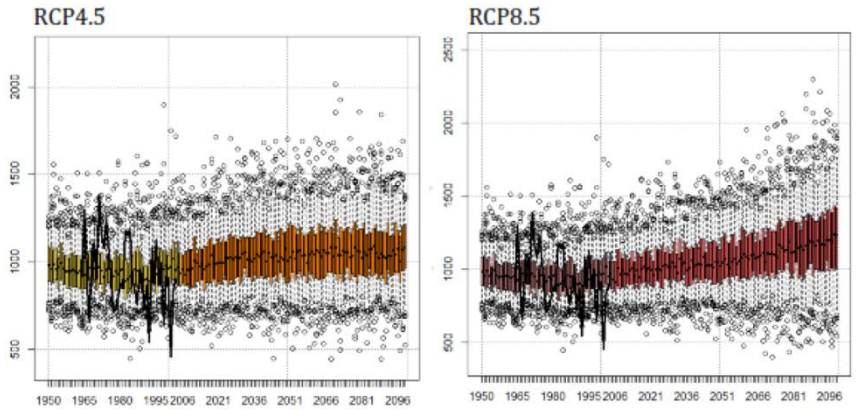
15. **The climatology in the project location is calculated by taking into account the historic values of weather stations in the Quito area and projection models[53] used to predict climate change in Ecuador.**[54] Numerous factors influence Quito's climatology, including: (a) Quito's location, where the Andes Mountains create a diversity of altitudes and produce a variety of climates and considerable climate changes over short distances; (b) Quito's location within the Intertropical Convergence Zone (ITCZ), where the northeast and southeast trade winds come together and drastically affect rainfall; in the longer term, changes in the ITCZ may result in severe droughts or flooding in nearby areas; and (c) Amazon disturbances, which create warm and humid air masses and affect rainfall. The annual precipitation rate in the Pichincha region, where Quito is located, has decreased in recent decades (see Figure 8.2). Projections of precipitation rates are uncertain, making it difficult to predict an increase or decrease in rainfall. The historic data of 15 weather stations in the Quito area and projection models for predicting climate change in Ecuador serve as the basis to calculate the annual precipitation rate, as well as the maximum 24-hour precipitation (especially important for the proper design of drainage elements to avoid flooding) in the project area.

Figure 8.2. Changes in annual precipitation rate (%), 1960–2006



Source: *Segunda Comunicación Nacional sobre Cambio Climático*. Ecuador 2011.

Figure 8.3. Historic and projected precipitation rate in Quito region



Source: Yates et al. (2013).[55]

16. The detailed design contains an assessment of surface and underground hydrology.

17. **On the one hand, the detailed design includes the assessment of surface hydrology along the entire layout.** The PLMQ will not significantly modify the surface hydrology in the project location because most of the construction is underground. The PLMQ's area of influence contains two significantly different hydrological surface areas. The first is the rural Quitumbe area with a natural creek crossing the Metro's layout. Here the layout crosses Quebrada Ortega (a surface creek). The detailed design prepared by Metro de Madrid presents a hydrological model of the Quitumbe area to verify whether the natural creek and its drainage constructions have the capacity to drain water in the event of a maximum 24-hour rainfall for return periods of 25, 100 and 500 years. This design identifies two

[53] Regional Climate Models ETA and PRECIS. See: *Segunda Comunicación Nacional sobre Cambio Climático. Ecuador 2011*

[54] See: *Conocimiento de la vulnerabilidad y posibles medidas de adaptación al cambio climático en el Distrito Metropolitano de Quito, 2015*, and *Segunda Comunicación Nacional sobre Cambio Climático. Ecuador 2011*.

[55] The model is based on CMIP-5 data processing for intensities of 4.5 and 8.5 watts/m^2 for the 1950–2100 analysis period.

drainage constructions which needed to be upgraded in order to be functional for rainfall with a 500-year return period. The second area corresponds to the rest of the Metro's layout: an urbanized area where the hydrological challenge is associated with urban drainage. The design includes a study of water filtration through stations and ventilation openings.

18. **On the other hand, the detailed design includes the assessment of underground hydrology in the project's area of influence.** The assessment concludes that the PLMQ's impact on hydrogeology[56] and aquifers in the Quito area is acceptable. The hydrology assessment uses numerical modeling of groundwater flow to predict the aquifer's behavior during and after the completion of works. It concludes that the PLMQ's impact on the aquifer is acceptable. The main impacts include: (a) the barrier effect of the tunnel: the simulation of the barrier effect created by the tunnel indicates relatively minor variations in the aquifer's groundwater levels, with the upstream level increasing by 1.2 meters (m) and the downstream level decreasing by 0.8 m. This modification of the groundwater level may be considered acceptable, considering the magnitude of the construction and the aquifer;[57] and (b) the drainage effect of the tunnel, which could generate an inflow of water from the aquifer into the tunnel during the construction and operational phases. The assessment of underground hydrology considers three scenarios (for three permeability factors[58]). Of these scenarios, the more realistic scenario estimates a 4.5 m reduction in the groundwater level and water flow entering the tunnel at 5.6 liters per second (l/s) per 100 m of tunnel. These values conclude that the impact of the tunnel's drainage effect is acceptable.

19. The drainage system in tunnels and stations will evacuate water filtration through the tunnel and through stations and other openings. The main drainage system comprises central- and lateral-eave gutters, collectors, collection boxes, and 10 pumping wells located along the layout. The water to be evacuated will comprise the water flow filtrated through the tunnel's lining and walls and the water flow accessing through stations and other open-surface elements, with a 50-year return period.

20. **In conclusion, the PLMQ's hydrological design includes a comprehensive analysis that follows international best practices and covers climatology, the project's impact on surface and underground water, and the design of drainage elements.** First, regarding climatology, the PLMQ's design takes into consideration the impact of climate change and ENSO to calculate future rainfall and the risk of flooding. Second, the detailed assessment of surface and ground water shows that the project's impact is acceptable. Third, the drainage-system design in tunnels and stations will limit the water flow entering the stations and will evacuate the infiltrated water to avoid flooding.

21. **It is recommended that the PLMQ schedule periodic maintenance of drainage infrastructure to ensure that the system functions hydraulically to avoid flooding.** The aims of this periodic maintenance are to ensure the inspection and cleaning of drainage elements, drain pumps, and immediately repair any deterioration. It is recommended that a drainage maintenance protocol be designed and that staff and resources be allocated to the periodic activity. A deficient drainage infrastructure increases the risk of flooding of the tunnels and stations.[59]

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[56] Hydrogeology is the study of groundwater with particular emphasis given to its chemistry, flow systems, and relation to the geologic environment (Davis and DeWeist, 1966, p.1).

[57] The magnitude of the aquifer of Quito is: (a) 60 to 150 m south of Panecillo hill; and (b) 172 m north of Panecillo hill.

[58] The permeability factors considered in the detailed design of the project are: 100, 1000 and 10,000 m/day. The permeability factor is: $\alpha = Ak/L$, where α is the permeability factor, A is the area of the tunnel section, k is the hydraulic conductivity and L is thickness of the lining

[59] Example of flooding of tunnels due to problems in the drainage system: http://www.abc.es/hemeroteca/historico-12-09-2008/abc/Madrid/parte-de-los-equipos-de-bombeo-del-tunel-de-la-m-30-no-estaban-operativos_804245327601.html

ANNEX 9. GENDER ANALYSIS AND ACTIONS
Country: Ecuador
Project Name: Quito Metro Line One (P144489)

Analysis

1. **Labor market and gender equality**. Ecuador is advancing in the Delivery and Sustainability of Basic Services to the B40.[60,61] One of the main challenges for the country is to improve the quality of labor supply among the poorest quintiles. High levels of informality in Ecuador also warrant a targeted approach to protect the incomes of these highly vulnerable groups. Each of these factors impacting labor supply also has a gender dimension. In recent years, Ecuador has made changes in its legislation to grant more power and rights to women, and has incorporated new policies on education, health, social security, and access to employment that have allowed the inclusion of women in the social environment. Access to basic education is one of the dimensions with the greatest progress and is very close to establishing gender equality.[62]

2. **However, statistics on labor supply show that women face substantially lower labor-force participation and higher rates of unemployment**, especially among young women between the ages of 15 and 24, while having higher levels of education. According to the *World Employment and Social Outlook: Trends for Women 2017,*[63] "limited access to and safety of transportation is estimated to be the greatest obstacle to women's participation in the labor market in developing countries, reducing their participation probability by 16.5 percentage points." In particular, 9.6 percent of women in Latin American and Caribbean countries perceive abuse or harassment as a constraint to their participation in the labor market.

3. **Sexual harassment as a barrier for women's participation in the economy. Quito is one of the cities with highest rates of sexual harassment.** According to the report "Línea de Base sobre la violencia sexual en el espacio público" prepared by the Alcaldía de Quito, over 91 percent of women have experienced verbal and physical harassment in public spaces. In addition, data on public transport show a 10 percent higher percentage use of public transport by women. While women are more dependent on public transport to access economic opportunities, the level of sexual harassment adds barriers to accessing said opportunities.

4. **Low participation of women in the transport sector**. According to the ILOSTAT database, which includes information related to transportation, storage and communications, only 11 percent of Ecuadorean women are employed in this sector (versus 89 percent of men). Statistics also show that only 5.3 percent of women are employed in the construction sector (versus 94.7 percent of men). These data indicate a very low participation of women in both sectors directly related to the project. Moreover, in the transport sector, violence in the workplace is widely recognized as one of the most important

[60] Bottom 40 percent of the population.
[61] According to the CEN, joint IBRD/IFC/MIGA Country Engagement Note for Ecuador for the period FY16–FY17.
[62] According to the report "Women in Ecuador, two decades of change," prepared by UN Women, in 20 years nearly the entire population between the ages of 5 and 14 attend basic education, with the attendance rate for girls slightly higher than for boys. The report also states that by 2014, 22% of men and women over age 18 have access to higher education without gender gaps; and 62% of this same population has a university degree. In addition, the university population is mostly female: 55%.
[63] The World Employment and Social Outlook: Trends for Women 2017 was prepared by the Labour Market Trends and Policy Evaluation Unit of the ILO Research Department.

contributing factors that lead to involuntary dropouts and low staff retention, according to ILO. Many of the causes of the scarce retention of personnel, such as precarious working conditions, are intensified in the case of women.

Actions and Indicators

5. **The project will contribute toward closing the employment gender gap** by improving urban mobility in the city of Quito, serving the growing demand for public transport, which is higher for women; and by generating the enabling conditions for women to be employed in Metro operations.

6. **Gender inclusion and participation in design.** The project will provide safer access to and from public transport for women through the following activities. Patronato San José,[64] a municipal agency that plans and implements social programs targeted to vulnerable populations leads the project Bájale al acoso, a broad-based social assessment, and a gender-sensitive stakeholder engagement plan will be conducted to further ensure that women's transport needs are heard and considered. Based on international and national best practices, the project will incorporate a reporting mechanism for cases of violence against women and girls in public transport. The city will implement a community action protocol to intervene in cases of sexual violence in the PLMQ. This protocol will use as a framework the existing Safe and Harassment-Free Transportation Plan for women and girls (www.bajalealacoso.com). This plan is coordinated with a study financed by the World Bank that seeks to strengthen women's skills to prevent and report harassment, as well as to implement communication and education campaigns to change behavior patterns and promote the use of sexual violence prevention tools in the PLMQ.

7. In terms of increasing women's participation in Metro operations staff,[65] the client will implement a study that explicitly includes a strategy to increase the percentage of women employed in in the company that will operate the Metro. Among other activities, the strategy will revise recruitment procedures and make the necessary modifications so that they are gender sensitive; it will also ensure that women have proper training opportunities. Women will have increased access to the qualified jobs created by Metro operations with a long-term target of equal opportunities for women workers by the Metro operator.

8. Results will be monitored through the (a) level of satisfaction of women using the Metro (with specific questions on sexual harassment and mobility); (b) implementation of a reporting mechanism for cases of violence against women and girls in public transport; and (c) the percentage of women directly employed by the PLMQ operator (20 percent).

[64] http://www.patronato.quito.gob.ec/

[65] If the EPMMQ is operated by a concessionaire, this strategy will be incorporated in the terms of reference of the bidding process.

ANNEX 10. SUMMARY OF ROAD SAFETY ISSUES

Country: Ecuador

Project Name: Quito Metro Line One (P144489)

1. **Road safety in Quito Metro Project**. Road safety is a developmental issue in Ecuador, and specifically in Quito. The project has developed and implemented strong Occupational Health and Safety (OHS) management systems and demonstrated higher-than-average performance. Unfortunately, between the end of 2017 and the beginning of 2018, four road-safety fatalities occurred in a short period of time. These fatalities occurred outside the project's work sites, but involved the operation of trucks that transport soil from the tunnel excavation to the selected landfills. Investigations of these fatalities are ongoing. The Bank team responded to the issue with two missions (December 2017, February 2018) and a set of specific remedial and preventive measures agreed with Quito Metro (EPMMQ) and the contractor (CL1).

2. **Actions undertaken by the Bank**. The Bank has implemented continuous support in traffic management throughout the project cycle, and several Aide-Mémoires and other project communications (October 2015, June 2016, September 2016, December 2016, August 2016, March 2017) discuss the issues related to the traffic management plan in terms of soil disposal at the landfills, with recommendations on how to address the possible key issues, reinforce current traffic management measures, audit the routes, etc.

i. **In early December 2017**, before the reported deaths, a specialized traffic management consultant visited Quito and reported that "overall it is clear that the Temporary Traffic Management (TTM) remains very professional and takes account of road safety by utilising engineering, enforcement and education solutions for all road users on the traffic detours". The mission noted that "road safety has been an integral part of the diversion plans with particular emphasis on the safety of pedestrians" and was "extremely impressed with the pedestrian integration designs." However, the mission stressed the importance of continuous review of truck routes to reduce the impact on residents.

ii. **In late December 2017**, after the early December accidents, the Bank conducted a special mission in which the Bank, working with the EPMMQ, CL1 and the contracted supervision company, developed an OHS (Operational Health and Safety) Action Plan (attached) to more completely assess the situation, implement actions to help reduce similar future incidents, and provide follow-up on the individual worker fatality incidents. No systemic issue or significant non-compliance was identified in relation to the fatalities. After the mission, the World Bank team has been working with the EPMMQ and CL1 on the OHS Action Plan implementation. The OHS Action Plan included several aspects specific to road-/transit-related incidents including: complete analysis and reporting on each fatality event; reviewing (and updating as needed) driver procedures and training; reviewing and re-evaluating truck routes (including identification of specific risks); holding bi-weekly meetings of the EPMMQ, CL1 and contract supervisor to discuss the OHS; and confirming the 2018 OHS training programs.

3. **After the last fatality in February 2018,** the Bank conducted another mission and the multilateral banks joined efforts to reinforce the message of the problem's severity and request additional immediate actions from both the EPMMQ and CL1. The team requested support from the Global Road Safety Facility (GRSF) and conducted a mission to provide recommendations and agree on a high-impact

short- and medium-term plan to significantly reduce the risks of new fatalities, with a zero-vision approach. Measures included five lines of action: (i) emergency speed management and fleet monitoring; (ii) route planning; (iii) driver testing; (iv) assessment of contractual arrangements; and (v) long-term measures. **With regard to long-term measures,** the Bank has met with the relevant organizations and presented different tools that would enable better management of road-safety data, in particular the DRIVER tool (Data for Road Incident Visualization, Evaluation, and Reporting). The clients demonstrated strong interest and the team is following up with the GRSF to identify sources of funds to support the client in the tool's adaptation to Quito's needs, while working on a plan to present to the client to address long term issues of road safety. With regard to **short-term measures**, the following were agreed:

a. Speed management and fleet monitoring. The activities involve both the introduction of technology and the improvement of monitoring and enforcement processes. GPS devices had been installed in all CL1 trucks, totaling about 70 of over 300. After the mission, Acciona required the subcontractors to install GPS on their trucks, and now 100 percent of the fleet is properly equipped. The team was informed that there is a four-strike procedure (verbal warning, then written warning, then penalty of 10 percent of one daily salary, then termination). However, evidence on actual sanctions and application of the procedure was incomplete. The World Bank team requested that Acciona improve reporting and suggested random checks until a full assessment of dynamic data was automated. The reporting is now fully automated and CL1 has been providing regular reports of the truck driving behavior. The Metropolitan Traffic Agency (*Agencia Metropolitana de Tránsito,* AMT, in Spanish) also collects information on speed radars, and these need to be checked periodically to cross-check with dump trucks working for the Metro.
b. Route Planning. The team recommended that current and new routes be inspected for potential road-safety risks. The AMT will conduct the inspection and prepare a list of traffic signaling to be manufactured and installed by Acciona. The AMT will also coordinate with the unit responsible for public outreach to help reduce community concerns and create awareness on road-safety risks.
c. Driver alcohol/drug testing. Alcohol is randomly checked on everyone working in the project. On a given day, a minimum of 50 to 60 random checks are performed, and the number increases before and after holidays and other risky dates. Drug testing is performed at a lower rate, but overall has a much lower percentage of positive results compared to alcohol. The team suggested a periodic report to understand how many truck drivers are being tested and how many of them are testing positive.
d. Contractual arrangements. Sub-contractors are paid by trip, so there is an incentive to make as many trips as possible during a given time. Because it is difficult to change this payment formula, speed monitoring becomes even more important. Sub-contractors do not work exclusively for the project, making it hard for Acciona to verify if they have exceeded working hours.

4. **Next steps.** The team believes that project supervision has implemented high quality standards for road safety as it relates to the actual construction. With the additional recent measures and support from other MDFs, the team believes that the EPMMQ is implementing a strong action plan that will substantially mitigate the potential risk of accidents. The process is ongoing and pressure should be kept in order to maintain the efforts.