

## Ex-Ante Evaluation (for Japanese ODA Loan)

South Asia Division 1, South Asia Department

Japan International Cooperation Agency

### 1. Name of the Project

- ( 1 ) Country: India
- ( 2 ) Project Title: Delhi Mass Rapid Transport System Project (Phase 4) (II) )
- ( 3 ) Project Site/ Target Area: The National Capital Territory of Delhi (Total Population: about 17 million) (2011 Census India)
- ( 4 ) Loan Agreement: March 26, 2024

### 2. Background and Necessity of the Project

( 1 ) Current State and Issues of the Urban Transportation Sector and Priority in India

Rapid urbanization in recent years has been accompanied by a rapid increase in the number of registered automobiles and motorcycles in India. On the other hand, public transportation infrastructure has not been well developed, and in major cities such as Delhi and Mumbai, traffic congestion caused by increased road traffic demand has become a serious problem, resulting in serious economic losses and automobile pollution such as air pollution and excessive noise. It is necessary to develop a public transport system to reduce traffic congestion and improve the urban environment.

In order to address the above issues, the Government of India has set forth the Metro Rail Policy (2017), which emphasizes the development of public transport system in these large cities from the standpoints of safety, energy efficiency, and environmental conservation, in addition to meet the transportation demands associated with recent economic growth.

As of 2016, the number of registered automobiles in Delhi was 9.71 million (according to India's Ministry of Statistics and Programme Implementation), which is even greater than that of other cities such as Bengaluru (about 6.11 million) or Chennai (about 4.94 million), and there is traffic congestion resulting from the increased number of automobiles. A survey by a private company reports that due to traffic congestion, it takes approximately 1.47 times longer to travel by car in Delhi than it would if there were no traffic congestion (placing Delhi 8th in the world as of 2020, according to this survey report covering 57 countries). The transportation sector in Delhi emits the largest amount of CO<sub>2</sub> compared to other cities in India, and air pollution due to the increase in the number of automobiles emits about 10 times the WHO standard of PM<sub>2.5</sub> per year on average.

The Government of National Capital Territory of Delhi has been planning and promoting urban transportation development, mainly the introduction of a mass rapid transport system, in order to reduce traffic congestion and air pollution in the National Capital Territory of Delhi and to meet the increasing transportation demand. The Delhi Master Plan 2021 (partially updated in May 2010), formulated by the Government of National Capital Territory of Delhi and approved by the Central Government (2007), states that the rapid transport system will be the core of the transport system in the National Capital Territory of Delhi. The development plan for Phases 1-4 has been formulated and implemented so far, with the goal of achieving approximately 10.8 million passenger transports per day by the end of the Phase 4 development plan. The “Delhi Mass Rapid Transport System Project (Phase 4)” (hereinafter referred to as the “Project”) plans to meet the increasing transportation demand by constructing three priority lines (extension of Lines 7 and 8, and new construction of Line 10) out of the six lines planned in Phase 4, and is positioned as a key project in the urban transportation sector in India.

( 2 ) Japan’s and JICA’s Policy Cooperation and Operations in the Urban Transportation Sector (especially in relation to key foreign policies such as the Free and Open Indo-Pacific Partnership (FOIP))

Japan’s Country Assistance Policy for India (March 2016) identifies “strengthening connectivity” through the development of transport infrastructure as a priority area, and to remove infrastructure bottlenecks to investment and growth, railways (including high-speed rail and metro) are needed to strengthen connectivity within major industrial cities and economic regions, as well as between regions in India. Since the Project will also contribute to the low-carbonization of the transportation sector through the development of a transportation system in the National Capital Territory of Delhi, it is not only aligned with Japan’s Country Assistance Policy for India, but is also positioned as part of the “Addressing Challenges in an Indo-Pacific Way (Climate and Environment)” in the “New Plan for a Free and Open Indo-Pacific (FOIP)”. The JICA Country Analysis Paper for India (March 2018) analyzed the need for support for infrastructure development, including mainline railways, urban railways, roads, and ports, with a focus on industrial clusters such as special economic zones and economic corridors located in the six major metropolitan areas and the Delhi-Mumbai Industrial Corridor in order to eliminate bottlenecks to economic growth. The Project is consistent with these policies and analyses.

JICA Global Agenda for Transportation states that JICA aims to “improve connectivity” to reduce the cost of moving people and goods, and to “combat climate change” by shifting traffic to public transport, and the Project is also consistent with these policies. For the transportation sector, 87 Japanese ODA loans totaling 4,328,573 million yen have been extended to India as of February 29, 2024, of which 54 ODA loans totaling 3,534,423 million yen have been committed as of February 29, 2024, to the railway sector, including the Delhi, Kolkata, Chennai, Bengaluru, Mumbai, Ahmedabad, and Patna metro projects. For Delhi Metro, ODA loans have been provided since FY1996, and a cumulative total of 825,184 million yen has been approved for Phase 1 through 4 (I).

### ( 3 ) Other Donors’ Activities

The World Bank (WB) has identified the improvement of connectivity and logistics as a priority in its Country Partnership Framework (for the Period FY 18-FY22), and in the rail sector, the WB has provided support for the Mumbai Urban Transport Project (2002 and 2010 approved, totaling \$972 million) and the Eastern Dedicated Freight Corridor Project (2011, 2014, 2015, and 2022 approved, totaling \$2,970 million). The Asian Development Bank (ADB) has recently been promoting support for the modal shift from automobiles to railways and decarbonization of the transportation sector, and has provided support for the Jaipur Metro (US\$157 million approved, 2013) and the Bengaluru Metro Lines 2A and 2B (US\$500 million approved, 2020), among others. The ADB has also provided support for Mumbai Metro Lines 2A, 2B, and 7 through co-financing with New Development Bank (NDB) (ADB has committed US\$926 million (2019) and NDB US\$260 million (2018)), Chennai Metro Lines 3, 4, and 5 (ADB has committed US\$1,131 million (2022), NDB US\$347 million (2022), etc.).

## **3. Project Description**

### ( 1 ) Project Description

#### ① Project Objective

The objective is to cope with the increase of traffic demand in Delhi by expanding the mass rapid transportation system, thereby promoting regional economic development, improving urban environment and eventually mitigating climate change, through relief of traffic congestion and decrease of pollution caused by increasing motor vehicles in National Capital Territory of Delhi

## ② Project Components

The project is to extend Line 7 and Line 8, which were constructed in Phase 3, and to construct a new Line 10, as well as to procure rolling stock, etc., in the section positioned as the fourth phase of the urban rapid transport system construction plan in the National Capital Territory of Delhi.

1 ) Civil engineering works for underground railway (about 29 km), elevated/above-ground railway (about 36 km), underground stations (18), and above-ground stations (27) (international competitive bidding and local competitive bidding)

2 ) Electrical, communication, and signaling systems, station section equipment construction, railcar depot expansion, automatic fare collection system, etc. (international competitive bidding, local competitive bidding, and negotiated contracts)

3 ) Procurement of rolling stock (312 standard gauge cars) (international competitive bidding)

4 ) Development of information coordination infrastructure and capacity enhancement support, etc. (international competitive bidding)

5 ) Consulting services (design review, bidding assistance, construction supervision, etc.) (short list method)

The ODA loan will cover (a) civil engineering work for underground railroads and stations, (b) and part of (c), (d) and (e).

## ③ Project Beneficiaries (Target Groups)

Direct beneficiaries: Metro passengers (about 5.2 million/day) (2023)

Final beneficiaries: Residents of the National Capital Territory of Delhi (about 17 million people) who will benefit from reduced traffic congestion, reduced traffic accidents, and less air pollution due to the metro improvement.

( 2 ) Estimated Project Cost: 496,558 million Yen (Japanese ODA loan amount of this tranche: 102,932 million Yen)

( 3 ) Schedule (Cooperation Period)

March/2021-September/2028 (91 months including defect liability period)  
Completion of the procurement of rolling stock and related items (scheduled in September 2026) is considered as the completion of the Project.

( 4 ) Project Implementation Structure

1 ) Borrower: President of India

2 ) Guarantor: None

3 ) Executing Agency: Delhi Metro Rail Corporation Limited (DMRC)

#### 4) Operation and Maintenance Agency: DMRC

#### (5) Collaboration and Sharing of Roles with Other Donors

##### 1) Japan's Activities:

As part of JICA's survey to promote digital technologies utilization and external co-creation in various project schemes (JICA DXLab), the consulting support for DMRC in formulating its data strategy and a PoC (proof of concept) to realize data linkage and open data with other transportation agencies is being implemented from July 2023. In order to implement the data strategy formulated in this survey, capacity building support and development of the information integrating database will be covered by the Project's loan.

In parallel with the above-mentioned survey and support by ODA loan to DMRC, efforts are underway to establish and operate a transportation data integrating database for the National Capital Territory of Delhi, involving various stakeholders including transportation operators (public and private) other than DMRC, the Government of National Capital Territory of Delhi, and academic institutions.

These efforts are expected to promote the integration and utilization of passenger data and real-time operation data across the entire National Capital Territory of Delhi, which will be used for effective rail extension and station installation planning in the Project and subsequent projects, optimization of operation schedules, and urban development, including TOD and station area development.

##### 2) Other Donors' Activities: None

#### (6) Environmental and Social Consideration

##### ① Category: A

② Reason for Categorization: The project falls into the railway sector under the JICA Guidelines for Environmental and Social Considerations (April, 2010).

##### ③ Environmental Permit:

Although preparation of an Environmental Impact Assessment (EIA) Report regarding the Project is not required under the domestic law in India, a report was prepared by DMRC in May 2018, subsequently revised in June 2020, and this has been approved by DMRC.

##### ④ Anti-Pollution Measures:

Regarding air quality, water quality, waste, noise and vibration during

construction work, there are plans to ensure conformance to India's emissions standards and environmental standards by means of sprinklers and wastewater treatment, excavated earth treatment, and installation of noise barriers, etc. Regarding the impact on the ground during construction, no serious influence due to land subsidence is expected, since loose ground and the inflow of groundwater will be prevented by adopting the sheet pile construction method, etc. During operation phase, measures to mitigate noise will be taken by installing soundproof walls, as well as measures to mitigate vibration such as installing rubber beneath tracks, etc.

⑤ Natural Environment:

There are two nature reserves (Asola Bhatti Wildlife Sanctuary and Okhla Bird Sanctuary) within a 10 km radius from the Project routes, but there is no Project implementation within these reserves. Elevated/underground routes and some station buildings are planned near buffer zone of the Asola Bhatti Wildlife Sanctuary. As the area is already highly developed, preliminary studies have confirmed that the Project will have minimal additional impact on wildlife.

⑥ Social Environment:

The Project involves land acquisition of approximately 0.19 ha of private land and involuntary resettlement of 32 persons from 8 households. DMRC is implementing the land acquisition and resettlement in accordance with the resettlement plan created in accordance with the Land Acquisition Act, the Resettlement Policy of the Government of National Capital Territory of Delhi and other national laws of India, and the JICA Guidelines for Environmental and Social Considerations, which are scheduled to be completed by June 2024. It has been confirmed that there are no deviations from the JICA Guidelines for Environmental and Social Considerations in terms of compensation levels, land acquisition, resettlement process, etc., and that there are no specific objections to the implementation of the Project from local residents during the resettlement discussions. Since the Project route passes near historical and cultural heritage sites designated by Indian national law, it is necessary to obtain permits from the Archaeological Survey of India (ASI), and permits for crossing the vicinity of all seven potentially affected structures have already been obtained.

⑦ Other/Monitoring

Under the supervision of DMRC, during construction phase, contractors will monitor air quality, water quality, waste, noise and vibration, etc., and external consultants commissioned by DMRC will monitor the same during operation phase. DMRC and Forest Department will monitor the ecosystem during construction and operation phase. The external consultant commissioned by DMRC is monitoring land acquisition, resettlement, and post-relocation living conditions during construction and in operation phase.

( 7 ) Cross-Sectoral Issues:

- ① Climate change: The Project is expected to contribute to climate change mitigation as it will help reduce greenhouse gas emissions by promoting modal shift. The Nationally Determined Contribution (NDC) of the country includes the use of rapid transport systems as one of the strategies for mitigation measures, and the Project is considered to be important. Phase 2 and Phase 3 have been registered with the United Nations as Clean Development Mechanism (CDM) projects, and DMRC hopes to register the Project as well if a new framework for GHG emissions trading, etc. is established by the international community in the future and the conditions can be met. The climate change mitigation benefits (estimated GHG emission reductions) are expected to be 138,172 tons CO<sub>2</sub> equivalent per year (as of 2041).
- ② Consideration for the disabilities: In accordance with national laws and regulations in India, DMRC has adopted station buildings and passenger cars (elevators, toilets, internal broadcasting, Braille blocks, wheelchair spaces, etc.) that are also designed for use by the elderly and disabled, and has provided customer care training for all front-line staff, including station staff and crew members.
- ③ Measures against AIDS/HIV and other infectious diseases: For large-scale civil engineering packages that mobilize a large number of workers to the construction site, DMRC has already confirmed that the contract with the construction operator will include the implementation of AIDS measures such as prevention and awareness activities for the workers.

( 8 ) Gender Category: GI (S) Gender Informed (Significant)

<Details of Activities/Reason for Categorization> In the Project, measures

such as introducing women-only cars, setting priority seats for passengers needing assistance (including women), and installing CCTV cameras in station buildings/trains are being taken in order to make women feel safe and comfortable when they use the metro. Also, as well as ensuring same wages for men and women on construction sites and providing facilities for female workers, female personnel will also be appointed to management position of project implementation. In addition, DMRC is providing dormitories for female workers and is carrying out activities to increase awareness for the prevention of gender-based violence. For these reasons, the Project is classified as a “gender activity integration project”.

( 9 ) Other Important Issues: None



#### 4. Target Outcomes

( 1 ) Quantitative Effects

1 ) Outcomes (Operation and Effect Indicators)

Indicator	Baseline (Actual value in 2020)	Target (2028) (2 years after project completion)
Operating rate (% /year)		
Line 7 extension	—	92
Line 8 extension	—	92
Line 10	—	89
Running distance (thousand km / year)		
Line 7 extension	—	5,784
Line 8 extension	—	10,536
Line 10	—	9,048
Running distance of women-only cars (thousand km / year)		
Line 7 extension	—	964
Line 8 extension	—	1,756
Line 10	—	1,508
Number of trains (number of running trains / day / direction)		
Line 7 extension	—	104
Line 8 extension	—	187
Line 10	—	98
Transportation volume (million passenger – km / day)		
Line 7 extension	—	2.58
Line 8 extension	—	7.30
Line 10	—	3.59
Income from passenger (million Rupees / day)		
Line 7 extension	—	9.62
Line 8 extension	—	27.68
Line 10	—	14.03

Note: All numerical values are for sections to be constructed by the Project (only the extended sections of Line 7 and Line 8, and from Aero City to Tughlakabad

on

Line 10).

2 ) Qualitative Effects

Mitigation of traffic pollution, congestion and climate change in the National Capital Territory of Delhi, improvements in convenience through punctuality in scheduled travel times, economic development of the National Capital Territory of Delhi, and promotion of societal advances for women.

3 ) Internal Rate of Return

Based on the assumptions listed below, the Project's Economic Internal Rate of Return (EIRR) and the Financial Internal Rate of Return (FIRR) will be 21.9% and 7.3%, respectively.

**【EIRR】**

Cost: Project cost, operation and maintenance costs (both excluding tax)

Benefits: Effects of reduction in travel time for Metro and other transport users, reduction in vehicle maintenance costs for Metro and road users, reduction in road traffic infrastructure maintenance costs, reduction in road traffic accidents, and reduction in road traffic pollutant emissions.

Project Life: 30 years

**【FIRR】**

Cost: Project cost, operation and maintenance cost

Benefits: Fare box revenue, advertisement revenue, and station commercial revenue in and around the stations, etc.

Project Life: 30 years

**5. External Factors and Risk Control**

( 1 ) Preconditions: None

( 2 ) External Factors: None

**6. Lessons Learned from Past Projects**

Based on the ex-post evaluation results of the Metro Manila Strategic Mass Rail Transit Development Project, which is ODA loan project for the Republic of the Philippines (evaluation year 2008), etc., the establishment of a financially independent project implementation structure is highlighted as an important issue from the viewpoint of ensuring suitable operation, management and maintenance.

From the ex-post evaluation reports of India's Delhi Mass Rapid Transport System Project and Phase 2 of the same project (evaluation years 2010 and

2015), etc., reinforcement of the skills and abilities of internal personnel taking into account DMRC's continuous phase implementation has been evaluated as good practice. The particular reasons for this include the fact that internal staff gained experience as consulting service counterparts early in the implementation of Phase 1, which enabled them to cultivate know-how in construction management, etc. and reduce their dependence on outside experts in Phase 2, and the fact that they have undertaken external projects including JICA projects in India and abroad such as Mumbai Metro, Patna Metro and Dhaka Metro, contributing to the spread of Metro technology both domestically and internationally.

In the Project, based on the previous assistance to DMRC to strengthen its internal human resources through the completion of Phase 3, technical transfer to DMRC staff regarding project supervision, etc. will be continued through the consulting services of the Project.

## **7. Evaluation Results**

The Project is in line with the country's development agenda and policies, as well as the cooperation policies and analysis of Japan and JICA, and aims to meet the increasing demand for transportation by constructing a mass rapid transport system in the National Capital Territory of Delhi, thereby contributing to local economic development and urban environmental improvement through reducing traffic congestion and automobile pollution, as well as mitigating climate change. It will also contribute to the SDGs Goal 9 (Build resilient infrastructure and foster innovation), Goal 11 (Make cities sustainable), and Goal 13 (Take action to combat climate change), etc. Therefore, it is highly necessary to assist the implementation of the Project.

## **8. Plan for Future Evaluation**

### ( 1 ) Indicators to be Used

As described in Sections 4 (1) to (3).

### ( 2 ) Future Evaluation Schedule

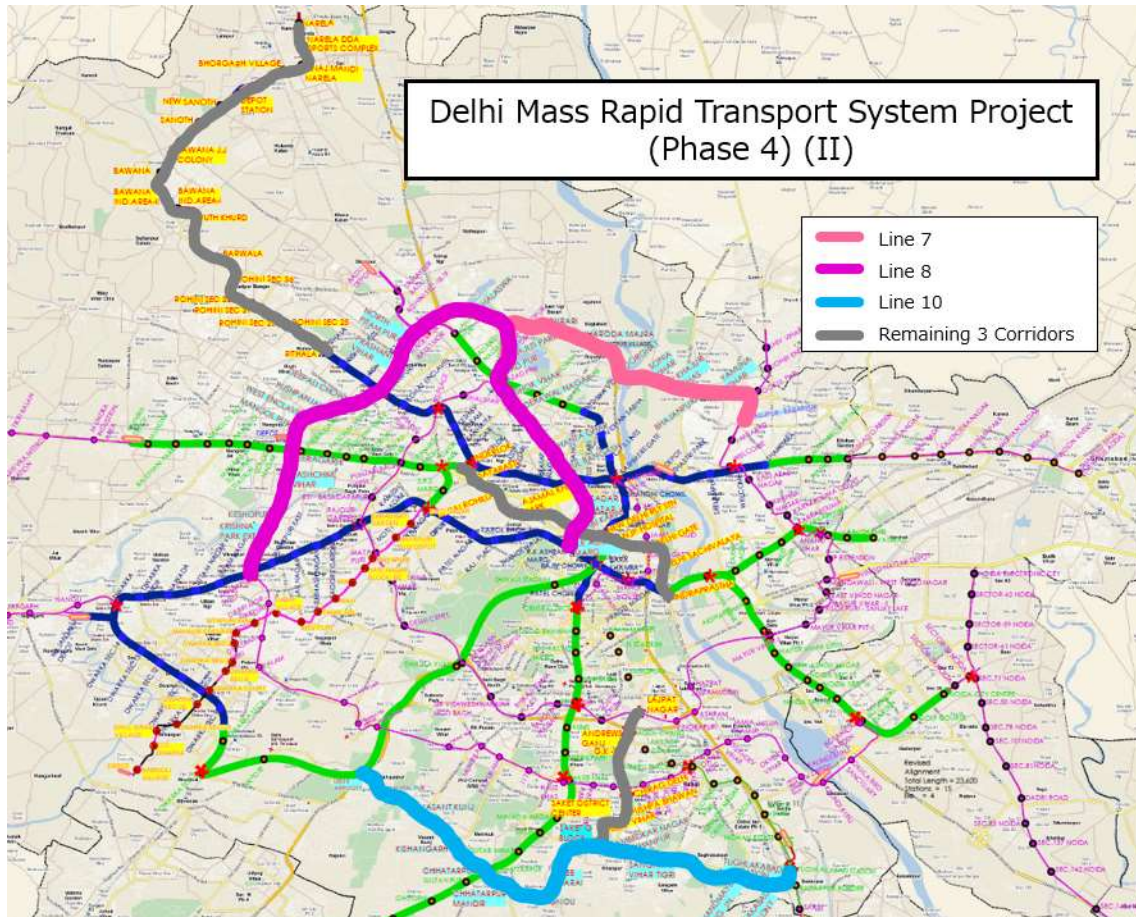
Ex-post evaluation: 2 years after the Project completion

END

Appendix: Map of the Delhi Mass Rapid Transport System Project (Phase 4)

(II)

Map: Delhi Mass Rapid Transport System Project (Phase 4) (II)  
 (Source: Created by JICA)



\*The Project covers only the extension of Line 7 and Line 8 and the new construction of Line 10.

Section	Extension	Number of Stations
Line 7 (Pink Line) Extension (Mukundpur - Maujpur)	Approx. 12km	8
Line 8 (Magenta Line) Extension (Janakpuri West – R.K. Ashram)	Approx. 29km	22
Line 10 (Silver Line) (Aerocity - Tughlakabad)	Approx. 24km	15
Phase 4 Total	Approx. 65km	45