

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

South Asia Division I, South Asia Department

Japan International Cooperation Agency

**1. Name of the Project**

- (1) Country: India
- (2) Project: Bengaluru Metro Rail Project (Phase3) (I)
- (3) Loan Agreement: March 24, 2026

**2. Background and Necessity of the Project**

- (1) Current State and Issues of the Transportation Sector/Area and the Priority of the Project in India

India has experienced rapid urbanization in recent years. As the number of registered motor vehicles has surged—from 67 million in 2003 to 320 million in 2020—road traffic demand has expanded significantly, while the development of public transport infrastructure has not kept pace. As a result, major metropolitan areas are facing severe traffic congestion, leading to considerable economic losses, environmental deterioration caused by vehicle emissions (such as air pollution and noise), and associated health risks. To address these challenges, the Government of India, under the Metro Rail Policy (latest revision in 2017), set a target of developing metro systems in 27 cities by 2025. The policy promotes the development of public transport systems—such as metro rail, conventional rail, and buses—emphasizing safety and energy efficiency. In major cities, metro development is particularly encouraged as it enables mass transit without placing further pressure on existing road capacity.

The state capital of Karnataka, Bengaluru, is known as the “Silicon Valley of India,” and as of October 2024, Japanese companies have established a total of 421 bases there (Embassy of Japan in India, etc.). This is the second-largest number of Japanese corporate presences in India. In recent years, there has also been an increase in the establishment of research and development centers by Japanese companies, reflecting moves to leverage the highly skilled talent concentrated in Bengaluru (JETRO).

Furthermore, the population of the Bengaluru metropolitan area is projected to increase to approximately 32 million by 2051 (Government of Karnataka, Bengaluru Metro Rail Corporation). Alongside this trend, the number of registered vehicles has also risen significantly—from about 6.11 million in 2015 to around 10 million in 2021—making traffic congestion a major challenge. Bengaluru is now one of the most congested cities in the world, requiring an

average of 34 minutes and 10 seconds to travel 10 km by car, ranking 499th out of 501 cities across 62 countries as of 2024 (TomTom Traffic Index). According to the Comprehensive Mobility Plan for Bengaluru (hereinafter “CMPB”), this congestion results in an annual economic loss of approximately 69.3 billion yen. Air pollution, for which vehicle emissions are a major contributing factor, has also become severe. The city’s PM2.5 levels are 6.5 times higher than the standard set by the World Health Organization (as of 2019, IQAir). CO<sub>2</sub> emissions from the transport sector are the second highest in India after Delhi (2015, Indian Institute of Science).

Given these circumstances, the Government of Karnataka, through the CMPB formulated in 2020, aims to promote a modal shift. To increase the share of public transportation use from 48% during peak hours in 2016 to 73%, the plan includes developing approximately 317 km of metro lines, promoting Transit-Oriented Development (TOD), and expanding the public transport network.

The “Bengaluru Metro Construction Project (Phase 3)” (hereinafter “the Project”) is positioned as an important initiative under both the national and Karnataka state policy frameworks. The Project seeks to meet rapidly increasing transport demand through the construction of two lines totaling approximately 44.7 km: Line 3-1, which will run along the western section of the Outer Ring Road and connect to the airport line, and Line 3-2, which will link the city center with the rapidly developing western areas.

Traffic volumes at major intersections near these routes reach up to about 160,000 vehicles per day (2021), making this one of the most severely congested areas in Bengaluru. Therefore, early implementation of the Project is urgently needed to achieve the CMPB’s objectives. Line 3-1 (Kempapura Station – JP Nagar 4th Phase Station) will form the city’s first circular metro route and enhance connectivity with the East–West Line, further improving convenience and increasing ridership. Additionally, the Project aligns with India’s Nationally Determined Contribution (NDC) under the Paris Agreement, which aims to reduce greenhouse gas emissions by 45% from 2005 levels by 2030.

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

*The Japan’s Country Development Cooperation Policy for India (November*

2023) identifies the “strengthening of multilayered connectivity” through the development of transport infrastructure as a priority area. With the aim of eliminating infrastructure bottlenecks that hinder investment and growth, it highlights the need for railway development to enhance connectivity both within major industrial cities and economic zones in India and between regions.

Furthermore, as the Project contributes to the low- and decarbonization of the transport sector through the development of the transport system in the Bengaluru metropolitan area, it is consistent not only with the Country Development Cooperation Policy but also with the *New Plan for a Free and Open Indo-Pacific (FOIP)* under the pillar addressing “Indo-Pacific—appropriate approaches to challenges (climate and environment).” In addition, the *JICA Country Analysis Paper on India (March 2025)* analyzes that, in order to eliminate infrastructure bottlenecks constraining investment and growth, support is needed for the development of railways (including MRT) that will serve as transport hubs and networks. This support should be extended while paying due attention to environmental and social impacts, so that connectivity can be strengthened within major industrial cities and economic zones in India as well as between regions. The JICA Global Agenda on “Transport” also aims to promote the development of transport infrastructure, enhance maintenance and management technologies, and ensure safety, while simultaneously advancing low- and decarbonization. Its goal is to create a society where everyone can move safely and freely, and where essential goods are delivered widely and equitably across the world. In light of these policies and analyses, the Project is fully consistent with all of the above.

The Project is also expected to contribute to Sustainable Development Goal (SDG) 8 (“Decent Work and Economic Growth”), Goal 9 (“Industry, innovation and infrastructure”), Goal 11 (“Sustainable cities and communities”), and Goal 13 (“Climate Action”).

As of the end of February 2026, a total of 91 Japanese ODA loan projects in the transport sector have been committed to India, amounting to JPY 4,654.435 billion. Among these, support for the railway sector—including metro projects in Delhi, Mumbai, Kolkata, Chennai, Bengaluru, Ahmedabad, and Patna—has resulted in 58 Japanese ODA loan commitments totaling JPY 3,860.285 billion as of the end of February 2026. For the Bengaluru Metro, JICA has provided the following support through Japanese ODA loans since FY2006, with cumulative commitments amounting to approximately JPY 116.572 billion:

- Bangalore Metro Rail Project: Support for a total of approximately 42.3 km on the East–West Line and North–South Line (Phase 1: JPY 44.704 billion, March 2006; Phase 2: JPY 19.832 billion, June 2011).
- Bengaluru Metro Rail Project (Phase 2): Support for Lines 2A, 2B, and 6 totaling approximately 79.5 km (JPY 52.036 billion, March 2021).

### (3) Other Donors' Activities

The World Bank lists the improvement of connectivity and logistics as a priority area in its current Country Partnership Framework. In the railway sector, it has previously supported projects such as the Mumbai Urban Transport Project (approved in 2002 and 2010, totaling USD 972 million) and the Dedicated Freight Corridor Project – Eastern Corridor (approved in 2011, 2014, 2015, and 2022, totaling USD 2,970 million).

In addition, for the construction of the Bengaluru Metro, the Asian Development Bank (ADB) has supported Lines 2A and 2B (approved in 2021, USD 500 million), the European Investment Bank (EIB) has supported Line 6 (approved in 2017 and 2018, EUR 500 million), and the Asian Infrastructure Investment Bank (AIIB) has supported Line 6 as well (approved in 2019, USD 335 million). The Agence Française de Développement (AFD) has also provided financing of EUR 110 million for the first development plan and EUR 200 million for the second development plan.

No support from other donors is expected for this project.

## **3. Project Description**

### (1) Project Objective

The objective of the Project is to cope with the increase of traffic demand in Bengaluru Metropolitan Region, 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.

### (2) Project Site / Target Area

Bengaluru Metropolitan Region, State of Karnataka (population approx. 11 million (2015 estimate, Government of Karnataka, Bangalore Metro Rail Corporation))

### (3) Project Beneficiaries (Target Group)

Direct beneficiaries: Users of this line (approximately 700,000 per day) (forecast

for 2034, about two years after completion)

Final beneficiaries: Residents of the Bengaluru Metropolitan Area (approximately 11 million) who will benefit from congestion mitigation, reduction in traffic accidents, improvement in air pollution, etc. resulting from the development of the metro system

#### (4) Project Components

This project involves the construction of two lines in the Bengaluru Metropolitan Area in India—Line 3-1, running along the western section of the Outer Ring Road and connecting to the airport line, and Line 3-2, connecting the central part of the city with the rapidly developing western area in recent years—covering a total length of approximately 44.7 km.

- a) Civil and architectural works (Line 3-1: 32.15 km, 22 stations (elevated); Line 3-2: 12.50 km, 9 stations (elevated))
- b) Procurement of trackwork and turnouts
- c) Electrical and mechanical works for stations, rolling stock depots, substations, etc.
- d) Automatic fare collection system
- e) Signaling and train control system
- f) Communication system
- g) Rolling stock (for Line 3-1: 192 cars (32 trainsets of 6-car formation); for Line 3-2: 60 cars (10 trainsets of 6-car formation))
- h) Construction of rolling stock depots (2 locations)
- i) Consulting services (design review, bidding assistance, construction supervision, etc.)

Among these, the portions to be financed by the Japanese ODA loan are part of items a), c), and g), as well as items b), d) through f), and i).

#### (5) Estimated Project Cost

305,331 million Yen (The amount of Japanese ODA loan for this tranche: 102,480 million Yen)

#### (6) Schedule

March 2026-March 2033 (A total of 84 months, including the defect liability period.) The project shall be deemed completed upon the commencement of service of all facilities (January 2032).

#### (7) Project Implementation Structure

- 1) Borrower: President of India
- 2) Guarantor: N/A

3) Executing Agency: Bangalore Metro Rail Corporation Limited (BMRCL)

4) Operation and Maintenance System : Operation and maintenance after project completion will be carried out directly by BMRCL.

(8) Collaboration and Sharing of Roles with Other Donors

1) Japan's Activity: N/A

2) Other Donors' Activity: N/A

(9) Environmental and Social Consideration/Cross-Sectoral Issues/Gender Category

1) Environmental and Social Consideration

① Category: A

② Reason for Categorization: This project falls under the railway sector and the category of projects with characteristics that are prone to significant impacts (large-scale involuntary resettlement) as specified in the "JICA Guidelines for Environmental and Social Considerations" (promulgated in January 2022).

③ Environmental Permit: Although the Environmental Impact Assessment (EIA) report for this project is not required under Indian domestic laws, it has been prepared. After obtaining approval from BMRCL, it was disclosed in November 2025.

④ Anti-Pollution Measures: During the construction phase, measures such as water sprinkling, wastewater treatment, disposal of surplus soil, and installation of noise barriers will be implemented to ensure compliance with national emission and environmental standards regarding air quality, water quality, waste, soil contamination, and noise and vibration. During the operation phase, measures will include the installation of septic tanks, compliance with legal requirements for waste management including hazardous waste, and wheel truing and rail grinding to address air quality, water quality, waste, soil contamination, and noise and vibration.

⑤ Natural Environment: The nearest national park and biodiversity hotspot are located more than 7 km away from the project area; therefore, the site does not fall within or near any environmentally sensitive zone. Although rare species such as the Bonnet Macaque (VU) and the Indian Flying Fox (NT) have been identified within the project area, no critical nesting sites have been observed. With measures such as pre-construction habitat surveys and securing movement corridors during

construction, adverse impacts on the natural environment are expected to be minimal. Furthermore, in accordance with the Government of India Guidelines (February 2010), compensatory afforestation (68,280 trees) will be carried out to offset the trees to be felled for the project (6,828 trees).

⑥ Social Environment: This project involves the acquisition of approximately 20 hectares of private land and the involuntary resettlement of 617 households (2,714 persons) and 2,173 businesses. Land acquisition and resettlement procedures will be carried out in accordance with the Resettlement Action Plan (RAP) prepared in line with domestic procedures of India and the JICA Guidelines for Environmental and Social Considerations. During consultations on resettlement, affected people expressed the need for adequate compensation and prior disclosure of information. In response, multiple individual and group consultations, as well as focus group discussions, were conducted to gather opinions from a wide range of affected people, including the elderly, women, business owners, and the poor. Compensation and resettlement procedures reflecting the concerns and requests of the affected people are planned to be implemented. No particular objections to the project have been raised by the affected people.

⑦ Other/Monitoring: During the construction phase of the project, internal monitoring by BMRCL and external monitoring by a third party will be conducted regarding land acquisition and resettlement. In addition, under the supervision of BMRCL, the construction contractors will monitor noise, vibration, soil, air quality, water quality, waste management, and landscape considerations. During the operation phase, BMRCL will conduct monitoring of noise, vibration, air quality, and water quality. As the project involves the construction and operation of a railway and a road on a single integrated structure, environmental impact assessment, mitigation planning, and monitoring will be carried out for the entire double-deck viaduct.

## 2) Cross-Sectoral Issues

① Climate Change and Biodiversity: The project is considered to contribute to climate change mitigation by promoting a modal shift and thereby reducing greenhouse gas (GHG) emissions. In the Nationally Determined Contribution (NDC) of India, which aims to achieve

net-zero GHG emissions by 2070, high-speed and mass rapid transport systems are emphasized as one of the key strategies for mitigation. Accordingly, this project is regarded as contributing to the achievement of the country's NDC. The estimated climate change mitigation effect of the project—expressed as the reduction in CO<sub>2</sub> emissions—is approximately 113,756 tons of CO<sub>2</sub> per year in 2034, two years after project completion.

② Consideration for Persons with Disabilities: In accordance with Indian domestic laws and regulations, stations and rolling stock designed to accommodate the use of elderly persons and persons with disabilities—such as elevators, toilets, public address systems, tactile paving, and wheelchair spaces—are planned to be adopted.

③ Measures for HIV/AIDS: For large-scale civil works packages that involve the mobilization of a substantial number of workers at construction sites, the contracts with construction contractors are planned to include requirements for implementing HIV/AIDS preventive awareness activities and other related measures for the workers.

### 3) Gender Category

[Gender Project] ■ GI (S) (Gender-Inclusive Project with Integrated Gender Activities)

#### <Details of Activities/Reason for Categorization>

During the Preparatory Survey, a Focus Group Discussion (FGD) was conducted with women to hear their concerns regarding public transportation in general. The discussions revealed gender-based issues such as harassment against women and safety concerns. In response, the project will introduce women-only cars on the lines to be developed, so that women can use the service with a greater sense of security. Furthermore, the operational performance indicators will include the metric “car-kilometers of women-only cars (thousand km/day)”.

#### (10) Other Important Issues

As part of its digital transformation (DX) initiatives, BMRCL has expressed strong interest in systems that enable dynamic visualization of financial, technical, and organizational KPIs; a project management system that contributes to procurement implementation and oversight; and the development of a transport stack with the Bengaluru Metro at its core. It was confirmed that detailed discussions regarding potential cooperation by JICA will be carried out going

forward. In addition, as part of JICA's study operation promoting digital utilization and external co-creation (JICA DXLab), a Proof of Concept (PoC) aimed at realizing the aforementioned project DX is currently being implemented from November 2024 to December 2026 (planned). Through this study operation, BMRCL will be able to organize, efficiently collect, and centrally manage data related to its operations, thereby contributing to the smoother management of metro operations.

#### 4. Targeted Outcomes

##### (1) Quantitative Effects

##### 1) Outcomes (Operation and Effect Indicators)

Indicator	Baseline (Actual value in 2026)	Target (2034) [2 years after project completion] To be stated separately for Line 3-1 and Line 3-2
Operating rate (% / year)*		
Line 3-1	-	93.1
Line 3-2	-	88.9
Running distance (thousand km / day)		
Line 3-1	-	59.3
Line 3-2	-	16.4
Running distance of women – only cars(thousand km / year)		
Line 3-1	-	9.9
Line 3-2	-	2.7
Number of trains (number of running train / day / direction)		
Line 3-1	-	157
Line 3-2	-	119
Transportation Volume (million passenger – km / day)		
Line 3-1	-	6.1
Line 3-2	-	1.6
Farebox Revenue (million Rs. / day)		

Line 3-1	-	30.3
Line 3-2	-	10.3

\*Calculated as: (Total annual operating days of the procured rolling stock) / (Number of procured rolling stock × (Number of operating days – Average number of non-operating days due to inspections)) × 100%.

## (2) Qualitative Effects

Mitigation of traffic congestion in the Bengaluru metropolitan area; climate change mitigation; reduction of health impacts caused by air pollution; improved convenience through ensuring punctuality of travel; economic development of the Bengaluru metropolitan area; and promotion of social participation of women and persons with disabilities.

## (3) Internal Rate of Return

Based on the assumptions listed below, the economic internal rate of return (EIRR) for the Project is 15.17%, and the financial internal rate of return (FIRR) is 3.75%.

### 【EIRR】

Cost : Project cost and operation & maintenance (O&M) cost (both excluding taxes)

Benefit : Travel time savings, vehicle operating cost savings, fuel cost savings, reduction in traffic accidents, reduction in air pollution, and savings in road infrastructure maintenance costs

Project Life : 35years

### 【FIRR】

Cost : Project cost and operation & maintenance (O&M) cost (including taxes)

Benefit : Fare revenue, advertising revenue, real estate revenue, etc.

Project Life : 35years

## 5. External Factors and Risk Control

(1) Preconditions: For the entire sections of Lines 3-1 and 3-2, this project adopts a double-deck viaduct structure in which a single elevated structure accommodates two levels: the upper deck for the railway under this project, and the lower deck for a two-lane road in each direction. This structural approach reflects the policy decided by the Government of Karnataka, taking into account the current situation in the Bengaluru metropolitan area, where public land available for transport infrastructure is insufficient despite growing transport

demand.

As the purpose of this project is solely the construction of the railway, the road component is not included within the project scope, and all costs related to the road portion will be fully borne by the Government of Karnataka. However, since both the upper railway section and the lower road section are to be procured and constructed as a single integrated package, securing financial resources by the state government for the road component is a prerequisite for realizing the full benefits of this project.

(2) External Factors: N/A

## **6. Lessons Learned from Past Projects**

In the ex-post evaluation (evaluation year: 2019) of the Japanese ODA Loan project “Bangalore Metro Rail Project,” it was learned that, from the project formulation stage, efforts were made to promote integration with Indian Railways, long-distance buses, and city buses. As a result, several stations were constructed along the metro line that enabled easy transfers to other transport modes, thereby improving user convenience and contributing to increased ridership.

This project places a strong emphasis on connectivity with other transport modes, in accordance with the Bengaluru TOD Policy formulated by the state government in 2022. At each station to be constructed, transport hubs such as station plazas will be developed. At major interchange stations with existing lines, skywalks will be constructed to improve transfer access. In addition, the stations to be developed under this project will provide feeder bus services and shared bicycles. Through these initiatives, the project aims to realize the TOD concept.

## **7. Evaluation Results**

This project contributes to reducing automobile-related pollution, promoting regional economic development, and mitigating climate change in the Bengaluru metropolitan area through the development of a mass rapid transit system. It is aligned with India’s development challenges and policies, as well as with the cooperation policies and analyses of the Government of Japan and JICA. The project is also expected to contribute to Sustainable Development Goal (SDG) 8 (“Decent Work and Economic Growth”), Goal 9 (“Industry, innovation and infrastructure”), Goal 11 (“Sustainable cities and communities”), and Goal 13 (“Climate Action”). Therefore, there is a strong need to support the implementation of this project.

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

(1) Indicators to be Used

As indicated in Sections 4.

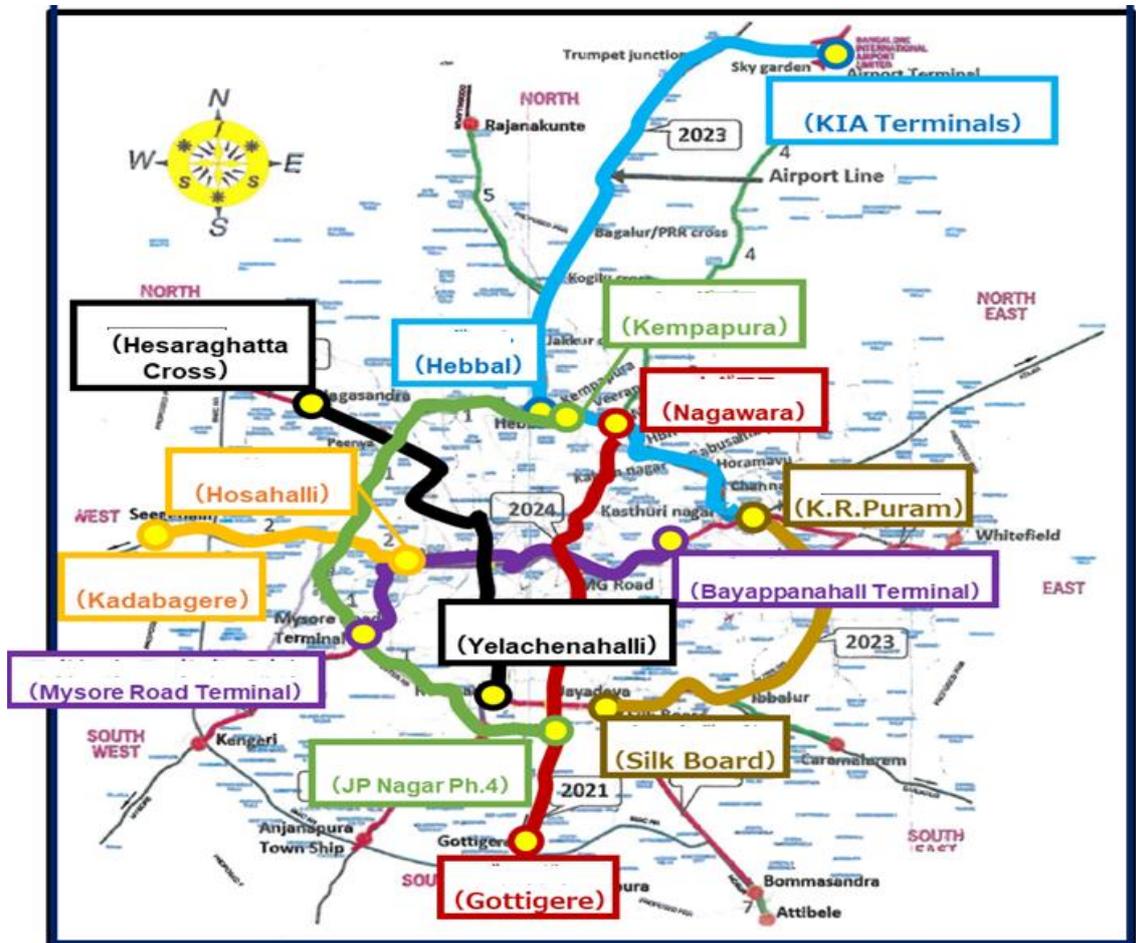
(2) Future Evaluation Schedule

Ex-post evaluation: 2 years after the project completion

END

Appendix: Map of Bengaluru Metro Rail Project (Phase3) (I)

Map of Bengaluru Metro Rail Project (Phase3) (I)



The following sections are the areas supported by JICA (the Phase 1 sections are already in operation, and the Phase 2 sections are scheduled for completion in 2027).

Phase 1
<p><b>North-South Line</b> Hesaraghatta Cross – Yelachenahalli (24.2 km, elevated stations)</p> <p><b>East-West</b> Mysore Road Terminal– Baiyappanaahalli (18.1 km, 12 elevated stations)</p>

Phase 2
<p><b>Line 2A</b> Silk Board–K.R. Puram (19.8 km, 13 elevated stations)</p> <p><b>Line 2B</b> K.R. Puram– Kempegowda International Airport (38.4 km, 16 elevated/2 at-grade stations)</p> <p><b>Line 6</b> Gottigere – Nagawara (21.3km, 6elevated stations/12undergr ound stations)</p>

Phase 3 (this project)
<p><b>Line 3-1</b> Kempapura – JP Nagar Phase 4 (32.15 km, 22 elevated stations)</p> <p><b>Line 3-2</b> Hosahalli – Kadabagere (12.5 km, 9elevated stations)</p>

Source: Prepared based on the BMRCL map