

Bangalore Metro Rail Project Phase 2

1. BACKGROUND

The DPR for the Phase-I of Bangalore Metro Rail Project was prepared by DMRC and submitted to BMRCL (erstwhile BMRTL) during May 2003 and DPR for extension of N-S line of Phase-I from Yeshwanthpur to Hesaraghatta Cross & R V Road Terminal to Puttenahalli cross was submitted during October 2007 & June 2008 respectively. The project has been sanctioned and is under implementation. The Phase-I comprises of two corridors.

- (i) East-West Corridor from Baiyappanahalli Terminal to Mysore Road Terminal – 18.10 km.
- (ii) North-South Corridor from Hesaraghatta cross Station to Puttenahalli cross – 24.20 km.

Out of a total of 42.30 km system about 8.80 km is underground section and balance about 33.50 km is elevated. Total 40 stations are planned out of which 7 stations are underground, 2 at grade and 31 are elevated. On East West corridor a maintenance depot with full workshop facilities is being constructed at Baiyappanahalli whereas for North – South Corridor a maintenance depot with full workshop facilities has been constructed at Peenya.

The Metro system is being implemented with 750 V DC Third Rail Traction System, Cab signaling with CATC, SCADA, and AFC. The rake interchange link is planned at Majestic station.

In the DPR for the Phase-II, the south end of N-S corridor has extension from Puttenahalli to Anjanapura Township (Nice Road) along the Kanakapura Road and from Hesaraghatta cross to Bangalore International Exhibition Center (BIEC) on Tumkur Road (NH-4). East-West Corridor is also proposed for extension on both ends. i.e. Mysore Road to Kengeri and Baiyappanahalli to White Field.

As regards extension of North-South corridor to Electronic City - Bommasandra Industrial Area, Government of Karnataka has desired that this line may be taken up even when Phase-I is in progress. Further extension of this line beyond Bommasandra Industrial Area may be needed in future as the city grows in this part of the city..

2. Traffic Demand

The detailed traffic study was got done from M/s Wibursmith Associates, Bengaluru. Based on the detailed household surveys and traffic surveys carried out during DPR study in 2002 - 2003 and subsequent DPR Studies for extension of N-S line in October & December 2007 and the survey done now as a part of this study, the Transport Demand Model was developed. The network for all the four extensions have been developed from the primary database and used in the transport Demand Model. The traffic demand on these four extensions and the proposed R V Road – Electronic City/Bommasandra corridor and the new corridor between IIM(B) and Nagawara in place has been projected.

3. PLANNING AND DESIGN PARAMETERS

DMRC has already implemented Phase I of Delhi Metro project. Various design norms and parameters have been firmed up by DMRC after detailed studies of norms followed by Metro systems in various countries. However, Delhi being a much bigger Metropolitan City than Bangalore, its needs are different. However a similar system is proposed for adoption for Bangalore city. Certain modifications to the design norms have been recommended keeping in view the specific needs of Bangalore city and with an idea of standardization of parameters for other metropolitan and major cities in the country.

For the elevated section of Bangalore Metro a box shaped deck as adopted for Delhi Metro has been recommended with overall top width of 9.519 m (track center 4.2 m to carry both the tracks. The section has side walkways at the floor level of the coach for emergency evacuation of passengers.

Bangalore Metro system will have modern, lightweight rolling stock made of stainless steel. Trains are proposed to be air-conditioned, consisting of 6 coaches from the beginning itself. Maximum acceleration (1.0 m/sec^2) and maximum deceleration (1.1 m/sec^2) parameters are similar to that of Delhi Metro system.

The system is proposed to have Standard Gauge tracks as this will facilitate provision of sharp curves with radii up to 120 m which becomes a necessity in this congested city. Other geometrical parameters are similar to that of Bangalore metro under execution.

It is proposed to provide 750 V dc, third rail traction system for this extension as being adopted for the phase I under implementation. The other systems like Signaling with Automatic Train Control and Protection system, Automatic Fare Collection system and tunnel ventilation, etc. are more or less similar to that of Phase I of Bangalore Metro.

4. PREPARATION OF DPR FOR PHASE-II

The State Government has accorded approval vide Order No. UDD 127 BMR 2010 dated 04.01.2011 for preparation of DPRs:

Sl. No.	Alignment	Colour of the Line shown in Map at Annexure-1	Length of the line (in km)				No. of Stations			
			At-Grade	Elevated	UG	Total	At-Grade	Elevated	UG	Total
1.	Extension of E-W line Mysore Road Terminal to Kengeri	Dark Blue	0	6.465	0	6.465	0	5	0	5
2.	Extension of E-W line Baiyappanahalli to ITPL – Whitefield		0	15.50	0	15.50	0	14	0	14
3.	Extension of N-S line Hesaraghatta Cross to BIEC		0	3.77	0	3.77	0	3	0	3
4.	Extension of N-S line Puttenahalli Cross to Anjanapura Township (up to NICE Road)	Dark Blue	0	6.29	0	6.29	0	5	0	5
5.	New Line – N -S IIMB to Nagawara	Red	0.48	6.98	13.79	21.25	0	6	12	18
6.	New Line - E-W R.V. Road to Bommasandra	Yellow	0	18.82	0	18.82	0	16	0	16
Total			0.48	57.825	13.79	72.095	0	49	12	61

It may be seen from the above that Phase-II includes a total length of 72.095 km (13.79 km underground) and 61 Stations with 12 Underground Stations. Each line can be traced along with the Station Names in the Map given at **Annexure-1 (Indicative ONLY)**

SALIENT FEATURES OF THE SIX LINES IN PHASE-II
Baiyappanahalli to ITPL – Whitefield (Extension of E-W Line)

The line starts from south side of Bangalore Chennai Railway line and crosses Kasturinagar road and Outer Ring road and reaches the Old Madras road. Then the alignment reaches the Whitefield road and runs along the median of Whitefield road and then on the median of Graphite India road. After this, the alignment runs along the median of road and touches the ITPL and Whitefield Satya Sai Ashram. The corridor has 14 stations namely, Jyothipuram, K.R.Puram, Narayanapura, Mahadevapura, Garudacharyapalya, Doddanakundi, Vishvesharaiah Industrial Estate, Kundalahalli, Vaidehi Hospital, Satyasai Medical Institute, ITPL, Kadugodi, Ujwala Vidyalaya and Whitefield.

Mysore Road Terminal to Kengeri (Extension of E-W Line)

The line continues to be on the median of the Mysore Road till it reaches the Kengeri station. The corridor has 5 stations namely: Nayandahalli, Rajarajeshwari nagar, Bangalore University Cross, R.V. College of Engineering and Kengeri.

Hesaraghatta Cross to Bangalore International Exhibition Centre (BIEC) (Extension of N-S Line)

The line continues to be on the RHS of the Tumkur road and traverses along the road up to BIEC beyond NICE road crossing. There are 3 stations namely, Manjunathanagar, Jindal and BIEC terminal. Bangalore International Exhibition Centre will be the main and initial beneficiary of this extension, as not much of a traffic is expected initially on this line. Therefore, this line will become more viable if BIEC shares cost of this line. Therefore, the work on this line can begin after BIEC agrees to share the cost.

Puttenahalli Cross to Anjanapura Township (up to NICE Road Crossing) (Extension of N-S Line)

The line continues to be on the median of Kanakapura road and traverses along the median of the road up to the Anjanapura Township (up to NICE Road Crossing). There are 5 stations namely, Anjanapura Road cross, Krishnaleela Park (ISKON), Vajarahalli, Talaghattapura and Anjanapura Township.

R.V. Road to Bommasandra (E-W New Line)

The line traverses along the R.V. road and turns left to the Marenhalli road and traverses on the median of Marenahalli road till short of Jayadeva Hospital junction flyover. At the Jayadeva Hospital junction the alignment shifts to the left and traverses on the footpath of the at grade road. After crossing Jayadeva junction flyover the alignment comes back to the median and traverses on the median of the road till the Silk Board junction. At the Silk Board junction the alignment turns towards right to reach the western side of Hosur road. Then the line runs on the centre of western side service lane of the Hosur road.

There are **16 Stations** on this corridor namely, R.V. Road, Ragigudda temple, Jayadeva Hospital (interchange Station of Gottigere – IIBM Nagawara line), BTM layout, Silk Board, HSR Layout, Oxford college, Muneshwara nagar, Chikkabegur, Basapura Road, Hosa Road, Electronic City– I, Electronic City, Huskur road, Hebbagodi and Bommasandra.

Gottigere - IIBM - Nagawara (N-S New Line)

The line traverses along Bannerghatta Road as elevated line up to Swagath Road cross and then goes underground just after Sagar Hospital near fire station. The entire length from this point is underground. The line passes through the Dairy Circle, and runs along the MICO industries and then reaches Hosur road, crossing Richmond Road at Vellara. After this, the line traverses below Brigade Road and crosses the M.G. Road underneath the Phase – I East – West metro line and reaches Kamaraj Road. Here the underground integrated station is planned which is 90 meters from the platform edge of the existing elevated M.G Road Station and is connected through escalators and stairs. After this the underground alignment crosses Cubbon road to reach Shivajinagar Bus Stand. Further, the alignment traverses below the Queens Road and reaches Cantonment Railway Station. From here the line traverses below Nandidurga Road, Tannery Road and reaches Nagawara after crossing ORR.

There are **18 Stations** on this corridor, 6 elevated and 12 underground. The Elevated Stations are Gottigere, Hulimavu, IIBM, J.P Nagar 4th Phase, Jayadeva Hospital (interchange Station of R.V Road terminal to Bommasandra line) and Swagath Road Cross. The 12 Underground Stations are Dairy Circle, Mico Industries, Langford town, Vellara Jn, M.G Road (interchange Station of East west corridor of Phase – 1), Shivajinagar, Cantonment Railway Station, Pottery town, Tannery Road, Venkateshpura, Arabic College and Nagawara.

Traffic Forecast

Traffic Forecast for Four Extensions

Year	Corridor	Peak Hour Sectional loading	Number of passengers (Lakhs/day)	Passenger KM (Lakhs)	Mean trip length
2016	East - West	18,835	4.27	49.09	11.50
	North - South	21,606	5.51	55.63	10.10
2021	East - West	24,200	6.51	75.52	11.60
	North - South	27,347	7.14	72.11	10.10
2031	East - West	32,501	8.80	102.61	11.70
	North - South	36,545	9.37	96.04	10.30
2041	East - West	37,006	10.07	117.46	11.70
	North - South	42,577	10.93	112.01	10.30

Traffic Forecast for R.V. Road to Bommasandra

Year	Peak Hour Sectional loading	Number of passengers (Lakhs/day)	Passenger KM (Lakhs)	Mean trip length
2016	13,078	2.40	19.27	8.0
2021	17,275	3.70	30.78	8.3
2031	21,274	4.55	38.22	8.4
2041	23,442	5.02	42.14	8.4

Traffic Forecast for Gottigere - IIMB - Nagawara

Year	Peak Hour Sectional loading	Number of passengers (Lakhs/day)	Passenger KM (Lakhs)	Mean trip length
2016	11935	2.62	24.37	9.30
2021	16381	4.03	38.20	9.50
2031	22806	5.58	52.69	9.50
2041	25315	6.19	58.81	9.50

Train Operations

Train Operations for Four Extensions

Train Operation	2016	2021
Designed Train headway	3 Minutes	3 Minutes
Operational Headway	4-8 Minutes	3 Minutes
Train Composition	6 Cars	6 Cars
Coaches required for Four Extensions	East - West .. 105 Coaches And North - South .. 81 Coaches	

Train operations for R.V. Road to Bommasandra

YEAR	2016	2021	2031	2041
Cars/trains	6	6	6	6
Head way (Minutes)	8	6	5	4.5
Max. PHPDT Demand	13078	17275	21274	23442
PHPDT Capacity Available	12195	16260	19512	21680
Requirement of Coaches	66	90	102	114

Train Operations for Gottigere - IIMB - Nagawara

YEAR	2016	2021	2031	2041
Cars/trains	3	3	3/6	3/6
Head way (Minutes)	4	3	3	3
Max. PHPDT Demand	11935	16381	22806	25315
PHPDT Capacity Available	11490	15320	23420	23420
Requirement of Coaches	69	93	141	141

Speed

The Design Speed in respect of all the Lines is 80 kmph and the Average Speed is 34 kmph.

Traction Power Supply

Particulars	Four Extensions	R.V. Road to Bommasandra	Gottigere - IIMB - Nagawara
Traction system voltage	750V DC Third Rail	750V DC Third Rail	25 KV AC
Current Collection	Third Rail bottom collection	Third Rail bottom collection	OHE
Power Sub Station	Anjanapura, Kengeri & ITPL Park	Naganathapura & R.V. Road	Hulimavu & Nagawara
Power Supply Source	66 KV AC	66 KV AC	66 KV AC
No. of Receiving Sub Stations	3	2	2
No. of Traction Sub Stations	14	8	2
SCADA System	Provided	Provided	Provided

Note : Exact number of Traction Substations will get finalized after Detailed Design.

Maintenance Facilities

Particulars	Four Extensions	R.V. Road to Bommasandra	Gottigere - IIMB - Nagawara
Maintenance Depot	Baiyappanahalli on E-W Peenya on N-S (Both provided in Ph-I) A new depot is proposed to be provided at Kengeri in Phase-II	Hebbagodi Depot Augmentation in existing infrastructure at Peenya Depot	Kothanur Depot
Stabling Facilities	Stabling facilities at Anjanapura Depot.	Disabled Stabling Line provided in the Oxford Station	Stabling facilities at Nagawara Stabling Depot

PROJECT COST

Delhi Metro Rail Corporation have prepared the DPRs of four extensions and the 2 new lines of R.V. Road to Bommasandra and Gottigere – IIMB – Nagawara corridors. The total Completion Cost of all Six Lines of Phase-II is estimated at Rs.26405.14 Crore. The details are as below:

Name of the Line	Description	Estimated Completion Cost (Rs. in Crore)
Baiyappanahalli to ITPL – Whitefield	Extension of Eastern Line of Phase-1	4845.00
R.V. Road to Bommasandra	New Line with Interchange Station at R.V. Road Station in the Southern Line of Phase-1	5744.09
Mysore Road Terminal to Kengeri	Extension of Western Line	1867.95
Gottigere - IIMB - Nagawara	New Arterial Line with a 13.79 km Underground Line.	11014.00
Puttenahalli Cross to Anjanapura Township (up to NICE Road)	Extension of Southern Line	1765.88
Hesaraghatta Cross to BIEC	Extension of Northern Line	1168.22
Total		26405.14

COMPLETION PERIOD OF PHASE-II

The Completion Period for all Lines of Phase-II will be 5 to 6 years from the date of approval by Government of India.

FINANCIAL INDICES

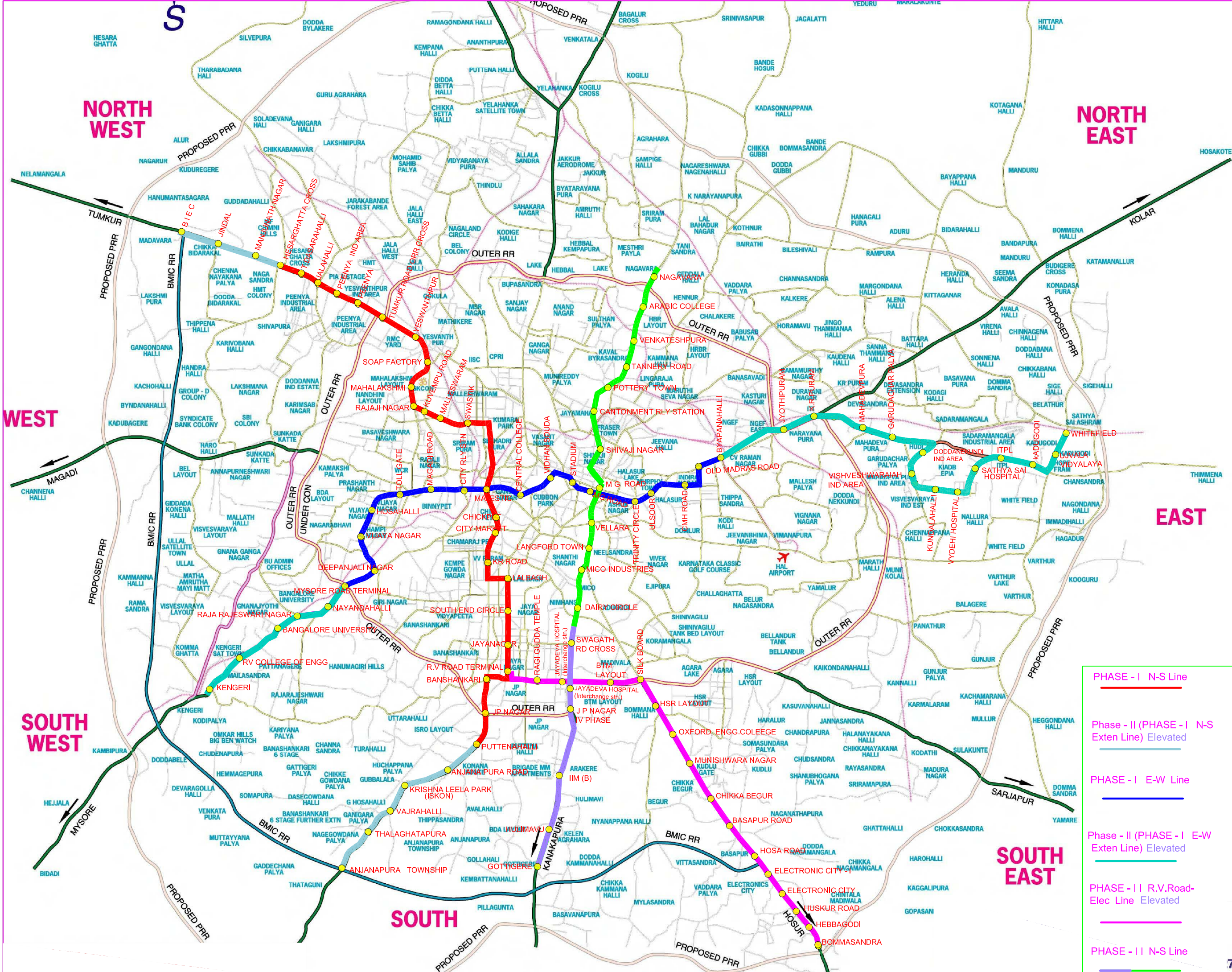
The Financial Indices:

Line	EIRR	FIRR
Four Lines	13.40%	6.30%
R.V. Road to Bommasandra	16.70%	4.40%
Gottigere - IIMB - Nagawara	13.20%	4.00%

Land Requirement:-

Since land is a scarce commodity especially in metropolitan areas, every effort has been made to keep land requirement to the barest minimum and acquisition of private property has been kept minimal. Land is mainly required for route alignment, station buildings, platforms, entry/exit structures, traffic integration, power sub-stations, temporary construction depots / work sites and sick line facilities etc.

DISCLAIMER: - The areas indicated in this report or the alignment map is only broadly indicative of the location of the stations and viaduct / tunnel as the case may be and should not be construed as approved locations or used as a record for any purpose.



PHASE - I N-S Line

Phase - II (PHASE - I N-S Exten Line) Elevated

PHASE - I E-W Line

Phase - II (PHASE - I E-W Exten Line) Elevated

PHASE - I R.V.Road-Elec Line Elevated

PHASE - II N-S Line