

**Land Use Development in Mumbai:
Demand, Costs, & Financing**

Over the course of time, developed land in the Mumbai Metropolitan Region (L) is a function of the land used for housing buildings (H). But it consists also of a largely fixed part (A), used for industry, major roads, railway tracks, airports, port, and of a third part (B) for schools, recreation, institutions. To keep things simple, we will ignore land used for commercial buildings (C); it is only a relatively small part of H (perhaps 5% presently), and a share that will decrease over the years, because H will increase (all other things constant) at the rate of GDP growth whereas C increases at the rate of population growth. Table 1 indicates the relative importance of these categories in 2005.

Table 1 - Major Developed Land Uses, MMR, 2005

(in km ²)	
Housing buildings (H)	76
Major infrastructure (A)	169
Other public spaces (B)	198
Total land developed (L)	440

Source : LEA. Land Use Report for L and for A. Estimates for H.

Nearly by definition, H is a function of housing floor space (F) and of the FSI (f) defined as F/H. With f, the average FSI, estimated to be 1.1, we have:

$$H = (1/f) * F = (1/1.1) * F = 0.9 * F$$

The developed land occupied by major public infrastructure (A) is estimated by LEA to be 169 km². This large number includes about 100 km² or industrial land, much of which is not very intensively used. A = 169.

Other public spaces (B) like land for streets, parks, or schools, will be assumed to be b*H, a function of housing land. Data for 2005 shows that b=2.6

$$B = b * H = b * (1/f) * F = 2.6 * (1/f) * F = 2.4 * F$$

We therefore have developed land L as a function of housing floor space F (and of FIS f):

$$L = 169 + (1/f) * F + 2.6 * (1/f) * F$$

Demand for Developed Land in 2021

The demand for housing floor space F is a function of unit housing floor prices, and of households income, which is itself a function of GDP. Assuming constant unit housing prices (per m2) constant, housing floor space will increase like GDP. With g the GDP growth rate, we will therefore have, after n years:

$$L = 169 + (3.6/f)*84(1+g)^n$$

For n=15, that is in 2021, and for various values of FSI f and of growth rate r, the quantity of developed land L will be as indicated in Table 2.

Table 2 - Developed Land As A Function of GDP Growth Rate and of Average FSIs, MMR, 2021 (in km2)

	Growth rate :	8%	10%	12%	14%
FSI :					
1.1 (present FSI)		1041	1317	1674	2131
2.2 (double present FSI)		605	743	921	1150
3.4 (triple present FSI)		460	552	671	823
4.4 (quadruple present FSI)		367	456	545	660

Source : Calculated according to the formula indicated above.
Note : For reference, presently developed land is 440 km2.

Table 2 shows how sensitive land consumption is to rates of GDP growth and even more so to FSIs. Developable land is scarce in the MMR, and an increase of 50% over present levels by 2021 would probably be an ambitious target. This would mean 660 km2. Table 2 shows that such a land development constraint could not be achieved with the present average FSIs, even in the relatively low growth scenarios. Table 2 also shows that the higher growth rates scenarios, and in particular the 12% growth rate scenario, the preferred one, imply at least a tripling of present averages FSIs.

Estimating Land Development Costs

Infrastructure and land development costs (LDC) consists of two parts. First, there are "fixed costs", investments which have to be made in any case, in the metro, in the railway, in the airport, in the port, in dams, in main water pipes, in sewers and in used water treatment plants. They are estimated to cost about Rs crores 129,000 (about US\$ 30 billion). Second, there are land development costs; The experience of CIDCO suggests a figure of Rs 1,200 per m2. This is Rs crores 120/km2. We therefore have (in Rs crores) for LDC as a function of L:

$$LDC = 129,000 + 120*(L-440)$$

Table 3 indicates infrastructure and development costs as a function of total developed land in 2021.

Table 3 - Infrastructure and Land Development Costs as Function of Land Developed, MMR, 2021

Land developed in 2021 (in km ²)	Costs over the 2006-2021 period	
	(in Rs crores)	(in US\$ billion)
500	136,000	31
600	148,000	34
700	168,000	36
800	172,000	39
900	184,000	42
1000	196,000	44
1,100	208,000	47

Development Charge

It is envisaged to finance infrastructure and land development costs by means of a development charge based on the sales value of housing floor (and also of commercial floor) multiplied by a rate r . Sales values are independent of FSIs, but not of GDP growth rates, not of unit (per m²) prices. Assuming unchanged unit prices, estimated to be Rs 40,000/m², we can produce Table 4.

Table 4 - Development Charge Proceeds, as a Function of GDP Growth Rate and Charge rate, MMR, 2006-2021 (in Rs crore)

GDP growth rate	8%	10%	12%	14%
Charge rate				
5%	36,000	54,000	76,000	102,000
10%	72,000	108,000	152,000	206,000
15%	108,000	162,000	228,000	308,000

Conclusions

The comparison of Tables 3 and 4 shows that a 10% charge in a 12% growth scenario coupled with a FSI three or four times the present levels would produce an amount of developed land consistent with availability constraints, as well as enough money to pay for the infrastructure backlog and the land development costs.

These numbers are only rough estimates. They are no better than the parameter values on which they are based, which could and should certainly be revised and improved. It would also be very useful to disaggregate spatially the model and to introduce a greater dose of geography into the analysis.

But the methodology used, although it simplifies reality, probably captures the essence of the problem, and the main conclusions arrived at are probably fairly robust.

1) One is that a high GDP growth rate will quadruple the amount of housing space per inhabitant and play a key role in relieving Mumbai's housing problems.

2) A second is that this would not be possible without a substantial increase (a tripling) of average FSIs.

3) A third is that this would not be achieved at an increase in densities, but, on the contrary, by a slight decrease.

4) A fourth is that the amount of additional developed land required —about 50% of the present developed land in the MMR— seems compatible with existing constraints on developable land.

5) A fifth is that a 10% development charge based on the value of additional floor sales would produce the amount of public money necessary to pay for the major infrastructure investments required as well as the cost of land development.