EVALUATING ALTERNATIVES FOR HOUSING INDIA'S URBAN POOR: Design Studies, Model and Application in Ahmedabad.

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ABSTRACT

The study evaluates the three alternatives identified by the (National) Planning Commission for housing the Urban Poor in India: Upgrading, site and services, and housing.

The basis for evaluation is the relationship of the cost of development to the cost of each of the components in development and the number of beneficiaries. The framework for evaluation is proposed as a model to assist: 1) Project designers to identify the relative importance of the various design parameters in development and to indicate quickly to the concerned agencies the impact of standards and regulations, 2) State and local agencies to determine the affordable standards, and 3) Allocation of available National resources by choosing affordable alternatives for housing the urban poor.

The application of the model is illustrated for Ahmedabad. Conclusions are drawn from the application and for a specific set of assumptions. The assumptions governing the values assigned to the parameters of the model are based on case studies and design studies for three low-income settlements in Ahmedabad.

Thesis Supervisor: Horacio Caminos
Title: Professor of Architecture

CONTENTS

PREFACE

The past studies for housing the urban poor generally can be classified into two categories: 1) Those that are primarily concerned with increasing the quantity of housing and 2) Those that are concerned with improving the quality of housing stock. The former invariably imply an increased share of resources (private or public) for housing and the latter, changes in the existing social, political or decision making systems. These studies, as valid as they may well be, fail to recognize several important realities - 1) 'It is clear that the need is great for better and more housing in urban areas. As stated earlier, given the overall resource constraints and more pressing competing claims on public resources, the vast majority of housing in urban areas will have to be met from private resources'; 2) It is difficult to imagine that the urban poor will be able to marshall more savings for housing today than they could, say, ten years ago 'when 50% of the country's population has been living below the poverty line continually for over a long period'; and 3) A set of social and political attitudes that has evolved over many years, I don't think, will change as fast as many advocates of improved housing might want it to.

I am not saying that such studies are not useful, far from it, but I do believe that they will not put forth perceivable, substantial and convincing results in a short period of time. The design studies and model I have proposed in this study are set in these realities - limited resources, a conservative system of decision making and a recognition of a need to increase and improve the housing stock.

This study, therefore, is oriented to make the best of what is already being made by helping: 1) To maximize the use of available national resources by choosing affordable alternatives for housing the urban poor, 2) To determine the affordable project parameters; particularly the level of services (standards), the scale of development, etc.; and 3) To use this data toward the generation of efficient and economical designs. The study will also help to expedite the customary time consuming negotiations determining each of these decisions at the National, state, local and project levels. In the illustration of its use, the model has been adapted to computer. It must be clearly understood, however, that the model and, in particular the computer program, are in an elementary stage of development.

The application of the model is illustrated for Ahmedabad, the seventh largest city and my home for the last eight years.

The methodology used in the evaluation of the case studies was developed in the Urban Settlement Design Program at the Massachusetts Institute of Technology. An important source for the methodology used in the model is Alan Bertaud's "Model for the Analysis of Alternatives for Low-Income Shelter in the Developing World."

The data for the study has been reconstructed, primarily, from two sources: 1) Information, including drawings, provided by the Ahmedabad Municipal Corporation, and 2) My field work, including interviews, surveys and photographs.

The study was conducted as a part of the two year program in Urban Settlement Design at MIT, and I am grateful to Professor Horacio Caminos and Reinhard Goethert, the directors of the program, for their advice, guidance and criticism. I enjoyed the invigorating company and immensely benefitted from the experience and knowledge of my colleagues from other developing countries in the program. I am indebted to numerous officials of the Municipal Corporation and many senior colleagues and friends for their cooperation during my field work in Ahmedabad during the Summer of 1981.

I am thankful to Mayank Shah, Shubhankar Sanyal, Yezdi Dordi and Sue Lichauco for their assistance with the photographs, drawings, computer programming and typing the text, respectively. I am also thankful to the R.D. Sethna Scholarship Fund, Bombay, for the partial financial assistance.

Reference:

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INTRODUCTION

India's population today is over 658 million and over 23% or 156 million is urban. The increase in urban population during the decade of 1971-81 is over 47 million or 4%. Particularly disconcerting is that nearly three quarters of the urban population is poor and most of the urban areas are without adequate services and utilities.

At present, the total housing 'shortage' in urban areas is estimated to be 5 million units, about 27 million people. The Planning Commission in a review of Public and Private sector investments in housing concluded that the country's housing problem cannot be solved in the sixth plan period, 1980-85. The combined outlay for the plan period, 1980-85, for urban housing is expected to be Rs. 94 billion (US $11.75 billion). It can be assumed that the bulk of Private sector investments will not serve the poor. Moreover, several programs compete for the Public sector outlay of Rs. 13 billion (US $1.63 billion). In this context, what is likely to be made available for the urban poor is through the following three programs:

1) Environmental Improvement of slums (upgrading): This forms part of the basic needs program. Facilities that will be provided include water supply, storm water drainage, paving of streets, street lighting and community water closets. The sixth plan views the problem of shelter and urban development as being inexorably connected with the provision of a safe water supply and adequate sanitation. The proposed plan outlay for this program is Rs. 1.5 billion (US $0.19 billion) and the total beneficiaries, about 10 million persons.

2) Site and Services Programs: Direct assistance to the Economically Weaker Sections (EWS) is proposed through site and services projects. The Planning Commission identifies a need for effective public programs through the provision of essential services like water supply and sewage disposal, along with low-cost shelter options. The plan outlay for the program is Rs. 4.8 billion (US $0.60 billion). The beneficiaries in the program will be given loans up to Rs. 3,000 (US $375) per household, at a concessional rate of interest and repayable over a period of 20-25 years. The program is likely to provide 1.62 million units or housing for 8.75 million persons.

3) Economically Weaker Section (EWS) and Low Income Group (LIG) Housing: Housing for the urban poor is also channelized through the Housing and Urban Development Corporation (HUDCO). EWS (30%) and LIG (25%) constitute 55% of HUDCO's allocation of loan disbursements. The plan outlay for HUDCO including loan recovery is Rs. 6 billion (US $0.75 billion). Assuming total utilization of limits stipulated by HUDCO, Rs. 8,000 (US $1,000) for EWS and Rs. 18,000 (US $2,250) for LIG housing, another 308 million units will be added or another 1.6 million persons will be housed.

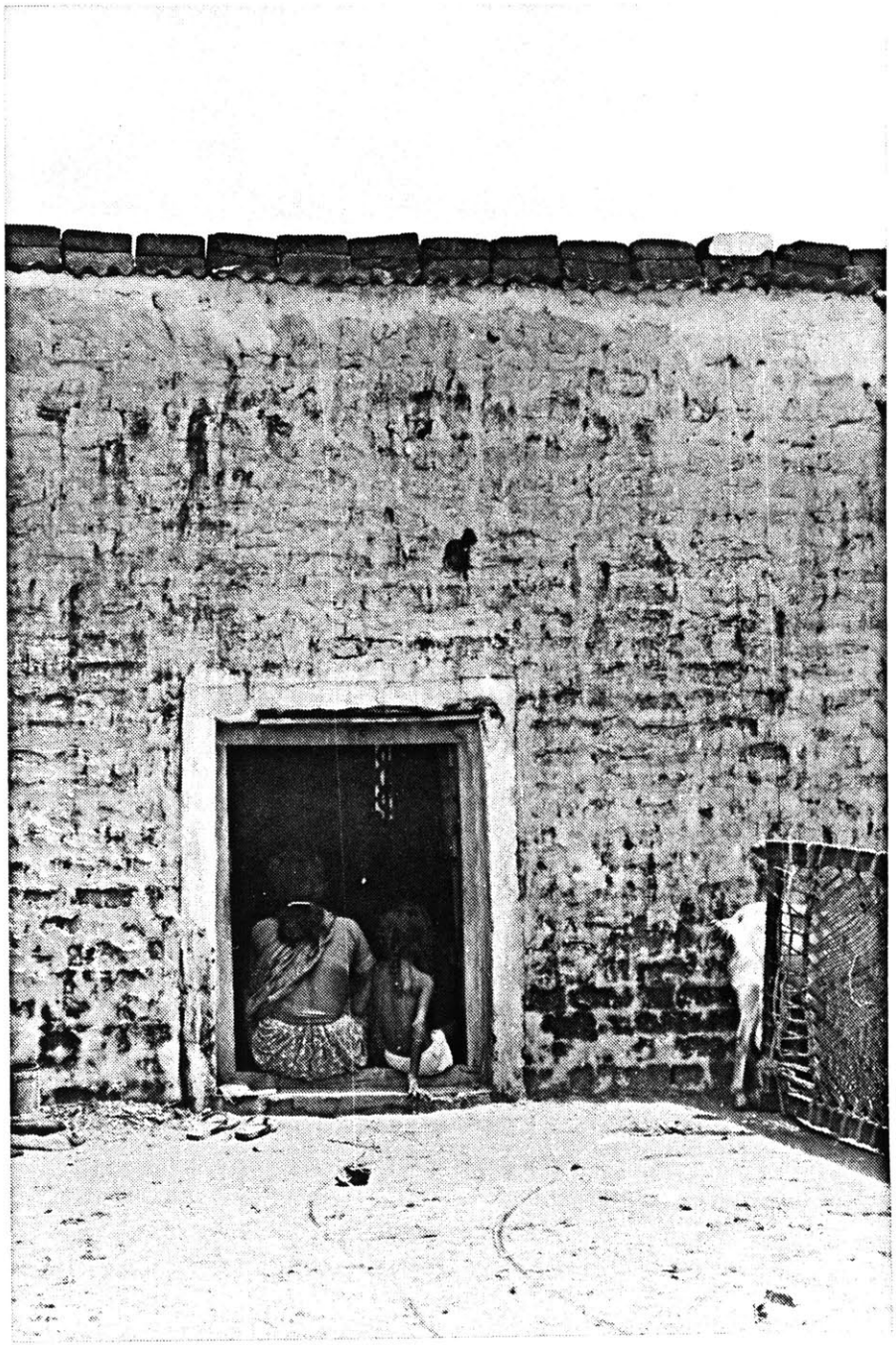
To summarize, total investment in housing for the urban poor during the five year period, 1980-85, is likely to be about Rs. 9.6 billion (US $1.2 billion) and the population to be housed is about 20 million.

The objective of the study is to evaluate the three alternatives identified by the National Policy Makers for housing the urban poor: Upgrading, Site and Services and Housing. The objective in the evaluation is: 1) to make

maximum use of available resources for each of the alternatives and in turn increase the number of beneficiaries, and 2) to help project designers to determine the focus for design activities in each of the alternatives. The basis for evaluation is the relationship of the cost of development to: 1) the number of beneficiaries and 2) the cost of each of the components (parameters) in development (design, the level of services, building materials, the level of technology, etc.).

The parameters can be identified and assigned values, under ideal conditions, through a review of existing projcts. But, given the nature of existing projects which are often ineptly designed, inferences thus drawn can only be misleading. In the first part of this study, therefore, each of the alternatives is applied to a case in Ahmedabad. Observations from the design studies are used to assign values to the parameters of the model.

The model is intended for: 1) Project designers: a) to identify the relative importance of the various design parameters in development, and b) to indicate quickly to the concerned agencies the impact of a standard or regulation. 2) State and local agencies: a) to identify the relationship between the cost of development and the number of beneficiaries, and b) to re-evaluate standards and regulations. 3) National Policy Makers to re-evaluate the alternatives for housing the urban poor. The application of the model is illustrated for Ahmedabad.



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PRELIMINARY DESIGN STUDIES

BACKGROUND

Urbanization in India: Urbanization in India has the following characteristics:

a) Rapid increase in the average rate of growth of urban population: In 1971, the urban population was five times the size it was in 1921, although the total population had only doubled.

b) Absolute size: Although the proportion of urban population to the total population is only 24%, the absolute size of about 156 million (1981) is enormous, by most standards.

c) Urban growth: Average annual rate of growth in population in cities and towns with a population of over 50,000 has been about 4% as opposed to about 2% for those with less than 50,000. This would imply that the larger cities and towns have absorbed a higher share of growth. This 'misconception' according to the Planning Commission is caused by the movement of towns into higher sized-classes along with the growth of population. The process of urbanization would appear relatively balanced if cities and towns in each size-class is kept constant.

d) Regional disparities: The difference in urban growth between different regions and cities is significant. The proportion of urban population to the total population varies from about 7% to 35%.

e) Increasing urban poor: Households, with an income of less than Rs. 500 (US $62.50) per month are considered poor, and constitute nearly 87% of the total urban population. In Madras, a survey conducted by the State Slum Clearance Board indicated an increase of nearly 78% in the population of urban poor, as against the general increase in the population of the city of only 42%, during the 1961-71 decade. This trend may well be true for other cities, as well.

f) Decreasing shelter supply: Urban population without housing is about 27 million and without exclusive amenities is about 91 million. Nearly 54% of urban households (average household size, 5.4) live either in one room (24%) or two room (30%) dwellings. Annual rate of expenditure on housing is a maximum of 10% of total income for the urban poor.

The thrust of National urbanization policies, during the sixth plan period (1980 - 85) are the following:

a) To lay greater emphasis in the provision of adequate infrastructure and other facilities in the small, medium and intermediate towns. The aim being to strengthen these market centers and equip them to serve as growth and service centers for the rural hinterland.

b) To maximize beneficiaries in large cities by adopting more realistic norms and standards for urban services and infrastructure.

Dwelling environments of the urban poor in India: The dwelling environments of the urban poor in general and squatter settlements in particular have the following characteristics:

a) Size: The variation in size between different settlements is significant and may range from a cluster of 25 households to a cluster of more than 900 households. The size of settlements seems to have a direct relationship with its age; the older it is, the larger it is.

b) Density of population: The density of population is

an important indicator of physical and social environments. Gross density of population may range from 300 persons per hectare in some settlements, to as high as 2,500 in others.

c) Location: The majority of urban poor walk to their place of work. Hence, either the settlements are located near their place of work, or they secure work near their place of residence. In Gujarat, for example, nearly 45% of the urban poor are settled within 1 km of their place of work. The trend among many present-day settlements is to locate themselves near the place of work. However, this cannot be generalized for all settlements or regions.

d) Occupation and Income: Urban poor are engaged in various trades and occupations. However, the seasonality and irregularity of jobs are very common and a vast majority is dependent on casual jobs and irregular income. In Gujarat, where the population living below poverty line in urban areas is relatively lower than those in other parts of the country; the per capita income among the urban poor is only about Rs. 40 (US $5) and the average household income rarely exceeds Rs. 200 (US $25) per month.

e) Migration: The size of the city may be one of the important criteria for migration, like in Gujarat where the larger cities have absorbed higher concentrations of migrating population. The reasons for migration could be many, although in Gujarat the search for employment and training is the predominant reason. The proportion of migrants among the urban poor varies from 10% in some cities to 30% in others.

f) Environment, Services and Shelter: Informal settlements of the urban poor are characterized in dwellings with inadequate ventilation, toilet and bathing facilities; and subject to flood or fire hazards. The settlements are characterized by a lack of hygiene, prevalence of contagious and chronic diseases, high infant mortality and lack of adequate municipal and social services. Housing for the urban poor in the formal sector has many similar problems, caused by inefficient planning and insignificant supply because of costs.

The lack of adequate services and utilities for the urban poor is best illustrated in the report on the regional plan drawn up by the Bombay Municipal Regional Planning Board - 'it is a shocking knowledge that (this) population of over 600,000 has among them only 1353 w.c.'s and 482 water taps.' In Ahmedabad, in some settlements, as many as 700 persons share a tap and 1000 persons, a w.c.

Shelters are characterized by mud walls and floors with salvaged galvanized iron, tin or asbestos sheet roofs. In Gujarat, the majority of the urban poor are huddled in less than 20 sq. m. per household. The enclosed area per person in many settlements is about 1 sq. m.

g) Tenure: The importance of tenure varies with differing perceptions of security in different settlements. For example, in some settlements in Ahmedabad, despite its illegal status, tenure is not a priority. Perception of security in such settlements is related to the strength of internal organization and political influence. However, in general, households owning the structure (not necessarily the land also), tend to invest than those who do not. The population who

own both land and structure is insignificant. Those who own neither land nor structure and do pay rent, pay about Rs. 12 (US $1.5, or about 6% of their monthly income) per month.

The sixth-five year plan, in reference to its objectives to improve conditions for the urban poor draws particular attention to the following:

a) Housing activity in small, medium and intermediate towns, which have been neglected until now.
b) Low-cost housing techniques including popular methods to bring down unit costs.
c) Modification of existing building by-laws, land use controls, minimum plot requirements and land requirements for roads; which often make it difficult to reduce the cost of shelter.
d) The avoidance of direct subsidies in urban housing. In case of higher and middle income groups; housing subsidies should be totally avoided. For low-income groups where subsidies are inevitable, they should preferably be for infrastructure and sanitation facilities, which in turn will help improve the environment for people to invest in their own dwelling.
e) Greater stimulus and support to private housing in the middle and lower income groups, so that there are incentives to channelize savings into housing construction.

Housing for the urban poor in Ahmedabad, Gujarat: The urban population in Gujarat for 1981 was 31% as against the all India average of 24%. Gujarat is the third most urbanized state in India and Ahmedabad ranks first in urbanization among all districts of Gujarat with 72% urban population. The majority of this urban population, nearly 90% or about 2.5 million live in the Ahmedabad urban area, the seventh largest city in India.

It is difficult to determine the housing shortage in the city. It is certain, however, that since 1941, when the city showed a very rapid increase in population the supply of housing, particularly for the urban poor has not kept pace with the demand. This is illustrated, that as far back as in 1976, nearly 22% of the city population was living in squatter settlements.

Squatter settlements in this study are synonymous to what the Ahmedabad Municipal Corporation defines as 'slums'; vis-a-vis, a) those that are unauthorized constructions on government, municipal or private land, b) those that are devoid of basic amenities like water supply, drainage, water closets, etc.; and c) those that are not in accordance with the building by-laws of the Municipal Corporation.

It can be assumed that the proportion of total population living in squatter settlements in 1981 has either remained the same or more likely, increased since the survey in 1976. This would mean that at present, at least as many as 550,000 people must be living in squatter settlements. This is in addition to another 550,000 people living in 'chawls', many of which by definition are no different from squatter settlements. In summary, HOUSING FOR THE URBAN POOR IN AHMEDABAD INCLUDES MORE THAN HALF THE POPULATION OF THE CITY.

The census of squatter settlements ('slums') in 1976 revealed that there were over 80,000 squatter dwellings, housing a population of over 400,000. About 78% of these dwellings were on private land. Literacy among squatters was as low as 10%. 83% of squatter were migrants who had come to the city before 1968. Nearly one third were employed in the textile industry and

about three quarters of the households earned less than Rs. 350 (US $43.75) per month.

Gujarat Housing Board, Gujarat Slum Clearance Board and Ahmedabad Municipal Corporation are the three agencies primarily responsible for public housing in Ahmedabad. The Gujarat Housing Board is responsible not only to all parts of the state, but to all sections of the population as well. Till 1975-76, the Board had built about 30,000 dwellings in Ahmedabad and not more than a third of these could have been for the poor. It is quite likely that the Board will not spearhead housing activity, particularly for the poor. Gujarat Slum Clearance Board on the other hand, in spite of its specific focus, lacks both material and man-power to make any significant strides in the near future. Moreover, like the Housing Board, the Slum Clearance Board is also responsible to all parts of the state. The Ahmedabad Municipal Corporation will continue to be responsible for housing the city's poor. The Corporation, however, considers housing not its 'obligatory' function, though 'it is aware of the acuteness of the problem in the city and the extreme hardships experienced in this regard by large parts of the poorer sections of the city's population. A comprehensive Development Plan for 1975-85 has therefore been prepared, wherein housing policy of the corporation has been chalked out at great length.'

The Development Plan for 1975-85 envisaged an annual target of about 18,000 households as beneficiaries under various schemes for the city's poor. The schemes included site and services projects, 'chawl' improvement, environmental improvement of squatter settlements (upgrading) and integrated area development projects. Very little is documented on how much has been completed, but it can be assumed that it will be certainly less that what was targeted. This is in addition to that 18,000 beneficiary households is in itself inadequate. The Municipal Corporation does concede that it cannot solve the problems of housing the city's poor through its efforts alone. It is difficult, however, to imagine who else would be willing to or could be endowed with this responsibility.

The reasons the Ahmedabad Municipal Corporation puts forth for its limited role are inadequate resources and diverse other responsibilities. These include the problem of providing civic services on privately owned land, lack of time and funds to acquire privately owned land, etc. The Corporation appeals for larger financial aid from the central and state governments to overcome these problems. It is, however, not likely that any significant increase in allotment from these sources will be forthcoming in the near future. In this context, the only choice available to the Municipal Corporation is to re-evaluate the envisaged development alternatives for housing the city's poor.

The following study will serve this re-evaluation. The objective is, as it should be; to maximize available funds and in turn, to increase the number of beneficiaries. The re-evaluation should include the following issues: Which settlements must be given a priority for upgrading? Which are the settlements where upgrading may not be the right alternative? If upgrading is not the right alternative, what would be? Is it necessary to leave some settlements as they are and upgrade them at a later date? Is it cheaper, as opposed to upgrading some settlements, to redevelop them as new site and services projects? Which part of the development imposes the maximum burden on finances? What difference does a change in a particular 'regulation' make on the cost of development?, etc.

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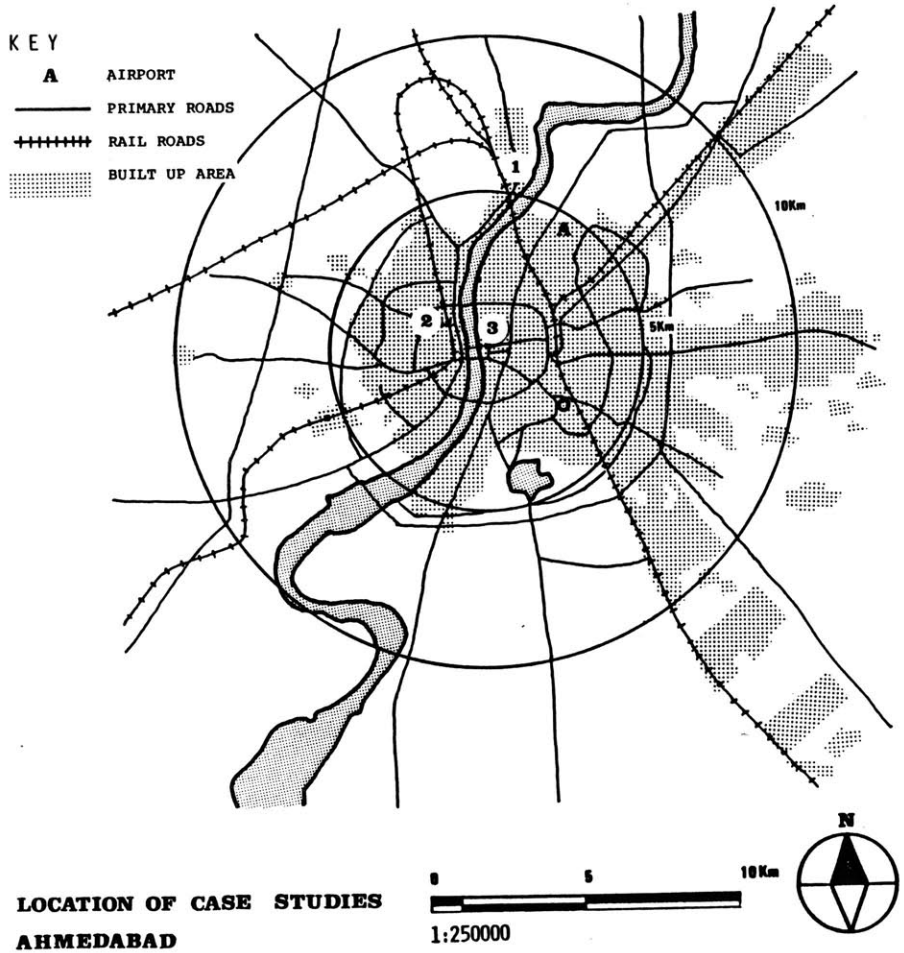
INTRODUCTION TO CASE STUDIES

The squatter settlements in Ahmedabad can be classified into three broad categories:

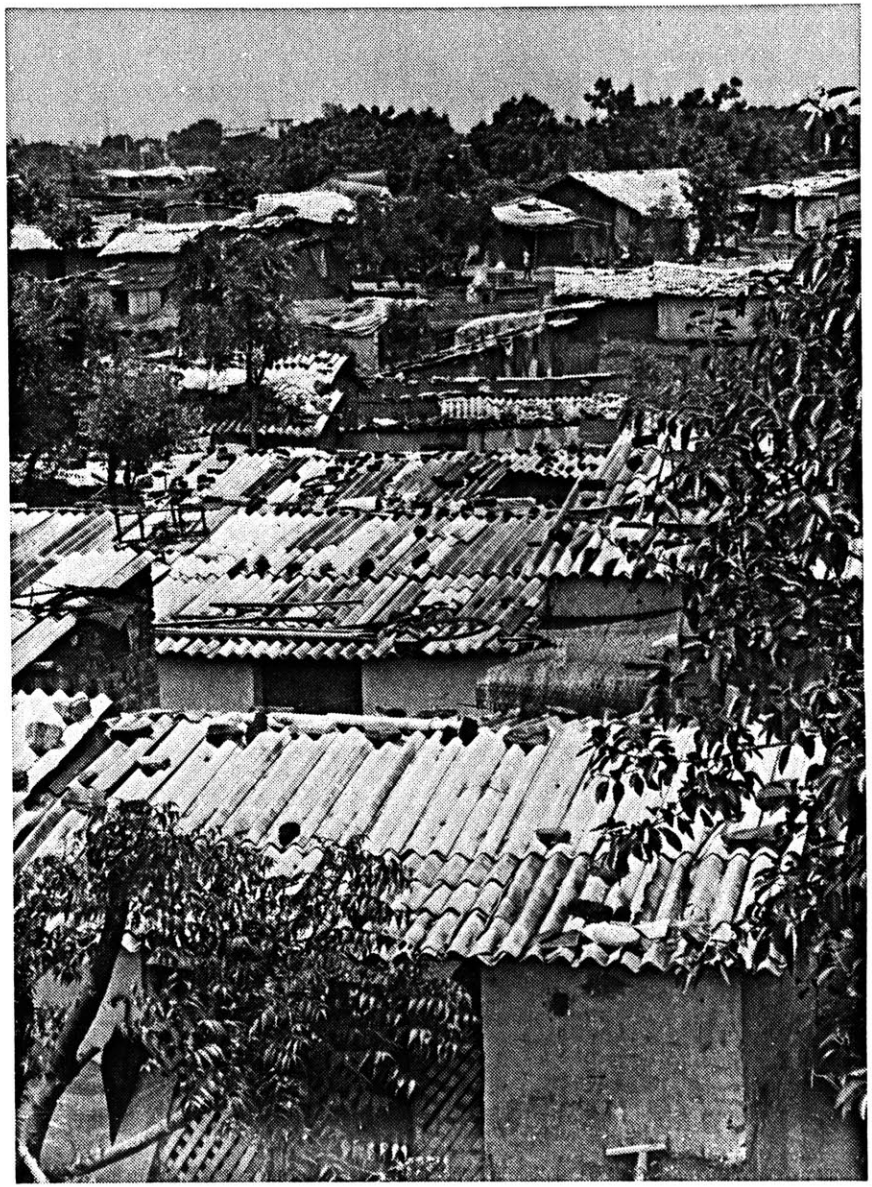
The first category consists of settlements that are located close to industrial areas and away from the city center. The inhabitants of these settlements, because of the nature and regularity of employment tend to have relatively higher incomes. Although the settlements lack access to most urban services, the dwellings tend to be better built and many inhabitants seem to be paying rent. The rent, however, may not be paid to the owner of the land; but either to earlier occupants who cornered big chunks of land or to other third parties who may not be even staying in the settlement. There also seems to be a higher turnover of inhabitants. This higher turnover implies a crucial difference from the other categories: a lack of any powerful internal organization or political influence. These settlements, despite its higher economic mobility are likely to have very little influence on public investments in housing.

The second category consists of settlements that once 'villages' were engulfed by urban growth. These 'villages', however, were often illegal settlements on the outskirts of the city developed by the migrating population. Many of these settlements were established during the last century and had over time developed social and occupational structures similar to those in a village. These settlements, in spite of their age are classified as illegal. They are characterized by continuing dependence on hereditary occupations (that may have been serving urban areas more profitably in the past, but no longer do) and impoverishment. These settlements, unlike those in the first category, have better access to urban services. The houses tend to be

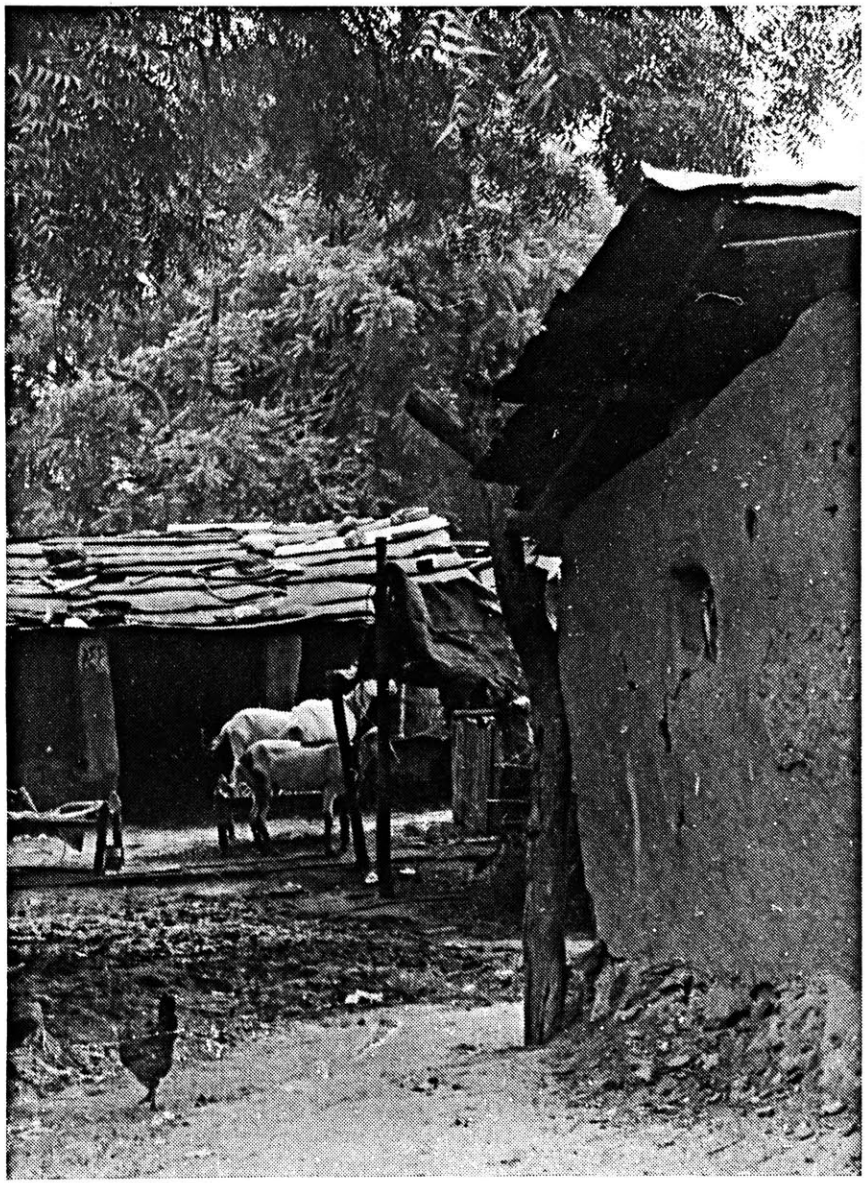


LOCATION OF CASE STUDIES
AHMEDABAD

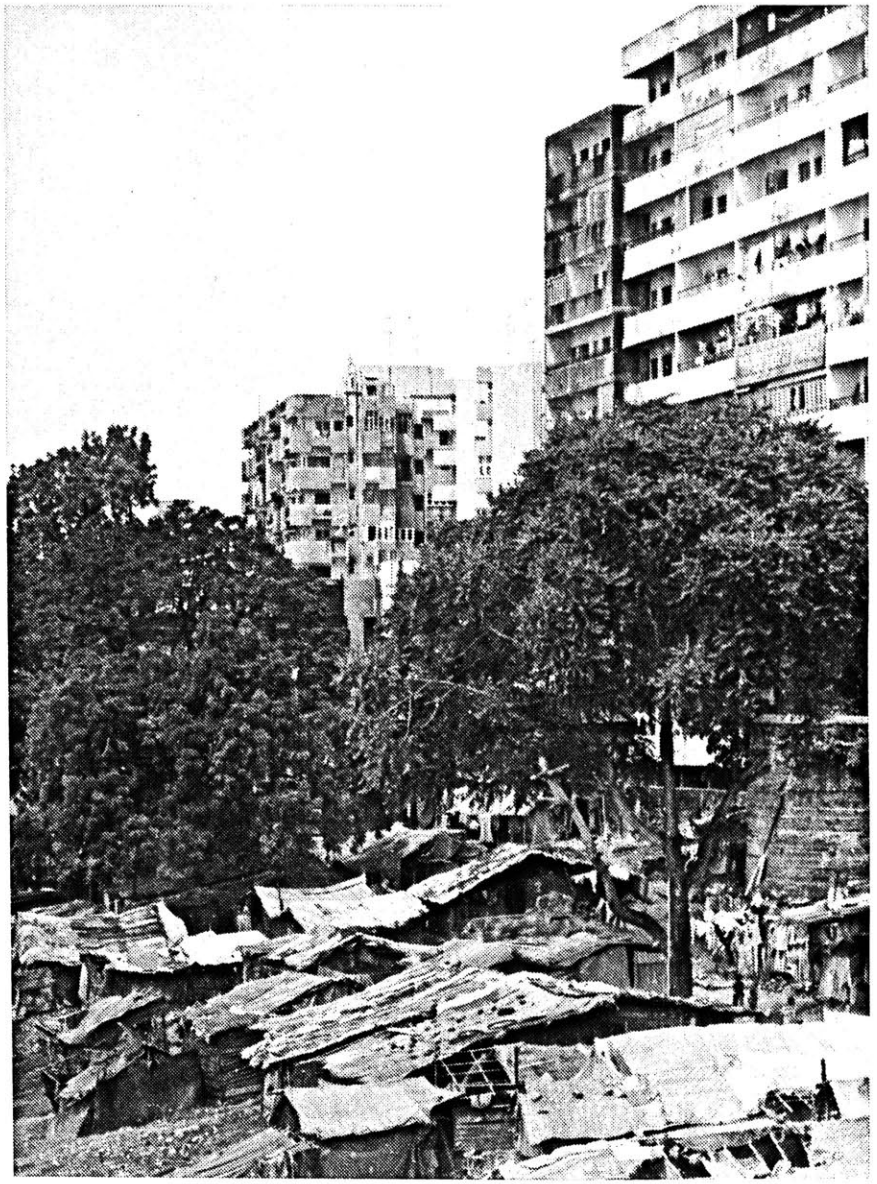
more makeshift and none of the inhabitants seem to be paying rent. Rent for the use of land may have been collected in the past by the owner. With the passage of time, however, when it became apparent that eviction is almost impossible, the occupants (probably with some political backing) may have stopped paying rent. The turnover of inhabitants seems to be very little and the settlements tend to be relatively close-knit groups.



A squatter settlement (an example from the first category) located far from the city center. The nature and regularity of income of the inhabitants seem to be responsible for the better built dwellings.



A squatter settlement (an example from the second category) that was once a 'village'. The settlement is characterized by continuing dependence on hereditary occupations, impoverishment and make-shift houses.



A squatter settlement (an example from the last category) along the river bank and close to the city center. Many of the settlements on the river bank are well below maximum flood levels.

There is a fairly strong internal organization capable of influencing political/public decisions on investments in housing.

The last category of settlements are those that are located close to the city center. The inhabitants of these settlements may be the poorest of the three categories. These settlements, by virtue of their location, have the best access to urban services. The houses tend to be less makeshift than those in the second category, but not as better built as in the first. This may seem inconsistant, given the economic status of the inhabitants; but given the higher densities of these settlements, the investment per capita on the dwelling may turn out to be lower than that in the second category. Among the three, the settlements in this category seem to have the most cohesive internal organization and the maximum political influence.

The settlement in Sabarmati, the first case study, is one of the settlements in the first category. Upgrading is the alternative proposed for the development of this settlement.

The settlement in Gulbai Tekra, the second case study, is representative of the settlements in the second category. Site and services is proposed as an alternative for the development of this settlement.

The settlement in Khanpur is among the settlements in the last category. High density, low-rise housing is proposed as an alternative for development.

Field surveys and interviews determine the choice of a particular alternative of development for the settlements. In general terms, the choice is the result of two factors: What the inhabitants need and what they will be provided, which is primarily based on political decisions.

Sources for Case Studies:

General Information	:	*Ahmedabad Municipal Corporation, Report on Census of Slums, 1976. Ahmedabad Municipal Corporation, Draft Revised Development Plan, 1975-85. Volume 1. Field Surveys, Author.*
Locality Land Use Plan	:	*Field Surveys, Author. Ahmedabad Municipal Corporation. (approximate)*
Settlement Plan:	:	*Ahmedabad Municipal Corporation. Field Surveys, Author. (approximate)*
Photographs	:	*Author.*

CASE STUDY 1: SABARMATI UPGRADING

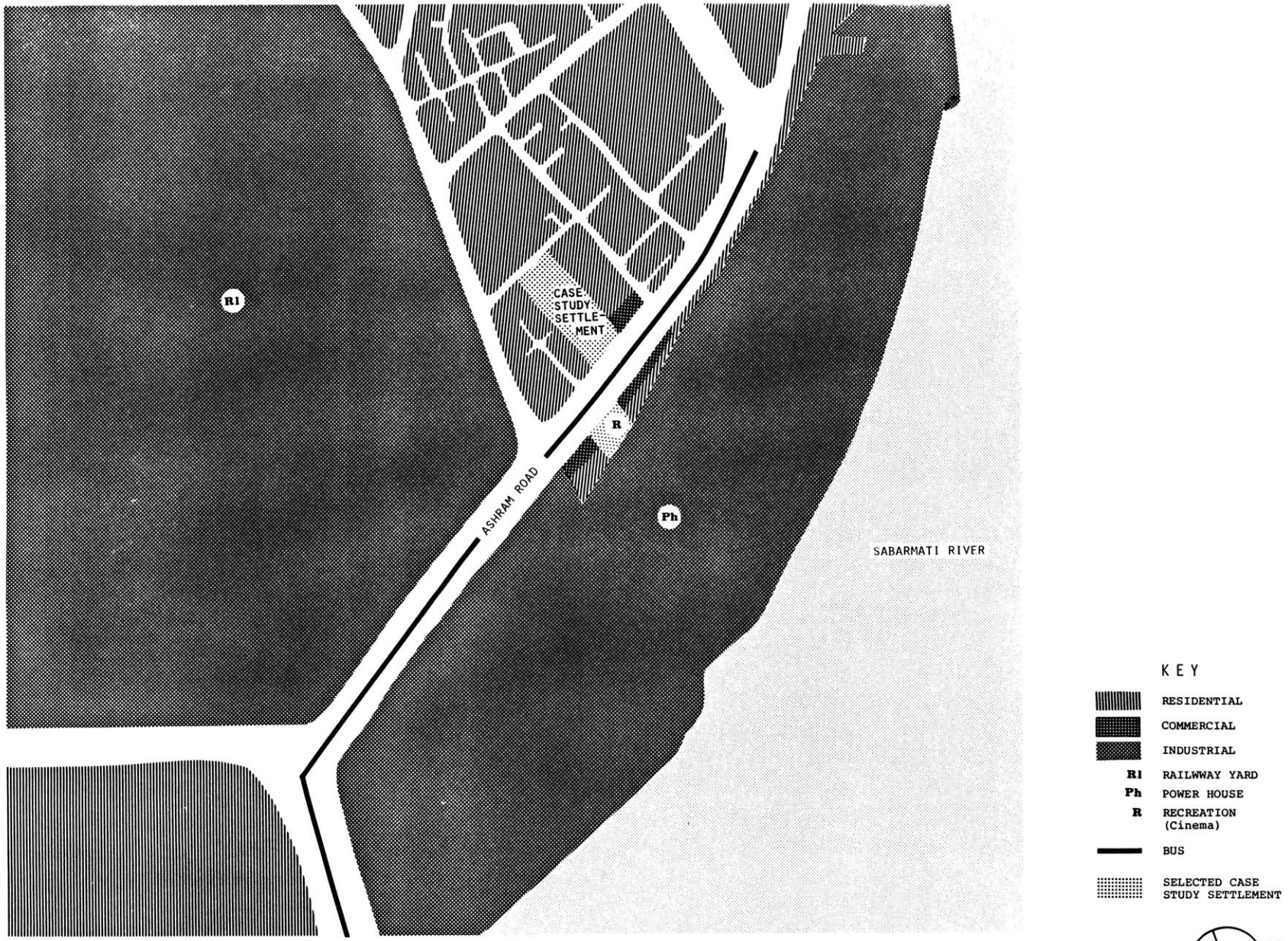
Locality: Sabarmati is located on the western bank of the Sabarmati River, about 7 km northwest of city center. The locality covers an area of about 430 hectares with a gross density of approximately 90 persons per hectare. The origins of this locality are not very clear, but it can be assumed that the significant growth must have occurred by the relocation of the power house in this area in 1934.

The locality is defined by the river and the power house along the eastern boundary and by the railway line along the western boundary. Land use can be broadly classified into two categories: industrial areas constituting the power house, railway yard and related activities; and residential areas with a predominantly low, low-middle and middle income households. This locality has one of the larger concentrations of squatter settlements among all west bank localities. Residential areas are interspersed with numerous small shops and hawkers. There is one municipal market and one cinema in this locality. There is also a concentration of activities related to truck operations.

The planning cannot be attributed to any principal idea. The layout is an arbitrary geometric pattern, to a large extent determined perhaps by the pattern of land ownership. In general terms, however, the layout can be classified as a combination of grid and gridiron patterns. Block sizes very considerabley and it is not possible to specify any typical block size for this locality.

Major circulation in this locality is governed by the main road, that passes through this locality alongside the power house. Intensity and composition of traffic varies with time of the day, but in general, the traffic is predominantly transitary and consists of trucks. The bus (the only available public transportation for inhabitants of this locality) passes through the main road. The access to the blocks is through a system of secondary and tertiary streets either leading to or off this main road.

The case study settlement is located adjacent to this main thoroughfare and across the power house.



LOCALITY LAND USE PATTERN

Settlement: The settlement covers an area of about 1.2 hectares and houses a population of 3,000 persons. There are about 460 lots with as many dwellings, and an average of 6.5 persons per dwelling. Although on record the land is owned by a private landlord, some inhabitants claim that they own both the lot and dwelling (they do not pay rent); while others claim that they pay rent to an 'inhabitant' landlord. Those who pay rent, pay between Rs. 25-35 (US $3-4) per month. It is an illegal squatter settlement.

Almost all inhabitants depend on casual employment (although in better paying industries like the power house, textile mills, etc.) and earn between Rs. 200-400 (US $25-50) per household per month. Distance of work for many is within 2 km and most of them walk to work. Literacy level is very low, with nearly 90% of the population having had no formal education.

There is neither a formal internal organization, nor a voluntary agency working in this settlement. There is, however, one political group.

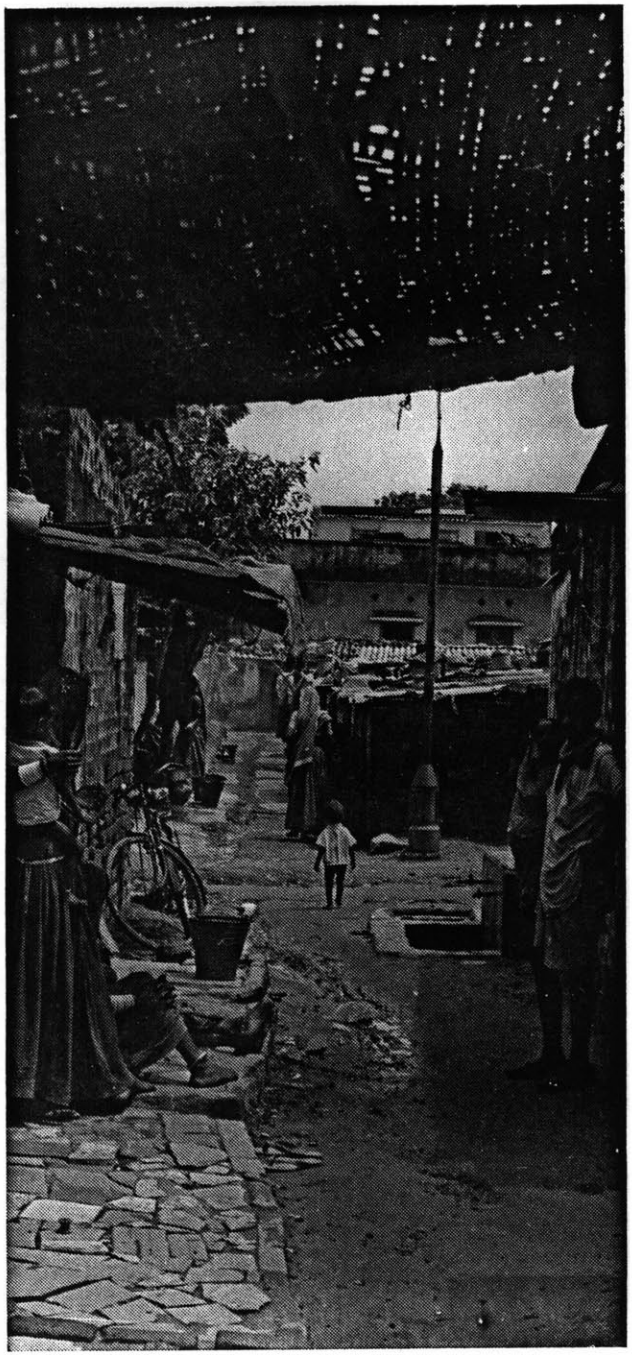
Most urban services are almost non-existant; the exception being a school, a municipal maternity dispensary and limited public transportation. The only source of recreation is the cinema house located close to the settlement. Utilities are inadequate and improperly located, consisting of badly maintained water taps, toilets and street lighting. There are neither paved walkways nor provision for storm drainage. There is a limited refuse collection service.

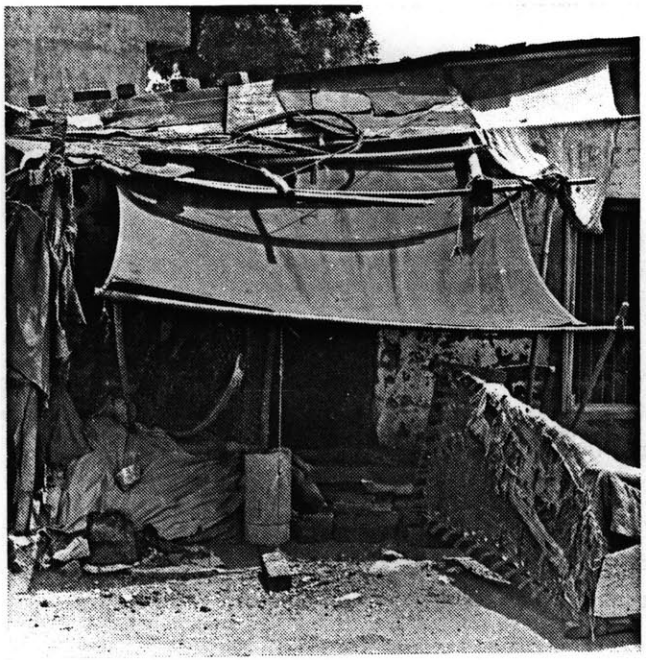
Houses are one-story clusters of row housing. Most houses are used by several families. Provision of water supply and toilets is through communal facilities, with each tap being shared by more than 200 inhabitants, and each w.c. by more than 350. The utilities, obviously, are too few to serve the whole community. Moreover, these communal facilities are located nearly 150 m away from the settlement and are badly maintained. Houses are built with mud or mud-brick walls, with galvanized iron or asbestos cement corrugated sheets for a roof.

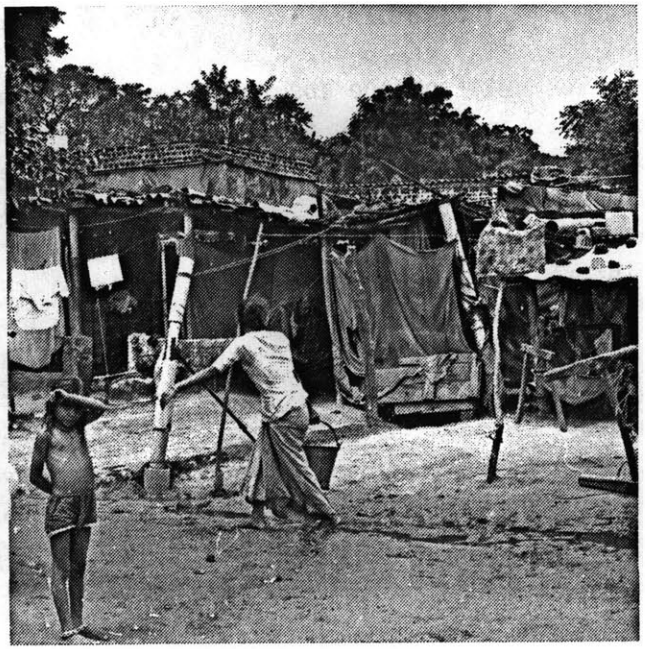
Most of the household activities take place in semi-private open areas. One reason is that there is very little enclosed space available (often less than 2 sq. m. per person) and the other reason is climate, since it probably encourages people to extend household activities into open spaces.

The mode of development is by 'popular' mutual help for some (invariably those who claim ownership of lot and dwelling) and contractor built institutional housing for others (invariably those who pay rent).

There are some households who do not mind being re-located. These households, in general are among the recent arrivals to this settlement with a higher and more permanent income, and pay rent.







(EXTREME LEFT) The extension of household activities onto the streets. Note the way the semi-private areas are progressively defined - placing a household object, paving, (TOP) a make-shift extension and finally, perhaps, a better built extension or an additional room. (BOTTOM) An inhabitant carrying water from the communal tap to the dwelling.

Preliminary design studies: The focus for upgrading is the re-organization of land utilization and improvement in the provision of utilities. Dwellings may also need some improvement, but it is considered a subsidiary issue and not included for upgrading. Dwellings are retained as they are and areas between them are re-organized. Raised platforms between groups of dwellings define condominiums and clusters. These platforms are for the semi-private use of households in each cluster and the responsibility for provision and maintenance rests with them. The definition of cluster areas helps to increase the semi-private space available to each dwelling or person. This in turn, reduces the large proportion of public area, which is neither optimally used nor maintained.

Public areas serve two functions: for circulation and social interaction. The objective in circulation is to provide clarity of hierarchy, use, identity and orientation; and minimize the need for public investment and maintenance. These are balanced with the social functions that the streets serve. In addition to streets, a place for the community to gather on special occasions is also provided.

Improvement in the provision of utilities would mean decreasing the number of people per tap or w.c.; reducing walking distances to the utilities, increasing the number of street lamps, providing storm drainage, etc. Increasing the number of taps or w.c.'s is relatively easy, but it is equally important to distribute this increase evenly across the settlement. This distribution is governed by three factors: available land for building, length of network and connection required, and walking distance to utilities. The design of the unit itself will determine to a large extent the definition for use and maintenance.

The objective in the design of the water supply and sewage disposal network and connections is to minimize: pipe length, excavation, change in direction, valves, manholes, etc. The priority for design is simplicity and clarity, which in turn will facilitate easy provision and maintenance. Transmission losses in electricity and street lighting are minimized by minimizing low tension cables and maximizing high tension cables. Easements are avoided for all networks.

To summarize: The usable area per person is increased from about 2.5 sq. m to 3.2 sq. m; public area is reduced from 50% to 15% of the total area; length of circulation is reduced to almost a third; the number of persons per tap is reduced from over 200 to 100 and per w.c. from nearly 400 to 60; average maximum walking distance to utilities is almost halved to about 70 m; and adequate street lighting is provided by 17 lamps. The raised platforms slope to the streets, which act as primary interceptors for storm drainage. A shallow channel along the middle of the main street carries storm water to the urban storm water disposal system. A place for public gathering is at one end of the main street close to the temple, which is the focus for most community activities. A smaller collective place, which could also serve as a stage for public gatherings is located behind the temple.

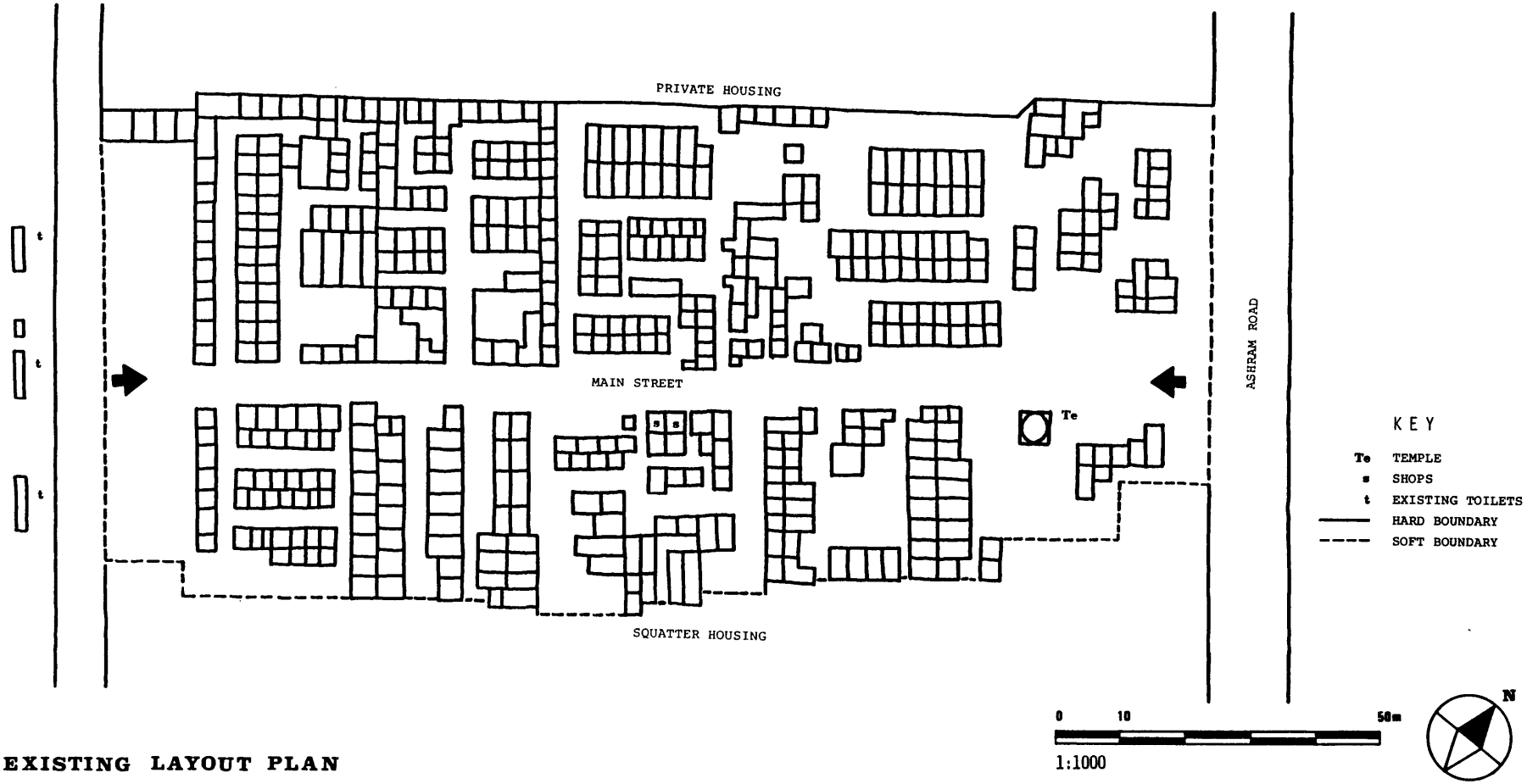
EXISTING SETTLEMENT

PROJECT DATA

	EXISTING	PROPOSED
Total Area Ha	1.2	1.2
Population	3,000	3,000
Gross Density P/Ha	2,500	2,500
Net Density P/Ha	4,100	3,200
Land Utilization		
% Public Area	40	15
% Semi-Public Area	0	6
% Private and Semi-Private Areas:	60	79
Circulation		
Length m/Ha	760	305
Land Sub-division		
Number of Lots/Ha	385	385
Average Area of Lot sq.m.	15	20
Average Size of Lot m/m.	N/A	N/A
Average Persons/Lot	6.5	6.5
Average Area/Person (Pri+S-Pri) sq.m	2.5	3.2

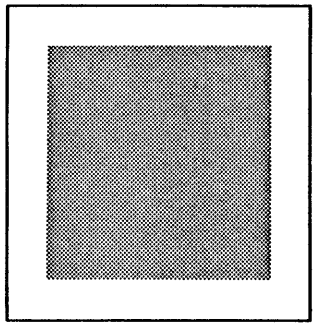
	EXISTING	PROPOSED
Utilities		
Water Supply		
Number of Taps/Ha	12	25
Persons/Tap	208	100
Lots/Tap	30	15
Average Max. Walking Distance to Tap m	140	70
Length of Network m/Ha	NA	210
Average Service Connection/Tap m	NA	2
Sewage Disposal		
Number of W.C.s/Ha	6	40
Persons/W.C.	415	60
Lots/W.C.	65	10
Average Max. Walking Distance to W.C.m	200	70
Length of Network m/Ha	NA	120
Average Service Connection/W.C. m.	NA	2

	EXISTING	PROPOSED
Electricity and Street Lighting		
Number of Poles/HA.	NA	21
Number of Lamps/HA.	NA	14
Length of High Tension Network m/Ha	NA	145
Length of Low Tension Network m/Ha	NA	365
Typical Dwelling		
Area sq. m.	15	No Change
Type: Shack/Permanent		No Change
Floor: One		No Change
Development: Popular/Institutional		No Change
Builder: Mutual help/Contractor		No Change
Mode: Incremental/Instant		No Change



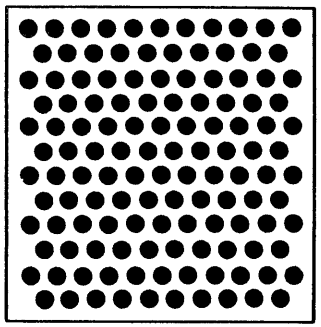
EXISTING LAYOUT PLAN

PROJECT SUMMARY DIAGRAMS (Existing)



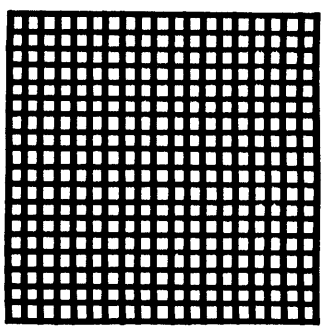
LAND UTILIZATION PERCENTAGES

Streets	40
Private and Semi Private Areas	60

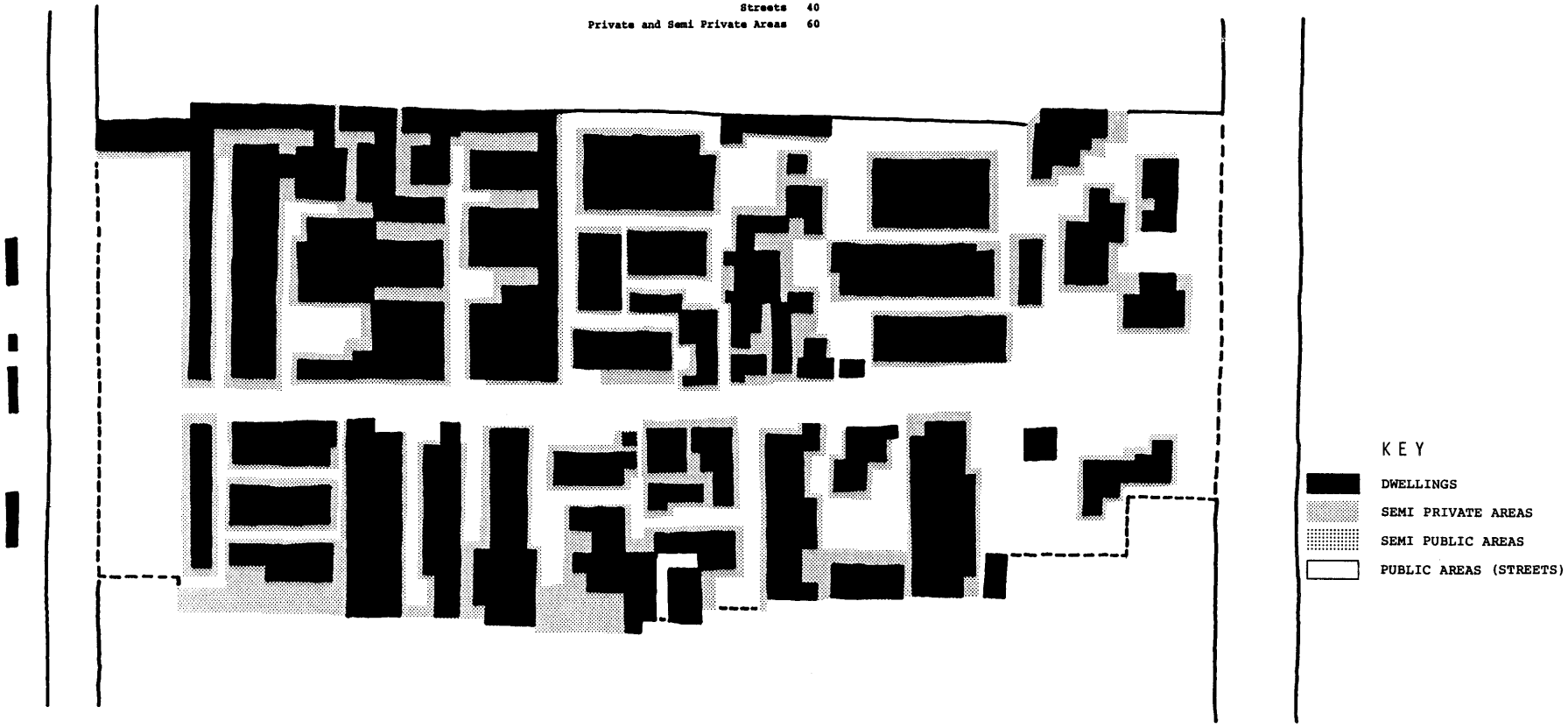


● 20 Persons per hectare

GROSS DENSITY 2,500 persons/hectare



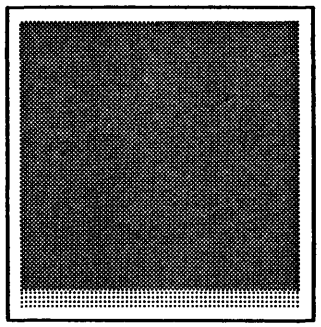
CIRCULATION EFFICIENCY length 760m/Ha



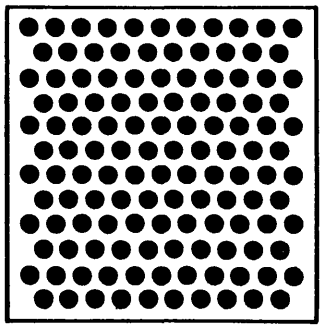
EXISTING LAND UTILIZATION

PRELIMINARY DESIGN STUDIES

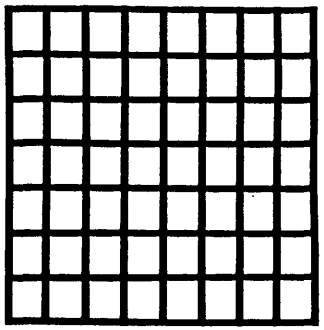
PROJECT SUMMARY DIAGRAMS (Proposed)



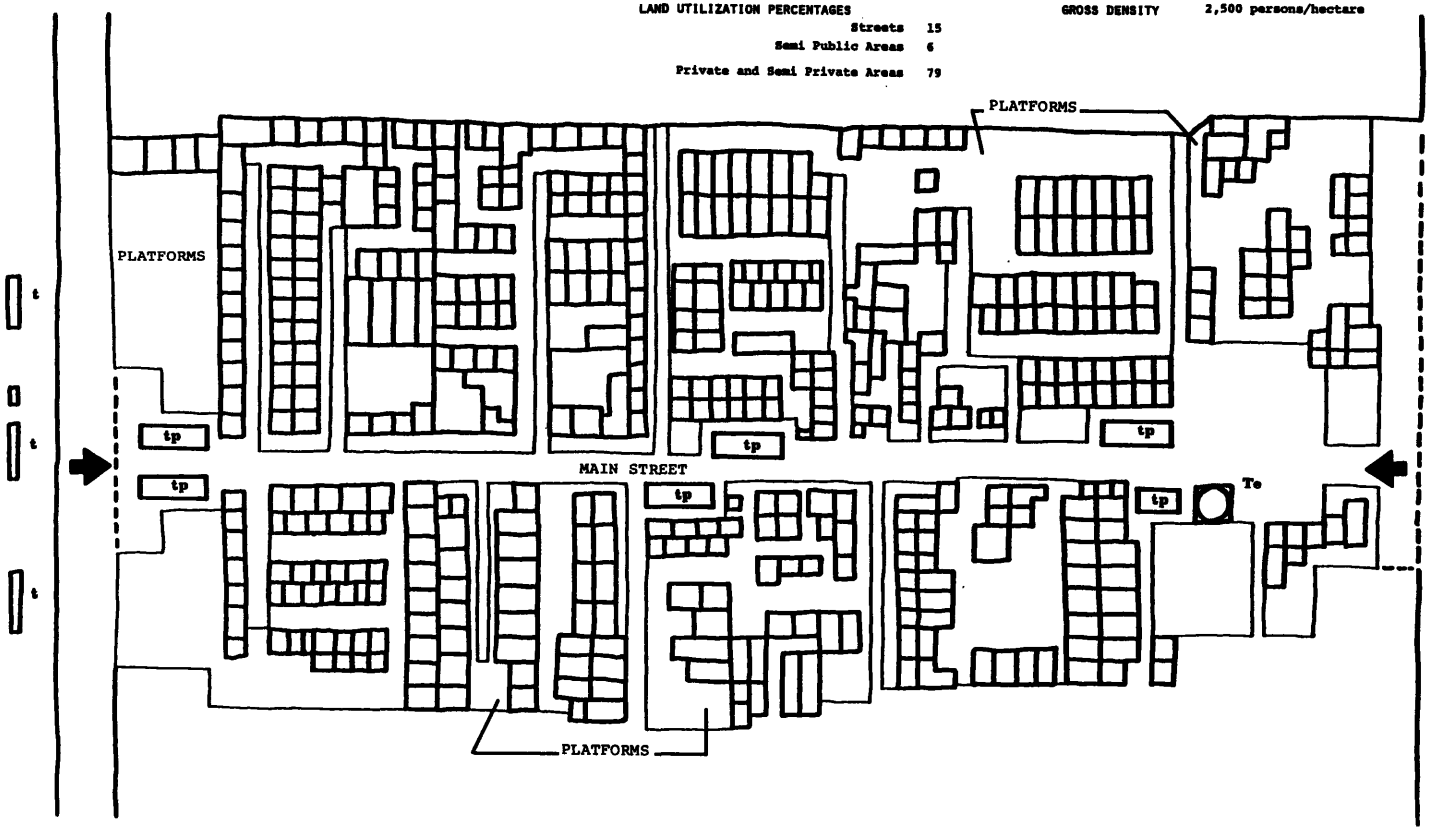
LAND UTILIZATION PERCENTAGES
Streets 15
Semi Public Areas 6
Private and Semi Private Areas 79



● 20 Persons per hectare
GROSS DENSITY 2,500 persons/hectare



CIRCULATION EFFICIENCY length 305m/Ha

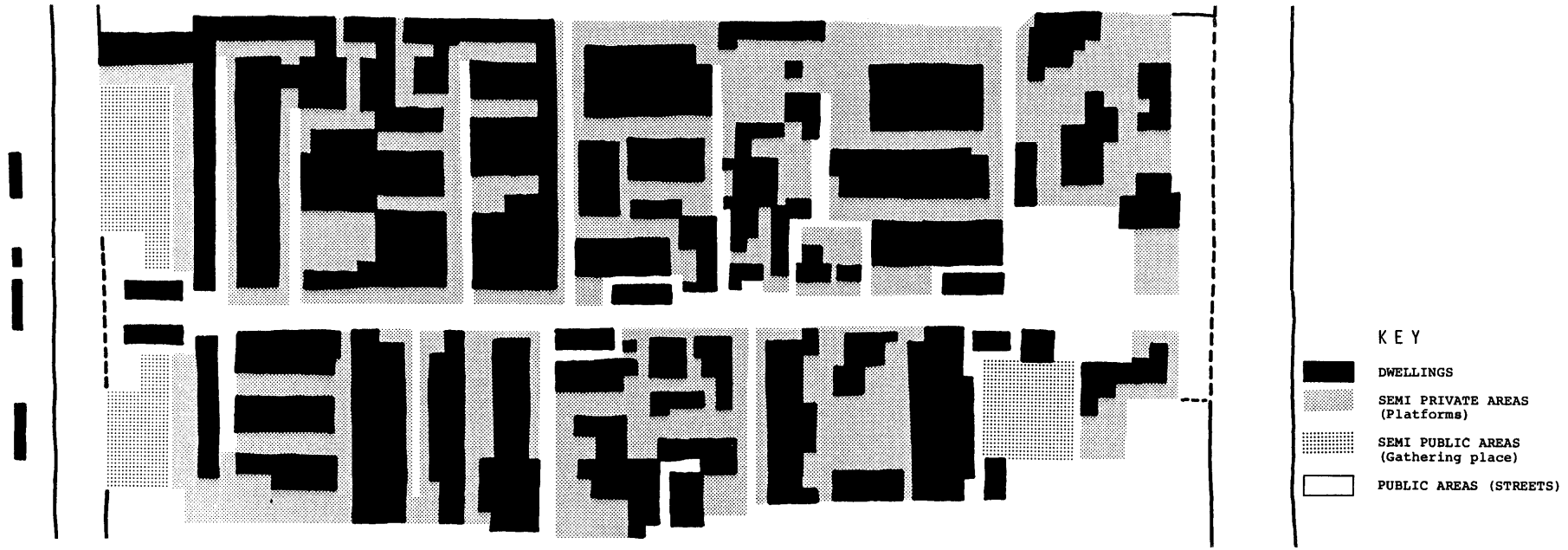


KEY
To TEMPLE
▪ SHOPS
t EXISTING TOILETS
tp PROPOSED TOILETS
——— HARD BOUNDARY
– – – – SOFT BOUNDARY

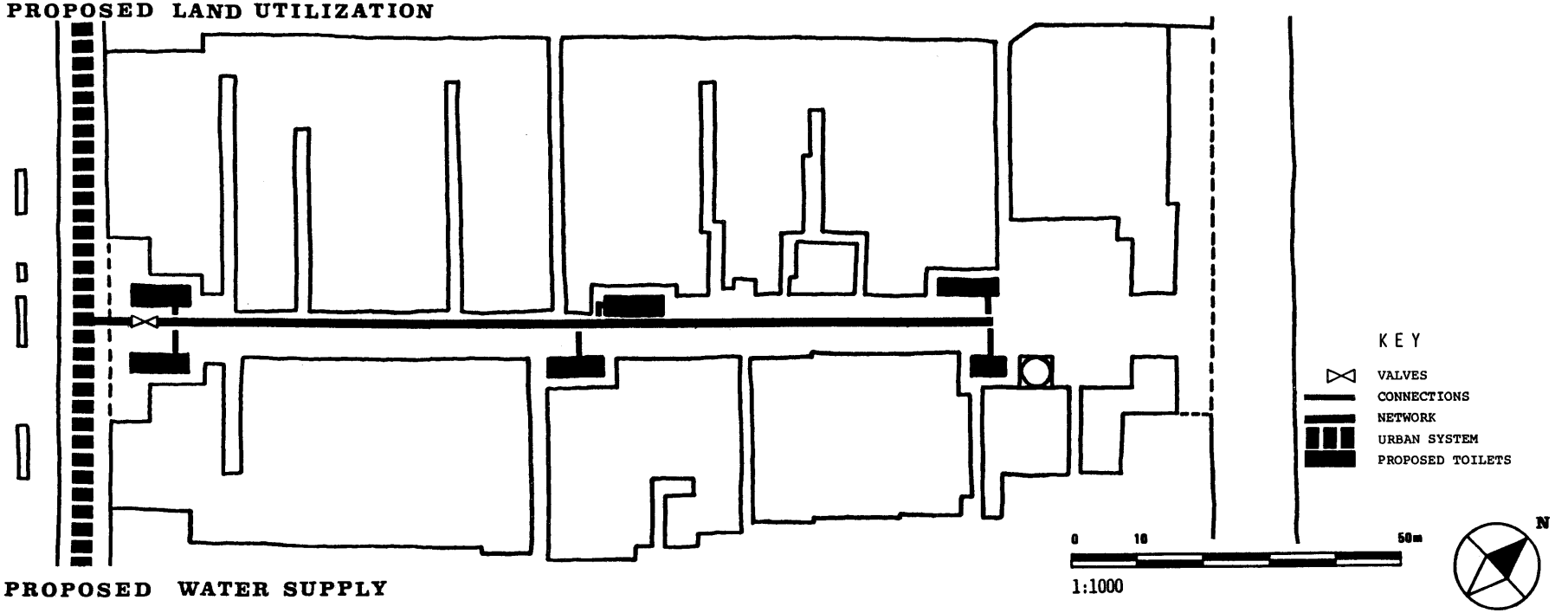
0 10 50m
1:1000

N

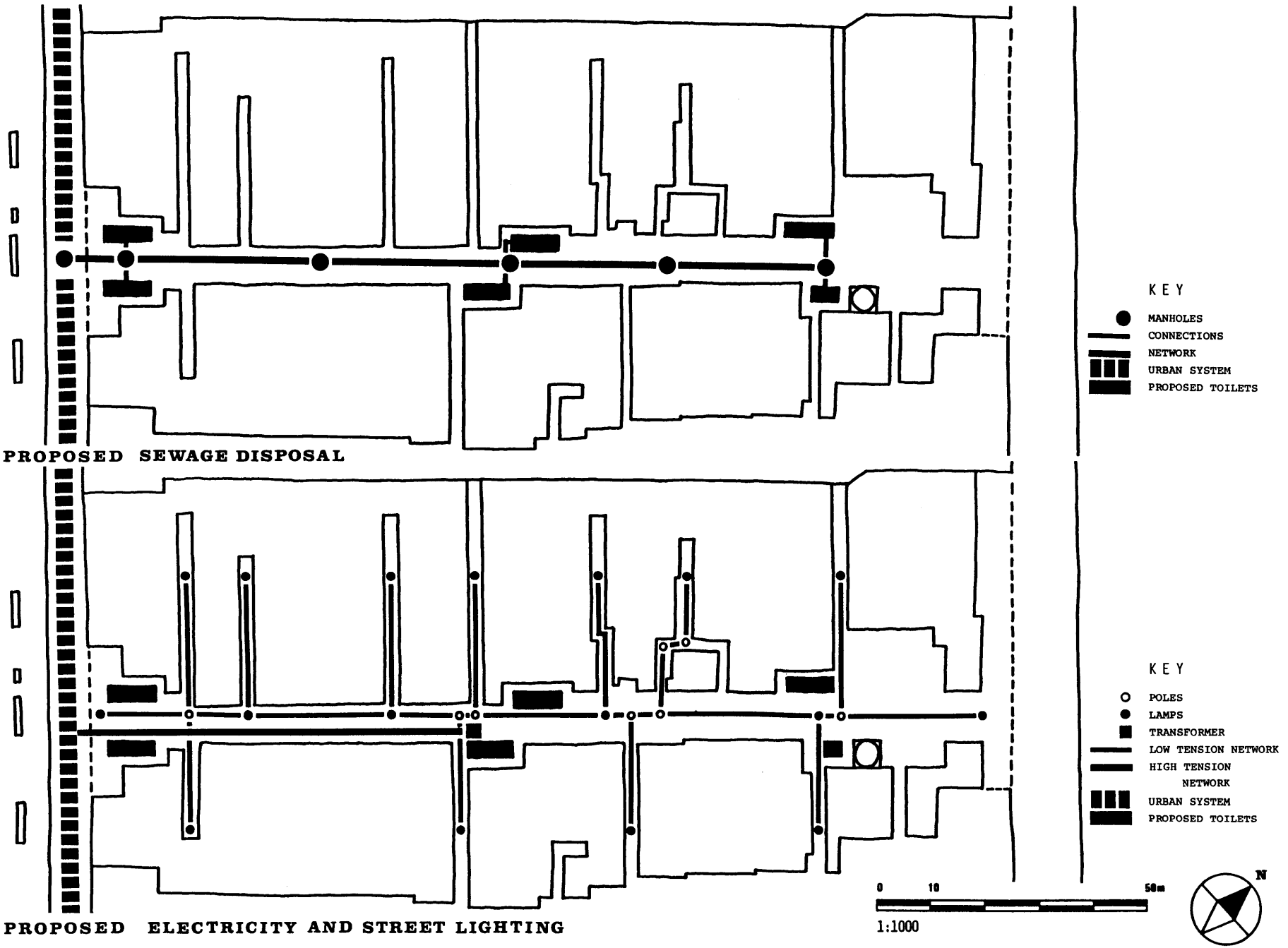
PROPOSED LAYOUT PLAN



PROPOSED LAND UTILIZATION



PROPOSED WATER SUPPLY


PROPOSED SEWAGE DISPOSAL
KEY
MANHOLES
CONNECTIONS
NETWORK
URBAN SYSTEM
PROPOSED TOILETS
PROPOSED ELECTRICITY AND STREET LIGHTING
KEY
POLES
LAMPS
TRANSFORMER
LOW TENSION NETWORK
HIGH TENSION NETWORK
URBAN SYSTEM
PROPOSED TOILETS
0
10
50m
1:1000
N

CASE STUDY 2: GULBAI TEKRA SITE AND SERVICES

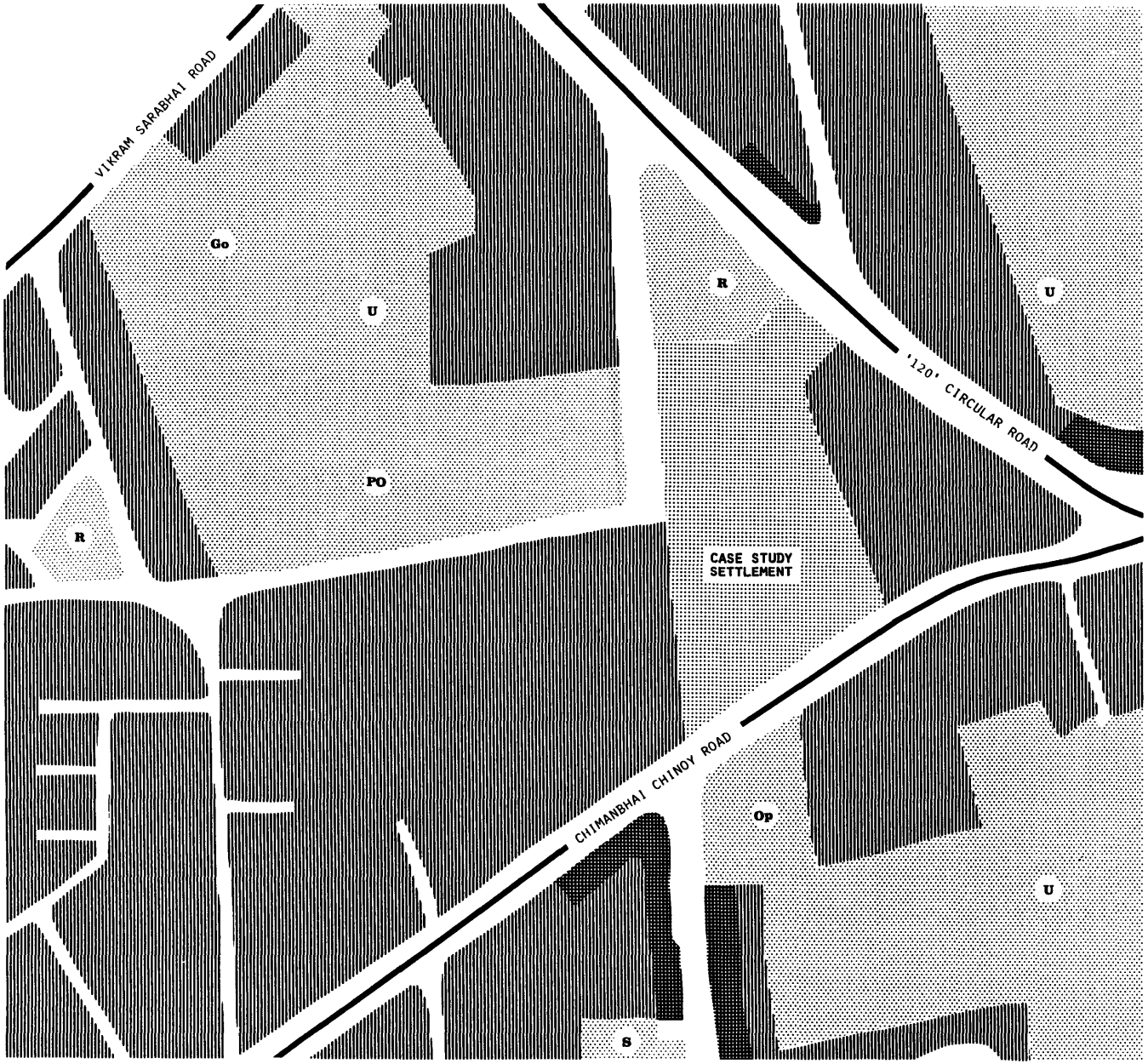
Locality: Gulbai Tekra is located on the western bank of the Rivar Sabarmati, about 5 km west of the city center. This locality is among the smaller sections (about 120 hectares) and has a relatively low gross density of population (about 60 persons per hectare). The origin is said to be group of migrants who fled a famine in a neighboring state, squatted and in due course settled down to make a village; sometime during the last century. Much of what is seen today (including what was once a 'village' and what is now a squatter settlement) however, must be attributed to two factors: a natural urban growth, and the location during the early sixty's of the university, government offices and other important institutions in or in close proximity to this locality.

The locality is almost exclusively residential and is bounded by government offices on the west side and educational institutions on the north. The residential areas in turn are almost exclusively middle, upper-middle and high income group housing. Almost all the squatter households in this locality are in one location. There are also many small shops and some hawkers.

The layout, as in Sabarmati, cannot be attributed to any principal idea.

The major circulation takes place all along the periphery. The traffic consists of mainly cars and other smaller vehicles. The buses (the only available public transportation) pass on all three sides. The access to most blocks, as in Sabarmati, is through a network of secondary and tertiary streets. Unlike Sabarmati, the access to the periphery and therefore public transportation, is shorter.

The specific settlement under study is located close to the north boundary, and along the peripheral road on the east side of the locality.



LOCALITY LAND USE PATTERN

Settlement: The settlement covers an area of about 8.5 hectares and houses a population of over 14,000. There are over 850 shacks with an average occupancy of about 16 persons to a dwelling. The settlement is located on land owned in part by private landlords and in part by the Municipal Corporation. A proposed road passes through the settlement, close to the southern periphery.

Nobody appears to be paying rent for the dwelling or land, and none own either dwelling or land. This settlement is, by definition, an illegal squatter settlement.

Unlike the settlement in Sabarmati, almost half of the working population is self-employed. The other half is distributed between industrial, government jobs and casual labour. As many as half of the population may be earning less than Rs. 200 (US $25) per household per month. The distance of work for those other than the self-employed (who more or less work in the settlement itself) rarely exceeds 2-4 km. Most of them walk or cycle to their place of work. The literacy level is very low, with as many as 95% of the population having had no formal education.

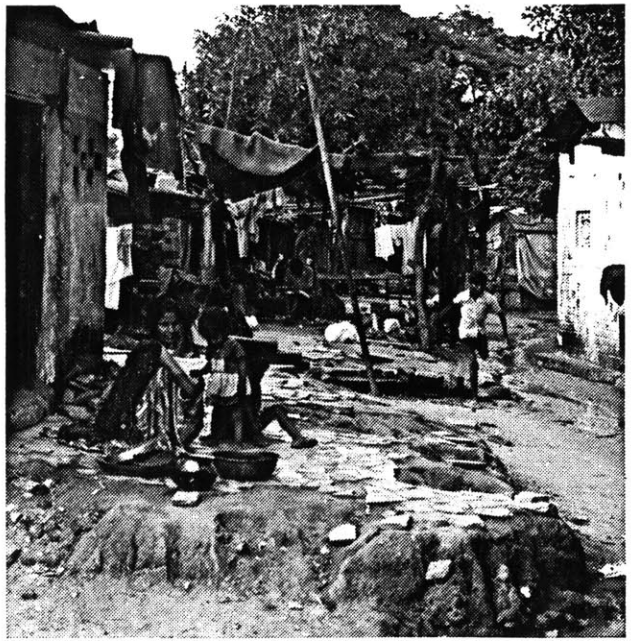
There is, unlike the settlement in Sabarmati, a fairly cohesive internal organization; and there are at least two voluntary agencies working in this settlement. Loyality is divided between two political parties.

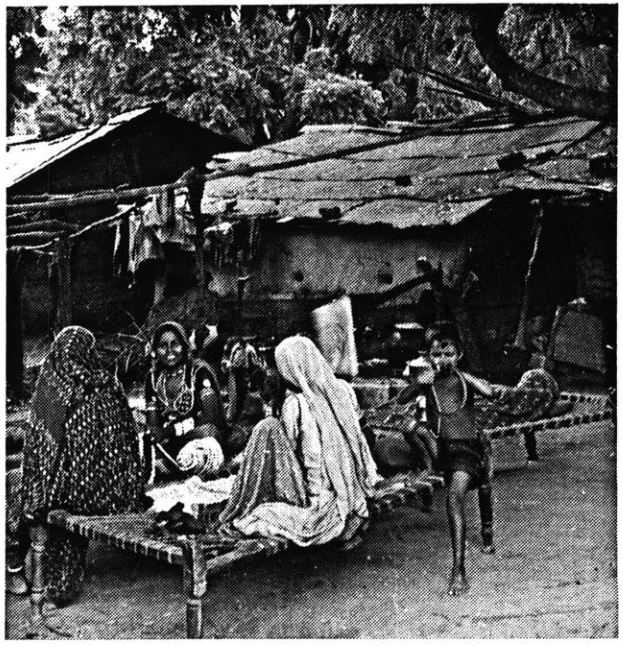
There is access to most urban services. The streets serve as playgrounds. Access to utilities consists of inadequate, improperly located and badly maintained taps, toilets and street lighting. There is a limited or infrequent refuse collection service.

Houses are all one-story shacks and seem to be randomly placed in clusters. Water supply and toilets are communally provided, with more than 500 persons per tap and 250 per w.c. These facilities are located even farther than in Sabarmati (at a distance of about 250 m) and are badly maintained. Shacks are built with mud or scrap materials for walls and thatch or scrap metal sheets for roofs.

Most of the household activities, like in the settlement in Sabarmati and for similar reasons, take place in the open.

Unlike Sabarmati, almost all houses have been built incrementally through mutual help. Again, unlike Sabarmati, almost no one is willing to change the location of their dwelling beyond the present settlement. All seem adverse to living on upper floors.





(TOP) Unpaved streets with no provision for storm drainage, underutilized or unused public areas, make-shift dwellings, 'village' like and deceptively serene atmosphere that characterize the settlement. (EXTREME LEFT) The extension of household activities and occupation onto the streets. Note the definition of semi-private space - either permanent (paved and raised platforms) or (LEFT) temporary and social (mobile cots).

Preliminary design studies: The major program parameters (area, population and density) are more or less determined by the existing situation. The proposed road close to the south end of the existing settlement is included in the program. The Municipal Garden (which neither is nor is likely to be used as a garden) on the west side is traded for a part of privately owned land on the north. Although the total area for new development is reduced by about a hectare, the population to be housed remains the same. It is desirable that the level of utilities be higher than that currently provided. The dwellings are to be developed from serviced lots (with plinth) through 'popular' or voluntary agency organized mutual help.

Public responsibility for provision and maintenance is minimized by optimizing the use of public land. Public land is used exclusively for circulation and provides for public congregation. The street layout is designed for clarity of hierarchy, use, identity and orientation; and also economy. Land is utilized to maximize private ownership and encourage maintenance. Semi-public areas are designed to be developed by public agencies. The school (intended to serve this settlement only) is located in the center of the settlement, away from the main street and potentially expensive land. Health and social services are in the center of the settlement and close to vehicular access. The corner lots, highest value land, are reserved for development as commercial buildings or for other semi-public activities that could serve the whole locality. The lots are designed for access from cluster courts. Lots along the streets are smaller and thus an increased number of households are given the opportunity of commercial activity.

Utilities are designed to minimize the number of persons per tap or w.c. and reduce the walking distance to these utilities, provide adequate street lighting and storm drainage; on one hand and for economy, simplicity and clarity, not only for provision but also maintenance; on the other.

The objective in the design of the water supply and sewage disposal networks and connections remain similar to that in upgrading: to minimize the length of pipes, change in direction, excavation, valves, manholes, etc. The unit itself must be designed to minimize materials for walls and roof and to clearly define responsibility for use and maintenance. Transmission losses in electricity and street lighting are lowered by minimizing and maximizing low tension and high tension cables, respectively.

To summarize: the usable area per person is retained at 3.8 sq. m; total public area is reduced from 36% to 13%; length of circulation is reduced by almost a fifth, from nearly 700 m to about 150 m per hectare; the number of persons per tap is reduced to 50 (a tenth of what it was) and per w.c. to 30 (a seventh of what it was); average maximum walking distance is about 350 m and street lighting is provided by 22 lamps. The main street carries storm water from the cluster to the urban network. Places for public gatherings are provided at three locations on the main street.

EXISTING SETTLEMENT

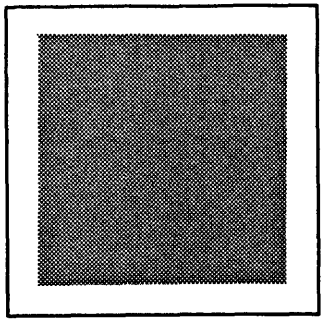
PROJECT DATA

	EXISTING	PROPOSED
Total Area Ha	8.5	7.5
Population	14,450	14,450
Gross Density P/Ha	1,700	1,925
Net Density P/Ha	2,650	2,600
Land Utilization		
% Public Area	36	13
% Semi-Public Area	0	13
% Private and Semi-Private Areas	64	74
Circulation		
Length m/Ha	700	150
Land Sub-Division		
Number of Lots/Ha	120	150
Average Area of Lot sq.m.	54	50
Average Size of Lot m/m	N/A	5/10
Average Persons Lot	14	13
Ave. Area/Person (Pri+S-Pri) sq.m.	3.8	3.8
Utilities		
Water Supply		
Number of Taps/Ha	3	36
Persons/Tap	565	54
Lots/Tap	40	4
Ave. Max. Walking Distance to Tap m	500	350
Length of Network m/Ha	NA	120
Average Service Connection/Tap m.	NA	0.5
Sewage Disposal		
Number of W.C.s/Ha	8	62
Persons/W.C.	212	31
Lots/W.C.	15	2.5
Ave. Max. Walking Distance to W.C. m.	250	125
Length of Network m/Ha	NA	110
Average Service Connection/W.C. m.	NA	0.7
Electricity and Street Lighting		
Number of Poles/Ha	NA	5
Number of Lamps/Ha	NA	3
Length of High Tension Network m/Ha	NA	54
Length of Low Tension Network m/Ha	NA	108
Typical Dwelling		
Area sq. m	54	40
Type:	Shack	Shack/ Permanent
Floor:	One	One
Development:	Popular	Institu- tional
Builder:	Mutual Help	Mutual Help/ Contractor
Mode:	Incremental	Incremental/ Instant

EXISTING LAYOUT PLAN

PROJECT SUMMARY DIAGRAMS (Existing)

1 Hectare

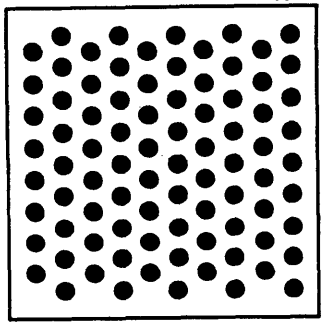


LAND UTILIZATION PERCENTAGES

Streets 36

Private and Semi Private Areas 64

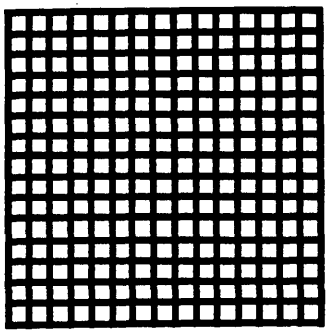
1 Hectare



● 20 Persons per hectare

GROSS DENSITY 1,700 persons/hectare

16 Hectares



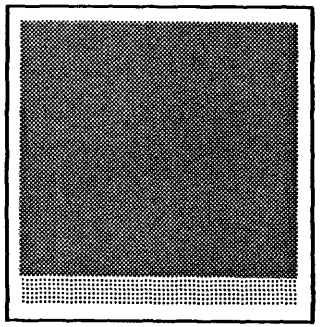
CIRCULATION EFFICIENCY length 700m/Ha

EXISTING LAND UTILIZATION

1:2500

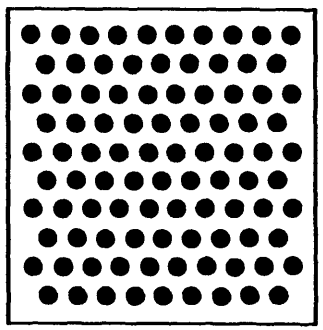
PRELIMINARY DESIGN STUDIES

PROJECT SUMMARY DIAGRAMS (Proposed)



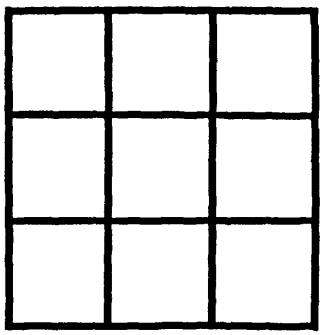
LAND UTILIZATION PERCENTAGES

Streets	13
Semi Public Areas	13
Private and Semi Private Areas	74

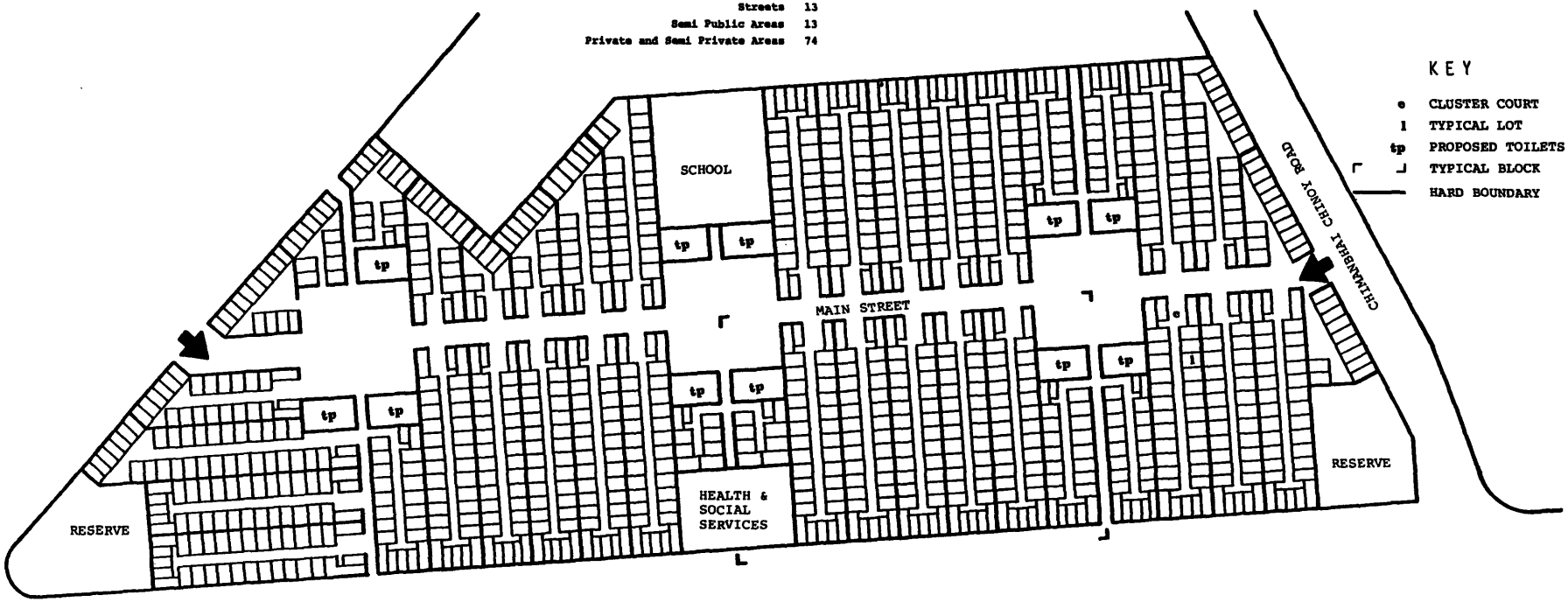


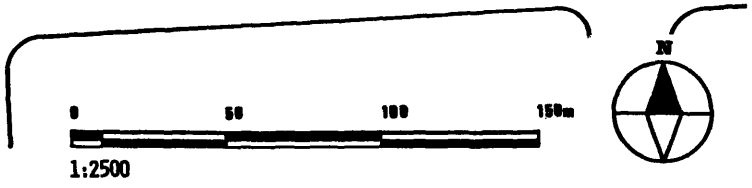
● 20 Persons per hectare

GROSS DENSITY 1,925 persons/hectare

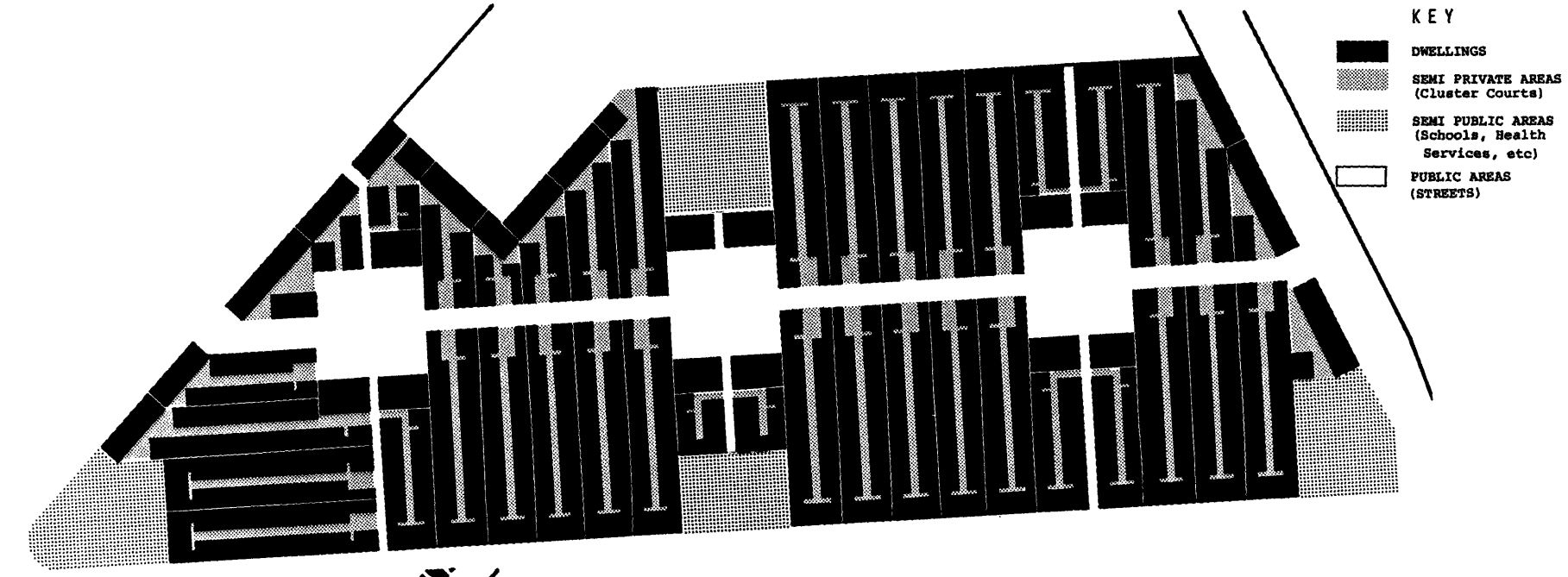


CIRCULATION EFFICIENCY length 150m/Ha

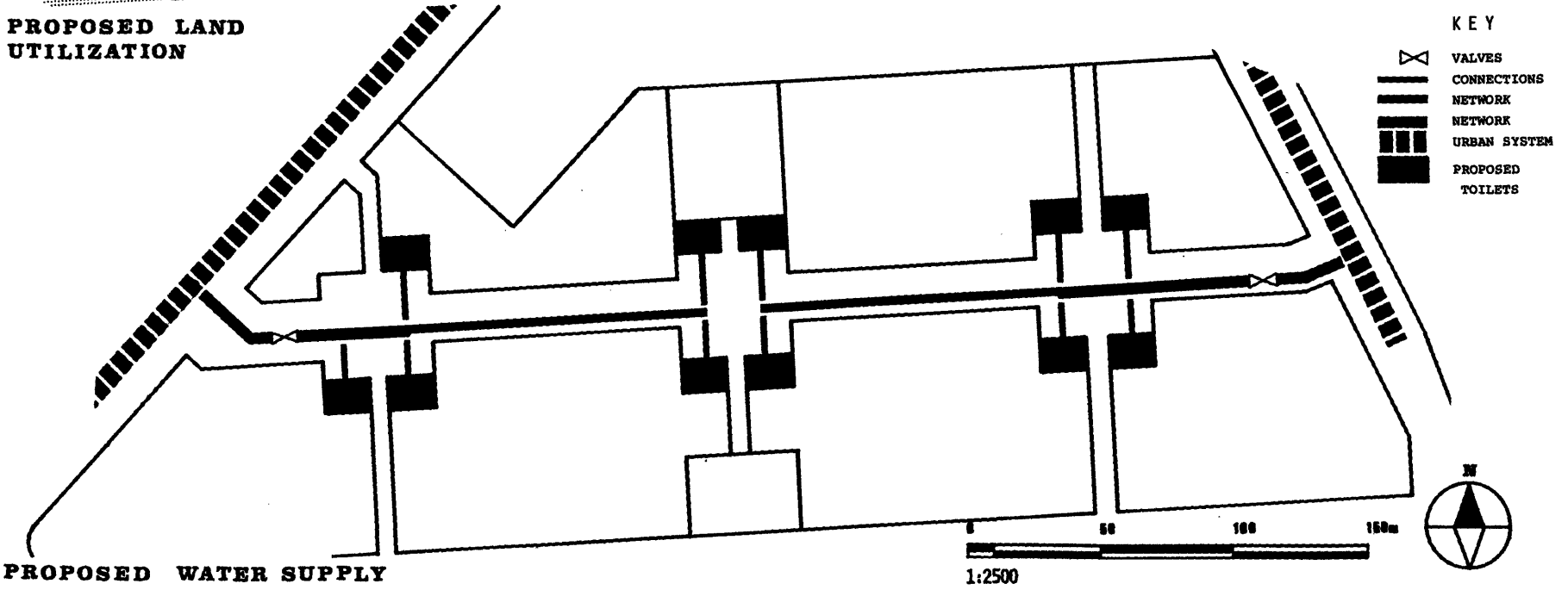




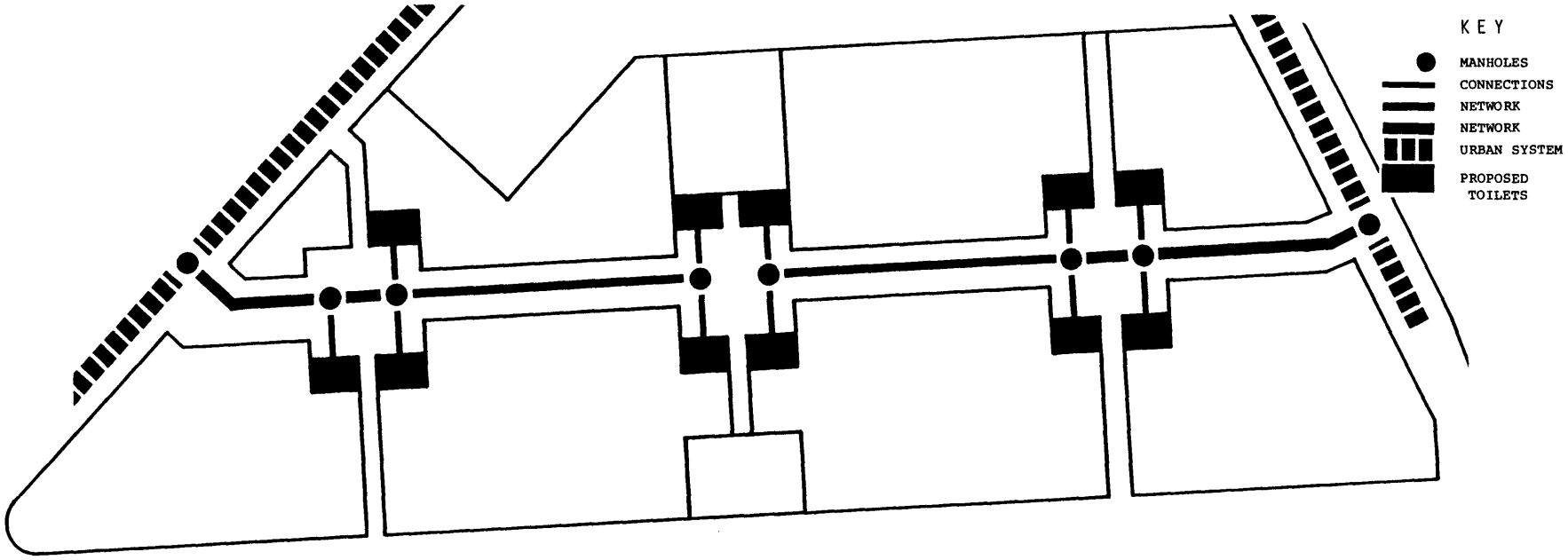
PROPOSED LAYOUT PLAN



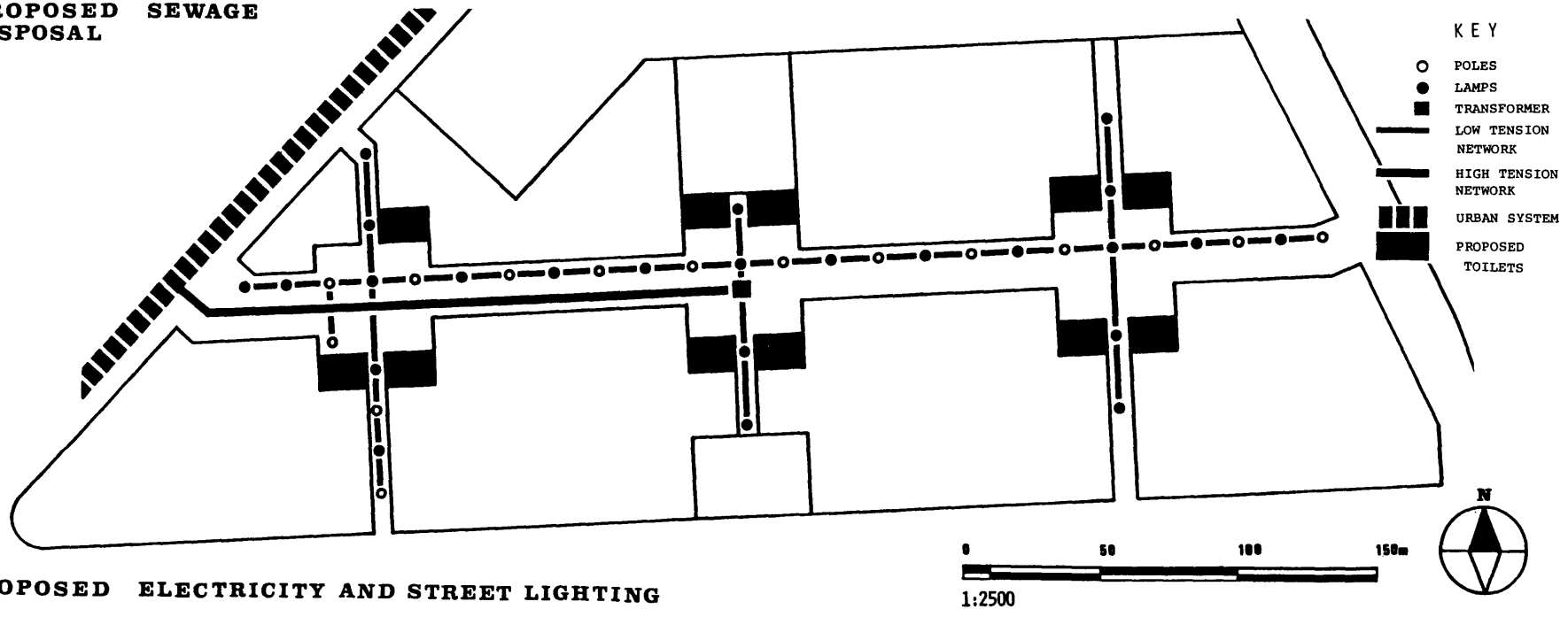
PROPOSED LAND UTILIZATION



PROPOSED WATER SUPPLY



PROPOSED SEWAGE DISPOSAL



PROPOSED ELECTRICITY AND STREET LIGHTING

CASE STUDY 3: KHANPUR
HIGH DENSITY LOW RISE HOUSING

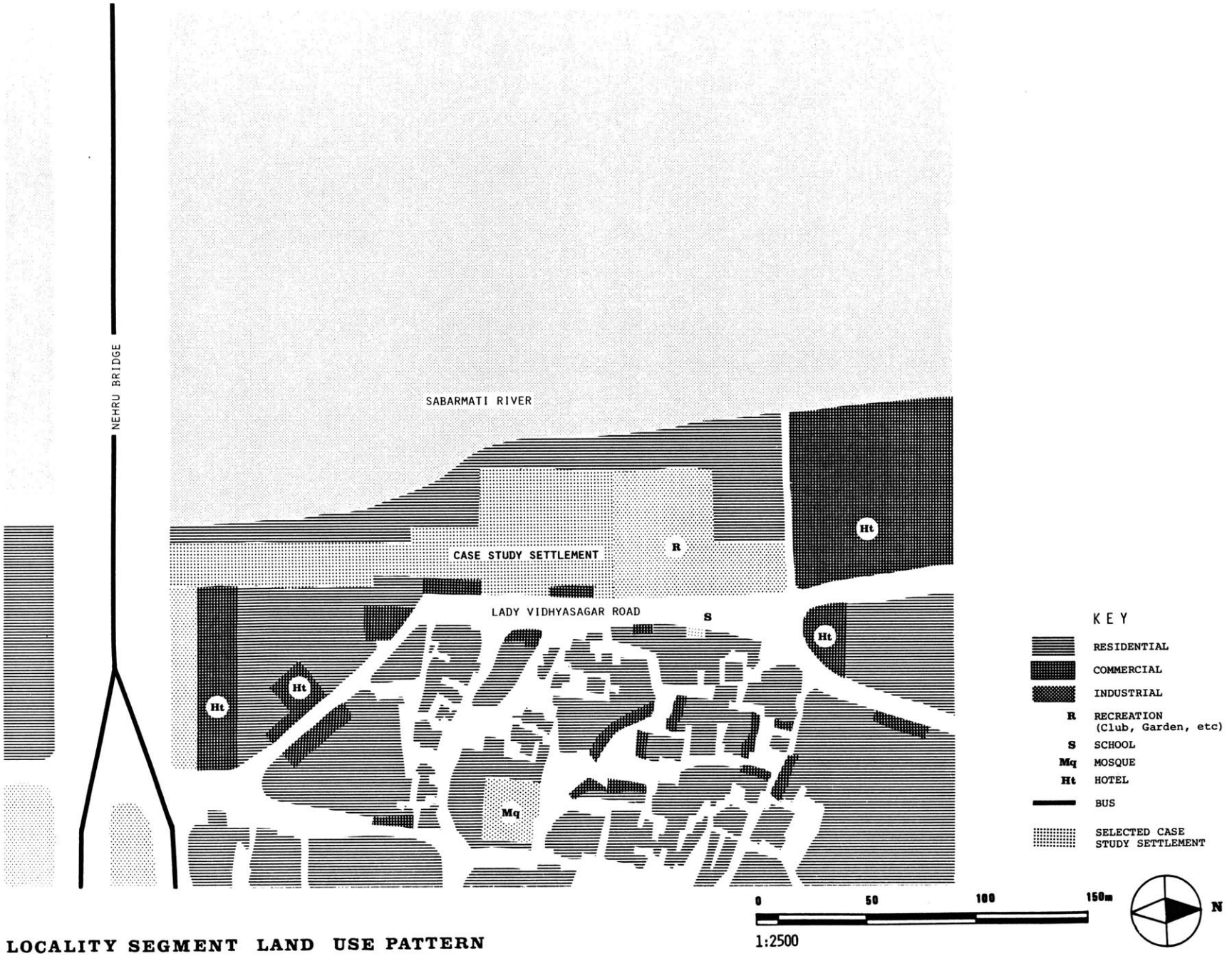
Locality: Khanpur, unlike Sabarmati and Gulbai Tekra, is located on the eastern bank of the Sabarmati River. The locality follows the fort-wall and is very close to the city center. It covers an area of about 109 hectares with a high gross density of over 500 persons per hectare. The origin of this locality goes back to the beginnings of the city itself.

The locality is bound by the river and a bridge on the west and south sides, respectively. The boundaries on the north and east sides are shared with neighboring localities. Land use, like in most inner city localities, is mixed and includes residential, recreational, commercial, educational and at times even small industrial areas. Khanpur, for example, has apart from a concentration of squatter settlements, quite a few upper middle or high income housing, two luxury hotels, many office buildings, innumerable small shops, a couple of schools, a college and a cinema. The squatter settlements, however, tend to occur along the outer edge of the fort-wall, on the river bank.

The layout like in other parts of the city cannot be attributed to any principal idea, but is particularly true for the walled inner city localities. Buildings tend to be closer to each other and taller, and the streets narrower. Building by-laws for inner city localities are different from those on the outside; and moreover by-laws have changed faster than the turnover of buildings. It is not uncommon to find a tall building abutting a narrow winding street.

Major vehicular circulation within the locality is along the main road, running close to the fort-wall. Pedestrian circulation seems to be equally intense in almost all streets.

The case study settlement is located off the main road, on the river bank, almost along the outer edge of the fort-wall and on either side of Khanpur gate.



LOCALITY SEGMENT LAND USE PATTERN

Settlement: The settlement covers an area of about 1 hectare and houses a population of over 4,000, many of whom are Muslims. There are about 400 lots, with almost as many dwellings and an average of 10 persons per dwelling. A few of these dwellings are temporary or seasonal, as they move in and out depending on the level of water in the river. A few others are well below flood levels and are submerged in the event of floods. The land is owned in part by the state (that which is counted as part of the river), in part by the mosque (that which is in close proximity to it) and the remainder by the Municipal Corporation.

Nobody seems to be paying rent for the land or the dwelling, and none own either. This settlement, like the other two, is an illegal squatter settlement.

Almost all of the inhabitants depend on casual employment. However, unlike Sabarmati, nearly three quarters of the households seem to earn less than Rs. 200 (US $25) per month. The distance to work for most is very small and almost all the workers walk. Literacy level is very low, with almost none of the inhabitants having had any formal education.

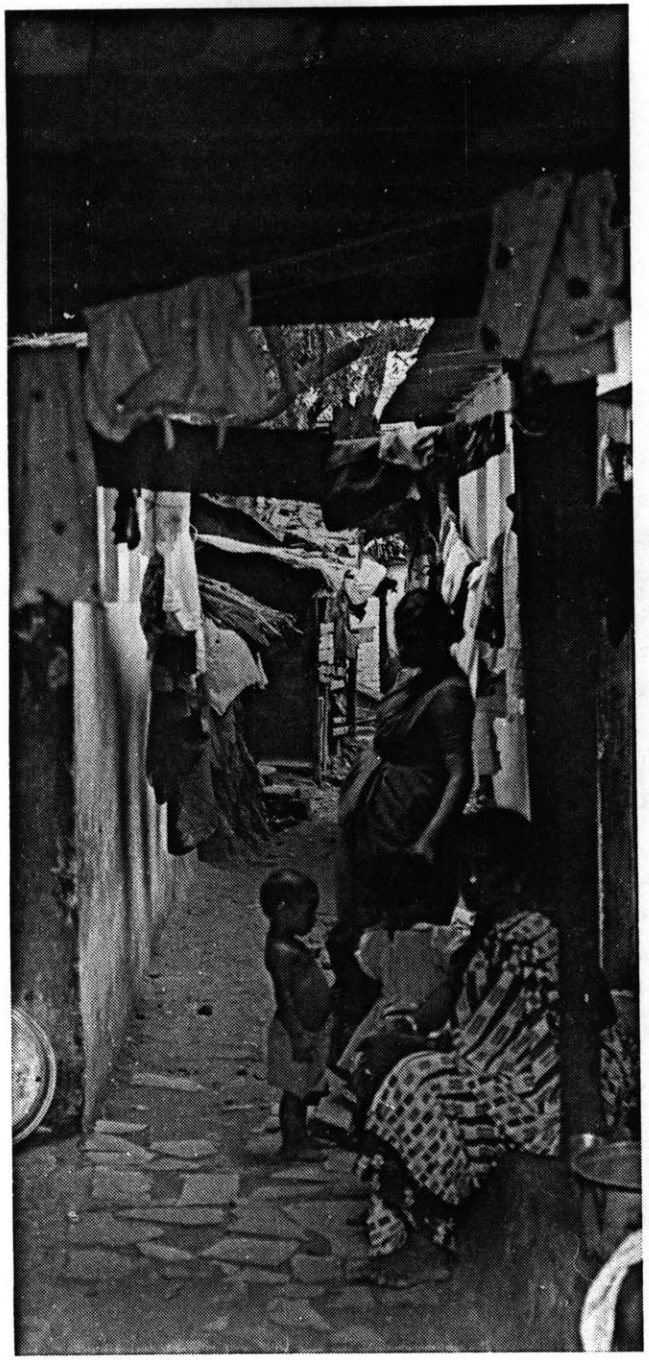
There is a very strong internal organization with a significant political influence.

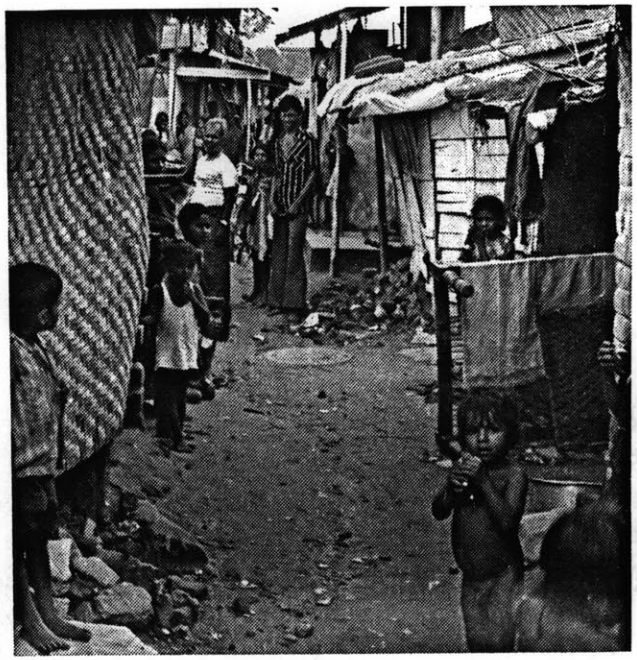
Access to most urban services is excellent. This is very beneficial to the inhabitants, not in terms of its direct utility (as very few go to school or dispensary, and even fewer take the bus to work) but as potential sources of employment. Utilities, like in almost all squatter settlements are inadequate, improperly placed and poorly maintained. There are no paved walkways and refuse collection is infrequent.

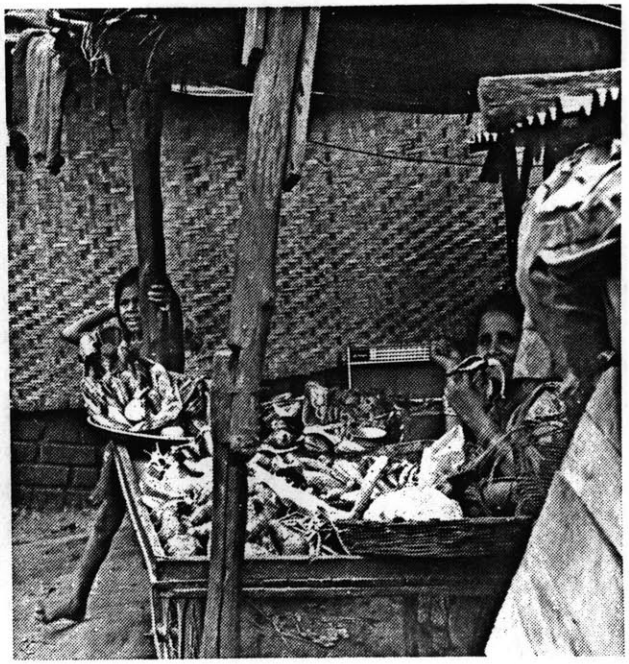
Houses are all one-story and seem to be randomly placed clusters of detached and row-housing. Provision of water supply and toilets are through communal facilities, with more than 200 persons per tap and as many as 1,000 per w.c. These facilities are located far from most dwellings (about 70 m) and are badly maintained. Houses are built with mud or mud-brick walls, with galvanized iron or asbestos cement corrugated sheets for the roofs.

Many of the household activities take place in the open areas. The houses, despite relatively superior material standards are built through 'popular' mutual help.

Almost none of the inhabitants, like in Gulbai Tekra, are willing to change the location of their dwelling beyond the present settlement. Moreover, for various reasons (including the belief that it is not advisable to build more than two-story structure since a part of the settlement is on filled-up soil) none of them anticipate more than two-story housing.







(EXTREME LEFT) The household activities extending onto the access ways to the dwellings to make semi-private cluster courts. (TOP) The narrow and badly maintained main street in the settlement. (BOTTOM) A small shop in the settlement.

Preliminary design studies: The program for the new development is governed by two factors: gross density of the existing settlement (about 4,000 persons per hectare) is well above average and it is not desirable to increase this any further; and only half the area of the existing settlement can be included in the program, as the other half is below flood levels and new development is not only not desirable, but also will never be acceptable to any public agency. Therefore, the project area is reduced by half, and if the density is retained, the project population also will be reduced by half. The households not included in the new development may continue to stay as they do or be relocated elsewhere. The existing mosque and the group of small tombs are retained.

It is desirable that the standard of dwellings and the area available per person are significantly increased. It follows that the provision of utilities must respond to these improvements. For the most part of the development, two-story single-loaded corridors and back to back dwellings with shared utilities (like the 'chawls') are proposed for housing. The project is designed to be developed by public agencies and built by a contractor.

The objectives in the design of public areas and circulation are similar to those in the site and services project. Provision for educational, social and health functions, however, are excluded from the program as the development is too small to support these activities and these facilities are available in this locality or in close proximity to it. The mosque and the tombs continue to support semi-public activities in the development. The place for public meetings is more or less determined by the location of the mosque.

The objectives in the design of utilities, including electricity and street lighting, remain again similar to those in the site and services project. The design of the unit itself may be less crucial in this development, as social responsibility for use and maintenance is more or less defined by the location , as well as, by reducing the number of users.

To summarize: the usable area per person is increased from 1.2 sq. m to 5.5 sq. m; public area is reduced from nearly 50% to about 15% of the total; length of circulation is reduced to a third, number of persons per tap is reduced to 18 and per w.c. to 25; average maximum walking distance to utilities is only 30 m; and street lighting is provided by 8 lamps. The main street carries storm water from the houses to the river. A place for public gathering is provided, on the main street and next to the mosque.

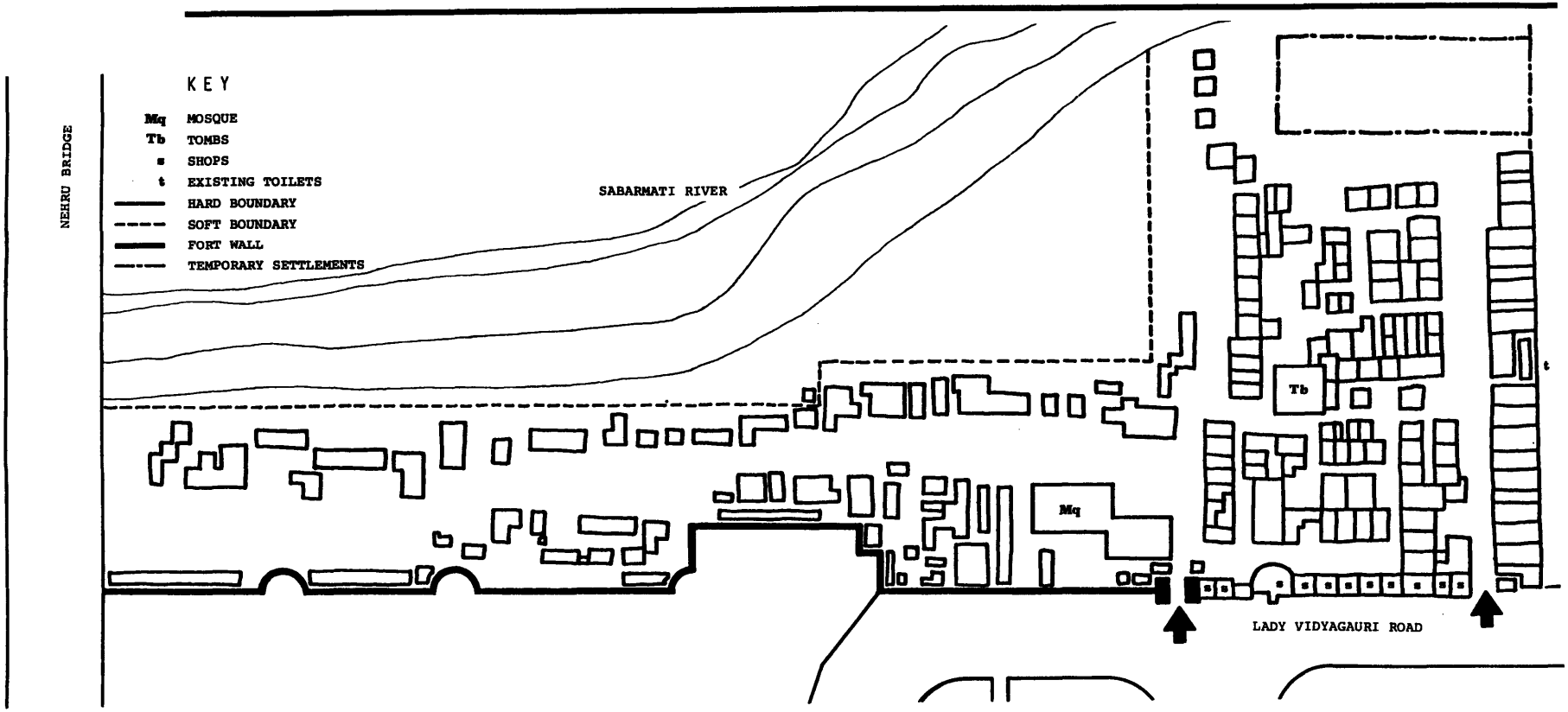
EXISTING SETTLEMENT

PROJECT DATA

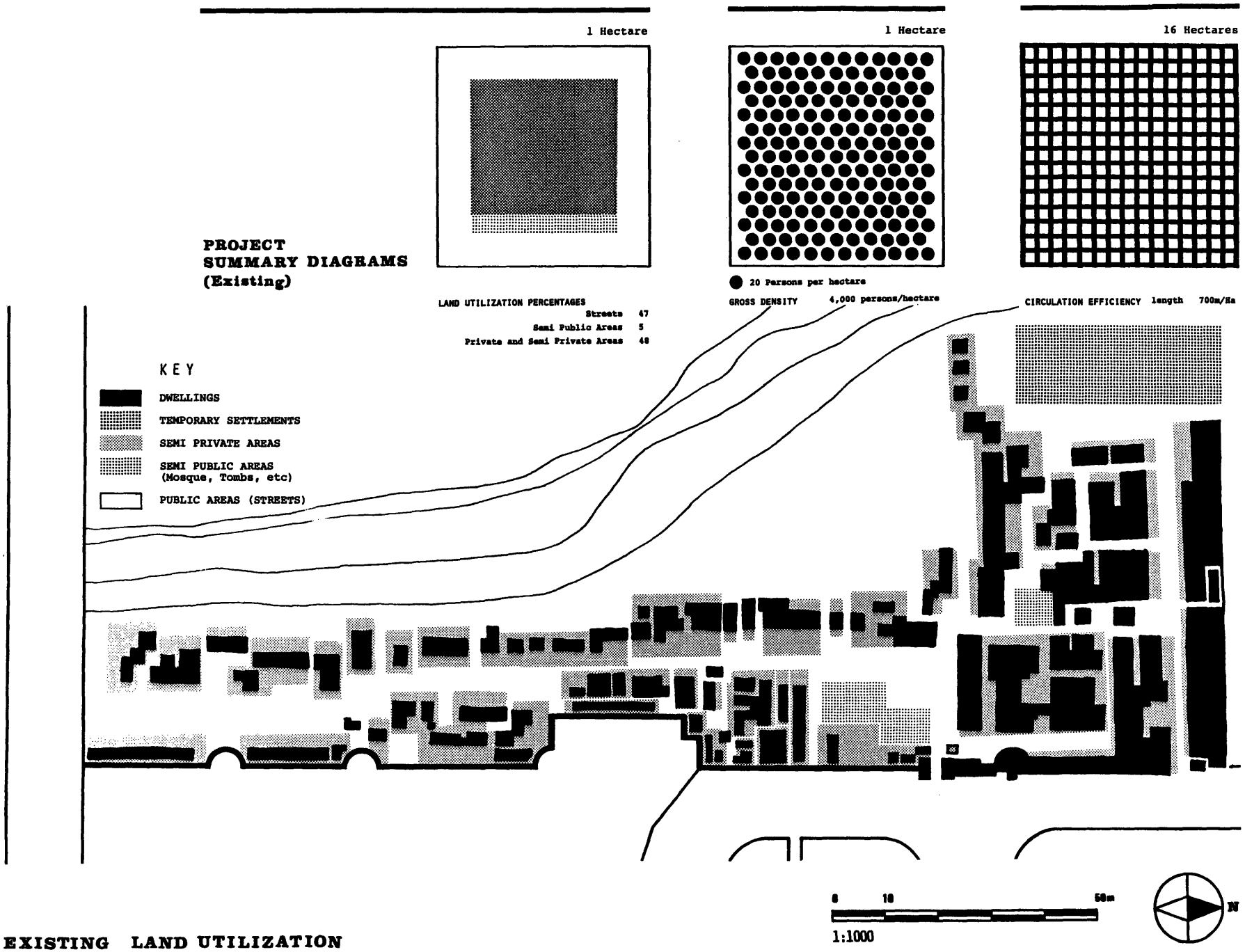
	EXISTING	PROPOSED
Total Area Ha	1	0.5
Population	4,000	2,020
Gross Density P/Ha	4,000	4,040
Net Density P/Ha	8,300	4,750
Land Utilization		
% Public Area	47	15
% Semi-Public Area	5	5
% Private and Semi-Private Areas	48	85
Circulation		
Length m/Ha	700	200
Land Sub-division		
Number of Lots/Ha	400	180
Number of Dwellings/Ha	400	404
Average Area of Lot sq.m.	12	39
Average Size of Lot m/m	N/A	3/13
Average Persons/Lot	10	10
Ave. Area/Person (Pri+S-Pri) sq.m.	12	5.5

	EXISTING	PROPOSED
Utilities		
Water Supply		
Number of Taps/Ha	20	224
Persons/Tap	200	18
Lots/Tap	20	2
Ave. Max. Walking Distance to Tap m	75	30
Length of Network m/Ha	NA	125
Average Service Connection/Tap m.	NA	1.5
Sewage Disposal		
Number of W.C.s/Ha	4	168
Persons/W.C.	1,000	25
Lots/W.C.	100	2.5
Ave. Max. Walking Distance to W.C. m.	75	30
Length of Network m/Ha	NA	120
Average Service Connection/W.C. m.	NA	1.8

	EXISTING	PROPOSED
Electricity and Street Lighting		
Number of Poles/Ha	NA	16
Number of Lamps/Ha	NA	8
Length of High Tension Network m/Ha	NA	100
Length of Low Tension Network m/Ha	NA	140
Typical Dwelling		
Area sq. m	12	27
Type: Permanent		Permanent
Floor: One		Three
Development: Popular		Institutional
Builder: Mutual Help/Contractor		Contractor
Mode: Incremental/Instant		Instant

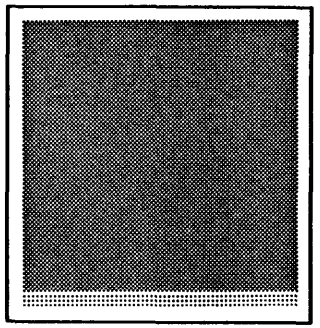


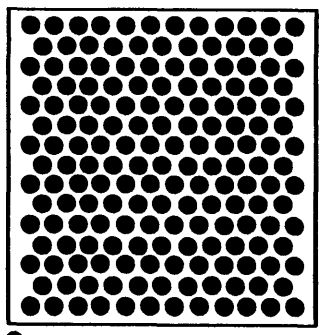
EXISTING LAYOUT PLAN

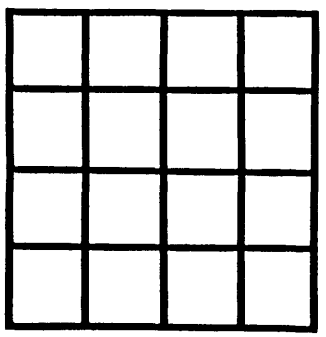


EXISTING LAND UTILIZATION

PRELIMINARY DESIGN STUDIES







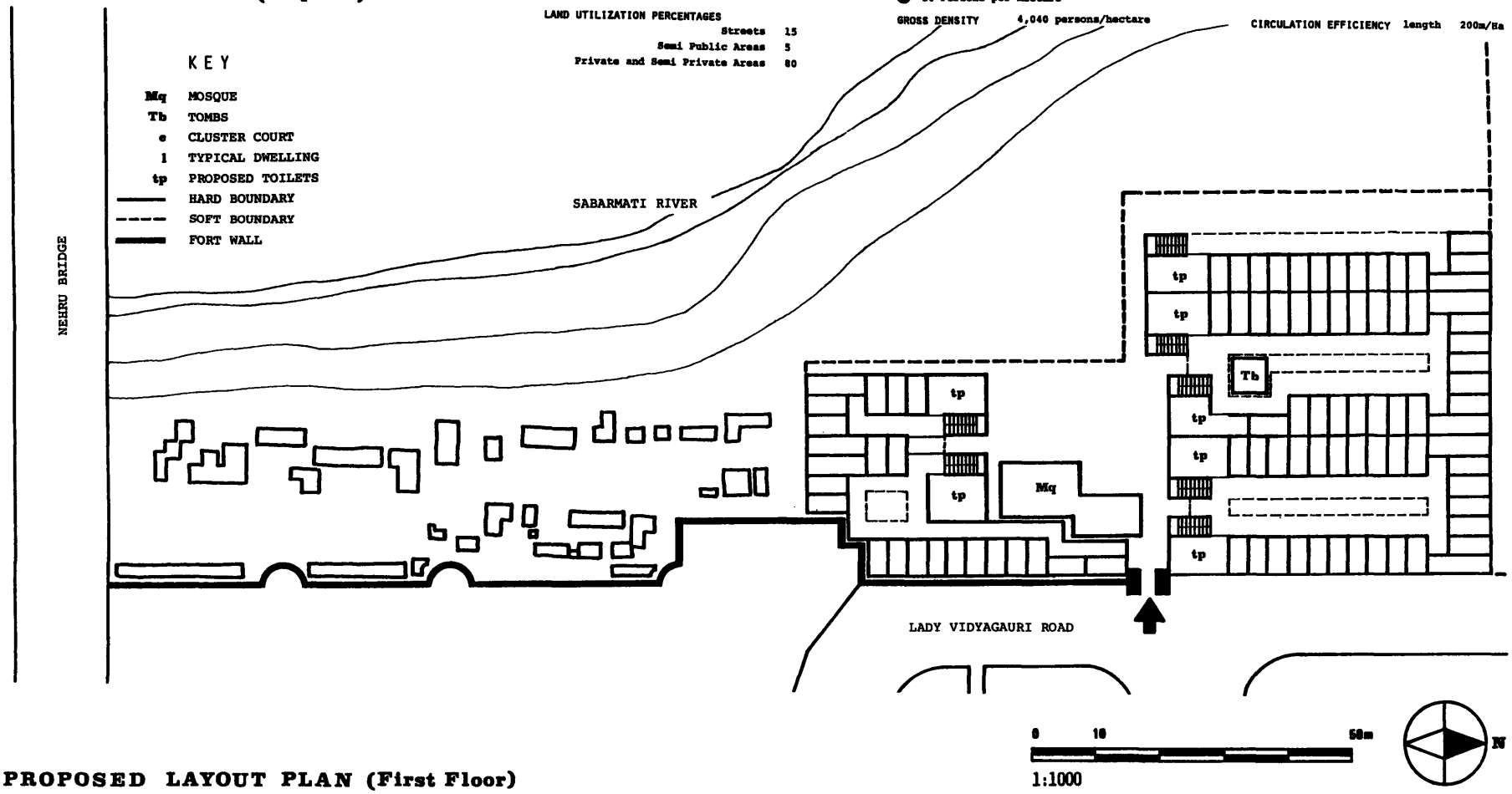
PROJECT SUMMARY DIAGRAMS (Proposed)

LAND UTILIZATION PERCENTAGES

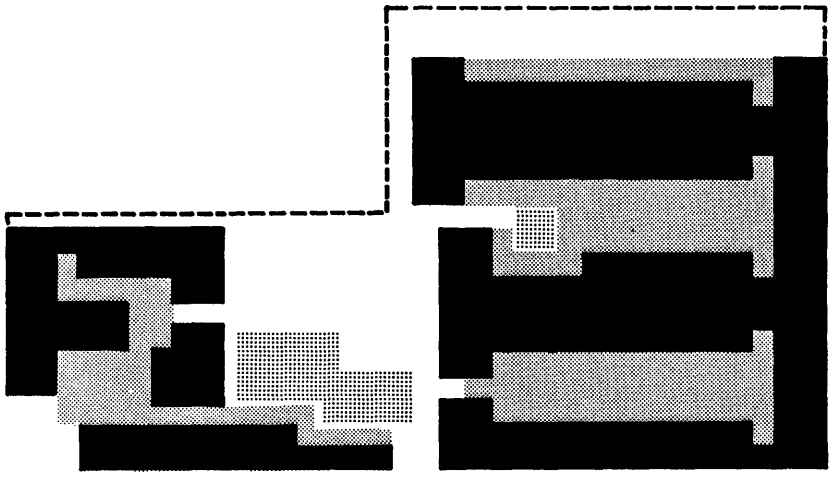
Streets	15
Semi Public Areas	5
Private and Semi Private Areas	80

GROSS DENSITY 4,040 persons/hectare

CIRCULATION EFFICIENCY length 200m/Ha



PROPOSED LAYOUT PLAN (First Floor)



KEY

- DWELLING
- SEMI PRIVATE AREAS (Cluster Courts)
- SEMI PUBLIC AREAS (Mosque, Tombs, etc)
- PUBLIC AREAS (STREETS)

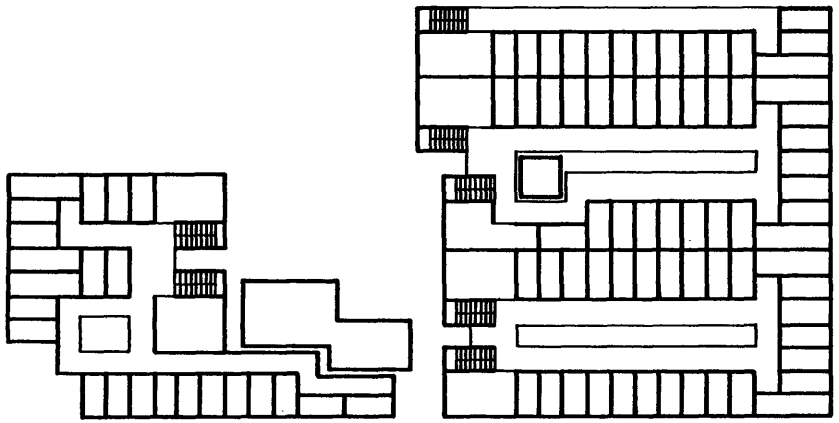
PROPOSED LAND UTILIZATION

KEY

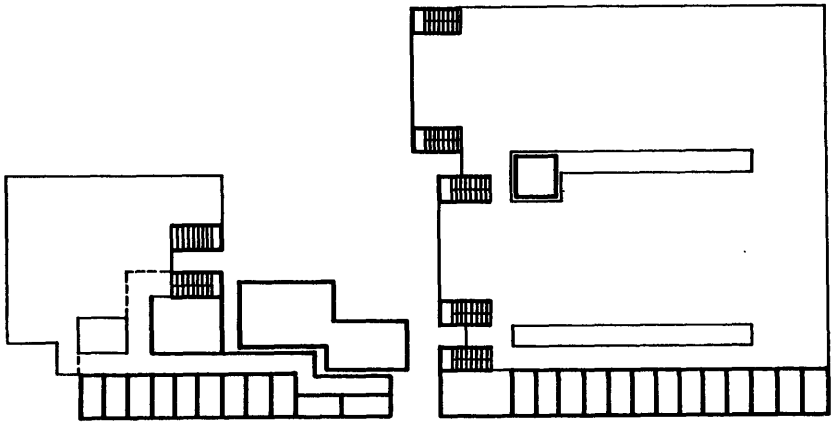
- VALVES
- CONNECTIONS
- NETWORK
- URBAN SYSTEM
- PROPOSED TOILETS

N

PROPOSED WATER SUPPLY



PROPOSED LAYOUT PLAN (Second Floor)



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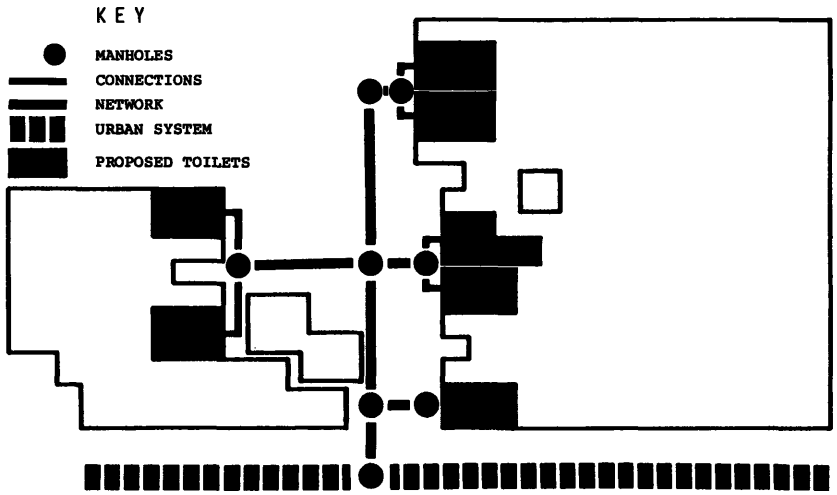
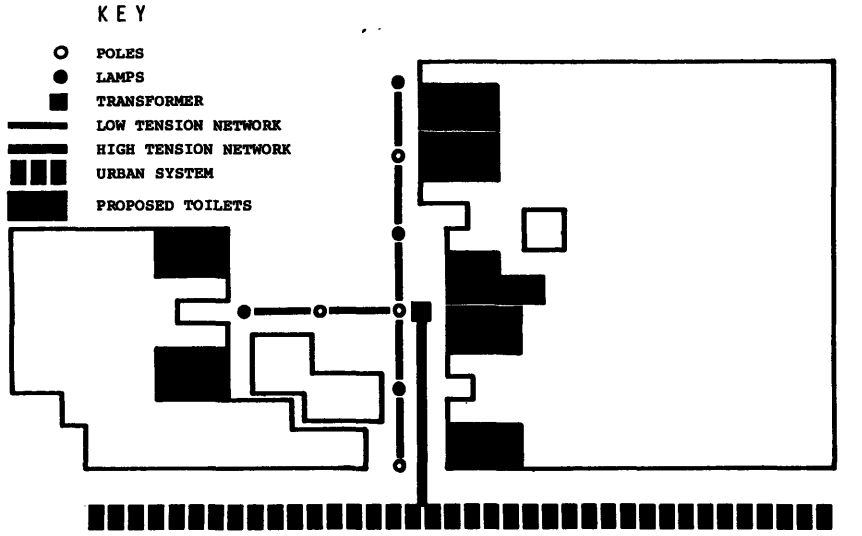
PROPOSED LAYOUT PLAN (Third Floor)



PROPOSED SEWAGE DISPOSAL



PROPOSED ELECTRICITY AND STREET LIGHTING

MODEL FOR EVALUATING ALTERNATIVES FOR HOUSING INDIA'S URBAN POOR

Introduction: For a typical housing project in India, the standards are set by the State and local planning agencies. The choice of building materials and the level of technology is often implicit in the directives of the financing agencies. The designers have very little flexibility and the result is a project more expensive than estimated and in the longer run, less housing than targeted is constructed. The objective of the model is to avoid this usual path. The model, therefore, must help designers at the project level in two ways: 1) to identify the relative importance of the various design elements in development (dwelling, circulation network, etc.) and 2) to indicate early and effectively to the concerned agencies the impact of a particular standard or regulation. The model must include all the components (design, program, building materials and the level of technology) that influence any project. The basis for evaluation will be the relationship between cost of development and the cost of providing for the various components.

The model, however, will fulfill only a part of its objective if it cannot accommodate negotiation between project designers and agencies responsible for the other parameters that govern the outcome of design activity.

Project design and implementation will be governed by: How the National resources are allocated for housing. How the state and local planning agencies identify alternatives for development and how the agencies set standards and regulations, etc. It is difficult to imagine design alone making a significant difference to the cost of a development if standards continue to be high and regulations imply expensive building materials. This is a very simple observation and has been made many times before. What has also been done, perhaps to a lesser extent, is supporting the observation by indicating the difference that a change in any of the parameters will make to the cost of development. What seems to have never been done, at least not convincingly, is to communicate the differences to other levels of decision making. No framework exists to accommodate communication and in turn negotiation between the various levels. The absence of a framework is manifest in the increasing disparity between 'estimated' and 'completed' housing, proliferating squatter settlements, under-utilization of available resources, lack of comprehensive plans for housing the urban poor, badly designed projects, etc.

The model must, therefore, not only serve project needs as a general tool, but also be a common language to the various levels of decision making.

The Model: The proposed model at the project level will fulfill the previous objectives. The basic variables will be the design parameters and it will be very easy to determine the relative importance of each of the components of design to the cost of development. It may be necessary in a particular alternative, for example, to devote utmost attention to the design of the dwelling as opposed to the network, if the dwelling is the important determinant in the cost of development. The model will also help, early in the design process, to measure the impact of a given standard or regulation. The designer, in a particular alternative, may recognize a significant influence of a standard on the cost of development and

decide to negotiate with the concerned agencies prior to any time consuming and detail design studies.

The model at the State and local levels will fulfill the objective to make maximum use of available resources. The relationship between the cost of development and the number of beneficiaries will govern the choice of an alternative for development. The State and local planning agencies may realize, for example, that by doing a series of small projects (as opposed to a single large project), they can increase the number of beneficiaries. The agencies, by assigning approximate values to design parameters can measure the impact of standards or regulations. The relationship between a standard and its impact on the cost of development can serve the re-evaluation of the standard. The agencies may realize that in a particular alternative, unless the stipulated area per person or lot is reduced, very little of the cost can be reduced.

The National Policy Makers by assigning approximate values to all the parameters can determine the cost of development for each of the alternatives. The relationship between the cost of development and the number of beneficiaries can govern the re-evaluation of a particular alternative for housing. The Policy Makers may realize, for example, that a larger share of national resources for housing the urban poor must be allocated for site and services projects as opposed to housing.

The parameters are classified into three categories: design, program and costs/technology. The classification will help National Policy Makers to allocate resources to other activities that influence the outcome of any housing project. A review of standards, for example, may be more crucial to a particular alternative rather than a search for new technology. Resources can be accordingly alloted for research and development activities. The classification will help State and local agencies, and project designers to understand each other's responsibilities, appreciate the limitations of these responsibilities and critically evaluate the performances as well.

How well the model will serve each level will depend on how appropriate the values assigned to the parameters are. How well it will serve as a framework for negotiation will depend - along with how well it serves each level - on the initiative of the personnel at each level.

Application: The application of the model is illustrated for Ahmedabad. The objectives are: 1) To determine the relative importance of the various components of development, and 2) To provide guidelines for the State and local planning agencies for identifying alternatives for development. The relative importance of the various components will govern the re-evaluation of standards and regulations; for example, if the dwelling is the most expensive component in a development, the re-evaluation will have to be on the material and space standards that govern the dwelling. How the model will serve at the National Policy level is not illustrated, but the application at project level will provide important clues toward policy decisions. For example, the proportion of infrastructure costs in a particular alternative may be very low and it may be realized that subsidizing infrastructure along will not significantly ease the burden of the intended beneficiaries.

The various components of development (parameters of the model) are classified into three categories: design, program and costs.

The previous design studies govern the values assigned to the design parameters in the application. It is assumed, for example, that none of dwellings will be

shifted for upgrading and thus the length of networks for circulation and utilities are relatively higher in upgrading, than for site and services or housing. It is also assumed (as evident from available cases in squatter settlements) that the additional area available per person in low density settlements is invariably undefined or public land.

The basic variables in the program parameters are the density of the project and the area for development. The observations determining the values assigned to the variables are: 1) A significant proportion of squatter settlements in the urban areas of Gujarat have less than 250 households, 2) All the 'Redevelopment and Housing Accomodation Programs' of the Ahmedabad Municipal Corporation have been in less than 8 hectare developments, 3) A significant proportion of the projects implemented or under review by the Gujarat Slum Clearance Board seem to be under 5 or 6 hectares, 4) The majority of available case study squatter settlements, particularly in the cities of Gujarat, are in the density range of 500 - 2,500 persons per hectare, and 5) It is quite likely that all the three alternatives may not be even feasible for settlements with a density of over 2,500 persons per hectare. The costs of various components of development are reconstructed from the Schedule of Rates published by the Ahmedabad Municipal Corporation. The choice of building materials and the technology for buildings and infrastructure is determined to a large extent by the conventional practice and economy.

Assigning a value to land is difficult and will lack merit, since the land is likely to be acquired outside of the conventional market. Moreover, the values will vary tremendously from one locality to another. The value for land, therefore, is not included in the model. Cost of electricity and street lighting is also not included in the computation because of unavailability of data. The level of provision in electricity and street lighting and thus the cost, therefore, is taken as the same for all the alternatives. Moreover, the service is generally provided in later phases of development. However, it will be simple, if need be, to extend the model to include cost of land; financial parameters, including monthly payments, interest rates, etc.

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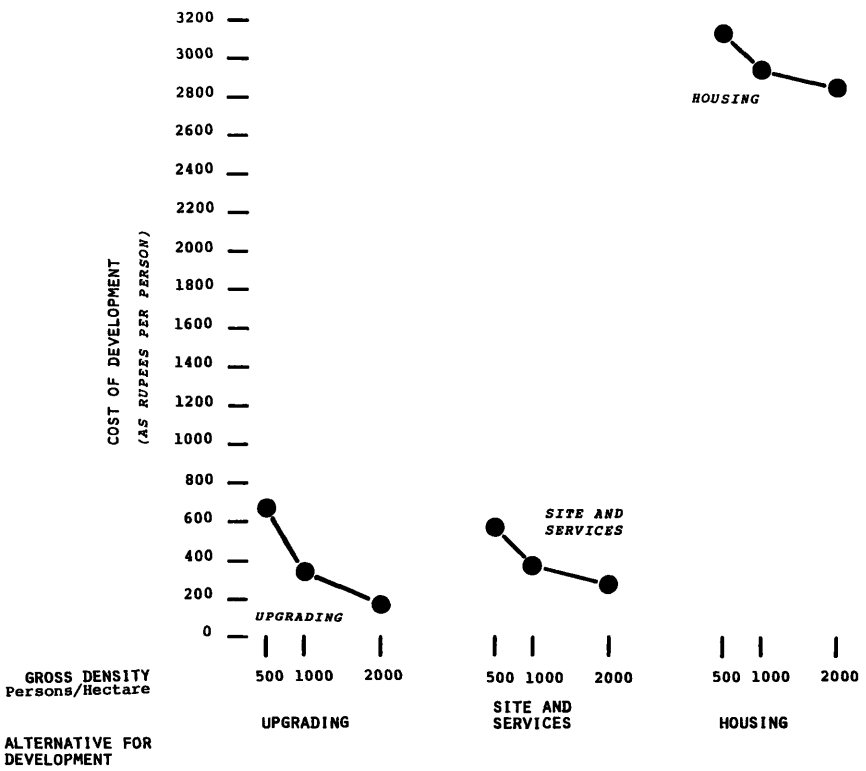
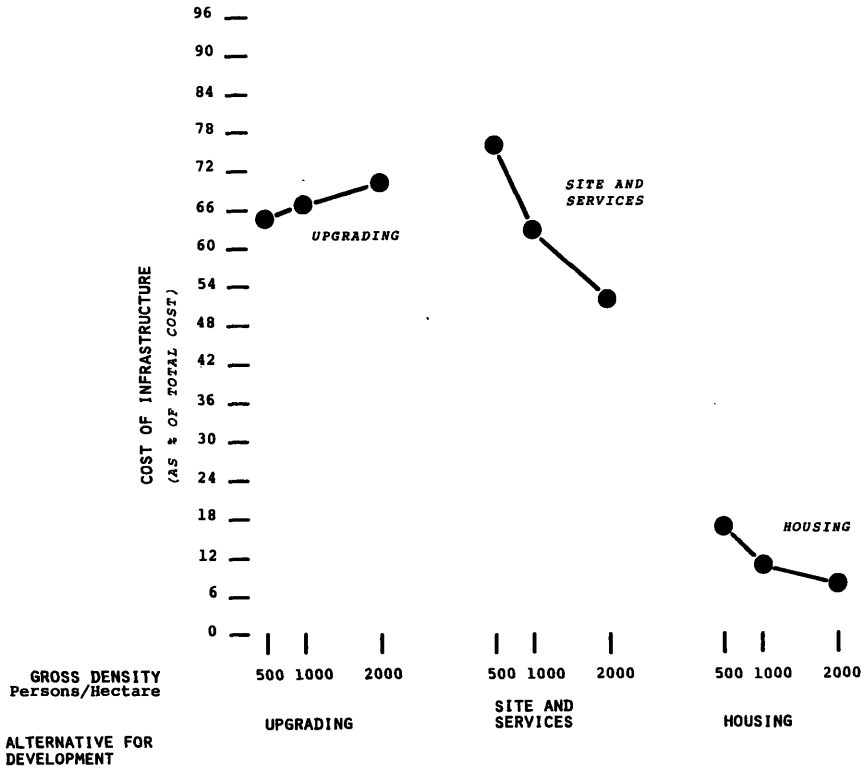
CONCLUSIONS

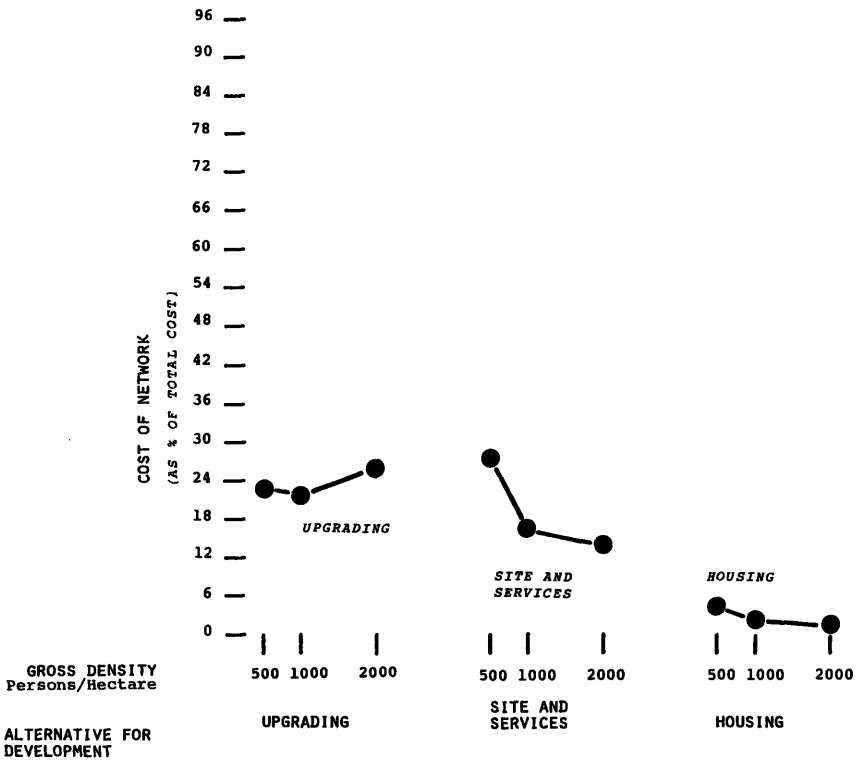


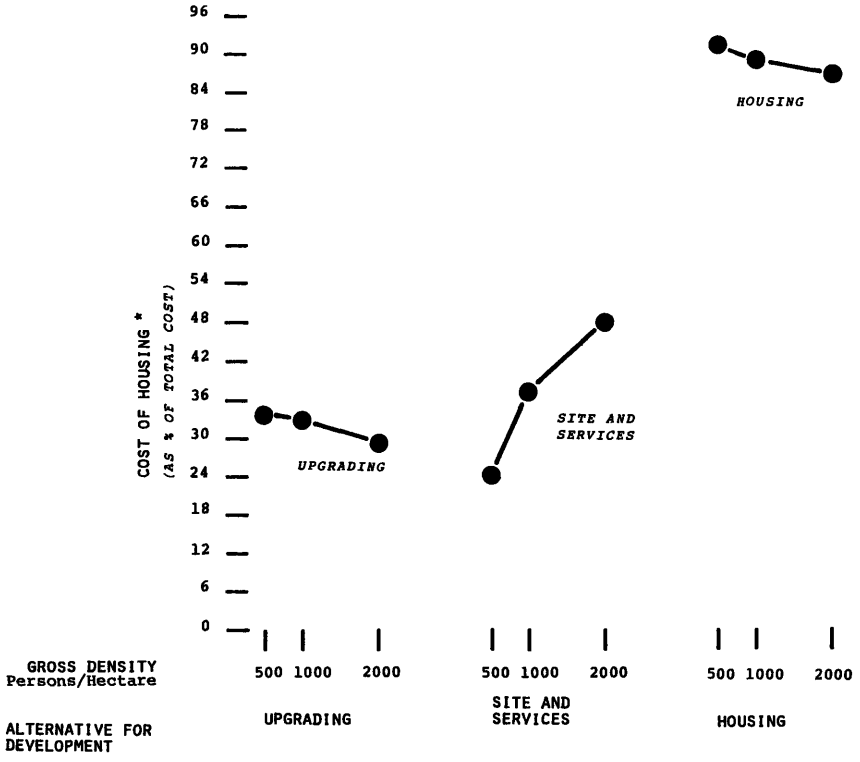


** The cost of dwelling includes: 1) The cost of developing the platforms in upgrading, 2) The cost of providing 30cm high plinth for the peripheral brick masonry walls in site and services and, 3) The cost of providing 3.0m high brick masonry walls and a R.C.C. roof in housing. The percentage of total area for circulation (public areas) and the enclosed area per person are assumed to remain the same for all the densities in the model. The important variable determining the cost of dwelling, therefore, is the cost of developing the semi-private areas (platforms in upgrading and, cluster courts in site and services and housing). The provision of platforms, and thus the cost for it, is included in upgrading whereas the cluster courts in site and services or housing is proposed for progressive development by the users and, thus, excluded from the cost of the dwelling.*

This is, but, one of the many differences in the levels of provision of services and dwellings between the alternatives. It must be clearly noted that the values assigned to the parameters of the model (see Appendix 1) determine the costs and, in turn, the conclusions and recommendations.

The conclusions are presented in three parts: 1) A series of graphs indicating the specific relationships of the cost of development and the cost of each of the components; infrastructure, network and housing to the density for the development. The relationships will govern - a) the choice of alternative for housing, b) the choice of project parameters, particularly the area and density for a project, c) the re-evaluation or design of financing or subsidy policies, and d) the focus for





design activity, 2) A set of general recommendations based on the above conclusions and, 3) An illustration of how the model can serve in a simulated project situation.

Irrespective of the alternative for housing, the density (as opposed to area) of the development is the prime determinant in the cost of development. The cost of development is inversely proportional to the density. The difference in the cost is relatively marginal between the site and services and upgrading. Site and services is substantially cheaper than upgrading for low density settlements. This is not suprising as the responsibility for development in upgrading low density settlements is relatively larger because the proportion of undefined or public land is relatively higher than what is required and can be designed for in new projects. Providing housing, it is clearly evident, is substantially more expensive than the other two alternatives.

The proportion of the cost of infrastructure is highest in upgrading and the least in housing. This is not surprising, since the level of provision for dwelling is the least in upgrading and the most in housing. The density of development also governs the proportion of

infrastructure costs, though the difference at the two extremes, upgrading and housing, is relatively small. The difference, however, is significant in site and services projects, where the proportion of infrastructure costs in higher density settlements are substantially lower.

The proportion of the cost of network to the total cost is almost equal for upgrading and site and services, and much less for housing. The difference in cost between infrastructure and network (excluding connections, fixtures and enclosures) is determined by the level of service connections (walking distance to utilities), fixtures (number of persons to a w.c./tap), etc. The proportion of the cost of network varies with the density because of the relation of the cost of pipes to the capacity.

The proportion of the cost of dwelling inversely correspondes to the proportion of infrastructure costs.

To summarize, it is obvious that the project density will influence the cost of development substantially more than the project area within the range of sizes considered. It is also obvious that even the density will become increasingly less critical as the standard of dwellings and utilities increases. The focus for design activity will vary with the density of the project and the alternative chosen for housing. It is also obvious that the object for re-evaluation will vary, but in general will correspond to the focus in design activity.

2) General Recommendations

The focus for design activity will be determined by the parameters of each project. It is difficult to imagine a 'receipe' for design, as much as it is to imagine one set of standards for all types of housing when what seems appropriate are standards, if not for each project (since that may be impractical), at least for each of the alternatives.

The choice between upgrading low density settlements and developing new high density site and services projects must be critically evaluated, since, the difference in the cost of development per person between them is significant. (Upgrading a 500 persons per hectare is thrice as expensive than developing a 2,000 persons per hectare site and services project.)

It must also be recognized that a policy for subsidizing infrastructure implies a larger share of public resources in upgrading and low density site and services projects. It is also readily apparent that housing projects (even if the infrastructure is subsidized) must be seriously re-evaluated as a viable alternative for housing the urban poor.

3) Example use of model

A designer is hired by a state agency to design a site and services project. The area for development is 8 hectares and the project density desired is given as 1000 persons per hectare. The project is budgeted at Rs. 300 per person and the standards for services and dwellings are specified. The model will enable the designer to quickly realize that it may not be possible to design for the specified program at the given budget. The designer will also know that the scope for reducing the cost lies either in reducing the level of utility services or reducing the cost of the dwelling, since the cost of the network is only 15 percent of the total cost. The designer also recognizes that the parameters defining the level of services and the dwelling are primarily the responsibility of the agency. The designer will be able to point out quickly to the agency, for example, that if

the number of persons per w.c. is changed from 40 to 60 or the area per person is reduced from 4 to 3 sq. m.; it may be possible to design within the given budget. Alternatively, the designer may recommend an increase in the density from 1000 persons per hectare to, say, 1950. The important thing, of course, that all this can be done in very little time and in a language the designers and the agencies understand - cost.

It must be clear that the foregoing conclusions and recommendations are primarily intended to indicate the kind of conclusions and recommendations that can be drawn using the model. The conclusions will vary with the values assigned to the parameters, which, in turn, will vary from one project to another, from one city to another, etc. The conclusions and the recommendations, therefore, have been deliberately limited to broad generalizations. It should be noted that the model is also not limited to what has been illustrated in the application or represented in the conclusions.

APPENDIX 1:

MODEL AND APPLICATION IN AHMEDABAD

Parameters for the Model:

(Independent Variables)

	Symbol	Explanation	Unit
Design	A1	Percentage of Total Area for Circulation (Public) Areas	%
	A2	Percentage of Total Area for Semi-public Buildings (Schools, Health Services, etc.; varies with project population)	%
	W1	Length of Water Supply Network	m/Ha
	W2	Length of Water Supply Connection (varies with the average maximum walking distance to tap)	m/tap
	S1	Length of Sewage Disposal Network	m/Ha
	S2	Length of Sewage Disposal connection (varies with the average maximum walking distance to w.c.)	m/w.c.
	E1	Length of High Tension Network in Electricity and Street Lighting	m/Ha
	E2	Length of Low Tension Network in Electricity and Street Lighting (varies with the number of lamps per hectare)	m/Ha
Program Parameters	A	Area of Development	Ha
	D	Gross Density of Development	P/Ha
	A3	Area per Person (varies with the level of services)	sq. m
	P	Persons per Lot (varies with the level of services)	Number
	P1	Persons per tap (varies with the level of services)	Number
	P2	Persons per w.c. (varies with the level of services)	Number
	L	Street Lamps	Number/Ha
Cost Parameters	C1	Cost of Paving Public Areas	Rs/sq. m.
	C2	Cost of Semi-public Buildings	Rs/sq. m.
	C3	Cost of Water Supply Network (varies with project population)	Rs/m.
	C4	Cost of Water Supply Connection	Rs/m
	C5	Cost of Water Supply Fixtures and Enclosure (varies with the level of services)	Rs/tap
	C6	Cost of Sewage Disposal Network (varies with project population)	Rs/m
	C7	Cost of Sewage Disposal Connection	Rs/m
	C8	Cost of Sewage Disposal Fixtures and Enclosure (varies with the level of services)	Rs/w.c.
	C9	Cost of High Tension Network	Rs/m
	C10	Cost of Low Tension Network	Rs/m
	C11	Cost of Street Lamps	Rs/number
	C12	Cost of Housing (varies with the level of services, and in Upgrading, with density)	Rs/sq. m.
(Dependent Variables)			
	CP	Cost of Public Areas	Rs
	CA	Cost of Semi-public Areas	Rs
	WA	Cost of Water Supply Network	Rs
	WB	Cost of Water Supply Connections, Fixtures and Enclosures	Rs
	CW	Cost of Water Supply	Rs
	SA	Cost of Sewage Disposal Network	Rs
	SB	Cost of Sewage Disposal Connections, Fixtures and Enclosures	Rs

CS	Cost of Sewage Disposal	Rs
CE	Cost of Electricity and Street Lighting	Rs
CH	Cost of Housing	Rs
HS	Cost of Housing including Service Connections, Fixtures and Enclosures	Rs
CI	Cost of Infrastructure	Rs
CD	Cost of Development	Rs
DP	Cost of Development per Person	Rs
DL	Cost of Development per Lot	Rs

Model Equations:

Cost of Public Areas:

$CP = C1 \times A1 \times A \times 10{,}000$ (1)

Cost of Semi-Public Buildings:

$CA = C2 \times A2 \times A \times 10{,}000$ (2)

Cost of Water Supply Network:

$WA(I) = C3(I) \times W1(I) \times A$ (3)

$WA(I) = WA(1)$ for Upgrading
$WA(I) = WA(2)$ for Site and Services
$WA(I) = WA(3)$ for Housing
$C3(I) = C3(1), C3(2), C3(3)$, etc., depending on A x D
$W1(I) = W1(1)$ for Upgrading
$W1(I) = W1(2)$ for Site and Services
$W1(I) = W1(3)$ for Housing

Cost of Water Supply Connections, Fixtures and Enclosures:

$WB(I) = C4 \times W2(I) \times A \times D \div P1(I) + C5(I) \times A \times D \div P1(I)$ (4)

$WB(I) = WB(1)$ for Upgrading
$WB(I) = WB(2)$ for Site and Services
$WB(I) = WB(3)$ for Housing
$W2(I) = W2(1)$ for Upgrading
$W2(I) = W2(2)$ for Site and Services
$W2(I) = W2(3)$ for Housing
$P1(I) = P1(1)$ for Upgrading
$P1(I) = P1(2)$ for Site and Services
$P1(I) = P1(3)$ for Housing
$C5(I) = C5(1)$ for Upgrading
$C5(I) = C5(2)$ for Site and Services
$C5(I) = C5(3)$ for Housing

Cost of Water Supply:

$CW(I) = WA(I) + WB(I)$ (5)

$CW(I) = CW(1)$ for Upgrading
$CW(I) = CW(2)$ for Site and Services
$CW(I) = CW(3)$ for Housing

Cost of Sewage Disposal Network:

$SA(I) = C6(I) \times S1(I) \times A$ (6)

$SA(I) = SA(1)$ for Upgrading
$SA(I) = SA(2)$ for Site and Services
$SA(I) = SA(3)$ for Housing
$C6(I) = C6(1), C6(2), C6(3)$, etc. depending on A x D
$S1(I) = S1(1)$ for Upgrading
$S1(I) = S1(2)$ for Site and Services
$S1(I) = S1(3)$ for Housing

Cost of Sewage Disposal Connections, Fixtures and Enclosures:

$SB(I) = C7 \times S2(I) \times A \times D \div P2(I) + C8(I) \times A \times D \div P2(I)$ (7)

$SB(I) = SB(1)$ for Upgrading
$SB(I) = SB(2)$ for Site and Services
$SB(I) = SB(3)$ for Housing
$S2(I) = S2(1)$ for Upgrading
$S2(I) = S2(2)$ for Site and Services
$S2(I) = S2(3)$ for Housing
$P2(I) = P2(1)$ for Upgrading
$P2(I) = P2(2)$ for Site and Services
$P2(I) = P2(3)$ for Housing
$C8(I) = C8(1)$ for Upgrading
$C8(I) = C8(2)$ for Site and Services
$C8(I) = C8(3)$ for Housing

Cost of Sewage Disposal:

$CS(I) = SA(I) + SB(I)$ (8)

$CS(I) = CS(1)$ for Upgrading
$CS(I) = CS(2)$ for Site and Services
$CS(I) = CS(3)$ for Housing

Cost of Electricity and Street Lighting:

$CE = C9 \times E1 \times A + C10 \times E2 \times A + C11 \times L \times A$ (9)

Cost of Housing:

$CH(I) = C12(I) \times A3(I) \times A \times D$ (10)

$CH(I) = CH(1)$ for Upgrading
$CH(I) = CH(2)$ for Site and Services
$CH(I) = CH(3)$ for Housing
$C12(I) = C12(1)$ for Upgrading
$C12(I) = C12(2)$ for Site and Services
$C12(I) = C12(3)$ for Housing
$A3(I) = A4(I)$ for Upgrading
$A3(I) = A3(2)$ for Site and Services
$A3(I) = A3(3)$ for Housing
$A4(I) = A4(1), A4(2), A4(3)$, etc.,

depending on density

Cost of Housing including Service Connections, Fixtures, and Enclosures:

$$HS(I) = WB(I) + SB(I) + CH(I) \quad (11)$$

HS(I) = HS(1) for Upgrading
HS(I) = HS(2) for Site and Services
HS(I) = HS(3) for Housing

Cost of Infrastructure:

$$CI(I) = CP + CA + CW(I) + CS(I) + CE \quad (12)$$

CI(I) = CI(1) for Upgrading
CI(I) = CI(2) for Site and Services
CI(I) = CI(3) for Housing

Cost of Development:

$$CD(I) = CH(I) + CI(I) \quad (13)$$

CD(I) = CD(1) for Upgrading
CD(I) = CD(2) for Site and Services
CD(I) = CD(3) for Housing

Cost of Development per Person:

$$DP(I) = CD(I) \div A \times D \quad (14)$$

DP(I) = DP(1) for Upgrading
DP(I) = DP(2) for Site and Services
DP(I) = DP(3) for Housing

Cost of Development per Lot:

$$DL(I) = DP(I) \times P(I) \quad (15)$$

DL(I) = DL(1) for Upgrading
DL(I) = DL(2) for Site and Services
DL(I) = DL(3) for Housing
P(I) = P(1) for Upgrading
P(I) = P(2) for Site and Services
P(I) = P(3) for Housing

Assigning values to the parameters of the model: The parameters are classified into three categories: design, program and costs. The design and case studies govern the values assigned to the design and program parameters. Requirements of service, conventional practice and the review of the regulations of a financing agency determine the choice of technology and the building materials. The costs are reconstructed from the schedule of rates for 1979-80, published by the Ahmedabad Municipal Corporation. The costs are adjusted to inflation, market trends, etc., and in general, are twice 1979-80 prices. The costs for providing semi-public facilities, like schools, health centers, etc., are not included in the computation. The finances for these facilities are envisaged from outside the resources earmarked for housing. Moreover, these facilities are not provided in the first phase of development. The semi-public areas are therefore included with the public area.

Assigning values to the design parameters: (Source: preliminary design studies)

	Upgrading	Site and Services	Housing
%Pub. and S. Pub. Area	20	20	20
Circulation. m/Ha	400	150	150
Water Supply network. m/Ha	225	150	150
Sewage Disposal network. m/Ha	150	125	125
Water Supply connection. m/tap	2	0.5	1.5
Sewage Disposal connection. m/w.c.	2	0.8	1.8

The thrust for design in circulation is to minimize public/central responsibility for the provision and maintenance, and maintain social interaction. Water supply and sewage disposal networks/ connections are designed to minimize the length of networks/connections, decrease the walking distance to the utilities and accomodate definition of social responsibility for use and maintenance of communal facilities. The network is designed for easy maintenance by avoiding easements. The number of valves, manholes, traps, etc. are minimized.

Assigning values to the program paramters: (Source: case studies and field surveys, author)

The program parameters are divided into two parts: the area and density parameters, which are the basic variables used in application and the rest.

Area Ha	Gross Density p/Ha
1	500
	1000
	2000
2	500
	1000
	2000
4	500
	1000
	2000
8	500
	1000
	2000

Majority of the squatter settlements, nearly 95% in Gujarat have less than 250 households. Various 'Development and Housing Accomodation' schemes in Ahmedabad have been without exception in settlements of less than 8 hectares. Majority of squatter settlements have densities in the range of 500-2500 persons per hectare. Moreover, it is quite likely that all the three alternatives outlined for development may not be even feasible for higher density settlements. The areas reserved for developing 'Economically Weaker Section' and 'Low Income Group' housing (with proximity to potential employment) are invariably small and scattered.

	Upgrading	Site and Services	Housing
% Open Area	25-50	25-30	25-30
Area/person sq. m.*	2-8	4	5
Av. Max. Walking Distance to tap/w.c. m.	75	50	25
Persons/Tap	100	50	25
Persons/w.c.	60	40	20
Water Consumption/ person/day. lit.	135	135	135
Persons/Lot	8	8	8

*Area/person in upgrading is the semi-private open area available per person. Area/person in site and services/housing is the enclosed private area available per person.

The level of services is a function of available financial resources (subsidies) and the affordability by inhabitants (loans). They increase with increasing access to loans. Enclosed area per person is also a function of affordability and increases with increasing access to loans and 'complete' housing. In upgrading, the enclosed area per person is independent of density; the additional area available to each person in low density settlements is in terms of semi-private open area between buildings.

Assigning values to the cost parameters: (Source: requirements of service, conventional practice, regulations of financing agency and schedule of rates published by Ahmedabad Municipal Corporation).

	Upgrading	Site and Services	Housing
Paving for Circulation Rs./sq. m.	70	70	70
Water Supply Network Rs./m.	125/175/ 225	125/175/ 225	125/175/ 225
Water Supply Connection Rs./tap	30	30	30
Water Supply Fixtures and enclosure. Rs./tap	150	400	900
Sewage Disposal Network Rs./m.	200/275 375	200/275/ 375	200/275/ 375
Sewage Disposal Connection. Rs./w.c.	60	60	60
Sewage Disposal Fixtures and enclosure. Rs./w.c.	1000	1250	1750
Housing (platforms) in upgrading only. Rs./sq. m.	30	--	--
Housing (plinth) in site and services only. Rs./sq. m.	--	35	--
Housing. Rs./sq. m.	--	--	525

Circulation network is designed for predominantly pedestrian circulation and as primary interceptors for storm drainage. Conventional materials are used because of availability. Reinforced cement concrete roof is used in order to facilitate the use of the terrace for extended activities.

(Basic data used for determining water supply and sewage disposal requirements are:

Network is designed for a maximum density of 4,000 persons per hectare.

Permissible velocity in water supply is 2-4 ft/sec or Permissible head loss is 5-20 ft/1,000 ft.

Permissible velocity in sewage disposal is 1.25-3 ft/sec or Permissible slope is .002-.004 ft/ft.

Peak water supply requirement is two times the average requirement.

Peak sewage flow is two and a half times the average flow.

Three sizes of pipes are used for network: 4", 6", and 9" (100, 150 and 225 mm.) in water supply; and 6", 9", and 12" (150, 225 and 300 mm.) in sewage disposal; for a maximum population of 2,000; 8,000 and 16,000 respectively.

Number of inlets/outlets for water supply/sewage disposal available is more than one, if the project population is more than 16,000.

NO ENGINEERING CALCULATIONS ARE MADE, APPROXIMATIONS WERE MADE FROM STANDARD NOMOGRAPHS.)

Program Used for Application: The equations used in the model are modified for computer calculation. The programs was written in 'Basic' language and was executed on an 'Apple II' micro-computer. Minor modifications were made for the symbols because the system did not permit more than two characters in naming the variables. For example, C10, C11 and C12 became CX, CY and CZ, respectively.

```
10  REM ...MODEL FOR EVALUATING ALTERNATIVES FOR HOUSING INDIA'S URBAN POOR
20  REM ...APPLICATION FOR AHMEDABAD
30  DIM C3(3),W1(3),W2(3),P1(3),C6(3),S1(3)
40  DIM S2(3),C5(3),P2(3),C8(3),CZ(3),A3(3)
50  PRINT 'ALTERNATIVE FOR HOUSING'
60  PRINT ' U FOR UPGRADING '
70  PRINT ' S FOR SITE AND SERVICES '
80  PRINT ' H FOR HOUSING '
90  INPUT A$
100 T = 0
110  IF A$ = 'U' THEN T = 1
120  IF A$ = 'S' THEN T = 2
130  IF A$ = 'H' THEN T = 3
140  INPUT 'PROJECT AREA';A
150  INPUT 'PROJECT DENSITY';D
160  REM ...COST OF PUBLIC AND SEMI PUBLIC AREAS
170  READ A1: REM ...PERCENTAGE OF PUBLIC AREAS
180  DATA  .20
190  READ C1: REM ...COST OF PAVING PUBLIC AREAS
200  DATA  70
210  READ A2: REM ...PERCENTAGE OF AREA FOR SEMI PUBLIC BUILDINGS
220  DATA  .0001
230  READ C2: REM ...COST OF SEMI PUBLIC BUILDING
240  DATA  .0001
250  REM ...COST OF WATER SUPPLY
260  IF (A * D <  = 0) THEN  GOTO 50
270  IF ((A * D <  = 2000) AND (A * D > 0)) THEN T1 = 1
280  IF ((A * D <  = 8000) AND (A * D > 2000)) THEN T1 = 2
290  IF ((A * D <  = 16000) AND (A * D > 8000)) THEN T1 = 3
300  IF (A * D > 16000) THEN  GOTO 50
310  FOR I = 1 TO 3
320  READ C3(I): REM ...COST OF WATER SUPPLY NETWORK
330  DATA  125
340  DATA  175
350  DATA  225
360  NEXT I
370  FOR I = 1 TO 3
380  READ W1(I): REM ...LENGTH OF WATER SUPPLY NETWORK
390  DATA  225
400  DATA  150
410  DATA  150
420  NEXT I
430  READ C4: REM ...COST OF WATER SUPPLY CONNECTION
440  DATA  30
460  FOR I = 1 TO 3
470  READ W2(I): REM ...LENGTH OF WATER SUPPLY CONNECTION
480  DATA  2
490  DATA  .5
500  DATA  1.5
510  NEXT I
520  FOR I = 1 TO 3
530  READ P1(I): REM ...PERSONS PER TAP
540  DATA  100
550  DATA  50
560  DATA  25
570  NEXT I
580  FOR I = 1 TO 3
590  READ C5(I): REM ...COST OF WATER SUPPLY FIXTURES AND ENCLOSURES
600  DATA  150
610  DATA  400
620  DATA  900
630  NEXT I
640  REM ...COST OF SEWAGE DISPOSAL
650  FOR I = 1 TO 3
660  READ C6(I): REM ...COST OF SEWAGE DISPOSAL NETWORK
670  DATA  200
680  DATA  275
690  DATA  375
700  NEXT I
710  FOR I = 1 TO 3
720  READ S1(I): REM ...LENGTH OF SEWAGE DISPOSAL NETWORK
730  DATA  150
740  DATA  125
750  DATA  125
760  NEXT I
770  READ C7: REM ...COST OF SEWAGE DISPOSAL CONNECTION
780  DATA  60
800  FOR I = 1 TO 3
810  READ S2(I): REM ...LENGTH OF SEWAGE DISPOSAL CONNECTION
820  DATA  2
830  DATA  .7
840  DATA  1.8
850  NEXT I
860  FOR I = 1 TO 3
870  READ P2(I): REM ...PERSONS PER W.C.
880  DATA  60
890  DATA  40
900  DATA  20
910  NEXT I
920  FOR I = 1 TO 3
930  READ C8(I): REM ...COST OF SEWAGE DISPOSAL FIXTURES AND ENCLOSURES
940  DATA  1000
950  DATA  1250
960  DATA  1750
970  NEXT I
980  REM ...COST OF ELECTRICITY AND STREET LIGHTING
990  READ C9: REM ...COST OF HIGH TENSION CABLE
1000  DATA  .0001
1010  READ E1: REM ...LENGTH OF HIGH TENSION CABLE
1020  DATA  .0001
1030  READ CX: REM ...COST OF LOW TENSION CABLE
1040  DATA  .0001
1050  READ E2: REM ...LENGTH OF LOW TENSION CABLE
1055  DATA  .0001
1060  READ CY: REM ...COST OF STREET LAMPS
1070  DATA  .0001
1080  READ L: REM ...NUMBER OF STREET LAMPS
1090  DATA  .0001
1100  REM ...COST OF HOUSING
1120  FOR I = 1 TO 3
1130  READ CZ(I): REM ...COST OF HOUSING
```

```
1140  DATA  30
1150  DATA  35
1160  DATA  525
1170  NEXT I
1180  FOR I = 1 TO 3
1190  READ A3(I): REM ...AREA PER PERSON
1200  DATA  0
1210  DATA  4
1220  DATA  5
1230  NEXT I
1240  IF ((D <  = 500) AND (D > 0)) THEN A3(1) = 8
1250  IF ((D <  = 1000) AND (D > 500)) THEN A3(1) = 4
1260  IF ((D <  = 2000) AND (D > 1000)) THEN A3(1) = 2
1270  IF (D > 2000) THEN  GOTO 50
1280  FOR I = 1 TO 3
1290  READ P(I): REM ...PERSONS PER LOT
1300  DATA  8
1310  DATA  8
1320  DATA  8
1330  NEXT I
1340  REM ...BEGIN CALCULATIONS
1350 CP = C1 * A1 * A * 10000: REM ...COST OF PUBLIC AREAS
1360 CA = C2 * A2 * A * 10000: REM ...COST OF SEMI PUBLIC BUILDINGS
1370 WA(T) = C3(T1) * W1(T) * A: REM ...COST OF WATER SUPPLY NETWORK
1380 WB(T) = (C4 * W2(T) * A * D / P1(T)) + (C5(T) * A * D / P1(T))
1390  REM ...COST OF WATER SUPPLY CONNECTIONS,FIXTURES AND ENCLOSURES
1400 CW(T) = WA(T) + WB(T): REM ...COST OF WATER SUPPLY
1410 SA(T) = C6(T1) * S1(T) * A: REM ...COST OF SEWAGE DISPOSAL NETWORK
1420 SB(T) = (C7 * S2(T) * A * D / P2(T)) + (C8(T) * A * D / P2(T))
1430  REM ...COST OF SEWAGE DISPOSAL CONNECTIONS,FIXTURES AND ENCLOSURES
1440 CS(T) = SA(T) + SB(T): REM ...COST OF SEWAGE DISPOSAL
1450 CE = (C9 * E1 * A) + (CX * E2 * A) + (CY * L * A)
1460  REM ...COST OF ELECTRICITY AND STREET LIGHTING
1470 CH(T) = CZ(T) * A3(T) * A * D: REM ...COST OF HOUSING
1480 HS(T) = WB(T) + SB(T) + CH(T)
1490  REM ...COST OF HOUSING INCLUDING SERVICE CONNECTIONS,FIXTURES AND ENCLOSURES
1500 CN(T) = CA + WA(T) + SA(T) + CE: REM ...COST OF NETWORK
1510 CI(T) = CP + CA + CW(T) + CS(T) + CE: REM ...COST OFINFRASTRUCTURE
1520 CD(T) = CH(T) + CI(T): REM ...COST OF DEVELOPMENT
1530 DP(T) = CD(T) / (A * D): REM ...COST OF DEVELOPMENT PER PERSON
1540 DL(T) = DP(T) * P(T): REM ...COST OF DEVELOPMENT PER LOT
1550  PR# 1
```

```
1560  PRINT 'ALTERNATIVE FOR HOUSING                                          = ',A$
1570  PRINT 'PROJECT AREA                                                     = ',A
1580  PRINT 'PROJECT DENSITY                                                  = ',D
1590  PRINT 'COST OF PUBLIC AREAS                                             = ',CP
1600  PRINT 'COST OF SEMI PUBLIC BUILDINGS                                    = ',CA
1610  PRINT 'COST OF WATER SUPPLY NETWORK                                     = ',WA(T)
1620  PRINT 'COST OF WATER SUPPLY CONNECTIONS, FIXTURES AND ENCLOSURES        = ',WB(T)
1630  PRINT 'COST OF WATER SUPPLY                                             = ',CW(T)
1640  PRINT 'COST OF SEWAGE DIDPOSAL NETWORK                                  = ',SA(T)
1650  PRINT 'COST OF SEWAGE DISPOSAL CONNECTIONS, FIXTURES AND ENCLOSURES     = ',SB(T)
1660  PRINT 'COST OF SEWAGE DISPOSAL                                          = ',CS(T)
1670  PRINT 'COST OF HOUSING                                                  = ',CH(T)
1680  PRINT 'COST OF HOUSING INCLUDING SERVICE CONNECTIONS, FIXTURES AND ENCLOSURES = ',HS(T)
1690  PRINT 'COST OF NETWORK                                                  = ',CN(T)
1700  PRINT 'COST OF INFRASTRUCTURE                                           = ',CI(T)
1710  PRINT 'COST OF DEVELOPMENT                                              = ',CD(T)
1720  PRINT 'COST OF DEVELOPMENT PER PERSON                                   = ',DP(T)
1730  PRINT 'COST OF DEVELOPMENT PER LOT                                      = ',DL(T)
1740  PR# 0
1750  PRINT ' '
```

Application for Ahmedabad: Values (Ref: Assigning Values to the Parameters of the Model) are assigned to the variables in the program and following are the results. All costs are in Indian Rupees.

```
ALTERNATIVE FOR HOUSING                                          = U
PROJECT AREA                                                     = 1
PROJECT DENSITY                                                  = 500
COST OF PUBLIC AREAS                                             = 140000
COST OF SEMI PUBLIC BUILDINGS                                    = 1E-04
COST OF WATER SUPPLY NETWORK                                     = 28125
COST OF WATER SUPPLY CONNECTIONS, FIXTURES AND ENCLOSURES        = 1050
COST OF WATER SUPPLY                                             = 29175
COST OF SEWAGE DIDPOSAL NETWORK                                  = 30000
COST OF SEWAGE DISPOSAL CONNECTIONS, FIXTURES AND ENCLOSURES     = 9333.33333
COST OF SEWAGE DISPOSAL                                          = 39333.3333
COST OF HOUSING                                                  = 120000
COST OF HOUSING INCLUDING SERVICE CONNECTIONS, FIXTURES AND ENCLOSURES = 130383.333
COST OF NETWORK                                                  = 58125.0001
COST OF INFRASTRUCTURE                                           = 208508.333
COST OF DEVELOPMENT                                              = 328508.334
COST OF DEVELOPMENT PER PERSON                                   = 657.016667
COST OF DEVELOPMENT PER LOT                                      = 5256.13334
ALTERNATIVE FOR HOUSING                                          = S
PROJECT AREA                                                     = 1
PROJECT DENSITY                                                  = 500
COST OF PUBLIC AREAS                                             = 140000
COST OF SEMI PUBLIC BUILDINGS                                    = 1E-04
COST OF WATER SUPPLY NETWORK                                     = 18750
COST OF WATER SUPPLY CONNECTIONS, FIXTURES AND ENCLOSURES        = 4150
COST OF WATER SUPPLY                                             = 22900
COST OF SEWAGE DIDPOSAL NETWORK                                  = 25000
COST OF SEWAGE DISPOSAL CONNECTIONS, FIXTURES AND ENCLOSURES     = 16150
COST OF SEWAGE DISPOSAL                                          = 41150
COST OF HOUSING                                                  = 70000
COST OF HOUSING INCLUDING SERVICE CONNECTIONS, FIXTURES AND ENCLOSURES = 90300
COST OF NETWORK                                                  = 43750.0001
COST OF INFRASTRUCTURE                                           = 204050
COST OF DEVELOPMENT                                              = 274050
COST OF DEVELOPMENT PER PERSON                                   = 548.1
COST OF DEVELOPMENT PER LOT                                      = 4384.8
ALTERNATIVE FOR HOUSING                                          = H
PROJECT AREA                                                     = 1
PROJECT DENSITY                                                  = 500
COST OF PUBLIC AREAS                                             = 140000
COST OF SEMI PUBLIC BUILDINGS                                    = 1E-04
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COST OF WATER SUPPLY CONNECTIONS, FIXTURES AND ENCLOSURES        = 18900
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COST OF SEWAGE DIDPOSAL NETWORK                                  = 25000
COST OF SEWAGE DISPOSAL CONNECTIONS, FIXTURES AND ENCLOSURES     = 46450
COST OF SEWAGE DISPOSAL                                          = 71450
COST OF HOUSING                                                  = 1312500
COST OF HOUSING INCLUDING SERVICE CONNECTIONS, FIXTURES AND ENCLOSURES = 1377850
COST OF NETWORK                                                  = 43750.0001
COST OF INFRASTRUCTURE                                           = 249100
COST OF DEVELOPMENT                                              = 1561600
COST OF DEVELOPMENT PER PERSON                                   = 3123.2
COST OF DEVELOPMENT PER LOT                                      = 24985.6
```

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COST OF INFRASTRUCTURE	= 218891.667	= 239658.334	= 417016.667	= 437783.334	= 524316.667	= 834033.334	= 965566.667
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COST OF DEVELOPMENT PER PERSON	= 338.891667	= 179.829167	= 657.016667	= 338.891667	= 191.079167	= 657.016667	= 361.391667
COST OF DEVELOPMENT PER LOT	= 2711.13334	= 1438.63333	= 5256.13334	= 2711.13334	= 1528.63333	= 5256.13334	= 2891.13334
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COST OF SEWAGE DIDPOSAL NETWORK	= 25000	= 25000	= 50000	= 50000	= 68750	= 100000	= 137500
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COST OF HOUSING INCLUDING SERVICE CONNECTIONS, FIXTURES AND ENCLOSURES	= 180600	= 361200	= 180600	= 361200	= 722400	= 361200	= 722400
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COST OF PUBLIC AREAS	= 140000	= 140000	= 280000	= 280000	= 280000	= 560000	= 560000
COST OF SEMI PUBLIC BUILDINGS	= 1E-04	= 1E-04	= 2E-04	= 2E-04	= 2E-04	= 4E-04	= 4E-04
COST OF WATER SUPPLY NETWORK	= 18750	= 18750	= 37500	= 37500	= 52500	= 75000	= 105000
COST OF WATER SUPPLY CONNECTIONS, FIXTURES AND ENCLOSURES	= 37800	= 75600	= 37800	= 75600	= 151200	= 75600	= 151200
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COST OF DEVELOPMENT PER PERSON	= 2939.45	= 2847.575	= 3123.2	= 2939.45	= 2856.0125	= 3123.2	= 2956.325
COST OF DEVELOPMENT PER LOT	= 23515.6	= 22780.6	= 24985.6	= 23515.6	= 22848.1	= 24985.6	= 23650.6

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APPENDIX 2:

DESIGN STUDIES

CASE STUDIES, NATIONAL CONTEXT

INDIA

PRIMARY INFORMATION		
Country:	Republic of India	
Capital:	New Delhi	
Population:	658,140,676 (1981)	
	156,188,507 (24%) urban	
Population Growth:	1.9% (1978)	
Area:	3,280,482 sq. km.	
Languages:	Hindi, English and 14 other official languages.	
Currency:	Rupee (Rs. 9.34 = US $1, March 30, 1982)	
Per Capita Income:	Rs. 730 (1978-79)	
Religion:	84% Hindu, 11% Muslim	
Government:	Democracy	
Major Cities:	Calcutta	7,005,362*
	Bombay	5,968,546
	Delhi	3,629,842
	Madras	2,470,288
	Hyderabad	1,798,910
	Bangalore	1,648,232
	Ahmedabad	1,237,016**

*Inside Municipal boundaries
** 2,515,195 (1981)

GEOGRAPHY: India, situated between 8°4' and 37°6' latitudes, dominates the South Asian Subcontinent. It is bounded on the east by Bangladesh, Burma and the Bay of Bengal; on the west by Pakistan and the Arabian Sea; and on the north by the People's Republic of China, Nepal and Bhutan. She measures 3,214 km. north to south and 2,933 km. east to west, has a land frontier of 15,200 km. and a coastline of 6,083 km. The topography has three major regions: 1) sparsely populated Himalaya Mountain region which extends along the north border; 2) heavily populated, well watered and fertile Indo-Gangetic plains; and 3) southern peninsula, including the tableland of Deccan Plateau.

The climate varies from tropical in the south to temperate in the north. The temperature rarely goes below freezing south of the Himalayas, in fact it reaches as high as 43°C. during summer. Precipitation ranges from over 1,000 cm annually in the northeast to less than 12 cm in the northwest.

PEOPLE: Two major ethnic groups predominate in India: Indo-Aryan in the north and Dravidian in the south. 84% of the people are Hindus, 11% Muslims and the rest are Christians, Sikhs, Jains, Parsis, Buddhists, etc. According to the 1961 census, 1,652 languages were reported as mother tongues. However, the 14 principal languages identified in the Indian Constitution are collectively spoken by about 87% of the people. English is

widely used in government, business and education throughout the country.

HISTORY: The known history of the Indian people spans some five millenia. Between 3000 and 1500 B.C., a number of settlements had developed in the Indus River Valley (now in Pakistan) into complex urban centers based on commerce, trade and agriculture. The Muslim Arabs came to India in the seventh and eighth centuries A.D. The Mughals reigned from 1526 to 1707 A.D.

The first British outpost in South Asia was established in 1857 and, a direct rule of the British Crown, in 1857. After partition of the Indian subcontinent into India and Pakistan, India became independent on August 15, 1947. India's constitution came into effect on January 26, 1950 and the country was declared to be a Democratic Republic.

GOVERNMENT: India is a sovereign Democratic Republic with a parliamentary form of government. The President, elected by an indirect electoral college, is the executive head of the Indian Union. He also acts as the Supreme Commander of the armed forces and appoints the Prime Minister, the Attorney General, Governors of the States of the Union, the Chief Justice and other justices of the Supreme Court and High Courts, and appoints and receives diplomatic representations.

The President is aided and advised by a Cabinet of Ministers, headed by the Prime Minister. Members of the Cabinet are chosen from among the two houses of the Parliament and are responsible to it. The two houses are: the Rajya Sabha, or the Council of States, and the Lok Sabha, or the House of the People. The former consists of a maximum of 250 representatives, 13 of whom are nominated and the rest are elected indirectly by the members of the state and territorial legislatures. Members of the Lok Sabha are elected directly by the people.

By 1974, there were 21 states and 9 union territories. The governmental structure at the state level is similar to that of the central government. A State Governor, appointed by the President, is aided and advised by a Cabinet of Ministers, headed by the Chief Minister.

The self-governing bodies at the Village, Block and District Levels are the "Gram Panchayat"; "Block Panchayat" and the "Zilla Parishad" respectively. In large towns and cities, the local self-governing body is the Municipality.

The judiciary is a single, integrated, hierarchical system, with the Supreme Court, the High Courts at the State levels and lower courts at the district and local levels. At the village level, judicial bodies called the "Nyaya Panchayat" try cases of minor offenses in many states but they have only limited powers and may only impose moderate fines as punishments.

ECONOMY: India has a mixed economy comprising of a small but growing public sector. According to National Account Statistics, gross fixed investment in the public sector as a percentage of gross domestic product rose from 2.3% in 1950-51 to 9.2% in 1978-79. A large share of public investment is in the field of energy, industries, social services, transport and irrigation. Public saving accounts for 22.9% of total domestic saving estimated for the sixth plan period (1980-85) while the balance of 77.1% represents saving generated in the private sector. Within the private sector, household saving dominates with a share of 70.1% of the total domestic saving.

Between 1950-51 and 1978-79 the underlying trend rate of growth of national income was 3.5%, of agricultural production 2.7% and of industrial production 6.1%. In per capita terms, income has grown at a trend rate of 1.3%, which after allowing for rising share of investment in national income, has meant a modest 1.1% rise in per capita consumption. Between 1950-51 and 1978-79, per capita consumption has grown by 46%.

POVERTY: The economic development during the last three decades has enabled a perceptive increase in average per capita income from Rs. 466 in 1950-51 to Rs. 730 in 1978-79, both at 1970-71 prices. In spite of this increase, the incidence of poverty in the country is still very high. Nearly 50% of the population has been living below poverty line continuously over a long period. (Poverty line is defined as the mid-point of the monthly per capita expenditure class having a daily calorie intake of 2,400 per person in rural areas and 2,100 in urban areas. In 1979-80 prices, the mid-points are Rs. 76 in rural areas and Rs. 88 in urban areas.)

INDUSTRIES: The progress of industrialization over the last thirty years has been a striking feature of Indian economic development. Industrial production has grown by almost five times during this period. The industrial structure has also been widely diversified covering almost the entire range of consumer, intermediate and capital goods. Impressive as these achievements are, the rate of growth in this sector has not been uniform. After a steady growth of about 8% during the first fourteen years, the fluctuations began: approaching near stagnancy in 1966-68, reaching 9.5% in 1976-77 and dipping to 1.4% in 1979-80.

HEALTH: In spite of several significant achievements, the health care system in the country suffers from some weaknesses and deficiencies. Development to a large extent has been limited co the promotion of curative and clinical services in the urban areas. The infrastructure of sub-centers, primary health centers and rural hospitals reach only a fraction of the rural population. The incidence of Malaria has shown an upward trend, since 1965. Of the estimated 3.2 million Leprosy patients in the country, 20% are infectious and another 20% suffer from various deformities. Nearly 2% of the total population in the country is estimated to suffer from radiologically active lesions and the incidence of TB continues to be high. There are an estimated 9 million blind people in the country. The decline in sex-ratio indicates the need for greater attention to maternal and child health care.

FAMILY PLANNING: The population of the country in 1981 (659 million) represents a growth of 83% over the 1951 population. The growth rate of population was 1.9% during 1978 alone. This incredible addition to the population has been the result of a sharp decline in the death rate coupled with a much slower decline in the birth rate. The prevalent high rate of mortality in general and infant mortality in particular has inhibited the acceptance of family planning. The infant mortality for 1976 was as high as 139 in rural areas, 80 in urban areas and 129 for the country as a whole.

EDUCATION: Despite a network of over 650,000 schools and colleges, the employment of over 3 million teachers and an annual budget of Rs. 3,000 crores, it has not been possible so far for the education system to achieve the goal of universal education of all children up to the age of 14 years, as enshrined in the Directive Principles of the Constitution. For every three children enrolled in primary and middle schools, one other eligible child is left out.

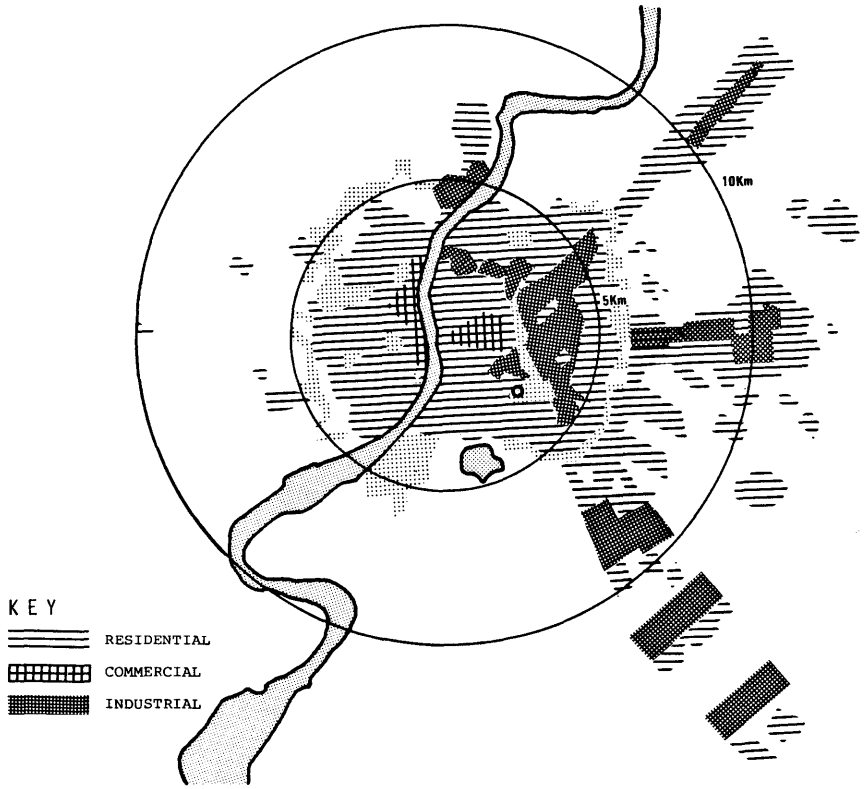
Socio-economic compulsion in families, particularly in rural areas and among the poor; not-too-relevant nature of curricular programs and the lack of essential facilities in schools seem to be even more detrimental than the non-availability of schools.

TRANSPORT: The principal modes of transport in India have been the railways and roads. Passenger traffic by rail increased from 66 billion in 1950-51 to 177 billion passenger km. in 1977-78, and freight traffic from 44 billion to 163 billion tonne km. In the same period, road transport is estimated to have increased from 23 billion to 250 billion passenger km. and freight traffic from 5.5 to 77 billion tonne km. The passenger traffic cleared by airways has grown steadily from 0.3 billion in 1955-56 to 3.4 billion passenger km. in 1977-78.

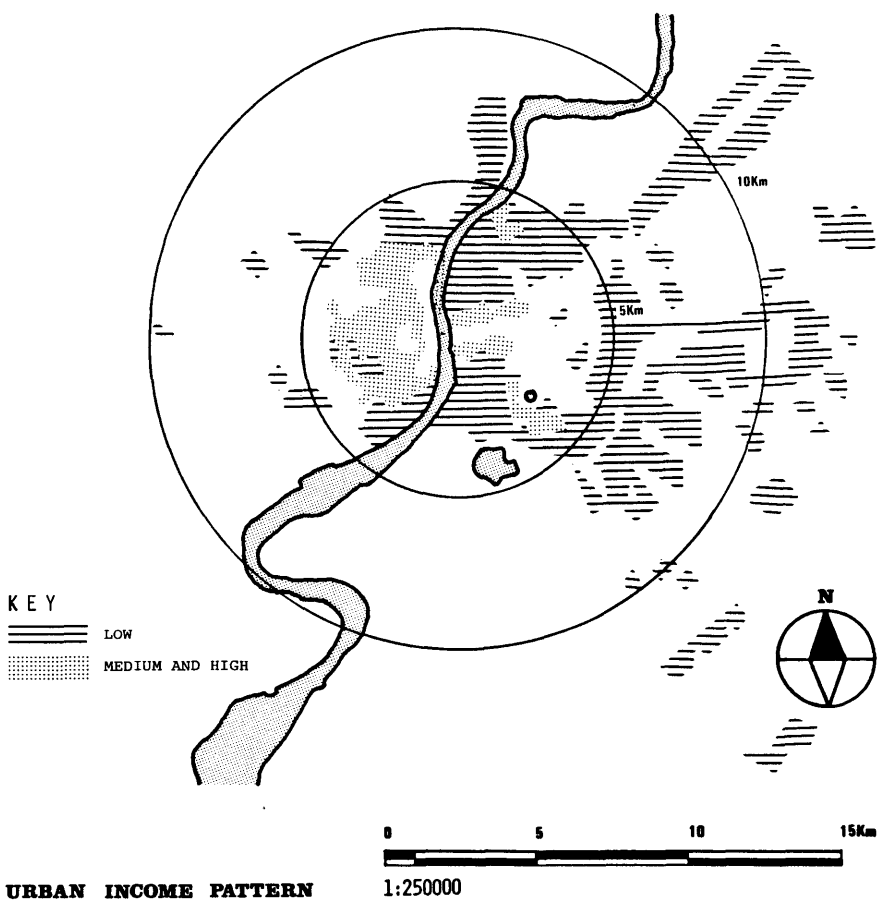
SCIENCE AND TECHNOLOGY: In the last thirty years or so, 119 universities affiliating 1,650 colleges, 5 institutions of technology, 150 engineering colleges, 100 medical colleges and 350 polytechnics have been established; and about 150,000 qualified and technical personnel are produced every year. The total stock of scientific and technically qualified manpower is estimated to be about 2.5 million, ranking India as the third largest compliment of such manpower in the world. The total expenditure on science and technology is now close to 0.6% of the Gross National Product.

CASE STUDIES, URBAN CONTEXT

AHMEDABAD



URBAN LAND USE PATTERN



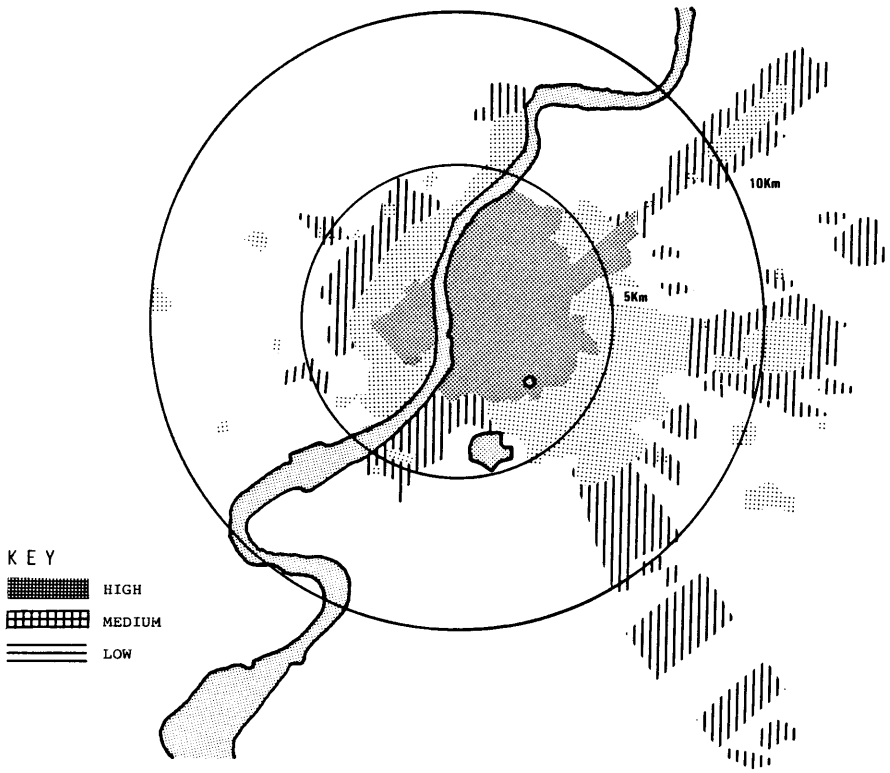
URBAN INCOME PATTERN

All three case studies in this study are from Ahmedabad. Ahmedabad, the biggest city in Gujarat, is located on 23°1' north latitude and 72°37' east longitude, about 600 km north of Bombay. Ahmedabad is the seventh largest city in India with a population of over 2.5 million. The capital of Gujarat was shifted in the early sixty's to Gandhinagar, a newly constructed town at a distance of 24 km from Ahmedabad. The city is well connected by road, rail and air with all the major cities of India.

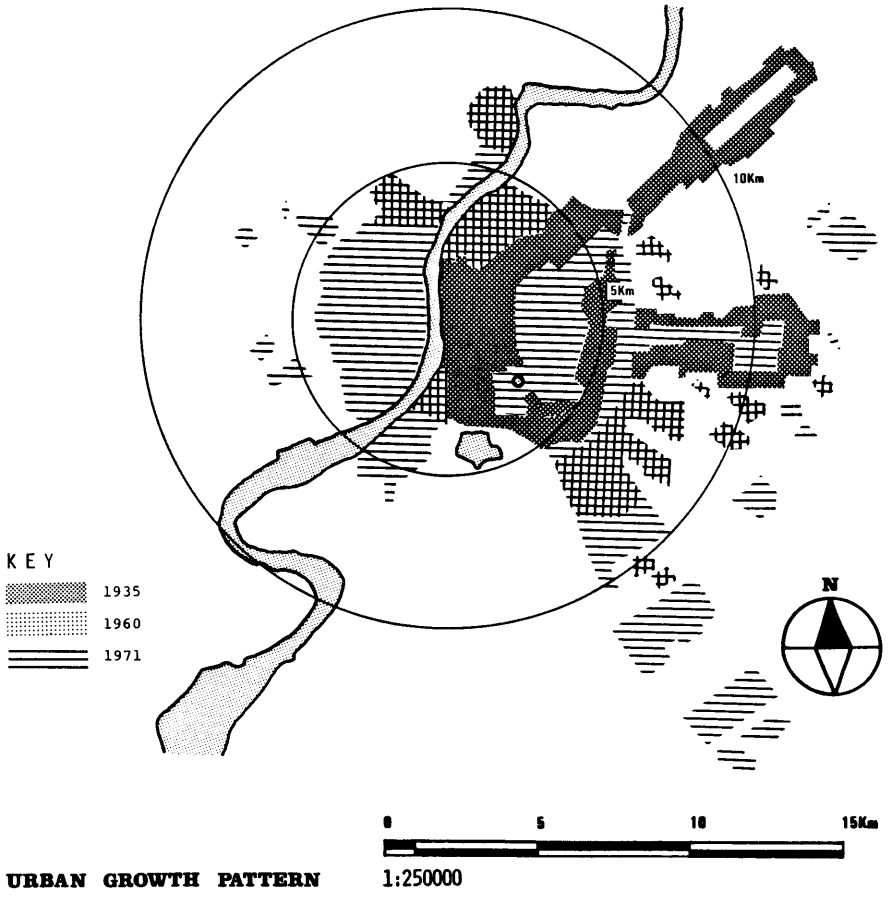
The city covers an area of about 10,000 hectares on plain, dry and sandy region. There are no forests nearby and the sea is about 90 km away. The Sabarmati River bifurcates the city into eastern and western parts. The river is perennial, but dries up in summer and becomes no more than a small stream.

The climate is hot and arid, but for a brief spell of mild monsoons (June-September) and winter (November-February). Mean maximum temperature in summer is about 40°C and the mean minimum in winter is about 11°C. The average annual rainfall is about 900 mm.

Ahmedabad was founded in the vicinity of an old Hindu town "Ashaval", by Ahmedshah in the early 15th century. The city then comprised of a small area, now known as the Bhadra fort. The city was enclosed by a wall containing 12 gates in 1487. Many of these gates and parts of the fort's wall as well, stand today. The city was planned according to Indo-Aryan traditions of a royal capital. After a brief and relatively insignificant interlude of Maratha rule, the administration of the city was taken over by the British in 1818. The British continued their dominance until India's independence in 1947.



URBAN DENSITY PATTERN



URBAN GROWTH PATTERN

Contemporary Ahmedabad is characterized by two important events, the rapid growth of textile industries and the creation of Gujarat as a separate state with Ahmedabad as its capital. These two events together, more or less, governed the growth of Ahmedabad in the last three decades. In the recent past, however, Ahmdedabad has witnessed a decline in the growth of the manufacturing sector and an increase in the trade and commerce sectors. Transport and communication is also gaining importance. Ahmedabad has also attracted in the last few years, a large number of small scale industries.

The population of Ahmedabad has almost tripled in the last three decades. What is interesting, however, is the distribution of population between the walled inner city areas and the peripheral areas. In 1951, 45% of the population lived in the walled inner city areas and in 1971, this population was reduced to 28%. Clearly, the peripheral areas are growing at a much faster rate than the inner city areas.

Density of population is related to two factors: the growth of population and extension of city limits. Density is also governed by other factors like available infrastructure, transportation and perception of security. Limited access to these services and security may well have been responsible for the high density of 22,552 persons/sq. km; as far back as 1881. Population density has been fluctuating; it dipped as low as 9,970 in 1911 and in 1971 was 17,053 persons per sq. km. The average density of population, however, conceals the marked differences between various localities. A locality on the western bank of the river, for example, may have a population density as low as 6,000

persons/sq. km, whereas a locality in the walled inner city may have as high as 100,000 persons/sq. km.

Generally, sex-ratios in urban areas tend to be lower than those in rural areas, as migrants often leave their families behind. How significant this difference will be, depends on the extent and nature of migration, economic activities, political stability and historical background of the city. In 1981, the sex-ratio (number of females per 1,000 males) for Ahmedabad was about 860, as against 844 for the whole state. The sex-ratio for Ahmedabad is lower than those for similar sized cities in India. It is, however, higher than those for Bombay, Calcutta or Delhi. Sex-ratios like density, vary from one locality to another. It tends to be below the city average in industrial areas and more than the city average in the more established inner city localities, and as well as in the relatively higher income west bank settlements.

Ahmedabad, as a premier center of industry and trade, has always attracted migrants, not only from other parts of the state, but from other states as well. Migration to Ahmedabad is neither a negligible nor a recent phenomenon. Nearly half of the city's population is born outside the city.

In 1971, the working age group accounted for about 57% of the total population and the younger age group (0-14 years), for another 36%. The proportion of workers has fallen consistently in the last three decades and in 1971 was 28%; 48% among males and 5% among females. This low participation rate may be a little misleading, for by definition many of the self-employed and almost all those who are engaged in household activities are excluded.

The literacy level is relatively high with about 59% of the population having had some formal education. Hindus representing three quarters of the population constitute the majority religious group. There are followed by Muslims, Jains and Christians.

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PHOTOGRAPH: An aerial view of the city showing one of the very few parks and the Sabarmati River. A section of the more recent west bank developments is seen in the background

GLOSSARY

The criteria for the preparation of the definitions have been as follows:
-FIRST PREFERENCE: definitions from "Webster's Third New International Dictionary", Merriam-Webster, 1971.
-SECOND PREFERENCE: definitions from technical dictionaries, text books, or reference manuals.
-THIRD PREFERENCE: definitions from Urban Settlement Design Program (U.S.D.P.) files. They are used when existing sources were not quite appropriate/satisfactory.
-FOURTH PREFERENCE: definitions by the author. They are used when existing sources did not include some local/colloquial terms.
Words included for specificity and to focus on a particular context are indicated in parentheses.

ACCESSES: The pedestrian/vehicular linkages from/to the site to/from existing or planned approaches (urban streets, limited access highways, public transportation systems, and other systems such as: waterways, airlines, etc.) (U.S.D.P.)

AMENITY: Something that conduces to physical or material comfort or convenience, or which contributes satisfaction rather than money income to its owner. (Merriam-Webster, 1971)

APPROACHES: The main routs external to the site (pedestrian/vehicular) by which the site can be reached from other parts of the urban context. (U.S.D.P.)

BLOCK: A block is a portion of land bounded and served by lines of public access. (U.S.D.P.)

BOUNDARY: Something (a line or area) that fixes or indicates a limit or extent (of the site). (Merriam-Webster, 1971)

BRICK: A molded piece of clay, normally kiln baked (common size in India: 3" brick, 4 1/2" wide and 9" long).

BRICK BAT LIME CONCRETE: A composite mixture consisting of small broken bricks (usually waste), lime, sand, etc. in predetermined proportions. (platforms)

BUILDING CODE: "A body of legislative regulations or by-laws that provide minimum standards to safeguard life or limb, health, property, and public welfare by regulating and controlling the design, construction, quality of materials, use and occupancy, location and maintenance of all buildings and structures within the city, and certain equipment specifically regulated therein." (BOCA, 1967)

CIRCULATION: System(s) of movement/passage of people, goods from place to place; streets, walkways, parking areas. (U.S.D.P.)

CLIMATE: The average condition of the weather at a particular place over a period of years as exhibited by temperature, wind, precipitation, sun energy, humidity, etc. (Merriam-Webster, 1971)

COMMUNITY: The people living in a particular place or region and usually linked by common interests: the region itself; any population cluster. (U.S.D.P.)

COMMUNITY FACILITIES/SERVICES: Facilities/services used in common by a number of people. It may include: schools, health, recreation, police, fire, public transportation, community center, etc. (U.S.D.P.)

COMMUNITY RECREATION FACILITIES: Facilities for activities voluntarily undertaken for pleasure, fun, relaxation, exercise, self-expression, or release from boredom, worry, or tension. (U.S.D.P.)

CONDOMINIUM: Condominium is a system of direct ownership of a single unit in a multi-unit whole. The individual owns the unit in much the same manner as if it were a single family dwelling: he holds direct legal title to the unit and a proportionate interest in the common land areas. Two types of condominiums are recognized: HORIZONTAL: detached, semidetached, row/grouped dwelling types; VERTICAL: walk-up, high-use dwelling types. (U.S.D.P.)

DESIGN: 1) The arrangement of elements that make up a work of art, a machine or other man-made object. 2) The process of selecting the means and contriving the elements, steps, and procedures for producing what will adequately satisfy some need. (Merriam-Webster, 1971)

DETACHED DWELLING: Individual dwelling unit, separated from others. (U.S.D.P.)

DEVELOPMENT: Gradual advance or growth through progressive changes; a developed tract of land. (U.S.D.P.)

DEVELOPMENT SIZE: There are two general ranges of size: LARGE: may be independent communities requiring their own utilities, services and community facilities; SMALL: generally are part of an adjacent urbanization and can use its supporting utilities, services, and community facilities. (U.S.D.P.)

DISTANCE: The degree or amount of separation between two points (the site and each other element of the urban context) measured along the shortest path adjoining them (paths of travel). (Merriam-Webster, 1971)

DRAINAGE: Interception and removal of ground water or surface water, by artificial or natural means. (De Pina, 1972)

DWELLING: The general, global designation of a building/shelter in which people live. A dwelling contains one or more dwelling units. (U.S.D.P.)

DWELLING BUILDER: Four groups are considered: SELF-HELP BUILT: where the dwelling unit is directly built by the user or occupant; ARTISAN BUILT: where the dwelling unit is totally or partially built by a skilled craftsman hired by the user or occupant; payments can be monetary or an exchange of services; SMALL CONTRACTOR BUILT: where the dwelling unit is totally built by a small organization hired by the user, occupant, or developer; 'small' contractor is defined by the scale of operations, financially and materially; the scale being limited to the construction of single dwelling units or single complexes; LARGE CONTRACTOR BUILT: where the dwelling unit is totally built by a large organization hired by a developer; 'large' contractor is defined by the scale of operations, financially and materially; the scale reflects a more comprehensive and larger size of operations encompassing the building of large quantities of similar units, or a singularly large complex. (U.S.D.P.)

DWELLING DEVELOPER: Three sectors are combined in the supply of dwellings: POPULAR SECTOR: the marginal sector with limited or no access to the formal financial, administrative, legal, technical institutions involved in the provision of dwellings. The housing process (promotion, financing, construction, operation) is carried out by the Popular Sector generally for 'self use' and sometimes for profit. PUBLIC SECTOR: the government or non-profit organizations involved in the provision of dwellings. The housing process (promotion, financing, operation) is carried out by the Public Sector for service (non-profit or subsidized housing). PRIVATE SECTOR: the individuals, groups or societies, who have access to the formal financial, administrative, legal, technical institutions in the provision of dwellings. The housing process (promotion, financing, construction, operation) is carried out by the Private Sector for profit. (U.S.D.P.)

DWELLING DEVELOPMENT MODE: Two modes are considered: PROGRESSIVE: the construction of the dwelling and the development of the local infrastructure to modern standards by stages, often starting with provisional structures and underdeveloped land. This essentially traditional procedure is generally practiced by squatters with de facto security of tenure and an adequate building site. INSTANT: the formal development procedure in which all structures and services are completed before occupation. (U.S.D.P.)

DWELLING FLOORS: The following numbers are considered: ONE: single story; generally associated with detached, semidetached and row/group dwelling types. TWO: double story; generally associated with detached, semidetached and row/group dwelling types. THREE OR MORE: generally associated with walk-up and high-rise dwelling types. (U.S.D.P.)

DWELLING LOCATION: Three sectors are considered in single or multi-center urban areas. Sectors are identified by position as well as by the density of buildings as follows: CENTER: the area recognized as the business center of the city, generally the most densely built-up sector; INNER RING: the area located between the city center and the urban periphery, generally a densely built-up sector; PERIPHERY: the area located between the inner ring and the rural areas, generally a scatteredly built-up sector. (U.S.D.P.)

DWELLING PHYSICAL STATE: A qualitative evaluation of the physical condition of the dwelling types: room, apartment, house; the shanty unit is not evaluated. BAD: generally poor state of structural stability, weather protection and maintenance. FAIR: generally acceptable state of structural stability, weather protection and maintenance with some deviation. GOOD: generally acceptable state of structureal stability, weather protection and maintenance without deviation. (U.S.D.P.)

DWELLING TYPE: The physical arrangement of the dwelling unit: DETACHED: individual dwelling unit, separated from others. SEMI-DETACHED: two dwelling units sharing a common wall (duplex). ROW/GROUPED: dwelling units grouped together linearly or in clusters. WALK-UP: dwelling units grouped in two to five stories with stairs for vertical circulation. HIGH-RISE: dwelling units grouped in five or more stories with stairs and lifts for vertical circulation. (U.S.D.P.)

DWELLING UNIT: A self-contained unit in a dwelling for an individual, family, or a group. (U.S.D.P.)

DWELLING UNIT AREA: The dwelling unit area (m^2) is the built-up, covered area of a dwelling unit. (U.S.D.P.)

DWELLING UNIT COST: The initial amount of money paid for the dwelling unit or the present monetary equivalent for replacing the dwelling unit. (U.S.D.P.)

DWELLING UNIT TYPE: Four types of dwelling units are considered: ROOM: A SINGLE SPACE usually bounded by partitions and specifically used for living; for example, a living room, a dining room, a bedroom, but not a bath/toilet, kitchen, laundry, or storage room. SEVERAL ROOM UNITS are contained in a building/shelter and share the use of the parcel of land on which they are built (open spaces) as well as common facilities (circulation, toilets, kitchens). APARTMENT: A MULTIPLE SPACE (room/set of rooms with bath, kitchen, etc.) SEVERAL APARTMENT UNITS are contained in a building and share the use of the parcel of land on which they are built (open spaces) as well as some common facilities (circulation). HOUSE: A MULTIPLE SPACE (room/set of rooms with or without bath, kitchen, etc.) ONE HOUSE UNIT is contained in a building/shelter and has the private use of the parcel of land on which it is built (open spaces) as well as the facilities available. SHANTY: A SINGLE OR MULTIPLE SPACE (small, crudely built). ONE SHANTY UNIT is contained in a shelter and shares with other shanties the use of the parcel of land on which they are built (open spaces.) (U.S.D.P.)

DWELLING UTILIZATION: The utilization indicates the type of use with respect to the number ov inhabitants/families. SINGLE: an individual or family inhabiting a dwelling. MULTIPLE: a group of individuals or families inhabiting a dwelling. (U.S.D.P.)

EASEMENT: Servitude: a right in respect of an object (as land owned by one person) in virtue of which the object (land) is subject to a specified use or enjoyment by another person or for the benefit of another thing. (Merriam-Webster, 1971)

EFFICIENCY: Capacity to produce desired results with a minimum expenditure of energy, time, money or materials. (Merriam-Webster, 1971)

ELECTRICAL NETWORK COMPONENTS: It is composed of the following: GENERATION: produces electricity; TRANSMISSION: transports energy to user groups; DISTRIBUTION STATION: divides power among main user groups; SUBSTATION: manipulates power into useful energy levels for consumption; DISTRIBUTION NETWORKS: provides electric service to user. (U.S.D.P.)

EXISTING STRUCTURE: Something constructed or built (on the site). (U.S.D.P.)

EXTERIOR CIRCULATION/ACCESSES (SITE PLANNING): The existing and proposed circulation system/accesses outside but affecting the site. These include limited access highways as well as meshing access to the surrounding area. Exterior circulation/accesses are generally given conditions. (U.S.D.P.)

FINANCING: The process of raising or providing funds. SELF FINANCED: provided by own funds; PRIVATE/PUBLIC FINANCED: provided by loan; PUBLIC SUBSIDIZED: provided by grant or aid. (U.S.D.P.)

FIRE/EXPLOSION HAZARDS: Danger: the state of being exposed to harm; liable to injury, pain, or loss from fire/explosion (at or near the site). (Merriam-Webster, 1971)

FLOODING: A rising and overflowing of a body of water that covers land not usually under water. (U.S.D.P.)

FLUSH TANK TOILET: Toilet with storage tank of water used for flushing bowl. (U.S.D.P.)

GRID BLOCKS: The block determined by a convenient public circulation and not by dimensions of lots. In grid blocks some lots have indirect access to public streets. (U.S.D.P.)

GRIDIRON BLOCKS: The blocks determined by the dimensions of the lots. In gridiron blocks all the lots have direct access to public streets. (U.S.D.P.)

GRID LAYOUTS: The urban layouts with grid blocks. (U.S.D.P.)

GRIDIRON LAYOUTS: The urban layouts with gridiron blocks. (U.S.D.P.)

GOVERNMENT/MUNICIPAL REGULATIONS: In urban areas, the development of the physical environment is a process usually controlled by a government/municipality through all or some of the following regulations: Master Plan, Zoning Ordinance, Subdivision Regulations, Building Code. (U.S.D.P.)

HEAD: (Static), the height of water above any plane or point of reference. Head in feet = (lb/sq in X 144)/(Density in lb/cu. ft.). For water at 68°F. (DePina, 1972)

HIGH-RISE: Dwelling units grouped in five or more stories with stairs and lifts for vertical circulation. (U.S.D.P.)

ILLEGAL: That which is contrary to or violating a rule or regulation or something having the force of law. (Merriam-Webster, 1971)

INDIAN PATENT STONE: A cement based hard floor finish either cast-in-situ or precast and fixed in place. (Circulation)

INFRASTRUCTURE: The underlying foundation or basic water network; storm drainage, electrical network; gas network, telephone network, public transportation; refuse collection, health, schools, playgrounds, parks, open spaces. (U.S.D.P.)

LAMP: Electric light bulb. (Street Lighting)

LAND COST: Price: the amount of money given or set as the amount to be given as a consideration for the sale of a specific thing (the site). (Merriam-Webster, 1971)

LAND DEVELOPMENT COSTS: The costs of making raw land ready for development through the provision of utilities, services, accesses, etc. (U.S.D.P.)

LAND OWNERSHIP: The exclusive right of control and possession of a parcel of land. (U.S.D.P.)

LAND SUBDIVISION: The division of the land in blocks, lots and laying out streets. (U.S.D.P.

LAND UTILIZATION: A qualification of the land around a dwelling in relation to user, physical controls and responsibility. PUBLIC (streets, walkways, open spaces): user - anyone/unlimited; physical controls - minimum; responsibility; - public sector. SEMIPUBLIC (open spaces, playgrounds, schools): user - limited group of people; physical controls - partial or complete; responsibility - public land utilization, residential, circulation, public facilities, etc. NET DENSITY: includes only the residential land and does not include land for other uses. (U.S.D.P.)

POSITION: The point or area in space actually occupied by a physical object. (the site) (Merriam-Webster, 1971)

LOCALITY: A relatively self-contained residential area/community/neighborhood/ settlement within an urban area which may contain one or more dwelling/land systems. (U.S.D.P.)

LOCALITY SEGMENT: A 400m X 400m area taken from and representing the residential character and layout of a locality. (U.S.D.P.)

LOCATION: Situation: the way in which something (the site) is placed in relation to its surroundings (the urban context). (Merriam-Webster, 1971)

LOT: A measured parcel of land having fixed boundaries and access to public circulation. (U.S.D.P.)

LOT CLUSTER: A group of lots (owned individually) around a semipublic common court (owned in condominium). (U.S.D.P.)

LOT PROPORTION: The ratio of lot width to lot depth. (U.S.D.P.)

MANHOLE: An access hole sized for a man to enter, particularly in sewer and storm drainage pipe systems for cleaning, maintenance and inspection. (U.S.D.P.)

MODE OF TRAVEL: Manner of moving from one place (the site) to another (other parts of the urban context). (U.S.D.P.)

NEIGHBORHOOD: A section lived in by neighbors and having distinguishing characteristics. (U.S.D.P.)

NETWORK EFFICIENCY (LAYOUT EFFICIENCY): The ratio of the length of the network to the area(s) contained within; or tangent to it. (U.S.D.P.)

OPTIMIZE/OPTIMALIZE: To bring to a peak of economic efficiency, specially by the use of precise analytical methods. (Merriam-Webster, 1971)

PLANNING: The establishment of goals, policies, and procedures for a social or economic unit, i.e., city. (U.S.D.P.)

PLOT/LOT: A measured parcel of land having fixed boundaries and access to public circulation. (U.S.D.P.)

POLE: A long and comparatively slender piece of wood or metal to hold lamps.

POPULATION DENSITY: It is the ratio between the population of a given area and the area. It is expressed in people per hectare. It can be: GROSS DENSITY: includes any kind of sector and user. PRIVATE (dwellings, lots): user - owner or tenant or squatter; physical controls - complete; responsibility - user. SEMIPRIVATE (cluster courts): user - group of owners and/or tenants; physical controls - partial or complete; responsibility - user. (U.S.D.P.)

LAND UTILIZATION: RESPONSIBILITY. The quality/state of being morally/legally responsible for the use and maintenance of land by the owners/users. (U.S.D.P.)

LAYOUT: The plan or design or arrangement of something that is laid out. (Merriam-Webster, 1971)

PROJECT: A plan undertaken; a specific plan or design. (U.S.D.P.)

PUBLIC CIRCULATION: The circulation network which is owned, controlled, and maintained by public agencies and is accessible to all members of a community. (U.S.D.P.)

PUBLIC FACILITIES: Facilities such as schools, playgrounds, parks, other facilities accessible to all members of a community which are owned, controlled, and maintained by public agencies. (U.S.D.P.)

PUBLIC SERVICES AND COMMUNITY FACILITIES: Includes: public transportation, police protection, fire protection, refuse collection, health, schools, and playgrounds, recreation and open spaces, other community facilities, business, commercial, small industries, markets. (U.S.D.P.)

PUBLIC UTILITIES: Includes: water supply, sanitary sewerage, storm drainage, electricity, street lighting, telephone, circulation networks. (U.S.D.P.)

REFUSE COLLECTION: The service for collection and disposal of all the solid wastes from a community. (U.S.D.P.)

RESIDENTIAL AREA: An area containing the basic needs/requirements for daily life activities: housing, education, recreation, shopping, work. (U.S.D.P.)

ROUGH KOTAH STONE: A hard stone, usually about 1" - 1 1/2" thick used for flooring.

ROW/GROUPED HOUSING: Dwelling units grouped together linearly or in clusters. (U.S.D.P.)

SAND: Loose, distinguishable grains of quartz/feldspar, mica (ranging from 2mm to 0.02mm in diameter.) (U.S.D.P.)

SEMI-DETACHED DWELLING: Two dwelling units sharing a common wall (duplex). (U.S.D.P.)

SETTLEMENT: Occupation by settlers to establish a residence or colony. (U.S.D.P.)

SEWAGE: The effluent in a sewer network. (U.S.D.P.)

SIZE: Physical magnitude or extent (of the site), relative or proportionate dimensions (of the site). (Merriam-Webster, 1971)

SLOPE: Degree or extent of deviation (of the land surface) from the horizontal. (Merriam-Webster, 1971)

STANDARD: 1) Something that is established by authority, custom or general consent as a model or example to be followed. 2) Something that is set up and established by authority as a rule for the measure of quantity, weight, extent, value or quality. (Merriam-Webster, 1971)

STORM DRAINAGE: Storm sewer: a sewer (system) designed to carry water wastes except sewage (exclusively storm water, surface runoff, or street wash). (Merriam-Webster, 1971)

STREET LIGHTING: Illumination to improve vision at night for security and for the extension of activities. (U.S.D.P.)

TENURE: Two situations of tenure of the dwelling units and/or the lot/land are considered: LEGAL: having formal status derived from law; EXTRALEGAL: not regulated or sanctioned by law. Four types of tenure are considered: RENTAL: where the users pay a fee (daily, weekly, monthly) for the use of the dwelling unit and/or the lot/land; LEASE: where the users pay a fee for long-term use (generally for a year) for a dwelling unit and/or the lot/land from the owner (an individual, a public agency, or a private organization); OWNERSHIP: where the users hold in freehold the dwelling unit and/or the lot/land which the unit occupies; EMPLOYER-PROVIDED: where the users are provided a dwelling unit by an employer in exchange for services, i.e., domestic live-in servant. (U.S.D.P.)

TOILET: A fixture for defecation and urination, esp. water closet. (7th Collegiate Webster, 1963)

TOPOGRAPHY: The configuration of a (land) surface including its relief and the position of its natural and man-made features. (Merriam-Webster, 1971)

TRANSPORTATION: Means of conveyance or travel from one place (the site) to another (other parts of the urban context). (Merriam-Webster, 1971)

TRAP: A fitting that provides a water seal to prevent sewer gases and odors being discharged through fixtures. (ROTC ST 45-7, 1953)

UNIT: A determinate quantity adopted as a standard of measurement for other quantities of the same kind. (Merriam-Webster, 1971)

URBANIZATION: The quality or state of being or becoming urbanized; to cause to take on urban characteristics. (U.S.D.P.)

UTILITIES: Include: water supply, sanitary sewerage, storm drainage, electricity, street lighting, gas, telephone. (U.S.D.P.)

UTILITY/SERVICE: The organization and/or infrastructure for meeting the general need (as for water supply, wastewater removal, electricity, etc.) in the public interest. (U.S.D.P.)

VALVE: A water supply distribution component which interrupts the supply for maintenance purposes. (U.S.D.P.)

WATER SUPPLY: Source, means or process of supplying water, (as for a community) usually involving reservoirs, pipelines, and often the watershed from which the water is ultimately drawn. (Merriam-Webster, 1971)

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EXPLANATORY NOTES

QUALITY OF INFORMATION

The quality of information given in drawings, charts and descriptions has been qualified in the following manner:

Approximate	:when deducted from different and/or not completely reliable sources.
Accurate	:when taken from reliable or actual sources.
Tentative	:when based upon rough estimations of limited sources.

QUALITY OF SERVICES, FACILITIES AND UTILITIES

None	:when the existence of services, facilities and utilities are unavailable to a locality.
Limited	:when the existence of services, facilities and utilities are available to a locality in a limited manner due to proximity.
Adequate	:when the existence of services, facilities and utilities are available to a locality.

METRIC SYSTEM EQUIVALENTS

Linear Measures

1 centimeter		= 0.3937 inches
1 meter	= 100 centimeters	= 39.37 inches or 3.28 feet
1 kilometer	= 1,000 meters	= 3,280.83 feet or 0.62137 miles
1 inch		= 2.54 centimeters
1 foot		= 0.3048 meters
1 mile		= 1.60935 kilometers

Square Measures

1 square meter		= 1,550 square inches or 10.7649 square feet
1 hectare	= 10,000 square meters	= 2.4711 acres
1 square foot		= 0.0929 square meters
1 acre		= 0.4087 hectares