VI. CASE STUDIES

This chapter describes the implementation of shallow sewer networks in human settlements under three different sets of physical and social conditions. All three case studies, however, relate to low-income settlements. The first two case studies are derived from experience in the implementation of the system in spontaneous and planned low-income housing areas in the north-east of Brazil. The third case study is derived from the extension of the shallow sewer technology to a low-income squatter settlement in Karachi, Pakistan. Water availability and usage patterns and the social and cultural patterns observed in the Brazilian and Pakistani case studies differ considerably, and the successful utilization of the technology under these contrasting conditions appears to endorse its almost universal applicability. The technology has, however, still to be tried out in cultures where the use of bulky anal cleansing materials is common.

A. Rocas and Santos Reis, Natal, Brazil (Two spontaneous squatter settlements) 26/, 39/, 42/, 47/

Shallow sewerage was first developed in the city of Natal, the capital of the north-eastern Brazilian State of Rio Grande do Norte, by the Sanitation Research Unit of the State Water and Sewerage Company (CAERN). Rocas and Santos Reis are two neighbouring squatter settlements situated in Natal, and approximately 15,000 people were settled in these areas which had an overall population density of 350 persons per hectare. The settlements resulted from spontaneous development activities and, hence, possess only vestiges of intentional planning.

The 3100 houses and buildings in the area were distributed over 86 blocks. Over half the houses were located on plot sizes less than 80 m² and had constructed areas less than 60 m²; they were therefore contiguous on at least one side with neighbouring properties with little or no lateral space. Some space was usually available at the back of the house for a small garden. Levels of income were noted to be exceptionally low with two thirds of the population earning subsistence wages below the country's poverty line.

Although levels of income were exceptionally low, the issuance of land titles to the dwellers had, over the years, encouraged the use of good quality material in construction throughout most of the two areas. A yard tap level of water supply was available in the area, and a minimum water tariff was applied to a majority of the premises by virtue of their small plot sizes. A quarter of the houses were not connected to any water-supply service, and these shared supplies with their neighbours. Most houses had a conventional but manually-flushed ceramic toilet bowl which was connected to leachpits constructed within the plot area; sullage was discharged into the street in front. The high density of the settlement and the need for frequent leachpit desludging created a sense of dissatisfaction with the system in the community.

Although CAERN had a plan to serve the area with conventional sewers, it was evident that such a proposal would prove neither technically nor economically feasible under the conditions in which it was intended to be applied, and hence would only yield a small proportion of house connections. The technical feasibility of

conventional sewerage was impaired by the need for deep excavation in an area of precarious, dense housing, and the cost of a conventional sewerage service was far beyond the community's means to pay. The CAERN research unit developed the concept of shallow sewerage as being the only way in which sewers could be financially feasible and could serve a large proportion of the community. A high rate of house connections was necessary in order to ensure that the sanitary intervention would have the maximum impact on the health of the community and that the cost of the intervention would be minimized.

Meetings were held with the community to discuss the problem of sanitation in the area and the advantages and disadvantages of various sanitation systems, including conventional and shallow sewerage. It was evident that the community held certain reservations about the trouble-free operation of the shallow sewer system, the feasibility of passing sewers through private properties and the maintenance implications. One pilot block, consisting of 28 houses, was mobilized, and plans for laying block sewers were prepared. Each householder consented to the construction of a common house connection - the block sewer - in his/her backyard and agreed to be responsible for the maintenance of the length of sewer laid within the property; a simple inspection chamber was built at each connection for this purpose. The sewage was treated in a communal septic tank and infiltrated into trenches designed for this purpose in a nearby open field.

The pilot block sewer was constructed and operated for over a year while planning of other block and street sewers proceeded. Then block meetings were arranged for the remaining 85 blocks, and residents in these blocks were encouraged to visit the pilot block and to talk to the people living there to obtain their views on the system. This led to spontaneous acceptance of the system and a great demand to extend it to the remaining blocks. The community collaborated with the research unit by providing access to their houses for purposes of executing the necessary surveys and, subsequently, for the construction of the block sewers and house connections. The community assumed responsibility for maintaining the block sewers, as in the case of the pilot block sewer, while CAERN is responsible for maintaining the street sewers. The lengths of both the house connections and street sewers were reduced considerably by virtue of the fact that common block sewers were installed. A layout of the shallow sewer network adopted for Rocas and Santos Reis is shown in figure 11.

An unprecedented connection rate of 97 per cent was achieved in the year of construction. Small subcontractors were used to construct the block sewers, while the street sewers were constructed by large contractors. Efforts were made to employ local labour in construction. Water closet and sullage house connections (including a grit/grease chamber), block and street sewers and one pumping station and rising main were provided.

The total capital cost of the systems in Rocas and Santos Reis was $325 per household, and full cost recovery is being achieved by a surcharge on the water bill of only 40 per cent. The surcharge for conventional sewerage is 100 per cent on a much higher water bill and, even then, it often entails some form of subsidy. Most of the households in Rocas and Santos Reis are unmetered and pay only the minimum tariff. The system has operated satisfactorily for over five years, and a study of the total annual cost per household of various sanitation options for settlements of different population densities

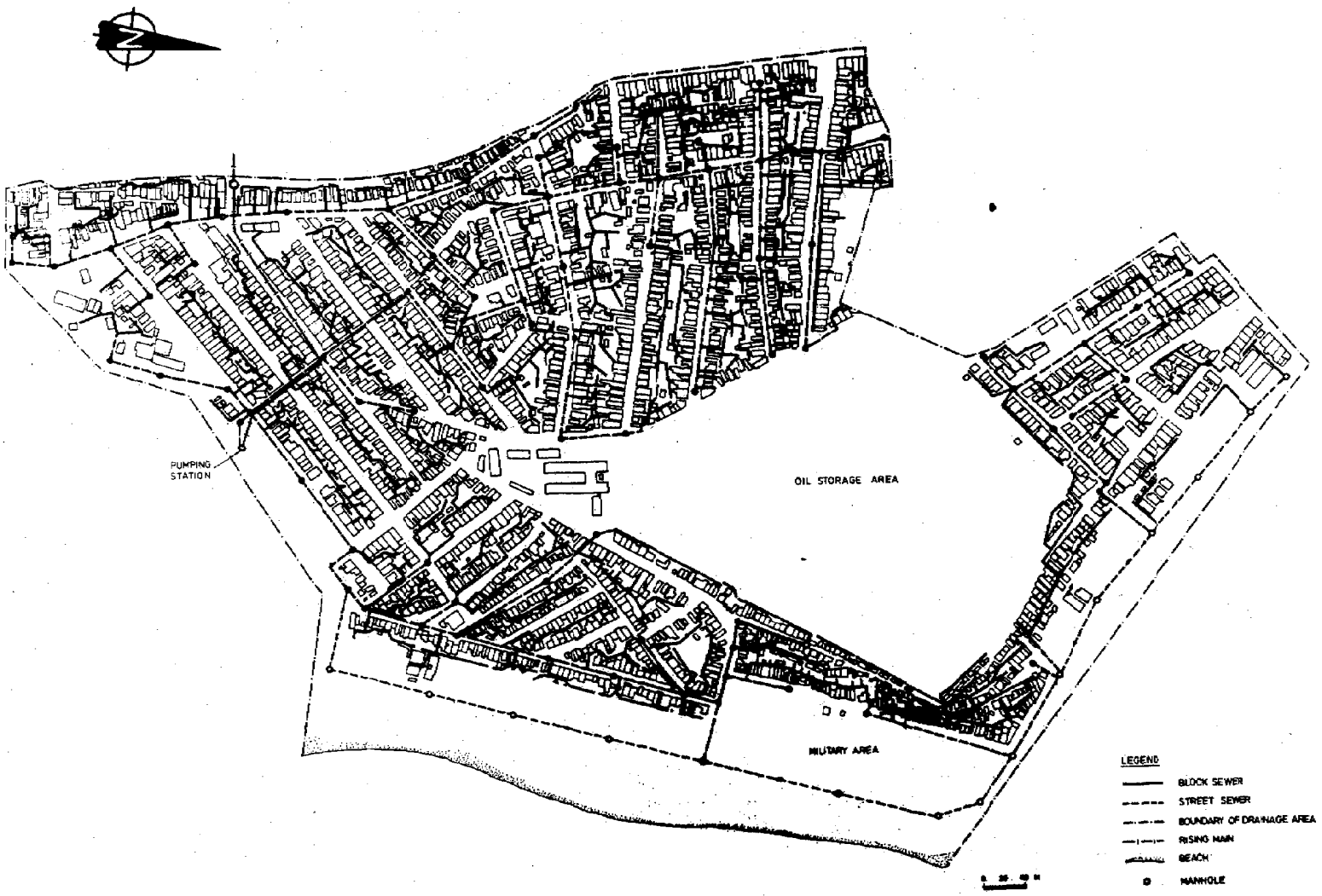

Figure 11. Shallow sewerage layout for the spontaneous settlements of Rocas and Santos Reis, Natal, Brazil

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Source: Companhia de Aguas e Esgotos do Rio Grande do Norte (CAERN), Projecto dos Sistemas de Esgotos Sanitarios da Cidade do Natal

found that shallow sewers were cheaper than even on-site sanitation systems at densities in excess of 160 persons per hectare (see figure 5. Changes in conventional approaches in executing the system to accommodate community participation in planning and maintenance work, and in adjusting tariffs to take account of the low investment costs, were successfully introduced by CAERN. The Sanitation Research Unit established by CAERN developed the methodology used and justified the changes in tariff structure introduced for the new system. Evaluations of the system undertaken at frequent intervals during the past five years have detected a gradual process of upgrading of plumbing installations through the provision of kitchen sinks, laundry sinks, showers etc. No problems have been observed, and information transferred during construction to the community in relation to maintaining the block sewers has proved adequate to ensure a high level of self-help maintenance. Blockages in block sewers have proved to be rare and, whenever these have occurred, they have been effectively removed by members of the community themselves.

Within five years, the shallow sewer system had spread to various towns within Rio Grande do Norte and was being implemented in all low-income housing schemes in Rio Grande do Norte without exception. During this period, it also spread to other states such as Pernambuco, Rio de Janeiro, Minas Gerais and Sergipe. 47/48/ The concept of a common house connection through the use of shallow block sewers is now being extended to the supply of water in order that the same basic unit of social mobilization - the block - can be used to supply water through a single meter for subsequent assessment of water and sewage tariffs amongst the householders connected to a common water meter and sewage house connection. Supplying, maintaining and reading water meters have been problem in developing countries, and the reduced number of meters achieved by adopting block meters, as opposed to individual household meters, creates considerable savings.

B. Planned low-income housing schemes in the State of Rio Grande do Norte, Brazil. 6/,38/,39/,41/,43/,44/,45/,46/

Concomitant with the development of the shallow sewer system in the unplanned, spontaneous squatter settlements of Rocas and Santos Reis in 1981, the concept was also extended to a low-income housing scheme in Santa Cruz, a city in the interior of the State of Rio Grande do Norte.6/ Eight hundred low-cost houses were built with an average gross population density of 110 persons per hectare, the houses intended for one of the poorest groups in Santa Cruz's community who had been made homeless during a flood earlier in the year. The houses were constructed to standard designs and were provided with in-house water connections and a pour-flush ceramic toilet bowl, a bathing area, and kitchen and clothes washing sinks. The kitchen and clothes-washing sinks were connected to a grit/grease trap and discharged to shallow sewers. Shallow sewers were laid through the back gardens and connected to a sparsely distributed street-collector sewer network which was laid in sidewalks to enable it to maintain its shallow depth. The topography of the project area was such that it covered parts of three separate drainage basins, and the sewage drained from each basin was connected to a different treatment works, consisting of a combination of anaerobic and facultative pond, a communal septic tank and a facultative pond, and also direct discharge to a facultative pond. The treated effluents were used for irrigating fodder crops.