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**THE DESIGN OF SHALLOW SEWER SYSTEMS**

United Nations Centre for Human Settlements (Habitat)

Nairobi 1986

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## FOREWORD

The importance of providing safe and adequate water supply and sanitation has gained increasing international attention over the last two decades. The concern of national and international organizations with the gross shortfall in the delivery of basic services, especially to the low-income urban and rural poor, was expressed at Habitat: United Nations Conference on Human Settlements, held at Vancouver, Canada, in 1976. Subsequently, the United Nations Water Conference, held at Mar del Plata, Argentina, in 1977, recommended that the period 1981-1990 be designated International Drinking Water Supply and Sanitation Decade. The Decade was launched by the General Assembly on 10 November 1980 at a one-day special meeting during its thirty-fifth session. In its resolution 35/18 of 10 November 1980, the General Assembly stated that during the Decade, Member States would assume a commitment to bring about a substantial improvement in the standards and levels of services in drinking water supply and sanitation by the year 1990. The United Nations Centre for Human Settlements (Habitat) is actively collaborating with other United Nations agencies in assisting national governments to achieve the objectives of the decade. UNCHS (Habitat) was directed by the Commission on Human Settlements, in its resolution 4/16 of 6 May 1986, to embark on a work programme to assist developing countries in the provision of adequate infrastructure in low-income communities. The work programme defines a role for UNCHS (Habitat) which would complement the activities of other United Nations agencies and take advantage of the particular strengths of UNCHS (Habitat) in information transfer, training and demonstration projects.

The effects and initiatives of many international agencies, in particular the World Bank, has led to the identification of a number of technologies for sanitation which are less costly than waterborne sewerage, yet able to provide the same health benefits and be both socially and environmentally acceptable to the users. A majority of these technologies rely on the on-site disposal of human wastes. Space for such disposal facilities is usually available in rural and low-density to middle-density urban areas. Their use in high-density urban areas, which are being increasingly supplied with water-distribution services, is limited. Unfortunately, the bulk of slum and squatter-settlement housing in the cities of developing countries is high-density and very few options are available for providing low-cost waste disposal facilities to these communities. Recently, however, the shallow sewer system of sanitation has emerged as a result of adapting design standards to suit the physical conditions of a majority of these low-income settlements and taking advantage of advances in knowledge on the mode of operation of sewer systems.

This technical manual sets out criteria, standards and procedures for designing and constructing shallow sewer systems. They are compared with other sanitation technologies, and the conditions under which they are considered to be particularly advantageous to low-income communities are established. Strategies for implementing shallow sewer systems, so as to promote the technology and provide a basis for comparing the cost of different sanitation technologies, are presented, together with methods of determining community affordability. Case studies of successfully implemented shallow sewer systems, including one executed by UNCHS (Habitat), are also considered. Finally, the manual presents a shallow sewer design example.

The manual is specifically designed to demonstrate technology that lends itself to application in low-income settlements and presents some novel approaches and institutional changes which have yielded positive results in the continued bid to narrow the deficit in the provision of urban services to poor communities. For these reasons, the manual has a special significance for the efforts of the International Year of Shelter for the Homeless (IYSH) which, amongst its various objectives, seeks to provide basic services to deprived communities. The programme, scheduled for 1987, recognizes the importance of the role that basic infrastructure can play in assisting the millions of poor all over the world to build and improve their shelter and neighbourhoods and, by so doing, to integrate them in the process of economic development.



Dr. Arcot Ramachandran  
Under-Secretary-General  
Executive Director

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## INTRODUCTION

### A. Background

The Commission on Human Settlements at its fourth session in 1981 requested the United Nations Centre for Human Settlements (Habitat) to implement the following activities for the provision of infrastructure in slums and squatter-settlement areas and in rural settlements:

(a) To continue the Centre's work on research and development in the field of human settlements infrastructure;

(b) To co-operate with other United Nations agencies and thereby make a significant contribution to the International Drinking Water Supply and Sanitation Decade;

(c) To execute demonstration projects integrating the provision of infrastructure with other aspects of community development;

(d) To promote the development, and the evaluation of appropriate materials, equipment, techniques, standards and training manuals related to the provision of infrastructure affordable for low-income groups, with special emphasis on alternative sanitation solutions;

(e) To communicate the experience acquired to developing countries and to make use of the Centre's considerable expertise in the collection and transfer of information and in the provision of training assistance.

UNCHS (Habitat) has, since 1981, been engaged in executing the above mandate. Through reports, such as the present document, it communicates the experience gained through these activities. This document presents an example of its work in identifying and promoting an innovative sanitation technology especially suited to the requirements of high-density, low-income settlements in developing countries.

### B. The problem of sanitation as it relates to human settlements in developing regions

In 1983, the World Health Organization <sup>1/</sup> estimated that, of the 2,552 million people who live in the four developing regions of Africa, Asia and the Pacific (excluding China), Latin America and Western Asia, less than a third had access to adequate sanitation. Urban areas are usually better endowed with sanitation than rural areas. An estimated 59 per cent of the total urban population in developing countries has adequate sanitation services while only 12 per cent of the rural people are so served. Where deficiencies have occurred in urban areas, these have traditionally been in low-income communities. Approximately 60 per cent of the population of Latin America is now urbanized, yet urban growth rates are expected to remain high until the end of the century. Slums and squatter settlements which house a majority of low-income urban people, form 30 per cent of Rio de Janeiro, 50 per cent of Recife, 60 per cent of Bogota, 72 per cent of Santo Domingo and 46 per cent of Mexico City. Sanitation coverage in these deprived urban areas is often no better than in the rural areas.

With only about a quarter of Africa's population living in urban areas, the continent is now experiencing the highest urban growth rate in the world - some 5 per cent per annum. Slums and squatter settlements accommodate 90 per cent of the population of Addis Ababa, 61 per cent of Accra, 33 per cent of Nairobi and 50 per cent of Monrovia.

East Asia, now nearly 30 per cent urbanized, can expect an urban growth rate of 3.7 per cent per annum in the present decade. South Asia, with more than three quarters of its population still in rural areas, has yet to experience the peak of its urban growth which is expected to be around 4.3 per cent annually during the next 15 years. Slums and squatter settlements account for 29 per cent of Seoul, 31 per cent of Pusan, 67 per cent of Calcutta, 45 per cent of Bombay, 40 per cent of Karachi and 60 per cent of Ankara. 2/

Within each of these regions, there are countries that experience annual urban growth rates of more than 6 per cent. If such growth continues a doubling of urban populations every 12 years or sooner will be experienced. Although urban areas are growing very quickly in nearly all developing countries, the slums and squatter settlements, which will accommodate the greatest proportion of the additional population are growing even faster. Estimates range from 6 to 12 per cent annually. Effective and affordable means of providing sanitation to these areas require urgent consideration.

In most developing regions of the world, rural people traditionally use the field or the bush for defecation. Rural settlements especially scattered communities, do not have the aesthetic incentive to demand sanitation and rely instead on the natural assimilative capacity of the surrounding countryside to serve their needs. While this practice is not recommended from the viewpoint of public health, it has less serious implications in these rural areas than in urban areas where large numbers of people are settled in a small space. Inadequate disposal of excreta is perhaps the single most important factor in the transmission of serious diseases causing both disability and death in these areas. It is in urban slums and squatter settlements that the lack of sanitation coupled with very high population densities, poses the severest problems of intra-community contamination and disease.

Urban slums are usually old, well established areas located near the centres of large cities, although recently, slum areas can also be found on the urban periphery where settlements have been developed for low-income workers. Slums are characterized by very high population densities: for example, in Delhi the average density of

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