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EVALUATION OF THE THIRD HOUSING GUARANTY PROJECT IN THE IVORY COAST

WASH FIELD REPORT NO. 113

FEBRUARY 1984

The WASH Project is managed by Camp Dresser & McKee Incorporated. Principal Cooperating Institutions and subcontractors are: International Science and Technology Institute; Research Triangle Institute; University of North Carolina at Chapel Hill; Georgia Institute of Technology—Engineering Experiment Station.

Prepared for:
**USAID Regional Housing
and Urban Development Office in Abidjan
Order of Technical Direction No. 164**

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February 22, 1984

Mr. George Deikun
Regional Housing and Urban Development Office
c/o U.S. Embassy
Abidjan, Ivory Coast

Dear Mr. Deikun:

On behalf of the WASH Project I am pleased to provide you with ten copies of a report on the Evaluation of the Third Housing Guaranty Project in the Ivory Coast.

This is the final report by Joseph Haratani and Harvel Sebastian and is based on their trip to Ivory Coast from October 10 to November 6, 1983.

This assistance is the result of a request by the Mission in September of 1983. The work was undertaken by the WASH Project in November of 1983 by means of Order of Technical Direction No. 164, authorized by the USAID Office of Health in Washington.

If you have any questions or comments regarding the findings or recommendations contained in this report we will be happy to discuss them.

Sincerely,

David Donaldson
Acting Director
WASH Project

cc. Mr. Victor W.R. Wehman, Jr.
S&T/H/WS

DBW:ybw

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and
Harvel Sebastian

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NOTE ON CURRENCY EQUIVALENTS

The unit of currency in the Ivory Coast is the CFA (Communaute Financiere Africaine) franc, referred to as CFAF. A fixed parity exists between the CFA franc and the French franc:

$$\text{FF } 1 = \text{CFAF } 50$$

The CFA franc floats against the dollar.

Throughout this report, the following rates have been used for the conversion of CFA francs into U.S. dollars and vice versa:

1968 and earlier years:	US\$1 = CFAF 247
1969	US\$1 = CFAF 256
1970	US\$1 = CFAF 278
1971	US\$1 = CFAF 278
1972	US\$1 = CFAF 252
1973	US\$1 = CFAF 223
1974	US\$1 = CFAF 241
1975	US\$1 = CFAF 214
1976	US\$1 = CFAF 230
1977	US\$1 = CFAF 240
1978	US\$1 = CFAF 210
1979	US\$1 = CFAF 205
1980	US\$1 = CFAF 225
1981	US\$1 = CFAF 280
1982	US\$1 = CFAF 340
1983	US\$1 = CFAF 380

ABBREVIATIONS AND ACRONYMS

AID	Agency for International Development
BNEC	Banque Nationale pour l'Epargne et le Credit National Bank for Savings and Loans
BCET	Bureau Central d'Etudes Techniques Central Office of Technical Studies
CAA	Caisse Autonome d'Amortissement The National Sinking Fund
DC	Direction de la Construction (MCU) Department of Construction
DCA	Direction Centrale d'Assainissement (MTPT) Central Department of Sanitation
DCH	Direction Centrale de l'Hydraulique (MTPT) Central Hydraulics Department
DCVR	Direction Centrale de Voiries et Reseaux (MCU) Central Department of Roads and Utilities
DDR	Direction de Developpement Regional Department of Regional Development
DCDU	Direction Centrale des Domaines Urbains (MCU) Central Department of Urban Planning
EECI	Energie Electrique de La Cote d'Ivoire National Electrical Energy Company
FNA	Fonds National de l'Assainissement National Sewerage Fund
FNH	Fonds National de l'Hydraulique National Water Supply Fund
FSH	Fonds de Soutien de l'Habitat National Housing Support Fund
GOIC	Government of the Ivory Coast
HG	Housing Guaranty (Loan)
HIG	Housing Investment Guaranty (USAID)
IBRD	International Bank for Reconstruction and Development (World Bank)
IMF	International Monetary Fund

LAP	Logement d'Accession a La Propriete Core Housing for Plot Acquisition
LBTP	Laboratoire des Batiments et Travaux Publics (MTPT) Construction and Public Works Laboratory
LEM	Lotissement d'Equipelement Minimum Minimum Standard Subdivision
MCU	Ministere de La Construction et de l'Urbanisme Ministry of Construction and Urban Planning
MTPT	Ministere des Travaux Publics et Transports Ministry of Public Works and Transport
ORSTOM	Office de Recherches Scientifiques Tropicales de'Outre-Mer Office of Overseas Scientific and Tropical Research
PACT	Propagande d'Action Contre le Taudis
PADCO	Planning and Development Collaborative International
RHUDO	Regional Housing and Urban Development Office
SETU	Societe d'Equipelement des Terrains Urbains National Urban Land Development Company
SICOGI	Societe Ivoirienne de Construction et Gestion Immobiliere The Ivoirian Housing Construction and Management Company
SITAF	Societe Ivoirienne de Transports Automobiles Africains Ivoirian Society for African Automotive Transport
SOCECI	Societe de Distribution de l'Eau de La Cote d'Ivoire Water Distribution Company
SOGEFIHA	Societe de Gestion Financiere de l'Habitat National Housing Finance Management Company

EXECUTIVE SUMMARY

Like most large cities, Abidjan is suffering from the effects of the worldwide recession, from its own special set of bureaucratic power struggles, and from market forces which tend to favor the rich at the expense of the poor. On top of these problems and constraints, Abidjan must also deal with an unprecedented population explosion and with a constituency structured along tribal and international lines. Most Ivoirian residents identify strongly with their village of origin and most non-Ivorians with their own country. Thus, Abidjan must address the needs of a constituency most of whom see themselves primarily as neither Abidjanaise nor Ivoirian. This fact, itself, makes the process of developing a workable city an extraordinary challenge for the urban development and shelter sector.

The physical interventions provided in any shelter program represent, at best, only half of the solution. The other half must come from social programs. Fortunately, these social programs are "people intensive" rather than capital intensive, and the people are there. What is needed, and recommended in this report, are leaders from both formal and informal institutions who can plan workable programs to motivate and organize the people to solve their own problems.

Findings and Conclusions

The team found that many of the Project 681-HG-003 interventions were generally well conceived and appropriate. These included the installation of both secondary and tertiary networks for potable water distribution and storm drainage and the upgrading of the secondary electrical grid. The team also agreed with the design standards used for primary access thoroughfares.

The team concluded that the number of primary streets as currently planned was not absolutely necessary. The design standards for secondary streets (particularly the width of the street and that of the total right-of-way) are greater than that needed for passenger cars and the occasional fire truck or utility vehicle. Many tertiary streets seemed unwarranted in these low-income neighborhoods where the majority of residents do not own vehicles.

The team could not justify the installation of a centralized water-carriage sewerage system since only a small percent of the household compounds are connected to the system; i.e., less than one percent in two neighborhoods as of later 1982. Current sewer systems present serious environmental pollution problems for which adequate solutions have not yet been found.

Finally, the team found that while Societe Ivoirienne de Transports Automobile Africains (SITAF) is doing a satisfactory job of solid waste collection in the central business district and in the middle of upper class neighborhoods, it is not providing adequate service in the poorer neighborhoods.

The team also found that erosion is a major problem, especially in areas where neighborhoods are built on plateaus which are bordered by steep cliffs that drop off to the flood plains along the lagoons. On the other hand, flooding is a serious problem in the flat, low-lying zones generally found between the lagoons and the ocean.

Regarding the threat of pollution of groundwater aquifers, Abidjan is fortunate in that its major aquifer is fairly well protected from direct infiltration from the ground surface by a 40 to 60-meter thick sedimentary clay and sandy clay formation.

The team found that neighborhoods as now constructed do little to favor social integration or to develop community participation in health and sanitation problems. To promote this, humanized space-use plans including gathering places should be envisaged along the neighborhood-cluster lines of the Niangon Nord project and should include space for sports, child-safe play areas, and trees and flowers. Such considerations should be an integral part of both technical and social planning. Such space could be obtained by eliminating non-essential thoroughfares from the current plans. A "social package" to complement the site construction efforts has been suggested. Its purpose is to help the Government of the Ivory Coast (GOIC) create channels of information and action agencies at the neighborhood and/or commune level.

Recommendations

Water Supply: Secondary and tertiary water distribution networks should be installed in all future RHUDO projects to allow direct connection to each building lot. However, because of present low connection rates, manually operated public fountains should be installed at convenient intervals and operated by a SODECI employee who would dispense water and collect fees.

Excreta Disposal: The team recommends that secondary and tertiary sewerage systems be planned, but not installed. Standardized pour-flush, water-seal toilets connected to septic tanks and/or leaching pits should be used.

Grey Water Disposal: Because of the universal practice in poorer neighborhoods of dumping grey water into the storm drains, the storm drainage system should be designed to handle the solids contained in grey water.

Storm Drainage: Open drainage channels should be installed using pre-cast, reinforced concrete tiles. Consideration should be given to covering the channels with locally manufactured slabs as quickly as possible to prevent accidents and their use to dispose of solid and household waste.

Solid Waste Collection: The USAID Regional Housing and Urban Development Office (RHUDO) should obtain the services of a solid waste systems management expert to study the present system and propose a workable, expanded system that includes local participation.

Streets and Walkways: High design standards for primary thoroughfares should be maintained, but the number of these thoroughfares should be reduced. Both the number and width of secondary streets should be reduced.

Most tertiary streets should be eliminated and replaced with walkways and community space. RHUDO should ask Bureau Central d'Etudes Techniques (BCET) to study the appropriateness and need for dead-end tertiary streets which have been included in the Niangon Nord project of Societe d'Equipment des Terrains Urbains (SEIU) to determine if they should be included in Project 005.

Electricity: RHUDO should include secondary grids in all future projects. It should also install adequate street lighting to improve security for residents at night.

Erosion Control: All walkways and open community space should be planted with grasses or stabilized with a soil-cement layer to control erosion. Terraces should be built to control erosion along steeper grades.

Flooding: Wherever affordable, streets should be paved and designed with an inverted crown to help handle flood waters. Walkways should also be designed to facilitate rapid but controlled drainage.

Catalytic Social Action: RHUDO should promote the design and implementation of a small social improvement project which could complement Housing Grant efforts. The goal would be to orient existing services and facilities and/or create new facilities and agencies to achieve health-related social action. As mentioned above a model plan is appended to this report.

ACKNOWLEDGMENTS

In an effort such as this evaluation, where time is so short, the task could not even begin, let alone be completed, without the extraordinary help and kindnesses shown by people too numerous to thank individually. Therefore, the WASH team members wish to express their appreciation to representatives of the various offices of the Ministries of Construction and Urbanism, Public Works and Transport, Environment, Social Affairs, Women's Affairs, and Public Health and to the entire staff of RHUDD for their kind and valuable assistance.

The team also thanks the representatives of SODECI, ORSTOM, and LBTP for their willingness to share their time and to provide vital information and extends its gratitude to the mayors of Abidjan for their generosity in giving of their time.

Special thanks to the staff of DCVR, BCET, SETU, and PACT who found time in their busy schedules to set up and attend meetings, make contacts and appointments, and even to travel with the team on site visits.

The team is deeply indebted to Mme. Brigitte Henquet and to Mme. Nicole Sabatie who worked so willingly and cheerfully over long hours during weekends and holidays interpreting, translating, and typing documents.

The team would be terribly remiss if it did not thank those who were its long-enduring hosts, the lovely people of Abidjan, and especially those families who accepted intrusion into their private lives with so much grace and understanding.

To all of you, "Thank you!"

Chapter 1

INTRODUCTION

1.1 Request for Consulting Services and Purpose

The RHUDO office in Abidjan requested the Water and Sanitation for Health (WASH) Project to provide a two-person team consisting of a sanitary engineer and a social scientist to evaluate the water supply and sanitation components of Project 681-HG-003. The purpose of the evaluation is to use the Project 003 experience as the basis for developing a set of recommendations for Project 681-HG-005.

The team was briefed by the WASH staff in Washington, D.C., on October 6, 1983 and travelled to Abidjan where it conducted its evaluation from October 10 to November 5, 1983.

Upon arrival in Abidjan, RHUDO also asked the WASH team to evaluate other Project 003 components (i.e., providing access to and within each neighborhood through a system of streets and walkways and providing electricity and street-lighting) and to address the problems of erosion, flooding, and possible pollution of groundwater aquifers. Although these topics had not been included in the WASH scope of work, the team, with WASH concurrence, agreed to address them.

1.2 Methodology

The evaluation began in early October 1983 in Washington, D.C., with a survey of background documents, interviews with pertinent officials, and a briefing by the WASH staff. Upon arrival over the weekend of October 8 and 9 in Abidjan, the team used the first days to review additional documents provided by the RHUDO office.

The first official event was a round table meeting which had been prearranged by the RHUDO staff with representatives of concerned agencies. The team members were introduced and the team's purpose explained at this meeting. Mr. Arnaud, DCVR Director, described the functions of the various agencies represented at the meeting and their relationship to the RHUDO project. Mr. Uk, DCVR deputy director, was appointed as the team's coordinator and liaison person.

Because of thoughtful advance planning by the RHUDO staff in setting up this meeting, the team had immediate access to key government officials and other counterparts which permitted early scheduling of interviews and subsequent meetings. It also helped the team to later convene an informal meeting among the agency representatives interested in developing appropriate, low-cost methods to solve Abidjan's water and sanitation problems. This group will meet again to review and discuss the contents of this evaluation report.

Individual interviews were held in pertinent ministries, and offices. There were repeated site visits accompanied by various counterparts. Field visits included random, informal interviews with residents of courtyards in Project 003 slum-upgrading sites.

Several smaller "round table" discussions were held, which helped the team develop its analysis through the exchange and discussion of observations and ideas. Both together and separately, the team members contacted urban specialists at the National University, the Ministries of Health, Women's Affairs, and Social Affairs, and ORSTOM to gain a broader understanding of demographic and social factors and growth trends of both Abidjan and other Ivory Coast cities.

Preliminary conclusions and recommendations were presented at a round table meeting during the third week to ensure full participation of all interested parties in the evaluation process through the airing of questions and controversies and to identify information gaps. A final series of meetings was held in the last week of the visit and an expanded executive summary of the final report in French was presented and discussed.

A rough draft of the final report was submitted to RHUDO before the team left Abidjan on November 6, 1983.

1.3 Project Background

The Regional Housing and Urban Development Office (RHUDO) has been financing urban housing programs in the Ivory Coast since 1967. The first two loans financed the construction of low-cost houses and stimulated the organizing of the Banque Nationale pour l'Epargne et le Credit (BNEC). The third loan (681-HG-003), the subject of this evaluation, was committed to a much broader and ambitious program than the previous two loans. The purpose was to establish and develop a coordinated Ivoirian housing sector capable of designing, implementing, financing, and managing a variety of replicable shelter projects for low-income families. Project outputs included slum upgrading, sites and services, and low-income rental housing (see Appendix A, Logical Framework).

This loan program was also the first financed jointly by AID and the World Bank in the Ivory Coast. AID's contribution was \$21 million. The total project budget was \$63.3 million, the balance being divided approximately equally between the World Bank and the Government of the Ivory Coast (GOIC).

Although not identified as a specific goal or purpose of this project, there was an overriding concern within both AID and IBRD with the need to encourage the GOIC to make major housing sector policy changes. The two key changes sought were (1) to shift from highly subsidized housing for middle and higher income families and (2) to move away from high design standards for infrastructure and to begin experimenting with and using low-cost alternatives.

During implementation, a number of modifications were made in the project.

1. BNEC, which was to become the central fiduciary for lower income projects, was replaced by the Caisse Autonome d'Amortissement (CAA).
2. The numbers of lots to be upgraded and of beneficiaries were reduced.

3. The sites and services component was implemented in only one of the two planned sites, and the numbers of lots and of beneficiaries reduced accordingly.
4. The numbers of rental housing lots and of beneficiaries were increased.

At the time of this evaluation, all Project 003 interventions were either complete or near completion. Project 005 (minus the interior cities component) had been authorized by AID/Washington in September 1983.

Chapter 2

EVALUATION SETTING

2.1 Urban and Social Landscape

The city of Abidjan has been the linch pin in the economic success story of the Ivory Coast. Built on the Plateau behind the lagoons, the city was conceived as a transshipment point for products from the interior going to the coast and to channel manufactured goods from the coast to the hinterland. Both the port and railroad were developed to this end. In a subsequent phase Abidjan became a center for processing raw products. After independence, industrial development policy moved toward the manufacturing of products which had until that time been imported.

Manpower, mainly Ebrie Lagoon dwellers, was soon, insufficient. Being agriculturalists and fishermen, the Ebrie villagers were never keen to become the laborers under the new economic order. Thus, port, industrial zone, and railroad began to draw labor from the interior. This trend soon broadened to include migrant labor (largely unskilled) from neighboring countries. Recurrent cycles of drought and an overwhelmingly high birthrate led to vast numbers of Voltaics leaving the Sahelian plains, and political unrest and straitened economies brought other neighbors from Upper Volta, Niger, Ghana, Mali, Guinea, Benin, and Togo.

Thus Abidjan saw population increases as follows:

16,000*	1936
247,000	1963
600,000	1971
950,000	1975
1,700,000	1983

The growth rate since 1965 has been calculated at 10.84 percent a year. Twenty-four percent of the Ivory Coast population is in cities. Abidjan, however, is the "central place" with capital and labor markets, business headquarters, goods, and distribution systems which draw migrant laborers from the hinterland.

* Figures are rounded. The last census was in 1975, and 1983 figures are projected. Statistics drawn from La Cote d'Ivoire en Chiffres, 80-81 Edition, Societe Africaine d'Edition.

A multiplicity of Ivoirian tribes* and their sub-tribes all contribute to Abidjan plurality, but are by now overwhelmed in a sea of "foreigners." In a place where people's loyalties, responsibilities, and patterns of cooperative interaction revolve around the tribe this heterogeneity poses specific problems for Abidjan's modern administrators and planners.

2.2 Housing Types

The Habitat Sector Study (PADCO, 1983) lists five types of housing in Abidjan.

- Type A. Private residential apartments and villas of medium to high-level comfort and status.
- Type B. Collective economy housing, usually apartment buildings, which have been built and are managed by the public housing agencies Societe Ivoirienne de Construction et Gestion Immobiliere (SICOGI) and Societe de Gestion Financiere de l'Habitat (SOGEFIHA).
- Type C. So-called "evolutive housing" employing a traditional African pattern of walled compound, with series of rooms built facing into an open court. With time the whole perimeter has rooms around it to be occupied either by extended family or eventually by tenants. Type C represents the old or traditional court (as in Ebrie villages engulfed by the growing city).
- Type D. More recently constructed houses, usually of "parpaing" (cinder-block) and cement.
- Type E. The shantytown shack or house of varying degrees of solidity characterized as "spontaneous" construction because it lacks any legal land tenure status.

The neighborhoods Project 003 deals with types C and D predominantly. Half of the city's population lives in type C or D housing. The greater part of Project 003 activities in Abobo Gare, Port Bouet II, Adjame, and Pelieuville are in neighborhoods of this sort (see Appendix B, Carte de Situation) although Adjame, and Pelieuville to a lesser extent, are seeing more and more courtyards where proprietors have raised a second story on at least one side of the courtyard.

Today in the courtyards, tenants still live a very communal life: women cook together and bathe the babies at the same time in the open court; men take a siesta together in the shade of an open-sided shed. All communal facilities (showers and toilets) are shared in densely populated lodgings.

Tribal groups: Agni-Ashanti, Kru, Northern and Southern Mande, Senoufou, Kwa, Bobo, Lobi, Foulbe, and their 60 odd sub-tribes.

For Port Bouet II, on 150 M² plots, the mean maximum number of persons is 16.5. In Abobo's 112 hectares, it was anticipated 500 M² parcels would hold up to 52.5 persons, though this density has not yet been generally reached because there is not much second story construction in Abobo.

Adjame, the most heavily populated zone due to its central location, with three and more stories built above the initial level, has a density of 52.9 persons per 500 M² parcel.

2.3 Sector Organization

The Ministry of Public Works and Transport (see Appendix C-1, Organization) defines norms, sets policy, organizes, and builds in major water and sanitation efforts. Responsibility is divided between the Central Office of Hydraulics and the Central Office of Sanitation. An in-house Bureau of Studies, the Construction and Public Works Laboratory, provides technical services and documentation.

A young Ministry of Construction and Urbanism (MCU) (see Appendix C-2, Organization), separated in 1978 from Public Works, now holds authority for infrastructure networks management and maintenance, and the installation of secondary and tertiary utility systems in urban districts and neighborhoods. Under the MCU, the National Urban Land Development Company (SETU) actually contracts and supervises the installation of utility systems. (See Appendix C-3, Organization). SETU is a parastatal agency, overseen by the MCU's Central Department of Roads and Utilities (DCVR). SETU's authority has been enlarged into the domain of sanitation, although this is currently being contested by the Ministry of Public Works and Transport. The Central Bureau of Technical Studies (BCET) provides technical, planning, monitoring, and evaluation services for DCVR. Although administratively housed in the MCU, BCET also works for the Ministry of Public Works and Transport and in fact serves to coordinate the two sometimes overlapping, sometimes competing, ministries.

Utilities development is funded in the Ivory Coast through a water-use tax which supports the National Hydraulic Fund (FNH) and the National Sanitation Fund (FNA). Further support for these funds comes from IBRD loans. The Ministry of Environment (MOE) maintains surveillance in matters of water supply and sanitation, with emphasis on levels of neighborhood sanitation, pollution of the lagoon, and eventually of the sea coast, and overall management of the natural environment. The role, to date, seems to be more of vigilance than control.

Chapter 3

FINDINGS AND CONCLUSIONS

3.1 General

The rapid growth of Abidjan has overwhelmed the shelter and other resources of the city (see Appendix D, Abidjan Growth). The heterogeneous nature of this urbanizing population presents planners and administrators with specific problems. Among them:

- How to provide appropriate, affordable shelter for a mobile, often transient population.
- How to provide adequate types and levels of water, sanitation, and public health services.
- How to mobilize city residents to help create, use, and maintain city resources and services.

The AID Urban Development Project 003 provided three types of shelter options: Slum upgrading in four locations (Abobo Gare, Port Bouet II, Adjame, and Pelieuville), serviced sites in Abobo, and low-cost rental housing in Marcory and Koumassi. Analysis of conditions and problems in upgraded areas offers a basis upon which to improve the design and operation of the follow-on project.

Two forms of collective housing are found in neighborhoods upgraded in Project 003:

- The "evolutive housing" usually consisting of an open courtyard with rooms around the perimeter which are in most cases constructed from cement-covered cinder blocks and which have community-use showers and toilets.
- Housing where landlords have sometimes built one or more additional stories in higher priced, desirable central areas (Adjame, and to a limited extent, Pelieuville).

Following are some basic facts regarding housing and water and sanitation in Abidjan.

1. The population growth has overwhelmed housing and services. For example, SETU and SOGEFIHA together had produced from their inception 64,400 lodging units, but the demand during this period would be closer to 100,000.
2. 1982-83 figures indicate that only 25.3 percent of the total population of the city are connected to the sewer system. Approximately 57 percent have connections to the SODECI potable water network.
3. A quarter of the population lives below the poverty level.

4. Due to a combination of geographic, regional, and economic factors, the population is extremely heterogeneous in origins. This has resulted in a lack of social integration of neighborhoods which has led to attitudes of powerlessness and feelings of obligation/responsibility limited to one's own household and identification along ethnic lines rather than with Abidjan.
5. A large portion of this newly urbanizing society does not understand city/community needs, nor the elements and correct use of urban technology. Even when people understand them, they do not always possess the means to use the technology because of shortfalls in the infrastructure systems.

The city provides, in fact, a classic picture of the cultural confusion inherent in massive culture change. People have not altogether separated from the old ways nor are they yet, culturally or materially, masters of the new.

This transition phase is best served through a flexible, open-ended system of intermediate level technologies which are adapted to the areas and the population concerned.

3.2 Water Supply Findings

3.2.1 Technical Aspects of Water Supplies

SODECI operates and maintains the potable water supply not only for Abidjan but for all urban and rural settlements of the Ivory Coast. In Abidjan the water source is an aquifer which is encountered between the depths of 50 to 100 meters below ground level.

The static ground level of this aquifer varies from 30 to 35 meters (at the ORSTOM compound at Km. 17 on the highway to the north of Abidjan) to 40-500 meters at the Plateau and Zone Nord well fields. At the other six well fields, the static level is reported to be around 60 meters below ground level (see Appendix E, SODECI Well Fields).

SODECI reports that there is a sufficient groundwater reserve capacity to supply Abidjan's rapidly growing population until 1990. At that point SODECI plans to begin using water from a lagoon east of Abidjan near Bingerville. The present groundwater is treated with lime for pH adjustment and is chlorinated.

In Project 003, secondary and tertiary distribution lines were installed at all project sites. However, in the upgrading sites, the percent of courtyards connected to the system varies between 4.7 percent in Port Bouet II and 67.6 percent in Adjame. Abobo Gare had a connection rate of 14.6 percent (BCET/Suivi, 1982).

In two courtyards visited in Treichville (not a Project 003 or 005 site), the water supply had been cut off, reportedly for non-payment of the water bills (see Photo No. 1).



photo 1

Treichville
Water pipe has been capped
because of non-payment of bill.



photo 1A

Treichville, Abidjan
Site of experimental flushing
unit. Water meter installed
in wall. Water has been cut
off for non-payment of bill.
Residents now buy water from
"pompe privee" in basins for
CFAF 25/20 liters.

It is reported that approximately 80 percent of the residents of courtyards are not connected to the water system and buy their water from pompes privees; i.e., proprietors with connections to the water system and who sell water to women for CFAF 20 to 35 for 20-liter basins (see Photo No. 2). This represents approximately a five to ten-fold increase over the price of water charged by SODECI. Water which is purchased by the basinful is used immediately or stored in oil-type drums (see Photo No. 3). Most storage drums are not completely covered and subject to contamination from the atmosphere (dust) and from the process of ladling.

Because most residents buy water by the basinful, the actual water consumption is very low, about 25 liters per capita per day.

Open, dug wells exist in the low-lying neighborhoods, i.e., Treichville, Marcory, Koumassi, Port Bouet, etc., of Abidjan. The Team was told that they did not exist in the plateau areas because the groundwater table is too deep for hand-dug wells. No wells were observed during the Team's random household visits in the plateau area, but wells were encountered in the low-lying areas (see Photo No. 4 and 4a).

Because of the small lot sizes in most neighborhoods and the almost exclusive use of septic tanks and leach pits for excreta disposal, plus the practice of using rope and bucket to lift water out of the wells, it is assumed that all open dug wells are contaminated (see Appendix F, "Latrines--Pollution Bacterienne").

The problem of residents using water from polluted wells was mentioned by the mayor of Port Bouet during the Team's meeting with her. Government officials stated that water from dug wells is used only for washing and flushing and not for drinking. In the Team's experience, strict adherence to such selective use of water has never been confirmed in practice and, therefore, cannot be taken at face value.

3.2.2 The Social Aspects of Water Supplies

In 1980, 56.8 percent of the population of Abidjan was connected to the water system. Water consumption is estimated at 110 liters per person per day for the "connected" individual versus 62 liters per person per day for the total city. Since these estimates cover luxury and middle-income zones, hidden within the figures are many poor area residents who use no more than 15 liters per person per day.

Residents in "Evolutive" housing of types C and D show rates respectively of 70 percent and 46 percent connection of water systems--usually with one tap in the courtyard serving all families living therein (six to eight families per courtyard is an average figure).

"Bidonville" or shantytown areas showed no more than 11 percent of lodgings connected. The usual reasons advanced for not having water connections are:

1. Too expensive to install
2. Too difficult to make the monthly lump-sum payment after installation.



photo 2
Treichville, Abidjan
Women buy water.



photo 3
Abobo Gare, Abidjan
Water storage barrels and
containers.

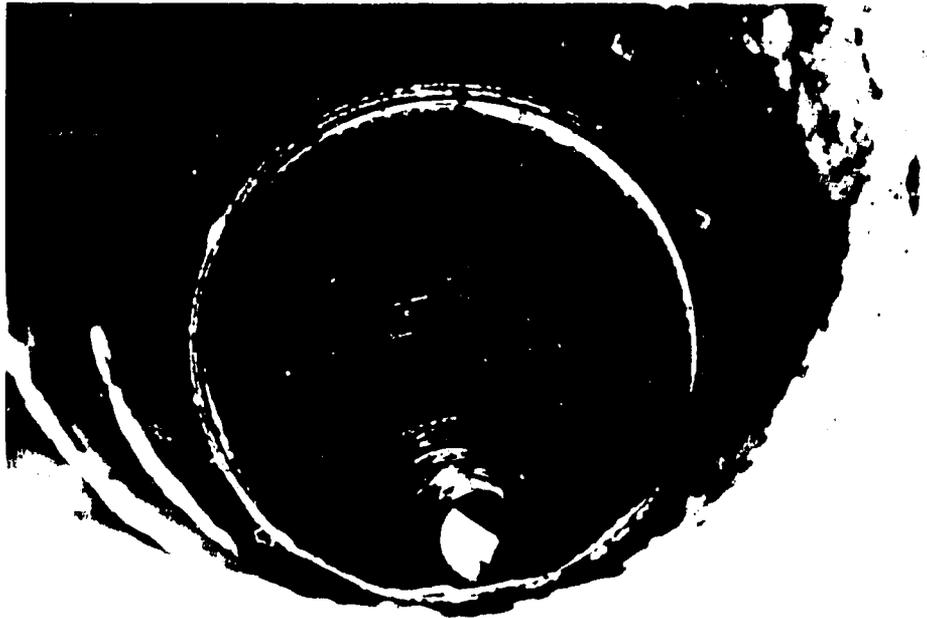


photo 4A

Treichville, Abidjan
Dug-well superstructure.
Note surface drain at right
of well. Septic tank installed
to left of well approximately
3 meters away.

photo 4

Treichville, Abidjan
Shallow (approx. 6
meters) well lined
with barrel walls.



3. Difficulty in dividing charges among tenants with different use patterns and family sizes.

As a general rule, SODECI does not deliver water to districts where legal residential status has not been established. This means most squatter settlements are not served by the water system.

It was found generally that one water seller can expect to service about 210 inhabitants. Water sellers in some areas incur heavy initial expense to establish their water system connection. Where the water distribution network is in the adjacent street, expense is minimal. Water is resold for prices differing with the neighborhood but ranging from 20 to 35 CFAF for a 20-liter basin. SODECI now plans to install public pay fountains.

It is the women and children who fetch water. They will pay more to buy water at an overhead or so-called "Swan's Beak" tap because they can stand underneath to fill the container on their heads and are not forced to lift a heavy bucket after filling. This is an important preference and public fountains must be designed with this feature.

During the torrential rainy season people catch water either in set out basins or from gutters. The poorest cease altogether to buy water then. Whether bought or taken from a courtyard tap, water is collected in assorted zinc or enamel basins and buckets. It is usually stored in 200-liter drums or clay jars and dipped with what comes to hand. Some people make a distinction between vessels used for water collection and those for other uses. Others do not.

Water Consumption
Domestic Needs Evaluated by the PDE
Domestic Water Needs in Litres/Person/day

Type of Housing	1974	1980	1985	1990	1995
C	80	78	79	81	83
D	65.9	65	66	68	70
E	26.9	26	26	26	26
V	25	26	28	31	35

Source: Jakob, 1980 Op. Cit.

3.3 Liquid Waste Disposal Findings

3.3.1 Technical Findings Regarding Waste Disposal

Excreta Disposal

Buildings in the central business district and the upper class, residential neighborhoods are plumbed with modern, sanitary fixtures and are served by secondary and tertiary water-carriage sewerage systems.

At present, most of the sewers dump raw sewage into the lagoons surrounding the city. This had degraded the aesthetic, physical, and bacteriological quality of the lagoons and also their chemical quality to the extent that harmful industrial wastes are present in the discharges. Fish catches from the lagoons have reportedly dropped significantly, but it is not known to what degree this is due to the sewage discharges.

The World Bank is involved in a series of projects designed to install primary trunk lines which will intercept secondary sewers discharging into the lagoons, and to eventually dispose of the sewage through an ocean outfall off the coast south of Port Bouet.

Secondary and tertiary sewers have been installed in all Project 003 sites and in most government-financed public housing projects. However, most of the so-called traditional and spontaneous neighborhoods are still served by individual excreta disposal systems, almost exclusively by septic tanks and/or leaching pits (see Photos Nos. 5, and 5a). There are many spontaneous settlements which have no formal excreta disposal facilities (see Appendix G, Situation de l'Assainissement Eaux Usees).

Leaching pits, rather than leaching fields, are used to dispose of septic tank effluent because the lot sizes commonly used (100 m² to 250 M²) do not provide enough area to install and operate leach fields.

Typical latrines in Abidjan are of the squat type (see Photo No. 6). Where water is not used for anal cleansing, it is generally used for flushing and cleaning the latrine slab. Due to these practices, almost all latrines use septic tanks or leaching pits or a combination of both for on-site excreta disposal. These tanks and/or pits are emptied periodically by vacuum pumpers operated by private entrepreneurs. The frequency of emptying depends on the number of users, the size and the design of the system, the permeability of the soil, and groundwater table. Data collected by the Team from reports (BCET/Suivi, 1982) and random household interviews indicate that the frequency of pumping can vary from once every month to once in 10 or more years.

The cost of emptying a tank is reported to be around CFAF 7,000 for a tanker truck load of up to 4 cubic meters of sludge. The proprietors of the housing compounds usually pay for the emptying, but as reported by BCET, in a few cases the cost is paid directly by the residents of the courtyard (BCET/ Suivi 1982).



photo 5
Abobo Gare, Abidjan
Septic tank under
contruction.



photo 5A
Abobo Gare, Abidjan
Septic tank under
construction.



photo 6

Pelieuville, Abidjan
Typical squat toilet, without
a water-seal.



photo 7

Abobo Gare, Abidjan
Bathing compartments.

Grey Water Disposal

In most courtyards the bathing facilities (often just a stall with concrete slab floor) are not plumbed to the septic tank (see Photo No. 7). The wastewater is channeled to the street to open surface drains or, infrequently, to sewers (see Photo No. 8). Wastewater from cooking and washing is usually carried out to the street and dumped into the closest storm drain gutter.

The main impetus behind these practices seems to be financial. A concerted effort is made by residents to control the volume of liquids entering the septic tank or leaching pit to reduce the frequency of emptying. As reported to the Team by SETU, these wastewater disposal practices produce a dense septic tanks sludge which is more difficult to pump out than normal sludge.

In spite of the practice of disposing of grey water in the street, the septic tank and leaching pit sludge is too wet for composting. Composting generally is not a viable alternative treatment because water is used to flush and clean the squat-type latrine slabs.

Another consequence of disposing of grey water in the storm drains is the frequent closing of the drainage system (see Photo No. 9). This is particularly troublesome in underground systems, but combined with the indiscriminate disposal of solid wastes, it also causes problems in open drainage channels. SETU is attempting to alleviate the clogging problem by installing steel bar grills on storm gutters (see Photo No. 10).

3.3.2 Social Findings Regarding Waste Disposal

Twenty-five percent* of the population of Abidjan is connected to the sewer networks according to official figures, although in the low-income neighborhoods of concerns, the connection rate is estimated at one percent. By 1990 the population is expected to double from the current 1.8 million figure, but fewer than half are projected to have sewer connections; i.e., about 1.8 million people will be without sewer service. Between 40 and 50 percent of the population have pit latrines or septic tanks of various design. Often the installations are simply water-tight vaults which, given density of habitation, must be pumped--often monthly. Landlords complain of the high cost, though usually the cost is passed on to the tenants. For this reason, landlords press for sewer installation.

Between 20 and 30 percent of city residents are without any excreta disposal facilities and use street corners, beaches, vacant lots, or any spot they can find.

* A realistic figure may be closer to 30 percent, given the number of unauthorized connections.



photo 8
Abobo Gare, Abidjan
Grated inlet to surface
drainage in courtyard.



photo 9
Abobo Gare, Abidjan
Clogged storm drain.



photo 10
Treichville, Abidjan
Storm water drain with steel
grill designed, fabricated
and installed by SETU.



photo 11
Attiecoube, Abidjan
Erosion undercutting
surface and underground
storm drainage system.

Sewer System Constraints

A series of problems accompanies the use of sewers in Abidjan. Water consumption per person per day is very limited for most inhabitants. Therefore, flows of water are insufficient in sewers that carry only black and grey water or in combined sewer/drains during the dry season. Connection levels are so low that sewers operate inefficiently. City residents--unaccustomed to urban level technology--dispose of anything, including plastic and rags, in the toilets. Cleansing materials may be anything that is available--frequently, newspapers or old notebook pages. Therefore, blockages are frequent, and repairs are not made very quickly.

Given population growth rates and densities the sanitation apparatus must ultimately evolve toward an extended sewer system. The WASH Team feels that the option for an immediate level of technology is the most realistic policy for the medium to long term, i.e., 20 to 30 years.

Latrine Practices

For the most part, people use squat latrines, especially where they are expected to serve multiple users. In private and upper income homes, however, flush toilets are expected. People most often use small enamel or plastic potties for young children which are then emptied into the latrine.

In the multiple family courtyards, several or all families may share a toilet. These toilets are kept fairly clean, sometimes through the landlord's effort or by tenants themselves. Nevertheless, they are often dark and odorous places which offer privacy but little comfort. In general, they are quite safely constructed. The major health result of such unpleasant toilets is that of habitual constipation. In addition to drinking little water and eating constipating foods, people are not prone to linger in latrines and thus exacerbate the problem. Latrines may be placed along the side or back wall of courtyards, often next to the shower. In multi-story lodgings, each floor will have its own latrine, and in higher cost apartments, each apartment may have its own facility--especially where there is a sewer connection--and running water is connected to the individual household.

Attitudes and Education

Attitudes toward facilities range from passive acceptance to indignation depending on income-class levels and expectations. In the courtyards most people patiently hope that the system--whatever it is--will just work. Tenants complain if a landlord does not have the tank pumped often enough. Landlords complain that costs are too high. The extraordinary economic success of the Ivory Coast in past years, in addition to government practices of subsidized housing, gave the elite and government cadres a taste for high-cost systems which in this more austere period are no longer possible. When such cadres, due to the housing shortage, come to live in low-cost type C and D housing, they are unhappy with unsophisticated systems because they have luxury models as their goal.

The WASH Team has examined the possibilities of using composting latrines, which theoretically might solve some problems here. Reaction has been unmitigated rejection of recycling, as anything to do with handling excreta is

seen as very defiling and status abasing. People who work with pumping facilities and sewage treatment are seen as only a step removed from actual contact.

The Team would like to urge that the Port Bouet I experiment be followed closely because a range of types of latrines is expected to be introduced to test acceptance and operation. There is also a project to try to use methane production from a school sanitary block to be built in Vridi village to cook hot lunches for the school children.

3.4 Storm Drainage Findings

3.4.1 Technical Findings Regarding Storm Drainage

Abidjan has two rainy seasons each year. The major rainy season lasts approximately four months. It begins in early April and continues to the end of July. The minor rainy season occurs during the months of October and November (see Appendix H, "Precipitations"). The annual rainfall during the past 20 years has averaged around 2,000 mm. The lowest annual rainfall recorded during this period was 1,500 mm for 1977, and the highest occurred in 1963 when 2,800 mm. fell.

About 65 percent of the total annual rainfall occurs during the major rainy season. Some 30 percent of the total falls during the month of June alone. The rainfall in Abidjan and the surrounding areas are characteristic of the classic tropical storm pattern with intense downpours alternating with heavy, steady rains. This rainfall pattern causes temporary flooding in low spots and along natural and man-made drainage courses. Roads in Abidjan and its suburbs, such as Koumassi and Port Bouet, become impassable at times. Where storm drainage occurs over unprotected soils, the effects of heavy erosion are evident (see Photo No. 11).

The central business district of Abidjan and much of the suburbs are served by improved surface or underground storm drainage systems. However, in many areas of the city, these systems have not been adequately maintained. Broken or damaged drainage channels are evident even in the central business district. Localized ponding of storm and wastewater around manholes and storm gutters caused by blockage or underground pipes is seen frequently, especially in areas where heavy erosion contributes to the collection of silt in the drainage system (see Photos No. 12 and 13).

In many of the suburban neighborhoods adjacent to the slum upgrading or sites and services areas, storm water runoff still occurs along unimproved and unprotected drainage courses. Gullies and washouts ranging from 10 to 20 meters deep were seen by the Team in the plateau area (see Photo No. 14). The cost of upgrading the Pelieuville site skyrocketed due to the need to install a major storm drain and construct a large earth fill to cover a deep erosion gully (see Photo No. 15).

In spite of the relatively high cost of installing storm drainage systems, the pattern of heavy rainfall in Abidjan makes it necessary to provide improved drainage systems to alleviate flooding in low-lying and flat areas and to control erosion of the plateau clay formation.



photo 12
Treichville, Abidjan
Street flooded from broken/plugged storm
drain pipe.



photo 13
Niangon, Abidjan
SETI Project/Sites and Services
Sand collecting in storm drains.
No houses built yet. No residents.



photo 14
Attiecoube, Abidjan
Erosion gully approximately
10 meters deep.

photo 15
Pelieuville, Abidjan
Informal playground on
earth fill. Before the
project there was a deep
ravine running through
this area.



3.4.2 Social Findings Regarding Storm Drainage

Appropriate rain water drainage for Abidjan is a multi-stranded problem. Because of the torrential rains streets and walkways can rapidly become ravines or morasses. Where open surface channels have been installed (Project-003 upgraded areas), the rushing canals become a hazard to cross and can present a real danger for small children. Further, people regularly use them to dispose of solid wastes of any sort where garbage removal is inadequate, and they are frequently blocked. Cleaning and maintenance is, at best, infrequent.

Furthermore, people illegally connect latrines and septic tanks to the storm drains, because they do not understand the dual sewer/drainage system, and because they do not want to pay for connections to the sewers. Therefore, the drains carry and deposit black and grey water and when blocked and overflowing spread it into the streets.

For all these reasons, there should be deep misgivings about the value of open-surface drains and they should be covered. At the same time, there is reason to doubt that low-income residents will give priority to a communal self-help effort to cover drain canals, given the general feeling that such tasks are the responsibility of the city and government authorities. If, however, for cost-reasons, Project 005 managers choose the open-drain option, it is suggested that the manufacture and disposition of cement slab covers could become a project for the civic youth-group activities and that as proposed under recommendations in Appendix K ("Social Planning") neighborhood associations could deal with this problem.

3.5 Solid Waste Collection

SITAF (La Societe Industrielle des Transports Automobiles Africains), an affiliate of the French company, La Lyonnaise des Eaux, holds the contract for solid waste disposal in Abidjan (see Photo No. 16). Three eight-hour shifts keep the trucks running daily on a 24-hour schedule. In spite of this, and the fact that 40 percent of the cities operating budget is allocated for public services including its contract with SITAF, the city is unable to meet the burgeoning city's needs as waste production increases, of course, with population growth.

Annual Production of Collected Solid Waste*

1978:	307,000 metric tons
1980:	351,000 metric tons
1990:	700,000 metric tons

J. Jakob: op. cit.



photo 16
Treichville, Abidjan
SITAF employee cleaning debris along gutter.



photo 17
Abobo Gare, Abidjan
Typical paved street in project area.

In theory, each courtyard is presumed to have a garbage can where people can deposit their refuse, and which is emptied when the SITAF truck passes. Problems encountered are as follows:

- One garbage can is usually insufficient for a courtyard of people. Therefore, there are garbage heaps and garbage is spread by animals.
- There may not be a garbage can, so people pile their trash where they can, in the storm drains, at corners, or in vacant spots.
- The trucks may not be able to enter the neighborhood because of road conditions or the absence of roads. In this case, sometimes dumpsters are placed, and people are supposed to bring their garbage to empty into them. Children, who often bring the garbage, can't reach the top, so they put it beside the dumpsters. People coming later do not want to wade through garbage to reach the dumpster. Often dumpsters are picked up and not replaced.
- Numbers of trucks are limited and take a long time conveying their loads to the dumps. Some areas therefore only get service when the local administration makes a pressing call, but garbage production does not cease and refuse piles up.
- Perhaps the most important single factor is that people do not see themselves as responsible for dealing with the problem. An Ivoirian sociologist suggests that in the popular view, Abidjan is a place ".where people pay and are served"--this, in contrast to the ethos of the village where people expect to do things for themselves and their group. A frequently heard comment is, "No, that is not for us (to do). That is for the government."

3.6 Findings Concerning Other Support Areas

3.6.1 Streets and Walkways

In all Project 003 sites, including upgrading, sites and services and rental housing, high design standards were maintained both with regard to load and wear resistance and to rights-of-way widths. High standards were used for the primary and secondary streets (see Photo No. 19). Street curbs were included in the standard design. Some sidewalks were paved, and others consisted of compacted laterite fill. In some designs, additional space was provided between the sidewalk and the property line (set-back). The Team feels that this space is unnecessary and should be eliminated completely.

3.6.2 Electricity

At all Project 003 sites there was upgrading or installation of secondary electrical grids. Street lighting was also included. These installations appear to be adequate, and most housing compounds were connected to the system, although some concerns were expressed about the desirability of additional street lights.



photo 18

Abobo Gare, Abidjan

Indiscriminate dumping of solid wastes. Probably due to inadequate garbage collection service.



photo 19

3.6.3 Erosion

Erosion is a general problem throughout that part of the city built on the sedimentary clay and sandy clay formation covering all the metropolitan area lying to the north of the Ebrie lagoons. It is a serious problem in the plateau areas which rise some 20 to 30 meters above the lagoons and are bordered by steep cliffs that drop to the flood plains. In the sandy Port Bouet and low-lying Marcory and Koumassi areas, erosion is not a major problem because of the porosity of the sand and flatness of the ground (see Appendix I, Coupe Topographique du Littoral).

Erosion studies indicate that on bare ground as much as two metric tons of soil per hectare of surface is lost annually (ORSTOM, 1972). ORSTOM also reported that the rate of erosion can be reduced tenfold by covering the ground surface with grass.

3.6.4 Flooding

As noted earlier flooding is a major problem in low-lying areas and along natural and man-made drainage courses. Flooding will continue to occur even where man-made improvements have been installed because of the extremely wide range of rainfall intensities encountered in tropical zones such as is the case of Abidjan. (It is not economically feasible to design and construct a storm drainage system which will handle a deluge of maximum intensity.)

In most of the suburban neighborhoods visited, except for undeveloped communal space and unpaved streets and walkways, practically the total neighborhood consisted of structures and paved courtyards. Under these surface conditions, the rainfall runoff factor approaches 100 percent. This situation only magnifies the problem of flooding, especially for residents who live downstream from these completely built-up neighborhoods.

3.6.5 Pollution of Groundwater Aquifers

RHUDO expressed its concern with the possible pollution of the main aquifer supplying Abidjan. This aquifer is deep enough (at least 40 meters below ground level) at all eight active well fields, including those located in central built-up zones of the city, to be reasonably safe from direct surface pollution. However, the drilling of all deep wells in and around the city must be monitored and controlled to prevent unintentional pollution of the aquifer through faulty well construction, e.g., unsealed space between the well-casing and the ground, or from abandoned bore-holes and wells which have not been sealed. Following these precautionary measures, chlorination of the well water as practiced at present should be sufficient to handle any residual pollution which may reach the aquifer.

With regard to the phreatic groundwater being tapped by hand-dug wells, as noted earlier, it must be assumed that it is polluted (see Appendix J, Points d'Eau-Cotes Piezometriques). Because the complete elimination of septic tanks and leach pits is virtually impossible, a more practical solution to the problem of indiscriminate use of polluted water from hand-dug wells is to provide affordable piped water to each housing unit.

A special loan fund should be established for poorer residents to use to cover the cost of installing a metered house connection. The loan would be amortized in small periodic payments stretched out over a reasonable period of time.

3.6.6 Maintenance

Maintenance of physical infrastructure is a pervasive problem which has contributed to the rapid breakdown of utility networks, such as street lighting, storm drains, streets and walkways. Even in the central business district and upper class neighborhoods, evidence of the lack of adequate maintenance can be seen. Some of the sidewalks have become erosion channels, and the covers of surface drainage channels are often broken or missing. In the poorer neighborhoods, these symptoms are widespread and the degree of deterioration much greater. Some of the primary thoroughfares have become unserviceable for vehicles such as buses and garbage trucks due to poor maintenance. Flooding caused by broken or clogged drains is the most obvious symptom of neglect.

Because maintenance is always one of the last problems to receive adequate attention in any society, developed or not, it is incumbent upon development institutions, such as RHUDO, to take this fact into consideration in its infrastructure designs to minimize and simplify maintenance.

Chapter 4

RECOMMENDATIONS

4.1 Introduction

Although many of the recommendations made below are generally applicable to all proposed Project 005 sites, there are significant differences in the physical characteristics of certain sites which require different solutions. Where these differences exist, site specific recommendations are made.

The recommendations made in this report on the subjects of excreta disposal and storm drainage systems were made with the understanding that a combined system of sewerage and storm drainage is prohibited by regulations in Abidjan. If this prohibition were to be relaxed in the future, the Team would make a totally different set of recommendations for excreta disposal and storm drainage. This change in policy would make it economically feasible and socially desirable to move directly to the installation of a combined underground drainage system to handle sewage, grey water, and storm run-offs. This change would obviate the need for the additional capital investments required to go through the intermediate stage of installing on-site excreta disposal systems and the recurrent costs of servicing them.

In developing the social aspects of their recommendations, the WASH Team has been guided by four requirements or constraints:

- The need to service a wider population, specifically in the 20 to 50 percentile income brackets.
- The behavior characteristics of this population with regard to technology use, purchasing choices and power, and ability to cooperate and coalesce for community improvement.
- A realistic cost approach to ensure replicability and continuing programs.
- The need to improve the conditions of life and to "humanize" the urban framework.

The choice of appropriate technology has been guided by these determinations in connection with the givens of the physical environment. The evaluation has brought to light the following:

1. Potable Water: In the fragile health conditions of the city, readily available sources of potable water at a nominal price become a first priority.
2. Excreta Disposal: A policy to permit widespread use of affordable latrines is essential for city health.
3. Storm Drainage: Open canals are less expensive to construct and do not prejudice future options for sewer installation. However, they present serious problems such as their being dangerous for

children, poor operation because of misuse, unsightliness, etc. The choice of an open system must be weighed and the social and technical factors balanced.

4. Solid Waste Disposal: A decentralized, multi-tier system is needed. Collection in neighborhoods should be done by paid local people with small collection vehicles. Such a system should be arrived at through mobilizing the neighborhood and commune.
5. Electricity: Adequate street lighting is necessary in a city where the crime rate is high. However, maintenance is the big problem because someone must change the bulbs, and this does not happen now.
6. Social Needs: There is vital need to bring people together and motivate them to work to improve their own neighborhoods and better their lives. Channels of information and agencies need to be created or reoriented at various levels of neighborhood, commune, and commune administration. While technical services need to be planned and provided, a social package of community services also needs to be developed to complement the site construction efforts. (Appendix K presents a series of recommended social actions to support RHUDO's housing efforts.)

Since urban development is a dynamic and on-going process, there is a need to keep abreast of changing shelter needs and living patterns and to provide new solutions which appropriately address these changes.

4.2 Recommendations

4.2.1 Water Supply

The Team finds that a piped, potable water supply is an absolute necessity whether or not dug wells are plentiful in the project area. Water drawn manually from open dug wells should be considered contaminated and should not be used for drinking. Both secondary and tertiary distribution networks should be installed at all Project 005 sites. Fire hydrants should be installed on the secondary network.

Because of the low hook-up rates in Project 003, the Team recommends that while the water distribution systems be designed for individual lot connections, the design should also include the installation of manually operated public fountains at convenient intervals. A resident vendor should be employed by SODECI to deliver water and collect fees which should be set substantially below that now being charged by private vendors. The fountains should be designed to deliver water into the basin perched on the customer's head instead of at ground level.

It should be noted that any savings to be realized by eliminating the installation of a tertiary water supply network and the means to assure final delivery of piped water to the residents would be relatively small and not justified because of negative public health implications.

4.2.2 Excreta Disposal

The experience to date in Project 003 shows that proprietors generally favor the use of septic tanks and leach pits over connecting to the sewerage system. Proprietors are willing to spend as much or more money to build an individual excreta disposal system than to connect to a sewer which is practically at his doorstep. As long as the large majority of lot owners is not willing to connect to a sewerage system, the cost of installing a separate, centralized water-carriage sewerage system cannot be justified. Therefore, project sites should be designed for the installation of individual excreta disposal systems. The project should include the preliminary design of the secondary and tertiary sewers and provide rights-of-way for the eventual installation of a centralized water-carriage system.

Because of the use of water for anal cleansing and/or for flushing and cleaning the squat-type latrine slab, composting toilets cannot be used. Rather than attempting to make major changes in the design of the on-site excreta disposal system, the Team recommends that the sites be designed for the installation of a well-designed pour-flush, water-seal toilet connected to an offset leach pit. The Team recommends a minor change in the design of the squat slab used at present. A water seal trap should be installed to stop odors emanating from the leach pit. A simple "S" trap, as shown in Appendix L, can be used.

Except for the high cost of building them, septic tanks connected to leaching pits would be the preferred solution for on-site excreta treatment and disposal. A well-designed and operated septic tank provides both primary and secondary treatment of sewage and produces an effluent virtually free of suspended solids, which is easy to dispose of through leach fields or pits.

If the cost of constructing septic tanks can be substantially lowered through the use of cheaper materials or, if they can be partially subsidized, septic tanks connected to leaching pits would be recommended over the use of leaching pits alone because they would lower the frequency and cost of emptying (see Appendices M and N, Schematics).

RHUDO should also ask BCET to assess the results of SETU's experimental, combined shower/toilet unit designed for intermittent flushing which is being tested in three installations. One was observed in Treichville (see Appendix O, Systeme d'Evacuation des Eaux Usees de Douches et de WC). This unit had been in operation for one year, and the only major maintenance required has been the replacement of the plunger seal in the shower component for storing waste water. SETU reports that the residents of the courtyards where the experimental units have been installed are very pleased with the system.

Since urban growth and development is a dynamic, on-going process, RHUDO should also arrange with BCET to closely monitor the rate of connections to sewers in Abobo Gare, Pelieuville, and Port Bouet II, with the goal of developing a set of criteria which could be used in the future to decide if and when sewers should be installed in slum upgrading and sites and services projects.

4.2.3 Grey Water Disposal

The widespread practice of dumping grey water (waste water from cooking, washing, and bathing) into the storm gutters has two major impacts. It reduces substantially the volume of sewage produced, and it contributes to the problem of clogging in the drainage system.

To alleviate this problem, steel bar-grills should be installed on all storm gutter entrances and cleaned daily by the SITAF street sweepers. The storm water drainage system should be designed and built to handle the smaller sized solids contained in grey water. It should also be designed for the convenient and secure installation of covers.

4.2.4 Storm Drainage

Storm drains should be designed to accept and transport grey water as part of its normal function. To reduce construction costs and to facilitate cleaning and maintenance of the system, open surface channels should be used wherever possible. Pre-cast, wire mesh, reinforced concrete tiles (approximately 6 to 8 centimeters thick) set in mortar to form a trapezoidal cross-section should be tried as a substitute for the poured-in-place concrete channels used in Project 003.

All storm drainage channels to be built in the sedimentary clay formation zones north of the lagoons must be lined with concrete or other suitable material to control erosion and to provide better flow characteristics to handle grey water solids during the dry season.

Because of the inherent danger of open channels, especially for toddlers and small children and the separate problem of residents using them to dispose of their solid wastes, the community interest in providing steel-reinforced covers (at least 10 centimeters thick) for the channels could be used as a catalyst around which community action committees and other groups could be formed. The formation of and action by community groups are necessary adjuncts to all shelter schemes, especially where the provision of public infrastructure is kept to a minimum to reduce project costs. To this end, RHUDO will need to continue to press relevant GOIC institutions into formulating and supporting a wide range of community-based organizations and activities (see Appendix K for a plan of activities in this area).

4.2.5 Solid Waste

Because the SITAF-operated, single-tiered, solid waste collection system is not reaching the poorer neighborhoods, RHUDO should obtain the services of a solid-waste management expert to study the present system in detail and make recommendations for alternative systems which would better serve the poorer neighborhoods (see Appendix P, Sample Terms of Reference, and Q, Designing a Solid Waste Collection System).

The indiscriminate disposal of solid wastes is a serious problem in poorer neighborhoods. It is quite apparent that the incentives necessary for the orderly collection and disposal of solid wastes generally do not exist in the

poorer neighborhoods. Since it is unrealistic to expect any sudden increase in funds for solid waste collection, the only clear alternative is to mobilize the neighborhoods to contribute their time, energy, and even funds, to solve their own collection problems. The installation of strategically placed, permanent solid waste collection bins could form the first tier of a multi-layered collection system. A small cadre of residents, solid waste workers paid by the municipality or by the neighborhood itself, could operate a fleet of push-carts to collect the wastes from the permanent bins and transport them to SITAF-owned dumpsters located along the main thoroughfare. SITAF's regular crews would empty the dumpster and haul the wastes to the final disposal site.

The same cadre of neighborhood workers could also be charged with removing kitchen waste solids from the grilled entrances of the storm drainage system and transport them along with the other solid wastes to SITAF's dumpsters.

4.2.6 Streets and Walkways

The standards used in Project 003 for primary thoroughfares should be maintained in Project 005. However, the number of primary thoroughfares should be reduced to the barest minimum. Residents should be expected to walk a few blocks to the bus route.

Paved secondary streets should be reduced in design standards and, where possible, in numbers. Access to these streets should be designed for light passenger vehicles by using narrower rights-of-way which make it tedious, if not difficult, for large buses and trucks to use. However, this reduced design standard for secondary streets must be adequate enough to allow access to septic tank vacuum trucks. Wherever possible, secondary streets should be dead-end streets with a cul-de-sac. Speed bumps should also be a part of the standard design to control the speed of vehicles within the neighborhood. Most, if not all, tertiary streets should be eliminated and, in general, the large amount of land area (32 percent in Abobo Gare) dedicated to streets should be reduced and the space used to increase lot size and/or converted to walkways and community space.

4.2.7 Electricity

Secondary electrical distribution networks should continue to be installed in all Project 005 sites and Project 003 extension sites. Adequate street lighting should also be included as an integral part of each project.

4.2.8 Erosion Control

All walkways and open community space should be planted with low-lying grasses to control erosion. Heavily used walkways may be stabilized with a lean, compacted soil-cement mixture. Terraces should be built along steeper grades to control erosion.

Terracing should be employed where steeper grades are encountered. Treated logs, reinforced concrete sleepers, or other locally produced materials should be used for constructing retaining walls.

4.2.9 Flooding

Storm drainage systems should be designed to rapidly transport rain runoffs away from project neighborhoods. RHUDO should request BCET to investigate the possibility of building streets with an inverted crown to carry off part of the runoff when the storm drains overflow. The use of streets with inverted crowns will require designing the total street system to double as storm drains.

Increasing the area of green space, i.e., planted with grasses, will reduce the rainfall runoff coefficient and help to ameliorate the flooding problem.

4.2.10 Recommendations for Specific Proposed Project Sites

Attiecoube Upgrading

RHUDC is considering upgrading all or part of Attiecoube, which is approximately 90 hectares in area, with a proposed budget of CFAF 500 million. Using half of the Project 003 cost of approximately CFAF 35 million per hectare for upgrading Abobo Gare as a baseline, it would cost CFAF 1,575 million to upgrade the 90 hectares of Attiecoube or over three times the proposed budget.

Because the Attiecoube site has serious erosion problems (similar to those encountered in Pelieuville), the Team believes that just the upgrading of streets, walkways, and storm drainage (which represented about 60 percent of project costs in the upgrading of Abobo Gare) would require more funds than the budgeted amount.

If the budget allocation of CFAF 500 million is to remain, the Team recommends that only a small section of Attiecoube be upgraded. This upgrading should include bringing a single main thoroughfare up to the standards used in Project 003 upgrading sites to allow easy access to buses, garbage trucks, and other large service and commercial vehicles.

Sections of unpaved streets should be selected and rerouted, if necessary, to form a limited paved network for vehicular access into the upgrading section of Attiecoube. While planning to obtain maximum access to the interior of the neighborhood with the least possible number of paved secondary streets, routes must be selected to avoid steep grades found on many existing streets. Dead-end streets should be used to discourage non-residents from entering the interior of the upgraded neighborhood.

Wherever possible, the steeper sections of existing paved and unpaved streets should be terraced to control erosion and converted into pedestrian walkways or community space. The sidewalks along these sections will require terracing or paving to control erosion.

The existing storm drainage system must be upgraded to provide adequate storm and grey water drainage from the neighborhood. Precast, wire-mesh reinforced concrete tiles should be tried as a substitute for the poured-in-place concrete channels. Open channels should be used wherever possible to keep drainage system costs to a minimum.

Port Bouet Sites and Service

All of Port Bouet lies on a flat formation of coarse sand. Here the Team recommends a storm drainage system consisting of plain, unlined ditches which can be easily cleaned and maintained with unskilled hand labor or with a tractor-drawn plow. RHUDO should ask the relevant agencies of the GOIC to collaborate with the mayor of Port Bouet in developing permanent programs, not only to maintain the storm drainage system but also to operate a practical solid waste collection system.

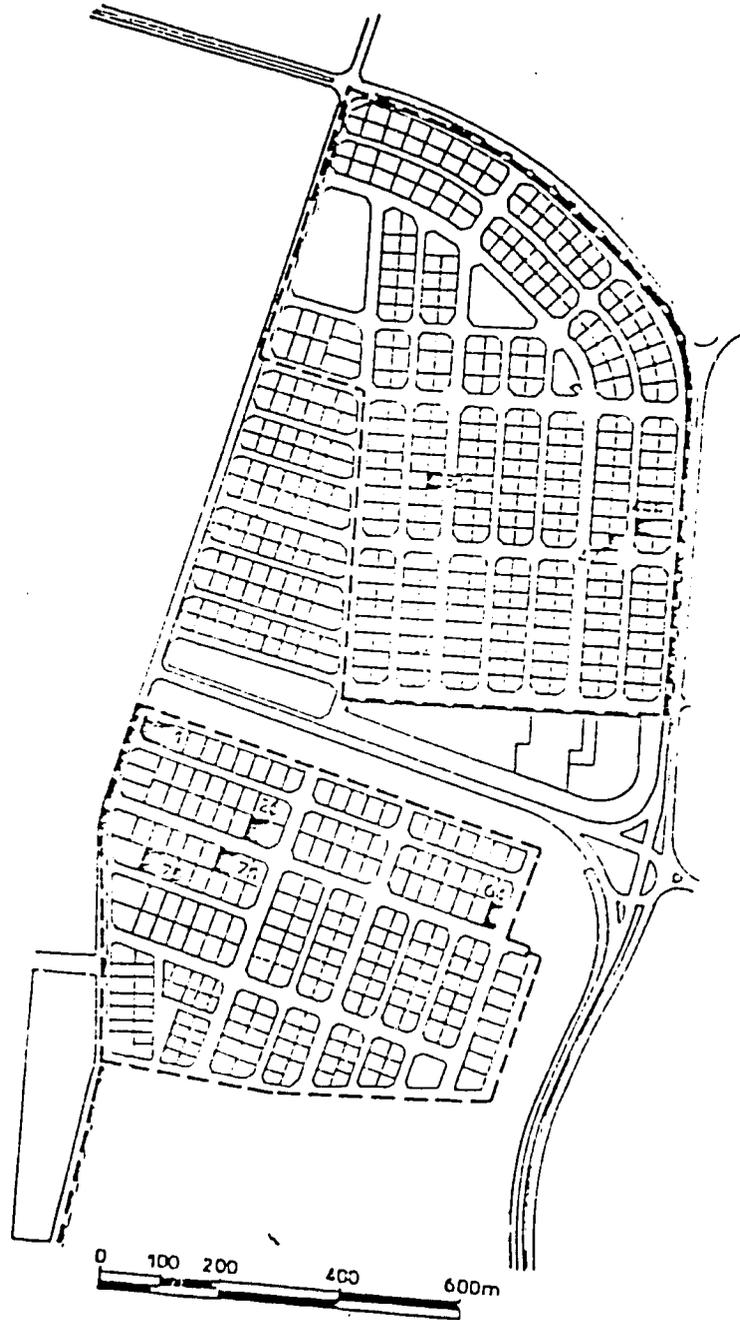
4.2.11 Social Support Activities

The Team has noted that many of the elements needed to catalyze real development around the physical effort to improve a neighborhood are neither coordinated nor fully focussed on the goals to be achieved. There is a vital need to mobilize and motivate people to work for the betterment of their own neighborhoods and families. Channels of information and agencies need to be created or reoriented at the several levels of neighborhood, commune, and commune administration, and technical services and social action need to be planned, coordinated, and implemented simultaneously. Therefore, the GOIC needs to develop a "social package" such as that presented in Appendix K to complement the site construction efforts.

ADJAME

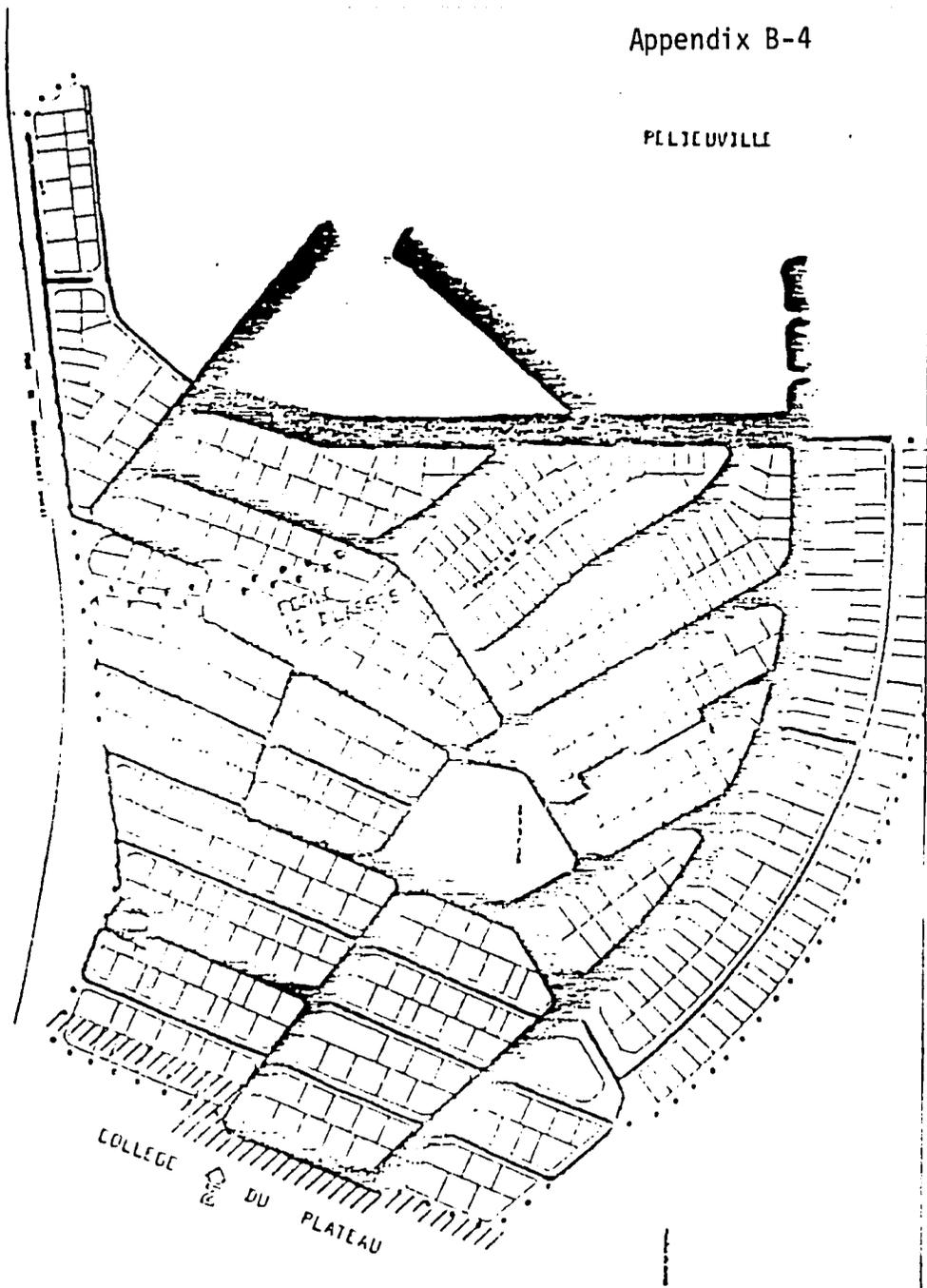
Appendix B-3

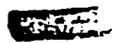
Localisation des cours enquêtées



Appendix B-4

PELLJEUVILLE



 RUES BITUMÉES
 VOIES PIÉTONNES

APPENDIX A

**Project Design Summary for Ivory Coast
Logical Framework**

Life of Project:
 From FY _____ to FY _____
 Total U.S. Funding _____
 Date Prepared: _____

PROJECT DESIGN SUMMARY

LOGICAL FRAMEWORK

Project Title and Number:

681-HQ-003

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
<p>Program or Sector Goal: The broader objective to which this project contributes:</p> <p>Improved shelter and related amenities for low-income urban residents.</p>	<p>Measures of Goal Achievement:</p> <ol style="list-style-type: none"> 1. Constantly increasing number of water outlets and sanitary facilities per capita in lower income area. 2. GOIC increases construction of community facilities designed to serve low income families. 3. More manifestations of community pride and organization, i.e., neighborhood associations, improved home and environs maintenance and independent construction projects. 	<ol style="list-style-type: none"> 1. Periodic reports from participating agencies. 2. SER/II and IBRD on site reviews. 	<p>Assumptions for achieving goal targets:</p> <ol style="list-style-type: none"> 1. GOIC remains committed to concept of carrying-out shelter projects for target group. 2. Target group will accept options offered as solutions to their shelter needs. 3. GOIC able to find funding for future projects. 4. Completed projects will result in environmental and health improvements.
<p>Project Purpose:</p> <p>Establish and strengthen a coordinated program operation to design, implement, finance and manage replicable shelter projects for lower income families.</p>	<p>Conditions that will indicate purpose has been achieved: End of project status.</p> <ol style="list-style-type: none"> 1. SETU, SICOGL, MCU & BNEC cooperate to complete IIG project on schedule. 2. Above institutions prepare proposals for future low income housing projects. 3. 100% of IIG assisted low-income affordable by families below median income. 	<p>Units to be established within MCU (for upgrading and LEM projects) to gather baseline data and monitor construction, management and socio-economic developments.</p> <ol style="list-style-type: none"> 1. Periodic reports from participating agencies. 2. SER/II and IBRD on site reviews. 3. IBRD/SER/II/ evaluation reports. 	<p>Assumptions for achieving purpose:</p> <ol style="list-style-type: none"> 1. Inflation/wage relationship remains relatively constant. 2. Lower income housing projects receive only minimal subsidies.
<p>Outputs:</p> <ul style="list-style-type: none"> Establishment of Central Fiduciary for lower income housing projects with trained and strengthened staff. Completed projects in: <ol style="list-style-type: none"> a) Slum Upgrading b) Sites and Services c) Low income rental housing Trained monitoring unit in MCU/SETU 	<p>Magnitude of Outputs:</p> <ol style="list-style-type: none"> 1. Consolidated BNEC, staff capable of executing responsibilities. 2. <ol style="list-style-type: none"> a) ± 4,000 lots for from 110,000 to 150,000 people. b) ± 4,000 lots for from 22,000 to 44,000 people. c) ± 2,000 units for ± 10,000 people. 3. Nuclear staff of 6 professionals 	<ol style="list-style-type: none"> 1. Construction reports. 2. Participating agencies reports. 3. On-site reviews. 	<p>Assumptions for achieving outputs:</p> <ol style="list-style-type: none"> 1. GOIC accepts concept of slum upgrading as viable alternative to slum clearance. 2. GOIC will not enter into loan agreements or future high subsidy shelter programs which would siphon funds from the sector. 3. LEM residents able to finance construction of houses. 4. Rental increases in slum upgrading areas moderate so that relocation for economic reasons avoided.
<p>Inputs:</p> <ul style="list-style-type: none"> NG IBRD TA GOIC Home Loans 	<p>Implementation Target (Type and Quantity)</p> <ol style="list-style-type: none"> 1. \$21 million 2. \$22 million 3. <ol style="list-style-type: none"> a) 72 man months to MCU monitoring unit and b) 96 man months to BNEC c) IIG short-term to Savings Division of BNEC. 4. \$20 million. 5. \$2 million from IBRD plus \$1 million from GOIC. 	<ol style="list-style-type: none"> 1. Disbursement records. 2. Participating Agency Reports. 	<p>Assumptions for providing inputs:</p> <ol style="list-style-type: none"> 1. US Investor will be found. 2. GOIC able to budget funding for its commitments. 3. Qualified/Trainable local personnel available.

Localisation des cours enquêtées

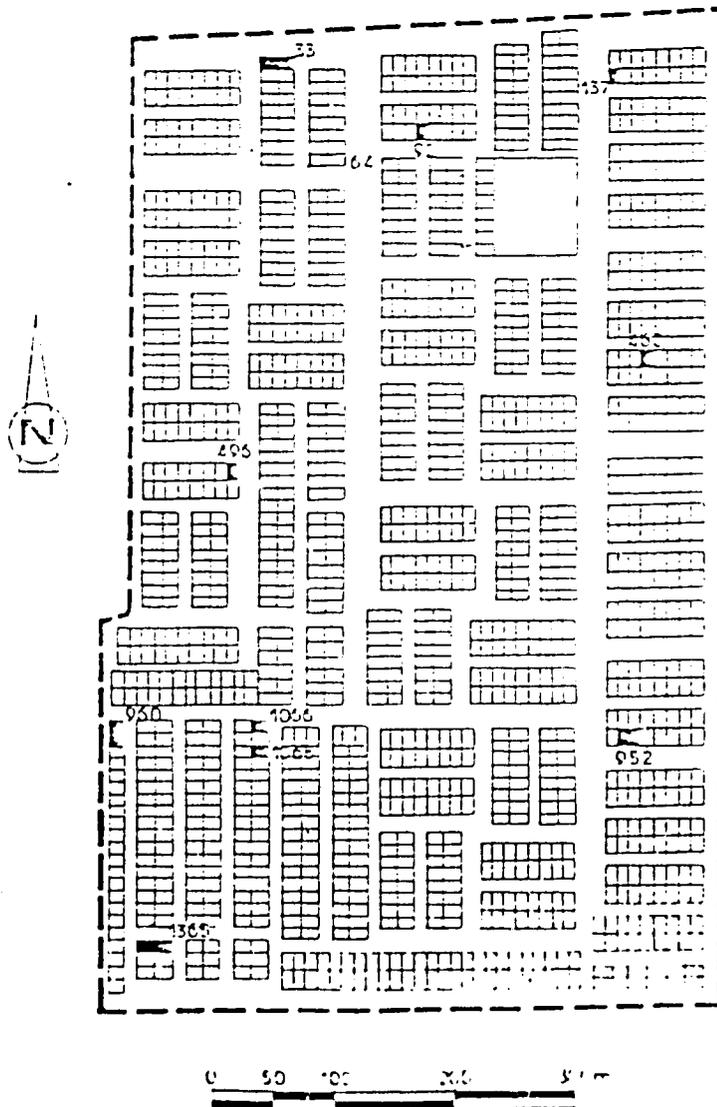


ABOBO CÔTE D'IVOIRE

Appendix B-1

PORT BOUET II

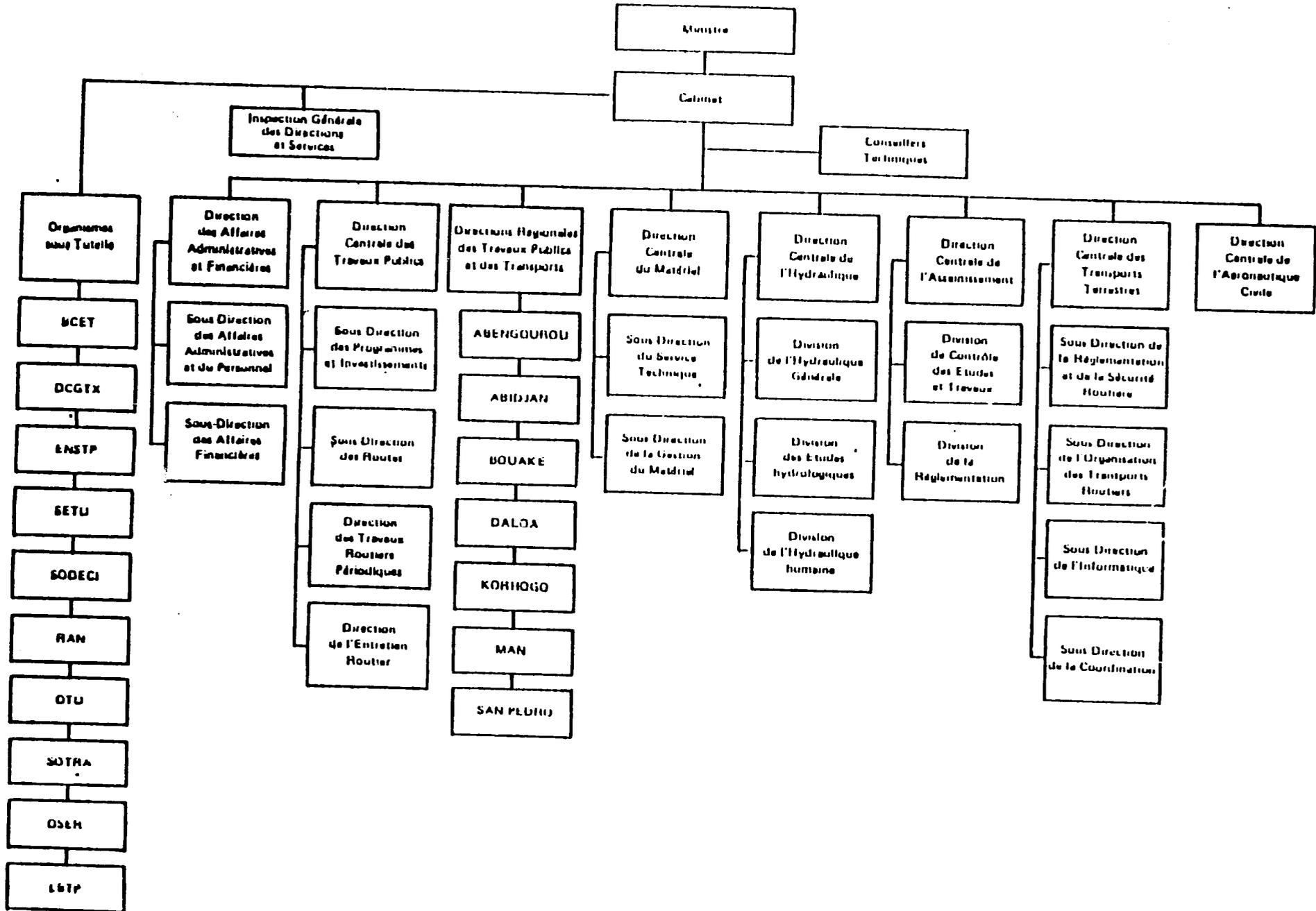
Localisation des cours enquêtées



APPENDIX C

Organization Charts for
Ministry of Public Works and Transport
Ministry of Construction and Urban Planning
National Urban Land Development Company

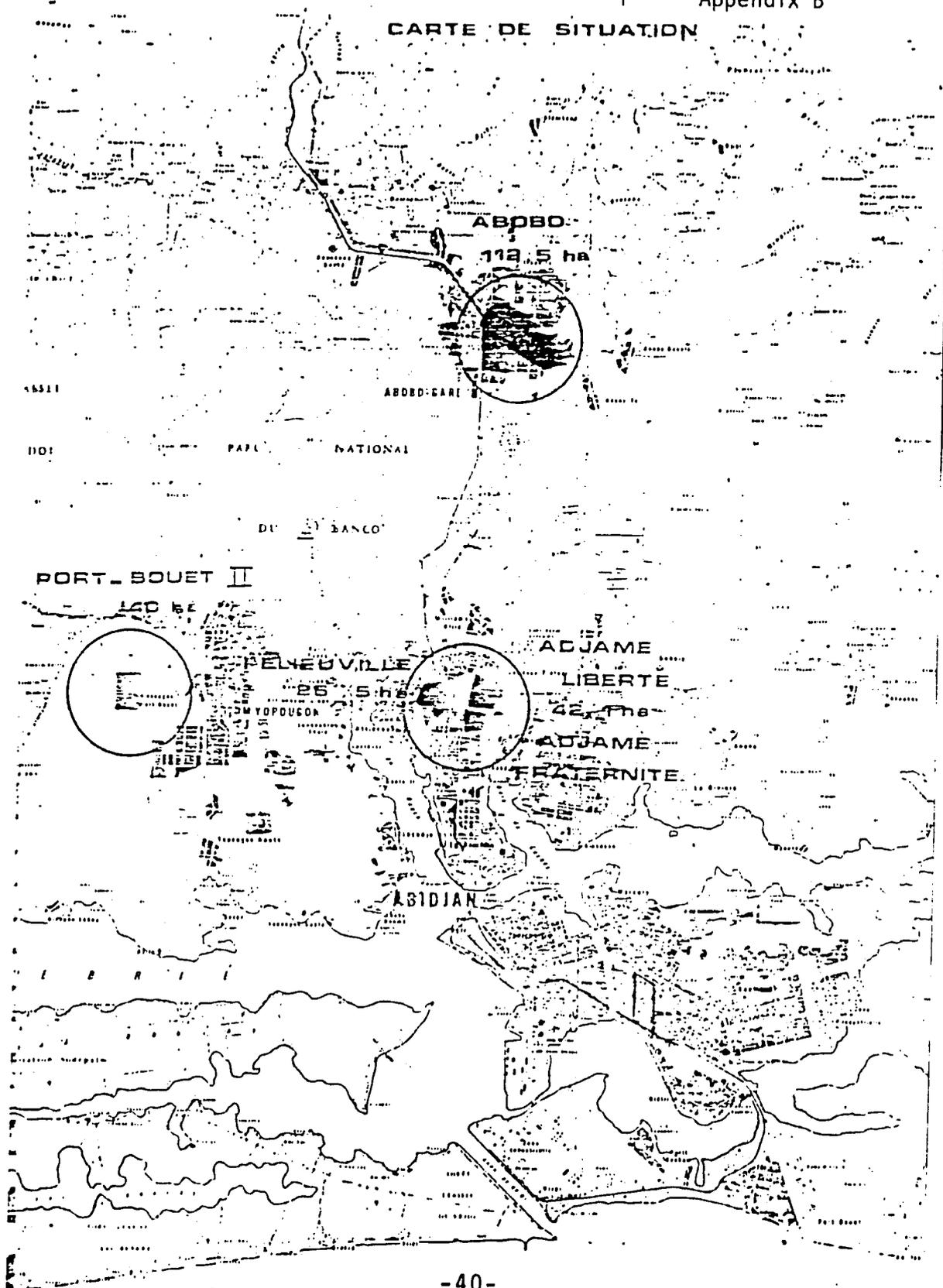
COTE D'IVOIRE
DEUXIEME PROJET DE DEVELOPPEMENT URBAIN
 Ministère des Travaux Publics et des Transports
 Organigramme



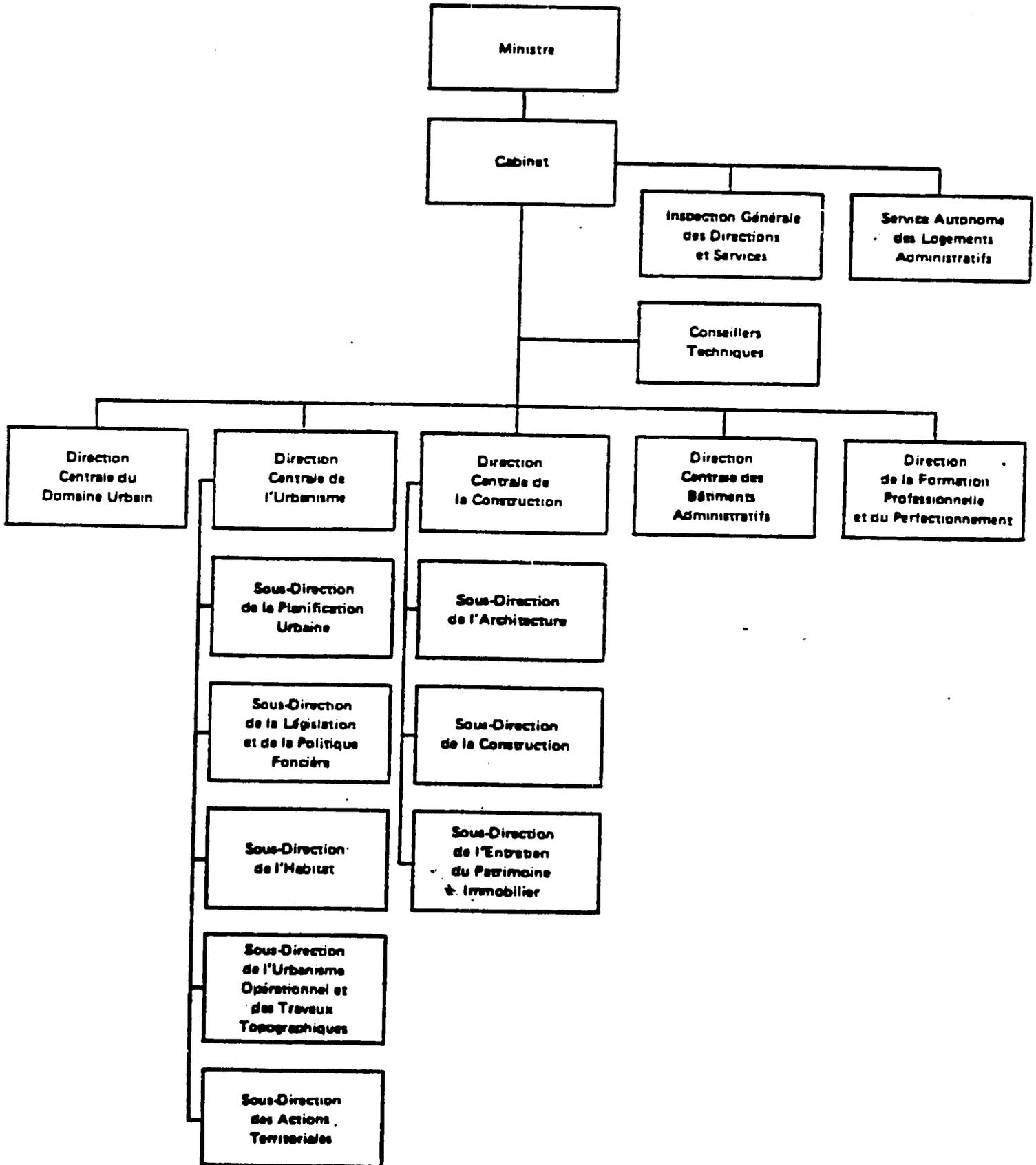
APPENDIX B

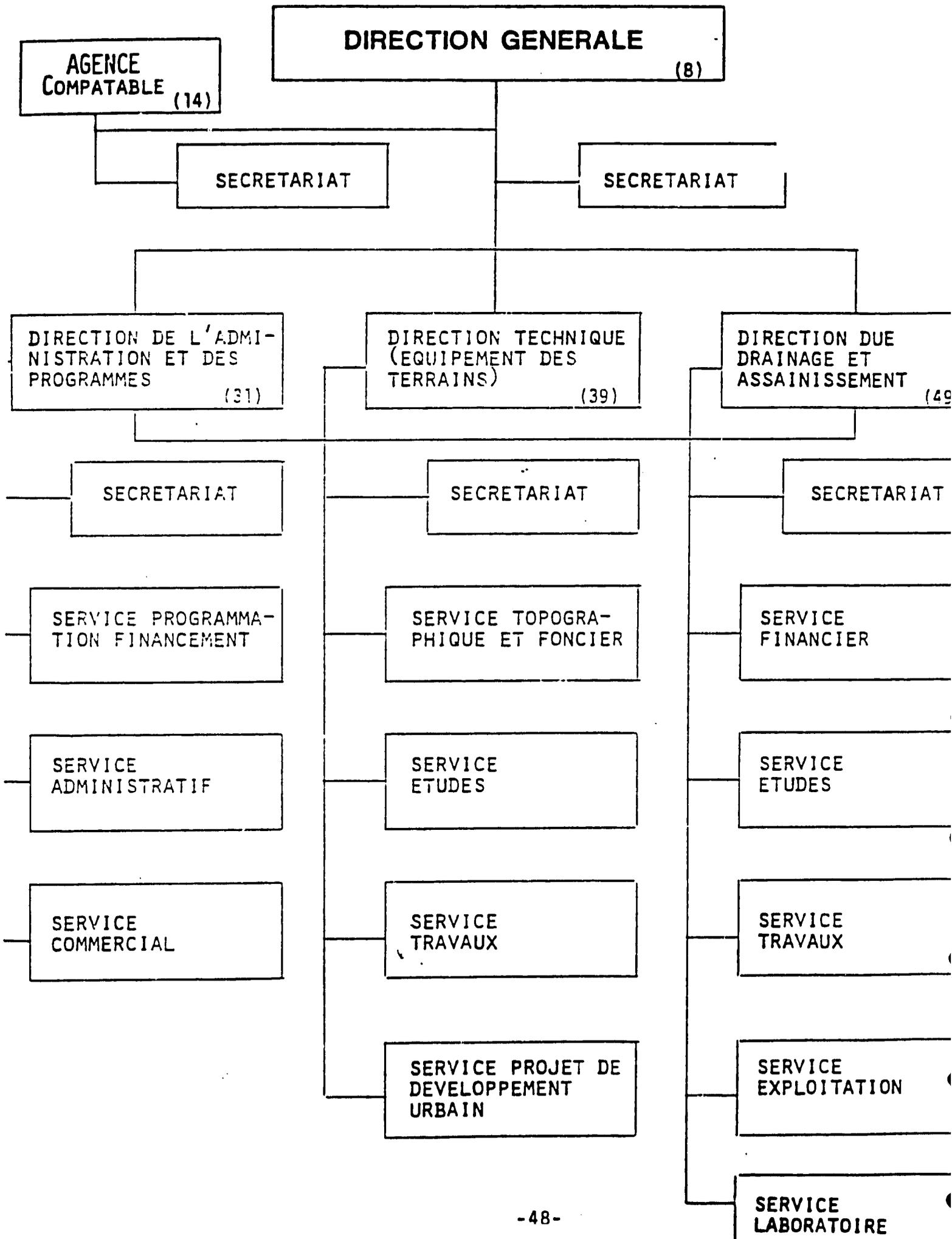
Location Maps for Housing Sites

CARTE DE SITUATION



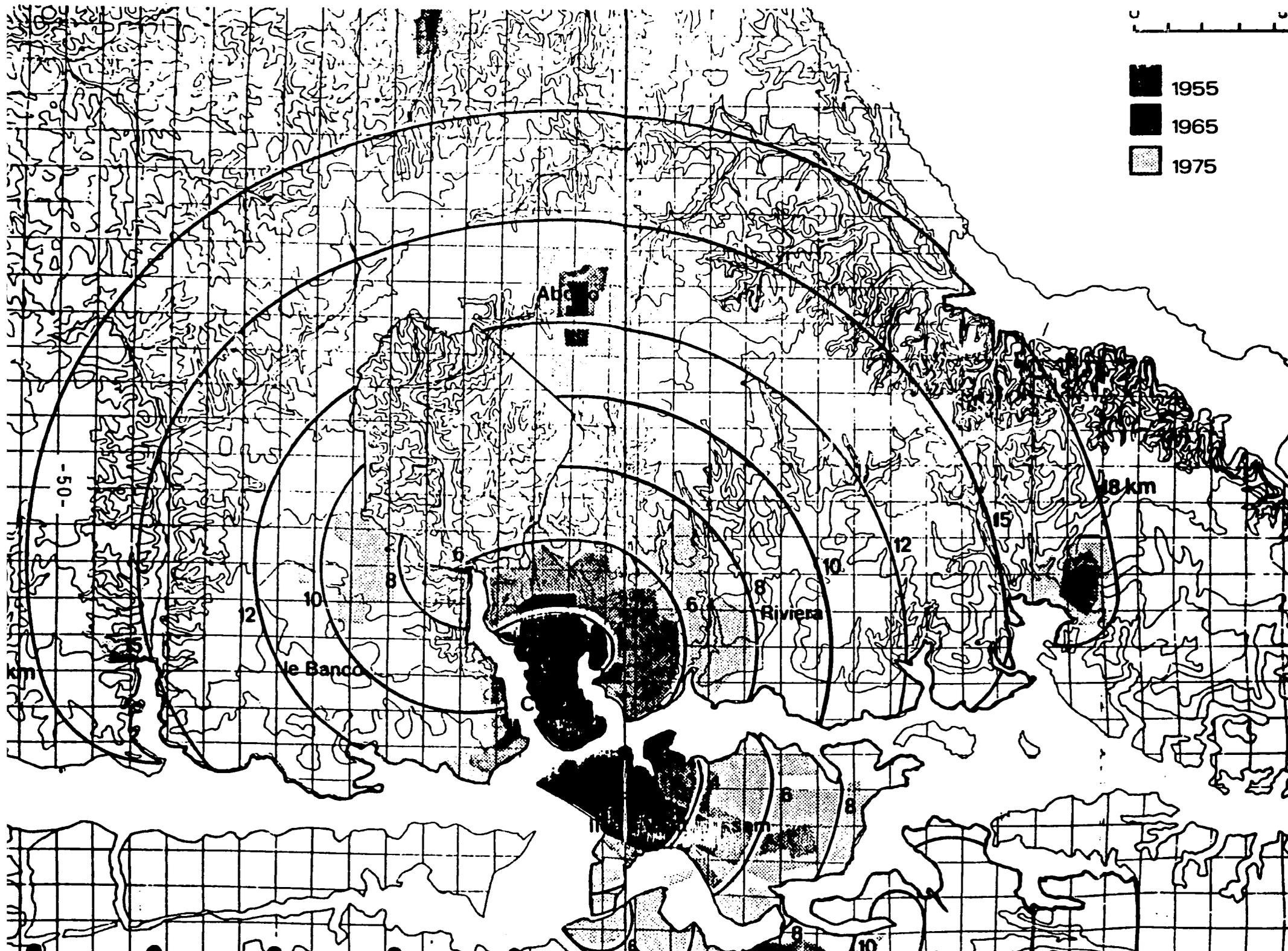
COTE D'IVOIRE
DEUXIEME PROJECT DE DEVELOPPEMENT URBANISME URBAIN
Ministère de la Construction et de l'Urbanisme
Organigramme





APPENDIX D

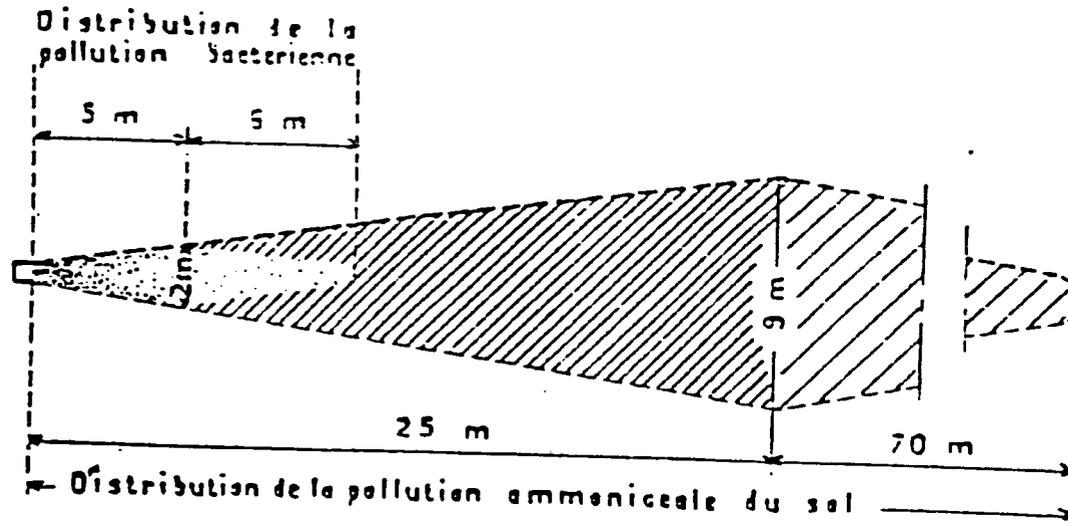
**Growth of Abidjan
(1955 to 1975)**



APPENDIX F

Potential for Ground Water Contamination from use of Latrines

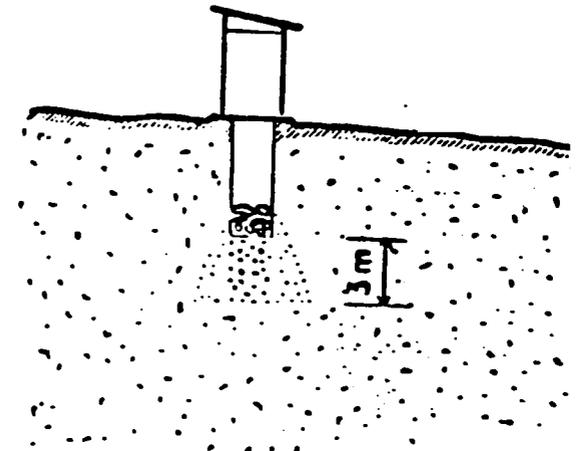
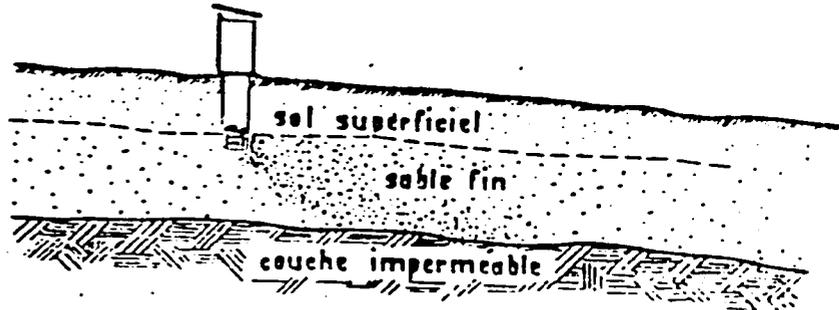
DANS LA NAPPE AQUIFERE



DANS UN SOL SEC



Flux de l'eau souterraine
1 à 3 m par jour



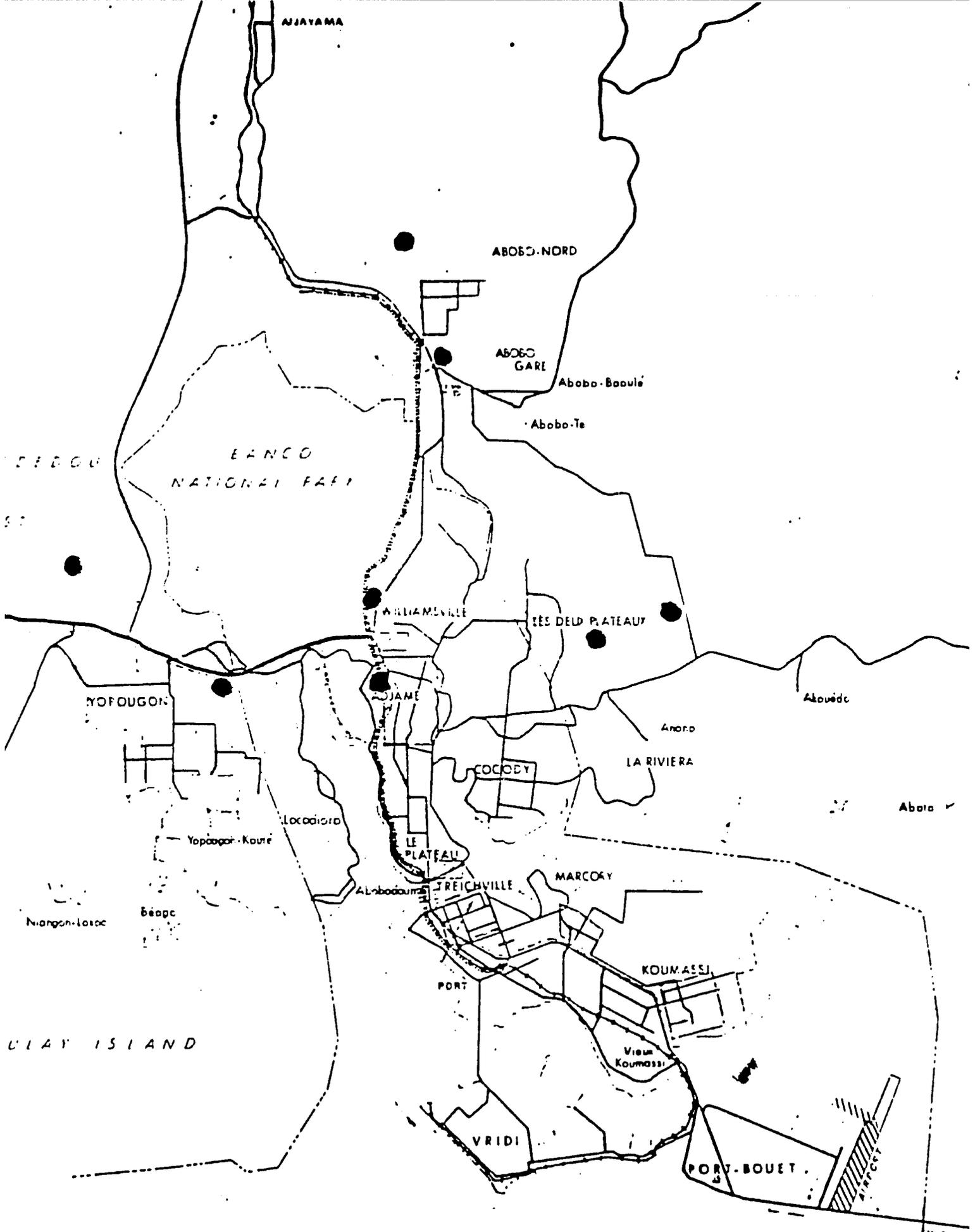
LATRINES

POLLUTION

BACTERIENNE

APPENDIX E

Location of Water Distribution Company's Well Field for Abidjan
(SODECI)



APPENDIX G

Sanitation Situation in 1975

VILLE D'ABIDJAN
SITUATION DE L'ASSAINISSEMENT EAUX USEES
en 1975

Quartiers	Population 1975	Nombre de fosses septiques 1975	Population raccordée aux fosses septiques 1975	Population raccordée à des sta- tions d'é- puration 1975	Population non résidente 1975	Rejet domestique en lagune (Equivalent habitant) 1975
Plateau	15.050	-	-	500	2.950	17.500
Adjamé	122.455	375	3.000	2.500	-	116.955
Attiécoubé	47.122	-	-	-	-	47.122
Williamsville	20.449	140	1.000	9.600	-	9.849
Treichville + Port	111.327	1.250	10.000	-	2.000	103.327
Marcory	64.655	1.000	5.100	-	-	59.555
Koumassi	144.215	6.250	50.000	700	-	93.515
Zones 3 à 4 C	20.000	2.300	15.000	-	-	5.000
Vridi	20.650	450	3.500	-	-	17.150
Port-Bouet + Aéroport	58.265	3.750	30.000	-	-	5.000 (23265)**
Cocody	26.835	2.750	15.000	9.700	6.500	8.635
Blokosso	7.300	900	7.300	-	-	-
Deux-Plateaux	27.000	750	4.356	10.000	-	(12.650)*
Yopougon	80.215	-	-	-	-	80.215
Locodjo	22.329	1.000	8.000	-	-	14.329
Abobo	141.678	3.000	24.000	10.500	-	(107.178)*
Riviéra	12.508	-	-	-	-	12.508
TOTAL	942.052	23.915	176.200	43.500	11.450	590.660

* Cette population rejette directement dans les talwegs

** Cette population rejette en mer.

$$(5) = (1) - (2) + (3) + (4) - (6)$$

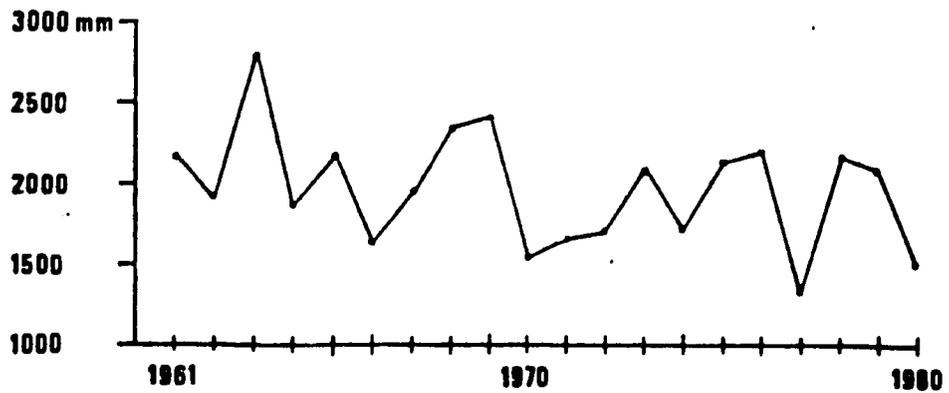
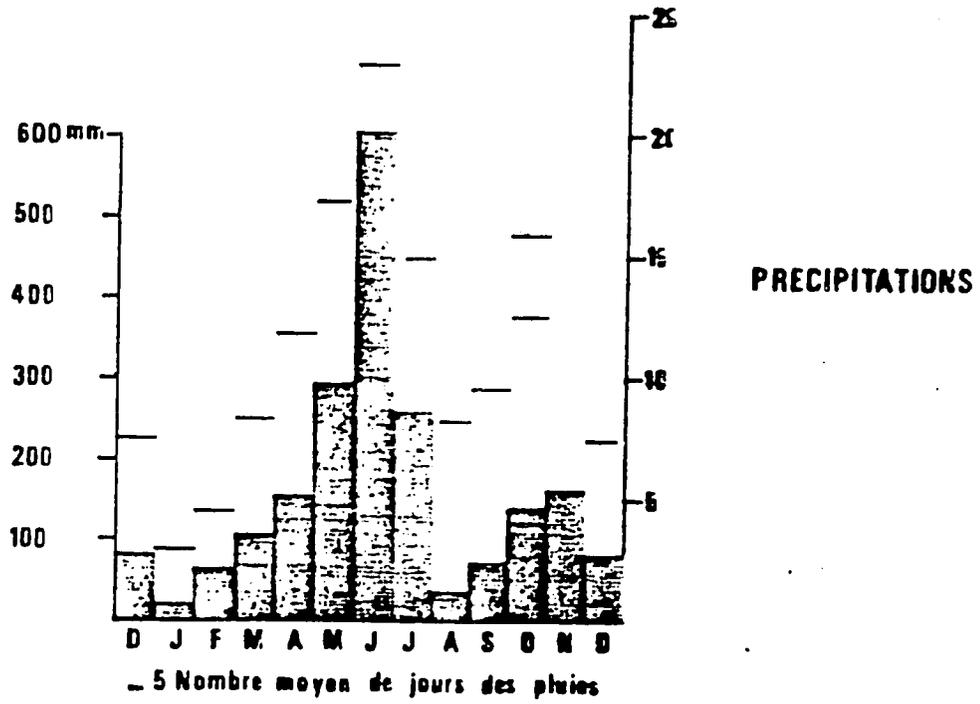
APPENDIX H
Rainfall Observations
(1961 to 1980)

ELEMENTS GENERAUX DU CLIMAT

OBSERVATIONS 1961-1980 (ABIDJAN - Aéro)

Source : ASECNA

fig.2



APPENDIX I

Cross Section of Terrain at Abidjan

COUPE TOPOGRAPHIQUE DU LITTORAL

(en face de Gonzagueville)

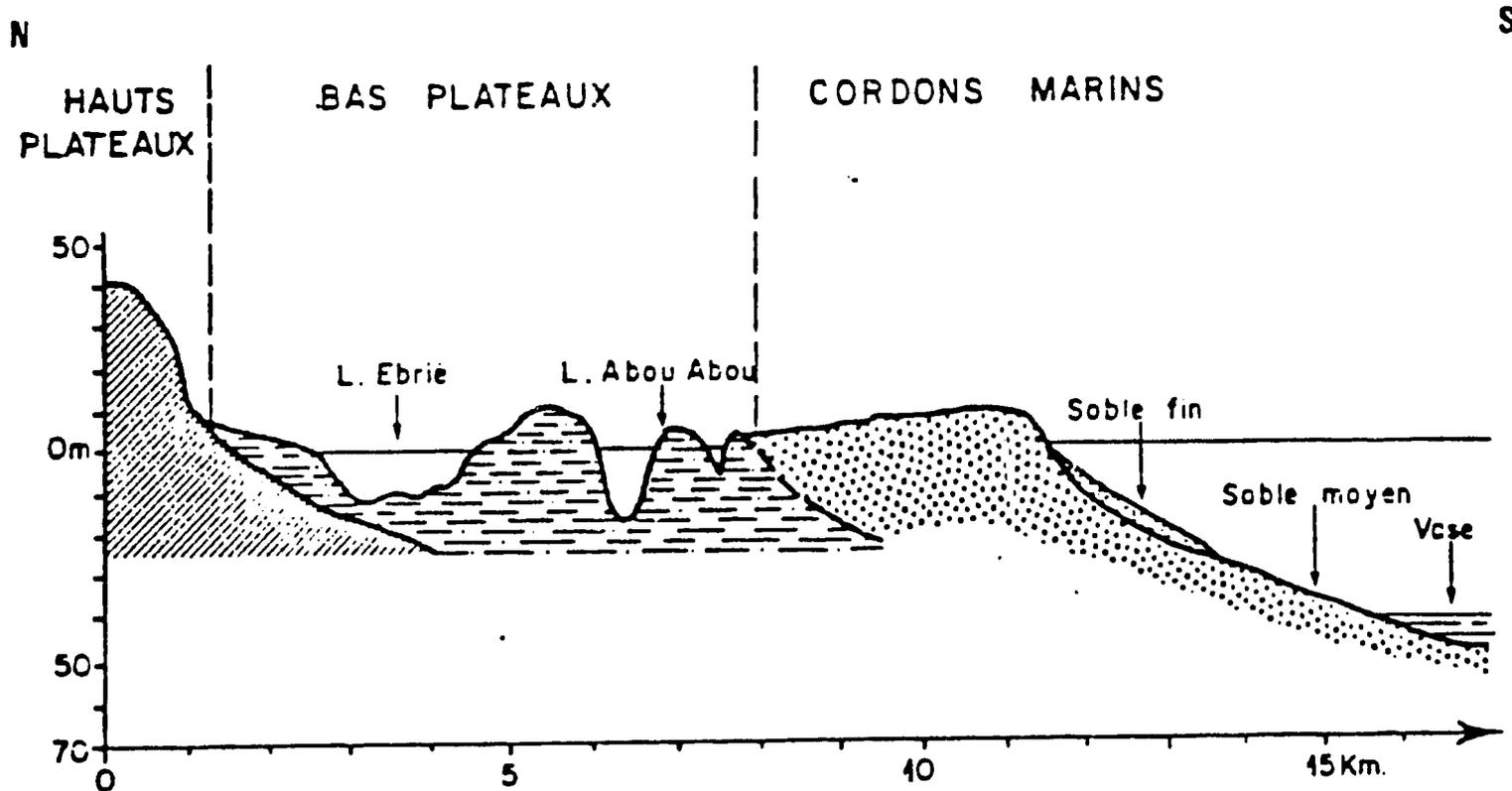


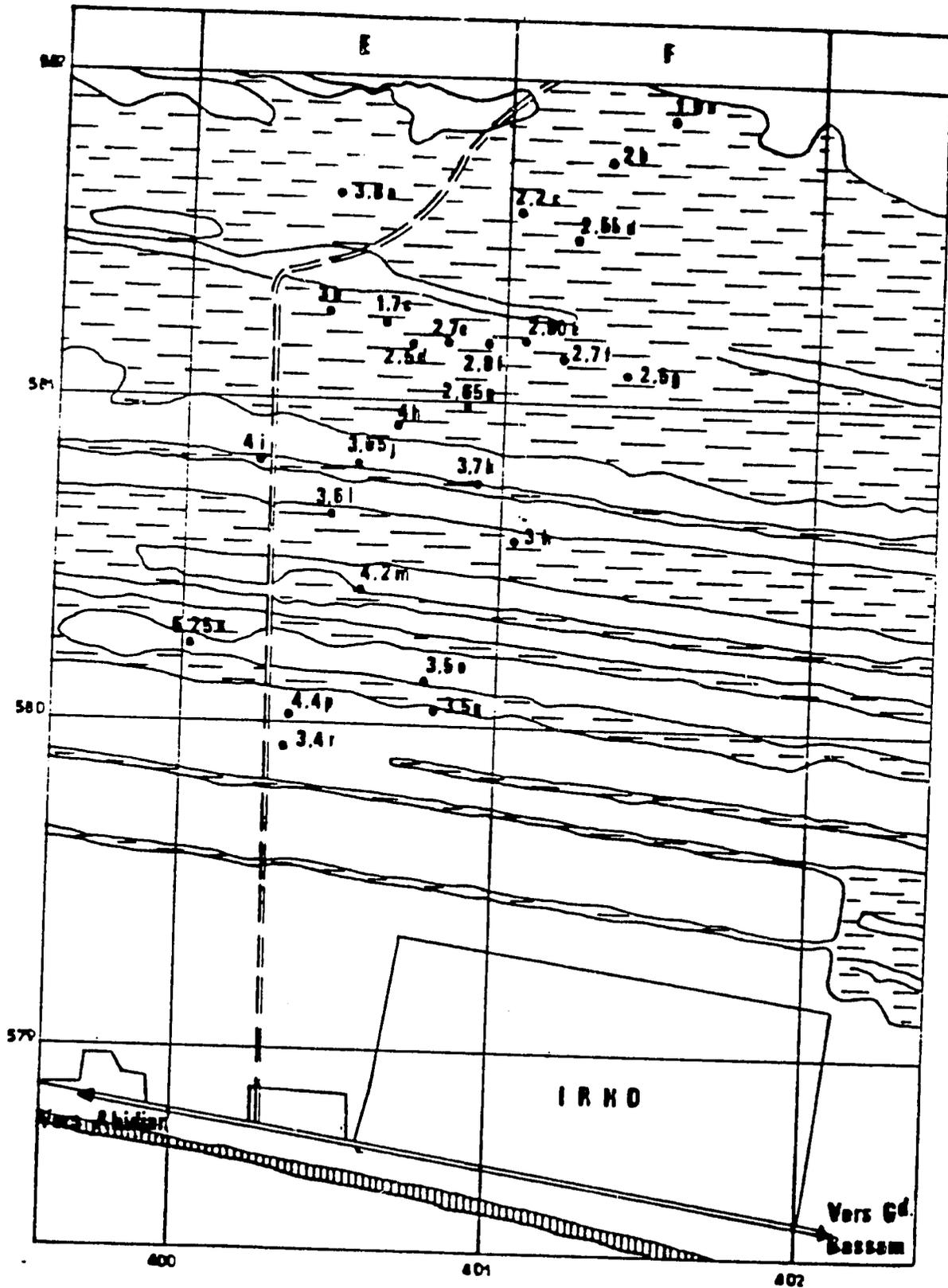
fig. 6

APPENDIX J

Piezometric Levels in the Area of the Airport

POINTS D'EAU-COTES PIEZOMETRIQUES-ZONE DE L'AEROPORT

Sources LBTP mi-mai 1961



• 4 i point d'eau et son niveau piézométrique
 [Hatched Box] Zones marécageuses

APPENDIX K

Recommended Social Actions to Support RHUDO Housing Effor

Recommended Social Actions to Support RHUDO's Housing Effort

1. Proposed Plan of Social Support Actions

Although infrastructure inadequacy is a major cause of the poor health and sanitation conditions in Abidjan, the lack of participation and abdication of responsibility by the populace is an element of major importance. Reasons for this state of affairs have been discussed previously at length. A model plan to a systematic attack on these problems is proposed in this appendix. The system created should:

1. Incorporate and sensitize neighborhood residents;
2. Create action oriented agencies where needed;
3. Reorient and coordinate existing services and resources;
4. Establish procedures for liaison;
5. Pinpoint and assign responsibilities
6. Provide regular educational channels and procedures for disseminating information
7. Develop continuous and long-range activities for women and youth in civic-oriented education and training.

From the social aspect, the two central problems are:

- 1) How to bring health and sanitation services to a satisfactory functional level; and
- 2) How to integrate neighborhood residents into a dynamic community, capable of generating an acceptance of responsibility and self-help activities to tackle neighborhood problems. The WASH team proposes the following model plan which we believe could catalyze appropriate action:

1.1 Build on the Site and Equip:

1) An Office for the Community Development Action Team

This building should also contain a Community Meeting room or space for Neighborhood Association meetings, films, etc. It should be adjacent to the building materials depot and have an atelier where the Construction Technician-Advisor would work with neighborhood residents.

2) A Youth House (Maison des Jeunes), with large workshop space, rudimentary theatre, library, etc., and sports field adjacent.

3) A Pilot Center for Women(Foyer des Femmes), which should include a nursery for young children, classroom space, and a large workshop space in which women could learn and develop skills and trades (for example, indigo dying). It would be desirable to group the women's center and well baby and mother clinic close together.

1.2 Additional Community Equipment

The site should also have a small market area, one or more elementary schools, public pay-fountains with overhead outlets, play areas and communal space distributed throughout the site, designated garbage can emplacements; and designated garbage "dumpster" emplacements. It would also be desirable to have an area on the site for small factory workshops, a sort of "production area" with access to a heavy-duty road and parking for delivery of supplies. Vehicle parking lots should also be included in the plan, since most houses will be accessible only on foot-paths. Regularly disposed fire-hydrants at regular intervals are a necessity.

1.3 Create at the Commune Level:

1) A Community Development Action Team

Members of the Community Development Action Team should be seconded from relevant Ministries and agencies and report to the Commune Mayor's Office from which they should have administrative support.

Team Composition:

1. Community Organizer
2. Social Workers
3. Outreach Paramedical
4. Sanitary Inspector
5. Directress of Women's Center
6. Director Youth House
7. BCET Ethno-sociologist

Team Responsibilities

1. Hygiene and health surveillance
2. Education, information, orientation
3. Programs

Mode of Operations: Outreach in the neighborhoods.

2) A Community Coordinating and Health Committee

This Committee should meet at least monthly and inform and advise the Mayor. The Committee should be made up of a representative of the Mayor, Chiefs of ethnic groups, and their spouses. Consulting with the Commune Mayor, it should:

1. Discuss problems;
2. Inform itself;
3. Determine and publish desirable policy regarding Commune needs
4. Motivate salubrious actions in the neighborhoods.

3) A Neighborhood Association(s)

All people assuming parcels of land should be charged a modest sum, which would make them a (paid) member of the Neighborhood Association. Both male and female heads of household and their spouses would be considered members of the association and should be expected to participate. They would:

1. Meet at regular intervals to determine problems, and report them to the Community Coordinating and Health Committee;
2. Publicize policy;
3. Organize action in conjunction with the Community Development Action Team;
4. Collect modest fees and pay neighborhood garbage-removal personnel with the funds so collected.

1.4 Provide Technical Assistance

AID should expect to provide two technical assistants for at least two years as the parcels of land are purchased and settled. In addition, arrangements should be made through the SHDS Project (currently working in the health education field in the Ivory Coast and the West African region) to develop environmental hygiene training modules and trainers as detailed below.

Technical Assistants:

1. Community Development Organizer

This is an ideal job for the Peace Corps and it is worth exploring to see if the Peace Corps is interested in sending a small contingent of volunteers back to the Ivory Coast. The Community Development Organizer would orchestrate goal-oriented interaction among the various elements until they could do it themselves.

2. Construction Technology Advisor

With office and workshop in the on-site Community Development Office, this advisor would help landowners to plan, estimate and choose materials, and handle construction problems. He would also back determined efforts for the beautification of the site with trees, gardens, etc. and provide advice. He would be back-stopped by BCET. (This could also be handled through the Peace Corps, at relatively low cost.)

1.5 Provide Training and Educational Materials

Using facilities of the SHDS Project in close coordination with the Institute for Health Education, the Ministry of Social Affairs, and the Ministry for Women's Affairs, a health and sanitation education program should be developed with three components.

1. Sanitation Inspectors

Develop a program to train Sanitation Inspectors to be attached to the Communes. Beginning with a class of (at least) 10, more could be subsequently trained for secondary cities and for large villages and rural centers. Where such personnel already exist, they could be enlisted to work with the Commune Development Action Teams.

Sanitary Inspectors would among other things inventory all wells, and provide regular chlorination; supervise the sanitation conditions of the market; make regular neighborhood visits and inspections to control for stagnant water, drainage-blockages, etc.; regularly visit all public fountains, and insure their operation and maintenance.

2. "Sanitation in Cities" Module

Develop a "Sanitation in Cities" training module with and for the Institute of Health Education. This would be offered to social workers, women's center trainers, and Ministry of Health extension workers, who should be trained together in a short seminar.

3. Community Coordinating and Health Committee

Develop a third training module, a seminar of one or two sessions, perhaps with film strips to be offered to the Community Coordinating and Health Committee, as well as Neighborhood Associations. These training materials could be used in subsequent projects and sites, as well as in secondary cities.

2.1 Proposed Women's Center Program

The Directress for Program Development in the Ministry for Women's Affairs is prepared to develop a special program for a pilot center which would offer health and sanitation education. A desirable program for the center would include:

1. Home and child care
2. Water use and community sanitation
3. Health and family planning
4. Orientation to the city, and problem resolution
5. Modern career skills and training.

2.2 Proposed Youth-House Program

Traditional patterns of social organization in West Africa include "generation class" and/or "age class" institutions. This means that among some tribes throughout an individual's life he belongs to the same generation which has a specific name, and to the same class within the generation. Through time, the whole generation changes its status and its role from youth to warrior to adult and family man to elder. Passage from one status to another is ritually and ceremonially recognized and each status prescribes its own role and responsibility. The work of "warriors" was sometimes military, but often social and economic. They sometimes built villages and did "public works." Age-class organization served to integrate tribal societies.

A youth program could build upon this tradition and integrate young people and mobilize them to public-spirited action. Many young people have little schooling and no trades. Therefore a desirable program would include:

1. Job training skills
2. Orientation to the city and problem resolution
3. "Age class" group development for civic works
4. Health and sanitation education
5. Sports
6. Perhaps a "Public Health Theatre Group" could be developed to carry the messages further

3.4 Miscellaneous Social Support Approaches

General approaches and ideas:

1. Give the site or neighborhood a special name, a "name of hope". Identification is important.
2. Study African traditional settlement and village space-use pattern and house design to be integrated into future housing efforts. The University's Ethno-sociological Institute would gladly give its students the research projects.
3. Encourage a return to African art as a part of neighborhood beautification.
4. Encourage neighborhood associations and youth groups to humanize and beautify the neighborhood, i.e., building benches and tables in small park-like squares or building simple children's play equipment, and planting trees, flowers, and gardens for better nutrition.

4. Existing Social Agencies

Agencies already exist which can be used to tackle health and sanitation problems in the neighborhood and are already active.

4.1 Governmental Agencies

The Ministry of Interior, through the Direction des Collectivites Locales is the line agency for the Mayor's Office. Abidjan has a newly decentralized mayoral government with ten sub-mayors now heading boroughs (Communes) of the City. The Communes do not have adequate budgets to cover either staff or services and are hard-pressed for resources. Among the Communes, Port Bouet is experimenting with ways to motivate social action.

The Ministry of Social Affairs Training Institute offers a three year post-baccalaureate course for social workers. Paramedical and social curricula prepare them to work in the (11) Social Centers in the Communes, and the associated PMI Centers ("Protection for Mother and Child"). The Directress is interested, among other things, in extending the program in health and hygiene and can be expected to take a lively interest in the community organization actions this paper identifies.

Social Assistants have been active in Project 003. Although brought in late, they have been successful in catalyzing resident acceptance of upgrading efforts. Many residents had previously been hostile to up-grading activities, which they saw as a sign of possible eviction or disruption of their homes and habitat.

The Ministry of Health's new field paramedicals can provide an important resource if their training emphasizes socially constructive pedagogical methods.

4.2 Private Sector Agencies

Comites Ethniques

Most important are the ethnic associations which provide a support structure for residents from different national and/or tribal origins. Example: A newly arrived Malien, Guineean, or Bambara from the north will first seek the chief of his ethnic national group, who sees that he finds a place to stay and, if possible, a job. The ethnic networks provide a matrix for problem resolution and social activities. Within their framework are "dance" groups. More than a course of amusement, these dance networks are the basis for important social and identity groups.

Within the ethnic communities are also to be found "Tontines"--voluntary savings associations--whose members contribute to a communal pot of money and who provide social insurance, mutual assistance, and occasional access to important monetary resources for people of very modest circumstance. They usually serve as burial societies as well in a culture in which ancestors and death rituals are vitally important.

Boy-Scouts and Sports Clubs

Sponsored by the Catholic Church, Boy Scouts in Africa often include many young people in late adolescence and young adulthood which traditionally may have been mobilized through the generation and age class association.

Along with the sports clubs, these age-groups cut across the narrow vertical socially inclusive groups which ethnic identification provides and offer a broader integrating mechanism which might be oriented toward cooperative community health and sanitation action.

4.3 Port Bouet Experiment

In the Commune of Port Bouet (I) the Mayor, Mme Aka N'Ga, is currently supporting a small pilot project which will test methods to coordinate technical and administrative services and involve local residents in planning and self-improvement efforts. Project efforts embrace five neighborhoods, to wit:

1. Petit Bassam and old Ebrie village;
2. Vridi village, a mixed zone of industrial building and types B, C, D and E housing;
3. La Pointe des Fumeurs, a spontaneous settlement;

4. Toviato, a spontaneous settlement, partly bulldozed, and partly built in solid materials;
5. Adioufou, an area of mixed land tenure. There is a prospective AID/RHUDO site in this area.

In Port Bouet:

1. The borough has been divided into small neighborhoods which are asked to designate their leader. These groups are then asked to participate in neighborhood planning, implementation, and maintenance. They are asked to form a neighborhood association.
2. The Commune Mayor is working to clarify and establish a guaranteed land tenure for those on parcels in the area. This is a knotty problem as yet unresolved. The current situation is described as "a durable provisional arrangement."
3. An outreach program is trying to achieve a multi-valent field-team approach which will visit the neighborhoods regularly.

Team Components

Action

Social Workers

Teach health, hygiene, nutrition, child-care, literacy.

A Youth Trainer

Recruit for the youth programs at the Pilot Youth Center

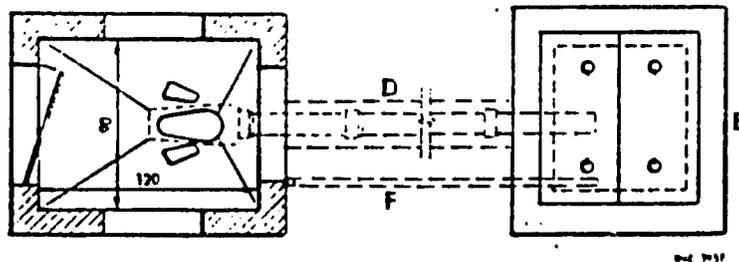
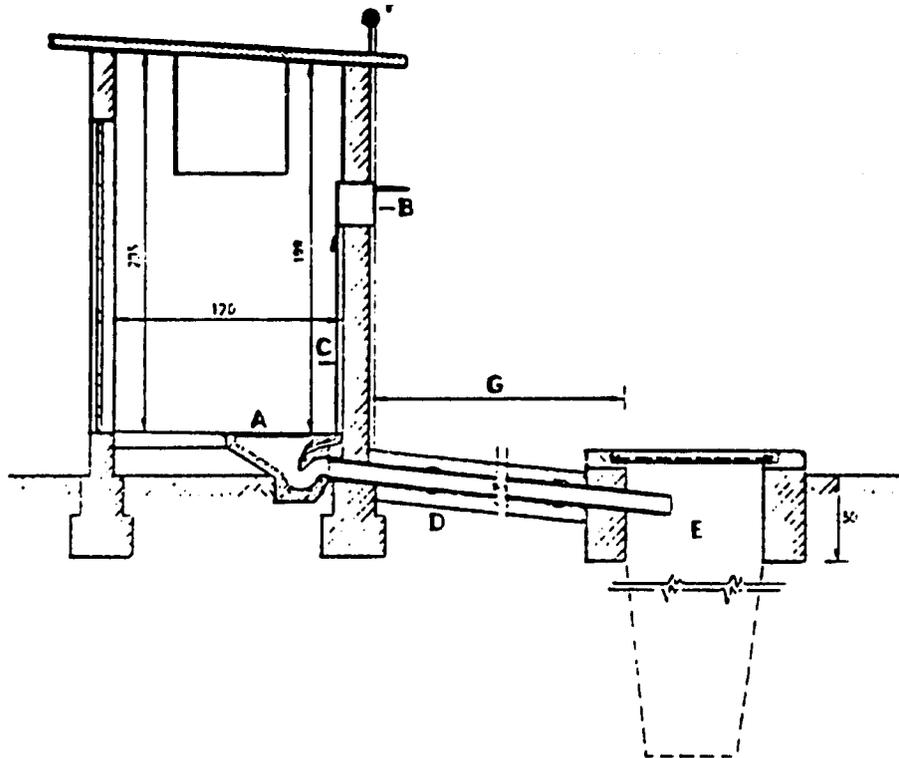
A Medical Technician

Examine, vaccinate, and weigh babies; provide child care guidance, and counseling.

4. Port Bouet Commune is seeking UNICEF help to build garbage receptacle emplacements and furnish garbage cans and big bins. They have started a well publicized "Clean Sweep" campaign where residents sweep the streets themselves.
5. A pilot youth center in Port Bouet is developing, under M. Theron, a program of non-formal education and sports. Under the aegis of the Ministry of Youth and Sports, the center hopes to generate official strategies for child oriented programs.
6. The Ministry for the Status of Women sponsors a fairly classic program of household skills in its women's centers. The Directress for Program Development hopes to move toward training women in income-generating skills and is prepared to build pilot community health efforts into the program.

APPENDIX L

Typical Water Seal Latrine



Measurements shown are in centimetres

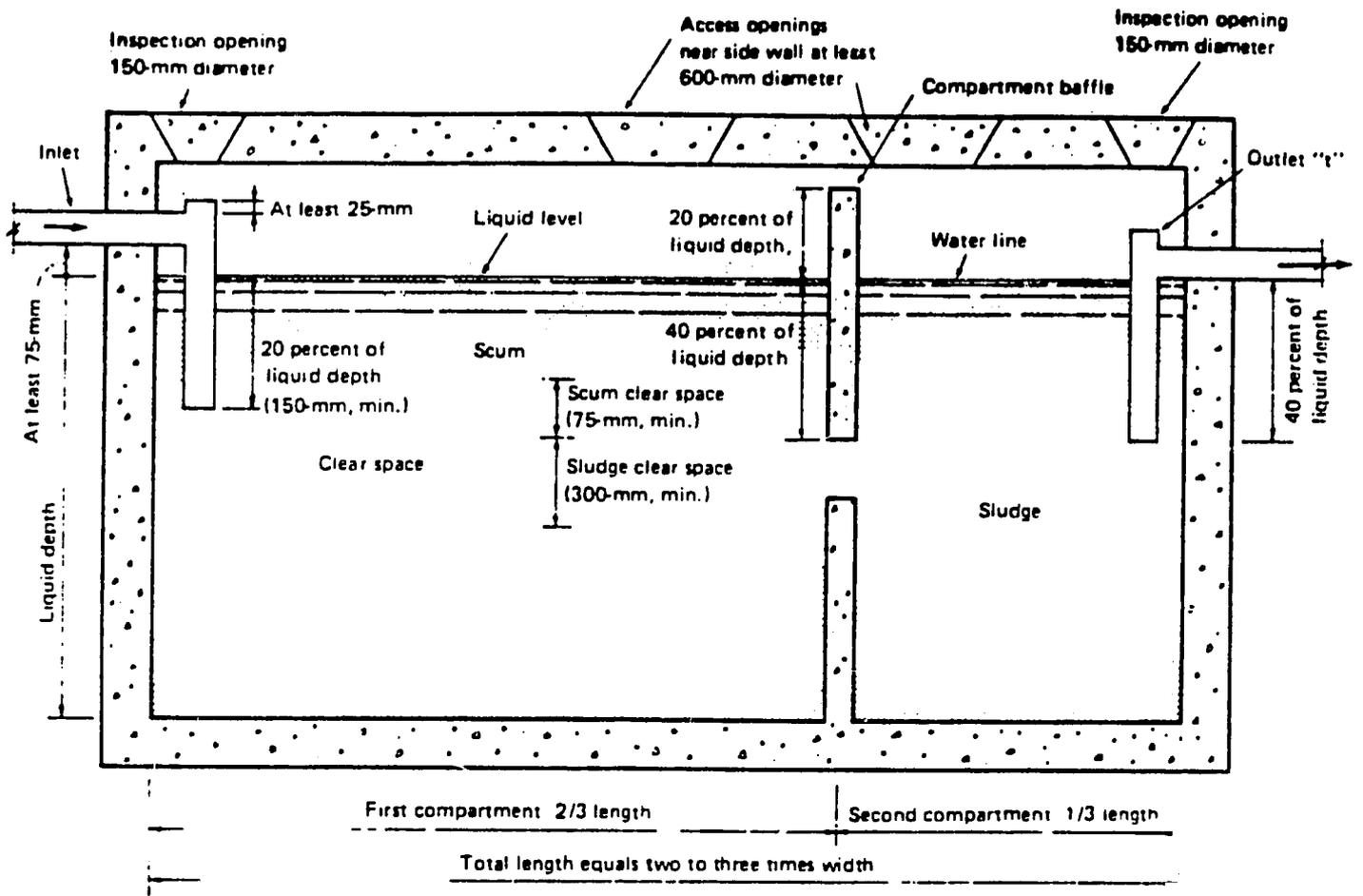
- A = Water-seal bowl with S trap
- B = Water tank, filled by hand and provided with plug cock and overflow pipe
- C = Water pipe leading from tank to bowl for flushing purposes
- D = Drain pipe embedded in concrete leading to seepage pit
- E = Seepage pit
- F = Ventilation pipe for pit
- G = Distance between bowl and pit should be as short as possible

Fig. 30. Pour-flush and soakaway system. (From Wagner & Lanox).

APPENDIX M

Schematic of Conventional Septic Tank

Figure 9 -1. Schematic of Conventional Septic Tank (millimeters)

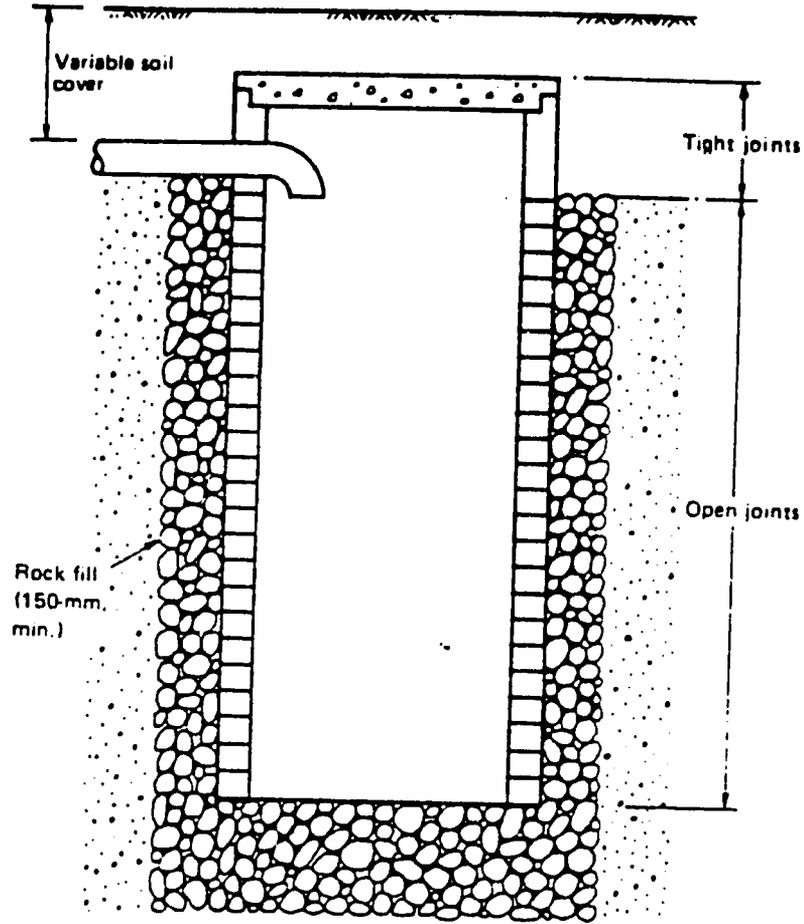


Note. If vent is not placed as shown on figures 13-2, 3, and 4, septic tank must be provided with a vent.

APPENDIX N

Schematic of Typical Soakaway

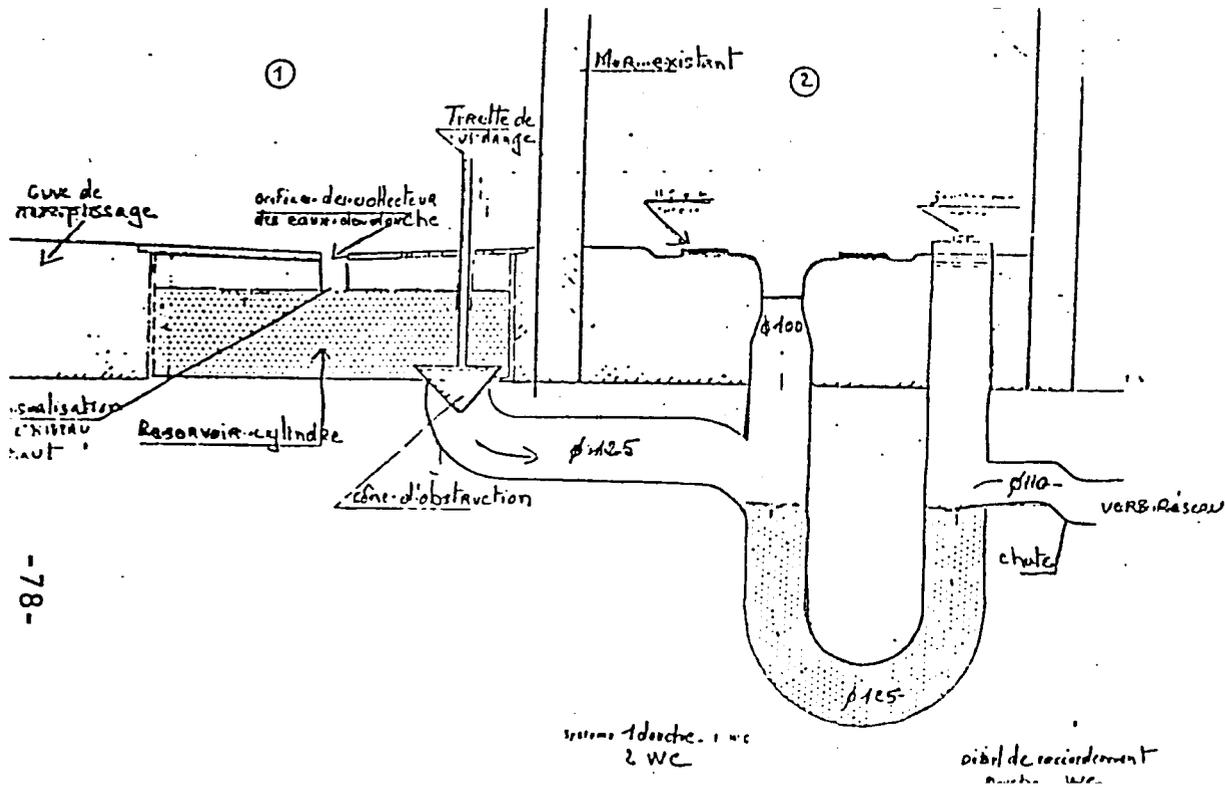
**Figure 9 -3. Schematic of Soakaway
(millimeters)**



Source: Adapted from Wagner and Lanoix (1958).

APPENDIX 0

Schematic of Water Reuse Device Being Pilot Tested by SETU



REPUBLIQUE DE COTE D'IVOIRE
 MINISTRE DE DES TRAVAIERS PUBLICS DES TRANSPORTS
 DE LA CONSTRUCTION ET DE L'URBANISME

SETU SOCIÉTÉ D'ÉQUIPEMENT DES TRAVAIERS PUBLICS

SYSTÈME D'ÉVACUATION DES EAUX
 USÉES DE DOUCHES ET DE WC
 CONCESSIONS DE PAS-STANDING

SETU - DDA

APPENDIX P

Terms of Reference for Solid Waste Specialist

**Environmental Management of Urban Solid Wastes in Developing
Countries**

A Project Guide

SAMPLE TERMS OF REFERENCE

(for Solid Waste Specialist)

**Sample Terms of Reference for Preparation and Appraisal Stages
of Solid Waste Management Projects:**

Every project for solid waste improvement is unique. In some cases, there is an expressed need for refuse collection vehicles. In other cases, there is a keen interest in a resource recovery system. In all cases, it is recommendable that the entire system of people, equipment, facilities, and organizations involved in the collection, transfer and disposal of refuse be reviewed. Special attention may be given to one particular aspect or the system; but only after the system is at least broadly assessed.

The Terms of Reference provided here are fairly comprehensive. There has been no differentiation made for Terms of Reference used in preparation versus appraisal. Certainly, the level of effort should be markedly different in the two stages of project development. However, the basic aspects of the refuse system needing to be studied, remain the same.

The level of effort required of a solid waste specialist in the conduct of a preparation or appraisal study is also site-specific. Generally, the smaller the city, the less time is required to review its needs. Furthermore, the amount of work required would depend on the competence of the local government officials responsible for refuse management and their ability to provide reliable adequate data readily.

Task 1:

The consultant will review existing reports pertinent to the development of baseline planning conditions for the study area of refuse management improvement. This will include available reports containing information on population, income distribution, land use, municipal institutional organization, municipal financial arrangements and revenue sources, commercial activity, industrial activity, land and water resources, climate and geography. Plans for future development, water supply and sanitation infrastructure, and institutional/financial arrangements would be reviewed.

This information is used to determine the quantity, character and distribution of solid wastes being generated. It is also used in determining the setting for disposal alternatives, and the management systems that govern the administration and financing of the refuse handling system.

Task 2:

The consultant will collect data on refuse generation rates, refuse composition, and refuse density. (During a preparation effort, this should include sampling and surveying of households, institutions and commercial establishments.) (During an appraisal effort, this should if possible include weighing of handcarts and trucks before and after loading to capacity.) Cooperation of the local government is essential to the performance of this task. Where citizens are involved in sampling and surveying, a social worker

and a representative of the refuse management agency should provide preliminary briefings, and obtain full cooperation. In addition, sanitation workers would be needed to provide manpower in collecting and sorting the samples.

Task 3:

The consultant will examine the existing sociocultural baseline of the project area to determine whether there are informal sectors of collection and recycling which might be encouraged to extend or upgrade their services, whether there are unique constraints to household storage of refuse, whether there are existing practices of using or recycling wastes at the household level which may affect projections of waste quantities, and whether the existing practices of discarding wastes require special modifications or public education efforts.

Task 4:

The consultant will examine the existing collection and transfer of refuse in light of road and traffic conditions, access to various neighborhoods (especially to urban poverty groups), design of dwelling and communal refuse storage containers, frequency of pick-up, time-and-motion of various types of collection methods, supervision of workers, inspection of service areas, size and productivity of collection crews, efficiency of collection and transfer routing, and citizen participation in the overall system.

Task 5:

The consultant will examine existing disposal facilities with respect to location and capacity of landfill sites; environmental issues of gas and leachate migration, fires, scavengers and vectors; and the need for land reclamation through engineered landfill practices. Proximity of landfill sites to shallow drinking water supply wells, to future public water supply development aquifers, recreational surface waters, etc., should be clearly noted with respect to hydraulic gradients and groundwater/surface runoff flow paths.

Task 6:

The consultant will assess the potential for resource recovery in view of existing and prominently pending markets for recovered materials or energy. The type of resource recovery methods viable for the study area should be related to the compositional nature of the refuse. The level of mechanization viable for the study area should be related to conditions of labor and capital costs, with various levels of mechanization assessed economically.

Potential cost recovery of resource recovery practices and systems with respect to existing and projected supply and demand of competitive products should be reviewed in the overall assessment of economic feasibility of the options. Mappings of refuse sources, potential plant locations, major transport routes and markets should be presented as part of the overall assessment of cost-effectiveness of resource recovery.

Task 7:

The consultant will review existing maintenance equipment and facilities, the skill level and length of service of mechanics and supervisors, and the stores of supplies and spare parts with respect to the needs of existing and pending refuse management equipment.

Travel times to and from the maintenance area should be reviewed relative to locations of refuse service areas. Assess the need for decentralized workshops to render services of daily maintenance and minor repairs, coupled with centralized facilities for major repairs and overhauls.

Task 8:

The consultant will provide specific recommendations for equipment and facilities for collection, transfer and disposal; staffing to administer, operate and maintain the upgraded system; and regulatory, educational and enforcement procedures to accommodate the system. To the extent possible, the recommendations should build on existing systems which are working effectively and to which existing municipal employees and citizens have become accustomed.

Task 9:

Investment, operating and maintenance costs for all recommendations in the plan for upgrading refuse management will be provided. Local and foreign exchange costs for the capital requirements will be identified. Unit costs and salary grade assumptions should be given, so that negotiation efforts or project updates may modify the costs, as needed.

A phased program of investments will be recommended in light of financial resources of the urban administration and cost recovery opportunities. The phased program should consider initial investment in those project elements that particularly address the needs of the urban poor and the opportunities for positive environmental impacts.

Task 10:

The consultant will provide basic management recommendations regarding the institutional and financial arrangements for refuse collection and disposal. Special attention to any disincentives attributed to decentralization of activities of sweeping, hauling, maintenance, etc., should be given. Overall organizational status of various institutional entities involved in refuse management should be assessed with respect to ability to plan improvements to the system and ability to obtain financial resources to carry out such plans.

If there is an informal private sector involved in collection, disposal or resource recovery, the consultant will review the obstructions or incentives provided by the existing institutional and financial arrangements regarding the encouragement of that sector to provide good service.

Task 11:

The consultant will provide a field memorandum at the end of the work period for presentation to the local government officials responsible for refuse management. The field memorandum should highlight the basic data and provide a description of the existing system. Problems and issues in refuse management should be outlined, together with basic recommendations for improvement, and an estimated budget line item for the anticipated improvement program.

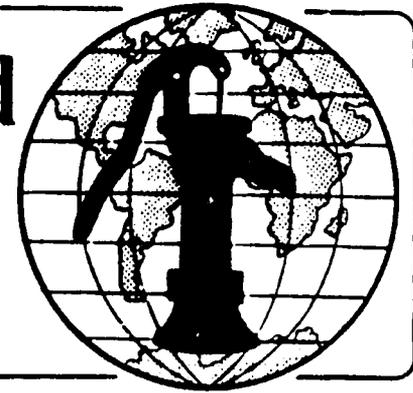
Task 12:

The consultant will provide a report, which fully addresses all of the above items of the Terms of Reference, to the level of detail commensurate with the work effort performed in the study area and the information generated and provided by others.

APPENDIX Q

Technical Notes on Designing a Solid Waste Collection System

Water for the World



Designing a Solid Waste Collection System Technical Note No. SAN. 3.D.3

A solid waste collection system is a means of removing solid waste from houses, yards, marketplaces, factories, or public buildings and transporting it to a landfill, composting area, or biogas plant. Designing a collection system involves selecting a method of collection, determining necessary materials, selecting personnel, and establishing a schedule of operation. The products of the design process are a detailed materials list and a scheduling chart. These products will be given to the construction supervisor prior to operation.

This technical note describes how to design a solid waste collection system and arrive at the essential end-products. Read the entire technical note before beginning the design process.

Useful Definitions

GARBAGE - Food and crop wastes from growing, harvesting, storing, preparing, cooking, or serving of food; these materials rot quite quickly.

RUBBISH - All material other than garbage that is thrown away, including broken dishes, utensils, and furniture; useless scraps of wood, metal, or glass; sweepings from house, yard, or street; and anything else that is discarded.

SOLID WASTE - Garbage, rubbish, animal manure, dead animals, and ashes.

Selecting a Method of Collection

The three basic methods of collection and transport are: (1) household, (2) community, and (3) paid-worker. The collection method selected should be compatible with the method of waste disposal or reuse. See "Methods of Solid Waste Management," SAN.3.M.

Household. This is suitable for small amounts of waste and an on-lot landfill, compost stack, or biogas plant if there is a lot of animal manure. Householders sweep out house, porch, and yard; put garbage in a container; shovel animal manure into a cart; and rake up waste from the harvest. They hand-carry or cart the waste to an on-lot site for disposal or reuse.

Community. This is suitable for larger amounts of waste and community disposal or reuse. Members of the community clean up houses, yards, stables, marketplaces, or public buildings and put wastes in either privately-owned or public containers. They load the containers on a vehicle and transport them to a community landfill or composting area. To function properly, this method requires unfailing cooperation among members of the community.

Paid-worker. This is suitable for larger amounts of waste and community disposal or reuse. Members of the community put solid waste in public containers located near a road, marketplace or public area, and paid workers transport the waste to a community disposal site. Or, there may be door-to-door collection from homes and shops. This method requires cooperation among community members and money to pay workers.

Table 1 summarizes the factors that influence the selection of a collection method.

Determining Necessary Materials

The types of materials needed can be roughly divided into three categories: (1) cleaning equipment, (2) containers, and (3) vehicles. All materials should be locally available.

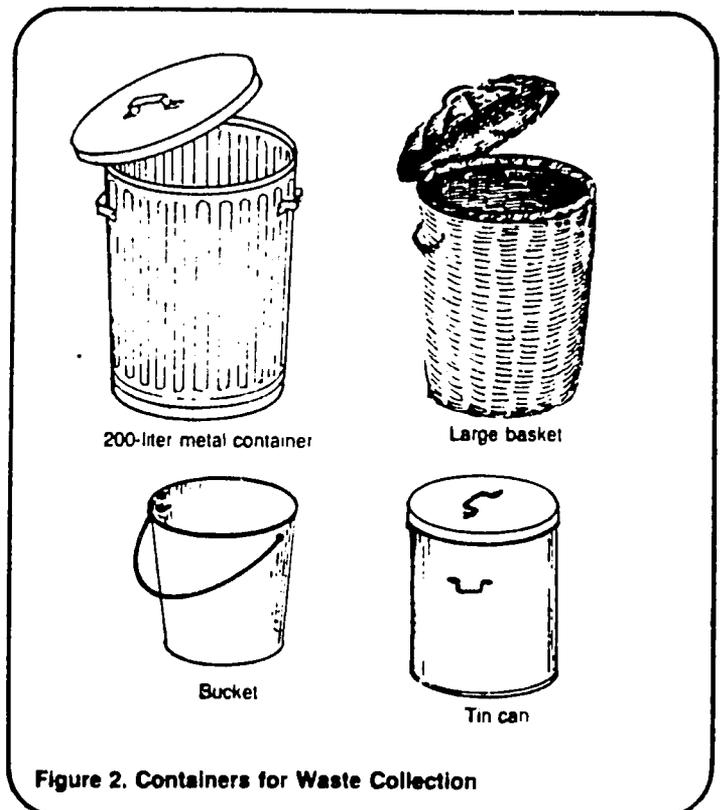
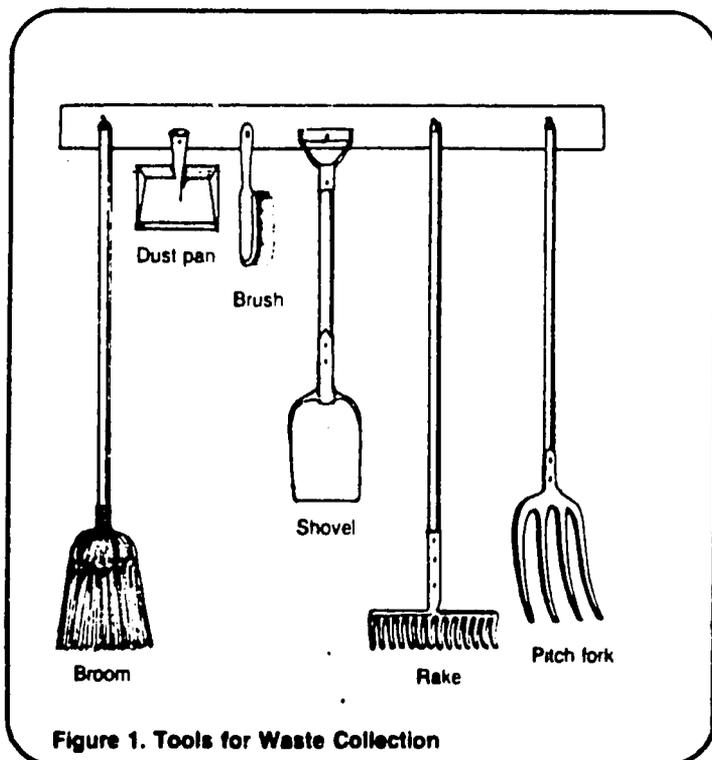
Cleaning equipment. The type of equipment depends on the area to be

cleaned, the nature of the waste, and personal preference. Brooms and dust-pans can be used to clean out houses, porches, sidewalks, or streets. Shovels can be used to remove animal manure from the yard. Rakes, pitch-forks, and shovels can be used to pick up harvest wastes or rubbish from factories or plants. For household and community systems, individuals must provide their own equipment. For paid-worker systems, the equipment should be provided by the community. See Figure 1.

Containers. The purpose of a container is to temporarily hold solid waste before disposal. The type of container and its size may vary depending on availability and local preference. Acceptable containers include buckets, baskets, boxes, cans, barrels, and drums. They all should have lids to keep out flies and keep in odors. Containers used for community and paid-worker collection systems should hold 50-200 liters and must be sturdy enough to stand up to rough handling. The number of containers needed depends on the amount of waste and the frequency of collection. There should be more than enough containers to hold all the waste generated between collection days. See Figure 2.

Table 1. Factors Influencing Collection Methods

Collection Method	Influencing Factors
Household	Small amounts of waste; on-lot site for disposal or reuse
Community	Larger amounts of waste; community site for disposal or reuse; community cooperation
Paid-worker	Larger amounts of waste; community site for disposal or reuse; community cooperation; money to pay workers



Vehicles. For all community and paid-worker systems, and for some household systems, vehicles are needed to transport solid waste, in containers or not, to the site for disposal or reuse. Vehicles should be locally constructed and may be hand-drawn, animal-drawn, bicycle-powered, or motorized. If containers are transported, the loading height of the vehicle should be no more than 1.0m for ease of handling. Vehicle repair and replacement parts must be readily available, especially for paid-worker

collection systems. See Figure 3. Design a storage shed for the vehicles. It should be weatherproof and have a door with a lock. Locate it near the disposal site.

Selecting Personnel

Every collection system must have someone in charge and someone to do the work.

For a household collection system, one member of the family should be responsible for seeing that waste is collected regularly. This person may also carry the waste to the disposal site.

For a community collection system, each marketplace vender or someone from each household voluntarily performs the work. However, a volunteer overseer respected by the community will have to organize the collection system. In addition, his or her continued presence will ensure a more efficient operation. The overseer could, for example, walk through the marketplace on collection day encouraging vendors to clean out their stalls and place garbage in containers.

For a paid-worker collection system, a paid supervisor must be hired. The supervisor must be a responsible person with the ability to give orders. He may or may not be charged with hiring workers. Workers should be able-bodied and capable of following orders. Their numbers will depend on the size of the collection system, but they should be able to complete their daily work within a reasonable length of time, for example six to ten hours.

When the method of collection has been selected and all necessary equipment and personnel have been determined, make out a materials list similar to Table 2 and give it to the construction supervisor.

Establishing a Schedule of Operation

Establishing an operation schedule involves determining the frequency of collection, selecting locations for containers, and, for paid-worker systems, determining a collection route. In all systems, the persons collecting wastes may also be the ones disposing of it in a landfill or

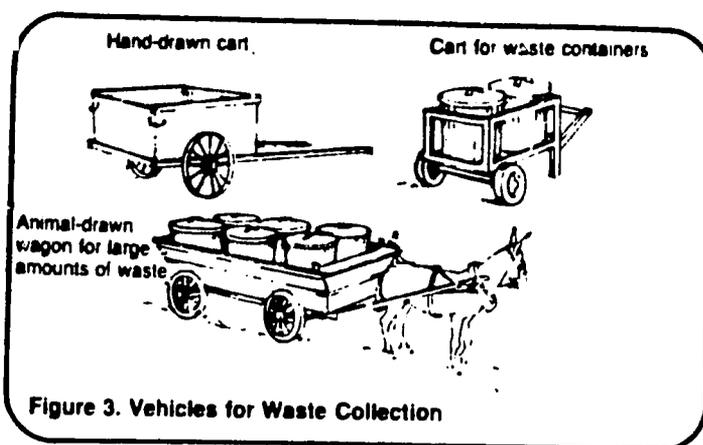


Table 2. Sample Materials List

Item	Description	Quantity	Estimated Cost
Labor	Supervisor (for one year)	1	_____
	Workers (for one year)	4	_____
Supplies	Equipment:		
	shovels	_____	_____
	brooms	_____	_____
	dust pans	_____	_____
	Containers:		
	200-liter metal drums with lids	_____	_____
	Vehicles:		
animal-drawn carts	_____	_____	
Other:	gloves	_____	_____
	boots	_____	_____
	first-aid kit	_____	_____

Total Estimated Cost = _____

placing it in a compost stack or biogas system. See "Designing a Landfill," SAN.3.D.1, "Designing a Composting System," SAN.3.D.2, and "Designing a Biogas System," SAN.3.D.4.

Frequency of Collection. Solid waste should be collected often enough so that the amount collected is easily handled. This may mean collecting daily or two or three times a week. In no case should collection be less frequent than once each week, because it takes just over a week for fly eggs to hatch and mature. Usually two collections per week are enough although a central market will require daily collection.

Some examples of collection frequency:

- Members of a household throw garbage into a garbage can after each meal. Every two or three days, one member of the family carries the can to the disposal site or compost stack.

- The community established a "Clean Day" to be observed once each week: every Saturday or Monday, for example. On this day, household members and shop keepers clean out their living and working areas and cart the waste to a community disposal site.

- Community members place their solid waste in public containers. Each day or two, paid workers either empty the containers into a vehicle or load them on a vehicle, and transport the waste to a community disposal site.

Location of Containers. Containers should be placed in easily accessible areas or collection points. If containers are transported from a collection point to a disposal site, they must either be replaced with empty ones or returned to the collection point.

It may be that a container is filled in one location and collected from another. For example, a container may be placed near a market stall and filled with garbage during the morning, then carried to the side of the road for collection by a paid worker in the afternoon.

Route. A collection route must be established for a paid-worker system in order to save time and effort and ensure efficiency of the system. An established collection route encourages a routine of cleanliness in the community. Plan the route so that it is as short and simple as possible and ends as near as practical to the disposal site.

When the schedule of operation has been established, draw up a scheduling chart similar to Figure 4, showing the route, collection points, collection days, and approximate time of collection, morning or afternoon. Give the chart to the construction supervisor.

In summary, give the construction supervisor a materials list and a scheduling chart similar to Figure 4 prior to operation of the collection system.

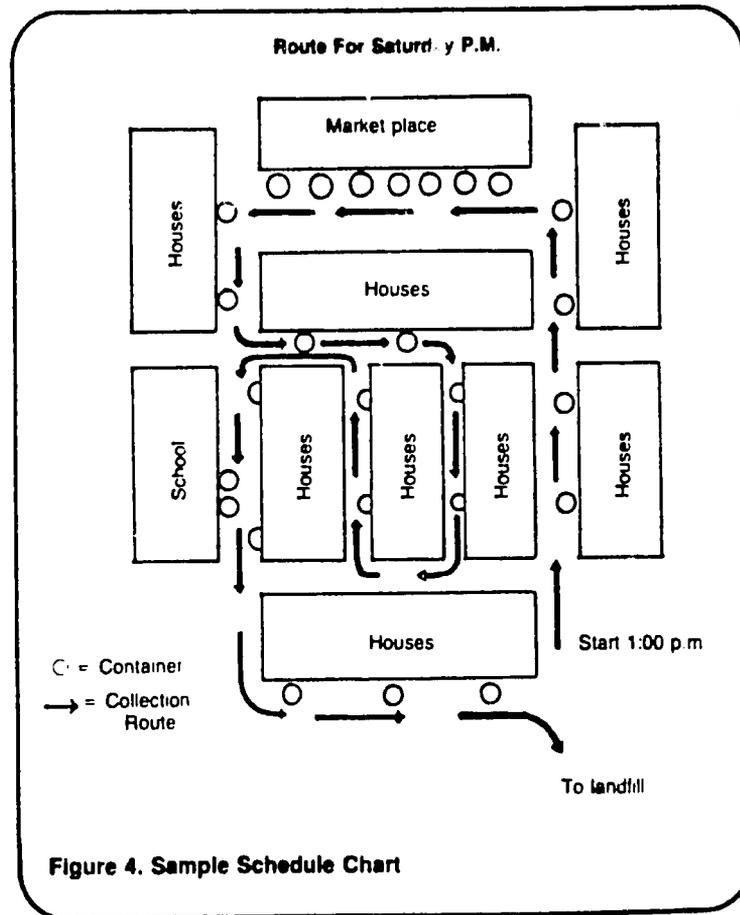


Figure 4. Sample Schedule Chart

Technical Notes are part of a set of "Water for the World" materials produced under contract to the U.S. Agency for International Development by National Demonstration Water Project, Institute for Rural Water, and National Environmental Health Association. Artwork was done by Redwing Art Service. Technical Notes are intended to provide assistance to a broad range of people with field responsibility for village water supply and sanitation projects in the developing nations. For more detail on the purpose, organization and suggestions for use of Technical Notes, see the introductory Note in the series, titled "Using 'Water for the World' Technical Notes." Other parts of the "Water for the World" series include a comprehensive Program Manual and several Policy Perspectives. Further information on these materials may be obtained from the Development Information Center, Agency for International Development, Washington, D.C., 20523, U.S.A.

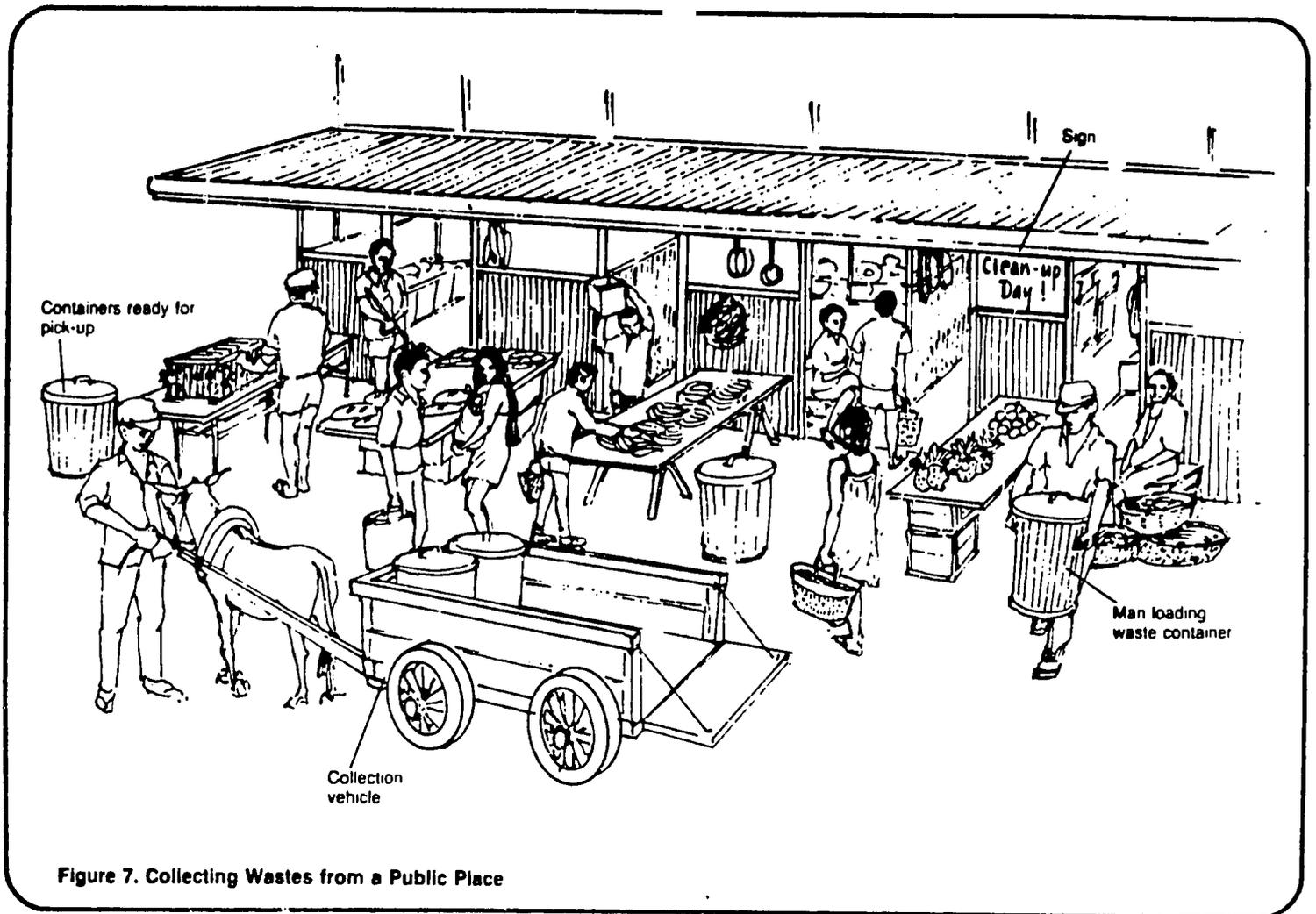


Figure 7. Collecting Wastes from a Public Place

Maintaining a Solid Waste Collection System

Once or twice each month, inspect the storage shed and vehicles for damage or excessive wear. Repair or replace broken or worn-out parts. Once each week, thoroughly clean all containers, vehicles, and tools.

Once the routine of collection has been established, continue with it. This is important for all systems: household, community, and paid-worker. A collection system will last for as long as you want it to. As long as it lasts, the community will be a clean, healthy, and pleasant place to live and work.

APPENDIX R
Officials Contacted

OFFICIALS CONTACTED

WASHINGTON

AID/PRE/H:

Mr. P. Glickman

AID/AFR/DR:

Messrs. J. Snead and B. Donnelley

Ivorian Embassy:

Mr. Sico, Cultural Attache

AID/WAFR:

Mr. F. Scordata

PADCO:

Mr. D. Kissick

STATE

Ms. C. Morgan, Ivory Coast Desk

World Bank:

Mr. F. Yacoub, Architect

Mr. G. Reed, TAG

Mr. C. Schultz, TAG

Mr. Caligari, Sanitary Engineer

ABIDJAN

AID/RHUDO Office:

Messrs. Lippe, Deikun, and Johnson

MCU:

M. Olivarietta, Technical Counselor to Minister

M. Nourri, Director of Urbanism

M. Chombart

DCVR:

Mr. Arnaut, Director

M. Uk, Project Coordinator for IBRD and USAID

M. Phillippe, Consultant and Liaison for IBRD and USAID

M. Kwa Brou, Assistant Director of Urban Planning

M. N'cho, Engineer

SETU:

M. Ebah, Director

M. Bamba

M. Ouayoro, Engineer

BCET:

Mme. Manou, Social Geographer
Mme. Toure, Ethno-sociologist
M. Revy, Engineer
M. Clement
Mme. Martine Iturrioz

PACT:

M. Gasselin

Port Bouet:

Mme. Aka-Anghui, Mayor of Port Bouet; Vice President, National
Assembly
M. N'Drie, Office Director

Ministry of Environment:

M. Bec, Engineer

Ministry of Public Health:

Dr. Charlet, Director of Program Development

Ministry of Public Works:

M. Lopez, Engineer, DCAD
M. Toubanc, Engineer

Ministry of Social Affairs:

Mme. Goudiamy-Elola, Director of Social Action

Ministry of Women's Affairs:

Mme. Aminata Traore, Director of Program Development

National University of the Ivory Coast:

Professor Aka-Ebah, Director of the Faculty of Economics & Social
Affairs
Professor M. Toure, Director of the Ethno-Sociology Institute

ORSTROM:

M. Alain du Bresson
M. Jean Collinet

LBTP:

M. Couland

IBRD/Abidjan:

M. Philip Owusu
M. Richard Drzewiecki

Abidjan Mayor's Office:

M. Malhomme, Technical Counselor

REFERENCES

References

1. AID-DLC/P - 1014
Housing Guarantee Paper: Ivory Coast: SOGEFIHA
2. AID-DLC/P - 2185
PP 681-HG-003 - Ivory Coast Low Income Urban Shelter Program
3. Republic of Ivory Coast, Ministry of Environment
Document: Assainissement de La Ville d'Abidjan: Rapport d'Expertise de L'Orstom - Oct. 1981 - Jan 1982
4. WASH Tech Report #11 - Elmendorf & Isely - Role of Women as Participants and Beneficiaries in Water Supply and Sanitation Program - 1981
5. UNDP - TAG Tech Note #1 - 1983
Simpson Herbert: Methods for Gathering Socio-cultural Data for Water Supply and Sanitation Projects
6. UNDP - TAG Technical Note #2
Heli Perret - 1983, Planning of Communications Support in Sanitary Projects and Programs
7. Project 681-HG-005
Environmental Threshold Decision
8. Social Feasibility Analysis in Low-Cost Sanitation Projects
UNDP - TAG Tech Note #5
Heli Perret 1983
9. AID Office of Housing
Evaluation and Monetary Guidelines November 1978
10. 1981, Kadja Daniel - Institut d'Ethno-Sociologie, Universite Nationale de La Cote d'Ivoire "Problematiques de l'Eau en Milieu Rural Ivoirien et Aspects Methodologiques de L'Animation Rurale" (en dossiers Fipad #23 - Mai/Juin 81)
11. April 1980, Mme J. Jakob Banque Mondiale Enquete sur Niveau de Desserte par Services Eau, Assainissement et Electricite (y inclus autres sources d'Energie domestique) et leur cout dans le budget familial
12. RHUDO Files: Ivory Coast 681-HG-003
13. PADCO: Etude Sectorielle de L'Habitat Cote d'Ivoire:
a) Synthese - Mars 1983
b) Etude Sectorielle - Mars 1983
(French and English versions)
14. 681-HG-005
Project Paper and Analysis

15. Feb 79, HG-001 (Cite Fairmont)
A case study Evaluation: AID Shelter Programs in the Ivory Coast 1965-76
16. IBRD/World Bank Document: Report #1200b-IVC
Ivory Coast: Appraisal of the Urban Development Project Nov. 15, 1976
17. Environmental Management of Urban Solid Waters in Developing Countries -
World Bank June 1982; Urban Development Paper #5
18. Appropriate Technology for Water Supply and Sanitation
A sanitation field Manual - Dec. 1980 World Bank
19. La Localisation des Industries a Abidjan: Interrogations sur des
Evidences - 1983 A. Dubresson (Centre Orstom de Petit Bassam) Orstom
20. Boualy Djragbou, Konan, Kouadio, and Soumahoro: Sept. 1983:
Memoire de CI de Licence: "L'Evolution Socio-Economique de
Bidjan-Adjame." Department of Social Sciences, Faculte des Lettres et
Sciences Humaines, Universite Nationale de Cote d'Ivoire
21. 681-HG-003 Mid Project Evaluation for 1980
003 Annual Evaluation July 1981
22. Documents: Observations sur Le'Colloque sur L'Habitat Economique dans Les
Pays en Developpement" Jan 1983 a L'Unesco. Francois Malhomme Juillet
1983

Malhomme F. Avril 1983
Note sur Le Premier Projet de Developpement Urbain: Tranche Habitat
23. "Updated Interim Report in Small and Medium Scale Ivoirian Construction
Contracts (S. Johnson - IIPUP, Jan 20, 1982)
24. 1978-79 ORSTOM - Enquete a Passate Repete (Demographique) Direction de La
Statistique, Ministere du Plan.