Environmental Assessment Sourcebook 1999

CHAPTER 9

POPULATION HEALTH AND NUTRITION; URBAN DEVELOPMENT; TRANSPORTATION; WATER SUPPLY AND SEWERAGE

Population, health and nutrition loans or credits typically do not have complex or significant adverse environmental impacts and are not covered in the project guidelines. The general topic of public health and safety is covered in this chapter, but it will have equal relevance to the projects discussed in Chapters 8 and 10. TMs managing population, health and nutrition projects should keep in mind that they are not necessarily altogether free of impacts. In fact, proper management of hospital waste, which could result from a variety of health projects can be a complicated undertaking.

Transportation is normally the Bank's second or third largest sector in terms of yearly loan and credit totals. In 1990, highways accounted for more than one-half of the total. Railway projects and ports and waterways were the other large categories. Roads and highways, inland navigation, and port and harbor facilities are the transportation categories included in this edition of the Sourcebook, as being the types of projects among those frequently financed that raise significant environmental issues. Other topics such as airports, urban mass transit, and railways, will be added if demand for EA guidelines warrants. This chapter also discusses some of the general environmental issues pertaining to urbanization which are relevant to a number of project topics.

The guidelines on wastewater collection, treatment, reuse and disposal have general applicability to any size system. However, in keeping with the Sourcebook's focus on loans or credits which may have significant environmental impacts, the emphasis is on projects in urban rather than rural areas. Water supply is not specifically covered, but the elements of water supply projects most likely to have significant impacts, dams and reservoirs, are discussed in detail in Chapter 8. The section on "Oil and Gas Pipelines" in Chapter 10 may be useful in environmental review of large water transmission mains. "Water Resource Management," in general, is discussed in Chapter 2. :

PUBLIC HEALTH AND SAFETY

General Issues

1. Like environment, public health and safety is a field unto itself and covers a wide spectrum of issues throughout nearly all Bank sectors. Broadly defined in the context of the overall goal of improving the quality of people's lives, it pertains directly to nearly every project and indirectly, to all. Even when more narrowly defined, public health and safety still encompasses a vast array of traditional considerations such as air and water pollution and provision of health care; and largely because of their general relevance, widespread health benefits can be promoted by integrating complementary health or safety components into non-health specific projects.

2. However, the very breadth of public health and safety that provides an opportunity to improve generally the quality of life poses special managerial problems. For instance, the institutions responsible for public health and safety tend to be among the weakest in governments, with limited real influence and budget except in cases of epidemics, disasters or emergencies. Additionally, responsibilities may fall into the proper oversight of several government agencies and so fall between institutional cracks. Consequently, there is a genuine risk that some of the broader and long-term issues may be overlooked. This section of the Sourcebook, therefore, focuses on identifying and overcoming special problems and on suggestions for setting realistic goals. :

Bank Policy, Procedures, and Guidelines

3. There is no formal Bank policy on public health and safety. General policy on the subject is mentioned primarily in operational directives, guidelines and technical papers. The overriding policy emphasizes that in design, implementation and eventual operation, projects should improve the quality of life of project beneficiaries or at the least, not diminish it. At least as much general policy direction is contained implicitly in procedures. In some cases, implicit health and safety policy is declared in public forum, as in the case of disposal of hazardous or toxic wastes: the Bank will not finance shipment or disposal of hazardous or toxic wastes from one country to another among borrowing countries. (The Guidelines noted below deal with safe handling and disposal of wastes generated within a country from its own operations.) In other cases, policy weaves its way into Bank practice through study seminars that later are formulated into policy, e.g., the seminar on Disaster Prevention and Mitigation which was issued later as an Environment Department Discussion Paper (Kreimer and Zador 1989). Still others with public health and safety implications fall entirely under a different category, such as women in development, social forestry or adjustment lending, and are not labelled specifically health or environment.:

Relationship to Bank Investments

4. Since the very nature of Bank work is directed toward improving the quality of life in developing countries, from its inception the Bank has been involved with public health and safety issues. Prior to the creation of the Population Health and Nutrition Department (PHN) in 1980, the Bank dealt with such issues through components primarily in agriculture, rural development, water supply, sanitation and urban development projects, as well as through various special programs. The majority of these components dealt with construction of health clinics, promotion of health education, and upgrading/rehabilitation of maternal/child health centers, hospitals and other health facilities. With the creation of the PHN Department, the Bank was able to expand these activities to free-standing projects.

5. After the Bank's reorganization in 1987, activities in population, health and nutrition were merged with those in education to form the Population and Human Resources Sector (PHR). The priorities in PHR lending are: population and family planning, including maternal and child health; financing health care delivery, especially at the regional and district levels; tropical disease control and AIDS; nutrition; and information, education and communication (IEC). :

6. These lending, policy and research activities within the Bank are supported by several collaborative initiatives with other organizations. These include: Research and Training in Tropical Diseases Programme (focusing on pertinent socioeconomic research and seven major tropical diseases that are important in developing countries -malaria, schistosomiasis, filariasis, African trypanosomiasis, Chagas' disease, leishmaniasis, and leprosy; Human Reproduction Programme; Safe Motherhood Initiative; Task Force for Child Survival; Global Programme on AIDS; U.N. Administrative Committee on Co-ordination/SubCommittee on Nutrition (ACC/SCN); and Onchocerciasis (River blindness) Control Programme.

7. Collaboration may occur within the Bank as well, of course. Projects or components such as housing, water supply, irrigation, drainage, roads, solid waste removal, etc., whose justification may not be health improvement explicitly, have impacts on health and can be significantly enhanced by public health and safety components or even parallel projects where the situation merits.:

8. For example, a component to provide stormwater drains (to help control mosquitos or other vectors that spread several tropical diseases) or a health education program can be added to an existing housing project to maximize the benefits from the improvements made to the physical environment. Examples of recurrent problems that can be addressed directly in this way include:

: . contamination of drinking water with fecal, agricultural, industrial and other waste; . unsafe handling, transport, storage and disposal of hazardous wastes from hospitals, industry, commerce and agriculture (see section on "Industrial Hazard Management," concerning industrial/hazardous materials safety); . spread of diseases such as schistosomiasis (through construction of dams) or malaria (through construction of rural roads or poorly maintained dams and irrigation systems); . contamination of food with pesticides and herbicides; . effects of natural disasters; and . deterioration of basic water, shelter, and health services in the public and private sector.:

9. In addition, public health and safety components can have beneficial impact indirectly on pervasive problems, especially:

. population growth outstripping provision of adequate food or of basic community services; . macroeconomic policies that inadvertently promote malnutrition, stress or the spread of diseases; . physical and mental stress from persistent congestion, noise, lack of privacy, fear of accidents or crime, drownings, fire and landslides -all directly associated with urban slums or squatter settlements or settlements on other marginal land; . physical stress, particularly to women and children, from hours spent daily fetching water, firewood, and getting to and from other work; and . serious diseases resulting from chronic low-dose exposure to household cooking and heating fumes and from illnesses associated with urban over-crowding.:

10. World Bank projects, furthermore, are in key positions to make significant contribution toward eradicating the six major diseases of developing countries: malaria, schistosomiasis, hookworm, diarrhea, respiratory ailments, and malnutrition. (A seventh category -accidents -should be added to these six. While accidents do not account for the same degree of illness and death as the others do, they are an important consideration in nearly all projects.) The task is very difficult, and made more so for not being able to control exposure outside the geographic or temporal confines of projects. Malaria and schistosomiasis control are especially problematic because they entail long-term control of mosquito and snail populations. (By comparison, hookworm and especially guinea worm control could quite likely be achieved in the short term.) Diarrhea, respiratory ailments and malnutrition involve behavioral change as well as improvement in physical circumstances, and so are even more difficult to control. Nevertheless, as has been discussed above, even small -but effective -components (e.g., education about the means of disease transmission) integrated consistently and systematically into Bank projects make cumulative contributions that over time become effective. :

Special Consideration

Unique Aspects of Public Health and Safety Projects

11. The following list provides a summary of considerations for public health and safety issues, as well as reminders of how their treatment may differ from projects in other sectors.

. Measurable improvement in many public health and safety issues depends on behavioral change and that takes time. This means prevention is more cost effective than cure. Preventive measures should be integrated into project design well before appraisal. This should be the primary focus of all public health and safety work. Even with the best preventive measures, health problems often manifest themselves well beyond the project cycle. Therefore, public health and safety also call for follow-up after the usual period of Bank involvement in projects, as do environmental considerations.

. Many health and safety improvements become perceptible only after the last of a set of interrelated variables falls into place and should be evaluated accordingly. In public health and safety programs, it is common to read incorrectly the lack of early success as evidence of failure.

. Behavioral change is labor-intensive for Bank staff as well as field staff, imposing on projects practical administrative constraints -particularly to time and budget.

. Some governments are reluctant to admit or publicize existent or potential public health and safety problems for political or economic reasons.

. Staff in ministries or agencies administering projects with public health and safety components often are not trained in environment or health.

. The agency or public utility responsible for executing proprojects with potential health impacts may not have in-house capability (i.e., trained staff or infrastructure), or accountability for environment or health.

. Strengthening individual institutions requires interministerial and interagency cooperation, a managerial practice that is not efficient in many developing countries.

. Agencies may balk at taking on administrative activities outside their normal scope of work, especially if it extends beyond the project cycle's funding.

. Funding as well as executing agencies may be reluctant to take on administratively cumbersome (e.g., labor-intensive) projects or components, even if justified on social grounds.

. Funds for public health and safety, and related social aspects, often come from local budgets rather than from loan funds and thus may be vulnerable to competing demands for limited resources.

. Beneficiaries themselves may not understand public health and safety problems and therefore prefer investments in more immediate needs, such as street lights, schools and public markets.:

Women and Public Health and Safety

12. No matter what combination of services make up a typical project, women figure predominantly as key participants and beneficiaries. Whether healthy or sick, women support families, manage households, fetch water and fuelwood, and care for children. Their specific needs will therefore require consideration as a high risk group and as a primary audience. Sustained health improvements from project interventions, in a large portion of bank projects, hinge on education and behavioral change, factors that frequently depend on women. The role of women in ensuring the success of a project or component should not be underestimated, and their opinions and participation should be actively solicited.:

Guidance for Environmental Assessments

13. There are two principles that underpin realistic planning for public health and safety programs. First, public health and safety improvements should be designed in the context of the multiple causes of disease and death so that those in separate projects (or even in other sectors) will be integrated. That is, reduction in disease generally depends on changes in both physical environment and behavior, with all the attending complexities, and individual interventions should be designed within that context. Second, interventions may not have a perceivable impact over the short-term (particularly on some of the most prevalent diseases), but should be done anyway and in such a way as to lay the needed foundation for future success. An example of these two principles is a hygiene education component in a clinic project that can strengthen and be strengthened by a drainage renewal component of a housing project.:

Health Components as Part of Project

14. A positive health impact can be included in a traditional infrastructure project in at least the following three ways:

(a) By improving facilities (even without a specific health project or component) where behavioral change is not necessarily required and therefore, follow-up is not required. Examples are:

. bacteriological/chemical contamination controlled by change in source or treatment of water;

. filariasis eliminated by improved waste disposal and drainage;

. respiratory diseases reduced by providing more efficient cooking/heating facilities and ventilation;

. Guinea worm eliminated by changing or protecting the source of water; and

. public safety enhanced by redesign of public buildings and housing in areas prone to earthquakes, hurricanes or floods.:

(b) By including public health and safety components which require only moderate programs and follow-up. Local conditions can often be substantially improved by relatively simple interventions. Moreover, improvements tend to take place in the short term and to continue, assuming proper maintenance of the facilities. Examples are:

. intestinal worms substantially reduced through provision of sanitation facilities combined with training in hygiene;: . accidents (such as drowning and burns) eliminated by modifications to the living environment and training in safety.

(c) By including public health and safety components which require extensive programs and follow-up. In many cases, a positive impact can actually occur within months but requires long-term follow-up to be sustained and to allow time for behavioral change. Examples are:

. diarrhea substantially reduced through the provision of water and sanitation facilities combined with training in personal and public hygiene;: . malnutrition substantially reduced through extensive long term health education provision of nutritional supplements, and improvement to living conditions and water supply.:

Free-Standing Public Health and Safety Projects

15. In some circumstances, a positive impact is best achieved by a project directly addressing public health and safety. Consequently, an environmental assessment should alert project officers to situations where a sole health component may not be effective, and a free-standing project is required. For example, controlling diseases such as schistosomiasis, malaria and those resulting from industrial pollution require substantial long-term efforts and are better tackled on a larger scale. The environmental assessment should note disease prevalence and recommend separate interventions, e.g., as a free-standing health project or a government program executed by another agency. Whether to design a health component to a non-health project or to design a free-standing project with a health impact is largely determined by the feasibility of including long-term administrative supervision in the project.:

Steps to Prepare Environmental Assessment

16. Gather baseline health data. Gather the information necessary to determine the current health status of the population living in the project area; specifically, to identify existing and predicted problems and to define a suitable response. This may begin simply with a list of the top ten causes of illness and death of the target population. If there are other projects planned or in progress (Bank or non-Bank) within the region, they should be identified.

17. Gathering and interpreting information could be performed by the entity responsible for managing the anchor project or the health/safety component. However, borrowers such as municipalities or public utilities may have no expertise in the health or education sector and no resources to provide assistance on long-term health components. The work will then most likely be performed by consultants engaged by the agency or through cooperative arrangements between the agency and local non-government organizations (NGOs). Where project organizations lack expertise in the health field to undertake extensive health-related activities, the EA may need to specify an alternative supervisory agency or begin the process of institution strengthening.

18. Relate basic data to sectors. A clearer definition of needs is produced by relating the top ten causes of illness and death to specific deficiencies, e.g., in housing, water and sanitation. Again, relate this analysis to other health and safety projects or activities in the target population.:

19. Determine source of existing and anticipated problems and type of project intervention or alternative. Carry the analyses a step further by comparing the main sources of the problems with the focal points of prevention, such as water quality control, waste disposal, and education.

20. Select the intervention required to achieve the fullest health impact from the investment. From a short list of possible health/safety projects or components identified, final selection can be made on the basis of their feasibility of implementation and potential impact. Wherever feasible, integrate components with ongoing health and safety activities. Each proposed initiative should be accompanied by terms of reference.

21. In view of administrative practicalities, health and safety projects or components can be defined as having shortor long-term impacts. A short-term impact is one that can be demonstrated within the project cycle, but may require follow-up. Demonstration or pilot projects, if coupled with long-term follow-up outside the project cycle, qualify as long-term impact components.:

22. The critical factor in each case is the capability of the project entity to administer, operate and maintain the component. Usually, free-standing projects provide for their own infrastructure. A primary necessity of the health/safety component is obtaining administrative support, perhaps through collaboration with an agency outside the project. In general, the more complicated the administration and the higher the requirement for follow-up, the greater is the need to consider public health and safety interventions as free-standing programs.

23. Determine complexity of interventions chosen. Analyze the possible interventions to determine whether they are appropriate within the project. Considerations to address include time span, labor and material requirements, follow-up, etc.:

24. List possible components. With an understanding of problems, potential interventions and their complexity, it should be possible to derive a list of projects or components. Again, the more complicated the intervention or component, the more likely it should be viewed as a separate project. In such cases, where project interventions would be administratively cumbersome, a component may consist of a demonstration project, or securing collaboration with another agency may be called for.

25. Preparing proposal for component. The list of possible projects or components can then be worked into a specific proposal and Terms of Reference prepared.

26. As routine parts of EA, all projects should be assessed for the possibility that they may impair public health and increase the risks of accidents. To help reduce these risks, all contracts might carry appropriate clauses, such as: "The contractor shall screen all candidates prior to hiring for their health status...shall appoint a permanent accident prevention officer...shall provide health facilities free to local people...." This ensures that the project will provide appropriate public health and safety measures and will engage experienced officials to administer them.:

Conclusion

27. This section has focussed on public health and safety as a general issue. These principles should be augmented by reading the other relevant sections of the Sourcebook: the chapter on social and cultural issues and the project-specific discussions on agriculture, industry, and so forth.

28. Again, it must be emphasized that in public health and safety programs, success cannot be defined or measured by standard parameters, e.g., rates of return or construction schedules. Ultimate benefits from

public health and safety measures are difficult or impossible to quantify because correlation with standard measures is complicated by many inter-related variables interacting simultaneously -and also because the unit measured is human life.

29. When designing projects, remember that nearly every Bank project can strengthen and be strengthened by a public health and safety measures within a project or as a separate component; Bank projects are well-situated to make a pivotal contribution to health and safety generally in developing countries; and even small components, if they are well-designed and integrated systematically into projects, can cumulatively contribute significantly to human wellbeing.:

ENVIRONMENTAL CONSIDERATIONS FOR DEVELOPMENT PROJECTS IN URBAN AREAS

1. Cities play a key role in the development process. They are, in general, productive places that make more than a proportionate contribution to national economic growth. However, the very process of urban growth often brings with it a deterioration in surrounding environmental conditions. As a locus for population growth, commercial and industrial activity, cities concentrate energy and resource use and waste generation to the point that both man-made and natural systems are overloaded and the capacities to manage these systems are over-whelmed. This situation is exacerbated with rapid urban population growth. The resulting environmental damages or costs threaten the continued productivity of cities and the health and quality of life of its citizens. Cities have become major "environmental hot spots" that urgently require special attention in regional and project EAs and in environmental planning and management at the metropolitan regional scale.

2. Urban systems and services (e.g., water supply, sanitation, public transport and roads) are increasingly congested due to population, commercial and industrial growth coupled with poor urban management. Natural resources (water, air, forests, minerals, land) vital to the cities' economic development and to future generations are lost or misused through inappropriate urban policies. The radius of impact of cities on resources lying far beyond their boundaries is steadily increasing. Furthermore, urban areas are inundated in their own wastes and choked on their own emissions as a result of inadequate pollution control and waste management policies and practices. :

3. Many negative impacts are associated with the conditions described above. The greatest health risks in many developing country cities are still linked to the traditional problems of excreta disposal. At the same time, there is increasing concern about the health risks of modernization due to toxic wastes and emissions, traumas (traffic and other accidents, violent deaths), and urban stress. The spatial scale of these impacts stretch from the household level through the community the urban area, and in some cases the region beyond. The impacts of greatest concern are still often found at the household and community scale, and are related to deficiencies in urban infrastructure and services. Urban dwellers, and particularly the urban poor, bear the brunt of deteriorated environmental conditions through health and productivity losses and diminished quality of life. Resource development costs are rising (e.g., the cost of new water supplies) as economically accessible high-quality resources are depleted. Emissions related to regional and global environmental problems are increasingly generated in urban areas or as a result of urban demand (for example, urbanization alone could be a major factor in world energy demand over the next generation). :

Environmental Impacts of Urban Growth

Pollution from Urban Wastes

4. Undoubtedly, the major pollutant of concern in developing country cities is human excreta. Fewer than 60 percent of the urban population in less developed countries has access to adequate sanitation, and only one third are connected to sewer systems. Where sewerage does exist, rarely do cities provide any treatment. Similarly, the collection and disposal of household garbage is a persistent problem of local government. Only half the urban residents benefit from collection services, and the municipal solid wastes that are collected end up in open dumps or drainage systems. Industrial wastes are a particular concern in

cities without adequate waste management capacity, as it is difficult to monitor discharges and ensure that hazardous wastes do not end up in city sewers or landfills. As a consequence, the sophisticated facilities and sites needed to treat and dispose of hazardous wastes are not yet in place and used in most developing countries. :

Urban and Household Air Pollution

5. Air pollution is a growing problem in large cities that have poor natural ventilation and significant mobile or stationary emissions. In many cities, conditions are worsening from year to year as emissions from fuel use and industry increase. For example, vehicle fleets and associated emissions are expected to grow 5-10 percent per year in developing countries with most of the growth concentrated in major cities. Urban emissions represent a significant and growing share of greenhouse gases and those responsible for the destruction of the ozone layer. As serious as ambient air pollution is in many large cities, a distinction should be made regarding indoor air pollution, which throughout the Third World is possibly a more serious and ubiquitous problem. In the housing environment, a major concern is the indoor combustion of high polluting traditional fuels for cooking and heating, which often results in daily exposure to high levels of toxic compounds. Occupational exposure to indoor air pollution and other toxics is also a frequent problem, especially in small manufacturing enterprises. From a public health viewpoint, the key problem is the total exposure of an individual over time from all urban sources -ambient, household, and occupational. :

Water Resource Problems

6. Urbanization, coupled with inseparable industrial development, has profound impacts on the hydrological cycle -both quantitative and qualitative. Available water resources around cities are being depleted and/or degraded to the point that marginal costs of supplies are increasing substantially. These cost increases arise both from the need to develop new, more remote sources and from increased treatment requirements resulting from deteriorating water quality. Depletion results largely from inadequate pricing policies and conservation measures. Overpumpage of groundwater in many cases leads to land subsidence with attendant damage to urban structures, to a lowered groundwater table, and in many cases to salinization problems. Improper disposal of urban and industrial wastes contributes to water quality deterioration of both surface sources and aquifers. In the case of groundwater, contamination is a particularly serious problem that can lead to the permanent loss of valuable high-quality drinking water supplies. The land surface impermeabilization in urban areas dramatically changes the runoff hydrograph, leading to higher peaking and more frequent flooding, and direct ground water recharge is often reduced. At the same time, urban runoff is a major source of non-point pollution. Water pollution problems in lakes, coastal and marine waters can result in amenity losses (recreational opportunities and tourism revenues), fisheries depletion, and health problems associated with contact recreation and fish and shellfish contamination. :

Energy Production and Consumption

7. Cities inevitably involve the consumption and, to a varying extent, the production of energy for home, business and transportation use. The very scale of urban energy use may lead to significant pollution problems, already discussed above. Excessive use is common, often the result of inefficient energy policies, such in the countries of Eastern Europe where energy consumption per unit GDP is four times that of their industrialized neighbors. The projected increases in energy use in cities of the less developed countries, based on population and economic growth forecasts and present inefficient consumption patterns and high-polluting fuel choices, portend worsening environmental impacts at local, regional and global scale and risks of major accidents. Appropriate fuel and energy pricing, improved energy planning and management practices, and energy saving technologies are needed as fundamental pieces of energy conservation strategies. Cities also affect natural heat balances. The heat generated by energy usage, including motor cars, combined with daytime heat trapping by urban structures and the slower release of stored heat at night, creates a heat island effect that can raise incity temperatures by 5o to 10o C. In hot regions and seasons it is almost invariably unfavorable, adding to discomfort and even contributing to deaths (e.g., among the elderly) when it aggravates a general heat wave. Thermal inversions are commonplace above

urban areas, trapping industrial emissions and products of fuel combustion and contributing to the formation of noxious photochemical "smog".:

Degradation of Land and Ecosystems

8. As cities grow, the failure of urban land markets induces inappropriate land development and pressure is exerted on surrounding natural ecosystems. Impacts may include the loss of wetlands and wildlands (together with their rich genetic diversity and hydrological buffering capacity), coastal zones, recreational areas, and forest resources (particularly due to accelerated deforestation to meet urban demand for firewood and charcoal). Urban development can negatively impact on downstream watersheds through increased runoff and erosion. Watershed degradation can also occur far from the city, as for example when major water supply or hydropower projects are built hundreds of kilometers away, or when firewood and charcoal are brought from such distances.:

Occupation of Hazardous Areas

9. The uncontrolled periurban development observed in many developing country cities leads to the occupation of low-lying lands, floodplains and steep hillsides by squatter and low-income groups. In addition to the land degradation that often results, the people populating such areas are themselves exposed to increased health hazards from flooding, landslides and mudslides, and erosion, and their dwellings and the surrounding community infrastructure are vulnerable to accidents, damage and collapse. Health risks may also result from living in close proximity to high-polluting industries or from industries working with hazardous wastes (e.g., Bhopal).:

Loss of Cultural Property

10. Often overlooked when considering environmental impacts is the degradation of cultural property in cities, whether it be historical or living monuments. Air and water pollution are primary culprits which accelerate the decay and destruction of these cultural resources. The impacts are felt in the loss of cultural heritage and of tourism revenue.:

Features of Urban Environment Requiring Special Consideration in EA

Dynamics of the Urbanization Process

11. Although the pace of urban growth is not without historical precedent, the sheer magnitude of population growth is overwhelming. Cities such as Mexico City and Sao Paulo are adding a half to threequarter million new inhabitants yearly. The now-evident slowdown in the rate of growth of the megacities will have little impact on the numbers of new dwellers seeking jobs, housing and services. On the other hand, the rate of growth of secondary and intermediate cities shows no sign of abating. Many developing countries will be faced with an explosion of urban population in cities of size classes from 20,000 up to 500,000 or one million, and should now be deciding on how to provide the needed urban infrastructure. Past government policies to influence or control rural-urban migration and industrial location have been misdirected and, by and large, have failed. Futhermore, the growth of many large cities is now dominated by natural increase rather than migration. Future efforts to rationalize urban growth should focus on family planning, and on neutral locational policies that seek to ensure equal opportunity of access for individuals and enterprises to efficient urban infrastructure and services in all cities and towns, rather than subsidized services for the privileged few in primary cities.:

Scale of Waste Concentration and Resource Consumption

12. Pollution prevention and control efforts are hampered by the scale of urban growth and the rapid concentration of urban wastes and emissions of all types. Scale here is defined as the product (per unit area) of population density times per capita waste generation (or resource use). The problem is exacerbated by

economic development as the quantity of urban wastes generated per capita tends to also increase rapidly with increased per capita income. The scale of the problem exceeds the capacity of local government to collect, treat and dispose of municipal sewage and solid wastes, the capacity of authorities to control dangerous wastes and emissions, and the capacity of nature to assimilate all such wastes. The challenge is to find ways of reducing urban waste generation in addition to building efficient, effective, and affordable waste management and pollution control programs.

13. An analogous scale problem exists on the input side as a result of the concentrated resource consumption taking place in urban areas. Urban demand for energy, water, food, minerals, timber and fuelwood, and other resources often has impacts on distant watersheds and forests. Increasingly important factors in the sustainable development and use of these resources are urban demand management, technological change and resource substitution.:

Cross-Media and Cross-Sectoral Issues

14. Most attempts to deal with urban environmental problems are partial, fragmented and compartmentalized. Four classes of fragmentation are common.

(a) Cities tend to give attention to problems perceived by the community (e.g., waste collection) while ignoring the externalities they occasion (e.g., siting and impacts of waste disposal).

(b) Programs that focus on a single environmental medium fail to protect other media (e.g., sewage treatment plants clean up the wastewater stream but produce large quantities of sludge that have to be dealt with; while disposing of sewage sludge and solid wastes on land may prevent surface water pollution problems at the expense of groundwater and soil quality). Tracing such cross-media effects is often complex.

(c) The failure to coordinate sectoral programs contributes both to the above cross-media problems and to the loss of resources spent on ineffective actions (e.g., investments in surface drainage without parallel improvements in solid waste collection and disposal; attempts to develop fisheries in waters polluted by municipal wastes).: (d) Jurisdictional conflicts impede effective actions or give rise to crucial gaps in prevention and control efforts.:

Deteriorated Living Environment and Public Services

15. In general the quality of the built environment and the provision of infrastructure services are adversely affected by the pace of urban growth and the inadequacy of institutional responses. Both investment and operational capacity are inadequate to meet the challenge. The results are manifest in substandard housing and ventilation, lack of water and sanitation, trash piles in streets and drains, proliferation of disease-carrying insects and rodents, traffic congestion, lack of open and green spaces, noise and stress, and vulnerability to natural disasters, among others.:

Impacts on the Poor

16. As the physical environment in and around cities deteriorates, those most affected are the urban poor, who make up 30 to 60 percent of the urban population in developing countries and whose numbers are growing. Foremost among the environmental concerns are the health problems of these inhabitants, whose substandard living environment does not protect them from human and other wastes and indoor air pollution. Intraurban studies confirm that the mortality and morbidity from gastroenteric and respiratory infections and malnutrition are significantly higher for the urban poor than for other urban residents. So too are the resulting costs of health care and the productivity losses. For the poor, the main environmental priorities remain improved housing and the provision of basic water and sanitation services at affordable costs. Moreover, in the rapidly industrializing cities of the developing world, there is evidence that the poor are also at significantly greater risk from chronic and degenerative diseases associated with modernization, as well as traumas and psycho-social problems stemming from environmental stress. Among the urban poor,

there are several particularly vulnerable groups -children, women, adolescents, cottage industry workers, and the elderly. Structurally, these groups are particularly exposed because they do not have the political strength to push for environmental improvements, the economic ability to invest in mitigating measures and pay for services, and the knowledge about alternatives.:

Spatial and Intergenerational Impacts

17. The analysis of spatial scale of environmental impacts is crucial to the understanding of urban environmental problems. These problems are also related to the provision, or lack thereof, of key urban infrastructure and services as is also indicated in the figure. The consideration of spatial scale of impacts pinpoints several important issues for developing countries.: (a) Health impacts are greater and more immediate at the household or community level and tend to diminish in intensity as the spatial scale increases.: (b) Equity issues arise in relation to the provision of basic services at the household or community scale (see discussion above on intraurban health differentials and poverty) and intertemporal externalities at the regional and global scale -particularly the inter-generational impacts implicit in non-sustainable resource use and global environmental issues.: (c) Levels of responsibility and decision making should correspond to the scale of impact, but existing jurisdictional arrangements often violate this principle.:

Some Causes of Urban Environmental Degradation

Insufficient Knowledge and Understanding

18. The complexity engendered by the unique features of the urban environment described above makes it difficult to adequately understand and analyze the relationships between problems, impacts, underlying causes and curative actions. The capacity to plan and implement responses to the urban environmental problems cited above, and the ability to build a political consensus, is hampered by insufficient knowledge of both the problems and the processes of environmental degradation. Environmental data for urban areas are usually lacking, and there is no broadly accepted analytical framework for understanding the problems, ranking them and designing environmental protection programs. Robust conceptual models in this area urgently need to be agreed upon and disseminated, whether they be simple, pragmatic planning models, expert systems, or more sophisticated environmental quality models for prediction. An analytical framework to guide data collection and problem analysis is provided (see Table 9.1 at the end of this section).:

Economic Policies

19. Inadequate pricing of both resources and services. Inefficient resource pricing (e.g., land, water, energy, food) undercuts attempts at resource management, and results in the inability to conserve scarce resources and the excessive use of natural resources leading to eventual ecosystem collapse. While this problem is not unique to urban resource management, the scale of urban consumption and the strong political pressure to keep prices down for urban consumers argues for particular attention to urban demand management. Inappropriate pricing of urban services results in inefficient allocation and inequitable distribution, as manifested by:: . urban poor without services despite a certain willingness and ability to pay . subsidized services for the rich . misallocation of funds between capital and recurrent expenditures . inability to recover costs and finance services locally leading to greater dependence on fiscal transfers from central government.

20. Consideration may be given to using subsidies (e.g., soft credits for service connection, life-line rates, or user cross-subsidies) as transitional measures to shield the urban poor from potential negative short-term impacts of structural adjustment, but in such cases they should be open, transparent, and well-targeted.:

21. Other sources of economic distortion. Hidden subsidies, poorly devised or enforced taxes, interest rates, exchange rates, and regulations lations can all lead to damaging distortions in the use of environmental resources, both physical and natural. Apart from direct pricing as mentioned above, other types of

distorting subsidies are common. For example, protective tariffs for manufactured products that are energy inefficient or highly polluting, failure to charge transport or stumpage fees for urban-bound fuelwood or charcoal production leading to ineffective forest management, and the adoption of an interest rate far below the cost of funds for municipal loans or housing finance that undermine the very sustainability of the financing mechanism. Excessive regulatory control of land markets results in unaffordable land prices and leads to the occupation and degradation of ecologically sensitive lands as well as the location of the poor on hazard-prone lands.:

Weaknesses in Environmental Planning and Management

22. Deficient legal and regulatory framework. Few countries have as yet established the comprehensive environmental protection legislation and regulations that are needed to manage urban environmental problems. The law should provide a clear assignment of jurisdiction and responsibility for monitoring and enforcement, as well as specify funding mechanisms for enforcement and control activities. It should also be consistent with current scientific knowledge and establish clear objectives, policies and processes for promulgating regulations and standards, and for setting and maintaining sanctions commensurate in value with environmental damage incurred. Regulations and standards should be kept simple, transparent and easy to apply. In many cases, significant environmental improvement could be achieved within existing legislation and regulations, if it were not for an almost total absence of monitoring and enforcement capacity.

23. Jurisdictional complexity in urban areas results from the multiplicity of actors (national and regional sector agencies, state or provincial governments, local government) with responsiblities for key functions unassigned, overlapping, underlapping or poorly defined. Often there is failure to match level of authority with extent of responsibilitiy or scale of impact. There is also a need to separate normative and operational functions. Thus local government may have an important role in regulating pollution from industry (particularly small-scale manufacturing), while at the same time municipalities are major polluters who should be regulated by regional or national authorities.:

24. Weak organization and management. Weak urban management hampers efforts to improve environmental conditions in cities. This cuts across both planning and operational responsibilities -for municipal waste management and pollution control, land management, drainage, traffic control and municipal finance. Environmental concerns are rarely incorporated into the planning process. In many countries, separate sector agencies provide individual environmental services with inadequate coordination between agencies. Cost recovery for services is seldom adequate even for operation and maintenance, leaving no funds for financing new investments for unmet demand. Inefficient management of municipal and industrial waste treatment and disposal operations makes pollution control a major priority in most urban regions. Public institutions lack the resources to do the job, but there is little effort to involve the private sector in the provision of urban environmental services under conditions that would favor efficient operations.:

25. Ineffective land use controls and property rights systems. Property rights issues contribute to the degradation of land and natural resources and to the inequitable distribution of such resources. Few countries have resolved basic land tenure problems that impede mobilization of household and community resources for basic environmental improvements. This is especially the case for periurban squatters and central-city slumdwellers. Water rights are another problem area, as urban industrial use of groundwater is often in direct conflict with the efficient development of regional water resources. The environmentally sound development of urban land use is often thwarted by the failure of local land markets due to overregulation in addition to the lack of land information systems and the absence of policies and actions to guide urban expansion away from areas poorly suited to urban development.:

Lack of Environmental Awareness and Political Will

26. Sometimes the link between environmental cause and effect is so remote in time or space that it is not recognized, or if it is, social and private interests may diverge. Political leaders often focus on immediate and

highly visible problems, leading to short-term "bandaid" solutions. Often, unfortunately, it takes an environmental disaster (e.g., Bhopal or a series of floods) to stimulate profound change. Public information campaigns and consultative processes are needed that identify the key environmental priorities, build the political will to deal with them, and help build community capacity to participate in the solutions. Too often environmental education is totally lacking in the formal educational system, is not seen as a function of environmental authorities, and is done a disservice by the press which tends to focus on sensationalistic treatment of environmental topics rather than real local priorities.:

Opportunities to Improve Urban Environmental Management

Policy Interventions

27. Economic policies can be a powerful tool for redressing the environmental imbalances occurring in and around cities. Pricing resources and services at their true marginal social cost would improve resource conservation and utilization. In comparison with other environmental policies, pricing measures tend to have a low cost and in many cases are fiscally positive. Subsidies for environmentally destructive activities should be removed. On the other hand, economic incentives are also needed to reduce excessive reliance on regulation and investment programs. Such administrative measures as pollution charges, tax incentives, and targeted subsidies may be useful.

28. Urban hygiene policies are also needed that focus on such areas as shelter improvements, water supply and sanitation, urban and industrial waste management, and accidents prevention. Other important areas are drainage, traffic management, energy management, and preventative health care programs. Policies should be aimed at increased affordability and coverage coupled with cost recovery.:

Environmental Management and Planning

29. A balanced legal and regulatory framework is necessary to support investment programs and economic policy instruments. While deregulation is sought in some areas (e.g., land markets), stricter regulation and enforcement is required in other (e.g., discharge standards). Environmental legislation may need to be updated to take into account new scientific knowledge, phase in environmental regulations and standards in accordance with investment and enforcement capacity, and create new consultative mechanisms between levels of government, business, and the public.

30. Land use management is crucial for mitigating the impact of urbanization on land and other resources. Land registration and information systems, property tax systems, land tenure arrangements, and spatial planning are all important management tools that are not used widely enough in developing country cities. Serviced urban land is a scarce good, and its use and expansion should be guided to spatially appropriate areas. The failure of urban land markets leads to such environmental problems as land degradation, loss of fragile ecosystems, and occupation of hazardous areas. Urban capacity to plan for and manage land use is crucial for environmental protection in such cases, as is attention to both formal and traditional property rights systems. Land development regulations and standards that constrain the provision of serviced and affordable urban land and housing should be removed or modified.:

31. Natural resource management. There are significant interactions of urban areas with the surrounding natural resource base both in terms of excessive urban demand for resources or through resource degradation resulting from urban actions or inactions. Manifestations of environmental impacts are common in water resources, forests and coastal zones. These occurrences point to the need for integrated regional planning and management of key natural resources around major urban areas. Furthermore a legal and regulatory framework for natural resource development is needed that can feasibly be implemented, clearly defines the relationship between legal and administrative authorities, clarifies property rights, and is comprehensible to the public. While local government may not have a major role to play in natural resource management, the influence of cities on resource development cannot be overlooked.

32. Improved urban waste management is a particular municipal function that demands urgent attention. The development of institutional capacity and the introduction of sound management practices are needed to achieve expanded coverage for low-income groups, efficient service provision, effective disposal operations. The potential role of the private sector in providing waste management services is greatly undervalued and should be explored further. :

33. Environmental planning means integrating environmental concerns into the overall urban planning process. This requires the incorporation of environmental information, policies, standards, techniques and monitoring into coordinated strategic action planning at the city level. Spatial, cross-media, intersectoral and intertemporal factors must all be accounted for in environmental planning.:

Institutional Improvements

34. A necessary improvement is in the area of institutional capacity for enforcement actions. Monitoring and enforcement are crucial whether adopting a command and control strategy, economic incentives, or a mix of the two for environmental protection. Since environmental problems cut across political boundaries, jurisdictional arrangements and responsibilities need to be spelled out. Typically, national environmental authorities are responsible for establishing environmental policies and regulations and providing technical and financial assistance to local governments for program implementation. Regulatory and enforcement actions to control private polluters are taken by state and local governments or special regional authorities created for river basin management or waste disposal districts. Municipal government is almost universally assigned responsibility for domestic waste collection and disposal, and in failing to manage these activities appropriately is itself a major polluter. A clear distinction must be drawn between such polluting activities of local government and those corresponding to local government control of industrial discharges (e.g., control of emissions in urban areas, of discharges into municipal sewers, and of hazardous waste disposal in municipal landfills). Regional, state or national authorities must be able to enforce regulations on municipal waste disposal by cities. Finally, the role of community groups, environmental NGOs, and the private and informal sectors in urban environmental management must be recognized and encouraged through appropriate enablement policies. :

Investments and Financing

35. Increased capital investment is also necessary for addressing the growing backlog of urban environmental infrastructure needs. There should be greater emphasis on the use of appropriate and costeffective technologies for environmental protection, together with reduced dependence on the public budget for such investments through the application of beneficiary charges. Public/private partnerships are an especially promising approach. The application of the "polluter pays" principle can reduce the cost to government of curative programs. At the very least, self-financing of environmental services through user and polluter charges must be sufficient to pay for recurrent costs of operations. Ideally, these charges should be linked to the long-run marginal costs of building, maintaining and operating environmental infrastructure.:

Environmental Education and Public Participation

36. To apply political pressure for environmental action, affected urban groups must understand the causes of their problems and be able to vocalize their concerns. Typically, though, there is little public awareness about the sources and effects of urban ecological decay. Further, target populations are rarely involved in the planning and implementation of environmental infrastructure and services. This is particularly true for vulnerable groups such as women, children and the elderly. Consciousness-raising is needed through bringing information about environmental hazards and alternatives to those most affected by environmental externalities. Awareness can motivate affected groups to participate in the process of environmental management. Environmental education is required to inform key urban groups about the causes of ecosystem and resource deterioration, as well as potential solutions at the household, community, city and regional levels. This can be accomplished through formal mechanisms (e.g., public schools, media

campaigns) and informal, targeted approaches (e.g., training community leaders, neighborhood extension agents). Public involvement can be broadened and deepened by encouraging a variety of actors (community movements, business organizations, consumer protection groups, political parties, youth groups and others) and by opening the planning and implementation processes to public participation. :

ROADS AND HIGHWAYS

1. This section treats the impacts of roads and highways, which comprise expressways, primary roads, or byways and rural roads (see "Rural Roads" section for details on the latter). Non-paved roads can have substantial impact, often more than paving and existing roads. Loans or credits to build, improve or rehabilitate roads and highways are almost exclusively done as transportation sector loans or specific road and highway investment projects. Relatively few loans or credits have been approved recently for the construction of highways along totally new alignments, where the full range of environmental impacts may be expected. Rehabilitation and maintenance projects are numerous, however, reflecting the widespread problem of inadequate road system maintenance (World Bank 1988). Sectoral transportation improvement or rehabilitation loans or credits addressing this problem normally include upgrading of some number of unpaved secondary roads to paved standards. This poses a two-phased risk to the environment first constructing, to non-paved standards, then returning later for paving on existing alignment -and should be avoided. Reconstruction of bridges and roadbeds to reduce flooding or flood damage can be a major component of road and highway improvement projects.:

Potential Environmental Impacts

2. Socioeconomic benefits provided by road and highway projects include all-weather reliability, reduced transportation costs, increased access to markets for local produce and products, access to new employment centers, employment of local workers on the project itself, better access to health care and other social services, and strengthening of local economies. However, new roads and highways can produce complex negative impacts. The impacts of improvement, rehabilitation and maintenance projects, although usually more limited, can still be significant, not only on natural resources and systems but also on the social and cultural environment.

3. Direct impacts of road and highway projects result from construction, maintenance, and traffic use. The most significant construction-related impacts are those related to clearing, grading or roadbed construction: loss of vegetative cover; foreclosure of other land uses; modification of natural drainage patterns; changes in groundwater elevation; landslides, erosion, stream and lake sedimentation; degradation of vistas or destruction of cultural sites; and interference with movements of wildlife, livestock, and local residents. Many of these impacts can arise not only at the construction site but also at quarries, borrow pits and materials storage areas serving the project. In addition, adverse environmental and sociocultural impacts can occur in both construction and maintenance projects as a result of air and soil pollution from asphalt plants, dust, noise from construction equipment and blasting; use of pesticides; fuel and oil spills; trash and garbage; and, on large projects, the presence of a non-resident labor force.:

4. Direct road and highway use impacts may include: increased demand for motor fuels; accidents with and/or displacement of non-motorized methods of transport; increased air pollution, noise, roadside litter; injury or death to animals and people attempting to cross roadways; health risk and environmental damage from accidents involving hazardous materials in transit; and water pollution from spills or accumulated contaminants on road surfaces.

5. A wide variety of indirect negative impacts have been attributed to road and highway construction or improvement (see Table 9.2 at the end of this section for examples). Many of them are primarily sociocultural and are discussed in more detail in the sections on "New Land Settlement" and "Induced Development" in Chapter 3. These include visual degradation by roadside billboards; impacts of unplanned land development induced by the project; disruption of local land ownership by speculation; construction of new secondary

roads; greater human access to wildlands and other natural areas; and labor force migration and displacement of subsistence economies.:

Special Issues

Induced Development

6. Many of the direct impacts on natural systems, historical and cultural resources, and right-of-way land uses can be avoided by judicious route selection. It is much more difficult to manage the impacts of new development and penetration into natural areas that may be induced by road construction or improvement. Usually that task falls to other agencies, which may not have been involved in planning the project and which, if they are at the local government level, may be ill-prepared to cope with induced development. New industry tends to locate where land is available and infrastructure exists; highway corridors are logical choices. Roadside commercial development takes place in response to speculation that improved access and greater visibility will bring more customers. Urban sprawl is a phenomenon of larger scale. In the absence of an overall plan, it consists of the expansion of urban areas outward along transportation corridors through industrial, commercial and residential developments.

7. Because of its unplanned nature, induced development proceeds without comprehensive consideration of impacts. Other infrastructure, especially that needed for waste management, may not exist. Social services may become overloaded. The land tenure of low-income landholders and indigenous peoples may be jeopardized by abrupt increases in local land values. Natural resources formerly protected from unplanned exploitation simply by their inaccessibility may become accessible and thus unprotected. Natural systems, visual amenities and historic and cultural resources may be disturbed. These individual developments also generate traffic, possibly overloading the very roads and highways which led to their existence in the first place.:

Loss of Agricultural Land

8. Prime agricultural land, relatively level and well-drained, provides an ideal alignment for roads, and many are located on it. The loss of land to the right-of-way itself may be relatively insignificant and is usually taken into account in deciding whether or not to proceed with a project. However, the phenomenon of induced development, coupled with increasing land values along roads, can lead to conversion of large tracts of agricultural land which were not considered in planning. Such conversions may turn out to have negative impacts on national programs for sustainable agriculture and food self-sufficiency as well as on the viability of the local agricultural economy. :

Deterioration or Loss of Ecologically Sensitive Areas

9. Road construction through wildlands, parks, natural forests and other undeveloped rural areas will inevitably lead to their conversion to other land uses, unless there is popular local support for conservation or preservation combined with effective management and law enforcement. This combination has proven elusive in most developing nations.:

Interference with Customary Local Transportation Methods

10. Pedestrians, animal drawn vehicles, and pedalled vehicles are important types of traffic on roadways in many countries, especially local roads and roads leading to major market towns. Upgrading of unpaved rural roads to paved standards that does not take into account the volume of such traffic will lead to unacceptable levels of accidents and displacement of slower modes of transport. An adequate number of safe crossings and separate or parallel restricted right-of-way for slow traffic should be incorporated into road and highway projects if there is existing or latent demand for non-motorized modes of transportation in the area.:

National/Global Implications

11. Road and highway construction may increase demand for motor vehicles and fuels and lubricants. If these must be imported, balance of payments problems may be exacerbated. Local and regional air quality may deteriorate, and contributions of greenhouse gases will increase. The EA should address these implications in project alternatives (see below).:

Project Alternatives

12. There are no alternatives to roads that fulfill the functions of providing relatively fast, cheap land transportation. Air, rail, and water transport are more likely to complement than to substitute for roads or highways. Alternatives to construction of a new roads or expansion of existing ones which deserve consideration in transportation planning from an environmental point of view include: improvements in traffic management and public transportation on existing roads, rail systems for freight or passengers, and increased investment in non-motorized transportation, at least, for short distances.

13. Alternatives which should be investigated in planning and designing an individual project include alignments to avoid valuable or sensitive resources and alignments that do not provide access to wildlands or other areas which should remain in their natural state.:

Management and Training

14. Experience shows that road maintenance is a weak area in the transportation sector. Inadequate maintenance or improper practices (with respect to chemical use, waste disposal, etc.) may lead directly to environmental impact, if vegetation, aesthetics, quality of runoff water, functioning of drains, or accident frequency are affected. Indirectly, deterioration because of inadequate maintenance will eventually necessitate rehabilitation work, which has potentially greater impacts. Management systems and training are necessary in the maintenance area.

15. Staff in road agencies may need training in good practice to control negative impacts of road construction, maintenance and operation. They may also need training in monitoring and inspecting road projects for environmental impacts and for implementation of mitigating measures. Equipment, vehicles, and operational budgets may be lacking, and standards may be weak or vague, e.g., for air, noise and water pollution. It may be necessary to develop pragmatically defined standards, and to create a special monitoring unit.:

Monitoring of Construction

16. Only construction impacts are treated here. The monitoring of immediate and longer term induced impacts and their mitigation will fall within the jurisdiction of regional development authorities, ministries of agriculture and others, according to the nature and scope of development that is induced by, or planned in parallel with, road and highway construction. If planned and integral to the project, the corresponding sections will indicate the kind of monitoring needed, e.g., land settlement or forest exploitation. If not integral to a road or transportation sector operation, certain impacts may be sufficiently important to justify a companion planning and development exercise, with its own monitoring functions.

17. Monitoring of construction impacts and of the timely and correct implementation of needed mitigating measures should be carried out according to a site-specific plan, by technical offices having mandate, personnel and the necessary capacities. In general, the most critical project elements to be monitored are the implementation and effectiveness of erosion and sedimentation control measures, disposal of debris and wastes, management and reclamation of borrow pits, and materials handling and storage areas.:

INLAND NAVIGATION

1. Projects undertaken to enhance inland navigation include dredging for channel provision, improvement and maintenance, port and harbor development (e.g., berthing facilities, barge flotilla areas, turning basins) and the construction of locks, canals, and waterways. In recent years, nearly all Bank lending in this subsector has been for rehabilitation or expansion of existing facilities.:

Potential Environmental Impacts

2. Dredging is the principal practice used worldwide to improve the navigability of inland waterways. Since dredging is a well established method and remains the primary means for the development and maintenance of routes for inland navigation, there exists an extensive information base on the impacts of inland waterway projects.

3. The alteration of natural waters and the development of man-made channels can cause physical, chemical, and biological changes in the water body, leading to direct and indirect adverse impacts on related ecosystems and communities in the environs.

4. Water, land and air pollution from dredging operations, materials disposal, construction activities and increased maritime traffic can result in the release of natural and anthropogenic contaminants to the environment. (A comprehensive checklist of environmental considerations is provided in Annex 10-2, "Port and Harbor Facilities.") Since numerous dredging and materials disposal methods exist for improving inland navigation, the combination of physical, chemical and biological effects will vary. Potential concerns include oil spills and discharges contaminant release, habitat destruction, circulation alterations, and transportation safety. Terrestrial impacts may include contamination due to dredge materials disposal, erosion and sedimentation from hydrologic changes, and loss of habitat due to shoreline and commerce-related development. (See list of mitigating measures in Table 9.3, at the end of this section.): 5. Dredging is not the only activity having an impact on the environment; the construction of dikes and river training works involves quarrying and transportation of large quantitiites of materials. :

Natural Resource Issues

Water

6. Aquatic systems can be affected by the following dredging operations: turbidity associated with the resuspension and settlement of sediments; partitioning of toxic contaminants and reintroduction to the water column; contaminant uptake by and accumulation in fish; short-term depletions of dissolved oxygen levels; modified bathymetry causing changes in circulation, species diversity, and water chemistry; and loss or modification of habitat and fisheries resources. Disposal of dredged materials may cause impacts similar to, but potentially more severe than, those associated with the dredging operation. Improved navigability will also result increased development and water traffic that may result in accidental spills and in the discharge of oily bilge, ballast water, anti-fouling materials, and sewage. As a result of these indirect impacts, some water-based recreational activities may be precluded.:

Land

7. The shorezone along the waterway can be affected by hydrologic alterations. These impacts include destruction of floodplain, increased erosion, loss of vegetation, flooding, and drainage of wetlands and mangroves. Further discussion of wetlands is provided in Chapters 2 and 3. Land disposal of dredge materials in confined and unconfined systems can impact underlying groundwater, contaminate surface runoff, and affect future land-use options. Additional terrestrial impacts would most likely result from increased vehicle traffic and industrialization related to the development of the shoreline and inland areas serviced by the port facilities.:

Social and Cultural Issues

8. Inland navigation projects may upset the local cultural, ethnic, historical and religious traditions. In some cases, project acceptance and success may be hampered by local concern for the potential destruction of historical places, parks, reserves and valuable coastal zone recreational and fisheries resources.

9. Project planning and EA should provide for community involvement. Review of the impacts of creating demands on the local technical and labor resources should be conducted to prevent unacceptable pressures on limited resources. Care must be taken to limit and/or prevent adverse impacts on scarce local commodities. For example, the destruction of habitat important to a valuable local fishery could result in undesirable economic and cultural impacts. (See Chapter 7 on community involvement.):

Special Issues

Environmental Law

10. Internationally, greater attention is being given to the importance of maintaining and protecting the structural and functional integrity of coastal zone resources; therefore, any inland navigation project that may affect these resources must comply with any development restrictions. Open-ocean disposal of wastes, including contaminated dredge materials, has received considerable scrutiny in recent years. Applicable local and international regulations, such as the Oslo Convention of 1974, the Paris Convention of 1978, and the London Dumping Convention of 1972, should be followed. (International treaties and agreements on the environment and international waterways are discussed in Chapter 2).:

Waterway Location

11. Many developing countries are characterized by dense human populations, inadequate potable water and sanitary waste disposal systems, intensive land use, and increasing levels of environmental degradation. Improving or developing a waterway for increasing maritime commerce and related port/harbor industries in an area currently experiencing multiple demands on environmental resources may be ill-advised, unless adequate mitigative measures are planned to ensure the proper handling of wastes from development-related activities. The decision to improve/develop a waterway is usually based on economic, geographic, physical and political parameters rather than on those of an ecologic nature. In choosing a location, the assimilative capacity of the prevailing natural and sociocultural systems should be considered, along with accessibility, employment needs and local commerce. :

Project Alternatives

12. Often, several planning, design and implementation alternatives exist for an inland navigation project. As a project progresses, Bank staff and consultants will describe the specific alternatives considered during project appraisal. Discussed below are various alternatives and considerations that can provide a framework for examination of a specific project by the environmental assessors and reviewers.:

Site Selection

13. The selection of a location for enhancement of inland navigation depends on many physical characteristics of the site as well as on socioeconomic concerns. Good locations typically satisfy the following criteria:

. Physical characteristics including wind, currents, weather and siltation do not require excessive maintenance.: . Suitable land area is adequate for the processing and waste management needs of any developing industries.: . Scheduling considerations such as the spawning and migration periods of indigenous biota are not violated.: . Need for resettlement is minimal.: . Project does not compete with other highly valued land uses.: . Project activities do not adversely affect the value of an existing resource, such as a fishery.: . Construction, operation and maintenance of the waterway does not damage sensitive habitats (e.g., estuaries, mangroves); rare, threatened, or endangered species; lands and waters used by indigenous peoples; cultural properties.:

Dredged Material Disposal

14. The initial screening for evaluating disposal options is a physical and chemical analysis for geotechnical character and the presence of contaminants in the sediments. Depending on the physical and chemical character of the dredged material, disposal may be confined, unconfined, or treated prior to release in open water, along the shoreline, or on land. Disposal must be in accordance with applicable regulations. Also, longterm monitoring of the dredging process and disposal may be required.:

Dredging Process

15. The primary categories of dredges include mechanical, hydraulic and new innovative technologies. When selecting the appropriate dredging technology or combination of technologies, the project engineer should consider the following site-specific factors: environmental constraints associated with the physical and chemical character of the sediments; susceptibility of indigenous aquatic species to dredgingrelated activities; cost and availability of equipment; disposal site location and limitations; physical conditions affecting the dredge, transit and disposal locations; and interference with other users at the dredge, transit, and disposal locations.:

Management and Training

16. Where applicable, a comprehensive dredging and dredged-materials management plan should be considered for inland navigation projects to ensure that development and maintenance can be carried out on schedule with minimum environmental effects. The plan should be based on: a characterization of the materials to be dredged; a vertical and horizontal profile of contaminant distribution in the channel sediments -to define homogeneity and locate prominent "hot spots"; an evaluation of sediment behavior using different dredging equipment and disposal options; and an analysis of potential longterm effects of maintenance on human and environmental health.

17. Support for efficient pollution control and waste reduction strategies may be important for dredging and construction activities, equipment operation and materials disposal. Project engineers should be familiar with state-of-the-art equipment and disposal technologies to ensure environmentally sound management of navigation projects.

18. All project staff should receive training under "standards of practice" for occupational health and safety and emergency response. The training should include procedures to be followed in the event of accidents, spills, explosions, or fires.

19. Training for government officials charged with supervision of an environmental management and monitoring plan may be required. To assess training needs, the capacity of local institutions to assume responsibility for environmental review should be evaluated, as well as the record of legal and regulatory agencies to monitor and enforce standards.:

Monitoring

20. A site-specific environmental monitoring plan that enables Bank and local government officials to manage a project and ensure compliance with environmental standards should be prepared for each individual project. Generic parameters that may require monitoring during project planning, start-up and operation are as follows: geotechnical and chemical characterization of sediments; water quality of project area and proposed disposal area; long-term chemical/physical testing of project area and disposal location; sediments and water quality; long-term monitoring of biota for the possible accumulation of contaminants;

maintenance of programs to keep a high level of employee environmental awareness; and monitoring of effects of project on populations and systems in the environs of the dredged area. :

PORT AND HARBOR FACILITIES

1. Maritime transport (shipping) conveys over 82 percent of world trade; therefore, port and harbor development projects (e.g., terminals, berthing facilities, turning basins) are usually associated with long-term economic benefit for developing nations. Technological advancement in marine transport and the integration of transport by land, sea, and air have increased the complexity of port and harbor development. The dynamic character and importance of maritime transport can lead to projects such as development of approach channels, canals, waterways, and turning basins; construction of quays, breakwaters, jetties, and groins; and possibly the building of deepwater ports, prefabricated ports, offshore and relocatable terminals. Nearly all of the Bank's lending in recent years has been for rehabilitation or expansion of existing facilities.:

Potential Environmental Impacts

2. The success of maritime commerce, fishing industries, and naval defense are dependent on port and harbor development; therefore, proper design, construction, and maintenance of these coastal and marine resources are important. Maritime development usually generates local environmental problems; however, development associated with sensitive estuaries or inland on freshwater rivers may yield regional-scale problems. The impacts of maritime development will differ by location because of variations in features such as geography, hydrology, geology, ecology, industrialization, urbanization and type of shipping.

3. The alteration of natural waters and the construction of man-made structures can lead to direct impacts on the water body being developed as well as direct and indirect impacts on related ecosystems and communities in the project environs.:

4. Dredging operations, materials disposal, shorezone development, increased maritime traffic and vehicle traffic in the port can result in the release of natural and anthropogenic contaminants to the environment. Since numerous dredging, materials disposal, and construction methods exist for developing port and harbor facilities, the combinations of physical, chemical, and biologic effects on the medium of interest will vary. Potential aquatic impacts include oil spills and discharges; contaminant release from sediment resuspension, surface runoff, and point source discharges; habitat destruction; changes in water chemistry and circulation; occupational and public health concerns; and transportation safety. Terrestrial impacts may include contamination due to dredged materials disposal; erosion and sedimentation due to hydrologic changes caused by channel deepening and widening and shorezone development (construction of breakwaters, etc.); loss of sensitive habitat (e.g., wetlands, mangroves) due to shoreline and port-related development; and loss of existing and future land use. Air impacts can include degradation of air quality due to emissions from industrial stacks and vehicular traffic, and the generation of fugitive dusts. (A summary of all potential environmental impacts is provided in Table 9.4. at the end of this section.) :

Natural Resource Issues

Water

5. Dredging and dredge spoil disposal activities for port development and maintenance can induce shortand long-term impacts on aquatic systems as follows: degradation of marine resources such as beaches, estuaries, coral reefs, and fisheries; resuspension and settlement of sediments; partitioning of toxic contaminants and reintroduction to the water column; contaminant uptake by and accumulation in fish and shellfish; increased turbidity causing decrease in light penetration and associated photosynthetic activity; short-term depletions of dissolved oxygen levels; modified bathymetry causing changes in circulation, possible saltwater intrusion to groundwater and inland surface water; altered species diversity and structure of benthic communities, and fluctuations in water chemistry; changes in shoreline structure; and loss of

habitat and fisheries resources. : Similar impacts can also result from increased maritime traffic and facility development along the shorezone.

6. Improved navigability and development of port facilities will increase maritime traffic and with it, the risk of spills and the discharge of oily bilge, ballast, anti-fouling materials and sewage. The increase in shorezone development will also contribute stress to the receiving aquatic system through point discharges of sewage, process and cooling waters, and accidental releases.:

Land

7. The waterfront region in the port and harbor area will be altered to suit new industry. These new industries can lead to relocation of villages, increased vehicular traffic, dust and airborne emissions from traffic and raw materials stockpiles, and contamination of surface runoff. Numerous port and harbor facilities are proximal to sensitive saltwater marshes, mangroves, and estuaries which can act as sinks for the collection of contaminated stormwater and sediment from the waterfront area. Further discussion of wetlands is provided in Chapter 2.

8. Land disposal of dredge materials in confined and unconfined systems can also affect underlying groundwater, contaminate surface runoff, and alter future land-use options. Increasing concern about the loss of wetlands and the effects of this loss on the hydrologic and biologic structure and function of biomes, will most likely preclude the use of wetlands as reclamation sites for dredged materials. :

Social and Cultural Issues

9. For the most part, new or expanded port and harbor facilities in a developing nation are welcomed since these projects provide new jobs and bring an influx of commerce to the region. However, improvements, expansion, and industrialization may upset the local cultural, ethnic, historical and religious traditions. In some cases, project acceptance and success may be hampered by local concern for the potential destruction of historical places, parks, reserves and valuable coastal zone recreational and fisheries resources. Community involvement in project planning is essential.

10. During the planning and implementation phases, projections should be made of the possible impacts of increased demands on the local technical and labor resources to prevent excess pressure on limited resources. Care must be taken to limit and/or prevent impacts on scarce local commodities. For example, the destruction of a valuable local fishery or recreational beach for the development of port and harbor facilities could result in undesirable economic and cultural impacts.:

Special Issues

Hazardous Materials/Cargoes

11. The shipping and handling of hazardous materials such as pesticides, explosives or pressurized gases at port facilities in developing nations could pose an unacceptable risk to human health and the environment. To protect workers and the surrounding communities, authorities should ensure that effective measures are enforced for monitoring the transport and handling of hazardous materials at the port (see "Industrial Hazard Management" section).:

Maintenance Dredging

12. Maintenance dredging is performed in approach channels and harbor basins to maintain depth and width and ensure safe access for large vessels. The dredged materials from maintenance dredging typically present a greater disposal problem than deeper sediments removed during construction dredging, since surficial sediments are composed of recently deposited materials that are usually contaminated. These younger sediments usually contain natural and anthropogenic contaminants and can arrive from

atmospheric fallout, erosion of local land surface and channel banks, fallout from biological activity in the water column, sediment transport from inland waters, point source dischargers, and surface runoff from the surrounding area. To mitigate potential contaminant release from the port area, the following should be addressed: proper design of stormwater handling and treatment facilities; sewage and wastewater outfalls; local land use (e.g., proximity of agricultural fields or mining operations); procedures for handling hazardous materials; and types of industries permitted to operate in the port area.:

Environmental Law

13. Internationally, greater attention is being given to the importance of maintaining and protecting the structural and functional integrity of marine and coastal zone resources; therefore, any port and harbor development which may affect these resources must comply with local and/or regional restrictions.

14. Open-ocean disposal of wastes, including contaminated dredge materials, has received considerable scrutiny in recent years. Applicable local and international regulations, such as the Oslo Convention of 1974, the Paris Convention of 1978, and the London Dumping Convention of 1972 should be followed. Also, the International Maritime Organization (IMO) is responsible for establishing guidelines for ports to prevent and control releases and discharges from ships. (International treaties and agreements on the environment and international waterways are discussed in Chapter 2.):

Port and Harbor Location

15. Many developing countries are characterized by dense human populations, inadequate potable water and sanitary waste disposal systems, intensive land use, and increasing levels of environmental degradation. Developing a port and harbor for increasing maritime commerce and port-related industry in an area currently experiencing environmental stress may be ill-advised, unless adequate mitigative measures are planned to ensure the proper handling of wastes from development-related activities. The decision to improve or develop port or harbor facilities is usually based on economic, geographic and political parameters rather than on those of an ecologic nature. In choosing location, the assimilative capacity of the prevailing natural systems should be considered along with accessibility, employment needs and local commerce. :

Project Alternatives

16. Often several project planning, design and implementation alternatives exist for development of a port and harbor facility. As a project progresses, Bank staff and consultants will describe the specific alternatives considered during project appraisal. Discussed below are various alternatives and considerations that can provide a framework for examination of a specific project by the environmental assessors and reviewers.:

Site Selection

17. Selection of a site for the development of new port or harbor facilities depends on many physical characteristics of the local surroundings as well as on socioeconomic concerns. Good locations typically satisfy the following criteria.

. Physical characteristics including, wind, tides, currents, weather and siltation do not require excessive maintenance or preclude maritime traffic.

. Alterations in circulation do not position the port where maximum sedimentation will occur, leading to increased frequency of maintenance dredging.

. Shorezone land area is adequate for the processing and waste management needs of any new waterfront industries.

. Scheduling considerations such as the spawning and migration periods for indigenous biota are not violated.

. Need for resettlement is minimal.

. Project does not compete with or displace other highly valued land uses such as fishing beaches, agricultural fields or villages.

. Project activities do not adversely affect the value of an existing marine or coastal resource, such as dunes or a shellfishery.

. Construction materials, skilled labor, support industries, energy and freshwater supply, waste disposal facilities and transportation are accessible.

. Construction, operation and maintenance of the port or harbor does not damage sensitive habitats (e.g., estuaries, mangroves) or rare, threatened or endangered species.: . Port access by road/rail can be established easily without excessive disturbance to communities.:

Dredged Material Disposal

18. The initial screening for evaluating disposal options is a physical and chemical analysis for geotechnical character and the presence of contaminants in the sediments. Depending on the physical and chemical character of the dredged material, disposal may be confined, unconfined, or treated prior to release in open water, along the shoreline, or on land. Disposal must be in accordance with applicable regulations. Also, long-term monitoring of the dredging process and disposal may be required.:

Dredging Process

19. The primary categories of dredges include mechanical, hydraulic and innovative technologies. When selecting the appropriate dredging technology or combination of technologies, the project engineer should consider the following site-specific factors: (a) environmental constraints associated with the physical and chemical character of the sediments; (b) cost and availability of equipment; disposal site location and limitations; (c) proximity of sensitive systems such as mangroves, estuaries, regional groundwater and freshwater bodies; (d) physical conditions affecting the dredge, transit and disposal locations; and (e) interference with other users at the dredge, transit and disposal locations.:

Management and Training

20. A comprehensive dredging and dredged-materials management plan should be considered for the port and harbor facilities to ensure that maintenance projects can be carried out on schedule with minimum environmental effects. Port authorities and engineers should develop a plan using data from a characterization of the materials to be dredged; a vertical and horizontal profile of contaminant distribution in the channel sediments -to define homogeneity and locate prominent "hot spots"; an evaluation of sediment behavior using different dredging equipment and disposal options; and an analysis of potential long-term effects of maintenance on human and environmental health.

21. Support for efficient pollution control and waste reduction strategies may be important for dredging and construction activities, equipment operation, materials disposal and waterfront industries. Port and industrial engineers should be familiar with state-of-the-art equipment and disposal technologies to ensure environmentally sound waste and spoils management.:

22. All project staff and laborers should receive training under "standards of practice" for occupational health and safety and emergency response. The training should include procedures to be followed in the

event of accidents, spills, explosions or fires. (For detailed discussion, see the "Industrial Hazard Management" section.)

23. Training for government officials charged with supervision of an environmental management and monitoring plan may be required. To assess training needs, the capacity of local institutions to assume responsibility for environmental review should be evaluated, as well as the record of legal and regulatory agencies to monitor and enforce standards.:

Monitoring

24. A site-specific environmental monitoring plan that enables Bank and local government officials to manage a project and ensure compliance with environmental standards should be prepared for each individual project. Generic parameters that may require monitoring during project planning, start-up and operation are as follows: geotechnical and chemical characterization of sediments; water quality of project area and proposed disposal area; long-term chemical/physical testing of project area; disposal location sediments and water quality; longterm monitoring of biota for the possible accumulation of contaminants; long-term monitoring of sediment transport, accretion (shoaling), erosion, and the impacts and effectiveness of any manmade structures (e.g., groins, jetties); maintenance programs to keep a high level of employee environmental awareness; and monitoring of effects of project on populations and systems in the environs of the port and harbor facilities.:

LARGE-SCALE HOUSING PROJECTS

1. Large-scale housing projects are residential developments with multiple units designed as integrated schemes on single tracts of land and cover a range of development types, from subdivisions to entire cities. At the upper end of the scale the category would include the residential sectors of new towns and cities.

2. The lower end is more difficult to determine because of the ease with which housing schemes can be split into smaller phases to avoid categorization. However, 20 acres or 10 hectares are sometimes used as the lower limit of development size for compliance with certain environmental regulations, and this might be a reasonable working limit for single family detached housing, attached, courtyard, and other types of low-rise schemes, regardless of the number of units. As the densities rise, the impacts have more to do with the number of units than the size of the tract, therefore, high density row or town house schemes, low or high-rise apartments, a reasonable lower limit might be around 100 units, regardless of tract size. These lower limits are arbitrary and there should be flexibility in interpreting them. When a number of small projects begin to aggregate into a larger neighborhood, they should be treated as a large project, since experience suggests that the environmental impacts will be just as severe as a single large project, and perhaps even greater, because there may be less enforcement of regulatory standards.:

3. Depending on the needs of the community, and the local sociopolitical framework, housing may be provided by either the public or private sectors, or a combination of both. Frequently the formal process is inadequate for community needs, and people provide their own housing using whatever materials and land is available. Most governments ultimately legitimize this squatter process by providing services and legalizing ownership. In some instances, sites and services are provided by a government agency and the units are built by individual residents. Large-scale housing projects, therefore, can come in several forms, from traditional public housing, government assisted private housing, upgrading of existing informal housing, and new sites and services projects, all of which are included in this section of the sourcebook. Because people are affected by their housing so intimately Chapter 7 on community participation is particularly relevant to these projects.:

Potential Environmental Impacts

Direct Impacts

4. Housing is an obvious and pressing human need. Until quite recently, the formidable task of providing sufficient housing for a burgeoning world population has overshadowed environmental considerations. However, with increasing pressure on land and resources has come a growing understanding of the major and severe environmental impacts generated by large-scale residential development. Many of the problems encountered in providing housing are themselves environmentally related, such as the increased costs of developing environmentally valuable, difficult, or hazardous sites. Poorly designed developments, even on essentially suitable sites, can be damaging to the environment, and threaten the health and welfare of the inhabitants. For the resident, there are many natural and manmade conditions that have serious negative impacts on the living environment and preclude the choice of a particular site; for example, flood dangers, unstable soil conditions, seismic or volcanically activity, highly saline soils, etc. Man-made conditions are related to waste disposal areas and land that has been subjected to industrial or extractive processes, such as mining (for further discussion, see Table 9.5 at the end of this section).:

5. Direct environmental impacts of housing, development occur at regional, local and site scales. The largest regional effects occur from the loss of land; prime agricultural land is often the major resource lost to development. Forests, wetlands, and habitats containing rare and endangered species, etc., are all threatened if adequate regional planning policies are not implemented. Care should therefore be taken to ensure that the long-term value of such lost or disrupted resources is identified and balanced against the need for housing.

6. Residential development contributes to air and water pollution from heating and cooling fuel use and sewage, etc. Increased solid wastes and traffic also can be expected. :

7. Disruption of existing natural systems from poorly designed projects accelerate erosion and siltation, affecting both surface and groundwater quality. Groundwater quantity may be diminished due to extraction and decreased infiltration of rainwater. Increased runoff and flooding occur due to the increased impervious area (e.g., paving), and removal of vegetation and disruption of natural drainage patterns. Existing streams experience more extreme flood/drought cycles. Stormwater drainage and sanitary waste systems tax the absorption and treatment capacity of local soils and drainage networks, and groundwater becomes polluted. Erosion, subsidence, landslides, and other mechanical failure of soils and subsoils occur on improperly developed sites, particularly where there are steep slopes. Removal of vegetation may affect local climatic conditions, causing extreme temperature fluctuations and greater exposure to wind and solar radiation. :

Construction Impacts

8. Building sites during construction are particularly vulnerable to environmental disturbance. Construction is often a rapid and disorderly process, with strong emphasis on completing the project and not on protecting the environment. Therefore, many seriously damaging and unnecessary impacts to the environment occur. Vegetation is removed, exposing the soil to rain, wind, and other disturbances. Excavation and grading further exacerbate this situation. Runoff increases resulting in erosion and siltation. Heavy machinery and the storage of materials compact soils making them less permeable and destroying their structure. Vegetation that is not removed may be damaged by construction equipment. Construction activity also affects the immediate surroundings of the site, e.g., by the congestion of existing roads and access points and increased noise and dirt. :

Indirect Impacts

9. The manufacture, extraction, or harvesting of materials, such as bricks, cement and aggregates, coral, lumber, etc., increases during construction. This may temporarily benefit the local economy, but it may also result in shortages, the wasteful exploitation of natural resources such as forests, or the overtaxing of the local labor force. Induced development may also occur due to changes in movement patterns caused by, for example, activities displaced by the new housing. Involuntary resettlement of existing populations may also be a factor. ("Involuntary Resettlement and "Induced Development" are discussed in Chapter 3.):

Special Issues

The Nature of Housing as a Development Type

10. While housing projects can consume considerable amounts of land they are composed of small individual units. The unitary quality of housing makes it very flexible, adaptable to almost any environment. This can be disadvantageous environmentally since it is relatively easy to build in unsuitable areas and ignore impacts and hazards at the outset. It also means that EA requires a broad knowledge of environmental impacts at many different scales. In addition, health and environmental regulations, increasing prosperity, and the use of cars as the major means of transportation, have all tended to lower project densities over the past few decades, increasing the overall consumption of land in industrial countries. Residential projects there may have influenced housing in developing countries and contributed to unnecessary environmental impacts in areas where the standards may be inappropriate for local needs and conditions.:

Cultural/Environmental Relationships

11. EA of large-scale housing projects requires an understanding of indigenous lifestyles and preferences in order to achieve and maintain sustainability. New development can damage the existing cultural fabric of a region or neighborhood. A community derives its character from many generations of interaction between the people and their surroundings. Large-scale housing development introduces change not only to the natural environment, but to these living patterns, to people's relationship to the land; and the effects on the people can be significant.

12. In traditional societies, an enduring relationship between a community and the land it occupies normally indicates a relatively stable ecological balance. The relationship may not be as productive and symbiotic as in a natural ecosystem, but it is stable on a human time scale. Therefore, the extent to which a large project disrupts traditional relationships to the land should be assessed.:

Mitigating Measures

Siting

13. Siting of projects to avoid ecologically sensitive, difficult, or unsafe areas is the best and most cost-effective way to minimize environmental impacts. To properly evaluate choice available, a regional data-base should be developed to identify and map principal environmental resources, such as major drainage patterns, freshwater and coastal wet-lands, forests and other important natural habitats, prime agricultural land, etc. Where a regional database has not been developed, satellite data, aerial photography, data from academic or commercial sources, or local anecdotal information may provide a useful approximation. Such an analysis can eliminate the least suitable sites from consideration.:

Site Analysis and Evaluation

14. After the initial site choice has been made, a site analysis and evaluation will identify potential environmental impacts. The goal is to understand how the site works; an extensive inventory is less important than to understand the essential nature of the site. Usually, only a few factors are critical to providing this basic overview of the site terrain, water regimen, soils and vegetation. However, a good topographic base map, with coontours at about two foot intervals, is essential to site analysis and should be required on all projects. :

Adaptive Strategies

15. Once the site analysis and evaluation is complete, there are several possible approaches for ensuring that a project is environmentally sound. Regulations for the protection of environmental quality are

necessary, but at best, they can ensure only that minimum standards are achieved. A more effective approach is to design environmentally adaptive strategies that are built into the projects from the outset. Such strategies are derived from understanding and emulating natural models. Using permeable paving to allow percolation of water back into the soil, stabilizing steep slopes with vegetation, and treating wastewater with biological methods are examples of adaptive strategies that have been developed in recent years. Many others are possible and EAs should be designed to foster such innovative approaches.

16. This type of adaptive approach may be limited by the flexibility of local regulations, working customs, cultural expectations and affordable costs. However, experience has shown that it is invariably more cost effective than more conventional methods, once an appropriate idea is understood and accepted. For example, the preservation and use of natural drainage patterns for new projects, in lieu of piped or concrete channels with curbs and inlets, has been shown to improve flood control while lowering costs substantially. Such techniques following natural models gain economically because they require less maintenance usually.

17. Simplified site development guidelines to assist the developer and designer work with the site's natural characteristics should be written for all projects. The goal is to integrate environment awareness into the entire design of the project, minimizing the need for costly after-the-fact mitigation measures.:

Design and Planning Standards

18. Evaluation of design and planning standards applied to a project may also be necessary to achieve environmentally sustainable performance, particularly if innovative adaptive strategies are to be encouraged. Building and planning standards in many developing countries were originally based on models from the industrial countries, and may be inappropriate. Standards for street widths, set backs, etc., may be overly generous, forcing consumption of too much land and increasing costs for roads and services. Reducing such requirements, provided open space set-asides are made to conserve critical environmental areas, should prove economical and environmentally beneficial as well, since less land is consumed per unit.:

Management, Training, and Monitoring

19. Planners, designers, engineers, public officials in charge of project regulation and execution, developers and contractors should be educated to the environmental problems caused by many conventional development practices. Training is also required in effective site evaluation, for which an ecological perspective is needed. The person(s) conducting the EA should be familiar with the basic natural habitats of the region. After a project is complete, residents, managers, maintenance people and local officials, should be instructed in the purpose of its design and its recommended maintenance. Simplified guidelines for operation and maintenance should be distributed to encourage continuing support and understanding of the design and to build a sense of community in the new project.

20. Monitoring of environmental conditions is necessary to ensure that systems continue to operate as they were designed. Such monitoring requirements should be identified during EA, e.g., testing the quality of groundwater where wells are in use. Technical and institutional capability for monitoring should be established or strengthened as necessary, as part of the project requirements.:

Agency Coordination

21. Since environment has not been of great concern to governments in the past, environmental responsibilities are often fragmented between many different agencies. The trend has been to approach this problem by forming new environmental departments (e.g., ministries) in the government. The existence of such agencies will not necessarily ensure environmental quality. They may need to be supplemented with environmental units in the implementing ministry (e.g., the ministry of (housing) and at the site. Above all, effectiveness can be greatly enhanced by building grass-roots understanding and support in the affected communities and NGOs (see Chapter 7).:

SOLID WASTE COLLECTION AND DISPOSAL SYSTEMS

1. The overall objectives of World Bank projects for solid waste collection and disposal are to: (a) provide appropriate and efficient collection of solid wastes in the urban environment; (b) provide effective and economic transport of collected wastes to disposal facilities; (c) provide environmentally safe, technically practical and low-cost disposal; and (d) strengthen institutions technically and financially to ensure cost-effective operation and maintenance of solid waste systems over the long-term.

2. Solid waste includes: street sweepings (including dead animals); pumped sludge from septic tanks and cesspits (but not wastewater treatment plant sludge); refuse collected from residential establishments, commercial enterprises, and institutions; pharmaceutical and surgical wastes from medical clinics and hospitals; and refuse and processing wastes from industrial manufacturing facilities. The composition of solid waste varies from country to country, and culture to culture. Solid waste can contain putrescible organic matter (e.g., kitchen and market wastes, fecal matter, septage); combustible organic matter (e.g., paper, textile, and bone); and plastics, metals, glass, oil and grease, and inerts (e.g., soil and ash). Solid waste can also contain pathogenic microorganisms (e.g., bacteria and parasites), and toxic chemicals (e.g., pesticides, heavy metals, volatile organics and solvents).:

3. To date, typical Bank projects in this category have included: municipal refuse collection vehicles, transfer stations and transfer trucks to increase collection service levels and lower the costs of collection and haul; septage collection vehicles and special treatment/disposal systems; workshop equipment and facilities for improved maintenance and repair of the municipal collection fleet; closure of unsanitary open dumps; refuse disposal by sanitary landfill; resource recovery by composting; pilot tests of alternative refuse collection methods for marginal zones of low-income residents and difficult access conditions; technical assistance in planning collection routes and methods; technical assistance in design and operation of disposal systems; institutional and financial strengthening of the organizational entities authorized to provide municipal solid waste management services.

4. In the future, because of need to decrease the amounts of municipal solid waste and to increase recovery of resources from them, typical Bank projects are expected to include technical assistance and policy incentives to increase segregation of secondary materials at the source and recycling; pilot tests for alternative methods of resource recovery; municipal refuse materials recycling and/or resource recovery facilities; industrial waste exchange and waste minimization. :

5. Furthermore, because of the industrial growth in some developing countries, future Bank projects are expected increasingly to include special handling and disposal facilities for potentially hazardous wastes. For purposes of this document, projects which specifically deal with hazardous wastes are discussed in the "Industrial Hazard Management" section.:

Potential Environmental Impacts

Public Nuisance Impacts

6. Uncollected solid waste is a public nuisance. It clogs sewers and open drains, encroaches on roadways, diminishes landscape aesthetics, and causes unpleasant odors and irritating dusts. Generally, a solid waste project would include improving waste collection and would thus lessen the quantity of uncollected waste. However, if a project is not appropriately designed to fit in with the needs and behavioral patterns of local residents, it could result in increasing impacts related to uncollected waste.:

Public Health Impacts

7. Public health can be affected when solid waste is not adequately contained at and collected from living and working environments. Furthermore, direct contact occurs when there is inadequate protection of

collection and disposal workers (e.g., gloves, boots, uniforms and changing/washing facilities). As a result, the design of a solid waste project needs to consider the economic costs of waste containment and worker protection relative to potential public health impacts in order to derive an appropriate level of design.

8. Public health also can be affected when solid waste is inadequately disposed within an open dump. Although a number of solid waste projects have called for closure of open dumps and implementation of alternative sanitary disposal practices, few projects have been successful at implementing this component of the project because of land acquisition and local finance issues, as well as pressures from informal sector recycling.

9. In an open dump, there is ready access to the waste by domestic animals and, subsequently, potential spread of disease and chemical contaminants through the food chain. From an open dump, windblown dusts may carry pathogens and hazardous materials. Gases generated during biodegradation within an open dump (and to a lesser extent, a sanitary landfill) may include toxic and potentially carcinogenic volatile organics (e.g., benzene and vinyl chloride), as well as typical biodegradation by-products (e.g., methane, hydrogen sulfide, and carbon dioxide). Smoke generated from burning wastes at open dumps is a significant respiratory irritant and can cause affected populations to have a much increased susceptibility to respiratory illness. :

Direct Impacts

10. Environmental damage from solid waste disposal typically can include contamination of soil, groundwater, surface water and air quality. Adverse impacts result from improper siting, inadequate design and/or poor operation. For example, seepage from solid waste contains fine particulates and microorganisms which can be filtered by soil matrices. Seepage also contains dissolved solids which can be attenuated by soil through precipitation, adsorption or ion exchange mechanisms. Under favorable hydrologic conditions, contaminated seepage (also called leachate) from solid waste can pass through the unsaturated soil beneath the solid waste deposit and enter groundwater.

11. Surface water can be contaminated as polluted groundwater is discharged into it, or by surface runoff directly from the solid waste deposit. Sources of air quality degradation include smoke from open burning; dust from inadequate containment, collection, and open dumping; and gases generated by decomposition of wastes within an open dump or sanitary landfill. (For a summary of the direct and indirect environmental impacts from solid waste collection and disposal, see Table 9.6 at the end of this section.):

Natural Resource Issues

Land Issues

12. The most obvious contamination of land is caused by windblown litter and clandestine dumping in open areas and along roadways. This contamination causes an aesthetic impact, which can result in diminished civic pride and loss of property value.

13. Soil underlying solid waste deposited within an open dump or sanitary landfill is typically contaminated by pathogenic microorganisms, heavy metals, salts and chlorinated hydrocarbons contained in seepage from the waste. The extent to which the soil attenuates such contaminants will depend on its porosity, ion exchange capacity, and ability to adsorb and precipitate dissolved solids. Furthermore, not all contaminants can be attenuated by soil. For example, anions, such as chloride and nitrate, pass readily through most soils without attenuation. Soils consisting of clay and organic matter are more likely to attenuate contaminants than soils consisting of sand, silt and gravel. If seepage continues after underlying soils have reached their full capacity to attenuate contaminants, contaminants may be released to groundwater.

14. When solid waste is processed by composting, the resulting compost product may be applied to agricultural land, wooded areas, and/or home gardens. Depending on the concentration of potentially

hazardous chemicals within the compost and the land application rate used, soil can be contaminated and plants can subsequently uptake toxic chemicals. Some chemicals stay within the soil matrix and build up to phytotoxic levels after repeated applications of composting.:

Water Issues

15. Through biodegradation and chemical oxidation/reduction mechanisms on deposited solid wastes, dissolved by-products of decomposition are added to the interstitial waters within the solid waste mass. Over time, the solid waste decomposes into smaller particles and the waste consolidates under its own weight, thus releasing the polluted interstitial waters.

16. Both the initial interstitial waters and any infiltration waters contaminated by decomposition by-products can seep into groundwater under certain hydrologic conditions (i.e., saturation of the waste to the point of field capacity and permeable conditions in soils underlying the wastes, as well as other hydrologic connections such as fractures in rock and inadequate casing and seals on wells).

17. Surface water can be polluted when it receives groundwater or surface runoff which has been contaminated with leachate from landfill areas. In the event that solid waste is placed in a sanitary landfill designed to enable leachate collection and leachate treatment, there may be a water quality impact attributable to the discharge of treated leachate into a receiving surface water. Potential impacts due to inadequate leachate treatment design, operational failures and bypasses, are as discussed for wastewater treatment under the category of "Wastewater Collection, Treatment, Reuse, and Disposal Systems.":

Air Issues

18. The most obvious air quality problems associated with solid waste collection and disposal are dust, odors and smoke. Less obvious air quality problems may arise when the biodegradation of hazardous materials in the solid waste leads to release of potentially toxic volatile organics. For the most part, following good design and operating practices can minimize these impacts.

19. The air quality problem most associated with solid waste collection is dust created during loading operations. The level of dust created depends largely on the method of collection selected. Dust is primarily a nuisance and an eye irritant; however, it may also carry pathogenic microorganisms which could be inhaled when airborne.

20. There is typically a putrid smell from hydrogen sulfide gas and other gases created by anaerobic biodegradation of wastes within an open dump or sanitary landfill. By contrast, at a compost facility where biodegradation is designed to occur by aerobic mechanisms, the odor is typically an unoffensive earthy smell. If the compost facility is not properly operated and anaerobic conditions develop, however, a foul odor could result.

21. Burning at a disposal site may occur underground and on the surface. Once an open dump begins to burn underground, it can last for decades, or until sanitary landfill methods (including gas collection and venting) are implemented.:

Social and Cultural Issues

Public Cooperation

22. In designing a solid waste collection system, social and cultural issues should be considered in order to maximize public cooperation and thus minimize costs. For guidance on involving communities in project design and implementation, see Chapter 7.

23. For example, curb-side collection can be used only in neighborhoods where residents can afford appropriate containers to be left along the curb (e.g., plastic bags or metal dustbins). When communal containers are used for collection, the distance and direction in which residents may have to walk to discharge their solid waste into a communal container should be designed to fit in with their normal routine. Where the chore of taking waste to the communal container is typically assigned to children, the height of the container or stairs up to the container opening should be designed accordingly. :

Frequency of Collection

24. When neighborhoods have a high density of population and limited space available for storage of waste, waste collection frequency may need to be daily instead of every two or three days. Furthermore, when the climate is hot and humid, collection frequency needs to be daily or every two days because fly reproduction and waste decomposition rates are accelerated by heat and humidity.

Littering and Clandestine Dumping: 25. Most solid waste service organizations place a high priority on providing collection service. On the other hand, they place a low priority on education and enforcement of public behavior regarding environmental regulations. The result is that the service organization unnecessarily wastes time and money trying to compensate for the uncooperative behavior of some residents by providing extra service.

26. It clearly takes more time and money (three to ten times more, is a common estimate) to pick up wastes which have been illegally discharged by littering along roadways or clandestine dumping on vacant lands. Furthermore, when the illegally discharged wastes are potentially hazardous materials (e.g., pumped sewage or industrial processing wastes), environmental impacts could be significant. Therefore, increased budgetary allocation to education, vigilance and enforcement is money well spent.:

Marginal Zones

27. In the marginal zones of cities, where rural immigration and illegal settlement onto open land has occurred, providing refuse collection service is difficult. Road access for refuse collection vehicles is poor and residents may not know how to cooperate with a refuse collection system. Furthermore, where residents are settled illegally and not paying property taxes, there may be less political commitment to providing refuse collection service.

28. Based on these conditions common to marginal zones, it is typical to see clandestine dumping of wastes around the periphery of these zones, as well as on open lands between homes. As the piles of refuse accumulate, residents are likely to set fire to them at night. An understanding of the community's current practices should be sought, and grass roots efforts made to educate residents in the need for adequate refuse disposal and, to the extent possible, to help them set up relatively self-reliant refuse management systems.:

Costs of Collection

29. Collection service in most developing countries consumes 30-60% of available municipal revenues. In many instances, these costs can be reduced by 30-50%. Excessive expenditure on collection service takes limited financial resources away from addressing other urban needs, such as public education. This problem can be avoided by giving adequate attention to the following in the design phase: inspection of service delivery; supervision of collection workers; selection of appropriate collection techniques; optimizing crew sizes; planning route designs; limiting direct haul to economically viable distances; and minimizing vehicle downtime for repairs.:

Siting Facilities

30. In designing a solid waste disposal system, social and cultural issues arise during the siting of facilities especially. Facility siting needs to conform to land-use plans. Siting should provide for enough land area for a buffer zone to minimize aesthetic impacts. Consideration should be given to proximity to residential developments (because of noise and truck traffic impacts, as well as gas migration), prevailing wind direction (because of dust, odor, and smoke), and groundwater flow (because of water supply wells and receiving surface waters).:

Recycling

31. For a significant number of the urban poor in developing countries, recovery of secondary materials is the primary source of income. Recovery of secondary materials primarily occurs as follows: informal sector workers go from door-to-door and purchase used clothing, paper, bottles, etc.; refuse collection workers sort through wastes collected while on their collection route; and pickers (also called scavengers) sort through wastes brought to land disposal sites. All such people engaged in materials recovery sell their recyclables to agents of industry. These agents provide sorting, processing, and storage to meet industry's procurement specifications. Any change in the collection or disposal system which might hinder recovery of secondary materials would have a serious impact on the feedstock and energy usage of local industry.

32. The informal sector network of recyclers is typically strongly organized despite its apparently informal nature. For example, refuse workers typically belong to a union, and pickers at disposal sites belong to either a union or cooperative. Therefore, planned changes in the collection or disposal system that would hinder materials recovery are likely to be sabotaged by the informal sector network.:

Other Special Issues

Landfill Gas Migration

33. Landfill gas develops from anaerobic decomposition of wastes within a land disposal site. Unless there are competent gas control systems installed and operating at the disposal site, landfill gas can migrate underground along the paths of least resistance in the unsaturated zone (in either upgradient or downgradient directions).: 34. Landfill gas can accumulate in basements of buildings along its migration pathway. Because landfill gas contains high concentrations of methane, it is potentially explosive. Landfill gas can also contain potentially toxic organic gases.:

Leachate Control

35. Ideally, a solid waste landfill is located in an area where the permeability of underlying soils is very low, the nature of the soils is attenuative of dissolved chemical constituents, and uses of the receiving ground or surface waters would not be significantly affected by contamination. When less than ideal siting conditions prevail, design could include placement and compaction of a layer of relatively impermeable clay soils between the base of the landfill and the first layer of solid waste.

36. When either the nature of the waste or the site necessitates leachate collection, the issue of treatment and control must be considered. If possible, the collected leachate should be discharged to the nearest sewer to be handled as part of the area's wastewater treatment system. If no sewers are located in proximity to the landfill, on-site treatment by biological and sedimentation mechanisms should be undertaken. Recycling of the treated leachate back into the landfill system should be considered.:

Medical and Toxic Wastes

37. In most cities of developing countries, there is no separate collection for medical wastes, and collection workers have no special protection for handling medical wastes and the vehicles receive no special cleaning. Medical wastes are discharged with other wastes at municipal disposal sites -with no special means of

protecting disposal site workers or pickers. Furthermore, at disposal sites where domestic animals are allowed to graze, there is the risk of reintroducing pathogenic microorganisms into the food chain.

38. To a limited extent, toxic wastes are similarly collected inadvertently as refuse collection workers service their normal routes. More commonly, however, toxic wastes are brought to municipal disposal sites by industries in their own trucks. Most disposal sites in developing countries do not have restricted access, nor do the disposal site supervisors keep any record of the nature and volume of wastes received. The wastes are dumped in the same work place as incoming refuse. Because there is no supervision of dumping, disposal workers or pickers have no forewarning of potential hazards to enable them to protect themselves. Also, there are no special safeguards at the disposal site to control the hazards that toxic wastes pose to the natural environment.:

Project Alternatives

39. For various aspects of a solid waste management project, there are appropriate alternative technologies or operating methods, as listed below.:

(a) Collection Systems::

. source reduction of wastes . self-reliant systems of on-site waste management . equipment includes: pushcart, animal cart, tractor, and truck . communal stationary container systems . communal portable container systems . curb-side collection systems from liftable containers. block collection systems with resident cooperation . separate collection for potentially hazardous materials

(b) Disposal Systems:

. source reduction of wastes . sanitary landfill (i.e., designed refuse cell construction) . sanitary landfill with gas and leachate control . landfill gas recovery and use . incineration with air pollution control . mass burn with energy recovery and air pollution control . refuse-derived fuel production . composting . separate disposal zone in sanitary landfill or separate disposal site for construction/demolition debris, bulky wastes and tires . separate disposal for potentially hazardous materials . hold and bleed pumped sewage into wastewater treatment facilities, where available, or provide separate disposal . separate incineration for medical wastes

(c) Recycling Systems:

. increase product durability . source segregation of recyclables . manual or mechanized sorting of recyclables at transfer stations and disposal facilities . financial incentives to private sector recycling initiatives . refurbishing and remanufacturing of durable products . modify procurement specifications to increase opportunities for products made from recycled materials :

Management and Training

40. Solid waste management consumes a significant portion of municipal revenues. To have efficient and effective collection and disposal service, the system needs to be continuously monitored and adjusted where necessary. The managing institution, therefore, needs the appropriate authority and competence to meet these responsibilities. For example, the managing institution should be at the department level in a municipality or be set up as a public enterprise so that it could be staffed with the appropriate gradelevel of professional engineers and planners. To the extent possible, the institution also needs to be empowered to generate revenues adequate to cover costs. As part of its mandate, the institution needs to be authorized to provide public education, perform inspections on public cleanliness, and enforce solid waste regulations.

41. Program support from the central government is necessary to allow local authorities to function properly, i.e., laws, regulations and policies at the central level are needed to support local ordinances, enforcement,

operations and plans. Technical support from the central level may be necessary as well. Development of the country-specific state of knowledge on waste management and guidance on appropriate technology requires expertise and finance; not only are the necessary resources usually unavailable at the local level, but to develop them at other than the central level would lead to duplication of effort. For example, it is preferable for waste quantity and composition data, operational norms, service costs, available technologies, and environmental impact issues to be comparatively analyzed at the central government level, with assistance from local officials.:

42. Solid waste management skills are not taught in a single curriculum in universities and adequate training seminars are not available. Solid waste managers benefit greatly by attending conferences which enable them to compare experiences. Solid waste managers would further benefit from training packages which specifically address the following: selection of appropriate collection equipment; development of collection equipment specifications; planning efficient route designs; special handling of medical wastes; design and operation of sanitary landfill, optimization of workshop maintenance and repair operations, and use of management information systems to facilitate accountability and performance monitoring.

43. Workers in solid waste systems also need training. In particular, drivers need training on the operation of the specific equipment to which they are assigned. Refuse collection workers, inspectors and supervisors need training on the public health aspects of solid waste management and on how to relate courteously and effectively with the people served. Workshop personnel need training in the repair and maintenance of each type of equipment serviced. When resource recovery systems are part of the solid waste management system specialized training for the operations and maintenance staff is needed. Everyone in the system needs training in occupational health and safety. :

Monitoring

44. In solid waste systems, monitoring of collection and disposal operations should be developed to:

. measure quantities of wastes collected under the auspices of the public cleansing institution;

. measure quantities of wastes brought to official disposal sites by others;

. supervise efforts of refuse collection workers and disposal site attendants;

. provide inspection regarding overall public cleanliness and adequacy/effectiveness of cleansing service delivery;

. provide inspection regarding violations of littering and clandestine dumping regulations;

. assess cost-effectiveness of collection systems;

. evaluate efficiency of collection route designs;

. maintain appropriate stock of spare parts and consumable supplies;

. monitor quality and migration of landfill gas;

. monitor quality and movement of leachate and leachate contaminated groundwater;

. monitor quality of receiving waters or land application site;

. ensure that sanitary landfill operating procedures are being followed.

TOURISM DEVELOPMENT

1. Tourism contributes significantly to the economies of developing countries. Growth in the sector has been more rapid there than in developed countries and has been continuous for several decades. Tourism projects may involve site identification and provision of access; construction of hotels and other visitor accommodations and amenities; creation of duty-free zones; and the establishment of facilities such as sports complexes, marinas and parks for other leisure-time activities. Supporting infrastructure is an important component of any tourism project. Park facilities, roads, solid waste collection and disposal, sewerage and drainage, and water distribution systems often need to be constructed or improved. Institutional strengthening is often funded under this category.:

Potential Environmental Impacts

2. Tourism projects frequently are comparatively small and, when screened for potential environmental impacts, are often placed in Category B. They warrant attention in the Sourcebook nevertheless: first, because of the close relationship between tourism and environmental quality; and second because of the many linkages between tourism development and other sectors in the same region.

3. The features of the natural and sociocultural environment that are important resources for tourism attract people because of aesthetic, recreational or educational/scientific value. However, many of the same features are particularly sensitive to disturbance by human activities. Negative impacts resulting from inadequately planned and uncontrolled tourism development can easily damage the very environments on which the success of the project depended (see Table 9.7 at the end of this section for examples). This in turn may severely reduce project benefits. In other words, without careful attention to the balance between the volume and type of tourist activity and the sensitivities and carrying capacities of the resources being developed, tourism projects can be not only environmentally harmful but also economically self-defeating. For example, an increasing number of hotels sited to attract tourists to a coral reef fail after a few years, because hotel effluents discharged offshore rapidly impair -or kill -the reef.:

4. Tourists increase demands on local infrastructure -transportation, water supply, wastewater collection and treatment, solid waste disposal, and health care facilities -and on the variety of public services that are usually the responsibility of local government. Often the demands have significant seasonal peaks. Without coordination and planning, service demands may exceed capacity, with adverse results for residents as well as tourists.

5. Indirect linkages between tourism and local cultures, businesses, resident populations and workforces are potential problems. Failure to recognize them can diminish project benefits as well as inflict adverse socioeconomic impacts on the local population. For example, commercialization of traditional artisan industries can lead to loss of authenticity with negative results for the artisans and possibly for the buyers as well.:

6. The magnitude and scale of impacts depend on the size and type of tourism development proposed, relative to the fragility of its proposed environment. Recreational tourism involving a variety of sporting activities and a large hotel complex infrastructure has a greater potential to degrade fragile ecosystems than projects which attempt to attract tourists with scientific or educational interests such as birding, nature photography or archaeology.

7. On the positive side, "ecotourism" projects can combine conservation of natural and cultural sites with economic and recreational benefits. Success depends on informed site selection, sound design and operating guidelines which take into account the sensitivity and capacity of the resources which form the tourist attraction. Consequently, a major concern in planning other types of development and analyzing their impacts is to avoid foreclosing tourism development options by degrading resources especially well-suited to it. Comprehensive environmental and land-use planning can identify options and alternatives over the long term and balance single and multiple use concepts. :

Special Issues

8. Availability of clean water for drinking, provision of wastewater treatment consistent with the capacity of local water bodies to assimilate pollution load, and adequate facilities for solid waste disposal are critical issues for this sector. If these services are provided by local government or independent utilities, the project sponsor should demonstrate that detailed information on the tourism development has been furnished to those agencies and that they are prepared and able to meet the project's needs. If the services are not available from local agencies, the plan for the project should show clearly how the developer proposes to provide them, and the impacts of the proposal should be considered in any EA or other environmental analysis. In either case, planners should recognize that tourists from industrial countries use more water and other resources and generate more waste per capita than do residents of developing countries.

9. Coastal zones are among the most attractive areas to tourists. Consequently, tourism constitutes an additional development pressure in areas already heavily used for ports and harbors, commercial fisheries and shell fisheries, and urban expansion. Too, the tendency for developers to seek out new, "unspoiled" sites, away from already congested beaches and towns, contributes to the trend toward urbanization of entire coastlines. The environmental effects of seasonal population increases can be particularly significant along the coast (see para 11). For additional discussion of coastal and marine resources, see the "Coastal Zone Management" section in Chapter 2. :

10. Most islands tend to be environmentally fragile and highly vulnerable to development pressures, especially from tourism. They tend to have distinctive flora and fauna which can be displaced by non-native species, which may be introduced during development. Island populations often include indigenous peoples with distinctive culture.

Natural resources such as coral reefs, seagrass beds, mangroves, tropical forests, waterfalls, caves, gorges, and geothermal areas are frequently concentrated in small areas which are attractive for tourism. Fisheries and other subsistence economies prevalent on islands can undergo transformation with even modest scale tourism development. The resource base of islands over the last decade shows major decreases in environmental quality from increased sediment, pesticide loading, eutrophication from fertilizers and sewage, coastal development, and industrial effluent discharge.

11. Because of the seasonal nature of many tourist activities, demands at peak periods may exceed the capacities of local public services and physical infrastructure. Typical problems are traffic congestion and demands in excess of capacity of water supply, wastewater and solid waste disposal systems. Wildlife may be affected by large influxes of people at the critical times of migration, feeding, breeding or nesting.:

12. Sociocultural considerations are particularly important in environmental assessment of tourism projects. Activities such as tours of archaeological sites may conflict with local religious beliefs. Hotel construction may cause displacement and involuntary resettlement. Induced development may occur at the fringes of tourist areas. The influx of large numbers of foreigners (tourists or migrant workers) into a local culture and the likely clash of contrasting life styles that result, can have serious impacts on local cultures. There is also the risk of exploitation of indigenous cultures, music and folklore.

13. The visual as well as the physical impact of accommodations and other structures that will be built to serve tourists should be considered. Ease of construction and "efficient" design should be tempered by considerations for harmony with the surrounding natural environment and sociocultural context. The impact of tourism infrastructure on resources valued for their aesthetics (e.g., waterfalls, gorges) view should be specifically addressed. Also, tariffs for water, sewerage, and other services may be necessary to avoid burdening local users unfairly.

14. Assessments of tourism projects should include analysis of the projected distribution of costs and benefits. Whereas the benefits of tourism may be assumed to accrue to local residents, residents are likely to incur more of the costs and may enjoy less of the benefits than visitors, immigrant workers or commercial

intermediaries. For example, if high-quality employment opportunities are expected to result, how many jobs will be made available to local residents and for how long, especially if training is required to qualify them for the work? National or regional laws and regulations concerning expatriate employment will provide a base for evaluation of probable impacts. :

Project Alternatives

15. Environmental assessment incorporates the concept of alternatives to the proposed project or to the ways of executing it. During project planning, alternatives should be identified and described in ecological technical, economic and social terms for decision makers. Special impacts associated with each alternative, suitability under local conditions, and institutional, training and environmental monitoring requirements will be identified and compared to the resources available.

16. A number of plans and strategies may be required to implement a sound tourism project. At minimum, a land-use management plan and a pollution control plan would enable environmental objectives to be incorporated early into the development process. Integrated planning is particularly desirable for tourism projects.:

Scale of Development

17. Alternatives may address the overall scale of development appropriate for the region. At one end of the range is small-scale, low-impact tourism -e.g., a wildlife refuge or field research station with low numbers of visitors (fewer than 100 at any time), offering forms of recreation such as hiking, nature photography and birding, and oriented toward education of the tourist. At the other end is large scale, high impact tourism, including major infrastructure development with all amenities, capacity for thousands of visitors, high density accommodations, and a wide range of recreation. Initial planning should consider scale and carrying capacity. :

Siting

18. Facility siting is a principal factor, not only for the process of the tourist development but for any attending adverse impacts, including population displacement and degradation or loss of natural and cultural resources. Frequently, unique habitats, natural hazards, beach or soil erosion, saltwater intrusion and other natural processes are not properly characterized, resulting in selection of unsuitable sites. Location should not be based on the "best looking" beach or most majestic scenic view but should be the result of a critical examination of alternative sites.:

Management and Training

19. Institutional support may be required to enable the tourism development project to succeed. Investments may need to consider public expenditures for infrastructure and commitments of staff and equipment beyond the means of local institutions to respond and manage the new development. If the country, region or locale has had a significant influx of tourism in the past there may be a small level of added support required to focus better on the environmental aspects of the project. Underdeveloped or undeveloped areas may require management and training in the management for the local natural resources staff (e.g., parks, fisheries, forestry officials), roads and sewer authorities, local pollution control authorities and environmental protection agencies, and even the institution responsible for tourism. The local labor force may need training in order to compete for jobs generated by the project and thus to participate fully in its benefits.

20. Frequently, legislative actions involving wildlife protection; national trusts such as parks, historic buildings, and archeological sites; accommodation of land, sea and water rights of indigenous peoples; and general environmental management of sensitive habitats are needed. Tourism development requires coordinated management between agencies responsible for tourism, parks and reserves, and pollution

control in order to avoid the deterioration of environmental resources. Management training, legal assistance, and organizational restructuring may be required: (a) to establish, monitor and enforce environmental legislation and standards; (b) to investigate, plan, and monitor potential adverse effects of pollution; (c) to mitigate and control such pollution or other adverse impacts resulting from tourism; (d) to provide assistance to nongovernmental organizations and others working to prevent deterioration of natural and cultural resources in a proposed development area; and (e) to assess social effects on local communities and reduce or plan human resettlement. :

Monitoring

21. Monitoring plans should include baseline data and periodic review of objectives to determine if plans are being realized. Typical profiles can be developed for protected and ecologically sensitive areas such as beaches, wetlands, reefs; water quality and sediment loading in all water bodies; erosion and sedimentation impacts associated with infrastructure development such as roads, ports, harbors, marinas, hotels, shopping centers and the like; impacts associated with recreational activities such as reef diving, spear fishing, use of all-terrain vehicles, and access to areas previously denied; degree of staging/phasing of development and any observed impacts; demands on transportation and other infrastructure such as water supply, wastewater treatment and solid waste disposal capacity, and the observed system responses; effects on local and regional society and economy.:

WATER SUPPLY

1. Water supply projects involve any or all of the following: construction, expansion or rehabilitation of dams and reservoirs, wells and intake structures, transmission mains and pumping stations, and treatment works and distribution systems; provisions for operation and maintenance of any of the facilities just listed; establishment or strengthening of metering, billing and collection functions; and strengthening of overall water utility management. This edition of the Sourcebook does not contain a single detailed section on water supply projects. However, most of the environmental issues which pertain to them are presented in the chapters listed below: : Chapter 2: Land and Water Resource Management Chapter 8: Dams and Reservoirs Chapter 9: Wastewater Collection, Treatment, Reuse, and Disposal Systems Chapter 10: Oil and Gas Pipelines

WASTEWATER COLLECTION, TREATMENT, REUSE, AND DISPOSAL SYSTEMS

1. This category includes new projects and project components and rehabilitation activities involving: conduits for collection and conveyance of wastewater, pumping stations, conventional and innovative treatment works, wastewater reclamation and reuse projects, ocean outfalls, wastewater treatment sludge management facilities, a variety of small-scale sanitation systems for rural and urban areas, and urban stormwater drainage projects. Where water quality problems are severe, as is the case in many densely-populated urban areas, individual wastewater projects may be executed as increments of long-term pollution control programs whose ultimate objectives realistically may take 10 to 20 years or more to achieve. Water pollution control programs often include significant institution-building and national water pollution control policy formulation components. :

Potential Environmental Impacts

2. The pollutants in municipal wastewater are suspended and dissolved solids consisting of inorganic and organic matter, nutrients, oil and grease, toxic substances, and pathogenic microorganisms. Urban stormwater can contain the same pollutants, sometimes in surprisingly high concentrations. Human wastes that are not properly treated and are disposed of at the point of origin or are collected and carried away pose risks of parasitic infections (through direct contact with fecal material) and hepatitis and various gastrointestinal diseases including cholera and typhoid (through contamination of water supplies and food).

3. When wastewater is collected but not treated properly before disposal or reuse, the same public health hazards exist at the point of discharge. If such discharge is to receiving water, additional harmful effects will occur (e.g., habitat for aquatic and marine life is impaired by accumulated solids; oxygen is depleted by decomposition of organic material; and aquatic and marine organisms may be further harmed by toxic substances, which may spread to higher organisms through bioaccumulation in food chains). If the discharge enters confined waters such as a lake or bay, its nutrient content can cause eutrophication, with nuisance plant growth which can disrupt fisheries and recreation. Solid waste generated in wastewater treatment (grit, screenings and primary and secondary sludge) can pollute soil and groundwater if not properly handled.:

4. Wastewater projects are executed in order to prevent or alleviate the effects of the pollutants described above on the human and natural environments. When properly carried out, their overall environmental impact is positive. Direct impacts include abatement of nuisances and public health hazards in the serviced area, improvement in receiving water quality, and increases in the beneficial uses of receiving waters. In addition, installation of a wastewater collection and treatment system provides an opportunity for more effective control of industrial wastewater through pretreatment and connection to public sewers and offers the potential for beneficial reuse of treated effluent and sludge. Indirect impacts include the provision of serviced sites for development, increased fishery productivity and revenues, increased tourist and recreational activity and revenues, increased agricultural and silvicultural productivity and/or reduced chemical fertilizer requirements if treated effluent and sludge are reused, and reduced demands on other water sources as a result of effluent reuse.:

5. A number of these potential positive impacts lend themselves to measurement and thus can be incorporated quantitatively into analyses of the costs and benefits of various alternatives when planning wastewater projects. Human health benefits can be measured, for example, by estimating avoided costs in the form of health care expenditures and lost workdays which would result from poor sanitation. Reduced drinking and industrial water treatment costs and increased fishery, tourism and recreation revenues can serve as partial measures of the benefits of improved receiving water quality. In a region where demand for housing is high, the benefits of providing serviced lots may be reflected in part by the cost differential between installing the infrastructure in advance or retrofitting unplanned communities. :

6. Systems in which treated wastewater or sludge are reused may be more expensive to construct and operate than those in which the sludge is disposed of as a waste product. In evaluating alternatives involving reuse, however, it is important to include such benefits as increased water availability to support development in the region, the opportunity to diminish irrigation demands on potential public water supply sources, reduced need for chemical fertilizers, incremental improvements in crop and timber production, and low-cost means to re-vegetate marginal soils or reclaim them for agriculture or silviculture. These too can often be measured, most of them by calculating avoided costs. Chapter 4 provides more details on economic evaluation methods.:

7. Unless they are correctly planned, sited, designed, constructed, operated and maintained, waste-water projects are likely to have a negative impact overall, failing to yield the full benefits for which the investment was made and adversely affecting other aspects of the environment besides. The individual items listed are selfexplanatory, for the most part, and will not be discussed in detail in the text. However, there are several characteristics common to many of the potential impacts and mitigating measures which should be emphasized as special issues throughout project preparation, assessment and implementation. These are: first, the importance of sound and comprehensive wastewater system planning; second, the fundamental dependence of wastewater projects on proper operation and maintenance (and thus on strong institutional support for both); third, selection of appropriate technology; fourth, the necessity for an effective industrial wastewater pretreatment program in any municipal system serving industrial customers; and finally, the need to consider a number of potential sociocultural impacts which are sometimes ignored in project preparation (see Table 9.8 at the end of this section for a summary of all potential impacts and recommended mitigating measures). :

Special Issues

Planning

8. Decisions on the type and location of effluent discharge and the level of treatment are crucial and should not be made without adequate information. Present wastewater volume and strength are basic information for the planning process, and realistic projections of volume are important to establish the magnitude and timing of the need for collection and treatment. In making and updating projections, other planned development activities should be taken into account so that extensions or expansions of wastewater infrastructure can be coordinated with them.

9. Level of treatment -the magnitude of pollutant removal a treatment process must achieve -depends on the performance standards which apply to the system. These are usually expressed as limitations on the concentrations of regulated substances permitted in the treated effluent. In the case of effluents which are to be applied to crops or otherwise used on land, the standards are set to prevent crop and groundwater contamination. National standards for effluent reuse may already exist; if they do not, they can be based on World Health Organization or World Bank guidelines or derived from the standards of other countries in which land application practiced.:

10. For discharges to surface waters, the process of setting standards often begins with classification of receiving waters based on the intended or desired uses. In the water quality standards of the People's Republic of China (PRC), for example, there are five classes ranging from Class I "very clean natural waters" to Class V "suitable for cooling water only in industry and can be used for agriculture." Receiving water quality standards can then be established on the basis of the scientific literature to provide for the uses in each classification. In the PRC, 29 parameters are covered for each surface water class. Classification of waters should be done with consideration for what is economically and technically realistic; requiring drinking water quality in a busy harbor, for instance, is not a sound use of pollution control resources. :

11. Ideally, effluent limitations for wastewater dischargers should be determined by a mathematical modelling process which takes into account the existing quality and flow characteristics of the receiving water body, calculates the maximum load of each pollutant which can be assimilated in each segment or zone under a specified statistical condition of dry-season streamflow (e.g., the minimum monthly flow in a five-year period) without causing the standards to be violated, and allocates that load among all dischargers. Such models require seasonal data on receiving water quality, volume and concentration of all discharges, and a long enough record of hydrologic data to show seasonal flow averages and permit calculation of the dry-season flow. :

12. In practice, national effluent limitations are often established to correspond to the various receiving water classes, to simplify the process of preparing discharge permits or establishing base/minimum levels of treatment. Modelling is reserved for situations in which adherence to those limits will not result in attainment of water quality standards and more stringent requirements must be applied (or where projects are being planned in countries without water quality or discharge regulations). PRC regulations prohibit any pollutant discharge to Class I and II waters and provide two sets of effluent limits for other waters -one for Classes III and IV and another, less restrictive, for Class V. PRC law specifies quantitative procedures whereby local discharge limits more strict than national standards may be set where necessary to achieve desired uses.:

13. Limitations on discharges to marine waters are usually simpler; they focus on preventing discoloration of the water and pollution by oil and grease, floating debris, and bacteria (in shellfish harvesting and recreational waters). The major planning task is to identify an acceptable location for the submerged outfall, where the effluent will not degrade significant water areas or contaminate shellfish beds and beaches. There are mathematical models for this purpose, which simulate the processes of dilution, dispersion, diffusion, stratification and pollutant decay or die-off. The models require current, temperature, salinity and water quality data collected over a full 12-month cycle, along with detailed bathymetric and ecological information.

14. Data collection and modelling are costly and time-consuming. However, in comparison to the capital and operating costs and expected life of wastewater systems, both the costs and the time are inconsequential, and the benefits -facilities which neither fall short of their water quality objective nor involve unnecessary expenditures -are substantial. Furthermore, data collection can sometimes occur in parallel with design and construction activities when wastewater projects are phased as described below.:

15. A second component of planning involves the sequencing and phasing of projects within individual wastewater systems, as parts of long-term pollution abatement programs, and in relation to activities in other sectors. For example, putting a collection system into operation without the treatment works merely concentrates harmful discharge and is a frequent cause of gross pollution of surface waters. The net effect is to increase water scarcity or increase the cost of treating water for drinking or other uses. Installing public water supply and proceeding with residential, commercial or tourist development will cause public health hazard or water pollution if wastewater infrastruture is not provided at the same time.:

16. In many cases, it is cost-effective to construct treatment works in a modular fashion, adding additional capacity as the collector system is extended and new connections are made. Phasing wastewater investments may be the only realistic way to make progress toward ultimate water quality objectives in densely populated, highly polluted areas, where a single project would exhaust all resources available for public works and physically disrupt the region. The level of treatment can be phased in a single project or as part of sector strategy, an approach which is helpful when environmental improvement is urgently needed but local financial resources are limited or the scientific data to determine exactly the extent of pollutant removal required has not been collected. It is important in any phased approach to reserve space for future expansion when acquiring sites and designing facilities.

17. Wastewater treatment generates sludge and other solid waste, such as grit, and grease screenings. Finding locations for landfill or incineration, or outlets for recycling, is often difficult. However, if solutions are not found, a portion of the pollutants removed from the wastewater will become pollutants of the land. Sludge management should be part of wastewater system planning.:

Operation and Maintenance

18. Treatment works and pumping stations will not perform properly unless they are operated and maintained properly. The most common causes of system failure are selection of inappropriate technology, lack of spare parts, shortages of trained operators and skilled technicians and craftsmen, and unreliable power or chemical supplies. Most of these in turn can be traced to institutional weaknesses in technical training and utility management, inadequate operating budgets and unattractive salaries (both often related to artificially low customer charges for water which do not produce revenues to cover the full cost of water supply and wastewater disposal services).:

Selection of Appropriate Technology

19. The concept of appropriate technology in wastewater systems has technical, institutional, social and economic dimensions. From a technical and institutional standpoint, selection of inappropriate technology has already been named as a primary cause of system failure. The wastewater environment is a hostile one for electronic, electrical and mechanical equipment. Maintenance is a never-ending process, and it requires support -spare parts, laboratories, trained technicians, specialized technical assistance, and adequate budgets. Even in developed countries, it is the simpler systems, selected and designed with maintenance in mind, which provide more reliable service. In developing countries, where some of the ingredients for a successful maintenance program may be lacking, this should be the first consideration in choosing treatment plant and pumping station technology. :

20. In small communities and rural settings, the technical options tend to be simpler, but the institutional considerations blend with the social and remain extremely important. Local institutions must be able to

manage the sanitation programs or systems. Community participation may be a key element in their success. Social preferences and customary practices are significant; some can be modified by education programs, but others may be rooted in cultural values and not subject to change. Economics become part of the decision in two ways. Not surprisingly, the simpler technologies, selected for ease of operation and maintenance, tend to be less expensive to construct and operate. Even when they are not, however, as may be the case when a great deal of land has to be acquired for stabilization ponds, a less expensive system which fails will ultimately be more costly than a more expensive one which operates reliably. :

Industrial Wastewater

21. In most circumstances, connecting industries to public sewer systems is sensible. It reduces the number of discharge points and thus the complexity and cost of monitoring and enforcement, provides the opportunity for better control of industrial effluent, and may be lower in total cost. Absolutely critical to success, however, is an industrial pretreatment program including regulations with specific limits on discharges of hazardous and toxic substances and other pollutants to public sewers, monitoring procedures, and enforcement capability. Otherwise, there is a risk of exposing water system personnel and components to hazardous materials, disrupting the treatment process, transporting toxic pollutants to receiving waters or the land, and contaminating treatment plant sludge so severely it cannot be put to beneficial use or even disposed of without difficulty. :

Sociocultural Issues

22. Treatment facilities require land; siting them can lead to involuntary resettlement. Moreover, treatment and disposal works can cause nuisances in the immediate vicinity, at least occasionally. Often, the lands and neighborhoods selected are those of "vulnerable groups" who can least afford the costs of dislocation and whose living environment is already impaired. Care should be taken to site treatment and disposal facilities where odors or noise will not disturb residents or other users of the area, to manage resettlement with sensitivity (see "Involuntary Resettlement" section in Chapter 2), and to include in the project mitigation plan provisions to mitigate or offset adverse impacts on the human environment. If these considerations are not included in project planning, there is substantial risk of solving one community's environmental problem by transferring it to another. :

Project Alternatives

23. A variety of siting and technological alternatives exists for wastewater collection, treatment and disposal, and sludge management. Several will be applicable in every situation.

(a) Collection Systems: . on-lot treatment . individual holding tanks with truck collection . small-diameter gravity, pressure or vacuum sewers . shallow sewers . flat sewers . simplified sewerage systems . conventional gravity sewers and force mains . regional collection systems . community or sub-regional systems: (b) Treatment Works: . community on-lot systems . oxidation ditches . stabilization ponds . aerated lagoons . artificial wetlands (or constructed wetlands) . land treatment . conventional biological treatment . physical-chemical treatment . preliminary or primary treatment with ocean disposal

(c) Disposal

. reuse in agriculture, silviculture, aquaculture, landscaping . reuse for groundwater recharge . rapid infiltration . underground injection . reuse in industrial applications . ocean outfall . surface water discharge . nightsoil treatment plants: (d) Sludge Management: . composting . co-composting with municipal refuse. reuse in agriculture or silviculture . reclamation of marginal land for reforestation, cultivation . energy recovery (methanization) . incineration . landfill . ocean disposal:

Management and Training

24. Institutional support is critical to successful wastewater utility operation. It begins with staffing. A large collection and treatment system will need a manager with technical and administrative experience an environmental engineer; supervisors and workers in operations, sewer maintenance and plant maintenance crafts; laboratory directors and technicians; and support staff in accounting, budgeting, and clerical areas. If the project includes on-site disposal systems, holding tanks or small-diameter sewers with settling tanks, staff will be needed to develop and enforce standards for the facilities, and to inspect and approve installations, and there will have to be provision for on-site system maintenance. A customer relations unit is essential to receive and investigate customer complaints, provide information to customers, and conduct education programs related to the system's services (e.g., hygiene and sanitation, on-site system upkeep). If the utility is responsible for revenue collection, a billing and collections group will be required. Job status and salaries must be adequate to attract qualified personnel and to avoid losing them once they have been trained.:

25. Wastewater systems can be operated successfully under a variety of organizational structures such as a department of municipal government, a local or regional sanitary district or authority, or a private operating company under contract to the government. For conventional sewer systems, the planning, construction, operation and administrative functions can be centralized within one of these organizational formats. For projects which involve individual onsite systems, or small community equivalents to them, some decentralization of function is appropriate. Planning the areas to be served by various types of on-site systems and setting standards for construction, installation, and maintenance should remain more or less centralized.

26. Permitting and inspecting installations and enforcing standards should be a governmental function; it is logical to delegate it to local authorities but it could be carried out by a centralized utility, in situations where the wastewater system is a hybrid of onsite and conventional sewerage. Technical assistance with installation and education of users in operation and maintenance are services best performed at the community level, by local authorities or NGOs. System maintenance, including septic tank pumping, is a service which should probably be privatized and carried out under supervision of local authorities. Where companies do not exist to perform maintenance reliably, having a centralized wastewater utility undertake it is an option. Septage disposal should be regulated according to government standards and supervised by the agency which administers the disposal facility, site, or reuse program.:

27. Training should begin before system start-up, with the assistance of the design consultant. Besides basic familiarization with the system, its relationship to the environment, and fundamentals of occupational health and safety, it should include operations and maintenance training on the actual equipment. Industrial waste control staff will need specialized training in sampling and enforcement procedures. Employees of connected industry will need training on operation and maintenance of pretreatment equipment. Any personnel who may have to enter confined spaces, work in deep trenches, maintain electrical equipment, or handle chlorine or other dangerous chemicals must be properly equipped and drilled in safety and accident response procedures. "Training the trainers" is a good concept, so that system staff can continue training programs throughout the life of the facilities.:

28. A wastewater utility needs to recover its full costs of service to sustain reliable operations. It thus must have or be able to obtain the capability to determine costs and develop rates. Rates typically include a fixed charge based on capital cost recovery and system administration, plus a variable charge based on a customer's metered water consumption. Surcharges are an appropriate means to recover the additional cost of serving industrial customers with discharges significantly exceeding the average strength of domestic wastewater. Where wastewater services are provided at less than full cost for some groups of customers as a matter of government policy, the government should make necessary provisions to avoid operating budget shortfalls, perhaps through intra-urban cross-subsidies.

29. A start-up plan should be prepared for any new wastewater facility of significant size to ensure that the requirements described above are met. The plan should provide for assembling staff, maintenance

equipment and spare parts in advance of need, training all personnel, and establishing revenue sources and budget.

30. Local, regional and/or national public health and environmental agencies will need the resources and training to monitor construction and operations of the system and, if necessary, to enforce compliance with performance standards. They may also have to support the utility itself in enforcement of industrial pretreatment regulations. Where national water pollution control standards, agencies and procedures are not fully developed, a program of institution-building should be coordinated with preparation of wastewater projects.:

Monitoring

31. Because these are environmental projects, good construction inspection practices to ensure that the system is built to specifications are also good environmental management practices. Particular attention should be given to adherence to the mitigation plan provisions to protect stream channels, beaches, and wetlands. An operational monitoring program should be developed to observe trends in influent volume and strength; detect hazardous substances entering treatment works; enforce industrial pretreatment regulations; control the treatment process; assess and manage treatment plant performance; monitor environmental quality at disposal locations; and ensure sludge products and reclaimed wastewater meet reuse standards.

32. The frequency and level of sophistication of sampling depends in part on the size of the system and the nature of its treatment processes. Monitoring is expensive; it requires laboratory facilities, equipment, and technicians. As a general principle, measure only parameters necessary for managing the system, safeguarding its staff and equipment, and protecting the environment.:

33. In designing the monitoring program, the emphasis should be on supporting sound operations of the wastewater system. This entails establishment of system performance standards. Data should be collected to monitor attainment of those standards, interpreted and then delivered efficiently and timely to those who must make operational decisions -the system's operators and managers. Monitoring data is also useful to designers for improvement of future projects. All too frequently, monitoring programs are seen only, or primarily, as enforcement tools. Although enforcement action may be necessary to achieve compliance with standards in some cases, a timely report placed in the hands of a conscientious treatment plant superintendent may be more effective in protecting the environment.:

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ANNEX 9-1

Sample Terms of Reference (TOR) An Environmental Assessment of Inland Navigation

Note: Paragraph number corresponds to those in the Sample Terms of Reference (TOR) Outline in Annex 1-3; additional paragraphs are not numbered

7. Task 1. Description of the Proposed Project. Project-specific descriptions of the following:: . Disposal options for dredged materials should be specified as open-water, shoreline or upland, and whether treatment or containment will be necessary, especially if the materials are contaminated.

. Dredging equipment requirements based on physical and chemical character of dredge material, disposal site, and physical conditions at the dredge site.

. Transportation requirements such as terminal facilities and berths, barges and vessels, pipelines, roads, and disruption of transit for commercial and recreational users.

. Energy-producing operations, including solid wastes, emissions, and discharges and their quantities, and transport and handling procedures for fuels and other hazardous materials.:

9. Task 3. Legislative and Regulatory Considerations. If open-water disposal in international waters is being considered then the requirements of the London Dumping Convention of 1972, Oslo Convention of 1974, and Paris Convention of 1978 should be evaluated. In addition, review of the Great Lakes Water Quality Agreement of 1978 between the United States and Canada should be consulted for scoping dredging projects.

10. Task 4. Determination of the Potential Impacts of the Proposed Project.: . Dredge Material Characterization Studies. Studies of the physical and chemical character of the dredge materials is important for selecting appropriate dredging equipment and disposal options, estimating quantities of different materials, and designing monitoring programs and mitigative measures. All sampling results should be statistically representative of the project area (i.e., vertical and horizontal extent) to ensure proper environmental planning and reduce the likelihood of encountering contaminated "hot spots".: . Screening for Sensitive Environments. Field evaluations of the ecosystems and communities in the project area environs will provide information concerning direct and indirect impacts on pervasive, sensitive, and/or threatened and endangered components of potentially affected systems. For example, alteration of flow within an aquatic system could yield adverse impacts on a downstream mangrove.

17. Consulting Team. The consultant team for preparation of an EIA for inland navigation projects should include members from the following professional disciplines: environmental impact specialist, team leader; civil/environmental engineer with experience in dredging projects and water-based transport; aquatic or marine biologist, or other specialty depending on the dredging site and natural resources which could be impacted; surface water hydrologist; land-use planner; and socioeconomist.:

ANNEX 9-2

Sample Terms of Reference (TOR) An Environmental Assessment of Port and Harbor Facilities

Note: Paragraph number corresponds to those in the Sample Terms of Reference (TOR) Outline in Annex 1-3; additional paragraphs are not numbered

7. Task 1. Description of the Proposed Project. Project-specific descriptions of the following:: . Disposal options for dredged materials should be specified as open-water, shoreline or upland, and whether treatment or containment will be necessary, especially if the materials are contaminated.

. Dredging equipment requirements based on physical and chemical character of dredge material, disposal site, and physical conditions at the dredge site.

. Transportation requirements such as terminal facilities and berths, barges and vessels, pipelines, roads, and disruption of transit for commercial and recreational users.

. Energy-producing operations, including solid wastes, emissions, and discharges and their quantities, and transport and handling procedures for fuels and other hazardous materials.

. Port-related industries which may be developed and serviced by the facilities including hazardous materials, handling, storage, processes, and disposal, special energy needs, and waste disposal requirements.

9. Task 3. Legislative and Regulatory Considerations. If openwater disposal in international waters is being considered then the requirements of the London Dumping Convention of 1972, Oslo Convention of 1974, and Paris Convention of 1978 should be evaluated. In addition, the International Maritime Organization (IMO) should be consulted for guidelines pertaining to releases and discharges from ships.

10. Task 4. Determination of the Potential Impacts of the Proposed Project.: . Dredge Material Characterization Studies. Studies of the physical and chemical character of the dredge materials is important for selecting appropriate dredging equipment and disposal options, estimating quantities of different materials, and designing monitoring programs and mitigative measures. All sampling results should be statistically representative of the project area (i.e., vertical and horizontal extent) to ensure proper environmental planning and reduce the likelihood of encountering contaminated "hot spots".

. Screening for Sensitive Environments. Field evaluations of the ecosystems and communities in the project area environs will provide information concerning direct and indirect impacts on pervasive, sensitive, and/or threatened and endangered components of potentially affected systems. For example, alteration of flow within an aquatic system could yield adverse impacts on a downstream mangrove.

. Effluent Characterization Studies. These may be necessary to design appropriate water pollution control options for the port facilities and industries. Ideally, one should identify sanitary wastewater streams, cooling water streams, and process water streams.

. "Null Zone" Identification. The existing location and potential relocation from development activities should be determined to mitigate the rate of sedimentation and saltwater intrusion as well as reduce the frequency of maintenance dredging activity.:

17. Consulting Team. The consultant team for preparation of an EIA for inland navigation projects should include members from the following professional disciplines: environmental impact specialist, team leader; civil/environmental/port engineer(s) with experience in dredging projects, port and harbor development, and water-based transport; aquatic or marine biologist, or other speciality depending on the dredging site and natural resources which could be impacted; surface water hydrologist; land-use planner; and socioeconomist.:

ANNEX 9-3

Sample Terms of Reference (TOR) An Environmental Assessment of Solid Waste Disposal Systems

Note: Paragraph number corresponds to those in the Sample Terms of Reference (TOR) Outline in Annex 1-3; additional paragraphs are not numbered

7. Task 1. Description of the Proposed Project.: (a) For project improvements to solid waste collectionl, include: physical layout of the neighborhoods to receive improved collection; social, cultural and economic conditions of the neighborhoods to receive improved collection; and description of the project elements, including method of collection proposed, pilot tests to confirm the proposed collection method as appropriate, pre-implementation activities of public education and involvement, cost recovery systems, equipment specifications and procurement plans, implementation plans, operation and maintenance procedures, responsible parties for each aspect of the system.

(b) For project improvements to solid waste transfer and disposal, include: physical layout of the overall urban area to be served by transfer and/or disposal facilities, including mapping of all major roads; strategic siting of the facilities, including economic justification for the overall strategic plan of collection service areas, direct haul routes, transfer stations, transfer routes and disposal locations; physical, ecological and demographic setting of facilities, including surrounding land use characteristics, proximity to residential neighborhoods, location of public water supply sources and private wells, direction of ground water flow, uses of surface waters, prevailing wind direction; and description of the project elements, including layout of proposed facilities (e.g., fencing, buildings, weighbridges, roads, ramps, drainage, gas and leachate control systems, monitoring wells); construction schedule, operating plans, closure plans, long-term monitoring plans, and responsible parties.

8. Task 2. Description of the Environment.

(a) For project improvements to collection systems:

Physical environment: neighborhood layout, showing locations for communal containers, stops for truck during block collection, or streets served by curb-side collection; conditions of road or walkway access for collection equipment; and climate and meteorology, as it affects refuse containment and frequency of collection. : Socio-cultural environment: population density and demographic level by neighborhood; community structure of local leaders and traditional public involvement process; employment and other activities indicating patterns of movement to and from neighborhood; education level with regard to sanitation and public health; and customs and attitudes relative to cooperation with collection system.

(b) For project improvements to transfer and disposal facilities:

Physical environment: location of proposed facilities with regard to nature of surrounding land uses and proximity to homes and other establishments; existing road and traffic conditions in the area of proposed facilities, versus proposed road and traffic conditions; existing topography and proposed changes, including area which will be affected by any visible aesthetic impacts; soils and geology; surface and ground water hydrology, and hydraulic connections between the proposed sites and receiving waters downgradient of the sites; existing and proposed uses of receiving waters, including location of private and public water supply wells and intakes; climate and meteorology, including prevailing wind direction. : Biological environment: flora and fauna; sensitive habitats (e.g., wetlands delineation); and rare, endangered, or commercially important species.: Socio-cultural environment: past uses of sites and consideration of any historic significance; land use and demographic character of surrounding neighborhoods; planned development activities; education, awareness, and sensitivity of public to proposed siting of facilities; and public concerns over traffic, insects, noise, dust, odor, smoke, or aesthetic issues.

9. Task 3. Legislative and Regulatory Considerations:

. Describe national laws and local ordinances which delineate the solid waste management responsibility and authority delegated to local government. Describe national laws and guidelines which define the design and operating standards which local governments are to meet in the conduct of their responsibilities. Include description of any environmental standards which are to be met, including any requirements for submission of environmental monitoring data or environmental impact assessment statements by local governments to the national government. Describe local ordinances which govern citizen responsibility to partici-pate in and cooperate with the solid waste system. : . Discuss the extent to which the local government uses education,inspection and enforcement to assure compliance with the available regulations. Describe the technical assistance, environmental monitoring, and regulatory enforcement activities provided by national and provisional government as a support to local government operations and actions.

10. Task 4. Determination of the Potential Impacts of the Proposed Project.

. For solid waste projects, there are numerous potential impacts to be reviewed as a part of design. For the most part, well conceived designs will minimize adverse impacts. Also, many potential impacts can be minimized by altering operating practices.. There are some potential impact issues whose consequences would be environmentally significant over the long term. With regard to these impact issues, special studies conducted as a part of environmental impact assessment are recommended. Specifically, prior to design of a land disposal site, borings need to be drilled both on-site and off-site to assess the character of soils and geology and confirm the flow of ground water. Data from these borings coupled with information on rainfall and infiltration should be used to make a simple determination of the quantity of leachate which could be generated and released from the land disposal site and its potential effect on the nearest receiving water.

14. Task 8. Development of a Monitoring Plan.

. For solid waste projects which include a land disposal facility, environmental monitoring should include gas and ground water monitoring wells and a regular schedule of monitoring for key indicators of contamination. If the land disposal site has a gas collection and ventilation system, periodic monitoring of the composition of gas being discharged from the vents is recommended. Also recommended is periodic monitoring, on-site and off-site with a portable meter, of the ambient air's oxygen and combustible gas levels. Similarly, for projects which include an incinerator or resource recovery plan, environmental monitoring should include air quality monitoring of stack gases.

17. Consulting Team. For solid waste projects, an optimum consulting team would include the following, in order of priority: civil engineers with experience in solid waste collection and disposal; hydrogeologists with experience in ground water pollution control; sociologists or psychologists with experience in community participation in project design and operation; land use planners with experience in facility siting; biologists with environmental assessment experience in facility siting; and meteorologists with experience in air pollution control.:

ANNEX 9-4

Sample Terms of Reference (TOR) An Environmental Assessment of Tourism Development

Note: Paragraph number corresponds to those in the Sample Terms of Reference (TOR) Outline in Annex 1-3; additional paragraphs are not numbered

7. Task 1. Description of the Proposed Project. Provide a full description of the project and its existing setting, using maps at appropriate scales.: The proposed project should include: general layout (size, capacity, etc.); preconstruction and construction activities; operation and maintenance; life span; plans for providing utility, waste disposal, and other necessary services; physical setting, ecological setting, demographic setting, sociocultural setting and institutional setting.

8. Task 2. Description of the Environment. If the tourism development is associated with an existing or planned park or reserve, include copies of park/reserve management plans, appropriate maps, and special studies characterizing the resources at issue.

9. Task 3. Legislative and Regulatory Considerations. Describe the pertinent regulations and standards governing environmental quality, health and safety, protection of sensitive areas, protection of endangered species, siting, land use control, rights of indigenous peoples, etc., at international, national, regional and local levels.

10. Task 4. Determination of the Potential Impacts of the Proposed Project. Special studies may include the following:: . Environmental carrying capacity of sensitive ecological sites or cultured properties. : . Social carrying capacity, including attitudes of local people to the proposed influx of foreigners and potential sources of conflict.: . Physical carrying capacity of local infrastructure and public services (if not adequately addressed in feasibility studies).

12. Task 9. Assist in Inter-Agency Coordination and Public/NGO Participation. In tourism projects, it is critical to involve all potentially involved government agencies, especially at the local level. It is also important to provide complete information to the affected community, so that community members can form their opinions about the project.

17. Consulting Team. A typical EA team may have any or all of the following disciplines: environmental impact specialist, team leader; civil engineer: wastewater, roads, ports and harbors, water supply; ecologist; cultural specialist such as park and recreation planner; urban sociologist or anthropologist; specialist in tourism supply/demand analysis; and legal expert(s) on land tenure, environmental law, cultural property protection.:

ANNEX 9-5

Sample Terms of Reference (TOR) An Environmental Assessment of Wastewater Collection, Treatment, Reuse, and Disposal Systems

Note: Paragraph number corresponds to those in the Sample Terms of Reference (TOR) Outline in Annex 1-3; additional paragraphs are not numbered

5. Study Area. The study area for the assessment consists of the drainage area to be serviced by the wastewater collection system; the tracts of land on which effluent or sludge are to be applied in reuse systems; marine, estuarine or inland waters which could be influenced by effluent discharge; remote sites identified for disposal of solid waste generated in the treatment process; and, if incineration is included as a sludge disposal technique, the airshed which might be affected.

7. Task 1. Description of the Proposed Project. Provide a full description of the project: location; general layout; unit process description and diagram; size in terms of population and population equivalents, present and projected; number and types of connected industries; anticipated influent and effluent characteristics; preconstruction and construction activities; schedule, staffing and support facilities and services; operation and maintenance activities; required off-site investments; and life span.

8. Task 2. Description of the Environment. Assemble, evaluate and present baseline data on the environmental characteristics of the study area. Include information on any changes anticipated before the project commences.: (a) Physical environment: geology (general description for overall study area and details for land application sites); topography; soils (general description for overall study area and details for land application sites); monthly average temperatures, rainfall and runoff characteristics; description of receiving waters (identity of streams, lakes, or marine waters; annual average discharge or current data by month, chemical quality; existing discharges or withdrawals).

(b) Biological environment: terrestrial communities in areas affected by construction, facility siting, land application or disposal; aquatic, estuarine or marine communities in affected waters; rare or endangered species; sensitive habitats, including parks or preserves, significant natural sites; species of commercial importance in land application sites and receiving waters.

(c) Sociocultural environment: present and projected population; present land use; planned development activities; community structure; present and projected employment by industrial category; distribution of income, goods and services; recreation; public health; cultural properties; indigenous peoples; customs, aspirations and attitudes.:

9. Task 3. Legislative and Regulatory Considerations. Describe the pertinent regulations and standards governing environmental quality, pollutant discharges to surface waters and land, industrial discharges to public sewers, water reclamation and reuse, agricultural and landscape use of sludge, health and safety, protection of sensitive areas, protection of endangered species, siting, land use control, etc., at international, national, regional and local levels (The TOR should specify those that are known and require the consultant to investigate for others.)

10. Task 4. Determination of the Potential Impacts of the Proposed Project. In this analysis, distinguish between significant positive and negative impacts, direct and indirect impacts, and immediate and long-term impacts. Identify impacts which are unavoidable or irreversible. Wherever possible, describe impacts quantitatively, in terms of environmental costs and benefits. Assign economic values when feasible. Characterize the extent and quality of available data, explaining significant information deficiencies and any uncertainties associated with predictions of impact. If possible, give the TOR for studies to obtain the missing information.: Special attention should be given to:: . The extent to which receiving water quality standards and/or beneficial use objectives will be achieved with the proposed type and level of treatment.: . The length of stream or expanse of lake or marine waters which will be positively or negatively affected by the discharge, and the magnitude of the changes in water quality parameters.: . Projected quantitative changes in beneficial uses, such as fisheries (species composition, productivity), recreation and tourism (visitor-days, overnights, expenditures), and waters available for portable supply, irrigation, and industrial use.: . Sanitation and public health benefits anticipated.

11. Task 5. Analysis of Alternatives to the Proposed Project. Describe alternatives that were examined in the course of developing the proposed project and identify other alternatives which would achieve the same objectives. The concept of alternatives extends to siting and design, technology selection, construction techniques and phasing, and operating and maintenance procedures. Compare alternatives in terms of potential environmental impacts, land and energy requirements, capital and operating costs, reliability, suitability under local conditions, and institutional, training, and monitoring requirements. When describing the impacts, indicate which are irreversible or unavoidable and which can be mitigated. To the extent possible, quantify the costs and benefits of each alternative, incorporating the estimated costs of any associated mitigating measures. Include the alternative of not constructing the project, in order to demonstrate environmental conditions without it.

12. Task 6. Development of Management Plan to Mitigate Negative Impacts. Recommend feasible and cost-effective measures to prevent or reduce significant negative impacts to acceptable levels. Estimate the impacts and costs of those measures, and of the institutional and training requirements to implement them.

Consider compensation to affected parties for impacts which cannot be mitigated. Prepare a management plan including proposed work programs, budget estimates, schedules, staffing and training requirements, and other necessary support services to implement the mitigating measures.

17. Consulting Team. The following specialties should be represented on the core consulting team: environmental engineering, environmental planning (or other environmental generalists); ecology (terrestrial, aquatic or marine, depending on type of discharge); water quality; soils science (for land application); wastewater utility management; and socioloby/anthropology. Other specialities that may be needed depending on the nature of the project are public health, agronomy, hydrology, land use planning, oceanography, water quality modelling, and resource economics. Specify dates for progress reviews, interim and final reports, and other significant events.

19. Other Information. Include here lists of data sources, project background reports and studies, relevant publications, and other items to which the consultant's attention should be directed. Examples are pre-feasibility studies, population and land use projections, land use plans, industrial activity information, water quality studies, sewerage service needs surveys, public health reports, sewer system evaluations.