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SRI LANKA INDUSTRIAL ESTATES SITING STUDY

VOLUME 1: MAIN REPORT

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(N A R E P P)

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SRI LANKA INDUSTRIAL ESTATES SITING STUDY

October 1995

EXECUTIVE SUMMARY

The identification and evaluation of potential sites for industrial development is a complex but necessary initial stage in the establishment of an economically and environmentally sustainable industrial base in Sri Lanka. Until recently selection of sites for industrial facilities was conducted primarily on a separate site-by-site, industry-by-industry basis. This approach has frequently been time-consuming, expensive, controversial, and frustrating for both government officials and industrial applicants. The Ministry of Industrial Development (M/ID) is determined to change that approach into one that is more comprehensive and more efficient. As part of this effort, M/ID asked NAREPP to conduct a review of their current industrial estate siting program.

To conduct this study, NAREPP assembled a multidisciplinary team of environmental professionals. The team members were assigned to review current industrial development trends and policies in Sri Lanka; to assess environmental concerns and environmental management practices associated with industrial development; to conduct preliminary environmental reviews of eleven of M/ID's candidate sites and provide a comparative analysis of the environmental and socioeconomic characteristics of each of the sites; and, using the lessons learned from the site analyses, to derive more general conclusions regarding measures that Sri Lanka can and should take to improve its industrial siting process.

The main report contains the team's review of current industrial trends (in Chapter 2), the sectoral-level analysis of environmental concerns and management practices related to industrial siting (in Chapter 3), a description of the analytical methodology developed by the team to carry out its assessment of the 11 proposed industrial estates (in Chapter 4), and a synthesis of the results of both the site-specific studies and the more general review of industrial siting, as well as the team's findings and recommendations for improving the industrial siting process in Sri Lanka (in Chapter 5).

Volume II of the report, which is being separately printed, contains the Summary Environmental Reports for each of the 11 proposed industrial estates that M/ID asked the study team to evaluate. The reports are presented in a standard format to facilitate site-to-site comparisons, along with maps and tables that contain the results of the on-site field evaluation part of the study. These reports also contain the team's findings and recommendations with regard to the key environmental capabilities and constraints relative to potential industrial development activities at each of the sites.

ENVIRONMENTAL CONCERNS IN INDUSTRIAL SITING IN SRI LANKA

In Sri Lanka, as in other rapidly-industrializing countries, inadequate attention to environmental concerns during industrial siting decisions may later lead to extremely costly problems. There have been major conflicts between industrial planners and developers in Sri Lanka over a number of projects. Among these have been running disputes over paper mill discharges into the Walawe Ganga; controversies over the odors, solid wastes, and toxic chemicals associated with tannery operations; erosion and sedimentation in several rivers due to uncontrolled sand mining; and other issues associated with agricultural and urban discharges into rivers and sensitive coastal wetlands. In addition to impacts from large-scale industrial plants, cumulative impacts of small and medium scale industrialization are major contributing factors to solid waste and drinking water problems in the Colombo District.

These environmental problems illustrate the need for changes of attitude and policies for planning, operating, and monitoring of industries in Sri Lanka. Fortunately, a further extension of past patterns is not the inevitable consequence of industrialization. Rather, such problems reflect inefficient technologies or wasteful processes as well as carelessness and lack of appropriate legal and economic policies. Through sound planning and management the problems of the past need not be perpetuated, but instead can be minimized or eliminated.

ENVIRONMENTAL PLANNING FOR INDUSTRIAL SITING

Environmental problems associated with industrial development can be effectively managed if appropriate policies are put into place and implemented. These policies must address environmental issues throughout the industrialization process, from initial siting decisions through management of industrial facilities throughout their operational lifetime. Under a national Clean Industrialization policy, adverse environmental impacts from industrial estates can in most cases be avoided or greatly reduced if a three-step strategy is adopted:

A: making careful siting decisions;
B: making the appropriate selections of industry type and mix;
C: requiring use of pollution prevention technology.

All three of these steps must be followed if clean industrial development is to be achieved. This study was designed primarily to review the estate siting process in Sri Lanka and to make recommendations for improving it; however the main report provides some advice and recommendations on implementing all three steps of the above strategy.

STUDY DESIGN AND SCOPE

The technical design of this study was based on the results of initial site surveys conducted in October and November 1994 by a joint NAREPP/GOSL/World Bank study design team. That team visited nine sites located in five provinces across Sri Lanka. Based on the survey team's findings, NAREPP prepared a detailed Terms of Reference for this second study. The analytical approach set out in the TOR was directed primarily at assessing the "environmental and socioeconomic sensitivity" of the sites, i.e., the capacity of the local

environment and the communities in the vicinity of each site to absorb industrial development. To assess the sites' sensitivity to or compatibility with industrial development, thirteen environmental parameters were evaluated in this study:

- Surface drainage and soil stability
- Surface water availability
- Wastewater assimilative capacity
- Air quality
- Noise
- Solid waste disposal capacity
- Cultural/religious resources
- Ecological resources
- Transportation availability
- Public utility availability
- Local labor availability (skilled/unskilled)
- Community infrastructure
- Site expandability

These parameters were employed to compare similar types of information from each of the sites, **not** to make absolute or final judgements about the suitability of individual sites for industrial development. A more specific environmental impact assessment (EIA) will be needed of any site being seriously considered for location of industries with medium and high-polluting potential before a final suitability determination can be made.

The M/ID asked the NAREPP review team to review and evaluate the environmental compatibility, using the designated parameters, of eleven sites that were under active consideration for possible development as industrial estates. **Table 1** lists the sites and their approximate locations. The team conducted the site visits in July and August 1995. During each visit, the team made detailed observations of the site and surrounding areas and conducted interviews with M/ID regional directors, local community leaders, and residents.

INTERPRETATION OF SITE RATINGS FOR 14 PARAMETERS

The team evaluated each site for each of the parameters (the Labour parameter was later divided into Skilled and Unskilled, making 14). The sites were rated for each parameter at one of three levels: High, Medium, or Low. The rating given is the estimated compatibility of the site for each parameter with regard to compatibility with typical industrial activities. For example, surface water availability at Senapura is rated as low, indicating that the limited availability of surface water at or reasonably near the site makes it relatively incompatible with many proposed industrial activities. This rating system is, of course, more qualitative than quantitative; however, team members made a considerable effort to be objective, and to use collectively their best professional judgement; all ratings were assigned following considerable deliberation and were based on group consensus.

The team's ratings of each site for the selected parameters are provided in **Table 5-1.** The table should not be used to conclude that any given site is "best" or "worst" for all types of industrial development. Each site has a different combination of scores that reflect site-

MINISTRY OF INDUSTRIAL DEVELOPMENT

INDUSTRIAL ESTATES SITING STUDY

PROPOSED SITES INCLUDED IN STUDY

SITE NAME	PROVINCE	DISTRICT	DIVISION
1. Bata-Atha	Southern	Hambantota	Ambalantota
2. Uragasmanhandiya (Yatagala)	Southern	Galle	Karandeniya
3. Wäljapala watta	Western	Gampaha	Minuwangoda
4. Käranawan watta	N. Western	Puttalam	Dankotuwa
5. Manaweriya	N. Western	Puttalam	Arachchikattuwa
6. Tamrhanakele	N. Western	Puttalam	Arachchikattuwa
7. Senapura	N. Central	Anuradhapura	Ippalogama
8. Tambuttegama (Mahaweli)	N. Central	Anuradhapura	Thambuttegama
9. Buttala (at Gamudawa Site)	Uva	Moneragala	Buttala
10. Mapakada (Viyanini Camp)	Uva	Badulla	Mahiyangana
11. Gemunupura	Uva	Badulla	Redimaliyadda

TABLE 1

INDUSTRIAL ESTATES COMPATIBILITY MATRIX 1995 Study Sites:	Bata-atha	Buttala	Waljapala	Karanawan watta	Senapura	Yatagala	Tambuttegama	Manawerlya	Tammanakele	Mapakada	Gemunupura
ENVIRONMENTAL PARAMETERS:											
Drainage/soil Stability	M	L	M	H	H	M	H	L	M	M	M
Surface water availability	M	M	M	L	L	M	M	M	M	M	L
Wastewater assimilative capacity	L	M	M	L	L	M	L	M	M	M	M
Air quality	H	M	H	H	M	H	H	M	H	H	M
Noise	M	L	L	M	M	M	H	M	H	H	M
Solid waste disposal capacity	L	L	L	L	L	L	L	L	L	L	L
Cultural/ religious resources	M	H	H	H	H	M	H	M	H	H	M
Ecological resources	L	M	H	M	H	H	H	M	H	M	M
Transportation availability	M	M	H	M	L	M	H	H	M	M	L
Public utility availability	M	H	H	M	M	M	H	H	L	M	L
Labor availability -- skilled	L	M	M	H	L	L	M	M	L	L	L
Labor availability -- unskilled	H	H	H	H	M	H	M	H	H	M	M
Community development capacity	M	H	H	H	L	M	H	M	M	L	L
Site expandability	M	L	L	L	M	H	L	L	H	L	L

Table 5 - 1 : Ratings of 11 Proposed Sites

H = High compatibility rating M = Medium L = Low

specific conditions. However, these data can be used to identify the relative frequency and level of environmental constraints across all sites with respect to each of the rating factors.

For example, in **Figure 5-3**, which has a separate pie-chart for each parameter (each circle is the sum of that parameter's ratings for the 11 sites) the darker portions of each 'pie' indicate lower levels of compatibility with industrial uses. Surface water, wastewater, skilled labor, and solid waste were rated at either medium or low compatibility for all 11 sites, while air quality, unskilled labor, and cultural/religious factors posed relatively few problems at most sites. Four of the parameters were viewed by the team as posing the most serious constraints on the establishment of industrial estates at these sites:

- **Surface water availability** is a constraint or limiting factor at the majority of sites. Significantly, none of the sites were considered by the review team to have "high" compatibility with industrial development in regard to available water supplies. This constraint indicates that development of these sites may have to be restricted to industries with very low water use requirements. The use of ground water may be an option at some sites *but sustainable ground water availability cannot be determined without detailed site-specific ground water data, which currently does not exist for any of the sites.*

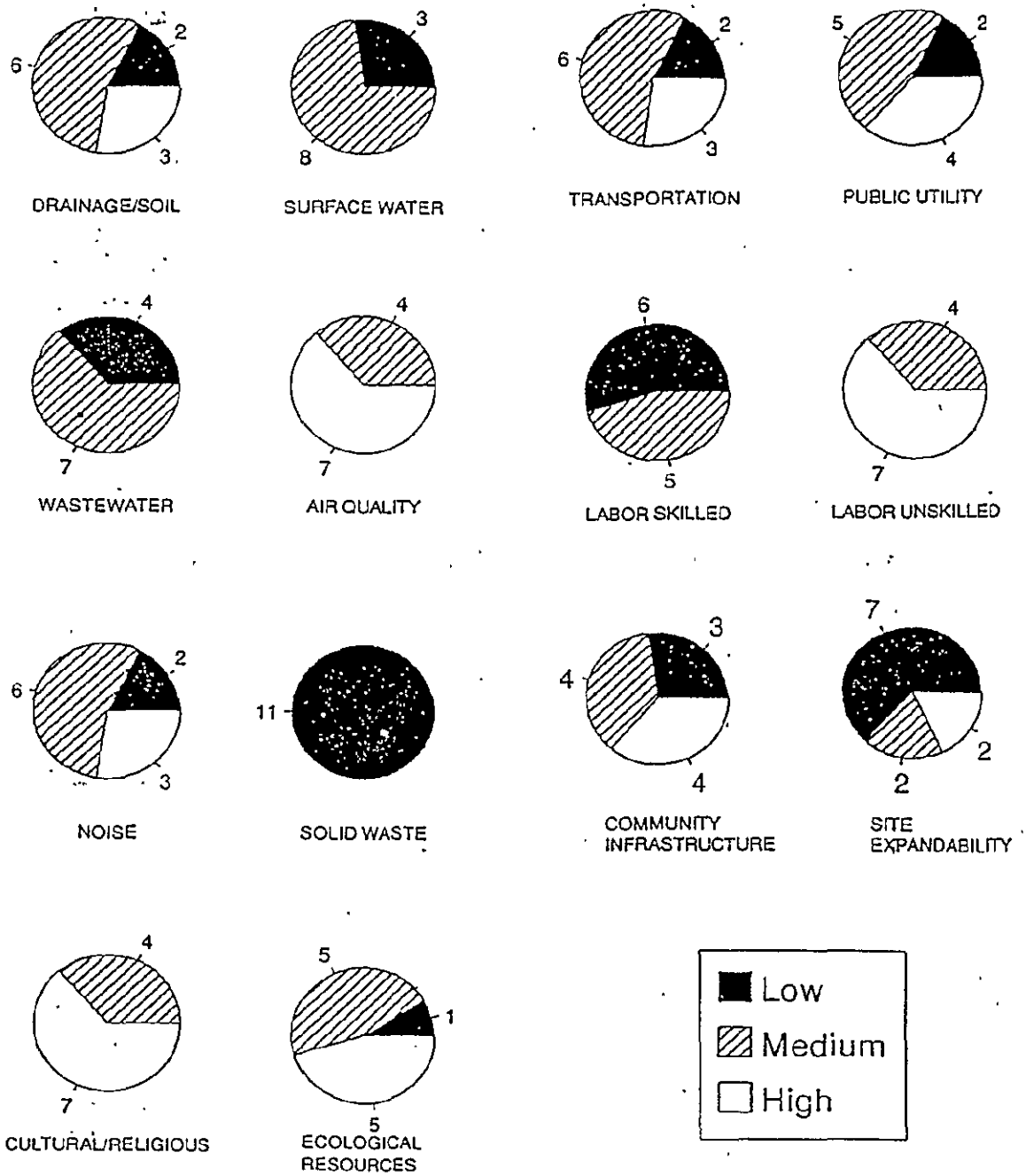
- **Limited waste-water assimilative capacity** is a constraint at the majority of the 11 sites. This conclusion is based on analysis of storage and flow rates for water bodies near the sites, as well as on consideration of other current or planned competing uses of these water bodies.

- **Solid waste disposal capacity** is a significant constraint at every site. The primary reason is that there are no existing properly constructed landfills at or near any of the sites; furthermore, on-site soil and groundwater conditions at some sites are incompatible with landfilling even if construction of such a facility were to be attempted. This constraint can be alleviated to some extent by requiring that, prior to development, the site manager must approve each industry's provisions for solid waste disposal, which could include construction of a landfill or installation of an on-site recycling system or other solid waste treatment unit. However, this requirement would add to the estate development costs and could lead to additional environmental problems. In addition, residues from some waste treatment systems (such as sludge or incinerator ash) would still need to be disposed of somewhere safely after receiving on-site treatment.

- **Limited space for future expansion** was a major constraint at most of the sites. The review team reached this conclusion after considering the characteristics of lands immediately surrounding the sites. There are physical barriers on many of these lands (e.g., existing structures, natural barriers such as streams, lagoons, etc. that would make future expansion of the sites onto these lands extremely difficult and expensive, if not unfeasible.

None of the sites was found to be ideally suited for high-polluting industries. Some sites are highly unsuitable, while others could accommodate high-polluting industries only with a significant expenditure for environmental protection measures. Unfortunately, given the

INDUSTRIAL SITES: ENVIRONMENTAL COMPATIBILITY



Ratings of 11 Sites for each factor

FIGURE 5- 3

typically small size of the sites and the fact that most of them have very limited potential for expansion, the need to make significant capital outlays for control measures greatly diminishes the appeal of many of these sites to investors.

The M/ID should consider the fact that developers of large industrial facilities will be looking carefully at ways to control their start-up costs, and are most likely to be attracted to sites where the managing entity has made substantial up-front investments in common infrastructure such as water supply, wastewater treatment, roads, power, and other industrial amenities. Such investments, whether by government or private parties, are not likely to be cost-effective on small sites with numerous other constraints.

DEVELOPING AGGREGATE ENVIRONMENTAL INDICATORS

The 13 parameters were next sorted into one of two groups (for sites, pollution assimilative capacity or resource availability) that each is most associated with. Seven of the environmental parameters were used to rate assimilative capacity, and 8 parameters were used to rate the second general criterion, resource availability. Two parameters (cultural/religious resources and ecological resources) can be applied to both indicators and were therefore included in the estimation process for both.

Once all the parameters for a site were rated, an aggregate ranking for each indicator was determined. Because in most cases only general assumptions can be made about the types of industries seeking to locate at a given site, each parameter was given equal weight in the estimation of an aggregate score or classification of each site. The two-part aggregate rating is determined for each site by adding up and comparing the number of H, M or L rankings for separately for each of the two indicators. A simple averaging method was used, whereby any single score of 'H' was matched up against any single 'L', thereby resulting in 2 ratings of 'M'. This exercise produces a composite or aggregate rating for each proposed industrial estate studied with regard to the two overall indicators. Thus an overall rating of 'M/ML' would mean that a site was rated <u>medium</u> overall for Pollution Assimilative Capacity, and <u>medium-to-low</u> overall for local resource availability. This was in fact the aggregate site rating computed for Senapura; the scores and aggregate ratings for each of the sites is given in **Table 5-2.**

RATING OF SELECTED INDUSTRY TYPES BY AGGREGATE INDICATORS

The separate and aggregate ratings in Table 5-2 were compiled for the sites themselves, not for any particular combination of industries at that site. To provide some basis for matching industries to sites, the team selected 10 general types of industries found in Sri Lanka and scored them against a similar set of parameters. Those scores were then used to produce aggregate ratings in the 'pollution potential' and 'resource consumption' categories. The results are shown in **Table 5-3.** In general terms, the table shows that different industry types vary considerably in their pollution and resource consumption impacts, which is not surprising; but the two tables taken together provide a systematic way to look for possible matches, or "fits," between a given site and a range of industries. Where a site's natural resources are limited, industry types with lower resource consumption (but possibly with

Table 5 - 2 RATING OF SITES ACCORDING TO POLLUTION ASSIMILATIVE CAPACITY AND RESOURCE AVAILABILITY

	SITES	POLLUTION ASSIMILATIVE CAPACITY								LOCAL RESOURCE AVAILABILITY									
		DRAINAGE/SOILS	WASTE WATER	AIR QUALITY	NOISE	SOLID WASTE	CULTURAL RESOURCES	ECOLOGICAL RESOURCES	AGGREGATE	CULTURAL RESOURCES	ECOLOGICAL RESOURCES	SURFACE WATER	TRANSPORT	PUBLIC UTILITY	LOCAL LABOUR (SKILLED)	LOCAL LABOUR (UNSKILLED)	COMMUNITY INFRASTRUCTURE	SITE EXPANDABILITY	AGGREGATE
1	Bata-Atha	M	L	H	M	L	M	L	M-L	M	L	M	M	M	L	H	M	M	M-L
2	Buttala	L	M	M	L	L	H	M	M-L	H	M	M	M	H	M	H	H	L	M-H
3	Waljapala	M	M	H	L	L	H	H	M-H	H	H	M	H	H	M	H	H	L	H-M
4	Karanawan watta	H	L	H	M	L	H	M	M-H	H	M	L	M	M	H	H	H	L	M-H
5	Senapura	H	L	M	M	L	H	H	M	H	H	L	L	M	L	M	L	M	M-L
6	Uragasmanhandiya (Yatagala)	M	M	H	M	L	M	H	M	M	H	M	M	M	L	H	M	H	M-H
7	Tambuttegama	H	L	H	H	L	H	H	M-H	H	H	M	H	H	M	M	H	L	M-H
8	Manaweriya	L	M	M	M	L	M	M	M-L	M	M	M	H	H	M	H	M	L	M-H
9	Tammanakele	M	M	H	H	L	H	H	M-H	H	H	M	M	L	L	H	M	H	M-H
10	Mapakada (Vianini Camp)	M	M	H	H	L	H	M	M-H	H	M	M	M	M	L	M	L	L	ML
11	Gemunupura	M	M	M	M	L	M	M	M-L	M	M	L	L	L	L	M	L	L	L-M

H - High
M - Medium

Table 5 - 3 RATING OF INDUSTRIES ACCORDING TO POLLUTION POTENTIAL AND RESOURCE CONSUMPTION

	INDUSTRIES	POLLUTION POTENTIAL								RESOURCE CONSUMPTION							
		WASTE WATER	AIR QUALITY	NOISE	SOLID WASTE	VISIBILITY	THERMAL		AGGREGATE	SURFACE WATER	ECOLOGY	TRANSPORT	PUBLIC UTILITY	LOCAL LABOUR	COMMUNITY INFRASTRUCTURE	LAND AREA	AGGREGATE
1	Textile Washing Plant	H	M	L	M	M	M		M	H	M	H	H	M	M	L	H-M
2	Apparel Industry	L	L	M	M	L	L		L	L	L	H	M	H	H	M	H-M
3	Manufacture of Fabricated Metal Products and Foundry	M	L	H	H	M	M		H-M	L	M	M	H	L	M	L	L-M
4	Manufacture of Leather (Tanning Industry)	H	H	L	H	H	M		H	H	H	M	M	M	M	M	M-H
5	Meat Processing, Curing, Preserving and Packing	H	L	M	H	L	M		M	H	L	H	H	M	M	L	M-H
6	Rice Mills	L	M	L	M	M	L		M-L	M	L	M	L	L	L	H	M-L
7	Manufacture of Cement Products for Construction Industry	L	M	M	L	M	L		M-L	M	H	H	L	M	L	H	M
8	Processing Pulp to Paper, Paper Board and Fibre Board	H	H	M	H	H	M		H-M	M	H	H	H	M	M	H	H-M
9	Treating and Preserving Wood	H	M	L	L	M	M		M	M	L	H	M	H	M	H	M-H
10	Manufacture of Motor Vehicle Parts, Motors Brakes etc.	M	M	H	H	M	M		M-H	L	L	M	M	M	M	L	M-L

H - High
M - Medium
L - Low

relatively high pollution potential) may be more appropriate. The system could be used in the preliminary stages of site development to identify which industry types should be encouraged to consider which available sites. Final siting decisions should, of course, be based on more site-specific and industry-specific analysis. This methodology offers a short-cut in the initial screening stages.

IMPROVING SRI LANKA'S INDUSTRIAL ESTATE SITING PROCESS

Perhaps the most significant general finding of this study is that **there is not yet a rational, systematic process of screening and selecting sites in Sri Lanka for industrial development.** As is depicted in **Figure 5-1**, industrial estate site selection at present appears to be solely supply-driven, i.e., tracts of land are selected without any consistent rationale, evaluated individually, and then offered to industrialists for whatever type of facility they are willing to develop. At some point an IEE or EIA may be undertaken, sometimes rather late in the process, to determine the environmental, social, and (to some extent) economic suitability of a single site. Consequently, substantial time and resources can be devoted to investigating sites that may have poor prospects for development because they have severe resource constraints, or present major environmental problems, or are otherwise unattractive to potential investors. When this happens, the search for alternative sites has to begin all over again, with additional costs in time and money.

A more rational strategy would be to implement an orderly siting process that begins with identifying an inventory of possible sites, based on both site characteristics and other considerations of industrial needs and constraints. Through a systematic screening process sites could be selected from this inventory based on a variety of factors, including industry resource needs, local community acceptance of certain types of development, and consistency of the proposed development with regional land use and infrastructure. Using such an inventory, it is possible to conduct and environmental assessment that allows for a comparison of alternative sites, thus favoring selection of one or more sites that are the most environmentally and economically suitable. The framework for such a strategy is suggested in **Figure 5-2.**

In the course of this study the NAREPP team encountered several recurring issues in the industrial estate siting process and in policies to develop and manage industrial estates. All of these issues are manageable and can be effectively addressed with appropriate policy and institutional measures, as recommended below. These issues are:

1. Improving market data indicating the level and types of industry interests in the sites: A recurring issue for almost all of the sites in this study is the absence of firm industry proposals or expressions of specific industry interests in the sites. Thus, there is no solid basis for site planning and design to accommodate specific industries.

2. Improving the tract definition process: The process for siting industrial estates in Sri Lanka begins with identifying lands owned by the Government that are of appropriate size and that are not currently in use or committed to other specific uses. Beyond this necessary first step, many additional measures must be taken to define and ultimately select specific tracts of land from among larger units. The establishment of firm site boundaries should take

SUMMARY OF CURRENT PROCESS FOR SITING INDUSTRIAL ESTATES

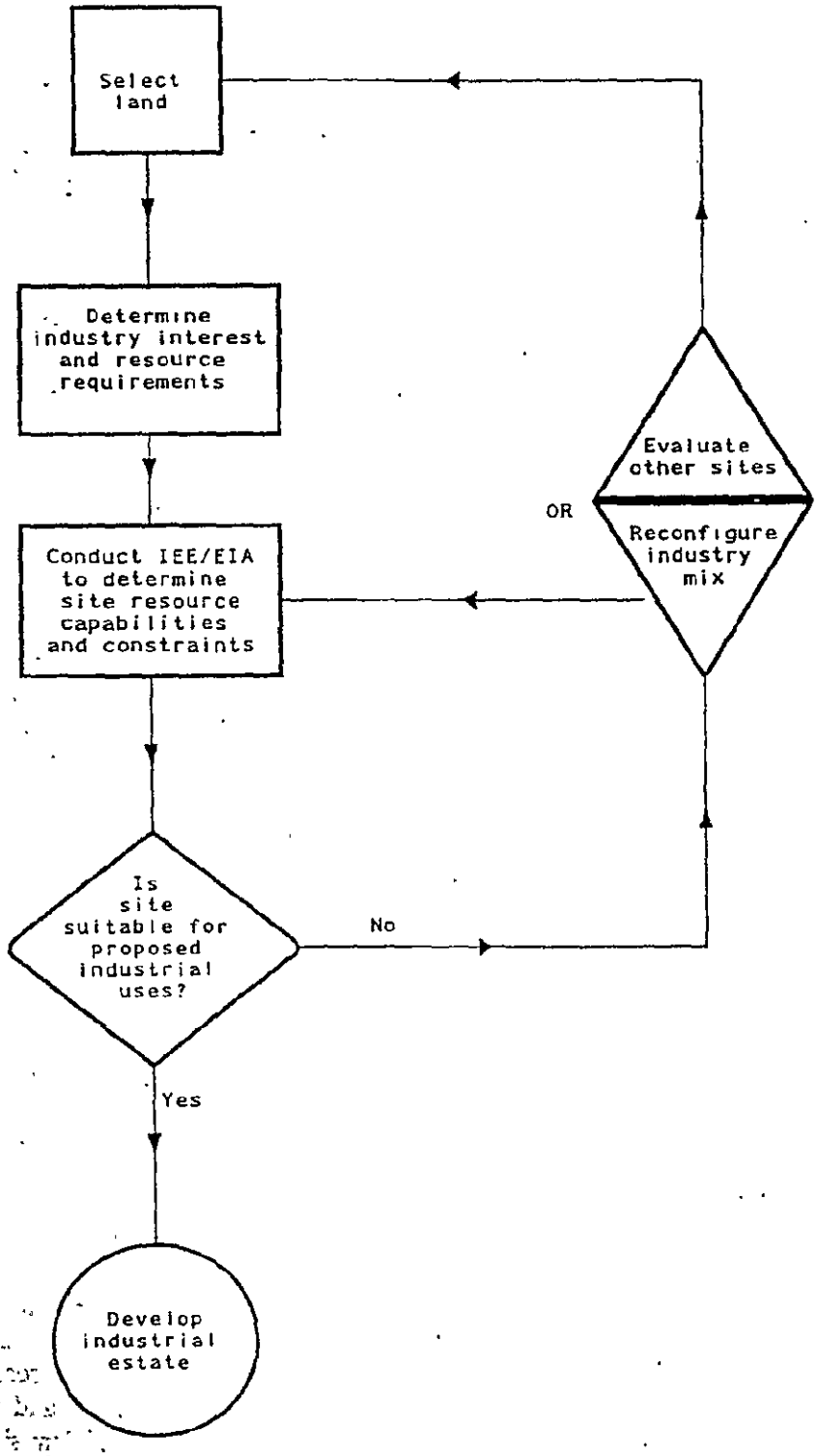


FIGURE 5 - 1

SUGGESTED APPROACH TO IMPROVE AND STREAMLINE INDUSTRIAL ESTATE SITING

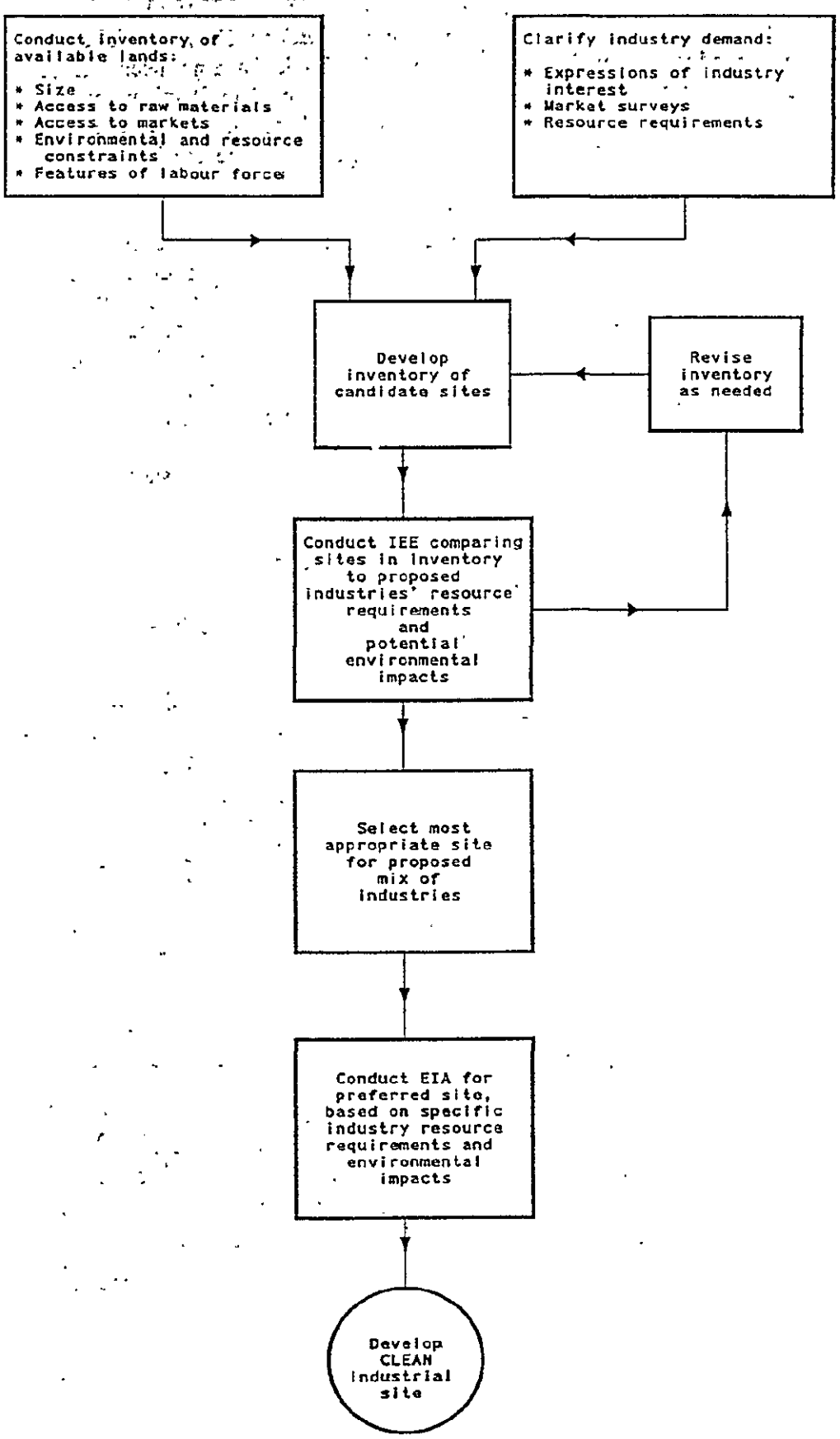


FIGURE 5 - 2

place near the end of this process, not the beginning, as appears to have been the case with most of the sites analyzed in this study.

3. Improving interagency coordination and communication: The industrial estate programs of the various industrial development agencies in Sri Lanka have not been well coordinated. In particular, there has not been a multi-agency institutional mechanism for systematically assessing the need for new estates on the basis of market demand. The recently-established Sectoral Committee on Industrial Estates and Projects may be the key to improving this much-needed coordination.

4. Preparing estate management plans that encourage pollution prevention and effective environmental management at the industrial estates: Detailed plans for developing and managing most of these estates have not been completed. While this is an issue of concern, it is not critical since few of the sites reviewed in this study have firm industry facility plans at this time. Thus there is an opportunity to initiate policies now that incorporate sound environmental principles into estate management plans. Doing so now will avoid many problems later. The principles that need to be embodied in estate management plans include:

- Apply polluter-pays principles to provision of estate services such as using common waste treatment and disposal facilities;
- Reward designs that prevent pollution before it is generated;
- Provide clear procedures and lines of authority for dealing with both planned and unplanned events.

5. Expanding the Inventory of Potential Sites: In spite of the large number of industrial estates currently proposed for Sri Lanka, our study shows that very few are likely even to be marginally suitable for medium and high polluting industries. In fact, of the eleven sites evaluated in this study none could be considered ideal for such industries. There is a growing need to develop an inventory of sites that are suited to particular industry needs. This inventory does not currently exist, largely because under the existing siting process individual tracts of land are first selected, then evaluated in terms of their economic, environmental, and social attributes. As sites are eliminated from further consideration for various reasons, there is little choice but to start the process of finding sites for analysis all over again.

6. Developing Effective Industrial Estate Management Plans: When evaluating individual estate proposals, the Sectoral Committee should closely examine the arrangements that are proposed for estate management, in particular provisions for sharing environmental management and oversight responsibilities among the industrial development agencies, CEA and local environmental authorities, estate developers, and individual industrialists. These provisions are extremely important and must be spelled out in detailed form, and carefully considered.

SRI LANKA INDUSTRIAL ESTATES SITING STUDY

CHAPTER 1

INTRODUCTION

Expansion and diversification of the existing industrial base in Sri Lanka are major components of the country's economic development strategy. Increased industrialization holds the promise of an improved economy. It is, however also fraught with numerous environmental and social risks if improperly planned and managed. The Government of Sri Lanka recognizes that one promising approach to minimizing these risks is to locate new industrial facilities in industrial estates that are designed and operated with appropriate infrastructure and environmental controls. This report provides the results of a study conducted by NAREPP (a joint project of the U.S. Agency for International Development and the Government of Sri Lanka); the study responds to the Government's request for an evaluation of the technical, policy, and institutional issues associated with industrial estate development and operation, and a review of current siting policies in light of these issues.

1.1 BACKGROUND

The Government of Sri Lanka (GOSL) has adopted a Clean Industrialization Policy, consisting of a set of measures to ensure that both existing and new industries are environmentally responsible. Among these is a policy adopted by the Cabinet in 1994 requiring that all new industries that are classified as high polluting (as defined by the Central Environmental Authority) be located in industrial estates. Further, all new industries classified as medium polluting must be located in industrial estates if they generate large quantities of solid and liquid wastes. This policy is intended to ensure that industries with the greatest pollution potential have appropriate environmental controls and are located in areas that are the most suitable with respect to their environmental and social-economic attributes.

One of the first industrial development programs to be affected by this policy is a program recently initiated by the Ministry of Industrial Development (M/ID) to foster the development of industrial estates at numerous locations throughout the country. Under this program, M/ID will be offering a package of incentives to encourage private investors to develop industrial estates on designated sites. Depending on investor interest, some of these sites might be developed as estates to support a wide range of industries, including those that fall in the low polluting as well as medium and high polluting potential categories.

Historically, industrial estate development planning in Sri Lanka has been carried out on a separate site-by-site basis. Recognizing that M/ID's program affords an excellent opportunity to apply Sri Lanka's new industrialization policy in a more comprehensive way an to entire new industrial sector, the Government of Sri Lanka requested NAREPP's assistance in reviewing M/ID's implementation plans. This activity included conducting preliminary environmental reviews of eleven of M/ID's candidate sites, comparing the environmental and socioeconomic characteristics of all of the sites, and using the lessons learned from the site analyses to derive more general conclusions regarding measures that Sri Lanka can and should take to improve its industrial siting process.

NAREPP has prepared this report in response to the Government's request. The report summarizes the results of a joint NAREPP/GOSL study that was initiated in June 1995 and completed in September 1995. The study design and methodology were derived in part from a preliminary siting survey done by NAREPP in 1994; the study also drew on environmental guidelines for industrial siting developed by the Central Environmental Authority in 1993 - 94 with assistance from NAREPP. NAREPP hopes that the findings provided herein will help lay the groundwork for an improved industrial siting process in Sri Lanka that will support the country's economic development objectives without compromising its environmental goals. Indeed, such a process, if carefully and rigorously implemented, can demonstrate the essential compatibility of economic and environmental policies.

1.2 OBJECTIVES OF THIS STUDY

This study is intended to assist the GOSL in implementing key elements of the Clean Industrialization Policy that relate to the siting and managing industrial estates. There are two major objectives:

A. To assist M/ID in screening its candidate sites to determine which sites may be most suitable for industrial estates in terms of their environmental and socioeconomic characteristics; and

B. Based on the lessons learned from this screening process, to develop general recommendations for improving the Government's overall industrial estate siting and development program and its related environmental management practices and policies.

1.3 DISCLAIMER

Readers of this report should keep in mind that the findings and recommendations contained herein represent the best professional judgement of the study team only; the draft report will be reviewed and revised before final printing and release.

CHAPTER 2

INDUSTRIAL POLICIES AND TRENDS IN SRI LANKA

This chapter focuses on the historical progression of industrialization and of national policies and programs relating to industrial estates in Sri Lanka, to provide a context for this industrial estate siting study.

2.1 HISTORICAL PERSPECTIVE

In Sri Lanka, private sector industrialization was first emphasized as a national policy during the late 1950s when the government adopted a policy of import substitution. Prior to this period most industrial activity was undertaken by the government. Private-sector industries were limited to a few commodities such as biscuits, aerated water, cigarettes, matches and soap.[1] The government focused on setting up and managing large scale industries. Although the government actively participated as chief investor and decision maker in the industrial development process, development of small and medium scale industries was left to the private sector. The protectionist policies adopted by the government opened up many markets for domestically-produced consumer goods.

The government's policy was influenced by economic theories that justified temporary protection of domestic sectors based on the 'infant industry' argument. Many financial policies of that period reflected the government's position of promoting import substitution. These included: licensing, high tariffs, quotas, a ban on luxury goods, foreign exchange restrictions, and extensive government intervention in industrial management.

Economic policies since the 1960s have fluctuated between more liberalized, market-oriented policies and strict regimes of controls. These variations have had an impact on the continuity of industrialization, and particularly on the private sector. Corresponding with the prevailing economic policies, industrial development trends fluctuated as well.

The broad economic reforms undertaken in 1977 led to an increase in industrial activity. Protectionist policies were largely replaced with open market policies. The tariff structure was revised and a scheme of tax incentives was introduced to attract foreign investors. The exchange rate was rationalized by means of devaluation, and a managed float policy was adopted to reflect market forces. These open-market liberal economic policies were further supported by fiscal and monetary proposals by the World Bank and International Monetary Fund under the Stabilization and Structural Adjustment Programs.

The period following 1977 saw a rapid expansion of industrial activity, mainly due to the availability of raw material, machinery, and spare parts. Furthermore, direct foreign investment responded to the government's policy of incentives to promote

industrialization. During the period 1978 - 1991 annual growth of industrial production reached an average of 8 per cent; the growth rate has declined somewhat since then.

2.2 CURRENT POLICY ON INDUSTRIALIZATION AND INDUSTRIAL ESTATES

Sri Lanka's industrial policy is based on the experience of other well-performing Asian economies[2]. The Government seeks to provide a "stable and sustainable" macroeconomic environment which will tend to accelerate industrial development[3]. The Government would like to develop an "internationally competitive, export oriented diversified industrial sector," characterized by a range of high-technology 'non-polluting' industries. But 'non-polluting' labor-intensive industries (other than garment production) are also encouraged. Foreign investment in the industrial sector is emphasized since it provides capital and access to modern technology and export markets.

Industrial development in rural areas is now being encouraged with a view to promoting regional development and to reduce urban congestion. Private sector investment in rural areas is to be encouraged by providing infrastructure facilities. Priority is to be given to agriculture-based industries and to the manufacture of finished agricultural goods.

The Regional Industry Service Committees (RISCs) serve as the regional extension of the Ministry of Industrial Development (M/ID), though other institutions also play important roles in planning and promoting industrial expansion (see below). The Ministry's 1995 Action Plan proposes measures to strengthen the ability of RISCs to execute infrastructure projects in their respective provinces. Under these plans the RISCs will be vested with responsibility to address several issues pertaining to promotion of industrial growth, including infrastructure, finance, and technology development.

The M/ID has adopted the policy of developing industrial estates as a key component of its national industrialization strategy. Due to cost as well as time constraints it is not feasible to provide infrastructure facilities necessary for industrial expansion on an island-wide scale. Industrial estates are a cost-effective way to provide such infrastructure and facilitate industrial development at specific locations. This approach has also been promoted as the best way to ensure that adequate environmental controls are exerted on industrial production. Two large industrial estates at Katana and Seethawaka are currently in the advanced planning stages at M/ID. The M/ID is also examining several sites across the country as potential candidates for regional industrial estates. Eleven such potential regional sites were analysed during this study; the principal findings and recommendations of the study team are presented in Chapter 5 of this report.

In a concurrent effort, initiated by the Ministry of Transport, Environment and Women's Affairs (M/TEWA) the Cabinet in 1994 approved a decision that all high and medium polluting industries should be located in designated industrial estates. Diffusion of polluting industries throughout the country has imposed significant difficulties for the Central Environmental Authority, which is charged with responsibility for monitoring and enforcing the nation's environmental regulations. The CEA's task should be made considerably easier if all high and medium polluting industries are located within designated industrial estates/parks. There is, however, considerable uncertainty as to

which specific industrial projects or facilities may be classified as high or medium polluting. Furthermore, strong arguments can be made on the basis of economics of scale theory which suggest that pollution abatement costs can be reduced if effluent from similar industries is treated centrally.

The decision to focus on industrial estates has been justified on the grounds of meeting the independent goals of both the M/ID and of the M/TEWA. It constitutes a 'win-win' policy in this regard and is therefore likely to receive support from the current Government. While there is general consensus on the broad concept of industrial estates development, the details of a national policy must be carefully considered, addressing concerns of the relevant government agencies as well as the private sector industries which will be subject to this policy. This report aims to support that task.

2.3 INSTITUTIONAL ASPECTS OF INDUSTRIAL ESTATE MANAGEMENT

The M/ID is the principal government agency responsible for industrial activities in Sri Lanka. The Ministry provides oversight on activities such as: foreign investment tracking and promotion, export promotion, facilitating private sector growth, providing infrastructure, financing investments, and strengthening regional industrial development. These activities are coordinated through a range of agencies including the Board of Investment (BOI), Export Development Board (EDB), Secretariat on Infrastructure Develop Institute (SIDI), the Industrial Development Board (IDB), and the Regional Industrial Service Committees (RISCs).

Several of these agencies are governed by separate laws or acts of Parliament that define their authority or jurisdiction for activities pertaining specifically to the respective agency. The BOI and IDB have specific mandates to promote industrial growth, and therefore engage in developing industrial estates. In addition, the Provincial Councils (PCs) and the Urban Development Authority (UDA) promote industrial estates as well. Finally, credit institutions such as the DFCC and NDB play an active role in the development of industrial estates. The specific roles of these agencies with regard to industrial estates are addressed in the following section. Since these agencies tend to operate within the scope of their specific mandates, on occasions their activities may cause redundancy or duplication. With respect to the siting of industrial estates, these overlapping mandates could result in the inefficient use of resources as well as in unforeseen environmental consequences if sites are located in close proximity and in relatively undeveloped areas. In one such instance, the BOI is developing an industrial zone directly adjacent to an industrial estate managed by IDB. Industrial growth in the area does not warrant two industrial estates. Such decisions reflect the lack of a mechanism to coordinate the activities of the relevant agencies involved with developing industrial estates.

In view of the need to coordinate siting of industrial estates, a Sectoral Committee has been established within the M/ID. The committee is chaired by the Secretary of M/ID with representation by the Treasury, Department of National Planning (NPD), BOI, Labour Ministry, M/ID, IDB and the UDA. All future proposals for industrial estates must be cleared by this committee prior to submission for cabinet approval. Guidelines for establishing industrial estates were also established by this committee. According to

the guidelines the first step is to conduct a demand survey of the proposed site. Thereafter approval is to be obtained by the RISCs and the Sectoral Committee. Clearance from the CEA must be obtained next, based on an Initial Environmental Examination (IEE) or Environmental Impact Assessment (EIA). Finally the proposal must be submitted by the relevant ministry for cabinet approval.

2.3.1 Ministry of Industrial Development

The M/ID is the primary authority responsible for developing and carrying out the industrial policy of the GOSL. As stated in its Action Plan for 1995, the Ministry proposes to develop industrial estates in several regions and two large industrial estates in the greater Colombo area. The latter are targeted for large-scale industries; Katana for high-polluting industries and Seethawaka for medium and high-polluting industries. The Government of Japan is providing assistance to develop infrastructure facilities at these two sites. The role of the Ministry is limited to identifying and promoting the development of industrial estates. It does not play a large role in managing or monitoring the sites.

The Regional Industrial Services Committees (RISCs) will be responsible for developing industrial estates in the regions. The Deputy Divisional Secretaries will identify suitable sites within their respective divisions. These proposals will be submitted to the M/ID via the respective RISCs. In July 1995 the Ministry identified 15 candidate sites and requested expressions of industry interest; among those sites are the 11 included in this study (see **Table 2.3.1** below). Once the sites are approved by the sectoral committee, the M/ID is to arrange for acquisition of the required land by appealing to the Cabinet.

Responsibility for managing the regional industrial estates will likely be assigned to private parties and would involve several elements. First, services such as maintenance of roads and utilities and providing central security for the premises are to be undertaken centrally rather than by each individual industry. Second, at industrial estates designated for high and medium polluting industries, waste disposal can be addressed most effectively by means of central facilities such as incinerators and centralized waste-water treatment facilities. Third, the management must serve as a forum to address various concerns that arise among industrialists occupying the estate. These may relate to internal issues among firms or issues that industries within the park face in common. These activities must be undertaken by the authority assigned responsibility for managing the estate.

In general, the strategy of the M/ID is to provide basic infrastructure (e.g., roads, telecommunication, power, and water) to the perimeter of the industrial estate site. A private contract would then be issued for development of infrastructure facilities within the estate such as central waste-water treatment and solid waste management on a Build-Own-Operate or Build-Operate-Transfer scheme (this policy is often abbreviated to BOO/BOT).

Table 2.3.1 below summarizes currently available information on the industrial estates proposed by the Ministry of Industrial Development.

Table 2.3.1: Potential Industrial Estates: Summary information

Name of industrial estate	District	Area (acres)	No. of sites available	Type of industries in occupation
Seethawaka	Avissawela	430.00	70	Large scale, medium and low polluting: gems, rubber, textiles
Katana	Negombo	205.00	50	Large scale high polluting: metal finishing and heavy machinery
Fullerton		30.00	50	
Bata-Atha	Hambantota	107		
Uragasmanhandiya	Galle	50		
Waljapala-watta	Gampaha	15		
Karanawan-watta	Puttalam	58		
Manaweriya	Puttalam	52		
Tammanakele	Puttalam	67		
Senapura	Anuradha-pura	15		
Tambuttegama	Anuradha-pura	40		
Buttala	Moneragala	35		
Viyanini Camp	Badulla	10.7		
Gemunupura	Badulla	85		

2.3.2 Board of Investment (BOI)

The BOI was created under the GCEC[1] law No. 4 of 1978 with the objective of attracting foreign capital and investors, promoting industrial development, and generating employment. To this end BOI develops and manages industrial estates to facilitate

[1] Greater Colombo Economic Commission

export-oriented industrial growth in the country[2]. At present BOI operates three industrial estates, located at Katunayake, Biyagama and Koggala. Two more estates are being developed at Pallekale and Hambantota. Details of these industrial estates are provided in Table 2.3.2-A

Table 2.3.2-A: Industrial estates managed by the BOI

Name of industrial estate	District	Area (ha.)	No. of Industries in occupation	Type of industry
Katunayake	Colombo	190	105	Low and medium polluting
Biyagama	Colombo	180	38	low, medium and high polluting
Koggala	Ambalangoda	91	11	low polluting (dry)
Pallekale	Kandy	82	5	low polluting
Hambantota	Hambantota	100	-	-

BOI assumes responsibility for identifying, approving, acquiring and developing sites, approving industries, and monitoring and managing sites. BOI develops infrastructure facilities within the industrial estate as well. Power, water, telephone and sewer lines are provided to the boundary of the individual lots within the estates. BOI also provides services ranging from maintenance of the public areas and infrastructure within the estate, providing overall security, and central treatment of solid and liquid waste.

Individual industries must comply with pre-treatment water quality standards specified by the BOI. These pertain to BOD and suspended solids. With regard to all other parameters the pre-treatment standards are the same as national effluent standards established by the Central Environmental Authority (CEA). Pre-treatment standards established by the BOI are given below in **Table 2.3.2-B** of this chapter.

Industries that wish to locate within BOI industrial estates are not required to conduct EIAs or IEEs for the proposed specific activity. Rather they undergo an initial environmental screening by the BOI before receiving approval. This screening constitutes Clearance for the industrial activity within the guidelines set forth by the BOI agreement, and is accepted by the CEA.

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[2]. BOI industries are no longer restricted to the industrial processing zones. They may locate anywhere in the country if they are willing to take pollution control measures that satisfy national effluent standards. BOI industries are therefore classified into two types: Zone Enterprises (industries located in one of the BOI operated zones) and Licensed Enterprises (BOI industries located outside the BOI estates).

Table 2.3.2-B Pretreatment Standards for Water Quality Established by the BOI

Parameter	Maximum Tolerance Limit
BOD (5 days at 20 ò C) mg/l	200
pH	6.0 - 8.5
Suspended solids	500
Total dissolved solids (inorganic) mg/l	2100
Temperature (o C)	40
Phenolic compounds mg/l	5
Oil and grease mg/l	30
Total Chromium mg/l	2 (Chromium VI 0.5)
Copper mg/l	3
Lead mg/l	1
Mercury mg/l	0.0005
Nickel mg/l	3
Zinc mg/l	10
Arsenic mg/l	0.2
Boron mg/l	2
Percent Sodium	60
Ammoniacal Nitrogen mg/l	50
Sulphides mg/l	2
Sulphates mg/l	1000
Chlorides mg/l	900
Cyanides mg/l	0.2
Radioactive Material	
Alpha emitters mc/ml	10 -7
Beta emitters mc/ml	10 -6

Source: BOI

2.3.3 Urban Development Authority

Under the UDA Law No. 41 of 1978, any area may be declared an "urban development area," at which stage the area comes under jurisdiction of the UDA. Operating within its mandate to promote well-planned urban development, the UDA has established industrial estates in various regions of the country. The UDA can act as a project approving agency (PAA) in reviewing plans for proposed industrial estates. UDA is also directly involved in siting industrial estates. The main functions served by the UDA relating to industrial estates development are:

1) acquisition of land for development as industrial estates; and

2) selection of industries through a selection committee which is also represented by IDB, M/ID, BOI and the PC.

The UDA assists in developing industrial estates with the support of the Ministry of Finance, Planning, Ethnic Affairs and National Integration. The industrial estates implemented by the UDA are given in Table 2.3.3

Table 2.3.3: Industrial Estates of the UDA

Name of industrial estate	District	Area (ha.)	No. of sites available	No. of industries in occupation
Peliyagoda: Stage 1	Gampaha	74.5	70	28
Peliyagoda: Stage 2	Gampaha	74.9	60	--
Kattuwana	Colombo	24.3	79	28
Modarawila: Stage 1	Panadura	10	32	08
Modarawila: Stage 2	Panadura	10	--	--

Source: UDA

2.3.4 Industrial Development Board

Under the Industrial Development Act No. 36 of 1969, the IDB is entrusted responsibility for promoting and developing small and medium scale industries[4]. It functions under the M/ID. Prior to the creation of the UDA, the IDB held sole responsibility for providing support to industries. In 1962 the IDB was responsible for establishing the first industrial estate in Sri Lanka, at Ja Ela. Several years later two other industrial estates were established; one in Pallekale and another in Atchuvely in the Jaffna district. The latter has ceased to operate due to political and economic instability in the region. Basic facilities such as roads, water supply, drainage, waste disposal, electricity, and telecommunication are provided at these estates.

In 1992 the IDB launched a project known as "Isuru Uyana," designed to provide land in industrial estates furnished with basic infrastructure such as roads, water and electricity. Under this project several industrial estates were established.

2.3.5 Central Environmental Authority

The CEA is vested with power to enforce the environmental regulations of Sri Lanka as stipulated in the National Environmental Act of 1980 and Amendments of 1988. The two main environmental regulations that are relevant to the industrial estates are (1) the Environmental Protection License (EPL) scheme; and (2) the requirement for the project proponent to conduct an IEE or EIA prior to siting an industry or industrial estate.

Any industrial activity that will result in the discharge of industrial effluent or emission of known air pollutants is required by law to obtain an EPL prior to commencing operations. The EPL is a conditional agreement to ensure that the industry meets pre-specified national water quality standards. Standards for emission of air pollutants have still to be gazetted. Since many industries were already in existence when the EPL system was enacted by law in 1990, the CEA adopts a somewhat different approach in issuing EPLs to existing industries. The conditional agreement upon which an EPL is issued is more tolerant for those older industries. New industries, however, must provide evidence that specific measures are being adopted during the construction of facilities to assure adequate treatment of effluents and other regulated substances.

The national effluent standards for water quality apply to effluent discharged from an industrial estate as well. Effluent from a central treatment facility at an industrial estate will therefore have to meet the same water quality standards as effluent discharged from a particular industry.

Under the National Environmental Act No. 47 of 1980, an EIA is required if a project qualifies as a "prescribed project."[3] There are two levels to the EIA process. First is an "Initial Environmental Examination" (IEE), which is a short and sometimes preliminary report specifying the possible environmental impacts of the project. For many projects, an IEE-level analysis is sufficient to meet environmental concerns. However, if the impacts are considered by the CEA to be significant, a more detailed "Environmental Impact Assessment" (EIA) must be conducted. The EIA is more comprehensive and must suggest alternatives to the proposed project design in order to determine the feasible option that has least impact on the environment. The procedure for conducting IEEs or EIAs is given in two concise publications available at the CEA.

The BOI industrial estates, which are the only industrial estates now equipped with centralized wastewater treatment facilities, are subject to the EPL regulations. Until recently, the BOI was authorized to issue EPLs directly to industries registered with them and located in areas outside the established zones (known as 'licensed enterprises'). CEA

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[3] The list of prescribed projects for which an EIA is normally required is established by the CEA and is published as Appendix 4 in their 1993 "Guidance for implementing the Environmental Impact Assessment (EIA) Process."

has now assumed authority for issuing EPLs to these BOI-registered firms. Industries within the BOI zones, however, are not required to have an EPL since these industries meet the pre-treatment standards established by the BOI and approved by the CEA. Furthermore, as mentioned above industries located within BOI industrial zones are not required to perform IEEs or EIAs, since they are subject to an approved screening process by the BOI. The opportunity for industries to simplify their environmental clearances has been a clear advantage to those located in BOI's industrial estates.

1. Vidanapathirana, U. (1993) A Review of Industrial Policy and Industrial Potential in Sri Lanka, Sri Lanka Economic Association Paper No. 2.

2. The Government of Sri Lanka Policy Statement, 1995.

3. The Ministry of Industrial Development Action Plan for 1995.

4. Gunaratne, M. H. (1993) "Industrial Estates of Sri Lanka", *Karmanta Souvenir Issue*, Industrial Development Board.

CHAPTER 3

ENVIRONMENTAL CONSIDERATIONS FOR INDUSTRIAL SITING IN SRI LANKA

Environmental problems associated with industrial development can be effectively managed if appropriate policies are put into place and implemented. These policies must address environmental issues throughout the industrialization process, from initial siting decisions through management of industrial facilities throughout their operational lifetime.

This chapter discusses a proposed overall framework within which industrial siting and management policies could be implemented. It includes a description of the general types of environmental impacts associated with industrial operations, followed by specific examples of industries that are most likely to locate in Sri Lanka.

Under a national Clean Industrialization policy, adverse environmental impacts from industrial estates can in most cases be avoided or greatly reduced if a three-step strategy is adopted. These steps are **A: making careful siting decisions; B: making the appropriate selections of industry type and mix; and C: requiring use of pollution prevention technology.** All three of these steps must be carefully followed if clean industrial development is to be achieved. This study has focused primarily on how to implement steps A and B; this chapter also provides some guidance on C.

3.1 LESSONS FROM PAST EXPERIENCE

As countries all over the world have learned, inadequate attention to environmental concerns in industrial siting decisions may later result in extremely costly problems. The disaster that occurred at Bhopal in India is one tragic illustration of this point. In Sri Lanka, pollution and waste problems have sometimes been severe enough that they have resulted in major conflicts between industry and the public. Some recent examples are provided in Table 3-1 below.

It is well known that industrial facilities have often severely polluted air, water and land. What equally needs to be understood is that a further extension of past patterns is not the inevitable consequence of industrialization. Rather, such problems reflect inefficient technologies or wasteful processes as well as carelessness and lack of appropriate legal and economic policies. Through sound planning and management the problems of the past need not be perpetuated, but instead can be minimized or eliminated.

Table 3-1

Recent Sri Lankan Examples of Industries Facing Community Opposition

Pulp & Paper Mill at Embilipitiya :	This mill discharges black liquor from the pulping process to Walawe Ganga. The liquor contains a lot of chemicals from the process; it is toxic to fish and aquatic life, and is also dark in color. The discharge is also upstream of the Ambalantota drinking water extraction point. Due to its use of straw as the basic raw material, this process has created the special problem of preventing use of the chemical recovery section that was designed to recycle chemicals and to control effluent.
Tanneries at Various Sites: (Rajagiriya, Mattakkuliya)	At present numerous tanneries are located in areas that have become heavily residential, although initially the tanneries were the only occupants. The practice of discharging wastewater containing highly toxic chemicals along with associated odors and solid waste without any effective control has brought strong protests and objections from nearby residents and downstream water users.
Alum plant at Ranala:	The facility produces sulfuric acid and alum. The 'acid factory' as it is known locally has brought strong local objection due to the creation of acidified well water, noxious gases, etc. The alum crushing process also contributes noise to the community.
Textile factories at Ratmalana:	Un-managed industrial development in this area has resulted in multicolored wastewater in municipal storm drains, frequently containing strong acids and other toxic chemicals and emitting noxious odors. Protests in the town are very strong and numerous.

Even industries that are often considered to be "low polluting" have often caused severe environmental problems. Examples include:

- **Sand Mining:** This activity has led to significant coastal erosion (southern coastal belt) and salinity intrusion (Maha Oya) affecting drinking water supplies.

- **Brick and Tile industry:** Raw material extraction has caused numerous environmental problems. Large-scale clay mining has dotted certain villages with abandoned clay pits clogged with water weeds and providing ideal breeding grounds for mosquitoes. The deep and gaping abandoned clay pits by the

riverside during flood season are becoming part of the river, resulting in riverbank erosion. This is a problem in the Maha Oya valley embracing Wennappuwa, Katana, Katugampola and Divulapitiya electorates where more than 900 tile factories operate.

- **Agricultural Processing:** Piles of sawdust (Moratuwa) paddy husk (Anuradhapura, Polonnaruwa districts) and coir dust (Chilaw, Kurunegala, Colombo - Coconut Triangle) are causing sedimentation and water pollution.

These and other environmental problems illustrate the need for changes in attitudes and policies for operating and monitoring industries. Cumulative impacts of small and medium scale industrialization are major contributing factors to solid waste and drinking water problems in the Colombo District. About 80% of all small and medium scale industries are located in the Colombo and Gampaha Districts. Because these industries were established long before the enactment of environmental laws, water discharges are often made to surrounding streams, drains, or land without any treatment. Some industries generate hazardous solid wastes that are mixed with normal household waste, creating major health risks.

The Kelani River is the main source of drinking water for the Colombo region and also serves as a sink for a substantial portion of Colombo's sewage and drainage. Numerous industries along the Kelani River and its tributaries discharge directly into it, including small, medium, and high polluting industries. At present most of these industries are downstream of the Ambatale water intake (14 km from the river mouth). However, there is a possibility that during the drought season when the water level in the river is low, thus allowing increased tidal mixing with downstream water, contaminants could find their way to the water intake. This realization has prompted the government to declare the area as an 'environmentally sensitive zone' to prevent additional industries from relying on the lower Kelani River for their discharges.

3.2 TYPES OF ENVIRONMENTAL CONCERNS ASSOCIATED WITH INDUSTRIAL DEVELOPMENT

Effective industrial siting and management policies must be designed to minimize environmental problems at the local and regional levels. In addition, it is important to recognize that the cumulative impacts of industrialization can have major implications for the country as a whole and must also be considered in national policy formulation. In this section, site-specific as well as industry sector-wide concerns are described.

3.2.1 Site-Specific Concerns

Siting of an industrial estate can result in significant on- and off-site impacts during both the construction and operational phases. Site-specific concerns can be broadly categorized as follows: (a) environmental impacts; (b) socio-economic impacts; (c) infrastructure demands and impacts and (d) land use changes. Evaluation of each of these four categories of potential impact, as further described below, should be performed early in the siting process.

a. Environmental Impacts:

These types of impacts can be broadly classified as follows:

- AIR QUALITY

  (i) Air emissions from stationary combustion sources
  (ii) Air emissions from mobile sources
  (iii) Air emissions from industrial processes
  (iv) Air emissions from solid waste disposal sources

  Air emissions have to be tackled at their sources with proper emission control technology and operating efficiency. During the initial siting when comparing the compatibility of several potential sites to handle air emissions the following points need to be considered:

  * the circulation and air exchange characteristics of the area (e.g. in a valley or in an area with historically low wind dispersion);
  * whether this site is near sensitive receptors, such as hospitals, schools, and/or homes for the elderly, handicapped, etc.;
  * the possibility and the frequency of inversions.

- SURFACE WATER QUALITY AND AVAILABILITY

  (i) Effluents from industrial processes
  (ii) Effluents from domestic sources
  (iii) Storm water discharges
  (iv) Water consumption

  If a discharge is necessary, it should be treated to the standards laid down by the relevant laws and regulations. In determining treatment criteria the assimilative capacity of the intended receiving waters should be duly considered. Some considerations are :

  * Receiving water bodies, particularly those with large seasonal flow variations, may not be able to assimilate industrial discharges without exceeding CEA standards, taking into account the dilution factor provided in the standards. (Generally, water bodies with high flow and high ambient water quality would be ranked higher than streams with low flow and/or poor water quality.)

  * Receiving water bodies may have aquatic species (e.g. prawn, fish, etc.) that are especially sensitive to industrial pollutants, and thus require additional protective measures.

- GROUND WATER QUALITY AND AVAILABILITY

  (i) Aquifer draw-down from supply wells
  (ii) Aquifer contamination from disposal of solid and liquid wastes
  (iii) Aquifer contamination from accidental spills

Although ground water is frequently the primary source for local drinking and household water, when industrial facilities are being sited scant attention is usually paid to the potential long-term effects on local ground water quality or availability from proposed withdrawals and discharges. These potential effects cannot be determined from casual observations; rather, site-specific quantitative hydrological testing is mandatory if such effects are to be properly assessed.

- SOLID AND HAZARDOUS WASTES

  (i) Solid and hazardous wastes from industrial sources
  (ii) Solid and hazardous wastes from domestic sources

The following examples illustrate some of the hazards associated with industrial wastes:

* Food processing produces wastes that frequently contain disease bacteria. These wastes can lead to epidemics if they are not properly disposed of. The same dangers are connected with pathogenic/infectious hospital wastes.

* Some materials used in factories, such as acids and mercury, can lead to acute injury and illness if people come into direct contact with them.

* Detergents and cleaning materials can aggravate allergies.

* Wastes can have airborne contaminants that may be toxic (e.g., asbestos, lead, corrosive vapors or combustion by-products).

* Even if human beings are able to avoid direct contact with hazardous materials, livestock or fish may come into contact with them and die, or pass these substances on to people who consume the meat (e.g. Itai-Itai and Minamata disease).

* Hazardous wastes, if improperly disposed of, can contaminate agricultural land and pollute both surface and ground water resources over wide areas and for a very long time; some contamination is essentially permanent.

Solid and hazardous waste management has now become a critical issue worldwide. In Sri Lanka the CEA has defined hazardous wastes, and all waste categories coming under that definition are listed by CEA as requiring appropriate treatment and disposal. The definition was made to comply with the international Basel Agreement. The applicability of the definition to control and monitor locally-generated pollution needs further consideration; it is important to provide

properly designed and managed hazardous waste disposal facilities if industrial growth in Sri Lanka is to be achieved without further environmental degradation.

Solid and hazardous waste can be managed in a number of safe ways. The following examples illustrate some approaches that should be considered in locating and designing industrial estates:

* Careful process design can help to separate hazardous wastes from other wastes, and to reduce the volume of hazardous wastes to a minimum. Hazardous waste should be stored, handled, and treated separately from other waste before being disposed of. Any land filling or incineration should be performed in a facility specifically designed for such wastes.

* The biodegradable fraction of solid non-hazardous wastes can frequently be separated from the non-biodegradable fraction; once separated, there may be markets for both components. For example, biodegradable non-hazardous wastes might be used in anaerobic digestion producing fuel gas and digested sludge as a soil conditioner. If these wastes are organic by-products from food processing, they may have value as food for animals.

* Non-biodegradable solid wastes often contain recyclable metals, plastics, and glass, which can be re-used on the site or sold to other facilities to substitute for new (and often more costly) raw materials. Appropriate policies to encourage such recycling and reuse are needed.

- ECOLOGICAL RESOURCES

Industrial facilities may cause directly observable impacts on local flora and fauna; they may also have cumulative off-site effects that degrade or threaten the existence of a sensitive area such as a wetland, park, or habitat for endangered or endemic species.

In industrial siting this concern has now come to the forefront as a result of the growing awareness of man's past disastrous management of our ecological inheritance. The biologist and author E.O. Wilson has said that "extinction is forever". Sri Lanka is fortunate to be a country rich in biodiversity; the nation's industrialization policy should not endanger this irreplaceable natural resource. Hence any siting decision should incorporate protection for:

* Native flora and fauna on-site and/or off-site that could be adversely affected by industrial development on the site;

* Important areas of natural habitat on-site and/or off-site such as wetlands, forests, streams, and lakes that could be adversely affected by industrial development on the site and by off-site impacts from water withdrawals and discharges, air pollutants, or disposal of solid wastes;

* Designated environmentally sensitive areas (national sanctuaries, wildlife parks and reserves, wilderness areas, etc.) that are located near the site or which could otherwise be degraded by site development and operations.

- NOISE:

  (i) Noise from process units/residential quarters (stationary sources)
  (ii) Noise from moving vehicles/loading and unloading (mobile sources)

Some industries are more prone to be noisy than others (rock crushing, metal fabricating, etc.). When looking at siting a number of industries in one area, the cumulative load should be estimated. In such instances the site should be evaluated to determine:

* If the site is in an area where on-site noise could be amplified and thus carry over long distances, such as in a valley are on a wide water body;

* If the site adjoins residences, schools, or other occupied buildings that are near enough to be adversely affected by noise generated on-site;

* If the site adjoins areas that have high aesthetic, cultural and/or religious values that could be adversely affected by noise generated on-site;

* If the site adjoins habitat of species that are particularly sensitive to noise.

Again, site layout, facility construction, and industrial processes can be designed to minimize both the generation of noise and its adverse effects if potential noise emissions are given appropriate consideration when these design steps are underway. As is true for most other environmental impacts, dealing with noise as an afterthought to industrial facility development is usually less effective and more costly.

- AESTHETIC VALUES

When aesthetic values are not considered, industrial buildings and utilities may have unappealing appearances and/or may obstruct scenic sites, generate annoying sounds and smells, etc. Once again, these values can best be protected if they are considered and addressed during the site and facility design stages.

b. Socio-economic Impacts:

Local labour availability, the capacity of local communities to support industrial development, and potential impacts on the area's cultural and religious resources are three important socio-economic factors to consider in industrial siting decisions. These factors can best be identified and addressed through advance consultation with local government officials and community leaders.

c. Infrastructure Demands and Impacts:

Industries require physical infrastructure such as public utilities and transportation facilities. The existence of a well-developed infrastructure makes it much easier to recruit industrial developers to the site and means fewer environmental impacts due to construction and upgrading of infrastructure. The costs of providing necessary infrastructure needs to be more fully considered in the siting process.

d. Effects on Adjacent Land Use:

When new industrial estates are established, particularly in relatively rural areas, major changes to existing and planned uses of adjoining lands inevitably result, too often with little or no organization, management, or even prior consideration. Such induced effects can and have caused a whole series of unanticipated adverse environmental and socio-economic impacts, some of which can interfere directly with the continued operation of the industrial estate itself. These types of impacts include conversion of land from agricultural or environmental purposes to sprawling residential and commercial uses, conflicting demands on local transportation, power, and water resources, traffic congestion, air and water pollution, and cultural and religious conflicts.

To anticipate and minimize these induced effects, local zoning requirements and regional land-use master plans can be useful tools in assuring that industrial development plans are carried out in accordance with the overall economic and social objectives of the local community and region. Such planning must, of course, be done **prior to development of the industrial estate** or it will be of little value in averting or minimizing these types of impacts. It must be done with the full cooperation and participation of local government officials and community leaders, because such plans will require local acceptance and enforcement to be effective.

3.2.2 Sectoral Concerns:

The expansion of industrial capacity in Sri Lanka raises a number of issues which go well beyond the site-specific impacts of establishing an industrial estate. These issues include concerns common to all industrial estates as well as those derived from links between the industrial and other sectors. With industrial growth will come a need to better address the following concerns: risks associated with industrial accidents or other emergencies; much larger volume of hazardous wastes to be transported, stored or otherwise disposed of; and the need for systematic attention to pollution prevention and waste minimization as part of the national environmental protection strategy. Key links between industrial development and other sectors include: the need for adequate infrastructure -- especially energy -- to support industrial growth; the balancing of industrial with other land uses in the context of regional development; and job creation.

a. Need for Emergency Management Planning

With the national expansion of industrial capacity -- and the concentration of industries in estates -- comes an inherent increased risk of industrial accidents or other emergencies. Depending on the type of industries which are developed in the country, the number of

people (both workers and the general public) whose health and safety are at risk may increase substantially over the current situation. The tragedy at Bhopal has demonstrated the potentially catastrophic consequences of inattention to this issue while also illustrating vividly the need for shared private and public sector responsibilities in addressing such concerns.

At present, Sri Lanka has no emergency management plan or institutional apparatus in place -- apart from some limited capability within the military -- to address and deal with such contingencies, and related guidelines for industrial facilities construction and operation (and their enforcement) remain weak. Proper emergency planning should include at least the following:

(i) Training fire-fighting and police personnel (the situation may be an explosion, fire, release of toxic substances).

(ii) Alarm system with direct lines to fire brigade or to emergency systems.

(iii) Proper site-specific emergency response plans that include:
- the organization scheme used to fight the emergency;
- the communication and evacuation routes;
- guidelines for fighting the emergency;
- information about hazardous substances;
- examples of possible accident sequences.

(iv) Agreement with local government authorities regarding co-ordination with industry contingency plans.

(v) Medical systems nearby that are capable of handling industrial emergencies.

b. Hazardous Waste Management

Expansion of industrial activity will likely result in the generation of a much larger volume of hazardous wastes than at present. These wastes -- which can include toxic chemical byproducts and low-level nuclear materials -- must be properly transported, stored and disposed of where safe and feasible. While individual industrial estates can address such issues, generally hazardous materials much be carefully regulated and dealt with as part of a national strategy.

In published reports one frequently sees the statement, *"All solid wastes generated shall be collected to a central place and disposed of periodically in an environmentally safe and nuisance-free manner in consultation with relevant local authorities."* However, this kind of statement is vague and at present local authorities do not possess sufficient knowledge or awareness to enforce this statement, to say nothing of dealing with hazardous waste handling, storage, and treatment. Training and local institution-building is increasingly needed as the potential for mishandling of hazardous waste increases.

Furthermore, at present there are no approved hazardous waste disposal sites in the country. The identification and development of a properly engineered hazardous waste disposal site is a matter of high priority. Availability of such a facility would enable off-site disposal for factories and help to ensure safe management of hazardous wastes.

The following components are necessary to support off-site disposal of hazardous wastes:

- Special transport systems to cater to handling hazardous waste;
- Solvent recovery facilities;
- Oil recovery facilities;
- Waste exchange facilities;
- Special hazardous industrial waste landfill site (with controlled access at all times);
- Incineration with gas cleaning systems.

These facilities could be made self-sustaining by levying of fees for waste disposal. The facilities also can have secondary product lines, i.e., solvent recovery lines and oil recovery lines. These changes could help both to enhance the national economy and to protect the environment.

A waste exchange facility primarily deals with others' waste from multiple facilities; on the basic premise that "One industry's waste is another industry's resource." This system requires a centrally-managed register of both the wastes that are being generated and the raw or process materials that are being sought, with continuous updating of that information. This system is then used to match waste producers with potential users so that waste treatment and disposal costs may be reduced.

c. Pollution Prevention and Waste Minimization

The concentration of industries within estates presents an important opportunity for environmental authorities to work with estate managers and investors to promote the use of pollution prevention measures in the design and operation of industrial facilities. A national waste minimization program has yet to take off, but technical assistance associated with the new Pollution Control and Abatement Fund (managed by the National Development Bank) is already placing process efficiency and energy conservation efforts within their environmental context.

The conventional approach to pollution control has been to use so-called "end-of-the pipe" treatment systems. This approach does not find much favor among industrialists because the methods involve incurring costs to meet legal requirements that do not yield monetary returns.

In "end-of-the pipe" treatment methodologies cross-medium environmental concerns also arise. During wastewater treatment, most pollutants are transferred to the sludge that is formed. This process thus adds to solid waste, although the liquid effluent problem is reduced. Incineration -- as a means of solid waste disposal -- transfers the pollution load to air. Improperly handled incineration can even aggravate the pollution potential beyond the level that was originally present (i.e. by incomplete burning of plastics, generation of

heavy metal vapors etc.) Thus the attractiveness of these traditional methods for pollution control has limited appeal even from an environmental protection perspective.

The pollution-prevention approach tackles the waste minimization problem at its source. Instead of treating waste after it is generated, the prevention of waste **before** it is generated is the objective. In an industrial process, less waste from raw materials means more products, resulting in higher conversion and efficiency rates. More products means higher financial rewards, which should certainly be attractive to industrialists.

An additional benefit of this approach from an environmental perspective is that not only can it tackle first-generation pollution problems (those created in the manufacturing process) but it can also tackle second generation pollution problems (those related to product use, such as packaging). The conventional approach is ineffective in tackling the latter class of problems.

Implementation of a pollution-prevention strategy requires in-depth knowledge related to process chemistry, chemical and process engineering design, and operation and maintenance practices. Initial capital outlay involving process and equipment modifications (rather than pollution treatment systems) may also be necessary. However, the easiest measures to implement under this strategy are good housekeeping practices.

As mentioned, preliminary efforts are underway to promote pollution prevention in Sri Lanka. There is an ongoing environmental program based on waste minimization supported by UNIDO; its first demonstration project is the distillery sector. Phase one of the project, involving the Distilleries Corporation of Sri Lanka Ltd. (DCSL) at Seeduwa, has been completed and has shown significant fuel savings, product quality improvement, and reduction of organic load in the spent wash effluent. This program demonstrates the potential for improving an already existing industry unit.

When siting a new industry, the type of process technology being proposed should be evaluated critically at the outset, to identify and encourage pollution prevention options. This approach can both improve the performance capacity and reduce the need for mitigation requirements. At this stage such planning and design can be done at the least cost, avoiding expensive retro-fitting and redesign efforts later on.

At present, the industrial technologies being used in Sri Lanka are frequently less efficient and much more highly polluting than those employed in other more industrial countries. Some examples where improved technologies could provide benefits are continuous drying in par-boiling of rice, use of centrifugal operation systems in cinnamon oil extraction, and removal of sulphur from fuels during the petroleum refining process.

d. Energy and Industrial Growth

If infrastructure bottlenecks are to be avoided in the expansion of industrial capacity and jobs, there must be close coordination among the energy, transport, and communication sectors. Because energy production and use have strong environmental implications, this coordination should be a particularly important component of the national program to develop industrial estates. The availability of adequate energy supplies at reasonable cost

is a key assumption in the country's industrialization strategy, and the demands of industrial estates -- together with opportunities to employ energy conservation measures within them -- must be carefully considered.

There is already a perception that national energy supplies are beginning to lag behind demand. This is partly due to a heavy dependence upon supply-side policy in the energy sector, which has given only limited attention to managing the demand of consumers through appropriate pricing schemes and promotion of energy efficiency. Just as in the case of pollution prevention, industrial estates offer an ideal setting for the promotion of energy conservation and waste minimization measures. In some cases (for larger or energy-intensive estates) there may also be the option of developing private power supplies -- both through the use of fossil fuels and renewable energy sources -- that may be established with the expectation that any unused capacity will be sold to the national grid. Attention to such issues will obviously require close coordination and cooperation between industrial development authorities and those in the energy sector.

3.3 THE ROLE OF ENVIRONMENTAL IMPACT ASSESSMENT IN INDUSTRIAL SITING AND MANAGEMENT

An EIA may be required as part of the siting process for a specific industry, a large industrial zone, or an industrial estate. In the latter two cases, EIAs must assess the cumulative environmental impacts of the mix of industry types and sizes planned for the area. If properly done, such EIAs remove the requirement for individual industry proponents to undertake full separate EIAs. The idea is to encourage industrialists to locate in pre-studied and approved areas rather than to look for separate, independent locations that would involve the separate preparation of full EIAs to assess the potential environmental impacts at each of those separate locations.

Large-scale industries are usually directed to specified industrial zones, where they would in turn have their own effluent treatment systems. Medium-scale industries, including those with high and medium pollution potential, are in future to be restricted to designated industrial estates. There they would usually have access to common liquid and solid waste management systems and would only require their own gaseous emissions control systems when appropriate.

An EIA for such an estate should analyse the water availability (both surface and ground water resource) and the assimilative capacity for waste water. It should also estimate the aggregate maximum possible water use and indicate the required volume and type of wastewater treatment based on maximum total flow. Once the industry mix is known, the availability could be matched with the demand and the necessity for pre-treatment by individual factories could be determined. The site evaluation, along with the knowledge of the mix, should indicate the maximum quantities and the quality of air and solid stream wastes. Waste minimization procedures should be recommended in the impact mitigation plan. In addition, a site-level EIA should point out any weaknesses in proposed processing techniques, energy use, and waste discharges, and then analyse process alternatives to modernize the process path that would give more products per unit time with less waste.

CHAPTER 4

METHODOLOGY USED IN THIS STUDY

Industrial siting, especially the siting of industrial estates, is an extremely complex process requiring consideration of multiple interacting environmental, social, political, and economic factors. This process requires the early involvement of government decision makers, industrialists, NGOs, and the public in the site selection and development phases, working within a common framework to identify and mitigate concerns well in advance of final siting decisions.

One of the first steps in conducting an effective siting process is to undertake a preliminary study that makes possible direct comparisons of a group of potential sites against a set of consistently applied environmental and social parameters. NAREPP has assisted the Ministry of Industrial Development (M/ID) in conducting this initial study, employing the methodology described in this chapter, of eleven candidate sites that were selected by the Ministry..

4.1 TECHNICAL DESIGN

The technical design of this study was based on the results of initial site surveys conducted in October and November 1994 by a joint NAREPP/GOSL/World Bank study design team, including staff representatives of the Central Environmental Authority, Board of Investment, Secretariat of Infrastructure Development and Investment, and Metropolitan Environmental Improvement Project. That team visited nine sites located in five provinces across Sri Lanka. That survey's major objectives were to determine the types and quality of data that were available for those sites and to identify the most critical factors that must be considered in evaluating the suitability of such sites for development as industrial estates.

The nine sites visited by the survey team were selected to provide a wide cross-section of environmental and socioeconomic conditions. For example, one of the selection factors employed by the survey team was to include sites in the wet, dry, and intermediate zones. Some of these sites were subsequently included in the list of eleven sites selected by M/ID for this study.

The 1994 survey identified a number of concerns common to most or all of these initial sites, including the following:

- Water availability for industrial use was a major question at all sites. Surface water data (both quantitative and qualitative) were extremely limited; local ground water data did not exist for most sites.

- Potential off-site impacts were just as important, or in many cases even more important, than on-site impacts.
- Most sites had very limited room for future expansion.
- Most sites lacked adequate locations for discharge of liquid wastes.
- Waste management facilities were lacking at all sites.
- The ability of local community infrastructure to absorb substantial industrial development was a major concern.

Based on the survey team's findings, NAREPP prepared a detailed Terms of Reference for this second study. In response to the survey team's findings that most of the sites did not have well-defined industrial proposals, the analytical approach provided in the TOR is directed primarily at assessing the "environmental and socioeconomic sensitivity" of the sites, i.e., the capacity of the local environment and the communities in the vicinity of each site to absorb industrial development. To assess the sites' sensitivity to or compatibility with industrial development, thirteen environmental parameters were evaluated in this study:

- Surface drainage and soil stability
- Surface water availability
- Wastewater assimilative capacity
- Air quality
- Noise
- Solid waste disposal capacity
- Cultural/religious resources
- Ecological resources
- Transportation availability
- Public utility availability
- Local labor availability (skilled/unskilled)
- Community infrastructure
- Site expandability

These thirteen parameters were employed to compare similar types of information from each of the sites, **not** to make absolute or final judgements about the suitability of individual sites for industrial development. A more specific environmental impact assessment (EIA) will be needed of any site being seriously considered for location of industries with medium and high-polluting potential before a final suitability determination can be made. Such site-specific detailed assessments should also evaluate alternative facility designs and process elements that could avoid or mitigate specific environmental impacts. Nevertheless, the site evaluation system employed in this study should be very useful for screening any number of proposed sites, i.e., to systematically compare proposed sites in order to determine which ones appear most suitable for various types and levels of industrial development. The consideration of site alternatives by this process should reduce the need to include detailed evaluations of alternative sites in subsequent EIAs for individual industrial estates.

4.2 IMPLEMENTATION OF THE STUDY

The study was conducted by a multidisciplinary team of Sri Lankan and U.S.-based consultants. Their expertise includes hydrology and water resources, water quality and environmental engineering, biology, ecology, industrial environmental management, chemical and process engineering, socioeconomics, environmental and economic policy, and environmental impact assessment. A list of the study team members and their areas of expertise is included as **Annex 1** to this report.

The TOR for this study was initially developed under the assumption that the Government of Sri Lanka would seek sites specifically for industrial estates to accommodate medium and high polluting industries. However, concurrent with NAREPP's initiation of study design, the Ministry of Industrial Development (M/ID) launched a program to encourage private-sector development of industrial estates that was more generally focused on a wide range of industries, not just on those falling within the categories of medium and high-polluting industries. Thus, the opportunity presented itself to further develop and apply the methodology to assist M/ID in determining which of its candidate sites might be suitable for "light" as well as "heavy" industry. M/ID requested that NAREPP review eleven candidate sites for this purpose. These sites are listed in **Annex 2** of this report.

The team initiated the study by contacting agencies and institutions in Sri Lanka to identify relevant environmental information that had already been collected and technical studies that had already been conducted on or near each site. On July 14, 1995, the NAREPP team assisted M/ID in conducting an open meeting at the Ministry to inform Sri Lanka government agencies, private institutions, and the general public of the study and to encourage their input and involvement.

The team received many valuable comments at the meeting. For example, several individuals suggested that "site expandability," which was not mentioned in the TOR, be included as an indicator of site suitability. As a result, this parameter was added to the list of those used in the study methodology.

The NAREPP review team conducted the site visits in July and August 1995. During each visit, the team made detailed visual observations of the site and surrounding areas and conducted interviews with the M/ID regional directors, local community leaders, and residents. In addition, the team's hydrologist and water quality expert collected water and soil samples and took flow measurements of water bodies on or near the site. The team compiled their observations and findings on the site review checklist that was provided in the TOR. The checklist, which is attached to this report as **Annex 3**, is an adaptation of the standard environmental checklist developed by the CEA for use in conducting Initial Environmental Evaluations (IEEs).

Upon completion of all eleven site visits, the NAREPP team assembled to evaluate the data for each site and collectively to derive conclusions regarding the environmental and socioeconomic suitability of these eleven proposed sites for establishment of industrial estates. In addition to evaluating each site individually, the team developed a comparative rating of the sites in accordance with the parameters given in the TOR. The site scoring matrix and details of the criteria governing the application of these parameters to the

industrial estate sites are provided in **Annex 4.** The criteria are primarily qualitative (although ratings of surface water availability and wastewater assimilative capacity were supported by quantitative sampling and analysis conducted at each site). The team's detailed environmental evaluations of each of the eleven sites are contained in **Volume II** of this study, in a series of Summary Environmental Reports, one per site. The team's comparative rating charts, as well as general findings and recommendations for improving Sri Lanka's industrial siting process, are provided in Chapter 5 of this volume.

4.3 DEVELOPMENT OF COMPARATIVE AGGREGATE RATING SYSTEM

Assessing and comparing the environmental suitability of a number of different sites as potential industrial estates requires the use of a systematic methodology for independently rating two principal components: A) **the relative compatibility of potential sites for industrial uses**, and B) **the relative environmental impacts of various types of industries.** This approach is needed to provide decision-makers in government and industry with a systematic and efficient way to correlate various proposals from different industries with the most appropriate potential sites. Industrial siting decisions made in the past without the benefit of such a methodology have, as noted earlier in this report, led to significant environmental, social, and economic problems.

To evaluate and inter-relate both components -- the potential sites and the types of industries that they might accomodate -- a properly designed methodology should employ a set of environmental parameters to score both sites and industries in relation to one or more general indicators (or in graphic terms, along separate but related general axes). The 13 environmental parameters used by the team lend themselves readily to this function, as explained further below.[1]

For classifying potential **sites**, the team determined that two key rating indicators should be used: 1) <u>pollution assimilative capacity</u> and 2) <u>local resource availability</u>. There is no hard reason for using only two indicators. Indeed, the number of indicators could be expanded to more completely reflect site-specific characteristics. But there is a tradeoff in terms of adding greater complexity to the evaluation methodology. Focusing the classification on two indicators allows analysis of sites in a two-dimensional matrix, which is relatively simple to visualize and to represent graphically. Furthermore, the two indicators that were selected provide a reasonable way of aggregating the important characteristics at the sites in terms of their capability to accomodate industrial activity.

Industrial activities interact with the environment in two principal ways: pollution generation and resource consumption. Thus for classifying **industries**, the two aggregate indicators selected by the team were: 1) <u>pollution potential</u> and 2) <u>resource consumption</u>. These two industry indicators, and the set of environmental parameters used to rate them, are to a great extent the inverse of the indicators and parameters used for rating the sites.

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[1] The 13 environmental parameters became 14 when the team decided that the labour parameter should be separated into two -- skilled labour and unskilled labour -- because the distinction is of considerable importance in the siting of industrial facilities.

4.3.1. Classification of Industrial Estates

During the field visits the team evaluated each site on the basis of the 13 parameters. The sites were rated for each parameter at one of three levels: High, Medium or Low. Table The rating given is the estimated compatibility of the site for each parameter with regard to compatibility with typical industrial activities. For example, surface water availability at Senapura is rated as low, indicating that the limited availability of surface water at or reasonably near the site makes it relatively incompatible with many proposed industrial activities. This rating system is, of course, more qualitative than quantitative; however, team members made a considerable effort to be objective, and to use collectively their best professional judgement; all ratings were assigned following considerable deliberation and were based on group consensus. .

The 13 parameters were sorted into two groups based on the criterion (i.e., for sites, pollution assimilative capacity or resource availability) that each most closely represents. The classification of each parameter is shown below in Table 4.3.1.

Table 4.3.1: Parameters and Corresponding Indicators

Parameter	*Corresponding indicator*
Drainage/Soil Stability	Pollution assimilative capacity
Surface water availability	Resource consumption
Wastewater assimilative capacity	Pollution assimilative capacity
Air quality	Pollution assimilative capacity
Noise	Pollution assimilative capacity
Solid waste disposal capacity	Pollution assimilative capacity
Cultural/religious resources	Pollution assimilative capacity/Resource consumption
Ecological resources	Pollution assimilative capacity/Resource consumption
Transportation availability	Resource consumption
Public utility availability	Resource consumption
Local labor availability	Resource consumption
Community development capacity	Resource consumption
Site expandability	Resource consumption

Seven of the environmental parameters were used to rate assimilative capacity, and 8 parameters were used to rate the second general criterion, resource availability. As indicated in the second column, two parameters (cultural/religious resources and ecological resources) can be applied to both indicators and were therefore included in the estimation process for both.

Once all the parameters for a site were rated, an aggregate ranking for each indicators was determined. Because in most cases only general assumptions can be made about the types of industries seeking to locate at a given site, each parameter was given equal weight in the estimation of an aggregate score or classification of each site. The two-part aggregate rating is determined for each site by adding up and comparing the number of H, M or L rankings for separately for each of the two indicators. A simple averaging method was used, whereby any single score of 'H' was matched up against any single 'L', thereby resulting in 2 ratings of 'M'. This exercise produces a composite or aggregate rating for each proposed industrial estate studied with regard to the two overall indicators. Thus an overall rating of 'M/ML' would mean that a site was rated medium overall for Pollution Assimilative Capacity, and medium-to-low overall for local resource availability. This was in fact the aggregate site rating computed for Senapura; the scores and aggregate ratings for each of the sites is given in Chapter 5.

4.3.2 Classification of Industry Types

For the purposes of this study it was only possible to classify potential industry impacts on the environment on the basis of broad industry types. The list of potential industry types that may conceivably locate in an industrial estate is lengthy; it is not possible to develop precise ratings or indicators for any of them without specific facility design, capacity, and process information that is beyond the scope of this study and which in any case is not available for any of the proposed industrial estates. Nevertheless, the study team did develop general ratings for several of these broad industry types; using the approach developed here the remaining industry types can be similarly rated by following the methodology explained here. It must be noted that a major assumption in developing this system of classification is that industries were evaluated on an "as typically practiced" (ATP) basis with regard to their resource demands and their pollution generating potential. Thus, because industries in Sri Lanka have not typically yet adopted significant pollution control or waste minimization measures, the ratings are based on the typical industrial impacts in the absence of such measures.

The methodology for classifying industries is very similar to that of ranking industrial estates, save for a few variations. In a sense the indicators used to classify industries are the inverse of those used in ranking industrial estates. The 'pollution assimilative capacity' indicator is replaced with 'pollution potential'; the 'resource availability' indicator is replaced with 'resource consumption'.

The basic field parameters are once more separated into two groups as they correspond to either of the criteria. The division of parameters between the two indicators is shown along with the parameter ratings and aggregate indicator scores for ten typical types of industrial facilities. The list of parameters used to assess industry types is slightly different from those used earlier to rate industrial estates, in that the pollution potential

criterion is rated on two additional parameters: visual or aesthetic, and thermal. The drainage, cultural and religious resources, and ecological resources parameters are not used in rating the pollution potential of industry types primarily because these parameters are heavily site-specific, whereas the industry ratings are derived independent of any specific location in order that they may then be associated with any of the site ratings. In this way a government official or an industrial developer can look for the best site-specific matches with a selected industrial type. For the same reason the cultural and religious resources parameter is excluded when computing the resource consumption indicator score.

Similar to the process adopted in rating specific industrial estates, a H, M, L rating is assigned to each of the parameters under the two aggregate indicators. Based on these, an aggregate rating is determined for each industry type in both criteria. It is then possible to plot the different types of industries in a pollution/resource matrix developed previously for each of the sites. The result is a pollution/resource matrix which displays both the aggregate rating for a specific site together with the aggregate rating for various industries that can be accommodated at the site, as is shown in **Table 4.3.2** below.

Table 4.3.2 Combined Site and Industry Pollution/Resource Matrix

	Low	Medium	High
High			
Medium			
Low			

CHAPTER 5

SECTORAL ANALYSIS AND EVALUATION OF INDUSTRIAL ESTATE SITING POLICIES

Chapter 5 summarizes the NAREPP Study Team's findings regarding each of the eleven sites, which were evaluated using a common set of key environmental and social parameters. This chapter provides a synthesis of the individual site findings in order to identify general concerns and lessons that can be more generally applied to the ongoing process of siting industrial estates in Sri Lanka. These findings, we believe, provide the basis for an improved industrial siting process, which is recommended below.

Perhaps the most significant general finding of this study is that there is not yet a rational, systematic process of screening and selecting sites in Sri Lanka for industrial development. As is depicted in **Figure 5-1**, industrial estate site selection at present appears to be solely supply-driven, i.e., tracts of land are selected without any consistent rationale, evaluated individually, and then offered to industrialists for whatever type of facility they are willing to develop. At some point an IEE or EIA may be undertaken, sometimes rather late in the process, to determine the environmental, social, and (to some extent) economic suitability of a single site. Consequently, substantial time and resources can be devoted to investigating sites that may have poor prospects for development because they have severe resource constraints, or present major environmental problems, or are otherwise unattractive to potential investors. When this happens, the search for alternative sites has to begin all over again, with additional costs in time and money.

A more rational strategy would be to implement an orderly siting process that begins with identifying an inventory of possible sites, based on both site characteristics and other considerations of industrial needs and constraints. Through a systematic screening process sites could be selected from this inventory based on a variety of factors, including industry resource needs, local community acceptance of certain types of development, and consistency of the proposed development with regional land use and infrastructure. Using such an inventory, it is possible to conduct and environmental assessment that allows for a comparison of alternative sites, thus favoring selection of one or more sites that are the most environmentally and economically suitable. The framework for such a strategy is suggested in **Figure 5-2.**

This chapter provides the initial groundwork for implementing such a strategy. The chapter is organized as follows:

- Section 5.1 summarizes and synthesizes the team's findings concerning the eleven sites evaluated in this study, and identifies recurring environmental and social issues that should be evaluated carefully in future siting studies.

SUGGESTED APPROACH TO IMPROVE AND STREAMLINE INDUSTRIAL ESTATE SITING

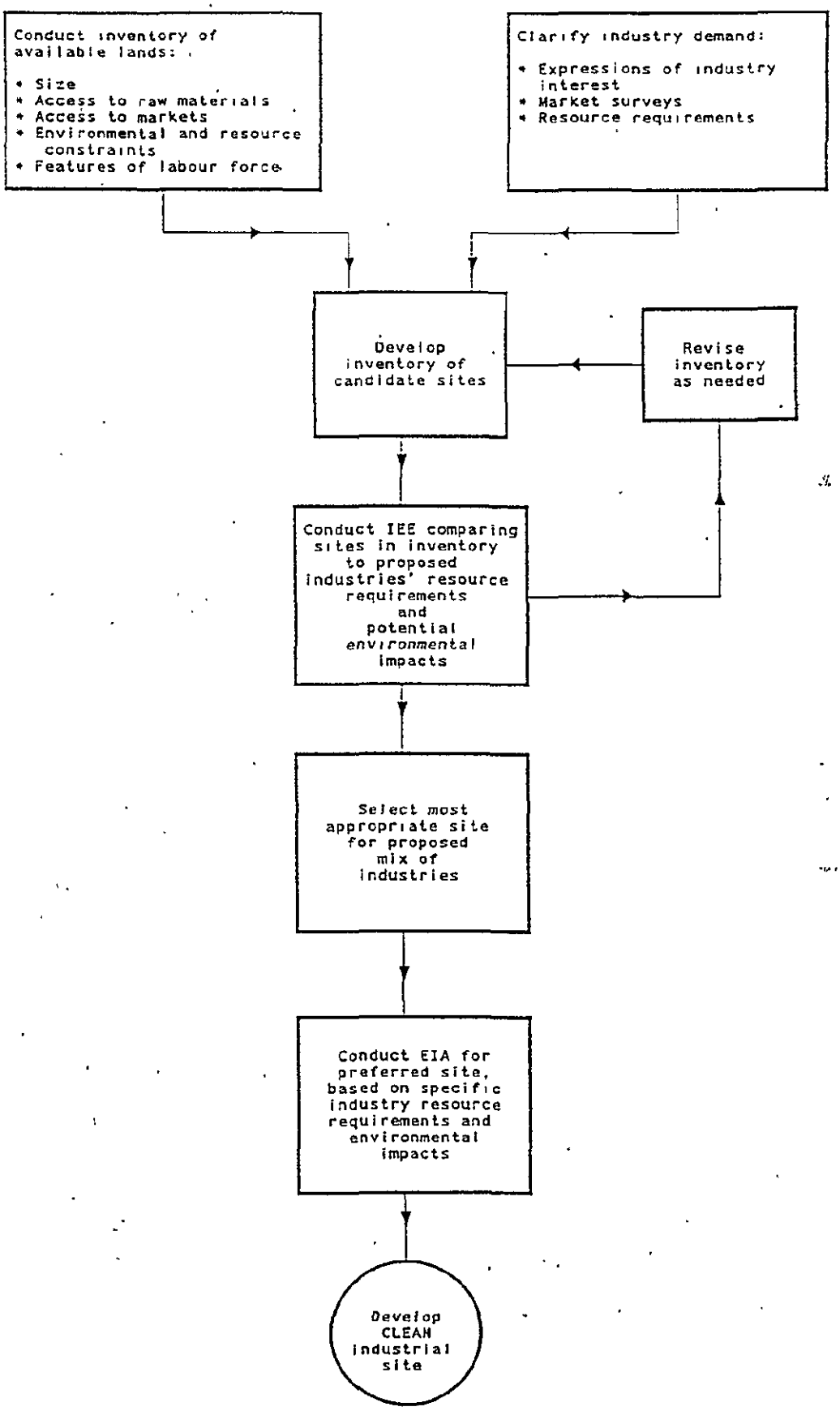


FIGURE 5 - 2

SUMMARY OF CURRENT PROCESS FOR SITING INDUSTRIAL ESTATES

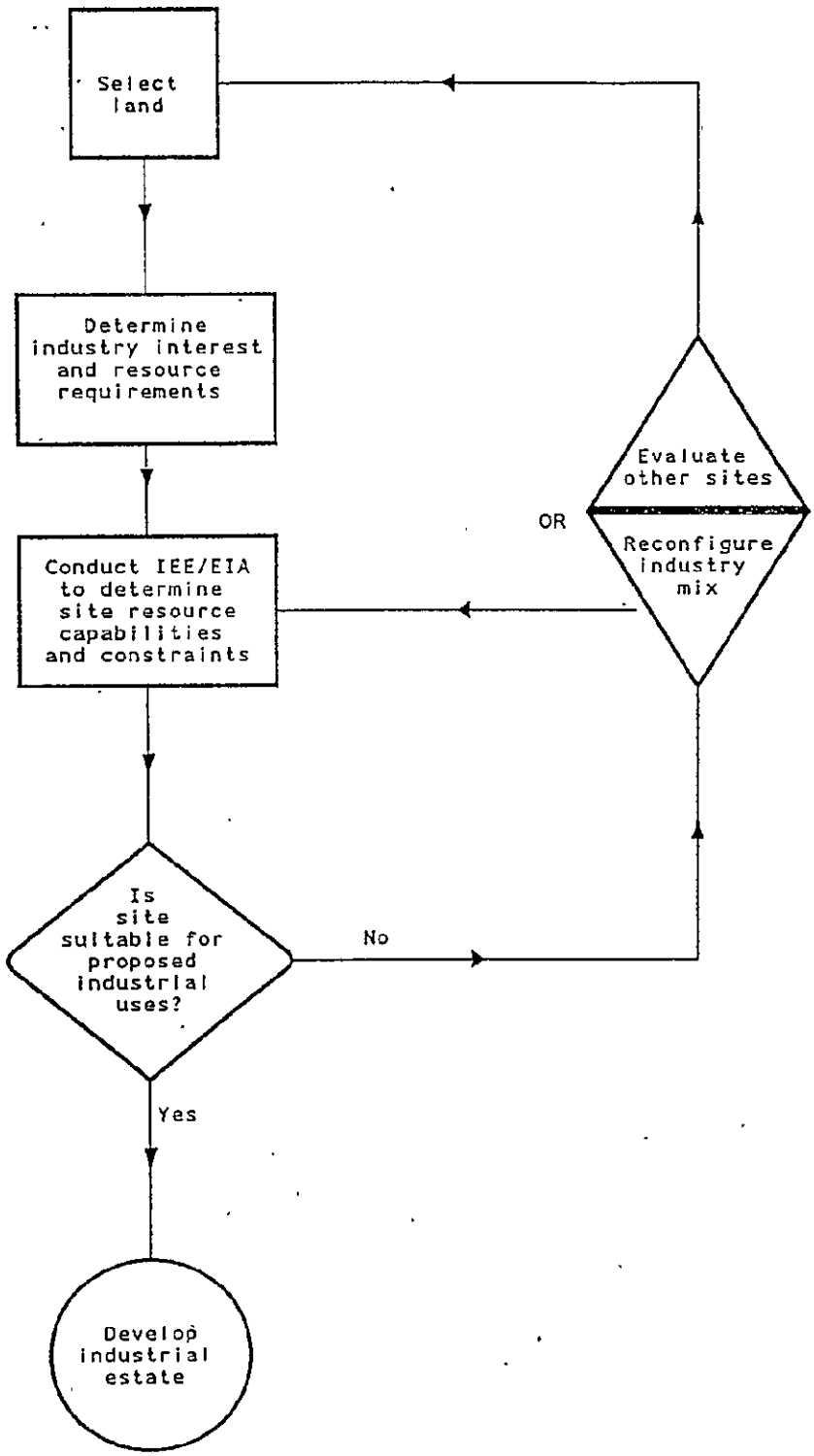


FIGURE 5 - 1

- Section 5.2 suggests a process for addressing some of these recurring issues as part of the IEE or EIA.

- Section 5.3 recommends some general measures for implementing a systematic industrial estate siting and management process in Sri Lanka, with specific recommendations for the newly-established Sectoral Committee on Industrial Estates and Projects.

5.1 SYNTHESIS OF SITE-SPECIFIC ANALYSES

Using the qualitative rating system described in Chapter 4, the NAREPP team collectively conducted a comparative analysis of the 11 sites. One major objective of this exercise was to identify environmental and socioeconomic constraints that tended to occur in multiple sites, thus indicating a possible need for additional evaluation and attention to these common concerns by policy makers. Several of these constraints can be alleviated by including specific engineering design requirements, such as those related to physical infrastructure, into the project construction permitting process. However, this step could increase development costs, making sites that require additional expenditures less attractive from an economic perspective than other sites that do not have these constraints.

5.1.1 Interpretation of Site Ratings for 14 Parameters

The team's ratings of each site for the selected parameters are provided in Table 5-1. The table should <u>not</u> be used to conclude that any given site is "best" or "worst" for all types of industrial development. Each site has a different combination of scores that reflect site-specific conditions. Nor was any attempt made to weight the score for one parameter more heavily than another. To do this it would be necessary to weigh separately each of the 13 criteria in the table and somehow derive a "total score" for each site across all criteria. This would be a difficult and questionable exercise. For example, it would be nonsensical to try to develop a consensus on the relative weights that should be placed on "cultural/religious resources" versus "labor availability".

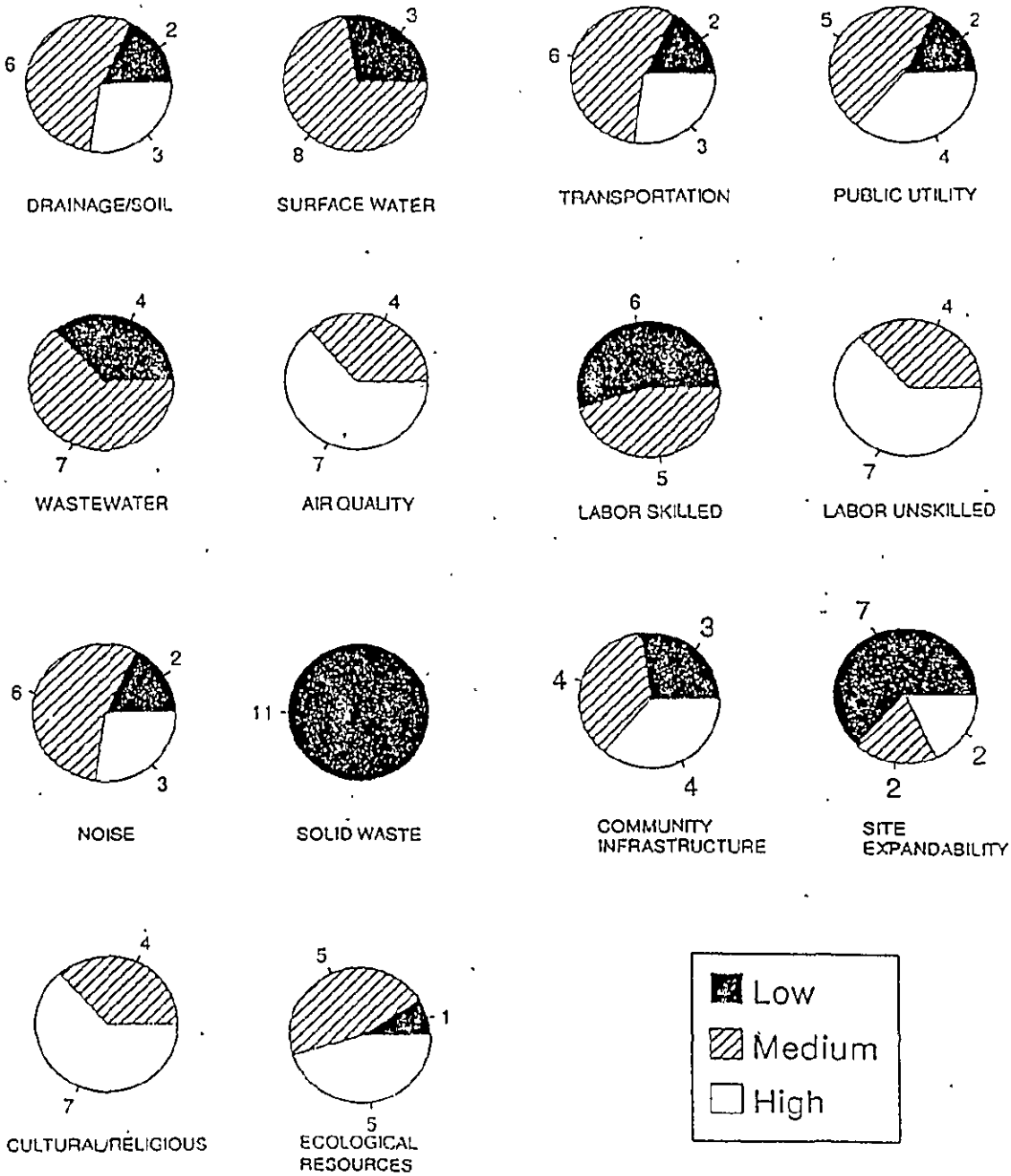
However, these data <u>can</u> be used to identify the relative frequency and level of environmental constraints across all sites with respect to each of the rating factors. The next two figures, which graphically depict the information from Table 5-1, clearly indicate a that quite a few of the sites are rated as having only Low or Medium compatibility with industrial uses for several of the same environmental factors. For example, in **Figure 5-3**, which has a separate pie-chart for each parameter (each circle is the sum of that parameter's ratings for the 11 sites) the darker portions of each 'pie' indicate lower levels of compatibility with industrial uses. Surface water, wastewater, skilled labor, and solid waste were rated at either medium or low compatibility for all 11 sites, while air quality, unskilled labor, and cultural/religious factors posed relatively few problems at most sites. The same results are shown in bar-chart form in **Figure 5-4**. Four of the parameters were viewed by the team as posing the most serious constraints on the establishment of industrial estates at these sites:

INDUSTRIAL ESTATES COMPATIBILITY MATRIX 1995 Study Sites:	Bata-atha	Buttala	Waljapala	Karanawan watta	Senapura	Yatagala	Tambuttegama	Manaweriya	Tammanakele	Mapakada	Gemunupura
ENVIRONMENTAL PARAMETERS:											
Drainage/soil Stability	M	L	M	H	H	M	H	L	M	M	M
Surface water availability	M	M	M	L	L	M	M	M	M	M	L
Wastewater assimilative capacity	L	M	M	L	L	M	L	M	M	M	M
Air quality	H	M	H	H	M	H	H	M	H	H	M
Noise	M	L	L	M	M	M	H	M	H	H	M
Solid waste disposal capacity	L	L	L	L	L	L	L	L	L	L	L
Cultural/ religious resources	M	H	H	H	H	M	H	M	H	H	M
Ecological resources	L	M	H	M	H	H	H	M	H	M	M
Transportation availability	M	M	H	M	L	M	H	H	M	M	L
Public utility availability	M	H	H	M	M	M	H	H	L	M	L
Labor availability -- skilled	L	M	M	H	L	L	M	M	L	L	L
Labor availability -- unskilled	H	H	H	H	M	H	M	H	H	M	M
Community development capacity	M	H	H	H	L	M	H	M	M	L	L
Site expandability	M	L	L	L	M	H	L	L	H	L	L

Table 5 - 1 : Ratings of 11 Proposed Sites

H = High compatibility rating M = Medium L = Low

INDUSTRIAL SITES: ENVIRONMENTAL COMPATIBILITY



Ratings of 11 Sites for each factor.

FIGURE 5-3

INDUSTRIAL SITES: ENVIRONMENTAL COMPATIBILITY

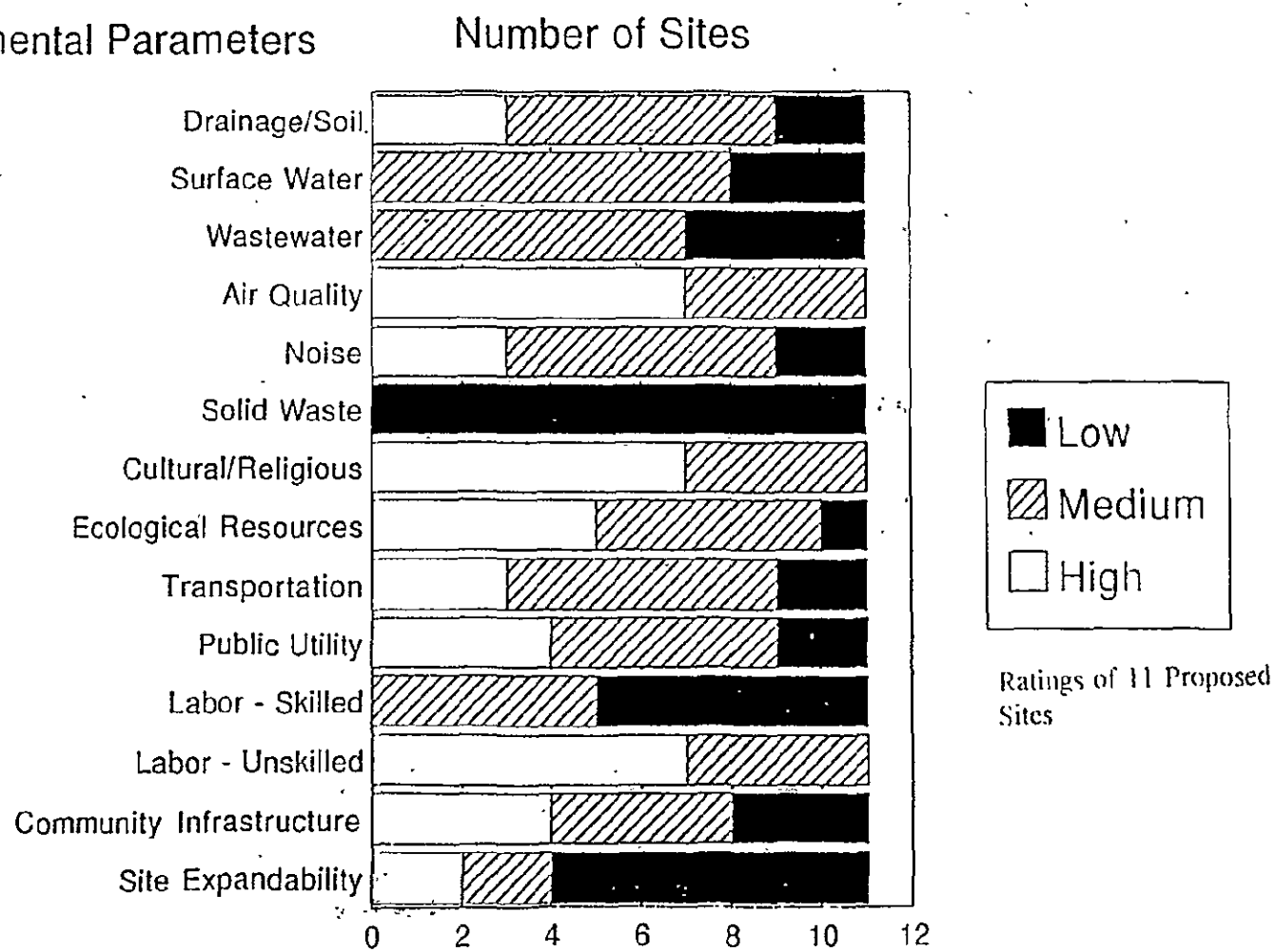


FIGURE 5 4

- **Surface water availability** is a constraint or limiting factor at the majority of sites. Significantly, none of the sites were considered by the review team to have "high" compatibility with industrial development in regard to available water supplies. This constraint indicates that development of these sites may have to be restricted to industries with very low water use requirements. The use of ground water may be an option at some sites *but sustainable ground water availability cannot be determined without detailed site-specific ground water data, which currently does not exist for any of the sites.*

- **Limited waste-water assimilative capacity** is a constraint at the majority of the 11 sites. This conclusion is based on analysis of storage and flow rates for water bodies near the sites, as well as on consideration of other current or planned competing uses of these water bodies.

- **Solid waste disposal capacity** is a significant constraint at <u>every</u> site. The primary reason is that there are no existing properly constructed landfills at or near any of the sites; furthermore, on-site soil and ground water conditions at some sites are incompatible with landfilling even if construction of such a facility were to be attempted. This constraint can be alleviated to some extent by requiring that, prior to development, the site manager must approve each industry's provisions for solid waste disposal, which could include construction of a landfill <u>or</u> installation of an on-site recycling system or other solid waste treatment unit. However, this requirement would add to the estate development costs and could lead to additional environmental problems. In addition, residues from some waste treatment systems (such as sludge or incinerator ash) would still need to be disposed of somewhere safely after receiving on-site treatment.

- **Limited space for future expansion** was a major constraint at most of the sites. The review team reached this conclusion after considering the characteristics of lands immediately surrounding the sites. There are physical barriers on many of these lands (e.g., existing structures, natural barriers such as streams, lagoons; etc. that would make future expansion of the sites onto these lands extremely difficult and expensive, if not unfeasible.

5.1.2 Rating of Sites by Aggregate Indicators

The team next attempted to consolidate the separate ratings for each site into two aggregate scores, one that would give some indication of a site's overall capacity to assimilate pollutants from various sources, and the other that would indicate the site's relative capability to provide physical and socioeconomic resources considered important for industrial development. The methodology for this step is described in Section 4.3 of this report; the results are displayed in **Table 5-2**. The table shows, for example, that the site at Buttala has an aggregate rating for 'pollution assimilative capacity' of M-L, or medium-to-low, and an aggregate rating for 'local resource availability' of M-H, or medium-to-high. The reader is urged not to place any absolute value on these aggregate ratings, but they do provide a basis for comparison from one site to another of the <u>relative</u> compatibility for development as industrial estates. The ratings also give some

Table 5 - 2 RATING OF SITES ACCORDING TO POLLUTION ASSIMILATIVE CAPACITY AND RESOURCE AVAILABILITY

	SITES	POLLUTION ASSIMILATIVE CAPACITY								LOCAL RESOURCE AVAILABILITY									
		DRAINAGE/SOILS	WASTE WATER	AIR QUALITY	NOISE	SOLID WASTE	CULTURAL RESOURCES	ECOLOGICAL RESOURCES	AGGREGATE	CULTURAL RESOURCES	ECOLOGICAL RESOURCES	SURFACE WATER	TRANSPORT	PUBLIC UTILITY	LOCAL LABOUR (SKILLED)	LOCAL LABOUR (UNSKILLED)	COMMUNITY INFRASTRUCTURE	SITE EXPANDABILITY	AGGREGATE
1	Bata-Atha	M	L	H	M	L	M	L	M-L	M	L	M	M	M	L	H	M	M	M-L
2	Buttala	L	M	M	L	L	H	M	M-L	H	M	M	M	H	M	H	H	L	M-H
3	Waljapala	M	M	H	L	L	H	H	M-H	H	H	M	H	H	M	H	H	L	H-M
4	Karanawan watta	H	L	H	M	L	H	M	M-H	H	M	L	M	M	H	H	H	L	M-H
5	Senapura	H	L	M	M	L	H	H	M	H	H	L	L	M	L	M	L	M	M-L
6	Uragasmanhandiya (Yatagala)	M	M	H	M	L	M	H	M	M	H	M	M	M	L	H	M	H	M-H
7	Tambuttegama	H	L	H	H	L	H	H	M-H	H	H	M	H	H	M	M	H	L	M-H
8	Manaweriya	L	M	M	M	L	M	M	M-L	M	M	M	H	H	M	H	M	L	M-H
9	Tammanakele	M	M	H	H	L	H	H	M-H	H	H	M	M	L	L	H	M	H	M-H
10	Mapakada (Vianini Camp)	M	M	H	H	L	H	M	M-H	H	M	M	M	M	L	M	L	L	ML
11	Gemunupura	M	M	M	M	L	M	M	M-L	M	M	L	L	L	L	M	L	L	L-M

H - High
M - Medium

indication of what types of industrial development may be more or less compatible with a given site's particular set of environmental resources and limitations.

5.1.3 Rating of Selected Industry Types by Aggregate Indicators

The separate and aggregate ratings in Table 5-2 were compiled for the sites themselves, not for any particular combination of industries at that site. To provide some basis for matching industries to sites, the team selected 10 general types of industries found in Sri Lanka and scored them against a similar set of parameters. Those scores were then used to produce aggregate ratings in the 'pollution potential' and 'resource consumption' categories. The results are shown in Table 5-3. In general terms, the table shows that different industry types vary considerably in their pollution and resource consumption impacts, which is not surprising; but the two tables taken together provide a systematic way to look for possible matches, or "fits," between a given site and a range of industries. Where a site's natural resources are limited, industry types with lower resource consumption (but possibly with relatively high pollution potential) may be more appropriate. The system could be used in the preliminary stages of site development to identify which industry types should be encouraged to consider which available sites. Final siting decisions should, of course, be based on more site-specific and industry-specific analysis. This methodology offers a short-cut in the initial screening stages.

Skeptics of this methodology are reminded that the term "high and medium polluting industries" represents an attempt to classify industries at an even higher level of aggregation than is shown in Table 5-3; this approach, we believe, provides a more useful method of estimating, in an admittedly general way, the overall environmental impact of a given industrial type. If more specific information is used in rating the separate parameters, the method can be used to rate a specific industrial facility or process. This strength of this rating system is that it considers environmental impact to be a combination of pollution generation <u>and</u> resource consumption.

None of the sites was found to be ideally suited for high-polluting industries. Some sites are highly unsuitable, while others could accommodate high-polluting industries only with a significant expenditure for environmental protection measures. Unfortunately, given the typically small size of the sites and the fact that most of them have very limited potential for expansion, the need to make significant capital outlays for control measures greatly diminishes the appeal of many of these sites to investors.

The M/ID should consider the fact that developers of large industrial facilities will be looking carefully at ways to control their start-up costs, and are most likely to be attracted to sites where the managing entity has made substantial up-front investments in common infrastructure such as water supply, wastewater treatment, roads, power, and other industrial amenities. Such investments, whether by government or private parties, are not likely to be cost-effective on small sites with numerous other constraints.

On the other hand, there are a number of positive findings in terms of the suitability of the sites for small and medium-scale industrial development:

Table 5 - 3 RATING OF INDUSTRIES ACCORDING TO POLLUTION POTENTIAL AND RESOURCE CONSUMPTION

	INDUSTRIES	POLLUTION POTENTIAL								RESOURCE CONSUMPTION							
		WASTE WATER	AIR QUALITY	NOISE	SOLID WASTE	VISIBILITY	THERMAL		AGGREGATE	SURFACE WATER	ECOLOGY	TRANSPORT	PUBLIC UTILITY	LOCAL LABOUR	COMMUNITY INFRASTRUCTURE	LAND AREA	AGGREGATE
1	Textile Washing Plant	H	M	L	M	M	M		M	H	M	H	H	M	M	L	H-M
2	Apparel Industry	L	L	M	M	L	L		L	L	L	H	M	H	H	M	H-M
3	Manufacture of Fabricated Metal Products and Foundry	M	L	H	H	M	M		H-M	L	M	M	H	L	M	L	L-M
4	Manufacture of Leather (Tanning Industry)	H	H	L	H	H	M		H	H	H	M	M	M	M	M	M-H
5	Meat Processing, Curing, Preserving and Packing	H	L	M	H	L	M		M	H	L	H	H	M	M	L	M-H
6	Rice Mills	L	M	L	M	M	L		M-L	M	L	M	L	L	L	H	M-L
7	Manufacture of Cement Products for Construction Industry	L	M	M	L	M	L		M-L	M	H	H	L	M	L	H	M
8	Processing Pulp to Paper, Paper Board and Fibre Board	H	H	M	H	H	M		H-M	M	H	H	H	M	M	H	H-M
9	Treating and Preserving Wood	H	M	L	L	M	M		M	M	L	H	M	H	M	H	M-H
10	Manufacture of Motor Vehicle Parts, Motors Brakes etc.	M	M	H	H	M	M		M-H	L	L	M	M	M	M	L	M-L

H - High
M - Medium
L - Low

- Most sites are served by relatively good transportation and public utility infrastructure.

- With one exception, ecological factors do not pose severe constraints to on-site development or expansion.

- Air quality considerations do not pose a major constraint at any site, provided that sound pollution prevention and control measures are taken.

- There is a reasonable good base of unskilled labor near all of the sites, and Sri Lanka's relatively high literacy level means that skilled labour can be readily trained if it is not immediately available.

- There are no outstanding cultural or religious resources (e.g., temples, archeological sites, etc.) at or near most of the sites that would be likely to be damaged or adversely affected by industrial development on the sites.

In other words, each site has certain positive and negative characteristics with respect to its compatibility with industry; these factors will affect whether and how development can occur. Without considering all of these characteristics, decision makers are hindered by having only an incomplete picture of the site. The risk of inappropriate decisions that have costly consequences is clear. It would obviously be a very costly mistake, for example, to make substantial private and public sector investment in water supply and waste water treatment facilities to meet the needs of industries on a year-round basis at a site where there are insufficient water supplies during the dry season.

Fortunately, such serious misallocations of resources can be avoided. By considering all of the important economic, environmental, and social factors together and early in the siting process, safe and sustainable industrialization can be undertaken. Achieving this objective should <u>not</u> require major additional expenditures or serious delays in siting decisions. Rather, it requires implementation of a coordinated, orderly planning process that allows for early site screening and decision making.

The interagency Sectoral Committee recently established by the Government of Sri Lanka provides a very promising institutional mechanism to guide such a process. To this end, Section 5.2 below provides several suggestions for the committee's consideration.

5.2 IMPROVING THE EIA/IEE PROCESS FOR INDUSTRIAL ESTATE SITING

A recurring issue found during this study was that there were significant deficiencies in available environmental information for each site and its surroundings. These information deficiencies hindered a complete environmental evaluation of each site. The subjects of most concern include:

Data required to evaluate cumulative impacts at the regional level: A thorough evaluation of the impacts of industrial development must assess additional demands on regional resources resulting from current and planned development at the regional level.

For example, in the Hambantota District, where the Bata-Atha site is located, there are several other major projects at various stages of planning that could have significant impacts on the area, including a petroleum refinery and a BOI industrial estate. At the same time, the Ceylon Tourist Board has recently announced plans for tourism development in the District. Greater consideration needs to be given to the cumulative resource needs (particularly water) and impacts of these projects and their compatibility or incompatibility with each other.

On a larger regional scale, expansion of the Galle Port and construction of the Colombo-Matara Highway will likely induce major new economic development and growth in the Southern Province. While these developments will provide positive economic benefits to the region, they also present competing demands for resources that need to be considered in planning the Bata-Atha site.

Due to limitations of data availability, combined with the time available to complete this study, the review team's evaluation was largely focused on environmental and social impacts at or near the sites. Therefore our evaluation of these sites necessarily provides an incomplete picture of the full implications of industrial estate development. In areas of Sri Lanka where development is especially high, such as the Galle and Hambantota Districts, regional planning is especially critical. Development of a regional plan or strengthening of the planning function is needed. EIAs for individual projects should address the compatibility of proposed with the overall plan for the region.

Surface water availability: Based on measurements taken by the review team in water bodies near each site, as well as historic flow and rainfall data available for watersheds and regions, the review team was able to derive rough estimates of water availability. In addition, to the extent data were available, the team identified existing uses. However, these data were extremely limited. To get an adequate picture of the impacts of industrialization on the region, water uses and needs throughout the watershed must be taken into account. Unfortunately, these data are very inadequate for most of the sites.

Surface water quality: Very limited water quality data were available for any of the water bodies near the sites. Therefore, the NAREPP team conducted a limited sampling and analysis program to support initial screening of the sites. While the data are sufficient for screening purposes, a more comprehensive water quality monitoring program should be established at sites that are ultimately selected for industrial development. This program should include survey monitoring to establish a statistically sound baseline prior to estate construction, and an ongoing monitoring program during estate construction and operation to ensure that (1) compliance with environmental standards are maintained and that (2) the required treatment processes are providing a sufficient level of environmental protection.

Ground water resources: Local hydrogeologic data were essentially nonexistent at all sites. Due to the limited time and resources available for this study, the Terms of Reference did not include making assessments of ground water at the sites. This does not mean that ground water information is not important -- in fact, the opposite is true. If industries operating on the estates will have significant water demands, a thorough analysis of ground water resources is essential. Before ground water can be considered as

a resource to support industrial estates, a hydrogeological analysis of the site is essential. This would include a determination of the geology underlying the site, depth and thickness of aquifers, aquifer productivity, and analysis of recharge and discharge. This analysis is essential in order to gain an understanding of the long-term impacts of using on-site ground water or other aquifers in the area of the site.

Ecological resources: Baseline data for local flora and fauna, critical habitat, and wetlands were unavailable for most of the sites. For a few sites, comprehensive ecological studies have been conducted in nearby regions that are very useful for assessing the off-site impacts of industrial estate development. These include, for example, data provided in CEA's Wetland Site Report prepared for the Chilaw Estuary, approximately 10 kilometers from the Manaweriya site, and the Wetland Site Report for the Kalametiya and Lunuwa Lagoons, which are within one kilometer of the Bata-Atha site. For the other sites, however, most baseline ecological data were absent..

Removal of these significant information deficiencies requires a concerted effort to be made as part of the IEE/EIA process. However, given the limitations of time and funding that are typical of many IEEs and EIAs, this process alone cannot be relied upon to provide all data needed to support effective decision making. What is required is an information strategy that makes maximum possible use of available data, combined with data generated during the EIA, and places shared responsibility on both the estate developer and M/ID during the project design stage.

This strategy can be implemented without placing an undue burden on the government or the potential industrial investor. It consists of the following steps:

1. Scoping sessions should be held by M/ID early in the EIA process to ensure the full participation of agencies and institutions with important information and citizens concerned. This participation may be enhanced if listings of sites under consideration are widely distributed well in advance of the initiation of individual EIAs. This may be an appropriate role for the Sectoral Committee.

2. M/ID should complete an IEE or EIA for each site, carrying out the analysis as far as possible within the limits of data availability and government resources. If firm industry proposals are not in hand at the time of the EIA, M/ID should make reasonable assumptions about possible industries in order to complete the analysis.

3. The results of M/ID's analysis should clearly indicate areas where information deficiencies have been identified, and describe very clearly the assumptions employed to complete the analysis in light of these deficiencies. For example, all assumptions regarding the volume of water to be drawn from water bodies in the area need to be documented. If groundwater studies are <u>not</u> conducted and documented for the site, this indicates that an assumption has been made that industries on the estate will rely on surface water supplies exclusively.

4. As specific industries submit proposals to locate their facilities on the estate, these proposals should be reviewed carefully to determine whether the characteristics of their facilities as planned are consistent with the assumptions employed in the

industrial estate environmental analysis. In the example cited above, if the facility's proposed water use combined with the water consumption of other facilities on the estate will exceed the levels upon which the EIA analysis were based, the industry sponsor should be required to conduct a new hydrologic analysis focused on the additional impacts of his facility's water use. If ground water is needed, it will be necessary for the facility sponsor to conduct a hydrogeologic assessment if such an assessment was not done as part of the EIA.

The basic principle behind this process is that individual facility sponsors should have the burden of demonstrating that their facility is consistent with the assumptions employed in the industrial estate's EIA. If the facility has potential impacts that were not fully assessed in the EIA the industry sponsor should be responsible for conducting a limited environmental analysis, focused on filling information gaps. Under this scheme, they would not need to duplicate work already done. Rather, they will only need to analyze the specific issues associated with their proposed operation that were not already adequately covered in the EIA.

5.3 IMPROVING SRI LANKA'S INDUSTRIAL ESTATE SITING PROCESS

In the course of this study the NAREPP team encountered several recurring issues in the industrial estate siting process and in policies to develop and manage industrial estates. All of these issues are manageable and can be effectively addressed with appropriate policy and institutional measures, as recommended below. These issues are:

1. Need to improve market data indicating the level and types of industry interests in the sites:

A recurring issue for almost all of the sites in this study is the absence of firm industry proposals or expressions of specific industry interests in the sites. Thus, there is no solid basis for site planning and design to accommodate specific industries.

The lack of data on industry interest poses three extremely difficult challenges to M/ID and the Divisional Directors. First, without a reasonable idea of the types of industries seeking to locate at a given site, it is not possible to plan effectively for site development, including determining the appropriate site size, layout and infrastructure needs. Second, it is extremely difficult to complete a meaningful IEE or EIA since the analysis must be based on speculation concerning the types of development likely to occur. Finally, a substantial amount of time and resources may be misdirected toward sites that have no reasonable prospects of development.

Industry data for the Karanawan-watta (Dankotuwa) site provides a good example of the kind of information that can provide a solid foundation for planning. Several firm industry proposals are in hand that describe proposed activities, expected production levels, and resource needs such as water demands and expected labor requirements. For most of the other sites, these data do not exist, primarily because of an absence of clearly-stated industry demand.

The fact that many sites do not have firm industry proposals like those for Karanawanwatta does not mean that site planning should be put "on hold." Rather, in lieu of specific proposals a systematic market analysis and continuing monitoring of investment interest in Sri Lanka can be used to guide the industrial estate siting program. The Government of Sri Lanka has recently adopted a policy of industrial estate selection based on market demand. Section 5.3 describes this policy and suggests a framework for incorporating market data into the overall estate planning process.

2. *Need to improve the tract definition process:*

The process for siting industrial estates in Sri Lanka begins with identifying lands owned by the Government that are of appropriate size and that are not currently in use or committed to other specific uses. Beyond this necessary first step, many additional measures must be taken to define and ultimately select specific tracts of land from among larger units. The establishment of firm site boundaries should take place near the end of this process, not the beginning, as appears to have been the case with most of the sites analyzed in this study.

One of the concerns identified during this study is that the areas and site boundaries of these 11 proposed estates were apparently fixed by M/ID prior to undertaking a systematic evaluation to match site resources with industrial interests. Thus the tracts of land now being offered to investors may be too small for viable industrial estates, or may not be located in areas that are environmentally or economically optimal.

Two examples may serve to illustrate this concern. The St. Martins Estate is a large government land holding (of approximately 400 acres) that is managed by several Government agencies. Within this large land parcel, three tracts have been designated for industrial estates: the existing St. Martins industrial estate, consisting of 17 acres, the Tammanakele site (67 acres), and the Manaweriya site.

As reflected in the site evaluations, each of these small parcels, when viewed in isolation from each other, has positive and negative characteristics. For example, the Tammanakele site has deficiencies in water resources, the Manaweriya site has serious drainage problems, etc. These problems, combined with the small size of the separate tracts, greatly diminish their development appeal. However, it is entirely possible that another larger site or combination of sites within the overall St. Martins Estate might be more suitable than are the small separate pieces now being offered.

Similarly the Bata-Atha site, consisting of 107 acres, is part of a much larger government-owned tract. There are serious concerns regarding potential adverse impacts of industrial discharges on the nearby wetland sanctuary and associated water bodies. As with St. Martins, it is possible that these concerns could be alleviated by looking at alternative tracts within the larger GOSL landholding.

An assessment of alternative tracts within the larger government landholding may reveal alternative tracts, or combinations of tracts, that are more attractive from the perspectives of both economics and environment. A related problem is that by establishing specific tracts too early in the process, the government may lock itself into an inventory of sites

that is too restrictive to allow for consideration of alternatives. Section 5.4* recommends a siting process that allows for the examination of alternative tracts and also provides for appropriate industry input.

3. Need to improve interagency coordination and communication:

As was pointed out in Chapter 2, the industrial estate programs of the various industrial development agencies in Sri Lanka have not been well coordinated. In particular, there has not been a multi-agency institutional mechanism for systematically assessing the need for new estates on the basis of market demand. The recently-established Sectoral Committee on Industrial Estates and Projects may be the key to improving this much-needed coordination.

Another dimension of the coordination/communication issue that still needs improvement is in the area of environmental policy. There are a number of environmental requirements and regulations that are new or under development, such as those for environmental monitoring and hazardous waste management. These requirements have a major and direct bearing on industry, and may be particularly difficult to apply in the context of industrial estate operation. For example, the provisions of each estate's Environmental Protection License are expected to include assignment of responsibilities and assessment of penalties for non-compliance, which may pose very difficult questions regarding legal responsibility for on and off-site enforcement of environmental laws.

Just as the Sectoral Committee can improve coordination among agencies with mandates for industrial development, a central coordinating mechanism is needed to integrate environmental policy considerations into industrial estate planning. For this reason, it is recommended that CEA or M/ETWA should be regularly represented on the Sectoral Committee in at least an advisory capacity.

4. Need to prepare estate management plans that encourage pollution prevention and effective environmental management at the industrial estates:

As discussed above, detailed plans for developing and managing most of these estates have not been completed. While this is an issue of concern, it is not critical since few of the sites reviewed in this study have firm industry facility plans at this time. Thus there is an opportunity to initiate policies now that incorporate sound environmental principles into estate management plans. Doing so now will avoid many problems later. The principles that need to be embodied in estate management plans include:

- Apply polluter-pays principles to provision of estate services such as using common waste treatment and disposal facilities;
- Reward designs that prevent pollution before it is generated;
- Provide clear procedures and lines of authority for dealing with both planned and unplanned events.

Once individual industries are located on estates with shared treatment facilities, some plant managers may be inclined to shirk their environmental responsibilities. The central management authority for the estate cannot and should not assume the full environmental liabilities associated with estate operations. It must be a shared responsibility between estate managers and industries, with the obligations of all parties clearly understood.

For example, central waste water and solid waste treatment and management facilities can have major advantages over individual facility treatment, such as economies-of-scale and more effective monitoring and control. However, if the prices charged industrial users of these services do not reflect the their full cost, this is an open door to poor environmental management. The pricing system established on each estate must therefore avoid providing subsidies for poor environmental performance.

The assignment of responsibilities and authorities for environmental management is a critical issue. Even under normal operating conditions, effective performance of a central waste-water treatment system can only be maintained if the pollutants in waste waters discharged to the system by industries on the estate are kept within the system's design limits. It may be necessary for some users to pre-treat their wastes to avoid damaging the central system (e.g., removal of heavy metals may be required). It is therefore essential that industrial users be closely monitored, that they maintain compliance with their pre-treatment standards, and that they take appropriate action when their standards are exceeded.

Contingency planning is also essential. All industries on an estate must have a clear understanding of their obligations when emergencies occur. For example, malfunction of the central treatment plant can have catastrophic environmental impacts if industries on the estate are permitted to continue discharging wastes to the unit. Furthermore, individual facilities must have plans for responding to spills and leaks of hazardous materials or toxic wastes.

Effective estate management policies and procedures should be reflected in each estate's environmental management plans, which should be tailored to specific estate conditions. **Figure 5-5** suggests the framework for such plans.

5.4 INSTITUTIONAL RECOMMENDATIONS FOR IMPROVING INDUSTRIAL ESTATE SITING AND MANAGEMENT

This section provides an institutional approach to implementing the recommendations made above on ways to improve industrial estate siting and development. This approach takes advantage of recent institutional changes made by the Government of Sri Lanka.

The Government has recently established a Sectoral Committee, represented by M/ID, the Treasury, Department of National Planning, BOI, Labor Ministry, and the Urban Development Authority. This Committee is charged with examining all newly-proposed industrial estates and industrial development projects.

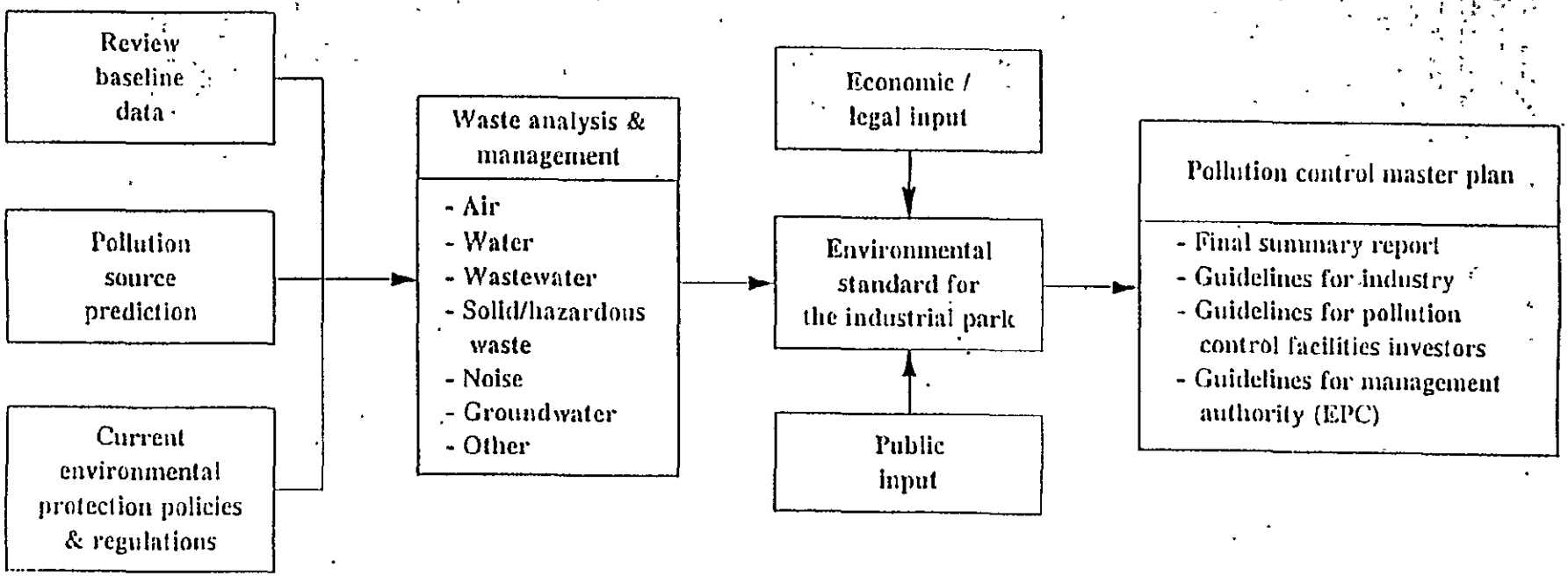


FIGURE 5 - 5 : Industrial Estate Master Plan Methodology

From : Shih-Ling Tu, et al. 1993(?)
Methodology and Considerations on Pollution Control Master Plan for Industrial Park Development

This central decision-making body provides an excellent mechanism to improve interagency coordination and planning, which should consequently alleviate a number of the problems described in Section 5.1. The following recommendations offer a framework for implementing an effective industrial estate planning and management program within this new institutional context.

1. Improving coordination and data-sharing on industrial sector needs and interests:

The lack of common or consistent information on the levels and types of industries that may be interested in locating in Sri Lanka is a serious obstacle to efficient estate planning. There are a variety of sources of such market data, such as:

- **Direct contact with potential investors**: The most important source is information obtained through direct contacts at all levels of government with industrialists. The RISCs have some of the most detailed data, but contacts between industrialists and officials at all levels of government are important. The Sectoral Committee should sponsor regular industry-government forums, seminars, etc. to increase such informal communication and information-sharing.

- **Industry responses to investment solicitations**: The responses of industry to government offers and advertisements, such as M/ID's recent requests for expressions of interest in industrial estates, constitute extremely valuable market data which should be compiled and published by the Sectoral Committee.

- **Market studies**: Selective surveys of industry interests and assessments of industry needs may be needed to supplement existing information. Market studies may focus on particular industry sectors, specific geographic regions, or more generally on the overall business climate. The Sectoral Committee should arrange for abstracts of these surveys to be published and shared among all the government departments and agencies concerned with industrial development.

Many agencies and institutions in Sri Lanka already collect and use such data. These efforts should continue. The Sectoral Committee can play an extremely valuable role in actively compiling this information and helping to ensure that it is shared among all agencies that have a stake in industrial estate planning and development.

2. Expanding the Inventory of Potential Sites:

In spite of the large number of industrial estates currently proposed for Sri Lanka, our study shows that very few are likely even to be marginally suitable for medium and high polluting industries. In fact, of the eleven sites evaluated in this study none could be considered ideal for such industries. There is a growing need to develop an inventory of sites that are suited to particular industry needs. This inventory does not currently exist, largely because under the existing siting process individual tracts of land are first selected, then evaluated in terms of their economic, environmental, and social attributes. As sites are eliminated from further consideration for various reasons, there is little choice but to start the process of finding sites for analysis all over again.

The fundamental problem with the current process is that it "puts the cart before the horse"; i.e., sites are selected before needs are defined. The process should be carried out in reverse order, i.e., define the needs and then select sites that have a reasonable likelihood of meeting these needs. There are certain minimum requirements that will determine the likelihood of industrial development as well as the types of industries that will develop, including:

- Size of available land;
- Access to raw materials;
- Access to markets;
- Characteristics of labor force;
- Water availability.

Before individual tracts of land are selected for analysis, regional planners should conduct an initial screening process of their regions to assess how area resources mesh with industry requirements. This process would not require a substantial amount of effort, and would save substantial time and resources by focussing further attention and analyses on those areas that are most likely to meet industry needs. The planning activities currently underway as part of the Ministry of Finance, Planning, Ethnic Affairs, and National Integration's Southern Area Development Programme may provide a useful model.

By establishing screening criteria that are fairly broad, a number of alternative sites can be identified that subsequently can be evaluated and compared in an IEE or EIA. By having a pool of alternative sites available for analysis, the likelihood of finding suitable sites would be greatly enhanced.

The Sectoral Committee can play a valuable role by developing such a process and by facilitating discussions among regional planners who attempt to use this process. In addition, the Committee could assist regional agencies in defining and applying initial site screening criteria.

3. Development of Effective Industrial Estate Management Plans:

When evaluating individual estate proposals, the Sectoral Committee should closely examine the arrangements that are proposed for estate management, in particular provisions for sharing environmental management and oversight responsibilities among the industrial development agencies, CEA and local environmental authorities, estate developers, and individual industrialists. These provisions are extremely important and must be spelled out in detailed form, and carefully considered. Some of the major issues that need to be addressed include:

(a) How will liability for violations of the estate's Environmental Protection License be shared among the estate manager, the individual industries, any contractors, and the government?

(b) How will responsibilities for monitoring and the actual monitoring data be shared among the estate managers, individual industries, and the government?

(c) How will contingency plans for emergency response be developed and enforced?

(d) Who will bear the cost of environmental damage to the land and underlying ground water that may result from estate operations?

As mentioned in Section 5.1, the study team believes that serious consideration should be given to including CEA or M\ETWA on the Sectoral Committee. Through such inter-agency participation, issues such as those listed above can be resolved more quickly and more effectively.

In conclusion, it is hoped that this industrial estates siting study has provided a constructive critique of current practices and that it also may help to improve those practices with the goal of more efficiently siting industries for economically and environmentally sustainable industrial development in Sri Lanka.

SRI LANKA INDUSTRIAL ESTATES SITING STUDY

VOLUME I

Annex 1

NAREPP STUDY TEAM MEMBERS

SRI LANKA INDUSTRIAL ESTATES SITING STUDY
1995

NAREPP TEAM MEMBERS

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2. Dr. S Bhuvendralingam	Water Quality Specialist and Environmental Engineer	University of Moratuwa
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ANNEX 1

SRI LANKA INDUSTRIAL ESTATES SITING STUDY

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Annex 2

TABLE OF PROPOSED SITES INCLUDED IN STUDY

MINISTRY OF INDUSTRIAL DEVELOPMENT

INDUSTRIAL ESTATES SITING STUDY

PROPOSED SITES INCLUDED IN STUDY

SITE NAME	PROVINCE	DISTRICT	DIVISION
1. Bata-Atha	Southern	Hambantota	Ambalantota
2. Uragasmanhandiya (Yatagala)	Southern	Galle	Karandeniya
3. Waljapala watta	Western	Gampaha	Minuwangoda
4. Karanawan watta	N. Western	Puttalam	Dankotuwa
5. Manaweriya	N. Western	Puttalam	Arachchikattuwa
6. Tammanakele	N. Western	Puttalam	Arachchikattuwa
7. Senapura	N. Central	Anuradhapura	Ippalogama
8. Tambuttegama (Mahaweli)	N. Central	Anuradhapura	Thambuttegama
9. Buttala (at Gamudawa Site)	Uva	Moneragala	Buttala
10. Mapakada (Viyanini Camp)	Uva	Badulla	Mahiyangana
11. Gemunupura	Uva	Badulla	Redimaliyadda

SRI LANKA INDUSTRIAL ESTATES SITING STUDY

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Annex 3

SITE VISIT CHECKLIST

INDUSTRIAL ESTATE SITING STUDY
SITE VISIT CHECKLIST

I. GENERAL INFORMATION

Site Name:

Date of Site Visit:

Persons Contacted to Obtain Site Information:

General Site Description:

Size (acres/hectares):

Topography/surface features (e.g., flat, rolling, hilly, steep, mountainous, etc.):

Elevation of the neighboring lands with respect to the site:

Steepest slope on site (approximate %):

Existing structures and/or on-site activities (e.g., agricultural activities):

Other general observations (Attach a hand-drawn diagram if appropriate):

Have any previous environmental analyses of this site been prepared? If so, describe:

Site History/Current Degree of Development on Site:

Are there any records or indications of past development of the site? If so, describe:

Are there any pending plans/proposals for on-site development? If so, describe:

Are there any pending development plans/proposals off-site that could affect on-site development? If so, describe:

II. CURRENT AND PLANNED FACILITIES/SERVICES TO SUPPORT INDUSTRIAL DEVELOPMENT

Utility Sources Serving the Site:

Potential sources of electricity and existing capacity:

Other energy supplies (e.g., natural gas, fuel oil):

Potential water supplies and existing capacity:

Potential telecommunications facilities:

Refuse service:

Sanitary sewer or septic system:

Waste management facilities (including domestic solid waste and industrial solid waste facilities in region):

Public Services Available or Planned That Could Serve the Site:

Fire protection:

Police protection:

Health care:

Schools:

Description of Transport Modes (Existing or Planned) That Could Serve the Site:

Public roads:

Rail service:

Port facilities:

Is site served by public transportation?

III. PHYSICAL ENVIRONMENT

Surrounding Land Use: Describe activities in areas adjacent to site, e.g., housing, commercial, industrial, etc. Include facilities with particular environmental sensitivity, e.g., schools, hospitals, nursing homes, etc. Identify significant pollutant sources in the area:

Current Zoning of the Site -- Is there any? Does a Master Plan Exist?

Protected Environmental Areas: Describe any National Reserve or Sanctuary, Wilderness Area, Forest Reserve, State Forest, or Village Forest, environmental protection area, botanical gardens, Man and Biosphere Reserve) located on the site or within one kilometer of its boundary.

Geology/Hydrogeology: Describe all available information, including: stratigraphy, lithology, depth to groundwater, direction of groundwater flow, groundwater quality, locations of water supply and/or monitoring wells in area, uses of groundwater in area:

Soils:

Description of soils (i.e., clay, sand, gravel, peat, muck):

If suitability/classification of agricultural soils is known, specify:

Indications/history of unstable soils:

Potential areas of erosion:

Hydrology:

Surface water bodies on or adjacent to site, and stream or river that it flows into (if appropriate):

Reservation area for the water bodies identified above, if any, and the act/regulation under which it is stipulated:

Flow rate of water bodies (annual average, maximum, minimum):

Describe drainage patterns (attach sketch if required):

Description of available upstream/downstream water quality:

Downstream water uses:

On-site flood hazard potential on site:

Coastal zones in vicinity of site:

Noise:

Qualitative assessment of ambient noise levels in vicinity of site:

Current sources of noise in area:

Air quality:

Description of available air quality data in vicinity of site:

Qualitative assessment of air quality on-site:

Existing emission sources in vicinity of site:

Meteorology:

Precipitation (Maximum daily/monthly; seasonal average; annual average):

Predominant wind patterns (If wind rose is available, please provide):

Is area subject to frequent inversions?:

Terrain features that affect local meteorology:

IV. BIOLOGICAL ENVIRONMENT

Flora: Identify predominant or major species of trees, shrubs, grasses, pasture, crop or grain, wet soil plants, water plants, etc.):

Fauna: Identify predominant or major species of birds, mammals, fish):

Is the site part of a migration route? If so, when are migratory species present?

Is the site frequently traversed by wildlife?

Rare or Endangered Species:

Briefly describe any sensitive wildlife habitats on site or within one kilometer of the site boundary, whether formally protected or not (include wetlands, forests, nature preserves):

IV. SOCIAL-CULTURAL ENVIRONMENT

Religious Sites:

Religious sites that are currently in use on or in vicinity of site:

Historical religious sites on-site or in vicinity of site:

Historical and Cultural Resources:

Archeological sites on-site or in vicinity of site:

Historically significant sites on-site or in vicinity of site :

Aesthetics:

What is tallest structure in vicinity of site?:

Note any scenic vistas that could be affected by industrial development on site:

Recreational Resources:

Note any designated and/or informal recreational opportunities in immediate vicinity of site:

Socioeconomic Information in region affected by development on site, (existing and currently projected). Describe sources of information and suitability of data for supporting this analysis.

Housing:

Population (full time and seasonal):

Land Use:

Planned Development Activities:

Community Structure:

Employment and Labor Market:

Distribution of Income, Goods, and Services:

Public Health Conditions:

Education:

Customs, Aspirations, and Attitudes of Local Populace:

Land Use:

Planned Development Activities:

Community Structure:

Employment and Labor Market:

Distribution of Income, Goods, and Services:

Public Health Conditions:

Education:

Customs, Aspirations, and Attitudes of Local Populace:

V. REGULATORY CONSIDERATIONS

Identify any regulatory programs in addition to GOSL requirements that could affect industrial development, e.g., environmental, health and safety standards, land use controls, etc.:

VI. OTHER COMMENTS

SRI LANKA INDUSTRIAL ESTATES SITING STUDY

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Annex 4

SITE RATING MATRIX AND RATING CRITERIA

INDUSTRIAL ESTATES COMPATIBILITY MATRIX 1995 Study Sites:	Bata-atha	Buttala	Waljapala	Karanawan watta	Senapura	Yatagala	Tambuttegama	Manaweriya	Tammanakele	Mapakada	Gemunupura
ENVIRONMENTAL PARAMETERS:											
Drainage/soil Stability											
Surface water availability											
Wastewater assimilative capacity											
Air quality											
Noise											
Solid waste disposal capacity											
Cultural/ religious resources											
Ecological resources											
Transportation availability											
Public utility availability											
Labor availability -- skilled											
Labor availability -- unskilled											
Community development capacity											
Site expandability											

INDUSTRIAL ESTATES SITING PROJECT

CRITERIA FOR RATING PROPOSED SITES

This site rating scheme is primarily a qualitative system for comparing sites in the study, not for making absolute judgements about the merits of individual sites for industrial development. Sites are rated lower in terms of their suitability for industrial development to the extent that they exhibit one or more of the properties listed under each numbered category; they are rated higher to the extent that they do not exhibit such properties.

1. **Drainage/soil stability:**

   - Portions of the site are in floodplains of nearby flowing water bodies.
   - There is a high potential for "ponding" on site during high rainfall due to poor drainage contours combined with highly impermeable soils.
   - Soils do not provide a stable foundation for construction (e.g, marshy, sandy, etc.).
   - Soils have high potential for erosion.

2. **Surface water availability:**

   - Surface water supply is limited, as determined by assessing the volume of surface water available at or near the site on a daily basis during periods of low flow (net of current and planned consumption by other users in the watershed).
   - Quality of water is unsuitable for sanitary or industrial process use.

3. **Wastewater assimilative capacity of surface waters:**

   - Receiving water bodies cannot assimilate industrial discharges without exceeding CEA standards, taking into account the dilution factor provided in the standards. (Generally, water bodies with high flow, high ambient water quality would be rated higher than streams with low flow and/or poor water quality.)
   - Receiving water body has aquatic species (e.g., prawns, fish, etc.) that are especially sensitive to industrial pollutants.

4. **Air quality:**

   - Site is in an area subject to frequent inversions.
   - Site is in area with poor ventilation (e.g., in a valley or in an area with historically low wind dispersion.
   - Site is near sensitive receptors, such as hospitals, schools, and/or homes for the elderly.

5. **Noise:**

- Site is in an area where on-site noise could be amplified and thus carry over long distances, such as in a valley are on a wide water body.
- Site adjoins residences, schools, or other occupied buildings that are near enough to be adversely affected by noise generated on-site.
- Site adjoins areas that have high aesthetic, cultural, and/or religious values where these values could be adversely affected by noise generated on-site.
- Site adjoins habitat of species that are particularly sensitive to noise.

6. **Solid Waste Disposal Capacity:**

- On-site hydrogeologic conditions are unsuitable for siting a landfill (e.g., due to highly permeable soils, high water table, etc.).
- Site does not have sufficient space for siting a landfill.
- Existing solid waste disposal facilities in the area are unsuitable for accepting industrial solid wastes.

7. **Cultural/Religious Resources:**

- Religious, archeological, cultural, and/or tourist sites are located near enough to the site to be adversely affected by pollution and/or other effects of industrial activities on the site.

8. **Ecological Resources:**

- Flora and fauna on-site and/or off-site could be adversely affected by industrial development on the site.
- Critical habitat on-site and/or off-site could be adversely affected by industrial development on the site.
- Designated Environmentally Sensitive Areas (National Reserves, Wilderness Areas, etc.) are located near the site.

9. **Transportation Availability:**

- Existing transportation infrastructure (i.e., roads, rail lines, water ports) are insufficient to support industrial activities (i.e., transportation of workers, transportation of raw materials and products).
- Existing public transportation service (i.e., bus service, commuter train service) is insufficient for transporting workers to and from the site.

10. **Public Utility Availability:**

- Existing utility infrastructure (i.e., electricity, oil/natural gas, telecommunications, drinking water supply) is insufficient to support industrial activities.

11. **Local Labour Availability:**

- Potential base of skilled labour in the local community is insufficient to support industrial activities.
- Potential base of unskilled labour is insufficient to support industrial activities.

NOTE: This parameter was later separated into two for site rating purposes: a) Skilled Labour; b) Unskilled Labour.

12. **Community Infrastructure:**

- Existing and planned public services in the local community (e.g., police protection, fire protection, health care facilities, schools) are insufficient to support additional demands from industrial development of the site.
- Existing and planned housing in the local community is insufficient to support additional demands for housing that may be expected to result from industrial development of the site.

13. **Expandability:**

- Land immediately surrounding the site is unavailable for future expansion of the site, due either to natural barriers (e.g., rivers and streams, mountains, etc.) or manmade barriers (e.g., adjoining lands are already developed, are restricted from development by zoning or special designation, etc.).
- Existing and planned land use in area immediately surrounding the site is incompatible with industrial development.

NOTE: This parameter was added as a result of comments at a public meeting held prior to conducting the field evaluations.