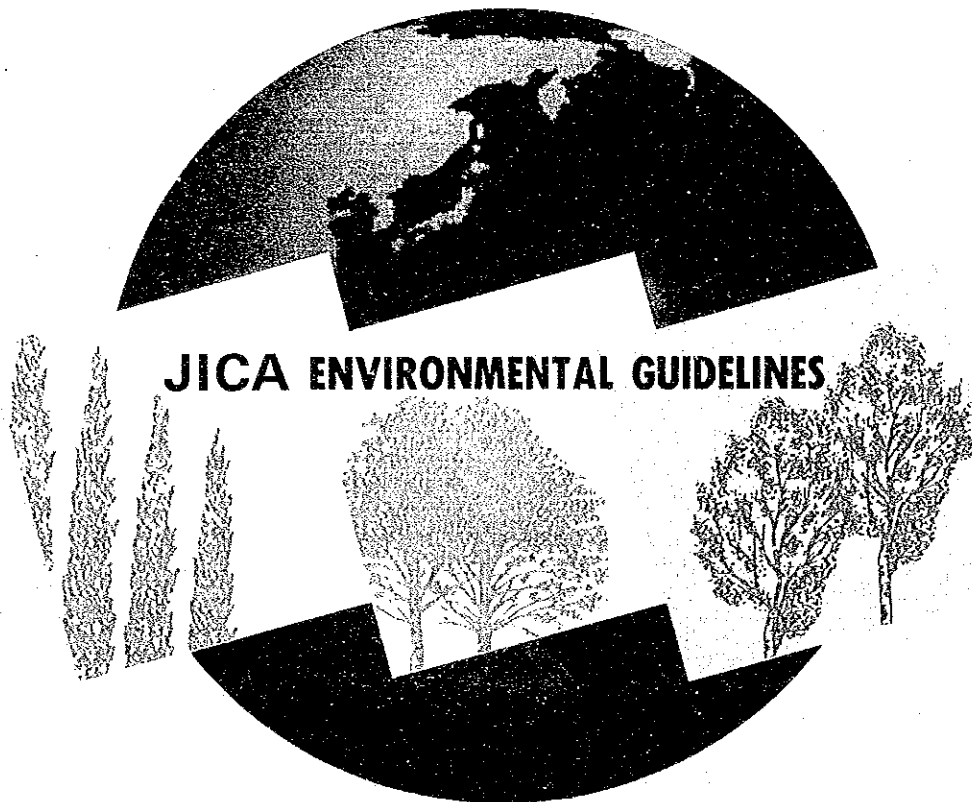


# **ENVIRONMENTAL GUIDELINES FOR INFRASTRUCTURE PROJECTS**

**V RIVER AND EROSION CONTROL**



**SEPTEMBER 1992**

**JAPAN INTERNATIONAL COOPERATION AGENCY**

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# **ENVIRONMENTAL GUIDELINES FOR INFRASTRUCTURE PROJECTS**

**V RIVER AND EROSION CONTROL**

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Environmental Guidelines  
for Infrastructure Projects

"Environmental Guidelines for Infrastructure Projects" was prepared to enable preparatory study members to conduct screening and scoping of environmental impact studies effectively and efficiently while maintaining a dialogue with their counterparts and officials concerned in the host countries for the purpose of predicting possible environmental problems caused by the infrastructure projects and to incorporate adequate environmental consideration into the projects.

The guidelines consist of the thirteen sectors listed below. This volume deals with environmental consideration for "River and Erosion Control".

Sector I	Ports and Harbors
Sector II	Airports
Sector III	Roads
Sector IV	Railways
Sector V	River and Erosion Control
Sector VI	Solid Waste Management
Sector VII	Sewerage
Sector VIII	Groundwater Development
Sector IX	Water Supply
Sector X	Regional Development
Sector XI	Tourism Development
Sector XII	Transportation Development
Sector XIII	Urban Transportation Development

Note: The guidelines for dam construction were published in February 1990 as a separate volume.



## PREFACE

In order to support sustainable development in developing countries, it is of great importance to give sufficient consideration to the environment in the implementation of development programs.

The Japan International Cooperation Agency (JICA) has continually placed special emphasis on environmental technical cooperation and has taken into account pertinent environmental consideration in development studies and implementation of projects.

Based on the recognition of the importance of environmental issues, JICA has prepared the guidelines concerning screening and scoping methods of environmental impact studies for the purpose of contributing to the planning of infrastructure development projects with sufficient environmental consideration.

The guidelines are to be used by JICA study team members when conducting preparatory studies of social and economic infrastructure development projects.

JICA committed the preparation of the guidelines to the International Engineering Consultants Association and organized an advisory group headed by Mr. Michio Hashimoto, president of the Overseas Environment Cooperation Center. Designated advisors of the group were from the Ministry of Health and Welfare, the Ministry of Transportation, the Ministry of Construction, and the Environment Agency. Also, the Ministry of Foreign Affairs provided sound and useful advice to the advisory group.

To all of these organizations and the personnel involved, I wish to acknowledge their much appreciated support.

September 1992

Akira Kasai  
Managing Director  
Institute for International Cooperation  
Japan International Cooperation Agency





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## **TERMINOLOGY**

### **Environmental Consideration**

To study whether a development project will have serious environmental impacts on the project site and its surrounding areas, analyze the study results, and establish necessary measures for avoiding or alleviating any adverse environmental impacts.

### **Environmental Impact**

The undesirable effect on the existing overall conditions of air, water, soil, and living things, assets, social information and circulation of goods, which are related to human life, or on their combined structures.

### **Preliminary Environmental Survey**

The environmental survey conducted during the preparatory study stage of a development project. This includes screening and scoping of the environmental impacts of a particular project. This survey is regarded as a component of the initial environmental examination.

### **Initial Environmental Examination (IEE)**

The examination undertaken at the outset of the development project planning stage to determine the environmental impacts that may be created by the particular project based on existing information and data, easily accessible information relating to the particular project, and comments and judgements of specialists who are familiar with the environmental impacts of past similar projects. This examination should be carried out in a short period at a low cost.

IEE has the following two objectives : 1) to evaluate whether EIA is necessary for the project and, if so, to define its contents; 2) to examine, from an environmental viewpoint, the measures for alleviating the effects of the project which requires environmental consideration but not a full-scale environmental impact assessment.

### **Environmental Impact Assessment (EIA)**

To study, forecast, and evaluate the environmental impacts of a development project, which is judged a detailed environmental examination, and to propose the establishment of an environmental protection standard and measures for avoiding or alleviating environmental impacts.

### **Environmental Management Plan**

To formulate an environmental monitoring system or methods based on the environmental protection standard to monitor the project's environmental impacts on surrounding areas, aiming at adequately protecting the environment both during and after project implementation.



## **Screening**

To evaluate whether or not it will be necessary to include an environmental consideration in a development project. Screening conducted in Japan before the preparatory study is called preliminary screening.

## **Scoping**

To identify the important environmental impacts among those which can be caused by the implementation of a development plan or development project, and to define the study items of the IEE or EIA based on the findings.

## **Project Description (PD)**

The major contents and features of the project. It includes the background of the project (including its upper level plan), the objectives, the executing agency, the beneficiary population, and the project scale.

## **Site Description (SD)**

The compact description of the project site which includes the natural and social environmental conditions in the areas that may be affected by the project.

## **Preparatory Study (PS)**

To examine the contents of the full-scale study of a requested project and to discuss the scope of work (S/W) of the full-scale study with the host country. This study is conducted at the preparatory stage of the project prior to conducting the full-scale study including the master plan and the feasibility study.

## **Full-scale Study**

The study generally conducted continuously after the preparatory study by carrying out field surveys to prepare the study report of a development project. The study report, with its conclusions and recommendations for project realization or project implementation, is submitted to the government of the host country. The full-scale study includes the master plan study, feasibility study, detailed design study, and map preparation.



**Master Plan Study (M/P)**

The study for preparing the basic plans for various development projects. In general, it is sectoral, or for each project.

**Feasibility Study (F/S)**

The study for evaluating the possibility, adequacy, and investment efficiency of a project. In general, it attempts to objectively verify the feasibility of a project from social, technical, economic, and financial viewpoints.

F/S is the core of JICA's development studies. The study report provides the government of the host country with the information needed to decide whether or not to implement the project. It is also used by international financial institutions to evaluate the appropriateness of financing the project once the government submits its loan request.





## ABBREVIATIONS

TOR (T/R) :	Terms of Reference
S/W :	Scope of Work
M/M :	Minutes of Meeting
Q/N :	Questionnaire
IC/R :	Inception Report
DF/R :	Draft Final Report
F/R :	Final Report
OECD :	Organization for Economic Cooperation and Development
DAC :	Development Assistance Committee



## Use of the Guidelines

The guidelines were prepared to provide personnel involved in JICA's preparatory study (including the preparatory work in Japan) with information that can be used to prepare the preparatory study report or compile project specifications while carrying out field surveys, hearings, and holding discussions with the officials of the host country during a short-time visit.

The use of the guidelines is shown in Figure i and explained herewith.

### «Preparatory work in Japan»

#### 1) Examination of the request

After examining the request, follow the procedure given below, unless it is judged a soft-type infrastructure project, which is supposed to have no serious environmental impacts, such as the preparation of topographical maps or a telecommunication project.

#### 2) Preliminary screening

Based on the request, collect and analyze the data and information and prepare the PD and SD in Japan, and conduct the preliminary screening by using them.

If any serious environmental impacts are suspected, the preparatory study team should include an environmental specialist.

Prepare questionnaires to the recipient government concerned and the draft of S/W including environment related items.

### «Work in the host country»

#### 3) Examination of the country's guidelines

At first, investigate the country's IEE/EIA implementing structure, the laws, and any existing guidelines (hereinafter referred to as the country's EIA guidelines). Then, it should be confirmed whether or not the project is subjected to IEE/EIA.

Case 1: If the contents of the country's EIA guidelines are sufficient, follow their guidelines.

Case 2: If the contents of the country's EIA guidelines are insufficient, follow their guidelines and add JICA's screening and scoping items.

Case 3: If the country has no EIA guidelines, follow JICA's guidelines.

#### 4) Screening

Reexamine the PD, SD, and the contents of screening prepared in Japan, based on the findings of the field surveys and data analysis. If it is evaluated that an IEE or EIA is required for the project, scoping should then be undertaken.

## 5) Scoping

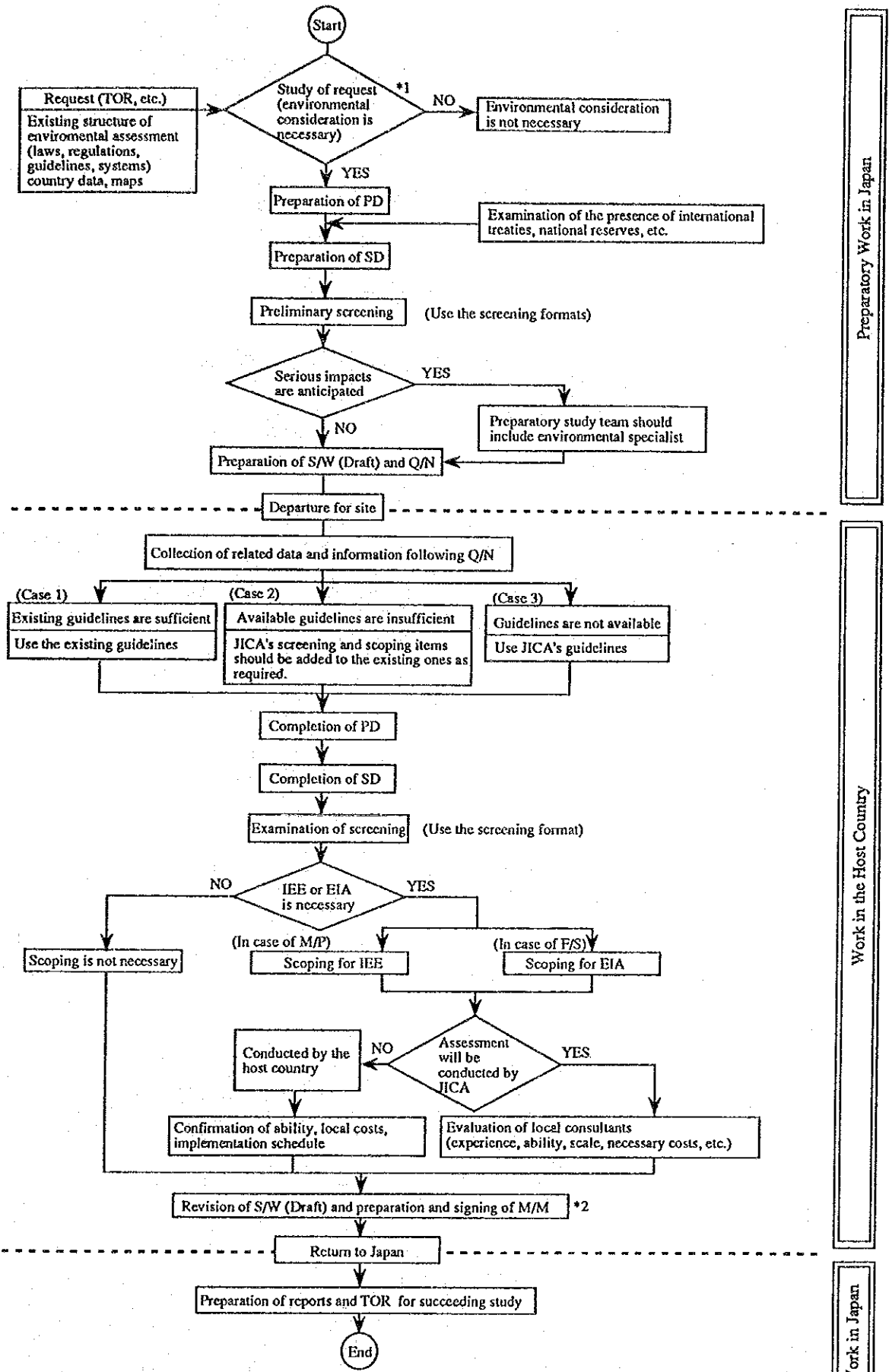
Evaluate the magnitude of impact on each environmental item, using the checklist method, to specify the items that are to be studied in IEE for M/P or EIA for F/S. In this process, making use of the explanation of items in the guidelines, try to grasp the features of possible environmental impacts. The results should be noted in the scope of work (S/W) and the minutes of meeting (M/M). When the environmental factors which may have serious impacts are not identified, it is necessary to mention in the M/M that such factors would be clarified through the full-scale study.

### «Work in Japan»

## 6) Report preparation

Based on the above-mentioned results, compile a preparatory study report which makes it possible to carry out the appropriate IEE or EIA in the full-scale study. TOR for the succeeding study should reflect the contents of the report.

Figure i Procedure of Environmental Consideration



Note : \*1. The environmental consideration is not necessary when infrastructure projects are not anticipated to have serious impacts, such as preparation of topographic maps and telecommunication projects, etc.  
 \*2. When the environmental factors that may have serious impact are not identified, it is necessary to mention in the M/M that such items would be clarified in the full-scale study.



# **CHAPTER 1**

## **OUTLINE OF ENVIRONMENTAL CONSIDERATION**





# CHAPTER 1

## OUTLINE OF ENVIRONMENTAL CONSIDERATION

### 1.1 Basic Concept

JICA's aid study report "Sectoral Study for Development Assistance-Environment" published in 1988 defined that "Environmental Consideration" is to study whether a development project will have significant impacts on the environment or not, to assess the impacts and to incorporate measures to prevent or alleviate their effects, if necessary.

The premise of this definition is the understanding that development aid should not end with a one-time involvement but should be continuous and sustainable. Thus, it is believed that environmental consideration is prerequisite for securing the sustainability of the development.

For the implementation of development projects in developing countries with the cooperation of the Japanese government, a careful environmental consideration should be carried out from the early stages of project planning with a long-term perspective in order to accomplish a well-balanced development.

As such development projects are implemented in the host countries, based on the decision making process of these countries, it is necessary to conform to their laws, rules and regulations related to environmental consideration.

In some developing countries, however, such laws, rules and regulations do not exist, while in others they are not properly enforced. The policies and structures for environmental consideration vary from one country to another.

Therefore, when undertaking the environmental consideration, it is necessary to take into account of the developing country's policies and structures and to understand the country's awareness of environmental problems, while holding sufficient discussions with the people concerned in a flexible manner.

With regard to environmental consideration, JICA's basic principles are to promote sustainable development aimed at improving the living standard of the residents, and harmonize the development with a desirable environment based on the country's willingness.

If environmental consideration is not sufficiently undertaken for implementing a development project and, if careful attention is not paid to the management of the surrounding natural resources, the base of the development might be jeopardized and the development might be halted. The base of the people's livelihood or even their subsistence can be also threatened. It is necessary, therefore, to try to ensure the sustainable development by harmonizing the development project with natural resources and the base of livelihood and subsistence of the residents in the area.

The guidelines describe screening and scoping procedures at the preparatory study stage to deal with the negative impacts of a development project on the environment of the project site and its surrounding area.

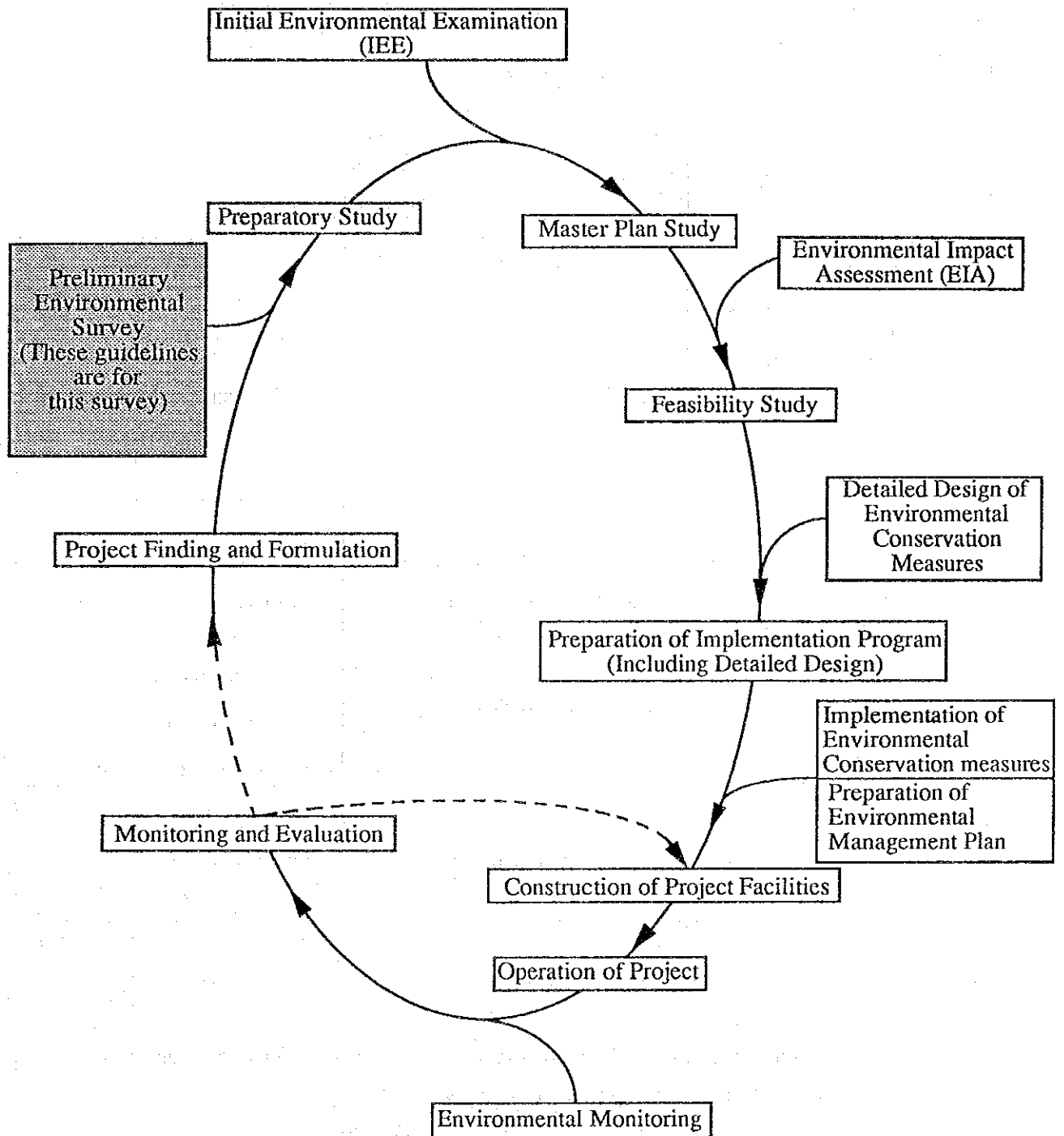
The process of environmental consideration in a project cycle is shown in Figure 1-1.

A development project begins with its finding and formulation. At each stage of the cycle, a series of environmental considerations, such as a preliminary environmental survey, an initial environmental examination (IEE), environmental impact assessment (EIA), and the design of environmental protection measures take place. Environmental monitoring is then conducted with project implementation. Through this process, sustainable development can be attained.

Definition of the environmental management plan mentioned here is limited to the monitoring system which handles the environmental impacts caused by the project.

Tables 1-1 and 1-2 illustrate the time flows corresponding to the project implementation stages and the environmental consideration stages. The flows start with an environmental survey, followed by the EIA, proceed to the examination of environmental conservation measures, and then to the monitoring stage.

Figure 1-1. Flow of Environmental Considerations in Project Cycle



**Table 1-1 Project Implementation Stages and Corresponding Environmental Consideration Stages**

Project Implementation Stages			Environmental Consideration Stages
Implementation by JICA	Preparatory Study		Preliminary Environmental Survey
	Full-scale Study	Master Plan Study	Initial Environmental Examination (IEE)
		Feasibility Study	Feasibility Study
Implementation by Executing Agency	Preparation of Project Implementation Plan (Including Detailed Design)		Examination of Environmental Conservation Measures
	Project Construction		Implementation of Environmental Conservation Measures
	Project Facility Operation		Environmental Monitoring

- Notes: 1. This table does not indicate strict correspondence.  
2. Some projects do not require IEE or EIA.  
3. Preparation of the project implementation plan includes the detailed design of the environmental conservation facilities and their construction.  
4. The item enclosed in a separate box indicates the major boundary for the guidelines.

Table-1.2 Incorporation of Environmental Consideration into JICA's Development Studies

	Study Flow	Contents and Timing Investigation	Examination Items
Project Finding	Request/Project Finding ↓ Acceptance of TOR ↓ Study on TOR	(Preliminary Screening) Judgment on necessity of IEE or EIA ↓	The project judged to cause serious environmental impact shall be rejected.
Preparatory Study	Preparatory Study	(Screening) Review of preliminary screening  (Scoping) Decision of important items for IEE or EIA Decision of work boundaries	
	Discussion and Agreement on S/W ↓ Preparation of Preparatory Study Report	↓	(Preparation of M/M, S/W) Examine the description of agreed items on screening and scoping. (Reporting) Clarification of background and agreed items.
Selection of Consultants	Preparation of Project Specification ↓ Selection of Consultants		(Project Specification) Define the boundary and work volume of IEE or EIA to be conducted by consultants  (Selection of consultants) Evaluate the appropriateness of the proposal for the project specification.
Full-scale Study	Preparation of and Discussion on IC/R ↓ Implementation of IEE or EIA ↓ Explanation of and Discussion on DF/R ↓ Preparation of F/R		(IEE or EIA) Discussion and decision on IEE/EIA items and methods based on the results of scoping.
			(Supervision of survey) Check whether IEE or EIA is conducted properly.  (Final reporting) Clarification of IEE or EIA results and recommendations.

Source: JICA, "Sectoral Study for Development Assistance-Environment", 1988.

Note: The shaded part is mainly covered by the guidelines.

## 1.2 Environmental Consideration for River and Erosion Control Projects

### 1.2.1 Definition of River and Erosion Control Projects in the Guidelines

The rivers dealt with in the guidelines are defined as waterways where the rainwater flows by gravity. They generally include the water-natured objects, such as flow-way from mountains to sea and lakes and swamps on the way, and the land adjacent to such rivers. The objective of river and erosion control projects is to prevent damages caused by flood and debris flows, and the projects are often implemented with other purposes, such as utilizing the water resources for navigation and irrigation. River and erosion control projects may include soil and debris retaining works, river improvement works, dyking works, and the construction of new channels (diversion channels) and pumping stations .

### 1.2.2 Typical Possible Impacts and the Points of Environmental Consideration

The river and erosion control projects are implemented to contribute to the lives and activities of human beings, but may sometimes cause undesirable impacts on the environment. Special attention should be paid to the following items in the environmental consideration.

#### Resettlement

Residents along the river may have to be relocated due to construction of new channels, widening of river courses, construction of dykes and other facilities. Since the areas along the river are convenient for utilizing the river water, such areas are apt to be occupied by illegal squatters, causing the population to increase. Especially in urban areas, squatters have to be resettled away from the city. These people may lose their means of living, such as collecting garbage, because favorable resettlement sites are usually not available in the vicinity.

#### Water Rights and Fishing Rights

The construction of drop structures and check dams may interfere with human lives and the propagation of fresh water fish thereby resulting in the decrease of the fish catch. As a result of the dredging work implemented to increase the flow capacity of river, the normal water level may decrease and it may become impossible to use the river water for irrigation with the existing intake facilities. Therefore, it is necessary to consider the living conditions and customs of residents and land use of the surrounding areas in the environmental consideration.

#### Hydrological Situation

When recurrent flooding is mitigated by river improvement work, the peak discharge in the downstream may become larger thereby increasing the risk of flooding. The diversion channels constructed to divert the flood discharge may decrease the river channel

flushing function by flood discharge and increase sedimentation due to a decrease in the tractive force of the river. Therefore, in the environmental consideration, it is necessary to consider the present navigation and fisheries situations and the downstream areas which are susceptible to flooding.

#### Fauna and flora

The growth and propagation of aquatic life may be obstructed due to a change in the flow situation as a result of a river course change and the diversion of flow, the loss of pools and shallows by dyking and the change of river course, the obstruction of the upstream movement of fish caused by the construction of weirs, the loss of shelter by the construction of revetments, etc. The flood diverted by the new diversion channels may increase the turbidity in the previously clear water zone and the aquatic life may become extinct or disperse. Therefore, it is necessary in environmental consideration to thoroughly grasp the values of the fauna and flora and the characteristics of the ecosystem in the area.





## **CHAPTER 2**

### **PROJECT DESCRIPTION AND SITE DESCRIPTION**



## CHAPTER 2 PROJECT DESCRIPTION AND SITE DESCRIPTION

### 2.1 Basic Concept

To conduct screening and scoping of the potential environmental impacts that may be caused by a development plan or project, it is essential to fully understand the "project description" and "site description" at the earliest stage.

Project description includes the contents and features of the project, such as its background, objectives, location, executing agency, number of beneficiaries, scale, structure, construction method, operation and maintenance, etc..

Site description includes the present conditions of the natural and social environment and pollution in and around the project area.

In particular, if the project site includes such areas as follow, they should receive special attention:

- a) Areas requiring soil conservation (high risk areas of erosion, salinization, etc.).
- b) Arid and semiarid areas subject to desertification.
- c) Tropical forests.
- d) Water sources.
- e) Habitats of value for the protection and conservation and/or sustainable use of fish and wildlife resources (wetlands, mangrove, swamps, coral reefs, etc.)
- f) Areas of unique interest (historical, archaeological, cultural, aesthetic and scientific).
- g) Areas of concentrations of population or industrial activities where further industrial development or urban expansion could create significant environmental problems.
- h) Areas of particular social interest to specific vulnerable population groups (e.g., nomadic people or other people with traditional life styles).

It should be borne in mind that the above items must be thoroughly studied in each project step.

### 2.2 Project Description and Site Description of River and Erosion Control Projects

The project description and the site description should be clarified in the formats shown in Tables 2-1 and 2-2 for screening and scoping.

However, at the project finding and preparatory study stages, sufficient information for the project description and site description may not be available. Thus, during the preparatory work prior to the preparatory study in the host country, the formats of Tables 2-1 and 2-2 should be filled in as complete as possible using all available information. The additional necessary information should be supplemented during the field surveys.

**Table 2-1 Format for Project Description (River and Erosion Control)**

Item	Description
Project Name	
Background	
Objectives	
Location	
Executing Agency	
Beneficiaries	
Project Components	
Type of Project	Flood Control/Erosion Control, Irrigation, Water Supply/Industrial Water, Electric Power Generation
Major Components/ Structures	River Rehabilitation / Regulation Pond, Diversion Channel, Pumping Plant
Scale of Project	Catchment Area:                      km <sup>2</sup> Length of Rehabilitation:              km Levees:                                      km,                                      sites
Appurtenant Facilities	Bridges, Levees, Drop Structures, Revetments, Gauging Stations
Others	

Note: The format should be filled in on the basis of the available existing data and information.

**Table 2-2 Format for Site Description (River and Erosion Control)**

Item		Description
Project Name		
Social Environment	Inhabitants: (residents/indigenous people/their views on the project, etc.)	
	Land Use along the River: (urban area / farmland / historic site / scenic spot / hospital)	
	Economy/Transportation: (commerce • agriculture and fishery • industrial zone/ferry terminal)	
Natural Environment	Topography and Geology: (steep slopes, soft ground, wetlands/dislocations etc.)	
	Coast and Marine Zone: (erosion • sedimentation/tide and current • depth)	
	Valuable Fauna and Flora and Their Habitats: (national parks/habitats of rare species, etc.)	
Pollution	Complaints: (pollution of the upmost concern, etc.)	
	Measures Taken: (institutional measures/ compensation, etc.)	
Others		

Note: The format should be filled in on the basis of the available existing data and information.



## **CHAPTER 3**

### **SCREENING**





## CHAPTER 3 SCREENING

### 3.1 Basic Concept

JICA's 1988 report, "Sectoral Study for Development Assistance-Environment," defines screening as "a process of judgement on whether a development project requires an environmental impact study or not." That is to say, screening is the first judgement in the process of environmental consideration and should commence at the initial stage of the project, such as project finding.

Screening in the guidelines is also based on the above definition. However, the evaluation of whether or not the IEE/EIA is required for a project should be based on appropriate ideas and views for harmonizing the sustainable development with the residents' livelihood and surrounding environment by taking into consideration the project features and its environment, but not on the quantitative standards.

### 3.2 Screening Methods

#### 3.2.1 Outline

As for the procedures for screening in addition to the provisions detailed in the annex to the 1985 OECD council recommendations, JICA's report, "Sectoral Study for Development Assistance-Environment", describes the following cross-sectional viewpoints:

- Can the project adversely affect the sustainability of production which depends mainly on natural resources ?
- Will the project significantly affect people's health ?
- Will the project lead to a deterioration or loss of valuable living resources and their habitats ?
- Will the project have an unreasonable impact on the livelihoods and subsistence of the people concerned ?

Based on the above viewpoints, the screening method should be examined in detail.

If there are laws or regulations concerning the environmental impact assessment for the project in the host country, it is necessary to discuss with the officials concerned of the country to make better environment considerations in accordance with the laws and regulations by referring to the guidelines.

On the other hand, if there are no such laws or regulations in the host country, it may be possible to formulate a standard with respect to the project scale and the land-use conditions for evaluating whether the development project requires an environmental

impact assessment or not. However, setting up a quantitative standard for judgement is not only difficult but its effectiveness is also doubtful because Japanese development assistance is provided to various countries and their environmental characteristics are vastly different.

It is considered to be more effective, therefore, to formulate certain ideas and viewpoints with qualitative expressions for evaluating screening.

### 3.2.2 Screening of River and Erosion Control Projects

Based on the above consideration, the following concepts are established in the preliminary environmental survey :

- The development project should be planned in such a way as to provide society with sufficient benefits while securing the areas' sustainable development and growth without being detrimental to the lives and existence of the residents.
- The development project should be planned in such a way as to maintain harmony with the natural environment, while avoiding significant damage to the existing environment, and preserve valuable natural environmental assets.

The examination of screening should be conducted from practical viewpoints for each environmental item based on the above concepts. The results of the examination should be clarified by using the screening format as shown in Table 3-1 and should be included in the preparatory study report.

The evaluation result of each environmental item should be noted on the format whether or not environmental impacts exist. As the overall evaluation, the conclusion and the reason for evaluating whether or not IEE/EIA is required should be described briefly on the format.

The guidelines should be applied for all environmental impacts that may be caused by the project implementation not only in the project area but also in any area that may be directly or indirectly affected during the construction and after the operation of project facilities.

**Table 3-1 Format for Screening (River and Erosion Control)**

No.	Environmental Item	Description	Evaluation	Remarks (Reason)
<b>Social Environment</b>				
1.	Resettlement	Resettlement due to land occupancy (transfer of rights of residence/land ownership)	[Y][N][?]	
2.	Economic Activities	Loss of base of economic activities, such as land, and change of economic structure	[Y][N][?]	
3.	Traffic and Public Facilities	Impacts on schools, hospitals and present traffic conditions, such as the increase of traffic congestion and accidents	[Y][N][?]	
4.	Split of Communities	Community split due to interruption of area traffic	[Y][N][?]	
5.	Cultural Property	Damage to or loss of value of churches, temples, shrines, archaeological remains or other cultural assets	[Y][N][?]	
6.	Water Rights and Rights of Common	Obstruction of fishing rights, water rights, rights of common	[Y][N][?]	
7.	Public Health Condition	Worsening of public health and sanitation conditions due to the generation of garbage and the increase of vermin	[Y][N][?]	
8.	Waste	Generation of construction waste, debris and logs	[Y][N][?]	
9.	Hazards (Risk)	Increase in danger from ground failure, cave-ins, etc.	[Y][N][?]	
<b>Natural Environment</b>				
10.	Topography and Geology	Changes of valuable topography and geology due to excavation or filling work	[Y][N][?]	
11.	Soil Erosion	Topsoil erosion by rainfall after reclamation and deforestation	[Y][N][?]	
12.	Groundwater	Lowering of the groundwater table due to overdrafting and turbid water caused by construction work	[Y][N][?]	
13.	Hydrological Situation	Changes of river discharge, flow velocity and riverbeds condition due to filling work and diversion channel	[Y][N][?]	
14.	Coastal Zone	Coastal erosion and change of vegetation due to coastal reclamation and coastal changes	[Y][N][?]	
15.	Fauna and Flora	Obstruction of breeding and extinction of species due to changes of habitat conditions	[Y][N][?]	
16.	Meteorology	Changes of temperature, rainfall, wind, etc. due to large-scale reclamation and building construction	[Y][N][?]	
17.	Landscape	Change of topography and vegetation due to reclamation. Deterioration of aesthetic harmony by structures	[Y][N][?]	
<b>Pollution</b>				
18.	Air Pollution	Pollution caused by exhaust gas or toxic gas from vehicles or factories	[Y][N][?]	
19.	Water Pollution	Pollution caused by the decrease of discharge or the inflow of sediments	[Y][N][?]	
20.	Soil Contamination	Contamination caused by discharge or diffusion of sewage or toxic substances	[Y][N][?]	
21.	Noise and Vibration	Noise and vibrations generated by vehicles and pumping operations	[Y][N][?]	
22.	Land Subsidence	Deformation of the land and land subsidence due to lowering of groundwater table	[Y][N][?]	
23.	Offensive Odor	Generation of exhaust gas and offensive odor by facility construction and operation	[Y][N][?]	
Overall Evaluation: Either IEE or EIA is necessary for the project implementation?			[Y][N]	



## **CHAPTER 4**

### **SCOPING**



## CHAPTER 4

### SCOPING

#### 4.1 Basic Concept

In JICA's 1988 report, "Sectoral Study for Development Assistance-Environment," scoping is defined as "a process of identification of the critical environmental impacts out of the possible environmental impacts of a development project. Through the scoping process, the priority fields or items of an environmental impact assessment are also identified". Further, it recommends that scoping should be carried out through discussions with the government of the host country. These discussions are to be based on discussion items prepared in advance, and by taking into account the aforementioned cross-sectional judgement provisions.

With the above definition and the methods used by various agencies, the guidelines provide material for conducting adequate scoping. The guidelines would enable even those who are not IEE and EIA specialists to understand the overall picture of the development project to conduct the sufficient scoping work during the short-term preparatory study period.

#### 4.2 Scoping Methods

##### 4.2.1 Outline

There are several technical methods for environmental impact assessment and its scoping. Each of them is selected in accordance with the project type, the project planning level, the features of the environmental conditions, etc. The most common methods are the checklist method, the matrix method, the overlay method, and the network method. In particular, the checklist and the matrix methods are commonly used by most agencies.

For "identification of the critical environmental impacts out of the possible impacts of a development project," as required by the definition of scoping in the "Sectoral Study for Development Assistance-Environment," it is necessary to include all environmental items which can be predicted to arise along with implementation of the project. To accomplish this, the checklist method seems to be the easiest to understand and the most useful.

Based on the above consideration, the checklist method is proposed for scoping in the guidelines.

To clarify important fields and items among those listed on the checklist, it is necessary to understand the causal relationships between the environmental items and the project related activities during the construction and the operation periods. Thus, to make it easier to understand scoping, the guidelines show typical causal relationships between development activities and environmental items by using the matrix as well as the checklist.

For reference purposes, a comprehensive matrix covering 13 sectors of social and economic infrastructure development projects is shown in Table 4-1.

#### 4.2.2 Scoping of River and Erosion Control Projects

The checklist for scoping of river and erosion control projects is shown in Table 4-2. The matrix for understanding the causal relationship between the development activities and the environmental items is shown in Table 4-3.

To use the checklist for scoping, the following conditions and procedures should be taken into account:

##### (1) Application conditions

###### 1) Periods covered by scoping

Scoping should cover both the construction and operation periods.

###### 2) Spatial extent of scoping

Scoping should not only cover the project site. It should take in the entire area that may be affected by changes in flow conditions and sedimentation supply.

###### 3) Types of Environmental Impacts

Environmental impacts subject to scoping are those having negative impacts on the existing environment.

##### (2) Evaluation method of important fields and items

The evaluation of each item should be rated according to the following categories:

A (serious impact is expected);

B (some impact is expected);

C (extent of impact is unknown but further examination is required because it might become clear as the study progresses);

D (no impact is foreseeable and IEE/EIA is not required).

Important fields and items for IEE/EIA should be identified with reference to "possible environmental impacts," "useful factors for evaluation," "measures," and "related subjects for study" as listed in Table 4-5.

The opinions and views of the host country should also be taken into consideration for the evaluation.



(3) Overall Evaluation

The evaluation results of each environmental item and the reasons for the evaluation should be clearly described on the checklist. The items evaluated as A, B, or C should be examined based on the screening concept to determine whether or not IEE/EIA is required, and the policies for further study of those items should be outlined. If it is possible to alleviate or avoid some environmental impacts by taking adequate measures, the contents should be described.

If, as the result of the evaluation, there are items which are evaluated as "C" or higher, some studies should be conducted for these items.

For the overall evaluation, opinions and views of the host country should be taken into consideration.

The overall evaluation form is shown in Table 4-4.

**Table 4-1 Comprehensive Matrix**

Project Type		Sectoral Development									Comprehensive Development			
		1. Ports and Harbors	2. Airports	3. Roads	4. Railways	5. River and Erosion Control	6. Solid Waste Management	7. Sewerage	8. Groundwater Development	9. Water Supply	10. Regional Development	11. Tourism Development	12. Transportation Development	13. Urban Transportation Development
Environment Items														
Social Environment	1	Resettlement	⊙	⊙	⊙	⊙	⊙	○	○		○	○	○	○
	2	Economic Activities	○	○	○	○					○	○	○	○
	3	Traffic and Public Facilities	○	○	○	○	○	○			○	○	○	○
	4	Split of Communities		○	○	○	○				○	○	○	○
	5	Cultural Property	○	○	○	○	○				○	○	○	○
	6	Water Rights/Rights of Common	⊙	○	○	○	⊙		○	○	○	○	○	
	7	Public Health Condition				○		○			○	○	○	
	8	Waste	○	○	○	○	○	○	○		○	○	○	○
	9	Hazards ( Risk )	○	○	○	○					○	○	○	○
Natural Environment	10	Topography and Soil Condition	○	○	○	○	○				○	○	○	
	11	Soil Erosion		○	○	○					○	○	○	
	12	Groundwater			○	○		○	⊙		○			
	13	Hydrological Situation	○	○	○	○	⊙	○		○	○	○	○	○
	14	Coastal Zone	⊙	○	○	○	○	○			○	○	○	
	15	Fauna and Flora	⊙	⊙	⊙	⊙	⊙	○	○	○	○	○	○	○
	16	Meteorology									○		○	
	17	Landscape	○	○	○	○	○	○	○	○	○	○	○	○
Pollution	18	Air Pollution	○	○	⊙			⊙	○		○		○	○
	19	Water Pollution	○	○	○	○	○	⊙	○	○	○	○	○	
	20	Soil Contamination	○		○			○					○	○
	21	Noise and Vibration	○	⊙	⊙	⊙	○	○	○	○	○	○	○	○
	22	Ground Subsidence								⊙				
	23	Offensive Odor	○					⊙	○		○		○	

Note: ⊙ : The environmental items to which special attention has to be paid

They might cause serious impacts that may affect the project formulation depending on the magnitude of the impacts and the possibility of the measures.

○ : The environmental items which may have a significant impact depending on the scale of project and site conditions

No mark : The environmental items requiring no impact assessment since the anticipated impacts are, in general, not significant.

In case of the comprehensive development projects, all the items are classified in ○, because their studies are usually at the master planning stage and the extent of impacts are not clear.

**Table 4-2 Checklist for Scoping (River and Erosion Control)**

No.	Environmental Item	Evaluation	Reason
<b>Social Environment</b>			
1.	Resettlement		
2.	Economic Activities		
3.	Traffic/Public Facilities		
4.	Split of Communities		
5.	Cultural Property		
6.	Water Rights and Rights of Common		
7.	Public Health Condition		
8.	Waste		
9.	Hazards (Risk)		
<b>Natural Environment</b>			
10.	Topography and Geology		
11.	Soil Erosion		
12.	Groundwater		
13.	Hydrological Situation		
14.	Coastal Zone		
15.	Fauna and Flora		
16.	Meteorology		
17.	Landscape		
<b>Pollution</b>			
18.	Air Pollution		
19.	Water Pollution		
20.	Soil Contamination		
21.	Noise and Vibration		
22.	Land Subsidence		
23.	Offensive Odor		

Note 1: Evaluation categories :

A: Serious impact is expected.

B: Some impact is expected.

C: Extent of impact is unknown ( Examination is needed. Impacts may become clear as study progresses.).

D: No impact is expected. IEE/EIA is not necessary.

Note 2: The evaluation should be made with reference to the "explanation of item" (Table 4-5)

**Table 4-3 Matrix for Scoping ( River and Erosion Control )**

Major Facilities / Activities Activities which may cause impacts Environmental Items		Dikes / Channels / Erosion Control Facilities / Pumping Stations and Water Gates				
		Overall Evaluation	Before Operation		After Operation	
			Reclamation and Spatial Occupancy	Operation of Construction Equipment and Vehicles	Spatial Occupancy	Operation of Facilities
Social Environment	1 Resettlement	◎	◎			
	2 Economic Activity					
	3 Traffic and Public Facility	○	○		○	
	4 Split of Communities	○			○	
	5 Cultural Property	○	○			
	6 Water Rights/Rights of Common	◎	○		○	◎
	7 Public Health Condition					
	8 Waste	○	○			
	9 Hazards ( Risk )					
Natural Environment	10 Topography and Geology	○	○			○
	11 Soil Erosion					
	12 Groundwater					
	13 Hydrological Situation	◎	◎			◎
	14 Coastal Zone	○	○			○
	15 Fauna and Flora	◎	◎		○	○
	16 Meteorology					
17 Landscape	○	○		○		
Pollution	18 Air Pollution					
	19 Water Pollution	○	○			○
	20 Soil Contamination					
	21 Noise and Vibration	○		○		○
	22 Land Subsidence					
	23 Offensive Odor					

Note:◎ : The environmental items to which special attention has to be paid. They might cause serious impacts that may affect the project formulation depending on the magnitude of the impacts and the possibility of the measures.

○ : The environmental items which may have a significant impact depending on the scale of the project and site conditions

No mark : The environmental items requiring no impact assessment since the anticipated impacts are, in general, not significant.



**Table 4-5 Explanation of Item 1 (River and Erosion Control)**

Item	1. Resettlement
Description	Resettlement due to land occupancy (transfer of rights of residence/land ownership)
Causes of Impacts	<ol style="list-style-type: none"> <li>1. Land acquisition for construction of diversion channels and cut-off, etc.</li> <li>2. Land acquisition for rehabilitation and widening of river channels</li> <li>3. Land-use restriction due to the construction of regulating ponds and sand pockets</li> <li>4. Resettlement may be required for the bank protection and revetment works</li> <li>5. People who come from the rural area to seek employment may illegally occupy the high water channel and riversides located in the center and/or outskirts of the city.</li> </ol>
Possible Environmental Impacts	<ol style="list-style-type: none"> <li>1. In the case of resettlement due to the river improvement, the resettlement area is generally located in the neighborhood. Thus, the living environment will not change a great deal if it is sufficiently compensated. However, it may become inconvenient for the inhabitants who presently live near the riverside to use river water.</li> <li>2. In the urban area, there is a possibility of losing the opportunity to obtain sources of income for inhabitants who are relocated away from the original site. It is also possible to cause inconvenience due to their separation from their farms.</li> </ol>
Useful Factors for Evaluation	<ol style="list-style-type: none"> <li>1. Resettlement may be difficult if inhabitants live on special environmental resources which are peculiar to the area.</li> <li>2. Resettlement may be difficult in cases where the inhabitants own the land.</li> <li>3. Careful attention should be paid to the resettlement when racial problems exist.</li> <li>4. Resettlement may be more difficult when there is no favorable resettlement area nearby.</li> </ol>
Measures	<ol style="list-style-type: none"> <li>1. Selection of resettlement area by considering the wishes of the inhabitants</li> <li>2. Meetings with the inhabitants and provision of necessary information</li> <li>3. Improvement of the living and economic situations in the resettlement area</li> <li>4. Sufficient compensation</li> <li>5. Job training and guidance</li> </ol>
Related Subjects for Study	<ol style="list-style-type: none"> <li>1. Number of inhabitants to be relocated and their economic conditions</li> <li>2. Conditions of the resettlement area</li> <li>3. Past cases of resettlement</li> </ol>

**Table 4-5 Explanation of Item 3 (River and Erosion Control)**

Item	3. Traffic and Public Facilities
Description	Impacts on schools, hospitals and present traffic conditions, such as the increase of traffic congestion and accidents
Causes of Impacts	<ol style="list-style-type: none"> <li>1. Depth of water in the existing river channel would become shallow due to a decrease of discharge by diversion.</li> <li>2. River crossing structures, such as diversion weirs, drop structures, groundsills, etc., would become obstacles for river traffic by boat and/or raft.</li> <li>3. The approach to the existing river would be obstructed by the installation of levees and bank protection.</li> </ol>
Possible Environmental Impacts	<ol style="list-style-type: none"> <li>1. River traffic by boat/rafting would become difficult or impossible.</li> <li>2. Water use, such as bathing and washing, would become difficult or impossible.</li> <li>3. In case the existing traffic way is cut off by the new river channel, the use of public facilities, such as schools and hospitals, would be restricted.</li> </ol>
Useful Factors for Evaluation	<ol style="list-style-type: none"> <li>1. The impact will be larger if the river traffic is the only traffic in the area.</li> <li>2. The impact will be larger in case the area near the river is heavily populated.</li> <li>3. Consideration should be given to public facilities, such as schools and hospitals.</li> </ol>
Measures	<ol style="list-style-type: none"> <li>1. Securing of river maintenance flow</li> <li>2. Application of usable bank protection</li> <li>3. Installation of stepped structures, etc.</li> <li>4. Installation of bridges, ferries etc.</li> <li>5. Discussions with the residents (especially with women)</li> </ol>
Related Subjects for Study	<ol style="list-style-type: none"> <li>1. Condition of water traffic</li> <li>2. Condition of water use (especially daily use)</li> </ol>

**Table 4-5 Explanation of Item 4 (River and Erosion Control)**

Item	4. Split of Communities
Description	Community split due to interruption of area traffic
Causes of Impacts	<ol style="list-style-type: none"> <li>1. Construction of new water channels, such as diversion, channel, cut-off, etc.</li> <li>2. Construction of embankments</li> </ol>
Possible Environmental Impacts	<ol style="list-style-type: none"> <li>1. Area split due to the construction of new channels</li> <li>2. Appearance of the partition within the area due to the construction of embankments</li> </ol>
Useful Factors for Evaluation	<ol style="list-style-type: none"> <li>1. The impact would be greater in densely populated areas.</li> <li>2. The antipathy of residents will be aroused if the construction of diversion channel offers no benefits to the area.</li> <li>3. The antipathy of residents will be aroused if they are to be located outside the embankments.</li> <li>4. Special attention should be given to those communities having long existing traditional activities and customs, and that are tightly united in their social activities.</li> </ol>
Measures	<ol style="list-style-type: none"> <li>1. Installation of bridges</li> <li>2. Operation of ferries</li> <li>3. Installation of land locks</li> </ol>
Related Subjects for Study	<ol style="list-style-type: none"> <li>1. Inhabitants' attitude</li> <li>2. Traffic survey</li> </ol>



**Table 4-5 Explanation of Item 5 (River and Erosion Control)**

Item	5. Cultural Property
Description	Damage to or loss of the value of churches, temples, shrines, archaeological remains or other cultural assets
Causes of Impacts	<ol style="list-style-type: none"> <li>1. Land acquisition for the widening or diversion of river channels and the construction of new water channels</li> <li>2. Possibility of scrapping or rehabilitating of river structures having cultural value</li> </ol>
Possible Environmental Impacts	<ol style="list-style-type: none"> <li>1. Loss of or damage to irreplaceable archaeological and cultural assets</li> <li>2. Loss of ancient landscape and cultural assets</li> <li>3. Loss of or damage to important cultural assets in the area that may affect the feelings of the inhabitants</li> </ol>
Useful Factors for Evaluation	<ol style="list-style-type: none"> <li>1. Special attention should be paid to the area's unique cultural assets.</li> <li>2. Special attention should be paid to the cultural assets specified by laws and regulations.</li> <li>3. Special attention should be paid to the cultural assets which are regarded historically and culturally important from global viewpoints.</li> <li>4. Buildings in unique tribal communities or villages should be treated carefully.</li> </ol>
Measures	<ol style="list-style-type: none"> <li>1. Preservation or relocation of the archaeological or cultural assets</li> <li>2. Reexamination of the construction plan</li> <li>3. Meetings with the inhabitants and provision of necessary information</li> </ol>
Related Subjects for Study	<ol style="list-style-type: none"> <li>1. Laws and regulations related to the preservation of archaeological remains and cultural assets</li> <li>2. Local history and folklore</li> <li>3. Preservation or relocation plans and measures</li> </ol>

**Table 4-5 Explanation of Item 6 (River and Erosion Control)**

Item	6. Water Rights and Rights of Common
Description	Obstruction of fishing rights, water rights, rights of common
Causes of Impacts	<ol style="list-style-type: none"> <li>1. Difference of land conditions in and outside the embankments</li> <li>2. Obstruction of land use due to the installation of retarding basins</li> <li>3. Stoppage of soil and water supplies by floods</li> <li>4. Obstruction of habitation, movement and spawning of fish due to the construction of flood control and erosion control facilities</li> </ol>
Possible Environmental Impacts	<ol style="list-style-type: none"> <li>1. Troubles may occur due to unfairness of the land condition in and outside the embankments.</li> <li>2. Land use for customary farming would be obstructed by a flood caused by a retarding basin.</li> <li>3. Decrease in fish catch of fresh-water fishermen</li> <li>4. Decrease in agriculture production due to the decline of soil fertility</li> <li>5. Decrease in groundwater quantity and/or increase in pump lifting depth may occur when the groundwater recharge by flood declines. (For example, in Bangladesh where rice is grown by irrigation using groundwater during dry seasons, shallow wells become unusable due to the lowering of the groundwater table when flood waters disappear.)</li> </ol>
Useful Factors for Evaluation	<ol style="list-style-type: none"> <li>1. Rights of landuse may often exist customarily in the area.</li> <li>2. Special attention should be paid to the farming that depends on flood sedimentation.</li> </ol>
Measures	<ol style="list-style-type: none"> <li>1. Meetings with the inhabitants and provision of necessary information</li> <li>2. Sufficient compensation and provision of substitute</li> <li>3. Regulation of land use</li> <li>4. Reexamination of construction plan</li> </ol>
Related Subjects for Study	<ol style="list-style-type: none"> <li>1. Past cases of water rights and rights of common</li> <li>2. Land ownership</li> <li>3. Land use</li> </ol>

**Table 4-5 Explanation of Item 8 (River and Erosion Control)**

Item	8. Waste
Description	Generation of construction waste, debris and logs
Causes of Impacts	<ol style="list-style-type: none"> <li>1. Generation of waste, such as debris and logs, due to the construction of new water channels, normalization or widening of river channels, etc.</li> </ol>
Possible Environmental Impacts	<ol style="list-style-type: none"> <li>1. Illegal disposal of trash into rivers and lakes, etc., if there is a shortage of or no disposal sites. In this case, water and soil pollution or the deterioration of landscape may occur.</li> </ol>
Useful Factors for Evaluation	<ol style="list-style-type: none"> <li>1. Amount of debris could be estimated from the scale of excavation work.</li> <li>2. When building structures are demolished, large amounts of construction waste would be produced.</li> </ol>
Measures	<ol style="list-style-type: none"> <li>1. Securing of disposal sites for waste dumps and construction waste</li> <li>2. Careful construction work and management</li> </ol>
Related Subjects for Study	<ol style="list-style-type: none"> <li>1. Physical and chemical characteristics of waste</li> <li>2. Land ownership and land use conditions for obtaining disposal sites</li> <li>3. Laws and regulations related to solid waste management</li> </ol>

Table 4-5 Explanation of Item 10 (River and Erosion Control)

Item	10. Topography and Geology
Description	Change of valuable topography and geology due to excavation or filling work
Causes of Impacts	<ol style="list-style-type: none"> <li>1. Large-scale excavation and filling work for river/erosion control construction work, such as embankment, bank protection, river improvement, floodway, diversion channel, cut-off, fill work, etc.</li> </ol>
Possible Environmental Impacts	<ol style="list-style-type: none"> <li>1. Loss or damage to scientifically valuable topography or geology due to large-scale excavation</li> <li>2. In the upper stream of large-scale checkdams, both banks would be buried by sedimentation.</li> </ol>
Useful Factors for Evaluation	<ol style="list-style-type: none"> <li>1. Significant impact will be caused if the riverside is heavily populated.</li> <li>2. Special attention should be paid to scientifically valuable topography or geology.</li> <li>3. Careful consideration should be given to areas having fresh-water fisheries.</li> </ol>
Measures	<ol style="list-style-type: none"> <li>1. Reexamination of reclamation</li> <li>2. Reexamination of the project plan</li> </ol>
Related Subjects for Study	<ol style="list-style-type: none"> <li>1. Topographical and geological surveys</li> <li>2. Geographical study</li> </ol>

**Table 4-5 Explanation of Item 13 (River and Erosion Control)**

Item	13. Hydrological Situation
Description	Changes of river discharge, flow velocity and riverbed condition due to filling work and diversion channel
Causes of Impacts	<ol style="list-style-type: none"> <li>1. Inflow into lakes by diversion channels</li> <li>2. Decrease or disappearance of water flow in the present river channel due to the construction of diversion channels and cut-off</li> <li>3. Concentrated flood runoff due to the improvement of upper streams (including branches)</li> <li>4. Flood runoff and peak discharge will be decreased by the diversion. Therefore, the tractive force in the downstream area of the present river channel from the diversion point will also decline.</li> </ol>
Possible Environmental Impacts	<ol style="list-style-type: none"> <li>1. Existence and breeding of aquatic life in the lakes will be obstructed by the water pollution and inflow of sewage.</li> <li>2. When the water quantity decreases in the present rivers, fishery and river transportation will be seriously affected.</li> <li>3. Flooding would occur in the downstream area due to the increase of flood peak discharge.</li> </ol>
Useful Factors for Evaluation	<p>Special attentions should be paid under the following conditions.</p> <ol style="list-style-type: none"> <li>1. The present river channels have a tendency to accumulate sedimentation.</li> <li>2. There are sections in the downstream area of the improvement site that are susceptible to flood damage.</li> <li>3. The present river channels are used for river transportation.</li> <li>4. There are ports at the river mouth.</li> </ol>
Measures	<ol style="list-style-type: none"> <li>1. Revision of diversion ratio</li> <li>2. Embankment construction and dredging work in the downstream area</li> </ol>
Related Subjects for Study	<ol style="list-style-type: none"> <li>1. Study of valuable aquatic life</li> <li>2. Water quality</li> <li>3. Unsteady flow analysis</li> <li>4. Sediment load analysis</li> </ol>

**Table 4-5 Explanation of Item 14 (River and Erosion Control)**

Item	14. Coastal Zone
Description	Coastal erosion and change of vegetation due to coast reclamation and coastal changes
Causes of Impacts	<ol style="list-style-type: none"> <li>1. Change of supply of littoral sediment due to the construction of diversion channels</li> <li>2. Decrease of sediment due to the construction of sand arresting structures</li> <li>3. Increase of turbidity in the marine zone due to flood runoff</li> </ol>
Possible Environmental Impacts	<ol style="list-style-type: none"> <li>1. The supply of sedimentation decreases between the original river mouth and floodways' river mouth causing the shoreline to retreat. This condition would lead to disaster.</li> <li>2. Destruction of sandy beaches and disappearance of recreational spots</li> <li>3. Collapse of seashore recharged by sediment yield</li> <li>4. Extinction of aquatic life due to the turbid water</li> </ol>
Useful Factors for Evaluation	<ol style="list-style-type: none"> <li>1. Sediment-rich seashores would be seriously affected.</li> <li>2. Breeding sites of aquatic life would be seriously affected.</li> <li>3. Coral would be seriously affected by turbid water.</li> </ol>
Measures	<ol style="list-style-type: none"> <li>1. Construction of seashore levees</li> <li>2. Groin, offshore levee</li> <li>3. Provision of beach nourishment</li> <li>4. Change of diversion channel plan</li> </ol>
Related Subjects for Study	<ol style="list-style-type: none"> <li>1. Oceanography (especially, wave, coastal current, and coastal sediment)</li> <li>2. Sediment load</li> <li>3. Aquatic life</li> </ol>

**Table 4-5 Explanation of Item 15 (River and Erosion Control)**

Item	15. Fauna and Flora
Description	Obstruction of breeding and extinction of species due to change of habitat conditions
Causes of Impacts	<ol style="list-style-type: none"> <li>1. Serious change of flow condition or loss of flow due to the change of river channels and the construction of diversion channels</li> <li>2. Disappearance of recreational spots due to the reclamation of river channels</li> <li>3. Impacts on turbidity and saline density due to the construction and flood discharge, and change of physical environment due to the bank protection and revetment works</li> <li>4. Change of habitat conditions of aquatic life due to the disappearance of flood.</li> <li>5. Obstruction of upstream movement of fish due to the constructions of weirs, checkdams and drop structures.</li> </ol>
Possible Environmental Impacts	<ol style="list-style-type: none"> <li>1. Impacts on biodiversity created by obstruction of living conditions of aquatic life, increase and/or growth of harmful species and the extinction of useful and/or valuable species</li> <li>2. Extinction and/or decrease of some species due to the loss of places for shelters and breeding</li> <li>3. Loss of fishing ground due to the extinction and dispersion of marine life caused by increase of turbidity</li> <li>4. Obstruction of seaweed and fish growth due to the loss of fresh water and nourishment supply</li> <li>5. Obstruction of living and breeding of fish that migrate in the rivers</li> </ol>
Useful Factors for Evaluation	<p>Special attention should be paid to the following cases.</p> <ol style="list-style-type: none"> <li>1. Installation of facilities and construction work which would affect the marine resources area</li> <li>2. Discharge to semi-closed and/or closed water basins, such as lakes, bays, lagoons, etc.</li> <li>3. There are sedimentation areas in which the sediment is supplied by flooding.</li> <li>4. There are endangered and/or rare species listed in the Red Data Books of the International Union for the Conservation of Nature and Natural Resources (IUCN).</li> <li>5. There is a vulnerable ecosystem (e.g. primary forests, wetlands and mangrove forests.)</li> </ol>
Measures	<ol style="list-style-type: none"> <li>1. Adoption of bank protection methods considering the ecological environment</li> <li>2. Consideration of maintenance flow</li> <li>3. Change of the location of diversion channel's mouth</li> <li>4. Installation of fish-passing facilities</li> <li>5. Compensation</li> </ol>
Related Subjects for Study	<ol style="list-style-type: none"> <li>1. Aquatic life</li> <li>2. Past cases of similar projects</li> </ol>

**Table 4-5 Explanation of Item 17 (River and Erosion Control)**

Item	17. Landscape
Description	Change of topography and vegetation due to reclamation. Deterioration of aesthetic harmony by the appearance of structures
Causes of Impacts	<ol style="list-style-type: none"> <li>1. Change of natural landscape by the construction of river and erosion control structures or sediment created by such construction</li> <li>2. Change of flow condition due to diversion</li> <li>3. Decrease of sediment supply along the coast due to diversion and sand trap work</li> </ol>
Possible Environmental Impacts	<ol style="list-style-type: none"> <li>1. Damage to landscape due to the construction of dikes, checkdams, groin and spur dikes, gates, etc.</li> <li>2. Damage to landscape due to the stagnation of river flow and the growth of aquatic plants</li> <li>3. Damage to landscape due to the loss of beaches</li> </ol>
Useful Factors for Evaluation	<ol style="list-style-type: none"> <li>1. The better landscape would have the larger impacts.</li> <li>2. Special attention should be paid to such landscape that is related to religion and tourism.</li> </ol>
Measures	<ol style="list-style-type: none"> <li>1. Modification of landscape</li> <li>2. Beach nourishment</li> <li>3. Adoption of usable methods</li> <li>4. Maintenance flow for purification</li> </ol>
Related Subjects for Study	<ol style="list-style-type: none"> <li>1. Present situation of tourism</li> <li>2. Ethnological survey</li> </ol>



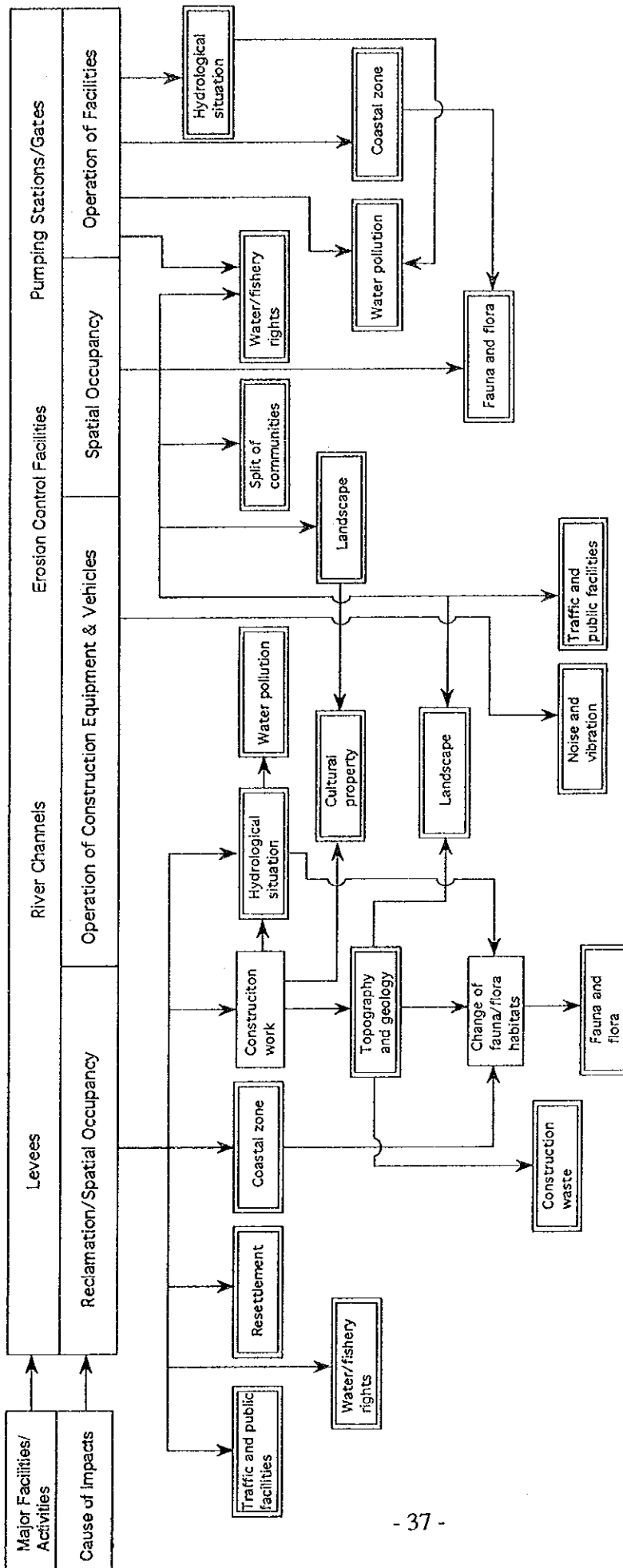
**Table 4-5 Explanation of Item 19 (River and Erosion Control)**

Item	19. Water Pollution
Description	Pollution caused by the decrease of discharge and the inflow of sediment
Causes of Impacts	<ol style="list-style-type: none"> <li>1. Excavation and dredging for river work</li> <li>2. Inflow of flood water to other basins by the construction of a diversion channel</li> <li>3. Loss of discharge in the existing rivers due to the construction of diversion and cut-off channels</li> <li>4. Intrusion of sea water into diversion channels</li> </ol>
Possible Environmental Impacts	<ol style="list-style-type: none"> <li>1. Temporary inconvenience in utilizing river water in the downstream area due to turbidity</li> <li>2. Obstruction of living and breeding of aquatic life due to turbidity by flood water in the basins never before affected by turbidity (even if the turbidity is only temporary during the flood, it may have a permanent effect on the aquatic life)</li> <li>3. Negative impacts on the public health, obstruction of water utilization, and offensive odor due to the deterioration of water quality in the channels where the discharge is decreased</li> <li>4. Intrusion of saline water to the groundwater due to seepage from the river</li> </ol>
Useful Factors for Evaluation	<ol style="list-style-type: none"> <li>1. The impact would be larger in cases where the riversides are densely populated.</li> <li>2. In case the basin has never been affected by turbidity, the impacts on aquatic life would be larger.</li> <li>3. Careful attention should be paid if valuable aquatic life exists in the downstream area.</li> </ol>
Measures	<ol style="list-style-type: none"> <li>1. Careful planning and management of construction</li> <li>2. Provision of maintenance flow for purification</li> <li>3. Provision of public water supply system.</li> <li>4. Provision of tidal gate</li> <li>5. Modification of diversion channel plan</li> </ol>
Related Subjects for Study	<ol style="list-style-type: none"> <li>1. Present water utilization</li> <li>2. Present water quality</li> <li>3. Present situation of aquatic life</li> <li>4. Present situation of groundwater utilization</li> </ol>

**Table 4-5 Explanation of Item 21 (River and Erosion Control)**

Item	21. Noise and Vibration
Description	Noise and vibration generated by vehicles and pumping operation
Causes of Impacts	<ol style="list-style-type: none"> <li>1. Operation of construction equipment and pile drivers, etc. for river and erosion control construction</li> <li>2. Operation of generators for discharge pumps</li> </ol>
Possible Environmental Impacts	<ol style="list-style-type: none"> <li>1. Living conditions of residents will be affected by the noise and vibration caused by the construction equipment.</li> <li>2. Living conditions of residents will be affected by noise from discharge pumping stations. (not only from generators, but also there is a possibility of noise from cooling facilities)</li> <li>3. Hospitals and schools would be affected more by the noise and vibration.</li> <li>4. In case of night operations, interruption of inhabitants' sleep, negative impact on cattle breeding, and the dispersion of wild animals may occur.</li> </ol>
Useful Factors for Evaluation	<p>Serious impacts may occur under the following conditions:</p> <ol style="list-style-type: none"> <li>1. There are densely populated areas.</li> <li>2. There are facilities that require quiet conditions, such as schools, hospitals, etc..</li> <li>3. There are soft ground areas, such as landfill, clayey soil layer, etc..</li> </ol>
Measures	<ol style="list-style-type: none"> <li>1. Improvement of construction methods (e.g., use of low vibration pile drivers)</li> <li>2. Change of cooling methods (air cooling systems produce a much higher noise level)</li> <li>3. Careful construction planning and management, (e.g., examination of construction period and working hours)</li> <li>4. Installation of acoustic walls and buffer zones</li> </ol>
Related Subjects for Study	<ol style="list-style-type: none"> <li>1. Inhabitants' awareness</li> <li>2. Locations and conditions of public facilities</li> <li>3. Geological survey</li> </ol>

# Appendix. Flow Chart of Environmental Impacts of River and Erosion Control Projects



Note :  : Indicates the environmental items shown in Table 4-3.

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