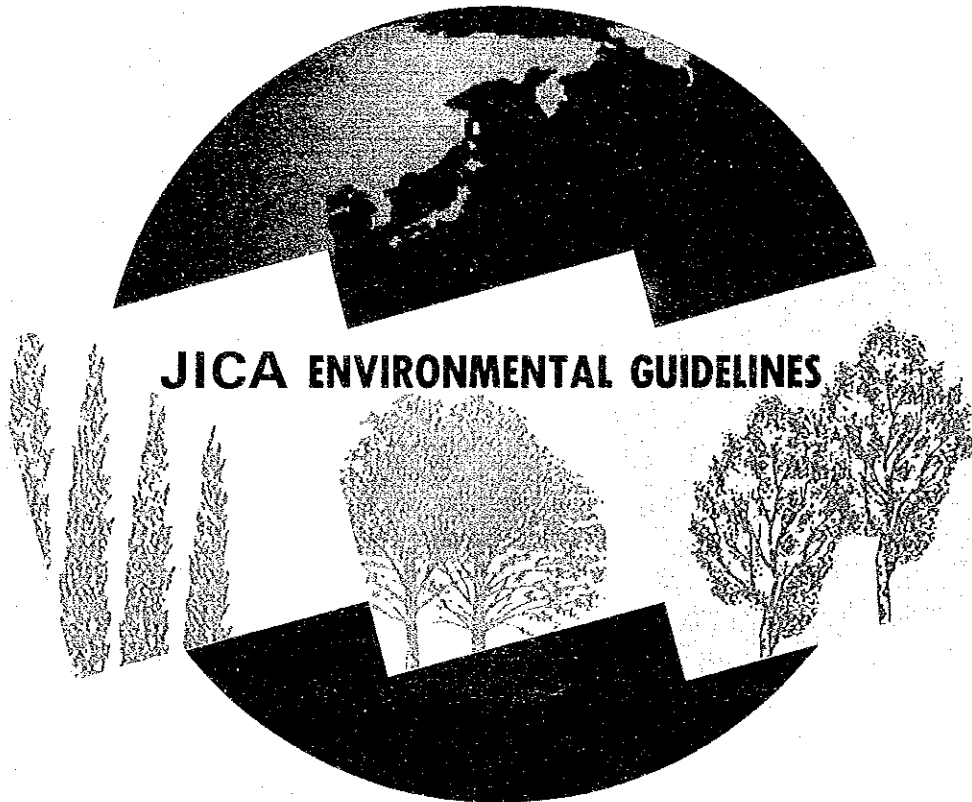


ENVIRONMENTAL GUIDELINES FOR INFRASTRUCTURE PROJECTS

VIII GROUNDWATER DEVELOPMENT



SEPTEMBER 1992

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ENVIRONMENTAL GUIDELINES FOR INFRASTRUCTURE PROJECTS

VIII GROUNDWATER DEVELOPMENT

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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 "Groundwater Development".

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.

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

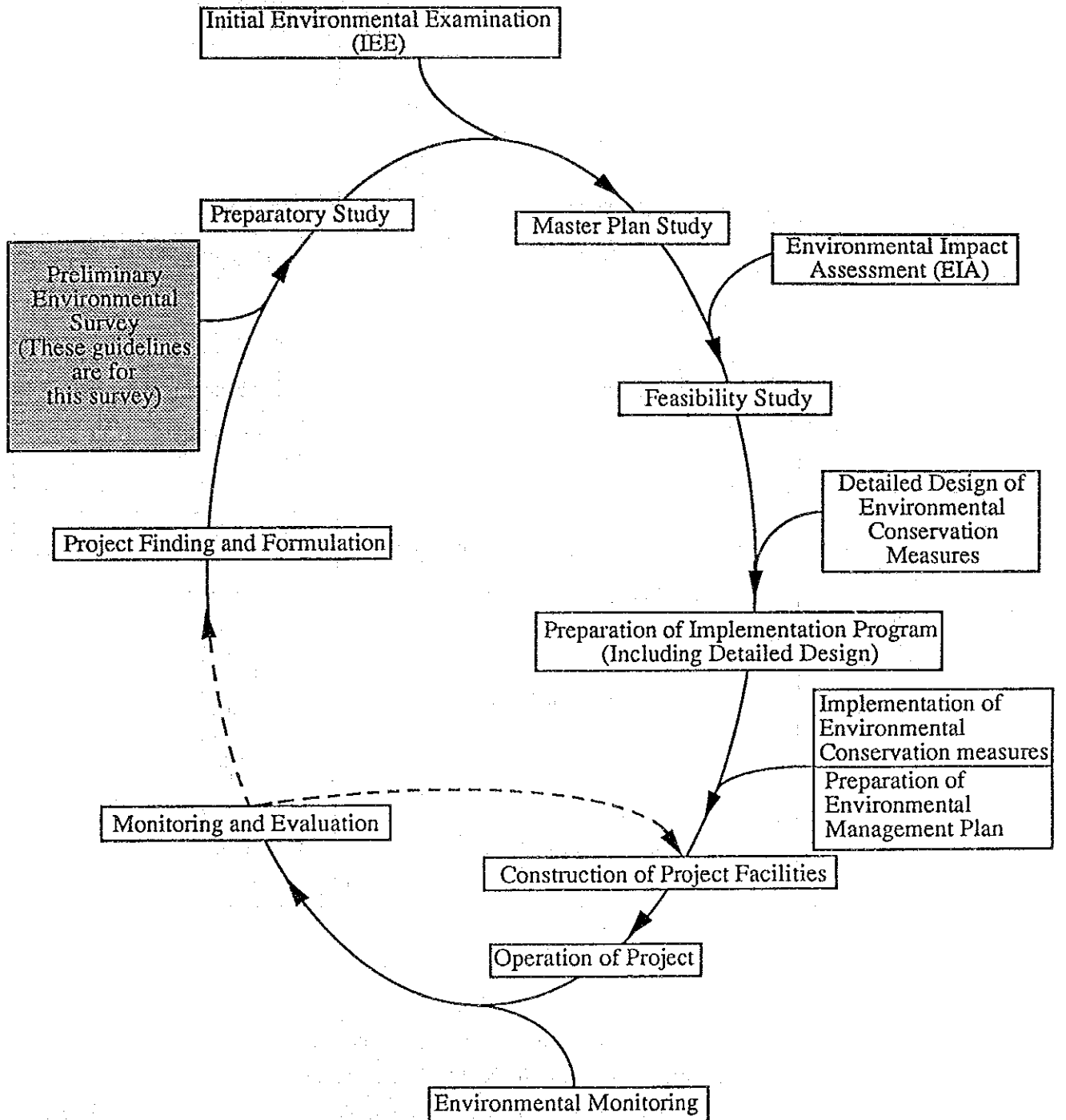


Table 1-1 Project Implementation Stages and Corresponding Environmental Consideration Stages

Project Implementation Stages				Environmental Consideration Stages
Implementation by JICA	Preparatory Study			Preliminary Environmental Survey
	Full-scale Study	Master Plan Study	Feasibility Study	Initial Environmental Examination (IEE)
		Feasibility Study		Environmental Impact Assessment (EIA)
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	
	Discussion and Agreement on S/W ↓ Preparation of Preparatory Study Report	(Scoping) Decision of important items for IEE or EIA Decision of work boundaries	(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		(IEE or EIA) Discussion and decision on IEE/EIA items and methods based on the results of scoping.
	Explanation of and Discussion on DF/R ↓ Preparation of F/R ↓		(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 Groundwater Development Projects

1.2.1 Definition of Groundwater Development Projects in the Guidelines

Groundwater development projects in the guidelines, include the development projects which drill and lift groundwater to supply domestic, industrial, and agricultural water, but exclude recharge facilities for groundwater preservation and underground dams.

1.2.2 Typical Possible Impacts and the Points of Environmental Consideration

Since groundwater development projects are conducted to improve the standard of public health and sanitary conditions, they have strong positive impacts on the living conditions of inhabitants. In case of overdraft, however, they could cause several typical environmental impacts as follows:

Groundwater

Overdraft causes the groundwater table to lower and the groundwater sources to become exhausted, involving the exhaustion of springs and wells which affects the people's livelihood. Moreover, the lowering of the groundwater table may cause groundwater pollution by seawater intrusion.

For environmental consideration, the present condition of groundwater resources and the available pumping capacity should be examined.

Land Subsidence

Land subsidence is caused by consolidation and contraction of clay layers due to the lowering of groundwater. Land subsidence may bring about the transformation and functional disorder of various structures, and the spread of flood damage area caused by the decrease in drainage capacity. These phenomena will raise the urban development cost.

For environmental consideration, the present condition of land subsidence and land use in the study area should be examined.

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 Groundwater Development 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 (Groundwater Development)

Item	Description
Project Name	
Background	
Objectives	
Location	
Executing Agency	
Beneficiaries	
Project Components	
Type of Project	Construction / Rehabilitation
Major Features	Drinking, Agricultural, Industrial Water / Reservoir / Improvement of Working Condition for Women and Children
Scale of Project/	Depth of Groundwater Sources : m
Water Quality	Water Quality :
Major Structures	Number of Drilling : Conveyance / Distribution Pipes : km
Reservoir Facilities	Number of Tanks ----- , Capacity ----- m ³
Purification plant	Treatment Process ----- Treatment Capacity ----- m ³ / day
Appurtenant Facilities	Transmission Line/Management Facilities
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 (Groundwater Development)

Item		Description
Project Name		
Social Environment	Inhabitants: (residents / indigenous people / their views on the project, etc.)	
	Public Facilities: (wells, reservoirs, water supply/electricity)	
	Public Health and Sanitation: (illness / infectious diseases, hospitals, sanitary habits)	
Natural Environment	Topography and Geology: (steep slopes, soft ground, wetlands / faults etc.)	
	Lakes, River System, Coast, Climate: (water quality and quantity, rainfall, etc.)	
	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 Groundwater Development 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 (Groundwater Development)

No.	Environmental Item	Description	Evaluation	Remarks (Reason)
Social Environment				
1.	Resettlement	Resettlement by land occupation (transfer of rights of residence, land ownership)	[Y][N][?]	
2.	Economic Activities	Loss of production base (land, etc.) and change of economic structure	[Y][N][?]	
3.	Traffic and Public Facilities	Impacts on existing traffic, schools, hospitals, etc. (e.g., traffic jam, accidents)	[Y][N][?]	
4.	Split of Communities	Separation of regional communities by hindrance of regional traffic	[Y][N][?]	
5.	Cultural Property	Loss or deterioration of cultural properties, such as temples, shrines, archaeological assets, etc.	[Y][N][?]	
6.	Water Rights and Rights of Common	Obstruction of fishing rights, irrigation and water rights	[Y][N][?]	
7.	Public Health Condition	Worsening of health and sanitary condition due to generation of garbage and appearance of harmful insects	[Y][N][?]	
8.	Waste	Generation of construction waste, surplus soils, sludge, domestic waste, etc.	[Y][N][?]	
9.	Hazards (Risk)	Increase in risk of cave-ins, ground failure and accidents	[Y][N][?]	
Natural Environment				
10.	Topography and Geology	Change of valuable topography and geology due to excavation and earthfill	[Y][N][?]	
11.	Soil Erosion	Topsoil erosion by rainfall after land reclamation or deforestation	[Y][N][?]	
12.	Groundwater	Lowering of groundwater table due to overdraft and turbid water caused by construction work	[Y][N][?]	
13.	Hydrological Situation	Change of discharge and water quality due to reclamation and drainage	[Y][N][?]	
14.	Coastal Zone	Coastal erosion and sedimentation due to change of littoral drift and reclamation	[Y][N][?]	
15.	Fauna and Flora	Interruption of reproduction or extinction of species due to change of habitat condition	[Y][N][?]	
16.	Meteorology	Change of micro-climate, such as temperature, wind, etc., due to large scale reclamation and construction	[Y][N][?]	
17.	Landscape	Deterioration of aesthetic harmony by structures and topographic change by reclamation	[Y][N][?]	
Pollution				
18.	Air Pollution	Pollution caused by exhaust gas or toxic gas from vehicles and factories	[Y][N][?]	
19.	Water Pollution	Water pollution of river and groundwater caused by drilling mud and oil	[Y][N][?]	
20.	Soil Contamination	Contamination caused by discharge or diffusion of sewage or toxic substances	[Y][N][?]	
21.	Noise and Vibration	Generation of noise and vibration due to drilling and operation of pumping machines	[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 offensive odor and exhaust gases	[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 Groundwater Development Projects

The checklist for scoping of groundwater development 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 cover not only the area around pumping wells, but also the groundwater basin where existing pumping wells are located.

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 (Groundwater Development)

No.	Environmental Item	Evaluation	Reason
Social Environment			
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)		
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 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 (Groundwater Development)

Major Facilities / Activities Activities which may cause impacts Environmental Items		Pumping Facilities				
		Overall Evaluation	Before Operation		After Operation	
			Reclamation and Spatial Occupancy	Operation of Construction Equipment	Spatial Occupancy	Operation of Facilities and Pumping
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, because 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 6 (Groundwater Development)

Item	6. Water Rights and Rights of Common
Description	Obstruction of irrigation and water rights
Causes of Impacts	<ol style="list-style-type: none"> 1. Lowering of groundwater table caused by overdrafting
Possible Environmental Impacts	<ol style="list-style-type: none"> 1. Decrease in pumping capacity of the existing wells which are located around the new wells 2. Drying up of private shallow wells <p>[Reference]</p> <p>Large-scale facilities, such as recharge ponds and underground dams, could affect the environment considerably.</p>
Useful Factors for Evaluation	<p>In the following cases, the impact could be significant, and careful environmental consideration is necessary:</p> <ol style="list-style-type: none"> 1. Many wells exist in the study area. 2. Water table has a recent tendency to lower. 3. A large quantity of groundwater is used for irrigation. 4. New wells are planned in such areas as special tribal community.
Measures	<ol style="list-style-type: none"> 1. Meetings with inhabitants and provision of necessary information 2. Sufficient compensation 3. Restriction of irrigation water 4. Groundwater utilization plan (water for living use should be given priority)
Related Subjects for Study	<ol style="list-style-type: none"> 1. Groundwater utilization 2. Groundwater capacity 3. Community structure

Table 4-5 Explanation of Item 12 (Groundwater Development)

Item	12. Groundwater
Description	Lowering of the groundwater table due to overdraft, and turbid water caused by construction work
Causes of Impacts	<p>1. Overdraft in the operation</p> <p>[Reference]</p> <p>Groundwater flow systems are changed considerably by the construction of recharge facilities and underground dams even though these facilities have many positive effects on groundwater development.</p>
Possible Environmental Impacts	<p>1. Lowering of the groundwater table and the exhaustion of wells which may affect the groundwater use in the area.</p> <p>2. Groundwater pollution caused by seawater intrusion as the result of the lowering of the groundwater table near the seashore</p>
Useful Factors for Evaluation	<p>1. Shallow wells (having an unconfined groundwater) tend to receive serious impacts.</p> <p>2. Special attention should be paid when the lowering of the groundwater table and land subsidence are progressing in the project area.</p> <p>3. Special attention should be paid if a large quantity of groundwater is utilized for irrigation.</p> <p>4. Special attention should be paid to seawater intrusion when the project area is close to the sea.</p>
Measures	<p>1. Restriction of irrigation</p> <p>2. Establishment of groundwater use plan</p> <p>3. Development of alternative water sources</p>
Related Subjects for Study	<p>1. Hydrogeological study (groundwater capacity, etc.)</p> <p>2. Pumping tests</p> <p>3. Experience of similar projects</p> <p>4. Water use situation study</p>

Table 4-5 Explanation of Item 19 (Groundwater Development)

Item	19. Water Pollution
Description	Water pollution of rivers and groundwater caused by drilling mud and oil
Causes of Impacts	<ol style="list-style-type: none"> 1. Disturbance of ground layer by drilling and the use of muddy water 2. Lowering of groundwater table caused by the overdraft of groundwater <p>[Reference]</p> <ol style="list-style-type: none"> 1. In the case of recharge facilities: Pollution of surface water caused by soil erosion 2. Underground dams: Excavation work --- groundwater suspension Injection work --- groundwater pollution by cement and chemicals
Possible Environmental Impacts	<ol style="list-style-type: none"> 1. Groundwater pollution caused by the construction of wells (drilling) would affect the utilization of groundwater 2. Deterioration of water quality caused by the lowering of the groundwater table in operation 3. Groundwater pollution caused by the seawater intrusion near the seashore
Useful Factors for Evaluation	<ol style="list-style-type: none"> 1. Shallow wells which utilize unconfined groundwater may be affected by water pollution. 2. If the groundwater table has a recent tendency to lower, careful consideration is necessary. 3. If a large quantity of groundwater is utilized for irrigation, special attention should be paid. 4. If new wells are planned near the seashore, careful consideration is necessary. 5. Water pollution is apt to take place in the areas where factories or waste disposal sites are located or sewage is not treated.
Measures	<ol style="list-style-type: none"> 1. Restriction of overdraft 2. Groundwater utilization plan 3. Improvement of sewage treatment facilities
Related Subjects for Study	<ol style="list-style-type: none"> 1. Hydrogeological survey (groundwater capacity, etc.) 2. Water analysis of seawater, surface water and groundwater 3. Land-use survey 4. Groundwater utilization

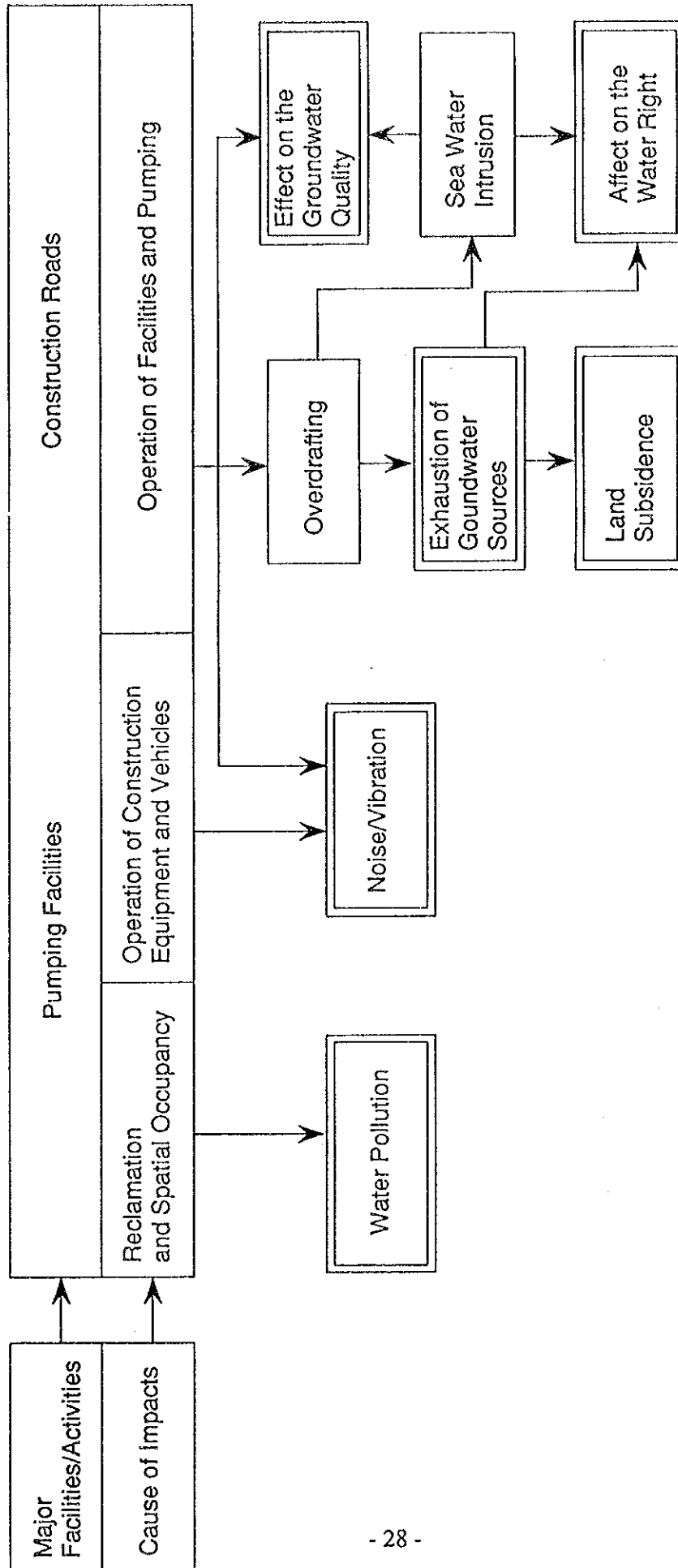
Table 4-5 Explanation of Item 21 (Groundwater Development)

Item	21. Noise and Vibration
Description	Generation of noise and vibration due to drilling and operation of pumping machines
Causes of Impacts	<ol style="list-style-type: none"> 1. Noise and vibration of drilling machines (the period is limited from a few months to one year) 2. Operation noise of lift pumps
Possible Environmental Impacts	<ol style="list-style-type: none"> 1. Impacts on inhabitants' living condition, dispersion of wild animals, and breeding of cattle. <p>[Reference]</p> <p>Large-scaled facilities, such as recharge ponds and underground dams, would have significant impacts on the environment.</p>
Useful Factors for Evaluation	<p>Serious impacts may occur under the following conditions:</p> <ol style="list-style-type: none"> 1. Densely populated areas, or such facilities that require a quiet atmosphere, are located nearby. 2. Breeding farms and the habitats of valuable species exist in the area. 3. The planning area includes soft ground, such as landfill, clayey soil layer, etc..
Measures	<ol style="list-style-type: none"> 1. Use of low-noise and low-vibration machines 2. Examination of the operation time 3. Examination of project location
Related Subjects for Study	<ol style="list-style-type: none"> 1. Land use, distribution and condition of public facilities, and inhabitants. 2. Geological survey. 3. Study of living conditions of valuable wildlife.

Table 4-5 Explanation of Item 22 (Groundwater Development)

Item	22. Land Subsidence
Description	Deformation of the land due to the lowering of the groundwater table
Causes of Impacts	1. Overdrafting of groundwater
Possible Environmental Impacts	<ol style="list-style-type: none"> 1. Land subsidence caused by the compaction and contraction of the clay layer which is generated by the lowering of the groundwater table 2. The expansion of the flood area as the result of the deterioration of the drainage function caused by land subsidence; the disturbance of socio-economic activities and the increase of urban development costs created by the deformation and malfunction of social and economic infrastructures
Useful Factors for Evaluation	<ol style="list-style-type: none"> 1. If the groundwater table has a recent tendency of lowering, careful attention should be paid. 2. In the area where the clay layer is thick, the effect of land subsidence may be greater. 3. If the exhaustion or malfunction of existing wells are reported in the study area, careful attention should be paid. 4. In the area where land subsidence has already occurred, the effect might be amplified.
Measures	<ol style="list-style-type: none"> 1. Groundwater utilization plan 2. Restriction of overdraft
Related Subjects for Study	<ol style="list-style-type: none"> 1. Hydrogeological survey (groundwater capacity, etc.) 2. Water utilization 3. Organizations and laws/regulations related to water resources and environment 4. Geological survey

Appendix. Flow Chart of the Environmental Impacts of a Groundwater Development Projects



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

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