

THE SOCIALIST REPUBLIC OF VIET NAM
MINISTRY OF AGRICULTURE AND RURAL DEVELOPMENT
CENTRAL PROJECT OFFICE

ENVIRONMENTAL IMPACT ASSESSMENT FOR VIET NAM WATER
RESOURCES ASSISTANCE PROJECT

VOLUME 2: REPORT NO. 3:
DRAFT FINAL ENVIRONMENTAL IMPACT ASSESSMENT OF
KE GO SUB-PROJECT

PREPARED BY
GEC GLOBAL ENVIRONMENTAL CONSULTANTS LTD.
AND
CENTER FOR BIOTECHNOLOGY FOR LIFE AND PRODUCTION

APRIL 2003

FINAL COPY

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EXECUTIVE SUMMARY

This report is a draft Environmental Impact Assessment for the Ke Go Sub-Project prepared as part of overall preparation of the Viet Nam Water Resources Assistance Project (VWRAP). This draft EIA was prepared with the configurations of the Ke Go Sub-Project as conceived, designed, and described in documents and information provide by the Consultant to the EIA Consultant as of 31 March 2003, supplemented by secondary data obtained by the EIA Consultant in documents, maps, interviews with local officials, and other similar sources. This EIA has been prepared in accordance with the national legal, policy, and regulatory requirements for environmental management and protection in Viet Nam as well as the various relevant IDA operational safeguard policies.

Summary of Ke Go Sub-Project Description

The Ke Go Sub-Project is located in Cam Xuyen and Thach Ha Districts of Ha Tinh Province in north central Viet Nam (Figure 2). The Ke Go Reservoir is located in Cam Xuyen District approximately 20 km south of Ha Tinh Town and serves an area north and east of the Reservoir. The Ke Go Sub-Project includes the following components:

- A conduit flood discharge spillway (under the main dam) with a design discharge of 320 m³/sec and a crest elevation 26.5 m;
- An intake sluice, designed for 320 m³/sec, under the main dam, and intended to be used for providing water to the hydropower station (see below) and for irrigation;
- An emergency flood spillway, located in a saddle between the main dam and the Doc Mieu spillway;
- A 17 km long main canal designed to irrigate 21,136 ha and with a design discharge of 28.2 m³/sec; and
- A total of nine primary canals, designated N1 to N9, running more or less parallel to the coastline, and equipped with various water control structures.

Because of insufficient maintenance, engineering works have degraded rapidly and seriously in recent years. Seepage through the body and foundation of the dams has been an ongoing problem. Dam toe seepage may reduce dam strength as well as create an artificial wetland environment immediately downstream of the dam. In addition, the conduit spillway experiences significant leakage through the conduit joints, resulting in approximately 200 l/s inundating the inspection barrel. The problem of conduit leakage was addressed in 1991 and 1993 and involved grouting and covering the joints with steel plates but these remedial measures had no positive effect. The canal system has experienced ongoing problems of erosion, siltation, and canal seepage, and the canal regulating structures have been poorly maintained and are now in poor condition.

A 2,100 kW hydropower station was constructed and operational from 1986 to mid-1988. A number of problems were incurred during the operation of the station, which unacceptably impacted upon the end use of the water for irrigation (e.g. contamination of irrigation with hydraulic oils and unacceptable leakage through conduit joints). Inadequate maintenance of the hydraulic, electrical and mechanical equipment led to the scheme being abandoned in less than three years of operation. The equipment is still at the site but in a dilapidated condition.

The overall objectives of the Ke Go Sub-Project are to:

- Upgrade the existing irrigation scheme;
- Improve reliability, flexibility, and effectiveness of the irrigation system;
- Reduce the cost of operation and maintenance;
- Enable the scheme to satisfy all reasonable water needs by supplying a sufficient quantity of water at the required times of the year; and
- Create the conditions for sustainable socioeconomic development using the application of modern design, engineering, and irrigation system management technologies.

This will be achieved by modernization of technical infrastructure from the headworks to the farm fields and by modernization of the management system for the entire Irrigation Scheme.

Modernization of the Ke Go Irrigation Scheme is intended to support the shift in the use of the reservoir from that of largely supplying water for agricultural purposes to an integrated water use scheme, supplying water to support:

- A 19% increase in the water supply for agriculture;
- Surplus water supply, up to 52.4 million m³/yr, for municipal and industrial use (at frequency 75%, total water availability volume will be 320 million m³/yr, with agricultural water requirement (in year 2010)

estimated at 267.6 million m³/yr¹; and

- Increase supply of domestic water to rural residents throughout the Sub-Project through increasing supply of water in the canal system.

The Ke Go Sub-Project will have a phased approach to modernization. This means that Ke Go Sub-Project investments will be grouped into two "phases". The first phase will include the finalized dam safety review, rehabilitation works for the dams, rehabilitation works for main and primary canals and rehabilitation works and modernization for two pilot areas representing about 20% of the command area. The second phase will include expanding the experiences gained through pilot testing to remaining 80% of the command area.

Main Conclusions of Impact Assessment

The Ke Go Sub-Project is environmentally feasible. The Sub-Project will have a number of significant positive benefits:

- Increase in beneficiary income and reduction of poverty throughout the command area through improved and reliable water supply for agricultural production; and
- Increases in employment and labor in a region with very high levels of unemployment and underemployment.

All of the potentially significant environmental impacts identified in the impact assessment can be mitigated and they are described below.

These conclusions apply to both phases of investments for the Ke Go Sub-Project. At this time, it is concluded that no separate environmental assessment is required for the second phase of investments.

Ke Go Sub-Project Environmental Management Plan

The Environmental Management Plan for the Ke Go Sub-Project consists of an environmental mitigation program and an environmental monitoring program.

The environmental mitigation program consists of:

- Proper management and disposal of dredged and excavated soils to minimize degradation of water quality;
- Proper environmental management of construction worker camps, including minimization of disruption to local residents from construction activities to limit localized environmental degradations and disturbance to local communities;
- Implementation of a comprehensive resettlement and compensation action plan;
- Environmental review of provincial aquaculture program and implementation of environmental action plan to mitigate incremental effects of incremental coastal aquaculture that arises as a result of the Sub-Project
- Maximization of employment opportunities for local residents to take full benefit of the employment opportunities created by the Sub-Project;
- Implementation of a Emergency Preparedness Plan for managing Ke Go Dam flood safety risk;
- Prevention of disruption to designated cultural and historical sites; and
- Extension of the local provincial program for IPM to command area beneficiaries to prevent possible degradation of aquatic resources from increased use of fertilizer and pesticides.

An important environmental mitigation will be the minimization of disruption to water users during canal lining. Improper timing of the construction activities associated with canal reinforcement will negatively affect water supply to farmers downstream. On the one hand, construction of canal reinforcements in the dry season can proceed very quickly, but water supply needs to be turned off during the construction periods; the dry season is the season when water supply via the irrigation scheme is most critical. On the other hand, water supply to the farmers via the irrigation scheme is not as critical in the rainy season and yet construction is much more problematic and expensive given the larger amounts of water in the system at that time. It will be necessary to develop rigid construction timetables for main and primary canal reinforcement to minimize disruption to the beneficiaries and at the same time have efficient implementation of this part of the Sub-Project. In addition, consultation with all affected parties will be required in order to reach agreement on how canal lining will proceed.

The recommended environmental monitoring activities are:

- Compliance monitoring of the environmental mitigation program;

¹ Domestic water supply for Ha Tinh Town comes from the Boc Nguyen Reservoir, operated separately from the Ke Go Reservoir.

- Surface and groundwater quality monitoring program to assess incremental effects of sedimentation, erosion, and fertilizer and pesticide use; and
- Effects monitoring for effectiveness of coastal aquaculture mitigation program.

The total cost of the Ke Go Sub-Project Environmental Management Plan is US \$349,113, consisting of US \$167,206 for the environmental mitigation program and US \$181,907 for the environmental mitigation compliance monitoring and environmental effects monitoring programs.

Institutions Responsible for Implementing the Ke Go EMP

The Ke Go EMP will be implemented within a comprehensive organizational framework under the overall VWRAP Project. VWRAP will engage several ministries, departments, and institutes, it will create a project management unit within MARD in Ha Noi (PMU) and Sub-Project Implementation Units (SIUs) in each province, and there will be numerous linkages between these institutions and numerous other existing institutions at the national, provincial, district, and commune levels (This assumes a decentralized modality for Sub-Project implementation and will need to be modified if a more traditional, centralized modality for Sub-Project implementation is selected. Under either modality, VWRAP PMU can be either CPO or another unit set up or designated by MARD). The following institutions will be responsible for the successful implementation of the Ke Go Environmental Management Plan:

VWRAP PMU – responsible for overall VWRAP implementation management and will contain environmental safeguard staff. VWRAP PMU will be responsible for overall quality assurance of EMP implementation.

Ke Go Sub-Project SIU – staffed by personnel from Ha Tinh DARD and Ha Tinh IMC, and will be responsible for daily implementation activities of the Ke Go Sub-Project. As a consequence, it will supervise and control the quality of construction and physical implementation of the Ke Go Sub-Project EMP

Vietnamese Environmental Regulators – MoNRE and Ha Tinh DoSTE will be responsible for all regulatory reviews and approvals of the Ke Go Sub-Project in accordance with the national legal framework for environmental protection and management.

Ha Tinh Provincial Organizations – Other Ha Tinh provincial departments will have important responsibilities such as implementing specific components of the mitigation program (IPM), ensuring their particular safeguards are being properly implemented (i.e. DoCI) and providing supplementary and secondary data to assist in the implementation of the Ke Go EMP (e.g., land use and commodity production data).

IDA – IDA will review the implementation of the EMP. Problems and issues that are identified will be raised to MARD as part of the regular Ke Go Sub-Project review process.

Environmental Safeguard Contractors – An Environmental Safeguard Contractor will be selected from the numerous national environmental consultant organizations in Viet Nam. The Environmental Safeguard Contractor will act as general contractor for primary data collection surveys and for preparation and submission of various compliance and effects monitoring assessment reports. They will also be responsible for undertaking some of the specific mitigation measures for the Ke Go Sub-Project.

Consultant Environmental Specialists - some of the resources of the Design and Supervision Technical Assistance under VWRAP will be used to engage two environmental specialists who will take on substantial implementation tasks for the EMP: (i) the Consultant's international environment specialist; and (ii) the Consultant's national environmental specialist seconded from a nationally-recognized environmental management institution. The secondment could be in the form of a fixed-term, renewable contract during pre-construction, construction, and operation phases. It is expected that the services of the Consultant's international environment specialist will be required for VWRAP implementation until the completion of the Detailed Design of the Ke Go EMP for the second phase of investments, at which time sufficient training and capacity building will have been given that remaining institutions and personnel will be able to implement the remainder of the Ke Go Sub-Project EMP. In this EMP, it is assumed that the Detailed Engineering Design for the second investment phase will occur in the third year of Ke Go Sub-Project implementation.

Summary of IDA Environmental and Social Safeguard Policies for Ke Go Sub-Project.

Bank Operational Policy	Summary of Assessment and Rationale	Recommendations
OP 4.01 – Environmental Assessment - Triggered	<ul style="list-style-type: none"> While Ke Go Sub-Project is classified as Category A, requiring a full-scale environmental assessment, the results of this EIA indicate that the scale and magnitude of the expected environmental impacts of the Ke Go Sub-Project are more like that of a Category B project. Environmental impacts of the Ke Go Sub-Project are mostly site-specific, none are irreversible; very few direct impacts are on environmentally important areas such as wetlands, forests, or other natural habitats, all are preventable, and mitigation measures have been designed for all possible environmental impacts 	<ul style="list-style-type: none"> Implement Ke Go Sub-Project Environmental Management Plan
OP 4.04 – Natural Habitats - Triggered	<ul style="list-style-type: none"> no impacts predicted for Ke Go Reservoir watershed, where all of the intact natural terrestrial habitats of the Sub-Project Area occur. Ke Go Sub-Project will provide increased water supply to an expanding provincial coastal aquaculture program which itself was not assessed for possible environmental impacts. There may be a risk of losing coastal wetland resources 	<ul style="list-style-type: none"> Environmental review of provincial aquaculture program to advise Ha Tinh Province on guidelines for ensuring coastal aquaculture is environmentally sustainable
OP 4.36 – Forestry – not Triggered	<ul style="list-style-type: none"> There will be no Sub-Project impacts on the two major forest resources in the Sub-Project Area: the Ke Go Nature Reserve, and the production forests on the hill slopes downstream of Ke Go Reservoir that are above the Sub-Project irrigated area 	
OPEN 11.03 – Cultural Property - Triggered	<ul style="list-style-type: none"> impacts are assessed as Unknown because, while the exact location of the each of the cultural and historic sites in the Sub-Project is known, the location of the Sub-Project activities listed above is not yet known in detail. Mitigation of any negative effects is possible, however. 	<ul style="list-style-type: none"> Mitigation recommended against any possible loss of or damage to nationally or locally designated cultural and historical sites by adjusting the siting of Sub-Project civil works, to be incorporated into the detailed design of the physical works Terms and conditions should be included in construction contracts to ensure the integrity of these historical and cultural resources
OP 4.12 – Involuntary Resettlement – Triggered	<ul style="list-style-type: none"> No households will need to be resettled and there is a requirement to pay compensation for 104 ha of permanent and 60 ha of temporary land acquisition 	<ul style="list-style-type: none"> Resettlement and Compensation Action Plan prepared as part of Ke Go Sub-Project Feasibility Study
OP 4.20 – Indigenous Peoples – Not Triggered	<ul style="list-style-type: none"> There are no members of recognized ethnic minority groups living in the command area of the Ke Go Sub-Project 	<ul style="list-style-type: none"> Ethnic Minority Development Plan prepared as part of Ke Go Sub-Project Feasibility Study
OP 4.37 – Safety of Dams – Triggered	<ul style="list-style-type: none"> Upgrading Ke Go Dam safety a major component of first investment phase. Specific engineering works are provided for increasing dam safety, and Emergency Preparedness Plan prepared as part of Ke Go Feasibility Study 	
OP 4.03 – Pesticide Management – Triggered	<ul style="list-style-type: none"> It is estimated that an additional 83 t of pesticides and herbicides will be required annually for the entire Sub-Project over and above estimates of current pesticide and herbicide application. This is about a 234% increase over estimated current pesticide and herbicide use throughout the Sub-Project. This impact is assessed as Unknown but potentially Significant without mitigation or monitoring. Existing baseline information on pesticide concentrations in the Sub-Project environment is non-existent and so current conditions can not be estimated, but the expected increase may be substantial, particularly as about 40% of Sub-Project beneficiaries have not yet received direct training in IPM methods. 	<ul style="list-style-type: none"> Both mitigation and monitoring are recommended. With respect to mitigation, IPM extension services should continue to be provided to Sub-Project beneficiaries as a part of the Sub-Project in accordance with the requirements of IDA OP 4.03. Extension services should include the topics of appropriate selection and application of pesticides and herbicides as well as basic techniques of IPM.
OP 7.60 – Projects in Disputed Areas – Not Triggered	<ul style="list-style-type: none"> Not triggered as none of the Sub-Project Area or the area of influence of the Sub-Project is part of a territory whose jurisdiction is disputed by another country 	
OP 7.50 – International Waterways – Not Triggered	<ul style="list-style-type: none"> Not triggered as: (i) None of the water bodies associated with the Ke Go Sub-Project form a boundary between, or flow through the territory of another country; (ii) None of the water bodies associated with the Ke Go Sub-Project are a any tributary or component of any waterway described above; and (iii) None of the water bodies associated with the Ke Go Sub-Project are recognized as a necessary channel of communication between the open sea and other states countries or of any river flowing into such waters. 	

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CURRENCY EQUIVALENTS

(as of April 2003)

Current Unit	-	Viet Nam Dong (VND)
US \$1.00	-	VND 15,300
VND 1,000	-	US \$0.065

ACRONYMS AND ABBREVIATIONS

ADB	Asian Development Bank
BP	Bank Procedure
CIDA	Canadian International Development Agency
CPC	Commune People's Committee
CPO	Central Project Office (of MARD)
DANIDA	Danish International Development Assistance
DARD	Department of Agricultural and Rural Development
DoCI	Department of Culture and Information
DoFi	Department of Fisheries
Dol	Department of Industry
DoSTE	Department of Science, Technology and Environment
DSA	Daily Subsistence Allowance
DWT	Dead-Weight Tons
EIA	Environmental impact assessment
EIRR	Economic Internal Rate of Return
EMD	Environmental Management Department (DoSTE)
EMDP	Ethnic Minority Development Plan
EMP	Environmental Management Plan
EPP	Emergency Preparedness Plan
FPD	Forest Protection Department
FS	Feasibility Study
GoVN	Government of Viet Nam
HEC	Hydraulic Engineering Company
HH	Household
IDA	International Development Association
IMC	Irrigation Management Company
IPM	Integrated Pest Management
IUCN	International Union for the Conservation of Nature
MARD	Ministry of Agriculture and Rural Development
MoNRE	Ministry of Natural Resources and Environment
NEA	National Environment Agency
NGO	Non-governmental organization
NKH	Nippon Koei Haskoning (the Consultant)
NLEP	National Law on Environmental Protection
NPV	Net Present Value
O/M	Operations and Maintenance
OP	Operation Policy
PAH	Project Affected Households
PFS	Pre-Feasibility Study
PMF	Probable Maximum Flood
PMU	Project Management Unit
PPC	Provincial People's Committee
RAP	Resettlement Action Plan
Sida	Swedish International Development Agency
SIO	Sub-Project Implementation Office
SIU	Sub-Project Implementation Unit
ToR	Terms of Reference
UXO	Unexploded Ordnance
VND	Viet Nam Dong
VWRAP	Viet Nam Water Resources Assistance Project
WB	World Bank

1: INTRODUCTION

1.1 Background and Objectives

The Government of Viet Nam (GoVN) has requested assistance from the International Development Association (IDA) to support the Water Resources Assistance Project (VWRAP)². VWRAP has the following objectives:

- Make Vietnamese agriculture more internationally competitive and increase farmer incomes by introducing modern irrigation infrastructure and management to the sector.
- Reduce flood and disaster risk by improving dam safety and management.
- Promote the environmentally sustainable development of Thu Bon Basin through integrated development and management of water resources.

VWRAP is comprised of four separate but integrated elements (please see Figure 1 for the location of the following components and Sub-Projects):

Component 1: Irrigation Modernization and Dam Safety in five irrigation schemes:

- *Dau Tieng (Tay Ninh Province and Ho Chi Minh City)*
- *Da Ban (Khanh Hoa Province)*
- *Ke Go (Ha Tinh Province)*
- *Yen Lap (Quang Ninh Province)*
- *Cam Son - Cau Son (Bac Giang Province);*

Component 2: Dam Safety:

- MARD Dam Repair Fund for other MARD dams outside the scope of VWRAP
- Hoa Binh Dam Safety Upgrading
- Dam Safety Institutional Development

Component 3: Thu Bon Integrated River Basin Development (Quang Nam Province):

- *Irrigation modernization and Dam Safety of the Phu Ninh Irrigation Scheme*
- *Quang Hue-Vu Gia River Control Works;*
- *Thu Bon Investment Preparation*

Component 4: Institutional Development and Capacity Building:

- Training and Capacity Building
- Design and Supervision Technical Assistance
- Design and Supervision Costs
- Provincial and MARD Incremental Costs

A separate EIA has been constructed for each of the italicized and underlined Sub-Projects in the above list and each of these is termed a Sub-Project for the purposes of the VWRAP EIA.

This report is a draft Environmental Impact Assessment (EIA) for the Ke Go Sub-Project prepared as part of overall VWRAP preparation. This report has been prepared and submitted in accordance with the Terms of Reference for Consulting Services for the VWRAP EIA Consultant (Annex 1). This document is one component of the overall VWRAP EIA:

Volume 1 - summary EIA of the entire VWRAP Project

Volume 2 - total of seven EIA reports, one for each of the Sub-Projects listed above

Volume 3 - Public Consultation Report

1.2 Overview of the Ke Go Sub-Project

The Ke Go Sub-Project is located in Cam Xuyen and Thach Ha Districts of Ha Tinh Province in north central Viet Nam (Figure 2). The Ke Go Reservoir is located in Cam Xuyen District approximately 20 km south of Ha Tinh Town and serves an area north and east of the Reservoir; the Ke Go Sub-Project includes the following

² The Ministry of Agriculture and Rural Development (MARD) obtained a grant from the Government of Japan to procure consultancy services to help prepare VWRAP; the Central Project Office (CPO) of MARD is the coordinating agency of VWRAP and engaged Nippon Koei Haskoning (NKH) as the Consultant, and GEC Global Environmental Consultants Ltd., in association with National Institute for Water Resources Research.

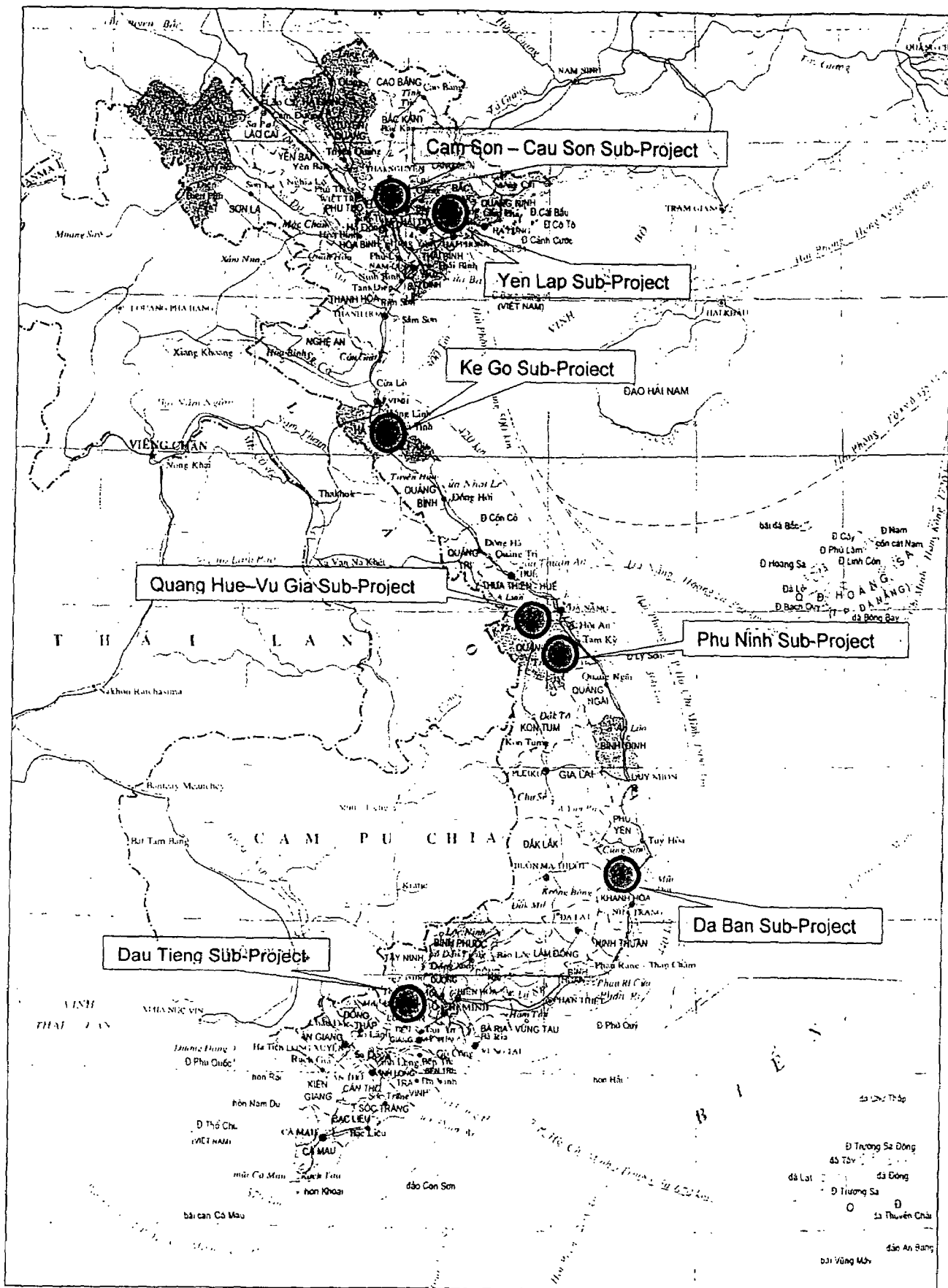
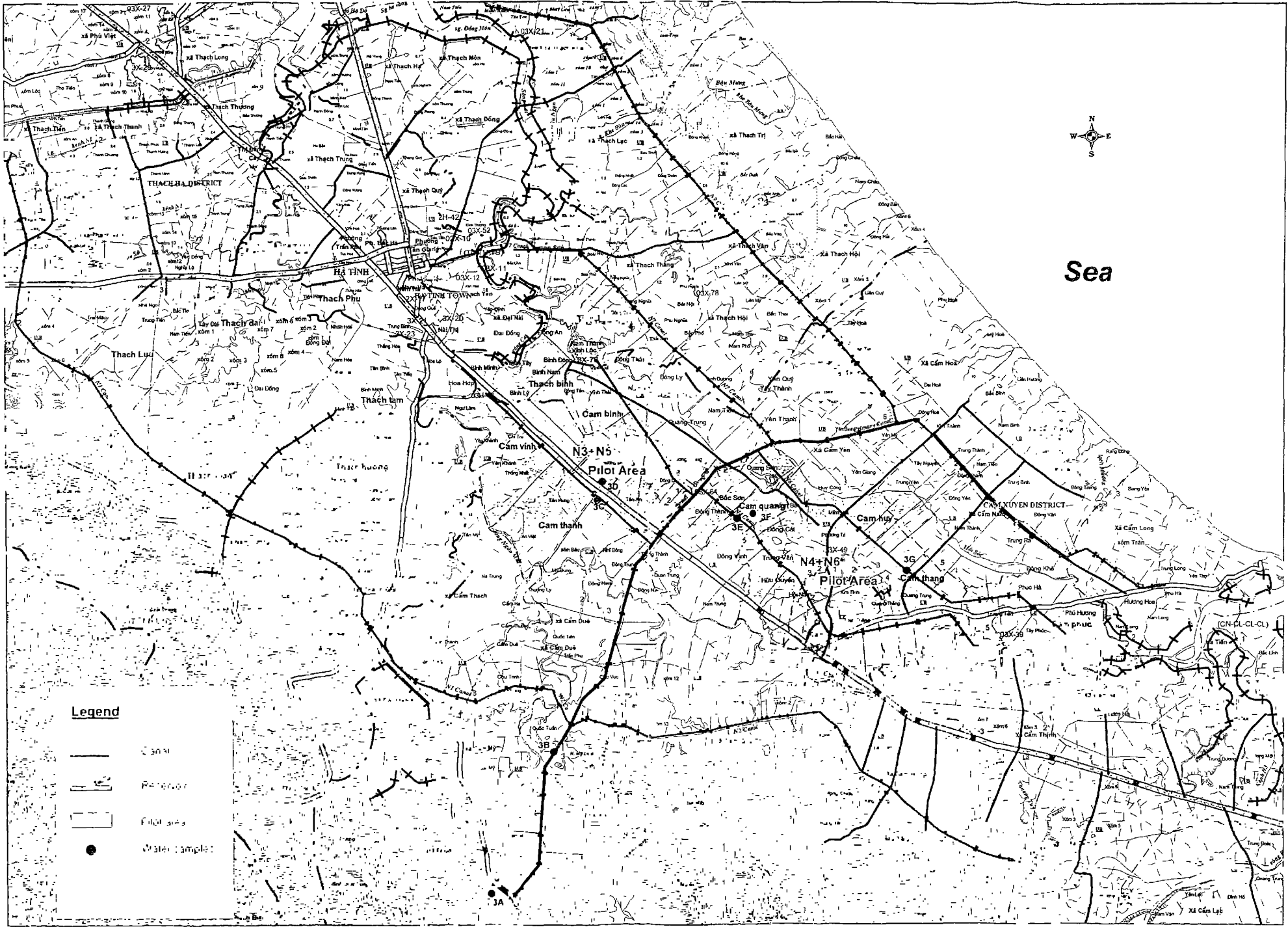






Figure 1: Location of components and Sub-Projects of VWRAP.



Sea

Legend

-  Road
-  River
-  Pilot area
-  Water sample

components:

- A conduit flood discharge spillway (under the main dam) with a design discharge of 320 m³/sec and a crest elevation 26.5 m;
- An intake sluice, designed for 320 m³/sec, under the main dam, and intended to be used for providing water to the hydropower station (see below) and for irrigation;
- An emergency flood spillway, located in a saddle between the main dam and the Doc Mieu spillway;
- A 17 km long main canal designed to irrigate 21,136 ha and with a design discharge of 28.2 m³/sec; and
- A total of nine primary canals, designated N1 to N9, running more or less parallel to the coastline, and equipped with various water control structures.

Because of insufficient maintenance, engineering works have degraded rapidly and seriously in recent years. Seepage through the body and foundation of the dams has been an ongoing problem. Dam toe seepage may reduce dam strength as well as create an artificial wetland environment immediately downstream of the dam. In addition, the conduit spillway experiences significant leakage through the conduit joints, resulting in approximately 200 l/s inundating the inspection barrel. The problem of conduit leakage was addressed in 1991 and 1993 and involved grouting and covering the joints with steel plates but these remedial measures had no positive effect. The canal system has experienced ongoing problems of erosion, siltation, and canal seepage, and the canal regulating structures have been poorly maintained and are now in poor condition.

A 2,100 kW hydropower station was constructed and operational from 1986 to mid-1988. A number of problems were incurred during the operation of the station, which unacceptably impacted upon the end use of the water for irrigation (e.g. contamination of irrigation with hydraulic oils and unacceptable leakage through conduit joints). Inadequate maintenance of the hydraulic, electrical and mechanical equipment led to the scheme being abandoned in less than three years of operation. The equipment is still at the site but in a dilapidated condition.

1.3 Legal, Policy, and Regulatory Context for Ke Go Sub-Project EIA

The Ke Go Sub-Project EIA has been prepared according to Viet Nam's legal, policy, and regulatory framework for environmental impact assessment³. The key legal instruments defining this national framework are:

- National Law on Environmental Protection (29L/CTN, 1994);
- Decree 175/CP/1994 on Implementation of the NLEP; and
- Circular 490/1998/TT-BKHCHNMT on Setting Up and Appraising EIA Reports

This EIA has also been prepared according to the following World Bank directives and guidelines for environmental impact assessment and natural resource management:

- Operational Policy 4.01 (and accompanying annexes) - Environmental Assessment;
- Operational Policy 4.04 - Natural Habitats;
- Operational Policy 4.36 - Forestry;
- Operational Policy 11.03 – Cultural Property;
- Operational Policy 4.12 – Involuntary Resettlement;
- Operational Policy 4.20 – Indigenous Peoples;
- Operational Policy 4.37 – Safety of Dams;
- Operational Policy 4.03 – Pesticide Management;
- Operational Policy 7.60 – Projects in Disputed Areas;
- Operational Policy 7.50 – International Waterways;
- Bank Policy 17.50 – Public Disclosure;
- General Policy 14.70: Involving Nongovernmental Organizations in Bank-Supported Activities;
- Where required, the Pollution Prevention and Abatement Handbook; and
- The Environmental Assessment Sourcebook⁴.

In addition, this EIA considers other key legal instruments in Viet Nam for environmental protection and natural resource management:

- TCVN 5592 National Surface Water Quality Standards
- TCVN 5944 National Groundwater Quality Standards

³ Annex 2 contains a detailed description of the legal, policy, and regulatory framework within which this EIA has been prepared.

⁴ World Bank Technical Paper No. 140

- TCVN 6980 (2001) Standards for Industrial Effluents Discharged Into Rivers Used for Domestic Water Supply
- Decree 18/1986, the Ordinance on Conservation and Management of Living Aquatic Resources
- 1991 Forestry Resource Protection and Development Act
- Decision 1171, 1986, on Special Forest Management for Protected Areas

This EIA has also been prepared in the context of a number of international environmental conventions to which Viet Nam is a signatory:

- 1972 Convention Concerning the Protection of the World Natural and Cultural Heritage (the World Heritage Convention).
- 1973 Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES Convention)
- 1992 United Nations Framework Convention on Climate Change; and
- 1992 Convention on Biological Diversity. In this context, the 2002 IUCN Red List of Threatened Species (found at www.redlist.org) was a main sourcebook for considering biodiversity resources within the Sub-Project's area of influence.

Finally, a number of national environmental and natural resources programs and plans were considered in the preparation of this EIA:

- National Strategy for Environmental Protection for 2001 to 2010
- National Biodiversity Action Plan (1995);
- Forest Protection Department 1998 Protected Areas Plan of Vietnam to 2010; and
- National Aquaculture Development Program (1999-2010).

1.4 Approach to VWRAP Definition, Preparation, and Implementation

IDA and MARD have agreed that VWRAP will have a phased approach to modernization in each of the Sub-Projects and VWRAP preparation adopted a similar approach through detailed investigations of:

- headworks, main and primary canals for each of the Sub-Projects; and
- a small number of pilot areas that consist of secondary and tertiary canal systems off the main and primary canals and which contain a total of about 20% of the total command area.

This approach was adopted so that the options (and combination of options) in terms of investments in physical infrastructure and management improvements that work best can be developed before full VWRAP implementation. The June 2002 IDA Aide Memoire notes that this approach will help reduce the risk associated with new infrastructure and water management techniques while still providing adequate budget to modernize the whole scheme. Annex 2 to the June 2002 IDA Aide Memoire indicates that this approach will mean that VWRAP works will be grouped into two "phases". The first phase will include the finalized dam safety review, rehabilitation works for the dams, rehabilitation works for main and primary canals and rehabilitation works and modernization for the pilot areas. The second phase will include expanding the experiences gained through pilot testing to the command areas beyond the pilot areas. Therefore, the general nature and design of the second phase (i.e., types of civil works, equipment, and facilities) will be similar to nature and design of the pilot area component of the first phase, the precise siting and location of the components of the second phase will not be known, and the VWRAP Project Implementation Plan (PIP) will contain as follows:

- Project and Sub-Project implementation arrangements for the entire VWRAP Project;
- detailed specification of the technical/engineering implementation of the first phase, including first year works detailed design and bid packages; and
- a programmatic framework specifying the arrangements and procedures for technical/engineering implementation of the second phase.

1.5 General Approach to EIA Preparation

1.5.1 Sources of Information Used in the Preparation of this EIA

Annex 3 contains a list of all the documents, maps, and other materials used in the preparation of this EIA.

Information used in preparing this EIA was obtained from a number of sources:

- A set of Sub-Project feasibility study reports prepared by the Hydraulic Engineering Consultant Company No. 1 (HEC-1) under contract to the Consultant;
- The March 2003 final PFS submitted by the Consultant to GoVN and IDA;
- Information provided by the Consultant during preparation of the overall FS that updates information contained in the HEC-1 reports described above;
- A detailed socioeconomic survey of pilot area households conducted by the Consultant⁵;
- The gathering of secondary data and information from various sources in government departments at the provincial, district, and commune level in Ha Tinh Province; and
- A small set of primary data on water quality was obtained in order to initiate the establishment of a water quality baseline for the Sub-Project.

1.5.2 EIA Methodology

VWRAP is classified as a Category A project and therefore requires the completion of a full EIA, and the overall approach and methodology for this EIA is based on the World Bank's Environmental Assessment Sourcebook. The Consultant has primary responsibility for meeting World Bank and GoVN policies on Involuntary Resettlement, Indigenous People and Dam Safety, and the contents, conclusions, and recommendations of this EIA are intended to support the Consultant in the preparation of Resettlement Action Plan and Ethnic Minority Development Plan.

The engineering works recommended in the Sub-Project feasibility study reports prepared by HEC-1 under contract to the Consultant represent the high end of investments contemplated for the Ke Go Sub-Project, in large part because of the extensive canal lining that these reports recommend. Financial constraints will limit the actual amount of canal lining that can be done in the Ke Go Sub-Project under VWRAP. However, because the preparation of the VWRAP FS occurred six weeks after the preparation of this draft EIA, not all the final information relating to the scope, scale, and location of the canal lining engineering works for the Ke Go Sub-Project could be included in this EIA. Therefore, the environmental assessments contained in this Ke Go EIA relating to canal lining can be considered as conservative. The actual environmental impacts from canal lining will be less than those described in this EIA because less length of canals will actually be lined under VWRAP.

1.5.3 Sub-Project Area of Influence

For this EIA, the area of influence of the Sub-Project is defined as:

- The Ke Go Reservoir catchment area;
- The total command area of the Irrigation Scheme; and
- Those locations that are outside of the watershed catchment area or the total command area of the Irrigation Scheme but which may be affected by the activities of the Sub-Project. This includes, for example, surface water and groundwater resources downstream of the command area, air quality outside of the command area, and natural habitats and ecosystems that may be located downstream of the command area. These are considered on a case-by-case basis in the Impact Assessment as possible cumulative effects of the Sub-Project on environmental resources (Chapter 4).

For the purposes of this EIA, the term "Sub-Project Area" is defined as the Ke Go Reservoir catchment area and the total command area of the Irrigation Scheme.

1.5.4 Scope of Environmental Management Plan for Ke Go Sub-Project

The Environmental Management Plan for the Ke Go Sub-Project (Chapter 5) contains the following components:

- mitigation and monitoring requirements for the first phase of investments (i.e., headworks, main and primary canals, pilot areas, and other non-agricultural uses of the water resources provided by the Ke Go Scheme), including cost estimates;
- mitigation and monitoring requirements for the second phase of investments (i.e., the remainder of the command area, exclusive of the pilot areas) including cost estimates. This second phase is based on an assessment of the similarity of the current environmental conditions in the pilot areas to the current

⁵ A note is made at each point in the Da Ban Sub-Project EIA where information from the socioeconomic surveys is used.

environmental conditions in the remainder of the Sub-Project's command area (found at the end of Chapter 3: Description of Existing Environment);

- implementation arrangements and implementation schedule for the overall Environmental Action Plan;
- a programmatic framework which specifies how the specific mitigation and monitoring activities associated with the second phase are to be designed in detail and implemented during overall VWRAP implementation;
- requirements for technical assistance to support implementation of the Environmental Management Plan including supervision and training; and
- a detailed workplan for the first year of VWRAP implementation (i.e., pre-construction)

1.6 Outline of the EIA for the Ke Go Sub-Project

Including this Introduction, the Ke Go Sub-Project EIA contains five sections:

Chapter 2 – Description of Ke Go Sub-Project A presentation, using the best available information of what engineering works are to be constructed, quantities of materials required, and land use changes in the command area that will be supported by the implementation of the Sub-Project

Chapter 3 – Description of Existing Environment a presentation of the current status of the physical, biological, and socioeconomic resources of the Sub-Project Area

Chapter 4 – Impact Assessment an evaluation of the environmental impacts of the Sub-Project

Chapter 5 – Environmental Management Plan mitigation and monitoring requirements, including implementation arrangements, costs, and schedule.

The EIA is supported by a set of technical annexes contained at the end of this volume.

2: DESCRIPTION OF KE GO SUB-PROJECT

The Ke Go Irrigation Scheme consists of the following components:

- Ke Go Dams and associated reservoir;
- Doc Mieu chute spillway;
- Conduit flood spillway;
- Intake sluice;
- Emergency flood spillway;
- Main and primary canals and associated water control structures; and
- Secondary, tertiary, and on-farm canal system and associated water control structures.

2.1 Summary of Current Situation

2.1.1 Ke Go Dams and Reservoir

The Ke Go Reservoir comprises a main dam and three auxiliary dams. All of the dams are homogenous earth-fill embankments. The reservoir characteristics and dam design parameters are summarized in Table 1 and Table 2. As per TCVN 5060-90 standard, the designed Ke Go Dam complex was constructed as Grade No. 3, with a design flood frequency of P=100 years.

In general, the body of the main dam is assessed as being in a normal condition. Generally, subsidence of the dam hasn't occurred. The problems that do exist are summarized as follows:

- During construction 13 piezometers were installed in the downstream slope. Water levels were recorded up to 1988. At present none of the piezometers is operational.
- The upstream revetment of the main dam has been eroded by wave action. To treat the problem of upstream deterioration concrete slabs have been laid between elevations +26 m and +32.5 m. The initial protection was with concrete slabs of 1 m x 1 m x 0.1 m thickness. When this initial protection was seriously damaged in 1990, heavier slabs of 5 m x 10 m x 0.2 m. The remaining slope sections are still protected with small slabs. Slab protection on the right hand abutment has been damaged; and
- The downstream face of the main dam is protected by a surface drainage system. However, the drainage network is now dilapidated and erosion of the downstream face is becoming increasingly problematic. At the normal water level of the reservoir (+32.5 m) more than twenty leakage zones have been detected in the downstream slope and are causing water-logging at the toe of the dam. Thirteen piezometers have been installed in the dam body for groundwater level monitoring but these are now clogged and therefore do not function correctly. The broken down join of intake sluice could be the main reason.

The condition of the three saddle dams is assessed as follows:

Auxiliary Dam No. 1 – This dam is generally in good condition, although the berm on the upstream side is partly eroded.

Auxiliary Dam No. 2 – The upstream slope is partly eroded. In addition, at high reservoir levels, water leaks through the right shoulder of the dam at about .004 m³/s.

Auxiliary Dam No. 3 – There may be some seepage on the left shoulder of the dam.

The management road (from Provincial Road No. 17 to the headworks area) is in poor condition and often submerged in the rainy season.

2.1.2 Ke Go Dam Flood Safety

The Ke Go Dam does not meet new required design flood probability standards. The Ke Go Dam was constructed according to national dam safety standards (TCVN 5060-90) with a flood frequency of 1,000 years (p=0.001). However, a new set of flood design standards prepared by Viet Nam and the World Bank recommends a design flood probability of P=0.0001 (10,000 years). Parameters for TCVN 5060-2002 and the recommended Viet Nam/World Bank standards are provided in Table 3. The Ke Go Dam, designed to withstand a 1,000 year flood event is designed far below the new standard.

Table 1: Ke Go Reservoir water level and storage characteristics.

Catchment Area	Dead Water Level	Normal Water Level	Max Water Level	Dead Storage	Useful Storage	Storage Volume at Normal Level
223 km ²	+14.7 m	+32.5 m	+35.0 m	24.9 x 10 ⁶ m ³	320.6 x 10 ⁶ m ³	345.5 x 10 ⁶ m ³

Table 2: Ke Go Dam design parameters.

Type	Maximum height	Crest Elevation	Crest width	Crest Length
Main Dam (Earthfill)	19.3 m	+35.6 m	5.0 m	989 m
Auxiliary Dam 1 (Earthfill)	19.3 m	+35.6 m	5.0 m	1,000 m
Auxiliary Dam 2 (Earthfill)	16.1 m	+35.6 m	5.0 m	920 m
Auxiliary Dam 3 (Earthfill)	19.2 m	+35.6 m	5.0 m	283 m

Table 3: Parameters for existing and required flood design for Ke Go Dam.

Parameter	Value
Catchment Area	223 km ²
Existing Flood Design Parameters	
Design Flood Frequency	1000 years
Discharge at Design Flood Frequency	3,650 m ³ /s
New Flood Design Parameters	
Required Design Flood Frequency	10,000 years
One-Day Rainfall	1,044 mm
Flood Peak	4,360 m ³ /s
Flood Volume	236 million m ³
Runoff Depth	1,058 mm

2.1.3 Doc Mieu Chute Spillway

The design characteristics of the Doc Mieu Spillway are contained in Table 4. In general, the spillway is in good condition. The problems that do exist are summarized below:

- Part of the inlet channel remains blocked by a natural rock barrier;
- The equipment for operating the spillway is not protected; and
- While the gates are in generally good condition, water leaks under the gates.

2.1.4 Conduit Flood Spillway

The design characteristics of the Conduit Flood Spillway are contained in Table 5. The flood spillway outlet is located on two sides of intake sluice/electric generator and the radial gate is manually operated. The existing flood spillway outlet is in good condition. It has not been operated recently.

2.1.5 Intake Sluice

The design characteristics of the intake sluice are contained in Table 6. The intake is controlled by two flat gates, a guard gate and the discharge control gate. The guard gate is reported to be difficult to handle, while the control gate is reported to work satisfactorily.

Near the end of the conduit the irrigation barrel is diverted towards the powerhouse and bifurcates into six pipes: three pipes 1.6 m to the hydropower station and three pipes to the irrigation outlet valves.

A major problem with the operation of the conduit spillway is the significant leakage through the conduit joints resulting in approximately 0.4 to 0.5 m³/s inundating the inspection barrel. The problem of conduit leakage was

Table 4: Doc Mieu main spillway design parameters.

Design Discharge	Spillway Type	Spillway Dimensions (n x B x H)	Spillway Sill Elevation	Gate Type
1,065 m ³ /s	chute spillway, by ferro-concrete	2 x 10 x 6 m	26.50 m	steel radial with dimension 2 x 10 x 6 m, crankshaft hoist

Table 5: Conduit flood spillway design parameters.

Design Discharge	Spillway Type	Spillway Dimensions (n x B x H)	Spillway Sill Elevation	Gate Type
320 m ³ /s	ferro-concrete tube/undersluice	2 x 3.2 x 4.5 m	26.50 m	steel radial with dimension 2 x 3.2 x 4.5 m, crankshaft hoist

Table 6: Intake sluice design parameters.

Design Discharge	Spillway Type	Spillway Dimensions (n x B x H)	Spillway Sill Elevation	Sluice Length
320 m ³ /s	ferro-concrete square conduit/pressure-actuated for generating power	1 x 3 x 3 m	+ 6.0 m	177 m

addressed in 1991 and 1993 and involved grouting and covering the joints with steel plates but these measures had no positive effect. The hoisting equipment on the intake sluice is now worn out and does not ensure safe operation. Another problem with this component of the system has been persistent slope percolation on the downstream face adjacent to the intake sluice.

2.1.6 Emergency Flood Spillway

Additional spill capacity was created by the completion of a rock cum earth emergency spillway in August 2001 and includes some holes for placing dynamite in the case of emergency flood. The spillway is 65 m wide. It is in good condition.

2.1.7 Primary Canals and Associated Water Control Structures

The Ke Go Irrigation Scheme has nine primary canals with a total length of about 92 km. The N1 Primary Canal is the most of these, serving about 50% of the designed command area. Upgrading of this canal was recently initiated with the assistance from an ADB loan. Under the assistance embankment slopes over a length of 23 km of canal were upgraded.

Due to the topography of the terrain where the primary canals are located, some canal sections have a rather high earth filled embankment. This, combined with insufficient maintenance, has deteriorated the primary canals resulting in the reduction of water conveyance capacity.

Existing canal regulating structures are in poor condition and many of the gates and sluices do not operate properly. Some twenty years of operation without ongoing maintenance has resulted deterioration of structural concrete and corrosion of steel frames and gates, thereby contributing to the shortfalls in irrigation supply.

2.1.8 Secondary, Tertiary, and On-Farm Canals and Associated Water Control Structures

Existing secondary, tertiary and on-farm canals are of a worse quality than the primary canals. In general, the lower level canals are in very poor condition at present and some areas have no canals at all. There is a clear difference in quality between the secondary canals managed by the IMC and canals that were maintained and operated by the communes. The latter are supported by the local authorities and have had canal slopes lined at many locations. Secondary and lower level canals have virtually no intake sluices.

2.2 Description of Sub-Project

2.2.1 Overall Objectives of Sub-Project

The overall objectives of the Ke Go Sub-Project are to:

- Upgrade the existing irrigation scheme;
- Improve reliability, flexibility, and effectiveness of the irrigation system;
- Reduce the cost of operation and maintenance;
- Enable the scheme to satisfy all reasonable water needs by supplying a sufficient quantity of water at the required times of the year; and
- Create the conditions for sustainable socioeconomic development using the application of modern design, engineering, and irrigation system management technologies.

This will be achieved by modernization of technical infrastructure from the headworks to the farm fields and by modernization of the management system for the entire Irrigation Scheme.

2.2.2 Changes in Water Use and Allocation with Modernization

Modernization of the Ke Go Irrigation Scheme is intended to support the following changes in water and land use within the Sub-Project area:

- A 19% increase in the water supply for agriculture;
- Surplus water supply, up to 52.4 million m³/yr, for municipal and industrial use (at frequency 75%, total water availability volume will be 320 million m³/yr, with agricultural water requirement (in year 2010) estimated at 267.6 million m³/yr⁶; and
- Increase supply of domestic water to rural residents throughout the Sub-Project through increasing supply of water in the canal system.

2.2.3 Ke Go Dams, Reservoir, and Management Road

The engineering works for the upgrading of the Ke Go Dam will consist of the following:

- Replace the damaged lining slabs of upstream slope located at elevation 13m to 26m by new concrete slab of bigger and thicker dimension;
- Repairing the damaged parts of the wave prevention wall and increasing the height of the wall crest to 36.60 m;
- Lining the dam surfaces with a 30 cm rock layer and covering with a 30 cm pebble layer; and
- Install lighting system on dam surface;
- Overhaul piezometers system; and
- On the downstream slopes, repairing the drainage trench system and seepage zones, and constructing new grass frames.

The engineering works for the upgrading of the three saddle dams will consist of the following:

- Replace the damaged lining slab of upstream slope by new concrete slab of bigger and thicker dimension.
- Overhaul wave wall and heighten to elevation of 36.6 m;
- upgrading dam surface; and
- Repairing upstream slope.

The management road from Provincial Road No. 17 will be upgrade to Grade No. 3 standard by widening to a width of 5 m of which 3.5 meters will be paved with asphalt as well as provision of an adequate number of water drainage trenches.

Quantities of material required for upgrading the Ke Go Dam complex and the headworks management road are presented in Table 8.

⁶ Domestic water supply for Ha Tinh Town comes from the Boc Nguyen Reservoir, operated separately from the Ke Go Reservoir.

Table 7: Changes in water use with the Ke Go Sub-Project.

Water Use	Current (m ³ /sec)	With Sub-Project (m ³ /sec)	Difference (m ³ /sec)	% Change
Agriculture	7.2	8.53	1.33	18.5
Aquaculture	No data available in Engineering Sub-consultant reports			
Domestic Water Supply	Water supply to rural residents will be increased but no data available in Engineering Sub-consultant reports			
Industrial Water Supply	0	1.67	1.67	-

Table 8: Quantities of engineering required for upgrading Ke Go Dam complex and associated structures.

Item	Unit	Quantities				
		Ke Go Dam and Saddle Dams	Spillways	Intakes	Management Road	Total
Earth Excavation	m ³	17,552	50,893	3,306	13,850	85,601
Other Material to be Removed ⁷	m ³	0	0	0	0	0
Earth-fill to be Provided	m ³	24,911	10,520	14,775	16,590	66,796
Rock, Sand, and Gravel ⁸	m ³	0	0	0	0	0
Masonry, Concrete, and Cement Mortaring ⁹	m ³	4,406	3,504	1,007	1,169	10,086
Total	m ³	46,869	64,917	19,088	31,609	162,483

2.2.4 Doc Mieu Chute Spillway

The engineering works for the upgrading of the Doc Mieu Chute Spillway will consist of the following items (Quantities of material required for upgrading the Doc Mieu Chute Spillway are presented in Table 8):

- Destroy the upstream rock barrier located in the inlet canal;
- Reinforce the spillway surface;
- Replace the damaged lining slabs by new reinforced concrete slabs of larger dimensions;
- Replace the old winch by a new hydraulic piston in view to obtain a more reliable gate operation;
- Reinforce radial gates;
- Install local and central electrical control;
- Upgrade the protection covering for the spillway equipment in purpose of creating good conditions for spillway operation in case of unfavourable weather;
- Upgrade the spillway management station to ensure a favourable condition for working and living condition for the staff and workers who reside their to manage the spillway, especially in rainy season; and
- Install lighting system.

2.2.5 Main Flood Spillway

The engineering works for the upgrading of the Main Flood Spillway will consist of the following items:

- Widening the main flood spillway to 200 m from its current width of 65 m to enable to Ke Go Dam Complex

⁷ This includes: Riprap; Parapet; Construction blocks; and Existing Concrete that is chipped out; as presented in the Dam Safety Report for the Ke Go Sub-Project prepared by HEC-1

⁸ This includes: Drain Rockfill; Gravel for Filter; Sand for Filter; and Stone as presented in the Dam Safety Report for the Ke Go Sub-Project prepared by HEC-1

⁹ This includes: Concrete (all types); Rock Masonry; and Cement Mortar as presented in the Dam Safety Report for the Ke Go Sub-Project prepared by HEC-1

- to meet the more stringent design flood standards;
- Reinforce the spillway surface in purpose of increasing flood discharge in compared with initial design;
- Reinforce dissipation basin;
- Repair damages in whole;
- Reinforcing spillway gate;
- Electrification of spillway operation; and
- Protection covering installed at sluice tower and spillway in purpose of becoming the headwork management station.

2.2.6 Conduit Flood Spillway

The engineering works for the upgrading of the Conduit Flood Spillway will consist of the following items:

- Repair of the broken joints that are causing high seepage;
- replacing old radial gates as required; and
- replacing gate operation machinery.

Quantities of material required for upgrading the Conduit Flood Spillway are presented in Table 8.

2.2.7 Intake Sluice

The engineering works for the upgrading of the intake sluice will consist of repairing the broken joints that are causing high seepage and upgrading and replacing as required the associated mechanical and electrical systems. Quantities of material required for upgrading the Intake Sluice are presented in Table 8.

2.2.8 Canals and Associated Water Control Structures

The engineering works for the upgrading of the canal system will consist of (Quantities of material required for upgrading the main, primary, and secondary canals are presented in Table 9):

Main Canal

- There is no need to upgrade or to overhaul the 5 km length head section of the canal.
- The remaining 12 km must be rehabilitated and the cross section brought back to the original designed section by means of back filling the eroded section and dredging silted places.
- Canal lining will be carried out at sections where adverse geological features caused frequent sliding of the embankments.
- For the Main Canal a system of Downstream Control of the water-levels will be introduced, combined with a local automatic control of the Cross Regulators in the canal.
- Construct access road next to the main canal.

Primary Canals

- Restore the current cross section into to the initial designed cross section by means of dredging silted sections and backfilling eroded canal embankments.
- Canal lining will be carried out at sections where adverse geological features caused frequent sliding of the embankments.
- Heighten and upgrade the embankment road to become the main access road.
- The Primary Canals will continue to operate under a system of Upstream Control.

Secondary, Tertiary, and On-Farm Canals

- Complete the canal infrastructure up to the level of the farm fields
- Restore the current cross section to the initial designed section.
- The Secondary Canals will continue to operate under a system of Upstream Control.
- Carry out canal strengthening in accordance with the GoVN Decision No. 66/2000/QĐ-TTg of June 13, 2000, regarding "Some policies and financial mechanism for the implementation of canals lining program".

The engineering works for the upgrading the water control structures will consist of:

Main and Primary Canals

- Repair of the damaged structures.

Table 9: Quantities of engineering required for upgrading canal system of Ke Go Irrigation Scheme¹⁰.

Canal System	Total Length (m)	Lined (m)		Excavation (m ³)	Earth-Fill, (m ³)	Concrete, Masonry (m ³)
		Current	With Project	Earth, Rock		
Main Canal	17.2	0	12	202,112	188,953	69,839
Primary Canals	99.4	7	99.4	247,382	146,438	65,506
Secondary Canals	90			164,819	124,275	79,059
Total	206.6	7	111.4	614,313	459,666	214,404

- Completion of outlets taking water from the primary canals for the secondary canals.
- The regulators in the Main Canal will be provided with Local Automatic Control and SCADA
- Offtakes from the Primary Canals will be provided with automatic water-level/discharge measurement devices (SCADA).
- Replacement all seriously damaged hoisting equipment. Electrification is recommended for hoisting requirement of sluices with dimension B ≥ 80 cm on Main canal.

Secondary, Tertiary, and On-Farm Canals

- Construct outlet structures on secondary canals as well as outlets from Main canals to Secondary and Tertiary canals.
- For structures on canals from secondary canals downwards: the hosting equipment will be manually operated at-site with (local) measurements. They will not be electrified yet
- Automatic water-level/discharge measurement devices (SCADA) will be installed.

2.3 Modernization of the Irrigation Management System

The Sub-Project activities for modernization of the irrigation management system will consist of:

- Electrification of the operation of water control structures down and including the structures controlling water into the secondary canals;
- Upgrading the technical capacity of irrigation management personnel;
- Upgrading the equipment and management facilities of the Ke Go IMC offices including the Management Stations; and
- Improvement of the water user fee policies and the application and implementation of those policies.

2.3.1 Summary of Surface Transportation Upgrading

Table 10 contains a summary of the planned upgrading of the surface transportation system within the Ke Go Sub-Project.

2.3.2 Drainage System

Drainage ability will be improved in whole scheme by repairing damaged drainage structures.

2.3.3 Requirements for Resettlement and Compensation for Land Acquisition

As currently configured, the Ke Go Sub-Project will not require any resettlement (Table 11). There are some very modest requirements for compensation as a result of land acquisition. It must be recognized, however, that the resettlement and compensation estimates contained in Table 11 do not include requirements that might occur when implementing the completion of the canal system at lower (tertiary and on-farm) levels.

2.4 Expected Changes in Agricultural Land Use

Table 12 provides the expected changes in land use within the command area as a result of Sub- Project

¹⁰ Does not include on-farm canal system.

implementation¹¹. The Sub-Project is expected to provide an additional 13,440 ha of cultivated agriculture per year.

Table 10: Description of planned upgrades to surface transportation in Ke Go Sub-Project.

Type	Length (km)		Width (m)		Excavation (m ³)	Earth-fill (m ³)	Other Fill (m ³)
	Current	With Sub-Project	Current	With Sub-Project			
Management Road for Headworks	20	20	4-8	6	13,850	16,590	1,169
Management Road along Main Canals	17.2	17.2	3	6	• Quantities are included in quantities for canals (Table 9)		
Management Road along Primary Canals	100	100	1-5	Na			
Roads/Paths along Lower Level Canals	• not available in design documents		0.8	••• not available in design documents			

Table 11: Summary of resettlement and compensation requirements for Ke Go Sub-Project.

Sub-Project Component	No. Households to be Resettled	Land Acquisition (ha)	
		Permanent	Temporary
Headworks	0	0.6	0
Canals	0	103.17	60
Total	0	103.77	60

Table 12: Expected changes in agricultural land use within the command area with Sub-Project implementation.

Land Use Type	Current	With Project	Increment
Winter/Spring Rice	7,061	13,780	6,719
Summer Rice	8,097	12,747	4,650
Seasonal Rice	0	3,273	3,273
Peanut	2,063	1,550	(513)
Sweet Potato	2,067	1,378	(689)
Total	19,288	32,728	13,440

¹¹ Derived from information provided in the financial analysis section of the final VRWAP PFS, submitted to MARD in March, 2003.

3: DESCRIPTION OF EXISTING ENVIRONMENT

3.1 Location of Sub-Project

The location of the Ke Go Irrigation Scheme is as follows:

- the catchment area is in the Rao Cai River Basin of Ha Tinh Province; this catchment 's borderline is from the North latitude 18° to 10°15', and East longitude from 105°45' to 106°05', and flow generated from the mountain with the height from 300–400 m;
- the Reservoir and headworks are located in Cam Xuyen District of Ha Tinh Province, about 300 km south of Ha Noi;
- the irrigation system covers an area of 21,136 ha which includes:
 - 18 communes of Cam Xuyen District;
 - 32 communes of Thach Ha District;
 - 10 communes of Ha Tinh Town

Just over 350,000 persons reside in the districts that form the Sub-Project. The Sub-Project Area has an average population density of 1,080 people per km². Population densities vary markedly across the scheme with the most sparsely populated area being Thach Ha District with 584 persons per km² and with Ha Tinh Town, with 1,917 persons per km². All Sub-Project residents are of the Kinh ethnic group. Most of the land in the Sub-Project is used for agriculture, and there remains only a small amount of unused land.

Synoptic information for the Sub-Project area is presented in Table 13 and Table 14.

3.2 Physical Resources

3.2.1 Climate

Ke Go's catchment area and its irrigation scheme lies in the tropical monsoonal region. Being located in middle part of Viet Nam, the Ke Go Sub-Project Area has two distinct seasons: the summer-autumn season with the Lao wind which is very dry and hot (May to September) and; the autumn-winter season with heavy rainfall at times accompanied by typhoons and tropical storms causing flooding (October to April).

Temperature The mean monthly temperature is around 23 to 24°C, with little change throughout the year (Figure 3); the maximum temperature is 30°C in June and July, while lowest temperatures are 18°C in January.

Rainfall The Sub-Project area has a tropical monsoon climate, with a pronounced rainy season from May to September, and a dry season from October to April (Figure 3). Total mean annual rainfall in the Ke Go area is about 2,700 mm, with almost 70% of this precipitation occurring in the rainy season.

Relative Humidity The mean relative humidity in Sub-Project area is high, the annual mean relative humidity is 85%, with highest humidity (93%) in February and lowest humidity (74%) in July (Table 15).

Sunshine Hours Sunshine hours are limited, with an annual average of slightly more than 1,570 sunshine hours, equivalent to about 4.3 hours a day (Table 15).

Evaporation Annual potential evaporation is 807 mm. The highest monthly evaporation is 135 mm (4 mm/day) in July, and the lowest monthly evaporation is 26 mm in February.

3.2.2 Landforms and Topography

The Ke Go Reservoir catchment lies in the mountainous areas of Huong Son, Huonh Khe, Cam Xuyen, and Ky Anh districts of Ha Tinh Province. This catchment lies between the North Truong Son Mountains and the Deo Ngang Mountain Pass between Ha Tinh and Quang Binh Provinces. The topography and terrain of Ha Tinh Province can be divided into four main types:

Mountainous Terrain This terrain is mainly found in the North Truong Son Mountains and Deo Ngang Mountain Pass. The topography is very complicated and is comprised of mountains with the elevation

Table 13: Synoptic land use information for the Ke Go Sub-Project Area¹².

	Basic Information			Agricultural land use							Forest Area			Nature Reserves	
	Area (ha)	Population	Population density/km ²	Total	2 rice	Spring winter rice	Autumn Summer rice	1 rice plus 1 dry season	Industrial crop	Summer rice	Production/Artificial forest land	Special land use	Protection	National	Provincial/ natural Forest land
N3 + N5 Pilot Area															
Cam Thanh Commune	1,097	7,404	675	641		540	547			0	7	0	0	0	0
Cam Binh Commune	1,088	5,538	509	606		520	508			0	0	0	0	0	0
Cam Vinh Commune	741	4,303	581	377		280	291			0	0	0	0	0	0
Thach Binh Commune	370	2,326	629			128	140			0					
N4 + N6 Pilot Area															
Cam Quang Commune	953	6,107	641	403		340	352			0	0	0	0	0	0
Cam Thang Commune	681	4,245	623	384		290	280			0	0	0	0	0	0
Cam Huy Commune	892	4,185	469	489		362	364			0	0	0	0	0	0
Cam Phuc Commune	792	3,883	490	372		230	116			54	0	0	0	0	0
Cam Xuyen Town	655	7,994	1,220	257		235	200			0	0	0	0	0	0
Summary, Pilot areas	7,271	45,985	648	3,432		2,925	2,798			54	7	0	0	0	0
Complete Command Area															
Ha Tinh Town	3,065	57,516	1,917	1,778		1,028	1,212		390	45	3	0	0	0	0
Thach Ha District	30,783	179,635	584	15,235		7,610	5,849		2,785	2,451	1,092	0	0	0	0
Cam Xuyen District	24,346	118,217	738	8,794		6,695	5,820		1,300	393	0	4,372	0	7,998	0
Summary, Complete Command Area	58,194	355,468	1,080	25,807		15,333	12,881		4,475	2,889	1,095	4,372		7,998	0
Upstream Area of Project															
Thach Dien Commune	2,937	5,812	198	400		313	314			0	-	-	-	-	-
Cam My Commune	16,140	6,203	38	417		200	209			40		3,253	7,972	7,972	
Cam Thinh	7,681	6,450	84	628		515	374			32		2,162	3,366	3,366	
Summary, Upstream Districts	26,758	18,465	110	1,446		1,028	897			72		5,415	11,338	11,338	

¹² Information is provided only for administrative units that are within particular parts of the Sub-Project; the boundaries of these administrative units do not necessarily correspond to the boundaries of the pilot areas, command areas, or areas of influence of the major headworks. The data give a qualitative understanding of the socioeconomic status of the Sub-Project area.

Table 14: Synoptic socioeconomic information for the Ke Go Sub-Project¹³.

	Basic Information			Household Size				Poverty		Ethnic Minorities								Cultural, Historic Sites		
	Area (ha)	Population	Population Density	Total No. HH	Average HH Size	No. Agr HH	Ha Ag land/Ag HH	% Below Minimum Poverty	No. Communes on National 135 Priority List	% Kinh	% Other	No. Ethnic Minorities	Name	% Pop'n	Name	% Pop'n	Name	% Pop'n	No. at National Level	No. at Local Level
N3 + N5 Pilot Area																				
Cam Thanh Commune	1,097	7,404	1,097	1,806	4.10	1,461	0.43	NA	0	100	0	0	0	0	0	0	0	0	0	0
Cam Binh Commune	1,088	5,538	1,088	1,354	4.08	1,095	0.55	NA	0	100	0	0	0	0	0	0	0	0	0	0
Cam Vinh Commune	741	4,303	741	1,037	4.15	839	0.45	NA	0	100	0	0	0	0	0	0	0	0	0	0
Thach Binh Commune	370	2,326	370	576	4.04	435		NA	0	100	0	0	0	0	0	0	0	0	0	0
N4 + N6 Pilot Area																				
Cam Quang Commune	953	6,107	641	1,515	4.03	1,225	0.33	NA	0	100	0	0	0	0	0	0	0	0	0	0
Cam Thang Commune	681	4,245	623	1,010	4.20	817	0.47	NA	0	100	0	0	0	0	0	0	0	0	0	0
Cam Huy Commune	892	4,185	469	985	4.25	797	0.61	NA	0	100	0	0	0	0	0	0	0	0	0	0
Cam Phuc Commune	792	3,883	490	936	4.15	757	0.49	NA	0	100	0	0	0	0	0	0	0	0	0	0
Cam Xuyen Town	655	7,994	1,220	1,964	4.07	1,589	0.16	NA	0	100	0	0	0	0	0	0	0	0	0	0
Summ., Pilot Area Communes	7,271	45,985	648	11,183	4.12	9,015	0.43	NA	0	100	0	0	0	0	0	0	0	0	0	0
Complete Command Area																				
Ha Tinh Town	3,065	57,516	1,917	14,028	4.1	5,597	0.31	13.1	0	100	0	0	0	0	0	0	0	0	0	2
Thach Ha District	30,783	179,635	584	41,775	4.3	31,583	0.48	32.3	0	100	0	0	0	0	0	0	0	0	0	3
Cam Xuyen District	24,346	118,217	738	18,147	4.2	14,681	0.6	21.8	0	100	0	0	0	0	0	0	0	0	0	2
Summ., Command Area	58,194	355,468	1,080	73,950	4.2	51,861	0.46	22.4	0	100	0	0	0	0	0	0	0	0	0	7
Upstream Area of Sub-Project																				
Thach Dien Commune	2,937	5,812	198	1,236	4.7	741	0.54	NA	0	100	0	0	0	0	0	0	0	0	0	0
Cam My Commune	16,140	6,203	38	1,279	4.85	767	0.54	NA	0	100	0	0	0	0	0	0	0	0	0	0
Cam Thinh Commune	7,681	6,450	84	1,316	4.9	790	0.79	NA	0	100	0	0	0	0	0	0	0	0	0	0
Summary, Upstream Area	26,758	18,465	110	3,831	4.82	2,298	0.62	NA	0	100	0	0	0	0	0	0	0	0	0	0

¹³ Information is provided only for administrative units that are within particular parts of the Sub-Project; the boundaries of these administrative units do not necessarily correspond to the boundaries of the pilot areas, command areas, or areas of influence of the major headworks. The data give a qualitative understanding of the socioeconomic status of the Sub-Project area.

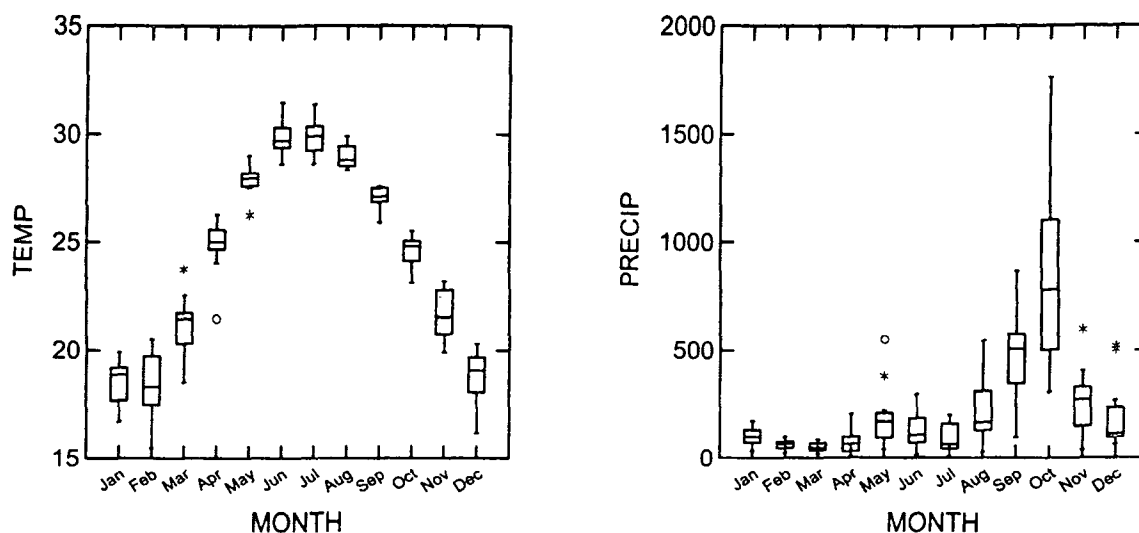


Figure 3: Historical monthly temperature ($^{\circ}\text{C}$) and precipitation (mm) in Ke Go Sub-Project Area. Source: Ha Tinh Town Hydrometeorological Station. Data are from 1991 to 2001.

Table 15: Basic climate information for Ke Go Sub-Project.

Factor	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
Average Temp	18.4	18.4	21.1	24.8	27.8	29.9	29.8	29	27	24.5	21.6	18.7
Number of sunshine hour in months	76.3	51.9	72.8	133.2	197.1	200.8	212.9	190.3	147.8	129.3	100.4	59.1
Rainfall (mm)	105.9	67	54.9	76.3	194.1	130.2	95.3	227.3	471	831	259.9	203.1
Mean relative humidity %	91	93	91	89	82	75	74	79	86	88	87	89

Source: Ha Tinh Town Hydrometeorological Station.

averaging about 400 m (the highest mountain is 1040 m elevation) and also numerous low mountains with average elevation from 80-130 m and many streams.

Hilly Terrain This is a transition landform from the mountainous terrain (above) to the alluvial plain (below). This area lies along National Road No. 15. The landforms intermix between the medium hills and low large uneven plain.

Alluvial Terrain This region is formed by the old alluvial river and marine sediments. The entire command area lies on this region from the Sot to the Nhuong River Mouths. This terrain is rather flat, sloping from west to east, and with average elevation of 4.0 m (while the highest and lowest elevations are 10 m and 2.5 m, respectively).

Coastal Terrain This region lies from National Road No. 1 to the coast. It is formed by sea alluvium, but also contains sandy dunes along the coast.

3.2.3 Soils

The soils of the Sub-Project Area consist of three main groups: Coastal Plain and Valley Soils; and Terrace soils:

Coastal Plain and Valley Soils (93%) consist of four sub-groups:

- **Sandy Soils** (22%) These soils are characterized by low amounts of humus (from 0.2 to 0.7%), low total nitrogen, low phosphate, and low acidity. These soils are found along the coast in Cam Xuyen and Thach Ha Districts. Land containing these soils contains bare or artificial forest; some parts grow

- dryland crops or short period industrial plants.
- **Saline Soils** (3%) are found along the coast. On the low saline soils rice and dryland crops can be grown, but crop yields are low in drought years. On the heavy saline soils, there are some aquaculture ponds, or white salt production fields, and some parts are still unused (likely coastal wetlands).
- **Saline acid soils** (10%) are found in lowlands. These soils are clayey and contain medium amounts of humus. Rice is cultivated on these soils.
- **Alluvial Soils** (58%) are classified by annual upgraded alluvium soil, rare upgraded alluvium soil, low clay alluvium soil, medium or high clay alluvium soil, old alluvium soil and river alluvium soil in the mountain areas. These soils are high in nutrients and are used to grow rice, dryland crops, and short duration industrial crops. Most of the command area is comprised of these soils.

Terrace Soils (7%) These soils have good nutrient content and are used to cultivate fruit trees.

3.2.4 Surface Water Hydrology

The hydrology of the Sub-Project Area comprises the Ke Go Reservoir, and the Rao Cai River. The Rao Cai River is only 29.4 km long, but the catchment area is rather large, with the width of 9km, and the average slope is $0.2^\circ/\infty$. There are separately flood season and dry season in Ha Tinh Province. The flood season is late, from August to October; and the small floods often appear during May or June.

Rao Cai River The Rao Cai River catchment is located in a high rainfall area, and the surface water quantity is rather abundant and depends on the rainfall completely. The annual flow is not evenly distributed throughout the year and the flood season accounts for 60 to 85% of the total annual flow. The average minimum monthly flow is $1.9 \text{ m}^3/\text{s}$, and the average annual flow is 56.3 l/s-km^2 ; and the flow coefficient is 0.57.

Ke Go Reservoir The Ke Go Reservoir is fed from a number of streams and rivers, of which the main river is Rao Cai River. There are two precipitation seasons in the Ke Go Reservoir catchment; the initiation of the first flood season is May with the main flood season is delayed by one or two months in comparison with other areas. The main flood season starts from August to the end December, and dry season lasts six or seven months in the year. As with the temporal pattern of rainfall, more than 70% of the total annual flow concentrated in five months of the wet season, and only 30% of the flow occurs in the dry season. Yearly flow is from $40 \text{ to } 50 \text{ l/s-km}^2$ and the water potential in this watershed is rather high. The average measured flow at Ke Go hydrological station is $13.6 \text{ m}^3/\text{s}$. The probable maximum flood frequency usually occurs in October (please see Figure 4 for a description of changes in Ke Go Reservoir level).

Salinity Intrusion After the construction of Ke Go Reservoir, the river flow was more strong affected by the downstream tidal regime. The tidal amplitude is from 1.5 to 2.0 m and can reach up to 3.0 m in some cases with a high flood tide. In the dry season, no water is discharged into the river downstream of the command area, and salinity intrusion reaches to within 8 km downstream of the main dam.

3.2.5 Surface Water Quality

There is no regular surface water quality monitoring of any kind within the Sub-Project Area and it is therefore not possible to make any comprehensive quantitative assessment of current water quality conditions within the Sub-Project Area. There have been a number of water quality surveys conducted, including a survey conducted as part of the preparation of this EIA; the main results of these surveys are found in Annex 4 (national water quality standards are provided in Annex 5).

The main features of surface water quality in the Sub-Project Area are as follows.

Ke Go Reservoir The reservoir generally has good quality water with most water quality parameters within national surface water quality standards. The Reservoir has a tendency towards eutrophication, as evidenced by high phosphate levels¹⁴. In addition, parameters such as COD and dissolved oxygen in recent years have become above national surface water quality standards. Heavy metals have not been found yet in the reservoir.

Command Area The limited water quality surveys that have been conducted in the command area to date indicate that surface water quality is generally acceptable, save for coliform levels and bacterial contamination.

¹⁴ Value of $\text{PO}_4\text{-P}$ < .01 mg/l, eutrophication risk is Low; .01 to .04 mg/l, risk is Medium; > .04 mg/l, risk is High. Source: ANZECC/ARMCANZ (2000)

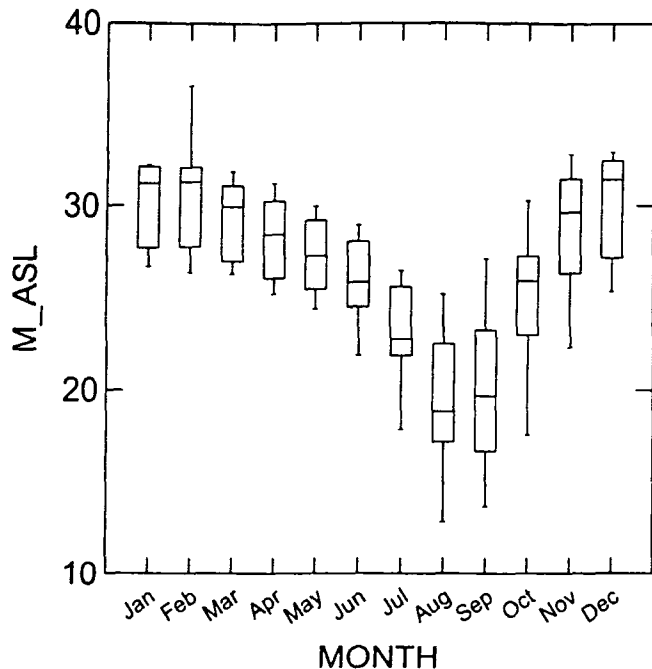


Figure 4: Ke Go Reservoir level. Data from 1990 to 2001, Ke Go IMC.

Pesticide levels in surface waters of the command area are unknown.

3.2.6 Groundwater Resources

Shallow groundwater resources throughout the Ke Go Irrigation Scheme have become more abundant as a result of development of the Ke Go Reservoir and increasing supply of water for irrigation. The groundwater levels depend on the water levels of Ke Go Reservoir and irrigation canal network, with groundwater levels changing with the amount of irrigation water supplied and used and the amount of precipitation. In rainy season, the groundwater level is from 0.5 – 1.5 m, and the dry season from 2.0-3.0 m. Groundwater resources in the Sub-Project Area are generally adequate and meet national groundwater quality standards except for bacterial pollution (coliform, and E.coli) (Annex 4 contains information on groundwater quality in the Sub-Project Area). In addition, a number of other water quality parameters periodically exceed national standards.

The deep groundwater resources are often polluted by salinity intrusion. Groundwater at a depth of greater than 5.0 m generally can not currently be used for any purpose.

Pesticide levels in the groundwater resources of the Sub-Project Area are unknown.

3.2.7 Air Quality

None of the air quality monitoring stations in the national Environmental Monitoring system maintained by the National Environment Agency of Viet Nam are located in or near the Sub-Project Area, and there are therefore no long term records of air quality from the Sub-Project Area.

Notwithstanding this lack of information, air quality appears to be generally good in the Sub-Project Area, with low levels of industrialization and not being downwind of major industrial facilities. Local residents indicated that they believed the climate has moderated, with less extreme hot days, as a result of constructing the Ke Go Reservoir.

3.2.8 Mineral Resources

There are a number of mineral resources in the Sub-Project Area:

Iron is found in Thach Khe (the coastal area of Thach Ha district), about 7km north east of Ha Tinh Town. The

estimation of this iron ore reserve is about 544 million tonnes, occupying nearly 50% of the total national iron ore reserves.

Titanium: Inmenhite mineral, containing titanium, is found along the coastal areas of Thach Ha, Cam Xuyen, Ky Anh and Nghi Xuan Districts. The reserves are estimated at 5.4 million t Inmenhite and 322,000 t Zircon.

3.3 Biological Resources

3.3.1 Terrestrial Ecosystems and Biodiversity

The area in which the Sub-Project is located is a transition from the Truong Son Mountains to hilly areas along the coast and Ha Tinh flat plain. There are essentially two types of terrestrial ecosystems in the Sub-Project Area:

- The catchment of the Ke Go Reservoir with mixed vegetative structure, largely forested consisting either natural forest and regenerated forest or artificial regenerated forest. The Ke Go Nature Reserve is found in this catchment area (see below); and
- A highly simplified agricultural ecosystem that produces annual crops, interspersed with fruit trees and trees planted for shelter and fuelwood purposes. The command area consists of almost entirely this type of terrestrial ecosystem.

3.3.2 Forest Resources

There are 5,467 ha of land designated as production forest within the districts and communes that form the Sub-Project Area (Table 13, Page 17). This land is found on the hills that are scattered throughout the Sub-Project Area, mostly to the immediate west and south of the main command area. Forests on these hills are secondary forests, scrubby, and highly degraded due to long-term exploitation for fuelwood and other purposes. Some of these areas have been artificially regenerated with eucalyptus and other tree species. These hill area production forests lie outside of the actual land that is currently served by the Ke Go Irrigation Scheme and there is no pumping contemplated in the Ke Go Sub-Project to deliver irrigation water to even the lower slopes of these hills. In fact, while the original design of the Irrigation Scheme called for some of the lower slopes of these hill areas to be serviced, the current Sub-Project will not provide irrigation water to these areas.

3.3.3 Aquatic Ecosystems and Biodiversity

There are essentially four types of aquatic ecosystems in the Sub-Project Area:

- The highly simplified and modified aquatic ecosystems of the aquaculture farming areas in the brackish water along coastal benches. Aquaculture has developed quickly in recent years;
- The highly simplified aquatic ecosystem represented by the irrigation canals;
- The aquatic ecosystems of the major rivers running through the Sub-Project Area; and
- The Ke Go Reservoir.

In the initial years of Ke Go Reservoir operation, fishery resources increased dramatically with the flush of nutrients into the ecosystem. Now, many years after this nutrient flush, increased sedimentation of the reservoir reducing aquatic habitat, and overfishing, aquatic biodiversity in the reservoir is rather poor. Both fisheries catch and catch per fisherman, an index of reservoir fisheries population have declined in recent years.

3.3.4 Biodiversity

Flora and fauna have been severely affected by the loss of habitat and exploitation. Biodiversity surveys have not been conducted specifically in the Sub-Project Area, but surveys have been conducted in the Ke Go Nature Reserve and the Nature Reserve does contain a number of rare and endangered species, a number of which are on the 2002 IUCN Redlist of Endangered Species (Table 16, Annex 6). To date 270 species of bird and 567 species of plant have been recorded in the Ke Go Nature Reserve. The recently described Giant Muntjac *Megamuntiacus vuquangensis*, is among 47 species of mammal recorded from the Nature Reserve. Ke Go Nature Reserve also conserves populations of 10 species of bird and 18 species of mammal now threatened with extinction (Anon.1992, Collar *et al.* 1994). The species diversity and levels of endemism within Ke Go Nature Reserve make its conservation a priority of international importance.

3.3.5 Nature Reserves and Protected Areas

The Ke Go Nature Reserve is located in Huong Khe, Cam Xuyen, and Ky Anh Districts in Ha Tinh Province (Annex 7). It comprises a 24,800 ha area within largest remaining block of broad-leaved evergreen forest in the level lowlands of central Vietnam. The Natural Reserve conserves a representative example of the lowland forest habitat which formerly extended throughout the coastal plain of central Vietnam but which has now largely been cleared for agriculture. These forests of central Vietnam comprises a biodiversity "hotspot", the so-called Annamese Lowlands Endemic Bird Area (ICBP 1992). The richness of the region's biodiversity is reflected in high levels of bird endemism; four species of bird have their global ranges confined to this small region. The Ke Go Nature Reserve aims to conserve populations of the two species which are confined to the northern part of this region - the boundaries of the natural reserve encompass all the recent forested localities in Ha Tinh Province for Vietnamese Pheasant *Lophura hatinhensis* and the locality from which Imperial Pheasant *Lophura imperialis* was collected in 1990.

Much of the Ke Go Nature Reserve lies within the watershed of the Ke Go Reservoir which provides irrigation water to villages in Cam Xuyen District. Watercourses in the south-eastern part of the Natural Reserve drain into the Gianh River watershed which forms the major river system in northern Quang Binh Province. Thus the Natural Reserve has a great economic value maintaining the agricultural viability of the surrounding agricultural areas. The park is divided into two zones, which based the biodiversity value, the current condition of the vegetation and present land-use, comprising a core zone of 20,537 ha and a habitat rehabilitation zone of 4,264 ha. The Nature Reserve offers some potential for environmental education and promoting public awareness. The protected area is considered to have a low potential for tourism.

3.4 Socioeconomic Resources

3.4.1 Population, Demography, and Ethnic Composition

The population of Sub-Project Area is 373,933 persons (Table 14, Page 18). The districts in the command area of the Sub-Project contain 355,468 persons, with population density of 1,080 persons per km², with the highest population density in Ha Tinh Town with 1,917 persons/km². About 18% of the population is less than 18 years of age and about 90% of total households are farm households. The average household size is 4.7. All of the population in the Sub-Project Area is Kinh; there are no members of ethnic minority groups in the command area.

3.4.2 Irrigation, Agriculture and Commodity Production

Irrigation Ke Go Reservoir started operation in 1983 to irrigate the region located in Cam Xuyen, Thach Ha Districts and Ha Tinh Town. One main irrigation canal of (capacity of 28.2 m³/s) and nine primary canals with total length of 90 km provide water for the command area. The main objective of the Ke Go Reservoir scheme was to provide water for irrigation of 21,136 ha in Ha Tinh Province. In fact, the irrigated area of Ke Go Reservoir is 13,700 ha (about 66% of total designed area), of which 10,676 ha (76%) receive sufficient supplies of water, the rest often suffering from inadequate supplies. Almost of the drought areas are located at the bottom end of the primary canals.

Drought is a frequent occurrence in the central provinces of Vietnam every year and was most severe in 1982, 1993, and 1998. 1998 was a particularly severe year for drought; a total of 28,300 ha of rice suffered from drought in Ha Tinh Province, of which 12,500 ha autumn-summer rice and summer rice were completely lost.

Salinity intrusion makes damage more severe in the parts lying along the river banks. This problem is critical during dry season when Ke Go Reservoir does not discharge water into the rivers downstream.

Waterlogging is also problem in this area because the drainage system was not completely constructed and much reliance for drainage is placed on the natural rivers of the Sub-Project Area. For example, in the pilot areas, in 2001, about 300 ha were waterlogged, in which 200 ha of crops were lost completely.

Agriculture Agriculture is the dominant economic activity of both the command area and the entire Sub-Project Area, comprising 44.3% of the total land in the districts with land within the command area:

- 74% of this agricultural area is used for the production of annual crops, including rice and maize;

Table 16: Summary of rare and endangered species found in the Ke Go Nature Reserve.

Class of Species	No. Species on IUCN 2000 Red List	No. Species in Viet Nam Red Book
Plant	10	10
Mammals	18	16
Reptiles	8	0
Birds	16	9

- 21% of this agricultural area is in food crops including groundnut, sugarcane, cassava, sweet potatoes, sesame, onion, various types of bean, and vegetables; and
- 5% remain area is fruit trees, tea, and rubber tree.

The cropping pattern applied by the farmers largely depends on the availability of irrigation water. If sufficient water is available at the proper times of the year, winter-spring rice and autumn-summer rice is the common cropping pattern. In some parts, water is not available from May and June for Autumn-summer rice crop, so in those parts will be grown summer rice crop starting later than one month as same time starting rainy season. In rainfed irrigation conditions, there are nearly 3,000 ha summer rice crop and some other food crops. In strictly rainfed irrigation conditions, sugarcane, cassava and tea, rubber tree, fruit trees are the most common crops. Crop diversification is increasing in the command area.

Cropping Intensity and Yield¹⁵ Cropping intensities vary from season to season and according to the location in the scheme. The average cropping intensity (CI) in the winter-spring season is nearly 76%, and 66% in the summer/autumn and summer season. In the winter/spring season, agricultural development is limited to small-scale cultivation of vegetables, groundnut and sweet potatoes, and the cropping intensity does not go beyond 40%. The annual cropping intensity for the entire scheme is about 180 percent. The CI is highest in the upper reaches of the scheme and at the head ends of the primary and secondary canals, as farmers there get adequate irrigation water supplies to cultivate land. In the tail-end areas of the canal commands, crops sometimes fail to mature either because of shortage of water or waterlogging caused by seepage and flooding.

The average annual yield of paddy rice is low; the average rice yield is 4 t/ha and varies from 3 to 5.5 t/ha. The average yield of maize is 2.6 t/ha, the soybean 0.8 t/ha, sweet potatoes 4.5-5.5 t/ha, cassava 5-6 t/ha, and groundnut 1.3-1.5 t/ha. Low rice yields are mainly owing to poor soil quality, inadequate irrigation water, inadequate application of fertilizer, and widespread use of low quality seeds.

IPM While IPM programs have been developed in communes located in the Sub-Project area, the reach of the IPM programs appears to be somewhat limited; about 70% of total communes in command area that have received IPM extension services or training in use of IPM techniques. In which about 50% of total villages have received IPM services or training in use of IPM techniques. The results of application of IPM technique have not changed the habits of farmers to use fertilizer and pesticide during past five years (1997-2001). The total fertilizer and pesticide applied in one ha cultivated land are 1501 kg and 1.15kg, respectively.

3.4.3 Aquaculture

Development of brackish water aquaculture is a strong driving force in the coastal areas of Ha Tinh Province, mostly due to the ongoing implementation of the National Aquaculture Development Program (1999-2010)¹⁶. Aquaculture is developing in Cam Xuyen and Thach Ha Districts, as well as Ha Tinh Town (Table 17). Brackish water aquaculture area increased 112% between 1996 to 2000 in the entire Sub-Project Area and in the current provincial economic development plan, the total area of brackish aquaculture in 2010 is scheduled to be 352% of the brackish water aquaculture area of 2000.

The water use and allocation by the Sub-Project for aquaculture will represent about 30% of total water supplied to brackish water aquaculture, with 10% coming from rainfall and 60% from marine waters¹⁷. Common tiger prawn, *Penaeus monodon*, is the most common brackish water aquaculture commodity produced and extensive, semi-intensive and intensive cultivation is practiced. While the yield under intensive cultivation can be very high,

¹⁵ This section is excerpted from the Ke Go Initial Social Assessment Report.

¹⁶ This has been accompanied by a concomitant decrease in the area of mangrove and other wetlands in coastal Ha Tinh Province (as indicated in Coastal and Marine Environmental Management Database prepared as part of ADB 5712-REG: Coastal and Marine Environmental Management in the South China Sea, Phase 2, September 2000).

¹⁷ None will be supplied by groundwater.

Table 17: Brackish water aquaculture development area in the Sub-Project Area (ha).

District	Total Area (ha)					
	1996	1997	1998	1999	2000	Planned for 2010
Ha Tinh Town	10	45	33	33	33	140
Thach Ha District	387	385	397	449	489	1,496
Cam Xuyen District	135	132	132	132	73	462
Total	532	562	562	614	595	2,098

Source: Ha Tinh Aquaculture Department

up to 2 t/ha/crop with 2 crops per year, intensive cultivation is expensive, requiring high capital investments and so most of the aquaculture is of the extensive variety, with much lower yields. Average annual yield is 0.1 t/ha.

There is little separation of water supply and drainage in the aquaculture areas and there is high water pollution of aquaculture ponds due to poor pond layout. Pond sediment waste which must be disposed of between crops is about 100 wet weight t/ha/crop (with 76% water content). Viral disease is a common problem with brackish water aquaculture throughout coastal Viet Nam.

3.4.4 Household Income and Incidence of Poverty

The average annual per capita net income (from all sources and including all costs) in the two pilot areas is VND 1.56 million (US \$101); about 90% of this is generated from agricultural activities (the rest from other activities such as hired-labor, secondary businesses, and handicrafts), and about 68% of the per capita total net income is generated from rice cultivation.

About 26% of the households in the two pilot areas do not meet the threshold poverty level of VND 100,000 per person per month (set by the 2001 National Strategy for Poverty Alleviation and Employment) (Figure 5).

3.4.5 Drinking Water Quality

The drinking water supply for Ha Tinh town is piped from the Boc Nguyen Reservoir, located next to the Ke Go Reservoir. The drinking water supply in rural area is mostly from dug wells into shallow groundwater. This groundwater source depends on the Ke Go Reservoir water level and operation of the canal network. Many households interviewed in the pilot areas use rain water for their drinking purpose and well water for their domestic purpose, although some households use well water for their both purposes. Most pilot area households are satisfied with their domestic and drinking water supply, although groundwater quality surveys of shallow wells in the pilot areas suggest that this water does not meet all national drinking water standards, particularly for coliform and bacterial contamination (Annex 4).

3.4.6 Disease and Public Health

The Sub-Project Area experiences most of the well-known diseases of tropical and sub-tropical areas. Although no specific data were obtained relating to health conditions of the residents, the universal presence of bacterial contamination in domestic and drinking water supplies means that beneficiaries are at risk to water-borne diseases of bacterial origin are likely prevalent. However, some interviewed people indicate that the incidence of waterborne diseases has decreased in the Sub-Project Area in recent years due to improved sanitary water supply and improved education on public hygiene.

3.4.7 Industry

The level of industrialization in most of the command area is extremely low and consists large of small scale agricultural support enterprises. Main industrial activities consist of white salt production at some places along the coastal area of Cam Xuyen, Thach Ha Districts, processing of aquatic products, and forest products processing, all of which are on a relatively small scale.

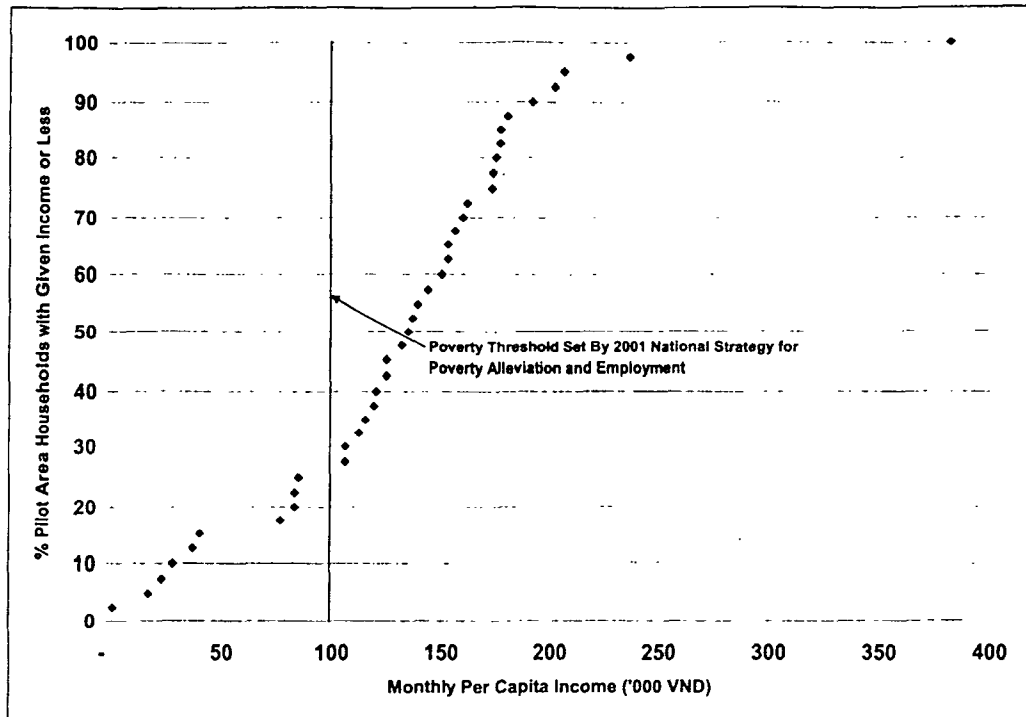


Figure 5: Incidence of poverty in two pilot areas. Data collected in socioeconomic survey conducted by Consultant.

3.4.8 Tourism Resources

There are a number of tourism resources in the Sub-Project Area. Cam Xuyen, Thach Ha have long beaches that are becoming increasingly attractive to tourists. The Ke Go Reservoir is designated as a priority tourism zone for provincial tourism development, although tourist visits to the reservoir are still rather low. There are no plans to introduce tourism into the Ke Go Nature Reserve.

3.4.9 Cultural, Aesthetic, and Historic Features

There are 5 designated national cultural and historic sites in the districts which form the Sub-Project Area (Table 18)¹⁸. None of these designated national sites are found in the three pilot areas.

3.4.10 Navigation and Transportation

Transportation Transportation along the main roads throughout the Sub-Project Area is good. The national road N1A and the railway from the north to the south are good quality; travel by road from Ha Noi to Ha Tinh now takes no more than six hours. All communes and many villages are serviced by roads. However, the provincial, district, and commune roads are in poor condition. These roads are unsurfaced, mostly ungraded, and are difficult to use; especially in the rainy season. This is especially true of the road from the provincial road to the Ke Go Reservoir Headworks and the paths running along the primary canals.

Navigation There are many rivers in the Sub-Project Area, but all of them are small and high slope and limited length, so no navigation is limited in this area.

¹⁸ We were not able to obtain information on provincial cultural and historic sites.

Table 18: Cultural and historic sites in districts that form the Sub-Project Area.

Name	Location	Designation
Le Khoi Temple and Tomb (Chieu Trung Dai Vuong)	Thach Kim Comm., Thach Ha Dist.	Historical site
Mr. Mai Kinh House, established Ha Tinh Party Committee (Sep. 1930)	Thach Viet comm., Thach Ha dist.	Historical site
Mr. Ha Huy Tap Keppsake House	Cam Hung comm., Cam Xuyen dist.	Historical site
Yen Lac Pagoda	Cam Nhung comm., Cam Xuyen dist.	
President Ho Chi Minh keepsake house- President visited and worked with Ha Tinh residents (dated 15/6/1957)	Bac Ha street, Ha Tinh Town	Historical site

4: IMPACT ASSESSMENT

Table 19 contains a summary of the predicted environmental impacts of the Ke Go Sub-Project. The detailed rationale for the assessment of specific impacts contained in Table 19 is given below, beginning with Section 4.3, Page 30).

4.1 Environmental Impact Assessment Methodology

The potential impacts of the Ke Go Sub-Project on each environmental resource are assessed as being in one of the following seven categories¹⁹:

NO IMPACT This assessment is made when there is no impact of the Sub-Project on the environmental resource of concern. This assessment is made if the Sub-Project activities of concern is to be spatially or temporally removed from the environmental resource.

SIGNIFICANT AND UNMITIGABLE IMPACT This assessment is made when there is expected to be an impact of the Sub-Project on the environmental resource of concern and:

- the time scale of the impact is equal to or longer than the life span or time scale of the resource of concern **OR**
- the area over which the impact may occur is equal to or larger than the area over which the resource of concern occurs **OR**
- the magnitude of the impact is equal to or larger relative to the abundance or quality of the resource of concern **OR**
- the environmental resource of concern: (i) is important to local human populations; (ii) requires compliance with national, provincial, or district environmental protection laws, standards, and regulations²⁰; (iii) requires compliance with Vietnam's international commitments²¹, triggers one of the IDA operational policies on environment;

AND any one of the following:

- there are no known mitigations **OR**
- it is uncertain whether the significant impact can be effectively mitigated with available mitigation activities.

MITIGABLE IMPACT The impact is Significant, as described above, but it can be effectively mitigated, through one of the following methods:

- **Impact Avoidance** - some aspect of the Sub-Project design, construction, or operation is changed such that the impact no longer occurs;
- **Impact Minimization** – measures are taken to reduce impacts to acceptable levels (e.g., ensuring that TCVN emission standards are met or a canal lining program the minimizes disruption to water users);
- **Impact Rectification** – the impact is allowed to occur, but mitigation measures are subsequently taken to rehabilitate the environment to a level whereby the impact is within acceptable limits, such as restoring and re-vegetating borrow sites; or
- **Impact Compensation** – the impact is allowed to occur but non-monetary compensation (first priority) or monetary compensation (second priority) are provided for losses created by the impact, such as in the case of resettlement or reforestation of an equivalent amount of forested land permanently lost through (say) construction of a new spillway.

This Chapter outlines the recommended mitigation and Chapter 5 presents each of the required mitigation

¹⁹ A general comment to the assessment of impacts contained in this EIA is that the actual amounts, scheduling, and location of various types of engineering used in the assessment of impacts are those contained in the following documents:

- Final VRWAP Pre-feasibility Study Report submitted to MARD and IDA in March 2003
- Ke Go Irrigation System Feasibility Study Report: Report on Dam Safety
- Ke Go Irrigation System Feasibility Study Report: Water Balance Report
- Ke Go Irrigation System Feasibility Study Report: Report on Modernization of Ke Go Irrigation System.

²⁰ Key Vietnamese documents include: Law on Environmental Protection (1993); CP 175 Providing Guidance on the Implementation of the Law on Environmental Protection (1994); CP 490 Circular letter of Guidance on Setting up and Appraising the Environmental Impact Assessment Report for Investment Projects (1998); and Tieu Chuan Viet Nam (1995, 1998, 2001) – national ambient and industrial air/water quality standards.

²¹ These include the Convention on Wetlands of International Importance especially as Waterfowl Habitat (RAMSAR), the Convention Concerning the Protection of the World Cultural and Natural Heritage (World Heritage Convention), and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

Table 19: Summary of expected environmental impacts of Ke Go Sub-Project.

LEGEND TO ENTRIES: BLANK - NO IMPACT I - INSIGNIFICANT IMPACT M - SIGNIFICANT IMPACT THAT IS MITIGABLE S - SIGNIFICANT IMPACT WHICH CAN NOT BE MITIGATED P - POSITIVE EFFECT C - COMBINATION OF IMPACTS U - EXTENT AND LEVEL OF IMPACT UNKNOWN	PHYSICAL RESOURCES							BIOL. RESOURCES					SOCIOECONOMIC RESOURCES									
	Soils	Surface Water Hydrology	Erosion, Sedimentation	Surface Water Quality	Groundwater Resources	Mineral Resources	Air Quality	Noise	Terrestrial Ecosystems, Biodiversity	Aquatic Ecosystems, Biodiversity	Rare and Endangered Species	Protected Areas	Forest Resources	Population and Communities	Employment	Infrastructure Facilities	Drinking Water Supply and Quality	Human Health	Income, Incidence of Poverty	Biological Resource Harvesting	Transportation and Navigation	Tourism Resources
Ke Go Dam, Saddle Dams, Spillways, and Intake Sluices - Basic Upgrading and Repair																						
Upgrading and Repair of Ke Go Irrigation Scheme Headworks						M								P	P	M			P			M
Ke Go Dam - Strengthening Flood Control Capacity																						
Occurrence of Flood Design Event	Safety assured through implementation of Emergency Preparedness Plan prepared by Consultant																					
Increase Width of Emergency Spillway	M		M						I	I				P		M						
Ke Go Main and Primary Canal Distribution System																						
Line Canals to Strengthen Severely Eroded Sections	C	C	C	C	U	M			M	C				P	P	M	U		P	C		M
Widen Canals at Appropriate Sections (Rocky Ground)	M	P	C	C		M			M	C				C	P	M			P	C		M
Add New Primary Canals Where Required	M	P	M	M	U	M			M	C				C	P	M			P	C	M	M
Upgrade Management Road Along Primary Canals						M			C	M				C	P	M			P	M	P	M
Replace and Upgrade Main Canal Gates, Hoisting Equipment, Other Civil Works			C			M								C	P	M			P			
Add New and Strengthen Inflow and Outflow Spillways and Drainage Sluices			P			M								C	P	M						
Improve Water Level and Discharge Regulation			C			M								P	P	M			P			
Lower Level Canal Irrigation System and Associated Regulating Structures																						
Complete Canal System to Farm Field Level	M	C	M	M	U	M			M	C				P	P	M			P	C	M	M
Implement Canal Lining Program			C	C	U	M			M	C				P	P	M	U		P	C		M
Strengthen Severely Eroded Sections	C	P	M	M		M			M	C				P	P	M			P	C		M
Replace and Upgrade Canal Sluice Gates, Hoisting Equipment, Other Civil Works			C			M								P	P	M						
Modernization of Irrigation Management System																						
Electrification of Operation of Water Control Structures	No Direct Impacts on Environmental Resources of Ke Go Sub-Project Area. Positive effects from institutional development and capacity building on improved water management resulting in increased crop production and socioeconomic conditions of beneficiaries																					
Upgrading Equipment and Management Facilities of Ke Go Irrigation Scheme																						
Design and Implementation of Improved Water User Fee Policies																						
Changes in Economic Activities																						
Changes in Land Use and Commodity Production	I			M	M				I	M				P		M			P	M		
Water Allocation to Municipal and Industrial Uses	Mitigable through strengthening environmental governance of industrial pollution control																					
Changes in Aquaculture	Unknown due to lack of EIA for provincial aquaculture program																					
Resettlement and Compensation																						
Resettlement of Project-Affected Households and Compensation for Land Acquisition	No environmental impact of resettlement because there will be no resettlement with Sub-Project																					
Cross-Cutting Activities Related to Construction of Engineering Works																						
Site Preparation and Clearing	Effects of construction camps and general construction activities are mitigable through good construction camp practices. Effects of disturbance, movement, and disposal of soils are mitigable through proper management and disposal of dredged and excavated soils																					
Construction Camps																						
Construction Activities																						
Handling of Excavated Material																						
Storage of Environmentally-Sensitive Materials																						
Cumulative Effects of Sub-Project Implementation on Environmental Resources Outside of Sub-Project Area																						
All Sub-Project Activities										U				P					P			M

measures in greater detail as part of the Ke Go Sub-Project Environmental Management Plan.

INSIGNIFICANT IMPACT This assessment is made when there is expected to be an impact of the Sub-Project on the environmental resource of concern but the impact is assessed to be too negligible to require intervention in the form of either mitigation or monitoring. This type of impact would occur when any one of the criteria for impact significance, above, are not met.

UNKNOWN IMPACT This assessment is made when one of the following apply:

- the presence of the Sub-Project activity of potential concern is uncertain;
- the occurrence of the environmental resource within the Sub-Project area is uncertain;
- the time scale of the impact is unknown;
- the spatial scale over which the impact may occur is unknown; or
- the magnitude of the impact can not be predicted.

POSITIVE This assessment is made when the effect of the given Sub-Project activity will be to improve the condition and integrity of the environmental resource of concern.

COMBINATION This assessment is made when more than one of the above assessments (i.e., some positive and some negative impacts) apply to the effect of a Sub-Project activity on an environmental resource of concern.

4.2 Application of IDA Operational Policies

Most of the IDA Operational Policies identified for possible application to VWRAP apply to the Ke Go Sub-Project and are used in the detailed assessment of environmental impacts, below. Some of the IDA Operational Policies, however, are not triggered by the Ke Go Sub-Project and are not considered further in this EIA:

Operational Policy 7.60 – Projects in Disputed Areas

- None of the Sub-Project Area or the area of influence of the Sub-Project is part of a territory whose jurisdiction is disputed by another country

Operational Policy 7.50 – International Waterways

- None of the water bodies associated with the Ke Go Sub-Project form a boundary between, or flow through the territory of another country;
- None of the water bodies associated with the Ke Go Sub-Project are a any tributary or component of any waterway described above; and
- None of the water bodies associated with the Ke Go Sub-Project are recognized as a necessary channel of communication between the open sea and other states countries or of any river flowing into such waters.

4.3 Activities with Consistent Impacts on all Environmental Resources

There are a number of Ke Go Sub-Project activities that are assessed to have the same impacts for all environmental resources they will affect, whatever phases of the Sub-Project (pre-construction, construction, and operation) they will occur and in whichever investment phase they will occur - first, second, or both. Rather than present these individually for each environmental resource in this chapter, they are presented synoptically below and not analyzed and presented further in the detailed assessment that begins with Section 4.6.1, Page 37.

4.3.1 Effects of Dam Safety Risk

In the event of a large flood, residents will be at risk to significant damage to them and their assets. This is assessed as a **SIGNIFICANT AND MITIGABLE IMPACT** through the implementation of the Ke Go Dam Safety Emergency Preparedness Plan (EPP) prepared as part of the overall Ke Go Sub-Project FS. The EPP will enable residents at risk to be notified and advised on what precautions they should take in order to minimize the risk to them in the event of a design flood occurrence.

4.3.2 Repairing and Upgrading Existing Civil Works and Facilities

A large number of Sub-Project activities involve the repairing of existing civil works and facilities. The following

specific activities are assessed as having **NO IMPACT** on any of the environmental resources of the Ke Go Sub-Project Area:

Main Ke Go Dam

- Replace the damaged lining slabs of upstream slope located at elevation 13m to 26m by new concrete slab of bigger and thicker dimension;
- Repairing the damaged parts of the wave prevention wall and increasing the height of the wall crest to 36.60 m;
- Lining the dam surfaces with a 30 cm rock layer and covering with a 30 cm pebble layer; and
- Install lighting system on dam surface;
- Overhaul piezometers system; and
- On the downstream slopes, repairing the drainage trench system and seepage zones, and constructing new grass frames.

Saddle Dams

- Replace the damaged lining slab of upstream slope by new concrete slab of bigger and thicker dimension;
- Overhaul wave wall and heighten to elevation of 36.6 m;
- upgrading dam surface; and
- Repairing upstream slope.

Doc Mieu Chute Spillway

- Destroy the upstream rock barrier located in the inlet canal;
- Reinforce the spillway surface;
- Replace the damaged lining slabs by new reinforced concrete slabs of larger dimensions;
- Replace the old winch by a new hydraulic piston in view to obtain a more reliable gate operation;
- Reinforce radial gates;
- Install local and central electrical control;
- Upgrade the protection covering for the spillway equipment in purpose of creating good conditions for spillway operation in case of unfavourable weather;
- Upgrade the spillway management station to ensure a favourable condition for working and living condition for the staff and workers who reside their to manage the spillway, especially in rainy season; and
- Install lighting system.

Main Flood Spillway

- Reinforce the spillway surface in purpose of increasing flood discharge in compared with initial design;
- Reinforce dissipation basin;
- Repair damages in whole;
- Reinforcing spillway gate;
- Electrification of spillway operation; and
- Protection covering installed at sluice tower and spillway in purpose of becoming the headwork management station.

Conduit Flood Spillway

- Repair of the broken joints that are causing high seepage;
- replacing old radial gates as required; and
- replacing gate operation machinery.

Intake Sluice

- repairing the broken joints that are causing high seepage and upgrading and replacing as required the associated mechanical and electrical systems.

Canals

- introduction of downstream control of the water-levels, combined with a local automatic control of the Cross Regulators in the canal (main canal)
- installation of Automatic water-level/discharge measurement devices (SCADA)
- Replacement all seriously damaged hoisting equipment.

4.3.3 Modernization of Irrigation Management System

The modernization of the Ke Go irrigation management system, consisting of upgrading the technical capacity of

irrigation management personnel, improvement of water user fee policies, and upgrading Ke Go IMC equipment and management facilities will have **NO IMPACT** directly on the environmental resources of the Sub-Project area. There will be indirect **POSITIVE** effects, however, from institutional development and capacity building on improved water management resulting in increased crop production and socioeconomic conditions of beneficiaries.

4.3.4 Construction Activities Associated with Sub-Project Implementation

The major engineering civil works of the Sub-Project will create the need for temporary construction worker camps. These construction camps will have negative impacts on the environment through land disturbance, generation of waste (solid and liquid), use of heavy vehicles and other machinery (increased noised levels localized air pollution, particularly in areas of human habitation), and requirements for domestic and drinking water supply. Despite the fact that the size and proposed location of the construction camps is unknown at this time, all these impacts are **MITIGABLE** through good construction camp practices.

In addition, there will considerable disturbance of soils in all aspects of canal system upgrading (Table 9, Page 14). There will need to be effective handling of soils so that they cause minimal disturbance to the environment, particularly with respect to sedimentation of water courses, and degradation of water quality. These impacts are assessed as **MITIGABLE**.

4.3.5 Environmental Impacts of Resettlement and Land Acquisition

Large-scale resettlement can cause environmental and social impacts if not implemented carefully implemented such as occurred as a result of resettlement during the construction of the Hoa Binh Dam in northern Viet Nam. Impacts of resettlement on the environment can include forest cutting or wetland encroachment, adoption of unsustainable agricultural practices and livelihood patterns, and land tenure issues. This is not the case with the Ke Go Sub-Project in which no households will need to be resettled. No mitigation or monitoring is required for the environmental impacts of resettlement.

About 104 ha of land will be permanently acquired and 60 ha of land will be temporarily acquired (Table 11, Page 15) as a result of the Sub-Project. Compensation will be paid²² and there will be **NO IMPACT** of permanent land acquisition on environmental resources of the Sub-Project Area. The effects of temporary land acquisition are assessed as **MITIGABLE** by restoring the landscapes to their original condition after it has been used.

While there may be PAHs as a result of completion of the lower level canal system in the command area, these cases would almost certainly all involve compensation for land acquisition rather than resettlement, given the small size of the canals involved and concomitant land acquisition required.

4.3.6 Mitigable Impacts of Increased Water Supply for Municipal and Industrial Use

The Sub-Project will increase water supply for non-commodity production uses, primarily municipal domestic and drinking water supply and industrial activities. Water supply for industry is expected to be provided at the rate of 1.67 m³/s with the Sub-Project, or 52 million m³/yr (0.142 million m³/day, Table 7, Page 12). About 30% of the estimated NPV generated by the Ke Go Sub-Project will come from the net incremental benefits of water sales for municipal and industrial water uses (figures given in the final Ke Go PFS report indicate EIRR = 12% for the entire Sub-Project; calculations made on the basis of only agricultural benefits result in an EIRR = 8%). The environmental issue concerning incremental environmental impacts of municipal and industrial water use is largely with the industrial sector; increasing the supply of water for domestic use will have substantial human health and other benefits. An expanding industrial sector will also provide many incremental socioeconomic benefits but will create incremental environmental impacts that will be difficult to control and manage.

Viet Nam has new industrial discharge regulations and also requires an approved EIA before licensing is given to an industrial park or individual industrial facility. However, this is no guarantee that there will be no unacceptable environmental pollution as a result of these facilities. Every single facility in an industrial zone can be meeting industrial discharge standards and yet the receiving waters can not meet ambient water quality standards because of cumulative effects. Environmental enforcement also remains extraordinarily weak in Viet Nam and there is little doubt that industrial facilities in even new industrial zones will create incremental environmental pollution within the Ke Go Sub-Project Area and its associated area of influence.

²² following the requirements of Decree No.22/1998/ND-CP dated 24 April, 1998

The sketchy surface water quality information that is available (Annex 4) suggests that the surface waters of Ha Tinh Province are currently rather unpolluted. Therefore, the incremental environmental effects of a large increase in water supply to industries that are likely to be poorly regulated may be more significant in Ha Tinh Province, unlike, for example, Ho Chi Minh City and the Dau Tieng Sub-Project, where existing levels of industrial pollution in surface waters are already high and the incremental effect may be modest (and where there is already substantial investment from IDA and ADB in industrial pollution control and treatment, as well as an emerging Dong Nai River Basin Organization to assist in dealing with inter-provincial water pollution and water quality issues).

While it is completely impractical for the Ke Go Sub-Project to finance the construction and operation of industrial pollution control facilities, because such a high proportion of the Sub-Project benefits accrue from municipal and industrial water supply, it is reasonable to expect VWRAP to provide support to Ha Tinh provincial departments (DoSTE, Dol, etc.) for strengthening their monitoring and enforcement capacity, raising awareness of industrial users, and strengthening the overall environmental governance of the industrial sector.

4.3.7 Provision of Increased Water Supply to Aquaculture

The Sub-Project will increase water supply to brackish water aquaculture in order to support expansion of this economic activity in the coastal zone of Thach Ha District (this is described in the provincial aquaculture development program, although the water balance calculations prepared by HEC-1 do not include such a water use, Table 7, Page 12); this impact is assessed as **MITIGABLE**.

This aquaculture expansion is part of the National Aquaculture Development Program (1999-2010). This National Program, approved with Decision No. 224/1999/QD-TTg specifies:

- an overall objective of achieving an aquaculture output of 2 million t/yr by 2010 from current levels of about 350,000 t/yr in 1999;
- plans for aquaculture in coordination with investments in water resource infrastructure to increase the efficiency of investment and use of land and water areas; and
- policies of development of aquaculture cultivation oriented towards increasing utilization of land and water areas for cultivating marine products.

Aquaculture is an extremely important economic activity in Viet Nam in general and in Ha Tinh Province. It is one of the largest sources of foreign exchange in the country. However, there are costs associated with aquaculture expansion:

Loss of Coastal Wetlands - Coastal and marine aquaculture production has increased rapidly in Viet Nam but this increase has largely been accomplished by extensification, rather than intensification of aquaculture production. Average aquaculture yields since 1993 have risen very little. This extensification has occurred at the expense of coastal ecosystems, such as the case of coastal wetlands in the Mekong Delta where IDA is financing a large-scale rehabilitation²³

Water Pollution – In general, aquaculture in coastal Viet Nam has not been sufficiently carefully planned. The result in some cases is increased water pollution, largely from unregulated flushing of pond sediment wastes into water systems that have not been planned to ensure separation of aquaculture pond intake and effluent²⁴.

Freshwater supply to brackish water aquaculture to be provided from the Ke Go Sub-Project is needed to achieve the correct salinity levels in the ponds at various stages of prawn development. Without the Ke Go Sub-Project, it is doubtful that aquaculture development will be able to proceed at the same rate it will be able to with the Sub-Project, and so there may in fact be incremental environmental effects of the Ke Go Sub-Project related to expansion of brackish water aquaculture. While Decree 175/CP requires overall strategies for regional and national development to be assessed for their environmental impacts, no EIAs were prepared for the provincial aquaculture plans. It would be prudent, as part of the pre-construction phase of the Ke Go Sub-Project Environmental Management Plan, to implement the following mitigation measures:

- conduct an EIA of that part of the Ha Tinh Provincial Aquaculture Program that will benefit from improved water supply from the Ke Go Sub-Project (largely Thach Ha District, Table 17, Page 25) to ensure proper

²³ Coastal Wetlands Protection and Development Project.

²⁴ Pollution from aquaculture activities was cited as the second most serious source of land-based pollution in coastal Viet Nam in a survey of the Directors of the provincial Science, Technology, and Environment Departments conducted as part of coastal community surveys under ADB TA 5712-REG: Coastal and Marine Environmental Management in the South China Sea, Phase 2 (GEC Ltd. 1999)

pond arrangements, wastewater management, and pond sediment management are put into place and to determine the amount of coastal wetlands that will be lost as a result of the expansion of coastal aquaculture made possible by the provision of water from the Ke Go Sub-Project;

- if possible, restore and/or rehabilitate an area of coastal wetlands as compensation for loss of coastal wetlands from aquaculture expansion as a result of the Ke Go Sub-Project; and
- provide resources to educate aquaculture households on best environmental practices to minimize environmental impacts of their activities.

4.3.8 Impacts on Population and Communities

There are four potential impacts on the population and communities of the Sub-Project, all of which are assessed elsewhere in this Chapter:

- Mitigable effects of disturbance to households and communities caused by construction activities (Section 4.3.4, Page 32);
- Mitigable effects of resettlement and compensation for land acquisition requirements (Section 4.3.5, Page 32);
- Positive effects of increased employment (Section 4.4.3, Page 35); and
- Positive effects on household income and overall level of economic activity (Section 4.4.4, Page 35).

4.4 Environmental, Social Resources Receiving Consistent Environmental Impact

There are a number of environmental and social resources of the Ke Go Sub-Project that are predicted to be affected in the same way from all Sub-Project activities (i.e., all positive or all negative impacts) for whatever phases of the Sub-Project (pre-construction, construction, and operation) they will occur and in whichever phase of investments they will occur - first, second, or both. Rather than present these individually for each Sub-Project activity in this chapter, these environmental resources are presented synoptically below and not analyzed and presented further in the detailed assessment beginning with Section 4.6.1, Page 37.

4.4.1 Impacts on Environmental Resources in Ke Go Reservoir Catchment

The Sub-Project will have **NO IMPACT** on the Ke Go Reservoir Catchment. There are no Sub-Project activities that will affect any environmental resources in the 223 km² catchment of the Ke Go Reservoir:

- The height of the Ke Go Dam and the saddle dams is not being increased and there will therefore be no land alienation from increased Reservoir height;
- The operation of the Ke Go Reservoir will be basically the same with the Sub-Project as under current conditions and the with-Sub-Project water level regime in the Reservoir will essentially be the same as it is at present. The exception to this is the increased water storage at the end of the rainy season, but this will not increase reservoir water levels to greater than design water levels;
- Access to the catchment area above the Ke Go Reservoir will not change. New roads into the catchment will not be built and no existing roads in the catchment area will be enlarged or improved;
- The remoteness of the catchment area means that no construction materials will be obtained from this part of the Sub-Project Area.

4.4.2 Sub-Project Impacts on Rare and Endangered Species

There have been no biodiversity surveys conducted in the command area and so it is not known whether the command area contains any rare and endangered species. The rare and endangered species contained in the 2002 IUCN Red List (Table 16, Page 24) are found in natural forested habitats which in the Sub-Project Area are found only in the catchment of the Ke Go Reservoir. It is extremely unlikely that there are any rare and endangered species in the command area because this area has long been almost exclusively used for human habitation and associated economic activities. Because of the likely absence of rare and endangered species in the command area, the effect of the Sub-Project on rare and endangered species in the command area is assessed as **NO IMPACT**. In addition, the prediction of no impacts of the Sub-Project on environmental resources in the catchment of the Ke Go Reservoir (see above) includes no effects of the Sub-Project on rare and endangered species in that part of the Sub-Project as well.

4.4.3 Sub-Project Impacts of the Sub-Project on Employment

Practically all Sub-Project activities will have a **POSITIVE IMPACT** on local employment. These positive effects will occur in a number of ways:

- short-term increase in employment from construction activities;
- Longer term increase in the requirement for on-farm labor; and
- Substantial indirect and induced employment generated as a result of both the short-term increase in construction employment and the increase in on-farm labor demand.

Direct and indirect benefits of local procurement will boost local economic activity over a period of 3-5 years. The only possible exception will be possible reduced labor requirements under a more automated irrigation management system. However, these are likely to be small and more than compensated for by the overall increase in employment with the Sub-Project. To reinforce the positive effects of the Sub-Project on local employment, it would be appropriate to give preference and priority to local residents in construction (and operation) of the Sub-Project wherever possible, by including a requirement in construction contracts for local hires and specific interest groups (e.g., women and ethnic minorities identified in the Ke Go EMDP as being potentially disadvantaged by the Sub-Project), as well as to train local workers before construction begins to increase relevant skills and minimize project delays.

4.4.4 Impact on Economic Activities, Income, and Incidence of Poverty

The Sub-Project will have a **POSITIVE IMPACT** on overall economic activity in the Sub-Project Area, as well as increasing household income and reducing the incidence of poverty in the Sub-Project Area. The increased short-term and long-term employment generated by the Sub-Project will increase the general level of economic activity in the Sub-Project Area. In addition, with a predicted 70% greater cropping intensity (Table 12, Page 15, using figures provided in the Yen Lap final PFS), coupled with similar expected increases in yields of agricultural commodities, net incomes from agriculture activities of agricultural households (the majority of command area households) are predicted to increase some 35% over and above current levels. The predicted increases in household incomes with the Sub-Project may be even greater with even higher crop diversification.

This increase in net income will also result in a decrease in overall poverty in the command area. It is predicted that the percentage of households in the two pilot areas not meeting the threshold poverty level of VND 100,000 per person per month (set by the 2001 National Strategy for Poverty Alleviation and Employment) will decline from about 26% at present to about 17% with the Sub-Project, a reduction in levels of absolute poverty of some 35% (Figure 6)²⁵.

There may be short-term negative effects to agricultural commodity production as a result of canal lining and other canal reinforcements. This can be mitigated by developing rigid construction timetables for canal reinforcement and lining to minimize disruption to the beneficiaries and at the same time have efficient implementation of this part of the Sub-Project. This will require a detailed implementation plan for canal lining developed consultation with the Sub-Project beneficiaries (Section 4.6, Page 37).

4.4.5 Sub-Project Impacts on Mineral Resources

The effects of removing rock (for road construction or during canal system expansion) from new borrow sites is **MITIGABLE** through the restoration of the borrow sites after construction is completed.

4.4.6 Sub-Project Impacts on Air Quality

There will be **NO IMPACT** of the Sub-Project on air quality in or outside the Sub-Project Area. The exception to this is the operation of construction equipment for various Sub-Project activities and these impacts are addressed in detail in Section 4.3.4.

²⁵ The data in the chart were obtained from the socioeconomic survey conducted by the Consultant in the Pilot Areas of the Ke Go Sub-Project. Net income without the Sub-Project is calculated as the sum of all income sources reported less the sum of all costs reported. Net income with the Sub-Project is calculated in the same way but assumes greater income from agricultural production due to the improvements in water supply. Table 12 suggests that cropping intensity will increase about 69% with the Sub-Project; it is assumed that yields of agricultural commodities will increase by the same percentage. Incremental agricultural net income is assumed to be 50% of total incremental income.

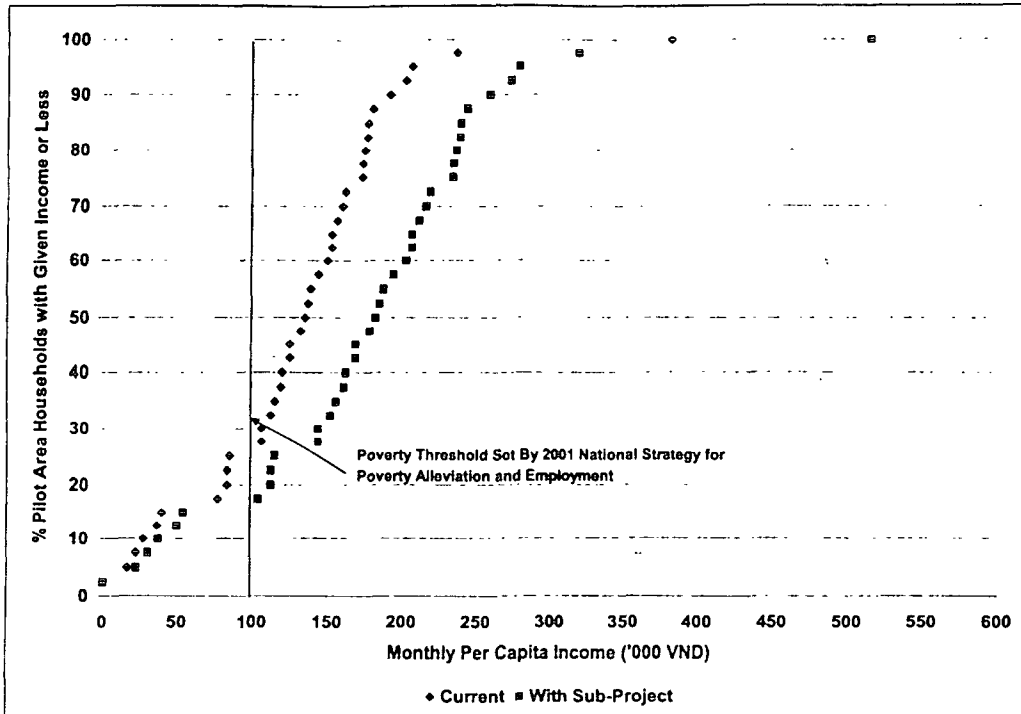


Figure 6: Predicted change in incidence of poverty in Pilot Areas with Sub-Project.

4.4.7 Sub-Project Impacts on Noise

There will be **NO IMPACT** of the Sub-Project on noise levels in or outside the Sub-Project Area. The exception to this is the operation of construction equipment for various Sub-Project activities and these impacts are assessed in detail in Section 4.3.4.

4.4.8 Sub-Project Impacts on Forest Resources

There will be **NO IMPACT** of the Sub-Project on forest resources in or outside the Sub-Project Area. The production forest land within the districts and communes that form the Sub-Project Area (Table 13, Page 17) lie outside of the actual land that is currently served by the Ke Go Irrigation Scheme and there is no pumping contemplated in the Ke Go Sub-Project to deliver irrigation water to even the lower slopes of these hills. Therefore, there will be no impacts on production forests in the command area from Sub-Project activities. This assessment, coupled with the assessment of no Sub-Project impacts on environmental resources within the Ke Go Reservoir Catchment (Section 4.4.1, Page 34), means that there will be no impacts of the Sub-Project on Forest Resources.

4.4.9 Sub-Project Impacts on Human Health

There will be **NO IMPACT** of the Sub-Project on the health of the Sub-Project beneficiaries. Expansion of the existing IPM program should prevent any negative effects of possible increased pesticide use and there may be positive benefits of households having increased disposable income on being able to make increased use of health care services.

4.4.10 Sub-Project Impacts on Nature Reserves, Protected Areas, or Protection Forests

Because there will be no Sub-Project activities taking place in the Ke Go Reservoir catchment and no effects on environmental resources of the Ke Go Reservoir catchment, the Sub-Project will have no effects on the Ke Go Nature Reserve.

4.5 Sub-Project Impacts of Pre-Construction

4.5.1 Impacts of the Legacy of Conflict

One of the ongoing consequences of the American War of the 1960s and 1970s is unexploded ordnance. Unexploded ordnance is uncovered throughout Viet Nam and there are casualties every year from accidents involving these materials. The Ke Go Sub-Project involves the movement of a great deal of earth (Table 8 and Table 9, Page 12 and Page 14) for upgrading of existing civil works and construction of new civil works. Mortar shells, aerial bombs, and other unexploded ordnance may all be found within the Sub-Project Area. Some de-mining has occurred at shallow depths, however virtually none has occurred in non-productive land or at depths greater than 2 m. There is a risk that unexploded ordnance will be uncovered during excavation, but this risk is assessed as **MITIGABLE**. As a precautionary measure, it will be necessary to provide resources for detecting and clearing unexploded ordnance in the Sub-Project Area²⁶ at those construction activities that will occur at depths greater than 2 m.

4.5.2 Requirements for Resettlement and Land Acquisition

These impacts are assessed as **MITIGABLE**. As indicated in Table 11, Page 15, no households will require resettlement, 104 ha of land will be permanently acquired, and 60 ha of land will be temporarily acquired. A detailed compensation scheme has been prepared according to both IDA and Vietnamese legal requirements.

4.6 Sub-Project Impacts of Construction

4.6.1 Impacts on Physical Resources

SOILS

Reduction in Erosion - POSITIVE The reinforcement and strengthening of sections of the canal system throughout the command area will be a positive effect on soils in the immediate vicinity of the engineering civil works. Erosion will be reduced at those locations and farmers will not have to continually contend with their land eroding along the canals. As well, the additional lining of the canal system will also have a positive effect of reducing soil erosion along those particular lined portions.

Alienation of Sub-Project Soils – INSIGNIFICANT Some soils will be permanently alienated as the management roads along the main and primary canals are upgraded and widened to a consistent width (Table 10, Page 15). However, this will be a small proportion of the total Sub-Project Area (an area equal to 0.013% of the total catchment area above Ke Go Dam plus full command area) and the effect is assessed as Insignificant. In addition, construction and/or upgrading of management roads along the main primary and lower-level canals will at worst cause only minor, temporary disturbances to soils from the actual construction activities themselves.

Earth Excavation, Storage, and Disposal - MITIGABLE Some 700,000 m³ of earth and rock will be excavated and 526,000 m³ of earth-fill will be used to upgrade the headworks and the irrigation canal distribution system (Table 9, Page 14). Soils to be excavated are unlikely to be contaminated as the entire Sub-Project Area has had little, if any, economic activities that would generate such contaminants. However, the large quantities of soil likely to be disturbed during construction are such that proper disposal, storage, and management of these soils are recommended as mitigation measures. Part of the mitigation measures will need to be ensuring that contaminated soil does not make it onto the Sub-Project site as earth-fill. One obvious means of disposal for some of these soils would be as inputs to upgraded management roads and canal tracks, as well as canal banks that need to be raised in order to accommodate possible downstream control of the irrigation system.

SURFACE WATER HYDROLOGY

Improved Efficiency of Water Use - POSITIVE The upgrading of the main and canal distribution system in the Ke Go Irrigation Scheme through dredging, re-aligning, and raising the main canals where required, replacing main sluice gates and hoisting equipment, implementation of a program of canal lining, and improving water level and discharge regulation will also have positive effects on surface water hydrology by increasing the efficiency of

²⁶ This mitigation is part of the ADB/GoVN financed Phuoc Hoa Water Resources Project and is an accepted mitigation measure for linear transportation projects in Viet Nam.

water use, thereby enabling greater water supply to be provided to the lower-level canal system. This is also the case with the completion and upgrading (through lining) of the lower-level canal system itself.

Improvement of Drainage - POSITIVE The strengthening of existing and provision of new inflow and outflow spillways and drainage sluices as part of the main canal system will improve the hydrological conditions in the command area with respect to the ability to cultivate crops in the rainy season.

Changes in Basic Hydrological Regime – INSIGNIFICANT The basic hydrological regime of the main, 1^o, 2^o, and 3^o canals will change only modestly with the Sub-Project and the hydrological network will not change, whatever irrigation management alternative for the canals is selected (i.e., upstream or downstream control). It is likely that the spatial and temporal patterns of drainage into the estuarine rivers and coastal channels of Ha Tinh Province at the bottom end of the command area will not significantly change. Therefore, the hydrological regime downstream of the command area is predicted to not change very much from the current regime.

Interruption of Canal Water Supply to Users During Canal Construction and Canal Lining – MITIGABLE Proper timing of the construction activities associated with main canal reinforcement and lining may negatively affect water supply to farmers downstream. On the one hand, construction of canal reinforcements in the dry season can proceed very quickly, but water supply needs to be turned off during the construction periods; the dry season is the season when water supply via the irrigation scheme is most critical. On the other hand, water supply to the farmers via the irrigation scheme is not as critical in the rainy season and yet construction is much more problematic and expensive given the larger amounts of water in the system at that time. It will be necessary to develop rigid construction timetables for canal lining to minimize disruption to the beneficiaries and at the same time have efficient implementation of this part of the Sub-Project. In addition, consultation with all affected parties will be required in order to reach agreement how much impact will be accepted by the affected groups.

SEDIMENTATION AND EROSION²⁷

Improvement of Canal Integrity and Canal Bank Stability - POSITIVE Because incremental lining throughout the entire canal system, as well as re-aligning and strengthening these canals will have a positive effect of reducing soil erosion along the canal system, sedimentation is likely to be reduced within the canal system as well. The lining or other reinforcement of sections of the canals will be a positive effect on soils in the immediate vicinity of the engineering civil works. Erosion will be reduced at those locations and farmers will not have to continually contend with their land eroding along the canals. This will reduce sedimentation into the canals and surface waters of the Sub-Project.

Earth Excavation, Storage, and Disposal - MITIGABLE There will be considerable moving and handling of soils involved with dredging in the main canals as well as raising the canals and strengthening them at locations that have eroded over time. The quantities of soil likely to be involved are such that proper disposal and management of these soils is recommended in order to minimize incremental sedimentation into the canals and other water bodies of the Sub-Project.

Disturbance of Sub-Project Soils During Implementation of Canal Engineering Works - MITIGABLE Most of the construction activities associated with upgrading the entire canal distribution system – completion of the canal distribution system at the lower levels, canal reinforcement, canal lining, and management road construction and upgrading - could cause local disturbance to soils and thereby increase sediment content of the main canals. Minimization of soil disturbance during the construction activities through the application of standard good practice techniques during construction is recommended in order to minimize additional sedimentation into the canals of the Sub-Project.

SURFACE WATER QUALITY²⁸

Changes in Erosion and Sedimentation – INSIGNIFICANT Erosion and sedimentation are the major issues with respect to surface water quality in the construction phase of the Sub-Project for the above Sub-Project

²⁷ All of the effects on erosion and sedimentation described below will be localized. The effects will not be detectable downstream of the command area and almost certainly not detectable in the estuarine and coastal waters of the coastal districts that have land in the Sub-Project command area.

²⁸ The absence of any existing surface water quality monitoring program in the Ke Go Sub-Project area makes it difficult to make quantitative predictions of Sub-Project impacts on surface water quality. It will be necessary to implement a water quality effects monitoring program as part of the Environmental Management Plan (Chapter 5) in order to ensure that the predictions and assessments made below are valid and appropriate.

activities. The extent to which the Sub-Project changes erosion and sedimentation in the surface waters of the Sub-Project (see above, Page 38), will be the extent to which these Sub-Project activities affect surface water quality in the Sub-Project Area.

Cumulative Environmental Effects of Sub-Project Construction on Surface Water Quality – INSIGNIFICANT While there is some risk that surface water quality in the command area may change significantly as a result of the construction activities of the Sub-Project, it is unlikely that this will be the case with water quality downstream of the command area. Sediment concentrations will almost certainly change in the surface waters within the Sub-Project, particularly in the dry season. This, however, is unlikely to significantly affect water quality downstream of the command area, in the estuarine and coastal waters of the coastal districts of the command area, because of the dilution of pollutants that would occur. However, the absence of any surface water quality monitoring information means that these predictions are uncertain. It would be prudent, therefore, to conduct surface water quality monitoring downstream of the command area to confirm the assessments of cumulative impact made above.

GROUNDWATER RESOURCES²⁹

Alteration of Rates and Patterns of Water Exchange Between Canals and Shallow Groundwater Systems -

UNKNOWN The issue related to groundwater and canal lining relates to changes in groundwater availability for crop production and possibly also for domestic and drinking water uses. Based on the socioeconomic survey results in the two pilot areas, most of the households in the Sub-Project Area use groundwater as a source of domestic water. Lining sections of the 1^o, 2^o, 3^o and on-farm canals will obviously prevent the exchange of canal water with the shallow groundwater system. This is likely to be most apparent in the dry season. Water levels in the canals at the throughout the command area are low during the dry season due to system inefficiencies. There is likely a net movement of water from the shallow groundwater to the canal system during the dry season at the present time. This flow will be prevented because of canal lining with the Sub-Project. This, plus the expected increased availability of irrigation water throughout the command area during the dry season (particularly at the bottom end of the system) will increase groundwater levels in the dry season. Little change is expected with the Sub-Project in the rainy season. Any shortfalls in shallow groundwater resources in the rainy season that appear as a result of canal lining can be compensated by increasing water supply from the canals.

It is worth noting that in the Dau Tieng Irrigation Scheme, Cu Chi District IMC indicated that groundwater levels had decreased near canals that were lined but that the decrease was marginal. However, because the magnitude of these effects can not be predicted and because of the importance of groundwater resources to Sub-Project beneficiaries, monitoring of groundwater levels in the vicinity of substantial canal lining activities is recommended.

4.6.2 Impacts on Biological Resources

TERRESTRIAL ECOSYSTEMS AND TERRESTRIAL BIODIVERSITY

Permanent Loss of Terrestrial Ecosystems – INSIGNIFICANT Upgrading and widening the management roads along the main and primary canals to a consistent width (Table 10, Page 15), will permanently alienate an area equal to about 0.013% of the total catchment area above Ke Go Dam plus full command area; these effects are assessed as insignificant. The command area does contain some non-agricultural land on the hills in the command area. However, the 104 ha of land that will be permanently acquired for the Sub-Project is land that is within the original irrigated area and contains only agricultural and residential land and no natural terrestrial ecosystems.

Alteration of Landscapes During Extraction of Construction Materials - MITIGABLE Mitigation will be required to restore vegetation at excavation sites after construction is completed and to return the landscapes to their original condition.

Disturbance of Terrestrial Ecosystems During Construction – MITIGABLE Construction activities will temporarily disturb terrestrial ecosystems within the Sub-Project Area at and downstream of the Ke Go Dam and into the command area. Also, areas used for earth storage will also disturb landscapes within the Sub-Project

²⁹ As with surface water quality, the absence of any existing groundwater quality monitoring program in the Ke Go Sub-Project area makes it difficult to make quantitative predictions of Sub-Project impacts on groundwater quality. Environmental effects monitoring conducted as part of the Environmental Management Plan (Chapter 5) will need to include groundwater quality monitoring in order to ensure that the predictions and assessments made below are valid and appropriate.

Area; it is estimated that about 60 ha of land will be temporarily acquired for construction activities (Table 11, Page 15). Even though compensation will be paid for the temporary use of this land, mitigation will be required to restore these sites after construction is completed and to return the landscapes to their original condition.

AQUATIC ECOSYSTEMS AND AQUATIC BIODIVERSITY

Creation of New Canals - POSITIVE The completion of the canal system in the command area will increase the area of open water in the Sub-Project area. While these will be highly simplified and modified aquatic ecosystems, they represent an increase in the total area of aquatic ecosystems in the Sub-Project Area.

Reduction in Erosion and Sedimentation - POSITIVE Erosion and sedimentation are the major issues with respect to surface water quality in the Sub-Project for the above Sub-Project activities and the extent to which the Sub-Project activities listed above reduce erosion and sedimentation in the surface waters of the Sub-Project (see above, Page 38), will be the extent to which these Sub-Project activities affect aquatic ecosystems in the Sub-Project Area.

Decrease in Nutrient Inputs from Eroding Soils - INSIGNIFICANT Lining of canal sections as well as re-aligning and strengthening sections of the primary canals will decrease the amount of nutrients entering the primary canals from Sub-Project soils and this will be an insignificant, negative effect of the Sub-Project on aquatic ecosystems.

Increase in Erosion and Sedimentation - INSIGNIFICANT The extent to which erosion and sedimentation are increased as a result of various Sub-Project activities (see above, Page 38) will be the extent to which these Sub-Project activities affect aquatic ecosystems in the Sub-Project Area.

Earth Excavation, Storage, and Disposal - MITIGABLE There will be considerable moving and handling of soils involved with dredging in the canals as well as raising the canals and strengthening them at locations that have eroded over time. The quantities of soil likely to be involved are such that proper disposal and management of these soils is recommended in order to minimize additional sedimentation into the main canals of the Sub-Project and minimize consequent negative impacts on aquatic ecosystems and biodiversity.

Disturbance of Sub-Project Soils During Implementation of Canal Engineering Works - MITIGABLE Most of the construction activities associated with upgrading the entire canal distribution system – completion of the canal distribution system at the lower levels, canal reinforcement, canal lining, and management road construction and upgrading - could cause local disturbance to soils and thereby negatively affect the integrity of canal aquatic ecosystems by increasing sediment content in main canals. Minimization of soil disturbance during the construction activities through the application of standard good practice techniques during construction is recommended in order to minimize additional sedimentation into the canals of the Sub-Project.

Cumulative Environmental Effects of Sub-Project Construction Activities on Aquatic Ecosystems - Effects on aquatic ecosystems downstream of the command area would be indirect and mediated through changes in surface water quality. As the effects of the Sub-Project on surface water quality outside of the Sub-Project are assessed to be likely insignificant (Page 38), it is also likely that the impacts of the construction of the Sub-Project on aquatic ecosystems downstream of the command area will also be significant. Again, however, the absence of any surface water quality or aquatic resources monitoring information means that these predictions are essentially uncertain. The recommended surface water quality monitoring downstream of the command area will enable these assessments of insignificant cumulative impact to be confirmed.

4.6.3 Impacts on Socioeconomic Resources

INFRASTRUCTURE FACILITIES

Cumulative Environmental Effects of Sub-Project Construction Activities on Infrastructure Facilities – MITIGABLE There may be damage caused to existing infrastructure, particularly roads, road signage, and bridges, caused by construction activities associated with implementation of the Sub-Project. These impacts are assessed as Mitigable and are presented above in Section 4.3.4, Page 32.

DOMESTIC AND DRINKING WATER SUPPLY AND QUALITY

Change in Water Exchange Between Canals and Shallow Groundwater Systems – INSIGNIFICANT

Groundwater is the primary source of domestic and drinking water for the Sub-Project beneficiaries (Section 3.4.5, Page 25). Lining sections of the canal system will obviously alter the exchange of canal water with the shallow groundwater system; the assessment of this effect is summarized below, from Page 39).

The issue related to groundwater and canal lining relates to changes in groundwater availability for crop production and possibly also for domestic and drinking water uses. Based on the socioeconomic survey results in the two pilot areas, most of the households in the Sub-Project Area use groundwater as a source of domestic water. Lining sections of the canal system will obviously prevent the exchange of canal water with the shallow groundwater system. This is likely to be most apparent in the dry season. Water levels in the canals at the throughout the command area are low during the dry season due to system inefficiencies. There is likely a net movement of water from the shallow groundwater to the canal system during the dry season at the present time. This flow will be prevented because of canal lining with the Sub-Project. This, plus the expected increased availability of irrigation water throughout the command area during the dry season (particularly at the bottom end of the system) will increase groundwater levels in the dry season. Little change is expected with the Sub-Project in the rainy season. Any shortfalls in shallow groundwater resources in the rainy season that appear as a result of canal lining can be compensated relatively easily by increasing water supply from the canals.

While these Sub-Project activities are likely to not have a major effect on domestic and drinking water supply, because the magnitude of these effects can not be predicted and the importance of the groundwater resource to Sub-Project beneficiary well-being, monitoring of the ability of beneficiary households to access groundwater for domestic and drinking water purposes is recommended.

TRANSPORTATION AND NAVIGATION

Improvement of Management Roads Along Main and Primary Canal System – POSITIVE The roads running along the canals are the main transportation routes for Sub-Project beneficiaries, both to getting products to market and to obtain inputs for their economic activities. The upgrading of the canal road system will make it easier to transport goods and people, increase the quality of products produced by the beneficiaries that are sold at the market and these effects are therefore assessed as Positive.

HISTORIC AND CULTURAL RESOURCES

Disturbance from Construction Activities – MITIGABLE While the exact location of each of the cultural and historic sites in the Sub-Project is known and the locations are maintained in the Ha Tinh DoCI, the location of many of the Sub-Project activities listed above is not yet known in detail. Despite this, it will be possible to mitigate against any possible loss of or damage to the cultural and historical sites listed above by adjusting the siting of Sub-Project civil works as necessary. It is recommended that this be incorporated into the detailed design of the physical works, in accordance with IDA Operational Policy OP 11.03 – Cultural Property. In addition, it is recommended that terms and conditions be included in the construction contracts to ensure the integrity of these historical and cultural resources. These terms and conditions will also need to be in accordance with IDA Operational Policy OP 11.03 – Cultural Property.

4.7 Sub-Project Impacts of Operation

4.7.1 Impacts on Physical Resources

SOILS

Depletion of Soil Nutrients and Decreasing Soil Grade – INSIGNIFICANT Increasing cropping intensity with the Sub-Project, brought about through changes in land use and commodity production, may deplete existing nutrients and decrease soil grade from Sub-Project soils more quickly than they might otherwise without the Sub-Project, and farmers may need to increase the amount of fertilizer they apply in order to compensate for this effect. This effect is expected to be negligible and is assessed as insignificant. It may be appropriate to monitor the total application of fertilizers as part of the EMP to assess whether or not this effect actually does occur.

SURFACE WATER QUALITY

Increase in Application of Fertilizers from Changes in Land Use - MITIGABLE Changes in land use and

commodity production (Table 12, Page 15) will cause more fertilizer to be applied. It is estimated that approximately an additional 28,000 t of fertilizer will be required annually for the entire Sub-Project over and above estimates of current fertilizer application without the Sub-Project (Table 20), about an increase of about 233%. Without a good database of surface water quality, it is very difficult to even qualitatively predict the environmental impacts of this increased fertilizer use. It is expected, though, that this level of incremental inputs may change the eutrophic status of surface waters within the Sub-Project.

Increase in Application of Pesticides from Changes in Land Use – MITIGABLE Changes in land use and commodity production (Table 12, Page 15) will cause more pesticides to be applied. It is estimated that an additional 83 t of pesticides and herbicides will be required annually for the entire Sub-Project over and above estimates of current pesticide and herbicide application (Table 21). This is also about a 234% increase over estimated current pesticide and herbicide use throughout the Sub-Project. This impact is assessed as Unknown but potentially Significant without mitigation or monitoring. Existing baseline information on pesticide concentrations in the Sub-Project environment is non-existent and so current conditions can not be estimated, but the expected increase is substantial.

Both mitigation and monitoring are recommended. With respect to mitigation, IPM extension services should continue to be provided to Sub-Project beneficiaries as a part of the Sub-Project in accordance with the requirements of IDA OP 4.03 – Pest Management Safeguards. Extension services should include the topics of appropriate selection and application of pesticides and herbicides as well as basic techniques of and approaches to IPM. With respect to monitoring, pesticide monitoring in the surface It should be noted that environmental concentrations of pesticides in other agricultural areas of Viet Nam with less crop diversification (and therefore higher risk of pest buildup in mono-crop agricultural systems) and with higher cropping intensity than what is predicted for the Ke Go command area with the Sub-Projects are orders of magnitude lower than national or international standards (for example, please see Table 22).

Cumulative Environmental Effects of Sub-Project Operation on Surface Water Quality – INSIGNIFICANT

While there is some risk that surface water quality in the command area may change significantly as a result of the Sub-Project operation, it is unlikely that this will be the case with water quality downstream of the command area. Nutrient and pesticide concentrations will almost certainly change in the surface waters within the Sub-Project, particularly in the dry season. This, however, is unlikely to significantly affect water quality downstream of the command area, in the estuarine and coastal waters of the coastal districts of the command area, because of the dilution of pollutants that would occur. However, the absence of any surface water quality monitoring information means that these predictions are uncertain. It would be prudent, therefore, to conduct surface water quality monitoring downstream of the command area to confirm the assessments of cumulative impact.

GROUNDWATER RESOURCES

Increased Application of Fertilizers - UNKNOWN The shift in land use to more intensive crop production and the increased use of fertilizers may cause shallow groundwater systems to become increasingly eutrophic, but deeper groundwater systems will likely be unaffected. The absence of good groundwater quality baseline information, however, makes assessment of Sub-Project impacts on groundwater resources very difficult. Groundwater quality monitoring is recommended within the Sub-Project to confirm this assessment.

Increased Application of Pesticides and Herbicides - UNKNOWN As with the increased use of fertilizers, the shift in land use to more intensive crop production and the likely increased use of pesticides and herbicides may cause shallow groundwater systems to become increasingly contaminated; deeper groundwater systems will likely be unaffected. Successful implementation of IPM extension services recommended above (Page 41) will be able to mitigate this potentially negative impact. However, the absence of good groundwater quality baseline information is a severe constraint that makes this impact prediction also uncertain, and periodic pesticide monitoring in shallow groundwater should therefore be a formal part of the overall Sub-Project monitoring program to confirm this prediction.

4.7.2 Impacts on Biological Resources

TERRESTRIAL ECOSYSTEMS AND TERRESTRIAL BIODIVERSITY

Changes in Land Use – NO IMPACT There will be no conversion of natural terrestrial ecosystems into agricultural land. In addition, because the irrigated area contains no natural terrestrial ecosystems but only what can best be considered as highly modified and simple terrestrial “ecosystems” in the form of agricultural land, any changes in land use to more intensive agriculture will be an Insignificant effect on terrestrial ecosystems.

Table 20: Estimated incremental inputs of fertilizer required for Ke Go Sub-Project.

Land Use	Fertilizer Required (t/ha) ³⁰	Cultivated Area ³¹ (ha)			Predicted Fertilizer Applied (t)		
		Current	With Project	Increment	Current	With Project	Increment
Winter/Spring Rice	0.65	7,061	13,780	6,719	4,590	17,914	13,324
Summer Rice	0.65	8,097	12,747	4,650	5,263	16,571	11,308
Seasonal Rice	0.65	0	3,273	3,273	0	4,255	4,255
Peanut	0.55	2,063	1,550	-513	1,135	853	-282
Sweet Potato	0.55	2,067	1,378	-689	1,137	758	-379
Total		19,288	32,728	13,440	12,125	40,351	28,226

Table 21: Estimated incremental inputs of pesticides required for Ke Go Sub-Project.

Land Use	Pesticide Required (kg/ha) ³²	Cultivated Area (ha)			Predicted Pesticide Applied (t)		
		Current	With Project	Increment	Current	With Project	Increment
Winter/Spring Rice	2	7,061	13,780	6,719	14.1	55.1	41.0
Summer Rice	2	8,097	12,747	-4,650	16.2	51.0	34.8
Seasonal Rice	2	0	3,273	3,273	0	6.5	6.5
Peanut	1.2	2,063	1,550	-513	2.5	1.9	-0.6
Sweet Potato	1.2	2,067	1,378	-689	2.5	3.3	0.8
Total		19,288	32,728	13,440	35.3	117.8	82.5

Table 22: Results of organochlorine pesticide sampling in the O Mon Xa No Sub-Project in 2001 dry season. These data were gathered as part of Crd-3198: Mekong Delta Water Resources Project. The agriculture area of O Mon Xa No Sub-Project is about 36,000 ha, the cropping intensity is 2.6, and triple cropping is practiced on 78% of the agriculture land.

Station	Pesticides	Surface Water Concentration(µg/L)	Total (µg/L)	National Standard (µg/L)
OX01	DDE	0.015	0.033	150
	HCHg	0.008		
OX02	HCHd	0.015	0.020	
	HCHg	0.005		
OX03	Parathion	0.024	0.034	
	DDT	0.010		
OX04	DDE	0.020	0.035	
	Quitozen	0.015		
OX05	HCHg	0.080	0.105	
	HCHd	0.025		
OX06	HCHd	0.020	0.020	
OX07	HCHd	0.020	0.035	
	HCHg	0.015		
OX08	DDE	0.008	0.008	

AQUATIC ECOSYSTEMS AND AQUATIC BIODIVERSITY

Increase in Application of Fertilizers - INSIGNIFICANT Any changes in the eutrophic status of surface waters of the Sub-Project Area caused by increases in fertilizer use (Table 20) as a result of changes in land use and commodity production (Table 12, Page 15) may negatively affect the integrity of the aquatic ecosystems of the Sub-Project. However, it is expected that the predicted level of incremental fertilizer use will not substantially change the water quality status of the Sub-Project. This is likely also the case with respect to impacts on aquatic ecosystems and this impact is therefore assessed as Insignificant.

³⁰ From economic crop budgets contained in final VRWAP Pre-feasibility Study Report, submitted to MARD in March 2003.

³¹ From final VRWAP Pre-feasibility Study Report, submitted to MARD in March 2003.

³² From economic crop budgets contained in final VRWAP Pre-feasibility Study Report, submitted to MARD in March 2003.

Application of Herbicides and Pesticides - MITIGABLE The application of pesticides and herbicides will increase with implementation of the Sub-Project (Table 21, Page 43). There is an extensive world literature on the effects of biocides on aquatic resources. There have been no monitoring programs or even surveys of bioaccumulation of biocides in aquatic resources in the Sub-Project Area and so predictions of the magnitude of any impacts of biocides on aquatic resources in the Sub-Project are difficult to make given the absence of baseline data, although first effects would likely be seen as bioaccumulation. Mitigation and monitoring recommendations made above pertaining to provision of extension services for pesticide use and IPM (Page 41) apply here as well and would likely mitigate any negative effects on aquatic ecosystems. It would be also be prudent to conduct a very modest amount of effects monitoring for possible bioaccumulation in aquatic resources with the Sub-Project.

Cumulative Environmental Effects of Sub-Project Operation Activities on Aquatic Ecosystems - Effects on aquatic ecosystems downstream of the command area would be indirect and mediated through changes in surface water quality. As the effects of the Sub-Project on surface water quality outside of the Sub-Project are assessed to be likely insignificant (Page 38), it is also likely that the impacts of the operation of the Sub-Project on aquatic ecosystems downstream of the command area will also be significant. Again, however, the absence of any surface water quality or aquatic resources monitoring information means that these predictions are essentially uncertain. The recommended surface water quality monitoring downstream of the command area will enable these assessments of insignificant cumulative impact to be confirmed.

4.7.3 Impacts on Socioeconomic Resources

DOMESTIC AND DRINKING WATER SUPPLY AND QUALITY

Increased Supply of Drinking Water – POSITIVE The Sub-Project will provide a reliable supply of drinking water to residents in the command area (Table 7, Page 12).

Increased Use of Fertilizer and Pesticide – MITIGABLE Degradation of groundwater resources that may occur as a result of increased application of fertilizer and pesticides may negatively affect domestic and drinking water quality. Those households that rely on shallow groundwater aquifers for drinking and domestic water supply may be affected by the Sub-Project through increases in pesticide contamination of shallow groundwater resources.

Successful application of IPM extension services will ameliorate any negative effects of increased application of chemical inputs to domestic and drinking water quality. The monitoring recommended for groundwater resources (see above) will enable confirmation of these assessments and of the success of the IPM extension services.

BIOLOGICAL RESOURCE HARVESTING

Cumulative Effects of Changes in Aquatic Ecosystems It is expected that any positive or negative changes in the status of biological resources within the Sub-Project will have similar effects on the levels of biological resource harvesting. The provision of additional aquatic ecosystems through increases and increases in canal area should improve resource harvesting. Decreases in surface water quality may have some effect on biological resources which would adversely affect biological resource harvesting by local households. No mitigation or monitoring additional to what is recommended for effects on aquatic resources (Page 40) is recommended.

4.8 Main Conclusions of Impact Assessment

The following are the main conclusions of the impact assessment of the Ke Go Sub-Project:

- the Ke Go Sub-Project is environmentally feasible. The Sub-Project will have a number of significant positive benefits:
 - Increase in beneficiary income and reduction of poverty throughout the command area through improved and reliable water supply for agricultural production and domestic use; and
 - Increases in employment and labor in a region with very high levels of unemployment and underemployment.
- All of the potentially significant environmental impacts identified in the impact assessment can be mitigated and they are described below in Chapter 6: Environmental Management Plan. These conclusions apply to both phases of investments for the Ke Go Sub-Project: (I) first phase of investments consisting of headworks, main and primary canals and the two pilot areas that consist of secondary, tertiary and on-farm

canal systems off the main and primary canals and which contain a total of about 20% of the total command area; and (ii) the remaining 80% of the command area.

- At this stage of VWRAP design, it is expected that no separate environmental assessment will be required for the second phase of investments;
- The programmatic framework for the environmental component of the second phase of investments needs to consist of a detailed design of the Environmental Management Plan (Chapter 5) for the remaining 80% of the command area based on the findings of the environmental management program for the first phase of investments and the actual engineering works in the second phase of investments; and
- The detailed design of the Environmental Management Plan (Chapter 5) for the remaining 80% of the command area should be done concomitant with the detailed technical and engineering design for the second phase of investments.

4.8.1 Summary of Bank Operational Policies in Regards to Ke Go Sub-Project

A summary of the IDA operational policies in regards to the Ke Go Sub-Project is provided in Table 23.

Table 23: Summary of IDA Environmental and Social Safeguard Policies for Ke Go Sub-Project.

Bank Operational Policy	Summary of Assessment and Rationale	Recommendations
OP 4.01 – Environmental Assessment - Triggered	<ul style="list-style-type: none"> While Ke Go Sub-Project is classified as Category A, requiring a full-scale environmental assessment, the results of this EIA indicate that the scale and magnitude of the expected environmental impacts of the Ke Go Sub-Project are more like that of a Category B project. Environmental impacts of the Ke Go Sub-Project are mostly site-specific, none are irreversible; very few direct impacts are on environmentally important areas such as wetlands, forests, or other natural habitats, all are preventable, and mitigation measures have been designed for all possible environmental impacts 	<ul style="list-style-type: none"> Implement Ke Go Sub-Project Environmental Management Plan
OP 4.04 – Natural Habitats - Triggered	<ul style="list-style-type: none"> no impacts predicted for Ke Go Reservoir watershed, where all of the intact natural terrestrial habitats of the Sub-Project Area occur. Ke Go Sub-Project will provide increased water supply to an expanding provincial coastal aquaculture program which itself was not assessed for possible environmental impacts. There may be a risk of losing coastal wetland resources 	<ul style="list-style-type: none"> Environmental review of provincial aquaculture program to advise Ha Tinh Province on guidelines for ensuring coastal aquaculture is environmentally sustainable
OP 4.36 – Forestry – not Triggered	<ul style="list-style-type: none"> There will be no Sub-Project impacts on the two major forest resources in the Sub-Project Area: the Ke Go Nature Reserve, and the production forests on the hill slopes downstream of Ke Go Reservoir that are above the Sub-Project irrigated area 	
OPEN 11.03 – Cultural Property - Triggered	<ul style="list-style-type: none"> impacts are assessed as Unknown because, while the exact location of the each of the cultural and historic sites in the Sub-Project is known, the location of the Sub-Project activities listed above is not yet known in detail. Mitigation of any negative effects is possible, however. 	<ul style="list-style-type: none"> Mitigation recommended against any possible loss of or damage to nationally or locally designated cultural and historical sites by adjusting the siting of Sub-Project civil works, to be incorporated into the detailed design of the physical works Terms and conditions should be included in construction contracts to ensure the integrity of these historical and cultural resources
OP 4.12 – Involuntary Resettlement – Triggered	<ul style="list-style-type: none"> No households will need to be resettled and there is a requirement to pay compensation for 104 ha of permanent and 60 ha of temporary land acquisition 	<ul style="list-style-type: none"> Resettlement and Compensation Action Plan prepared as part of Ke Go Sub-Project Feasibility Study
OP 4.20 – Indigenous Peoples – Not Triggered	<ul style="list-style-type: none"> There are no members of recognized ethnic minority groups living in the command area of the Ke Go Sub-Project 	<ul style="list-style-type: none"> Ethnic Minority Development Plan prepared as part of Ke Go Sub-Project Feasibility Study
OP 4.37 – Safety of Dams – Triggered	<ul style="list-style-type: none"> Upgrading Ke Go Dam safety a major component of first investment phase. Specific engineering works are provided for increasing dam safety, and Emergency Preparedness Plan prepared as part of Ke Go Feasibility Study 	
OP 4.03 – Pesticide Management – Triggered	<ul style="list-style-type: none"> It is estimated that an additional 83 t of pesticides and herbicides will be required annually for the entire Sub-Project over and above estimates of current pesticide and herbicide application. This is about a 234% increase over estimated current pesticide and herbicide use throughout the Sub-Project. This impact is assessed as Unknown but potentially Significant without mitigation or monitoring. Existing baseline information on pesticide concentrations in the Sub-Project environment is non-existent and so current conditions can not be estimated, but the expected increase may be substantial, particularly as about 40% of Sub-Project beneficiaries have not yet received direct training in IPM methods. 	<ul style="list-style-type: none"> Both mitigation and monitoring are recommended. With respect to mitigation, IPM extension services should continue to be provided to Sub-Project beneficiaries as a part of the Sub-Project in accordance with the requirements of IDA OP 4.03. Extension services should include the topics of appropriate selection and application of pesticides and herbicides as well as basic techniques of IPM.
OP 7.60 – Projects in Disputed Areas – Not Triggered	<ul style="list-style-type: none"> Not triggered as none of the Sub-Project Area or the area of influence of the Sub-Project is part of a territory whose jurisdiction is disputed by another country 	
OP 7.50 – International Waterways – Not Triggered	<ul style="list-style-type: none"> Not triggered as: (i) None of the water bodies associated with the Ke Go Sub-Project form a boundary between, or flow through the territory of another country; (ii) None of the water bodies associated with the Ke Go Sub-Project are a any tributary or component of any waterway described above; and (iii) None of the water bodies associated with the Ke Go Sub-Project are recognized as a necessary channel of communication between the open sea and other states countries or of any river flowing into such waters. 	

5: ENVIRONMENTAL MANAGEMENT PLAN FOR KE GO SUB-PROJECT

This Chapter presents the Environmental Management Plan (EMP) for the Ke Go Sub-Project. The purpose of the Ke Go EMP is to provide clear guidance on how to ensure the Sub-Project:

- complies with Vietnamese environmental laws, environmental commitments, and IDA environment policies throughout pre-construction, construction, and operation phases;
- employs a suitable organizational framework for environmental protection throughout pre-construction, construction, and operation;
- manages and monitors mitigation measures described in the MoNRE and IDA-approved EIA report;
- can provide emergency response mechanisms to unanticipated environmental issues;
- allocates appropriate financial resources to implement the EMP; and
- undertakes the transition in environmental management and protection from the first to the second phase of investments.

To achieve these objectives, the EMP contains:

- the Vietnamese legal and administrative framework under which the EIA will be approved and the EMP will be implemented;
- IDA's EIA approval requirements;
- significant adverse environment impacts that are anticipated in all phases of the first and second phase of investments – pre-construction; construction; and operation - and a mitigation program for impact avoidance, minimization, rectification, or compensation;
- a program to monitor the performance and effectiveness of the mitigation program;
- a monitoring program to assess the overall environmental effects of the Sub-Project on the environmental resources of the Sub-Project area and the associated area of influence;
- An organizational framework for the effective implementation of the mitigation and monitoring programs, including: collection of environmental information related to the Sub-Project, management, and reporting; project management decisions on the environment; implementation of project management decisions; and external review of EMP activities. This organizational framework contains implementation arrangements, implementation schedule, and responsibilities for the EMP;
- EMP reporting requirements;
- a programmatic framework which specifies how the specific mitigation and monitoring activities associated with the second phase of investments are to be designed in detail and implemented during overall VWRAP implementation;
- cost estimates for each component of the EMP;
- requirements for technical assistance to support implementation of the Environmental Management Plan including supervision of mitigation and monitoring and training.

The EMP is the “master document” from which all other environment-related project documents and actions are guided. This includes construction method statements, tender documents, contractor specifications, general conditions of construction contract, site environmental management plans, ToRs for environmental specialists, and allocation of budgets for environmental protection and monitoring. If an ambiguity exists on how to deal with environmental issues in any project documents or activities, the EMP shall serve as the authoritative reference document.

Any major changes to the Project or the legal and administrative frameworks that it operates under may require that MARD provide addenda to the EMP. These addenda should be reviewed and approved by MoNRE.

5.1 Vietnamese Legal and Administrative Frameworks

5.1.1 The Legal Framework for Environmental Management

Viet Nam's framework for environmental management continues to rapidly evolve, with new policies being produced every year. This section introduces the Viet Nam's relevant environmental policies.

Law on Protection of the Environment (LEP) was enacted in 1993. The LEP:

- Identifies the responsibilities of the state centre, provinces, organizations and individuals to prevent and remedy environmental deterioration and pollution and carry out specified environmental protection functions;

- Provides for the development of environmental standards and submission of environmental impact assessment reports on new and existing facilities;
- Provides for responsible parties to pay compensation for environmental damage;
- Establishes the right of individuals and organizations to petition for enforcement of regulations;
- Calls for civil and criminal penalties for violations; and
- Encourages international environmental co-operation.

Decree 175/CP was promulgated in 1994 to guide implementation of the LEP and provides broad guidelines for division of responsibility among Ministries; environmental impact assessments; pollution prevention and disaster control; sources of finance; and environmental inspections and standards.

Circular No. 490 was promulgated in 1998 to provide guidance on setting up and appraising environmental impact assessment reports for investment projects. The Circular identifies the legal requirements according to the stages of implementation of a project and its category; defines the content of project subject to the EIA procedures; and specifies management of the EIA report appraisal.

To supplement the above policies a large range of decisions, regulations, and standards may also be considered:

Decree 24/2000/ND-C specifies the implementation on the Law on Foreign Investment in Viet Nam (Article 82) concerning environmental protection as follows: 1) enterprises with foreign investment capital and joint ventures are obligated to observe regulations, satisfy standards in environment protection, and comply with Vietnam legislation on environment protection; 2) if investors apply international advanced environmental standards these standards should be registered with MoNRE.

Resolution No. 5/1997/QH10 identifies projects of national importance to be approved and decided by the National Assembly (Provision 2, Article 2) as "projects which result in major or potentially serious impacts on the environment". For these projects, one of the contents to be submitted to the National Assembly for approval and decision on investment is "fundamental issues that need to be solved in the project implementation: environment protection, population movement/resettlement..."

Decree 52/1999/ND-CP was appended to include environmental considerations for construction management as follows: 1) for PFS, Provision 3 of Article 23 stipulates that requirements for environment study relating to the "selection of construction sites, estimation of land use area needed, in ways which comply to the principle of minimizing land use and environmental and social impacts, and resettlement to the lowest possible level". 2) Provisions 4 and 7 of Article 24 stipulate that FS must propose "specific site options (or regions, routes) which much match with construction plans (including documents on site selection, together with proposed solutions for minimizing environmental and social impacts)," and "architectural alternatives, construction solutions, preliminary designs suggested for selection, environment management and protection solutions". 3) For technical design: Section B, Provision 1, Article 37 and Section A, Provision 2, Article 38, contain regulations on appraisal and approval of "techniques for the protection of environment and ecology; for prevention and combating of explosion and fire and for occupational safety and industrial sanitation."

Decree 26/1996/CP provides regulations on the punishment of administrative violation of Environmental Protection Law. Chapter 1 describes the general provisions for punishment under the Environment Protection Law. Chapter 2, Article 6 details recommended punishments for parties who violate environmental pollution and prevention act. These punishments include financial penalties for not submitting an EIA report.

Tiêu Chuẩn Việt Nam (TCVN) are national standards established by MoNRE and applied to all government agencies. They include engineering, construction, scientific, and environmental standards. The environmental standards include acceptable limits of many air, noise, and water quality parameters. In general, the list of biophysical parameters is broad enough such that most monitoring programs can employ TCVN standards as metrics of evaluation. There are some exceptions — of most importance to the Ke Go Sub-Project, sediment, soil, and vibration standards do not yet exist. Most TCVN standards are direct translations of ISO standards.

5.1.2 The Administrative Framework for Environmental Management

The country's administrative framework is undergoing substantial restructuring. The Government of Viet Nam is in the process of creating a new administrative framework for environmental management. For the Ke Go Sub-Project, the framework's relevant institutions are as follows:

Ministry of Natural Resources and Environment (MONRE). MONRE was established by a Prime Ministerial Decision on November 11, 2002. This new ministry will include four vice-ministers and 16 departments. The

new MoNRE will merge numerous departments from several national agencies. These are outlined in Decree 91/2002/ND-CP: Providing for the functions, duties, powers and organizational structure of the Ministry of Natural Resources and the Environment.

Environmental Impact Assessment and Appraisal Department. This Department is under MoNRE. According to Decree 91/2002/ND-CP, the Department's function includes: To appraise environmental impact assessment reports of projects and of business and production establishments; to issue environmental standards; and to carry out uniform management of the issue and revocation of certificates of eligibility of environmental standards in accordance with the law. It is expected that the Environmental Impact Assessment and Appraisal Department will be guided by the Vietnam's established regulatory framework.

Provincial Departments of Science, Technology and Environment (DoSTE). The Environmental Management Division (EMD) of each provincial DoSTE is responsible for ensuring environmental protection and management of provincial matters in accordance with LEP, Decree 175, and Circular 490. The decision to restructure DoSTEs will likely occur in 2003, after decisions have been made on how to restructure MoNRE at the central level. It is expected that regardless as to where EMD is housed, its environmental protection function will remain intact. For this reason, the EMD will likely remain a key partner to the successful monitoring and implementation of the Project.

5.1.3 Vietnamese Environmental Requirements

The Ke Go Sub-Project will irrigate more than 16,000 ha in Ha Tinh Province. Due to the Sub-Project's large irrigation and reservoir area, MARD is required to submit a detailed EIA report to MoNRE's Environmental Impact Assessment and Appraisal Department. The format for the detailed EIA report format is found in Appendix II of CP 175. MARD is required to submit this report with CP 490's Annex IV.1: *Application for Appraisal of EIA Report*. Once the report is received, MoNRE will establish a committee to review and evaluate the project's potential impacts and mitigation measures. The committee traditionally includes DoSTE and/or PC representatives from the affected provinces, senior technical experts from central-level organizations, and selected MoNRE staff. The committee will review the detailed EIA and provide written comments to MoNRE. According to Section III (5) of CP 490, appraisal of the EIA report is due within 60 days of the date a sufficient and eligible document of the EIA report is received by the relevant Government Management Agencies of Environmental Protection. In case that the EIA report is unsatisfactory, the EIA report appraisal agencies have 5 days of the date the EIA report is received to notify the proponent requirements for adjustment or addition. Within 10 days following the date of the EIA report is approved, the relevant appraisal agencies will issue a decision on the approval of the EIA report of a proposed project. The format for a MoNRE decision on EIA reports is found in Annex V of CP 490. An original copy of this decision is the clearest indication that a project has been subject to a legally-sanctioned environmental assessment process.

5.2 IDA Environmental Requirements

IDA considers this project as "Category A" (*"projects with significant adverse environmental impact"*). The EIA will be submitted to the appropriate IDA department for review and to the IDA Board of Directors at least 120 days prior to loan approval.

5.3 Overall Approach to Implementation

The implementation of the Ke Go Sub-Project EMP will follow the implementation of the overall Ke Go Sub-Project. The Ke Go Sub-Project will begin with a Detailed Engineering Design (Pre-Construction) Phase for the first phase of investments (i.e., headworks, main and primary canals, pilot areas, and non-agricultural uses of the water resources provided by the Ke Go Irrigation Scheme), followed by a Construction Phase and an Operational Phase for the first investment phase. At some point during the Construction Phase for the first investment phase, the Detailed Engineering Design Phase will be implemented for the second phase of investments (i.e., the remainder of the command area, exclusive of the pilot areas), followed by the Construction and Operational Phases for this second investment phase.

The implementation of the Ke Go Sub-Project EMP will follow the same pattern. The Detailed Design of the Ke Go Sub-Project EMP for the first investment phase will be completed at the same time as the Detailed Engineering Design for the first investment phase. The Ke Go Sub-Project EMP for the first investment phase will then be implemented during the Construction and Operational Phases of the first investment phase.

Similarly, the Detailed Design of the Ke Go Sub-Project EMP for the second investment phase will be completed at the same time as the Detailed Engineering Design for the second investment phase based on the overall Ke Go Sub-Project EMP as outlined in this EIA and the lessons learned and results from the first investment phase. The Ke Go Sub-Project EMP for the second investment phase will then be implemented during the Construction and Operational Phases of the second investment phase.

5.4 Institutions Responsible for Implementing the Ke Go EMP

The Ke Go EMP will be implemented within a comprehensive organizational framework under the overall VWRAP Project. VWRAP will engage several ministries, departments, and institutes, it will create a project management unit within MARD in Ha Noi (PMU) and Sub-Project Implementation Units (SIUs) in each province, and there will be numerous linkages between these institutions and numerous other existing institutions at the national, provincial, district, and commune levels³³. The following institutions will be responsible for the successful implementation of the Ke Go Environmental Management Plan:

VWRAP PMU – responsible for overall VWRAP implementation management and will contain environmental safeguard staff. VWRAP PMU will be responsible for overall quality assurance of EMP implementation.

Ke Go Sub-Project SIU – staffed by personnel from Ha Tinh DARD and Ha Tinh IMC, and will be responsible for daily implementation activities of the Ke Go Sub-Project. As a consequence, it will supervise and control the quality of construction and physical implementation of the Ke Go Sub-Project EMP

Vietnamese Environmental Regulators – MoNRE and Ha Tinh DoSTE will be responsible for all regulatory reviews and approvals of the Ke Go Sub-Project in accordance with the national legal framework for environmental protection and management.

Ha Tinh Provincial Organizations – Other Ha Tinh provincial departments will have important responsibilities such as implementing specific components of the mitigation program (IPM), ensuring their particular safeguards are being properly implemented (i.e. DoCI) and providing supplementary and secondary data to assist in the implementation of the Ke Go EMP (e.g., land use and commodity production data).

IDA – IDA will review the implementation of the EMP. Problems and issues that are identified will be raised to MARD as part of the regular Ke Go Sub-Project review process.

Environmental Safeguard Contractors – An Environmental Safeguard Contractor will be selected from the numerous national environmental consultant organizations in Viet Nam. The Environmental Safeguard Contractor will act as general contractor for primary data collection surveys and for preparation and submission of various compliance and effects monitoring assessment reports. They will also be responsible for undertaking some of the specific mitigation measures for the Ke Go Sub-Project.

Consultant Environmental Specialists - some of the resources of the Design and Supervision Technical Assistance under VWRAP will be used to engage two environmental specialists who will take on substantial implementation tasks for the EMP: (i) the Consultant's international environment specialist; and (ii) the Consultant's national environmental specialist seconded from a nationally-recognized environmental management institution. The secondment could be in the form of a fixed-term, renewable contract during pre-construction, construction, and operation phases. It is expected that the services of the Consultant's international environment specialist will be required for VWRAP implementation until the completion of the Detailed Design of the Ke Go EMP for the second phase of investments, at which time sufficient training and capacity building will have been given that remaining institutions and personnel will be able to implement the remainder of the Ke Go Sub-Project EMP. In this EMP, it is assumed that the Detailed Engineering Design for the second investment phase will occur in the third year of Ke Go Sub-Project implementation.

5.5 Environmental Mitigation Program for Ke Go Sub-Project

Table 28, Page 67, contains the environmental mitigation program for the Ke Go Sub-Project, based on the assessment of environmental impacts contained in Chapter 4: Impact Assessment. Table 28 is organized according to the different phases of the Sub-Project – pre-construction, construction, and operation – for each of

³³ This assumes a decentralized modality for Sub-Project implementation and will need to be modified if a more traditional, centralized modality for Sub-Project implementation is selected. Under either modality, VWRAP PMU can be either CPO or another unit set up or designated by MARD.

the two investment phases.

5.6 Environmental Mitigation Compliance Monitoring for Ke Go Sub-Project

The Environmental Mitigation Compliance Monitoring Program is designed to determine if the environmental mitigation measures for the Sub-Project (Table 28) are being implemented properly and are having the intended effects of avoiding, limiting, or rectifying negative environmental impacts. If mitigation compliance monitoring indicates that mitigation measures are not being implemented effectively or are not being effective, the appropriate responsible institutions will need to take corrective action. Table 29, Page 72, describes the Environmental Mitigation Compliance Monitoring Program for the Ke Go Sub-Project.

5.7 Environmental Effects Monitoring Program for Ke Go Sub-Project

The Environmental Effects Monitoring Program for the Ke Go Sub-Project will measure ambient biotic and abiotic indicators of Sub-Project activities on the environmental resources of the Sub-Project Area and the associated area of influence. Chapter 4: Impact Assessment describes a number of instances in which it is necessary to monitor environmental conditions to determine if the Sub-Project is having any effects on the environment and the magnitude of those effects. The results of the Environmental Effects Monitoring Program will be used, if necessary, to modify the Sub-Project design or implementation to reduce unexpected environmental impacts and to confirm the predictions about Sub-Project environmental impacts made in this EIA. Table 30, Page 74, describes the Environmental Effects Monitoring Program for the Ke Go Sub-Project.

5.8 Reporting Requirements for Ke Go EMP

Table 24 summarizes the reporting requirements for the Ke Go Sub-Project and the institutional responsibilities for preparing these reports. All annual reports produced as part of the Ke Go Sub-Project Environmental Management Plan will be required to contain:

- An assessment of the success of mitigation activities (in the case of Sub-Project performance monitoring) or an assessment of the actual environmental effects of Sub-Project implementation in comparison to predictions made in the original EIA (in the case of environmental effects monitoring);
- An explicit assessment as to whether the existing EMP framework is sufficient or not; and
- If it is concluded that the existing EMP framework is not sufficient, a description of the reasons why it is not sufficient and a detailed set of recommendations for re-design of the EMP framework, complete with revisions to data and information to be gathered, data analysis to be performed, reporting, and budgets.

The technical and planning reports (Table 24) will be supported by a broad range of administrative policies and contractual agreements. They include but are not restricted to:

- Inception reports;
- terms of reference;
- contractor specifications for environmental protection and mitigation;
- general Conditions of Contract for protection of the environment; and
- site Environmental Management Plans produced by construction contractors.

Both the VWRAP PMU Environmental Specialist, on behalf of the VWRAP PMU, and the Ke Go Sub-Project SIU will keep an electronic and paper library of all EMP planning, technical, and administrative reports produced by the Sub-Project. This information will be organized in a way that will be readily available for regulators, donors, government agencies, and other Sub-Project stakeholders as required.

5.9 Organizational Framework for Implementing the Ke Go EMP

5.9.1 Key Features of Organizational Framework

The organizational framework for the Ke Go Sub-Project EMP that is outlined in detail below:

- works within the Sub-Project's overall organizational framework;

Table 24: Reporting requirements for the Ke Go Sub-Project Environmental Management Plan.

Report	Responsibility for Preparation	Frequency	Institutions for Review and Approval
Reports Prepared Once During EMP Implementation			
Environmental Review of Ha Tinh Provincial Aquaculture Program and Environmental Action Plan	Environmental Safeguard Contractor supported by Consultant Environmental Specialists	Prepared during first year of VWRAP implementation	VWRAP PMU, MARD, IDA, Ha Tinh DoFI, Ha Tinh DoSTE, MoNRE
Detailed Design Document for Ke Go Sub-Project Environmental Management Plan: First Investment Phase	Consultant Environmental Specialists, supported by Environmental Safeguard Contractors and Ke Go SIU	Once, during first year of VWRAP implementation, prior to initiation of construction	Ke Go SIU, VWRAP PMU, IDA, MARD, MoNRE, Ha Tinh DoSTE
Detailed Design Document for Ke Go Sub-Project Environmental Management Plan: Second Investment Phase	Environmental Safeguard Contractor, supported by Consultant Environmental Specialists and Ke Go SIU	Once, in year immediately prior to implementation of investments in remaining 80% of command area	Ke Go SIU, VWRAP PMU, IDA, MARD, MoNRE, Ha Tinh DoSTE
Canal Lining Schedule and Detailed Implementation Plan: First Investment Phase	Ke Go SIU	Once, during first year of VWRAP implementation, prior to initiation of construction	Ha Tinh PPC, VWRAP PMU, IDA, MARD, MoNRE, affected communes and villages
Canal Lining Schedule and Detailed Implementation Plan: Second Investment Phase	Ke Go SIU	Once, in year immediately prior to implementation of investments in remaining 80% of command area	Ha Tinh PPC, VWRAP PMU, IDA, MARD, MoNRE, affected communes and villages
Ordnance Survey and Treatment Completion Report for First Investment Phase	Ministry of Defence Contractor	Once, during first year of VWRAP implementation, prior to initiation of construction	Ha Tinh PPC, VWRAP PMU, IDA, MARD, MoNRE, affected communes and villages
Ordnance Survey and Treatment Completion Report for Second Investment Phase	Ministry of Defence Contractor	Once, in year immediately prior to initiation of construction in remaining 80% of command area	Ha Tinh PPC, VWRAP PMU, IDA, MARD, MoNRE, affected communes and villages
Regular Reports During EMP Implementation			
Annual Report on Implementation of Coastal Aquaculture Environmental Management Plan	Selected Provincial Agency with assigned responsibility for coastal aquaculture EMP	Annual for each year that coastal aquaculture EMP is implemented	Ke Go SIU, VWRAP PMU, IDA, MARD, MoNRE, Ha Tinh DoSTE
Annual Report on Implementation of IPM Program in Command Area Communes	Ha Tinh DARD	Annual for each year that IPM program extension services are provided	Ke Go SIU
Ke Go Sub-Project Mitigation Compliance Progress Report	Environmental Safeguard Contractor supported by Consultant Environmental Specialists	Monthly	Ke Go SIU
Ke Go Sub-Project Environmental Mitigation Compliance Monitoring Report	Environmental Safeguard Contractor, supported by Consultant Environmental Specialists for first three years, and supported by Ke Go SIU throughout Sub-Project implementation	Annual during construction period	Ke Go SIU, VWRAP PMU, IDA, MARD, MoNRE, Ha Tinh DoSTE
Ke Go Sub-Project Environmental Effects Monitoring Progress Report	Environmental Safeguard Contractor supported by Consultant Environmental Specialists	Six months into each year	Ke Go SIU, VWRAP PMU, IDA, MARD, MoNRE, Ha Tinh DoSTE
Ke Go Sub-Project Environmental Management Report, integrating all results from Ke Go Sub-Project EMP (mitigation, mitigation compliance monitoring, and environmental effects monitoring) into a single annual report	Consultant Environmental Specialists, supported by Environmental Safeguard Contractor for first three years and Environmental Safeguard Contractor supported by Consultant Environmental Specialists for remainder of implementation	Annual, beginning with pre-construction of first phase of investments	Ke Go SIU, VWRAP PMU, IDA, MARD, MoNRE, Ha Tinh DoSTE
Periodic Reports Required As Needed			
Technical Design of Revised Ke Go Sub-Project Environmental Management Plan	Consultant Environmental Specialists, supported by Environmental Safeguard Contractor, and Ke Go SIU, depending on nature of redesign that is required	Required every time modification of EMP is required	IDA, Ke Go SIU, VWRAP PMU, MARD, MoNRE, Ha Tinh DoSTE

- works within the practical human resource constraints of environmental management capacity in Viet Nam;
- explicitly accounts for all aspects of what is required in successfully implementing the Environmental Management Plan: information collection, EMP management, reporting, and revision if necessary,

- management decisions on the environment, and implementation of EMP management decisions;
- uses existing procedures within the GoVN and between the GoVN and IDA that are already in place for reviewing and approving modifications to the Environmental Management Plan that are required in the case of Sub-Project design modifications or strengthening of existing mitigation and monitoring programs;
- ensures that the reporting that is done as part of Environmental Management Plan implementation includes information that is needed by MARD, other concerned national agencies, and IDA to make decisions regarding the need for revisions to the Environmental Management Plan as may be required for the second phase of investments.

5.9.2 Institutional Responsibilities for EMP Implementation during Pre-Construction Phases

The Pre-Construction Phase will essentially be the detailed design phase for the first phase of investments. Unless otherwise noted, all responsibilities detailed below apply to both pre-construction phases, i.e., for both the first and second investment phases.

VWRAP PMU

VWRAP PMU will have overall responsibility for successful implementation of environmental management activities. VWRAP PMU will make management decisions that support effective implementation of the EMP; this will include:

- approving ToRs, bidding documents, and contracts for the Environmental Safeguard Contractors, including the environmental review of provincial aquaculture program;
- efficiently manage the reviews of the following documents and ensure they are approved in a timely manner:
 - Environmental Review of Ha Tinh Provincial Aquaculture Program and Environmental Action Plan (1st investment phase);
 - Canal Lining Implementation Plans
 - Detailed Design Documents for Ke Go Sub-Project Environmental Management Plan: First and Second Investment Phases
 - Set of terms and conditions for environmental mitigation to be included in construction contracts
 - Pre-Construction Phase Ke Go Sub-Project Environmental Management Report (to serve as environmental baseline); and
- Participate in environmental training programs conducted by the Consultant Environmental Specialists (up to Year 3 of Sub-Project implementation).

KE GO SUB-PROJECT SIU

The responsibilities of the Ke Go Sub-Project SIU in the Pre-Construction Phase will be to:

- review and approve the following environmental documents prepared during the pre-construction phases:
 - Ordnance Survey and Treatment Completion Reports
 - Detailed Design Documents for Ke Go Sub-Project Environmental Management Plan: First and Second Investment Phases
 - Pre-Construction Phase Ke Go Sub-Project Environmental Management Report (to serve as environmental baseline)
- Implement the Ke Go Sub-Project RAP and EMDP;
- in consultation with Ha Tinh DARD, Ke Go IMC, and the districts and communes with jurisdiction in the pilot areas of the Ke Go Sub-Project develop a canal lining program that has the signed agreement of all these stakeholders and prepare Canal Lining Implementation Plans;
- Prepare Terms of Reference for Ministry of Defence contractors for survey and treatment of UXO;
- Prepare terms and conditions to include in construction contracts:
 - Environmental management of construction camps
 - Canal lining (to be taken from approved canal lining implementation plans)
 - Minimization of effects of construction activities on local residents
 - Avoidance of cultural and historic sites
 - Minimization of effects of dredged and excavated soils
- Work with the Environmental Safeguard Contractor to prepare environmental mitigation compliance monitoring report formats and reporting procedures;
- provide physical, biological, and socioeconomic information to the Environmental Safeguard Contractors as

- required to complete the environmental baseline for the Ke Go Sub-Project area and the associated area of influence; and
- Participate in environmental training programs conducted by the Consultant Environmental Specialists (**up to Year 3 of Sub-Project implementation**).

HA TINH PROVINCIAL ORGANIZATIONS

The responsibilities of the Ha Tinh Provincial Departments in the Pre-Construction Phases will be to:

- review and approve the following environmental documents prepared during the pre-construction phases:
 - Environmental Review of Ha Tinh Provincial Aquaculture Program and Environmental Action Plan (Ha Tinh PPC, Ha Tinh DoSTE) (**1st investment phase**)
 - Canal Lining Implementation Plans (Ha Tinh PPC, Ha Tinh DoSTE, Ha Tinh DARD)
 - Detailed Design Documents for Ke Go Sub-Project Environmental Management Plan: First and Second Investment Phases (DoSTE);
 - Pre-Construction Phase Ke Go Sub-Project Environmental Management Report (to serve as environmental baseline) (DoSTE)
- participate in the Ke Go Sub-Project EIA approval process;
- serve as executing agency (DoSTE) and implementing agency (DoFI) for the environmental review of coastal aquaculture in Thach Ha District (**1st investment phase**);
- provide physical, biological, and socioeconomic information to the Environmental Safeguard Contractors and Consultant Environmental Specialist as required to complete the environmental baseline for the Ke Go Sub-Project area and the associated area of influence (DARD, DoSTE, others);
- advise MoNRE on any environmental concerns regarding project design, construction, and operation (DoSTE); and
- Participate in environmental training programs conducted by the Consultant Environmental Specialists (**up to Year 3 of Sub-Project implementation**).

CONSTRUCTION CONTRACTORS

Construction contractors will commit to all proposed environmental protection and mitigation measures in key construction documents: general conditions of contract, contractor specifications, conditions of contract, etc. They will draft method statements for the Site EMP and any other relevant environmental protection measures and submit to the Ke Go SIU for approval.

ENVIRONMENTAL SAFEGUARD CONTRACTORS

Environmental Safeguard Contractor responsibilities during the Pre-Construction Phase will include:

- conducting the environmental review of the coastal aquaculture program in Thach Ha District under Ha Tinh DoSTE (executing agency) Ha Tinh DoFI (implementing agency) (**1st investment phase**);
- providing technical support to the Consultant Environmental Specialists in preparing both Detailed Design Documents for Ke Go Sub-Project Environmental Management Plan: First and Second Investment Phases;
- providing technical support to the Consultant Environmental Specialists in the preparation of the Pre-Construction Phase Ke Go Sub-Project Environmental Management Report (to serve as environmental baseline) for review and approval (**1st investment phase**);
- conducting the Pre-Construction Phase information gathering according to the Detailed Design Document;
- conducting the following activities:
 - designing and establishing environmental monitoring database information and reporting system for the Ke Go Sub-Project
 - designing environmental reporting structures and formats, including environmental mitigation compliance monitoring report formats and reporting procedures; and
- Participating in environmental training programs conducted by the Consultant Environmental Specialists (**up to Year 3 of Sub-Project implementation**).

CONSULTANT ENVIRONMENTAL SPECIALISTS

The Consultant Environmental Specialists will verify as to whether or not major design changes have occurred since GoVN and IDA approval of the EIA report. If major design changes have occurred, then these changes will

need environmental approval from GoVN and IDA. The Consultant Environmental Specialists will also:

- Prepare a detailed Inception Report for all aspects of the consulting assignment, including a detailed training and capacity building program;
- Assist VWRAP PMU to prepare and finalize the following ToRs for the Environmental Safeguard Contractor:
 - Environmental review of coastal aquaculture program in Thach Ha District (**1st investment phase**)
 - Environmental Mitigation Compliance Monitoring of construction contracts
 - Environmental effects monitoring for effects of coastal aquaculture in Thach Ha District
 - Environmental effects monitoring for effects of sedimentation, erosion, fertilizer, and pesticide application
- Prepare both Detailed Design Documents for Ke Go Sub-Project Environmental Management Plan: First and Second Investment Phases for review and approval;
- supervise Pre-Construction Phase information gathering according to the Detailed Design Document (**up to Year 3 of Sub-Project implementation**);
- provide assistance to the Environmental Safeguard Contractors (**up to Year 3 of Sub-Project implementation**) in:
 - designing and establishing environmental monitoring database information and reporting system for the Ke Go Sub-Project;
 - designing environmental reporting structures and formats, including environmental mitigation compliance monitoring report formats and reporting procedures
- Provide technical assistance to Ke Go Sub-Project SIU in finalizing environmental terms and conditions for construction contracts:
 - Environmental management of construction camps
 - Canal lining (to be taken from approved canal lining implementation plans)
 - Minimization of effects of construction activities on local residents
 - Avoidance of cultural and historic sites
 - Minimization of effects of dredged and excavated soils;
- preparing and submitting the Pre-Construction Phase Ke Go Sub-Project Environmental Management Report (to serve as environmental baseline) for review and approval (**1st investment phase**); and
- conducting environmental training programs for VWRAP PMU, Ke Go Sub-Project SIU, Ha Tinh Provincial Organizations, and Environmental Safeguard Contractors (see Section 5.11, Page 59) (**up to Year 3 of Sub-Project implementation**).

5.9.3 Institutional Responsibilities for EMP Implementation during Construction Phases

Unless otherwise noted, all responsibilities detailed below apply to both construction phases, i.e., for both the first and second investment phases.

VWRAP PMU

The responsibilities of the VWRAP PMU in the Construction Phases will be to:

- efficiently manage the reviews with national environmental regulators, MARD, and GoVN of the following documents and ensure they are approved in a timely manner:
 - Annual Ke Go Sub-Project Environmental Management Report, integrating all results from Ke Go Sub-Project EMP (mitigation, mitigation compliance monitoring, and environmental effects monitoring) into a single annual report
- If necessary efficiently manage the review and approval by national environmental regulators, MARD, and GoVN of technical modifications to the Ke Go EMP if required (please see Section 5.12, Page 60); and
- Participate in environmental training programs conducted by the Consultant Environmental Specialists (**up to Year 3 of Sub-Project implementation**).

KE GO SUB-PROJECT SIU

The responsibilities of the Ke Go Sub-Project SIU in the Construction Phases will be to:

- Supervise the program for survey and treatment of UXO by the Ministry of Defence contractors;
- Assist the Environmental Safeguard Contractor in environmental mitigation monitoring activities;
- provide Sub-Project construction progress information to the Environmental Safeguard Contractors and Consultant Environmental Specialist as required to complete the annual monitoring reports;

- review and approve the following environmental documents prepared during the construction phases:
 - Annual Report on Implementation of Coastal Aquaculture Environmental Management Plan
 - Monthly Ke Go Sub-Project Mitigation Compliance Progress Reports
 - Annual Ke Go Sub-Project Environmental Mitigation Compliance Monitoring Report
 - Annual Ke Go Sub-Project Environmental Management Report, integrating all results from Ke Go Sub-Project EMP (mitigation, mitigation compliance monitoring, and environmental effects monitoring) into a single annual report
- Participate in environmental training programs conducted by the Consultant Environmental Specialists (up to Year 3 of Sub-Project implementation).

HA TINH PROVINCIAL ORGANIZATIONS

The responsibilities of Ha Tinh Provincial Organizations in the Construction Phases will be to:

- implement the Environmental Action Plan for coastal aquaculture in Thach Ha District (implementing agency to be selected during preparation of environmental review, but candidate organizations are Ha Tinh DoSTE, DARD, or DoFI);
- prepare an implementation plan for the IPM program to be conducted under the Sub-Project and submit to Ke Go Sub-Project SIU for approval (DARD)
- provide physical, biological, and socioeconomic information to the Environmental Safeguard Contractors and Consultant Environmental Specialist as required to complete the annual monitoring reports (DARD, DoSTE, others);
- review and approve the following environmental documents prepared during the construction phases:
 - Annual Ke Go Sub-Project Environmental Mitigation Compliance Monitoring Report (DoSTE)
 - Annual Ke Go Sub-Project Environmental Management Report (DoSTE)
- Participate in environmental training programs conducted by the Consultant Environmental Specialists (up to Year 3 of Sub-Project implementation).

CONSTRUCTION CONTRACTORS

The responsibility of the construction contractors will be to properly and effectively implement the environmental mitigation terms and conditions contained in their construction contracts.

ENVIRONMENTAL SAFEGUARD CONTRACTORS

The responsibilities of the Environmental Safeguard Contractors in the Construction Phases will be to:

- Monitor construction contractors during construction activities and report on their compliance with the environmental terms and conditions contained in their contracts;
- Prepare the monthly Ke Go Sub-Project Mitigation Compliance Progress Reports
- Prepare the annual Ke Go Sub-Project Environmental Mitigation Compliance Monitoring Report
- Conduct the Construction Phase environmental information gathering according to the Detailed Design Document for the following environmental effects monitoring:
 - Environmental effects of coastal aquaculture in Thach Ha District;
 - Water quality effects from erosion, sedimentation, fertilizers, and pesticides.
- providing technical support to the Consultant Environmental Specialists in the preparation of the Construction Phase Ke Go Sub-Project Environmental Management Reports (annual) for review and approval (1st investment phase);
- Supervise and provide technical assistance to VWRAP PMU, Ke Go Sub-Project SIU, and Environmental Safeguard Contractors in the implementation of their components of the Ke Go Sub-Project EMP (after Year 3 of Sub-Project implementation);
- prepare and submit the Construction Phase Ke Go Sub-Project Environmental Management Reports (annual) for review and approval (after detailed design of EMP for 2nd investment phase);
- Participate in environmental training programs conducted by the Consultant Environmental Specialists (up to Year 3 of Sub-Project implementation).

CONSULTANT ENVIRONMENTAL SPECIALISTS

The responsibilities of the Consultant Environmental Specialists in the Construction Phases up to Year 3 of Sub-

Project implementation will be to:

- Supervise and provide technical assistance to VWRAP PMU, Ke Go Sub-Project SIU, and Environmental Safeguard Contractors in the implementation of their components of the Ke Go Sub-Project EMP;
- If necessary prepare environmental reviews of technical design modifications and revise the Ke Go EMP for approval (please see Section 5.12, Page 60);
- prepare and submit the Construction Phase Ke Go Sub-Project Environmental Management Reports (annual) for review and approval; and
- conduct environmental training programs for VWRAP PMU, Ke Go Sub-Project SIU, Ha Tinh Provincial Organizations, and Environmental Safeguard Contractors (see Section 5.11, Page 59).

5.9.4 Institutional Responsibilities for EMP Implementation during Operational Phases

Unless otherwise noted, all responsibilities detailed below apply to both operational phases, i.e., for both the first and second investment phases.

VWRAP PMU

The responsibilities of the VWRAP PMU in the Operational Phases will be to:

- efficiently manage the reviews with national environmental regulators, MARD, and GoVN of the following documents and ensure they are approved in a timely manner:
 - Annual Ke Go Sub-Project Environmental Management Report, integrating all results from Ke Go Sub-Project EMP (mitigation, mitigation compliance monitoring, and environmental effects monitoring) into a single annual report
- If necessary efficiently manage the review and approval by national environmental regulators, MARD, and GoVN of technical modifications to the Ke Go EMP if required (please see Section 5.12, Page 60); and
- Participate in environmental training programs conducted by the Consultant Environmental Specialists (**up to Year 3 of Sub-Project implementation**).

KE GO SUB-PROJECT SIU

The responsibilities of the Ke Go Sub-Project SIU in the Operational Phases will be to:

- Assist the Environmental Safeguard Contractor in conducting environmental mitigation monitoring activities;
- provide Sub-Project operational information to the Environmental Safeguard Contractors and Consultant Environmental Specialist as required to complete the annual monitoring reports;
- review and approve the following environmental documents prepared during the operational phases:
 - Annual Report on Implementation of Coastal Aquaculture Environmental Management Plan
 - Annual Report on Implementation of IPM Extension Program
 - Annual Ke Go Sub-Project Environmental Management Report, integrating all results from Ke Go Sub-Project EMP (mitigation, mitigation compliance monitoring, and environmental effects monitoring) into a single annual report
- Participate in environmental training programs conducted by the Consultant Environmental Specialists (**up to Year 3 of Sub-Project implementation**).

HA TINH PROVINCIAL ORGANIZATIONS

The responsibilities of Ha Tinh Provincial Organizations in the Operational Phases will be to:

- Continue to implement the Environmental Action Plan for coastal aquaculture in Thach Ha District (implementing agency to be selected during preparation of environmental review, but candidate organizations are Ha Tinh DoSTE, DARD, or DoFI);
- implement the IPM program to be conducted under the Sub-Project (DARD)
- provide physical, biological, and socioeconomic information to the Environmental Safeguard Contractors and Consultant Environmental Specialist as required to complete the annual monitoring reports (DARD, DoSTE, others);
- review and approve the following environmental documents prepared during the pre-construction phases:

- Annual Ke Go Sub-Project Environmental Mitigation Compliance Monitoring Report (DoSTE)
- Annual Ke Go Sub-Project Environmental Management Report (DoSTE)
- o Participate in environmental training programs conducted by the Consultant Environmental Specialists (**up to Year 3 of Sub-Project implementation**).

ENVIRONMENTAL SAFEGUARD CONTRACTORS

The responsibilities of the Environmental Safeguard Contractors in the Operational Phases will be to:

- o Monitor construction contractors during construction activities and report on their compliance with the environmental terms and conditions contained in their contracts;
- o Prepare the monthly Ke Go Sub-Project Mitigation Compliance Progress Reports
- o Prepare the annual Ke Go Sub-Project Environmental Mitigation Compliance Monitoring Report
- o Conduct the Operational Phase environmental information gathering according to the Detailed Design Document for the following environmental effects monitoring:
 - Environmental effects of coastal aquaculture in Thach Ha District;
 - Water quality effects from erosion, sedimentation, fertilizers, and pesticides.
- o providing technical support to the Consultant Environmental Specialists in the preparation of the Operational Phase Ke Go Sub-Project Environmental Management Reports (annual) for review and approval (**up to Year 3 of Sub-Project implementation**);
- o Supervise and provide technical assistance to VWRAP PMU, Ke Go Sub-Project SIU, and Environmental Safeguard Contractors in the implementation of their components of the Ke Go Sub-Project EMP (**after Year 3 of Sub-Project implementation**);
- o prepare and submit the Operational Phase Ke Go Sub-Project Environmental Management Reports (annual) for review and approval (**after Year 3 of Sub-Project implementation**);
- o Participate in environmental training programs conducted by the Consultant Environmental Specialists (**up to Year 3 of Sub-Project implementation**).

CONSULTANT ENVIRONMENTAL SPECIALISTS

The responsibilities of the Consultant Environmental Specialists in the Operational Phases up to Year 3 of Sub-Project implementation will be to:

- o Supervise and provide technical assistance to VWRAP PMU, Ke Go Sub-Project SIU, and Environmental Safeguard Contractors in the implementation of their components of the Ke Go Sub-Project EMP;
- o If necessary prepare environmental reviews of technical design modifications and revise the Ke Go EMP for approval (please see Section 5.12, Page 60);
- o prepare and submit the Operational Phase Ke Go Sub-Project Environmental Management Reports (annual) for review and approval; and
- o conduct environmental training programs for VWRAP PMU, Ke Go Sub-Project SIU, Ha Tinh Provincial Organizations, and Environmental Safeguard Contractors (see Section 5.11, Page 59).

5.10 Policy Guidelines for Detailed Design: Second Phase of investments

Preparation of the Detailed Design of the Ke Go EMP for the second phase of investments will proceed as follows:

- o While no separate and additional environmental assessment is required for the second phase of investments, VWRAP PMU will formally confirm this conclusion prior to the detailed design of the engineering works for the second investment phase and will obtain approval for this from MoNRE, MARD, and IDA.
- o VWRAP PMU, with the assistance of the Consultant Environmental Specialists, will be responsible for preparing a Detailed Design Document for the Ke Go Sub-Project: Second Investment Phase. This Detailed Design Document will use the lessons learned from the results of the environmental management of the first investment phase of the Ke Go Sub-Project and will be prepared concomitant with the detailed technical and engineering design for the second phase of investments.
- o While no separate and additional environmental assessment is required, consultation with affected groups and communities in the remaining 80% of command areas will be required. This consultation will include, but not be restricted to:
 - Presenting the results and findings of the environmental management of the first phase of Ke Go Sub-

- Project investments to affected groups and communities
- Description of engineering works to be implemented in second investment phase, expected environmental effects, and scope of proposed environmental management plan.
 - Receipt of comments and suggestions from affected groups and communities on environmental issues associated with second investment phase and scope of proposed environmental management plan. These will be documented as a consultation record as part of the final detailed design document for the Environmental Management Plan for the second investment phase.
 - The results of the consultation will be used to prepare a final detailed design document for the Environmental Management Plan for the second investment phase.
 - VWRAP PMU will submit and obtain approval for the final detailed design document for the second investment phase from MoNRE, MARD, and IDA.
 - Upon receiving the necessary approvals, VWRAP PMU will be responsible for ensuring that the Environmental Management Plan for the second investment phase of the Ke Go Sub-Project is implemented according to the detailed design document.

5.11 Training and Capacity Upgrading Requirements for EMP Implementation

5.11.1 Evaluation of Environmental Management Capabilities

Ke Go Sub-Project SIU Ke Go Sub-Project SIU will be comprised of representatives from Ha Tinh DARD and Ke Go IMC, both of which have received little training in environmental mitigation and project performance monitoring for environmental protection. In particular, Ke Go IMC has no environmental group in its organization and none of its staff have received any training in environmental mitigation and compliance monitoring³⁴. Extensive capacity building will be required.

Environmental Safeguard Contractors Environmental Safeguard Contractors will be selected according to IDA procurement requirements (either CQ or QCBS). There are numerous national consultant organizations in Viet Nam that will be able to demonstrate strong capacity sampling and basic environmental information-gathering. Based on experience with national consultant organizations in previous IDA-financed water resources projects, capacities of these organizations are weaker in the area of analysis and interpretation of data that are gathered, drawing conclusions from the results of the analysis, and developing recommendations about environmental impacts of the Ke Go Sub-Project for future effects monitoring, as will be required in the reporting for the Ke Go Sub-Project EMP.

VWRAP PMU This will be a new organization and so its capacity for environmental management is unknown at this time. Using CPO as a guide, it is likely that the environmental staff of VWRAP PMU will be very competent in providing coordination of environmental aspects of water resources investment projects, but will have less capability in the areas of analysis and interpretation of data that are gathered, drawing conclusions from the results of the analysis, and developing recommendations about environmental impacts of VWRAP.

Government Environmental Regulators MoNRE has received extensive training and capacity building through multi-year donor projects from CIDA, Sida, and now DANIDA³⁵ in EIA, environmental management, environmental protection, and environmental monitoring. Through these very large donor projects, MoNRE has been able to provide extensive training to all provincial DoSTEs, including Ha Tinh DoSTE. No training or capacity building for these institutions is required and none is recommended.

5.11.2 Recommended Training and Capacity Building

It is expected that the budget for the recommended training and capacity building, below, will be provided by the VWRAP Training and Capacity Building Fund.

Ke Go Sub-Project SIU Ke Go Sub-Project SIU will receive training and capacity building in the following areas:

³⁴ The same is true for other construction supervision organizations operating in Viet Nam that have been consulted as part VWRAP EIA preparation and implementation of other water resources projects (i.e., all VWRAP Sub-Project IMCs and PMB 416, as well as SIO 418 and SIO 419 for the MDWRP).

³⁵ For example, CIDA has financed two phases (total of eight years) of the Viet Nam-Canada Environment Project (VCEP), with the National Environmental Agency as the Executing Agency and provincial environmental organizations receiving extensive training in EIA, environmental management, environmental information systems, and urban and industrial pollution control. Total CIDA grants for VCEP have been approximately US \$10 million.

- preparing and working with terms and conditions to be included in construction contracts. These terms and conditions will include as required responsibility for mitigation and compensation for non-compliance;
- for technical supervision staff training on how to conduct civil works monitoring and supervision to ensure environmental mitigation measures are being properly implemented (frequency of monitoring, type of works to be supervised, assessment and reporting); and
- preparation of compliance monitoring reports in accordance with the reporting requirements outlined above in Table 24.

Also, construction contractors may require training on the proper implementation of the environmental mitigation measures in order to meet the terms and conditions included in their contracts and on the preparation of Site Environmental Management Plans. This training will need to be conducted at field locations with demonstrations of mitigation measures as required. The training will be designed so that technical supervision staff from the construction supervision entities will be able to deliver such training to additional contractors as they are engaged for construction works.

Environmental Safeguard Contractors Training and capacity building will be provided in environmental monitoring. This training will focus on detailed design of the environmental monitoring system, including:

- specification of environmental impacts;
- clear set of indicators or criteria, such as water quality standards, or species richness indices; for example, which are used to evaluate changes in environmental conditions;
- preparation of environmental baselines for environmental conditions in the Ke Go Sub-Project against which changes in environmental conditions may be assessed;
- spatial and temporal controls for environmental monitoring to make it possible to ascribe changes in environmental conditions to Sub-Project effects rather than changes in factors unrelated to the Sub-Project;
- design for the data gathering or data analysis;
- QA/QC;
- analysis and presentation of data and results;
- development of database information systems; and
- reporting structures and formats in accordance with reporting requirements outlined above in above in Table 24.

VWRAP PMU Technical assistance will be provided to environment (and other) staff in VWRAP PMU in incorporating the results of environmental management programs (such as the Ke Go Sub-Project Environmental Management Plan) into water resources project management decision making. Considerable on the job training will be provided through implementation of the environmental components of the Design and Supervision Technical Assistance.

5.12 Requirements for Flexibility and Adaptability in EMP Implementation

This Environmental Impact Assessment makes predictions about the environmental impacts of the Ke Go Sub-Project (Chapter 4) based on existing information and understanding of the environmental and social resources of the Ke Go Sub-Project Area (Chapter 3) and the engineering works required for the Sub-Project as they are currently defined (Chapter 2). While the assessment concludes that the Ke Go Sub-Project is environmentally feasible, as with all predictions of environmental impacts, there is some uncertainty in the reliability of these predictions, certainly not so much uncertainty as to not proceed with the Sub-Project, but uncertainty nonetheless. There are a number of sources of this uncertainty:

- the actual impacts that occur as a result of Sub-Project implementation may be different than the predictions made in this EIA because of the limited data and information available for a number of the environmental and social resources of the Sub-Project area;
- the recommended mitigation measures may not be able to prevent negative environmental impacts;
- during Sub-Project implementation, various factors may require Sub-Project design modifications whose environmental impacts are beyond the scope of this EIA; or
- the specific engineering works with regards to the second phase of investments are unknown.

The organizational framework for the Ke Go Sub-Project is sufficiently flexible and adaptable to be very responsive to these unexpected situations. It is able to accommodate numerous situations during construction and operation of the Ke Go Sub-Project as described below. This concept of requiring the organizational framework to be adaptable to changing Sub-Project circumstances is in fact supported by IDA OP 4.01 – Environmental Assessment.

Scenario 1: Unexpected Environmental and Socioeconomic Impacts Trigger Sub-Project Design Modifications, Environmental Review of Design Modifications, and Possible Revisions to EMP There may be a need for modifications to the Sub-Project design in order to ameliorate or reduce unexpected environmental and/or socioeconomic impacts that were not predicted in this EIA. There is experience with this type of situation in water resources projects in Viet Nam. In the Mekong Delta Water Resources Project, for example, the South Mang Thit Sub-Project needed re-design as a result of unexpected and negative impacts of using an inappropriate sluice design that had been approved in the Sub-Project FS. If this scenario were to occur at any stage during implementation of the Ke Go Sub-Project, the institutional arrangements for implementing the Ke Go Sub-Project Environmental Management Plan (Section 5.9, Page 51) will ensure that:

- The new FS that is required for the Sub-Project modifications will include an environmental review of the Sub-Project modifications. This environmental review will include a revision of the Environmental Management Plan if necessary, with adjustment of budgets, sampling regimes, and reporting requirements; and
- The new FS for the Sub-Project modifications and the associated environmental review and revised Environmental Management Plan will be reviewed and approved using existing review and approval procedures for feasibility studies and environmental assessments in Viet Nam and between the GoVN and IDA. Existing review and approval procedures are sufficient and adequate³⁶.

Scenario 2: Detailed Design of Second Phase of investments Accompanied by Environmental Review and Possible Revisions to EMP Necessitated by the Investments There will be a requirement to review the detailed design of the second phase of investments for the Ke Go Sub-Project for environmental effects and, if necessary, modify the Environmental Management Plan. The institutional arrangements for implementing the Ke Go Sub-Project Environmental Management Plan (Section 5.9, Page 51) will ensure that:

- An environmental review will be prepared as part of the detailed design for the second phase of investments for the Ke Go Sub-Project. This environmental review will examine the lessons learned from monitoring the environmental effects of the first phase of investments;
- This environmental review will include a detailed design of the Environmental Management Plan for the second phase of investments, including budgets, sampling regimes, and reporting requirements; and
- The detailed design for the second phase of investments and the associated environmental review and revised Environmental Management Plan will be reviewed and approved using existing review and approval procedures in Viet Nam and between the GoVN and IDA. As above, existing review and approval procedures are sufficient and adequate.

Scenario Situation 3: Review and Possible Revisions to EMP to Strengthen Existing Mitigation and Monitoring Programs Results from implementing the Environmental Management Plan may suggest that there is a need to modify the Environmental Management Plan for one of the following reasons:

- Additional mitigation measures are required because the Sub-Project is having unexpected environmental effects that are not predicted in this EIA and these effects can be mitigated by modifying Sub-Project implementation rather than by modifying Sub-Project design;
- mitigation measures that were specified in the original Environmental Management Plan are not proving to be effective and need to be strengthened or modified;
- mitigation measures that were specified in the original Environmental Management Plan are proving to be too stringent and can be relaxed to improve cost-effectiveness;
- the effects monitoring sampling regime needs to be adjusted to better detect impacts of the Sub-Project.

Again, there is experience with this type of situation in water resources projects in Viet Nam. In the Mekong Delta Water Resources Project, for example, the water quality monitoring program was adjusted two years into Project implementation in order to better detect Project impacts downstream of the Project area. If this scenario were to occur at any stage during implementation of the Ke Go Sub-Project, the institutional arrangements for implementing the Ke Go Sub-Project Environmental Management Plan (Section 5.9, Page 51) will ensure that:

- a revised Environmental Management Plan to suit the revised requirements for environmental protection will be prepared, with adjustment of budgets, sampling regimes, and reporting requirements to suit the new requirements; and
- the revised Environmental Management Plan will be reviewed and approved using the existing review and approval procedures in Viet Nam and between the GoVN and IDA.

Scenario 4: No Changes Required in EMP Results from implementing the Environmental Management Plan

³⁶ These procedures were followed in the case of the South Mang Thit Sub-Project.

may suggest that no changes are required to either the Sub-Project design or the Environmental Management Plan itself and the Environmental Management Plan can continue to proceed as designed.

5.13 Costs of Ke Go Sub-Project Environmental Management Plan

The total cost of the Ke Go Sub-Project Environmental Management Plan is US \$349,113, consisting of US \$167,206 for the environmental mitigation program and US \$181,907 for the environmental mitigation compliance monitoring and environmental effects monitoring programs. Detailed costs are provided in Table 25 and Table 26 for the Environmental Mitigation Programs and the Environmental Monitoring Programs (compliance monitoring and environmental effects monitoring), respectively. Table 27 contains a list of the assumptions made in the preparation of the cost of the Ke Go Sub-Project Environmental Management Plan

Table 25: Detailed costs and schedule for Environmental Mitigation Program for Ke Go Sub-Project.

Environmental Mitigation Cost Item	Units	US \$ per Unit	Year of Implementation							Total
			1	2	3	4	5	6	7	
PRE-CONSTRUCTION PHASES			COSTS ARE INCLUDED IN SUB-PROJECT RESETTLEMENT AND DETAILED DESIGN COSTS							
Environmental Review of Coastal Aquaculture										
Fees - National Safeguard Contractor	days	60	60	-	-	-	-	-	-	3,600
DSA - National Safeguard Contractor	days	50	60	-	-	-	-	-	-	3,000
Travel	lump sum	500	1	-	-	-	-	-	-	500
Data Acquisition, Reporting, Miscellaneous	20% personnel		720	-	-	-	-	-	-	720
Subtotal			7,820	-	-	-	-	-	-	7,820
Administration Fee (8% of Subtotal Costs)			626	-	-	-	-	-	-	626
Total			8,446	-	-	-	-	-	-	8,446
CONSTRUCTION PHASES										
Detection and Clearing Unexploded Ordnance										
Survey and Treatment in First Investment Package	communes	1000	-	9	-	-	-	-	-	9,000
Survey and Treatment in Second Investment Package	communes	1000	-	-	51	-	-	-	-	51,000
Subtotal			-	9,000	51,000	-	-	-	-	60,000
Administration Fee (8% of Subtotal Costs)			-	720	4,080	-	-	-	-	4,800
Total			-	9,720	55,080	-	-	-	-	64,800
Mitigation of Incremental Coastal Aquaculture Effects										
Wetland Restoration and Rehabilitation	ha	500	-	20	50	30	-	-	-	50,000
Environmental Extension Services to Aquaculture Households	hh	10	-	350	350	-	-	-	-	7,000
Subtotal			-	13,500	28,500	15,000	-	-	-	57,000
Administration Fee (8% of Subtotal Costs)			-	1,080	2,280	1,200	-	-	-	4,560
Total			-	14,580	30,780	16,200	-	-	-	61,560
OPERATIONAL PHASES										
Integrated Pest Management Program for Command Area										
IPM Extension in First Investment Package	communes	500	-	-	9	-	-	-	-	4,500
IPM Extension in Second Investment Package	communes	500	-	-	-	25.5	25.5	-	-	25,500
Subtotal			-	-	4,500	12,750	12,750	-	-	30,000
Administration Fee (8% of Subtotal Costs)			-	-	360	1,020	1,020	-	-	2,400
Total			-	-	4,860	13,770	13,770	-	-	32,400
Total, Environmental Mitigation Program			8,446	24,300	90,720	29,970	13,770	-	-	167,206

Table 26: Detailed costs and schedule for Environmental Monitoring Programs for Ke Go Sub-Project.

Environmental Monitoring Cost Item	Units	US \$ per Unit	Year of Implementation							Total	
			1	2	3	4	5	6	7		
MITIGATION COMPLIANCE MONITORING											
Mitigation Compliance Monitoring of Construction Contracts											
Fees - National Safeguard Contractor	days	60	11	22	22	22	22	22	22	11	8,011
DSA - National Safeguard Contractor	days	50	11	22	22	22	22	22	22	11	6,676
Travel	lump sum	500	1	1	1	1	1	1	1	1	3,500
Reporting, Miscellaneous	20% personnel		134	267	267	267	267	267	267	134	1,602
Subtotal			1,857	3,215	3,215	3,215	3,215	3,215	3,215	1,857	19,790
Administration Fee (8% of Subtotal Costs)			149	257	257	257	257	257	257	149	1,583
Total			2,006	3,472	3,472	3,472	3,472	3,472	3,472	2,006	21,373
ENVIRONMENTAL EFFECTS MONITORING											
Environmental Impacts of Coastal Aquaculture											
1. Coastal Water Quality Monitoring											
<i>Analysis Costs</i>											
pH	sample	2	18	18	18	18	18	18	18	18	252
Conductivity	sample	1	18	18	18	18	18	18	18	18	126
TSS	sample	6	18	18	18	18	18	18	18	18	756
BOD5	sample	6	18	18	18	18	18	18	18	18	756
COD	sample	8	18	18	18	18	18	18	18	18	1,008
Fe	sample	8	18	18	18	18	18	18	18	18	1,008
Al	sample	6	18	18	18	18	18	18	18	18	756
NO3-2	sample	5	18	18	18	18	18	18	18	18	630
PO4-P	sample	5	18	18	18	18	18	18	18	18	630
DO	sample	5	18	18	18	18	18	18	18	18	630
Total Analysis Costs, Coastal Water Quality			936	936	936	936	936	936	936	936	6,552
Sampling Costs (20% of Analysis Costs)			187	187	187	187	187	187	187	187	1,310
Personnel, Reporting Costs (20% of Sample and Analysis Costs)			225	225	225	225	225	225	225	225	1,572
Subtotal Costs			1,348	1,348	1,348	1,348	1,348	1,348	1,348	1,348	9,435
Administration Fee (8% of Subtotal Costs)			108	108	108	108	108	108	108	108	755
Total Costs, Coastal Water Quality Monitoring			1,456	1,456	1,456	1,456	1,456	1,456	1,456	1,456	10,190
2. Wetland Quality Monitoring											
Personnel Costs, Field Work	day	60	6	6	6	6	6	6	6	6	2,625
Personnel Costs, DSA and Travel	day	50	6	6	6	6	6	6	6	6	2,188
Personnel Costs, Reporting	day	60	2	2	2	2	2	2	2	2	840
Total, Personnel Costs			808	808	808	808	808	808	808	808	5,653
Equipment Rental and Supplementary Data Acquisition	% personnel Costs	20	162	162	162	162	162	162	162	162	1,131
Subtotal Costs			969	969	969	969	969	969	969	969	6,783
Administration Fee (8% of Subtotal Costs)			78	78	78	78	78	78	78	78	543
Total Costs, Coastal Wetland Quality Monitoring			1,047	1,047	1,047	1,047	1,047	1,047	1,047	1,047	7,326
Total Costs, Environmental Impacts of Aquaculture			2,502	2,502	2,502	2,502	2,502	2,502	2,502	2,502	17,515

Table 26: Detailed costs and schedule for Environmental Monitoring Programs for Ke Go Sub-Project., continued

Environmental Monitoring Cost Item	Units	US \$ per Unit	Year of Implementation							Total	
			1	2	3	4	5	6	7		
Environmental Monitoring for Effects of Sedimentation, Erosion, Fertilizers and Pesticides											
1. Surface Water Quality Monitoring											
<i>Analysis Costs</i>											
pH	sample	2	48	48	108	108	108	108	108	108	1,272
Conductivity	sample	1	48	48	108	108	108	108	108	108	636
TSS	sample	6	48	48	108	108	108	108	108	108	3,816
BOD5	sample	6	48	48	108	108	108	108	108	108	3,816
COD	sample	8	48	48	108	108	108	108	108	108	5,088
Fe	sample	8	48	48	108	108	108	108	108	108	5,088
Al	sample	6	48	48	108	108	108	108	108	108	3,816
NO3-2	sample	5	48	48	108	108	108	108	108	108	3,180
PO4-P	sample	5	48	48	108	108	108	108	108	108	3,180
DO	sample	5	48	48	108	108	108	108	108	108	3,180
Na	sample	5	48	48	108	108	108	108	108	108	3,180
Mg	sample	5	48	48	108	108	108	108	108	108	3,180
Ca	sample	5	48	48	108	108	108	108	108	108	3,180
Biocides	sample	100	12	12	27	27	27	27	27	27	15,900
Fecal Coliform	sample	9	48	48	48	48	48	48	48	48	3,024
<i>Total Analysis Costs, Surface Water</i>			4,848	4,848	10,368	10,368	10,368	10,368	10,368	10,368	61,536
2. Groundwater Quality Monitoring											
<i>Analysis Costs</i>											
pH	sample	2	14	14	24	24	24	24	24	24	296
Conductivity	sample	1	14	14	24	24	24	24	24	24	148
TSS	sample	6	14	14	24	24	24	24	24	24	888
BOD5	sample	6	14	14	24	24	24	24	24	24	888
COD	sample	8	14	14	24	24	24	24	24	24	1,184
Fe	sample	8	14	14	24	24	24	24	24	24	1,184
Al	sample	6	14	14	24	24	24	24	24	24	888
NO3-2	sample	5	14	14	24	24	24	24	24	24	740
PO4-P	sample	5	14	14	24	24	24	24	24	24	740
DO	sample	5	14	14	24	24	24	24	24	24	740
Fecal Coliform	sample	9	14	14	24	24	24	24	24	24	1,332
Biocides	sample	100	14	14	24	24	24	24	24	24	14,800
<i>Total Analysis Costs, Groundwater</i>			2,254	2,254	3,864	3,864	3,864	3,864	3,864	3,864	23,828
<i>Total Analysis Costs, Surface Water Plus Groundwater</i>			7,102	7,102	14,232	14,232	14,232	14,232	14,232	14,232	85,364
<i>Sampling Costs (20% of Analysis Costs)</i>			1,420	1,420	2,846	2,846	2,846	2,846	2,846	2,846	17,073
<i>Personnel, Reporting Costs (20% of Sample and Analysis Costs)</i>			1,704	1,704	3,416	3,416	3,416	3,416	3,416	3,416	20,487
<i>Supplementary Data Acquisition</i>			1,000	1,000	1,500	1,500	1,500	1,500	1,500	1,500	9,500
<i>Subtotal Costs</i>			11,227	11,227	21,994	21,994	21,994	21,994	21,994	21,994	132,424
<i>Administration Fee (8% of Subtotal Costs)</i>			898	898	1,760	1,760	1,760	1,760	1,760	1,760	10,594
Total Costs, Water Quality Monitoring			12,125	12,125	23,754	23,754	23,754	23,754	23,754	23,754	143,018
Total Costs, Environmental Monitoring Programs			16,833	18,099	29,728	29,728	29,728	29,728	29,728	28,262	181,907

Table 27: List of assumptions made in cost estimation of Ke Go Sub-Project Environmental Management Plan.

Item	No.	Comments	
No. Communes in Pilot Areas	9	• Socioeconomic information for Ke Go Sub-Project	
No. Communes in Remainder of Command Area	51	• Socioeconomic information for Ke Go Sub-Project	
No. Surface Water Sampling Locations in Pilot Areas in First Investment Phase	10	• Requirements estimated using professional judgment and water quality monitoring specialists at Sub-Institute for Water Resources Planning and Management	
No. Surface Water Sampling Locations Upstream and Downstream of Command Area in First Investment Phase	8		
No. Surface Water Sampling Locations in Command Area in Second Investment Phase	30		
No. Surface Water Sampling Locations Upstream and Downstream of Command Area in Second Investment Phase	6		
No. Surface Water Samples per Year at Each Location	3		
No. Groundwater Sampling Locations in Pilot Areas in First Investment Phase	10		
No. Groundwater Sampling Locations Upstream and Downstream of Command Area in First Investment Phase	4		
No. Groundwater Sampling Locations in Command Area in Second Investment Phase	20		
No. Groundwater Sampling Locations Upstream and Downstream of Command Area in Second Investment Phase	4		
No. Groundwater Samples per Year at Each Location	1		
No. Surface Water Samples for Coastal Aquaculture Monitoring	6		
Rates for Water Quality Analyses and Associated Percentages for Sampling Costs, Personnel Costs, etc. for Water Quality Monitoring			• Derived and extrapolated from Phuoc Hoa Water Resources Project EMP and Mekong Delta Water Resources Project EMP
US \$ per day for national consultant	60		• Assumes a 22 day working month, market price
DSA for national consultant	50		
US \$ to survey and treat (if necessary) one commune for UXO	1,000	• Extrapolated from Phuoc Hoa Water Resources Project EMP	
US \$ to restore/rehabilitate one ha of coastal wetland	500	• From PFS conducted for ADB 5712 Coastal and Marine Environmental Management in the South China Sea, Phase 2 (2000)	
US \$ to implement IPM in a commune	500	• Professional judgment	

Table 28: Environmental mitigation program for Ke Go Sub-Project.

Pre-Construction Phases

MITIGATION OF EFFECTS OF EXPANDED COASTAL AQUACULTURE IN THACH HA DISTRICT, PRE-CONSTRUCTION PHASES	
RESOURCES TO BE PROTECTED	<ul style="list-style-type: none"> • Surface Water Quality – Section 4.6.1, Page 38 • Aquatic Ecosystems and Aquatic Biodiversity - Section 4.6.2, Page 40 • Terrestrial Ecosystems and Terrestrial Biodiversity – Section 4.6.2, Page 39
MITIGATION DESCRIPTION	<ul style="list-style-type: none"> • Conduct an environmental review of the area of coastal aquaculture in Thach Ha District that is to benefit from the increased supply of freshwater water from the Sub-Project. Key issues to be examined include loss of coastal wetlands and other coastal ecosystems, management of sediment pond wastes and pond wastewaters, and existing provisions for environmental management of this program. Output will be a set of recommendations to Ha Tinh Province for effective environmental management of the coastal aquaculture program in Thach Ha District.
PHASE OF SUB-PROJECT	<ul style="list-style-type: none"> • Pre-Construction: First Investment Phase
MITIGATION TARGETS	<ul style="list-style-type: none"> • An approved detailed environmental management program for coastal aquaculture in Ha Tinh Province, including a detailed schedule for implementation
MONITORING REQUIRED	<ul style="list-style-type: none"> • No monitoring required at this stage
RESPONSIBILITIES FOR IMPLEMENTATION	<ul style="list-style-type: none"> • Consultant Environmental Specialist to prepare detailed Terms of Reference for study as part of detailed design of EMP: First Investment Phase • An appropriate Environmental Safeguard Contractor will be engaged to conduct the environmental review and prepare the Coastal Aquaculture Environmental Management Plan (CQ selection recommended). Inputs will be supervised by the Consultant Environmental Specialists • Ha Tinh DoSTE will be executing agency for the environmental review • Ha Tinh DoFI will be the implementing agency for the environmental review
REPORTING REQUIREMENTS	<ul style="list-style-type: none"> • A completed and approved Environmental Review of Coastal Aquaculture in Thach Ha District • Institutions to review coastal aquaculture environmental management plan include: VWRAP PMU, MARD, IDA, Ha Tinh DoFI, Ha Tinh DoSTE, MoNRE
MITIGATION COSTS (US \$)	8,446 - Please see Table 25, Page 63 for detailed description of costs and implementation schedule.
MITIGATION OF RESETTLEMENT AND LAND ACQUISITION	
RESOURCES TO BE PROTECTED	<ul style="list-style-type: none"> • Populations and Communities – Section 4.3.8, Page 34 • Infrastructure, Local Facilities – Section 4.6.3, Page 40 • Local Employment Levels – Section 4.4.3, Page 35 • Economic Activities and Income – Section 4.4.4, Page 35
MITIGATION DESCRIPTION	<ul style="list-style-type: none"> • detailed design, approval, and implementation of Resettlement Action Plan for Sub-Project affected households in accordance with IDA Operational Policy 4.12 – Involuntary Resettlement • implementation of approved procedures for compensation for loss of land or other assets in accordance with IDA Operational Policy 4.12 – Involuntary Resettlement
PHASE OF SUB-PROJECT	<ul style="list-style-type: none"> • Pre-Construction: First Investment Phase • Pre-Construction: Second Investment Phase
MITIGATION TARGETS	<ul style="list-style-type: none"> • All Sub-Project-affected persons are fairly compensated.
MONITORING REQUIRED	<ul style="list-style-type: none"> • Monitoring of RAP implementation required
RESPONSIBILITIES FOR IMPLEMENTATION	<ul style="list-style-type: none"> • Implementation responsibility rests with Ke Go Sub-Project SIU • Ke Go Sub-Project RAP contains complete details on implementation responsibilities, costs, and reporting requirements
REPORTING REQUIREMENTS	
MITIGATION COSTS (US \$)	
MITIGATION OF DISRUPTION TO WATER USERS FROM CANAL LINING, PRE-CONSTRUCTION PHASES	
RESOURCES TO BE PROTECTED	<ul style="list-style-type: none"> • Surface Water Hydrology – Section 4.6.1, Page 37 • Aquatic Ecosystems and Aquatic Biodiversity - Section 4.6.2, Page 40 • Domestic and Drinking Water Supply and Quality – Section 4.6.3, Page 40 • Populations and Communities – Section 4.3.8, Page 34 • Economic Activities and Income – Section 4.4.4, Page 35
MITIGATION DESCRIPTION	<ul style="list-style-type: none"> • ensure lining occurs with minimal disruption to economic activities of water beneficiaries by developing a canal lining schedule that is a combination of construction efficiency and minimal water user disruption • develop a canal lining schedule using a thorough and well-documented consultation process that obtains approval for water disruption to water users and provincial government (responsible for implementing provincial economic development plans and responsible for meeting provincial economic output targets)

Table 28: Environmental mitigation program for Ke Go Sub-Project., continued.

Pre-Construction Phases, continued

MITIGATION OF DISRUPTION TO WATER USERS FROM CANAL LINING, PRE-CONSTRUCTION PHASES, CONTINUED	
PHASE OF SUB-PROJECT	<ul style="list-style-type: none"> • Pre-Construction: First Investment Phase • Pre-Construction: Second Investment Phase
MITIGATION TARGETS	<ul style="list-style-type: none"> • Two canal lining plans, each complete with detailed implementation schedule and terms and conditions for construction contractors, one for each investment phase, that have the approval of Ha Tinh Province, affected districts and communes, and with villages in the affected communes having been consulted and informed.
MONITORING REQUIRED	<ul style="list-style-type: none"> • Monitoring required to ensure canal lining program proceeds as approved and affected households are satisfied with the disruption they endure. Monitoring results from first investment phase will be used to modify the design of the canal lining program for the second investment phase if required.
RESPONSIBILITIES FOR IMPLEMENTATION	<ul style="list-style-type: none"> • Ke Go Sub-Project SIU will have primary responsibility for developing canal lining schedule. Ke Go Sub-Project SIU will have the responsibility for preparing the appropriate terms and conditions to include in the construction contracts for canal lining. These terms and conditions should include specification of penalties for non-compliance with agreed lining schedule. • VWRAP PMU, IDA, MARD will have the opportunity to review draft plans as they are prepared • Ha Tinh PPC will give final approval of each of the canal lining plans.
REPORTING REQUIREMENTS	<ul style="list-style-type: none"> • Two reports will be prepared, one for each investment phase. These reports will consist of the detailed implementation schedule for the canal lining of each of the two investment phases
COMMENTS	<ul style="list-style-type: none"> • It will be necessary obtain approval for canal lining for water supply disruption from water users and provincial government (responsible for implementing provincial economic development plans and responsible for meeting provincial economic output targets) through an extensive and documented consultation process
MITIGATION COSTS (US \$)	<ul style="list-style-type: none"> • Part of detailed design costs for Ke Go Sub-Project
MITIGATION OF EFFECTS THROUGH CONSTRUCTION CONTRACTS: DISRUPTION TO WATER USERS FROM CANAL LINING; EFFECTS OF DREDGED AND EXCAVATED SOILS; AVOIDANCE OF CULTURAL AND HISTORIC SITES; DISRUPTION TO LOCAL COMMUNITIES FROM CONSTRUCTION ACTIVITIES	
RESOURCES TO BE PROTECTED	<ul style="list-style-type: none"> • Surface Water Hydrology – Section 4.6.1, Page 37 • Aquatic Ecosystems and Aquatic Biodiversity - Section 4.6.2, Page 40 • Domestic and Drinking Water Supply and Quality – Section 4.6.3, Page 40 • Populations and Communities – Section 4.3.8, Page 34 • Economic Activities and Income – Section 4.4.4, Page 35 • Cultural and Historic Resources – Section 4.6.3, Page 41
MITIGATION DESCRIPTION	<ul style="list-style-type: none"> • Develop terms and conditions to be included in construction contracts to avoid or minimize the effects of construction activities on important environmental resources in the Ke Go Sub-Project and associated area of influence (see Table 28 below, under Construction Phase for details of terms and conditions to be included)
PHASE OF SUB-PROJECT	<ul style="list-style-type: none"> • Pre-Construction: First Investment Phase • Pre-Construction: Second Investment Phase
MITIGATION TARGETS	<ul style="list-style-type: none"> • Approved set of terms and conditions included in all construction contracts
MONITORING REQUIRED	<ul style="list-style-type: none"> • No monitoring required at this time
RESPONSIBILITIES FOR IMPLEMENTATION	<ul style="list-style-type: none"> • Ke Go Sub-Project SIU will have primary responsibility for developing canal lining schedule • Consultant Environmental Specialists will provide technical assistance to Ke Go Sub-Project SIU in preparing these terms and conditions
REPORTING REQUIREMENTS	<ul style="list-style-type: none"> • none
MITIGATION COSTS (US \$)	<ul style="list-style-type: none"> • Part of detailed design costs for Ke Go Sub-Project

Construction Phases

MITIGATION OF RISKS FROM UNEXPLODED ORDNANCE	
RESOURCES TO BE PROTECTED	<ul style="list-style-type: none"> • Populations and Communities – Section 4.3.8, Page 34 • Infrastructure, Local Facilities – Section 4.6.3, Page 40
MITIGATION DESCRIPTION	<ul style="list-style-type: none"> • Carry out UXO detection survey in all areas of unproductive/unused land that is going to be disturbed from construction activities or civil works that will require excavation to below 2 m depth. • Safely remove and secure all ordnance prior to beginning construction work.
PHASE OF SUB-PROJECT	<ul style="list-style-type: none"> • Pre-Construction: First Investment Phase • Pre-Construction: Second Investment Phase

Table 28: Environmental mitigation program for Ke Go Sub-Project., continued.

Pre-Construction Phases, continued

MITIGATION OF RISKS FROM UNEXPLODED ORDNANCE, CONTINUED	
MITIGATION TARGETS	<ul style="list-style-type: none"> No injuries or deaths caused by UXO detonation during construction phase
MONITORING REQUIRED	<ul style="list-style-type: none"> No monitoring is required
RESPONSIBILITIES FOR IMPLEMENTATION	<ul style="list-style-type: none"> Ministry of Defence will be responsible for implementing this component of the mitigation program. They have undertaken similar activities for other infrastructure projects in Viet Nam.
REPORTING REQUIREMENTS	<ul style="list-style-type: none"> Ordnance Survey and Treatment Completion Report to be submitted by Ministry of Defence contractors
MITIGATION COSTS (US \$)	64,800 - Please see Table 25, Page 63 for detailed description of costs and implementation schedule.
MITIGATION OF EFFECTS OF EXPANDED COASTAL AQUACULTURE, CONSTRUCTION PHASES	
RESOURCES TO BE PROTECTED	<ul style="list-style-type: none"> Surface Water Quality – Section 4.6.1, Page 38 Aquatic Ecosystems and Aquatic Biodiversity - Section 4.6.2, Page 40 Terrestrial Ecosystems and Terrestrial Biodiversity – Section 4.6.2, Page 39
MITIGATION DESCRIPTION	<ul style="list-style-type: none"> Implementation of the priority components of the environmental management plan for the Thach Ha District coastal aquaculture program developed in the pre-construction phase of the first investment phase. These components are expected to included but not be restricted to: <ul style="list-style-type: none"> Restoration and rehabilitation of up to 100 ha of degraded wetlands in Thach Ha District (actual amount will depend upon results of environmental review of Ha Tinh coastal aquaculture conducted in pre-construction phase) Environmental extension services provided to aquaculture households on appropriate management of sediment pond wastes and pond wastewaters
PHASE OF SUB-PROJECT	<ul style="list-style-type: none"> Construction: First Investment Phase
MITIGATION TARGETS	<ul style="list-style-type: none"> No net loss of important coastal ecosystems as a result of coastal aquaculture program implementation Minimization of impacts on coastal water quality from implementation of coastal aquaculture program
MONITORING REQUIRED	<ul style="list-style-type: none"> Compliance monitoring will be required to ensure mitigation targets as specified in the coastal aquaculture environmental management plan are met Environmental effects monitoring will be required to assess effects of coastal aquaculture in Thach Ha District on the coastal aquatic environment
RESPONSIBILITIES FOR IMPLEMENTATION	<ul style="list-style-type: none"> The executing and implementing agencies for implementing the priority components of the environmental management plan for the coastal aquaculture program will be selected upon approval of the actual environmental management plan (see above); candidate institutions are Ha Tinh DARD, Ha Tinh DoSTE, and Ha Tinh DoFi National Safeguard Contractors will provide technical assistance to the implementing agency as required Funds for implementation of priority components of environmental management plan to be financed from VWRAP funds.
REPORTING REQUIREMENTS	<ul style="list-style-type: none"> Annual mitigation progress reports to be prepared by the implementing agency and submitted to Ke Go Sub-Project SIU Annual Ke Go Sub-Project Environmental Management Plan report will include summary of implementation progress and documentation of changes in coastal wetlands and coastal water quality in Thach Ha District.
MITIGATION COSTS (US \$)	61,560 - Please see Table 25, Page 63 for detailed description of costs and implementation schedule.
MITIGATION OF DISRUPTION TO WATER USERS FROM CANAL LINING, CONSTRUCTION PHASES	
RESOURCES TO BE PROTECTED	<ul style="list-style-type: none"> Surface Water Hydrology – Section 4.6.1, Page 37 Aquatic Ecosystems and Aquatic Biodiversity - Section 4.6.2, Page 40 Domestic and Drinking Water Supply and Quality – Section 4.6.3, Page 40 Populations and Communities – Section 4.3.8, Page 34 Economic Activities and Income – Section 4.4.4, Page 35
MITIGATION DESCRIPTION	<ul style="list-style-type: none"> Implement canal lining program according to implementation plan developed during pre-construction (detailed design phases)
PHASE OF SUB-PROJECT	<ul style="list-style-type: none"> Construction: First Investment Phase Construction: Second Investment Phase
MITIGATION TARGETS	<ul style="list-style-type: none"> Canal lining implemented according to two canal lining plans All stakeholders consulted and informed during design of canal lining programs, including those who signed the canal lining plans are satisfied with results of implementation
MONITORING REQUIRED	<ul style="list-style-type: none"> Compliance monitoring required to ensure canal lining program proceeds as approved and affected households and communities are satisfied with the disruption they endure. Monitoring results from first investment phase will be used to modify the design of the canal lining program for the second investment phase if required.
RESPONSIBILITIES FOR IMPLEMENTATION	<ul style="list-style-type: none"> Mitigation measures to be implemented as terms and conditions of construction contracts. Ke Go Sub-Project SIU will be responsible for overseeing the implementation of the canal lining plan Construction contractors will be responsible for implementing the mitigation measures according to contract terms and conditions

Table 28: Environmental mitigation program for Ke Go Sub-Project., continued.

Construction Phases, continued

MITIGATION OF DISRUPTION TO WATER USERS FROM CANAL LINING, CONSTRUCTION PHASES	
REPORTING REQUIREMENTS	<ul style="list-style-type: none"> Reporting on compliance with mitigation measures to be part of environmental mitigation compliance monitoring activities
MITIGATION COSTS (US \$)	<ul style="list-style-type: none"> Part of detailed design costs for Ke Go Sub-Project
MITIGATION OF EFFECTS OF DREDGED AND EXCAVATED SOILS	
RESOURCES TO BE PROTECTED	<ul style="list-style-type: none"> Soils – Section 4.6.1, Page 37 Sedimentation and Erosion – Section 4.6.1, Page 38 Surface Water Quality – Section 4.6.1, Page 38 Aquatic Ecosystems and Aquatic Biodiversity Section 4.6.2, Page 40
MITIGATION DESCRIPTION	<ul style="list-style-type: none"> Use of the construction area at the headworks site should be strictly delineated and controlled. Remove topsoil before starting construction activities. Remove topsoil under the future stockpile. Separate topsoil stockpiles and earth stockpile to avoid mixing both soils. Create small stockpiles with topsoil (less than 2 meters high) in order to conserve its characteristics for future use after the construction works Where possible, used dredged and excavated soils in engineering works such as road foundations. Identify and clearly delineate stockpiles for storage of excavated soils where required. Ensure stockpiles are a suitable distance from surface water sources. Ensure compensation is provided for stockpile acquisition. Remove topsoil under stockpile sites before starting construction activities. Separate topsoil stockpiles and earth stockpiles to avoid mixing. Create small stockpiles with topsoil (less than 2 m high)
MITIGATION DESCRIPTION, CONTINUED	<ul style="list-style-type: none"> Construct sedimentation basins to capture water coming from pumping activities and runoff from stockpiles. Maintain sedimentation basins in good working condition. Rehabilitate all agricultural and other land affected by construction activities associated with engineering civil works to pre-construction conditions Compensate, according to the RAP, farmers living along canals who have been affected by the disposal of spoil.
PHASE OF SUB-PROJECT	<ul style="list-style-type: none"> Construction: First Investment Phase Construction: Second Investment Phase
MITIGATION TARGETS	<ul style="list-style-type: none"> best practices* implemented according to specifications. No soil dumped outside of approved disposal areas. Borrow pits in environmentally suitable locations, sites re-vegetated to pre-construction conditions at end of construction 100% of agricultural land rehabilitated and 100% of damaged roads rehabilitated Farmers living along canals are adequately compensated for damage caused to their assets during construction
MONITORING REQUIRED	<ul style="list-style-type: none"> Compliance monitoring will be required to ensure mitigation targets are met
RESPONSIBILITIES FOR IMPLEMENTATION	<ul style="list-style-type: none"> Mitigation measures to be implemented as terms and conditions of construction contracts. Ke Go Sub-Project SIU will be responsible for preparing terms and conditions with technical assistance from the Consultant Environmental Specialists. Construction contractors will be responsible for implementing the mitigation measures according to contract terms and conditions.
REPORTING REQUIREMENTS	<ul style="list-style-type: none"> Reporting on compliance with mitigation measures to be part of environmental mitigation compliance monitoring activities
MITIGATION COSTS (US \$)	<ul style="list-style-type: none"> Costs for mitigation measures are included as part of construction contract costs.
MITIGATION TO AVOID DISRUPTION TO CULTURAL AND HISTORIC SITES	
RESOURCES TO BE PROTECTED	<ul style="list-style-type: none"> Cultural and Historic Resources – Section 4.6.3, Page 41
MITIGATION DESCRIPTION	<ul style="list-style-type: none"> All mitigation regarding cultural and historic sites to be implemented in accordance with IDA Operational Policy 11.03 – Cultural Property Locate construction facilities (worker camps, etc.) to avoid permanent alienation of important cultural or historic sites Where possible, locate engineering civil works to avoid permanent alienation of important cultural or historic sites Mark and fence off important cultural and historic sites that are adjacent or near to construction facilities and engineering civil works to prevent damage Construction contractors to include plan for avoidance of cultural and historic sites as part of their technical bids
PHASE OF SUB-PROJECT	<ul style="list-style-type: none"> Construction: First Investment Phase Construction: Second Investment Phase
MITIGATION TARGETS	<ul style="list-style-type: none"> All cultural and historic sites within the Sub-Project remain intact and in the same condition as prior to construction
MONITORING REQUIRED	<ul style="list-style-type: none"> Compliance monitoring will be required to ensure mitigation targets are met
RESPONSIBILITIES FOR IMPLEMENTATION	<ul style="list-style-type: none"> Mitigation measures to be implemented as terms and conditions of construction contracts. Ke Go Sub-Project SIU will be responsible for preparing terms and conditions with technical assistance from the Consultant Environmental Specialists. Construction contractors will be responsible for implementing mitigation measures according to terms and conditions.

Table 28: Environmental mitigation program for Ke Go Sub-Project., continued.

Construction Phases, continued

MITIGATION TO AVOID DISRUPTION TO CULTURAL AND HISTORIC SITES, CONTINUED	
REPORTING REQUIREMENTS	<ul style="list-style-type: none"> Reporting on compliance with mitigation measures to be part of environmental mitigation compliance monitoring activities
MITIGATION COSTS (US \$)	<ul style="list-style-type: none"> Costs for mitigation measures are included as part of construction contract costs.
MITIGATION OF POSSIBLE DISRUPTION TO LOCAL COMMUNITIES FROM CONSTRUCTION ACTIVITIES	
RESOURCES TO BE PROTECTED	<ul style="list-style-type: none"> Populations and Communities – Section 4.3.8, Page 34 Infrastructure and Local Facilities – Section 4.6.3, Page 40
MITIGATION DESCRIPTION	<ul style="list-style-type: none"> All vehicles must meet noise and air emission national standards. Households, outside construction Right-of-Way ROW (inside is included in the RP) which have suffered damage from road construction or road traffic impact should be compensated. Speed limits must be enforced on permanent and temporary roads. Safety signs and guard rails should be installed as needed. Specific security measures should be designed for village and school areas along the temporary and permanent project roads (e.g. speed bumps located at each end of residential areas or near schools). Compensate, according to the Resettlement Plan, households outside the ROW who have suffered damage from road construction or construction-related traffic.
PHASE OF SUB-PROJECT	<ul style="list-style-type: none"> Construction: First Investment Phase Construction: Second Investment Phase
MITIGATION TARGETS	<ul style="list-style-type: none"> No injuries or death to Sub-Project caused by construction activities Households outside of ROW are adequately compensated for disturbance caused by road traffic, other construction activities All inquiries and any complaints from local residents are promptly and properly dealt with by construction contractors.
MONITORING REQUIRED	<ul style="list-style-type: none"> Compliance monitoring will be required to ensure mitigation targets are met
RESPONSIBILITIES FOR IMPLEMENTATION	<ul style="list-style-type: none"> Mitigation measures to be implemented as terms and conditions of construction contracts. Ke Go Sub-Project SIU will be responsible for preparing terms and conditions with technical assistance from the Consultant Environmental Specialists. Construction contractors will be responsible for implementing the mitigation measures according to contract terms and conditions.
REPORTING REQUIREMENTS	<ul style="list-style-type: none"> Reporting on compliance with mitigation measures to be part of environmental mitigation compliance monitoring activities
MITIGATION COSTS (US \$)	<ul style="list-style-type: none"> Costs for mitigation measures are included as part of construction contract costs.

Operational Phases

MITIGATION OF INCREASED APPLICATION OF PESTICIDES AND FERTILIZERS DUE TO AGRICULTURAL EXTENSIFICATION AND INTENSIFICATION	
RESOURCES TO BE PROTECTED	<ul style="list-style-type: none"> Surface Water Quality – Section 4.6.1, Page 38 Groundwater Resources – Section 4.6.1, Page 39 Aquatic Ecosystems and Aquatic Biodiversity - Section 4.6.2, Page 40 Domestic and Drinking Water Supply and Quality – Section 4.6.3, Page 40 Human Health - Section 4.4.9, Page 36
MITIGATION DESCRIPTION	<ul style="list-style-type: none"> strengthening existing IPM practices in the command area through the provision of training in IPM techniques, pesticide and fertilizer selection and use, and encouragement of crop diversification. IPM extension will be conducted in accordance with IDA OP 4.03 – Pesticide Management
PHASE OF SUB-PROJECT	<ul style="list-style-type: none"> Operation: First Investment Phase Operation: Second Investment Phase
MITIGATION TARGETS	<ul style="list-style-type: none"> No change in eutrophic status of surface and groundwater resources within and immediately downstream of Sub-Project No change in pesticide levels in surface and groundwater resources within and immediately downstream of Sub-Project Decrease or no change in amount of pesticide and fertilizer used in Sub-Project area per ha of crop cultivation
MONITORING REQUIRED	<ul style="list-style-type: none"> Effects monitoring will be required to measure environmental conditions in surface and groundwater resources
RESPONSIBILITIES FOR IMPLEMENTATION	<ul style="list-style-type: none"> IPM program to be implemented by Agriculture Extension offices under Ha Tinh DARD, and involving comprising village level extension officers, subject matter specialists, agriculture extension centers; provincial extension units; farmer association support organizations
REPORTING REQUIREMENTS	<ul style="list-style-type: none"> Annual IPM program implementation reports to be provided by Ha Tinh DARD to Ke Go Sub-Project SIU.
MITIGATION COSTS (US \$)	43,200 - Please see Table 25, Page 63 for detailed description of costs and implementation schedule.

Table 28: Environmental mitigation program for Ke Go Sub-Project., continued.

Operational Phases, continued

MITIGATION OF INCREMENTAL EFFECTS OF PROVISION OF WATER FOR INDUSTRIAL USES, OPERATIONAL PHASE	
MITIGATION DESCRIPTION	<ul style="list-style-type: none"> Implementation of program for strengthening environmental governance of industrial pollution control in Ha Tinh Province
PHASE OF SUB-PROJECT	<ul style="list-style-type: none"> Operation: First Investment Phase Operation: Second Investment Phase
MITIGATION TARGETS	<ul style="list-style-type: none"> strengthened environmental governance of industrial pollution control in Ha Tinh Province, including strengthened enforcement and compliance monitoring of industrial pollution regulations in Ha Tinh Province
RESPONSIBILITIES FOR IMPLEMENTATION	<ul style="list-style-type: none"> This mitigation will be part of a mitigation program for environmental governance of industrial pollution control to be conducted at the Project level within VWRAP
REPORTING REQUIREMENTS	
MITIGATION COSTS (US \$)	
MITIGATION OF EFFECTS OF DESIGN FLOOD OCCURRENCE	
RESOURCES TO BE PROTECTED	<ul style="list-style-type: none"> Populations and Communities – Section 4.3.8, Page 34 Infrastructure and Local Facilities – Section 4.6.3, Page 40
MITIGATION DESCRIPTION	<ul style="list-style-type: none"> Implementation of Ke Go Dam Emergency Preparedness Plan
PHASE OF SUB-PROJECT	<ul style="list-style-type: none"> Operation: First Investment Phase Operation: Second Investment Phase
MITIGATION TARGETS	<ul style="list-style-type: none"> Please see Ke Go Sub-Project FS for details regarding Ke Go Dam EPP
MONITORING REQUIRED	
RESPONSIBILITIES FOR IMPLEMENTATION	
REPORTING REQUIREMENTS	
MITIGATION COSTS (US \$)	

Table 29: Environmental Mitigation Compliance Monitoring Program.

Pre-Construction Phases

MITIGATION OF EFFECTS OF EXPANDED COASTAL AQUACULTURE IN THACH HA DISTRICT – PRE-CONSTRUCTION PHASES	
MITIGATION PERFORMANCE MONITORING ACTIVITIES	<ul style="list-style-type: none"> Review and approval of Environmental Review of Coastal Aquaculture in Thach Ha District
RESPONSIBILITIES FOR MITIGATION PERFORMANCE MONITORING	<ul style="list-style-type: none"> Institutions to review and approve coastal aquaculture environmental management plan include: VWRAP PMU, MARD, IDA, Ha Tinh DoFI, Ha Tinh DoSTE, MoNRE
TOTAL ESTIMATED COST	<ul style="list-style-type: none"> Costs included as part of VWRAP implementation
MITIGATION OF RESETTLEMENT AND LAND ACQUISITION	
MITIGATION PERFORMANCE MONITORING ACTIVITIES	<ul style="list-style-type: none"> Ke Go Sub-Project RAP contains complete details on implementation responsibilities, monitoring, costs, and reporting requirements
RESPONSIBILITIES FOR MITIGATION PERFORMANCE MONITORING	
TOTAL ESTIMATED COST	

Table 29: Environmental Mitigation Compliance Monitoring Program. continued

Pre-Construction Phases, continued

MITIGATION OF DISRUPTION TO WATER USERS FROM CANAL LINING	
MITIGATION PERFORMANCE MONITORING ACTIVITIES	<ul style="list-style-type: none"> Review and approval of Canal Lining Plan prepared by Ke Go Sub-Project SIU (one for each investment phase)
RESPONSIBILITIES FOR MITIGATION PERFORMANCE MONITORING	<ul style="list-style-type: none"> Ha Tinh Province and affected districts and communes will review and approve plans. All villages in the affected communes will have been consulted and informed regarding the plans prior to approval
TOTAL ESTIMATED COST	<ul style="list-style-type: none"> Costs included as part of VWRAP implementation
MITIGATION OF RISKS FROM UNEXPLODED ORDNANCE	
MITIGATION PERFORMANCE MONITORING ACTIVITIES	<ul style="list-style-type: none"> Review and approval of Ordnance Survey and Treatment Completion Report prepared by Ministry of Defence contractors (one for each investment phase)
RESPONSIBILITIES FOR MITIGATION PERFORMANCE MONITORING	<ul style="list-style-type: none"> Ke Go Sub-Project SIU will be responsible for appropriate review and approval of completion reports
TOTAL ESTIMATED COST	<ul style="list-style-type: none"> Costs included as part of VWRAP implementation
MITIGATION OF EFFECTS THROUGH CONSTRUCTION CONTRACTS: DISRUPTION TO WATER USERS FROM CANAL LINING; EFFECTS OF DREDGED AND EXCAVATED SOILS; AVOIDANCE OF CULTURAL AND HISTORIC SITES; DISRUPTION TO LOCAL COMMUNITIES FROM CONSTRUCTION ACTIVITIES	
MITIGATION PERFORMANCE MONITORING ACTIVITIES	<ul style="list-style-type: none"> supervision of construction contractors during construction activities and reporting on their compliance with the environmental terms and conditions contained in their contracts synoptic reports will be prepared for each construction contractor visit (approximately 10 inspections per month). These will be integrated into a monthly summary report that will be submitted to Ke Go Sub-Project SIU. A twice-yearly Ke Go Sub-Project Performance Monitoring Report, summarizing construction contractor performance in the previous six months, will be prepared and submitted to Ke Go Sub-Project SIU. All monthly summary reports and the twice-yearly Ke Go Sub-Project Performance Monitoring Report will also be sent to VWRAP-PMU Annual compliance monitoring results will be integrated into the annual Ke Go Sub-Project Environmental Monitoring Report Design of the reporting formats and supervision procedures will be completed during the Pre-Construction (Detailed Design) Phase
RESPONSIBILITIES FOR MITIGATION PERFORMANCE MONITORING	<ul style="list-style-type: none"> An appropriate Environmental Safeguard Contractor will be engaged to conduct supervision visits to construction sites, and prepare mitigation performance monitoring reports described above. Supervision visits will be conducted with technical supervision staff of Ke Go Sub-Project SIU to provide on-the-job training. Consultant Environmental Specialists will assist in design of the reporting formats and supervision procedures during the Pre-Construction (Detailed Design) Phase.
TOTAL ESTIMATED COST	US \$21,373 - Please see Table 26, Page 64 for detailed description of costs and implementation schedule.
MITIGATION OF EFFECTS OF EXPANDED COASTAL AQUACULTURE IN THACH HA DISTRICT - CONSTRUCTION PHASES	
MITIGATION PERFORMANCE MONITORING ACTIVITIES	<ul style="list-style-type: none"> Annual reports prepared by implementing agency on progress of implementation of environmental management plan for coastal aquaculture in Thach Ha District and submitted to Ke Go Sub-Project SIU and VWRAP PMU for review and approval
RESPONSIBILITIES FOR MITIGATION PERFORMANCE MONITORING	
TOTAL ESTIMATED COST	<ul style="list-style-type: none"> Costs included as part of VWRAP implementation

Operational Phases

MITIGATION OF ONGOING DEGRADATION OF SURFACE WATERS IN IRRIGATION SCHEME BY AQUATIC WEEDS – OPERATIONAL PHASES	
MITIGATION PERFORMANCE MONITORING ACTIVITIES	<ul style="list-style-type: none"> Annual reports prepared by Environmental Safeguard Contractor on progress of implementation of action plan for control of aquatic weeds Ke Go IMC will be responsible for appropriate review and approval of progress and final completion reports
RESPONSIBILITIES FOR MITIGATION PERFORMANCE MONITORING	
TOTAL ESTIMATED COST	<ul style="list-style-type: none"> Costs included as part of VWRAP implementation

Table 29: Environmental Mitigation Compliance Monitoring Program. continued

Operational Phases, continued

MITIGATION OF INCREASED APPLICATION OF PESTICIDES AND FERTILIZERS DUE TO AGRICULTURAL EXTENSIFICATION AND INTENSIFICATION	
MITIGATION PERFORMANCE MONITORING ACTIVITIES	<ul style="list-style-type: none"> Annual IPM implementation reports to be provided by Ha Tinh DARD to Ke Go Sub-Project SIU Ke Go Sub-Project SIU will be responsible for appropriate review and approval of progress and final completion reports of IPM program for Ke Go Sub-Project command area
RESPONSIBILITIES FOR MITIGATION PERFORMANCE MONITORING	
TOTAL ESTIMATED COST	<ul style="list-style-type: none"> Costs included as part of VWRAP implementation

Table 30: Sub-Project Environmental Effects Monitoring Sub-Program.

ENVIRONMENTAL EFFECTS OF EXPANDED COASTAL AQUACULTURE IN THACH HA DISTRICT AND EFFECTS OF COASTAL AQUACULTURE ENVIRONMENTAL MANAGEMENT PLAN	
MONITORING OBJECTIVE	<ul style="list-style-type: none"> Determine: <ul style="list-style-type: none"> what are the environmental effects of increasing aquaculture as a result of providing freshwater from the Ke Go Sub-Project to the aquaculture sector in coastal Ha Tinh; and the success of the environmental management program for the coastal aquaculture sector developed under VWRAP.
ENVIRONMENTAL INDICATORS TO BE MEASURED	<ul style="list-style-type: none"> the exact environmental indicators to be measured will be determined during the environmental review of the coastal aquaculture program conducted during the pre-construction phase of the first investment phase (Table 28, Page 67), but it is expected that the following environmental indicators will be need to be measured: <ul style="list-style-type: none"> Ambient freshwater and coastal water quality: pH, conductivity (EC), total suspended solids (TSS), BOD5, COD, Fe, Al, nitrate-nitrite (NO2-3), phosphate (PO4-P), dissolved oxygen Integrity of coastal wetlands and condition of any wetlands restored as part of coastal aquaculture environmental management plan: area of wetland by wetland category and condition of these wetlands
SAMPLING LOCATIONS	<ul style="list-style-type: none"> Ambient freshwater and coastal water quality: <ul style="list-style-type: none"> Six sampling locations within and adjacent to the aquaculture area in Thach Ha District: one sampling location upstream and four sampling locations within the aquaculture area, as well as one sampling location in the nearshore coastal area of Thach Ha District. Integrity of coastal wetlands and condition of restored wetlands: <ul style="list-style-type: none"> All coastal wetlands throughout Thach Ha District will be surveyed (approximately 1,700 ha)
SAMPLING SCHEDULE, FIRST AND SECOND INVESTMENT PHASES	<ul style="list-style-type: none"> Ambient freshwater and coastal water quality: <ul style="list-style-type: none"> Each year, 3 times per year in each survey location (once after each shrimp crop and once during rainy season) Integrity of coastal wetlands and condition of restored wetlands: <ul style="list-style-type: none"> Annually: Year 1 to provide a pre-Sub-Project baseline
ADDITIONAL DATA AND INFORMATION TO BE COLLECTED	<ul style="list-style-type: none"> Up to date, timely, and accurate information for each year of Sub-Project on: <ul style="list-style-type: none"> land use and commodity production construction and operation of the Sub-Project
RESPONSIBILITIES FOR IMPLEMENTATION	<ul style="list-style-type: none"> an Environmental Safeguard Contractor will be engaged (CQ selection recommended) to implement this component of the Environmental Effects Monitoring Program under the direction of the Ke Go Sub-Project SIU. Detailed ToR for the Contractor will be prepared by the Consultant Environmental Specialist during Detailed Design Phase for Ke Go Sub-Project. Consultant Environmental Specialist will oversee and guide Environmental Safeguard Contractor during first three years of implementation.
REPORTING REQUIREMENTS	<ul style="list-style-type: none"> for first three years of Sub-Project implementation, Consultant Environmental Specialists, with the assistance of the Environmental Safeguard Contractor, will include results in annual Ke Go Sub-Project Environmental Management Plan Report. After this, reporting responsibility will lie solely with Environmental Safeguard Contractor. The Environmental Safeguards Contractor will also be required to prepare a six-month progress report in each year of the monitoring.
TOTAL ESTIMATED COST, FIRST AND SECOND INVESTMENT PHASES (US\$)	17,515 - Please see Table 26, Page 64 for detailed description of costs and implementation schedule.
ENVIRONMENTAL EFFECTS MONITORING OF WATER QUALITY FOR EFFECTS OF SEDIMENTATION, EROSION DUE TO SUB-PROJECT ACTIVITIES AND APPLICATION OF PESTICIDES AND FERTILIZERS DUE TO AGRICULTURAL EXTENSIFICATION AND INTENSIFICATION	
MONITORING OBJECTIVE	<ul style="list-style-type: none"> Determine what are the effects of extensification and intensification of agricultural land use and commodity production on the ability of surface and groundwater resources in the Sub-Project to: <ul style="list-style-type: none"> meet ambient surface and groundwater quality standards meet irrigation water standards meet domestic and drinking water stands

Table 30: Sub-Project Environmental Effects Monitoring Sub-Program. continued

ENVIRONMENTAL EFFECTS MONITORING OF WATER QUALITY FOR EFFECTS OF SEDIMENTATION, EROSION DUE TO SUB-PROJECT ACTIVITIES AND APPLICATION OF PESTICIDES AND FERTILIZERS DUE TO AGRICULTURAL EXTENSIFICATION AND INTENSIFICATION, CONTINUED	
MONITORING OBJECTIVE	<ul style="list-style-type: none"> • Determine what are the effects of extensification and intensification of agricultural land use and commodity production on the ability of surface and groundwater resources in the Sub-Project to: <ul style="list-style-type: none"> – meet ambient surface and groundwater quality standards – meet irrigation water standards – meet domestic and drinking water standards
ENVIRONMENTAL INDICATORS TO BE MEASURED	<ul style="list-style-type: none"> • With respect to ambient surface and groundwater quality, the following environmental indicators will be measured: <ul style="list-style-type: none"> – pH, conductivity (EC), total suspended solids (TSS), BOD5, COD, Fe, Al, nitrate-nitrite (NO2-3), phosphate (PO4-P), dissolved oxygen, total pesticide and herbicide • With respect to irrigation water standards, the following environmental indicators will be measured in surface waters: <ul style="list-style-type: none"> – Na, Mg, Ca (enabling calculation of sodium absorption ratio [SAR]), fecal coliform (pH, TSS, Al, and dissolved oxygen will also be used to assess Sub-Project effects on ability of surface waters to meet irrigation water standards) • The following environmental indicators, collected above, will be used to assess Sub-Project impacts on domestic and drinking water quality: <ul style="list-style-type: none"> – pH, conductivity (EC), total suspended solids (TSS), BOD5, COD, Fe, Al, nitrate-nitrite (NO2-3), phosphate (PO4-P), dissolved oxygen, fecal coliform
SAMPLING LOCATIONS, FIRST INVESTMENT PHASE	<ul style="list-style-type: none"> • surface water quality sampling will be conducted in the following 16 locations (all stations should be spatially referenced at establishment to enable mapping and spatial analysis of water quality results):: <ul style="list-style-type: none"> – Ke Go Reservoir as an upstream spatial control; – Two in main canals; – Pilot areas: a total of 10 locations in the pilot areas (one at top and one at bottom of each pilot area); – Downstream (drainage area): two locations just outside of the command area and one location in coastal wetlands as downstream spatial controls • Groundwater quality sampling will be conducted in the following 14 locations: <ul style="list-style-type: none"> – Pilot areas: 10 locations distributed throughout the pilot areas – Spatial Controls: 4 locations outside the command area to serve as spatial controls (two upstream and two downstream of irrigated areas)
SAMPLING LOCATIONS, SECOND INVESTMENT PHASE	<ul style="list-style-type: none"> • Surface water quality sampling will be conducted in the following 36 locations (all stations should be spatially referenced at establishment to enable mapping and spatial analysis of water quality results): <ul style="list-style-type: none"> – Ke Go Reservoir as an upstream control; – Two in main canals; – Command area: a total of 30 locations in the command area – maintain pilot area sampling locations established in first investment phase; add 20 sampling locations in the remaining 80% of the command area, i.e., half the sampling density of the pilot areas in four times the total area to be sampled; – Downstream (drainage area): two locations just outside of the command area and one location in coastal wetlands • Groundwater quality sampling will be conducted in the following 24 locations: <ul style="list-style-type: none"> – Command Area: a total of 20 locations in the command area – maintain pilot area sampling locations established in first investment phase; add 10 sampling locations in the remaining 80% of the command area. i.e., ¼ the sampling density of the pilot areas in four times the total area to be sampled; – Spatial Controls: 4 locations outside the command area to serve as spatial controls (two upstream and two downstream of irrigated areas)
SAMPLING SCHEDULE, FIRST AND SECOND INVESTMENT PHASES	<ul style="list-style-type: none"> • for surface water quality: <ul style="list-style-type: none"> – pre-construction (for each investment phase, to establish pre-Sub-Project baseline): 3 times per year in each survey location (rainy season and two in dry season) – construction: 3 times per year in each survey location (rainy season and two in dry season) – operation: 3 times per year in each survey location (rainy season and two in dry season) • for groundwater quality: <ul style="list-style-type: none"> – pre-construction (for each investment phase, to establish pre-Sub-Project baseline): 1 time per year in each survey location (dry season) – construction: 1 time per year in each survey location (dry season) – operation: 1 time per year in each survey location (dry season) – with respect to total pesticides and herbicides, for both surface and groundwater quality, monitoring to be done once per year, in peak of dry season (April) in each of three phases for each investment phase
ADDITIONAL DATA AND INFORMATION TO BE COLLECTED	<ul style="list-style-type: none"> • Up to date, timely, and accurate information on: <ul style="list-style-type: none"> – construction and operation of the Sub-Project, – annual or seasonal land use and commodity production within the command area; – weather data from Hydrometeorological Stations; – IPM activities from Ha Tinh DARD – groundwater information from Hydrogeological Service

Table 30: Sub-Project Environmental Effects Monitoring Sub-Program. continued.

ENVIRONMENTAL EFFECTS MONITORING OF WATER QUALITY FOR EFFECTS OF SEDIMENTATION, EROSION DUE TO SUB-PROJECT ACTIVITIES AND APPLICATION OF PESTICIDES AND FERTILIZERS DUE TO AGRICULTURAL EXTENSIFICATION AND INTENSIFICATION, CONTINUED	
RESPONSIBILITIES FOR IMPLEMENTATION	<ul style="list-style-type: none"> • an Environmental Safeguard Contractor will be engaged (CQ selection recommended) to implement this component of the Environmental Effects Monitoring Program. Detailed Terms of Reference for the Contractor will be prepared by the Consultant Environmental Specialist during Detailed Design Phase for the Ke Go Sub-Project. The Consultant Environmental Specialist will oversee and guide Environmental Safeguard Contractor during first two years of Sub-Project implementation or until completion of Detailed Design Document for Ke Go Sub-Project Environmental Management Plan: Second Investment Phase (whichever comes first).
REPORTING REQUIREMENTS	<ul style="list-style-type: none"> • for first three years of Sub-Project implementation, Consultant Environmental Specialists, with the assistance of the Environmental Safeguard Contractor, will include results in annual Ke Go Sub-Project Environmental Management Plan Report. After this, reporting responsibility will lie solely with Environmental Safeguard Contractor. The Environmental Safeguards Contractor will also be required to prepare a six-month progress report in each year of the monitoring.
COMMENTS	<ul style="list-style-type: none"> • it will be necessary to ensure that the pesticides and herbicides that are monitored are representative of the entire suite of pesticides and herbicides that are used in the Sub-Project • the sampling regime for second investment phase will need to be reviewed during the detailed design (pre-construction) phase of the second investment phase. • 15% of budget should be spent of QA/QC; MoNRE Circular on QA/QC for environmental monitoring should be followed.
TOTAL ESTIMATED COST, TOTAL OF FIRST AND SECOND INVESTMENT PHASES	143,018 - Please see Table 26, Page 64 for detailed description of costs and implementation schedule.

ANNEX 1: TERMS OF REFERENCE FOR EIA

TERMS OF REFERENCE FOR CONSULTING SERVICES FOR VWRAP EIA CONSULTANT

I. BACKGROUND INFORMATION

1. The Government of Vietnam (GoVN) has requested a Credit from the International Development Association (IDA) to help finance the proposed Vietnam Water Resources Assistance Project (VWRAP). In order to carry out VWRAP preparation, the GoVN through the Ministry of Agriculture and Rural Development (MARD) has obtained a PHRD grant from the Japanese Government to procure the consultancy services. VWRAP is scheduled for IDA appraisal in mid-2003. The Central Project Office (CPO) under MARD will lead the overall coordination for VWRAP preparation and manage the grant. It will enter a contract with the Consultant to undertake the services specified herein.
2. VWRAP has three components: (1) Integrated Development of the Thu Bon Basin; (2) Irrigation Modernization; and (3) Dam Safety Management. VWRAP is classified as a "Category A" environmental project, requiring an independent EIA report per IDA requirements. Preparation of the overall project is being done under another contract. The consultants responsible for overall VWRAP preparation are referred to as the "Consultant". The consultant responsible for executing this TOR is referred to as the "EIA Consultant", which includes an EIA international expert and a local EIA team, to complete the scope of work mentioned hereafter at the section of scope of work for the EIA consultant.
3. Some attached reference documents provide a comprehensive description of the VWRAP physical investments (i.e. subprojects) and should be considered an integral part of this TOR. The EIA Consultant and the Consultant are required to work together to integrate the EIA into the project's technical, economic, financial, social, and institutional analyses. The Consultant will carry the primary burden for collecting and analyzing environmental information, holding consultations, and producing an environmentally sound project. The Consultant will provide the EIA Consultant with technical analyses, reports, and engage in technical discussions with the EIA team on engineering analysis, etc. The role of the EIA Consultant is to work with the Consultant to help manage the EIA process, provide specialized environmental analysis where required, and independently produce an EIA report. The specific scope of work is presented below.
4. **Component 1 of VWRAP** is less well-defined at this time and subprojects in the Thu Bon Basin will be identified/confirmed during the formulation of the Thu Bon Integrated Basin Plan (TIBP). Possible subprojects in the Thu Bon Basin include: flood protection works, modernization of water delivery and drainage systems, small storage facilities for local irrigation, mini-hydropower generation, rural water supply, upper watershed management, improvement of flood preparedness and warning, etc. Total estimated investment cost of these sub-projects is around US\$20 million.
5. Under **Components 2 and 3 of VWRAP**, the subprojects are relatively well defined: i) Dau Tieng—mainly in Tay Ninh province), ii) Ke Go—Ha Tinh province, iii) Cam Son-Cau Son—Bac Giang province, iv) Da Ban in Khanh Hoa province; and v) Yen Lap in Quang Ninh province. The schemes range in size from 10,000-50,000 ha with investment needs estimated to be on the order of \$5-20 million for each scheme. Infrastructure investments include: remedial dam safety works and possible installation of micro-hydropower plants; canal lining and improved water distribution systems; rehabilitation of pumping stations; etc.

II. OVERALL SCOPE OF WORK FOR THE EIA CONSULTANT

6. The types of environmental issues that could occur are listed below. The EIA Consultant is expected to screen and rank the most pressing environmental impacts.
 - Water availability, basin water balances, and water use rights, water quality due to sedimentation, runoff and the use of agricultural chemicals
 - Dam safety
 - Downstream impacts from reservoirs and irrigation schemes,
 - Effects of water abstraction, flood control and salinity control structures on: aquatic ecology, particularly fish resources, hydrology including groundwater recharge and water quality, plant and animal ecology.
 - Involuntary resettlement and project affected people, including impacts on indigenous people.
 - Impacts of resettlement on the environment eg. forest cutting or wetland encroachment, new agricultural practice and livelihood patterns, land tenure
 - Impacts on cultural property
 - Impacts on natural habitats and nature reserves

- Construction impacts, including: construction camps, disposal of dredged material, road safety, etc.
7. The EIA Consultant will help manage the EIA process and prepare an Environmental Impact Assessment and Environmental Management Plan (EMP) for VWRAP. The EIA will meet IDA requirements for Environmental "Category A" projects (OP 4.01 "Environmental Assessment" and associated annexes) and be in compliance with all Vietnamese laws and regulations.
 8. The scope of work for the EIA Consultant is limited to EIAs for the investment subprojects only, meaning 5 subprojects in the component 2 and priority investment subprojects in Thu Bon river basin, and not the TIBP. (The TIBP can be considered a regional environmental study by itself.) The EIA Consultant will prepare a separate EIA/EMP for each subproject, which will then be merged into one final EIA report. The Consultant shall be the main source of information. The EIA Consultant may also request the Consultant (or request MARD to direct the Consultant if necessary) to collect additional information or, if more expedient and within the budget of the EIA Consultant, collect the information itself. The EIA shall cover the issues below, and other relevant matters.
 9. *Policy, legal and administrative framework.* Review policy, legal, and administrative framework within which the EIA is carried out at the national and provincial levels. This includes, among other topics: environmental quality, water resources, dam safety, health and safety, protection of sensitive areas, protection of endangered species, siting, land use control, resettlement, protection of cultural property etc.
 10. *Define the Project and its Area of Influence:* Define the proposed subproject and its geographic, ecological, social, and temporal context, including any off-site investments that may be required (i.e., access roads, construction camps, product storage facilities, sediment disposal areas, etc.). Ascertain the need for plans for resettlement, project affected people, or indigenous peoples. Develop maps showing the project site and the project's area of influence.
 11. *Collect Baseline Data:* Assess the dimensions of the study area and describe relevant physical, biological, and socio-economic conditions, including any changes expected before the project commences. Also take into account current and proposed development activities within the project area, but not directly connected to the project. Data should be relevant to decisions about project location, design, operation, or mitigatory measures. The accuracy, reliability, and sources of data should also be assessed.
 12. *Assess Environmental Impacts:* Predict and assess the project's likely positive and negative impacts, including possible cumulative impacts, in quantitative terms to the extent possible. Identify mitigation measures and residual impacts that can not be mitigated. Explore opportunities for environmental enhancements. Identify and estimate the extent and quality of available data, key data gaps, and uncertainties associated with predictions, and specific topics which require further attention.
 13. *Analyze Project Alternatives:* Systematically compare feasible alternatives to the proposed project site, technology, design, and operation including the "without project" situation—in terms of their potential environmental and social impacts; the feasibility of mitigating these impacts, their capital and recurrent costs, suitability under local conditions, and their institutional, training, and monitoring requirements. For each of the alternatives, quantify the environmental impacts to the extent possible, and attach economic values where feasible. State the basis for selecting the particular project design proposed.
 14. *Environmental Management Capabilities.* This would include issues relating to assessment of the existence, role and capability of environmental units on-site, or at the agency and ministry level, potential participation of project affected people in project implementation, local mass organisations, NGOs and/or academic institutions, and the role of the local population in maintaining the existing ecosystems. Based on these findings, recommendations should be made concerning the establishment and/or expansion of such units, and the training of staff, to the point that EIA recommendations can be implemented.
 15. *Public Consultation and Disclosure:* The EIA Consultant is expected, in conjunction with the Consultant, to plan, manage, and document the consultation and disclosure process. The Public Consultation and Disclosure Plan will be approved by MARD and should contain information on how stakeholders will be identified, key consultation points, objectives of the consultation, level of consultation, consultation techniques and methodology, and timetable. The Consultant will be requested to prepare necessary material to facilitate the consultations. The World Bank Environmental Assessment Sourcebook (Update 26, May 1999 "Public Consultation in the EIA Process") provides guidelines and techniques for effective consultation. The EIA Consultant, in conjunction with the Consultant, will also consult with affected groups throughout project implementation as necessary to address EIA-related issues. The disclosure of the EIA reports as required by the OP 4.01 and BP 17.50, should be approved by MARD in agreement with MoNRE, which is in charge of EIA appraisal.
 16. The Consultant will organize, in conjunction with the EIA Consultant and with the assistance of the IMC and Provincial authorities, at least two stakeholder consultation meetings for each subproject. The Consultant will cover the costs of the consultations. The first consultation should take place to discuss the conceptual approach to scheme improvements and the scope of work for the EIA, and the second

consultation should review the Draft Final Feasibility Study/EIA. The Consultant shall cover the costs of these consultations. The Consultant shall cover the costs of these workshops. Relevant stakeholders should be invited to both workshops including: MARD officials, provincial authorities, IMC officers, local mass organizations, NGOs and/or academic institutions, farmer representatives, etc. per the Public Consultation and Disclosure Plan.

17. *Environmental Management Plan*: An EMP shall be prepared which consists of the set of mitigation, monitoring, and institutional measures to be taken during construction and operation to eliminate environmental and social impacts, off-set them, or reduce them to acceptable levels. The plan also includes the actions necessary to implement these measures. Specifically:
18. *Mitigation*: Identify feasible and cost-effective measures that may reduce potentially significant adverse environmental impacts to acceptable levels. The plan should include compensatory measures if mitigation measures are not feasible, cost-effective, or sufficient. The proposed mitigation measures should include technical details and an implementation plan for each mitigation measure and describe linkages with other mitigation plans (e.g., involuntary resettlement, indigenous peoples, cultural property, etc.) required for the project.
19. *Monitoring*: The monitoring program should provide information about key environmental issues and the effectiveness of mitigation measures during project construction and operation. The objectives and types of monitoring should be identified with clear linkages to the impacts assessed in the EIA and the mitigation measures described in the EMP. The monitoring program should provide a set of monitoring indicators, specify descriptions, technical details, and reporting procedures. Monitoring reports should also be submitted to the local environmental authorities (DoSTEs). Independent environmental monitoring is not necessary in general, but environmental monitoring should be a part of the project monitoring to be carried out by a sub-contractor to the Consultant. Independent environmental monitoring could be undertaken if required by the local authorities under certain circumstances.
20. *Capacity Development and Training*: The EMP draws upon the EIA's assessment of the existence, role, and capability of environmental units on site or at the agency and ministry level. If necessary, recommend the establishment or expansion of such units, and the training of staff, to allow implementation of EIA recommendations. The EMP shall provide a description of the institutional arrangements—who is responsible for carrying out the mitigatory and monitoring measures (e.g., operation, supervision, enforcement, monitoring of implementation, financing, reporting and staff training).
21. *Implementation Schedule and Cost Estimates*: For all three aspects (mitigation, monitoring, and capacity development) the EMP shall provide (a) an implementation schedule for measures that must be carried out as part of the project, showing phasing and coordination with overall project implementation plans; and (c) capital and recurrent cost estimate and sources of fund for implementing the EMP. These figures should be integrated into the total subproject cost tables.

III. SCOPE OF WORK FOR THE INTERNATIONAL EIA EXPERT

22. The international expert is responsible to coordinate with the local EIA consultant team (composing expert/specialist in the Table 1) to complete the General Scope of Work for the EIA Consultant. More particularly, the international expert will have following responsibilities:
 - To take the position of the EIA consultant team leader and will coordinate all activities of the EIA consultant team;
 - To review all data and information that were collected and processed by the local EIA consultant team and reasonably propose to the local team further needed data and information collections;
 - To guide the local EIA consultant team to co-prepare draft EIA reports; and
 - With the close assistance by the local EIA consultant team, the international expert will complete and submit final EIA reports, which have to be acceptable by both MARD and IDA, for all investment subprojects.

IV. SCOPE OF WORK FOR THE LOCAL EIA TEAM

23. The local team is responsible to assist and coordinate with the international EIA expert to complete the General Scope of Work for the EIA Consultant. More particularly, the local team will have following responsibilities:
 - Based on data and information provided by the VWRAP Consultant and requirements for preparation of the EIA reports for investment subprojects, the local EIA consultant team will carry out further data and information collections, surveys, and investigations, if required. To be responsible for data inputs, data analyses and processes. Both primary and processed data will be conveyed to the international expert;
 - With the guidance by the international expert, co-prepare and submit draft EIA reports for investment subprojects. Assist the International EIA consultant to complete final EIA reports, which have to be acceptable by both MARD and IDA, for all investment subprojects; and
 - To be liaison between the international EIA expert and local related agencies.

V. EIA CONSULTANT STAFFING AND SUBMISSION OF REPORTS

24. **EIA Consultant Team Profile.** It is expected that the EIA Consultant team will compose an international expert with experience preparing international-level EIA reports as the team leader and a local team. Table 1 contains suggested areas of expertise for national/experts, and qualifications of key staff. The EIA Consultant may propose alternative staffing to match the proposed lines of action. Under no circumstance does acceptance of the staffing list in Table 1 release the EIA Consultant from any responsibility under these TOR.
25. **Reports.** Final EIA reports for all investment subprojects are to be submitted to MARD and IDA by February, 2003. The number of EIA reports to be submitted and schedule for report submission are in Table 2. The international EIA expert will bear all the cost for the reproduction of the English version of EIA report, whereas the local EIA team will be responsible for the reproduction of the Vietnamese version of the EIA reports. The local EIA consultant team will have to make sure that the meanings of the Vietnamese version of EIA reports are matched with their English version. Electronic copies of all reports should be provided to both MARD and IDA, to the extent possible.

Note: The EIA Consultant shall reach agreement with the Consultant and MARD during project implementation on how best to package the feasibility studies (FS), resettlement action plans (RAPs), management plans (MPs), and EIAs for each investment subproject. MARD will make extra copies of reports as required for consultation/workshop purposes.

VI. INPUTS FROM THE GOVERNMENT

26. **GoVN Input, Data and Coordination Arrangement.** MARD, through CPO, will be the project coordinating unit. The CPO will coordinate with participating Ministries, agencies, and provincial authorities to provide counterpart inputs, and arrange review and participate in discussions with the EIA Consultant on issues related to the assignment. It will facilitate and assign counterpart staff to assist the EIA Consultant in obtaining necessary visas, authorizations and access to facilities for carrying out the services. It will make available to the EIA Consultant all *existing* aerial photographs, maps, studies, plans, reports, drawings and information relevant to the execution of this assignment within the MARD. IDA will assist the GoVN in (i) supervision of PHRD grant implementation; (ii) VWRAP preparation; and (iii) liaison with other donors.
27. The international EIA expert will receive and inherit the EIA inception/ scoping report which was prepared by the previous international EIA expert in association with the local EIA consultant team.

VII. GUIDANCE TO EIA CONSULTANTS

28. The EIA Consultant will be *based in Hanoi* (unless otherwise agreed-upon with MARD), and will be provided by the Government with an office, preferably shared with the Consultant. The EIA Consultant will pay its costs for local transport, operational costs, office equipment (tel./fax/copying), secretarial support, required office equipment and supplies, translation and printing/copying. The EIA Consultant will submit the following items to the Government: (i) licensed copies of all proprietary computer software used together with manuals; (ii) copies of all software developed under the consultancy assignment in magnetic form, together with source listing and full documentation; (iii) satellite imagery and maps procured and used; (iv) copies of all data used in magnetic form and hard copy; and (v) complete description of all methodologies used and the assumptions made.

Table 1: Suggested Staffing Profile for the EIA Consultant

<i>Expertise</i>	International (mm)	Local (mm)
Environmental Expert	3.5	6
Environmental Specialist		8
Social-Resettlement Expert		3
Total	3.5	17

Environmental Expert: The international environmental expert should have at least 10 years experience preparing EIAs for water resources projects in Asia which meet the requirements of international development agencies, such as the World Bank or the Asian Development Bank. Experience in Vietnam would be a plus. The local expert should have at least 10 years experience preparing EIAs in Vietnam, with significant experience in the preparation of water resources projects for international agencies.

Environmental Specialist: Should have experience in the environmental assessment of water resources projects, including dams, flood control structures, and irrigation works in Vietnam.

Social-Resettlement Expert: Should have practical experience in social assessment techniques and the preparation of resettlement plans.

Table 2: Reporting Obligations

Of the Local EIA Team:

<i>Outputs</i>	<i>Number of copies</i>
Draft EIA Reports for Dau Tieng and Cau Son-Cam Son subprojects	10 Vietnamese, 10 English
Draft EIA Reports for Ke Go, Da Ban and Yen Lap subprojects and priority investment subprojects in Thu Bon river basin	10 Vietnamese, 10 English

Of the International EIA Expert:

<i>Outputs</i>	<i>Number of copies</i>
Final EIA Reports for Dau Tieng and Cau Son-Cam Son subprojects	10 Vietnamese, 10 English
Final EIA Reports for Ke Go, Da Ban and Yen Lap subprojects and priority investment subprojects in Thu Bon river basin	10 Vietnamese, 10 English
Final EIA Report (integrating EIA Reports for all subprojects)	10 Vietnamese, 10 English

ANNEX 2: POLICY, LEGAL, AND ADMINISTRATIVE FRAMEWORK FOR EIA

THE LEGAL FRAMEWORK FOR ENVIRONMENTAL MANAGEMENT IN VIET NAM

Environmental Impact Assessment Legislation

The key environmental legislation in Vietnam consists of:

- Law on Protection of the Environment (LEP) – enacted in December 1993. The LEP:
 - Identifies the responsibilities of the state centre, provinces, organizations and individuals to prevent and remedy environmental deterioration and pollution and carry out specified environmental protection functions;
 - Provides for the development of environmental standards and submission of environmental impact assessment reports on new and existing facilities;
 - Provides for responsible parties to pay compensation for environmental damage;
 - Establishes the right of individuals and organizations to petition for enforcement of environmental regulations;
 - Calls for civil and criminal penalties for violations; and
 - Encourages international environmental co-operation.
- Decree 175/CP – promulgated in October 1994 to guide implementation of the LEP and provides broad guidelines for:
 - Division of responsibility among Ministries;
 - Environmental Impact Assessments;
 - Pollution prevention and disaster control;
 - Sources of finance; and
 - Environmental inspections and standards.
- Circular No. 490 – promulgated in April 1998 to provide 'Guidance on setting up and appraising environmental impact assessment reports for investment projects'. The Circular:
 - Identifies the legal requirements according to the stages of implementation of a project and its category. Projects are effectively divided into two categories; No. 1 type projects - all of which require EIA and include projects that have potential to pollute the environment, cause environmental degradation or may have difficulty complying with controls and standards; and No. 2 type projects - including projects which do not require EIA but require registration with the environmental standards registration board'.
 - Defines the content of project subject to the EIA procedures; and
 - Specifies management of the EIA report appraisal
- All projects must follow the process established in the circular:
 - *Application for investment license* - for No. 1 type projects this includes the submission of document that sets out the potential impacts of the project (to be appraised by relevant state agencies), and for No. 2 type projects requires the submission of the registration form and technical and economic feasibility report. On approval an investment license is issued;
 - *Design stage* - No. 1 type projects prepare and submit the EIA report and technical and economic feasibility report; and
 - *Completion stage* - prior to operation relevant agencies coordinated regarding the issuance of construction licenses, inspections and stipulation of environmental standards, and approvals and certifications by the environmental standards registration board. Once all of these processes have been completed the relevant environmental license is issued.

The Circular establishes the timeframes for review and appraisal; examination of the environmental standard registration and issuance of a certificate shall be completed within 20 days of submission, and an EIA report must be reviewed within 30-60 days of submission (or three months for complex or controversial proposals), and the recommendations and decisions of the review must be ratified within 10 days.

Vietnamese EIA Requirements for Ke Go Sub-Project

According to Vietnamese legislation (Decree 175/CP, Circular 490/1998/TT-BKHCHNMT), the Ke Go Sub-Project requires an Environmental Impact Assessment (EIA) as it consists of the upgrading of an existing irrigation scheme. The project owner must set up and submit an environmental impact assessment report to the Government Management Agencies of Environmental Protection for appraisal.

Other Relevant Legislation

ORDINANCE ON CONSERVATION AND MANAGEMENT OF LIVING AQUATIC RESOURCES

Decree 18/1986, the Ordinance on Conservation and Management of Living Aquatic Resources prohibits all activities that are “detrimental to aquatic resources and cause pollution to the living environment of all aquatic species,” including the use of destructive fishing methods (toxic and harmful substances, explosives, electric currents), the introduction of toxic substances into the marine environment, habitat destruction (mangroves, coral reefs, marine flora, etc.), and emplacement of installations or devices that are harmful to aquatic resources.³⁷ For these purposes, the Minister of Fisheries is empowered to regulate habitat protection, total allowable catch, fishing areas, permissible fishing gear, endangered species, introduction of alien species, and so on³⁸.

LEGAL INSTRUMENTS FOR PROTECTED AREAS

The legal framework for terrestrial protected areas in Viet Nam dates to the 1980s, but the system of protected areas in Viet Nam is currently guided by the 1991 Forestry Resource Protection and Development Act³⁹. This legal instrument authorizes the existence of three categories of forestland: protection forest (critical watersheds and wetlands); special use forests (protected areas); and production forests.

The framework for the designation and management of special use forests is set out in Chapter 4, Part 2 of this Law. Implementation of the Act is done through a set of supplementary ordinances and decrees, such as Decision 1171, 1986, on Special Forest Management for Protected Areas, which defines permissible and prohibited activities in protected areas. A number of decrees to strengthen forest protection (national and provincial) have also been issued. They broadly specify the management principles of each forest category identified in the 1991 Forestry Resource Protection and Development Act; the separation of forest protection from production; and the nature of contractual arrangements with farmers and punishment of illegal use of protected forests.

Vietnamese Environmental Management Administration

The keys agencies and entities with environmental responsibilities in Viet Nam include:

- Ministry of Science, Technology and Environment (MoNRE) – MoNRE is the lead agency for environmental review purposes.
- National Environmental Agency (NEA) – Within MoNRE, the NEA has the responsibility to apply the LEP.
- Provincial Department of Science, Technology and Environment (DoSTE) – Each province has a DoSTE which is in charge of Environmental Management. They also have formal authority to review and comment on environmental aspects of investment applications and to resolve pollution-related disputes.

Requirements for Consultation and Disclosure

Save for certain provisions, there are no specific requirements for consultation in the national legal, policy, and regulatory framework for environmental impact assessment in Viet Nam (i.e., National Law on Environmental Protection [NLEP, 1993]; Decree 175/CP/1994 on Implementation of the NLEP; Circular 490/1998/TT-BKHCHNMT on Setting Up and Appraising Environmental Impact Assessment Reports). Most of the provisions requiring consultation are related to the appraisal of environmental impact assessments:

- The Ministry of Science, Technology, and Environment (MoNRE) is responsible for appraising reports on the assessment of environmental effects of projects and economic entities for larger projects (identified in Appendix II of Decree 175/CP). The National Environmental Agency (NEA) is assigned the responsibility

³⁷ Article 8, Ordinance on Conservation and Management, supra.

³⁸ Articles 9-13, *ibid.*

³⁹ No. 58 LCT/HDNN8

for assisting MoNRE in performing these environmental management responsibilities⁴⁰, MoNRE/NEA is required to complete appraisals within 60 days of receiving the required EIA reports and associated documentation;

- National government ministries are responsible for the implementation of state management of environmental protection. This means that they participate as required in the appraisal of environmental impact assessments for larger projects.
- Provincial (and city) People's Committees are responsible for the implementation of state management of environmental protection. This includes appraising reports on assessment of environmental effects of projects and local economic entities for smaller projects. The provincial Departments of Science, Technology, and Environment (DoSTE) are responsible to the provincial (and city) People's Committees for this task and provincial government departments participate in appraisals as required.

In addition, mass associations (such as Women's Union, Labour Union, etc.) are responsible for assuring the proper implementation and compliance with the legal, policy, and regulatory framework for environmental protection.

Disclosure during the EIA process, as described in Circular 490/1998/TT-BKHCMNT on Setting Up and Appraising Environmental Impact Assessment Reports, consists of the EIA Appraisal Council to which the EIA documents are provided for review. This Council, acting as a Consultant to MoNRE/NEA, consists of scientists, managers who have appropriate subject-matter knowledge, as well as social organizations and representatives of local people.

Key National Policies and Plans

GENERAL NATIONAL POLICIES

Policies on Decentralization of Planning and Management The GoV has also been promoting decentralization through a series of laws, decrees and regulations. The major guiding principle has been to give greater power, autonomy and responsibility to districts and communes. The new Budget Law also attempts to bring greater transparency and stability into financing for local development. At provincial level there is also greater awareness of the need to involve local communities in planning and implementation of development activities. The February 1998 Politburo Directive on Grassroots Democracy (30-CT/TW) proposes that people at the community level should participate more actively planning and decision making by (a) being better informed about the law, (b) participating in local decision making before final decisions are made, and, (c) supervising, controlling, and evaluating the operations and activities of their local authorities.

ENVIRONMENTAL POLICIES AND PLANS

National Plan for Environment and Sustainable Development (NPESD) In 1991, the State Committee for Sciences, with the assistance of UNDP, Sida, UNEP and IUCN prepared a National Plan for Environment and Sustainable Development 1991-2000 - Framework for Action (NPESD), which was then adopted by the Government. The NPESD, together with complementary reports submitted by Viet Nam to the United Nations Conference on Environment and Development convened in Rio de Janeiro in 1992, provided a broad, wide ranging framework for environmental action in Viet Nam, including marine environmental protection.

National Strategy for Environmental Protection for 2001 to 2010 This National Strategy replaced the NPESD which expired in 2000. Key strategic directions in the National Strategy are:

- Pollution prevention
- Conserve and sustainably use natural resources and biodiversity
- Environmental improvement in the urban, industrial, and rural areas
- Enhance environmental awareness and forest environmental morality

National Biodiversity Action Plan On December 22, 1995, the National Biodiversity Action Plan (BAP) was approved by the Prime-Minister. The BAP identifies the major causes for loss biodiversity as: over exploitation, leading to deforestation, extinction of species, soil erosion and flooding, overfishing; water and marine pollution;

⁴⁰ There may be changes in the responsibilities for environmental management at the national and provincial levels with the recent formation of the new Ministry of Natural Resources and Environment. However, the basic allocation of responsibilities between the central government and the provinces will not change.

degradation of coastal areas due to human activities; and transition to a market economy and the emphasis on development.

The goals of the National Biodiversity Action Plan include:

- a definition of and approach to biodiversity conservation and action which accommodates the multiple livelihood needs of the Vietnamese people, particularly rural populations residing in areas of high biodiversity;
- reviewing and establishing priorities in provinces, special-use forests, and protected areas (terrestrial and coastal/marine), using detailed forest status maps, identifying necessary investments in infrastructure, personnel, research, and community extension and economic programs for buffer zones;
- listing the necessary research, education, and extension activities in the environmental sector for central, provincial and local government agencies; and
- listing conservation activities required outside protected areas, e.g. integrated watershed management, biologically sound agricultural methods, particularly in hill and mountain areas, restoration of degraded lands, economic activities such as agricultural germplasm and marketing non-timber forest products, preservation of genetic material in zoos and botanical gardens, etc.

The BAP identifies many acts required for the protection of biodiversity. Those relating to the coastal and marine environmental management are as follows:

- establish new laws and regulations for biodiversity protection;
- examine existing laws to identify weakness and propose amendments to promote sustainable development;
- enact laws to protect sensitive terrestrial and aquatic areas;
- identify and protect areas with high biodiversity and establish buffer zones around them;
- identify wetlands in need of protection;
- identify areas which should be designated as new reserves;
- establish a national network of databases and information on biodiversity;
- strengthen the role of local governments in decision-making;
- strengthen the participation of local communities and non-governmental organizations.

Decision No. 224/1999/QĐ-TTg of 8 Dec 1999 by the Prime Minister on the approval of the Aquaculture Program for 1999-2010, which includes:

- an overall objective of achieving an aquaculture output of 2 million t/yr by 2010 from current levels of about 350,000 t/yr
- plans for aquaculture in coordination with investments in water resource infrastructure to increase the efficiency of investment and use of land and water areas
- policies of development of aquaculture cultivation, specifically: increasing utilization of land and water areas for cultivating marine products, favorable credit for poor farmers and fisherman; and preferential conditions for remote areas.

ANNEX 3: SOURCES OF INFORMATION USED IN THE PREPARATION OF THIS EIA

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18. National Law on Environmental Protection (29L/CTN, 1994)
19. Decree 175/CP/1994 on Implementation of the NLEP and
20. Circular 490/1998/TT-BKHCMNT on Setting Up and Appraising Environmental Impact Assessment Reports
21. Operational Policy 4.01 (and accompanying annexes) - Environmental Assessment
22. Operational Policy 4.04 - Natural Habitats
23. Operational Policy 4.36 - Forestry
24. Operational Policy 11.03 – Cultural Property
25. Operational Policy 4.12 – Involuntary Resettlement

26. Operational Policy 4.20 – Indigenous Peoples
27. Operational Policy 4.37 – Safety of Dams
28. Operational Policy 4.03 – Pesticide Management
29. Operational Policy 7.60 – Projects in Disputed Areas
30. Operational Policy 7.50 – International Waterways
31. Bank Policy 17.50 – Public Disclosure
32. General Policy 14.70: Involving Nongovernmental Organizations in Bank-Supported Activities
33. The Pollution Prevention and Abatement Handbook
34. The Environmental Assessment Sourcebook.
35. TCVN 5592 National Surface Water Quality Standards
36. TCVN 5944 National Groundwater Quality Standards
37. TCVN 6980 (2001) Standards for Industrial Effluents Discharged Into Rivers Used for Domestic Water Supply
38. Decree 18/1986, the Ordinance on Conservation and Management of Living Aquatic Resources
39. 1991 Forestry Resource Protection and Development Act
40. Decision 1171, 1986, on Special Forest Management for Protected Areas
41. 1972 Convention Concerning the Protection of the World Natural and Cultural Heritage (the World Heritage Convention).
42. 1973 Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES Convention)
43. 1992 United Nations Framework Convention on Climate Change
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46. National Strategy for Environmental Protection for 2001 to 2010
47. National Biodiversity Action Plan (1995)
48. Forest Protection Department 1998 Protected Areas Plan of Vietnam to 2010
49. National Aquaculture Development Program (1999-2010).

**ANNEX 4: SUMMARY OF WATER QUALITY INFORMATION FOR KE
GO SUB-PROJECT**

Table 31: Water quality in Ke Go Sub-Project Area, Ha Tinh Province, 20 December, 2002

No	Parameter	Unit	3A	3B	3C	3D
1	Temperature	oC	19	19.1	19.3	18.9
2	pH		7.00	7.05	7.21	7.1
3	Conductivity	μS/cm	217	225	270	257
4	Turbidity	NTU	25	29	47	22
5	Amoniac (NH ₄ ⁺)	mg/l	0.25	0.27	0.40	0.06
6	NO ₂ ⁻	mg/l	0.04	0.05	0.09	0.01
7	NO ₃ ⁻	mg/l	3.7	3.9	3.0	4.7
8	Phosphate (PO ₄ ³⁻)	mg/l	0.05	0.06	0.09	0.02
9	Alkalinity	mg/l	98	100	122	134
10	Sulphate (SO ₄ ²⁻)	mg/l	6.7	7.0	7.2	9.0
11	Total Iron	mg/l	0.27	0.30	0.32	0.85
12	NaCl	mg/l	22.2	22.5	23.0	22.9
13	CL ⁻	mg/l	12.0	12.3	12.5	12.1
14	HCO ₃ ⁻	mg/l	96	98	115	128
15	Hardness(CaCO ₃)	mg/l	110	115	120	130
16	Suspended Solid	mg/l	20	23	65	18
17	Disolved load	mg/l	200	207	243	221
18	COD	mg/l	22.9	23.0	29.6	4.2
19	BOD ₅	mg/l	13.7	14.0	19.1	2.5
20	DO	mg/l	7.50	7.30	6.20	4.30
21	Coliform	Col/100ml	230	280	630	70
22	Fecal- Coliform	F.c/100ml	110	150	240	32
23	Cl.ferfrigens	no/10ml	3	4	9	1

Water sample sites

- 3A- Ke Go Reservoir
- 3B- Surface water in the Main canal
- 3C- Surface water in the irrigation canal N3
- 3D- Well water next to the irrigation canal N3

Table 32: Water quality in Ke Go Sub-Project Area, Ha Tinh Province, 20 December, 2002, additional sampling stations.

No	Parameter	Unit	3E	3F	3G
1	Temperature	oC	19.0	19.0	19.2
2	pH		7.20	7.25	7.08
3	Conductivity	μS/cm	270	2.62	279
4	Turbidity	NTU	60	20	49
5	Amoniac (NH ₄ ⁺)	mg/l	0.02	0.03	0.32
6	NO ₂ ⁻	mg/l	0.05	0.02	0.10
7	NO ₃ ⁻	mg/l	4.0	5.4	3.2
8	Phosphate (PO ₄ ³⁻)	mg/l	0.08	0.04	0.16
9	Alkalinity	mg/l	130	128	152
10	Sulphate (SO ₄ ²⁻)	mg/l	8.0	7.9	8.2
11	Total Iron	mg/l	0.32	0.28	0.31
12	NaCl	mg/l	24.0	22.1	37.5
13	CL ⁻	mg/l	12.7	11.9	21.1
14	HCO ₃ ⁻	mg/l	128	124	134
15	Hardness(CaCO ₃)	mg/l	150	160	155
16	Suspended Solid	mg/l	58	17	57
17	Disolved load	mg/l	225	230	240
18	COD	mg/l	27.6	3.7	25.3
19	BOD ₅	mg/l	16.3	2.4	16.0
20	DO	mg/l	6.5	4.5	5.10
21	Coliform	Col/100ml	710	20	830
22	Fecal- Coliform	F.c/100ml	300	5	34
23	Cl.ferfrigens	no/10ml	13	1	16

Water sample sites

- 3E- Surface water in the irrigation canal N4
- 3F- Well water next to the irrigation canal N4
- 3G- Surface water in the irrigation canal N6

Table 33: Surface water quality in Ke Go Sub-Project Area, Ha Tinh Province, 2001

No	Parameter	Unit	M1	M2	M3
1	pH		7.6	5.9	6.3
2	COD	mg/l	115	227	37
3	BOD ₅	mg/l	58	155	20
4	NO ₂ ⁻	mg/l	0.23		
5	NO ₃ ⁻	mg/l	4.25		
6	Coliform	Col/100ml	60,000	80,000	58,000
7	Cd	mg/l	Und		
8	Pb	mg/l	Und		
9	As	mg/l	0.018		
10	Cu	mg/l	0.037		
11	Zn	mg/l	Trace		
12	Suspended Solid	mg/l	108	57	67
13	DO	mg/l	1.2	1.4	7.6
14	Conductivity	mg/l	0.05		0.02
15	Total solid	mg/l	352		
16	NH ₄ ⁺	mg/l	3.6		
17	Total P	mg/l	2.8	0.35	0.78
18	Total Iron	mg/l	1.2		
19	Detergent	mg/l	0.01		
20	Cr	mg/l	0.03		
21	Turbidity	mg/l		57	78

Water sample sites

- M1- Surface water in Cay River, under the influence of Do Diem Frozen Food Factory Thach Ha District, dated 28 May, 2001
M2 - wastewater from Beer Factory, dated 29 May, 2001
M3 - wastewater from Ha Tinh Hospital, dated 27 May, 2001

Table 34: Surface water quality in Ke Go Sub-Project Area, December, 1998

No	Parameter	Unit	Middle Ke Go reservoir (surface) 22/10/1998	Middle Ke Go reservoir (bottom) 22/10/1998	Rao Cai River 23/10/1998	Rao Mon River 23/10/1998
1	pH		7.0	6.9	6.94	7.21
2	Salinity	o/oo	0.0	0.0	0.0	0.0
3	Turbidity	NTU	0.5	0.5	0.3	0.3
4	Suspended solids	mg/l	16.50	19.0	23.0	29.0
5	DO	mg/l	4.25	4.1	4.93	4.9
6	BOD ₅	mg/l	0.3	0.3	0.4	1.07
7	COD	mg/l	0.87	0.82	3.2	3.2
8	Ca	mg/l	12.75	13.5	14.7	14.7
9	Mg	mg/l	9.1	9.2	10.5	10.5
10	Fe	mg/l	0.01	0.01	0.01	0.01
11	Ni	mg/l	0.0	0.0	0.0	0.0
12	Cu	mg/l	0.0	0.0	0.0	0.0
13	Zn	mg/l	0.0	0.14	0.16	0.16
14	Mn	mg/l	0.001	0.001	0.002	0.002
15	K	mg/l	0.01	0.01	0.01	0.01
16	Na	mg/l	0.85	0.97	0.95	0.95
17	HCO ₃ ⁻	mg/l	11.35	11.25	9.78	8.97
18	Cl ⁻	mg/l	1.05	1.05	1.5	1.5
19	SO ₄ ²⁻	mg/l	0.09	0.08	0.01	0.01
20	PO ₄ ³⁻	mg/l	15.0	12.0	15.0	14.0
21	NH ₄ ⁺	mg/l	0.083	0.082	0.078	0.068
22	NO ₂ ⁻	mg/l		0.009	0.009	0.009
23	NO ₃ ⁻	mg/l		0.004	0.003	0.003
24	Coliform	vk/100ml				
25	Hg	mg/l				
26	As	mg/l				

Source: Ke Go Reservoir basic survey 1998, Hanoi Water Resources University

Table 35: Additional surface water quality data in Ke Go Sub-Project Area, December, 1998

No	Parameter	Unit	Rao Pheo river 23/10/1998	Cau Phu 25/10/1998	Cau Cua Hoi (Cam xuyen town) 25/10/1998
1	pH		7.0	6.26	6.48
2	Salinity	o/oo	0.0	0.2	0.1
3	Turbidity	NTU	30.0	0.4	0.4
4	Suspended solids	mg/l	0.4	185.0	126.0
5	DO	mg/l	4.5	4.0	4.15
6	BOD ₅	mg/l	1.0	0.1	0.28
7	COD	mg/l	3.0	2.4	3.2
8	Ca	mg/l	15.2	50.0	46.8
9	Mg	mg/l	11.0	27.5	23.2
10	Fe	mg/l	0.01	0.01	0.01
11	Ni	mg/l	0.0	0.0	0.0
12	Cu	mg/l	0.0	0.0	0.0
13	Zn	mg/l	0.14	0.15	0.15
14	Mn	mg/l	0.002	0.002	0.002
15	K	mg/l	0.01	4.24	3.42
16	Na	mg/l	0.83	13.42	8.24
17	HCO ₃ ⁻	mg/l	8.2	18.24	16.0
18	Cl ⁻	mg/l	1.4	24.7	16.2
19	SO ₄ ²⁻	mg/l	0.01	9.2	7.0
20	PO ₄ ³⁻	mg/l	14.0	14.0	14.0
21	NH ₄ ⁺	mg/l	0.06	0.088	0.065
22	NO ₂ ⁻	mg/l	0.008	0.003	0.004
23	NO ₃ ⁻	mg/l	0.002	0.004	0.003
24	Coliform	vk/100ml		200	150
25	Hg	mg/l			0.0
26	As	mg/l			0.0

Source: Ke Go Reservoir basic survey 1998, Hanoi Water Resources University

Table 36: Surface water quality in Ke Go Sub-Project Area, August, 1997

No	Parameter	Unit	Middle Ke Go reservoir (surface) 27/8/1997	Middle Ke Go reservoir (bottom) 27/8/1997	Middle Ke Go reservoir (surface) 28/8/1997	Middle Ke Go reservoir (bottom) 28/8/1997
1	pH		7.15	6.8	6.9	6.63
2	Salinity	o/oo	0.0	0.0	0.0	0.0
3	Turbidity	NTU	0.9	0.999	1.1	1.1
4	Suspended solids	mg/l	18.0	20.0	18.0	19.0
5	DO	mg/l	4.55	4.49	4.49	4.5
6	BOD ₅	mg/l	0.95	1.0	0.48	0.95
7	COD	mg/l	0.8	1.4	1.0	1.1
8	Ca	mg/l	13.2	13.2	13.1	13.2
9	Mg	mg/l	9.0	9.0	9.0	9.0
10	Fe	mg/l	0.01	0.01	0.01	0.02
11	Al	mg/l	-	-	-	-
12	Ni	mg/l	0.0	0.0	0.0	0.0
13	Cu	mg/l	0.0	0.0	0.0	0.0
14	Zn	mg/l	0.15	0.15	0.15	0.15
15	Mn	mg/l	0.002	0.002	0.001	0.001
16	K	mg/l	0.01	0.01	0.01	0.01
17	Na	mg/l	0.92	0.92	0.95	0.99
18	HCO ₃ ⁻	mg/l	9.76	9.76	9.78	9.78
19	Cl ⁻	mg/l	1.2	1.2	1.20	1.20
20	SO ₄ ²⁻	mg/l	0.1	0.2	0.15	0.18
21	PO ₄ ³⁻	mg/l	14.0	14.0	14.1	14.2
22	NH ₄ ⁺	mg/l	0.078	0.078	0.075	0.08
23	NO ₂ ⁻	mg/l	0.033	0.049	0.034	0.037
24	NO ₃ ⁻	mg/l	0.052	0.039	0.05	0.053
25	Pb	PPb				
26	Hg	PPb				
27	As	PPb				

Source: Ke Go Reservoir basic survey 1997, Hanoi Water Resources University

Table 37: Additional surface water quality in Ke Go Sub-Project Area, August, 1997

No	Parameter	Unit	Rao Cai River (tide) 27/8/1997	Rao Cai River (tide) 27/8/1997	Cau Phu (tide) 27/8/1997	Cau Phu (tide) 28/8/1997
1	pH		7.0	6.97	6.19	6.1
2	Salinity	o/oo	0.0	0.0	0.01	0.01
3	Turbidity	NTU	1.12	0.14	8.9	9.0
4	Suspended solids	mg/l	41.0	42.0	37.0	37.0
5	DO	mg/l	4.81	4.80	4.27	4.25
6	BOD ₅	mg/l	0.81	0.83	0.8	0.81
7	COD	mg/l	3.2	3.2	4.0	4.0
8	Ca	mg/l	24.4	24.5	10.0	10.0
9	Mg	mg/l	9.5	9.7	9.5	9.4
10	Fe	mg/l	0.09	0.09	0.25	0.2
11	Al	mg/l	-	-	0.0	-
12	Ni	mg/l	0.0	0.0	0.06	0.06
13	Cu	mg/l	0.0	0.0	0.10	0.1
14	Zn	mg/l	0.07	0.07	0.18	0.2
15	Mn	mg/l	0.003	0.003	0.004	0.004
16	K	mg/l	1.1	1.1	2.2	2.1
17	Na	mg/l	1.38	1.4	4.9	5.0
18	HCO ₃ ⁻	mg/l	15.86	19.9	9.76	9.8
19	Cl ⁻	mg/l	2.0	2.0	3.0	3.0
20	SO ₄ ²⁻	mg/l	0.1	0.1	8.0	8.0
21	PO ₄ ³⁻	mg/l	12.0	12.0	16.0	16.5
22	NH ₄ ⁺	mg/l	0.026	0.026	0.036	0.04
23	NO ₂ ⁻	mg/l	0.03	0.03	0.02	0.02
24	NO ₃ ⁻	mg/l	0.316	0.3	0.484	0.48
25	Pb	PPb	0.38		0.29	
26	Hg	PPb	4.00		2.0	
27	As	PPb	<2		< 2	

Source: Ke Go Reservoir basic survey 1997, Hanoi Water Resources University

Table 38: Additional surface water quality in Ke Go Sub-Project Area, August, 1997

No	Parameter	Unit	Cau Cua Hoi (Cam xuyen town) -tide 27/8/1997	Cau Cua Hoi (Cam xuyen town) -tide 28/8/1997
1	pH		6.57	6.23
2	Salinity	o/oo	0.01	0.01
3	Turbidity	NTU	9.0	9.1
4	Suspended solids	mg/l	35.0	35.0
5	DO	mg/l	4.7	4.70
6	BOD ₅	mg/l	0.85	0.84
7	COD	mg/l	0.8	0.8
8	Ca	mg/l	8.4	8.4
9	Mg	mg/l	9.5	9.5
10	Fe	mg/l	0.25	0.24
11	Al	mg/l	-	0.0
12	Ni	mg/l	0.06	0.06
13	Cu	mg/l	0.08	0.07
14	Zn	mg/l	0.18	0.19
15	Mn	mg/l	0.003	0.003
16	K	mg/l	2.1	2.1
17	Na	mg/l	4.9	5.0
18	HCO ₃ ⁻	mg/l	9.76	9.8
19	Cl ⁻	mg/l	3.0	3.1
20	SO ₄ ²⁻	mg/l	8.0	8.0
21	PO ₄ ³⁻	mg/l	15.0	16.0
22	NH ₄ ⁺	mg/l	0.039	0.039
23	NO ₂ ⁻	mg/l	0.02	0.03
24	NO ₃ ⁻	mg/l	0.484	0.484

Source: Ke Go Reservoir basic survey 1997, Hanoi Water Resources University

ANNEX 5: SUMMARY OF VIET NAM WATER QUALITY STANDARDS

Standard for quality of surface water -TCVN 5942-1995

No	Parameter	Unit	Limited value	
			A	B
1	pH	-	6-8.5	5.5-9
2	BOD5	Mg/l	<4	<25
3	COD	Mg/l	<10	<35
4	DO	Mg/l	≥ 6	≥ 2
5	Suspended solids	Mg/l	20	80
6	Asen	Mg/l	0.05	0.1
7	Bari	Mg/l	1	4
8	Cadimi	Mg/l	0.01	0.02
9	Lead	Mg/l	0.05	0.1
10	Cr (VI)	Mg/l	0.05	0.05
11	Cr (III)	Mg/l	0.1	1
12	Cu	Mg/l	0.1	1
13	Zn	Mg/l	1	2
14	Mn	Mg/l	0.1	0.8
15	Ni	Mg/l	0.1	1
16	Fe	Mg/l	1	2
17	Hg	Mg/l	0.001	0.002
18	Tin	Mg/l	1	2
19	Amoniac (N)	Mg/l	0.05	1
20	Flo	Mg/l	1	1.5
21	Nitrat (N)	Mg/l	10	15
22	Nitrit (N)	Mg/l	0.01	0.05
23	Xianua	Mg/l	0.01	0.05
24	Phenola (total)	Mg/l	0.001	0.02
25	Oil	Mg/l	Nil	0.3
26	Detergent	Mg/l	0.5	0.5
27	Coliform	MPN/100ml	5000	10000
28	Total pesticide (without DDT)	Mg/l	0.15	0.15
29	DDT	Mg/l	0.01	0.01
30	Gross beta activity α	Bq/l	0.1	0.1
31	Gross beta activity β	Bq/l	1.0	1.0

Note: A column can be supplied for domestic water source (have to be treated and follow the standard)

B column is used in other purposes (specific standard for surface water supply for agriculture and aquatic breeding)

Sanitation standard for drinking water and domestic water on physical and chemical aspects (maximum limitation)
Decision No 505BYT/QD, on 3/4/1992

No	Parameter	Unit	For city	For rural and small plant
(1)	(2)	(3)	(4)	(5)
1	Pure Sneller	cm	>30	>25
2	Colour, scale : Cobalt	units	<10	<10
3	Smell, taste (air-tight after boil at 50-60°C)	point	0	0
4	Undissolvable	mg/l	5	20
5	Dry lees	mg/l	500	1000
6	pH	mg/l	6.5-8.5	6.5-8.5
7	Hardness (CaCO ₃)	mg/l	500	500
8	Salts: - coastal land	mg/l	400	500
	- main land	mg/l	250	250
9	DO (organic)	mg/l	0.5 -2.0	2.0 - 4.0
10	Amoniac – surface water	mg/l	0	0
	- groundwater	mg/l	3.0	3.0
11	Nitrit	mg/l	0	0
12	Nitrat (N)	mg/l	10.0	10.0
13	Alumium	mg/l	0.2	0.2
14	Copper	mg/l	1.0	1.0
15	Iron	mg/l	0.3	0.5
16	Mangan	mg/l	0.1	0.1
17	Natri	mg/l	200	200
18	Sunphate	mg/l	400	400
19	Zinc	mg/l	5.0	5.0
20	Hydrogen sulfide	mg/l	0	0
21	Chlorobenzen và Cholorophenol	mg/l	0	0
22	Detergents	mg/l	0	0
23	A sen	mg/l	0.05	0.05
24	Cadimi	mg/l	0.005	0.005
25	Crom	mg/l	0.05	0.05
26	Xyanua	mg/l	0.1	0.1
27	Florua	mg/l	1.5	1.5
28	Lead	mg/l	0.05	0.05
29	Mercury	mg/l	0.001	0.001
30	Selen	mg/l	0.01	0.01
31	Aldrin và Dieidrin	µg/l	0.03	0.03
32	Benzene	µg/l	10	10
33	Benzo (a) pyrene	µg/l	0.01	0.01
34	Carbon tetrachloride	µg/l	3.0	3.0
35	Chordane	µg/l	0.3	0.3
36	Chloroform	µg/l	30	30
37	2,4D	µg/l	100	100
38	DDT	µg/l	1.0	1.0
39	1,2 –dichlorethan	µg/l	10	10
40	1,1 –dichlorethan	µg/l	0.3	0.3
41	Heptachlor và heptachlor epoxide	µg/l	0.1	0.1
42	Gamme – HCH (lindane)	µg/l	3.0	3.0
43	Hexachlorobenzene	µg/l	0.01	0.01
44	Methoxychlor	µg/l	30	30
45	Pentachloro phenol	µg/l	10	10
46	Tetrachloroethene	µg/l	10	10
47	Trichloroethene	µg/l	30	30
48	2,4,6 Trichlorophenol	µg/l	10	10
49	Trihalomethenes	µg/l	30	30
50	Gross beta activity α	Bq/l	0.1	0.1
51	Gross beta activity β	Bq/l	1.0	1.0

**Sanitation standard for drinking water and domestic water on bacterium and organism
Decision No 505BYT/QD, on 3/4/1992**

No	Exponent	Unit	Standard	Note
I	Bacterium standard			
	A. Water supplied by pipeline			
	A1. Water has been treated at the plant			
	-Faecal coliform	Number /100ml	0	- Turbidity 1 NTU - Pasteurized by clor, pH 8.0. To touch after 30 minutes. Surplus Clor 0.2-0.5 mg/l
	-Coliform organisms	Number / 100 ml	0	
	A2. Water has not been treated at the plant			
	-Faecal coliform	Number /100 ml	0	Ensure 98% of samples in the year obtain the standard . - Sometime Appearance, not always.
	-Coliform organisms	Number /100 ml	≤ 3	
	A3. Water in pipeline			
	-Faecal coliform	Number /100 ml	0	Ensure 95% of samples in the year obtain the standard - Sometime Appearance, not always.
	-Coliform organisms	Number /100 ml	≤ 3	
B. Not supply water by pipeline yet				
-Faecal coliform	Number /100 ml	0	- Not always - If always appearance, need to test sanitation, repair, protection of water sources	
-Coliform organisms	Number /100 ml	10		
C. Botle water				
-Faecal coliform	Number /100 ml	0		
-Coliform organisms	Number /100 ml	0		
D. Emergency water supply				
-Faecal coliform	Number /100 ml	0	- need to be boiled in emergency cases	
-Coliform organisms	Number /100 ml	0		
II	Organism standard			
	- Protozoa		0	
	- Helminths		0	
	- Free organisms (alga,...)		0	

Water quality guidelines for irrigation TCVN 6773 : 2000

Parameter	Unit	Standard
1. Total disoluted soild	mg/l	< 400 applied for salinity instrusion soil (water content EC $\leq 0.75 \mu\text{S/cm}$, 25oC) <1000 applied for area with good irrigation and drainage condition (water content EC $\leq 1.75 \mu\text{S/cm}$, 25oC) < 2000 and low ratio SAR (see Annex A) in water, applied for area which is grown by saline resistant plants, good irrigation and drainage condition. (water content EC $\leq 2.25 \mu\text{S/cm}$, 25oC)
2. Ratio SAR in irrigation water		≤ 10 , applied for areas of poor irrigation and drainage condition. ≤ 18 , applied for areas of good irrigation and drainage condition > 18 applied for areas of poor nutrient soil
3. Bo (B)	mg/l	≤ 1 , applied for soil that having very sensitive plants with Bo ≤ 2 , applied for soil that having medium sensitive plants with Bo ≤ 4 , applied for soil that growing other plants
4. Disloved Oxygen	mg/l	≥ 2
5. pH		5.5 -8.5
6. Clorua (Cl-)	mg/l	≤ 350
7. Herbicide (for each type of herbicide seperately)	mg/l	≤ 0.001
8. Mercury (Hg)	mg/l	≤ 0.001
9. Cadmi (Cd)	mg/l	0.005 – 0.01
10. Asen (As)	mg/l	0.05 – 0.1
11. Lead (Pb)	mg/l	≤ 0.1
12. Crom (Cr)	mg/l	≤ 0.1
13. Zin (Zn)	mg/l	Not more than 1, in case pH soil ≤ 6.5 Not more than 5, in case pH > 6.5
14. Fecal coliform	MPN/100ml	Not more than 200 (applied for soils which are grown vegetables and uncooked plants) No standard applied for soils that are grown other plants

TCVN 6980: 2001

Water quality – Standards for industrial effluents discharged into rivers used for domestic water supply

Hanoi 2001

Foreword

TCVN 6980: 2001 prepared by Technical Team TCVN / TC 147 “Water quality”, recommended by General Department for Standards, Metrology and Quality (STAMEQ), issued by Ministry of Science, Technology and Environment (MOSTE).

1. Scope of application

- 1.1. These standards stipulate in detail limits values of parameters and concentrations of pollutants in industrial effluents by discharge volumes and flow rates of receiving rivers.

In these standards, industrial effluent is understood as waste liquid or wastewater from production processes, processing, and business of industries. The distance between the discharge point and receiving body is in accordance with the current regulations.

- 1.2. These standards are applied concurrently with TCVN 5945: 1995 and used to control the quality of industrial effluents discharged into rivers or springs (hereunder commonly called “rivers”) having water quality suitable for domestic water supply.

2. Reference standards

TCVN 5945: 1995 Industrial effluents – Discharge standards

3. Limit values

- 3.2 Limit values of parameters and concentrations of pollutants in effluents by discharge volume when discharged into rivers with different flow rates, shall not exceed the values shown in Table 1.

Parameters and concentrations of pollutants not stipulated in Table 1 are applied as stipulated in TCVN 5945: 1995.

- 3.2 Sampling, analysis, calculation and identification methods for each parameter and concentration are stipulated in the corresponding TCVNs or by other methods stipulated by competent environment agencies.

TCVN 6980: 2001

Table 1. Limit values and concentrations of pollutants in industrial effluents discharged into rivers used for domestic water supply

Parameters	Q > 200m ³ /s			Q = 50+200m ³ /s			Q < 50m ³ /s		
	F1	F2	F3	F1	F2	F3	F1	F2	F3
1. Color, Co-Pt at pH=7	20	20	20	20	20	20	20	20	20
2. Smell, sense	No bad smell	No bad smell	No bad smell	No bad smell	No bad smell	No bad smell	No bad smell	No bad smell	No bad smell
3. BOD ₅ (20° C), mg/l	40	35	35	30	25	25	20	20	20
4. COD, mg/l	70	60	60	60	50	50	50	40	40
5. Total suspended solids, mg/l	50	45	45	45	40	40	40	30	30
6. Arsenic, As, mg/l	0.2	0.2	0.2	0.15	0.15	0.15	0.1	0.05	0.05
7. Lead, Pb, mg/l	0.1	0.1	0.1	0.08	0.08	0.08	0.06	0.06	0.06
8. Mineral oil & grease, mg/l	5	5	5	5	5	5	5	5	5
9. Organic oil & grease, mg/l	20	20	20	10	10	10	5	5	5
10. Copper, Cu, mg/l	0.4	0.4	0.4	0.3	0.3	0.3	0.2	0.2	0.2
11. Zinc, Zn, mg/l	1	1	1	0.7	0.7	0.7	0.5	0.5	0.5
12. Total phosphorus, mg/l	10	10	10	6	6	6	4	4	4
13. Chloride, Cl ⁻ , mg/l	600	600	600	600	600	600	600	600	600
14. Coliform, MPN/100 ml	3000	3000	3000	3000	3000	3000	3000	3000	3000

Notes:

Q is river's flow rate, m³/s

F is volume of effluent, m³/day (24 hours)

F1 – From 50 m³ up to 500 m³/day

F2 – From 500 m³ up to 5000 m³/day

F3 – equal or more than 5000 m³/day

TCVN 6981: 2001

Water quality – Standards for industrial effluents discharged into lakes used for domestic water supply

Table 1. Limit values and concentrations of pollutants in industrial effluents discharged into lakes used for domestic water supply

Parameters	V > 100 x 10 ⁶ m ³			V = (10 ÷ 100) x 10 ⁶ m ³			V < 10 x 10 ⁶ m ³		
	F1	F2	F3	F1	F2	F3	F1	F2	F3
1. Color, Co-Pt at pH=7	20	20	20	20	20	20	20	20	20
2. Smell, sense	No bad smell	No bad smell	No bad smell	No bad smell	No bad smell	No bad smell	No bad smell	No bad smell	No bad smell
3. BOD ₅ (20° C), mg/l	30	30	30	20	20	20	15	15	15
4. COD, mg/l	60	60	60	40	40	40	30	30	30
5. Total suspended solids, mg/l	50	50	50	40	40	40	30	20	15
6. Arsenic, As, mg/l	0.05	0.04	0.04	0.04	0.03	0.03	0.03	0.02	0.02
7. Lead, Pb, mg/l	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1
8. Chrome (Cr) III, mg/l	0.2	0.2	0.2	0.15	0.15	0.15	0.10	0.10	0.10
9. Mineral oil & grease, mg/l	5	5	5	5	5	5	5	5	5
10. Organic oil & grease, mg/l	20	20	20	20	20	20	20	20	20
11. Copper, Cu, mg/l	0.4	0.4	0.4	0.3	0.3	0.3	0.2	0.2	0.2
12. Zinc, Zn, mg/l	1	0.8	0.8	0.7	0.7	0.7	0.5	0.5	0.5
13. Total phosphorus, P, mg/l	10	8	8	8	6	6	6	4	4
14. Chloride, Cl ⁻ , mg/l	500	500	500	500	500	500	500	500	500
15. Coliform, MPN/100 ml	3000	3000	3000	3000	3000	3000	3000	3000	3000

Notes:

V is water volume of lake, m³

F is volume of wastewater, m³/day (24 hours)

F1 – From 50 m³ up to 500 m³/day

F2 – From 500 m³ up to 5000 m³/day

F3 – equal or more than 5000 m³/day

TCVN 6982: 2001

Water quality – Standards for industrial effluents discharged into rivers used for water sports and recreation

Table 1. Limit values and concentrations of pollutants in industrial effluents discharged into rivers used for water sports and recreation

Parameters	Q > 200m ³ /s			Q = 50÷200m ³ /s			Q < 50m ³ /s		
	F1	F2	F3	F1	F2	F3	F1	F2	F3
1. Color, Co-Pt at pH=7	50	50	50	50	50	50	50	50	50
2. Smell, sense	No bad smell	No bad smell	No bad smell	No bad smell	No bad smell	No bad smell	No bad smell	No bad smell	No bad smell
3. BOD ₅ (20° C), mg/l	50	40	40	40	30	30	30	30	30
4. COD, mg/l	100	80	80	80	60	60	60	60	60
5. Total suspended solids, mg/l	100	90	90	90	80	80	80	70	70
6. Arsenic, As, mg/l	0.1	0.08	0.08	0.08	0.07	0.07	0.06	0.06	0.06
7. Lead, Pb, mg/l	0.5	0.5	0.5	0.5	0.5	0.4	0.4	0.4	0.4
8. Chrome (Cr) III, mg/l	0.1	0.08	0.08	0.08	0.08	0.08	0.06	0.06	0.06
9. Total phosphorus, P, mg/l	10	8	8	8	6	6	6	5	5
10. Chloride, Cl ⁻ , mg/l	600	600	600	600	600	600	600	600	600
11. Coliform, MPN/100 ml	3000	3000	3000	3000	3000	3000	3000	3000	3000

Notes:

Q is river's flow rate, m³/s

F is volume of effluent, m³/day (24 hours)

F1 – From 50 m³ up to 500 m³/day

F2 – From 500 m³ up to 5000 m³/day

F3 – equal or more than 5000 m³/day

TCVN 6983: 2001

Water quality – Standards for industrial effluents discharged into lakes used for water sports and recreation

Table 1. Limit values and concentrations of pollutants in industrial effluents discharged into rivers used for water sports and recreation

Parameters	$V > 100 \times 10^6 \text{ m}^3$			$V = (10 \div 100) \times 10^6 \text{ m}^3$			$V < 10 \times 10^6 \text{ m}^3$		
	F1	F2	F3	F1	F2	F3	F1	F2	F3
1. Color, Co-Pt at pH=7	50	50	50	50	50	50	50	50	50
2. Smell, sense	No bad smell	No bad smell	No bad smell	No bad smell	No bad smell	No bad smell	No bad smell	No bad smell	No bad smell
3. BOD ₅ (20° C), mg/l	50	40	40	30	30	30	30	20	20
4. COD, mg/l	100	80	80	70	60	60	60	40	40
5. Total suspended solids, mg/l	80	80	80	70	70	60	60	50	50
6. Arsenic, As, mg/l	0.1	0.08	0.08	0.08	0.07	0.07	0.06	0.06	0.06
7. Lead, Pb, mg/l	0.5	0.5	0.5	0.5	0.4	0.4	0.4	0.4	0.4
8. Chrome (Cr) III, mg/l	0.1	0.08	0.08	0.08	0.08	0.08	0.06	0.06	0.06
9. Total phosphorus, P, mg/l	8	6	6	6	5	5	5	4	4
10. Mercury, Hg, mg/l	0.005	0.005	0.005	0.005	0.004	0.004	0.004	0.004	0.004
11. Chloride, Cl-, mg/l	500	500	500	500	500	500	500	500	500
12. Coliform, MPN/100 ml	3000	3000	3000	3000	3000	3000	3000	3000	3000

Notes:

V is water volume of lake, m³

F is volume of effluent, m³/day (24 hours)

F1 – From 50 m³ up to 500 m³/day

F2 – From 500 m³ up to 5000 m³/day

F3 – equal or more than 5000 m³/day

Table 1. Limit values and concentrations of pollutants in industrial effluents discharged into rivers used for protection of aquatic life

Parameters	Q > 200m ³ /s			Q = 50÷200m ³ /s			Q < 50m ³ /s		
	F1	F2	F3	F1	F2	F3	F1	F2	F3
1. Color, Co-Pt at pH=7	50	50	50	50	50	50	50	50	50
2. Smell, sense	Light	Light	Light	Light	Light	Light	Light	Light	Light
3. pH	6-8.5	6-8.5	6-8.5	6-8.5	6-8.5	6-8.5	6-8.5	6-8.5	6-8.5
4. BOD ₅ (20° C), mg/l	50	45	40	40	35	30	30	20	20
5. COD, mg/l	100	90	80	80	70	60	60	50	50
6. Total suspended solids, mg/l	100	100	100	90	80	80	80	80	80
7. Arsenic, As, mg/l	0.1	0.1	0.1	0.08	0.08	0.08	0.05	0.05	0.05
8. Cadmium, Cd, mg/l	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01
9. Lead, Pb, mg/l	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
10. Iron, mg/l	5	5	5	4	4	4	3	3	3
11. Cyanide, CN ⁻ , mg/l	0.1	0.1	0.1	0.05	0.05	0.05	0.05	0.05	0.05
12. Mineral oil & grease, mg/l	10	5	5	10	5	5	5	5	5
13. Organic oil & grease, mg/l	20	20	20	20	10	10	10	10	10
14. Organic phosphorus, mg/l	1	1	0.8	0.8	0.5	0.5	0.5	0.5	0.5
15. Total phosphorus, mg/l	10	8	8	6	6	6	5	5	4
16. Chloride, Cl ⁻ , mg/l	1000	1000	1000	800	800	800	750	750	750
17. Surface active substance, mg/l	10	10	10	5	5	5	5	5	5
18. Coliform, MPN/100 ml	5000	5000	5000	5000	5000	5000	5000	5000	5000
19. PCB, mg/l	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01

Notes:

Q is river's flow rate, m³/sF is volume of effluent, m³/day (24 hours)F1 – From 50 m³ up to 500 m³/dayF2 – From 500 m³ up to 5000 m³/dayF3 – equal or more than 5000 m³/day

TCVN 6985: 2001

Water quality – Standards for industrial effluents discharged into lakes used for protection of aquatic life

Table 1. Limit values and concentrations of pollutants in industrial effluents discharged into lakes used for protection of aquatic life

Parameters	V > 100 x 10 ⁶ m ³			V = (10 ÷ 100) x 10 ⁶ m ³			V < 10 x 10 ⁶ m ³		
	F1	F2	F3	F1	F2	F3	F1	F2	F3
1. Color, Co-Pt at pH=7	50	50	50	50	50	50	50	50	50
2. Smell, sense	Light	Light	Light	Light	Light	Light	Light	Light	Light
3. pH	6-8.5	6-8.5	6-8.5	6-8.5	6-8.5	6-8.5	6-8.5	6-8.5	6-8.5
4. BOD ₅ (20° C), mg/l	50	40	40	40	30	30	30	20	20
5. COD, mg/l	90	80	80	70	60	60	50	50	50
6. Total suspended solids, mg/l	100	90	90	80	70	70	70	70	70
7. Arsenic, As, mg/l	0.1	0.07	0.07	0.05	0.05	0.04	0.04	0.03	0.03
8. Cadmium, Cd, mg/l	0.02	0.015	0.015	0.01	0.01	0.01	0.005	0.01	0.01
9. Lead, Pb, mg/l	0.5	0.4	0.4	0.3	0.3	0.3	0.2	0.1	0.1
10. Iron, mg/l	5	5	5	4	4	4	3	3	3
11. Cyanide, CN-, mg/l	0.1	0.1	0.1	0.05	0.05	0.05	0.05	0.05	0.05
12. Mineral oil & grease, mg/l	10	10	10	5	5	5	5	5	5
13. Organic oil & grease, mg/l	10	10	10	7	7	7	5	5	5
14. Organic phosphorus, mg/l	0.5	0.5	0.5	0.5	0.5	0.5	0.3	0.3	0.3
15. Total phosphorus, mg/l	6	6	6	5	5	5	4	4	4
16. Chloride, Cl-, mg/l	750	750	700	650	600	600	500	500	500
17. Chloride free, mg/l	1	1	1	1	1	1	1	1	1
18. Surface active substance, mg/l	5	5	5	5	5	5	5	5	5
19. Coliform, MPN/100 ml	5000	5000	5000	5000	5000	5000	5000	5000	5000
20. PCB, mg/l	0.05	0.04	0.04	0.04	0.03	0.03	0.01	0.01	0.01

Notes:

V is water volume of lake, m³

F is volume of effluent, m³/day (24 hours)

F1 – From 50 m³ up to 500 m³/day

F2 – From 500 m³ up to 5000 m³/day

F3 – equal or more than 5000 m³/day

TCVN 6986: 2001

Water quality – Standards for industrial effluents discharged into coastal waters used for protection of aquatic life

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3. Limit values

- 3.1 Limit values of parameters and concentrations of pollutants in wastewater by discharge volume when discharged into rivers with different flow rates, shall not exceed the values shown in Table 1.

Parameters and concentrations of pollutants not stipulated in Table 1 are applied as stipulated in TCVN 5945: 1995.

- 3.2 If the coastal area has coral ecosystem or other ecosystems sensitive with temperature, then the effluents discharged into that area should not raise the temperature of the receiving coastal area by more than 3 °C, measured at 100 m from the discharging point within the effluent propagation.
- 3.3 Wastes containing biphenyl polychlorinated (PCB), poliaromat hydrocarbon (PAH) may be discharged into coastal waters at “trace” level by current analytical methods.
- Wastes containing radioactive substance, inflammable solvents, floating solids of more than 1 mm, are not allowed to be discharged into coastal waters.
- 3.4 Central or local competent agencies can stipulate limit values and concentrations of the parameters in Table 1 more stringent depending on objectives, requirements on protection of a specific marine area.
- 3.5 Sampling, analysis, calculation, identification methods for each parameter and concentration are stipulated in corresponding TCVNs or by other methods stipulated by competent environment agencies.

Table 1. Limit values and concentrations of pollutants in industrial effluents discharged into coastal waters used for protection of aquatic life

Parameters	Permissible levels		
	F1	F2	F3
1. Color, Co-Pt at pH=7	50	50	50
2. Smell, sense	No bad smell	No bad smell	No bad smell
3. pH	5 - 9	5 - 9	5 - 9
4. BOD ₅ (20 °C), mg/l	50	20	10
5. COD, mg/l	100	80	50
6. Total suspended solids, mg/l	100	80	50
7. Arsenic, As, mg/l	1	0.5	0.1
8. Lead, Pb, mg/l	1	0.5	0.5
9. Chrome VI, Cr, mg/l	1	0.5	0.1
10. Copper, Cu, mg/l	1	0.5	0.1
11. Zinc, Zn, mg/l	2	1	1
12. Manganese, Mn, mg/l	5	5	1
13. Mercury, Hg, mg/l	0.005	0.001	0.001
14. Total nitrogen (by N), mg/l	20	15	10
15. Mineral oil & grease, mg/l	10	5	5
16. Organic oil & grease, mg/l	30	20	10
17. Organic phosphorus, P, mg/l	0.5	0.2	0.2
18. Surface active substance, mg/l	10	5	5
19. Coliform, MPN/100 ml	5000	5000	5000

Notes:

F is volume of effluent, m³/day (24 hours)

F1 – From 50 m³ up to 500 m³/day

F2 – From 500 m³ up to 5000 m³/day

F3 – equal or more than 5000 m³/day

TCVN 6987: 2001

Water quality – Standards for industrial effluents discharged into coastal waters used for water sports and recreation

3. Limit values

- 3.1 Limit values of parameters and concentrations of pollutants in wastewater by discharge volume when discharged into rivers with different flow rates, shall not exceed the values shown in Table 1.

Parameters and concentrations of pollutants not stipulated in Table 1 are applied as stipulated in TCVN 5945: 1995.

- 3.2 Wastes containing biphenyl polychlorinated (PCB), poliaromat hydrocarbon (PAH) may only be discharged into coastal waters at “trace” level by current analytical methods.

Wastes containing radioactive substance, inflammable solvents, floating solids of more than 1 mm, are not allowed to be discharged into coastal waters.

- 3.3 Sampling, analysis, calculation, and identification methods for each parameter and concentration are stipulated in corresponding TCVNs or by other methods stipulated by competent environment agencies.

Table 1. Limit values and concentrations of pollutants in industrial effluents discharged into coastal waters used for water sports and recreation

Parameters	Permissible levels		
	F1	F2	F3
1. Temperature, °C	50	50	50
2. Color, Co-Pt at pH=7	30	30	30
3. Smell, sense	No bad smell	No bad smell	No bad smell
4. pH	5.5 – 8.5	5.5 – 8.5	5.5 – 8.5
5. BOD ₅ (20 °C), mg/l	50	40	30
6. COD, mg/l	100	80	50
7. Total suspended solids, mg/l	100	80	60
8. Arsenic, As, mg/l	1	0.5	0.1
9. Lead, Pb, mg/l	0.5	0.4	0.4
10. Chrome VI, Cr, mg/l	1	0.5	0.1
11. Fluoride, F-, mg/l	25	25	15
12. Mercury, Hg, mg/l	0.005	0.004	0.004
13. Sulfide, mg/l	1	0.5	0.5
14. Total nitrogen (by N), mg/l	20	15	10
15. Total phosphorus, mg/l	6	5	4
16. Mineral oil & grease, mg/l	5	5	5
17. Organic oil & grease, mg/l	10	10	10
18. Surface active substance, mg/l	10	5	5
19. Coliform, MPN/100 ml	3000	3000	3000

Notes:

F is volume of effluent, m³/day (24 hours)

F1 – From 50 m³ up to 500 m³/day

F2 – From 500 m³ up to 5000 m³/day

F3 – equal or more than 5000 m³/day

Water quality – Fresh water quality guidelines for protection of aquatic lifes

1. Scope of application

These standards applied as a guideline for assessment of suitable and safe surface water quality for aquatic life.

- 1.3. These standards applied as a foundation for requirement of water quality management to protect aquatic life.

2. Water quality for protection of aquatic life

In order to protect aquatic life, all socio-economic activities relating to waste water and surface water exploitation and use do not change value of any parameter in the Table 1.

Parameters	Unit	Standard	Note
1. Disolved Oxygen	mg/l	5	Average daily
2. Temperature	oC	Natural temperature in the basin	Seasonal
3. BOD ₅ , 20oC	mg/l	< 10	
4. Pesticide (organic clo)			
Aldrin/ Dieldrin	µg/l	< 0.008	
Endrin	µg/l	< 0.014	
B.H.C	µg/l	< 0.13	
DDT	µg/l	< 0.004	
Endosulfan	µg/l	< 0.01	
Lindan	µg/l	0.38	
Clordan	µg/l	0.02	
Heptaclo	µg/l	0.06	
5. Pesticide (organic Phospho)			
Paration	µg/l	≤ 0.40	
Malation	µg/l	≤ 0.32	
6. Herbicide			
2, 4 D	mg/l	≤ 0.45	
2,4,5 D	mg/l	≤ 0.16	
Paraquat	mg/l	≤ 1.80	
7. CO ₂	mg/l	< 12	
8. pH		6.5 – 8.5	
9. NH ₃	mg/l	≤ 2.20 ≤ 1.33 ≤ 1.49 ≤ 0.93	pH = 6.5, t°C = 15 pH = 8.0, t°C = 15 pH = 6.5, t°C = 20 pH = 8.0, t°C = 20
10. Xyanua	mg/l	≤ 0.005	
11. Copper	mg/l	0.002 – 0.004	Depend on hardness of water (CaCO ₃)
12. Asen	mg/l	≤ 0.02	
13. Crom	mg/l	≤ 0.02	
14. Cadmi	µg/l	0.80 – 1.80	Depend on hardness of water (CaCO ₃)
15. Lead (Pb)	mg/l	0.002 – 0.007	Depend on hardness of water (CaCO ₃)
16. Selen	mg/l	≤ 0.001	
17. Mercury (total)	µg/l	≤ 0.10	
18. Oil (mineral)	mg/l	Not see oily film, emulsion	
19. Phenol (total)	mg/l	≤ 0.02	
20. Disolved solid	mg/l	≤ 1000	
21. Suspended solid	mg/l	≤ 100	
22. Surface active matters	mg/l	≤ 0.5	

Drinking water quality

(Promulgation based on Decision No 1329/2002/BYT/QD dated 18/4/2002 by Ministry of Health)

A. Explanation of terminology

- Drinking water: in these standards applied for drinking water, food processing, water in water treatment plants to provide for drinking and domestic uses.
- The sense parameters: all parameters are impacted to the sense characteristic of water, if over the limited level making the difficulty for water users.

B. Applied limitation

The water uses for drinking, manufactory, food processing, water in pipe lines from urban water treatment plants, or water collection plants to provide for more than 500 people.

C. Applied limitation

The water uses for drinking, manufactory, food processing, water in pipe lines from urban water treatment plants, or water collection plants to provide for more than 500 people.

**ANNEX 6: SUMMARY OF BIODIVERSITY INFORMATION FOR HA
TINH PROVINCE**

Table 39: List of rare mammals in Ke Go Nature Reserve.

	Scientific name	VIETNAMESE NAME	English Name	IUCN 2000 Redlist	Vietnam Red Book
Mammalia		THÚ			
1	<i>Felis temmincki</i>	BEO LỬA	Panther	LR/nt	V
2	<i>Cynocephalus variegatus</i>	CHỒN DỜI	Weasel	R	
3	<i>Pygathrix nemaeus</i>	VOOC VÁ		E	E
4	<i>Helarctos malayanus</i>	GẤU CHỒ		E	V
5	<i>Lutra lutra</i>	RÁI CÁ THƯỜNG	Common Otter (E) Old World Otter (E)	VUA2cde	T
6	<i>Hylobates gabriellae</i>	VƯỜN MÃ HUNG		E	E
7	<i>Macaca arctoides</i>	KHỈ MẶT ĐỎ	Bear Macaque (E) Stump- Tailed Macaque (E) Stumptail Macaque(E) Macaque Brun (F) Macaca Ursin (S)	VUA1cd	V(+)
8	<i>Macaca nemestrina</i>	KHỈ ĐUÔI LỚN		V	
9	<i>M. assamensis</i>	KHỈ MỐC			V
10	<i>Nicticabus caucang</i>	CULI LỚN	Loris		V
11	<i>Arctictis binturong</i>	CÁY MỤC		V	
12	<i>Manis pentadactyla</i>	TÊ TÊ VÀNG	Chinese Pangolin (E)	LR/nt	E(*)
13	<i>Petaurista petaurista</i>	SÓC BAY LỚN	Flying squirrel		R
14	<i>Panthera tigris</i>	HỔ	Tiger	E	E
15	<i>Ursus thibetanus</i>	GẤU NGƯA	Asiatic Black Bear (E)	VUA1cd	E(*)
16	<i>Bos gaurus</i>	BÒ TÓT		E	V
17	<i>Capricornis sumatraensis</i>	SƠN DƯƠNG	Chamois	V	V
18	<i>Elephas maximus</i>	VOI	Elephant	V	E
aves		CHIM			
1	<i>Cairina scutulata</i>	NGAN CÁNH TRẮNG	Swan	E	E
2	<i>Rheinartia ocellata</i>	TRỊ SAO	Pheinaridia ocellata	T	V
3	<i>Lophura hatinhensis</i>	GÀ LÔI LAM ĐUÔI TRẮNG	pheasant	E	E
4	<i>L. imperialis</i>	GÀ LÔI LAM MÀO ĐEN	pheasant	E	CR
5	<i>L. diardi</i>	GÀ LÔI HỒNG TÍA	Lophura diardi	T	V
6	<i>Arborophila charitonii</i>	GÀ SO CHÂN VÀNG	Hill partridge		V
7	<i>Carpococcyx renauldi</i>	PHƯỚNG ĐẤT		T	
8	<i>Ceryle lugubris</i>	BỒI CÁ LỚN	Kingfisher	T	
9	<i>Alcedo hercules</i>	BỔNG CHANH RỪNG		T	V
10	<i>Buceros bicornis</i>	HỒNG HOÀNG	Great hornbill	T	
11	<i>Rhyticeros undulatus</i>	NIỀM MỎ VẪN		T	
12	<i>Picus rabieri</i>	GỖ KIẾN XANH ĐẦU ĐỎ	woodpecker	T	V
13	<i>Psarisomus dalhousiae</i>	MỎ RỘNG XANH		T	
14	<i>Pitta ellioti</i>	ĐUÔI CỤT BỤNG VẪN		T	
15	<i>Temnurus temnurus</i>	KHÁCH ĐUÔI CỜ		T	
16	<i>Jabouilleia danjoui</i>	KHIẾU MỎ DÀI		T	V
17	<i>Paradoxomis davidianus</i>	KHIẾU MỎ DẸT ĐUÔI NGẮN		T	V
Reptilia		BÒ SÁT			
1	<i>Cistoclemmus galbinifrons</i>	RÙA HỘP TRẮNG VÀNG			V
2	<i>Gekko gekko</i>	TẮC KẾ			T
3	<i>Indotestudo elongata</i>	RÙA NÚI VÀNG	Elongated Tortoise (E) Pineapple Tortoise (E)	EN A1cd+2cd	V
4	<i>Manouria impressa</i>	RÙA NÚI VIỄN	Impressed Tortoise (E)	VU A1acd, B1+2acd	V
5	<i>Naja naja</i>	RẮN HỔ MANG			T
6	<i>Ophipagus hannah</i>	RẮN HỔ MANG CHÚA			V
7	<i>Python molurus</i>	TRẦN ĐẤT			V
8	<i>Varanus salvator</i>	KỶ ĐÀ HOA			V

Table 10: List of rare plants in Ke Go Nature Reserve.

No	Scientific Name	VIETNAMESE NAME	English Name	IUCN 2000 Redlist	Vietnamese Red Book
1	<i>Aquilaria crassna</i>	TRÁM HƯƠNG		CR A1cd	(E)
2	<i>Churasia tabularis</i>	LÁT HOA			(K)
3	<i>Dalbergia tonkinensis</i>	SƯA		VU A1cd	(R)
4	<i>Madhuca pasquieri</i>	SẾN MẬT		VU A1cd	(K)
5	<i>Parashorea chinensis</i>	CHỖ CHỈ		EN A1cd, C2a, D	(K)
7	<i>Podocarpus henryi</i>	KIM GIAO			(T)
8	<i>Manglietia fordiana</i>	VÀNG TÂM			(T)
9	<i>Calamus platyacanthus</i>	SONG MẬT			(T)
10	<i>Sindora tonkinensis</i>	GU LAU		DD	(V)

Note for IUCN Redlist of Threatened Species

EX: Extinct
 EW: Extinct in the wild
 CR: Critically and Endangered
 EN: Endangered
 VU: Vulnerable
 LR/cd: Lower Risk /Conservation Dependent
 LR/nt: Lower Risk /Near Threatened
 DD: Data Deficient

Note for Vietnamese Red Book:

(+) A group can be 5 – 6 individuals
 Level V: Vulnerable
 Level E: Endangered
 Level R: Rare
 Level T: Threatened

ANNEX 7: DESCRIPTION OF KE GO NATURE RESERVE

Ke Go Nature Reserve

Alternative site name(s)

Ho Ke Go

Province(s)

Ha Tinh

Status

Decreed

Management board established

Yes

Latitude

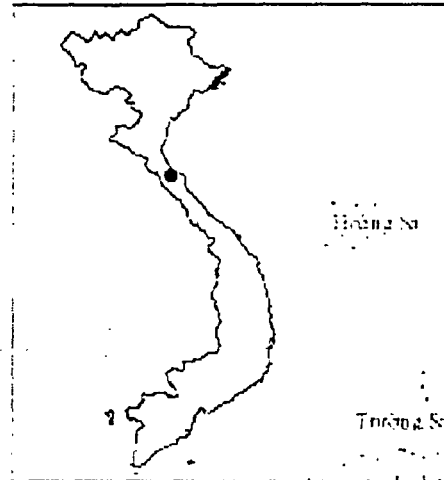
18°00' - 18°09'N

Longitude

105°50' - 106°07'E

Bio-unit

05c - North Annam



Conservation status

Ke Go is located in Huong Khe, Cam Xuyen and Ky Anh districts in the south of Ha Tinh province. The site does not include Ke Go reservoir. Prior to 1990, the Ke Go area was under the management of Cam Ky Forest Enterprise, which managed all the forested areas in Ky Anh and Cam Xuyen districts, Ha Tinh province. In 1990, Cam Ky Forest Enterprise ceased logging operations and part of the area under its management was designated as Ke Go Reservoir Watershed Protection Forest (WPF). On 1 June 1994, following decision No. 773 QD/UB of Ha Tinh Provincial People's Committee, a management board was created for Ke Go Reservoir WPF. When Ke Go Nature Reserve was decreed in 1996, it combined 7,511 ha previously under the management of Ky Anh II Forest Enterprise, 5,905 ha previously under the management of Ha Dong Forest Enterprise and 11,385 ha previously under the management of Ke Go Reservoir WPF (Le Trong Trai *et al.* 1999).

Ke Go is situated in the Annamese lowlands, an area noted for the occurrence of several endemic bird species, including the globally endangered Vietnamese Pheasant *Lophura hatinhensis* and the globally critically endangered Imperial Pheasant *L. imperialis* (Stattersfield *et al.* 1998). BirdLife International, in collaboration with the Centre for Natural Resources

and Environmental Studies (CRES), first initiated field surveys for these enigmatic pheasants in 1988. In early 1990, the two organisations identified the forests of Ke Go as being potentially important for the conservation of these species (Le Trong Trai *et al.* 1999).

Following the rediscovery of Vietnamese Pheasant *Lophura hatinhensis* and Imperial Pheasant *L. imperialis* in southern Ha Tinh province in 1988 and 1990 respectively (Robson *et al.* 1991), an investment plan for Ke Go Nature Reserve was published by BirdLife International and FIPI in August 1996 (Le Trong Trai *et al.* 1996). This investment plan gave the total area of the nature reserve as 24,801 ha, comprising a strict protection area of 20,537 ha and a forest rehabilitation area of 4,264 ha. Following Decision No. 970/TTg, Ke Go Nature Reserve was decreed by the government of Vietnam on 28 December 1996. The establishment of the nature reserve was approved by Ha Tinh Provincial People's Committee on 3 May 1997, following Decision No. 519/QD-UB, and a management board was formed on 12 June 1997. Ke Go Nature Reserve is currently under the management of Ha Tinh Provincial DARD (Ha Tinh Provincial DARD 2000). Ke Go Nature Reserve is included on the 2010 list with an area of 24,801 ha (FPD 1998).

Topography and hydrology

The northern boundary of Ke Go Nature Reserve follows the southern shore of Ke Go reservoir. To the south, the nature reserve extends to the border between Ha Tinh and Quang Binh provinces. The topography of the nature reserve is comprised of gently undulating low hills, a landscape typical of the midlands of central Vietnam. Elevations in the nature reserve range between 50 and 497 m, although most of the nature reserve is below 300 m.

There are three main watersheds in Ke Go Nature Reserve. The Rao Boi watershed feeds Ngan Sau river, which flows into the Ngan Pho river, which in turn flows into the Lam River, and thence into the South China Sea. Ke Go reservoir watershed is fed by a number of rivers and permanent streams and covers the largest area of the nature reserve. The Chin Xai-Cat Bin watershed feeds the Khe Canh river, which flows south into Quang Binh province and, eventually, joins the Gianh river.

Biodiversity value

Ke Go Nature Reserve supports 24,284 ha of natural forest, equivalent to 98% of the total area. However, the forest has been selectively logged in the past, 76% of it is classified as heavily disturbed, and undisturbed primary forest is virtually absent. Lightly disturbed forest is concentrated at higher elevations, while heavily disturbed forest is distributed in more accessible lowland areas. Below 300 m, the tree flora is dominated by *Michelia* spp., *Cinnamomum* spp., *Madhuca pasquieri* and *Erythrophleum fordii*. Above 300 m, the tree flora is dominated by *Hopea* spp. (Le Trong Trai *et al.* 1999).

To date, 46 species of mammal, 270 species of bird and 562 species of plant have been recorded at Ke Go Nature Reserve. Ten globally threatened mammal species have been recorded at the nature reserve. However, several of these species, in particular Asian Elephant *Elephas maximus*, Gaur *Bos gaurus* and Tiger *Panthera tigris*, may already be extinct or reduced to relict populations as a result of hunting. Buff-cheeked Gibbon *Hylobates gabriellae*, another species of conservation concern, is reported to be extremely rare

in the area as a result of unrestricted hunting and exploitation of the forest (Le Trong Trai *et al.* 1999).

Ke Go Nature Reserve is situated in the Annamese Lowlands Endemic Bird Area, and supports populations of five restricted-range bird species: Imperial Pheasant, Vietnamese Pheasant, Crested Argus *Rheinardia ocellata*, Short-tailed Scimitar Babbler *Jabouilleia danjoui* and Grey-faced Tit Babbler *Macronous kelleyi*. Of greatest significance, Ke Go Nature Reserve, together with the adjacent forest area in northern Quang Binh province, is the only site in the world known to support a population of Vietnamese Pheasant.

Conservation issues

The major threats to biodiversity at Ke Go Nature Reserve are hunting, illegal timber extraction, charcoal production, fuelwood collection and fragrant oil extraction (Le Trong Trai *et al.* 1999). There are 8,873 households in the buffer zone of Ke Go Nature Reserve, with a total of 39,917 people, belonging mainly to the Kinh ethnic group (Ha Tinh Provincial DARD 2000). Around half of these households supplement their incomes through the exploitation of forest resources such as firewood, charcoal, palm leaves, rattans and honey (Le Trong Trai *et al.* 1999).

Fragrant oil distillation is widely practised and has significantly contributed to the degradation of the forest at Ke Go Nature Reserve. Fragrant oil is distilled from *Cinnamomum parthenoxylum*, although other members of the Lauraceae family are also used. It is estimated that, for each tree fragrant oil is distilled from, one square kilometre of forest is negatively affected, because the process requires large quantities of firewood (Le Trong Trai *et al.* 1999).

Timber is extracted for use locally in construction but is also illegally exported abroad. The tree species favoured for timber are *Hopea* spp., although other species of lower value are also exploited (Le Trong Trai *et al.* 1999).

Hunting also plays an important role in the local economy. Prior to the opening of Vietnam's economy, animals were hunted principally for local consumption. However, the opening of Vietnam's economy has changed this pattern significantly: foreign demand for

wild animals has broadened the range of species subject to hunting and increased overall hunting pressure. Populations of large and medium-sized mammals suffer from constant hunting pressure. Moreover, the use of non-specific hunting methods, such as traps and snares, threatens ground bird species, such as Vietnamese Pheasant (Le Trong Trai *et al.* 1999).

Ke Go Nature Reserve has a staff of 70, including 56 forest guards. The staff are stationed at the nature reserve headquarters and five guard stations (Ha Tinh Provincial DARD 2000).

Ke Go Nature Reserve is contiguous with a large area of natural forest in northern Quang Binh province. This area is included within Khe Net proposed nature reserve (see Khe Net site card). Together, the two sites contain one of the largest remaining areas of natural forest in the Annamese lowlands.

Other documented values

Ke Go Nature Reserve protects a large proportion of the watershed of Ke Go reservoir. This reservoir has high economic importance, since it supplies domestic water for Ha Tinh town and irrigates 22,000 ha of agricultural land. Similarly, the nature reserve protects part of the watershed of the Gianh river, an important source of water for irrigation in Quang Binh province (Le Trong Trai *et al.* 1999).

The potential timber and tourism values of the nature reserve are less apparent. Due to the intensity and duration of past commercial logging, the commercial timber value of the forest at Ke Go has declined significantly, to the extent that commercial logging is of dubious economic viability. The nature reserve remains, however, an important source of timber and non-timber forest products for local communities. The presence of numerous globally threatened and restricted-range bird species could attract a small number of specialised ecotourists, particularly overseas bird watchers. Overall, however, the proposed nature reserve can be considered to have low potential for general ecotourism because wildlife populations have been seriously depressed by hunting, to the point at which most mammals and large birds are impossible to observe. In addition, Ke Go is a lowland area and lacks any major landscape features, and the

nature reserve currently has no visitor facilities (Le Trong Trai *et al.* 1999).

Related projects

Prior to the establishment of Ke Go Nature Reserve, CRES, Ky Anh District People's Committee and Ha Tinh Provincial Department of Science, Technology and the Environment implemented a project to protect the Gat Che Me area in the east of the nature reserve. This project was supported financially by ORO-VERDE.

Between 1992 and 1998, with funding from the National Environment Programme of Vietnam, the Institute of Ecology and Biological Resources conducted a biodiversity survey of the Ke Go area.

In 1996, as part of the European Union-funded project *The Conservation of Biodiversity in the Annamese Lowlands and the Da Lat Plateau, Vietnam*, BirdLife and FIPI prepared an investment plan for Ke Go Nature Reserve.

In 1996, with funding from the Danish Embassy in Hanoi, BirdLife and Oxfam UK-Ireland implemented a one-year environmental education project. This project worked in collaboration with Ky Anh District Department of Education and Training in the buffer zone of Ke Go Nature Reserve.

Between 1997 and 1999, with funding from the British Birdwatching Fair, BirdLife implemented the *Ke Go Forest Project*. Project activities include construction of two guard stations, provision of motorbikes and other equipment, and training for nature reserve staff.

In 1998, the Non-timber Forest Product Research Centre of the Forest Science Institute of Vietnam, began implementing the project *Sustainable Utilisation of Non-timber Forest Products*, with funding from the Netherlands Government and technical support from IUCN. The aim of the project is to promote the conservation of biodiversity through the sustainable use of non-timber district forest products. Pilot activities are currently being carried out, in collaboration with CRES, in Cam Xuyen in the buffer zone of Ke Go Nature Reserve, and, in collaboration with ECO-ECO, in the buffer zone of Ba Be National Park (Raintree *et al.* 1999).

Since 1998, the Department for International Development of the United Kingdom government has been funding a poverty alleviation programme in Ha Tinh province entitled the *Ha Tinh Poverty Programme*. This programme is being implemented by ActionAid, Oxfam Great Britain and Save the Children (UK), in collaboration with the Vietnam Women's Union (Anon. 1997a, 1998, 1999).

In 2001, Dansk Ornitologisk Forening (BirdLife Denmark), together with Ha Tinh Provincial DARD and the BirdLife International Vietnam Programme will begin implementing an integrated conservation and development project entitled *The Sustainable Management of Ke Go Nature Reserve*. This project will be funded by Danida. The project will aim to conserve the biodiversity of Ke Go Nature Reserve while improving the socio-economic conditions of local communities in the buffer zone. The project has three main objectives: (i) to strengthen the capacity of the nature reserve management board to undertake management planning and facilitate management of natural resources by local communities; (ii) to develop community-based resource-use activities that support the conservation objectives and address environmental, productive and social issues in the buffer zone; and (iii) to raise environmental awareness among the local population and authorities, in order to support the objectives of the management plan and the long-term conservation of the nature reserve.

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Ke Go Nature Reserve

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Khe Net Proposed Nature Reserve

Alternative site name(s)

Rao Net

Province(s)

Quang Binh

Status

Proposed

Management board established

No

Latitude

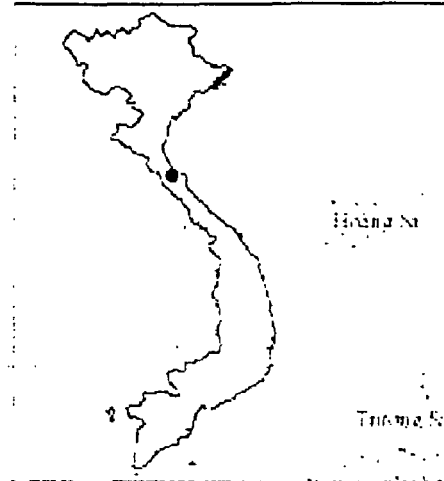
18°02'N

Longitude

105°58'E

Bio-unit

05c - North Annam



Conservation status

In 1994, BirdLife International conducted a field survey in the lowland forests of central Vietnam, with the aim of identifying a suitable site for the conservation of endemic pheasant species, including Vietnamese Pheasant *Lophura hatinhensis* and Imperial Pheasant *L. imperialis*. Based on the results of this survey, BirdLife recommended establishing a nature reserve at Khe Net, in Quang Binh province, with the objective of protecting the only known population of Vietnamese Pheasant in the world (Eames *et al.* 1994).

In 1999, following their review of the Special-use Forests network of Vietnam, BirdLife and FIPI reiterated the proposal to establish a nature reserve at Khe Net (Wege *et al.* 1999). Following this proposal, BirdLife and FIPI conducted a biodiversity survey and socio-economic assessment of Khe Net in 2000, in order to collect data for a feasibility study for the establishment of a nature reserve at the site. The feasibility study will be published in early 2001, and will propose that a nature reserve be established with a total area of about 23,600 ha (Le Trong Trai *et al.* in prep.).

The Khe Net area is currently under the management of Tuyen Hoa Forest Enterprise (Le

Trong Trai pers. comm.). Khe Net is not included on any government decision regarding the Special-use Forests system (MARD 1997). The future establishment of a nature reserve at the site is dependent upon an investment plan being prepared, and being approved by Quang Binh Provincial People's Committee and MARD.

Topography and hydrology

Khe Net proposed nature reserve is located in Tuyen Hoa district in the lowlands of north-central Vietnam. The topography of the proposed nature reserve is characterised by low hills, at elevations below 400 m. The largest watercourse running through the site is the Khe Net stream, which forms part of the watershed of the Gianh river. The Khe Net stream is fed by five main streams: the Khe Che, Khe Mon, Khe Lan Anh, Khe Da Mai and Khe Bui Nhui. These streams all originate on the low ridge that forms the boundary between Ha Tinh and Quang Binh provinces.

Biodiversity value

Khe Net is contiguous with Ke Go Nature Reserve, which lies in Ha Tinh province to the north. The two sites combined support one of the largest remaining tracts of lowland evergreen forest in the Annamese Lowlands Endemic Bird Area (EBA). This EBA

Khe Net Proposed Nature Reserve

supports nine restricted-range bird species, five of which occur in the Khe Net-Ke Go area: Vietnamese Pheasant, Imperial Pheasant, Crested Argus *Rheinardia ocellata*, Short-tailed Scimitar Babbler *Jabouilleia danjoui* and Grey-faced Tit Babbler *Macronous kelleyi* (Stattersfield *et al.* 1998, Le Trong Trai *et al.* 1999). Most notably, the Khe Net-Ke Go area is the only area in the world known to support a population of the globally endangered Vietnamese Pheasant (Le Trong Trai *et al.* 1999).

The vegetation of Khe Net proposed nature reserve is a mosaic of undisturbed and selectively logged lowland evergreen forest. Most of the ridge-tops in the proposed nature reserve are covered by tall forest, with a closed canopy, and, despite the fact that large timber trees have been selectively extracted in many areas, the forest retains an essentially primary character. Degraded forest areas usually occur on steeper slopes, and are often mixed with areas of secondary forest and tall bamboo. Most of the forest on flatter areas in the eastern part of the proposed nature reserve has been logged, and is now replaced by secondary vegetation types, with few tall trees and large numbers of palms (Le Trong Trai *et al.* in prep.).

The composition of the flora of Khe Net proposed nature reserve is similar to that of Ke Go Nature Reserve. A total of 566 vascular plant species have been identified at the site, ten of which are listed in the *Red Data Book of Vietnam*, including *Sindora tonkinensis*, *Parashorea chinensis*, *Cinnamomum parthenoxylon*, *Manglietia hainanensis* and *Calamus platyacanthus* (Le Trong Trai *et al.* in prep.).

The mammal fauna of Khe Net is characterised by high species diversity but low abundance. Several globally threatened species that have been recorded at the site are believed to occur at very low densities as a result of high hunting pressure. These include Gaur *Bos gaurus* and Southern Serow *Naemorhedus sumatraensis*. During the BirdLife/FIPI survey in 2000, a population of Ha Tinh Leaf Monkey *Semnopithecus francoisi hatinhensis* was discovered at Khe Net. This discovery is of great conservation significance, as it is the first time in Vietnam that this primate has been recorded away from the Phong Nha-Ke Bang limestone area. In addition, the BirdLife/FIPI survey recorded the recently described large mammal,

Giant Muntjac *Megamuntiacus vuquangensis*, at the proposed nature reserve (Le Trong Trai *et al.* in prep.).

Conservation issues

In the past, human pressure on the forest along the Ha Tinh-Quang Binh provincial border was intense. In the past five years, however, selective logging and non-timber forest product (NTFP) exploitation appear to have subsided somewhat. Since 1997, the focus of the activities of Tuyen Hoa Forest Enterprise has shifted away from exploitation and towards forest protection and natural regeneration. Hunting, however, continues to be a problem at Khe Net, and threatens to eradicate a number of species of global conservation concern, unless measures are rapidly implemented to control it (Le Trong Trai *et al.* in prep.).

Other documented values

The forest at Khe Net performs an important watershed protection function for the Gianh river. Khe Net proposed nature reserve also provides an important NTFP resource for local communities, particularly palm leaves, which are a major source of income for many households in the surrounding area.

Related projects

With funding from the national 661 Programme, Tuyen Hoa Forest Enterprise is currently implementing a forest regeneration and protection programme at the site.

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Vu Quang Nature Reserve

Alternative site name(s)

None

Province(s)

Ha Tinh

Status

Decreed

Management board established

Yes

Latitude

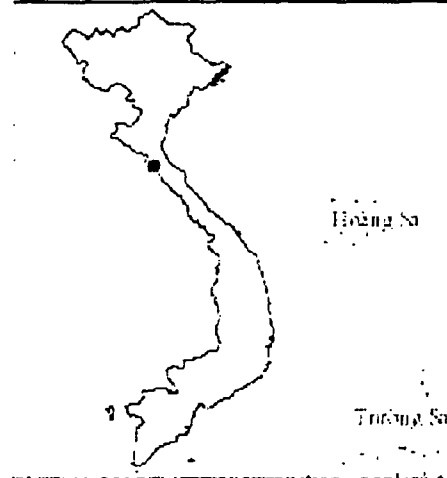
18°09' - 18°25'N

Longitude

105°16' - 105°36'E

Bio-unit

05c - North Annam



Conservation status

During the French colonial period, Vu Quang was designated as a forest reserve, with an area of about 30,000 ha. Because of this classification, the area was closed to local communities. In the 1960s, Trai Tu Forest Enterprise was established, incorporating much of what is now Vu Quang Nature Reserve. In 1977, Trai Tu was divided into Trai Tu and Vu Quang Forest Enterprises. The area of Vu Quang Forest Enterprise was 32,000 ha, and the main management objective was forest exploitation; commercial logging activities continued at Vu Quang until 1993 (Eve 2000).

On 9 August 1986, Vu Quang was included on Decision No. 194/CT of the Chairman of the Council of Ministers as a 16,000 ha nature reserve (MARD 1997). In 1993, an investment plan was prepared by FIPI and WWF, which proposed establishing a 55,950 ha nature reserve, comprising a 38,300 ha strict protection area and a 17,650 ha forest rehabilitation area (Anon. 1993). On 16 March 1994, this investment plan was approved by Ha Tinh Provincial People's Committee, following Decision No. 483/QD-UB. Subsequently, on 14 June 1994, a management board was established by the provincial people's committee, following Decision No. 829/QD-UB. Finally, on 18 May 1998, the management of the strict protection and forest rehabilitation areas was transferred to the nature

reserve management board, following Decision No. 562/QD-UB-NL2 of the provincial people's committee. The total area transferred was 54,743 ha, comprising a strict protection area of 39,217 ha and a forest rehabilitation area of 15,526 ha (Eve 2000). These are the figures given by Ha Tinh Provincial DARD (2000) as the current area of the nature reserve.

In 2000, a draft management plan was prepared for the nature reserve by the *WWF Indochina Programme-Vu Quang Conservation Project* (Eve 2000). Vu Quang Nature Reserve is currently under the management of Ha Tinh Provincial DARD (Ha Tinh Provincial DARD 2000). Vu Quang is included on the 2010 list as a 55,950 ha nature reserve, including 36,286 ha of forest (FPD 1998).

Topography and hydrology

Vu Quang Nature Reserve is located in Huong Son and Huong Khe districts, Ha Tinh province. The nature reserve is situated towards the northern end of the Annamite Mountains. The nature reserve contains an elevation gradient of over 2,000 m, from 30 m in the lowlands in the north-east of the nature reserve to 2,286 m at the summit of Mount Rao Co, on the border with Laos.

Vu Quang Nature Reserve contains the catchments of three rivers: the Nam Truoi, Rao No and Khe Tre

rivers. These rivers originate in the south of the nature reserve as steep, narrow, fast-flowing streams, although, as they flow north, they become broader and more placid.

Biodiversity value

At low elevations, the landscape of Vu Quang Nature Reserve is largely anthropogenic and consists of many elements including human habitation, agricultural land, grassland and scrub. There are also a few remaining patches of natural forest on steep and inaccessible slopes, and isolated stands of trees and bamboo along rivers and streams. At medium elevations, deeper within the nature reserve, the landscape consists of open secondary forest and other seral forest formations. Between 100 and 500 m, much of the forest has been selectively logged, although, above 500 m, the slopes are covered by primary forest (Eames *et al.* in prep.).

There are five major forest types at Vu Quang Nature Reserve. Lowland evergreen forest, which formerly covered much of the nature reserve, is distributed at elevations between 100 and 300 m in the north and north-east of the nature reserve. Lower montane evergreen forest is distributed at elevations between 300 and 1,000 m in the centre of the nature reserve, with some small patches in the north and north-east. Medium montane evergreen forest is distributed at elevations between 1,000 and 1,400 m, along a narrow strip, stretching from the west to the south-east of the nature reserve. This forest type is dominated by broadleaf trees but supports some coniferous species in the Podocarpaceae and Cupressaceae families, such as *Fokienia hodginsii*. Upper montane evergreen forest is distributed at elevations between 1,400 and 1,900 m on steep slopes and ridges in the south and south-west of the nature reserve. This forest type supports some conifers but is dominated by members of the Elaeocarpaceae, Fagaceae, Lauraceae and Magnoliaceae families. At 1,500 m, near the Laotian border, the forest is characterised by the presence of the conifer *Keteleeria evelyniana*. Elfin forest is distributed at elevations between 1,900 and 2,200 m in the southernmost part of the nature reserve. At these elevations, continuous cloud cover and high precipitation favour the development of forest dominated by *Rhododendron*,

together with members of the Fagaceae, Lauraceae, and Elaeocarpaceae families (Eames *et al.* in prep.).

In 1992, the attention of the world scientific community was focussed on Vu Quang Nature Reserve, following the discovery of a previously undescribed large mammal species, Saola *Pseudoryx nghetinhensis* (Vu Van Dung *et al.* 1993). In 1993, this discovery was followed by that of another large mammal species, Giant Muntjac *Megamuntiacus vuquangensis* (Do Tuoc *et al.* 1994). In the years since these discoveries, however, both species have been recorded at a number of other sites in Vietnam and Laos (e.g. Le Trong Trai *et al.* 1999). Consequently, the importance of Vu Quang as a site for mammal conservation may not be as high as was at one time supposed, although the site does support populations of a number of other mammal species of conservation concern, including Gaur *Bos gaurus* and Red-shanked Douc Langur *Pygathrix nemaeus nemaeus* (Eve 2000).

A total of 273 bird species are known from Vu Quang Nature Reserve, including 21 globally threatened or near-threatened species (Eames *et al.* in prep.). Vu Quang Nature Reserve lies in the Annamese Lowlands Endemic Bird Area (EBA) (Stattersfield *et al.* 1998). However, the site only supports three restricted-range species, Crested Argus *Rheinardia ocellata*, Short-tailed Scimitar Babbler *Jabouilleia danjoui* and Grey-faced Tit Babbler *Macronous kelleyi*, none of which are restricted to the EBA. In addition, results of a complementarity analysis with 13 other protected areas in the Annamese Lowlands EBA reveal that Vu Quang Nature Reserve does not fall within the critical sub-set of sites necessary to conserve maximum avifaunal diversity, and should not, therefore, be considered to be a regional bird conservation priority (Eames *et al.* in prep.).

In addition to the mammal discoveries, five previously undescribed fish species have been discovered at Vu Quang Nature Reserve since 1992: *Parazacco vuquangensis*, *Crosscheilus vuha*, *Pararhoedus philanthropus*, *P. equalitus* and *Oreoglanis libertus*. Finally, two species of amphibian and 15 species of reptile recorded at Vu Quang are listed in the *Red Data Book of Vietnam* (Eve 2000).

Vu Quang Nature Reserve

Conservation issues

According to the draft management plan prepared by Eve (2000), a variety of human activities threaten the biodiversity of Vu Quang Nature Reserve. Clearance of forest for agriculture and the development of human settlements is destroying natural habitats and fragmenting forest cover at the nature reserve. Concomitant with human encroachment is the increase of a number of other prime threats such as hunting, grazing of livestock and logging.

Hunting, often to supply the illegal wildlife trade, is the greatest direct threat to the fauna of the nature reserve. Hunting levels at Vu Quang are intensive and nearly every species of mammal and bird is potential prey for hunters. Illegal timber extraction takes place throughout the nature reserve and logging trails can be found everywhere. The nature reserve meets the fuelwood requirements of about 6,000 households in eight neighbouring communes. The quantity of firewood removed from the nature reserve each year is equivalent to the clear-felling of about 428 ha of forest. Cattle can be found throughout the nature reserve at all times of year, and are left to graze freely at all times. Bamboo and rattan are exploited from forest areas close to human habitation. Finally, the extraction of fragrant oil from *Cinnamomum parthenoxylon* and other tree species is an extremely destructive process (Eve 2000).

A further threat is the planned development of National Highway 2, the proposed route of which cuts through Vu Quang Nature Reserve. If this road development were to go ahead, it would have an irreversible impact on the nature reserve. Besides fragmenting habitat and facilitating access to the forest, road construction may lead to human settlement close to the core areas of the nature reserve (Eve 2000).

At the landscape level, Vu Quang Nature Reserve is an important link in the Annamite Mountains, between Pu Mat Nature Reserve to the north and Phong Nha Nature Reserve to the south. Vu Quang, together with Nakai-Nam Theun National Biodiversity Conservation Area in Laos, protects the central section of what is perhaps the largest remaining block of contiguous natural habitat in northern Indochina.

Other documented values

Vu Quang has historical value because the revolutionary Phan Dinh Phung, who led a resistance movement against the French colonial regime, established a base there between 1885 and his death in 1896 (Eve 2000).

According to the draft management plan prepared by Eve (2000), the nature reserve has three main non-biodiversity values for local communities: watershed protection, non-timber forest products (particularly medicinal plants) and fishing.

Related projects

Between June 1995 and June 2000, the *WWF Indochina Programme-Vu Quang Conservation Project* was implemented with funding from the Royal Netherlands Embassy. Project activities during the first three years included guard-station construction, road upgrading and other infrastructure development, and socio-economic and biological research. Project activities during the final two years included field surveys and community development activities, including irrigation, infrastructure development, planting of fruit trees, apiculture, community forestry and community farming. By the end of the project, over 2,000 households had been involved in project activities (Eve 2000).

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