

CHAPTER 3

IMPLEMENTATION PLAN

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3-1 Implementation Plan

3-1-1 Implementation Policies

After signing the Exchange of Notes (E/N) with the Government of Japan, the Government of Lao will enter into an agreement with a Japanese consulting firm for the detailed design. Thereafter the implementation plan for facility construction and procurement of equipment and materials will be formulated and the Japanese contractor for the project will be decided by tendering, which will be attended by a representative of the executing agency of the Government of Lao. Thereupon, the procurement of equipment and materials, and the construction of the facilities will commence.

(1) Obligations of the Consultant

As this project concerns the construction of deep wells, it is very important to have an accurate understanding of the hydrogeologic conditions prior to the conduct of the work. Therefore, it is the responsibility of the Consultant to ① select the well drilling sites in consideration of pumpage, water quality, haulage distance and drainage conditions, ② conduct electric logging to determine screen position and depth, ③ determine whether a hand pump should be installed according to the pumping test results, and ④ supervise and direct the Contractor to ensure the smooth conduct of the construction work. Also, the Consultant will explain to the executing agency any decided item and relevant data pertaining to the above, and properly conduct technology transfer, which shall include the operation of the drilling rig to be procured.

A local consultant will be contracted to assist the Japanese consultant in promoting the rural water supply project, encouraging the participation of all executing agency members and beneficiary residents through the conduct of the following:

- Organization of water users' associations in each beneficiary village.
- Education and training programs on water supply facility operation and maintenance.

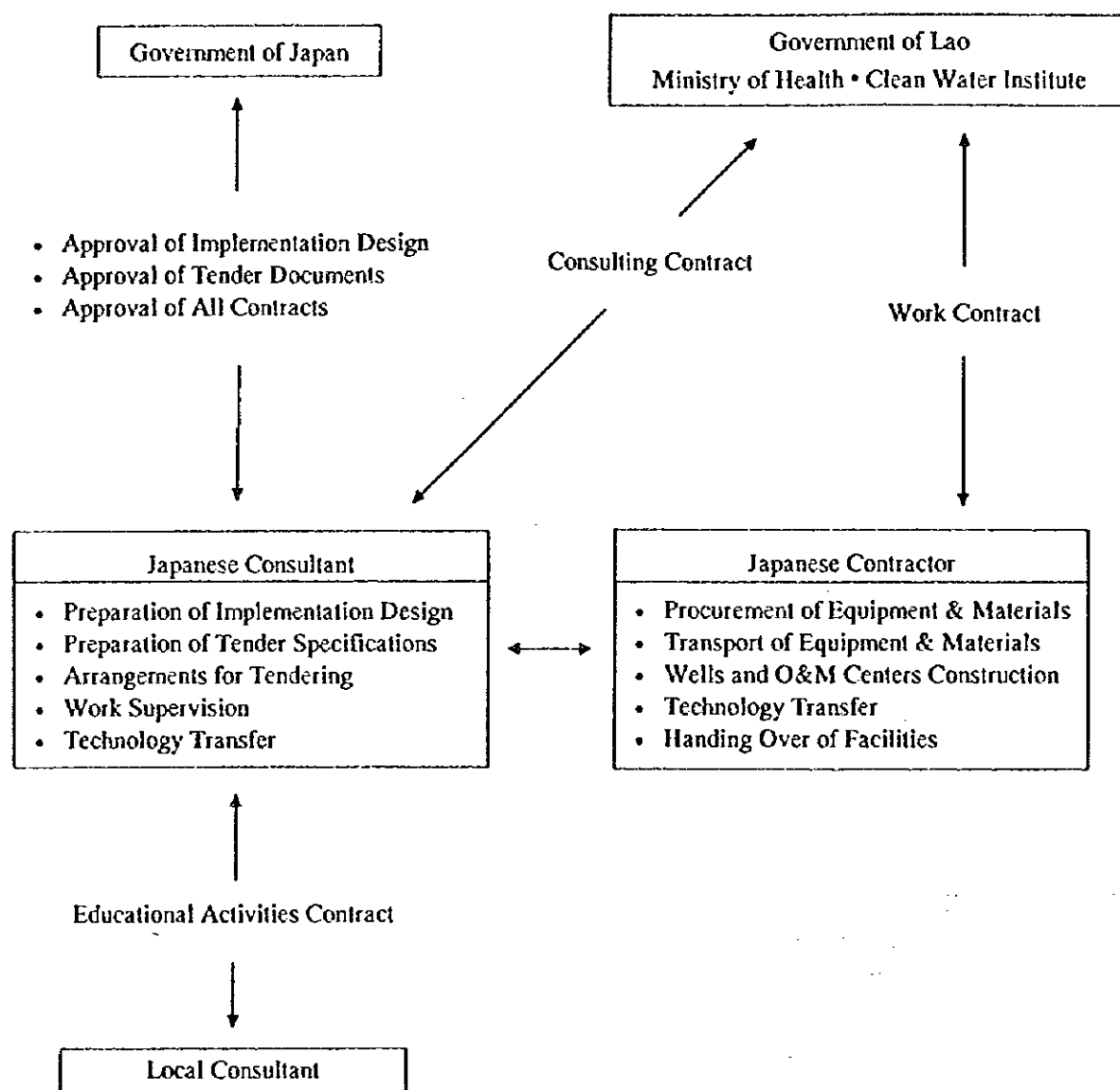
(2) Responsible Government Agency

The Lao government agency mainly in charge of project supervision is the Clean Water Institute (CWI) within the Ministry of Health. Each provincial health department will be responsible for the actual implementation of the works in the site. Prior to the conduct of the works by the Japanese contractor, CWI and the Health Departments will make all necessary arrangements such as acquisition of land for the construction of the wells and O&M centers, ground leveling, and installation of electricity and water supply system. The Water Supply Environment and Sanitation Section (WSESS) of the health departments will be responsible for the promotion of rural water supply undertakings. With the cooperation of the beneficiary villages, WSESS will take charge of the operation and management of the facilities to be constructed through this project.

Based on the Provincial and Rural Water Supply Project, WSESS will be in charge of the construction of water supply facilities using the equipment and materials provided by the Japanese government through this project.

(3) Implementation System

The system for the implementation of the construction works, contracting and educational activities is as follows:



3-1-2 Implementation Considerations

(1) Transportation and Communication

All equipment and materials procured will be sent to Vientiane, the capital city, via Thailand. Pakxe is a remote area in the southern province of Champasak 750km of Vientiane. The section of national highway no. 13 linking Vientiane and Savannakhet is paved, but the section connecting Savannakhet and Pakxe is not. Passage in this section is extremely difficult in the rainy season, and the transport of equipment and materials through this route would take over three days. Also, care should be taken during transport to avoid damage to or theft of equipment and materials. Most equipment and materials necessary for the construction works will be sent in via Thailand and transported to the site by ferry across the Mekong River. Therefore, precautionary measures should be taken as ferry accidents, e.g. capsizing, are frequent.

Except national highway 20, most of the roads in both provinces are unpaved and quite impassable in the rainy season. Therefore, local conditions during the dry and rainy season must be fully taken into consideration in the formulation of the equipment and materials transportation plan and implementation plan.

There are a few hotels in Pakxe that provide international communications and facsimile services. Saravan City has only one guest house run by the provincial government, and it offers none of the said services. Therefore, a wireless communication system will be required during the implementation of the project.

(2) Electricity

Electricity (220V, 50Hz) is supplied from the hydropower station at the Xe Set River. However, due to decline in river water level in the dry season, electricity is purchased from Thailand. Power interruptions are also frequent at this time of the year. Because most villages are not electrified, the project sites and office should be provided with a portable generator.

(3) Materials for Construction

Construction materials such as wood and aggregates are available in Lao. Fuel, cement, reinforcing bars, pipe, etc., are mainly imported from Vietnam and Thailand as they are sometimes difficult to obtain in Lao due to ridiculous price and exchange rate fluctuations. Accordingly, equipment and materials for the construction works should be directly purchased in Thailand through a Thai contractor. A purchase and transportation plan should be formulated as well.

3-1-3 Scope of Work

In case the project is implemented under the Japanese grant aid program, the scope of work and responsibilities to be shared by both governments are as shown in Table 3.1.

Table 3.1 Responsibilities of the Japanese and Lao Governments

Work Items	Responsibilities of the Japanese Side	Responsibilities of the Lao Government
① Equipment & Materials Procurement	Procurement and delivery of drilling rig and spare parts, vehicle and spare parts, and other auxiliary machinery. Procurement of equipment made in Japan or third countries. Shipment of equipment to Lao; transportation and delivery of equipment to project site, including installation and guidance in usage.	Shoulder custom and other taxes
② Construction of Hand Pump Deep Wells	Well construction, hand pump installation, platform construction.	Acquisition of site, solicit participation of executing agency members in well construction works (technology transfer)
③ Construction of O&M Centers	Construction of O&M centers	Land acquisition, ground leveling, construction of fences and gate.
④ Others		Organization of water users' organization

3-1-4 Supervisory Plan

The team formed by the central and provincial governments (Champasak and Saravan) is responsible for the supervision of construction works with the assistance of the Japanese consultants. The supervisory team will be headed by the director or deputy director of CWI. A project manager will be assigned to each provincial Health Department and the supervisory staff will mainly consist of engineers and assistant engineers of WSESS. The supervisory works are outlined below.

(1) Project management

- To keep in touch with concerned central, provincial and rural government agencies.
- Hold discussions with the consultants whenever necessary and report the progress of the works to the Minister of Health.
- Supervise progress of the works
- Inspect work records and reports
- Extend guidance in organizing water users' associations and their operation
- Manage personnel and the accounts

(2) Supervision of well construction works

- Confirm and instruct the access route and well drilling locations

- Encourage villagers' participation, check the structure of organized water users' associations, and verify villagers' acknowledgment of the methods for the appropriate operation of the association.
- Instruct the continuation or discontinuation of drilling works based on the resistivity sounding results.
- Monitor well drilling works and their completion, confirming whether the following are in conformity with the established specifications: drilling depth, logging data, screen position, amount and quality of gravel for packing, gravel packing procedure, well cleaning method, pumping test data, water quality, pump base materials and construction, pump installation, etc.
- Supervise progress of the works
- Monitor drill cuttings and inspect and arrange well drilling records.
- Hold discussions with the consultant and report progress of works to the project manager.

(3) Supervision of O&M Construction

- Inspect workshop drawings
- Monitor construction works
- Inspect interior finish
- Supervise progress of the works
- Hold discussions with the consultant and report progress of works to the project manager.

The consultant is responsible not only for direct supervision of the works but also for giving guidance and assistance to the supervisory staff during construction to facilitate the conduct of the project, and in implementing on-the-job-training. The consultant will assign at least one supervisory staff mainly for the well construction works, for the duration of the works, and the following experts to the site:

- Architect : to supervise building works
- Hydrogeologist : to deal with wells with low productivity and poor water quality
- O&M Expert : to take charge of educational activities on sanitation, facility maintenance, water users' association operation, in cooperation with the local consultant.

The local consultant will be hired for the entire period of the project implementation stage and for almost a year after the construction works are completed, to monitor the autonomous O&M activities of the villagers and the services of the responsible agencies.

3-1-5 Equipment & Materials Procurement Plan

(1) Drilling rig

Lao currently owns a PAT shallow well drilling rig from Thailand, as well as drilling rigs from the USA, Russia and India provided by USAID in 1960. Except for the former, the

manufacturers of the other rigs have no local branches, hence the difficulty in obtaining relevant spare parts. The country of origin and the type of machinery will be selected based on drilling rig price, capacity, ease in procurement and transport, as well as spare parts prices, service guarantee and the possible curtailment of the repair period.

(2) Vehicles

The countries for the procurement of the proposed truck with cranes, pick-up trucks and motorcycles will be determined based on prices, availability of service guarantee, obtainability of spare parts and the maintenance capability of the Lao counterpart.

(3) Casing pipe & riser pipe

Although 4 inch PVC casing pipes are manufactured in Lao, their production output and strength are insufficient. Accordingly, in terms of price, ease in transport and durability, the pipes will be purchased in Thailand.

(4) Hand pumps

The most commonly used deep well hand pump in Lao is the India Mark III pump provided by UNICEF. Since the executing agencies are acquainted with the structure and quite adept with the repair and installation methods, the purchase of this hand pump type from India will be planned.

Rustproof riser pipes and accessories will be purchased in view of the slightly acidic quality of groundwater in the greater part of the project area, which is believed to have caused rusting.

Table 3.2 shows the proposed countries for the procurement of equipment and materials.

Table 3.2 Equipment & Materials' Proposed Country of Origin

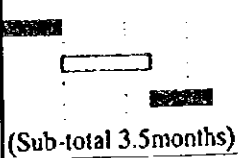
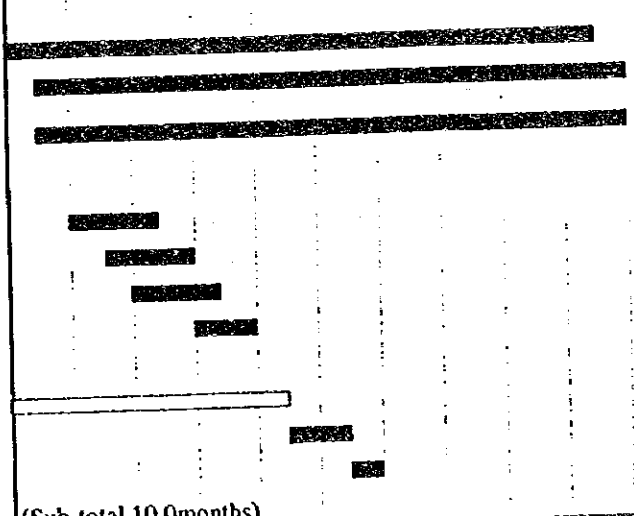
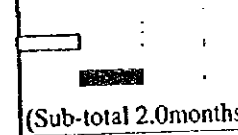
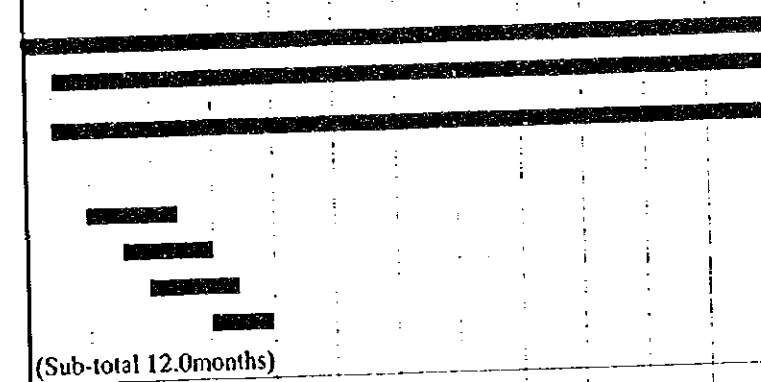
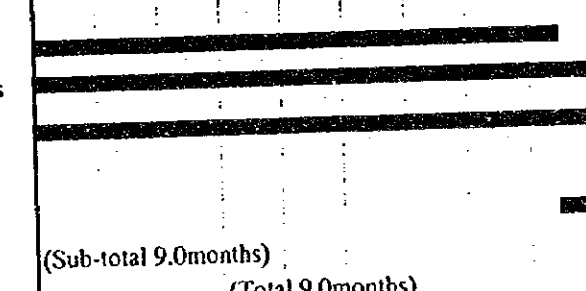
Equipment	Japan	Lao	Thrd Country	Remarks
① Drilling rigs	○		○	
② Truck cranes	⊙		△	
③ Spare parts	⊙		⊙	procurable from > 1 source
④ Vehicles	⊙		○	
⑤ Motorcycles	○	○	○	
⑥ Hand pumps				
⑦ Repair tools	⊙		⊙	procurable from > 1 source
⑧ Physical prospecting apparatus	⊙			
⑨ Water quality test kits	⊙			
⑩ Water tanks	△		⊙	

Note: ⊙: most preferred country of origin ○: potential country of origin △: under consideration

3-1-6 Implementation Schedule

The implementation of the project will be divided into two phases, namely Phase I and II. Table 3.3 shows the project implementation schedule.

Table 3.3 Implementation Schedule

Contents		1	2	3	4	5	6	7	8	9	10	11	12
Phase 1	Detailed Design	 (Sub-total 3.5months)											
	Construction & Procurement	 (Sub-total 10.0months)											
Phase 2	Detailed Design	 (Sub-total 2.0months)											
	First Year Construction & Procurement	 (Sub-total 12.0months)											
	Second Year Construction & Procurement	 (Sub-total 9.0months) (Total 9.0months)											

(1) Implementation Design

The implementation design will commence after the contract with the consultant has been signed and approved by the Government of Japan. Based on the basic design, the implementation design will entail field surveys, works in Japan, production of various design layouts, and formulation of specifications and tender documents. The details will be finalized upon the approval of the Government of Lao.

(2) Equipment Procurement

Equipment will be procured right after the contract with the manufacturer is approved by the Government of Japan. It is estimated to take: 4.5 months from the time of order until completion and 1.5 months for packaging, shipping, land transport, customs inspection and hand over, and transport within Lao.

(3) Procurement of Equipment & Materials for Facility Construction

The water supply facilities to be constructed are hand pump wells. The phased implementation of the works, including the procurement of equipment and materials, is outlined below.

Phase I (Single Fiscal Year)

① Manufacture and Procurement of Equipment & Materials

Drilling rigs, truck with crane, spare parts, vehicles, motorcycles, hand pumps, repair tools, physical prospecting apparatus, physical logging apparatus, water quality test kits, fuel tank and water tanks will be procured.

② O&M Center in Saravan Province: floor area of 346m²

administration office (including meeting room), storage, repair room, garage, staff room

③ Hand Pump Well Construction

One hundred and five (105) hand pump wells will be constructed in the 63 villages (31 in Champasak and 32 in Saravan). The construction works will include well logging, pumping tests, and platform and drainage construction. Table 3.4 outlines the 63 target villages.

Phase II (Government Loan)

① O&M Center in Champasak Province: floor area of 544m²

administration office (including meeting room), storage, repair room, garage, staff room

② Hand Pump Well Construction

Two hundred (200) hand pump wells will be constructed in 126 villages (64 in Champasak and 62 in Saravan). The works will include well logging, pumping tests, and platform and drainage construction. Table --- outlines the 126 target villages.

3-1-7 Obligations of the Recipient Country

The obligations of the recipient country are as follows:

1. Acquisition of site for well construction.
2. Acquisition and leveling of site for O&M center construction.
3. Construction of O&M center fences and gates, and installation of water supply and electrical system.
4. Payment of charges imposed by the bank in accordance with the Banking Arrangement (B/A) immediately after the issuance of the Authorization to Pay (A/P).
5. Exempt construction machinery and equipment to be brought in and taken outside of Lao for the conduct of the project from taxes and duties, in accordance with the grant aid agreement.
6. Exempt Japanese experts from taxes on income for services rendered under the contract.
7. Establishment of a project site for the supervision of the project works, and allocation of personnel.
8. Extend guidance and support for the sound operation and maintenance of equipment and machinery procured.
9. Provide funds to cover the expenses to be shouldered by the Lao counterparts for the completion of the project.
10. Issue visa for the Japanese experts for their entry into Lao and their stay therein for the performance of the project works.
11. Establish water users' associations in recipient villages.

The obligations of the Lao government during the implementation of the services are as follows:

- 1). Build approach roads (a total of 70km) for the 41 wells to be constructed in sites assessed as "very difficult" to access.
- 2). Supply electricity to and install a water supply system for the two O&M centers.
- 3). Acquire the land for the construction of the wells and the O&M centers, conduct the following for the latter: ground leveling and construct fences.

3-2 Project Cost Estimation

3-2-1 Rough Estimation of Project Cost

The rough estimation of the project cost (supporting works) according to the share of the Government of Lao is shown below.

- (1) Project cost to be covered by the Government of Lao

Table 3.5 Share of the Government of Lao in Project Expenses

Work Classification	Details	Unit Cost	Amount
Access road preparation	70km	65,000km	4,550,000
Site acquisition for O&M centers	8,000m ²	-	-
Electrical & water supply installation	2 places	1,235,000/place	2,470,000
Erection of fences	450m	20,000m	9,000,000
Total			16,668,000

- (2) Conditions for calculation

Time of calculation : April 1997 (average of the past 6 months)
Exchange rate : US\$1.00 = ¥117.92; 1 kip = ¥0.12
Implementation period : Overall project period (Phases I & II)
Others : Implementation will be in accordance with the Japanese grant aid program.

3-2-2 Operation & Maintenance Expenses

- (1) Basic Operation & Maintenance Policy

This project intends to adequately and effectively conduct operation and maintenance activities in accordance with the following policies:

A. Executing Agency

The facilities, equipment & materials constructed and procured under the grant aid program will be placed under the jurisdiction of the Ministry of Health and the provincial Health Departments concerned. CWI will reinforce the provincial Health Departments (HD) and the WSESS, equipping them with skills vital to the effective and sustainable conduct of O&M. Each HD will strengthen the organizational structure of the WSESS, in consideration of the placement of some of the WSESS staff in the O&M center, for the effective conduct of services.

B. O&M Center

The HD's and WSESS will guide and train the water users' associations, regularly patrol and monitor village conditions, listen to the complaints of the villagers and check facility-use conditions. As such, the section will be in charge of the general supervision of the water supply facilities. Further, in constant anticipation of the beneficiaries' needs, the section will store spare parts to instantaneously cope with well repair or construction

demands. Personnel remuneration for the conduct of periodic inspections and facility O&M will be allocated from the provincial HD budget. Well O&M, e.g. daily inspection, minor repairs, will be the responsibility of the water users' associations, and expenses incurred by such activities will be borne by the association.

C. Recipient Villages

Every recipient village will organize a water users' association to supervise the operation and maintenance of water supply facilities constructed under this project. The association will collect water use charges from facility users for the purchase of essential spare parts to maintain the facilities in favorable condition for sustainable use.

(2) O&M System of Water Supply Executing Agency

The well O&M and users' education units of the rural WSESS will determine the frequency of periodical inspections on well water quality, supervise facility operation and maintenance, and conduct major repairs to preserve the facilities.

The well operation and maintenance activities at every village will be regularly inspected at least once a month.

(3) Personnel Allocation Plan

The WSESS requires personnel capable of running the rural water supply services, monitoring and supervising the operation and maintenance of facilities constructed by the Japanese, and conducting O&M educational activities and emergency repairs. It also requires personnel for the improvement of future water supply services. Due to the wide coverage of the water supply services and the traffic conditions in both provinces, the O&M center will be the service base, promoting the services with the cooperation of district personnel. The increase in the WSESS personnel and the number to be assigned to the O&M center are shown in Table 3.6.

Table 3.6 Operation, Maintenance & Management Personnel

Position	No. of Personnel	
	Champasak	Saravan
Project Manager	1	1
Supervisor of Well O&M	2	2
Manager of Well Drilling Equipment	2	-
Mechanics	2	1
Sanitary Education Staff	1	1
Total	7	4

(4) Water Users' Association O&M System

A water users' association will be organized for every constructed well. Villages with more than one well (two to three) will have the equivalent number of associations. In such villages, a board of directors for water management will be established and headed by the village chief. The board will consist of water users' association representatives and will cope

with matters relevant to the conduct of mutual assistance.

A water users' association will consist of 4 to 5 members who will carry out the following roles:

● **Association Leader:**

The leader will supervise the management of the association and the independent operation and maintenance of the facilities in cooperation with regional officers in charge.

He or she is also responsible for nominating a daily pump operator to keep the water tank full to facilitate water fetching chores in villages where hand pump wells are affixed with an aeration and filtering system.

● **Treasurer:**

The treasurer will be in charge of the collection of a monthly fee from the association members for facility maintenance, manage the accounts and dispense them for the procurement of necessary pump parts and the payment of services for pump/well repair.

● **Sanitation Administrator:**

The sanitation administrator will instruct the villagers on the importance of using clean and safe drinking water, and will see to it that the surrounding of houses and the wells is kept clean at all times.

He or she is also in charge of cleaning the filter of wells with a filtering system.

● **Well Inspector(s)**

The well inspector(s) will conduct daily well inspection (lubrication of pumps, inspection of handle bolts, water quality and pumpage) and report the conditions to the chairman on a regular basis. For major repairs that are carried out every three years or so, the well inspector (s) will request technicians from the WSESS as well as assign several villagers to assist in the repair works.

(5) O&M Expenses

The expenses for the water users' associations O&M activities cover:

- expenses for hand pump replacement
- expenses for minor and necessary repairs such as replacement of hand pump chain or packing
- expenses for periodical inspection which is partly borne by the O&M center.

The O&M cost to be shouldered by the family of an association member will range from 700 to 800 kips/month, and is broken down as follows:

- | | |
|---|---------------------------|
| - procurement of pump parts | 200~300 kips/month/family |
| - partial payment for pump repair services | 200~300 kips/month/family |
| - partial payment for well restoration
(every three years) | 200 kips/month/family |

✓ CHAPTER 4

EVALUATION AND RECOMMENDATIONS

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4-1 Project Effects

The coverage rate of water supply services in the study area is low at only 13% of the population. Most inhabitants rely on contaminated water sources, such as ponds, dug wells and rivers, for their domestic water needs, hence the rampancy of water borne diseases such as diarrhea, parasitic diseases, skin and eye diseases, and a high infant (up to 5 years old) mortality rate of 14%. Therefore, to improve rural living conditions, it is necessary to immediately construct facilities that would provide sanitary and stable water supply.

This project intends to provide water supply facilities by constructing deep wells in 189 villages without access to stable and safe water resources in the southern Lao provinces of Champasak and Saravan, to contribute to the attainment of the goals of the fourth national five year plan on groundwater development.

The population that would be affected by the project will be about 56,000 in Champasak and about 47,000 in Saravan, and the water supply rate in these provinces will be improved from 11% to 21% and 14% to 31%, respectively. Accordingly, the prevalence of water borne diseases will be reduced, as well as the time spent by women on water fetching chores.

Also, the procurement of high performance drilling machinery is expected to improve the well construction capabilities of related organizations, leading to the construction of more wells in villages without safe water resources and, consequently, the acquisition of clean water.

Through actual involvement in the conduct of the project works, the executing agencies will be trained in the proper operation and maintenance of the wells. Concurrently, the operation and maintenance educational activities for the villagers through the water users' associations will not only heighten O&M consciousness but also promote the sustainable use of the facilities.

If the Japanese and Lao sides succeed in implementing all the planned undertakings, this project would largely contribute to regional social and economic development.

4-2 Technical Cooperation & Cooperation with Other Donors

Various cooperation agencies, such as UNICEF, SIDA and NGOs, are currently formulating an Action Plan, targeting 2002, for rural water supply improvement and environmental sanitation. And with the cooperation of CWI and the provincial health departments, these agencies are devising educational activities to improve rural water supply and sanitary conditions.

This project also gives considerable importance to the conduct of educational activities for the beneficiaries to ensure the continuous use of the facilities after the project is completed. To successfully carry out these activities, the activities of other donor agencies will be used as reference.

4-3 Recommendations

- (1) This project will provide relevant well drilling machinery to enable the government to independently drill wells. However, the effective use of the machinery will be affected by the personnel and budget restrictions the Health Departments face. Therefore, after the completion of this project, various agencies related to CWI and the HD should urgently devise a plan for the construction of wells in both provinces and at the same time ensure the smooth conduct of water supply facility installation and well construction programs, including the establishment of a well construction system and adoption of budgetary measures at the HD level.
- (2) In Lao, water supply facility operation and maintenance have been defective because of insufficient funds and personnel, and there have been many cases where damaged wells have been left unrepaired. To ensure the sustainable use of the wells, an O&M system should be established with the O&M center at the core, taking steps to ensure sufficient budget and adequate personnel allocation to enable Lao to independently operate and maintain the facilities.
- (3) The rural water supply project puts considerable importance to the conduct of facility operation and maintenance by the villagers. This system is currently non-existent in Lao as people rely on the HD for O&M services, unwilling to operate and maintain the facilities themselves. Consequently, this project includes the organization of water users' associations and the conduct of O&M educational activities. For the villagers to incessantly conduct O&M, the HD has to continue periodic patrolling and training activities, making sure the villagers fully understand the importance of O&M.

APPENDICES

1. List of Study Team Members

Name	Title	Organization
Yuji MARUO	Team Leader	JICA Institute for International Cooperation, Senior Development Officer
Yuichi SUGANO	Coordinator	JICA Grant Aid Study & Design Department, First Basic Design Study Division
Kinya NAKAMURA	Chief Engineer	Overseas Operation Department Kokusai Kogyo Co., LTD.
Eiji TAKEMORI	Procurement Plan	Overseas Operation Department Kokusai Kogyo Co., LTD.
Kensuke SAKATO	Operation & Cost Estimation	Overseas Operation Department Kokusai Kogyo Co., LTD.

2. Study Schedule

Day	Date	Movement & Activities	Organization	Accommodation
1	Feb 24 Mon	Narita → Bangkok JL717	JICA/Consul	Bangkok
2	Feb 25 Tue	Bangkok → Vientiane TG690 Courtesy call: JICA office, Embassy of Japan & CIC	JICA/Consul	Vientiane
3	Feb 26 Wed	Inception Report Explanation to CWI and Meeting	JICA/Consul	Vientiane
4	Feb 27 Thur.	Courtesy call to Ministry of Health Meeting with CWI	JICA/Consul	Vientiane
5	Feb 28 Fri	Vientiane → Pakse Courtesy call to Champasak Provincial Health Department	JICA/Consul	Pakse
6	Mar 1 Sat	Meeting with Saravan Provincial Health Department, Site Survey	JICA/Consul	Pakse
7	Mar 2 Sun	Site Survey in Champasak Province, Test Wells	JICA/Consul	Pakse
8	Mar 3 Mon	Pakse → Vientiane Meeting on M/D with CWI	JICA/Consul	Vientiane
9	Mar 4 Tue	M/D Conference with CWI	JICA/Consul	Vientiane
10	Mar 5 Wed	M/D Signing, Report at Embassy of Japan and JICA Office	JICA/Consul	Vientiane
11	Mar 6 Thur.	JICA Officials to Bangkok TG691 Data Collection	JICA Consultant	Bangkok Vientiane
12	Mar 7 Fri	Data Collection, Meeting, and Survey	Consultant	Vientiane
13	Mar 8 Sat	Data Collection, Meeting, and Survey	Consultant	Vientiane
14	Mar 9 Sun	Data Collection, Meeting, and Survey	Consultant	Vientiane
15	Mar 10 Mon	Data Collection, Meeting, and Survey	Consultant	Vientiane
16	Mar 12 Tue	Vientiane → Bangkok QV415	Consultant	Bangkok
17	Mar 13 Wed	Data Collection, Meeting, and Survey	Consultant	Bangkok
18	Mar 14 Thur.	Data Collection, Meeting, and Survey	Consultant	Bangkok
19	Mar 15 Fri	Data Collection, Meeting, and Survey	Consultant	Bangkok
20	Mar 16 Sat	Data Collection, Meeting, and Survey	Consultant	Bangkok
21	Mar 17 Sun	Bangkok → Narita TG640	Consultant	Japan

3. List of Parties Concerned in the Recipient Country

- (1) Prime Minister's Office
Deputy Director General : Dr. Bountheuang MOUNLASY
- (2) Ministry of Health
Minister : Dr. Pounmek DALALOY
- (3) NIHE and CWI
Deputy Director of NIHE : Dr. Nuanta MANIPHOSAY
Head of Water Supply Division of CWI : Dr. Kongkham MIBOUN
- (4) Champasak Province
Governor : Mr. Onneua PHOMMACHANE
- (5) Champasak Provincial Health Department
Director : Dr. Toukham VANEMIXAY
Deputy Director : Dr. Wath KONGKEO
Deputy Director : Dr. Theum KHAMKEO
- (6) Water Supply & Environmental Sanitation
Champasak Provincial Health Department
Chief of WSES : Dr. Kaysone THONGSAVAN
Deputy Chief of WSES : Mr. Souvanethong MENEVILAY
- (7) Saravan Provincial Health Department
Director : Dr. Khoutdra VONGSRAVANE
- (8) Water Supply & Environmental Sanitation
Saravan Provincial Health Department
Chief of WSES : Dr. Somphan SILAVY
Deputy Chief of WSES : Dr. Thong KHAY
Deputy Chief of WSES : Mr. Bovnkane
Staff of WSES : Mr. Bauathong

4. Minute of Discussion

MINUTE OF DISCUSSION

BASIC DESIGN STUDY
ON
GROUNDWATER DEVELOPMENT PROJECT
IN
CHAMPASAK AND SARAVAN PROVINCES
IN
LAO PEOPLE'S DEMOCRATIC REPUBLIC

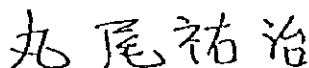
In response to the request for the Grant Aid Project from the Government of Lao People's Democratic Republic (hereinafter referred to as "Lao PDR"), the Government of Japan decided to conduct a Basic Design Study on the Project for Groundwater Development in Champasak and Saravan Provinces (hereinafter referred to as "the Project") and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA has sent to Lao PDR a study team (hereinafter referred to as "the Team"), which is headed by DR. YUJI MARUO, Development Specialist, Institute for International Cooperation, JICA and is scheduled to stay in the country from February 25 to March 12, 1997.

The Team held discussions with the officials concerned of the Government of Lao PDR and conducted a field survey at the study area.

In the course of discussion and field survey, both parties have confirmed the main items described on the attached sheets. The Team will proceed further works and prepare the Basic Design Study Report.

Vientiane, March 5th, 1997



Dr. YUJI MARUO

Leader

Basic Design Study Team,

Development Specialist

JICA



Dr. NOUANTA MANIPHOU SAY

Deputy Director of NIHE

Ministry of Health

ATTACHMENT

1. Objectives :

The objectives of the Project is to improve living conditions through construction and procurement of equipment for water supply, e.g. construction of wells with pumps in Champasak and Saravan Provinces.

2. Project Sites :

The project sites are 95 villages of Champasak Province and the 94 Villages of Saravan Province. (ANNEX-I)

3. Responsible and Executing Organizations :

- (1) The Ministry of Health is the responsible agency of the Project.
- (2) The National Water Supply and Environmental Health Programme (Ex. the Clean Water Institute), National Institute of Hygiene and Epidemiology and provincial Public Health Department are the executing agencies of the Project.

4. Items Requested by the Government of Lao PDR

After discussions with the Team, following items were finally requested by Lao PDR side:

(1) Construction of water supply facilities

- a. Deep well with hand pump : 304 sets, 186 villages in both provinces
- b. Submersible motor pump well : 1 set, covering 3 villages in Champasak

(2) Construction of Enlightening , Operation and Maintenance Center :

2 sites, in both provinces

(3) Procurement of equipment and materials

- a. Drilling rig with accessories and supporting equipment : 2 sets
- b. Truck Crane : 2 nos.
- c. Spare Parts : 2 lots
- d. Pick-up Truck : 2 nos.
- e. Motorcycle : 4 nos.
- f. Hand pump : 30 nos.
- g. Tools : 2 lots

- | | |
|----------------------------|--------|
| h. Geophysical Equipment : | 2 sets |
| i. Water Analysis Kit : | 2 sets |

However, the final components of the Project will be decided after further studies.

5. Japan's Grant Aid system

- (1) The Government of Lao PDR has understood the system of Japan's Grant Aid explained by the Team as described in ANNEX-II.
- (2) The Government of Lao PDR will take the necessary measures described in Annex-III for the smooth implementation of the Project on condition that the Grant Aid Assistance by the Government of Japan is extended to the Project.

6. Schedule of the study

- (1) The consultants will proceed to further studies in Lao PDR until March 12, 1997.
- (2) JICA will prepare the draft final report in English and send it to the Government of the Lao PDR.
If the Government of Lao PDR has comments on the draft final report, the comments will be submitted to the JICA Laos office within one month after receipt of the draft final report.
- (3) JICA will complete the Final Basic Design Report in English and send it to the Government of Lao PDR by the end of August, 1997.

7. Other Relevant Issues

- (1) The Team expressed their serious concern about operation and maintenance of the water supply facilities.

The Government of Lao PDR agreed to allocate necessary personnel and local component of the budget for operation and maintenance of the facilities, if the Japan's Grant Aid will be extended to the Project. Ministry of Health requested the Team to elaborate comprehensive and practical action plans on operation and maintenance scheme which include such programmes as enlightening and hygiene education for beneficiaries, on the job training for pump minder or book keeping training for treasurer of village water committee etc..

The candidate villages should establish their water committee prior to commencement

of the construction of water supply facilities with the help of the district and provincial Public Health Department. The representative from the candidate villages and the district and provincial Public Health Department will make an agreement which defines respective responsibility of the three parties on operation and maintenance of the facilities.

(2) The Government of the Lao PDR has requested additional two equipment;

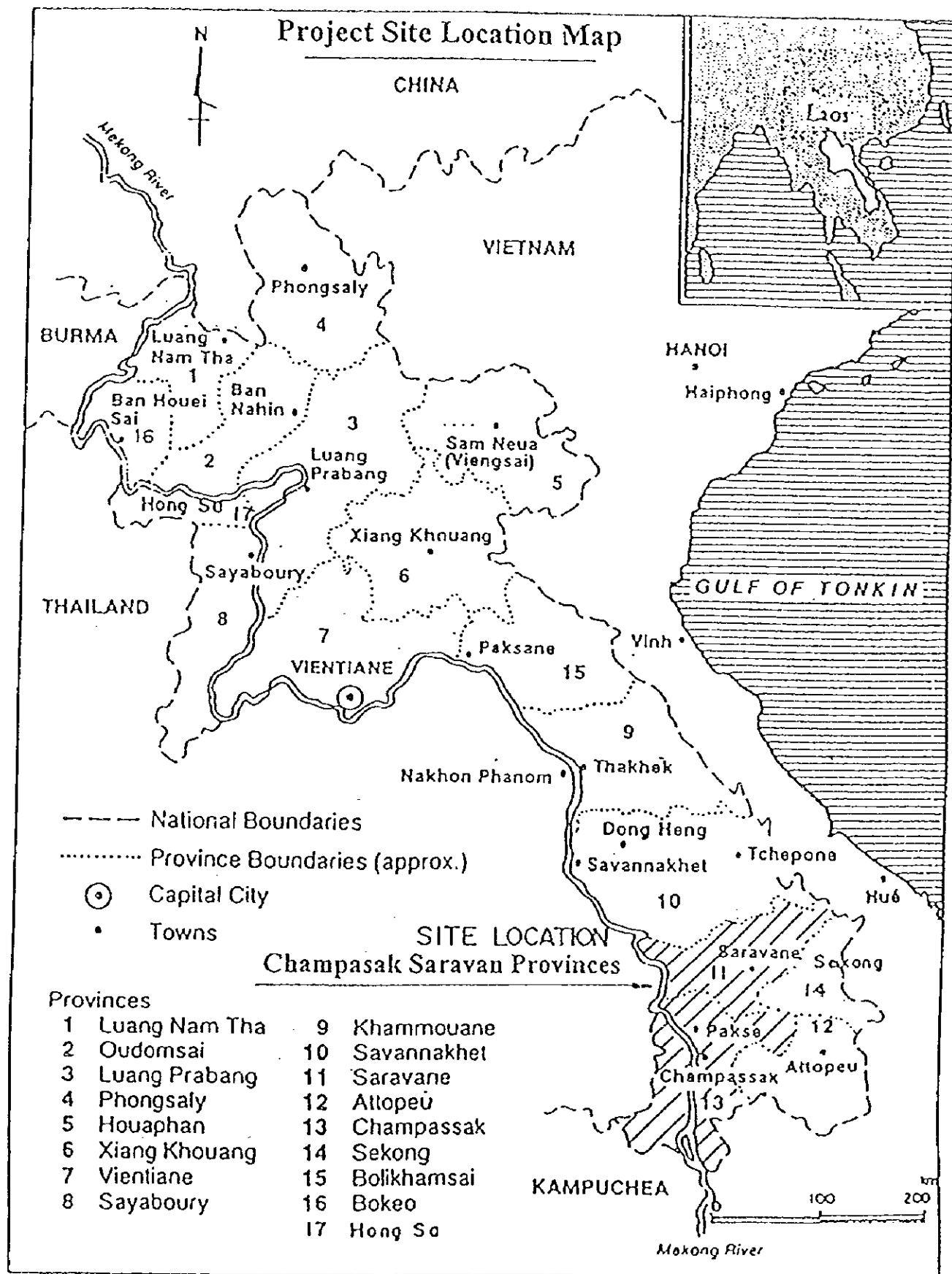
Pumping Test Kits 2 units (for groundwater potential analysis)

Personal Computer 2 units (for well inventory and data analysis)

The Team will convey the requests to the Government of Japan.

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ANNEX - II

JAPAN'S GRANT AID PROGRAM

1. Japan's Grant Aid Program

1) The Japan's Grant Aid Program is executed by the following procedures.

- Application (request made by a recipient country)
- Study (Preliminary Study / Basic Design Study conducted by JICA)
- Appraisal & Approval (Appraisal by the Government of Japan and Approval by the Cabinet of Japan)
- Determination of Implementation (Exchange of Notes between both Governments)
- Implementation (Implementation of the Project)

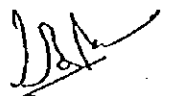
2) Firstly, an application or a request for a project made by the recipient country is examined by the Government of Japan (the Ministry of Foreign Affairs) to see whether or not it is suitable for Japan's Grant Aid. If the request is deemed suitable, the Government of Japan entrusts the conduct of a study on the request to JICA (Japan International Cooperation Agency).

Secondly, JICA conducts the Study (Basic Design Study), using a Japanese consulting firm. If the background and objective of the requested project are not clear, a Preliminary Study is conducted prior to a Basic Design Study.

Thirdly, the government of Japan appraises to see whether or not the Project is suitable for Japan's Grant Aid Program, based on the Basic Design Study report prepared by JICA. The results are then submitted to the Japanese Cabinet for approval.

Fourthly, the Project approved by the Cabinet becomes official when endorsed by the Exchange of Notes signed by the both Government.

Finally, for the implementation of the Project, JICA assists the recipient country in preparing contracts and so on.



2. Contents of the Study

1) Contents of the Study

The purpose of the Study (Preliminary Study / Basic Design Study) is to provide a basic document necessary for appraisal of the project by the Government of Japan. The contents of the Study are as follows:

- a) to confirm the background, objectives, benefits of the project and also institutional capacity of agencies concerned of the recipient country necessary for project implementation,
- b) to evaluate appropriateness of the Project for the Grant Aid Scheme from a technical, social and economic point of view,
- c) to confirm items agreed upon by both parties concerning the basic concept of the project,
- d) to prepare the basic design of the project,
- e) to estimate project cost

Final project components are subject to approval by the Government of Japan and therefore may differ from an original request.

Implementing the project, the Government of Japan requests the recipient country to take necessary measures involved, which are itemized on Exchange of Notes.

2) Selecting (a) Consulting Firm(s)

For smooth implementation of the study, JICA uses (a) registered consulting firm(s). JICA selects (a) firm(s) through proposals submitted by interested firms. The firm(s) selected carry(ies) out a Basic Design Study and write(s) a report, based upon terms of reference made by JICA. The consulting firm(s) used for the study is (are) recommended by JICA to the recipient country after Exchange of Notes, in order to maintain technical consistency and also to avoid possible delay in the implementation if a new selection process is repeated.

3) Status of a Preliminary Study in the Grant Aid Program

A Preliminary Study is conducted during the second process for project formulation & preparation as mentioned above.

A result of the study will be utilized in Japan to decide if a Basic Design Study should be conducted for the Project.

Based on the result of the Basic Design Study, the Government shall proceed to the stage of decision making process (appraisal and approval).

It is important to notice that at the Preliminary Study stage, a commitment is made by the Japanese side concerning the realization of the Project under the Grant Aid Program.

3. Japan's Grant Aid Scheme

1) What is Grant Aid ?

The Grant Aid Program provides a recipient country with non reimbursable funds needed to procure facilities, equipment and services for economic and social development of the country under the following principles in accordance with relevant laws and regulations of Japan. The Grant Aid is not in a form of donation or such.

2) Exchange of Notes (E / N)

The Japan's Grant Aid is extended in accordance with the Exchange of Notes by both Governments, in which the objectives of the Project, period of execution, conditions and amount of the Grant, etc. are confirmed.

3) "The period of the Grant Aid" means one Japanese fiscal year which the Cabinet approves the Project for. Within the fiscal year, all procedures, such as Exchange of Notes, concluding a contract with (a) consulting firm(s) and (a) contractor(s), and the final payment to them must be completed.

4) Under the Grant, in principle, products and services originating from the recipient country are to be purchased.

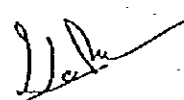
When the two Governments deem it necessary, the Grant may be used for the purchase of products or services of a third country.

However the prime contractors, namely, consulting, contractor and procurement firms, are limited to "Japanese nationals". (The term "Japanese nationals" means Japanese physical persons or Japanese juridical persons controlled by Japanese physical persons).

5) Necessity of the Verification

The Government of the recipient country or its designated authority will conclude into contracts in Japanese yen with Japanese nationals. Those contracts shall be verified by the Government of Japan. The "Verification" is deemed necessary to secure accountability to Japanese tax payers.

6) Undertakings required to the Government of the recipient country



In the implementation of the Grant Aid, the recipient country is required to undertake necessary measures such as the following:

- a) to secure land necessary for the project and to clear and level the land prior to commencement of the construction work,
- b) to provide facilities for distribution of electricity, water supply and drainage and other incidental facilities in and around the sites,
- c) to secure building prior to the installation work in case the Project is providing equipment,
- d) to ensure all the expenses and prompt execution for unloading, customs clearance at the port of disembarkation and internal transportation of the products purchased under the Grant Aid,
- e) to exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which will be imposed in the recipient country with respect to the supply of the products and services under the Verified Contracts,
- f) to accord Japanese nationals whose services may be required in connection with the supply of the products and services under the Verified Contracts, such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work.

7) Proper Use


The recipient country is required to maintain and use facilities constructed and equipment purchased under the Grant Aid properly and effectively and to assign staff necessary for their operation and maintenance as well as to bear all expenses other than those to be borne by the Grant Aid.

8) Re-export

The products purchased under the Grant Aid shall not be re-exported from the recipient country.

9) Banking Arrangement (B / A)

- a) The Government of the recipient country or its designated authority shall open an account in the name of the Government of the recipient country in an authorized foreign exchange bank in Japan (hereinafter referred to as "the Bank"). The Government of Japan will execute the Grant Aid by making payment in Japanese yen to cover the obligations incurred by Government of the recipient country or its designated authority under the contracts verified.



- b) The payments will be made when payment requests are presented by the Bank to the Government of Japan under an Authorization to pay issued by the Government of the recipient country or its designated authority.

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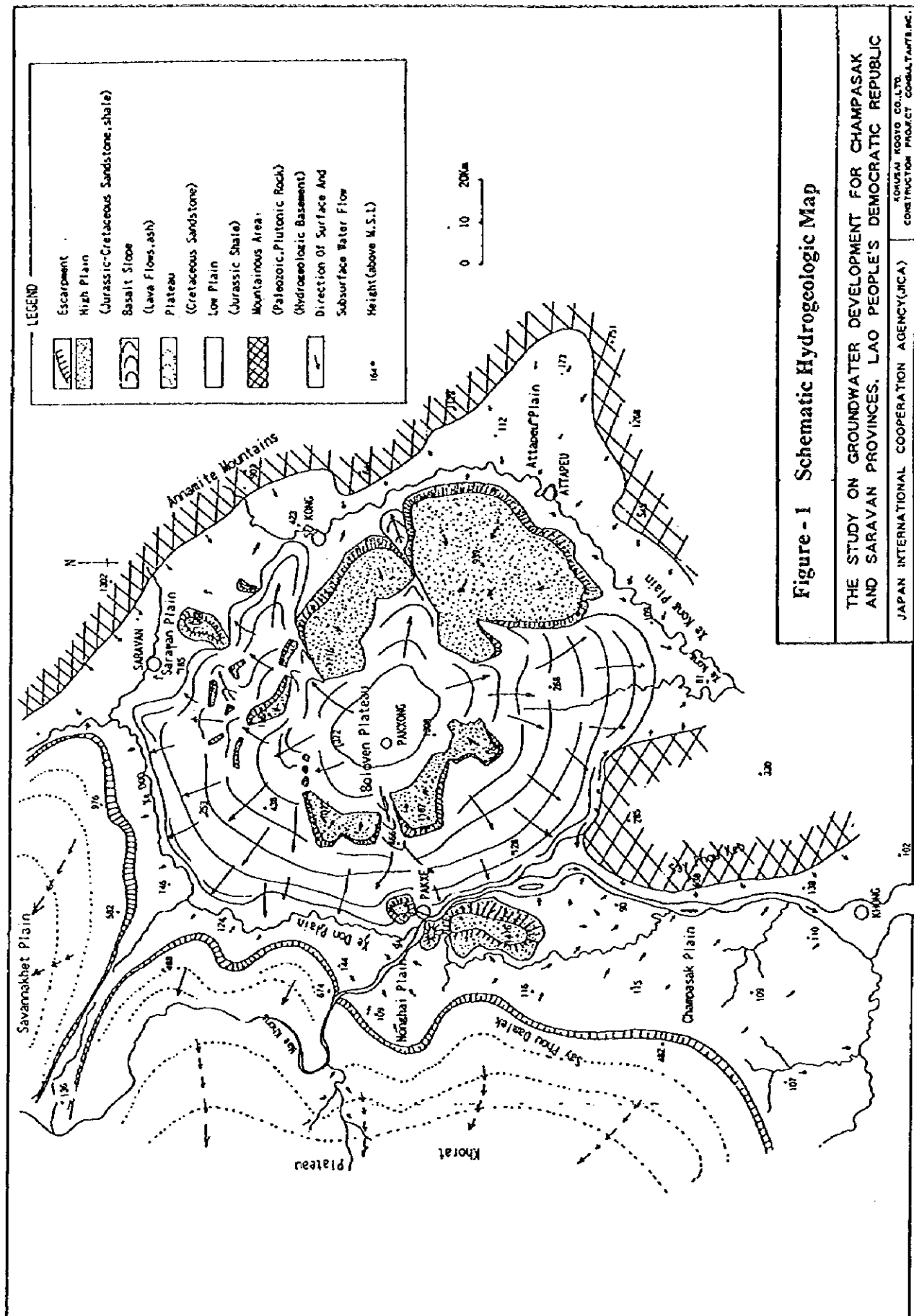
ANNEX - III

Necessary measures to be taken by the Government of Lao PDR under the Japan's Grant Aid System.

1. To secure the sites for the Project.
2. To clear, level and reclaim the site prior to commencement of the Project.
3. To undertake incidental outdoor works such as gardening, fencing, gates and exterior lighting in and around the site.
4. To bear commission of Authorization to Pay (A/P) and payment commission to a Japanese foreign exchange bank for the banking services based on the Banking Arrangement (B/A).
5. To facilitate prompt unloading and customs clearance at port of disembarkation in Lao PDR and internal transportation therein of the products purchased under the Grant Aid.
6. To exempt the Project items as well as Japanese nationals from custom duties, internal taxes and other fiscal levies which may be imposed in Lao PDR with respect to the supply of the products and services under the verified contracts.
7. To accord Japanese nationals, whose services may be required in connection with the supply of products and the services under the verified contracts, such facilities as may be necessary for their entry into Lao PDR and stay therein for the performance of their work.
8. To use and maintain properly and effectively all the equipment purchased under the Grant Aid.
9. To bear all the expenses other than those to be borne by the Grant Aid.
10. To facilitate acquisition of visas and work permits, etc., enabling entry and re-entry of Japanese nationals involved in the Project.



5. Hydrogeologic Maps



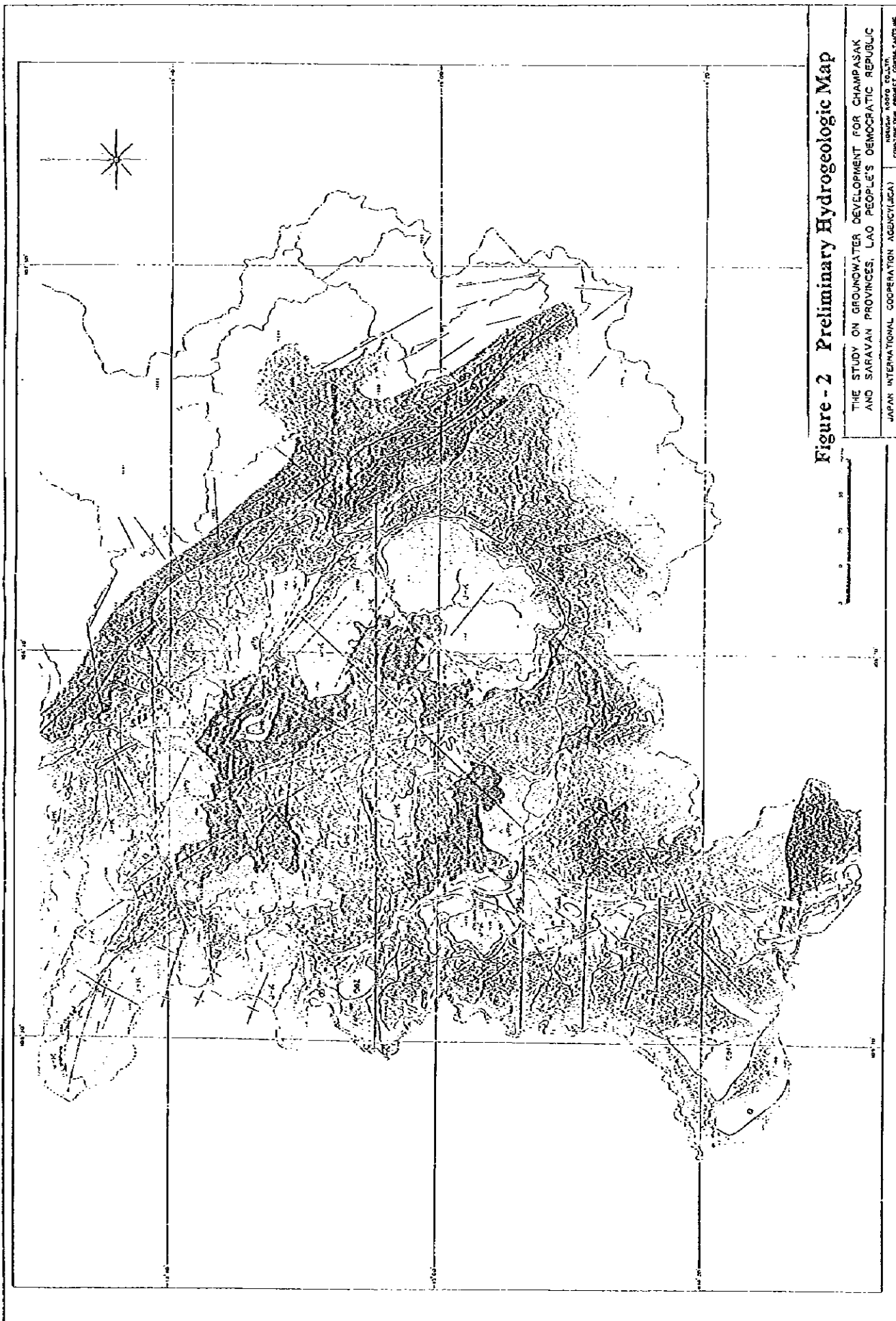


Figure -3 Legend of Preliminary Hydrogeologic Map

Geologic Time	Symbol	Formation	Lithofacies	Classification Of Aquifer	Geological Structure
CENOZOIC	QUATERNARY	(Holocene)	<div>Qal</div> <div>Q+</div>	Intergranular Aquifer	<div>Strike and dip</div> <div>Fault</div> <div>Fault (approximate)</div> <div>Photointerment</div>
		(Pleistocene)	<div>VN-Q</div> <div>VNg</div> <div>VPg</div>	Intergranular and Fissured Aquifer	<div>Axis of downwarping</div> <div>Axis of upwarping</div> <div>Volcanic cone</div>
	TERTIARY	Neogene	Boloven Basalt (Basalt Flows)	Fissured Aquifer	
		Paleogene	Basalt lava flows.		
MESOZOIC	Cretaceous	J-K	Mostly continental sandstone, fine to medium. Evaporite.	Intergranular Aquifer Fissured Aquifer	
			Mostly red continental shale interbedded sandstone and shale.		
	Triassic	Mangiang Formation	Acidic volcanics ; Rhyolite, tuff, Quartz porphyry etc.	Fissured Aquifer	
			Marine flysh sediments. Interbedded slate and sandstone. Basement complex : metasediments.		
PALEOZOIC	Permian - Carboniferous	C-P	Pz		
PALEOZOIC	Plutonic Rocks	Permian - Carboniferous	Mostly granodiorite and monzogranite.		




Figure - 4 (1) Preliminary Groundwater Potential Hydrogeologic Features

Types of Hydrogeologic Features		Province, district	Village Number	Test well Point
<p>Of</p> <p>Topography: Flood plain, Accumulation Terrace. Lithology: Sand, silt, clay, gravel. Geologic Time: Quaternary Aquifer: Sand, gravel Water Depth (Dry season, G.L. -m): 6-13m Well yield: (Test well) $Sc=14-128m^3/day/m$; $Q_{max}=133-380m^3/day$ (Existing well) $Q_{max}=120-86m^3/day$ Water Quality (Test well) $PH=7.1-7.4$, $EC=376-767 \mu s/cm$ (Existing well) $PH=7-8$, $EC=400-600 \mu s/cm$ Groundwater potential: A</p>		<p>Saravan (S)</p> <p>Lakhonepheng Khongtedon Vapay Saravan Laongam Champasak (C)</p> <p>Sansomboon Bachiang Pattinophong Sukhuma Khong</p> <p>1, 5, 17, 18, 22, 23, 24, 25, 33, 34, 35, 36</p> <p>12, 20, 22, 23, 24, 25, 26, 29, 30, 31, 32, 33, 34, 35</p> <p>42, 43, 44, 46, 47, 48, 49, 50</p> <p>75</p> <p>80, 82, 83</p> <p>84, 85, 91, 93, 95, 97</p>		
		<p>Saravan (S)</p> <p>Lakhonepheng Khongtedon Vapay Saravan Laongam Champasak (C)</p> <p>Sansomboon Bachiang Pattinophong Sukhuma Khong</p> <p>21, 28</p> <p>100</p>		
		<p>Saravan (S)</p> <p>Lakhonepheng Khongtedon Vapay Saravan Laongam Champasak (C)</p> <p>Sansomboon Bachiang Pattinophong Sukhuma Khong</p> <p>7, 9, 10, 11, 12, 13, 14, 15, 16</p>		
		<p>Saravan (S)</p> <p>Lakhonepheng Khongtedon Vapay Saravan Laongam Champasak (C)</p> <p>Sansomboon Bachiang Pattinophong Sukhuma Khong</p> <p>97, 98, 99, 100</p>		
<p>Qt</p> <p>Topography: Alluvial fan, Talus slope. Lithology: Sand, silt, clay, Sandstone, shale. Geologic Time: Quaternary, Jurassic Aquifer: Unconsolidated sand, Jurassic sandstone. Water Depth (Dry season, G.L. -m): 7-8m Well yield: (Test well) (Existing well) $Q_{max}=0-168m^3/day$ Water Quality (Test well) $PH=$ —, $EC=$ — (Existing well) $PH=7-8$, $EC=450-800 \mu s/cm$ Groundwater potential: C</p>		<p>Saravan (S)</p> <p>Lakhonepheng Khongtedon Vapay Saravan Laongam Champasak (C)</p> <p>Sansomboon Bachiang Pattinophong Sukhuma Khong</p>		
		<p>Saravan (S)</p> <p>Lakhonepheng Khongtedon Vapay Saravan Laongam Champasak (C)</p> <p>Sansomboon Bachiang Pattinophong Sukhuma Khong</p>		
		<p>Saravan (S)</p> <p>Lakhonepheng Khongtedon Vapay Saravan Laongam Champasak (C)</p> <p>Sansomboon Bachiang Pattinophong Sukhuma Khong</p>		
		<p>Saravan (S)</p> <p>Lakhonepheng Khongtedon Vapay Saravan Laongam Champasak (C)</p> <p>Sansomboon Bachiang Pattinophong Sukhuma Khong</p>		
<p>QtC</p> <p>Topography: Accumulation terrace Lithology: Gravel, shale, sandstone Geologic Time: Tertiary, Jura-Creta Aquifer: Gravel, Sandstone Water Depth (Dry season, G.L. -m): 7-9m Well yield: (Test well) $Sc=16m^3/day/m$; $Q_{max}=72m^3/day$ (Existing well) $Sc=$ —, $Q_{max}=$ — Water Quality (Test well) $PH=5.6$, $EC=96 \mu s/cm$ (Existing well) $PH=$ —, $EC=$ — Groundwater potential: B</p>		<p>Saravan (S)</p> <p>Lakhonepheng Khongtedon Vapay Saravan Laongam Champasak (C)</p> <p>Sansomboon Bachiang Pattinophong Sukhuma Khong</p>		
		<p>Saravan (S)</p> <p>Lakhonepheng Khongtedon Vapay Saravan Laongam Champasak (C)</p> <p>Sansomboon Bachiang Pattinophong Sukhuma Khong</p>		
		<p>Saravan (S)</p> <p>Lakhonepheng Khongtedon Vapay Saravan Laongam Champasak (C)</p> <p>Sansomboon Bachiang Pattinophong Sukhuma Khong</p>		
		<p>Saravan (S)</p> <p>Lakhonepheng Khongtedon Vapay Saravan Laongam Champasak (C)</p> <p>Sansomboon Bachiang Pattinophong Sukhuma Khong</p>		
<p>Ba1</p> <p>Topography: Basalt slope. Lithology: Mudflow deposit, loam, ash, lava flows. Geologic Time: Neogene-Quaternary Aquifer: Lava flows Water Depth (Dry season, G.L. -m): 20-35m Well yield: (Test well) $Sc=3-20m^3/day/m$; $Q_{max}=20-127m^3/day$ (Existing well) $Q_{max}=90-1000m^3/day$ Water Quality (Test well) $PH=5.6-5.9$, $EC=65-116 \mu s/cm$ (Existing well) $PH=6-7$, $EC=10-100 \mu s/cm$ Groundwater potential: B-C</p>		<p>Saravan (S)</p> <p>Lakhonepheng Khongtedon Vapay Saravan Laongam Champasak (C)</p> <p>Sansomboon Bachiang Pattinophong Sukhuma Khong</p> <p>38, 39, 40, 41, 42, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59</p> <p>64</p>		
		<p>Saravan (S)</p> <p>Lakhonepheng Khongtedon Vapay Saravan Laongam Champasak (C)</p> <p>Sansomboon Bachiang Pattinophong Sukhuma Khong</p>		
		<p>Saravan (S)</p> <p>Lakhonepheng Khongtedon Vapay Saravan Laongam Champasak (C)</p> <p>Sansomboon Bachiang Pattinophong Sukhuma Khong</p>		
		<p>Saravan (S)</p> <p>Lakhonepheng Khongtedon Vapay Saravan Laongam Champasak (C)</p> <p>Sansomboon Bachiang Pattinophong Sukhuma Khong</p>		

Figure - 4 (2) Preliminary Groundwater Potential Hydrogeologic Features

Types of Hydrogeologic Features	Province, district	Village Number
8a2 Topography: Basalt slope. Lithology: Basalt lava flows. Geologic Time: Noogene-Quaternary Aquifer: Lava flows, autohectated lava. Water Depth (Dry season, G.L. -m): 13-24m Well yield: (Test well) Sc=700-1900m ³ /day/m; Qmax=1728-3800m ³ /day (Existing well) Qmax=—m ³ /day Water Quality (Test well) PH=6.4, EC=165-210 μs/cm (Existing well) PH=5-7, EC=15-200 μs/cm Groundwater potential: A	Saravan (S) Lakhonepheng Khongxedon Vap Saravan Laongan Champasak (C) Sanasomboon Bachiang Pathomphone Sukhuma Khong	82, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96 43, 44, 60, 61 62, 63, 67, 68, 69, 70, 71, 72, 73
8a3 Topography: Basalt slope. Lithology: Basalt lava flow, sandstone, shale. Geologic Time: P-Phg basalt lava, J. sandstone. Aquifer: Basalt lava, Jurassic sandstone. Water Depth (Dry season, G.L. -m): 4-12m Well yield: (Test well) Sc=19, 1m ³ /day/m; Qmax=267m ³ /day (Existing well) Qmax=144-211m ³ /day Water Quality (Test well) PH=7.0, EC=569 μs/cm (Existing well) PH=6-7, EC=41-260 μs/cm Groundwater potential: B	Saravan (S) Lakhonepheng Khongxedon Vap Saravan Laongan Champasak (C) Sanasomboon Bachiang Pathomphone Sukhuma Khong	51, 52, 53, 54, 57, 58, 59, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 82 37 66, 71
Ep Topography: Erosional plain Lithology: Red shale, fine to medium sandstone. Geologic Time: Jurassic Aquifer: Sandstone, sandy shale. Water Depth (Dry season, G.L. -m): 7-12m Well yield: (Test well) Sc=3-166m ³ /day/m; Qmax=17-166m ³ /day (Existing well) Qmax=0-672m ³ /day Water Quality (Test well) PH=7.0-7.3, EC=447-627 μs/cm (Existing well) PH=6.5-8, EC=300-700 μs/cm Groundwater potential: B	Saravan (S) Lakhonepheng Khongxedon Vap Saravan Laongan Champasak (C) Sanasomboon Bachiang Pathomphone Sukhuma Khong	15, 16 17, 27, 28, 37, 38 39, 40, 41, 45, 54, 55 60, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 82 26, 28, 29, 31 63
Eh Topography: Erosional hill Lithology: Red shale, sandstone, conglomerate. Geologic Time: Jurassic-Cretaceous Aquifer: Sandstone, conglomerate. Water Depth (Dry season, G.L. -m): 9-20m Well yield: (Test well) Sc=1-17, 3m ³ /day/m; Qmax=9-72m ³ /day (Existing well) Qmax=144-108m ³ /day Water Quality (Test well) PH=6.7-7.1, EC=750-1000 μs/cm (GL-60-180m) (Existing well) PH=5-7, EC=600-1000 μs/cm Groundwater potential: B-C	Saravan (S) Lakhonepheng Khongxedon Vap Saravan Laongan Champasak (C) Sanasomboon Bachiang Pathomphone Sukhuma Khong	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14 19 2, 3, 4, 5, 6, 7, 8, 9, 20, 21, 27, 30, 32

Figure - 4 (3) Preliminary Groundwater Potential Hydrogeologic Features

Types of Hydrogeologic Features		Province, district	Village Number
<p>E1, E2</p> <p>Topography: Erosional terrace</p> <p>Lithology: Slate, sandstone, Acidic tuff, dacite.</p> <p>Geologic Time: Permian-Triassic</p> <p>Aquifer: Fractured aquifer</p> <p>Water Depth (Dry season, G.L. -m): 8-17m</p> <p>Well yield:</p> <p>(Test well) SC=4, 6-36, 9m³/day/m; Q=at=32-120m³/day</p> <p>(Existing well) Q=at=3m³/day</p> <p>Water Quality</p> <p>(Test well) T=6, 8-7, 3, EC=430-763 μS/cm</p> <p>(Existing well) PH=7, 2-7, 2, EC=300-600 μS/cm</p> <p>Groundwater potential: B-C</p>		<p>Saravan(S)</p> <p>Lakhonepheng</p> <p>Khongxeden</p> <p>Vayy</p> <p>Saravan</p> <p>Laongam</p> <p>Champasak(C)</p> <p>Sanasomboon</p> <p>Bachiang</p> <p>Pathomphone</p> <p>Sukhuma</p> <p>Khong</p> <p>86, 87, 88, 89, 90, 92, 94, 96, 98, 99</p>	
<p>P</p> <p>Topography: Plateau, high plain</p> <p>Lithology: Medium-coarse sandstone, mudstone.</p> <p>Geologic Time: Jurassic-Cretaceous</p> <p>Aquifer: Sandstone, Fractured.</p> <p>Water Depth (Dry season, G.L. -m): Deep, Shallow (perched)</p> <p>Well yield: low</p> <p>Groundwater potential: C</p>		<p>Saravan(S)</p> <p>Lakhonepheng</p> <p>Khongxeden</p> <p>Vayy</p> <p>Saravan</p> <p>Laongam</p> <p>Champasak(C)</p> <p>Sanasomboon</p> <p>Bachiang</p> <p>Pathomphone</p> <p>Sukhuma</p> <p>Khong</p>	
<p>M</p> <p>Topography: Mountains</p> <p>Lithology: Metasediments, plutonic rocks.</p> <p>Geologic Time: Proterozoic-Paleozoic</p> <p>Aquifer: Fractured aquifer, Sand in valley.</p> <p>Water Depth (Dry season, G.L. -m): Deep shallow</p> <p>Well yield: Low</p> <p>Groundwater potential: C-D</p>		<p>Saravan(S)</p> <p>Lakhonepheng</p> <p>Khongxeden</p> <p>Vayy</p> <p>Saravan</p> <p>Laongam</p> <p>Champasak(C)</p> <p>Sanasomboon</p> <p>Bachiang</p> <p>Pathomphone</p> <p>Sukhuma</p> <p>Khong</p>	

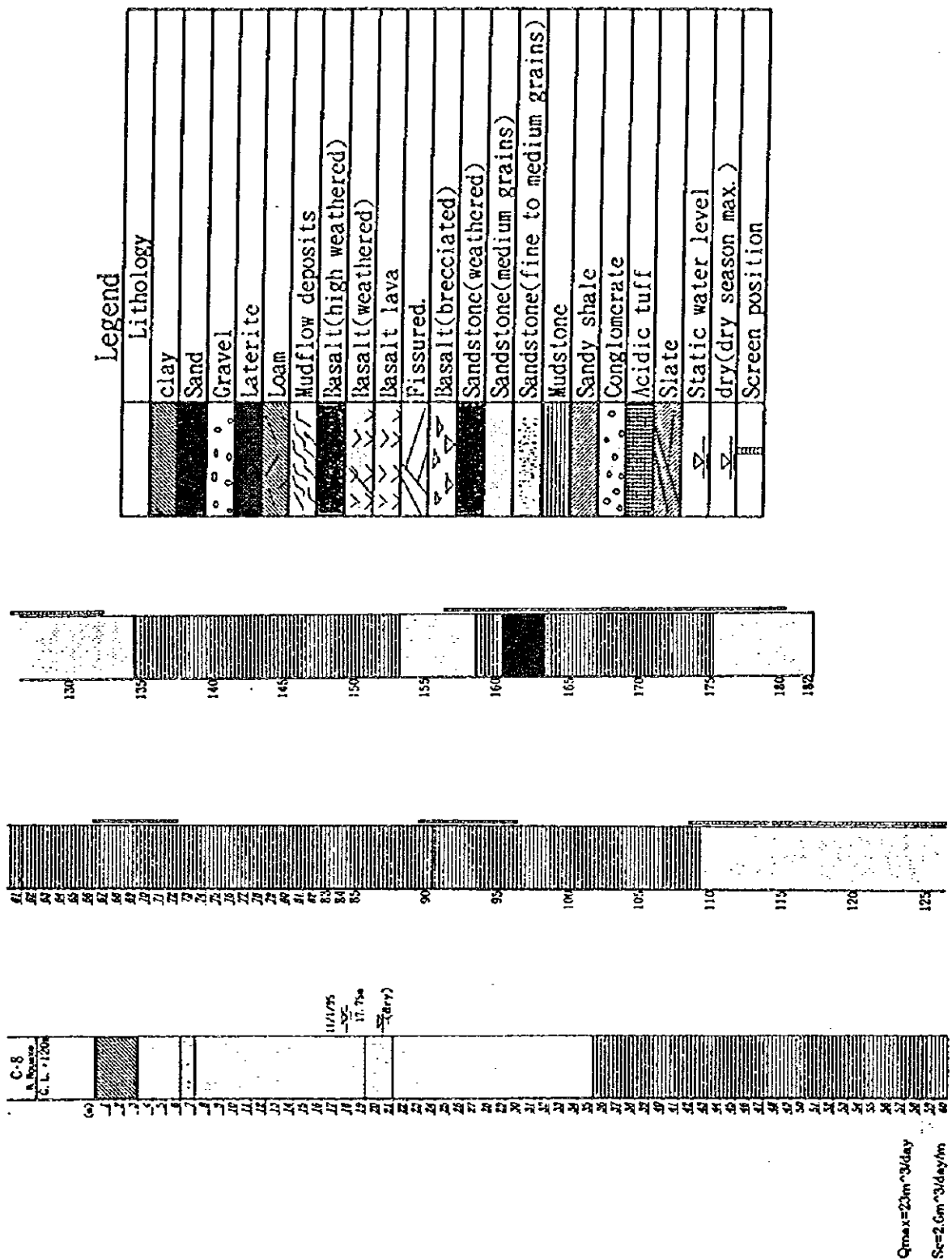


Figure - 5 (1) Lithology and Specific Capacity of Test Wells

THE STUDY ON GROUNDWATER DEVELOPMENT FOR CHAMPASAK
AND SARAVAN PROVINCES, LAO PEOPLE'S DEMOCRATIC REPUBLIC

JAPAN INTERNATIONAL COOPERATION AGENCY(JICA)

KOHSEN KOSYO CO., LTD.
CONSTRUCTION PROJECT CONSULTANTS INC.

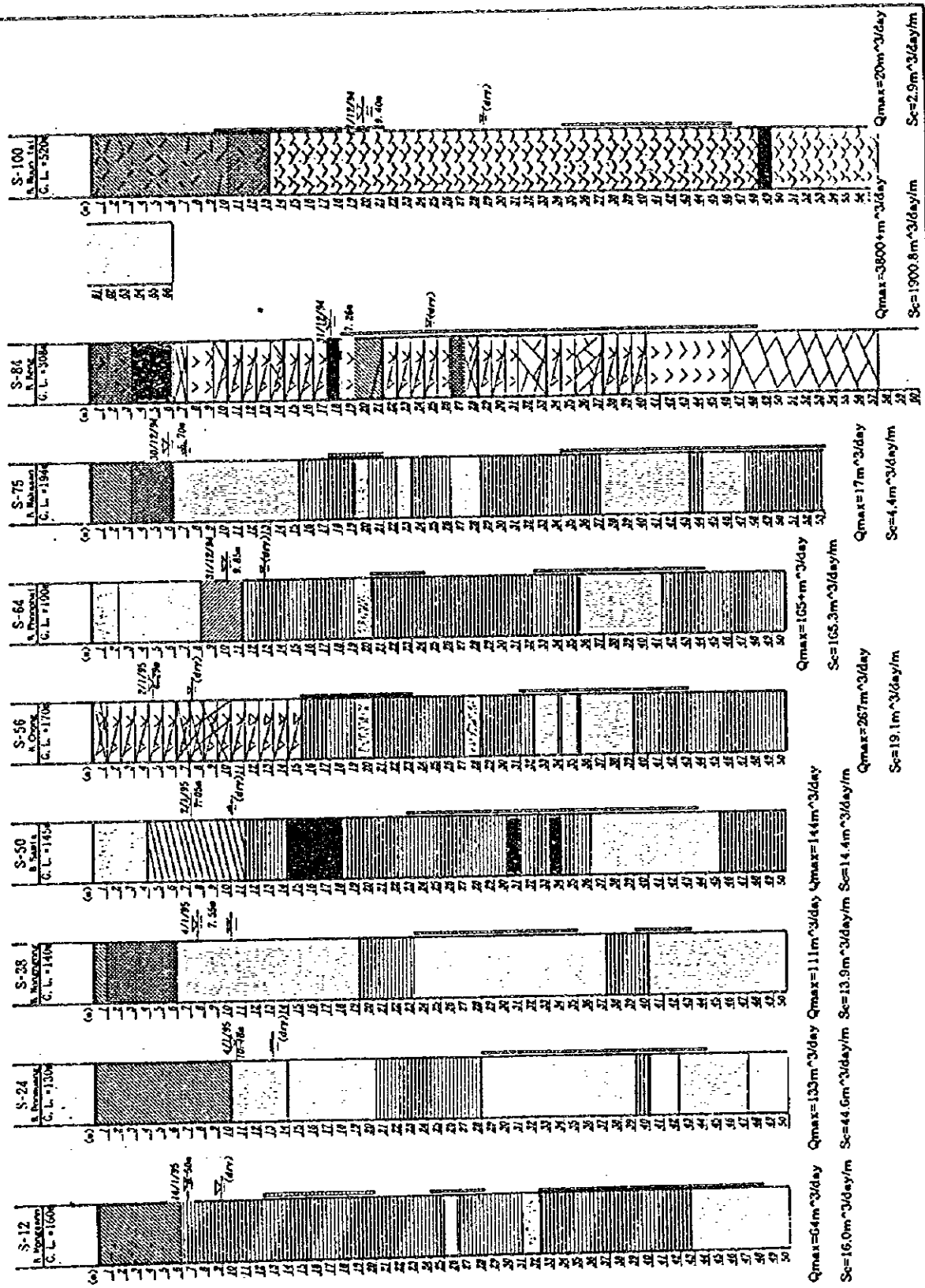


Figure - 5 (2) Lithology and Specific Capacity of Test Wells

THE STUDY ON GROUNDWATER DEVELOPMENT FOR CHAMPASAK
AND SARAVAN PROVINCES, LAO PEOPLE'S DEMOCRATIC REPUBLIC

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

KOSUDA KOTO CO., LTD.
CONSTRUCTION PROJECT COORDINATOR

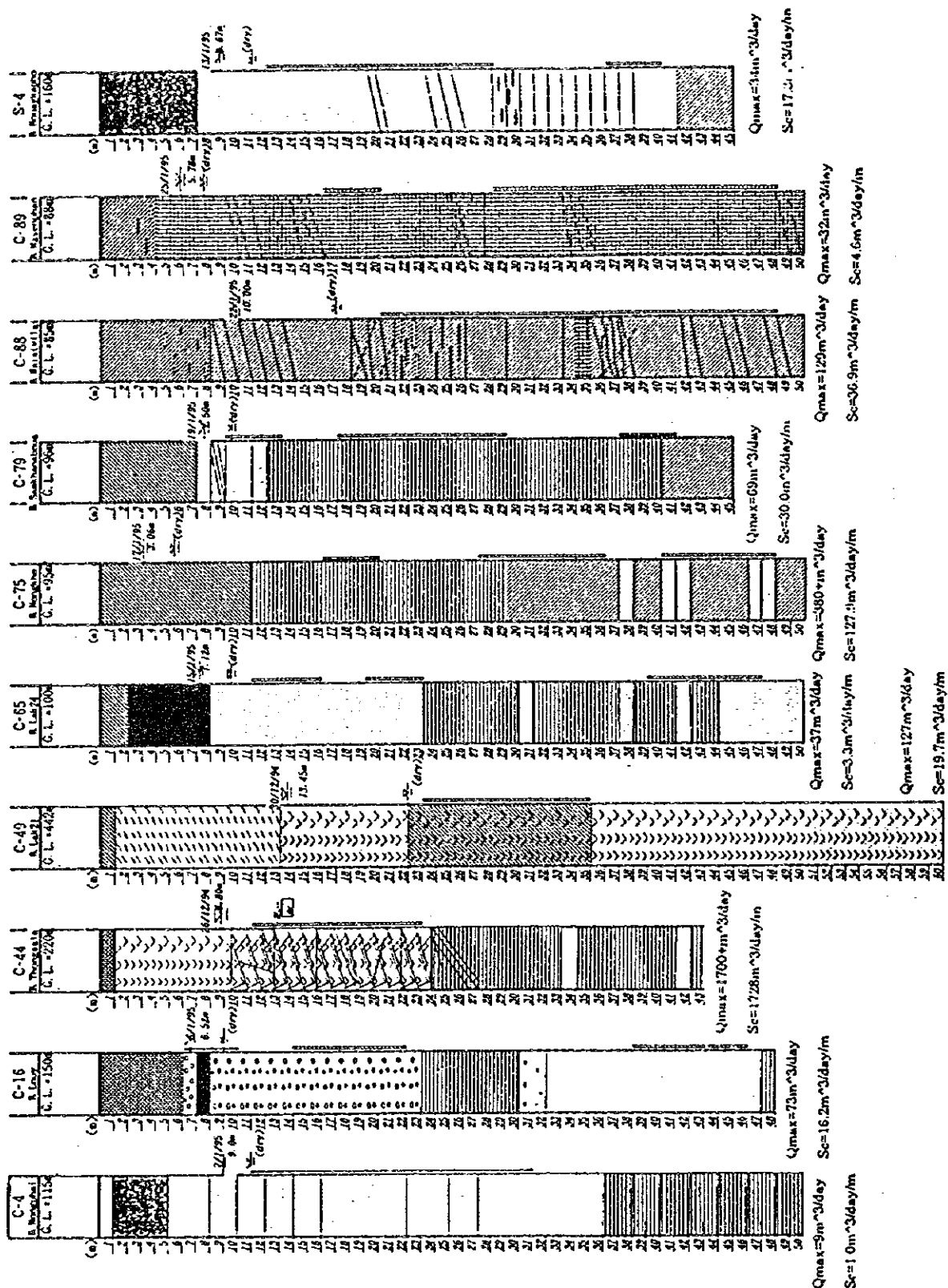


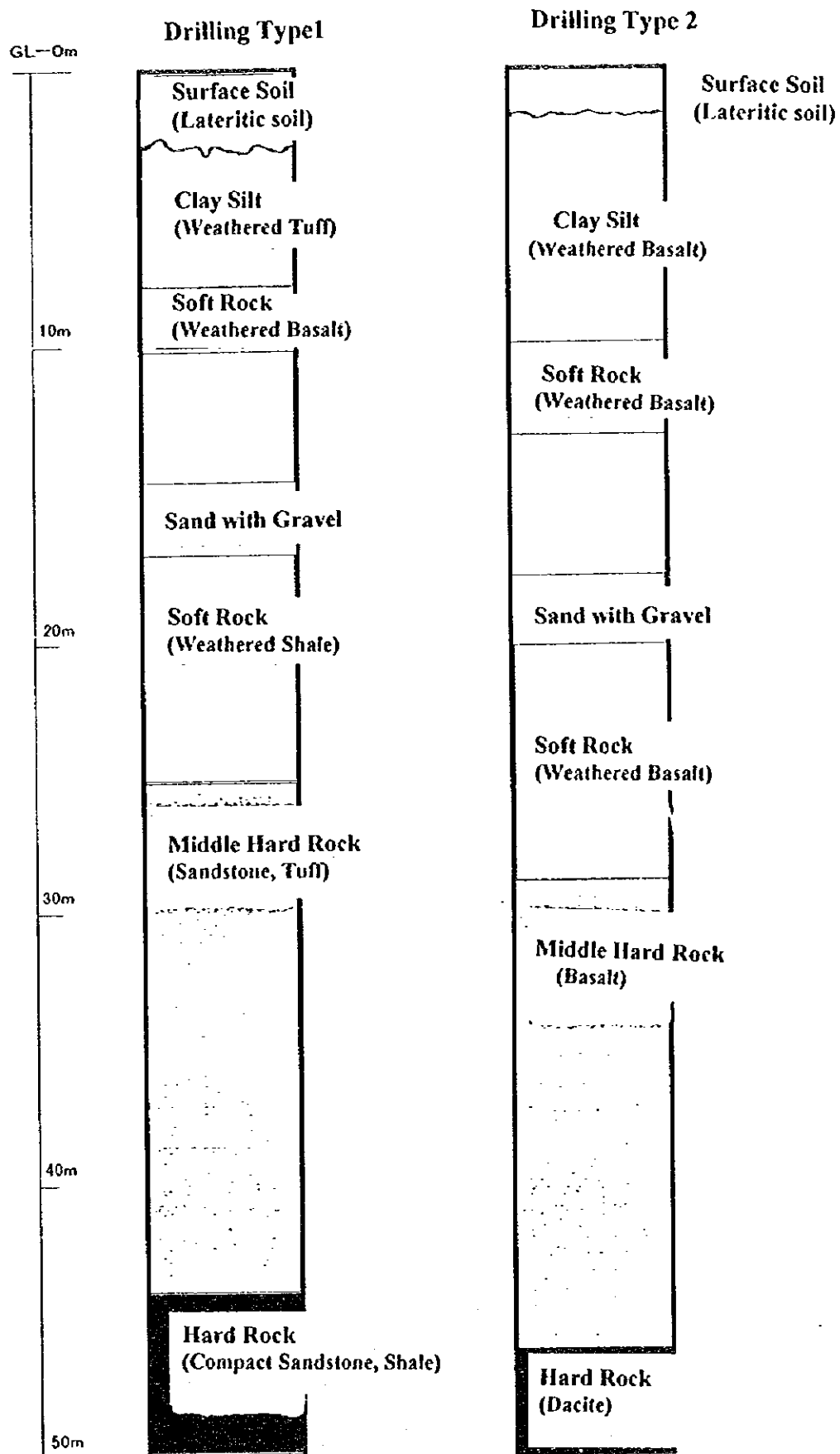
Figure - 5 (3) Lithology and Specific Capacity of Test Wells

THE STUDY ON GROUNDWATER DEVELOPMENT FOR CHAMPASAK AND SARAVAN PROVINCES, LAO PEOPLE'S DEMOCRATIC REPUBLIC

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Figure - 6 Classification of Geological Structure



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