WATER AND SANITATION
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AN ASSESSMENT OF SAVE THE CHILDREN FEDERATION, INC. (USA) RURAL WATER SUPPLY SYSTEMS AND TRAINING NEEDS IN NEPAL

WASH FIELD REPORT NO. 157

DECEMBER 1985

Prepared for
Save the Children Federation, Inc. (USA)
Office in Kathmandu, Nepal, and the USAID Mission to Nepal
WASH Activity No. 163

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by

Carl R. Johnson

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EXECUTIVE SUMMARY

At the request of the Save the Children Federation, Inc. (USA) of Nepal (SCF) and the USAID Mission to Nepal, the Water and Sanitation for Health (WASH) Project sent a consultant to Nepal from September 16 to October 4, 1985, to assess the rural drinking water supply projects constructed by SCF. The projects are located in the Gorkha District of Nepal, and they have been constructed as part of SCF's community-based integrated rural development program. The objectives of the assignment were to inspect the projects and to develop recommendations for improving the technical aspects of SCF's water supply program, particularly in the areas of project implementation, design, construction, maintenance, and training. The work included field visits to inspect the projects that were either built or under construction by SCF as well as interviews with USAID and SCF staff in Kathmandu and in the project areas. The following report presents the background, findings, conclusions, and recommendations of this assignment.

Key Findings and Conclusions

1. SCF conducts a fundamentally sound drinking water supply program founded on village beneficiary initiative, using simple gravity-flow technology and predominantly local materials and that has provisions for continued maintenance of the water system by the beneficiaries.

2. In general, the construction quality and reliability of SCF water projects either equal or exceed that of projects constructed by other governmental and nongovernmental agencies in rural Nepal.

3. SCF's approach to drinking water supply projects provides a firm foundation from which to further enhance certain aspects of its program. Improvements may, however, be made in the following areas:

   Implementation - The present use of the village development committee in directing the implementation of the water projects should be further refined to involve a subcommittee of project beneficiaries although some subcommittees have already been activated; the various steps of project implementation (request for project, feasibility survey, planning, design, construction, and maintenance) should be formally defined; Nepali staff overseers should be given a clearly defined, technical decision-making role.

   Design - Materials selection, procurement, transportation, and storage are generally excellent; design methods, however, need improvement to ensure proper pipe size and reservoir tank size and to increase protection of water sources from monsoon flood damage and from contamination.

   Construction - Techniques can most readily be improved by ensuring that construction is performed in accordance with the detailed design and that it is performed in a sequence that conveys water from source, to reservoir, to taps, in a step-by-step manner that ensures that water will flow to each part of the system before constructing the next downstream structure.

Maintenance - Maintenance improvements include increased emphasis on preventive maintenance, maintenance committees formed according to the guidelines for membership, and a dedicated two-year period in which SCF oversees the maintenance committee regarding practices.

Training - A training program should be conducted that builds on the present skills of the SCF staff and provides instruction as follows:

a. Training of field office coordinators to instruct village beneficiary subcommittees in water supply management concepts

b. Training of overseers and suboverseers in certain water supply design techniques

c. Training of overseers and suboverseers to train village maintenance committees and special plumbers.

Recommendations are presented to improve SCF's water supply program, to repair and reconstruct part of existing projects that do not function properly, and to outline the scope and nature of the proposed training program. Training should be performed during the second phase of this WASH assignment. It is recommended that the training involve a WASH engineering consultant; a Nepali trainer; the SCF water supply intern; and all SCF field office coordinators, overseers, and suboverseers.

Chapter 1

INTRODUCTION

1.1 Background

A WASH consultant was on assignment in Nepal from September 16, 1985 to October 4, 1985, at the request of the Save the Children Federation of the USA (SCF) and the USAID Mission to Nepal. SCF operates a community-based, integrated rural development program in the Gorkha District of Nepal in collaboration with the Nepal Social Services National Coordination Council and through a Private Voluntary Organization (PVO) Co-financing Grant from USAID. The goal of SCF's program, initiated in 1981, is to improve the social, economic, and environmental conditions of children and families in selected rural areas of Nepal through a program of community-based integrated rural development. SCF currently works in five village panchayats[1] -- Deurali, Dhuwakot, Takukot, Majhlakuribot, and Pandrung -- which have a total population of approximately 17,000 people.

1.2 Scope of SCF's Work

1.2.1 General

The scope of SCF's work includes:

- Health care
- Water resource and physical infrastructure development
- Human resources development
- Agricultural and economic development
- Resource conservation and appropriate technology.

SCF's objective is to work in a village for five to ten years, during which time the village is to develop self-sufficiency for continued development.

1.2.2 Scope and Objective of SCF's Water Supply Efforts

Regarding SCF's development efforts, drinking water supply projects are usually among the highest priority identified by the village. This report hereafter focuses on the drinking water supply projects implemented by Save the Children Federation. Its drinking water supply projects date from 1981, with most construction occurring during 1983, 1984, and 1985.

Drinking water supply work by SCF involves extensive reliance on village initiative, labor, and materials to implement, to construct, and to maintain

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[1] Panchayat is the Nepali term for the village municipal government unit. Each panchayat has nine wards.

water systems. Sites for drinking water systems are selected to serve the greatest number of people per unit of cost. Total water supply expenditures to date are estimated by SCF to be about $100,000 serving approximately 4,900 people. This cost includes tools, materials, skilled labor for construction, and volunteer labor from the village, but excludes SCF technical staff costs and overhead.

1.3 Water Supply Characteristics of the Project Area

The SCF drinking water projects in the Gorkha District lie in the lower to middle hills region of central Nepal. The elevation ranges from 800 feet to 4,000 feet above sea level. Temperatures vary from 49° to 88° F (January to May extremes). The climate is semitropical, with a monsoon season from June to September. Average annual precipitation is 1,000 to 3,000 mm. Natural forest vegetation, where it exists, tends to preserve groundwater level throughout the dry season. Agricultural land clearing and deforestation for fuel harvesting, however, has occurred to a great extent, thereby causing severe depletion of water supply springs in the hill regions during dry weather. As a result, a significant difference exists between the monsoon season and dry season water resources, which is an important factor in the design of SCF's gravity-flow drinking water systems, as discussed later.

SCF estimates that before it became involved in water supply projects, approximately two-thirds of the population in its project areas obtained water from rivers or streams and one-third from hillside springs. Most villages have traditionally been located on hilltops for protection from malaria in the valleys. The walking distance for water typically ranges from one-half to one hour or more in the dry season. Further, most traditional sources of water are subject to contamination by animals, runoff from agricultural land, and human waste.

Water is used sparingly in hill villages because of the difficulty in obtaining it. A recent report cited in Nepal's English language daily newspaper states that only 1 percent of the population of the country has access to clean water. The difficult situation for water supply contributes to a national infant mortality rate of 140 to 200 per 1,000, and a crude death rate of approximately 27 per 1,000.

Chapter 2

SCOPE OF WORK

2.1 Scope of Development

The scope of work was developed by SCF and the USAID Mission to Nepal, during the period December 1984 to February 1985. Initial concepts included a combined engineering assessment and training assignment consisting of four parts:

a. Evaluation of the implementation process, design, and long-term viability of SCF and USAID Rapti Integrated Development Project water systems

b. Recommendations for appropriate community-based maintenance programs

c. Recommendations for improved design

d. Training of three levels of construction and maintenance personnel.

Discussions with the WASH Office in the spring of 1985 resulted in a two-phase approach. The first phase would consist of activities "a, b, and c" during the period September to October 1985. The second phase, "d," would be performed in January 1986.

2.2 Original Scope of Work

The scope of work that resulted from the foregoing planning is presented below:

1. Review relevant project documents.

2. Visit gravity-fed water supply systems in the SCF and Rapti Project areas.

3. Assess these systems regarding:

Design:	Leak and pipe rupture prevention, quality of materials, and workmanship
Implementation:	Timing, planning, materials arrival, supervision, and level of participation by population
Maintenance:	Maintenance requirements, training, and related problems.

4. Develop recommendations in these areas, including:

   a. Specific suggestions for design improvements within the budget and rural development philosophy of Save the Children Federation

   b. Suggestions for improving maintenance of projects, with particular reference to maximizing the participation of populations obtaining agreement on implementation procedures and realistic scheduling.

5. Prepare a draft report for review by USAID and SCF.

6. Hold one or more briefings with USAID, SCF, and other nonprofit voluntary agencies on the findings and recommendations of the assignment.

2.3 Revised Scope of Work

Two revisions were made to the original scope of work. First, it was impossible to schedule a field visit to the Rapti Project area during the September-October time period due to a schedule miscommunication by the WASH Office and a concurrent evaluation of that project by others. For these reasons, the USAID Mission to Nepal chose to make the September-October assignment approximately a 14-day assignment focusing on SCF systems, with the Rapti Project assessment rescheduled for January 1986.

Second, the briefings with the other nonprofit voluntary agencies also was rescheduled for January 1986. Briefings with USAID and SCF, however, were held. The two elements of the original scope of work that were rescheduled for January 1986 will be performed in conjunction with the second phase of this assignment originally scheduled for January 1986.

Chapter 3

DESCRIPTION AND CURRENT STATUS OF SCF DRINKING WATER PROJECTS IN NEPAL

3.1 Drinking Water Project Description

Water supply efforts of Save the Children Federation date from 1981. Its earliest projects were built with the technical assistance of U.S. Peace Corps volunteers. Since 1983, however, it has hired its own Nepali overseers and suboverseers for design, construction supervision, and training of village maintenance committees.[1]

SCF's water supply projects have been implemented concurrently with its other community development efforts. The Nepali overseers and suboverseers are responsible for the design and construction of water systems as well as for the design and construction of schools, irrigation projects, and other infrastructure. The overseers and suboverseers train village maintenance committees and special plumbers in maintenance techniques and pipe and masonry repair. The entire community development effort (including drinking water system construction) is largely directed by a village development committee consisting of up to 12 persons from each panchayat. A history and current status of water systems completed by SCF is presented in Table 1 on the following page.

3.2 Current Status

SCF is currently evaluating its water supply projects while continuing work on systems now under construction. The goal of SCF's evaluation is to:

- Improve fiscal control
- Improve the critical aspects of water system implementation, including planning, design, construction, and maintenance and community involvement
- Create a sound technical basis for expanding water supply efforts into other village panchayats, with special emphasis on training a larger staff of Nepali overseers and suboverseers.

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[1] An overseer is a Nepali engineering technician position requiring three years of technical training and an examination. A suboverseer is a technical staff person who has yet to complete either the overseer training or examination.

Table 1

History and Current Status of SCF
Drinking Water Systems in Nepal

Village Panchayat	Year Started	Systems Completed	Systems Under Construction	Systems Approved for Construction	Approximate Number of People Served
Deurali	1981	5	1	0	1,900
Takukot	1983	10	6	1	2,750
Majhlakuribot	1984	1	3	0	1,550
Pandrung	1984	0	2	1	800
Dhuwakot	*	*	*	*	210
		16	12	2	7,210 **

Notes: * USAID Resource Conservation and Utilization Project (RCUP) built the water systen here in 1982 and 1983, prior to SCF involvement. The system has never been operational (see Section 5.3.1.). SCF began work in Dhuwakot in 1985.

** Approximately 4,900 persons are currently served by either completed systems or systems now under construction.

Chapter 4

ACTIVITIES OF THE WASH CONSULTANT

4.1 General

The WASH consultant's activities included interviews with USAID personnel, with SCF personnel in Kathmandu and in the field offices, field visits to each of the village panchayats where SCF is constructing water systems, inspection of 18 completed systems or systems under construction, and review of design files of 3 other systems. In addition, training needs were assessed through discussions with Nepali overseers and suboverseers and through observation of maintenance work by special plumbers and observation of construction work by skilled laborers. All observations were oriented toward the following:

1. Identifying the strengths of the SCF program
2. Determining the needs for improvement in materials, design, workmanship, implementation, construction techniques, and training
3. Ascertaining causes of problems
4. Identifying priorities for improvement.

4.2 Itinerary

The writer's itinerary was as follows:

September 12-13	--	Briefings with WASH staff in Washington, D.C.
September 12	--	Meeting with Dr. Jake van der Vlugt, former Health Officer of the USAID Mission to Nepal.
September 12	--	Meeting with Mr. Peter Buijs, private consultant, who had visited the SCF water systems in April 1985.
September 14-16	--	Air travel, Boston to Kathmandu.
September 16	--	Registration at U.S. Embassy in Nepal, telephone discussions the USAID representative Barbara Spaid.
September 17	--	Meeting with Mr. Gary Shaye, Director of SCF Nepal; meetings with other SCF staff; and review of relevant project documents.
September 18	--	Meeting with Barbara Spaid and Carl Dutto of USAID to discuss the Rapti Integrated Rural Development Project, additional discussions with SCF, and review of project documents.

September 19	--	Travel: Kathmandu to Dhuwakot.
September 20	--	Inspection of Dhuwakot system, travel to Deurali, and observation of plumbing techniques.
September 21	--	Inspection of Deurali water projects and interviews with suboverseer.
September 22	--	Inspection of Deurali water projects and travel from Deurali to Sikar.
September 23	--	Travel from Sikar to Takukot.
September 24	--	Inspection of Takukot and Majhlakuribot water projects and interviews with overseers and construction supervisor.
September 25	--	Observation of plumbing techniques and report preparation and review of Takukot water project files.
September 26	--	Inspection of Takukot water projects and report writing.
September 27	--	Inspection of Pandrung water projects.
September 28	--	Travel from Pandrung to Kathmandu.
September 29	--	Report preparation.
September 30	--	Briefing with SCF and report writing.
October 1	--	Briefing with USAID and report writing.
October 2	--	Report preparation.
October 3	--	Report review with SCF and discussions with USAID regarding second phase of work in Rapti and training.
October 4-5	--	Travel from Kathmandu to Boston.

Chapter 5 describes the findings and conclusions of these activities.

Chapter 5

FINDINGS AND CONCLUSIONS

5.1 General

This chapter first presents the overall findings of the SCF water supply program in Nepal. These are supported by a discussion of specific project findings which exemplify typical conditions observed during the field visits. Conclusions are then presented regarding opportunities for further improvement in the SCF water supply program for project implementation, design, construction, maintenance, and training. Recommendations for instituting these improvements are presented in Chapter 6.

5.2 Overall Project Findings

1. SCF has constructed, expanded, or repaired 16 water supply systems in four village panchayats since 1981. Twelve systems are currently under construction.

2. Total expenditures to date (September 1985) have been approximately $100,000 serving 4,900 people, or $20 per capita, including costs for tools, materials, and skilled labor but excluding costs of SCF technical staff and overhead. This per capita cost is similar to that reported by WHO in its report on water systems built by the Ministry of Panchayat and Local Development, with assistance from UNICEF in the western region of Nepal in 1983.

3. SCF has generally been successful in:

   a. Procuring and transporting predominantly local materials or those made in Nepal for its drinking water projects

   b. Establishing and supporting village development committees that initiate the request for a water system, identifying the scope and schedule for construction, and enlisting the voluntary labor of villagers for construction

   c. Guiding the village development committee in taking responsibility for maintenance of the completed drinking water project, including establishment of a maintenance committee and appointment of one or more special plumbers

   d. Recruiting Nepali overseers and suboverseers and constructions supervisors to perform the bulk of the technical design and construction supervision and maintenance training. SCF now has four such staff and plans to hire two or three more individuals.

4. While SCF's program in drinking water supply is successful, a number of opportunities exist for improving the program in the

areas of project implementation, design, and construction and for establishing an effective mechanism for continued maintenance by the village beneficiaries.

5. Typical problems observed in the field within these areas included the following:

   a. Implementation: Village disputes were neither thoroughly resolved nor understood prior to water system construction, thereby leading to vandalism or, in some cases, a lack of community support for the project. Village committees do not always understand the physical limitations of water supply systems, including source constraints; the impact of adding additional taps; and the importance of elevation gradients in gravity-flow water systems. Overseers leave SCF for other jobs either with the government or with private engineering firms.

   b. Design: Design errors exist in sizing pipes and reservior tanks. The location of reservoirs regarding break pressure tanks is improper. The design of tap distribution pipes inhibits equal flow between taps. Failure is evident in the design for both dry weather and monsoon season flows. A lack of air valves and washout valves exists.

   c. Construction: Although masonry construction methods and plumbing are generally good to excellent, the construction scope does not always follow the design plan (such as adding taps, moving taps and tanks, and changing pipe sizes). This situation exacerbates the design problems of small flows and unequal flows between taps where excavation is difficult. The pipe is sometimes exposed and subject to breakage. (Pipe rupture from pressure was not problematic, however.)

   d. Maintenance: Maintenance committees are not fully trained in preventive measures. Maintenance committees are not fully responsive. Special plumbers understand the basics of pipe repair but are apparently unaware of quality control measures. Maintenance tools are lacking in some locations.

6. Particular findings of program needs and problems within these four areas are classified below and discussed thereafter:

Implementation	Design	Construction	Maintenance
Staffing	Design methods	Masonry and pipe lines	Maintenance committee
Cost estimates and design files	Materials	Landslides and erosion	Plumber training
Village development committee approach	Source selection and protection	Nonequal flow distribution	Preventive maintenance

It is emphasized that SCF's needs and problems in these areas are not related to the basic SCF program approach but rather to the difficulty of constructing and maintaining rural water supply projects in Nepal. These needs and problems are common to drinking water projects carried out by other agencies in Nepal, both governmental and nongovernmental. In general, the construction quality and operational reliability of SCF water systems either equal or exceed that of projects built by other governmental and nongovernmental agencies in rural Nepal.

5.2.1 Implementation

Staffing

The SCF agreement with His Majesty's Government of Nepal Social Service National Coordination Council (SSNCC) encourages the use of Nepali national staff and limits SCF to two full-time expatriate staff. In the water supply field, there is great competition for Nepali engineers and overseers in Nepal, positions are available with either governmental or private engineering firms that can offer much higher salaries, greater job security, and less difficult working conditions than any nongovernmental, nonprofit voluntary agency. Thus, SCF has had difficulty in attracting and keeping its staff of overseers and suboverseers. SCF does not currently provide special water supply training for its overseers and suboverseers, and there is a need for such training to strengthen SCF's program.

To address some of the training needs, SCF has arranged for an expatriate intern for one year of service in water supply starting on October 15, 1985. Recommendations for the utilization of this person in a training role alongside Nepali staff are presented in Chapter 6.

Cost Estimates and Design Files

Design costs estimates are maintained in the village field office, and final cost records of actual expenses are maintained in Kathmandu. Table 2, on the following page, presents a sample of typical water supply project expenditures.

Design files at the villages appear to be essentially complete, although they could be expanded to include the following:

a. A narrative description of the project

b. A map of the system (in addition to the hydraulic profile)

c. A construction schedule and an accounting of volunteer labor effort in person-days.

In some situations, the profiles shown on the hydraulic design represented the elevations of trails rather than the actual pipe route. These profiles should instead show the actual route of the pipe, to ensure that pipe sizes are correct.

Table 2

Representative Project Costs in Takukot Panchayat

Project Identification	Estimated Cost at Time of Design (NCRs.)	Number of Persons Served	Cost per Person	
			NCRs.	U.S. $
Bahirpani	38,950	252	155	$ 8.6
Banspani	84,180	320	263	14.6
Bahakot	108,300	500	216	12.0
Devi Than	26,800	70	383	21.2
Bhaluswara	39,940	200	199	11.1
Moharia	79,830	262	303	16.8

Notes: a. Currency Conversion at 18 Nepali Rupees (NCRs) = 1 U.S. $.

b. Estimated costs include tools, materials, skilled labor, but exclude SCF technical staff and overhead.

Village Development Committee Approach

Save the Children Federation relies extensively on a village development committee to initiate and direct all community-based development efforts, including water supply. Each village-developed committee has up to nine ward subcommittees. Often, water supply projects serve only a part of the village and may serve two or more wards. Thus, in many cases, the subcommittee and the village development committee do not always represent the beneficiaries of the water project. Consequently, SCF has implemented some water projects, without a thorough understanding of prior village disputes in the water project services area and without a thorough knowledge of the water project service area needs.

The village development committee in Takukot has chosen not to accept maintenance responsibility for water projects until the projects are made fully operational by SCF. As a consequence, certain projects (that the village believes do not operate properly) are working at partial capacity, but are not being maintained. Recommendations for improving the composition of the committee responsible for project implementation and for formally demarcating the villages' maintenance responsibility are detailed in Chapter 6.

5.2.2 Design

Design Methods

Discussions with the overseers and suboverseers revealed that they were comfortable with the design of simple water projects involving six or less taps, but they felt that they needed more design training in complex systems with more than six taps, or with other unusual hydraulic constraints. The overseers and suboverseers use the UNICEF Handbook on Gravity-Flow Water Systems, but believed that the graphical design examples presented therein were too complicated. Most of the water projects observed by the writer tended to have standard design problems, such as reservoir too close to intake, over-reliance on single main pipelines, and lack of operational control valves to equalize flow distribution. The recommendation for training to improve project design methods is presented in Chapter 6 of this report.

Materials

The materials procured by SCF are generally excellent. Transportation and storage of materials do not appear to be a problem. The following cost information was obtained for pipe, cement, and slate:

Galvanized Iron Pipe (made in India)

Size (in)	Cost in Gorkha (Nepali Rupees per Meter)
1/2	19
1	40
1-1/4	51
2	81

High density Polyethylene Pipe (made in Nepal)

Size (mm)	Class	Cost in Gorkha (Nepali Rupees per Meter)
20	IV	6.0
32	III	10.0
50	III	23.0
63	III	26.0
75	III	50.5
90	III	73.0
110	III	108.0

Cement (made in Nepal): 145 Nepali rupees per bag in Gorkha (50 kg).

Slate: 1-1/4 Nepali Rupees per piece (each piece 25 cm X 25 cm X 6 mm) cost in Takukot.

Wood, Sand, and Stone: Donated by the village from local resources. Wood must be cut in accordance with an agreement from the Forestry Department of the national government in certain situations.

Float valves for break pressure tanks are of a design that can either be easily broken or forced out of adjustment. Valve box designs generally do not provide protection against tampering by curious children. Recommendations for improvement in float valves and valve box design are presented in Chapter 6.

Source Selection and Protection

Source selection in rural hill areas of Nepal must consider both dry season low flow and monsoon season flood flow. Dry season flows extend for two to four months and may be less than 10 percent of the average flow during the remainder of the year. The five major criteria in selecting a source include:

1. Sufficiently high elevation to serve the village
2. Able to be protected from contamination
3. Protection from monsoon flood damage
4. Accessible without landslide damage to pipe
5. Provision of 45 liters per capita per day.

Limited water supplies in the hills of rural Nepal often require that the first four criteria be met and that the fifth be used as a benchmark by which to gauge the adequacy of the source. While SCF strives for the minimun of 45 liters per capita per day (lpcpd) some systems provide as little as 20 Lpcd during the dry season, because there is no other water supply available within reasonable economic limits. This is a pragmatic approach to water supply in Nepal, when no other source is available.

Source protection by SCF can generally be improved by closer attention to the design standards presented in the UNICEF "Handbook for Gravity-Flow Water Systems." Recommendations for improving source protection, including relating source protection to other SCF health education efforts, are presented in Chapter 6.

5.2.3 Construction

Masonry Construction and Pipelines

Masonry construction is good. SCF uses local skilled masons for masonry work. If, however, local masons are unavailable, masons from the nearest large town, Gorkha, are used. Taps are relatively large and normally require 8 to 12 bags of cement. Save the Children Federation, however, achieves broader social objectives of community meeting places with the large tap area and has thus chosen to construct larger taps as a standard. Reinforced concrete slab construction appears to be of adequate structural strength. Access to reservoirs/intake tanks and valve boxes, however, is generally difficult, because the covers of reinforced concrete are too heavy to lift. These covers also leak, thereby increasing the likelihood of tank contamination. Provisions for tap drainage can be improved, but this activity is given a low priority status by village users. Pipe construction is generally good. Where excavation is difficult, pipe is exposed and subject to breakage. Some broken joints were observed due to poor joining techniques.

Landslides and Erosion

The steep hills and monsoon flooding in Nepal promote landslides and severe soil erosion. One SCF system must be annually repaired for landslide damage, and another system construction has been stopped because of a landslide. Erosion was observed around several SCF drinking water system structures as a result of monsoon flood damage, but generally the village workers anticipate flood damage and construct stone wall levees or slope protection. Recommendations for avoiding landslide damage and correction erosion problems are presented for applicable specific water systems in Chapter 6, Section 6.3.

Nonequal Flow Distribution

While nonequal flow distribution often stems from design errors, other causes in SCF systems include the following:

1. Additional taps constructed not in accordance with the original design
2. Valve box construction that allows valves to be tampered with
3. Lack of preventive maintenance to adjust valve settings periodically.

5.2.4 Maintenance

SCF requires that each group of water system beneficiaries form a maintenance committee to be responsible for repairs and operation of the water system. In general, maintenance committees have been successfully formed, with 20 out of 28 identified systems reported to have maintenance committees, and a "special plumber" has been appointed. The other eight systems either had not formed a maintenance committee, have a committee that is nonresponsive, or lack an appointed special plumber.

The beneficiaries of the water systems are expected to pay up to 1 rupee per month per house (or an equivalent in grain) to support maintenance activities. The effectiveness of the collection procedures is unknown.

Training of Special Plumbers

SCF overseers and suboverseers train special plumbers in techniques of pipe repair and valve repair. Tools are provided by SCF, and replacement valves are available for purchase at SCF field offices. Extra polyethylene pipe is left in the village for pipe repair purposes.

The WASH consultant witnessed two special plumbers perform joining of polyethylene pipe. Although both plumbers performed the basic work well, they omitted certain quality-control procedures that could result in weak pipe joints. In Dhuwakot, the special plumber lacked some of the required tools, but this water system was not constructed by SCF. Recommendations for improved training of special plumbers are presented in the following chapter.

Preventive Maintenance

The SCF program maintenance training is largely geared to repairs rather than to prevention. The consultant's experience is that preventive maintenance is

generally unappreciated in Nepal, and most mechanical equipment and structures are repaired after something fails to operate. The consultant also observed water projects in Deurali, Takukot, and Majhlakuribot where valves had been shut or taps broken and the people using the taps had not requested repairs. Most intakes tanks and reservoir tanks were observed to be in need of cleaning, but tap stands were generally kept clean. Recommendations for preventive maintenance training are presented in Chapter 6, Section 6.4.

5.3 Specific Project Findings

This section presents the findings of selected water supply projects implemented by SCF. Further, at SCF's request, a description of the Dhuwakot water supply project built by the USAID and HMG Ministry of Forestry and Conservation Resource Conservation and Utilization Project (RCUP) in 1982 and 1983 is presented. Corresponding to each project described in this section is a set of recommendations in Chapter 6 for improving, repairing, or reconstructing the project.

Dhuwakot

The Dhuwakot drinking water project was constructed by a Nepali contractor working for the USAID Resource Conservation and Utilization Project. The construction, reported to have taken 11 months to complete, involved two to three full-time masons as well as paid laborers from the village who earned 18 to 25 rupees per day for digging the pipe trench and carrying sand and stone. The total cost of the system is unknown.

The Dhuwakot project was designed to serve approximately 58 homes, a school, a health post, and the panchayat building. The service area includes approximately 210 people, representing almost 10 percent of the panchayat. A number of houses in the service area of the system are vacant; the residents have moved to lower elevations near their rice fields and closer to the Pokhara Road. Reportedly, this migration has been occurring for the last five years.

The system consists of the following components:

- Intake structure and sedimentation tank
- One and a half inch diameter transmission main from intake to reservoir
- Twenty-one cubic meter reservoir with wood-framed, slate roof
- Four break pressure tanks
- Seven taps in the village, plus one tap at the intake, plus one at the reservoir
- One-half inch to two-inch distribution piping from the reservoir to the taps.

The reservoir is situated approximately 100 meters elevation above the tap next to the SCF office, and the intake is 12 to 15 meters elevation above the reservoir. The system has never operated. The village reports that water flowed from most taps unevenly for to or three days, then ceased. Water would not flow to certain taps when other taps were open. Only a fraction of the flow available at the source was carried through the transmission main to the reservoir tank.

The problems with this project fall into three categories:

a. Implemenation
b. Design
c. Construction.

Implementation Problems. The implementation problems included failure to research the traditional use of the source, failure to involve voluntary help from the village, and failure to establish a maintenance program. The source had previously been used for irrigation by a group of houses not served by the water project. These houses are in a part of Dhuwakot called Dharapani. The people of Dharapani requested a drinking water tap as compensation for the lost irrigation water, but their request was refused, because it had not been budgeted. As a result, the people of Dharapani reportedly vandalized the intake tank and the transmission main from the intake to the reservoir.

While there was an implementation committee comprised of village residents, no significant effort was called for on the part of the village to construct the system. Little attention was given to maintenance, few tools were left for the village, and the training reportedly was incomplete.

Design Problems. Inspection of the system indicates that the transmission pipe is too small, that the reservoir is larger than necessary, and that the distribution piping arrangement does not allow equal distribution of flow between taps. All of the break pressure tanks are situated below the reservoir, thereby causing leakage from the reservoir unless the float valves are installed. Redundant break pressure tanks exist.

Construction Problems. The masonry construction is generally good, but the pipeline joints are of poor quality. Pipe is exposed and broken in some places. Covers on the tanks fit poorly, thereby allowing contamination to enter the system and valve boxes to be tampered with.

Deurali: Bhatta Pesi*

This water system was functioning well when inspected in September 1985. The suboverseer actively encouraged the village maintenance committee to keep the taps and tanks clean, and they were observed to be in good and well-maintained condition, although the reservoir access cover was missing.

*Design data for this and other SCF water systems are presented in Appendix A.

Deurali: Kapedhara

The source is relatively isolated and fairly well protected. The reservoir tank has a loose-fitting cover that can be a source of contamination. The reservoir was in need of cleaning when observed. The transmission pipe from the intake to the reservior lacks air valves and washout valves, and it does not carry its design flow to the reservoir. The maintenance committee does not have repair tools, and the committee is not active, reportedly due to a long-standing village dispute which does not involve the water project. A poor flow distribution to certain taps occurs in dry weather.

Deurali: Yangkot

This system was first built by Save the Children Federation in 1981; then the source was improved in early 1985. The 1981 source was a stream; in 1985, a spring source was added, but the stream inflow remains. The reservoir is loosely covered and needs cleaning. The intake from the stream must reportedly remain in service because the spring flow alone is insufficient in dry weather. The stream intake should be reconstructed to minimize the chance of contamination. Unequal flow distribution to certain taps in dry weather is apparent.

Deurali: Sunar Gaon

This system is operation, but work at the intake to prevent contamination is incomplete. Protection of the intake is particulary important, because it is located on a trail that is frequently travelled. The first tap has a relatively low flow because the village workers chose to locate it at a higher elevation than advised by the overseer.

Deurali: Chakku

This is a contemplated project in Deurali. It has not been attempted previously because of a village dispute over water rights. The village developmer committee reports that the dispute is settled and that they are eager to proceed with the project.

The Chakku project would serve three villages from three sources, as follows:

- Chakugoan (45 homes, 4 taps) — Keurepani .09 lps
- Hatiyagoan (38 homes, 2 taps) — Keurepani .066 lps
- Dhakal, Katuwa and Simalthok (32 homes, 3 taps) — Ranipani .18 lps.

The suboverseer reports that the two Keurepani sources can serve Chakugoan, Dhakal, Katuwa, and Simalthok and that Ranipani can serve Hatiya Gaon. Given the history of the village dispute in this area, it was agreed with the suboverseer that three separate sytems should be considered. Further, the present use of the water sources for irrigation should be thoroughly explored by SCF to avoid any later misunderstanding about water rights.

Deurali: Purandi

This is one of the first SCF systems constructed in 1981 with the technical assistance of a U.S. Peace Corps volunteer. The source and the reservoir tank are approximately at the same elevation. Inspection of the system indicates that the work can be repaired and reconstructed. Recommendations appear in Chapter 6 of this report.

Takukot: Bhaluswara

This system was observed to be funtioning well in September. A previous problem with pipe breakage has apparently been corrected. The cause of the breakage was reported to be vandalism by an aggrieved landowner whose field was disturbed by the pipe. No water tap was provided near this home.

Takukot: Bahakot

This system does not achieve the anticipated design flow from the intake tank to the reservoir. The transmission pipe from the intake tank to the reservoir is too small for the minor difference in elevation between the source and reservoir. In addition, the transmission main lacks air valves and washout valves to ensure that the pipe line is purged of air and debris. One tap was reportedly added to the system during construction, not in accordance with the original design. This additional tap tends to make equitable water sharing among the users difficult. During the visit, the reservoir tank access cover was jammed in position, and four men could not lift it. Recommendations for repairs to this system are given in Chapter 6.

Takukot: Banspani

This system serves the main bazaar area of Takukot. The source needs additional protection, and it is not large enough to fill the reservoir during the night in dry weather. Reportedly, the reservoir is only half full in the morning during dry weather conditions. The low dry weather flow makes equal distribution of flow between taps most difficult under the present piping arrangement. Moreover, one tap was added during construction, not in accordance with the design, and this additional tap also creates flow distribution problems. Recommendations for repairs to this system are presented in the following chapter.

Takukot: Bahun Pani (Ward 4)

This is a source protection project involving a masonry intake tank, a sedimentation tank (which also serves as a small reservoir), and two taps in one tapstand structure. SCF uses the term "well repair" for this system and others like it, but this term is an understatement given the extent of construction involved.

The system was approximately two-thirds constructed when observed in September. Monsoon rain erosion had started to undermine the sedimentation tank foundation, and has left some pipe exposed and susceptible to breakage. Reportedly, the volunteer effort for construction of this system was difficult to muster, but the general quality of the work appears good.

Takukot: Bhutaha Khola and Dharapani

These are two well repair projects constructed in early 1985. Both projects need some additional masonry work, source protection, and drainage improvements. The Bhutaha Khola intake is threatened by a small landslide. A village dispute at the Dharapani project (reportedly the dispute is unrelated to the water system) made construction difficult and continues to plague the maintenance effort. Recommendations to correct the situations at Bhutana Khola and Dharapani are presented in Chapter 6.

Takukot: Chapani

This is a "well repair" project constructed by SCF in early 1985 that enjoyed quick and sound construction, and now had an ambitious maintenance committee that keeps the taps in fine condition.

Takukot: Bairapani

This is reported to be Takukot's best SCF water system, and the consultant's observations confirmed that it is operating in good condition.

Majhlakuribot: Khumaltari

This system was built two years ago. The pipe extending from the intake tank to the reservior has each year been broken by a landslide approximately 100 feet wide in its most active area. One valve on the one tap was broken when observed in September. Recommendations for repair of this system appear in the following chapter.

Majhlakuribot: Kamidhara

This system is the subject of a report by a U.S. Peace Corps volunteer, James Woodrich. The intake tank and reservoir have been constructed for a system of 13 taps, but the present source is too small and can serve only eight taps. The village development committee enlisted volunteer support for construction of the system on the promise of providing 13 taps. Consequently, the system should be completed with 13 taps and one or more additional sources identified. Recommendations for proceeding with this system are presented in Chapter 6.

Pandrung: Devi Than

The reservoir tank and the intake tank at one source were under construction when this system was inspected in late September. Changes have occurred in the location of one of the sources since design, and this has apparently caused confusion about the sufficiency of the water supply to serve the requested four taps. The WASH consultant believes that the water supply can be conserved in the dry season to support four taps. Specific recommendations are presented in Chapter 6.

Pandrung: Tunibot

Work on this system has stopped, pending the resolution of a large landslide crossing. Excavation for the reservoir has been partially completed, and a

small amount of pipe has been portered to the village. If SCF chooses to continue with this system, it will be difficult to design and to construct. If the landslide extends to a higher elevation, it will be infeasible. Recommendations for investigating the feasibiilty of further construction are presented in Chapter 6 of this report.

5.4 Conclusions

1. SCF conducts a fundamentally sound drinking water supply program, founded on beneficiary community initiative, using simple gravity-flow technology and predominantly local or Nepali-made materials, with provisions for community take-over of the water system, and continued maintenance by the village.

2. In general, the quality of SCF water project either equals or exceeds that of projects constructed by other governmental and private voluntary organizations in rural Nepal.

3. SCF's approach to water supply projects provides a firm foundation from which to make further improvements in certain technical and implementation aspects of its program, to repair systems that do not now function properly, and to prevent similar problems in future work.

4. To improve implementation of SCF's drinking water projects, the present use of the village development committee in directing the water project work should be refined to involve a subcommittee of beneficiaries. The various steps of implementation (request, survey, planning, design, construction, maintenance) should be formally defined, and Nepali overseers should be given a cleary defined role in technical decision-making.

5. To enhance the design of SCF's drinking water projects, there are three major apects for improvement: materials, design methods, and prevention against contamination of the supply. Materials selection, procurement, and transportation appear generally excellent, except for the choice of float valves. Design methods need to be improved, to ensure that pipes and tanks are sized correctly and that materials are used cost-effectively throughout each project (generally pipes are too small, tanks and taps too large). Most sources need improved protection to reduce chances of contamination, and most reservoirs and break pressure tanks have loose-fitting covers and/or poor fencing which can lead to contamination.

6. To improve the construction of SCF's drinking water projects, improvement can most readily be achieved by ensuring that construction is performed in accordance with the approved design. Masonry and pipeline construction techniques are generally good to excellent, except that pipe joining for polyethylene pipe needs more attention to quality-control procedures.

7. To improve the maintenance of SCF drinking water systems, a need exists to improve the composition of the maintenance committee, to institute preventive maintenance training, to provide guidance to the village on maintenance practices for an extended period of time, and to ensure that appointed maintenance people from the village are appropriately compensated for their work.

8. To implement the recommendations of this assignment, a training program should be conducted, as envisioned in the original scope of work. The training should include: (1) direct training of Nepali overseers and suboverseers in technical design procedures; (2) training of overseers and suboverseers to train village maintenance committees and special plumbers; and (3) training of SCF field office coordinators to train village development committees in the aspects of water supply management and gravity-flow water system limitations.

Chapter 6

RECOMMENDATIONS

6.1 General

Recommendations are presented in the following areas:

1. SCF program improvements

   - o Implementation
   - o Design
   - o Construction
   - o Maintenance

2. Repair and reconstruction of SCF projects that are not functioning properly

3. Scope of the training program for the second phase of this WASH assignment.

The recommendations for improvements to the SCF drinking water supply program are based on the findings and conclusions presented in the foregoing chapter. The recommendations for repairs and reconstruction of specific SCF projects are based on the consultant's inspection of these projects, review of design files and reports prepared by others, and analysis of hydraulic characteristics of the systems. Further, the recommendations for repair and reconstruction of projects are presented to assist SCF in its stated objective to complete all of the existing projects in a well-functioning manner before proceeding with new projects in other areas. The recommendations for training are intended to set forth the scope of the second phase of this WASH assignment. SCF recognizes the need for improved training of its staff and of village beneficiaries in drinking water supply and sees the training as an integral part of its effort to improve its approach to water supply projects before undertaking new projects in other village panchayats.

6.2 Program Improvements

6.2.1 Implementation

The objective of these recommendations is to enhance the critical aspects of SCF's approach to project implementation, while making maximum use of existing staff and staff-structure, optimal use of village resources and knowledge, and working to a position where the village can effectively assume responsibility for system maintenance and repair.

Beneficiary Subcommittee

SCF should begin its approach to water project implementation by forming a subcommittee of beneficiaries for water project construction. The present practice of relying entirely on the village development committee and ward subcommittees has resulted in implementation problems, as noted in several of

the examples in Section 5.3. By forming a subcommittee of water project users (the actual beneficiaries of the project) at the start of the project, the previous problems can be either minimized or avoided. The complexity of the water supply project also warrants the use of a dedicated subcommittee, and this subcommittee can evolve into the maintenance committee. Discussions with representatives of the USAID Rapti Integrated Development Project indicate that they have used the water-user beneficiary committee approach successfully in many of their projects.

Formal Implementation Steps

SCF should take a step-by-step approach to project implemention, as show in Table 3 on the following page. Many of the steps are now being performed but without documentation of the decisions reached or the results obtained. The new proposed steps are intended to reinforce the existing implementation approach and to provide the necessary milestones and checkpoints.

The proposed new implementation steps shown in Table 3 offer the following advantages. The beneficiary subcommittee -- composed of actual users of the water project, rather than panchayatwide representatives -- can thoroughly explain and better resolve among themselves disputes that are present or that may arise with the water system. It will be an opportunity for two-way communication so that SCF can better understand the nature and scope of existing or potential water use problems. The meeting with the subcommittee also will provide SCF the opportunity to explain the source limitations tap locations and other aspects of water conservation to the subcommittee. The results of this meeting will be documented in a Nepali-language map of the system that identifies all taps, names each tap, identifies the houses served by each tap, and shows the source location. This document will form the plan from which SCF will prepare the detailed design of the system.

After construction, a formal test procedure should be performed in accordance with the steps outlined in Annex I of the Ministry of Panchayat and Local Development ""Procedures for the Implementation of Rural Drinking Water Projects" that is available in the SCF field offices. The formal test will serve to document that the system works and that it is ready for village acceptance. Following village acceptance, SCF should provide guidance in preventive maintenance, in addition to the pipe repair training that the overseers now give to the special plumbers. The scope of this two-years of maintenance guidance is presented later in this section.

Staffing

SCF has hired a one-year intern for water supply work starting in October 15, 1985. This person should work closely with Nepali counterpart and suboverseers to provide them on-the-job training and assistance with hydraulic design problems. He should also be fully involved in the training phase of the WASH assignment.

SCF's overseers and suboverseers should be given a clearly defined technical decision-making role regarding water system design and construction methods, and maintenance training. The decision of the overseers and suboverseers on tap locations and tank size should be final, as long as it is in accordance with the Nepali-language system map prepared intitially by the village water

Table 3

Proposed Water Project Implementation Steps

1.	Village requests a drinking water project.
2.*	SCF assists village development committee to form a subcommittee of water project beneficiaries to direct the implementation of the project.
3.	SCF performs the drinking water survey.
4.*	SCF overseer and subcommittee meet to discuss survey results.
5.*	SCF overseer and subcommittee document the survey results and the proposed locations of taps and reservoir tank and source in a simple, Nepali-language map that names each tap location and source and identifies the homes to be served by each tap.
6.	SCF designs the system and procures material.
7.	Subcommittee arranges for transportation of material to village and schedules construction.
8.	Subcommittee enlists voluntary labor and skilled labor for construction. Construction performed under SCF supervision.
9.*	SCF overseer tests the system, and subcommittee witnesses test.
10.	Village accepts the system and forms maintenance committee.
11.*	SCF overseer provides two years of preventive maintenance guidance.
12.	Village accepts full responsibility for system maintenance.

Note: Proposed new implementation steps are indicated by an asterisk (*). See text for description of new steps.

project subcommittee. In the past, the advice and decisions of overseers have at times been overridden by either administrative or political decisions that have contributed to technical problems in operating certain water systems, as noted in Section 5.3.

6.2.2 Design

The objective of the recommendations for design improvements is to ensure that designs are as simple as possible, result in a clean water supply with low maintenance requirements, are correct in terms of pipe size and equal flow among taps, are cost-effective in their use of materials, and that opportunities for staging construction over two or more phases are identified.

It is recommended that SCF continue to use the UNICEF Handbook for Gravity-Flow Systems as the basis for design. This handbook should be supplemented with overseer and suboverseer training in certain design concepts. A training handbook and a Nepali-language water system design brochure should be prepared for the second-phase training of this WASH assignment, and these documents can be used in future trainings by SCF. The scope of the design training is discussed further in Section 6.4 of this report.

Technical Review

Save the Children Federation should institute a technical design review process for its water projects. At first, these design reviews should be conducted with the assistance of the SCF water supply intern who would review the designs prepared by the Nepali overseers and suboverseers, to ensure that pipe sizes, tank size, tap location, and cost estimates are correct. The technical design review procedure should evolve into a peer review process during the one-year tenure of the intern. Overseers should be encouraged to discuss their designs with other overseers and suboverseers and to share ideas on technical decisions that involve engineering judgment.

Materials

Materials selection and procurement and transportation are excellent. The only recommendation is for SCF to seek a self-enclosed float valve design for break pressure tanks and to use orifice plates as an alternative to globe valves for flow regulation. Both of these new materials are suggested to reduce maintenance needs and to make the water systems less susceptible to tampering and vandalism. The design of access covers to tanks and valve boxes can be improved to make these easier to lift, yet protect against unauthorized opening, and prevent contamination. The UNICEF handbook shows design details, and other concepts are shown in Figure 6-1 on the following page.

Source Protection

More emphasis should be placed on the design of protection for water supply sources. Protection is needed against monsoon flood flows and contamination year round. The UNICEF handbook shows source protection designs that SCF should follow. Further, it is recommended that SCF include in its health

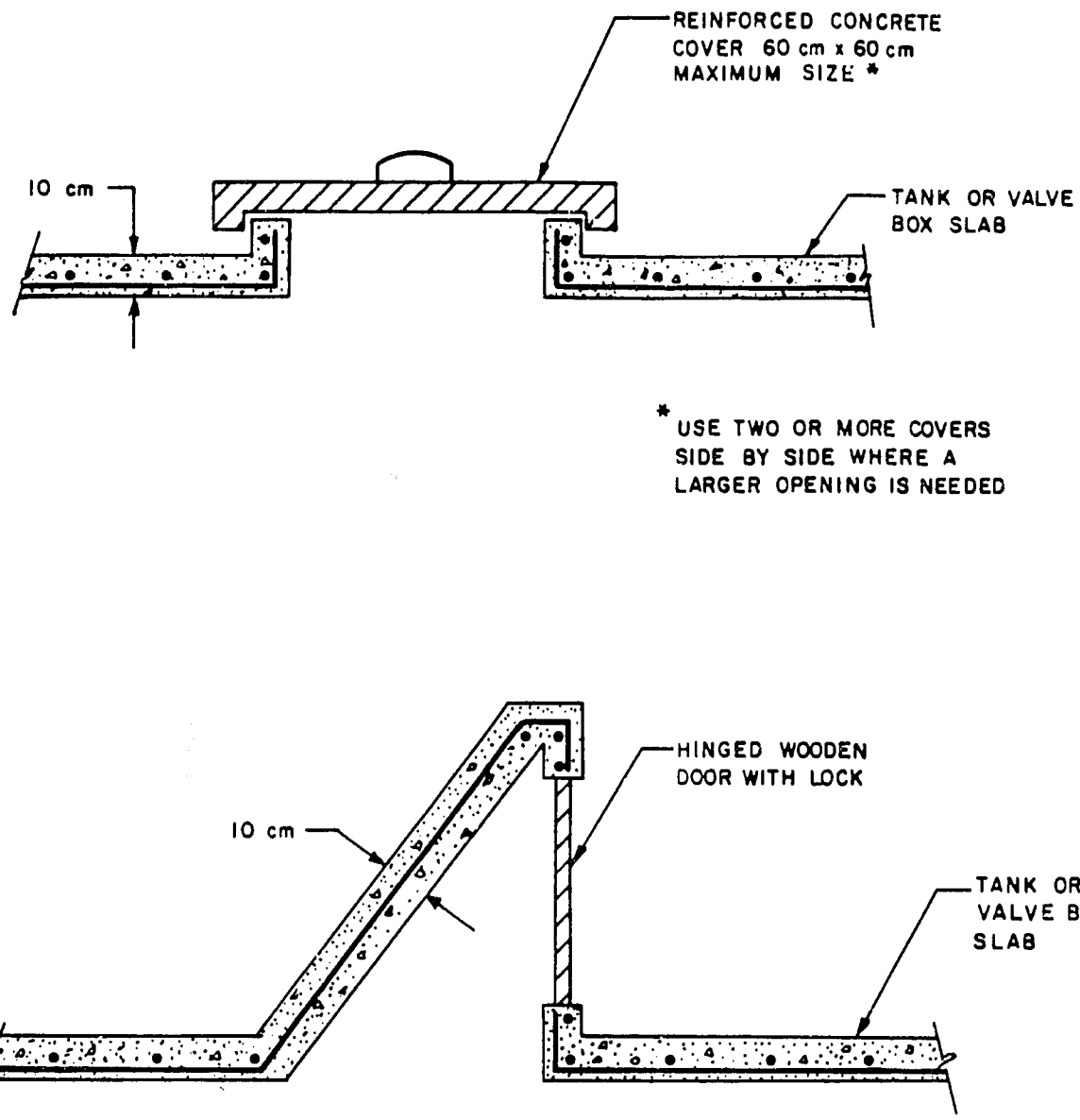


FIG. 6-1 TANK ACCESS AND VALVE COVER DESIGN CONCEPTS

training efforts an understanding and appreciation of source protection in drinking water systems.

6.2.3 Construction

The objective of the construction recommendations is to ensure that construction is performed in accordance with the approved design, that materials quality-control procedures are followed during critical construction steps, such as polyethylene pipe joining and cement mixing, and that construction is performed in a logical sequence, thereby ensuring that the water project will operate correctly as designed.

Construction Sequence

Several SCF projects have been built with construction of the intake tank, reservoir, and taps occurring concurrently and before installation of the water pipes. The disadvantage of this approach is that tank and tap elevations may not be optimal for proper flow and equal distribution of flow. It is recommended that SCF perform water project construction in a sequence that begins at the source and progresses toward the last tap. All work at the source should be completed before installing the pipe to the reservoir tank. The pipe to the reservoir should be laid in the trench without backfilling the trench, and flow initiated in the pipe. After it is determined that water is properly flowing to the reservoir tank location, then the pipe trench should be backfilled and the reservoir construction started. After the reservoir is complete, work should progress downstream to the taps. This sequence of work will avoid the types of problems that occurred at Parundi and Bahakot, where flow from the intake to the reservoir did not meet design expectations.

Quality Control

Save the Children Federation should place more emphasis on construction quality control, particularly on polyethylene pipe joining. The techniques of pipe joining are discussed thoroughly in the UNICEF handbook, and these should be stressed in the training to be performed in the next phase of this assignment. The quality of cement mortar and masonry was observed to be generally good. As an alternative to masonry, one overseer asked for training on ferrocement tank construction. Ferrocement tanks would offer the SCF water program the advantage of lower cost for certain reservoir tanks where ferrocement construction is feasible. While it would be difficult to construct a ferrocement tank as part of the training in the second phase of this assignment, it is recommended that this type of construction by pursued by the SCF water supply intern.

6.2.4 Maintenance

The objectives of these recommendations is to improve SCF's approach to water system maintenance and to create a smoother transition from SCF's participation to total village self-sufficiency in water supply system maintenance.

Maintenance Committee

SCF should consider standardizing the composition of the maintenance committees formed by the village beneficiaries. The Ministry of Panchayat and Local Development offers the following guidelines for their water projects, and these should be considered by SCF:

- One member from each tap user group
- One ward chairman of the panchayat
- One representative of school or health post in the user area
- At least two women on the committee.

SCF may choose to include the village pradhan panch or other village official in the committee as an ex officio member.

Preventive Maintenance

Training during the second phase of this assignment should include preventive maintenance techniques for intake and reservoir cleaning, equalizing of flow distribution among taps, and overall system inspection. Typical preventive maintenance tasks should include:

- Weekly intake cleaning during the monsoon (monthly or bimonthly cleaning other seasons)
- Monthly reservoir cleaning during the monsoon (quarterly cleaning during other seasons)
- Weekly inspection of all taps and tanks, including adjustment of flow control valves to equalize flow distribution among the taps.

See Section 6.4 for a further discussion of the scope of preventive training.

Maintenance Guidance

SCF should consider a two-year program of guiding the maintenance committee in carrying out its responsibilities. Given that SCF makes a five- to ten-year commitment to a village, and the water projects have so far been constructed early in this time frame, then the additional effort for maintenance guidance does not add significantly to SCF's involvement. Moreover, this effort by SCF is expected to be most beneficial from the standpoint of village understanding of maintenance activities. The village maintenance committee should be responsible for performing maintenance work, but the SCF overseer should check the performance of the work and in doing so provide on-the-job training to the maintenance committee and special plumbers.

Compensation for Special Plumbers

Persons responsible for maintaining the water systems (special plumbers) should be compensated for their effort. Discussions with the SCF overseers indicated that a rate of pay of 20 rupees per day, or 10 rupees per half day, would be appropriate. Table 4, on the following page, shows a proposed maintenance budget for a water system of five to eight taps. Because of the cost of maintenance, villages with a large number of small projects such as

Table 4

Proposed Maintenance Budget for a Water System with Five to Eight Taps

Labor of Special Plumber		
Weekly inspections and monsoon season intake cleaning	52 weeks at 1/2 day per week at Rs 10 per half day	= Rs 520
Monthly reservoir cleanings and so forth	12 months at 1 day at Rs 20 per day	= Rs 240
Subtotal		Rs 760
Materials		
Two valves		Rs 90
Miscellaneous		Rs 50
Subtotal		Rs 140
Total		Rs 900

the one in Takukot, should consider appointing one special plumber for several small projects to share the cost of maintenance efforts.

6.3 Recommendations for either Repair or Reconstruction of Specific Projects

This section presents specific recommendations that address the needs and problems of certain projects observed during the field inspections.

Dhuwakot

While this project was not constructed by SCF, it may consider performing repair work on the project as part of its integrated community-based development program. For this reason, recommendations for reconstruction of parts of this project are offered. It is noted that the District (Jilla) Panchayat Office in Gorkha reportedly surveyed and mapped the project early in 1985 and may be contemplating repair work on the system. Any effort on the part of SCF should be coordinated with actions by the Jilla Panchayat.

The recommended reconstruction is shown in Figure 6-2. The work includes relaying of pipe, abandoning concept of the nine taps, and adding one new tap and one new intake. The pipe sizes shown on Figure 6-2 are preliminary and are, therefore, subject to either refinement or confirmation by a detailed resurvey and design.

The work is proposed to be performed in three stages to provide budgeting flexibility for SCF. In the first phase, a new intake and tap would be built to serve the homes in Dharapani and thus resolve the dispute that led to the initial vandalism. Also during the first phase, a new pipeline would be constructed from the intake to the reservoir. At the end of this phase, water will flow from the intake to the reservoir. At the end of this phase, water will be available to the village at the existing reservoir tap.

During the second phase, repairs would be made to the distribution piping to restore flow to selected local taps. An additional tap that was added during the original construction, but considered unnecessary from the standpoint of caste separation or distance to users, should be abandoned. Distribution pipe repairs will most likely require the excavation of most of the pipe, inspection of the joints, and replacement of defective pipe.

During the third phase, after water flow is restored to local taps, repairs to the masonry at the reservoir, break pressure tanks, and taps, where necessary, should be performed. The highest priority of this work should be to seal the break pressure tanks from contamination.

If Save the Children Federation chooses to undertake the repair of this project, the work should be approached as if a new project were being implemented. All of the implementation steps outlined in Section 6.2 should be followed. This approach also applies to the repairs discussed below. Initiative for the repair should arise from the village, based on SCF's promise of technical and material assistance.

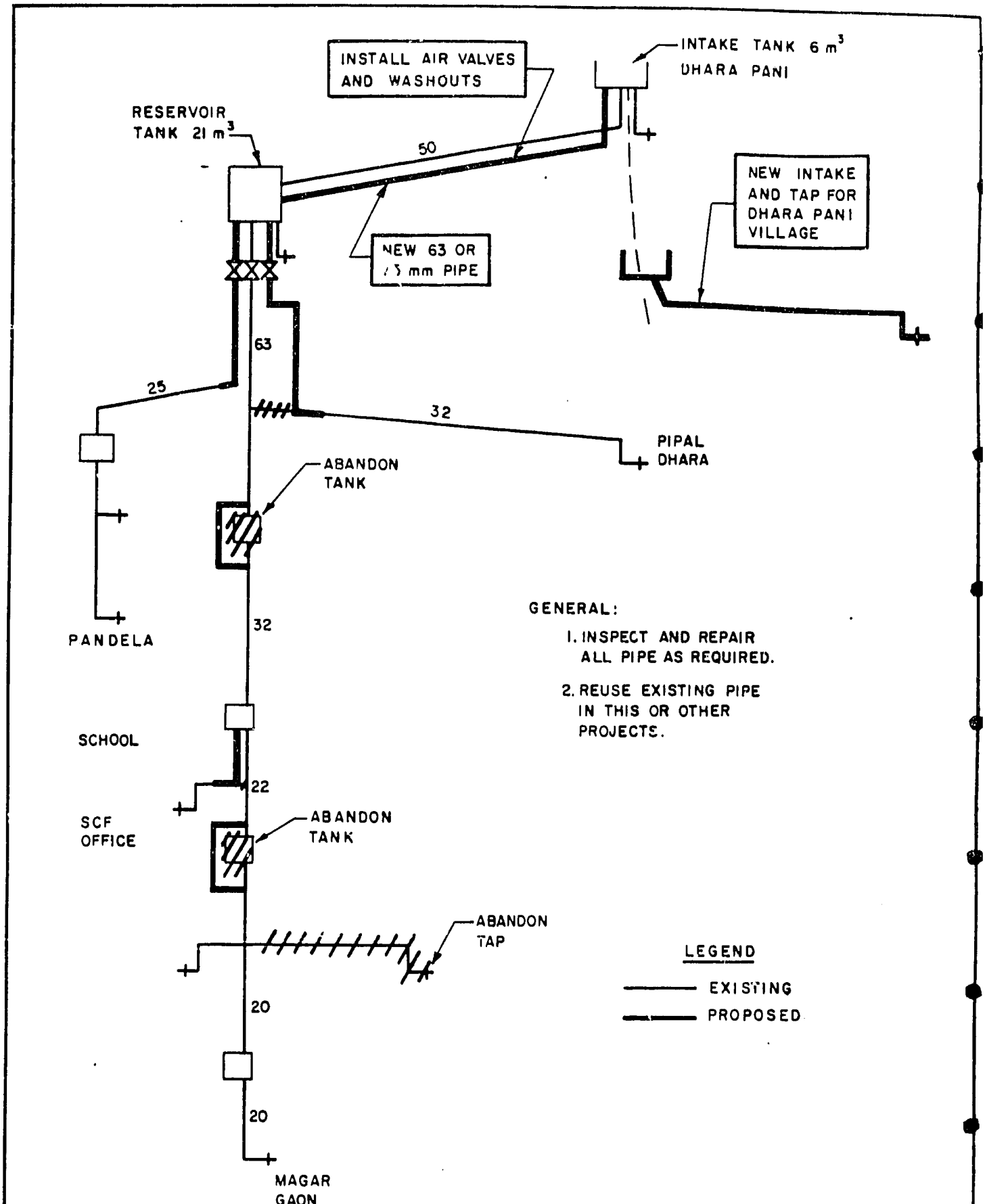


FIG. 6-2 PROPOSED IMPROVEMENTS TO THE DHUWAKOT WATER PROJECT

Deurali: Bhatta Besi

This system needs a new cover on the access to the reservoir tank. The reservoir cover should be constructed in accordance with the concepts shown in Figure 6-1. The suboverseer reported some dry weather flow distribution problems. If this situation reoccurs, the new piping concept shown in Figure 6-3, on the following page, should be installed.

Deurali: Kape Dhara

Figure 6-4 shows the proposed improvements to resolve the unequal flow distribution problems. In addition, the reservoir roof should be reconstructed with tighter-fitting roofing or reinforced concrete. The maintenance committee should be reformed, and the village dispute that now interferes with maintenance should first be explored and understood by SCF and then resolved.

Deurali: Yangkot

The reservoir should be refitted with a new cover -- either a tight-fitting GI sheet or reinforced concrete. The intake from the spring should be enclosed in a covered channel, as shown in Figure 6-5. Unequal flow distribution in the extreme taps can be minimized by installing the new pipelines, as shown in Figure 6-6.

Deurali: Sunar Goan

The intake tank should be protected from contamination, as indicated in the UNICEF Handbook referenced previously.

Deurali: Chakku

Because this is a new project, it should be approached as outlined in Section 6.2, with particular emphasis on formation of one or more beneficiary committees for implementation of the project. On the basis of the results of discussions with the village regarding the previous water rights dispute and the nature of the beneficiary communities, it may be best to implement this work as two or three separate systems.

Deurali: Purandi

The source and reservoir are almost equal elevation. A 15 cm by 15 cm masonry channel should be constructed to route flow from the source to the reservoir, a distance of approximately 50 meters. The channel should be covered and a midpoint access hatch provided. The slope of the channel should be set to deliver all of the source flow to the reservoir. It may turn out that only the lower portion of the reservoir can be used, after the channel slope is set. If so, then the reservoir can be expanded horizontally to add capacity at a later date. After flow to the reservoir is successfully achieved, then repairs should be made to the distribution piping.

Takukot: Bhaluswara

SCF should ascertain that the cause of the vandalism in this system is thoroughly understood by the field office and maintenance committee.

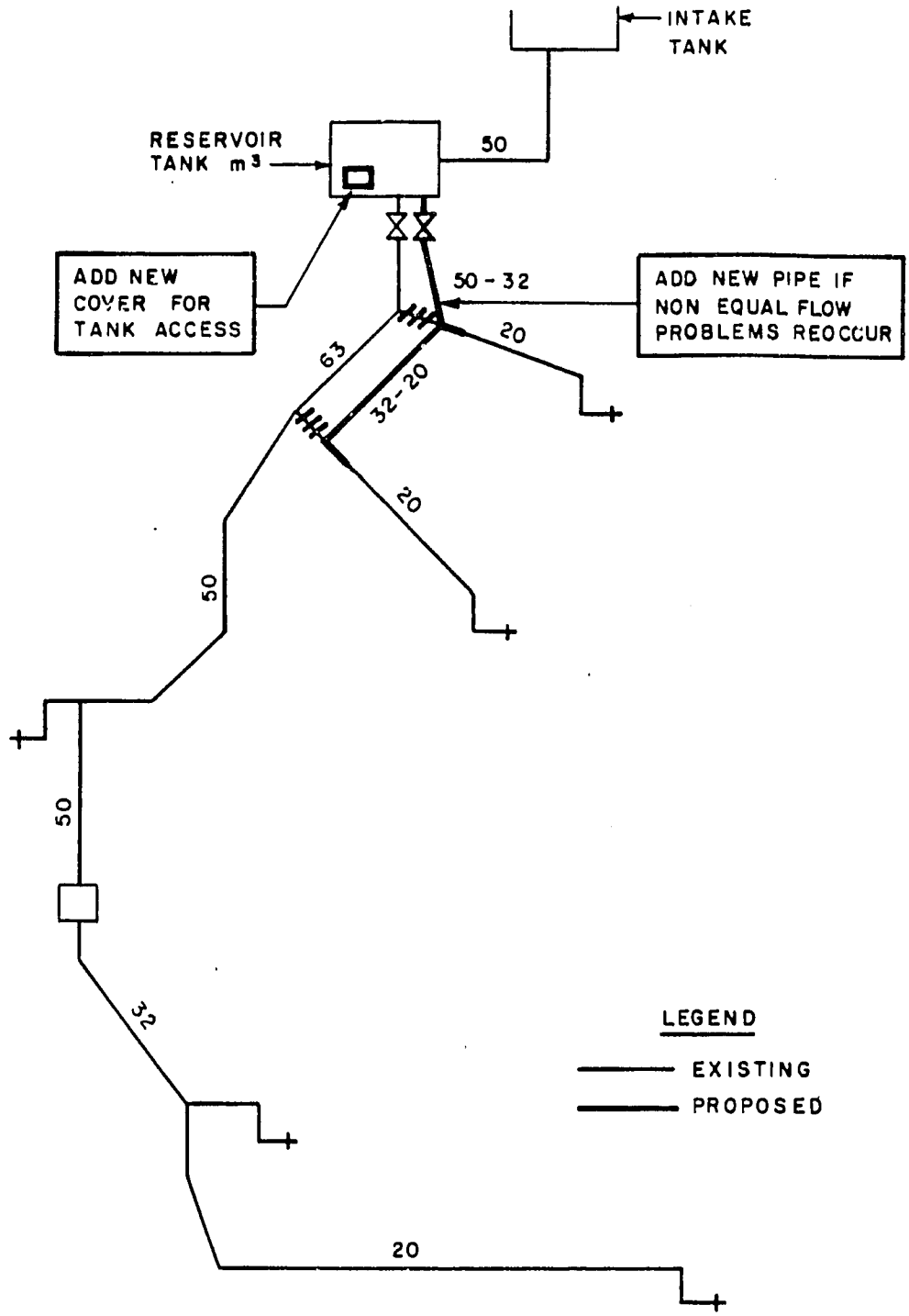


FIG. 6-3 PROPOSED IMPROVEMENTS TO THE BHATTA BESI WATER PROJECT

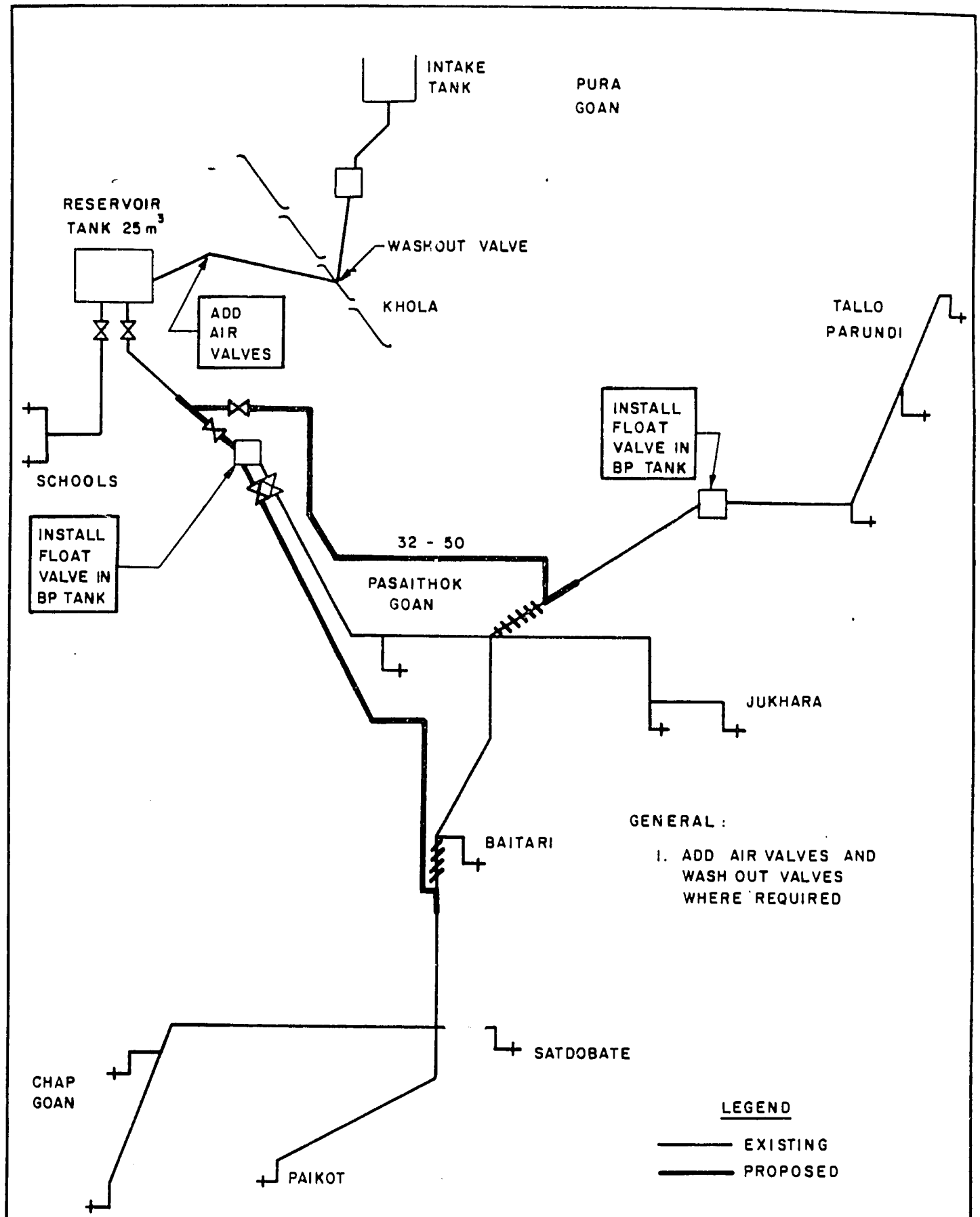
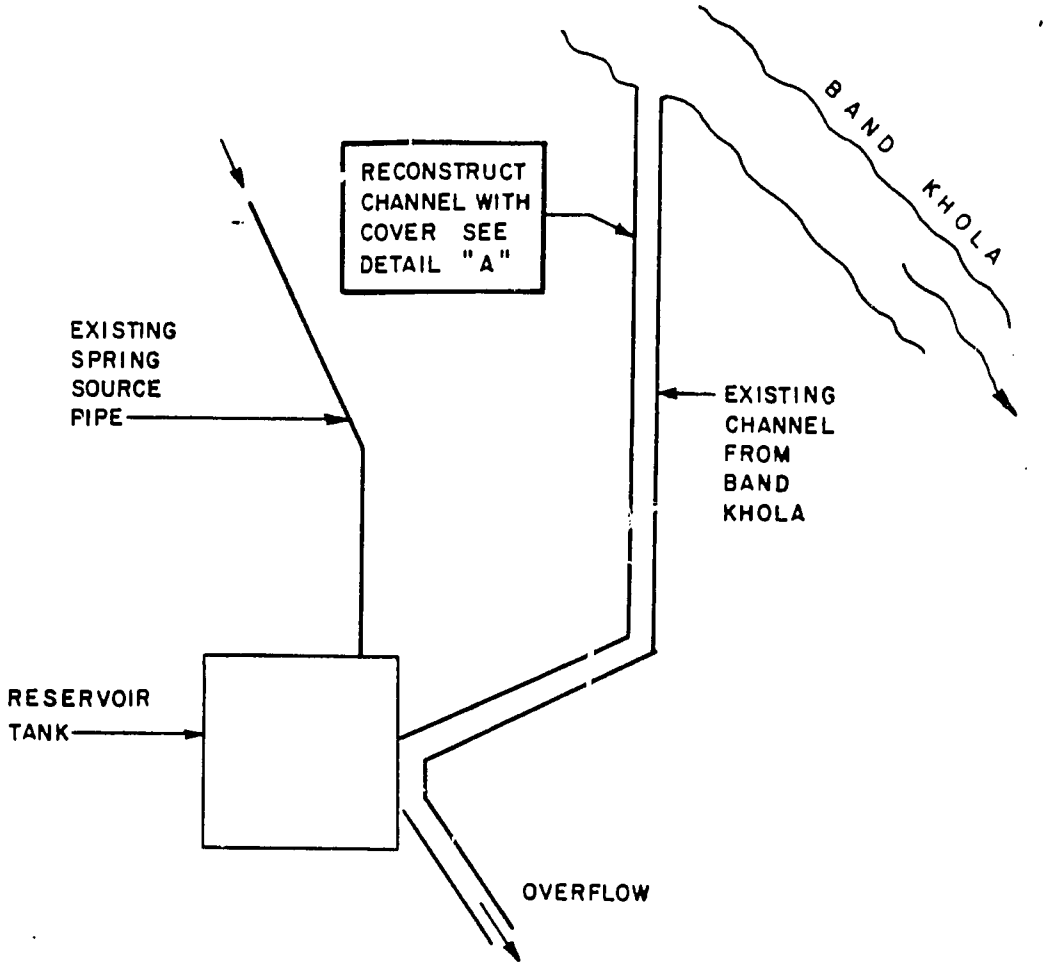
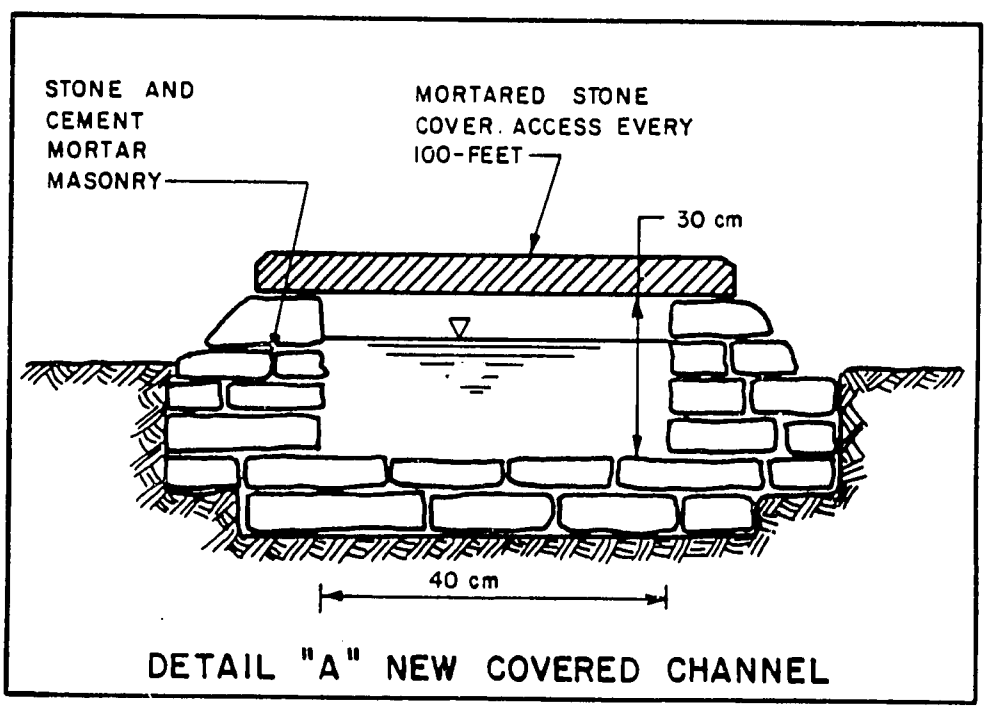


FIG. 6-4 PROPOSED IMPROVEMENTS TO THE KAPE DHARA WATER PROJECT





DETAIL "A" NEW COVERED CHANNEL

FIG. 6-5 PROPOSED IMPROVEMENTS TO YANGKOT KHOLA INTAKE

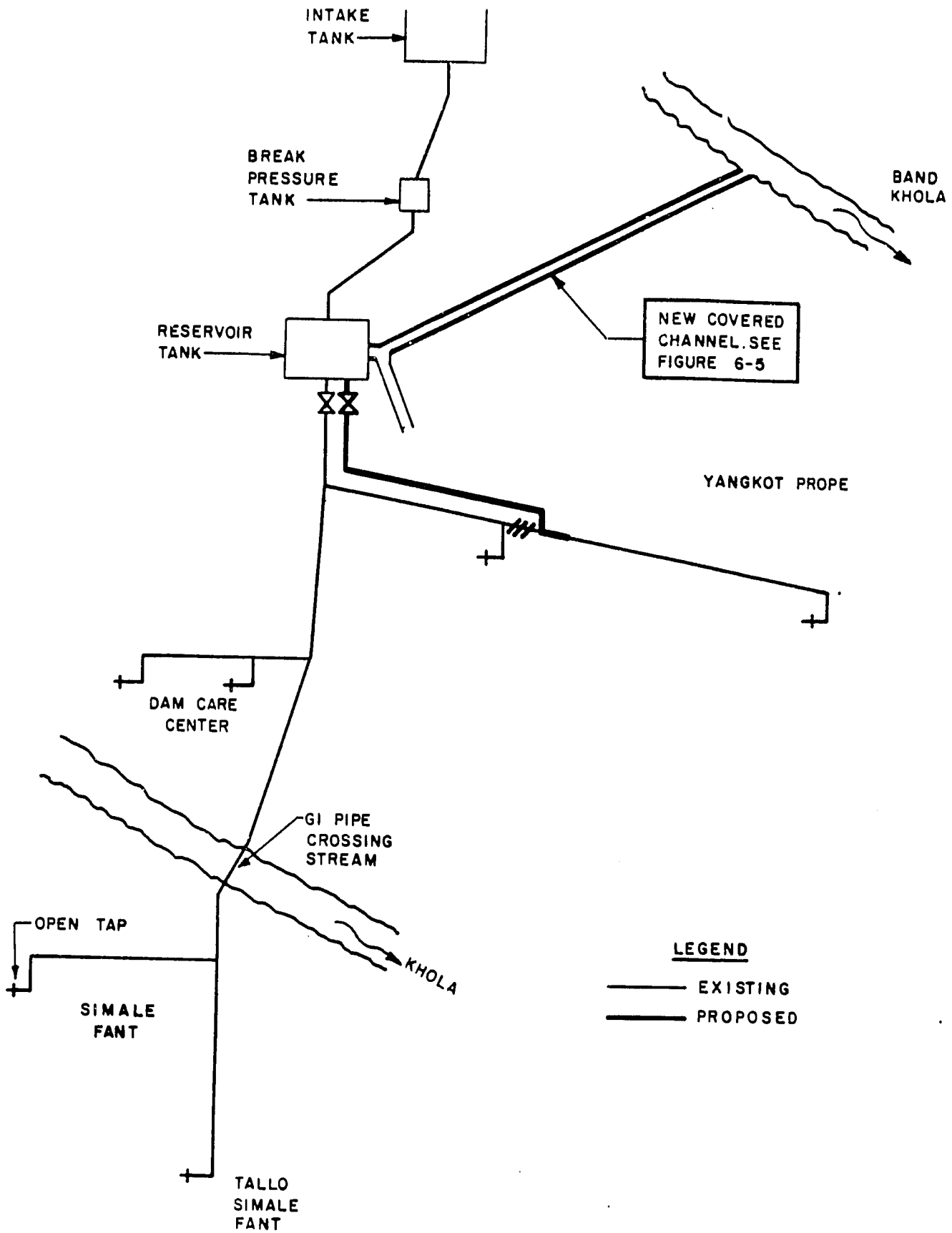


FIG. 6-6 PROPOSED IMPROVEMENTS TO YANGKOT WATER PROJECT

Consideration should be given to compensating the person whose land was disturbed by the pipe excavation.

Takukot: Bahakot

This system should have a new pipe from the intake to the reservoir, as shown in Figure 6-7 on the following page.

Takukot: Banspani

This system needs protection of the intake structure and new distribution piping. The intake protection should be in accordance with the UNICEF Handbook, the new pipeline in accordance with Figure 6-8. In that this system does not provide 45 lpcd in the dry weather, a water conservation and/or rationing system should be considered by the village for dry weather months.

Takukot: Bahun Pani Ward 4

When work is resumed on this system, the structures should be protected with stone walls from erosion suffered during this monsoon season.

Takukot: Bhuta Khola and Dharapani

Both of these systems need improvement to the intake structures, in accordance with the design presented in the UNICEF Handbook.

Takukot: Chapani

This system works well and no improvement is deemed necessary.

Takukot: Bairapani

This system also functions well. Both this and Chapani should be used a examples for other projects.

Majlakuribot: Khumaltari

The pipe crossing the active area of the landslide should be suspended from pillars and encased in bamboo. Much of the land between the intake and the reservoir is slowly sliding, and future pipeline reconstruction should be anticipated. Suspension and encasement of the pipe, however, should help to reduce the frequency of pipe repairs.

Majlakuribot: Kamidara

The report entitled "Gorkha: A Field Report on Training Possibilities for the 1985 Peace Corps Water Supply Training" by Jim Woodrich, U.S. Peace Corps Volunteer, discusses the situation with the sources and construction on this system. The report concludes that the existing source can be augmented with either the Satasidhara source or the Koripani source. The former would require that a second reservoir be build; the latter would make full use of the existing reservoir. SCF should form a water supply project subcommittee in the beneficiary area of this project to discuss the costs and village support for

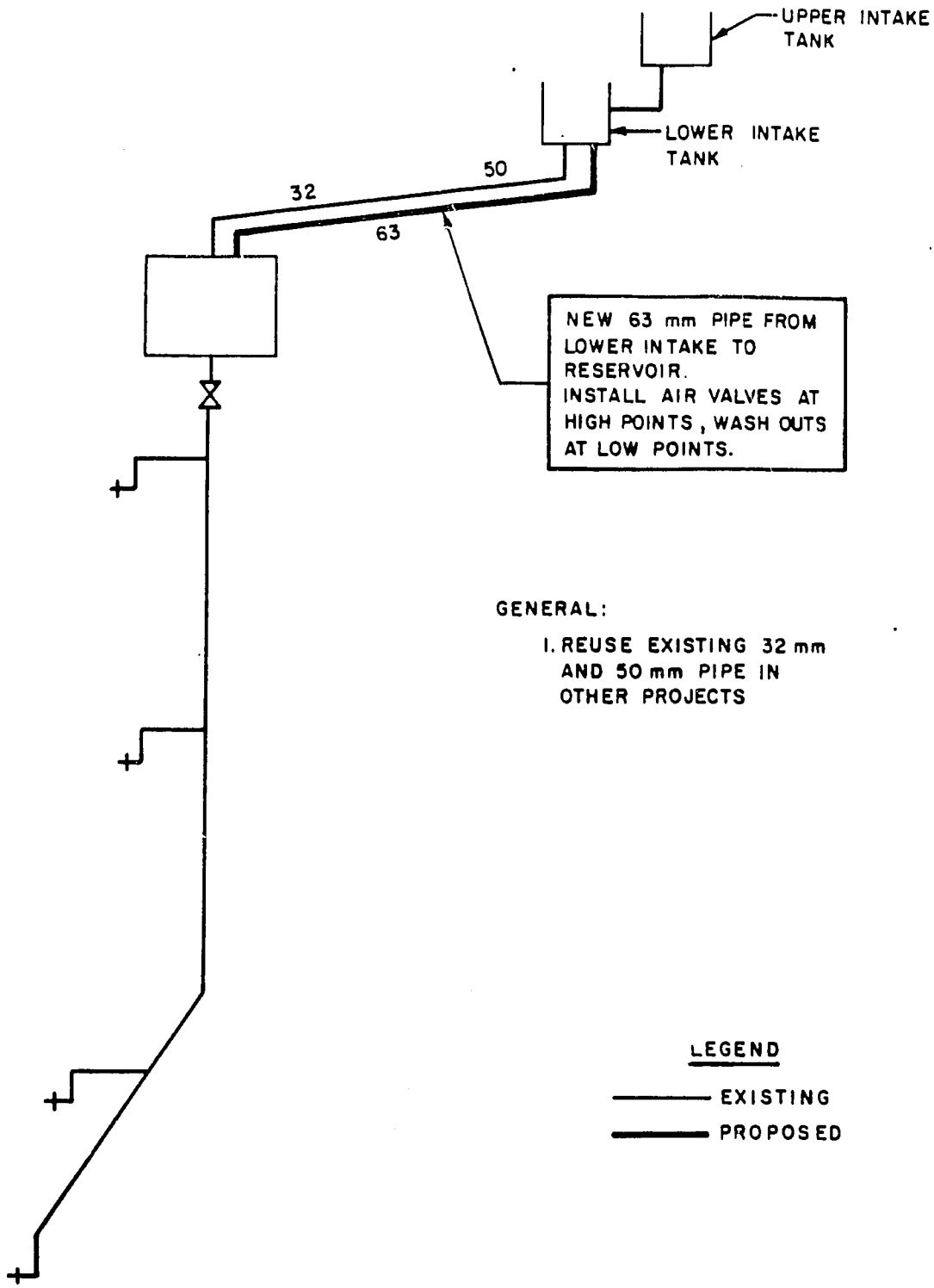


FIG. 6-7 PROPOSED IMPROVEMENTS TO THE BAHAKOT WATER PROJECT

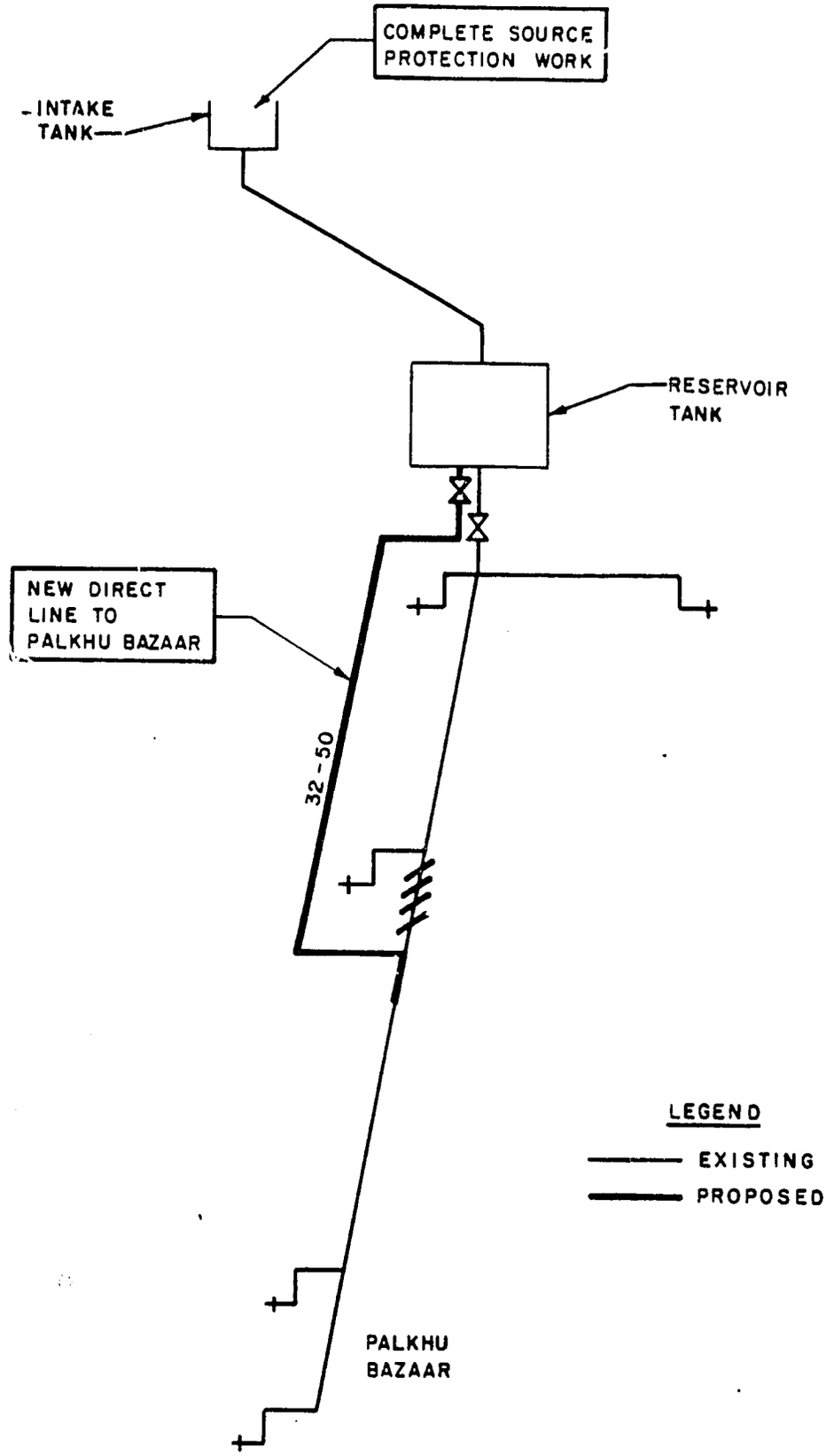


FIG. 6-8 PROPOSED IMPROVEMENTS TO THE BANSPANI WATER PROJECT

both of these alternatives then select the alternative deemed most implementable from the perspective of the village subcommittee.

Pandrung: Devi Than

The overseer reports a dry season flow of 0.08 lps. This flow, if correct, would be adequate for the originally conceived four taps on this system, if dry weather water conservation measures are adopted by the maintenance committee. The higher of the two sources was observed to have a red algae growth in the intake tank, which may cause water taste problem. Completion of the intake structure, including shielding it from sunlight, may minimize this problem. Other recommendations in the report entitled: "Save the Children Federation: A Report on the Gorkha Water Projects" by Jim Woodrich, U.S. Peace Corps Volunteer, should be adopted.

Pandrung: Devi Tunibot

It is recommended that SCF perform more detailed feasibility surveys of this project. During dry weather, excavation at the source should be performed to determine the highest elevation from which a suitable flow can be drawn. If a high enough elevation source is found, to allow crossing the top of the landslide area closest to the source, then consideration should be given to changing the location of the reservoir to the village side of the landslide. To route the pipe above the landslide closest to the source, it will be necessary to tunnel through the ridge for a distance of 50 to 100 meters. Once this tunnel is constructed, a second less active landslide must be crossed. It should be possible to suspend the pipe across this second landslide on a cable crossing with the pipe encased in bamboo.

The report by Jim Woodrich (cited above) proposes that other sources on the village side of the landslide be investigated in the dry weather. If such sources can be found, then SCF might choose to provide a smaller water system with less flow per person as an alternative to undertaking the otherwise technically complex and difficult original project.

6.4 Recommendations for the Phase Two Training

The objective of these recommendations for training is to define the scope and nature of a training program for SCF field staff that recognizes the staff's strengths and addresses their immediate and longer-term needs for drinking water supply implementation, design, construction, and maintenance.

Training needs have been identified, as follows:

1. Training of Trainers in Village Water Supply Management

2. Training of Overseers and Suboverseers in Water Supply Design Techniques

3. Training of Overseers and Suboverseers to Train Village Maintenance Committees and Special Plumbers

It is recommended that the first two workshops be performed concurrently over an approximately a six-day period at a field office central to SCF's field sites. Six, three-hour sessions are envisioned for each workshop, and during each day one session for each of the two workshops would be held.

The third workshop would be performed in approximately four days during the second week, also in three-hour sessions each day. The remaining time in each day of the second week would be structured to accomplish a review and critique of training performed by trainees. Each workshop is discussed in more detail below.

6.4.1 Training of Trainers in Village Water Supply Management

It is proposed that this training be given to SCF's field office coordinators in each of the five impact areas. The subject matter should include:

- Role of water supply in SCF's CBIRD program
- Hydrologic cycle and health aspects of water supply
- Gravity-flow water system limitations and advantages
- Daily water needs of people and agriculatural livestock
- Reservoir storage concepts and water conservation
- Planning a water supply system and forming a water project subcommittee
- Water rights and identifying and resolving water disputes.

This training would be conducted by a Nepali trainer assisted by a WASH project engineer and one or more SCF overseers and the SCF water supply intern.* The purpose of the training is to develop training skills within the group of SCF field office coordinators to instruct village development committee members and water project beneficiary subcommittee members in concepts of drinking water supply management. Awareness of the water supply concepts is more the objective of the ultimate village committee and subcommittee training, rather than imparting detailed technical knowledge which the overseers now possess. It is hoped that through this training, the implementation of new drinking water projects may proceed with a better understanding by the beneficiaries of project objectives and physical limitations of the supply. Further, SCF should be able to start drinking water projects with a more thorough understanding of existing water rights, village expectations, and potential disputes.

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*At the time of this writing, preliminary discussions were taking place with USAID regarding the feasibility of also doing a similar training for their Rapti Integrated Development Project. Opportunities for sharing a Nepali trainer nominated by the USAID Rapti project should be explored.

After the first week of training is completed, it is suggested that the second week be used by the trainees to work with a village water supply subcommittee to plan either the repair or the reconstruction of one of the projects discussed in Section 5.3. Through this work with the subcommittee, the consultant trainer and engineer staff.

6.4.2 Training of Overseers and Suboverseers

It is proposed that training be given to all of SCF's overseers, suboverseers, and construction supervisors in certain gravity-flow water system design and maintenance techniques. The subject matter, identified through discussions with the overseers and suboverseers, should include:

- Review of the UNICEF Handbook on Gravity-Flow Water Systems
- Review of the Ministry of Panchayat and Local Development "Policy for Maintenance" of gravity-flow water systems
- Several examples of a complex water system design involving 8 to 12 taps and branch lines
- Reservoir tank sizing, and judgments on water demands versus supply limitations
- Break pressure design for low maintenance
- Landslide and stream crossings
- Air valve and washout valve design
- Selection of pipeline size
- Preventive maintenance requirements for intakes, reservoirs, and taps and control valves
- Design of covers for access to tanks and control valves.

The purpose of this training is to enhance the design skills of the existing SCF technical staff and to provide a core group of overseers and suboverseers who can assist new overseers who join the staff at a later date. As part of this work, a Nepali-language design brochure should be developed, and a physical model of a gravity-flow water system (including a 10-liter reservoir, 10 mm and 16 mm and 20 mm tubing and small taps) should be fabricated to demonstrate the effect of elevation difference, pipe size, and pipe branches on water distribution and flow. The training handbook, Nepali-language design brochure and physical model may be used in subsequent training performed by SCF, and the physical model also may be used in planning new water projects with village subcommittee, to demonstrate how their system would operate.

6.4.3 Training of Overseers and Suboverseers to Train Village Maintenance Committees and Special Plumbers

It is proposed that this training be given to SCF's existing staff of overseers, suboverseers, and construction supervisors. The subject matter should include:

- Role of village maintenance committee
- Responsibility of the committee
- Appointment of special plumbers
- Responsibilities of special plumbers
- Contracts with committees and special plumbers
- Preventive maintenance activities
- Pipe, valve, tap, and tank repairs
- Budgeting, collection, and payment of money for maintenance services.

The purpose of this training is to strengthen and expand the maintenance training now given by SCF to its village committees and plumbers. After the training is completed, each of the trained overseers and suboverseers should train a village maintenance committee and special plumber from one or more of local projects discussed in Section 5.3. The WASH consultant staff should prepare a critique, of the effectiveness of this training effort.

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1. Buijs, P. Memorandum to Gary Shaye on "Water Supply Activities," July 29, 1985.

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APPENDIX A

Characteristics of SCF Water Projects

CHARACTERISTICS OF SCF WATER PROJECTS

Project Location and Minimum Source Flow (lps)	Persons Served at Present	Number of Taps	Length of Pipe (m)	Reservoir Tank Size (m^3)	Minimum Daily Per Capita (lpcpd)
Deurali Village Panchayat					
Bhatta Besi (0.08)	145	5	1283	5	45
Sunar Goan (0.07)	121	3	180	3	45
Yangkot (0.2)	634	6	2000	20	27*
Thimure (0.03)	45	1	475	None	45
Kapedhara	1000**	13	7000	25	Unknown
Purandi	150**	3	Unknown	5	Unknown
Pandrung Village Panchayat					
Devi Than (0.08)***	439	3	2150	6**	18
Kuwapani	30	1	Source Protection	1**	Unknown
Tunibote (0.15)***	343	8	2100	10**	39
Majlakuribot Village Panchayat					
Kamidhara (0.6)***	840	13	3000	5.7	56
Bhul Bhule (0.11)***	280	5	1500	5	34
Chiurebhir (0.17)***	238	4	1480	5.5	62
Kumaltari (0.14)	189	4	391	4.5	64

* Does not include supplementary stream source also available to Yangkot.
** Estimate.
*** Currently under construction.
**** Proposed Project.

Project Location and Minimum Source Flow (lps)	Persons Served at Present	Number of Taps	Length of Pipe (m)	Reservoir Tank Size (m^3)	Minimum Daily Per Capita (lpc pd)
Takukot Village Panchayat					
Mohariya (0.12)	263	3	1120	4.5	31
Bahakot (0.1)	500	4	Unknown	6.0	17,
Rithepani (0.09)	125	1	Source Protection	2.5	30
Banspani (0.12)	320	5	1600	10.0	32
Bairapani (0.25)	252	4	426	4.0	46
Bhaluswara (0.15)	200	3	1816	6.0	50
Kuwapani (0.12)***	196	2	200	1.8	33
Bandhapani (0.15)	70	2	222	1.8	118
Kurepani (0.03)	77	2	Source Protection	2.0	33
Gandhak Pani (0.05)	224	1	Source Protection	2.5	20
Devi Than Mashar (0.13)	70	2	800	2.5	112
Bahun Pani, Ward 1 (0.17)	50	1	Source Protection	None	720
Bahun Pani, Ward 4 (0.05)	86	1	Source Protection	3.0	50
Dhara Pani (0.27)	20	1	Source Protection	None	1000
Bhutaha Khola (0.25)	50	1	Source Protection	None	450
Chapani (0.05)	100	2	Source Protection	1.3	43
Karkichhap (0.18)****	141	6	Unknown	6.0	57

**** Proposed project.