

824
BW 89



**WATER AND SANITATION
FOR HEALTH PROJECT**

Operated by
CDM and Associates

Sponsored by the U.S. Agency
for International Development

1611 N. Kent Street, Room 1001
Arlington, VA 22209-2111 USA

Telephone: (703) 243-8200
Fax (703) 525-9137
Telex WUI 64552
Cable Address WASHAID

EMERGENCY TECHNICAL ASSISTANCE TO BOTSWANA FOR RURAL WATER SUPPLY

LIBRARY
INTERNATIONAL REFERENCE CENTRE
FOR COMMUNITY WATER SUPPLY AND
SANITATION (IRC)

WASH FIELD REPORT NO. 269

JULY 1989

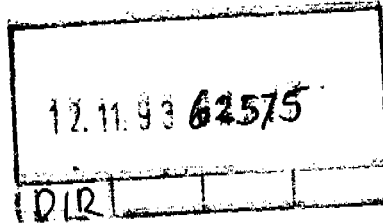
The WASH Project is managed by Camp Dresser & McKee International, Inc. Principal cooperating institutions and subcontractors are: Associates in Rural Development, Inc.; International Science and Technology Institute, Inc.; Research Triangle Institute; Training Resources Group; University of North Carolina at Chapel Hill; University Research Corporation.

**Prepared for the USAID Office
of Foreign Disaster Assistance
and the USAID Mission in Botswana
under WASH Activity No. 430**

824-BW89-5906



1 November 1993



TAS 472

Dear Colleague,

On behalf of the WASH Project, I am pleased to provide you a copy of "Integrated Assessment of Hazardous Waste Management in Botswana," WASH Field Report No. 421, by Nancy Convard and Larry O'Toole. This report is based on a field visit to Botswana between June 11 and 28, 1993. It assesses hazardous waste management in Botswana, characterizes the country's policy and technical needs, and offers recommendations on establishing a hazardous waste management program.

Please let me know if you require additional copies of this report or of related reports listed on the reverse of the title page.

Comments or suggestions about this or any other WASH report are always welcome.

Sincerely yours,

A handwritten signature in black ink, appearing to read 'J. Ellis Turner'. The signature is written in a cursive, flowing style.

J. Ellis Turner
WASH Project Director

WASH Field Report No. 269

EMERGENCY TECHNICAL ASSISTANCE
TO BOTSWANA FOR
RURAL WATER SUPPLY

Prepared for the USAID Office
of Foreign Disaster Assistance
and the USAID Mission in Botswana
under WASH Activity No. 430

by
Michael Webster
Fred van der Geest
Philip Roark

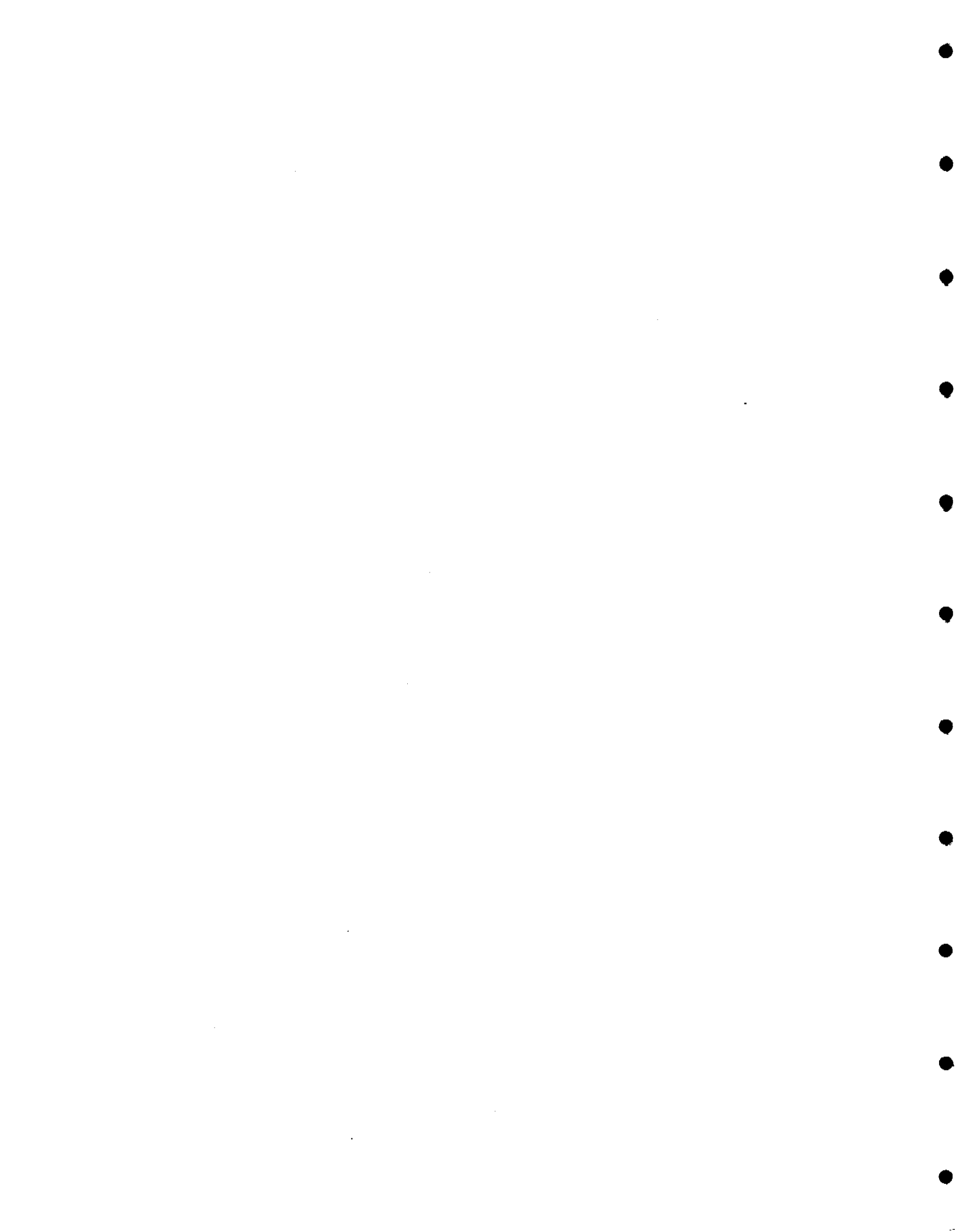
LIBRARY, INTERNATIONAL REFERENCE
CENTRE FOR COMMUNITY WATER SUPPLY
AND SANITATION (IIRC)
P.O. Box 93150, 2509 AD The Hague
Tel. (070) 314911 ext 141/142
RN 15N 5906
LO: 824BW89

July 1989

Water and Sanitation for Health Project
Contract No. 5942-C-00-4085-00, Project No. 936-5942
is sponsored by the Office of Health, Bureau for Science and Technology
U.S. Agency for International Development
Washington, DC 20523

CONTENTS

CHAPTER	PAGE
ACKNOWLEDGMENTS	iii
1. INTRODUCTION	1
2. BACKGROUND	3
3. RESULTS OF TECHNICAL ASSISTANCE	7
3.1 Rehabilitation of Drill Rigs	7
3.2 Training	7
3.3 Spare Parts Purchase	7
3.4 Six Emergency Wells	8
3.5 Priority List of Villages	8
3.6 Planning and Maintenance Procedures	8
3.7 Liaison	9
3.8 WASH Advisors	9
3.9 Drilling of Emergency Sites	9
4. LESSONS LEARNED	11
PHOTOGRAPHS	13
APPENDICES	
A. Webster Report	21
B. van der Geest Report	49



ACKNOWLEDGMENTS

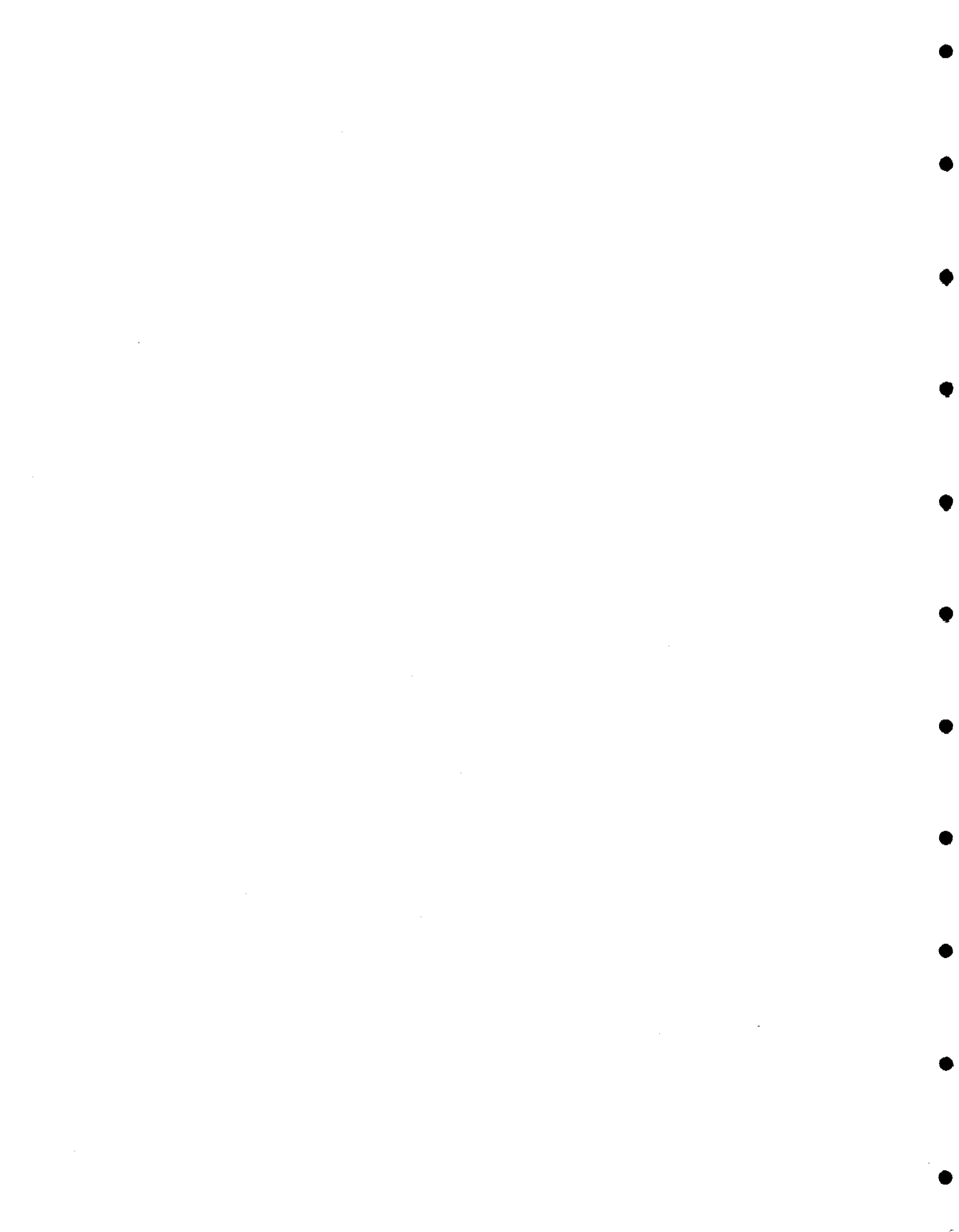
Many people contributed to the success of this humanitarian project. It would not be a success without the efforts of Rolf Bergstrom, Senior Hydrogeologist (Drilling) of the DWA, and Pushkar Brahmhatt, Mission Engineer--USAID Mission Gaborone. All involved, from DWA Director M. Sekwale to the mechanics and drillers, were most helpful and cooperative throughout the activity.

Chapter 1

INTRODUCTION

WASH was requested by the Office of Foreign Disaster Assistance (OFDA) in February of 1988 to provide technical assistance to Botswana for drought relief. The assignment required the services of two consultants--Michael Webster, a drill rig manager, and Fred van der Geest, a field operation liaison specialist. Initially, the duration of the assignment was to be five months for each consultant, but Webster was extended for a total of nine months. Field operations of the consultants began in April of 1988 and lasted until December of that year.

This report provides a summary of the WASH consulting assignment. The main body of the report consists of a short background to the assignment, summary of results, and lessons learned. Final reports for each of the two consultants provide more detail and are attached as appendices.



Chapter 2

BACKGROUND

In December 1987, at the request of the USAID Botswana mission, OFDA asked WASH to send a reconnaissance team to Botswana to assess emergency drought conditions. The purpose of the mission was to determine what short-term emergency action could be accomplished within one year. A team consisting of Ralph Preble, a hydrogeologist, and Jonathan Hodgkin, a pump specialist and mechanical engineer, arrived in Botswana in January 1988. They spent four weeks in the field. Their findings were stated in WASH Field Report No. 229, February 1988. A summary of those findings is provided below.

"Botswana is now in the seventh year of drought which has severely depleted the groundwater reservoir on which the country depends. Boreholes are drying up in many areas. The situation is particularly critical in the eastern part of the country where higher population densities (greater water need) and hydrogeological conditions make the location of new supplemental drilled wells difficult. This situation has caused substantial disruption of life and caused increased human suffering particularly in rural areas. To date, no human deaths can be directly attributable to the drought due in large part to the continuing effective relief efforts of the Government of Botswana (GOB).

"These efforts have included a substantial program of trucking water to the most drought-stricken villages. During a three-month period in late 1987, it became necessary to transport water to Mahalapye, a village of over 30,000. Many rural area dwellers have found it necessary to migrate to villages and towns as crops have failed, livestock died, and traditional water sources dried up. Roughly half of the country's population are now recipients of the GOB's supplemental feeding program. Livestock mortality is reaching 25 percent with about half attributable to drought conditions. At the end of 1987, mortality reached 35 percent, and a 40 percent mortality of draft animals was reported in some areas. Plowing was delayed and planting was late in all areas. A poor harvest is predicted even if normal rains occur during the balance of the season. Recent rains have not eased public water supply problems even though a general greening of the countryside has resulted. An end to the drought is far from assured. If the rains fail now, as they did last year, the water supply situation could easily become desperate.

"In direct response to the potable water needs in many areas, the GOB Cabinet has directed the Department of Water Affairs (DWA) to mount an emergency effort to drill new wells in the most severely affected villages. A priority list of 57 villages with an estimated population of possibly 100,000 people has been assembled from a total list of some 800 locations. Failing water supplies, attributed to drought conditions, is cited as the reasons for placement of practically all the 57 villages on the list. Major funding will be by the GOB, from its own reserves. It is anticipated that this emergency program, along with some continuation of other on-going programs will involve all major private sector companies capable of siting and drilling wells.

"The Director of DWA, Mr. Moremi Sekwale, along with other GOB officials, confirms that constraints include inadequate transportation facilities, lack of well-siting capacity, lack of drilling-supervisory capacity, and, most pressing at this time, the poor condition of DWA well drilling equipment as well as the delays inherent in GOB procedures for procuring spares and technical assistance to address this situation.

"At the present time, only one new rotary rig, one 9-year-old rotary rig overhauled in 1987, and one new percussion rig are in satisfactory working order. Eleven others, comprising the entire public water well drilling capability, are in desperate need of major overhaul.

"The DWA Director confirmed the poor condition of four of the DWA's rotary drill rigs and requested that the WASH team report that the overhaul of these four rotary rigs be considered as their first priority in any assistance they would be recommending. Next of importance was training to minimize rig failures in the future, expatriate manpower to organize and supervise drilling programs and replacement of certain worn-out drilling tools and (fishing) tools to retrieve lost parts.

"Other forms of assistance were suggested by the Director but the team considered them to be more long-term and development oriented."

After reviewing the recommendations of Preble and Hodgkins, OFDA asked WASH to provide the follow-up team of Webster and Van Der Geest to begin an extended tour of technical assistance.

The key objectives of the WASH assignment were as follows:

- Rehabilitate four rigs.
- Train Botswana mechanics and drillers in repair.
- Purchase spare parts for drill rig.
- Drill six emergency wells.
- Update priority list of 57 drought wells.
- Improve planning and maintenance procedures, both on national and local level.
- Provide liaison between USAID mission and GOB in drought-relief activities.
- Provide WASH advisors in well drilling and field operations.
- Begin drilling of emergency drought sites.

Funding of the assignment as provided by OFDA is provided in the budget below.

A.	Technical Assistance	\$140,000
B.	Rehabilitation of Two Schramm Rigs and Training	230,000
	(1) Procurement of spare parts for Schramm drill rigs	
	(2) Procurement of hydraulic hose fittings for Schramm rigs	
	(3) Classroom Training in hydraulic and electrical repair	
	(4) Rehabilitation of drill rigs and on-the-job training	
C.	Replace Drilling Tools	40,000
D.	Drill, and Equip with Hand Pumps Six Wells in Ngamiland	<u>95,000</u>
	TOTAL	\$500,000



Chapter 3

RESULTS OF TECHNICAL ASSISTANCE

3.1 Rehabilitation of Drill Rigs

The initial request to rehabilitate four drill rigs was reduced to the repair of two Schramm rigs. A thorough inventory and cost estimate of required spare parts had revealed that the budget was sufficient for the repair of only two rigs. Two other rigs, manufactured by Atlas Copco, are of Swedish origin and remain unrepaired.

Procuring spare parts proved to be difficult and time consuming. Bids were requested by USAID Botswana through international tender to provide an extensive list, prepared by Mike Webster, of equipment and spare parts. The low bidder selected was a South African firm, Techmin. Some of the equipment required special manufacturing, but despite repeated calls by WASH and the mission to the manufacturer--Schramm, Inc.--regarding the emergency procurement, extended delays were experienced. In addition to the three months required for assembling and manufacturing the required parts, the orders received in Botswana were missing some parts and had to be reordered. While the spare parts were on order, the rigs were completely stripped and prepared for rehabilitation. Also, training mechanics who reviewed on-going drilling operations selected units to be field sites.

By November 1989, all parts were received and inventoried in Botswana. The rigs were then repaired and commissioned to begin drilling operations in March 1989. Thus, the objective of rehabilitating two drill rigs was successfully met, although it took four months longer than expected.

3.2 Training

Training in hydraulic and electrical technologies was conducted in two classes for periods of two weeks each. The first class in June 1989, was attended by four mechanics, three drillers, and two foremen. The second class provided instruction to four mechanics, two foremen, and two drillers. Thus, a total of 17 water agency employees received classroom training. The course was taught by an Atlas Copco instructor, and attendees were said to have been most satisfied with the results. In addition to the classroom training, on-the-job training in rig mechanical systems, electrical, and hydraulic systems was provided by a representative of Techmin. Emphasis, in this phase, was placed on the Schramm drill rigs.

3.3 Spare Parts Purchase

As described in Section 3.1, spare parts for two Schramm drill rigs were purchased, totaling \$240,381.

3.4 Six Emergency Wells

To utilize as many resources as possible to combat the drought, and also to assist the private sector, bids to drill six wells were solicited from drilling entrepreneurs. The well sites were in villages experiencing a drought emergency. These villages are located in difficult terrain.

A local firm, Geotest, was selected as the low bidder to construct the wells. The results, however, were disappointing. The first completed well contained excessive salinity and was abandoned. While en route to the second site, the drill rig became bogged down in heavy sands, and the drive train was damaged. The time required to repair the drive train and order sand tracks (used to cross sandy terrain) became excessively long. Ultimately, the contract was cancelled because the contractor remained unresponsive to repeated requests to complete the work.

3.5 Priority List of Villages

The initial list of 57 emergency villages was increased to include 25 additional villages. These villages became the main focus of drought emergency assistance, and efforts were coordinated to direct most government and international aid to help these villages. The total of 82 villages listed in Mr. van der Geest's final report is in the appendix.

3.6 Planning and Maintenance Procedures

As a part of Mr. van der Geest's work, he was placed in the position of Assistant Water Engineer within the Department of Water Affairs. In this role he helped coordinate day-to-day activities relating to drought-relief.

Among his specific accomplishments, he

- contributed to the preparation of the instruction manual for water system operators;
- assisted in needs assessment of the North East District, and provided both immediate and long-term organizational systems for water system managers;
- assisted in establishing performance guidelines for water system managers;
- assisted in preparation of seminars for District Council Water Clients;
- provided oversight of emergency borehole construction program and data gathering on the status of existing systems; and

- provided troubleshooting during visits to individual water departments to assess set-up, including workshops, storerooms, offices, transport, preventive maintenance procedures, etc.

3.7 Liaison

Both Mr. Webster and Mr. van der Geest were given major roles by the Department of Water Affairs in facilitating drought relief efforts. They provided a liaison between the government and the USAID mission engineer, Pushkar Brahmhatt. This liaison was particularly important in writing commodity specifications, soliciting bids, communicating with suppliers, and ultimately in solving problems related to procurement. This was a difficult and complicated undertaking which could not have been successful without strong cooperative efforts among all parties. That the undertaking was successful attests to the priorities the USAID mission and the Government of Botswana placed on drought relief.

3.8 WASH Advisors

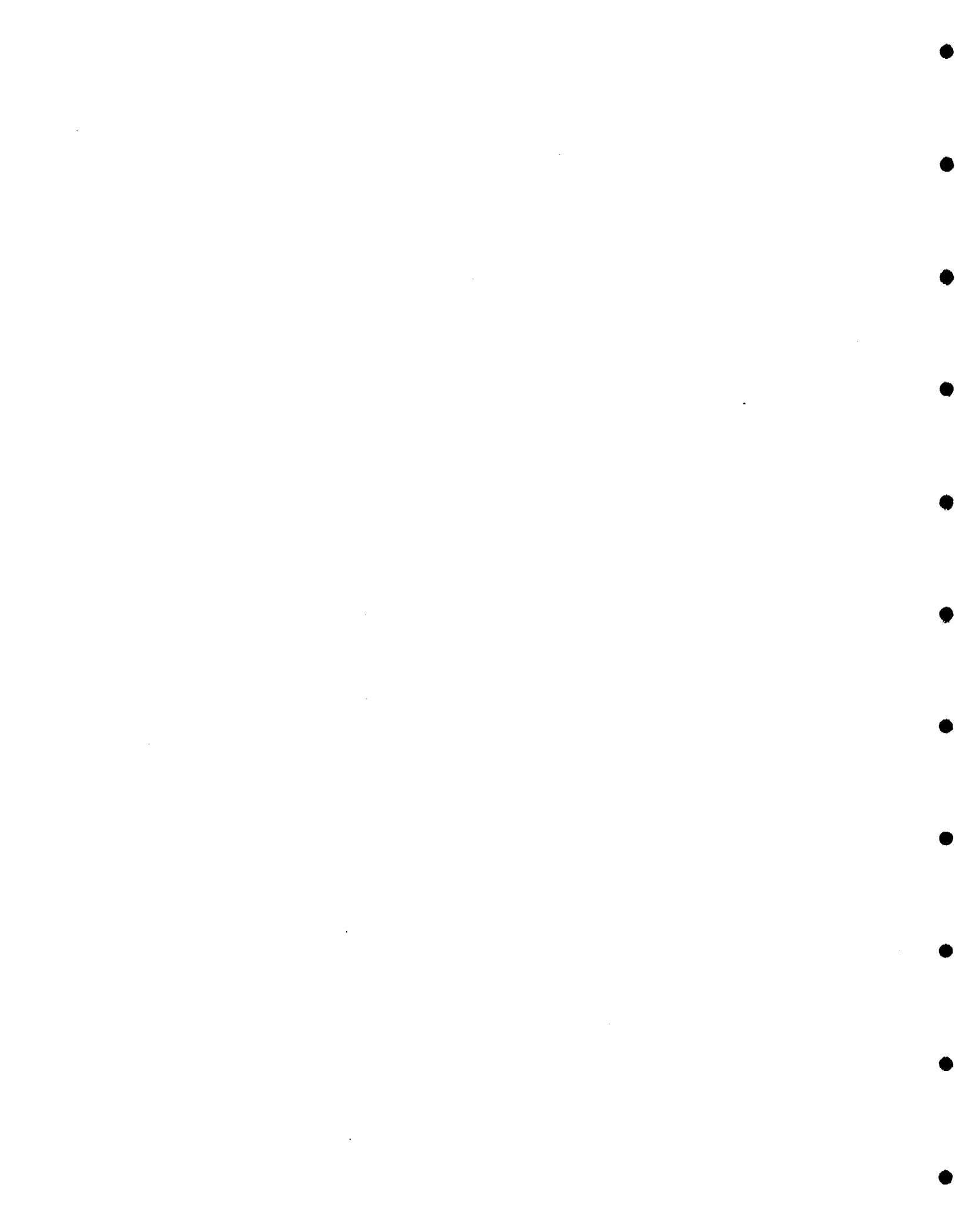
WASH advisors were in the field continuously from March to December 1989. Mr. van der Geest's tour lasted from March to October. He has since accepted a long-term contract through SIDA to continue the same activities he undertook through the WASH contract. Mr. Webster's tour was originally from March to October, but it was extended through December.

3.9 Drilling of Emergency Sites

For the construction of a water system, five steps are required. The table below provides a summary of the activities and the progress as of February 1, 1989.

<u>ACTIVITY</u>	<u>COMPLETED</u>	<u>ONGOING</u>	<u>OUTSTANDING</u>
SITING	75	6	1
DRILLING	60	9	13
TESTING	42	2	38
DESIGN	32	3	47
CONSTRUCTION	25	3	54

As seen in the table, progress has been reasonably good. The project is underway in seventy-five villages. Twenty-five of the eighty-two priority villages have completed construction and are now operational. The two rehabilitated Schramm rigs did not contribute to this progress. These rigs were scheduled to be commissioned in early February 1989, and as of this report they should be operating.

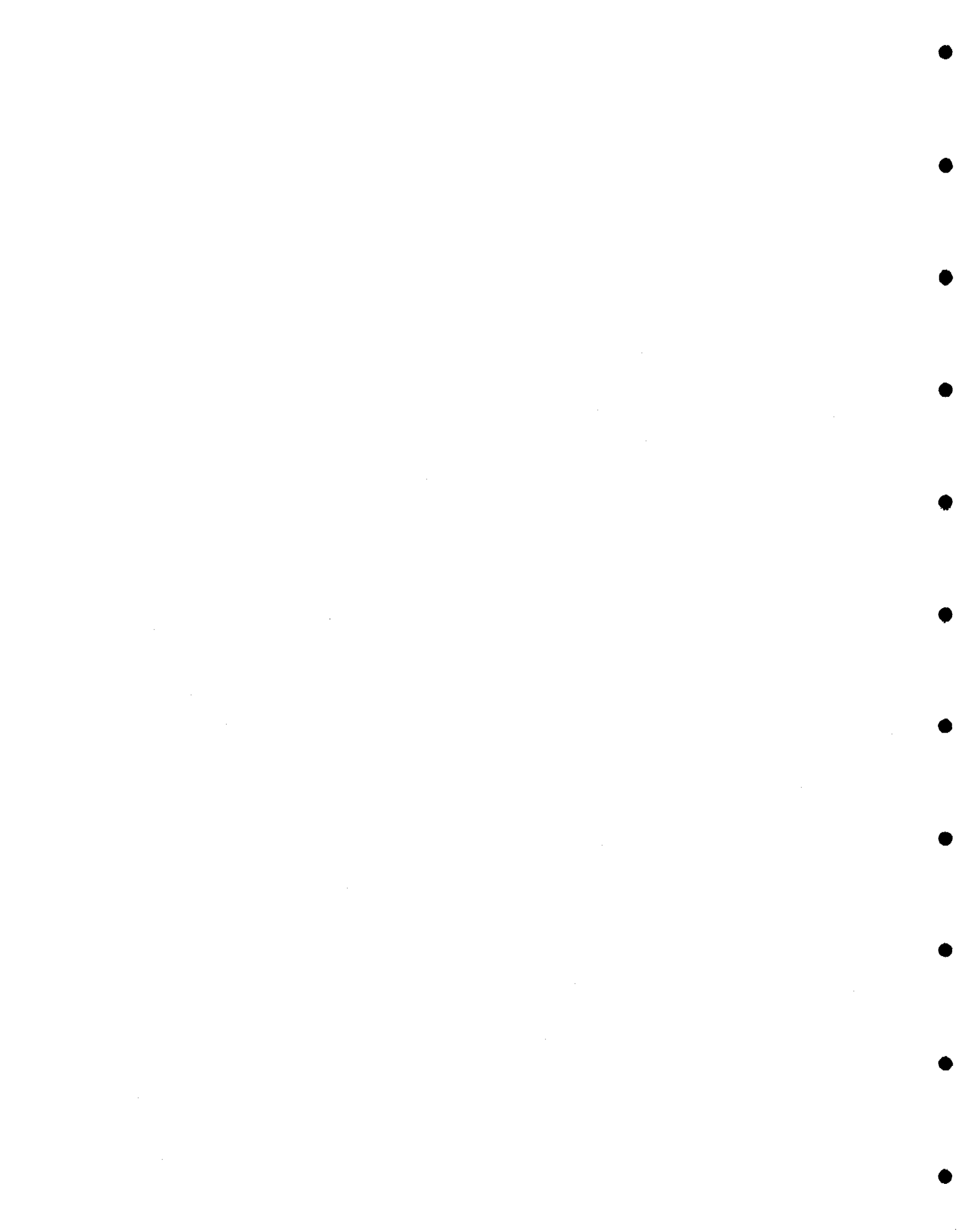


Chapter 4

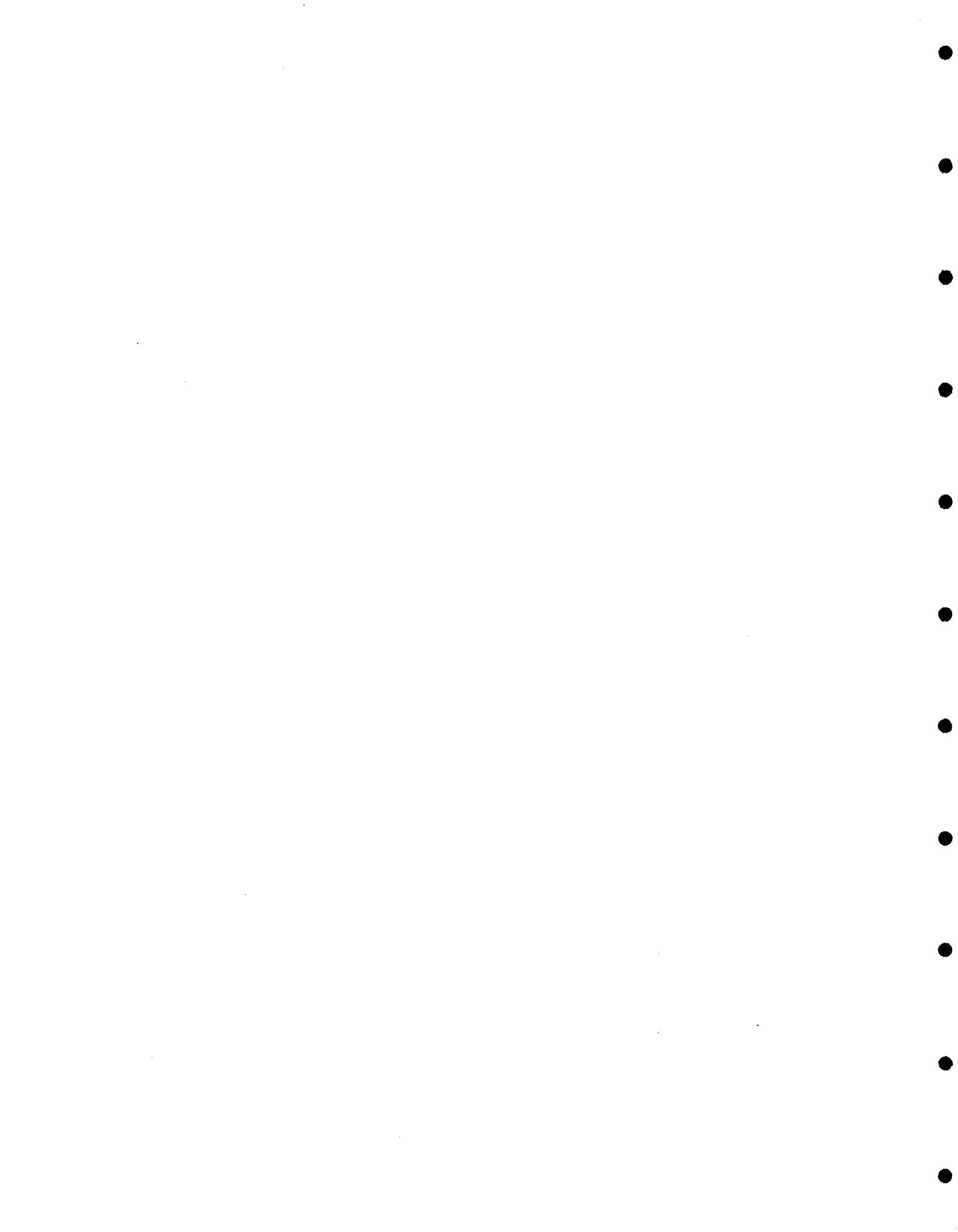
LESSONS LEARNED

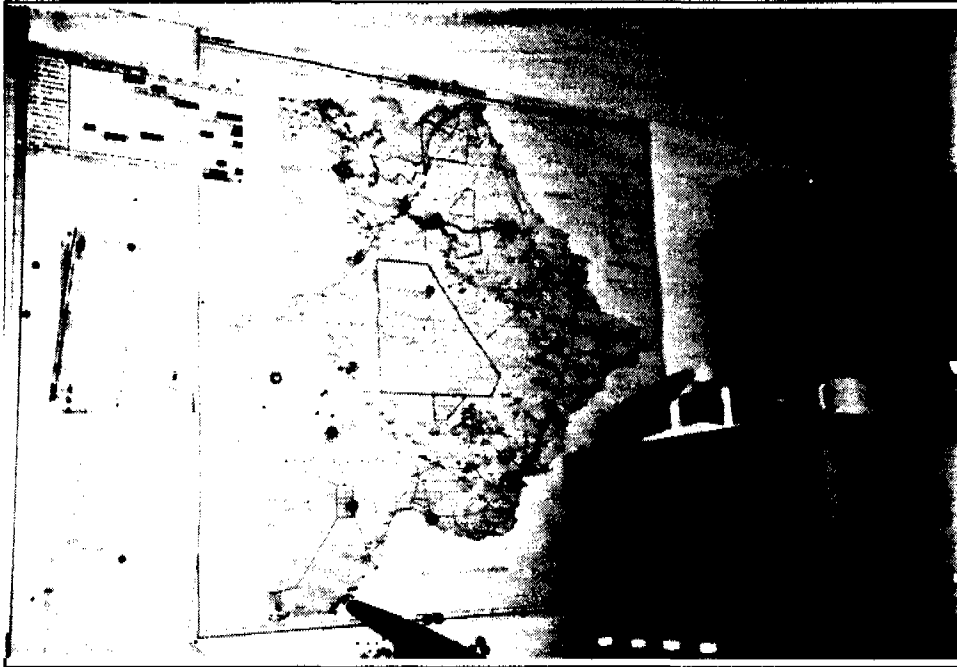
OFDA and WASH have cooperated on several assignments that respond to emergency drought assistance requests. The Botswana assignment, however, was unusual for OFDA because technical assistance was required over a relatively long period (eight months). Thus, the following are offered as lessons learned from this assignment. These may be helpful in planning future assignments.

- To repair specialized equipment such as drilling rigs, a long lead time is needed. The process requires parts specification, ordering (perhaps through bidding), assembly of parts, manufacture of some parts, and shipping. It can take from three to four months to accomplish this, even longer if problems are encountered. Initial estimates of the cost required and time spent rehabilitating complicated equipment must be considered gross estimates. When planning, consider the possibility of modified budgets and uncertain completion time.
- The process of water development also requires much time. Site selection, drilling, water testing, design of the distribution system, and construction of the system all require one to three months per village when part of a regional effort involving many sites.
- Environmental concerns of water development must always be considered. This does not appear to be a problem in the Botswana case, because the water systems were meant to replace existing systems. But future projects must always consider the potential negative effects of water development, particularly in fragile arid zone lands.
- Reliance on private sector entrepreneurs that are not well-established in a developing country should be viewed cautiously. Such firms are often too inflexible to deal with the exacting requirements of emergency aid.

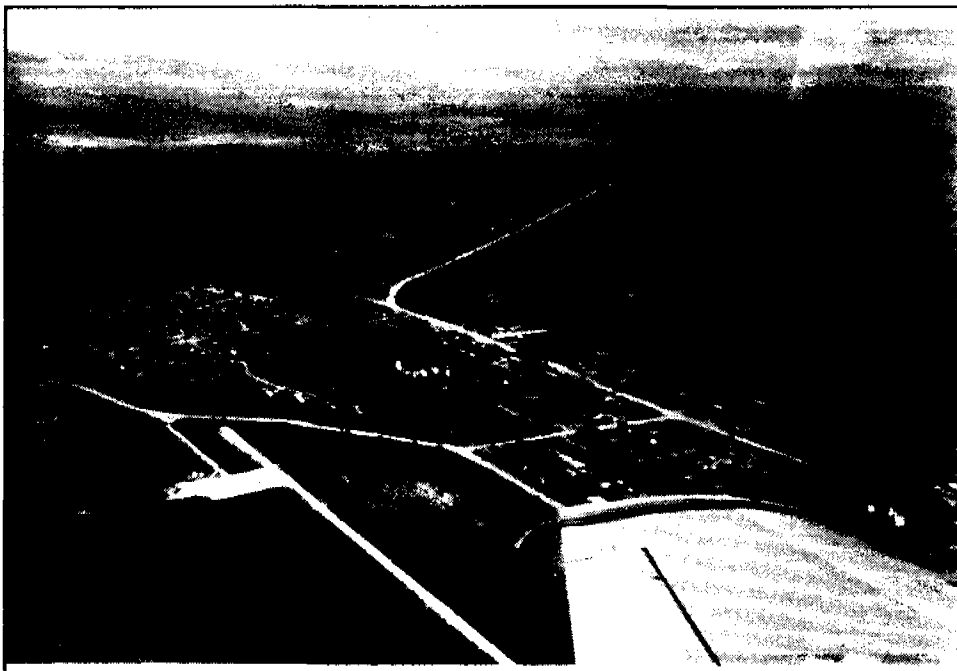


PHOTOGRAPHS

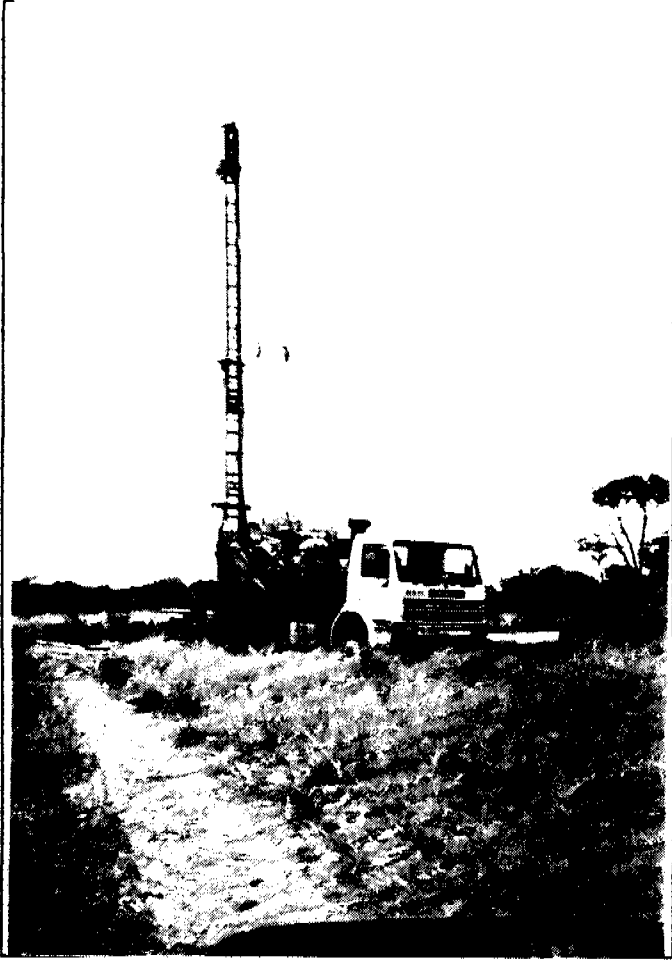




1. Circles on map of Botswana showing widespread locations of drilling sites. Drought affected villages as much as 1000 kms apart.

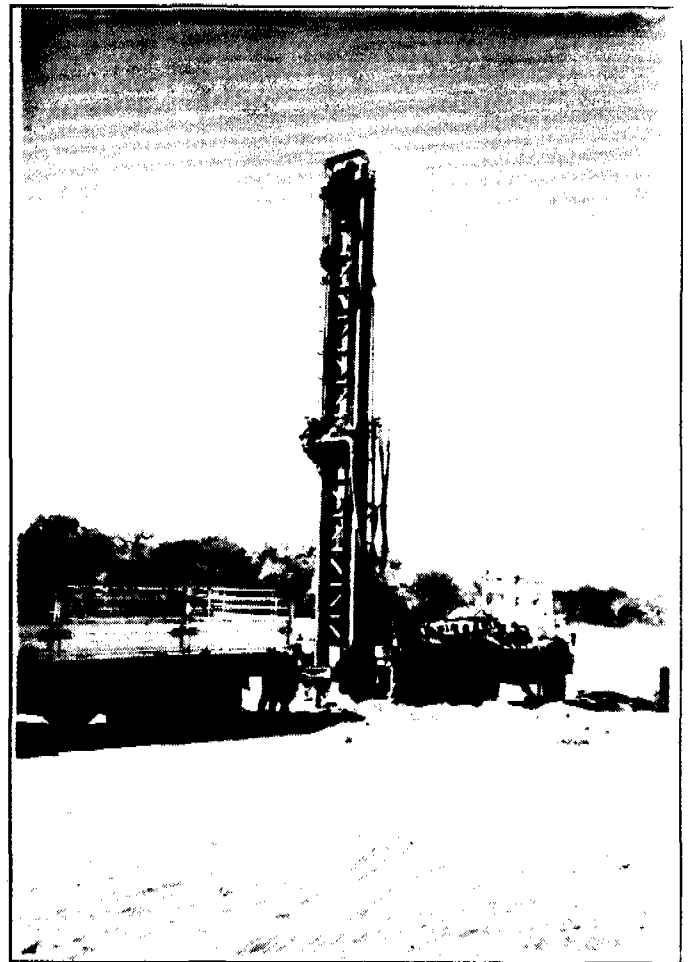


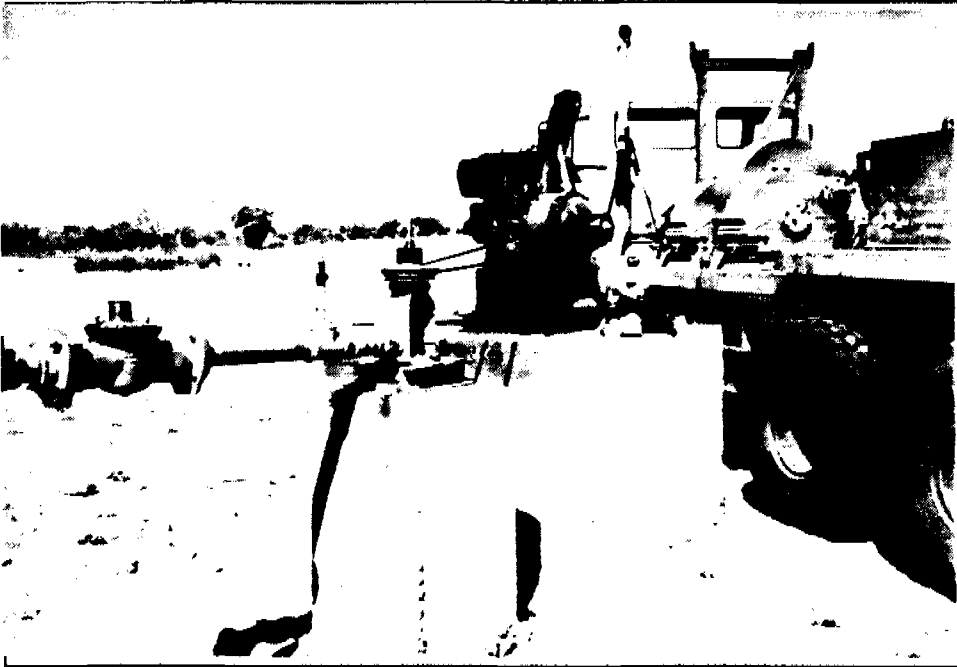
2. Aerial view of village in northern Botswana, Ghanzi, which was site of drilling.



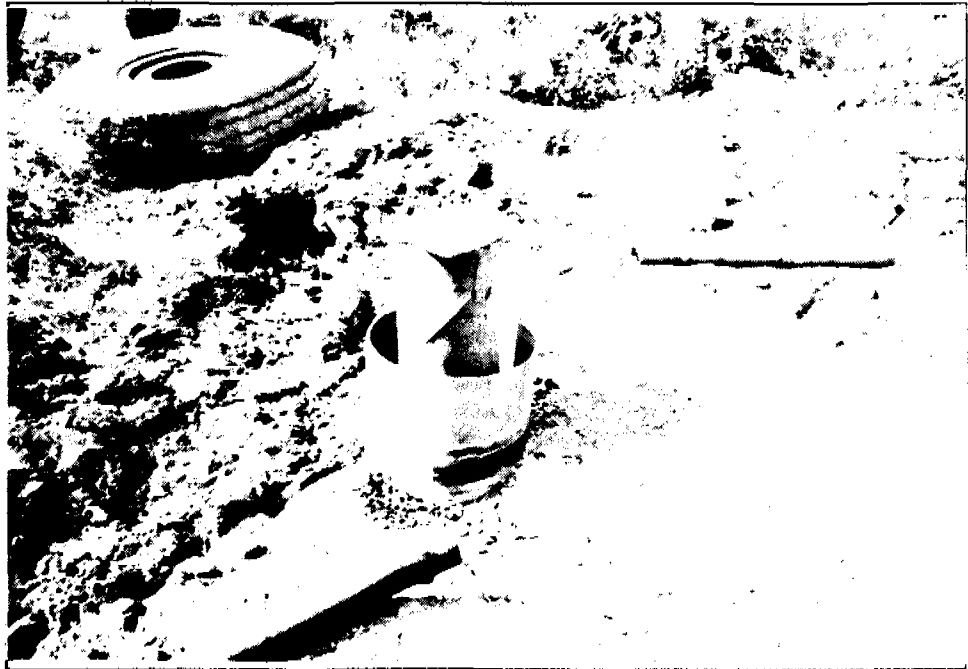
Photos 3 & 4.

Drilling is conducted under varying conditions. Sand is frequently a problem in the north and western parts of the country.

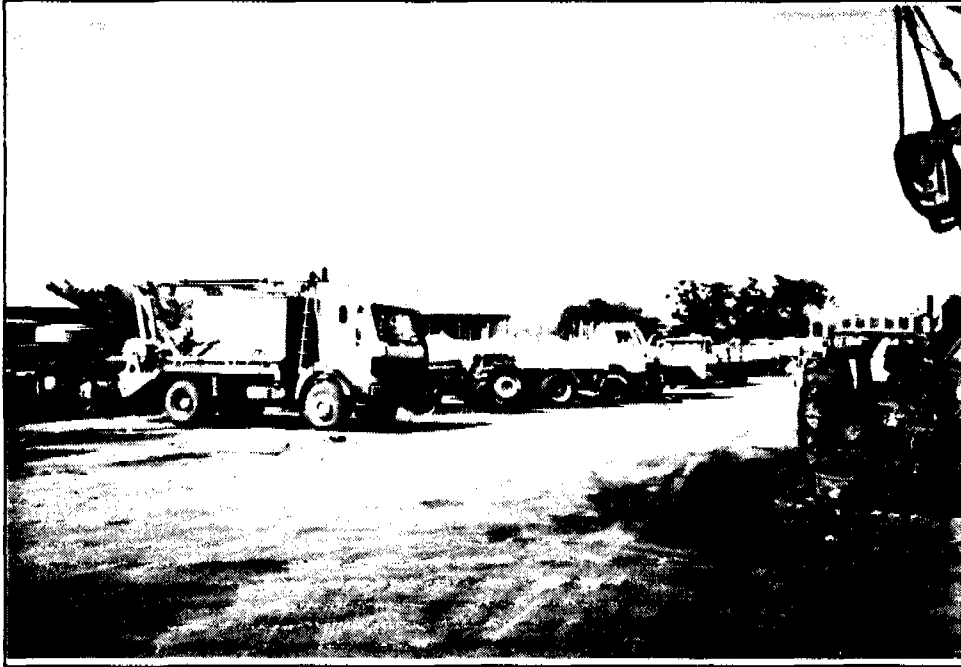




5. Well equipped with pump. Water distribution system is under construction.

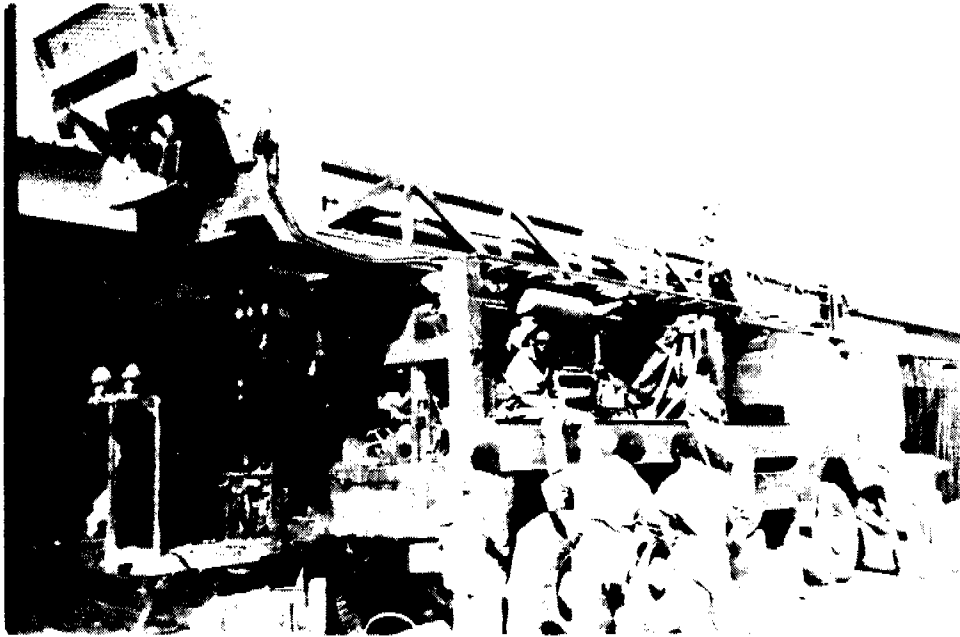


6. Borehole abandoned because of tools lost down the hole.



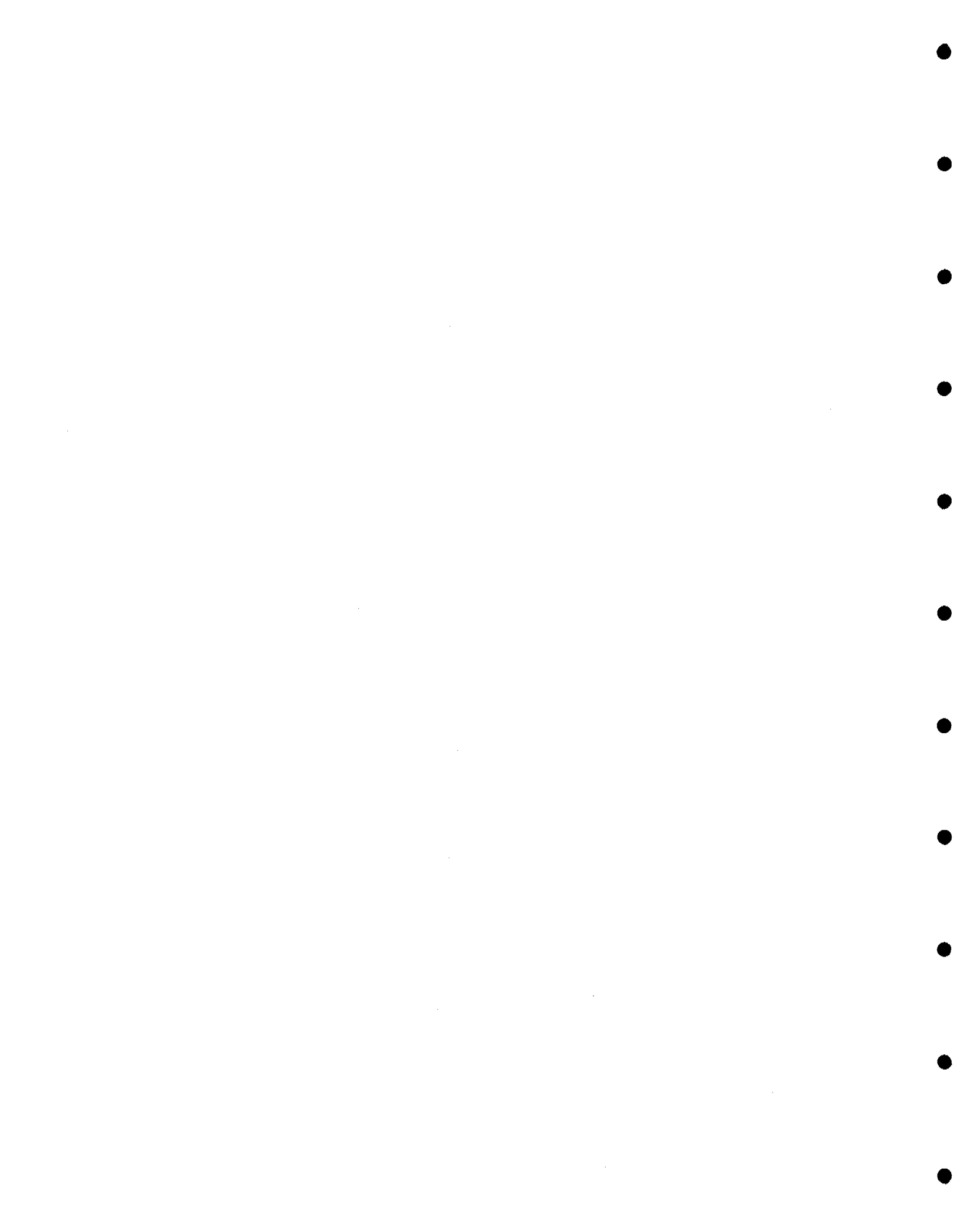
7 & 8. Department of Water Affairs Workshop.





9 & 10.
Trainees receiving instruction in
drilling repair.



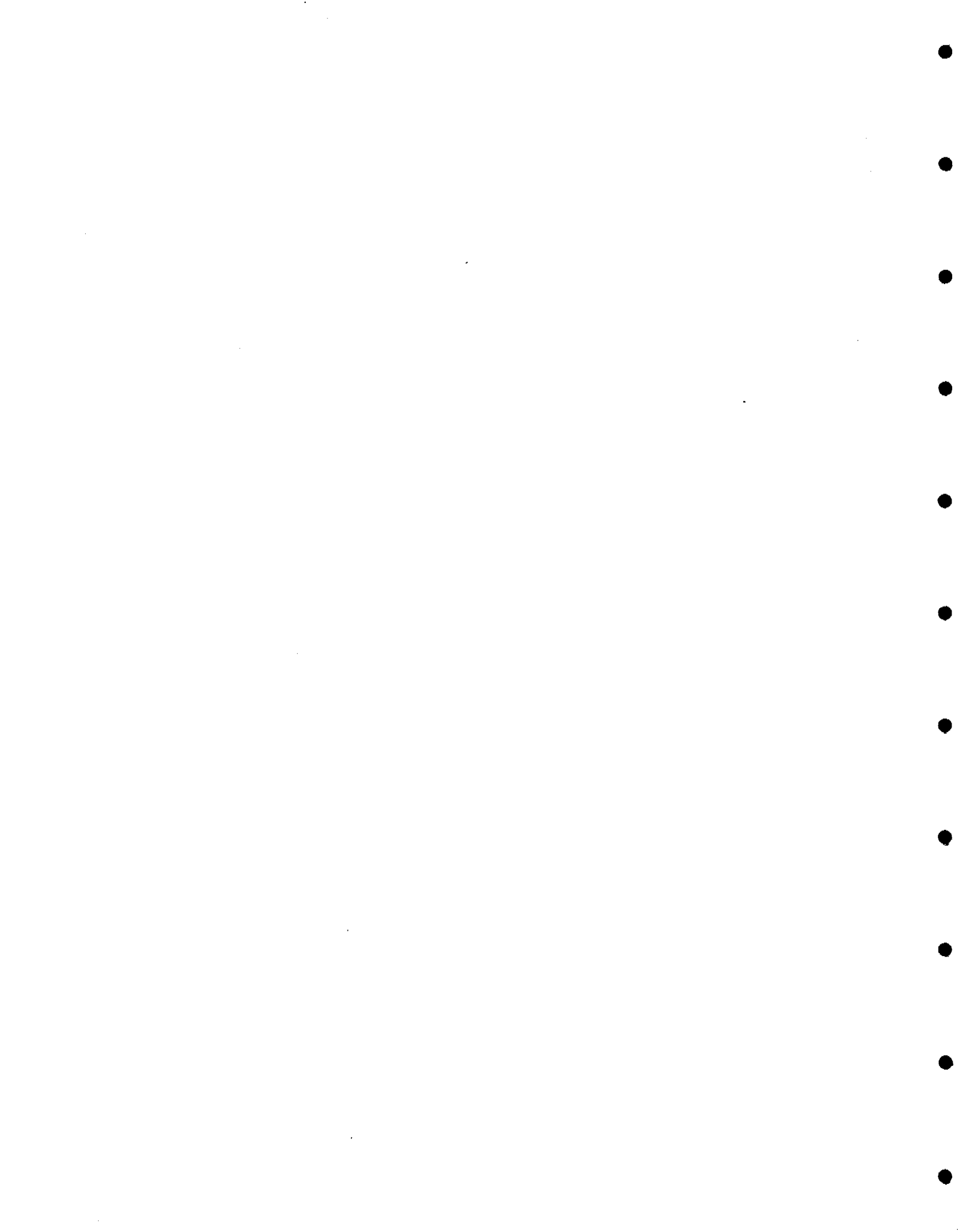


APPENDIX A

Final Report

Prepared by
Michael Webster

January 1989



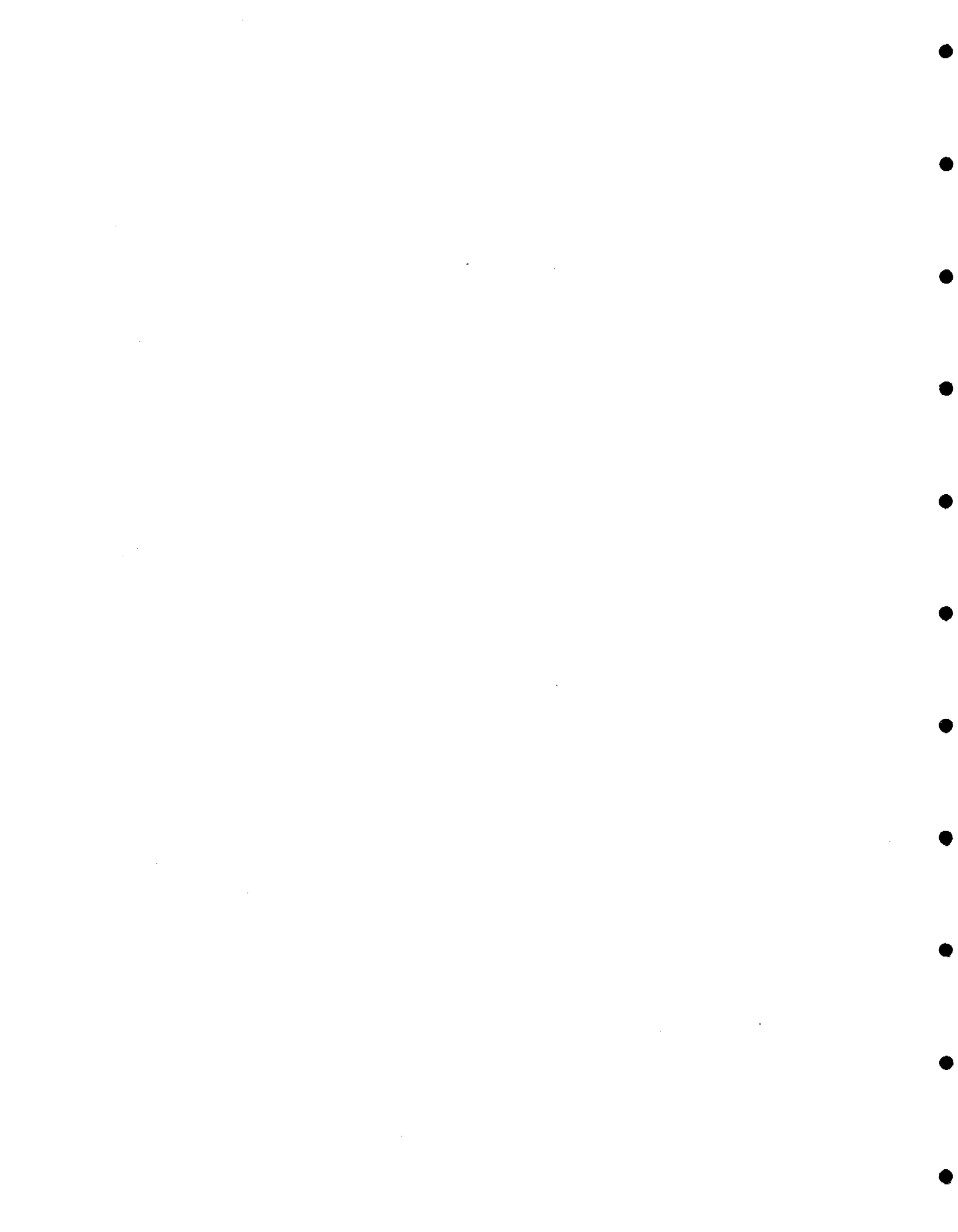
CONTENTS

CHAPTER	PAGE
ACRONYMS	25
1. REHABILITATION OF DRILLING EQUIPMENT	27
1.1 Parts	27
1.2 Location	28
1.3 On-the-Job Training	29
1.4 Hydraulic Hose Replacement	30
1.5 Classroom Instruction	31
1.6 Execution	32
1.7 Contract Award Sums	34
1.8 Actual Expenditures	34
2. SHORT-TERM TECHNICAL ASSISTANCE	35
2.1 Michael Webster	35
2.1.1 Parts	35
2.1.2 Training	35
2.1.3 Hydraulic Hoses	36
2.1.4 On-the-Job Training	36
2.1.5 Ngamiland Emergency Borehole Project	37
2.1.6 Emergency Drilling Tools	37
2.1.7 Technical Assistance to the Department of Water Affairs	38
2.2 Short-term Technical Assistance - Mr. van der Geest	39
3. DRILLING SIX EMERGENCY BOREHOLES FOR NWDC NGAMILAND	41
4. PROVISION FOR EMERGENCY DRILLING TOOLS	43
4.1 Total Expenditures - Fishing Tools	44
4.2 Summary of Project Costs	44
5. EMERGENCY CONSOLIDATED BOREHOLE PROGRAM	45
5.1 Pump Testing	45
5.2 Siting	45
5.3 Contractors	45
5.4 Expenditures	46
6. RECOMMENDATIONS	47



ACRONYMS

DWA	Department of Water Affairs
ECBP	Emergency Consolidated Borehole Program
NWDC	North West District Council
P	Pula--monetary currency of Botswana (one Pula = \$.5085 US)
SIDA	Swedish International Development Authority
TCM	
USAID	U.S. Agency for International Development
WASH	Water and Sanitation for Health project



Chapter 1

REHABILITATION OF DRILLING EQUIPMENT

1.1 Parts

As per WASH Report No. 229, \$250,000 was earmarked for rebuilding the hydraulic and electrical systems of four USAID-funded drilling rigs. Two of the machines were American-made Schramm-type drills, and the other two were Atlas Copco drills--Swedish made. After extensive examination of these machines, a list of not only hydraulic and electrical parts, but all parts found worn on the machines was forwarded to the manufacturers for cost-of-part replacement. On receipt of the quotes, it was apparent that the funds allotted for this activity were sufficient to repair the hydraulic and electrical components of the four machines identified in WASH Report 229. But due to other worn components that were identified during comprehensive inspection of the drills, we realized that replacing only the hydraulic and electrical systems would not necessarily improve the production of the drills, this because most of the other components would continually be failing.

A meeting was held with the DWA Director and the USAID Engineer to discuss the problem. It was unanimously decided that the funds for this activity were sufficient to completely repair two machines. The two drills selected for repair were the American-made Schramm drills. The Senior Hydrogeologist at the DWA said he would approach his sponsor, the Swedish Aid Agency (SIDA), for funds to repair the Swedish-made Atlas Copco drills. The lists of required parts were sent to Schramm, USA, and their Botswana distributor, IPTC, as well as to Atlas Copco for official pro-forma quotations. The parts list detailed over 125 replacement items for each of the four machines.

The quotations received were as follows:

Schramm Inc.	Parts	\$112,231.74
	Forwarding (est)	251.00
	Air Freight (est)	23,725.00
	Insurance (est)	462.00
	Total	\$136,669.74
IPTC	Parts	\$106,341.91
	Forwarding (est)	251.00
	Air Freight (est)	23,725.00
	Insurance	462.00
	Total	\$130,779.91

NOTE: Seven items were not quoted on by IPTC. the total sum of the seven components was \$704.48. To make the comparison fair, we reduced Schramm's quote by this amount, bringing their total quote to \$135,965.26.

The Technical Review committee recommended award to IPTC for supply of parts for the following reasons:

- IPTC was \$5,185.35 more cost effective
- Communication with IPTC would be easier due to the nearer location.

A USAID Letter of Commitment was forwarded to IPTC on June 28, 1988. The stated lead time for supply of the parts was 16 weeks from this date with approximately 80 percent of the parts to be shipped within 2 weeks. This proved to be an inaccurate projection.

NOTE: We had problems obtaining quotes from both Schramm and IPTC. Schramm did not promptly answer our inquiries. This delayed our hoped-for project parameters. IPTC submitted a total of three quotations before they achieved their final price. Since we were under strict guidelines to ask for reasonable competition on the bidding, we persevered until our position was understood by both suppliers. As a result of our subsequent meetings with executives from both companies, we hope we have preempted many problems with company attitudes, part prices, and supply lead times that could arise.

1.2 Location

The rehabilitation of the drilling rigs was a two-fold program--to completely rebuild the machines, and to provide on-the-job training of DWA selected mechanics and drillers. Since the project had been delayed by the stalling tactics of the parts suppliers, a decision was made by all parties to try to repair the machines by September, working on both rigs at the same time. This presented another problem: the premises available on the DWA grounds were not large enough for the project, and it would be difficult to control on-site parts management at that location. After searching Gaborone for a suitable location, we found a site at a local Botswana drilling contractor--Techmin (Botswana) Pty Ltd. Since the on-the-job training instructor was contracted to Techmin, an agreement was reached with Techmin for the repairs and the training exercises to be conducted on Techmin's premises.

The first of the Schramm drills was moved to Techmin's premises on June 20, 1988, and the second arrived on June 27 for cleaning and disassembly. Because most of the parts were promised to be in-country within 5 to 6 weeks, our plan to disassemble and clean the machines would be performed during that time. Total repair time was estimated to be 16 weeks from the start of the project.

The contract between Techmin and DWA was signed. Techmin was to be responsible for 24-hour security, fire and theft insurance, adequate space to rebuild the drills simultaneously, adequate space for two DWA parts storage containers, use of shop utility hand tools, a steam cleaning machine, and use of a heavy lifting crane on demand. (The Schramm trainer mechanic services were also included in this contract - see On-the-Job Training.)

The contract amount for use of the listed facilities and services was as follows:

▪ Yard facilities as per contract (per mo.)	\$1,500.00
Contract duration 4 months x 1500	
Total	\$6,000.00

1.3 On-the-Job Training

The DWA personnel selected for the first phase (two months) of the job training program were four mechanics, three drillers, and two drill foremen. The second phase consisted of four mechanics, two foremen, and two drillers. The training program consisted of practical training on drill rig mechanical systems, electrical systems, and hydraulic systems. The instructor contracted for this task was Mr. Daan Brink of the Republic of South Africa. Mr. Brink first received factory training (Schramm, Inc.) in 1964. He is recognized as one of the better mechanics in Africa. We had asked Schramm for an alternative mechanic/instructor from the U.S. to perform this task. However, no one was available for the intended length of our program. Mr. Brink is contracted to Techmin (Botswana) Pty. Ltd., for field service repair/consulting for Botswana. The costs for Mr. Brink's services were as follows:

A. Trainer \$1,440.00 @ week x 8 weeks	\$11,520.00
Per Diem \$60.00 @ day x 120 days	7,200.00
Travel Allowance (One round trip @ month between Gaborone and Johannesburg 800 km x 0.33/km x 4 trips	1,056.00
Subtotal	\$19,776.00
B. Rent of Techmin's yard/facilities 4 months	\$6,000.00
Subtotal	\$25,776.00
*C. Funds for unforeseen part procurement	\$15,000.00

*Since many parts were expected to be found worn once the machines were disassembled, we thought it would speed procurement if we could order the parts immediately without time-consuming contract alterations. We therefore added \$15,000.00 to Techmin's contract for procurement of any unforeseen parts. I assessed these part requirements and sent letters to Techmin authorizing the procurement.

Original Contract Amount	\$40,776.00
Contract Extension (See Execution)	19,119.60
Total Contract	\$59,895.60

1.4 Hydraulic Hose Replacement

The hydraulic hosing systems were in extremely poor condition on both of the machines. To make these drills as field reliable as possible, the hoses had to be replaced. A replacement hose list was drafted using the Schramm parts book. Although the parts book listed the length and size of hoses, it did not refer to the type of end fittings on each hose or to the specifications the hose must meet for a particular system (i.e., working pressure rating, etc.). The task of drafting a list for replacement hoses involved breaking down each system and matching hoses to the various hydraulic pressures in the particular system. (We repeatedly asked Schramm for this information but they returned no workable answers.) Then we forwarded a list to 4 local firms for replacement of the hoses. The quotations received were as follow:

▪ Botswana Distributing	\$24,500.00
▪ Fluid Systems	28,041.44
▪ Hydro Repairs	19,663.93
▪ Techmin	25,000.00

These quotations reflected supply of hoses, fittings, crimping fittings to hoses, and installation of new hoses. While we were awaiting these quotations, another problem came to light: the hydraulic hoses that were replaced during the last few years were continually failing. Upon investigation, it was discovered that no one was aware of the various hose pressure ratings used in the four different types of hydraulic systems on the machines. For example, they were replacing hoses rated for 2000 psi on 4000 psi systems. Since most of the heavy equipment the DWA operates is hydraulically actuated, it would be a clear advantage for the DWA to have its own hydraulic hose machinery as well as the training to use it. A decision to acquire this equipment and to have DWA personnel do the actual replacement was reached. The only company in Southern Africa who could supply this equipment was Botswana Distributing. An agreement was reached with Botswana Distributing that they would, at no charge, provide full training on the equipment upon its purchase.

The technical review committee evaluated the quotations and made the following recommendations:

- Hydro Repair's quote was \$4,836.07 lower than that of Botswana Distributing. However, Hydro Repairs was a young company with no track record. The TCM believed that this company submitted the lower bid to obtain their first contract; with time a critical factor, we decided we could not take a chance with this new company.
- Botswana Distributing provided the next lowest quote. We approved it for the following reasons: The quote was reasonable, and the company has an excellent reputation. They could supply the necessary crimping machinery and arrange a training course on hydraulic hose system rating, fittings, and hose construction.

- The crimping machinery needed were a hydraulic high pressure crimping machine and a combination hose skiver and cut off saw. The units were also supplied with crimping charts. The cost of this equipment was as follows:

Crimper and skiver/cut off saw	\$10,497.50
Use Charts	N/A
Five day training course	N/A
Subtotal	\$10,497.50

NOTE: That these prices were reasonable was confirmed by our inquiries with other hydraulic suppliers in South Africa.

Cost of hydraulic hoses and fittings:

Various sizes and types as required	\$24,500.00
Crimping machinery	1,497.50
Total Contract Amount	\$34,997.50

1.5 Classroom Instruction

As per WASH Report 229, upgrading DWA personnel in hydraulic and electrical technologies was deemed vital in keeping the DWA machinery in production. Some of the DWA personnel were previously instructed in these fields by an instructor from the Atlas Copco Company in Sweden. The previous courses achieved excellent results, and most of the training aids for the courses were still on hand. The DWA requested that we use the Atlas Copco course again. We requested a quotation from Atlas Copco for training two groups for periods of two weeks each. Since the DWA only had three electrical training panels from the previous course, and a total number of eight panels were required, we asked for a quotation to supply five of these units. The quotation received was as follows:

Training rep. 1,300.00/week x 4 weeks	\$5,200.00
Lodging/car rental 770/week x 4 weeks	3,080.00
Per diem 40/day x 28 days	1,120.00
Airfare 2000/trip x 2 trips	4,000.00
Electrical training panels 760/ea x 5	3,800.00
Airfreight for panels	1,748.64
Subtotal	\$18,948.64

The DWA also asked a company technician to examine an Atlas Copco 1302 ROTAMEC drill that was involved in a roll-over accident to determine the nature and feasibility of repairing the drill. We allowed the technician three days for his inspection.

Training rep three days	\$560.00
Lodging/car rental	330.00
Per diem	120.00
 Total Contract Amount	 \$19,958.64

This quotation was deemed reasonable, and a contract was drafted and signed between DWA and the Atlas Copco local authorized agent--Scan African Trading Pty. Ltd.--for this sum.

The first two-week course commenced on June 6 and ended June 16. Four mechanics, three drillers, and two foremen attended. I had the opportunity to observe some of the classes, and I was very impressed with the instructional content and presentation. Mr. Ingvar Nilsson presented the course. The trainees' opinions of the course were very high.

The second course began on August 29. The trainees were four mechanics, two foremen, and two drillers. The course was identical to the first one, and the classroom training was completed on September 9.

Since Mr. Nilsson's time was shortened by four days because of previous commitments on the first course, and we still had three days contracted for his inspection, Mr. Nilsson made a suggestion to place the trainees in the field. Upon approval the trainees and trainer were mobilized to an Atlas Copco drill operating approximately 50 km outside Gaborone. The groups camped at the drill site and received practical instruction in various troubleshooting techniques as well as preventive maintenance practices. This turned out to be extremely useful. This course was taught from September 12 to September 19.

The trainees rated the course by Atlas Copco highly. It was deemed a well-presented course during which Atlas Copco made a substantial effort to fine-tune their instruction. The training aides provided were most helpful.

1.6 Execution

The hydraulic hose training program for both groups of trainees commenced on June 20 and ended on June 24th. The first group consisted of four drillers, three mechanics, and two drill foremen. The second group consisted of four mechanics, two drillers, and two drill foremen. After completion of the hydraulic hose training course, the first group of trainees resumed their regular duties at the DWA, and the second group remained for the first on-the-job training program, which began on June 27. Cleaning and disassembly of the drills then continued through August 8. Under the instruction of Mr. Brink, the drills were completely cleaned and disassembled. Most of the machines were also prepared and spray painted at this time. Hydraulic hose replacement was progressing slowly because the trainees were extremely careful and conscientious in their work. As of the 8th of August, the drills were completely disassembled. No further work could be initiated, as the parts were still on order. Mr. Brink's services were suspended until further notice. The trainees continued hose replacement and painting until August 19, when the first shipment of parts arrived. (Upon conducting an inventory of the first parts shipment, we

discovered that according to the packing lists in the crates, only 40 percent of the parts had been sent. We spend much time with IPTC settling this problem. It turned out to be a Schramm error.) Mr. Brink was recalled and component assembly commenced on August 23. The air compressor clutches were installed, and the hydraulic pump drive gear boxes were overhauled. The top drive gear boxes were also partially assembled but could not be completed due to lack of parts.

The first on-the-job training term was completed on August 26, and Group Two was released to attend the second Atlas Copco classroom course. Training Group One then continued assembly of the machines until September 12. Then they were sent to attend the Atlas Copco course with Group Two. No work was accomplished from September 12 to September 18. Mr. Brink's services were again suspended. On September 19 the hydraulic hose replacement continued with Group One, which both DWA technical staff and I supervised until October 10, when most of the parts finally arrived. Mr. Brink and his son were then summoned, and repair began on October 18. (Mr. Brink could not start earlier due to other commitments. Since the parts' arrival put this activity far behind schedule, the only hope of trying to accomplish this task within the year was to contract Brink's son, Pieter Brink, also a qualified mechanic.)

Since our contract time of four months had expired with Techmin, one negotiated a contract extension amount with Techmin for the use of the facilities as well as for the services of the two Brinks. (All costs remained the same except for the additional Pieter Brink wage of \$1,440.00 (US) a week and the living allowance which was adjusted to \$100 (US) a day to include both mechanics.) Both the trainer mechanics were employed until December 2, when Daan Brink had to return to South Africa because of other commitments. Pieter Brink remained to work on the project until December 10. Close to the completion of the repair/training program, we reviewed their invoices and amended the contract sum to an additional P 37,600.00 (US \$19,119.60). This brought the total contact sum to \$59,895.60 (US).

Repair of the machines continued six days a week, 10 to 12 hours a day. The masts of the drills were re-equipped with new pulldown cylinders, chains, jib-boom assemblies, rebuilt top drives, new sprockets, new bushings, and rebuilt table assemblies. Hydraulic pumps and motors were installed along with new hydraulic control valves and safety relief valves. The first drill was ready for field commissioning on December 3, but it could not be put in use at this time because Pieter Brink was attempting to complete the second drill by December 10. The most recent information suggests that both drills are now ready for commissioning. However, due to repairs required on the drill carriers, the equipment cannot be placed in the field until the end of January or the first week of February. Mr. Brink is standing by to commission the machines on DWA funds. Most businesses, including the DWA, do not operate from December 19 until January 9 each year. The drills are now being repaired at a Mercedes truck dealership.

1.7

Contract Award Sums

1.	Parts for two type Schramm T 685 DHH Model Drilling Rigs	\$135,000.00
2.	Mechanical training services and repair premises	59,895.60
3.	Supply of hydraulic hose crimping machinery and hoses/fittings	34,997.50
4.	Instruction services with training aids	19,958.00
	Total Award Values	\$249,851.10

1.8

Actual Expenditures

1.	Parts for two type Schramm T 685 DHH Model Drilling Rigs	\$133,029.27
2.	Mechanical training services and repair premises	59,895.60
3.	Supply of hydraulic hose crimping machinery and hoses/fittings	27,498.58
4.	Instruction services with training aids	19,958.00
	Total Program Cost	\$240,381.45
	Funds Remaining from Activity	\$9,618.55

Chapter 2

SHORT-TERM TECHNICAL ASSISTANCE

2.1 Michael Webster

The tasks within the specific activity were as follows:

2.1.1 Parts

1. Met with USAID procurement personnel on procedures to be used in activity.
2. Inspected the four drilling rigs and drafted a comprehensive parts list.
3. Submitted the parts lists to the relevant manufacturers.
4. Engaged in extensive communication with parts suppliers on proper part selection, out-dated part numbers, etc.
5. Cost evaluated part supply tenders.
6. Drafted conditions of contract for part supply contract.
7. Arranged signing of part supply contract.
8. Communicated extensively with parts supplier on late parts.
9. Ordered parts as required.
10. Helped arrange storage containers for parts.
11. Helped arrange customs clearance of parts.
12. Inventoried parts.
13. Cost certified part invoices.
14. Drafted payment authorization letters.
15. Kept USAID, DWA, WASH, and Central Tender Board informed.

2.1.2 Training

1. Drafted scope of work for Atlas Copco instructor.
2. Cost evaluated course quotation.
3. Drafted conditions of contract for Atlas Copco course.

4. Arranged signing of Atlas Copco contract.
5. Arranged Atlas Copco training courses.
6. Cost certified invoices.

2.1.3 Hydraulic Hoses

1. Inspected drills, drafted list of hose types.
2. Compiled a hydraulic hose replacement list.
3. Distributed hose/fitting list to local companies.
4. Cost evaluated quotations.
5. Drafted conditions of supply contract.
6. Arranged signing of supply contract.
7. Helped arrange electrical connection of crimping equipment.
8. Ordered hoses/fittings as required.
9. Assisted in training of crimping equipment use.
10. Did several inventories of stock.
11. Occasionally supervised hose replacement.
12. Monitored shipping of specialized fittings.
13. Cost certified final invoices.

2.1.4 On-the-Job Training

1. Held price negotiation meetings with Mr. Brink.
2. Held price negotiation meetings with Techmin.
3. Drafted training scope of work for Mr. Brink.
4. Drafted conditions of contract for Techmin.
5. Arranged signing of contract.
6. Arranged work visas for trainer.
7. Helped arrange first group of trainees.

8. Helped to set up course.
9. Arranged purchasing system for petty parts with Techmin.
10. Arranged supply of various tools/misc. parts required.
11. Held extensive meetings with Techmin on repair goals/schedules.
12. Extensively monitored expenditures on project.
13. Cost certified invoices as presented.
14. Arranged signing of contract extension.
15. Drafted payment authorization letters.
16. Kept USAID, DWA, WASH, and Central Tender Board informed.

2.1.5 Ngamiland Emergency Borehole Project

The Ngamiland project was split between Mr. Van Der Geest and me. Mr. van der Geest travelled to the selected villages and investigated the topography, road conditions, and existing hand dug wells/locations; took water samples from wells in use; estimated bedrock depths; and investigated areas where large amounts of water could be obtained for drilling. This information was passed to the siting section of the DWA, where hydrogeologists composed charts and maps of expected formations. Mr. van der Geest's information was then cross-referenced with this information and compared to some previous well logs from some boreholes in the general areas. Mr. Bergstrom and I then developed theories on expected borehole constructions and estimated yields. We then drafted a contract for bidding this work and let it for bidding. The tenders we received were cost evaluated and awarded. Mr. van der Geest then maintained liaison among the contractor, USAID, and the Department of Water Affairs.

2.1.6 Emergency Drilling Tools

1. Interviewed all key staff of DWA on most urgent tool needs.
2. Did inventory of DWA drilling tool stores.
3. Made a recommendation to procure a full set of "Fishing Tools."
4. Drafted a Fishing Tool recommended list.
5. Meetings with DWA Senior Hydrogeologist (Drilling), Borehole Drilling Superintendent, and Borehole Inspectors.
6. Researched appropriate companies who could supply tools.

7. Finalized list, submitted it to specialized tool companies in the U.S./Canada.
8. Cost evaluated quotations.
9. Helped prepare paperwork for USAID Purchase Orders.

2.1.7 Technical Assistance to the Department of Water Affairs

1. Inspected the private-sector drilling contractor equipment for use in the "Emergency Consolidated."
2. Rewrote drilling equipment questionnaires to private contractor firms on equipment capabilities.
3. Consulted on suitable areas where specific private contractor equipment would be most efficient.
4. Consulted on alternative drilling techniques with various type formations.
5. Drafted drawings to modify a Bomag mud drilling rig over to DWA standard drilling strings (API Standard).
6. Designed improvisational fishing tools for field operation.
7. Collected data on down hole geophysical logging equipment.
8. Advised on practical ways to store spare parts.
9. Assisted with repair examinations of DWA Atlas Copco drills.
10. Drafted technical specifications for supply of new drill pipe.
11. Kept track of "Emergency Consolidated" while Mr. Bergstrom was out of the country.
12. Recommended drilling changes for the Palla Road well field.
13. Completed a study of all items needed for the next fiscal year, made recommendations for needed equipment, drafted a comprehensive list, and presented same. On approval, drafted an international tender for supply of the items. Expected value of the document is approximately US \$2 million.
14. Instructed the advanced drillers course on specification of drilling equipment, equipment inspection techniques, and typical capability ratings of most standard drills.
15. Assisted the Senior Technical Officers with troubleshooting hydraulic problems on an Atlas Copco drill.

16. Advised on thread types on reusable flush joint casing.

Total Cost - Michael Webster

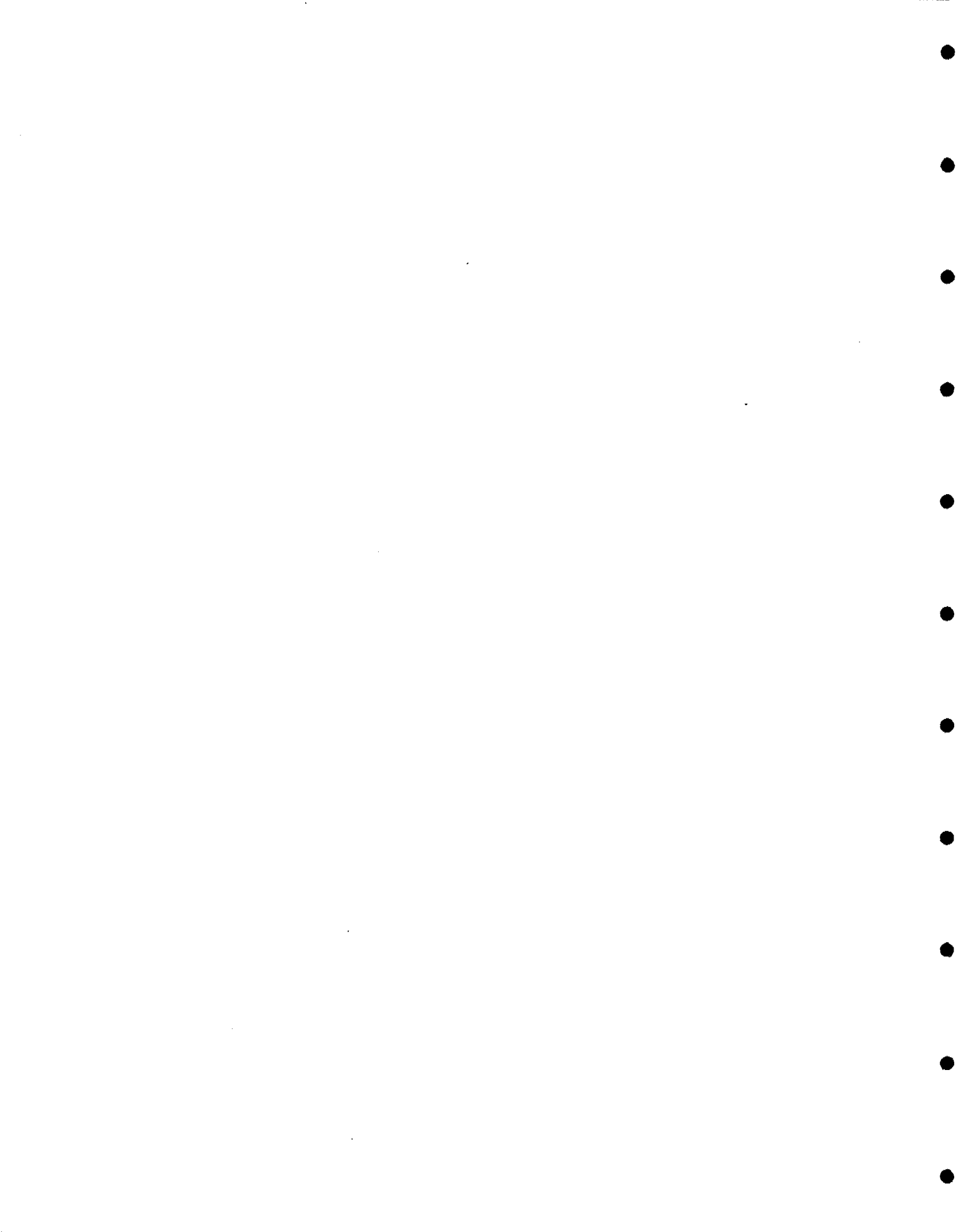
WASH Consultant from 18 March 1988
through 12 December 1988 \$65,000.00

NOTE: Due to the parts problem, my contract was extended twice. I do not have access to these figures.

2.2 Short-term Technical Assistance - Mr. van der Geest

Not in receipt of his final report at this time.

WASH Consultant from 18 March 1988
through 30 October 1988 \$40,000.00



Chapter 3

DRILLING SIX EMERGENCY BOREHOLES FOR NWDC NGAMILAND

With the information Mr. Van Der Geest gathered from a field trip to the target villages of Magopa, Dobe, Chikomicho, Tsodilo, Tamacha, and Samedupe, Mr. C. Molosiwa--DWA Hydrogeologist--prepared a detailed geological report on the Ngamiland area. We then pulled all the records on existing boreholes in the approximate area. By cross-referencing this data, we could predict the type of borehole construction method required for each village as well as their probable depths and water characteristics. Mr. Bergstrom and I then drafted a document with bidding specifications. We released the document to four local companies, and two quotations were returned. The quotations for the program were as follows:

- | | | |
|----|------------------------------|----------------------------------|
| 1. | Techmin (Botswana) Pty. Ltd. | P 184,492.00 |
| 2. | Geotest | P 127,058.00
(US \$64,608.99) |

NOTE: Techmin bid percussion type drilling method and Geotest bid for direct rotary method. We asked for either method in the document.

The TCM recommended that Geotest be awarded the work. Geotest started mobilization to Samedupe approximately the third week of July. They encountered problems on the way up and did not commence until the second week of August. Samedupe is located on the southern end of the Okavango Delta and most of the previously attempted boreholes were not usable because of the water's high saline content. It was expected that the borehole would be completed to a maximum depth of 40 meters in an unconsolidated formation requiring sand screens to be installed. The borehole was drilled to this depth, and casing and screens were installed. The borehole was then air-lifted for a number of hours to develop the formation and establish the well yield. It soon became apparent that the well was producing saline water and the personnel attempted to remove the casing and screens before abandoning the hole. However, the screens became "sand locked" (a common problem), and retrieval was not possible.

Instructions from Mr. van der Geest mobilized the drill to the next selected village of Thamacha located high on the west side of the Okavango Delta. This borehole was expected to be of the same construction as Samedupe. But the probable depth was expected to be approximately 80 meters. Drilling commenced, and according to Geotest, a promising water sand was encountered at 60 meters. Casings and screens were then set in this formation and development began. The sands were not water productive and the borehole was abandoned without retrieval of the casings and screens.

The drill was then mobilized to Chickamicho, located approximately due west from Thamacha. Heavy sands stopped the drill crew approximately 20 km from Tsodilo

and approximately 60 km from Chickamucho. The drive train of the drill was damaged, and the machine sat in need of parts until approximately mid-September, when it was repaired. Geotest then requested payment for work completed so that they could order specialized sand tracks to be fitted on the drill rig.

At that time it came to light that Geotest was having a significant cash-flow problem and was unable to procure the tracks without our payment. After we rejected several invoices because they were incorrect, a payment of approximately P 38,000.00 was authorized on the condition that the sand tracks would be ordered immediately (the sand tracks were to be custom made in America with an estimated delivery lead time of one month). On October 12, Geotest received their check. By November 3, I had not received any communication from them, so I sent a telefax requesting updated information. Geotest did not respond to the telefax, so I placed a telephone call to the managing director on November 10. He told me that the tracks had not yet been ordered, and they anticipated that this would occur in January. He also indicated he would like further payment for demobilization from Chickamucho (a site he never reached). This problem was brought to the attention of the USAID Mission and the DWA Director.

We held a meeting at the Director's office on November 28 with Geotest. Geotest informed us that they still had cash-flow problems and that the drilling rig to be used on our contract was temporarily on a different job. After a severe reprimand by the director, Geotest promised that the tracks would be ordered within the next two weeks and that recommencement would occur around the third week of January, 1989. The sand tracks have apparently now been ordered (as of Jan 16, 1989). We hope this project can now be resumed.

Chapter 4

PROVISION FOR EMERGENCY DRILLING TOOLS

The DWA was supplied with some very poorly constructed drill pipe. They have been losing many drilling tools down holes because of tool joint separation from the drill pipe. Another factor contributing to this problem was that the drill pipe was inadequate for drilling conditions. These conditions weakened the fatigue points and worsened matters. DWA accepted my recommendation to procure drill pipe specifically suited to the larger hole applications and that will meet or exceed rigid specifications. However, until this new pipe arrives sometime around August 1989, any tools lost down the boreholes will likely not be recovered because of the lack of properly designed "fishing tools."

I examined the most common kind of drill string failures and matched the appropriate fishing tools to our particular problems. The proposed list was approved and sent out for quotations. Only three companies based in the U.S. could supply most of these specialty items. Quotations were sent by the following firms:

- | | | |
|----|--------------------------------------|-------------|
| 1. | Bowen Tools (Houston, Texas) | \$27,512.00 |
| 2. | Houston Engineering (Houston, Texas) | 25,190.00 |
| 3. | Gotco International (Houston, Texas) | 25,177.35 |

NOTE: None of these companies could meet our specifications on one item--oil jars. We were informed that the only company that likely could supply us was Canadian-based Griffith Oil Tools. The oil jar prices quoted by this company were deemed reasonable, and a USAID Purchase Order was issued to Griffith Oil Tools.

- | | | |
|----|--------------------------------------------------|-------------|
| 4. | Griffith Oil Tools Ltd., supply of oil jars only | \$10,771.76 |
|----|--------------------------------------------------|-------------|

The TCM recommended the supply of "fishing tools" be awarded to Gotco International and the supply of the oil jars to Griffith Oil Tools Ltd. USAID Purchase Orders were then forwarded to these companies in mid-September. The tools were to be delivered in December 1988. (The latest information, provided on January 16, is that the oil jars had arrived, and the fishing tools were enroute.)

4.1 Total Expenditures - Fishing Tools

1.	Gotco	\$25,177.35
2.	Griffith	10,771.76
	Total Expenditure	\$35,949.11
	Funds remaining from activity	\$ 4,050.89

4.2 Summary of Project Costs

1.	Rehabilitation of drilling equipment	\$240,381.45
2.	Short-term technical assistance	65,000.00
3.	Short-term technical assistance	40,000.00
4.*	Drilling Ngamiland boreholes	95,000.00
5.	Emergency drilling tools	35,949.11
	Total Costs	\$476,330.56

* The funding for the Ngamiland Emergency Borehole drilling will probably be used in the future although delays have stopped progress at this time.

Chapter 5

EMERGENCY CONSOLIDATED BOREHOLE PROGRAM

5.1 Pump Testing

The ECBP is getting results more quickly than expected since the start of the project in June. Of the 400 boreholes anticipated to be completed for 82 villages on the emergency list, 211 boreholes have been drilled (some of these boreholes may not produce enough to warrant pump installations--approximately 90 boreholes have yet to be pump tested). Two private contractor units and six DWA units are now pump testing, with more private-sector units expected to start early in the new year. The eight units are currently testing approximately ten boreholes a week (Borehole drilling production is approximately four holes a week). The testing rate is thus diminishing the current backlog of 90 boreholes waiting to be tested, and has accounted for 150 boreholes. The DWA has produced 61.

5.2 Siting

Five villages now remain to be sited. (Originally 57 of the initial villages needed siting.) Of the additional 25 villages to be sited, only four have not been done. Out of Water Affairs' normal drilling programs for 1988/1989, 17 sites are awaiting. At present there are five consulting firms engaged in borehole siting and supervision of drilling and pump testing:

1. Wellfield Consulting Services
2. Water Resources Consultants
3. Tswana Technical and Consulting Services
4. Earth Resource Consultants
5. Hydromin

5.3 Contractors

Currently, seven contractors are engaged in the program that consists of 14 drilling rigs. No new contractors will be used as production is balanced with other activities. The private contractors have completed 150 boreholes out of the 211 constructed. The contractors engaged in the program are:

1. Ipoletse
2. De Wet
3. Pula
4. Techmin
5. T.G.B.

5.4 Expenditures

A warrant of P 5,900,00.00 (vote no. 101-342-65 PHG/301) was submitted to DWA on 17 June 1988. An additional warrant of P 4,735,000.00 (vote no. 51-101-05 PHG/301) was received on 21 July 1988. These funds were allocated for siting, test pumping, and drilling. Because work started before the warrants were received, some of the contracted works were paid out of normal operating monies, which are not reflected here. The total expenditures up to 15 November 1988 are as follows:

Drilling	P 2, 049,676.70
Siting/supervision	823,965.62
Test Pumping	32,258.50
Subtotal	P 2,905,900.72
Equipment (spare parts, etc.)	P 143,988.24
Total	P 3,049,888.96
Unspent Balance	
Vote No. 101-342-65 PHG/301	P 3,628,398.07
Vote No. 51-101-05 PHG/301	4,614,063.14
Total Remaining	P 8,242,461.21

Note: Some of the money that is now out for international tender will be used to procure much-needed drilling accessories. This amount may reach P 4,000,000.00. Geophysical equipment will also be purchased at an estimated cost of P 400,00.00.

Chapter 6

RECOMMENDATIONS

It is expected that many producing boreholes could be drilled in water-bearing sandstones located deep beneath a Basalt formation. Boreholes have been sunk to depths of over 500 meters and have not penetrated this Basalt rock. The problem is the high cost of this exploratory drilling. If the private sector ever grows to where it could service the drilling requirements of the country, very few people would risk drilling boreholes to these extreme depths without knowing where producing zones might be found. Since there would be no demand for these expensive risks, no contractors would want to spend large amounts of capital to purchase equipment capable of obtaining deep depths. But this could leave potential water resources untapped and thereby limit economic development. If the government invested in equipment capable of this exploration, costs could be lowered by drilling small-diameter test holes that would increase hammer performances and penetration rates. The machine could be equipped with dual-wall drill pipe for continuous uncontaminated chip sampling, which would also help geophysical charting. This information could be vital in the long-range planning of Botswana's communities and industries.

- We recommend that the Government consider this proposal. Expected pullback specifications to reach depths in excess of 600 meters is 75,000 lbs.

The quality of some of the borehole contractors leaves much to be desired. Since there is no ground water control legislation specifically dealing with borehole construction methods and materials, contractors are installing the lowest-cost materials, such as borehole surface casings with wall diameters so thin you could collapse the pipe by simply stepping on it. Also I have seen no evidence of surface casing groupings (of which hard and expensive lessons were learned in the western nations) which may allow aquifer contamination by surface agents running down the casings. In my opinion, some personnel who drill the boreholes are not qualified to do so. Botswana's water resources are scarce. Protective measures must be adopted soon.

- We recommend that the Government legislate reasonable borehole construction method laws, minimum material standards, and a qualification apprenticeship of drillers--preferably with the cooperation of an advisory board from the drilling industry. A Government borehole inspector should be trained to inspect boreholes after the act is in place, and penalties must be severe enough to deter poor construction practices.

With nine months of experience gained at the DWA, a number of highly trained and competent personnel have been lured from the Government posts to the higher-paying private sector. The DWA cannot improve its performance in production or efficiency should this continue. Thousands of Pulas are spent educating and training these people, and when they become knowledgeable in their fields, they

leave the DWA. I do not envision localization of higher technical trades if this trend continues.

- We recommend the Government find ways to keep these employees.

Other topics addressed include providing performance bonuses for drill crews, supplying meals at drill sites, and increasing wages in order to increase morale and borehole production.

APPENDIX B

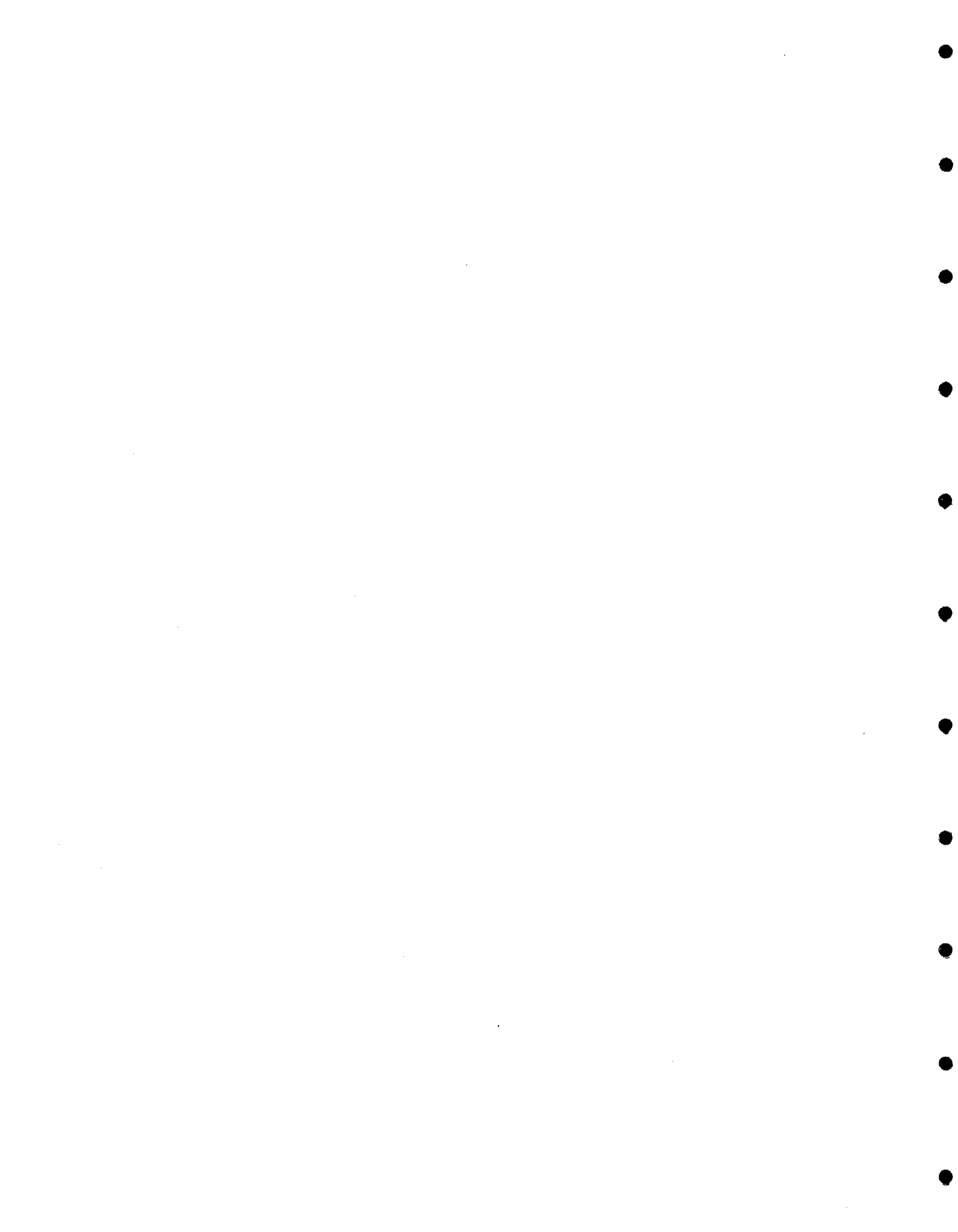
Final Report

Period: April 1988 - September 1988

by

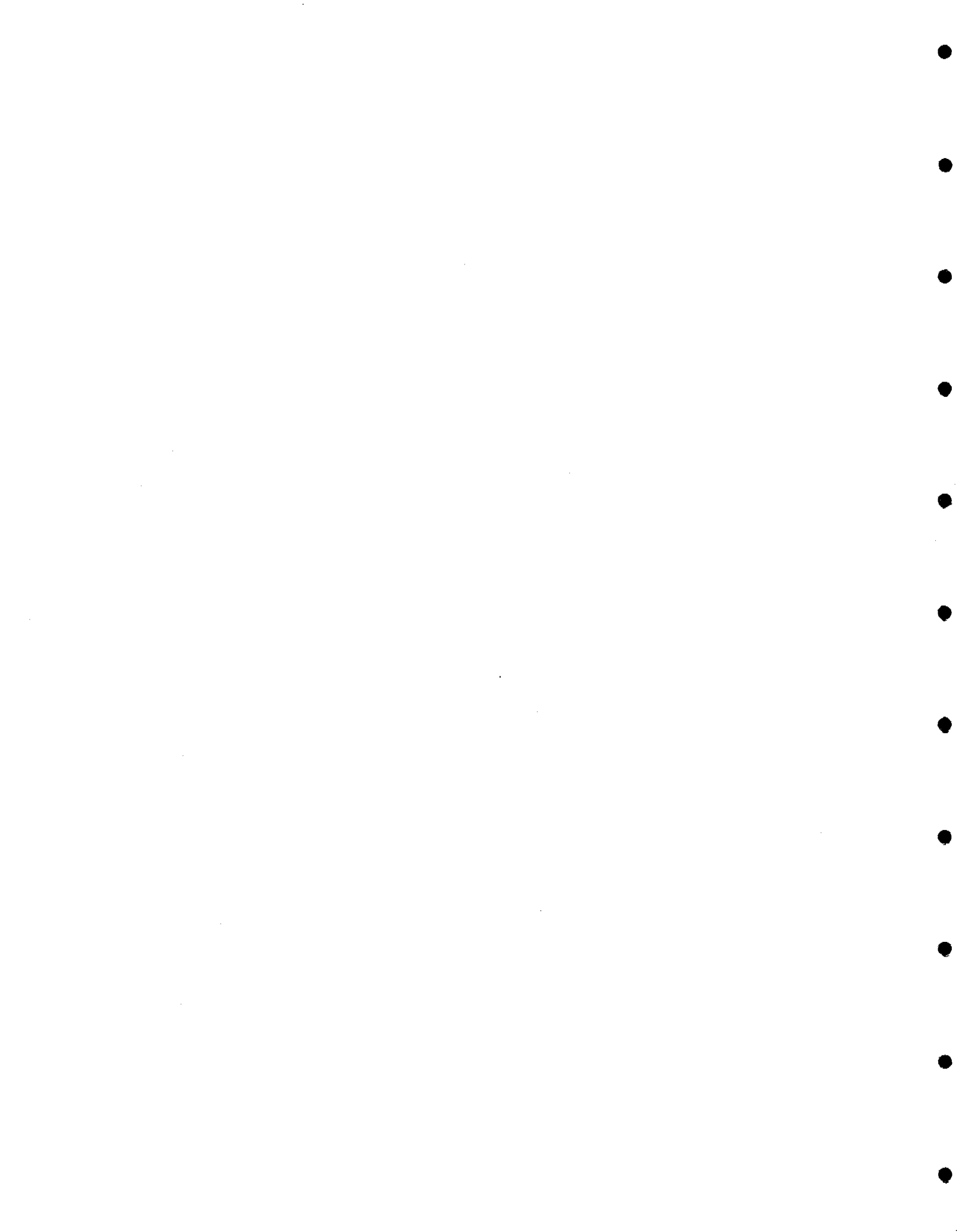
Fred van der Geest

29 December 1988



CONTENTS

CHAPTER	PAGE
ACRONYMS	53
1. BACKGROUND	55
1.1 Project Background	55
1.2 Key Objectives	55
1.3 Scope of Work	55
1.4 Department of Water Affairs, District Councils, Ministry of Local Government and Lands	56
2. ACCOMPLISHMENTS	57
2.1 Short-term Results	57
2.1.1 Six Boreholes North West District Council	57
2.1.2 Trouble Shooting	57
2.2 Midterm Results	58
2.2.1 Training	58
2.2.2 Emergency Drilling	58
2.2.3 Training of Technical Officer on Data Gathering	59
2.2.4 Familiarization of Water Maintenance Departments	59
2.2.5 SIDA Evaluations	59
2.2.6 Seminars	59
2.3 Long-term Results	60
2.3.1 Manpower Planning	60
2.3.2 Instruction Manual	60
2.3.3 Design Manual for Village Water Supply	60
2.3.4 Seminars	60
2.3.5 Training Development	61
3. CONCLUSIONS	63
APPENDICES	
B-1 Report on Field Trip to Northeast District	65
B-2 Water Supply Inspection Report	77
B-3 Consolidated Emergency Village Water Programme	83
B-4 District Council Positions	89



ACRONYMS

ABM	Assistant Borehole Mechanic
APF/PF	Assistant Pipefitter/Pipefitter
BO	Borehole operator
CTO	Chief Technical Officer (Higher National Diploma Water Engineering)
DC	District Council
DWA	Department of Water Affairs
GOB	Government of Botswana
MLGL	Ministry of Local Government and Lands
NEDC	North East District Council
NWDC	North West District Council
SIDA	Swedish International Development Authority
SO	Senior Operator
STA	Senior Technical Assistant
STO	Senior Technical Officer
TA	Technical Assistant (City & Guilds)
TO	Technical Officer (National Diploma Water Engineering)
ULGS	Unified Local Government Services
USAID	U.S. Agency for International Development (overseas mission)
WASH	Water and Sanitation for Health project



Chapter 1

BACKGROUND

1.1 Project Background

In December 1987 a post for Assistant Water Engineer was created for the Ministry of Local Government and Lands (MLGL) in Botswana. Originally the Swedish International Development Authority (SIDA) was asked to recruit for this position. But because of a serious housing shortage, all recruitments for SIDA Gaborone were delayed until March of 1989. However, because the drought was very intense in December 1987, MLGL successfully appealed to USAID to organize technical assistance to the Government of Botswana (GOB). This assistance originates from ACT 429 by R. Preble and J. Hodgkin.

1.2 Key Objectives

During the briefing session held in Washington during March of 1988, the participants agreed that it was necessary to:

- visit and assess water conditions in 57 villages, and write reports detailing observations.
- prioritize villages, and recommend solutions to their water needs.
- assist the GOB in developing a program for drilling and other solutions to the low water supply.
- attempt to leverage other resources (funds, organizations, equipment, etc.) to solve drought problems.

This was based on Appendix Q of WASH Field Report No. 229.

Due to the urgency of the situation, the GOB had already attended to the first two items; therefore, the statement of work (SOW) changed so drastically that my role became one of "civil servant," implementing mainly what others recommended. I found myself in a direct in-line position as the Assistant Water Engineer. As a result, a new SOW was drawn up, discussed, and agreed upon with USAID Mission and the GOB.

1.3 Scope of Work

- Follow-up on the six villages in NWDC that will get boreholes, and, if necessary, visit them again.
- Revise instruction manual for District Council Water Units.

- Prepare and partly conduct a seminar for the Heads of District Council Water Units.
- Investigate North East District Village water supplies.
- Design a data storage system for all water supplies under the District Councils.
- Write terms of reference for the investigations of the remaining districts.
- Organize a map showing all rural village water supplies now under MLGL.
- Act as Water Engineer during absence of Mr. C. Lindblom.

1.4 Department of Water Affairs, District Councils, Ministry of Local Government and Lands

To understand the context of this report, it is important to be aware of the task divisions among the different ministries. Reference is made to the report of J. Hodgkin, pages 27 and 29:

"The Rural Village Water Supplies (population 200-5,000) are built by DWA. Operation and maintenance of the water supplies fall under the District Councils, and the DCs fall under MLGL. Coordination and advice are the main courses on the menu."

Chapter 2

ACCOMPLISHMENTS

The assistance provided can be divided into three categories:

- A. Short term
- B. Middle term
- C. Long term

Thus, attention would gradually be shifted from short-term to midterm assistance and then from mid- to long-term assistance.

2.1 Short-term Results

2.1.1 Six Boreholes--North West District Council

Reference is made to the report on ACT 429 by J. Hodgkin and R. Preble. Because of the immediate workload of M. Webster, I was asked to assist in this task.

Initially, two boreholes were drilled, but both were unsuccessful: one was drilled in Samedupe and struck salty water and another was drilled in Tamacha that turned out to be dry. On the way to Tsodilo the rig got stuck, and the drilling company realized that sandtracks were necessary to continue. Due to financial problems and unforeseen delays, the tracks have not yet arrived. Therefore, the final report on this will be prepared and sent separately to USAID Botswana after all drilling has been completed. The estimated average number of beneficiaries is 200 per village.

2.1.2 Trouble Shooting

It had been known for some time that the North East District Council had major problems organizing the maintenance of village water supplies. A visit in May 1988 resulted in advice which is detailed in a report (see Appendix B-1, pages 1-9). This report was discussed with all District Council officers involved and resulted in a number of measures to alleviate the problems. Many problems were solved with the assistance of DWA because of the availability of detailed information that had been collected. (See Appendix B-2.)

Furthermore, there have been many problems in the districts for which Headquarters provided sufficient action to avoid or alleviate health hazards created by collapsed boreholes, broken down equipment, etc. (e.g., fund distribution, waiver of tender, coordination of cooperation between DWA, District Councils (DCs), and suppliers).

2.2 Midterm Results

2.2.1 Training

Job Categories

BO	Borehole Operator
APF/PF	Assistant Pipefitter/Pipefitter
ABM	Assistant Borehole Mechanic
SO	Senior Operator
TA	Technical Assistant (City & Guilds)
STA	Senior Technical Assistant
TO	Technical Officer (National Diploma Water Engineering)
STO	Senior Technical Officer
CTO	Chief Technical Officer (Higher National Diploma Water Engineering).

As recommended by a needs analysis in 1987, an overall program was established complete with course contents designed by a Swedish training consultant. Funds were secured via SIDA, and the first courses (1,4,5 & 10) were held in November and December of 1988.

The course contents are based mainly on the Instruction Manual that has been continually updated since my arrival. The needs analysis had shown a poor overall efficiency in the water departments, mainly because there was a lack of proper supervision. The overall efficiency of the Borehole Operators has been estimated to be as low as 40 percent. By increasing efficiency, the staff will perform their jobs more effectively, including supervision.

The entire training exercise stressed that the Borehole Operator should delegate all small jobs which require only a few spares or tools and little knowledge. The training also stresses that the Borehole Operator is in charge of the day-to-day operation of the entire scheme, including tanks, standpipes, soakaways, and valve chambers. He is, in effect, a village water supply operator. Obviously, the Borehole Operator cannot perform the entire job alone. The whole staff, ranging from Assistant Borehole Mechanic to Chief Technical Officer, should realize the importance of proper supervision and efficient distribution of spares and tools.

2.2.2 Emergency Drilling

A progress report, dated 25 January 1989 (Consolidated Emergency Water Supply Program = 57 + 25 additional villages), from DWA, is included in Appendix B-3. Reference is made to J. Hodgkin, page 24, point 3.4. During the last eight months, MLGL's role was restricted to processing queries from the DC regarding progress. The process of identification and prioritizing, which also falls under the MLGL Water Engineer, was already finalized.

2.2.3 Training of Technical Officer on Data Gathering

As it has proven useful in the North East District Council to collect detailed information about village water supplies (see 2.1.2), efforts were made to teach and guide the officers in charge of the other water maintenance units to collect the necessary data themselves.

At present 40 percent of this data has been collected with an estimated 60 to 80 percent quality. Based on this information, a project memorandum for rehabilitation, extensions, and augmentation will be drawn up within a year. This should result in a reliable, tailor-made water supply for each rural village in Botswana within four to eight years (see Appendix B-2).

The officers in charge will have gained the experience and confidence needed to maintain the same level of service to the community after the exercise is over.

2.2.4 Familiarization of Water Maintenance Departments

During visits to the water departments for TO training (see 2.2.3), time is devoted to becoming familiar with the entire organization: the workshops, storerooms, offices, etc. The aim is not only to become familiar with the units themselves, but also to give advice on how to improve performance according to the guidelines set forth in the Instruction Manual (see 2.3.2) and to adjust the manual where necessary.

2.2.5 SIDA Evaluation

The Swedish International Development Authority is the main donor and assistant in developing the rural water sector in Botswana. Their involvement dates from to 1971. Reference is made to J. Hodgkin, page 30, point 4.2.1.

SIDA procedures require evaluations every year and an in-depth investigation on progress every fourth year. This year, MLGL was involved in the in-depth investigation of two of the programs: District Development Support and Rural Village Water Supplies. Both projects, through the assistance they offer, have a major impact on the development of new approaches.

2.2.6 Seminars

Twice a year seminars are organized for all District Council Heads of Water Departments and Units. These gatherings are mainly designed to brief Council Heads on developments in training, instruction manuals, the availability of funds, and the current status of evaluations. These seminars also give suppliers, technology specialists, the DWA, alternative technology promoters, and manufacturers the opportunity to present their ideas and products. The Heads of Water Departments/Units give an indication of how work is faring in the districts by presenting and discussing progress reports. The approach for these progress reports is now being reviewed to bring back the "constructive element," which has slowly disappeared from them.

2.3 Long-term Results

2.3.1 Manpower Planning

Another department under MLGL, the Unified Local Government Services (ULGS), is responsible for the training, recruitment, and transfer of District personnel. The MLGL Water Engineer provides technical advice that is necessary to make decisions about whom to send abroad for further studies and when to ask aid organizations for assistance to secure a smooth transition to a full-fledged water department.

Because at any given time 33 percent of the personnel is attending long-term training courses, it takes a long time to bring together the necessary personnel. If all estimates for April 1989 to March 1990 are approved, from the 38 senior positions in the District councils, there will be 16 vacancies. (See Appendix B-4.)

In different studies a progressive shift of responsibility for village water supplies from Department of Water Affairs toward District Councils is advocated. This has implications for future manpower requirements.

2.3.2 Instruction Manual

This manual contains a set of guidelines on how to organize and structure management and reporting in the water units. It serves as a source of information for both new and established TOs. The book is based on the practical experience of two expatriate TOs, and it was thoroughly discussed during one of the seminars. At present, senior administrative officers are reading it, and after they discuss the manual with District Council Secretaries, it will be printed.

2.3.3 Design Manual for Rural Village Water Supply

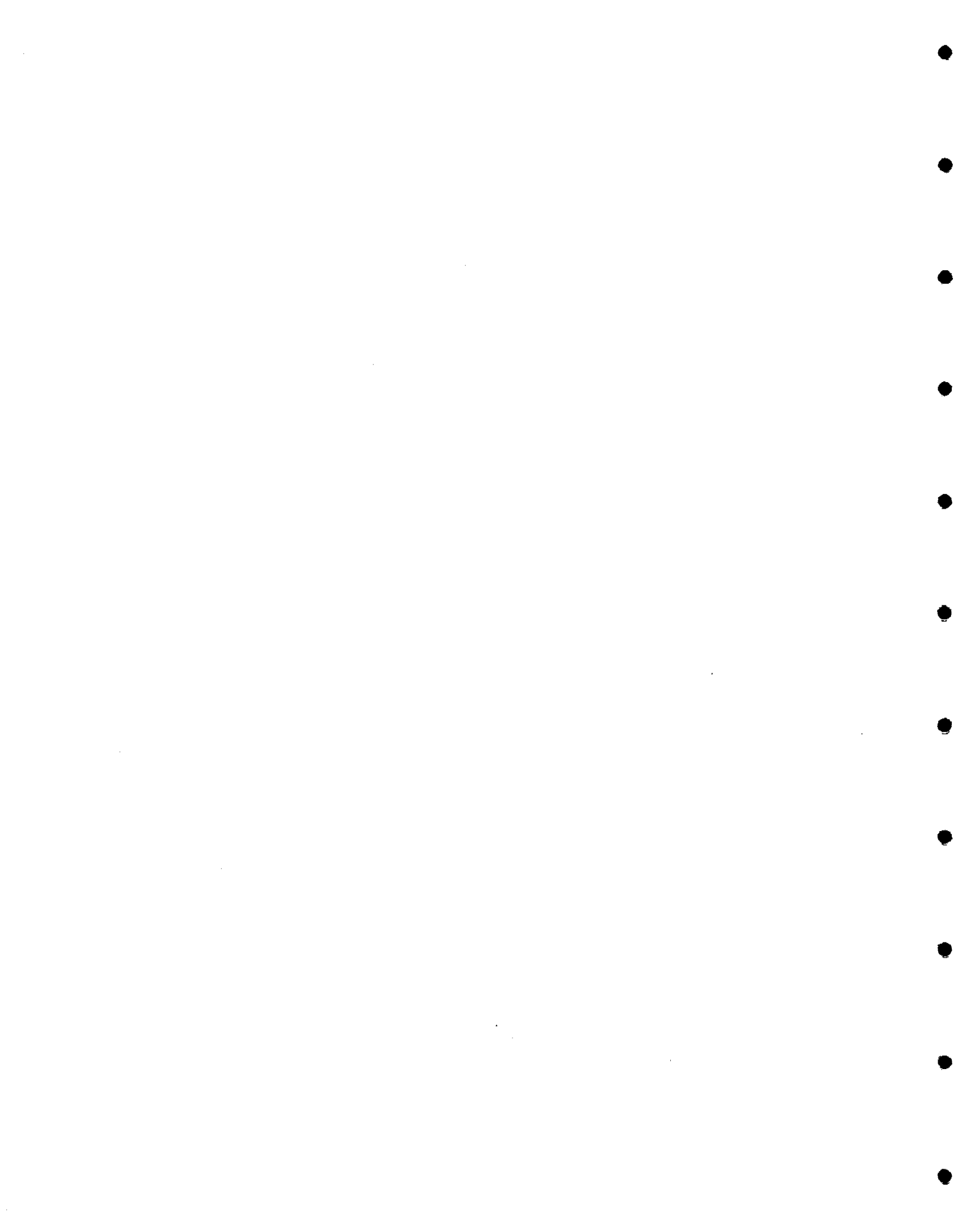
DWA is preparing this document, which standardizes the construction and design of rural village water supplies to provide clarity and consistency. The manual standardizes the design criteria and technical requirements of transmission and distribution pipelines, storage tanks, and borehole installations. It lists the documents required and the procedures to follow, and it shows how to estimate construction costs.

2.3.4 Seminars

Twice a year, seminars are held for the 15 District Council Heads of Water Units and Departments and their counterparts. These seminars provide reports on how the officers are progressing and information on future training needs.

2.3.5 Training Development

In studies done in 1987, recommendations were made to establish a Water Industry Training Unit, which would be responsible for monitoring, rationalizing, and coordinating the training for all water and sanitation sections. Until this unit is developed, it would be ideal to have a full-time trainer for the District Councils who would work in close cooperation with the existing DWA training section.



Chapter 3

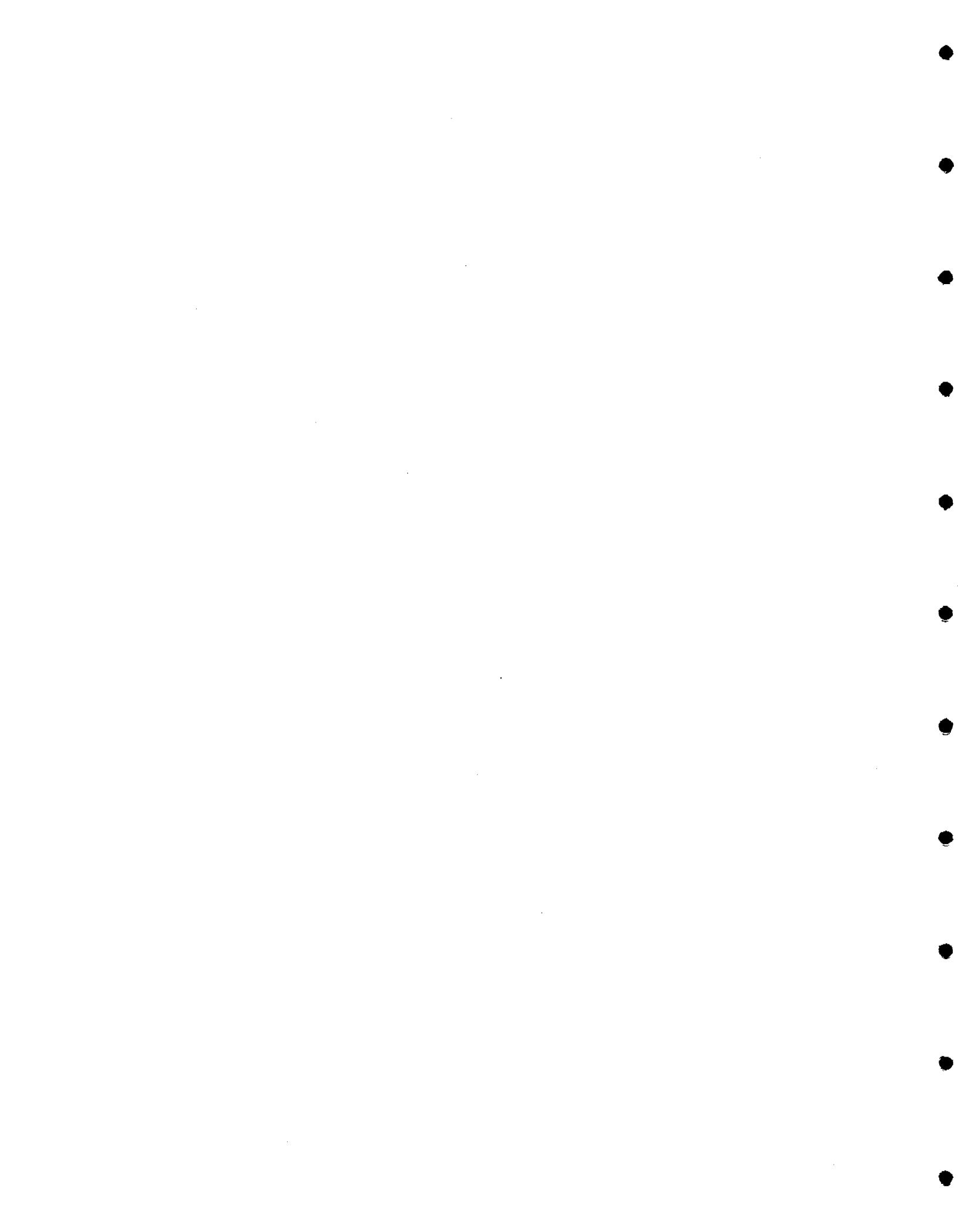
CONCLUSIONS

Since 1971, remarkably good and ever-improving water services have been provided to the people in the rural villages. Equally remarkable is that these services are still regarded as "a gift from heaven" by the consumers and not yet as a right. For unknown reasons, consumers generally do not complain easily about a defaulting system, although in many cases complaints would be justified. One reason for this could be that villagers participate very little in the procedures that are part of providing water, from the design up to the operation. The main conclusion reached in the field of operation and maintenance of rural village water supplies is that there remains a long way to go before an efficient system is established in each district.

The water departments still play a role in the District Councils because of influential foreign support, but they do not stand alone. Many of their problems originate within other supporting departments.

Some of these problems are misplaced invoices, ineffective communication undefined organizational structures, shortage of personnel, low-quality personnel, unnecessary adherence to time- and money-consuming routines, and lack of planning. A water department cannot survive without supporting departments such as procurement, transportation, treasury, and personnel. To overcome these problems will take much initiative, determination, tact, training, and above all, sufficient qualified personnel.

A major recommendation is to recruit and train sufficient technical management candidates.



Appendix B-1

Report on Field Trip to North East District
5 May 1988 - 20 May 1988

Fred van der Geest
Private Bag 0067
Gaborone

To: The Permanent Secretary
Ministry of Local Government and Lands
Private Bag 006
Gaborone

25 May 1988

Purpose:

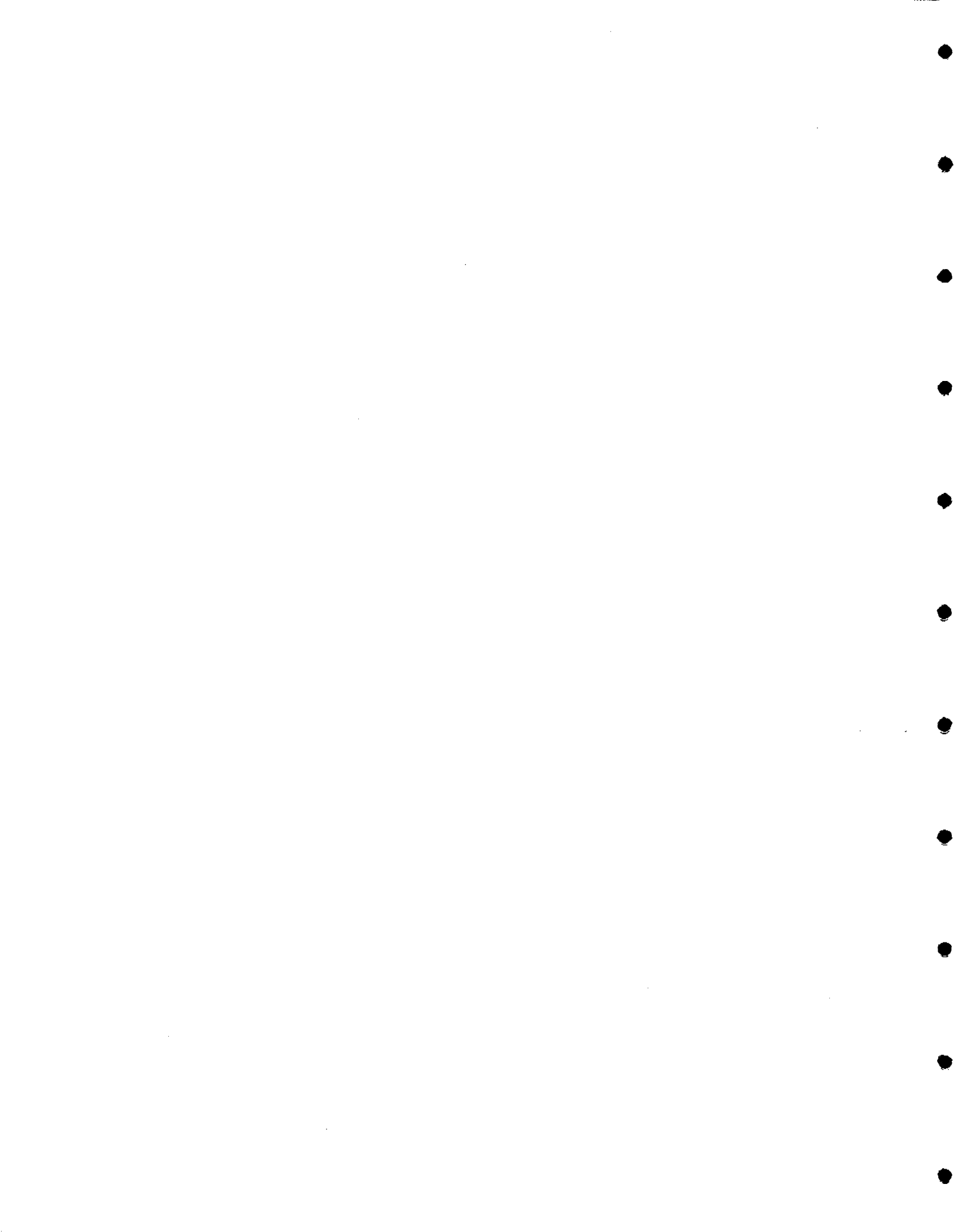
Last year, MLGL, DWA, and SIDA recognized and expressed the need to scrutinize all Rural Village Water Supplies in Botswana to judge progress and plan for the future.

SIDA has earmarked funds for this exercise, which is to be performed by consultant engineers. NEDC was chosen as a pilot project in order to gain the experience necessary to write the Terms of Reference for this study. The findings are to be sent only to DWA (SWED), MLGL, and NEDC. Where possible, the council leader of a particular village was contacted and informed about the present situation. All expressed concern.

Besides the situation in each village, both MLGL and the Council Secretary of NEDC wanted to get a clear picture of what is needed to improve the Water Unit performance. This report is made especially to meet that request. Reference is made to the recently developed Instruction Manual for Council Water Maintenance Units. It provides more details about the issues discussed in this report.

On 20 May 1988, the rough contents of this report were discussed with the Deputy Council Secretary, Mr. Temane; Chief Technical Officer, Mr. Morobane; Senior Technical Officer, Mr. Motswakhumo; and Technical Water Officer, Mr. Mmusi. It was stressed that to guide ongoing developments MLGL should continue to carefully and regularly monitor the situation. I would like to thank them for their kind cooperation.

cc: DWA - Senior Water Engineer Design
- Water Engineer Design - North
MLGL - Council Secretary
- Water Engineer
NEDC - Chief Technical Officer
- Senior Technical Officer
- Council Architect
- Physical Planner
USAID - Botswana Mission
WASH - Operation Center - USA



Report
Water Unit NEDC

Maintenance

It should be fully understood that once a water supply situation is created, it should be maintained. After receiving a scheme from DWA, the Council is responsible for adjusting the borehole equipment, the number of standpipes, and the storage capacity to the developing needs of that village.

Too-severe adjustments and/or inappropriate designs should be identified immediately and reported to the DWA. At present, the situation in a village deteriorates quickly.

Manpower

According to the recommended standards, typical workload at NEDC-Water Unit requires the following workforce:

- 1 Senior Technical Officer
- 1 Technical Officer
- 1 Senior Technical Assistant
- 1 Senior Operator
- 4 Technical Assistants
- 20-25 Laborers
- 39 Pump Operators
- 39 Relief Operators
- 1 Messenger/Cleaner
- 1 Storeman/clerk
- 1 Bricklayer

At present there are:

- 1 Technical Officer
- 1 Technical Assistant
- 1 Senior Operator
- 6 Laborers
- 39 Pump Operators
- 1 Messenger/Cleaner
- 1 Storeman/Clerk

Clearly, more personnel are needed to perform the job effectively.

I also found that, in five of six cases, laborers were employed as relief operators. By working in two jobs these employees are, in essence, working 365 days per year, which is against Botswana law. Many of these employees have many accumulated leave days as a result.

The best way to circumvent this problem would be to prepare a document explaining the situation. Then, each time a pump operator requests leave, explain the situation to him/her, and consult the Kgosi and the Village Development Committee Chairman to identify suitable candidates for the job.

The responsible officers in NEDC are fully aware of the manpower constraints at the Water Unit, and the first steps are being made toward a solution. Provisions have been made for 39 Relief Operators, six Laborers, one Technical Assistant, and one Senior Technical Officer. Supplementary estimates should be prepared to obtain funds for the remaining vacancies.

The overall level of maintenance is poor. Solving this problem will require much initiative, determination, investment, and temporary assistance. Some temporary measures would include obtaining

1. a Senior Technical Officer, recruited from the UK for three years
2. drought relief funds that provide for casual labor, tools, and vehicles
3. LG56 funds to develop the Water Unit into a full-fledged unit
4. people from other departments who are temporarily without work, such as plumbers or bricklayers.

Even the DWA task to develop the first scheme should be viewed as a temporary measure.

Workshop and Office

The Ministry of Finance and Development Planning has applied for funds to erect a completely new Water Unit at Masunga. The required space should be at least 3000 m³. The Council Architect, NEDC, will maintain close contact with MLGL and the Water Unit to find the most appropriate site. Thought should be given to keeping the old Water Unit in Francistown as a sub-depot for the southern part of the district. Both Water Unit and sub-depot should then have their telephones connected. More importantly, there should be a connection to the power mains for the workshop equipment.

Diesel Delivery

The Instruction Manual describes the different methods of diesel delivery and the capability of each of them to improve the performance by and control of the pumpers. It is important to have regular controls and reports on the overall performance of both the machinery and the workforce. A total of 5000 ltr of diesel/month is a reasonable amount in North East District.

Votes

It is noticed that most of the available funds were underutilized in past years. Yet the need is still growing. Only a crystal-clear financial situation can show a justification to increase the different votes used. This can be obtained by keeping Commitment Ledgers as per 1 April 1988.

Store

The store is almost empty: it is recommended that a six-month stock of each item be purchased. But standards should be implemented first. For example, for each four engines in the field, one standby unit should always be available. Most engines used are TS 2, LT 1, and ST 1. Gradually replace the other types by one of the chosen STD types, and only take spares for those chosen.

Transport

The transport situation is still reasonable, except for the burned-down landcruiser. However, with the increase in manpower, there will be a need for more vehicles, and they should be provided.

Water Department

Although wished for by many, it was considered too early to consider establishing a separate Water Department--one that would be independent of Works. However, if development is not encouraged, it might be necessary to establish the Water Department as a separate entity.

General Observations

- Pumpers and laborers are entitled to two pairs of overalls and one pair of boots each year.
- Council employees throughout the District should have private connections.
- Monthly meetings should be held between Technical Officers Water, Technical Officers Works, and between Technical Officers Water and Technical Assistants. Minutes should be kept.
- The exercise of static water level, drawdown, and yield should be repeated in September/October to determine the long-term quality of the borehole.

Fred van der Geest
WASH Consultant
Private Bag 0067
Gaborone

To: Permanent Secretary
Ministry of Local Government and Lands
Attn: Water Engineer
Private Bag 006
Gaborone

Gaborone, 17 June 1988

Report
on Field Trip
Rural Village Water Supplies
North East District

Reference is made to my letter of 25 May 1988. Hereby I send you the promised report per village water supply in NED.

General Observations and Conclusions

- In many villages, the summer water demand was double the normal demand.
- The lack of maintenance and inevitable adjustments in design criteria and designs are the cause of a tremendous range of quality levels in the different village water supplies. Villages that have been attended by the program and considered complete often require additional attention. The NEDC has a long way to go before a satisfactory maintenance situation is created.

As part of the water supply schemes, I have, as requested by the Council Secretary, drafted priority lists. These should enable council to compile/review their total long-term planning for both NEDC and DWA activities. Field reports per village are sent only to MLGL; DWA and NEDC go to Water.

Boreholes

Fifteen boreholes were found which might still be used if they prove suitable in yield and quality. At present, Makaleng/Matenge, Nlapkwane, and Siviya from the existing RVWS schemes are in immediate need of exploration for new water sources. Ranked in priority by the Consultant, they are: Ramokhwebana, Jackalais I, Mapoka, Sechele, and Gambule.

Since DWA Borehole Testing Units are fully occupied, it is advisable to seek assistance from the private sector to testpump these boreholes. At present only Techmin and TGB are known to clean boreholes in a professional manner.

Complete list of boreholes to be tested:

1. Sechele: 69
- 2/3. Remokgwebana: 3728 and 2nd spare
4. Mapoka: Borehole near school
5. Kalakamate: 2167
- 6/7. Jackalasi I: 3249 and 3726
8. Gambule: Council Borehole 2159
9. Moroka: Former roads and cattle Borehole
10. Zwenshambe: Former roads Borehole
- 11/13. Masunga: 3459/301/4858
- 14/15. Themashange: 332/3315
16. Butale: Former council Borehole
17. Masingwaneng: 2114

The priority list for reinstalling/re-equipping, again, according to the Consultant, is:

1. Themashange (NE)
2. Mapoka (2x) (DWA)
3. Makaleng (DWA)
4. Ditladi (DWA)
5. Jackalasi II (DWA)
6. Gulubane (NE)
7. Kalekamate (NE)
8. Tsamay (NE)
9. Sekakengwe
10. Mbalambe (DWA)
11. Gambule (DWA)
12. Sechele (DWA)

Botalaothe, Toteng, Modo, Mowane, Mabudzane, Gungwe, Magazin, and Themane are villages or wards that originally belonged (at least in the population census 1981) to villages already attended by DWA. These areas are not yet served by DWA even though they are fairly large settlements. At the moment they are served by a bowser delivery. Gungwe, Mowane, and Mabudzane might simply need a well with handpump. Themane and Magazin were not visited because of time constraints. Modo could be connected to immigration boreholes. The situations in Botalaothe and Toteng remain problems that need to be solved.

At least twice a year, water samples should be taken by the District Medical Health Team to monitor gradually increasing pollution. Normally the Water Unit provides transport.

Storage Tanks

Many Lipptanks await connection to the water supply systems. Why delay? On the priority list they are being treated as already connected.

According to Pythagoras ($\pi R^2 \times H$) the volumes of the former standard Hanoya tanks were not 25 and 45 but 18 and 38 m³. The minimum storage capacity is defined 1-1/4 times daily demand. An estimated 250 m³ is still needed to cover the minimum needs of the villages in NED.

The priority list for increasing storage capacities according to observations of the consultant:

1. Themashanga
2. Matshelegabedi
3. Tshesebe
4. Matsiloje
5. Moroka
6. Ramokgwebana
7. Kalekamate
8. Sekakangwe
9. Masunga
10. Senyawo
11. Nlapkwane

This is the priority list for maintenance of the existing water storage tanks, according to the consultant's observations:

1. Jackalas II
2. Tsamaya
3. Jackalasi I
4. Themashanga
5. Moroka
6. Matselegabedi
7. Nlapkwane
8. Senyawo
9. Ditladi
10. Matsiloje
11. Tsesebe
12. Butale

Standpipes and Extensions

In total, there are over 200 standpipes: approximately 70 need immediate reconstruction, and about 140 do not yet have a soakaway. Very few were fenced. Because of the scattered nature of the villages in NEDC, the aim to reach groups of more than 100 people with a standpipe within 400m average walking distance, is difficult to meet. However, it is necessary to monitor these expansions to get a clear technical picture of the situation near new clusters of households.

More than 50 new standpipes need to be constructed. A total of 50 km pipeline is needed to connect those standpipes and other structures, such as Lipptanks and seemingly abandoned boreholes. Council should use wire in-stock to fence the standpipes (12,000m).

To avoid health hazards the pumpers should be instructed to clean out the soakaways regularly. Currently the pumpers do not have the most basic necessities for cleaning and upkeep such as soap, a broom, some tools, a spade, taps, V-belts, and most importantly, supervision!

This priority list for extensions according to the consultant:

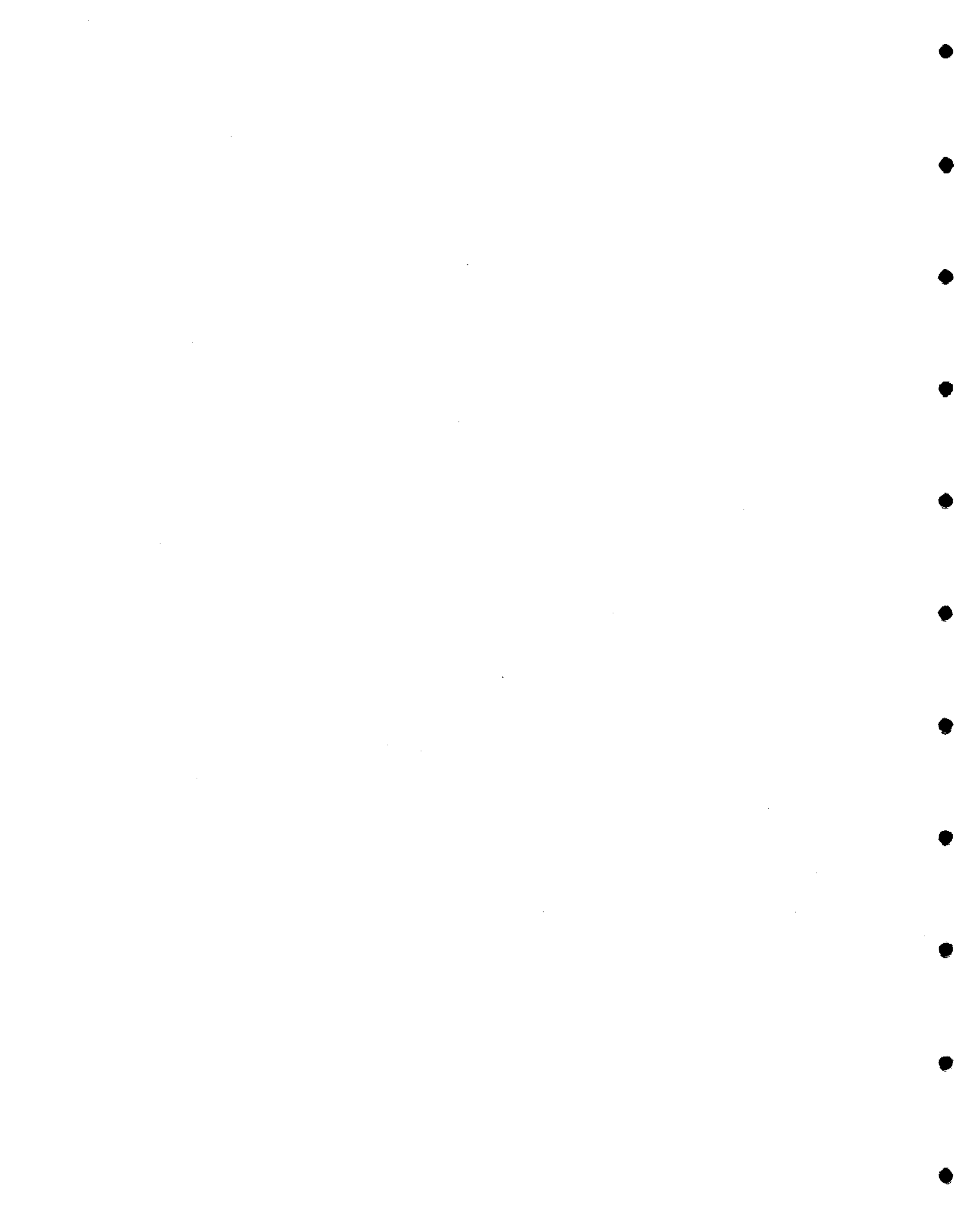
1.	Tati Siding	over 6000m
2.	Siviya	over 5200m
3.	Themashanga	over 3000m
4.	Tshesebe	2800m
5.	Tsamaya	3900m
6.	Mapoka	3800m
7.	Kalekamata	1800m
8.	Sekakangwe	2200m
9.	Nlapkwane	1900m
10.	Mosojane	2000m
11.	Jackalasi I	2400m
12.	Senyawwe	1500m
13.	Matselegabedi	over 1000m
14.	Masunga	800m
15.	Jackalas II	800m
16.	Butale	1800m
17.	Moroka	300m
18.	Gulubane DWA	2200m
19.	Ditladi DWA	800m
20.	Gambule DWA	1000m
21.	Sechele DWA	over 1300m
22.	Modo	1300m
23.	Ramokgwebana	1700m
	Total	over 50,000m

Private Connections

Council and Government officials are entitled to private connections to their houses. Only where there are adequate boreholes can Council accept additional ones. Since there is a tremendous maintenance backlog, it is advised to concentrate on reducing that backlog and to discontinue private connections for a while.

cc: DWA - SWED
DWA - WED-North
NEDC - Council Secretary
NEDC - TOW and CTO
NEDC - CFDA Coordinator

Encl: Field reports per village



Water Supply Inspection Report

Village: Gambule (Sub)District: NEDC
 Date: 14-5-88 Time: 17.00 hrs Inspector: F. vd Geest

GENERAL

Pop Census '81: 687 Year of First Compl: Not yet
 Est Pop Now: 800 Date of Hand-over: Not yet
 Pop Census Design: Not yet Design Demand: ?
 Actual Demand: 9 m³/day
 Infra Structure: Health Post, Prim. School (252 p)

BOREHOLE

Official Number: 2159 Pump Element: About 1.5"
 Date Borehole Drilled: Before '78 Pump Speed: ?
 Tested Yield: ? No. Columns, Size: 12 x 3"
 Borehole Depth: ? Discharge Head: D12
 Casing diam: ? Pressure Gauge: No
 Static Water Level: No access Water Quality: ?
 Design Pump Rate: ? Date Sample Taken: ?
 Pump Rate (m³/hr): 2.6 m³/hr Demand Covered: Probably
 Draw Down: ? Extra Borehole Needed: Maybe ?
 Est Yield: ? Level Indicator: No

Comments: might be used for RVWS, to be testpumped first.

TANKS

Types: Corrugated iron Liner: No
 Cover: OK Level Indicator: No
 Stand: No Date of Last Compl: ?
 Sizes: 9 m³, on floor
 Condition: ?

RETICULATION

Sizes Used: Not yet there SP Condition:
 Total Length: Soakaways:
 Leaks: SP Fenced:
 No. PC: Valve Condition:
 Water marks: Date of Last Compl:
 No. SP:
 Extensions Needed:

ENGINE

Number: 297 6/1 22 Air Filter: Not there
 Aver. Running Hrs/Day: Engine Bolts: OK
 3.5 Human, 3.5 livestock Clean: OK
 Exhaust: OK Cooling System: OK
 Leaks: Little Last Service: Feb. 1988
 V-Belts: OK Pulley Size: ?
 Frame: OK Engine Speed: ?
 Fuel Consumption: 0.35 ltr/hr
 Engine Hour Meter: No

Comments: Old installation with D12, can 0.35 ltr/hr be true?

PUMP HOUSE

Locked: In shambles
Clean:
Soap & Tools:
Spares:
Fenced:
Water Meter (m³)

Funnel:
Burglar Bars:
Oil Can:
Diesel Storage:
Tap:
Pressure Release Valve:

PUMPER

Name: ?
Log Book OK: ???
Any Reports:

On Duty:
PC Water Meters:

PART-TIME/RELIEF PUMPER

Name:
Log Book OK:

On Duty:
Any Reports:

KGOSI/VOC-CHAIRMAN/PRINCIPAL were not available

Conduct Pumpers:
Misuse Water:
Extensions:

INSPECTOR

Name: F. van der Geest

Total Impression: design made 10/88 for complete rehabilitation

- Gambule is on the RVWS programme
- Reticulation and tank really needed! Also for school.
- Pumper to be considered as Senior Operator, seems very organized.

Suggestions:

- Access to Borehole to be made.
- Borehole 0.8 km South East of the school to be tested and sampled for future use!! If found OK, then DWA should be asked to help with reticulation design. Masukwane tank can be used near the school. Construction of a temporary pipeline should be considered by Council.
- Cattle trough to be removed from Borehole site to avoid pollution.

FOR MLGL:

Est Constr Cost Up Till Now:
Est Constr Cost to Update Coml Scheme:

Year Projection

Plan:
Plan:

Water Supply Inspection Report

Village: Makaleng (Sub)District: NEDC
 Date: 16-5-88 Time: 16.50 hrs Inspector: F. vd Geest

GENERAL

Pop Census '81: 1410 Year of First Compl: 1976
 Est Pop Now: 1200 (1400 incl. Date of Hand-over: ?
 Botalaote and Toteng)
 Pop Census Design: 1000/1985 Design Demand: ?
 Actual Demand: 45 m³/day
 Infra Structure: Pr.School (410p), Clinic+Maternity,
 Sec.School(330p)

BOREHOLE

Official Number: Riverextraction Pump Element: D42 horizontal
 Date Borehole Drilled: Pump Speed: 1200
 Tested Yield: No. Columns, Size: N.A.
 Borehole Depth: Only 2 from 5 are OK Discharge Head: N.A.
 Casing diam: Pressure Gauge: No
 Static Water Level: No access Water Quality: ?
 Design Pump Rate: Date Sample Taken:
 Pump Rate (m³/hr): 4.5 m³/hr Demand Covered: Hardly
 Draw Down: No access Extra Borehole Needed: Yes, or
 backwash
 Est Yield: ? Level Indicator: No
 Comments:

TANKS

Types: Lipp + Braithwaith Liner: No
 Cover: OK Level Indicator: No
 Stand: No Date of Last Compl: 16-5-87
 Sizes: 100 m³ straight connected,
 at school 27+35 spare +
 4x2x2- 27 m³ at Borehole
 Condition: OK

RETICULATION

Sizes Used: 90 & 63 75 & 50 SP Condition: Design too old
 Total Length: Soakaways: To be made
 Leaks: SP no. 3 leaking badly SP Fenced: No
 No. PC: None Valve Condition: Some broken
 Water marks: OK Date of Last Compl: 1988
 No. SP: 8
 Extensions Needed: No

ENGINE

Number: R369 ST1 37R
Aver. Running Hrs/Day: 10
Exhaust: Inside still
Leaks: Yes
V-Belts: OK
Frame: OK
Fuel Consumption: 0.6 ltr/hr
Engine Hour Meter: No

Air Filter: Needs replacement
Engine Bolts: OK
Clean: Not really
Cooling System: OK
Last Service:
Pulley Size:
Engine Speed: 1700

Comments: Total rehabilitation of pumphouse needed

PUMP HOUSE

Locked: OK
Clean: Reasonably
Soap & Tools: No
Spares: No
Fenced: No
Water Meter (m³): 57529+22486

Funnel: No
Burglar Bars: Yes
Oil Can: No
Diesel Storage: In shed
Tap: OK
Pressure Release Valve:

PUMPER

Name: Mosimane Wakgotla
Log Book OK: Mixes 2 watermeters
on 1 log
Any Reports: No

On Duty: Yes
PC Water Meters: By Revenue

PART-TIME/RELIEF PUMPER

Name:
Log Book OK:

On Duty:
Any Reports:

KGOSI/VOC-CHAIRMAN/PRINCIPAL

Conduct Pumpers: OK
Misuse Water: No, except for leakage
Extensions: Yes, but not justified

INSPECTOR

Name: F. van der Geest

Total Impression:

Except for river extraction, installation and SPs quite reasonable.

Suggestions:

- To use abandoned tank (Hanoya 38 m³) somewhere else.
- SP to be reconstructed to present DWA design.
- Check 3 of the 5 well points, seem to be clogged.
- Re-install 2nd engine as a back up system!
- River extraction installation should be completely revised, an attempt can be made to wash out clogging.

FOR MLGL:

Est Constr Cost Up Till Now:
Est Constr Cost to Update Coml Scheme:

Year Projection

Plan:

Plan:

Water Supply Inspection Report

Village: Moroka (Sub)District: NEDC
 Date: 11-5-88 Time: 12.07 hrs Inspector: F. vd Geest

GENERAL

Pop Census '81: 988 Year of First Compl: April 1983
 Est Pop Now: 1800 Date of Hand-over: 1 May 1983
 Pop Census Design: 1700/92 Design Demand: 45 m³/day
 Actual Demand: 90 m³/day
 Infra Structure: Prim. School (531p), Health Post

BOREHOLE

Official Number: 4175 Pump Element: ES 30
 Date Borehole Drilled: ? Pump Speed: 1000
 Tested Yield: ? No. Columns, Size: 11x3mx50x16
 Borehole Depth: ? Discharge Head: 50x254
 Casing diam: 6" Pressure Gauge: No
 Static Water Level: 17.3 m Water Quality: OK
 Design Pump Rate: 7.8 m³/hr Date Sample Taken: ?
 Pump Rate (m³/hr): 9.8 Demand Covered: Hardly
 Draw Down: 3.7 m Extra Borehole Needed: Yes, is there
 Est Yield: >13 m³/hr Level Indicator: No
 Comments: ?

TANKS

Types: Hanoya Liner: No
 Cover: OK Level Indicator: OK
 Stand: 6 m Date of Last Compl: April 1983
 Sizes: 18 + 38 m³
 Condition: Leaking, storage needs to be increased

RETICULATION

Sizes Used: 110, 90, 63 mm SP Condition: Covered in sand
 Total Length: 1060, 2200, 2700 Soakaways: Not there
 Leaks: No SP Fenced: No
 No. PC: 9 Valve Condition: OK
 Water marks: OK Date of Last Compl: April 1983
 No. SP: 9
 Extensions Needed: 300 m North

ENGINE

Number: R 114 ST2 28 Air Filter: Dirty
 Aver. Running Hrs/Day: 9, Engine Bolts: OK
 sometimes 10 Clean: Leaking all over
 Exhaust: OK Cooling System: OK
 Leaks: Plenty Last Service: April 1988
 V-Belts: OK Pulley Size: 210
 Frame: OK Engine Speed: 1500
 Fuel Consumption: 0.8 ltr/hr
 Engine Hour Meter: No

Comments: The tankstraps are broken

PUMP HOUSE

Locked: No
Clean: Reasonably
Soap & Tools: No
Spares: No
Fenced: No
Water Meter (m³): 64829

Funnel: No
Burglar Bars: No
Oil Can: No
Diesel Storage: At borehole
Tap: Yes
Pressure Release Valve: OK

PUMPER

Name: Ompatile Oneng
Log Book OK: Yes
Any Reports: No

On Duty: Yes
PC Water Meters: By revenue

PART-TIME/RELIEF PUMPER

Name:
Log Book OK:

On Duty:
Any Reports:

KGOSI/VOC-CHAIRMAN/PRINCIPAL

Conduct Pumpers: OK
Misuse Water: Yes, even Kgosi waters garden, but doesn't pay revenue.
Many people water their gardens from the SP.
Extensions: Proposed 5 ext.! Only 1 justified

INSPECTOR

Name: F. van der Geest

Total Impression:

Village is very scattered. For the number of people present, there is a lot of water needed, about 50 ltr./day. They do seem very industrious.

Suggestions:

- Water quality and yield of old Borehole used by Roads and cattle to be checked and hooked up if found OK. Distance to scheme not checked yet.
- One extension to the North, 300 m.
- Distance old Roads Borehole to scheme still to be measured.
- Water storage to be increased.

FOR MLGL:

Est Constr Cost Up Till Now:
Est Constr Cost to Update Coml Scheme:

Year Projection

Plan:

Plan:

Appendix B-3

Consolidated Emergency
Village Water Programme

DESIGN SECTION

DATE: 1 FEBRUARY 1989

CONSOLIDATED EMERGENCY

VILLAGE WATER PROGRAMME

57 VILLAGES (57 villages)
+25 VILLAGES (25 villages)
TOTAL (82 villages)

SUMMARY STATUS FOR WORK PROGRESS

<u>ACTIVITY</u>	<u>COMPLETED</u>	<u>ONGOING</u>	<u>OUTSTANDING</u>
SITING	75	6	1
DRILLING	60	9	13
TESTING	42	2	38
DESIGN	32	3	47
CONSTRUCTION	25	3	54

Consolidated Emergency Water Programme (57 villages only)

CENTRAL DISTRICT

Serowe-Palapye Sub-district

1.	Gojwane/Marulamantsi	Design completed
2.	Lesenepole	Completed
3.	Gootau	Rising Main to Lecheng/Tender Evaluation ongoing
4.	Lerala	Drilling completed
5.	Mogapi	Drilling completed
6.	Majwaneng	Siting completed
7.	Seolwane	Drilling completed

Mahalapye Sub-district

8.	Sefare/Chadibe	Drilling ongoing
9.	Seleka/Malete	Drilling completed
10.	Ramokgonami	Testing ongoing
11.	Mookane	Drilling completed
12.	Makwate	Drilling completed
13.	Matlhako	Testing ongoing

Tutume Sub-district

14.	Tutume	Completed
15.	Makobo	Siting ongoing
16.	Maitengwe	Testing completed
17.	Borolong/Tlhalogang	Completed
18.	Mathangwana	Completed
19.	Sebina	Completed
20.	Chadibe North	Completed
21.	Natale	Siting ongoing

Bobirwa Sub-district

22.	Bobonong	3 boreholes being equipped, constr. reticulation ongoing
23.	Mabolwe	Completed
24.	Tsetsebjwe	To be connected to Moletji
25.	Tobane	Drilling completed
26.	Molalatau	Completed

Boteti Sub-district

27.	Kedia	Drilling ongoing
28.	Mopipi	Drilling ongoing
29.	Moremaoto	Siting completed

Gantsi District

30.	West Hanahai	Siting ongoing
31.	Bere	Drilling ongoing
32.	Groot Laagte	Completed
33.	Rooibrak	*

Kgalagadi District

34.	Middlepits	To be connected to Khuis
35.	Ghakibane	To be connected to Khuis
36.	Hereford (Bray)	Completed

Kweneng District

37.	Dutlwe	Resiting required
38.	Losilagokong	Testing completed
39.	Sojwe	Drilling completed
40.	Hatsalatladi	Drilling completed
41.	Dipuduhudu	Drilling ongoing
42.	Sorilatholo	Siting ongoing

North East District

43.	Tati Siding	Completed
44.	Senyawe	Completed
45.	Pobe-Pobe	*
46.	Mapoka	Completed
47.	Ditladi	Completed

North West District

48.	Puduhudu	Completed
49.	Gomare	Drilling completed
50.	Shakawe	Completed
51.	Sehitwa	Completed

South East District

52.	Metsimaswaane	Design ongoing
-----	---------------	----------------

Southern District

53.	Ranaka	Completed
54.	Manyana	Completed
55.	Digawana	Design completed
56.	Mosi	Completed/Still busy
57.	Sese	Construction still ongoing

-- / Work not yet started
* / Villages to be replaced

SUMMARY STATUS

<u>ACTIVITY</u>	<u>COMPLETED</u>	<u>ONGOING</u>	<u>OUTSTANDING</u>
SITING	52	4	1
DRILLING	45	5	7
TESTING	33	2	22
DESIGN	27	1	29
CONSTRUCTION	22	2	33

Additional 25 Villages in Critical Water Situation

CENTRAL DISTRICT

Serowe/Palapye Sub-district

- | | | |
|----|-------------|--------------------|
| 1. | Diloro | Drilling completed |
| 2. | Lecheng | Completed |
| 3. | Moreomabele | Testing completed |

Mahalapye Sub-district

- | | | |
|----|---------------|--------------------|
| 4. | Otse/Lephephe | Drilling completed |
| 5. | Dibete | Drilling completed |

Tutume Sub-district

- | | | |
|----|------------|--------------------|
| 6. | Mandunyane | Siting ongoing |
| 7. | Mabisikwa | Drilling completed |

Bobirwa Sub-district

- | | | |
|----|---------|-------------------|
| 8. | Moletji | Testing completed |
|----|---------|-------------------|

North East District

- | | | |
|-----|----------------|------------------|
| 9. | Matenge | Drilling ongoing |
| 10. | Tsamaya/Siviya | Design ongoing |

Ngamiland District

- | | | |
|-----|-----------|--------------------|
| 11. | Bothatogo | Siting completed |
| 12. | Tubu | Drilling completed |

Gantsi District

- | | | |
|-----|---------|----------------|
| 13. | Makunda | Siting ongoing |
|-----|---------|----------------|

Kgalagadi District

14.	Draaihoek	Drilling ongoing
15.	Hukuntsi	Construction ongoing
16.	Hunhukwe	Drilling ongoing
17.	Kgothu	Siting completed
18.	Makopong	Siting completed
19.	McCarthy's Rust	Drilling completed
20.	Ngwatle	Settlement to be moved to Monong
21.	Werda	Completed
22.	Zutsha	Siting completed

Kweneng District

23.	Gakuto	Drilling ongoing
24.	Kopong	Design ongoing
25.	Lentswe-Le-Tau	Design completed
- /	Not yet sited	

SUMMARY STATUS

<u>ACTIVITY</u>	<u>COMPLETED</u>	<u>ONGOING</u>	<u>OUTSTANDING</u>
SITING	23	2	-
DRILLING	15	4	6
TESTING	9	-	16
DESIGN	5	2	18
CONSTRUCTION	3	1	21

Appendix B-4

District Council Positions

	WE	CTO	STO	TO	
CENTRAL					
Serowe HQ	Vac	-	Vac	Vac	
Proposal	SIDA	-	IVS	Vac	
Serowe	-	-	-	Dikokole	No changes
Mahalapye	-	-	Vac	Molapisi	
Proposal	-	-	Tumedi	New	
Tutume	-	-	Vac	Vac	
Proposal	-	-	IVS	Vac	
Bobirwa	-	-	-	Ramontsh.	
Proposal	-	-	-	New	
Boteti	-	-	-	Tumedi	
Proposal	-	-	-	Tlhaban.	
GHANZI					
Ghanzi	-	-	Broekema	Kabasia	
Proposal	-	-	Kabasia	New	
Charleshill	-	-	-	Vac	No changes
KGALAGADI					
Tsabong	-	-	Meijer	Letsididi	
				Keulen	No changes
Hukuntsi	-	-	-	Vac	
Proposal	-	-	-	New	
NORTH WEST					
Maun	-	-	Waterman	Hetolang	
Proposal	-	-	Waterman	New	
Gomare	-	-	-	Vac	
Kasane	-	-	-	Molatedi	No changes
NORTH EAST					
Francistown	Vac	-	Vac	Mmusi	
Proposal	SIDA	-	IVS	Mmusi	
KGATLENG					
Mochudi	-	-	Vac	Vac	
Proposal	-	-	IVS	Vac	
KWENENG					
Molepolole	Vac	-	Vac	Siwela	
Proposal	SIDA	-	IVS	Siwela	
Letlhakeng	-	-	-	Vac	
SOUTH EAST					
Ramotswa	-	-	Vac	Motingwa	
Proposal	-	-	Hetolang	New	
SOUTHERN					
Kanye	-	Bhangui	Vac	Vac	
Proposal	-	Bhangui	Ramonts.	Motingwa	