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ENVIRONMENTAL ASSESSMENT OF THE PUBLIC SERVICES IMPROVEMENT PROJECT COMPONENT III - WATER SUPPLY, SANITATION, AND HEALTH

EL SALVADOR

WASH FIELD REPORT NO. 299

FEBRUARY 1990

Prepared for
the USAID Mission to El Salvador
WASH Task No. 086

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.

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Prepared for the USAID Mission to El Salvador
under WASH Task No. 086

By

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and

Carlos de la Parra

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RELATED REPORTS

Appropriate Technology for Rural Water Supply and Sanitation in El Salvador: A Brief Review and Bibliography, by Charles S. Pineo. September 1981. WASH Field Report No. 26.

Preliminary Design for Handpumps Installation Project in El Salvador, by Luis Moncada Gross and Oscar R. Larrea. June 1986. WASH Field Report No. 187.

An Assessment of USAID/El Salvador's Pilot Potable Water and Environmental Support Project. May 1988. WASH document.

Public Services Infrastructure Damage Assessment Report. July 1988. Development Associates.

Domestic Water: A Concept Paper. 1986. USAID/El Salvador.

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QUALIFICATIONS OF PREPARERS

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Carlos de la Parra—Born 1955; Citizen of Mexico; BS National Polytechnic Institute in Mexico City (Civil Engineering 1979), Studied Master's program San Diego State University (Management of Water Resources, thesis pend.). Presently is Academic Researcher on Environmental Studies for El Colegio de la Frontera Norte in Tijuana, Mexico; Private consultant on hydraulic and sanitary engineering, management of natural resources and appropriate technology; Positions held include 1986-present as Senior Engineering Consultant for the Environmental Defense Fund on an alternative technology wastewater system being developed; Director of the Development of the Decentralized Wastewater Treatment and Reuse System, under review by the Government of Mexico. 1980-1983 Head of the State Utilities Public Services, Water and Wastewater System in Tecate, Mexico. Recent projects include the design of a wastewater treatment and reuse system for a submetropolitan area of Tijuana,Mexico; the design and start-up of a wastewater treatment system for Tijuana's slaughter house; the development of small appropriate technology systems for rural developments between Tecate and Tijuana, Mexico; other relevant projects in the past have been the upgrading of small water systems and community development work in the rural areas of Tecate, Mexico.

ACRONYMS

AID	U.S. Agency for International Development
ANDA	*Administración Nacional de Acueductos y Alcantarillados* (National Water and Sewer Authority)
ANDA/MU	Management Unit for AID Project 519-0320, Component III
CEL	*Comisión Ejecutiva Hidroeléctrica del Río Lempa* (Executive Commission for Lempa River Hydroelectricity)
CENREN	*Centro de Recursos Naturales* (Center for Natural Resources, a branch of the Ministry of Agriculture)
CENTA	*Centro de Tecnología Agrícola* (Center for Agricultural Technology, a branch of the Ministry of Agriculture)
EA	Environmental Assessment
EAP	Economically Active Population
FENADESAL	*Ferrocarriles Nacionales de El Salvador* (The national railways company)
GOES	Government of El Salvador
ISDEM	Salvadoran Municipal Development Institute
MOE	*Ministerio de Educación* (Ministry of Education)
MOH	*Ministerio de Salud y Asistencia Social* (Ministry of Health)
MOH/DES	*Departamento de Saneamiento Ambiental del Ministerio de Salud Pública y Asistencia Social* (Department of Environmental Sanitation of the MOH)
OEDA	*Oficina Especializada del Agua, dependiente de ANDA* (Office Specialized on Water, a branch of ANDA)
PAHO	Pan-American Health Organization
PLANSABAR	*Plan Nacional de Saneamiento Básico Rural* (National Agency for Rural Sanitation)
ROCAP	Regional Office for Central American Projects, dependant of AID
UNDP	United Nations Development Plan

UNICEF	United Nations Children's Fund
WASH	Water and Sanitation for Health
WHO	World Health Organization

EXECUTIVE SUMMARY

Background

A grant agreement was reached between the United States and the Government of El Salvador (GOES) for AID Project No. 519-0320, Public Services Improvement, Component III-Water Supply, Sanitation and Health. The assessment took place between October 12 and October 31, 1989. This assessment provides guidelines for subproject selection and development to ensure that environmental concerns are addressed in the final project design. Included in this report are a description of the primary project and its alternatives, a description of the affected environment and environmental consequences, and recommendations for impact mitigation.

The Project and Its Alternatives

Component III of the Public Services Improvement Project will support the restoration and installation of water supply and sanitation systems, in conjunction with community organization and health education activities, in the small rural communities of El Salvador. The purpose of this project is to increase access to potable water and reduce water-borne disease to improve the health of the people, reduce the cost of health care and improve economic productivity. This project will serve two categories of the rural population of El Salvador. One will be communities with 400 people or less, which will receive approximately 900 wells with handpumps. The second will be communities of 400 to 2000 people, where about 120 existing small water supply systems will be restored or expanded.

The elements of the project are: water supply, including sources; watershed management and water quality monitoring; sanitation and drainage, including latrines, sewerage and drainage methods; training and education; operation and maintenance.

The proposed actions for water supply sources include using spring water, well water and their ancillary systems. As an alternative to these sources, surface water could be considered, although the likelihood of a good quality source is in doubt. Ancillary systems for water supply include transmission mains, storage tanks and distribution pipes in the larger systems.

Watershed management will be included in the project by training ANDA personnel only. As an alternative, MOH health promoters and rural teachers could also be trained in watershed management, so that this information is transmitted to the villagers and their children.

Water quality monitoring is recommended on a bimonthly basis to ascertain the potability of the water supplies. This proposed monitoring program would include physical, chemical and bacteriological tests. As an alternative, a complete the rainy season, and bacteriological tests would be done by MOH health promoters using portable kits every two months if possible, but no less than twice a year.

For sanitation, dry pit or pour-flush latrines are proposed. As alternatives, vented improved pit latrines could be used for households, double-vented improved pit latrines used for schools, and compost latrines could be used where high groundwater conditions preclude the use of other type of latrines. Sewerage will be improved and expanded in larger communities that are already sewered.

Drainage is proposed at handpump and storage tank installations to properly drain overflows using open channels and drainage pits. As an alternative, overflow drainage could be provided by pipes, absorption trenches and absorption pits.

An extensive training and education program will cover many aspects. As an alternative, this program could be expanded to include environmental orientation to help preserve, protect and enhance areas of needed environmental emphasis, such as watershed and wetlands protection, soil conservation, and to protect historical and archeological resources, endangered plant and animal species.

Operation and maintenance of these subprojects would be carried out by beneficiaries, except for complex maintenance which would be done by ANDA on demand. As an alternative, regular annual inspection and required maintenance could be performed by ANDA personnel.

The no-action alternative would be invoked if any activities described above were deemed incompatible or detrimental to the objectives of the project beyond the reach of reasonable remedial measures.

The Affected Environment

The affected environment is primarily in rural areas of El Salvador. Subprojects are expected to be located throughout the country, from the coastal areas to the coffee growing mountains. The country covers a total of 21,000 km^2, with elevations ranging from sea level to 2730 m. There are three climatic zones: hot, temperate and high tropics. Annual precipitation ranges from 1800 to 2700 mm. The geology of the country includes sedimentary, volcanic and intrusive formations. Soil types include the latosols, which cover about one third of the country, regosols and litosols, which cover most of the remainder. The country is divided into 10 watersheds, of which the Lempa River watershed covers about half the country's area. There are four major lakes in the country: Lake Ilopango, Lake Guija, Lake Coatepeque and Lake Olomega. In addition there are artificial reservoirs used for hydroelectric power. Groundwater availability totals 76.8 m^3/second. Surface water quality is generally poor because of untreated wastewater discharges and uncontrolled use of fertilizers, pesticides and industrial waste water discharges.

Major ecosystems in the country include dry tropical, humid tropical and subtropical humid forests, plus *very* humid subtropical, *very* humid low mountainous subtropical and *very* humid mountainous subtropical rainforests.

There are approximately 500 archeological sites that have been discovered in El Salvador, of which only 10 classify as structures of significance and have been established as national monuments. It is expected, however, that there are many archeological sites of lesser importance that have not yet been discovered and will continue to be found in various places throughout the country. Of the 21,000 km^2, about half contain cattle and agricultural activities of some sort. The remainder are covered by forest and chaparral.

The endangered species list is lengthy for the size of the country. There are 65 species of trees, 61 species of flowers and 128 animals included in this list.

The country's population is estimated at "more than 5 million." The country is the most densely populated in the continent, with 50% living in rural areas and 50% in urban areas. Infant mortality was 53/1000 in 1988, although in rural areas is as high as 81/1000. Illiteracy was estimated to be 38% in 1968. It is estimated that nearly two million Salvadorans live outside the country.

Environmental Consequences

The proposed actions and the alternatives will produce short-term, long-term, and indirect impacts. In addition there will be some energy-use impact and an irreversible and irretrievable commitment of resources. In general, the smaller water supply and sanitation projects are not expected to have significant negative impact on the environment when designed with mitigative actions. The larger projects could include some significant impact; but again, they could be designed to avoid negative impact on the environment.

Recommendations

Chapter 5 of the report contains the comprehensive list of recommendations to mitigate project impact, and to promote watershed management and protection, water quality monitoring, appropriate technology for water supply, sanitation and drainage, training and education, operation and maintenance. Additional recommendations are presented in Appendices A,B,C,D and G. The most significant recommendations of this EA report are the following:

1) Subproject selection criteria should include environmental factors, such as effects on wetlands and floodplains, historical and archeological resources and endangered animal and plant species, and groundwater quality.

2) An Environmental Review Survey and Matrix should be performed for each subproject, to determine project impacts on watershed, groundwater and land use, using the forms included in Appendix E. In addition, a simple environmental assessment should be performed by ANDA personnel, during the subproject planning phase, using the format suggested in Appendix F.

A finding of No Significant Impact should be issued by the GOES before subproject implementation. The AID/El Salvador Mission Environmental Officer should perform audits of this process from time to time.

3) Training and education efforts for ANDA water project promoters and MOH health promoters should include watershed management and protection.

4) Bacteriological tests should be performed on the water supplies every two months if possible, but at least twice a year. These tests could be performed on-site by either MOH health promoters or ANDA personnel using portable kits. Physical/chemical tests including pesticides should be performed at least once a year during the rainy season.

5) Water supply sources will be mostly springs and wells and should not require treatment if facilities are properly designed and constructed. Components of larger water supply systems should be designed and constructed following existing ANDA design norms.

6) Community latrines should be double pit vented type when groundwater conditions are favorable (>1.80 m below ground surface during the wet season). Household latrines should be single pit vented, when the high groundwater during the wet season is at least 1.80 m below the ground surface. Compost latrines should be used when the groundwater is less than 1.80 m below the ground surface during the wet season.

7) Drainage from wells and storage tanks should be provided using piping and absorption pits or trenches to avoid mosquito breeding pools.

8) Training and education programs should include environmental aspects such as watershed protection, soil conservation, wetlands, archeological resources and endangered species protection. Water quality monitoring basics should be included in the training and education of MOH health promoters so that they can perform routine bacteriological tests on the water supplies.

9) ANDA should institute an annual inspection and maintenance program through its regional offices for the subprojects once they have been constructed.

Chapter 1

INTRODUCTION

1.1 Purpose and Objectives

Prepare an Environmental Assessment Report in accordance with AID regulations 22 CFR 216.6 for Component III (Water Supply, Sanitation and Health) of the AID Public Services Improvement Project (519-0320) in El Salvador.

1.2 Scope of Work and Scoping Process

After a preliminary determination of the scope of work to be included in this Environmental Assessment (EA), the WASH team held a series of meetings with personnel from USAID/El Salvador, which is summarized in the Appendix H,"Summaries of Interviews and Field Trips." The purpose of these meetings was to further define the scope of the work. This scoping process concluded that the EA should undertake the following tasks:

1) Obtain and review pertinent documents relating to the project including:

    - Concept Paper, Domestic Water, El Salvador 1986;
    - An Assessment of USAID/El Salvador's Pilot Potable Water and Environmental Support Project, WASH May 1988;
    - Public Services Infrastructure Damage Assessment Report, Development Associates, July 1988;
    - Public Services Improvement Project Paper.

2) In conjunction with AID and ANDA, identify significant issues to be addressed in the EA.

3) Develop a schedule of work and draft outline of goals for the EA.

4) Describe the proposed actions of the project (Component III) and the alternatives to these actions.

5) Describe the environment that will be affected by the proposed actions and their alternatives.

6) Describe the environmental impact of the proposed actions and alternatives, including the no-action alternative in comparative form. (The environmental impacts to be described and compared will include short and long-term impacts, direct and indirect impacts, impacts on historic and archeological resources, endangered species, land use and energy use.

Other impacts analyzed will refer to irreversible and irretrievable commitment of resources.)

7) Make recommendations on measures to mitigate any adverse environmental impacts of the proposed actions.

8) Make field evaluations of existing and proposed projects with the assistance of ANDA.

9) Review current criteria used by ANDA for locating water intake structures, latrines and wells, and submit recommendations for improvements, as appropriate.

10) Prepare recommendations for construction practices which will reduce erosion from run-off water from storage tanks, wells and household connections, and eliminate pools of water associated with poor drainage.

11) Recommend water quality monitoring programs and programs for protection of water supplies, as appropriate.

12) Recommend environmental criteria for sub-project selection.

13) Review proposed training and operation and maintenance programs and recommend changes if required.

14) Prepare an Environmental Assessment Form, to be used for the evaluation of future construction projects, and a typical report format for future environmental assessments of Water Supply, Sanitation and Health projects.

15) Accomplish all of the above tasks in close collaboration with USAID/El Salvador project management and environmental officer, as well as with designated ANDA personnel.

16) Conduct briefing and debriefing sessions at the initiation and termination of the EA for USAID/El Salvador and ANDA.

17) Provide regular oral updates on the EA to USAID/El Salvador during the course of the work.

18) Prepare and submit a draft report of the EA document for review by USAID and ANDA in English.

19) Submit a final EA report to USAID, incorporating the comments received. The report will be submitted in English (10 copies) and Spanish (10 copies).

1.3 General Description of Project

Component III of the Public Services Improvement Project will provide support to restore or install water supply and sanitation systems, in conjunction with community organization and health education activities, in small rural communities in El Salvador.

One population to be addressed will be communities with populations of approximately 400 or fewer, communities that have not been targeted by any agency or donor for Potable Water Supply and Sanitation and health projects. Over the life of the project approximately 900 simple water systems will be constructed in communities where more sophisticated systems are neither financially nor technically feasible. The private sector contractor hired to install these simple water systems will also install the requisite number of latrines. To the degree possible, with the exception of the pits themselves (which will be a labor contribution of the villagers), the private contractor is expected to utilize local-hire labor during installation of the water systems, the latrines and their protective housing.

A second population to be served by the project are communities between 400 and 2,000 persons. Although the number of small rural water systems may yet be defined by the implementing agencies, it is expected that approximately 50 systems to serve close to 120 communities will be in this part of the project. These are systems that are not functioning at their full or needed capacity because of deferred maintenance or being overtaxed because of increases in population, and they will be restored or expanded. The implementing agency for Component III of the project will be the ANDA/Management Unit.

Community organization, sanitation and health education activities will be included here as well. All construction activities will be preceded, accompanied and followed by community organization activities to foster subproject sustainability and health education, to foster the proper use of the water and sanitary facilities and to improve health status of the rural populations receiving the subprojects. Among the entities available to provide such training is the Salvadoran Municipal Development Institute (ISDEM), the Ministry of Health through its Community Health division (MOH/CH), and in community schools, the Ministry of Education will participate through the teachers, who will receive educational and promotional materials financed under the project. The schools will be targeted for water and sanitation systems/points, and the teachers will receive training for their use.

1.4 Threshold Environmental Decision

A positive determination of the need for an Environmental Assessment of Component III, Water Supply, Sanitation and Health of the Public Services Improvement Project was made on July 28, 1989, as indicated on the PID cable included in Annex A of the Project Paper. The EA was intended as an environmental review document to guide site selection, subproject selection and development, and to provide sound environmental planning and monitoring.

Chapter 2

ALTERNATIVES—INCLUDING THE PROPOSED ACTIONS

As indicated in the previous chapter, the project covers three major elements: water supply, sanitation and health. Other actions include training and education, operation and maintenance. No action is an alternative consideration if any of the following activities is judged to be undesirable in the long or short term.

Other alternatives to the proposed actions relating to environmental concerns will also be discussed.

The construction of the water supply, sanitation and health projects will include specific activities occurring at preselected locations according to standards of site selection and design. Criteria have been reviewed both in written form and as applied in projects built previously.

The planned rural water supply projects include two general categories:

a) Projects serving populations between 400 and 2,000 people.

   These projects include approximately 120 existing small, rural water systems in need of repair or expansion due to deferred maintenance or increases in population, and

b) Projects serving populations of 400 people or less.

   These projects include approximately 900 simple water systems such as wells with handpumps or gravity fed systems utilizing springs.

In the first group of projects (serving communities between 400 and 2,000 people), the most likely types of construction that will occur are: water transmission pipes, water storage tanks, distribution pipes, spring intakes, wells, sewerage and latrines.

Proposed actions and alternatives relate to water supply, including supply sources, watershed management and water quality monitoring; sanitation and drainage, including latrines and drainage; training and education; operation and maintenance; and no action.

2.1 Water Supply

2.1.1 Water Supply Sources

The proposed sources are groundwater and spring water. No surface water supply is being considered.

a) Spring Water

This kind of source is preferred if it is located relatively close to the community. Chlorination has been provided in PLANSABAR projects, however it is conceivable that chlorination may not be required if the source is protected and a water quality monitoring program is carried out.

b) Well Water

The most prevalent type of water source for small rural water supply is well water. This source is usually of good quality and does not require chlorination.

Alternative Surface Water Supply

This source includes small streams and creeks capable of supplying water in a steady manner. This type of source is the most likely to be polluted and also it is likely to be unsteady. Most small streams practically dry-up or diminish their flow substantially during the dry season.

2.1.2 Water Transmission Distribution and Storage

In larger existing projects (serving more than 400 people) water transmission, distribution and storage may be required. ANDA has standards of design which should be used.

2.1.3 Watershed Management

The project does not include a clearly defined management element, because it is aimed at improving childhood survival, not at natural sources management.

Watershed management has a direct impact on water quantity and quality, which are very important parameters to the success of this project implementation. The training plan of the project includes a proposal of short courses, including water quality and water catchment and conservation, for appropriate ANDA personnel.

An Alternative

This training program could be amplified to include MOH health promoters, and it could be part of the general information to be disseminated during the health promotion efforts throughout the population that will benefit from the project.

2.1.4 Water Quality Monitoring

This project includes a special covenant by which the GOES agrees to provide, in form and content and by the date specified in the Project Implementation Letters (PILS), a report indicating the procedures to be utilized to monitor the potability of water brought into the villages under the project and to monitor system maintenance needs.

At the present time ANDA and PLANSABAR have water quality monitoring programs for projects that they manage. It appears however that there is not a systematic and continuous program to monitor small wells with handpumps. Once the well is built, a first analysis is made to ascertain the water quality of the well, but no continuous monitoring is carried out.

The project proposes that once the subprojects are completed, these projects (handpumps and latrines) will be turned over to the local communities for management operation and maintenance with assistance from ANDA for major maintenance.

An Alternative

The required water quality monitoring program should also be carried out by ANDA on a semi-annual basis. The tests to be performed should include physical, chemical and bacteriological parameters such as those included for bigger water sources.

2.2 Sanitation and Drainage

The project includes building latrines or septic tanks for about 1,000 communities, schools and homes, and improving drainage to avoid mosquito breeding pools.

2.2.1 Latrines

The project proposes building some community latrines for schools and small population centers, and individual latrines for homes.

a) Community Latrines

This type of latrine should be used only for schools. It appears unlikely that community latrines would be useful in other settings.

b) Appropriate Technology for Individual Latrines

PLANSABAR has standards for the construction of house latrines. The latrines presently built are dry pit latrines for each household. Other latrines in use are the pour flush type and the elevated latrine.

Most of the dry pit latrines are built with a single hole directly under the superstructure and slab. This requires moving the entire structure to another location once the pit fills up.

In some locations pour flush latrines have been installed. These latrines are located in areas that have individual shallow wells in each house. These latrines are cleaner than dry pit and odorless. In addition, the pit is located away from the slab and is connected to the latrine through a pipe, so that when it fills there is no need to move the structure to make another pit.

None of the latrines are vented.

Alternatives that are recommended: 1) Vented latrines; 2) for community latrines such as schools, the use of the double pit vented latrines; 3) in high ground water areas, the use of composting toilets.

Vented pit latrines will minimize odors and practically eliminate flies in the latrines. The vent consists of a PVC pipe painted black of about 3" diameter (10 cm) which connects the upper part of the pit to the atmosphere. The vent is located vertically along the wall of the superstructure and terminates about 1 meter above the roof with a fine screen on the top so that flies cannot go through it. This type of vent will provide an air draft from the pit up and down the latrine when the latrine is in use.

Flies that go into the latrine will be sucked into the vent and die there, falling later to the latrine. Venting will provide more pleasant conditions in the latrine and encourage its use.

Double pit vented latrines include two pits separated by a wall and access to the pits through the top slab. A section of the pits is located outside the superstructure to provide access to the pits for cleaning. Pits are vented. This system provides the capability of cleaning the pits when they reach their capacity, and consequently they are permanent installations. Only one pit is in operation when the other is being cleaned. They are vented to avoid odors and flies.

Compost toilets or latrines include a pit which allows the organic matter to dry and decompose anaerobically. It requires removal of processed waste which is no longer pathogenic and offensive. This type of toilet is a good solution in areas where the groundwater is high.

Figures in Appendix G show details of the latrines and compost toilet.

c) Sewerage

In larger existing projects serving more than 400 people, piped sewage collection systems may be improved and extended. ANDA has standards of design for sewers which should be used for the design of these projects.

2.2.2 Drainage

In the water supply projects proper drainage in the design is of great importance to reduce the possibility of mosquito breeding and contamination of the water sources.

The handpumps design includes a channel to drain the excess water away from the well or to channel it to the nearest creek so that good drainage is provided and pools of standing water are avoided.

In addition, water storage tanks are designed with overflow pipes, discharging to drainage ditches.

An alternative to the above is to pipe the drainage to the nearest drainage ditches or streams or to provide infiltration trenches with perforated pipe or infiltration pits. Providing pipes for drainage will avoid the need to keep the ditches clean of brush and weeds, which grow because of continuous watering and thereby obstruct flow, producing standing water pools.

2.3 Training and Education

2.3.1 Training

Annex N of the project paper includes an extensive training plan. Proposed training activities include short courses conducted in El Salvador, printed materials, radio messages, video tape development for the staff of MOH Health Education Division; observation trips for Health Education and Community Health Division Staff to third-world countries to review other water supply and sanitation and health programs; training for ANDA staff in new forms of organizational decentralization and financial management; training for ANDA water promoters, in the relationship of water supply and sanitation to health; short courses for appropriate ANDA staff in such areas as environmental sanitation, water quality, water catchment and conservation and appropriate technology; and short courses for regional ANDA and MOH staff with mayors and other municipal officials in the criteria for subproject selection and in the formulation of subproject implementation plans.

Training and community organization will be provided by organizations such as the Salvadoran Municipal Development Institute (ISDEM). This is an ambitions training plan that will prepare ANDA and MOH staff as well as local officials.

2.3.2 Education

The Grant Agreement indicates that health education relating to water use and sanitation must accompany the implementation plans for individual subprojects.

Health education is to be delivered by health promoters from the Community Health Division of the Ministry of Health and by local health volunteer workers in the communities. The health promoters with technical assistance will train rural health workers and adult village groups, such as parent groups and water-users associations.

Health and hygiene will also be emphasized by teachers in community schools which will receive educational and promotional materials for this purpose. These schools will be targeted for water and sanitation systems, and teachers will receive training for their use.

Materials will be made available at the community level (posters, pamphlets, audio-visual) on the relationship of potable water supply and sanitation and health by the health promoters, and the water promoters will utilize similar materials to illustrate water supply and sanitation options to the water-user communities.

The training and education component of the project is quite comprehensive and it proposes to reach the schools as well as the communities.

An Alternative

The training and education component could include environmental orientation to help preserve, protect and enhance aspects of needed environmental emphasis such as watershed protection, soil conservation, wetlands protection, and protection of archeological resources, endangered plants and animals species.

In addition, training and education should include basics of water quality monitoring, so that the local health promoters are able to do routine tests on the water supply to monitor its potability.

2.4 Operation and Maintenance

The proposed operation and maintenance of the subprojects will be carried out by the beneficiary communities except for the complex maintenance and repairs that are beyond the reasonable means of the community. These will be carried out by ANDA through its regional offices. The ANDA offices will be staffed and supplied with the required personnel and equipment to provide the complex maintenance to the facilities when they require it.

The method by which problems with the systems are going to be reported is not well defined. It appears that ANDA will only provide support when it is requested through the community health promoter.

An Alternative

The ANDA regional maintenance offices could have a plan for regular maintenance of the facilities so that instead of reacting to problems, they are prevented. The maintenance program could include annual inspections of the facilities to determine their adequacy and condition, and to perform needed repairs and overhauls.

Chapter 3

AFFECTED ENVIRONMENT

3.1 Areas Affected by the Project

The affected environment is primarily in rural areas throughout El Salvador. The coverage ranges from the coastal areas to the mountainous coffee growing sites. The physical and socioeconomic characteristics of the areas involved are described below.

3.2 Physical Characteristics

The country of El Salvador covers a total surface of 21,000 km^2. It is one of the smallest countries in Central America, with drainage towards the Pacific Ocean, and has no access to the Atlantic. Although its highest peak does not surpass 2730 m in elevation, its topography is considered to be abrupt due to recent tectonic and volcanic activity.

3.2.1 Climate

There are three climatic zones in El Salvador, which depend on the elevation above sea level. According to the classifications by Koppen, Sapper and Lauer, they are as follows:

a) Hot tropical sabanas or Hot. Range from 0 to 800 m above sea level, with dry winters (from November through April), a maximum temperature of 22 degrees Celsius or more just prior to the rainy season (March or April). Annual temperatures range from 22 to 28 degrees Celsius, depending on the elevation. Annual precipitation in these areas is 1900 to 2300 mm, or 75" to 90".

b) Warm tropical sabanas or Temperate. Range from 800 to 1200 m above sea level with the dry season being the same time span and temperature range as the Hot region. The temperature during the warmest month is below 22 degrees celsius, but there are at least four months during the year with temperatures above 10 degrees celsius. The annual temperature range, depending on elevation, is between 19 degrees and 22 degrees celsius. Annual recorded precipitation is 2400 mm or 94".

c) High tropics. Ranging from 1200 m to 2700 m above sea level, include two zones:

- From 1200 to 1800 m above sea level, still temperate weather, with annual temperatures ranging between 16 and 20 degrees celsius, and no-frost; annual precipitation is 1800 mm or 70" in some areas and as high as 2700 mm or 106" close to the border with Honduras;

- From 1800 to 2700 m above sea level, cold temperatures ranging from 10 degrees to 16 degrees celsius, with frost conditions during parts of the year in the valleys. The dry season is reduced to 3 or 4 months in the sierra zones near the border with Honduras; annual precipitation reaches 2700 mm or 106".

3.2.2 Soils and Geology

El Salvador is located on the Pacific Ocean slope of the Central American complex, between the Brazilian and the Canadian plates. It emerged at the end of the Mesozoic Era, when the convulsions of these plates lifted mesozoic sediments and paleozoic rocks to the sea surface. Periodic seismic activity and recurrent volcanic eruptions are proof of the persistent instability of this zone.

The geologic elements are as follows:

a) Sedimentary formations. Marine sediments exist in the extreme NW portion of the country. Besides these, there are lacustrine and fluvial sediments in the SW and SE that interphase with piroclasts which show that these are contemporary with relatively young volcanic activity.

b) Volcanic formations. The major portion of the country is covered by rhiolites and basaltic rocks of volcanic origin. To the north of the Lempa and Torola rivers, frequent outcrops of rhiolites and andesites can be detected; a succession of andesites to basalts can be as deep as 1500 m. There are also volcanic depressions like the ones where lakes Ilopango and Coatepeque are located.

c) Intrusive formations. In the mountains close to Metapán and Chalatenango there are intrusive rocks, basically forming granites and granodiorhites, where they are in contact with marine sediments that show metamorphic contact, manifested in the calcareous layer.

With respect to soils, there are 15 different types altogether, divided mainly into four groups that represent 89% of the country's soil types. This classification is in accordance with that used by the U.S. Soil Conservation Service (SCS).

The most frequently occurring type of soils is the red clay *latosoles* (35%), derived from volcanic lavas blended with piroclasts. These soils are well cemented in undulating-to-mountainous terrain of steep slopes in general. They are predominantly present in the north and northwest, with scattered occurrences from the Pacific sea coast to the extreme eastern and the extreme western regions of the country. The *latosoles* have shallow depths and frequent outcrops of andesites and basalts. Fertility in these soils is from medium to poor.

The second most abundant type of soils is the *regosoles* (20%), darker looking red clays originating from piroclastic materials and occurring in the central-strip portion of the country, predominantly to the east. *Regosoles* show a higher degree of fertility and less frequent rock outcrops than latosoles. However, these soils are also very shallow in depth.

The *litosoles* are the third most abundant soil type (19%). These are soils that were formed under great pressures and show frequent outcrops of lava. They are very shallow in depth and therefore are not very productive.

The fourth most abundant soil type is alluvial (15%), located in flatlands and areas close to rivers and floodplains. These soils have very high productivity and are generally located in the coastal plains and dispersed throughout the interior valleys. Other soil types include the grumosoles, black clayish soils with surprisingly low organic content. These too can be found in the interior valleys of the country.

3.2.3 Hydrology

El Salvador is divided into 10 watersheds, which are namely: 1) Lempa River, 2) Paz River, 3) Paz and Sonsonate rivers (from the San Francisco River to the Copinula), 4) Bandera, Sensunapán and San Pedro rivers, 5) Pululuga and Comalapa rivers, 6) Jiboa River, 7) between the Jiboa and the Lempa, 8) between the Lempa and the Grande de San Miguel (from the El Progreso River to the Molino River), 9) the Grande de San Miguel River and 10) the Goascorán River and others. The largest of these watersheds is the Lempa River watershed, with 18,240 km^2, of which 10,255 km^2 are within El Salvador.

The Lempa River watershed covers 48.6% of the nation's total area, and is the most important water source in the country. The watershed provides 68% of the total surface water available and has three large hydroelectric dams that have been built in it: the "Cerrón Grande", the "5 de Noviembre" and the "15 de Septiembre." Through these three dams and together with Lake Guija, the Lempa River provides 95% of the electrical energy of El Salvador. There are 360 rivers in El Salvador. The smaller rivers have an intermittent flow regime, which is changing due to intense deforestation. Many of these rivers do not reach 1 cubic meter per second of average flow rate. Total surface runoff in El Salvador is 677 cubic meters per second, which corresponds to 37% of the total precipitation.

The main natural lakes in the country cover 146 km^2, divided into: Lake Guija, with 44 km^2 of which 32 are in El Salvador; Lake Ilopango, which occupies 71 km^2; Lake Coatepeque, 25 km^2 and Lake Olomega, 18 km^2. The artificial lakes in the country add up to a total extension of 190 km^2, and include the reservoirs behind Cerrón Grande (135 km^2), 5 de Noviembre (20 km^2) and 15 de Septiembre (35 km^2) dams.

Groundwater availability totals 76.8 cubic meters per second. The Lempa River watershed includes 48.9 cubic meters per second, but due to the hydrogeology of the basin, only 53% can be drafted in a cost effective manner. The Grande de San Miguel river basin provides 12.52 cubic meters per second, with the remaining basins supplying less than 4 cubic meters per second each, although exploitation of the coastal basins is limited by saltwater intrusion.

Water quality is generally poor, mainly because of untreated wastewater discharges, uncontrolled use of fertilizers and pesticides in agriculture, waste discharges from agro-industrial plants such as coffee and sugar cane, and improper disposal of solid wastes.

3.2.4 Ecosystems, Wetlands and Floodplains

The ecology of El Salvador presents a variety of ecosystems, all of which could be impacted by the water supply, sanitation and health component of the project. It is clear though, that the most sensitive ecosystem to groundwater withdrawal are wetlands, which can be found in the flatlands close to the Pacific coastline.

The major ecosystems were described in a 1975 study directed by Dr. L.R. Holdridge and funded by the United Nations. The descriptions were based on vegetation and their association:

a) Dry tropical forest, covering 17,460 hectares in the NW portion of the country, close to the Guija and the Metapan lakes. It is an area of low precipitation with little agricultural possibilities. The predominant species are the "palo de queso" (*Omphalea oleifera*) and the "talpajocote" (*Tailisia olivaeformis*).

b) Humid tropical forest, extending to 64,890 hectares in two different areas, one to the west (between Sonsonate and La Libertad) and the other to the north of San Francisco Gotera (in the Torola river watershed). The latter is an area with more than 2000 mm of annual precipitation, steep slopes and mostly occupied by agriculture and cattle development. The Sonsonate area is known for the production of balsam wood, a highly valuable export commodity for the country. The predominant species in this type of forest, probably impacted by economic interests, are the Honduran mahogany (*Swietenia macrophyllia*) and cedar (*Cedrela salvadorensis*).

c) Subtropical humid forest, more than 1.8 million hectares and as much as 85.6% of the country's territory, has monsoon-type climate: six months of continuous rain and six months of dry weather. It extends from sea level to 1700 meters above sea level, from steep slopes to coastal plains that contain alluvial soils. The lower areas register higher temperatures and remain dominated with forest, while the higher areas have been invaded by coffee plantations. The vegetation in the higher elevations are typified by *Ceiba pcutandra*, *Tabebuia rosea* and *Cedrela feseilis*, with other species present, mainly chaparral (*Curatella americana*) and some oak (*Quercus aleoides*).

The lower region presents the only real wetland area in the country. With greater temperatures than the higher areas, it reaches an extension of 45,000 hectares, basically in the coastal areas in the form of mangroves. The predominant species here is the red mangrove (*Rhizophora mangle*) and includes the Nancuchiname forest, an 1140-hectare area that has been considered for an ecological reserve. These coastal plains have fostered the growth of exotic species, locally known as "teca" (*Tectona grandis*) and "melina" (*Gmelina arborea*), well adapted to this zone because of their deciduous nature. *Crescentia alata*, locally known as "morro" grows in other floodplain areas, in the inland valleys of dark grumosole soils, subject to flooding near Chalatenango.

d) Very humid subtropical rainforest, occupying 170,280 hectares (8.1% of national territory) in the zone immediately above the humid subtropical, is advantageous because of its andosol soils for growing coffee, and it continues to be taken over by these activities. Where deeper soils are present, the association of oak (*Quercus trestis*) and "zopilocuavo" (*Piscidia grandiflora*) is the predominant vegetation. *Drypetes lateriflora* and *Manilkara chicle* are also typical, although agriculture and cattle grazing appear to be taking over this region.

e) Very humid, low mountainous-subtropical rainforest covers 33,750 hectares that correspond to 1.6% of the nation's territory, and comprises three coniferous areas known as Sabanetas, La Palma and Montecristo, in the high-volcano areas of San Miguel, San Vicente, San Salvador and Santa Ana. They are dominated by *Quercus tristis*, *Myrica cerifera* and various species of the Compositae family.

f) Very humid, mountainous-subtropical rainforest has only 360 hectares of extension and is restricted to Cerro El Pital in Chalatenango, over the 2500 m elevation. *Pinus ayacahuite* and *Abies religiosa* are the predominant trees, highly populated with epiphytes, while *Eicarceae* and *Bacharis* shrubs might constitute the major portion of vegetation in these high areas.

3.2.5 Historic and Archeological Resources

There are approximately 500 archeological sites that have been discovered in El Salvador, divided into three main orders used to classify the sites in order of importance. Only 10 sites classify as first order (structures of significance), 150 sites are of second order (structures of little significance), 250 sites are of third order (contain no structures), and the rest are of fourth order. It is expected that an equal quantity of archeological sites are yet to be discovered, although these sites most likely would be of second, third and fourth order.

Virtually all of the first order sites have been established as national monuments, but only 14 out of the estimated 750 hectares in which these structures stand have been purchased by the government. The Department of Santa Ana contains the greatest number of these (Tazumal, El Trapiche, Tehuacán, Casa Blanca—first order; Monte Vista—second order) with the Department of La Libertad having three more (San Andrés—first order; La Cuchilla and La Laguneta —second order).

Archeological resources in El Salvador lack sufficient official attention. Natural occurrences (floods, earthquakes, erosion) as well as human activity (theft, contraband and commercialization) have been the major causes for the poor conservation of these resources. There is a lack of clear and effective legislation and an absence of educational effort to protect these invaluable resources. In addition, urban and agricultural developments continue to destroy many archeological sites. It is expected that many cemeteries which have not been discovered, except by accident, will continue to be found in various places throughout the country.

3.2.6 Land use

Of the 21,000 km^2 (or 2.1 million hectares), an estimated 1.1 million hectares or more contain cattle and agricultural activities of some sort. In 1983, 592,700 hectares (28.2% of the nation's total) were dedicated to agriculture in annual, semipermanent and permanent crops, and 522,400 hectares (24.8%) were dedicated to cattle grazing and other cattle activities. Forest areas totaled 265,500 hectares (12.6%) and chaparral 628,100 hectares (29.9%). According to the Office of Agricultural Economic Policy of the GOES, 95,400 hectares were "without agricultural possibilities", of which 77,515 hectares were occupied by water bodies, urban areas and roadways.

3.2.7 Endangered Species

The endangered species list of El Salvador is lengthy considering the size of the country. Altogether there are 65 species of trees, 17 of which are concentrated and endemic to the area known as El Imposible-San Benito. Of these the Rubiaceae, the Capparidaceae, the Malvaceae and the Celestraceae families are the most numerous. Thirteen other endangered species are also endemic to another area called Montecristo, while 5 more species are in the San Salvador area. The list also includes 61 different species of flowers and 128 animals, including 5 freshwater fish, 3 amphibians, 21 reptiles, 78 birds and 21 mammals.

3.3 Socioeconomic and Political Characteristics

The population census which should have occurred in the year 1980 did not take place. However, it was estimated that by July 1 of that year, 4.5 million people lived in El Salvador. A common figure heard in 1989 estimates is "more than 5 million," although at an estimated annual growth rate of 2.5%, the population should be over 5.6 million people.

A study performed by the Ministry of Planning, cited in the "Statistical Yearbook-1980" published by the Statistics and Census Office of the GOES, considered the Economically Active Population (EAP) to be 1.5 million people, an equivalent to 33.26% of the total population at that time. Of that EAP, 78.6% were male, and 44.16% were from urban areas.

With 21,000 km^2-plus of total area, El Salvador was estimated to have at that time a population density of 216 inhabitants/Km2; the uneven distribution varied from 36 individuals/km^2 in the municipality of Periquin de Morazan to 5,884 individuals/km^2 in San Salvador. The city has experienced annual growth rates of 7.2% during recent years. Presently, the Metropolitan Area of San Salvador is estimated to have over one million people and close to 30% of the nation's total population, a rise from the 13.34% estimated in 1980.

The country is the most densely populated in all of the continent. According to recent statistics by the United Nations and the U.S. Census Bureau, over 46% of the population is under 15 years of age, with 50% living in rural areas and 50% in the urban zones. Damage and losses linked to the war are estimated at $1.5 billion. The electrical sector has received close to $60 million in damage. The national railways company, Ferrocarriles Nacionales de El Salvador (FENADESAL), which carries 30% of the cement, 40% of the coffee and 15% of the total cargo of the nation, has been the most heavily hit entity in the war and has suffered the greatest damage in its infrastructure. In addition, the roadways and highways are in poor condition, mainly due to the declining economy and restricted access for maintenance because of the war. Damage from the 1986 earthquake totaled $1.1 billion.

The Gross National Product (GNP) has fallen from growth rates of 5.4% in the 1960s and 1970s to a drop of 25% between 1980-1985, reaching 2%, 0.6% and 2.6% in 1985, '86 and '87. Trade deficit was $398.1 million in 1988. Foreign debt is at $160 million.

Social indicators for health and education show that infant mortality has descended from 77/1000 in the year 1977 to 53/1000 in 1988, although in the rural area the rate is as high as 81/1000; infant malnutrition has dropped during those years from 18% to 15%. Diarrhea is a major problem since a recent study showed that 29.1% of all children under five years of age have had it in their recent past. Illiteracy has gone down from 50% in 1965 to 38% in 1978.

Expenditures in education, though, show a decrease from 23.6% of the national budget in 1970 to 16.2% in 1985.

Migration is a highly conspicuous issue in El Salvador. It is estimated that nearly two million Salvadorans live outside their country, primarily in Guatemala, Honduras and the United States. The GOES has made official requests to other lowly populated countries to relocate citizens of El Salvador, recently to Bolivia and Australia.

Chapter 4

ENVIRONMENTAL CONSEQUENCES

4.1 Impacts of Alternative Projects and Proposed Actions

This section presents an analysis of the environmental impacts of the proposed actions and alternatives with discussions of the impacts.

4.1.1 Short-Term Construction Impacts

Construction impacts are generally short term and include dust, construction noise, siltation and erosion. All the construction activities that will take place in the project will potentially produce the above.

Appropriate construction techniques should be included in the specifications for the construction of the projects and include: use of hay bales and fabric dams which will catch the silt but allow passage of water.

Construction should be carried out preferably in the dry season, using dust control measures such as wetting.

Construction noise should be minimized and controlled so that it does not became a nuisance to the dwellings in the vicinity of the construction project.

4.1.2 Long-Term Impacts

Long-term impacts are those that affect the environment in a permanent way. The long-term impacts affect the physical characteristics of the affected environment.

Different components of the project impact on different parts of the environment. Following is a discussion of these impacts.

The project could affect wetlands and floodplains, archeological resources, land use and endangered species.

Water intakes from spring and surface waters are located in wetlands and floodplains. The projects should be designed so that they will produce as little disruption as possible to wetlands surrounding the area. Other structures and pipes should not be located on wetlands or floodplains. Any wetland that was disturbed during construction should be restored after completion of construction.

Archeological resources can be impacted by construction activities in the project. There are many archeological sites that have not yet been found and could be located in the areas of the project. During subproject planning a preliminary investigation to determine if an archeological site is likely to be found in the project area should be conducted. If there is that possibility, an archeologist should be engaged to determine the importance of the site and the need for an archeological dig. If such activity is required, the site should be documented and any artifacts should be retrieved and stored by the proper entities, such as the National Archeological Museum "David J. Guzmán" and the "Oficina del Patrimonio Cultural."

Land use will be affected by the projects. Water supply wells and handpumps should be located so that they do not encourage unwanted changes in the use of the land. Sewer systems should be designed so that they do not encourage an increase in local population.

Endangered plant and animal species could be affected by the project. In order to minimize the impact on these species the subprojects should disturb surrounding vegetation as little as possible.

4.1.3 Direct Impacts

Direct impacts are those that are immediately apparent and can be easily identified, such as construction impacts. These aspects of the project have been discussed above.

4.1.4 Indirect Impacts

Indirect impacts are those not immediately apparent, such as an increase in local population because of better water supply and sanitation systems, or the extinction of endangered species by the elimination of habitats. The projects are not likely to produce indirect impacts if properly planned, designed and constructed.

4.1.5 Energy Use Impacts

Most of the subproject components will not have an impact on energy use. The only exception is the use of electric pumps which may be needed to expand the capacities of existing subprojects.

4.1.6 Irreversible and Irretrievable Commitment of Resources

The project is contemplating the investment of substantial amounts of money from USAID and the GOES. Once the subprojects are built these resources are going to be committed and they cannot be retrieved.

It is conceivable, however, that some pieces of equipment, such as handpumps and latrines slabs, could be retrieved and used elsewhere.

4.2 Comparison of the Impacts of Proposed Actions and Alternatives

4.2.1 Water Supply

A. Sources

As Proposed: Springs

Positive Impacts:

1. Does not require energy use,
2. Usually does not require chlorination.

Negative Impacts:

1. Requires intake construction on wetlands and may dry up the water downstream where it may be used for irrigation or other uses,
2. Requires transmission pipe and storage tank construction,
3. It may impact wetlands, endangered species, archeological resources.

As Proposed: Wells

Positive Impacts:

1. It does not require construction on wetlands and flood plains,
2. If operated by hand it will not require energy use,
3. It does not require transmission pipe or storage tank if operated by hand,
4. Usually does not require chlorination,
5. Requires minimum construction.

Negative Impacts:

1. It may slightly affect archeological resources,
2. If used with pumps may require energy use, transmission pipe, and storage tank, with consequent construction and long-term impacts.

Alternative: Surface Water

Positive Impacts:

1. Easily available for communities near rivers and streams.

Negative Impacts:

1. Usually of poor quality and polluted,
2. Requires building intakes in flood plains and construction on wetlands,
3. Requires construction of transmission pipes and storage tanks, with the consequent construction impacts,
4. It will usually require treatment and chlorination,
5. It may impact archeological resources.

B. As Proposed: <u>Water Supply Transmission, Storage and Distribution</u>

Positive Impacts:

1. It will provide safe water to house taps,
2. Depending on the source quantity, it may provide water all day.

Negative Impacts:

1. Requires substantial amount of construction, with the consequent construction impacts,
2. It may impact wetlands and archeological resources,
3. It will require a larger commitment of resources.

C. <u>Watershed Management</u>

As proposed: Training of ANDA personnel

Positive Impacts:

1. It will train ANDA personnel in designs and methods to protect and manage watersheds which affect water supply sources in the project.

Negative Impacts: 1. It does not reach the people who are most likely to produce changes in the watersheds.

Alternative: Include MOH health promoters and MOE teachers in watershed management training.

Positive Impacts: 1. Watershed management will reach adults and children most likely to affect watersheds.

Negative Impacts: 1. It will require a greater training effort and may require a greater commitment of resources.

D. Water Quality Monitoring

As proposed: Complete tests to be performed every two months; at present no regular monitoring program in place.

Positive Impacts: 1. Proposed program will provide required monitoring.

Negative Impacts: 1. Will require substantial resources to provide monitoring.

Recommended alternative: ANDA with MOH would provide regular water quality monitoring. Physical-chemical tests would be made once a year, and bacteriological tests performed every two months, if possible, but no less than twice a year.

Positive Impacts: 1. This regular monitoring program will guarantee good quality water supply, and accomplish the goals of the project, with reasonable commitment of resources.

Negative Impacts: 1. A regular monitoring system will require more manpower and laboratory work and consequently will cost more.

4.2.2 Sanitation and Drainage

A. Latrines

As proposed: Community latrines; unvented, single pit to be used in schools.

Positive Impacts:

1. Will promote the use of latrines by children in school.

Negative Impacts:

1. It will produce construction (short-term) impacts.
2. It may affect archeological resources and groundwater quality in high groundwater areas.
3. It may produce odors and promote fly breeding.

As proposed: Individual family latrines, dry pit unvented, or pour flush.

Positive Impacts:

1. Dry pit latrines will minimize chance of ground water and surface contamination.
2. Pour flush latrines have water seal, are clean and do not produce odors or promote fly breeding.

Negative Impacts:

1. Both types of latrines will produce short-term construction impacts, and may affect archeological resources.
2. Dry pit latrines will produce odors and promote fly-breeding.
3. Neither type of latrine is suitable for areas with high groundwater because they will contaminate the groundwater.

Recommended alternative: Use double pit vented latrine for community latrines in schools.

Positive Impacts:

1. It will preclude odors and fly breeding.

2. It will provide uninterrupted service because it has two pits.

Negative Impacts:

1. It will produce construction impacts.
2. It may affect archeological resources and groundwater quality in high groundwater areas.
3. It will require a higher amount of resources to be built.

Recommended alternative: Use dry pit vented latrine for individual families.

Positive Impacts:

1. It will preclude odors.
2. It will avoid fly breeding.

Negative Impacts:

1. Same as the double pit vented latrines.

Recommended alternative: Use compost toilet

Positive Impacts:

1. It will preclude groundwater contamination in high groundwater areas.
2. It will preclude fly breeding and odors.
3. It will recycle nutrients to the land by using the composted matter.

Negative Impacts:

1. It will require higher commitment of resources.
2. It will produce construction impacts.
3. It may affect archeological resources.

Alternative: Sewerage

Positive Impacts:

1. Eliminates groundwater contamination near dwellings.
2. It is more convenient than pit latrines.

Negative Impacts:

1. It will produce construction impacts.
2. It may affect wetlands and archeological resources.
3. It will require a greater commitment of resources.

B. Drainage

As proposed: For handpumps and storage tanks overflows, open channel drainage is proposed.

Positive Impacts:

1. Drains excess water away from well if properly maintained.

Negative Impacts:

1. When not properly maintained ditch becomes clogged with weeds and produces pools of water.

Recommended alternative: Provide piped drainage with absorption pit or absorption field.

Positive Impacts:

1. Will preclude the formation of mosquito breeding pools of water.
2. Does not require continuous maintenance.

Negative Impacts:

1. It will produce short-term construction impacts.
2. It may affect archeological resources.
3. It will require a greater commitment of resources.

4.2.3 Training and Education

As proposed: Includes many aspects such as health, hygiene, financial management, water quality, water conservation and other.

Positive Impacts: 1. It will provide training and education in many aspects important to the project.

Negative Impacts: 1. It does not include sufficient emphasis in areas of environmental orientation.

Recommended alternative: Include aspects of environmental orientation in the training and education program.

Positive Impacts: 1. It will provide needed information presently lacking regarding important environmental aspects such as: watershed protection, soil conservation, wetlands protection, protection of archeological resources and endangered species.

Negative Impacts: 1. It will require a greater commitment of resources in the training and education program.

4.2.4 Operation and Maintenance

As proposed: The facilities will belong to the beneficiaries and maintenance will be carried out by them except for complex maintenance to be performed by ANDA on demand.

Positive Impacts: 1. It will guarantee attention from the beneficiaries so that they care and keep the facilities properly maintained.

2. Because the facilities will belong to the community they will have a vested interest in operating and maintaining the facilities.

Negative Impacts: 1. It does not include professional attention from ANDA until a serious problem requiring complex maintenance develops.

Recommended alternative: ANDA to perform a complete inspection and required maintenance once a year through its regional offices, plus complex maintenance when required.

Positive Impacts:

1. It will prevent the occurrence of more serious problems requiring greater effort to correct them once they happen.

2. It will allow ANDA to plan the maintenance program in a more rational manner.

Negative Impacts:

1. It may require a greater commitment of resources by ANDA.

4.2.5 No Action: Do not perform the activities described above

Positive Impacts:

1. No construction impacts.

2. No impacts on archeological resources, wetlands or flood plains.

3. No impact on energy use.

4. No irretrievable or irreversible commitment of resources.

5. No impact on land use.

Negative Impacts:

1. No improvement in hygiene and health of the intended beneficiaries.

2. No improvement in child survivality.

3. Continued environmental deterioration by improper disposal of human wastes.

4. No improvement in the quality of life of the intended beneficiaries.

Chapter 5

RECOMMENDATIONS

5.1 General

In this section recommendations are presented for impact mitigation, watershed protection, water quality monitoring, training, water supply sources, latrines, sewerage drainage, training and education, and operation and maintenance. Other recommendations are presented in more detail in Appendices A, B, C, D and G.

5.2 Recommendations for Environmental Impact Mitigation

The project will include the construction of several components in the subprojects. These include construction of wells, spring intakes, water transmission pipes, storage tanks, water distribution mains, latrines, and sewerage. These subprojects will produce short-term construction impacts and other long-term impacts as discussed earlier. An environmental assessment for each subproject should be performed by ANDA personnel during the subproject planning phase. A finding of No Significant Impact should be issued by the GOES, before subproject implementation, as discussed in greater detail in Appendix F. The AID/Mission Environmental Officer should conduct audits of this process from time to time.

Following are recommended actions to mitigate environmental impacts of the subprojects.

a) All wetlands impacted by construction should be restored to their original condition by replacing surface soils with native soil material and indigenous vegetation.

b) Sedimentation runoff (siltation) during construction should be minimized by utilizing siltation basins, hay-bale dams, mulching, jute netting or other appropriate techniques as required.

c) When crossing stream beds, impacts should minimized by constructing crossings at straight angles to the stream and during low flow conditions in the dry season. The stream bed should be returned to its original contours.

d) Clearing of trees and vegetation should be kept to a minimum.

e) Dust resulting from construction activity should be controlled by wetting as required.

f) Construction vehicles and equipment should be required to have suitable mufflers. Construction activities should be confined to daylight hours.

g) No fill should be placed above original contours of the sites. Excess excavation materials should be disposed of properly so that they do not produce siltation or affect wetlands.

h) Projects should be sited to avoid wetlands, flood plains, archeological sites or habitats of endangered species.

5.3 Recommendations for Watershed Management and Protection

a) Efforts should be made to perform an assessment and classification of the watersheds during subproject planning, using the forms included in Appendix E.

b) Community promotion to encourage watershed protection and preservation should begin with the community water committees. This will require training the ANDA water project promoters and the MOH health promoters in watershed protection.

c) Additional watershed management and protection efforts should be made through community schools with help of teachers and promotional materials.

d) A basic program of training and education should emphasize the relationship between watershed protection and conservation and the quality and quantity of the water supply. Given the extensive watershed destruction and deterioration through deforestation, shifting agriculture and uncontrolled use of pesticides, investments could be lost without attention to watershed preservation.

5.4 Recommendations for Water Quality Monitoring

a) Bacteriological tests should be performed on the water supplies every two months, if possible, but at least twice a year, once during the rainy season and another during the dry season. The test could be performed on site using portable kits (millipore) by either the health promoters of the MOH or ANDA personnel.

b) Physical-chemical tests including pesticides should be performed on the water supplies at least once a year during the rainy season.

c) During the development of the water supply source, quality tests should be performed to ascertain the suitability of the source for human consumption.

5.5 Recommendations for Water Supply Sources and Systems

a) Water supply sources to be used should not require treatment. The sources to be used should be springs or wells.

b) Springs should be tapped at the sources. This will preclude the possibility of contamination.

c) Siting criteria for wells and springs are discussed in Appendix B.

d) Other components of the water supply systems such as transmission piping, storage tanks, and distribution piping should be designed and constructed following the existing Design Norms of ANDA.

5.6 Recommendations for Latrines

a) Community latrines should be double pit vented type when ground water conditions are favorable (> 1.80 m below the ground surface in the wet season). A typical design of this type of latrine is included in Appendix G.

b) Household latrines should be single pit vented when groundwater conditions are favorable (> 1.80 m below ground surface in the wet season). A typical design of this type latrine is included in Appendix G.

c) Compost latrines or elevated latrines should be used when groundwater is less than 1.80 m below ground surface during wet season.

If elevated latrines are used, the bottom of the pit should be at least 0.6m above the highest elevation of the groundwater. A typical design of a compost toilet is included in Appendix G. Another design of a compost latrine is presently being installed by the MOH Department of Environmental Sanitation, in conjunction with UNICEF. Photographs and scale model of this design are presented in Appendix I.

d) Siting criteria for latrines are included in Appendix B.

5.7 Recommendation for Drainage

a) Drainage from wells and storage tanks should be provided using piping and absorption pits or trenches to avoid mosquito breeding pools.

5.8 Recommendations for Training and Education

a) The training and education programs should include environmental aspects such as watershed protection, soil conservation, wetlands protection and protection of archeological resources and endangered species.

b) The training and education program should include the basics of water quality monitoring so that MOH health promoters are able to do routine bacteriological tests on the water supply to monitor its potability.

5.9 Recommendations for Operation and Maintenance

a) Although the beneficiaries are expected to own, operate and maintain the systems, except for complex maintenance, it is recommended that ANDA institute an annual inspection and maintenance program through its regional offices.

PHOTOGRAPHS

Photo 1: Household elevated unvented latrine in high groundwater area. Not effective in avoiding groundwater contamination.

Photo 2: Household water supply tap.

Photo 3: Typical unvented household dry-pit latrine.

Photo 4: Handpump at school. Note erosion caused by overflow from hand-pump drainage.

Photo 5. Hand pump in use at community house

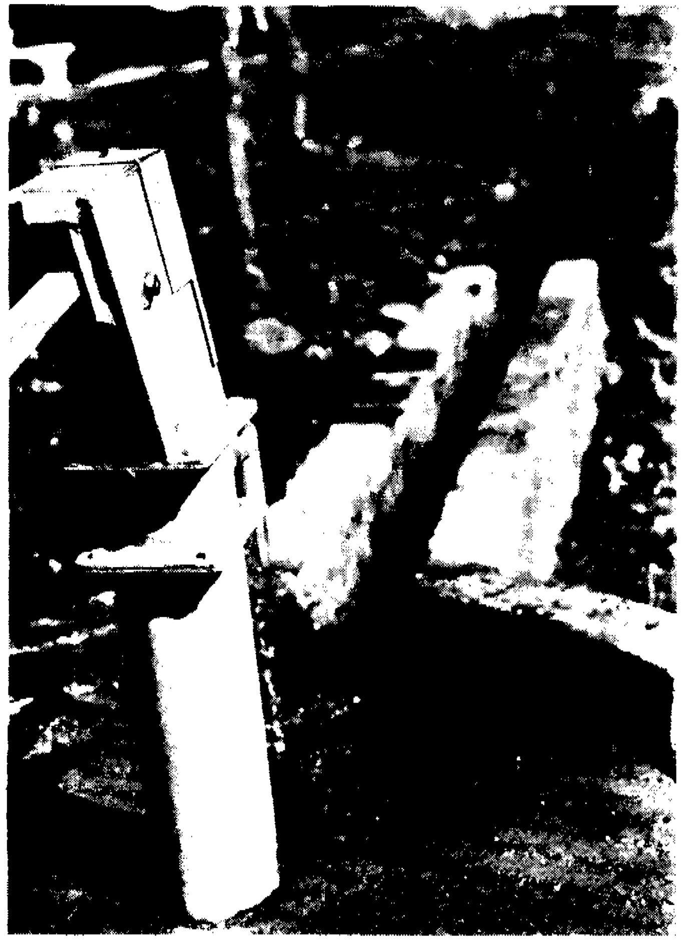


Photo 6. Handpump at the community house. Note poor drainage system and water pools.

Photo 7: Handpump at school in use.

APPENDIX A

Environmental Criteria for Subproject Selection

APPENDIX A

Environmental Criteria for Subproject Selection

The subproject selection criteria discussed in the project paper (Annex M) take into account accessibility, community support, national priorities, related interventions, socioeconomic return, other donor activities, relative financial cost, equity, covering of recurrent costs, documentation of need, related school programs and community size. The following are suggested as environmental criteria for subproject selection.

Suggested Environmental Criteria

Subprojects should not be located in areas where they will produce significant negative impacts on:

- wetlands and floodplains,
- historical and archeological resources,
- endangered animal and plant species, or
- groundwater quality.

APPENDIX B

Siting Criteria Review

APPENDIX B

Siting Criteria Review

All of the structures related to Water Supply, Sanitation and Health have in the past been sited, in part using guidelines from hydrogeologic studies, but also using criteria exercised in the field, and based on common sense and experience of the personnel involved in the project. Many times this decision has come down to a consensus of all those involved, including the community.

There is a definite need for standardizing this decision making process. This in turn will help reduce the cases of wells contaminated by latrines or any other source, or wells being flooded by rivers that have "grown" in the rainy season of wetter years, beyond recent memory.

B.1 Existing standards

In order to establish viable criteria for future sites for wells, springwater intakes or latrines, a careful review must be performed on any and all norms, written or unwritten, that have been taken into account by the different agencies in previous efforts.

B.1.1 Wells

The major consideration taken into account by all agencies when providing a community with freshwater wells is that they be at a safe distance from any possible contamination source. And although there are cases in which the distance from a latrine is less than 15 m, this seems to occur more due to actions from the villagers than from sanitation or health institutions.

One of the major institutions involved in the siting of wells has been the Pan-American Health Organization (PAHO). This organization renders a decision based on hydrogeologic considerations as well as common sense to avoid obvious contamination points. A definite minimum distance from these possible contamination sources has not been agreed upon, although 15 to 20 m seems to be an unwritten norm. But the major problem associated with this process is that PAHO only offers a recommendation, which is subject to change by other parties involved, and which, according to PAHO, has in some cases resulted in a less than desirable range.

A community wanting a well makes a request to AID, which notifies ANDA of the need. ANDA in turn performs a field inspection to verify the status of the problem, then requests a hydrogeologic study by PAHO, which after performing the study recommends a drilling site. ANDA then returns to the community to propose that site. At this point the decision is made, one that might include non-technical considerations, like the distance from the center of the community to the well, or other aspects that are secondary to the technical rationale. There is no written process to be followed by all those involved.

B.1.2 Springwater intakes

To take advantage of a freshwater spring, the only prevalent criterion is that the intake structure be constructed as close to the spring as possible. No maximum distance has been established. The removal of vegetation in the immediate surroundings is kept to "as little as necessary" and is based on the good judgment of the field personnel involved in the project. As in the case of wells, there are no written guidelines to be followed by the involved parties.

B.1.3 Latrines

Siting a latrine is practically left to the convenience of the future user, with recommendations merely provided by the agency involved. The minimum distance seems to be observed in the overwhelming majority of cases, but there are instances where sanitary norms are overridden by personal considerations. No written code exists to regulate the decision making process.

B.2 Proposed changes to the standards

Whatever norms, rules or regulations are observed in the siting of structures should be integrated into a document that can be regarded as the standard. This document could be referred to as Norms for Siting Wells, Latrines and Springwater Intakes (Normas para la ubicación de pozos, letrinas y obras de toma para manantiales), and should include guidelines for all institutions involved in water supply, sanitation and health projects in the country. It is recommended that the following specifications be incorporated into the guidelines.

B.2.1 Wells

Almost all of the issues considered presently while siting a well appear to be appropriate, although a standard needs to be set to make the process objective. Based on a literature review, we recommend the following guidelines:

A feasibility report for the location of freshwater wells in every community should include:

- Character of local geology; slope of ground surface.
- Nature of soil and underlying strata (whether clay, sand, gravel, rock, especially porous limestone); coarseness of sand or gravel; depth of water-bearing stratum, expected depth of water table; location, log of local wells in use or abandoned.
- Slope of water table as determined from observation of other wells, or as indicated by ground surface.

- Extent of drainage area likely to contribute water to the supply.

- Nature, distance and direction of local sources of pollution.

- Possibility of surface-drainage water entering the supply and of wells becoming flooded; methods of protection that can be implemented locally by the villagers.

For wells having an intake depth of 20 m or more, the minimum acceptable distance from any contamination source may vary depending on the formations that exist in the area:

- Unconsolidated: 20 m. Lesser distances only after a comprehensive sanitary survey and physical inspection of the site and immediate surroundings.

- Unknown: 50 m. Unless a thorough geologic survey can be performed to establish that favorable formations exist.

- Consolidated: 50 m.

As a general rule, and where available geologic information is poor, the distances between a well and any possible contamination source should be restricted to the following:

- 50 m from a seepage or cesspool;

- 30 m from soil absorption systems;

- 30 m from a pit or a septic tank;

- 30 m from animal pens, barns or silos.

The norms or guidelines document should also include the following:

- The locations of all wells should be designated by the entity that is responsible for the hydrogeologic study (PAHO). Whenever possible, wells should be drilled at the designated site, or the rationale in changing the site should be included in the project log book, a new site clearly designated, with all points of the feasibility report counterchecked against this new designated site, and signed by the entity responsible for the hydrogeologic study.

- Wells should be located away from floodplains and wetlands and from any flatland that is or has been subject to inundation. They should be as elevated as the hydrogeologic conditions permit.

- Whenever possible, wells should be sited up-gradient from contamination sources in the area. If this condition cannot be met, wells should be sited at least 50 m away from contamination sources, regardless of the geologic formation of the area.

B.2.2 Springwater intakes

Prior to siting a springwater intake, the dependability of the source should be evaluated. It is recommended that the proposed source be monitored for two consecutive years during the dry season (March or April) before designating it as dependable. The lowest flow during the monitoring period should be equal to, or greater than, the maximum daily demand of the population to be served. A flow of 300 liters (75 gallons) per capita/day should be the basis for calculations and comparisons.

The water should be tested twice a year prior to establishing the source as acceptable. The quality of the water should meet the *International Standards for Drinking Water* published by the World Health Organization without the benefit of any treatment whatsoever.

After the spring is established as a viable source, the intake must meet the following minimum requirements:

- Location of intake must be at, or as close to, the source as possible so as to preserve the quality of the water.

- The intake structure should in no case allow the water to flow over a surface that will erode or dissolve under normal flow.

B.2.3 Latrines

The siting of latrines must also be based on a standard set of norms. Most of these are being observed but have been left unwritten. The following additions are recommended:

- The siting of latrines should be performed in accordance with the set of written guidelines referred to earlier (Norms for Siting Wells, Latrines, and Springwater Intakes).

- All siting of latrines must be made by a member of one of the agencies involved in the water supply, sanitation and health effort of the GOES, in accordance with the set of guidelines.

- The location of latrines should observe the minimum distances required from wells or any other water source. If unconsolidated formations are present in the underlying strata, the minimum distance from any water source should be 20 m while in areas overlying consolidated formations, the minimum distance from any water source should be 50 m.

- The latrine should be for the use of one family only or for use in schools and public buildings.

- The latrine should be located at the point where the groundwater is deepest, spotted through visual inspection and/or recalled immediately by the local community after the rainy season.

- The type of latrine selected should depend on the lowest groundwater depth that can be recalled at the chosen site, in accordance with the following:

  - From 0.00 to 1.80 m : Elevated Composting Latrine (double chamber, type UNICEF)

  - From 1.81 m and more: Ventilated Improved Latrine (double or single pit)

  - For one-family dwelling: single pit

  - For schools, public buildings or multiple family dwellings: double pit, chamber.

- Under no circumstances should the groundwater table come within 60 cm of the base of the pit of the latrine.

APPENDIX C

Construction Practices Review

APPENDIX C

Construction Practices Review

In accordance with the scope of work, what follows is a brief review of the construction practices that are in place in Component III of the Project. This review is an analysis of documents that indicate the norms and methodology that should be followed throughout the construction process, but also an evaluation of how the written norms are enacted in the field and how the quality of the work is controlled.

C.1 Existing standards

C.1.1 Wells

The major norms regulating the construction of freshwater wells are contained in two documents: ANDA's Technical Norms (*Normas técnicas para el diseño y construcción de acueductos y alcantarillados sanitarios*), and the Bidding Document No. 16 provided by ANDA-AID for contractors and containing technical specifications on "Well Perforation and Installation of Hand-pumps." What follows is a brief summary of findings.

In the bidding document, ANDA provides information related to the physical features of the well, the construction process, construction specifications and a clear description of how the well should be cleansed through continuous pumping until the water is free of particles. Hydrogeologic information of the work region is also provided.

The technical information defines the scope of work for the contractor as "..the contractor will drill, design and deliver in the indicated site, one or more deep wells .." (ET. 1.1). The action of drilling is defined as "..the penetration of the ground through mechanical means at depths beyond 20 meters .." and points out the verticality as that "permitted by the norms of the American Water Works Association (AWWA) for drilling wells." (ET. 1.2)

The document establishes that the bore of the well should be a minimum of 8" in diameter. The drilling should be performed with a rotating drill equipped with direct grout circulation or reversible or hydropneumatic.(ET. 3.1)

During the drilling, samples should be taken of each of the formations encountered (ET. 3.3) and/or every 10' of depth. The drilling speed should be controlled by logging the time used for every 2 feet drilled (ET. 3.2). The rotating drill should be equipped with grout with a viscosity to be controlled in accordance with norms from the American Petroleum Institute (API). (ET. 3.4)

The intake screen recommended is 4" in diameter and made of PVC-plastic, SDR-26, ASTM F 480-76 or ASTM D 2241-76. (ET. 5.3b). The casing should be the "same specifications as the screen." (ET. 6.1b). This is in apparent contradiction with the Technical Norms published by ANDA, which state that the "sections of the casing should be joined by electrical welding .." alluding to steel and not plastic as the appropriate material.

C.1.2 Springwater intakes

There are fewer regulations for the construction of springwater intakes than for the construction of wells. Only one paragraph of ANDA's Technical Norms is dedicated to these structures. It states that the springwater intake, "..whether in hillsides or flatlands should include overflow pipe, cleanout and ventilation. It should also be provided with inspection hole to guarantee its cleanliness. It will be made of rock masonry, clay bricks or concrete, in all cases guaranteeing its sanitary security."

C.1.3 Latrines

There are a large variety of latrines being used presently in El Salvador, although many of them are just variations on the single dry-pit latrine. These variations concern the location of the superstructure with relation to the pit itself. Some latrine superstructures are directly over the pit, others are slightly in front of it and allow for future relocation of the pit or the possibility of cleaning out the used pit. Another variation on the dry-pit latrine is the elevated latrine, which is used in places where the water table is practically at surface level, with the intention of eliminating groundwater contamination.

The pour-flush porcelain latrine used recently by ANDA-AID in essence is not a dry-pit latrine. It uses a one-litre pour-flush system to transport the waste to the pit, which is located to the side of the shed to permit relocation of the pit as many times as necessary.

Another type is the elevated compost-latrine, to be built in the coastal areas by the Ministry of Health together with UNICEF. This consists of a two compartment latrine built over sand-cement blocks with the ability to separate urine and deliver it to a gravel drain outside the latrine compartment, while delivering composted feces through a back removable cover. The clean-out feature of the compost latrine gives this structure a permanent life-span, and is considered appropriate for places where a very shallow water table exists. Set-backs associated with its use are the need for maintenance (requires ash and once-a-week stirring) and a higher cost (perhaps twice as much as the single dry-pit latrine).

The technical information on the dimensions, materials and other specifications is provided through construction plans. PLANSABAR provides very specific drawings on the single dry-pit latrine, with the materials for the shed being the only variations observed. There are no written technical norms published by ANDA as construction guidelines specifying materials or dimensions.

C.2 Proposed changes to those standards

C.2.1 Wells

An irregularity exists regarding the materials of which well casing should be constructed. Although the technical norms published by ANDA allude to the use of steel, recent work has been performed with PVC pipe, as determined by the bidding documents provided to the contractor by ANDA. There are definite advantages and disadvantages to both types of material. While steel casings offer more security against horizontal shear forces caused by seismic activity, there are corrosion problems associated with its use which are absent when using PVC piping. But PVC piping offers little support against any horizontal movement and is subject to breakage, promoting the influx of shallower, lower quality water and/or collapsing.

It is recommended that an in-depth study of this issue be performed to identify areas where corrosion is more apt to occur and to what extent this is a problem in each area of the country. Thereby a decision can be made on whether PVC or steel is more advisable. It must be noted that ANDA's experience and therefore its norms are related to deeper and bigger wells, where greater resistance by the casing material is definitely required. The lack of uniformity in both documents should in any case be corrected.

The overflow drainage system integrated into the construction of the wells has not produced the desired effect. The presence of ponding or small-stream erosion can be seen in more than one hand pump well already constructed. This is basically due to the absence of a drainage pit or absorption well at the end of the concrete ditch. It is recommended that the absorption well be built with clear specifications regarding the dimensions and the materials to be used. The pit should be filled with a very porous material like sand or gravel, and should allow for side wall absorption and surface evaporation. It would have to be of the order of 5 to 7 feet in depth and 4 to 7 feet in diameter. The dimensions would depend on the permeability of the subsoil.

The overflow of storage tanks should be piped to an existing natural stream or drainage. Present facilities pipe the overflow to a nearby spot where the water is expected to disperse or follow a drainage ditch. This practice has not eliminated the ponding problem in all cases. Piping to an existing natural stream is also an alternative approach to manage the overflow of wells and eliminate the ponding problem there also.

C.2.2 Springwater intakes

In order to safeguard the quality of the water captured from a spring, technical specifications need to be expanded. The following measures are recommended:

- The intake structure should isolate the water from possible sources of contamination, such as surface water or seepage from animal or human waste.

- Structure should be fenced and/or screened to prevent animals from coming in contact with the water.

C.2.3 Latrines

Dry-pit latrines

Odor problems present in the dry-pit latrines being used can be resolved by adding a ventilation pipe, properly equipped with a fly screen and cover. This minor addition is one of the changes recommended in this type of latrine, which is shown in Appendix G and is called the single-ventilated improved pit latrine. Other changes refer to the location of the pit with respect to the superstructure and the use of double-ventilated improved pit latrines (Appendix G) in public buildings. It is recommended that the single-ventilated improved latrine be constructed so that the shed need not be moved when the dry pit is filled. The double-pit latrine is considered to be adequate for schools and other public buildings, with 20-25 persons/latrine being required as a ratio.

Pour-flush latrines

As a way of allowing gases to exit the pit, a ventilation pipe needs to be added to the design. The addition of a clean-out feature (a T-joint) is advisable to allow maintenance on the porcelain seat.

Elevated compost latrines

This type of latrine (shown in Appendix G) offers great advantages but is twice the cost of a dry-pit latrine. More research on the materials being used is recommended. It is estimated that close to US $30 is spent by the Ministry of Health-UNICEF per latrine. The use of other materials on the walls, such as ferro-cement (thin membrane cement) instead of building blocks, could lower overall cost.

Of major importance is that each type of latrine should be suited to the different physical conditions of each environment. In areas of shallow groundwater (close to wetlands), the elevated compost latrine is necessary to avoid contamination. Where groundwater is deeper, and the presence of water is not a problem, the use of the pour-flush latrine could prove to be the most adequate. In areas of poor water availability, the S-VIP latrine may be the option. There is a place for every type of latrine, but criteria must be clearly established and written into the technical norms to prevent improper choices of these sanitary structures.

APPENDIX D

Water Quality Monitoring Programs

APPENDIX D

Water Quality Monitoring Programs

D.1 Existing programs

The Ministry of Health has the responsibility to oversee water quality monitoring and control, as established by the Decree No. 50 published in the official newspaper on October 16, 1987. The Ministry's standards are outlined in the "Apuntes Sobre la Calidad de las Aguas de Uso Potable", prepared by the Department of Environmental Sanitation (Depto. de Saneamiento Ambiental), MOH.

ANDA and PLANSABAR have programs that monitor the water quality of the projects they have built. Both institutions have laboratory facilities capable of performing bacteriological and physical-chemical tests. ANDA also has purchased enough millipore kits for field tests to assess the bacteriological quality of the water on site. Although pesticide tests are beyond the capabilities of both of these institutions, CENTA (Center for Agrological Technology), a division of the Ministry of Agriculture, has performed them in the past. The installed capacity for a complete testing and monitoring program for pesticides in foodstuffs is also available.

It appears, however, that testing hand pump installations in the rural areas has not been regular.

D.2 Proposed programs

Annex H of the Project Paper proposes that water testing routines be enforced and that bacteriological and chemical analyses be done at least every two months. This program seems too ambitious and probably onerous for the institutions. We believe that the water quality should not vary considerably every two months with regards to physical and chemical characteristics. As far as the bacteriological tests, these could be performed on site with more regularity, although every two months may be excessive due to the numerous installations to be monitored.

D.3 Recommended changes

The water quality monitoring programs should be carried out on a regular basis for all installations, including hand pumps. The program should include annual tests of chemical and physical characteristics, including pesticides, and an effort must be made to link the installed capacities of the Ministries of Health and Agriculture.

Bacteriological tests should be performed more frequently. The suggested period for these tests in the Project Paper is two months. If this periodicity can be met, given the number of projects to be constructed, the program should be more than adequate. A semi-annual test program, i.e. one test every six months, should be regarded as a minimum. The health promoters of the MOH could be trained to perform these tests using the millipore kits purchased by ANDA.

It is inferred that the rainy season represents the single most significant physical factor that will promote a change in water quality. Therefore, these semi-annual tests should coincide with the beginning and end of the rainy season. A third bacteriological test in the middle of the season may also prove worthwhile, although personnel and financial restrictions may be limiting factors.

APPENDIX E

Environmental Review Survey Form

APPENDIX E

Environmental Review Survey Form

Person______________________________ Date ____________________

A. Name and location of community (Caserío, Cantón, Municipio, Departamento)

(NOTE: Provide community profile data)

B. Watershed Factors

1. Present Condition:

	YES / NO	COMMENTS
__Excellent__:		
Without erosion or deforestation problems, little human impact, quantity and quality of water is excellent, positive stability tendency, natural regeneration occurring.	(___)(___)	____________________
__Good__:		
With small problems of deforestation and limited human impacts, quantity and quality of water is good, some negative stability tendency, mostly natural regeneration occurring.	(___)(___)	____________________
__Poor__:		
Much deforestation and erosion, moderate level of human impact, quantity and quality of water is variable, stability tendency is negative, little natural regeneration.	(___)(___)	____________________
__Bad__:		
Very bad deforestation and erosion, high level of human impacts, quality and quantity of water is very variable, stability tendency is negative, very little natural regeneration.	(___)(___)	____________________

	YES / NO	COMMENTS
2. Activities in Watershed		
Traditional Agriculture (Corn and Beans, Zacate)	(___)(___)	____________________
Production Agriculture (Bananas, Coffee, Sugar Cane)	(___)(___)	____________________
Cattle Grazing	(___)(___)	____________________
Forest Harvesting	(___)(___)	____________________
Family Dwellings	(___)(___)	____________________
Other (identify)	(___)(___)	____________________
No present activities	(___)(___)	____________________

3. Land Ownership in Watershed (describe)

Private lands: ____

National lands: ____

Undocumented lands: _____________________________________

	YES / NO	COMMENTS
4. Conservation Potential for Watershed and Water Source		
Community land rights established in watershed (e.g., any legal process through Municipality or other)	(___)(___)	____________________
Reforestation methods applicable (e.g.,planting, vegetation conversion)	(___)(___)	____________________
Protection methods applicable (e.g., fencing)	(___)(___)	____________________

Management practices applicable
(e.g., erosion controls, alternative
grazing lands) (___)(___)______________

5. Hydrologic Characteristics

a. Duration of rainy season: ______________

Duration of dry season: ______________

Duration of canicula: ______________

b. Approx. annual precipitation: ______________

Approx. size of watershed: ______________

Approx.cover of natural vegetation (%): ______________

c. Sources of contamination, describe if applicable:

Dwellings: ______________

Pesticides: ______________

Fertilizers: ______________

Cattle: ______________

Erosion: ______________

Others: ______________

d. Existing users of proposed water source,

Describe if applicable:

Animal use, e.g., cattle: ______________

Irrigation uses: ______________

Family use: ______________

Others: ______________

e. Water quality of water source

Chemical/physical: ____________________

Bacteriological: ____________________

Pesticides/hydrocarbons (if suspected): ____________________

C. Groundwater Factors

	YES / NO	COMMENTS
1. Present condition:		
<u>Low groundwater table</u>: (below 40 m) Little contamination potential from latrines	(___)(___)	____________
<u>Moderate groundwater table</u>: (4 to 40 m) Possibility of contamination from latrines, unless 30 m separation from latrines is maintained	(___)(___)	____________
<u>High groundwater table</u>: (0 to 3 m) Latrine contamination potential is high without protection measures or special designs, with or without hand dug wells	(___)(___)	____________

2. Seasonal variation in groundwater table (describe)

Dry season: ____________________

Wet season: ____________________

3. Existing wells in community

Number: ____________________

Average depth: ____________________

Static water level: ____________________

4. Existing latrines in community

Number: ______________________________

Average age: ______________________________

Pit or surface type: ______________________________

5. Reports of groundwater quality related problems (e.g.,contamination, teeth problems.)

Describe: ______________________________

6. Records of tests of groundwater quality

Chemical/physical: ______________________________

Bacteriological: ______________________________

Other: ______________________________

D. Land/Geologic Factors

	YES / NO	COMMENTS
1. Drainage Conditions Within Watershed:		
Mountainous:		
Lands very steep with high peaks and deep valleys, generally high in elevation	(___)(___)	______________
Rough:		
Some steep lands and valleys, moderately sloped lands occurring, moderate elevation	(___)(___)	______________
Undulating:		
Rolling lands with few steep parts, some gradual slopes, moderate elevations	(___)(___)	______________
Plains:		
Mostly flat lands, little natural drainage, low elevations	(___)(___)	______________

2. Drainage Conditions Within Community:

Mountainous/rough:

Broken up and mostly steep slopes with very defined natural drainage ways (___)(___)____________________

Undulating:

Some natural drainage due to elevation differences, some flat areas with ponding waters (___)(___)____________________

Flat:

Many flat areas with ponding waters, poor natural drainage (___)(___)____________________

3. Soils:

a. Watershed soils

- rocky, little top soils (less than 30 cm) (___)(___)____________________
- medium soils (30-60 cm) (___)(___)____________________
- deep soils (90 cm) (___)(___)____________________

b. Community soils

- rocky, little top soils (less than 30 cm) (___)(___)____________________
- medium soils (30-60 cm) (___)(___)____________________
- deep soils (90 cm) (___)(___)____________________

c. Degree of erosion evident

- watershed erosion, describe: ____________________________
- community land erosion, describe: ____________________________

d. Soils conservation practices evident:

- watershed practices, describe: ____________________________
- community practices, describe: ____________________________

ENVIRONMENTAL REVIEW MATRIX FORM
FOR
RURAL WATER AND SANITATION PROJECTS

Note:

Information to be based on a completed Environmental Review Survey.

I. WATERSHED FACTORS

A. Present Condition: Implications and Appropriate Actions

Excellent:	(__)	Primary actions should be preservation oriented, especially community land rights establishment. Watershed restrictions/preservation are the most feasible techniques.
Good:	(__)	Preventive measures need emphasis, community land rights, conservation techniques, some reforestation, fencing of defined area to protect water source/watershed.
Poor:	(__)	Comprehensive approaches needed, interagency coordination essential, need for community land rights, reforestation, fencing of water source/watershed, water system longevity in jeopardy.
Bad:	(__)	Land may be beyond repair, potential for water system to serve useful life of 20 years very poor, comprehensive rehabilitation may be needed before establishing a water system.

B. Activities in Watershed/Contamination Potential

Heavy agricultural use:	(__)	Danger from uncontrolled use of chemicals and pesticides, erosion controls needed with conservation emphasis, water sources highly vulnerable.
Cattle grazing:	(__)	Contamination potential if no fencing containments used, field rotation needed, with conservation emphasis to avoid erosion from overgrazed land, water sources highly vulnerable, possibility should be investigated to relocate cattle and retire/preserve watershed areas.

Family dwelling:	(__)	Degree of contamination potential proportional to dwelling densities, emphasis needed on community land rights establishment, conservation practices, fencing watershed and reforestation. Also wastes control, e.g., latrines.
No present activities:	(__)	Emphasis on community land rights establishment, conservation/preservation practices, fencing and monitoring by community.

C. Land Ownership in Watershed

Private lands:	(__)	Communities may work through the GOES to pay for lands to be reserved or to relocate dwellings. Direct negotiations with land owners needed. Financial costs may be high.
National lands:	(__)	Communities must work through the GOES. Negotiations with land dwellers needed to limit activities, establish boundaries and improve watershed. Negotiated payments may be necessary to restrict watershed lands. Financial costs should be reasonable.
Undocumented lands	(__)	Community must petition local municipal mayor (Terreno Ejidal) for land rights to protect and conserve watershed. Land dwellers practices can be modified or alternatives sometimes found, e.g., relocate cattle grazing lands. Financial costs should be reasonable.

D. Conservation Potential for Watershed and Water Source

Community land rights established in watershed	(__)	Best potential to establish watershed restrictions and conservation, fencing protection possible and ability to undertake reforestation program if needed, longevity of water source enhanced, costs usually dependent on land ownership and size of protection area defined as necessary.
Reforestation methods applicable	(__)	Emphasis on appropriate species planting, lowest cost alternatives selection, community participation and usually intensive efforts combining soil conservation techniques and watershed protection measures, e.g., 5-month growth followed by planting and monitoring for minimum 2 years to establish new growth. Can be extensive undertaking but essential to rehabilitate areas in need.

Protection methods applicable	(__)	Emphasis on preventive measures, restricted access, fencing, community monitoring, prohibited activities like cutting, burning and planting, limits on additional dwellings, cattle grazing. Reasonable costs usually anticipated.
Management practices applicable	(__)	Emphasis on erosion control, soil conservation techniques, possible relocation and rotation of grazing lands, natural fertilizer use and promotion of permanent types of agriculture. Where needed, conservation techniques are essential to prevent further watershed deterioration. Also essential to protect long-term water quality of water source.
Restricted water source usage, i.e., at source	(__)	Community restricted use has best potential to allow physical protection at a water source; fencing possible; minimizes competition for water; longevity dependent on watershed conservation. Overuse, e.g., water to be shared with irrigation or animal watering may compromise community water use.

E. Water quality tests

Bacteriological analysis:	(__)	Usually most important test to establish potability, tests may indicate human or animal fecal contamination and need for immediate preventive actions, chlorine addition offers disinfection and a degree of safeguarding from recontamination. Continual testing, record keeping and monitoring highly recommended.
Chemical/physical analysis:	(__)	Useful for initial determination of potability, little modification potential if outside boundaries of chemical quality; treatments possible for physical parameter control, e.g., filtration, sedimentation techniques. Also useful to perform periodically to monitor water quality changes over time, impacts from watershed activities and seasonal variations.
Pesticides/ hydrocarbon analysis:	(__)	Useful for baseline determination of potability, especially if chemical applications occurring in watershed; may indicate need to control/change practices in watershed. Determinations needed during rainy and dry seasons to understand variations and effects of runoff. Very useful for long-term monitoring and contaminant control in sensitive watersheds.

II. GROUNDWATER FACTORS—WATER WELLS AND LATRINES

A. Water Table: Implications and Recommended Actions

Low, below 40 m (___)	Little groundwater cross-contamination potential if standard sanitary protection is used at a well. Water quality usually stable, low monitoring level necessary.
Moderate, 4-40 m (__)	Hand pump wells applicable, emphasis on proper location and protection should complement proper latrine promotion; contamination potential exists if sanitary protection measures ignored; water quality is vulnerable, continual water quality bacteriological monitoring needed.
High, 0-3 m (__)	Implies need for special designs of latrines to prevent cross-contamination in watertable; may be impossible for pit-type latrine to function, surface composting latrine types are applicable if maintained and compatible in design with the community. Water wells need regular bacteriological monitoring and maintenance to maintain potability.

B. Existing Wells or Latrines in Community

Significant number present, e.g., multifamily wells and family latrines common (__)	Implies need to determine present potential of cross-contamination and adequacy of designs in place, may result in design modifications before additional wells/latrines can be safely provided.
Low number present, e.g., few wells and family latrines (__)	Less potential impact from present wells or latrines, some care needed in locations where present designs are inadequate to protect new installations, e.g., avoid wells in vicinity of latrines in high groundwater table areas.

III. LAND/GEOLOGIC FACTORS

A. Drainage Conditions in Watershed

Mountainous or rough lands: (__)	Erosion potential high, soil conservation emphasis needed, watershed management program essential to establish longevity of water source; contamination prevention measures are critical.

Undulating or flat lands:	(__)	Some erosion potential and soil conservation measures needed. Watershed management program essential to establish longevity of water source; contamination prevention measures are usually less difficult but still essential.

B. Drainage Conditions in Community

Mountainous or rough lands	(__)	Soil conservation practices needed, adequate drainage usually not problematic, water wells and latrines need standard protection from runoff intrusion.
Undulating or flat lands	(__)	Drainage improvement measures may need attention and possible construction of cross-ditching, piping, drainage pits. Recontamination potential is high for standing pools of water; disease-carrying vectors can breed also. Emphasis needed also on individual drainage pits at well sites and family waste-water discharge.

C. Soils

Watershed soils

Rocky, under 30 cm	(__)	Most erosion potential and need for soil conservation techniques and watershed management program; most potential for contamination of water source; may imply need for serious rehabilitation measures in watershed, i.e., if deforestation has occurred.
Medium, 30-60 cm	(__)	Moderate erosion potential, need for soil conservation to preserve watershed, watershed management program needed to preserve water source longevity.
Deep, 90 cm.	(__)	Excellent soils with good potential for longevity of a water source if watershed protection measures applied. Most feasible areas to establish new vegetation and soil conservation measures to minimize erosion.

Community soils

Rocky, under 30 cm	(__)	May imply need for surface type composting latrines. Surface runoff contamination potential is high with need to protect wells and latrines from intrusions. Waste water may need piping to reach absorption areas.

Medium to deep 30-90 cm	( )	**Standard latrine designs usually applicable if no high groundwater problems present. Contamination potential less but still imperative to provide protection from runoff intrusions and proper drainage of used waters.**

Reviewer Comments:

____
____
____

Positive or negative environmental evaluation (based on environmental factors presented):

____
____
____

BY: ____________________________ **date:** ________________

APPENDIX F

Typical Report Format For A Subproject Environmental Assessment

APPENDIX F

Typical Report Format For A Subproject Environmental Assessment

A. Project Identification

Project Name:____________________

Address:____________________

Project Location:____________________

Project Number:____________________

B. Summary of Environmental Review

1. Project description. (Provide a complete description of the project, including all of its elements, locations, plans and intended construction schedule.)

2. Purpose and need. (Describe the purpose and need for the project.)

3. Discussion of alternatives. (Describe and discuss alternatives investigated for the project, such as water supply sources, pipe routes, intake and tank locations, etc. and the no-action alternative. Include figure showing alternatives.)

4. Impacts of the proposed project on the environment

   a. Direct impacts

      1) Water quality

      2) Environmentally sensitive areas

         - floodplains
         - wetlands
         - stream modifications
         - dredge and fill requirements

      3) Socioeconomic impacts. (Describe the costs and benefits of the project and its impact on the beneficiaries.)

      4) Historical and archeological impacts. (Describe impacts on historical and archeological resources, if any.)

5) Endangered species. (Describe impacts on endangered plant and animal species, if any.)

b. Indirect impacts. (Describe any indirect impacts such as induced growth.)

5. Mitigation of environmental impacts. (Describe mitigation measures to be implemented to minimize impacts of the proposed project.)

6. Summary of agency and public consultation. (Indicate meetings and other consultation carried out for the preparation of the environmental assessment.)

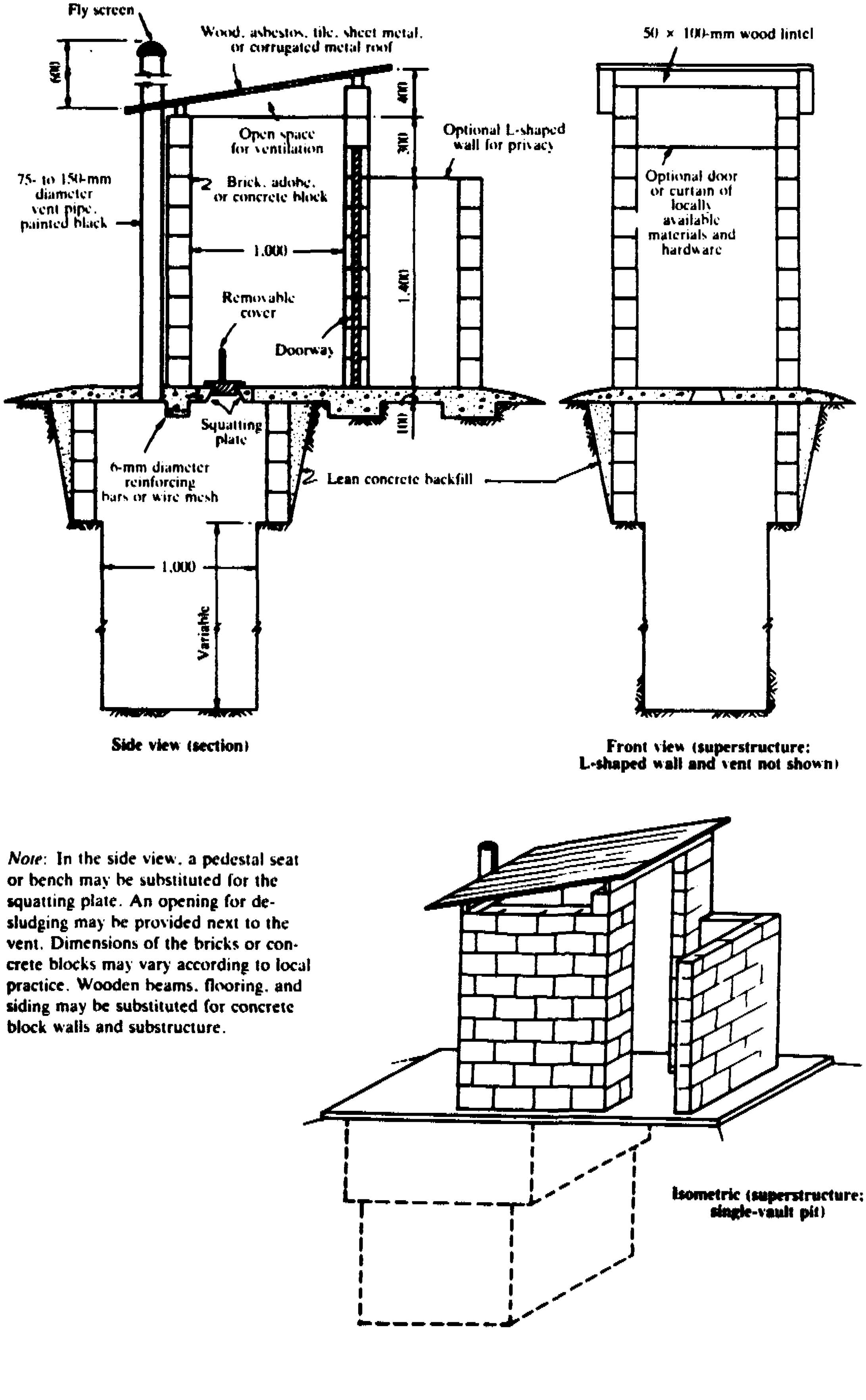
C. Finding of No Significant Impact

For the project to proceed, a Finding of No Significant Impact should be issued by an agency charged with the protection of the environment by the GOES. In the absence of such an agency, for projects funded by AID/GOES this finding could be issued by the Mission Environmental Officer.

APPENDIX G

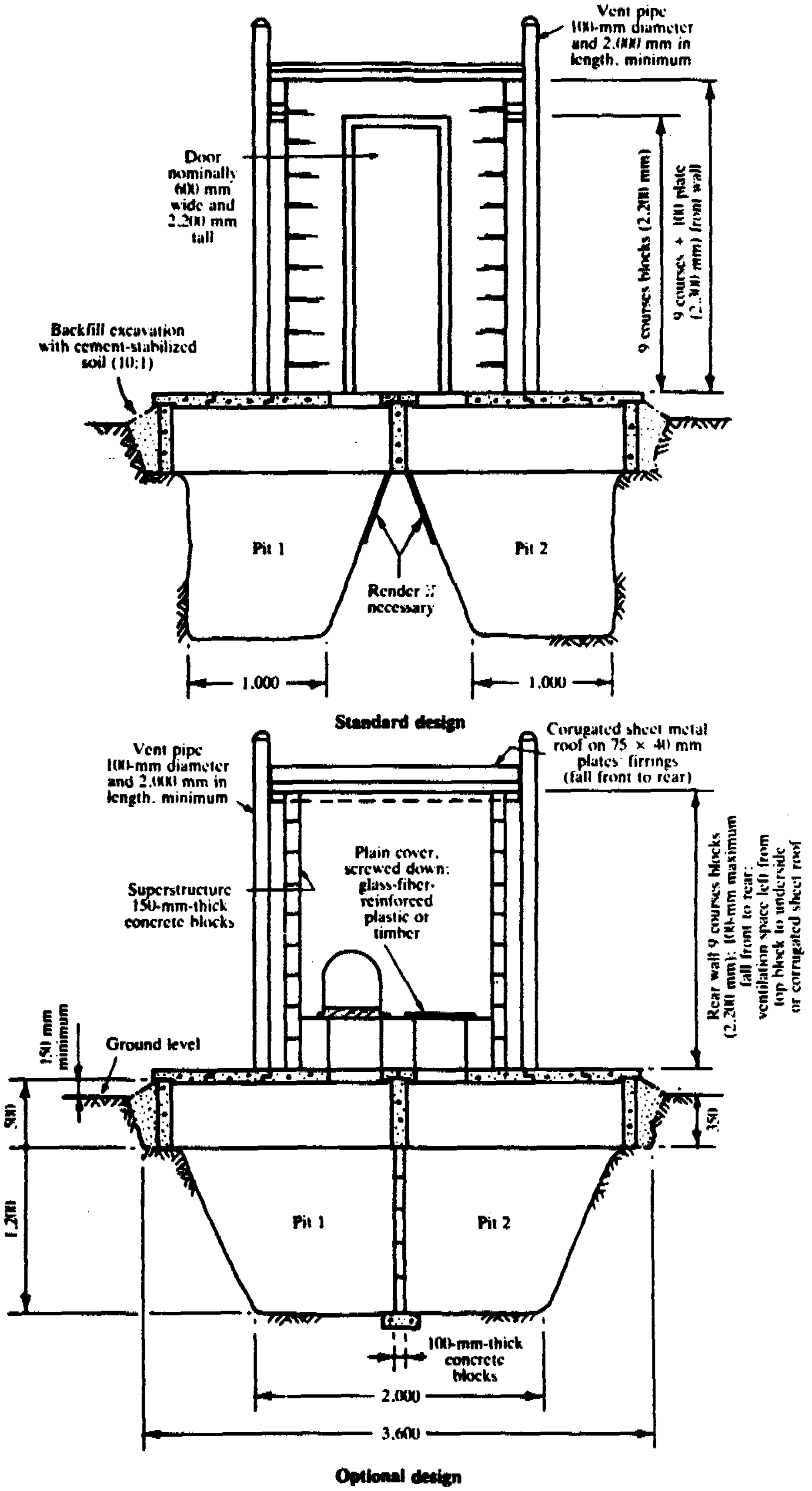
Recommended Typical Designs for Latrines

Figure 10-2. *VIP Latrine*
(millimeters)



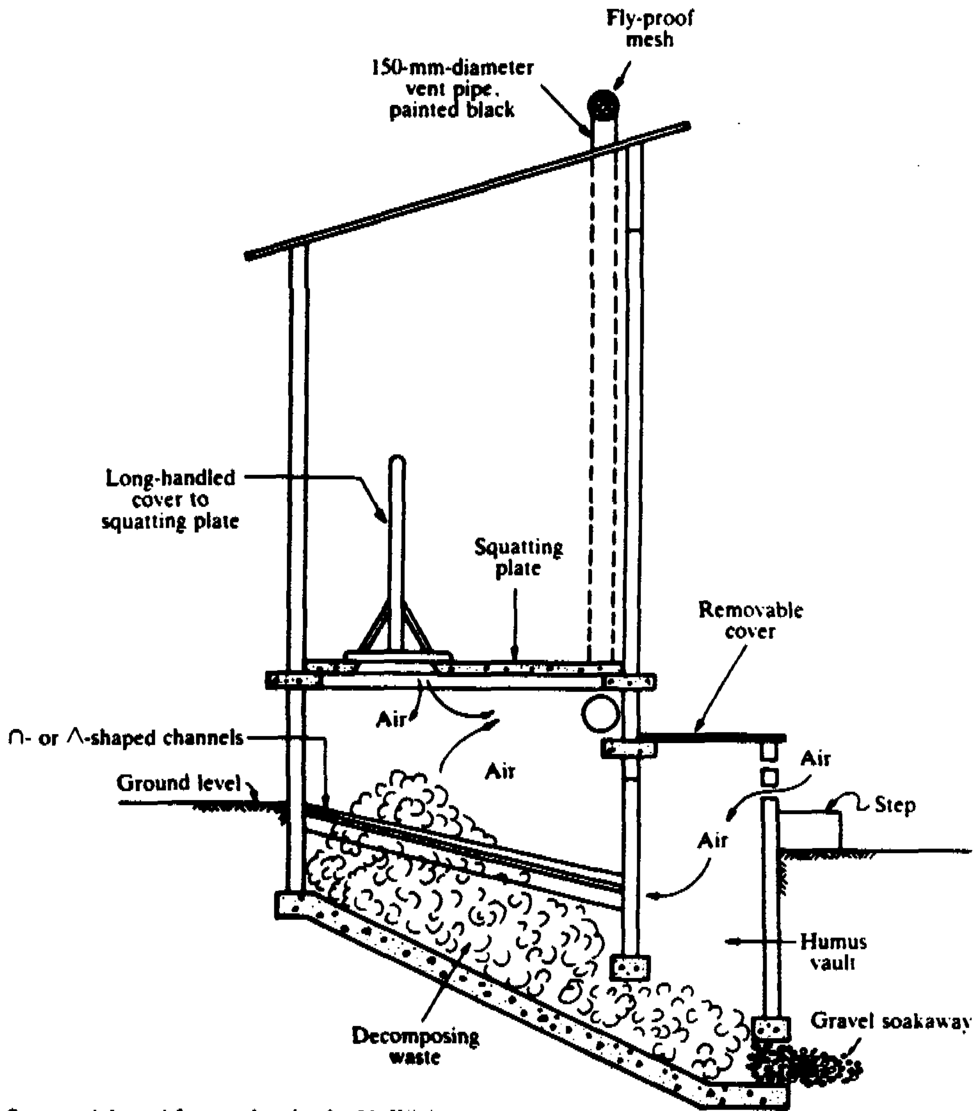
Note: In the side view, a pedestal seat or bench may be substituted for the squatting plate. An opening for desludging may be provided next to the vent. Dimensions of the bricks or concrete blocks may vary according to local practice. Wooden beams, flooring, and siding may be substituted for concrete block walls and substructure.

Figure 10-3. *VIPD Latrine*



Source: Adapted from a drawing by R. Carroll.

Figure 11-1. *"Multrum" Continuous-composting Toilet*
(millimeters)



Source: Adapted from a drawing by U. Winblad.

APPENDIX H

Summary of Interviews and Field Inspection Trips

APPENDIX H

Summary of Interviews and Field Inspection Trips

INTERVIEW SUMMARIES

<u>Scoping process, meetings and interviews</u> (October 13-October 16, 1989).

MEMBERS OF USAID/EL SALVADOR PERSONNEL INTERVIEWED

Mr. Joseph Pastic,	Deputy Project Development Officer
Mr. Kraig Baier,	Deputy Infrastructure Regional Development (IRD) Officer
Mr. Tibor Nagy,	Chief Engineer, IRD
Ms. Karin Macfarland,	Project Officer
Mr. Leopoldo Reyes,	Deputy Project Officer
Mr. Oscar López,	M I D Engineer
Mr. Rodolfo Cristales,	Environmental Officer

A series of meetings was carried out to review the Scope of Work and Outline prepared by the WASH team for the preparation of the Environmental Assessment for Component III—Water Supply, Sanitation and Health of the Public Services Improvement Project. The issues and conclusions resulting from the meetings are summarized below.

1. Siting criteria to locate wells and latrines should be reviewed and recommendations should be made to improve the existing criteria if needed.

2. Proper technology and construction practices should be reviewed and recommendations for improvement should be included in the EA.

3. Water quality monitoring programs should be reviewed to determine their adequacy and recommendations should be made to improve the programs if needed.

4. Health promotion and self-sufficiency, project goals should be reviewed in order to provide proper operation and maintenance once they have been built.

5. All project components will be implemented by ANDA-MU, except for health education and training which will be provided by the Ministry of Health (MOH).

6. The Environmental Profile of El Salvador is available and should be used to discuss the affected environment.

7. Pesticides can have a significant impact on water quality, the monitoring program should include pesticides test.

MEETINGS AND INTERVIEWS WITH LOCAL AGENCIES AND ORGANIZATIONS

ANDA/MU (October 13, 1989)

MU members present during the meeting:

Ing. Héctor Ibarra, Director of the ANDA/MU;

Ing. Hugo Bonilla,

Mr. Israel Flores

ANDA/MU members provided us with information on the Pilot Potable Water and Environmental Support Project study. Information and documentation was provided which included existing design norms, contract documents and construction plans on wells and water supply systems. Program of field visits to system installations was agreed upon at this meeting.

PLANSABAR (October 16, 1989)

Personnel interviewed:

Ing. Arnoldo Dheming, Director of PLANSABAR

Ing. Rigoberto Cruz Monge and

Ing. Leticia Rodes de Segurado, both members of the Planning and Design Department.

Information was obtained on latrine design, septic tank design and small water and sewerage projects.

ANDA/OEDA (October 18, 1989)

Personnel interviewed:

Ing. Carlos Roberto Ochoa Córdova, Director of OEDA

Information received included the background on research performed on groundwater in El Salvador. A data bank of hydraulic and hydrologic information is compiled annually by this organization through the funding of PNUD. Ing. Ochoa briefed us on the work performed by CENTA on pesticides and heavy metal detection performed by CEL and CENTA too.

MOH/DES (October 26, 1989)

Persons interviewed:

Ing. Coralia Morán, MOH/DES

Lic. Modesto Rebollo, UNICEF

After telephone conversations held on October 25 with both, we received invitation to attend a presentation the following day. At Hospital Rosales, Ing, Coralia Morán gave a 30 minute presentation on the sanitation program being conducted by these two organizations, centered on compost latrine construction through the coastal areas of El Salvador (2160 latrines projected).

OTHER PERSONS CONTACTED:

- Joseph Weiss, Project Director for Louis Berger International Inc., conducting an assessment of the National Infrastructure sector of the AID/GOES project; meeting of 30 minutes to exchange views.

- Ricardo Nunez Woitschach, PAHO/WHO/UNDP. Telephone conversation to discuss well design, construction practices, well siting criteria and PAHO relationships and interactions with PLANSABAR and ANDA.

- Frank Zadroga, ROCAP Environmental Officer. Telephone conversation to discuss the scoping process of the project.

SUMMARY OF FIELD VISITS

October 19,1989

Visiting Party	Ing. Oscar López	USAID/El Salvador.
	Ing. Israel Flores	ANDA
	Ing. Fernando Requena	WASH
	Ing. Carlos de la Parra	WASH

1. Tihuilocoyo. 400 to 800 families-cooperative.

The system includes a handpump and pour-flush latrines. Each house its own shallow well.

Groundwater is about 3.5 m below ground surface. Pour flush latrines are installed with pits away from the superstructure. The latrine is connected to the superstructure by pipe.

Systems are working well. In appears that the handpump is not used except for drinking water, the individual shallow wells are used for all other uses.

There is a plan to outfit the well with an electric pump to an existing storage tank and install a distribution system to the cooperative with house taps.

2. Rosario de la Paz. Municipality.

The project is a piped system with an electric pumped well and two elevated storage tanks. The town also has sewerage.

The system is working well and it does not seem to have any problems. The storage tanks do not seem to have overflows provisions. The pump is attended when in operation.

This is a project which was enlarged by ANDA by adding one storage tank to the water supply system.

3. Oscar Osorio. Small community (caserio).

The caserio is located in a very wet area. Some latrines are elevated to avoid ground water contamination. The water supply is piped to each house which is provided with a tap.

The system provides good water supply; however, poor drainage and very wet soils do not allow for good sanitation. It appears that the existing latrines do not prevent groundwater contamination because groundwater is almost at the surface.

The area is very wet and not very suitable for dwellings, nevertheless these dwellings are already there and greatly improved by the water supply and sanitation.

October 20, 1989

Same members in the field team of October 19,1989.

1. Caserio San José. 300 people.

Interviewed Mr. Santos Portillo Diaz—Vice President of the council.

The community has two hand pumps and household latrines. One handpump is at the school. Both pumps are working well and the community is happy with the project.

Piped drainage is provided at the hand pumps so that no erosion or standing pools are created by the excess water from the hand pumps.

The system is managed by the community. Latrines are simple inverted. There are problems of odors and flies in the summer. Venting latrines would eliminate these problems for the caserío.

2. Trincheras-La Unión.

One hand pump at the school. The system is working well. Drainage of excess water is poor, although it did not create pools of water.

October 24, 1989

Visiting Party Ing. Oscar López USAID/ El Salvador.

Ing. Fernando Requena WASH

Ing. Carlos de la Parra WASH

Frontera Puente Arce—Ahuachapán.

Interviewed: Jorge Alberto Martínez Escoto—President of Improvement Committee.

Rutilio Lemus—Treasurer.

Francisco Ramírez—Trustee.

Water supply system provides poor quality water and it is insufficient. System was designed and built by PLANSABAR in 1982.

The system consists of a 4-in. well 36 m deep with an electric pump, a transmission main, a storage tank, and distribution system to 110 homes. The well is located in a flood plain and was flooded some time ago. Since the flooding incident the well has lost capacity and supplies only 84 homes now.

The well is open and overflows when the pump is stopped because of a facility check valve.

Pumping occurs only 6 hours daily because of a lack of a transformer. The water is not chlorinated because of a lack of chlorine.

There are two latrines close to the well.

The community has grown and has about 150 more homes since the well was installed.

The community pays PLANSABAR C 11.00 per house per month for the service.

The community wants an alternate source of water such as a spring which is located about 3 km. away. But they would be happy with any other safe and sufficient source.

The well is not properly located, is not protected from surface contamination, and does not have proper electric supply.

A new well above the flood plain, properly protected and with sufficient electrical supply, seems to be the solution. An additional storage tank may be needed, as well as expansion of the distribution network.

APPENDIX I

References

APPENDIX I

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