AN EVALUATION OF EPA'S SAFE DRINKING WATER PROGRAM IN

CENTRAL AMERICA

Office of International Activities
Office of Policy, Economics, and Innovation
U.S. Environmental Protection Agency

Industrial Economics, Inc.
Marasco Newton Group

May 2002

This evaluation was led by EPA's Office of International Activities and Office of Policy, Economics, and Innovation. Substantial technical and analytical support was provided by Industrial Economics, Inc. and Marasco Newton Group under Contract 68-W-98-207 between EPA and Industrial Economics, Inc. Stephanie Adrian represented EPA's Office of International Activities, Eric Marsh represented EPA's Office of Policy, Economics, and Innovation, Josh Habib and Andrew Schwarz represented Industrial Economics, and Bill Michaud represented Marasco Newton Group.

This page intentionally left blank.

TABLE OF CONTENTS

TABLE OF CONTENTS (Cont'd)

LIST OF ACRONYMS

ANDA	-	Salvadoran water utility
CRS	-	Catholic Relief Services
CCP	-	Composite Correction Program (for treatment plants)
CEPIS	-	The Pan American Health Organization's technical center in Peru
COPAS	-	A working group on water treatment in El Salvador comprised of U.S. and Salvadoran government officials.
CPE	-	Comprehensive Performance Evaluation (for treatment plants)
CTA		Comprehensive Technical Assistance (for treatment plants)
ENACAL	-	Nicaraguan water utility
EPA	-	U.S. Environmental Protection Agency
GC	-	Grupo Colaborativo de Agua (an organization of water professionals in Honduras)
MOH	-	Ministry of Health
NGO	-	Non-governmental organization
OIA	-	Office of International Activities
ORD	-	Office of Research and Development
OW	-	Office of Water
PAHO	-	Pan American Health Organization
QA	-	Quality assurance
QC	-	Quality control
SANAA	-	Honduran water utility
SOPs	-	Standard operating procedures
SWP	-	Source water protection
USAID	-	U.S. Agency for International Development

This page intentionally left blank.

EXECUTIVE SUMMARY

INTRODUCTION

In 1997 EPA launched an International Safe Drinking Water Initiative, choosing Central America as a priority region. The initiative focused on improving water quality, and El Salvador was selected as a pilot country. In October 1998 Hurricane Mitch devastated the region and EPA, among other US government agencies, was called upon by the US Agency for International Development (USAID) to assist in the rehabilitation of the region. With additional funds from USAID, EPA expanded its program to include Honduras and Nicaragua. This effort later became known as *EPA's Safe Drinking Water Program in Central America*.[1]

EPA's primary focus – developed following assessment visits to El Salvador, Nicaragua and Honduras, and discussions with USAID Missions in each country - was to assess and address the adverse health effects affecting the population as a result of poor drinking water quality. Specifically, EPA, led by the Office of International Activities (OIA), aimed to improve drinking water quality by strengthening the capacity of institutions - particularly the water utilities and the ministries of health - responsible for providing safe drinking water in targeted rural and key urban/periurban areas in El Salvador, Nicaragua and Honduras.

Based on country priorities identified by government institutions, USAID Missions, EPA experts in the U.S., and the ability to identify regional or in-country partners who were willing to participate in and provide sustainability to the program activities, EPA identified four key components for its safe drinking water activities in Central America. These four components include: 1) laboratory capacity-strengthening; 2) drinking water treatment plant optimization; 3) source water protection, and; 4) safe drinking water program development. These components served as the foundation for the Safe Drinking Water Program.

PURPOSE OF THE EVALUATION

As the Safe Drinking Water Program neared completion at the end of 2001, OIA sought to determine how effective the Program had been in meeting its goals. Furthermore, OIA hoped to identify lessons learned that could increase the likelihood of long-term sustainability of the Program's outcomes, as well as help promote and guide safe drinking water efforts in other regions. Accordingly, over the course of several months during the end of 2001 and the beginning of 2002, OIA developed and implemented an evaluation on the effectiveness and sustainability of its Safe Drinking Water Program in Central America. Two consulting firms, Industrial Economics, Inc. and Marasco Newton Group, provided technical and analytical support to EPA. Together, EPA, including OIA and EPA's Office of Policy, Economics, and Innovation, and the consultants comprised the evaluation team. This report discusses and analyzes the results - including key outcomes and recommendations - stemming from the evaluation.

[1] Through the interagency agreement, which was signed in September 1999, EPA was awarded $2 million by USAID to conduct the work in Central America.

EVALUATION METHODOLOGY

To assess the effectiveness of the Safe Drinking Water Program, the evaluation team first collected and analyzed numerous documents and reports related to the Program. To help link program activities and outcomes to goals and objectives, the evaluation team then developed preliminary logic models for each of the program components. Based in part on these models, the evaluation team developed a series of interview guides to help gather the identified information.

Using the interview guides, the project team conducted over 60 open-ended, semi-structured interviews with personnel in El Salvador, Honduras, and Nicaragua who participated in EPA's Safe Drinking Water Program training, workshops and pilot projects. These were conducted during a two-week visit to the three countries in February 2002. The team also interviewed several EPA Headquarters and Regional staff and managers who helped develop and conduct training programs. The project team compiled and analyzed the interview summaries and identified the key outcomes for each component. In addition, the evaluation team developed recommendations regarding action items to maintain sustainability of the Program as well as approaches to help initiate similar programs in other regions.

OVERALL PROGRAM EFFECTIVENESS

EPA's Central America Safe Drinking Water Program has realized success in its short-term efforts to build capacity and enhance cooperation among water professionals working toward the long-term goal of improving the quality of drinking water available in the region. The Program achieved its greatest success with the more technical components - the laboratory and treatment plant program components. Nevertheless, additional efforts are clearly needed to attain the ultimate goal of improving water quality in the region. For example, most of the concepts and techniques associated with the source water protection and safe drinking water components have not been integrated into existing water quality projects. Continued work by EPA could help institutionalize aspects of these components into the work of environmental and health organizations and agencies in the region.

EPA efforts to develop partnerships with international and local stakeholders in Central America was instrumental to the success of the Program. For example, EPA identified the Pan American Health Organization (PAHO) as a key resource to assist with identifying a network of water professionals to include in the workshops and pilot projects. EPA also established strong partnerships with the Salvadoran water utility (ANDA), Grupo Colaborativo de Agua (GC) and water utility (SANAA) in Honduras, and the Ministries of Health and the Environment in each of the three countries. There were, however, challenges associated with developing and maintaining effective partnerships; communication among various partners was often difficult. In Nicaragua, the partnership with ENACAL -the public water utility- at times suffered from poor communication in part due to EPA lacking a permanent presence in-country, which prevented contact on a more regular basis.

The evaluation team also identified some key impediments that limited the Program's ability to achieve greater success. As an initial matter, the lack of sufficient resources to fund all of the laboratory equipment needed, or make training more widely available limited the ability of the Program to achieve greater progress toward its goals. In addition, the absence of a strong drinking water regulatory framework in each country limited the degree to which the Program could gain appropriate visibility to garner sufficient resources to continue the various program components. The lack of trust between organizations at the senior management level also limited the ability to share lessons learned among programs and subsequently diluted the value of the workshops. While the workshops helped make progress toward increasing understanding of issues such as source water protection, the lack of widespread technical expertise in the host countries limited the degree to which new ideas or concepts could be institutionalized. The most difficult impediment EPA encountered was the strict two-year timeline that all US government agencies were forced to adhere to as part of the interagency agreement with USAID. December 31, 2001 was stipulated as the project period end date that could not be altered under any circumstances. Due to the nature of development work, this was unrealistic, and, although EPA made every effort to complete work by this date, a three-month extension was finally granted to allow adequate closure for EPA activities. In addition, multiple earthquakes in El Salvador in early 2001 and droughts in Honduras and Nicaragua stalled the Program at different times because in-country partners were focusing on emergency relief priorities. This timeline was actually mandated by Congress when it appropriated the Supplemental funding to USAID that was eventually provided to the US agencies.

OUTCOMES AND RECOMMENDATIONS

Key Outcomes

Laboratory capacity-strengthening component. The evaluation team found that the laboratory capacity-strengthening component appropriately focused on helping laboratories achieve accreditation and engaged an appropriate set of key labs in the targeted countries. The team also found that the program component, in aggregate, exceeded expectations for improvements in the operations of the participant laboratories. Qualitative data suggests that these improvements have and will continue to result in improvements in the reliability of analytical data produced by the laboratories. On the other hand, the evaluation team also found that the component did not focus enough attention on strengthening key inter-organizational relationships among senior managers, primarily between the Ministries of Health and utilities, but also among these organizations and key university laboratories. More resources could have been devoted to facilitating a dialogue and agreement among senior managers within the laboratories' organizations regarding their roles relative to drinking water quality and procedures for effectively fulfilling these roles.

Source water protection component. The evaluation team determined that the source water protection component has succeeded in introducing the general concepts and techniques for source water protection, increasing awareness about the relationship between source water and safe drinking water quality, and augmenting the network of drinking water officials involved

in source water protection. For example, a limited number of source water protection activities have been initiated and the concepts have been incorporated to some degree into existing projects. On the other hand, the interviews demonstrated that program component participants still lack sufficient knowledge and support from decision officials and stakeholders, such as farmers and small communities, to adequately address source water problems. In addition, a lack of early communication among the participants limited the sharing of lessons learned from the pilot projects between communities.

Treatment plant optimization component. The use of Comprehensive Performance Evaluation (CPE) demonstrations, through the treatment plant optimization component, effectively communicated the tools necessary for the national water utility to collect and analyze information needed to make sound decisions regarding existing plant operations and priorities for plant improvements. In addition, the program component was insightful in that it engaged not only the water utility but also its principal regulator under the current system, the Ministry of Health. The evaluation team found that the impact of the program component would have been greater if it had included follow-up technical assistance to address key design and other performance limiting factors identified through the CPE demonstrations.

Safe drinking water program development component. The safe drinking water program development component, comprised of workshops and pilot projects dealing with sanitary survey inspections, the fundamentals of safe drinking water and source water protection, did help build capacity among water supply professionals and communities and spawned several safe drinking water activities at the local system level. However, the evaluation team also found that there was no evidence of widespread adoption of the tools discussed during the workshops and illustrated by the pilot projects.

Key Recommendations

The evaluation team developed recommendations regarding the sustainability of each of the four program components as well as their potential transferability to new regions. Since many of these recommendations cut across the four program components, in this summary we present the recommendations for EPA's Safe Drinking Water Program as a whole. Some of our overall **sustainability recommendations** include the following:

- Additional support should be provided to strengthen the technical capacity of key drinking water analytical laboratories and assist these laboratories in achieving accreditation for analyses of critical importance to public health.

- Senior decision-makers in the Ministries of Health, Ministries of the Environment, water utilities, and other critical institutions should engage in a dialogue to raise their awareness of the role of water analytical laboratories in protecting public health, facilitate structural changes that would strengthen the links between laboratory data and water quality decisions, and create a sustainable source of funding for the laboratories.

- Training in the various aspects of improving water quality should continue with water professionals (e.g., at non-governmental organizations and universities) and governmental officials (e.g., Ministries of Health and the Environment, municipal committees). Moreover, the training should take place in various regions of each country, including rural areas, to reach a wide and diverse audience.

- International organizations should continue to work with local Ministries, municipalities and organizations to help institutionalize drinking water quality programs at the Federal, regional and local level.

- Local agencies need to commit to implementing lessons learned from training or pilot projects to ensure that time and resources are being spent most efficiently. For example, staff that attend training workshops need to demonstrate how they will use the information and share it with other individuals (e.g. a mini-course based on the one they attended).

- Efforts should be made to work with Federal and municipal governments to incorporate additional water quality issues (e.g., source water protection) into the legal framework.

- U.S. agencies should continue to provide resources to help strengthen work that was done in Central America. With a strong foundation already built through these efforts, additional resources could be devoted toward ensuring sustainability. These resources could provide additional trainings, demonstration projects, and equipment that help to further impact water quality.

The evaluation team identified several recommendations to enhance the transferability of Program activities to new regions. The team determined that future programs would likely benefit from:

- Early and effective use of local stakeholders who represent a cross-section of key organizations and agencies in the host country. For example, programs would benefit from strategic discussions with key organizations and laboratories on identifying priority analytical methods to be targeted for accreditation, considering the pollutants of primary concern to public health

- Additional efforts to engage senior decision-makers from key organizations to help strengthen inter-organizational relationships.

- Linking of drinking water activities (e.g., workshops and pilot projects) so that parties can share ideas, information, and critical analyses throughout the planning and implementation stages of each project.

ADDITIONAL SECTIONS OF REPORT

This report includes three additional sections and appendices. The section "Lessons Learned for Future Program Development" provides recommendations for improving future planning and implementation for this program as well as other international support programs.

This section is primarily intended for agency managers or staff who anticipate, or are currently involved in, the development of international programs focused on protecting public health and the environment. Next, the section "Improving the Future Capacity to Conduct Evaluations" discusses how to build in evaluation components at the beginning of a program to better assess overall program effectiveness. A "Conclusions" section summarizes the key achievements and shortcomings of the Program and provides suggestions for future activities. Finally, the Appendices include a list of the interviewees for this evaluation, and the interview guides that the evaluation team used during discussions with these interviewees.

SECTION I: INTRODUCTION

BACKGROUND

In 1997 EPA identified Central America as a priority region in which to launch an International Safe Drinking Water Initiative. With some initial EPA funding, a program for El Salvador as a pilot country was under development. The focus of the program was on improving water quality. In October 1998, Hurricane Mitch devastated the region and EPA, among other US government agencies, was called upon by the US Agency for International Development (USAID) to assist in the rehabilitation of the region. With additional funds from USAID, EPA expanded its program to include Honduras and Nicaragua. This effort later became known as *EPA's Safe Drinking Water Program in Central America*.[2] (Throughout the report this will be referred to as the Program).

EPA's primary focus – developed following assessment visits to El Salvador, Nicaragua and Honduras, and discussions with USAID Missions in each country - was to assess and address the adverse health effects affecting the population as a result of poor drinking water quality. Specifically, EPA, led by the Office of International Activities (OIA) and supported by the Office of Water (OW), EPA Regions 2, 9, and 10, and the Office of Research and Development (ORD) – specifically the laboratories located in Cincinnati, Ohio, aimed to improve drinking water quality by strengthening the technical capacity of institutions – particularly the water utilities and the ministries of health – responsible for providing safe drinking water in targeted rural and key urban/periurban areas in El Salvador, Nicaragua and Honduras.

Based on country priorities identified by government institutions, USAID Missions, EPA experts in the U.S., and the ability to identify regional or in-country partners who were willing to participate in and eventually provide sustainability to the program activities, EPA identified four key components for its safe drinking water activities in Central America. These four components included: 1) laboratory capacity-strengthening; 2) drinking water treatment plant optimization; 3) source water protection, and; 4) safe drinking water program development. These components served as the foundation for the Safe Drinking Water Program and are discussed in further detail below as well as in Sections III through V of this report. A map illustrating where each of the four components took place is shown in Exhibit 1.

[2] Through the interagency agreement, which was signed in September 1999, EPA was awarded $2 million by USAID to conduct the work in Central America.

The *laboratory capacity-strengthening* component was the most fundamental element of EPA's program because it addressed the lack of valid water quality data in the region. None of the national governmental labs in Nicaragua, Honduras or El Salvador were able to produce reliable and valid data on water quality prior to the initiation of EPA's program as determined through the absence of quality control measures. The Pan American Health Organization (PAHO) was EPA's key partner in implementing this effort – particularly PAHO's technical center, CEPIS, located in Lima, Peru and headed by Sergio Caporali. A series of assessment trips by EPA and PAHO revealed that lab equipment was outdated or lacking, technicians were not trained properly, lab space was often inadequate and quality control procedures did not exist. EPA determined that, to improve these labs' ability to perform adequate drinking water analyses, and ultimately enable them to achieve laboratory accreditation, it would assist labs in moving toward accreditation by training lab personnel, managers and technicians in both the methods and quality control issues required. Focusing on a goal of accreditation provided a clear roadmap for further improvements in laboratory operations. If the laboratories were able to achieve accreditation, this would increase the stature of the laboratories within their individual organizations, with the courts, within the water treatment community, and with the public. This promises to strengthen the links between laboratories and water quality decision-makers, provide a structure for sustained improvements in data reliability (to maintain accreditation) and, as a result, increase the potential that laboratories will increasingly influence meaningful improvements in drinking water quality.

The *treatment plant optimization* component of the program in El Salvador focused on training Salvadoran water professionals – primarily those responsible for surface water treatment plant operations – to evaluate the performance of their plants using a US-developed technique called Comprehensive Performance Evaluation (CPE). This tool can be used to evaluate the performance of the plants, identify performance limiting factors, and make remedial recommendations to managers for plant improvements. Since the quality of the public drinking water supply varies significantly throughout the year depending on whether it is the rainy or dry season, the quality of the distribution system, and the ability of the treatment plant to remove contaminants, the CPEs are useful analytical tool for managers. The CPEs can help identify performance limiting factors including infrastructure, staffing, management and safety issues. EPA initially brought several Salvadoran water professionals to St. Louis, Missouri, for a demonstration CPE and subsequently conducted four in-country CPEs. EPA also trained more than 30 treatment plant personnel in El Salvador in how to conduct CPEs and utilize the results.

The source water protection component in Nicaragua was designed to help select communities deal with the range of contaminants that impact drinking water quality. In certain regions of the country heavy rainfall and flooding can bring a significant amount of contaminants from agricultural areas into source waters. Along with sticks, rocks and sediment, microbiological contamination from overflowing latrines, sewer systems and pesticide residues from agricultural runoff infiltrate the drinking water system. The assistance provided was based on a U.S. approach to source water protection that employs community involvement and focuses on the identification of contaminant sources as well as the delineation of protection zones that can be managed by the community. EPA implemented demonstration projects in three communities and conducted three workshops, providing water professionals from the

communities and the capital, Managua, with the opportunity to hear the results of the pilot projects and learn about key elements of source water protection.

Exhibit 1

EPA's Safe Drinking Water Program in Central America: Project Location List

Honduras
DW_1 = Zona de Reserva de Merendón
DW_2 = Departmento de Lempira
DW_3 = Nacaome
DW_4 = San Lorenzo

El Salvador
TP_1 = El Rosario
TP_2 = Rio Lempa
TP_3 = Tamulasco
TP_4 = Chilama
TP_5 = Guluchapa
L_1 = San Salvador

Nicaragua
SW_1 = Ocotal
SW_2 = Esteli
SW_3 = Matagalpa
L_2 = Managua

LEGEND
TP = Treatment Plant Optimization
L = Lab Capacity Building
SW = Source Water Protection
DW = Drinking Water Program

50 100 200
Kilometers

* PAHO's Technical Center, located in Lima, Peru, is another project location.

The final program component, *safe drinking water program development* in Honduras, was initiated to address an overall lack of awareness among professionals and decision makers concerning how to set priorities for improving drinking water quality in the country. This approach was developed through consultations with PAHO/Honduras and the Grupo Colaborativo de Agua (GC) (a network of water professionals in Honduras), and the water and sanitation specialist at the USAID Mission in Tegucigalpa. This collaborative group determined that implementation would take place through a series of trainings that focused on the policy aspects of developing safe drinking water programs and the technical tools necessary to make decisions

As the Safe Drinking Water Program neared completion at the end of 2001, OIA sought to determine how effective the Program had been in meeting its goals. Furthermore, OIA hoped to identify lessons learned that could increase the likelihood of long-term sustainability of the Program's outcomes, as well as help promote and guide safe drinking water efforts in other regions of the world. Accordingly, over the course of several months during the end of 2001 and the beginning of 2002, OIA developed and implemented an evaluation of the effectiveness and sustainability of its Safe Drinking Water Program in Central America. Two consulting firms, Industrial Economics, Inc. and Marasco Newton Group, provided technical and analytical support to EPA. Together, EPA, including OIA and EPA's Office of Policy, Economics, and Innovation, and the consultants comprised the evaluation team. In addition, the evaluation team has included some recommendations relating to the transferability of the Program elsewhere in Central America. This report discusses and analyzes the results - including key outcomes and recommendations - stemming from the evaluation.

OBJECTIVES OF THE EVALUATION

The evaluation sought to answer a set of key questions about the Central American safe drinking water program:

- How effective was the Program in building capacity to improve water quality in the region?

- What were the key successes and challenges associated with each of – as well as across - the four program components (e.g., laboratory capacity building, treatment plant optimization, source water protection, and safe drinking water)?

- How effective were project partnerships among EPA, other Federal and international agencies, and in-country stakeholders?

- Are aspects of the Program likely to be sustained in the region in the short and long-term? Can the countries continue the program independently or do they require further assistance – from EPA or others- for sustainability?

METHODOLOGY

The evaluation team realized early in the process that the evaluation would depend primarily on the collection and analysis of qualitative information. There was not only a lack of quantitative data available but in addition, the absence of baseline data prevented the team from comparing pre- and post-program data.

As a first step in the process, the evaluation team collected and analyzed numerous documents related to the Safe Drinking Water Program. These included quarterly reports generated by EPA, summaries of the program components prepared by project managers, and reports from a mid-course review conducted for the Program.[3]

The evaluation team then developed preliminary logic models for each of the program components. A logic model links program activities and outcomes to stated goals and objectives and helps identify the type of information needed to report on progress made toward those goals. Using the models developed for the program components (see Exhibit 2) the evaluation team developed a series of interview guides to help gather the identified information.

Using the interview guides the project team conducted over 60 open-ended, semi-structured interviews with personnel in El Salvador, Honduras, and Nicaragua who participated in EPA's Safe Drinking Water Program training, workshops and pilot projects.[4] These interviews were conducted during a two-week visit to the three countries in February 2002.[5] The team also interviewed several EPA Headquarters and Regional staff and managers who helped develop and conduct training programs. A complete list of interviewees and the interview guides are included in the Appendix.

The project team compiled and analyzed the interview summaries and identified the key outcomes for each component. In addition, the evaluation team developed recommendations regarding action items to maintain sustainability of the Program as well as approaches to help initiate similar programs in other regions.

---

[3] Other documents reviewed include EPA's initial proposal to USAID (*US Environmental Protection Agency Implementation Plan for Supplemental Funding for Hurricane Relief in Central America*, June 1999), eight EPA quarterly reports to USAID, a progress report to the Office of Management and Budget (*Hurricane Mitch (CACEDRF) USAID & OMB Review: Activities of the Environmental Protection Agency*, June 20, 2001), a summary of source water protection training and demonstration activities prepared by Horsley and Witten, workshop feedback forms, and an EPA Safe Drinking Water Program summary that discusses key lessons learned.

[4] Care was taken to meet the requirements of the Paperwork Reduction Act.

[5] The types of questions asked varied depending upon the particular role of the interviewee. For instance, in the laboratory-strengthening component in addition to basic questions about the program component, different questions were developed for both management and technicians.

ORGANIZATION OF THE REPORT

The remainder of this report contains five sections. Section III discusses overall program effectiveness; Section IV presents background information, outputs (e.g., number of trainings), outcomes (e.g., what the trainings accomplished), and recommendations for each of the four program components; Section V provides recommendations for improving future program effectiveness; Section VI presents our conclusions; and Section VII includes appendices.

EXHIBIT 2
EPA'S SAFE DRINKING WATER PROGRAM LOGIC MODEL

Objectives	Program Component Elements	Ways to Measure Progress for Each Program Component Element	
		Subjective Measures	**Objective Measures**
Laboratory Strengthening Program in El Salvador and Nicaragua			
Strengthen the capacity of key drinking water analytical laboratories to produce data of known quality. Strengthen the informal and formal links between improvements in analytical data quality and drinking water quality.	Drinking water analytical laboratory training	Review of methodology used to develop training program and identify participants. Feedback from EPA team leads, PAHO, and key personnel involved in laboratory operations or oversight at different organizational levels regarding: • Improvements in reliability of analytical data; • Increased capacity to analyze pollutants of greatest concern; • Success in moving toward accreditation; and • Improvements in organizational relations.	Review of CEPIS laboratory evaluation report to identify: [6] • Frequency with which laboratories meet QC criteria for PE sample analyses of pollutants of greatest concern; and • Quality of QC program documentation and implementation relative to accreditation standards.
	Procurement and delivery of laboratory equipment	Review of methodology used to identify laboratory equipment needs and delivery equipment. Feedback from laboratory personnel regarding usefulness of new laboratory equipment regarding: • Improvements in reliability of analytical data; • Increased capacity to analyze pollutants of greatest concern; and • Success in moving toward accreditation.	Review of documentation indicating whether laboratory equipment identified during needs assessment has been procured and delivered

[6] Note that baseline data regarding laboratory performance and QC program quality is unavailable; therefore, *improvements* in laboratory performance cannot be measured. Although accreditation requirements can be used as a standard for measuring success, full attainment of these standards should not be the measure of success. Rather, the degree of attainment should be evaluated within the context of information regarding improvements obtained through interviews.

EXHIBIT 2 (cont.) **EPA'S SAFE DRINKING WATER PROGRAM LOGIC MODEL**			
Objectives	**Program Component Elements**	**Ways to Measure Progress for Each Program Component Element**	
		Subjective Measures	**Objective Measures**
Source Water Protection Program in Nicaragua			
Initiate planning for source water protection programs. Prioritize source water protection areas and map key pollution sources and risks. Develop source water protection pilot sites. Increase number of local officials trained in source water protection. Initiate public outreach and help foment community involvement. Increase local, regional, and national linkages on source water protection.	Prioritization of source water protection areas	Review of methodology used to prioritize areas. Feedback from national and local water quality officials, and public.	Future measurable improvements (e.g., BMPs implemented, reduced runoff from agricultural and urban sources, water quality improvements) in prioritization areas.
	Pilot Projects	Review of methodology used to select pilot projects. Review of methodology to implement pilot projects. Feedback from national and local water quality officials, and public.	Analyze mapping of point and nonpoint sources. Analyze findings of risk and pollution sources associated with pilot projects. Where applicable, analyze preliminary management approaches proposed for pilot sites.
	Workshops	Feedback from evaluation forms. Review of training materials. Feedback from interviews with water quality officials.	Assessment of increase in staff knowledge on source water protection in local water offices. Future measurable improvements in source water protection (e.g., risk assessment of pollution sources) and water quality (e.g., contaminant levels).
	Public outreach and community support	Feedback from public meetings. Review of outreach materials. Assessment of increased regional and national program linkages.	Number of people attending meetings; informational materials mailed or disseminated at meetings; future public involvement and presence of community groups.

EXHIBIT 2 (cont.) **EPA'S SAFE DRINKING WATER PROGRAM LOGIC MODEL**			
Objectives	**Program Component Elements**	**Ways to Measure Progress for Each Program Component Element**	
		Subjective Measures	**Objective Measures**
Treatment Plant Optimization Program in El Salvador			
Strengthen the capacity of the major water utility in the country to more effectively use existing treatment plants to protect the potable water supply from microbial pathogens.	Treatment plant CPE demonstration-based training program.	Review of methodology used to develop CPE demonstration program and identify participants. Feedback from EPA team leads, PAHO, and key personnel involved in treatment operations and oversight at different organizational levels regarding: • Improvements in water quality; • Improvements in plant operations that have a direct impact on water quality; and • Improvements in understanding of capacity issues and performance limiting factors.	Review of systematically collected turbidity and operational data to identify ability to consistently attain national turbidity standards.[7]

[7] Note that baseline data regarding treatment plant performance is unavailable; therefore, *improvements* in treatment plant performance cannot be measured. Although national standards can be used to measure success, full attainment of these standards should not be the measure of success. Rather, the degree to which these standards are consistently met should be evaluated within the context of information regarding improvements obtained through interviews.

EXHIBIT 2 (cont.) EPA'S SAFE DRINKING WATER PROGRAM LOGIC MODEL			
Objectives	**Program Component Elements**	**Ways to Measure Progress for Each Program Component Element**	
		Subjective Measures	**Objective Measures**
Safe Drinking Water Program in Honduras			
Raise awareness among key Honduran agencies and organizations regarding the protection and management of drinking water quality. Increase the number of senior management, technical specialists and public officials within the country trained to develop safe drinking water programs. Develop and deliver workshops on sanitary survey instruments, the fundamentals of safe drinking water, and source water protection.	Selection of workshops and pilot projects.	Review of methodology used to select and implement pilot projects. Feedback from interviews with EPA and partner agencies involved in selecting pilot projects and workshops.	Number and type of workshops held and pilot projects conducted.
	Workshops	Review of approach and materials used to develop and conduct workshops. Feedback from interviews with workshop participants, including Honduran water quality officials, NGOs, and university representatives (e.g., asking whether workshops had appropriate balance of theory and field work). Feedback from workshop evaluation forms. Assessment of linkages developed between workshops and pilot projects.	Number of participants attending workshops. Assessment of participants' increase in knowledge regarding safe drinking water issues - perhaps through use of surveys before and after program. Future measurable improvements in drinking water quality (e.g., contaminant levels). Measurable improvements in source water protection (e.g., risk assessment of pollution sources). Evidence of workshop participants using knowledge gained from program in their jobs (e.g., using sanitary surveys).
	Pilot Projects	Feedback from interviews with pilot project participants. Review of products or final reports from pilot projects. Assessment of linkages developed between workshops and pilot projects.	Assessment of participants' increase in knowledge regarding safe drinking water issues. Number and type of parties involved in pilot projects. Future measurable improvements in drinking water quality in pilot project areas (e.g., contaminant levels). Evidence of sustainability of activities from pilot projects (e.g., initiation of drinking water programs at Honduran governmental agencies, NGOs, or universities).

This page intentionally left blank.

SECTION II: OVERALL PROGRAM EFFECTIVENESS

EFFECTIVENESS IN BUILDING CAPACITY TO IMPROVE DRINKING WATER QUALITY

EPA's Central America Safe Drinking Water Program has realized success in its short-term efforts to build capacity and enhance cooperation among water professionals working toward the long-term goal of improving the quality of drinking water available in the region. However, much more could be done in order to realize this long-term goal.

The Program has successfully provided training on concepts including the importance of protecting source waters and providing clean drinking water to populations and has demonstrated the potential value of these ideas through pilot studies undertaken in Honduras and Nicaragua. In addition, through training, on-site visits, and demonstration projects, the Program provided valuable support towards improving the capacity of laboratories to analyze water quality and strengthening the capacity of a major water utility in El Salvador to use treatment plants to protect water supplies from mircobial pathogens.

The evaluation team's assessment of the Program, conducted primarily through interviews of participants throughout the Program, has provided mostly qualitative evidence of the success noted above. Individuals have learned about tools and resources available to protect source waters and improve laboratory-testing capabilities and, in certain cases, have been provided with the opportunity to put these tools to work. In one instance, the USAID water specialist in Honduras indicated that he felt the concepts and terminology learned in the safe drinking water workshops were already becoming part of everyday vocabulary for some professionals based on his relationships with them. In the same respect, Nicaraguan officials in one municipality, Esteli, are assessing how additional source water protection work could be continued in their city.

As noted, there is little quantitative evidence of significant change in water quality. This finding is not unexpected though given the nascence of the Program and the absence of baseline data against which to compare those measures that could be quantified. Since many of the concepts, tools, and approaches introduced by the Program were new, one would expect to see limited adoption in the short term. For example, since the individuals who received the training on the principles of source water and drinking water protection included a broad cross-section of stakeholders, and the opportunities for immediate application of new concepts and tools were complex and often unclear, follow-up activities would be the key to ensure adoption and/or implementation of some or all of the principles. Additionally, laboratories continue to finalize quality control manuals and implement the steps learned in the training courses as they move

towards accreditation. Achieving accreditation, either by a national accreditation body or more importantly to the labs, an international body, would provide labs with enhanced credibility among their peers and the public and would provide them with more confidence in their own data. It is also important to point out that due to the fact that water quality data testing did not undergo quality control procedures prior to this work, it is nearly impossible to determine whether changes in the treatment plants, for example, resulted in direct improvements to water quality.

As will be discussed below in more detail, this evaluation indicates that ongoing support from EPA or other organizations and donors is critical to building upon the successes realized thus far, and to ensuring that safe drinking water efforts continue with the same level of intensity, and eventually become institutionalized within each country.

EFFECTIVENESS OF PROJECT PARTNERSHIPS

One of the keys to the success realized in the Program thus far has been the commitment by EPA to work closely with other international and, more importantly, local stakeholders to foster long-term relationships in each of the selected countries. At the outset of the Program, EPA worked with USAID to develop the key aspects of each drinking water effort. These agencies also identified key in-country partners to help them develop and implement the Program. For example, EPA identified PAHO as a key resource to assist with identifying a network of water professionals to include in the workshops and pilot projects. PAHO also helped develop and deliver the workshops, and train in-country professionals to present the materials at future trainings. On the lab and treatment plant components as well as with the work in Honduras on safe drinking water program development, EPA also benefited from its relationship with CEPIS - PAHO's technical center based in Lima, Peru. By working closely with PAHO, EPA helped convey the message to water professionals in the affected countries that significant drinking water expertise should continue to be tapped at the regional level.

EPA also established strong partnerships with the Salvadoran water utility (ANDA), Grupo Colaborativo de Agua (GC) and water utility (SANAA) in Honduras, and the Ministries of Health and, to some extent, the Ministries of Environment in each of the three countries. The Grupo Colaborativo played a key role in gathering key decision-makers for the drinking water workshops, and SANAA became very active in the laboratory component as well as the institutionalization of sanitary surveys. As a USAID representative noted, the Grupo Colaborativo was an effective partner as it included representatives from NGOs, government ministries, the private sector, and academics. These individuals often have relationships with senior policy-makers, which can help initiate and sustain these programs.

Through the design and implementation of the pilot projects in Nicaragua, EPA developed strong connections with local universities and the ongoing watershed program in Matagalpa. The universities also enabled students and professors to work on the projects and are interested in conducting the research and analysis necessary for some of EPA's projects (e.g., delineating source water protection areas around Esteli's wells). The watershed program in Matagalpa (Proyecto Cuencas) was able to incorporate EPA's project into its existing work on developing watershed management plans.

There were, however, challenges associated with developing and maintaining effective partnerships. For example communication among various partners was often difficult. In Nicaragua, the partnership with ENACAL -the public water utility- suffered from poor communication, as for example, when ENACAL representatives failed to show up for a workshop. ENACAL at times seemed unclear as to its role as part of EPA's program. Effectively communicating with PAHO, a very centralized organization, was sometimes difficult as much of the work for these projects was conducted at a regional or country level. EPA was fortunate to have particularly good relationships with the Program Coordinator from PAHO, Peter Toft, the technical advisers at CEPIS, and the country advisers, which helped facilitate the process. Sometimes the difficulties were between EPA and the USAID Mission in Nicaragua due to logistical and administrative issues. These difficulties did create delays in the implementation of the source water protection and lab capacity program components until they could be resolved. In addition, this strained relationship made it difficult at times for EPA to manage programs effectively. These creative differences are not uncommon to international programs, but the effects on the Program were more serious due to the strict program and budget end date of December 31, 2001, stipulated by Congress.

Overall, effectively developing and nurturing partnerships is critical to the long-term success of the drinking water program. EPA's experience indicates that partnerships with groups that have a wide representation in the country (e.g., Grupo Collaborativo) are generally most effective, and that partnerships with universities provide resources and creative ideas. It is very important to maintain effective relationships with government agencies. NGOs are also important partners as they have a permanent presence in and knowledge about the community as well as a realistic view of what can or cannot be accomplished. In addition to these partnerships, EPA learned the importance of building linkages among institutions. For instance, some of the participants in the Nicaragua source water protection programs indicated that they would have appreciated more opportunity to share ideas across the different communities that participated in the source water demonstration projects. As was the case, the pilot projects were carried out separately in separate communities with little or no cross over. The reason for this was not to be exclusive but rather to use the pilot projects as illustrative examples to include in a manual that was being developed. EPA later recognized that there was greater value in the pilot projects than originally anticipated and therefore would have been worthwhile to focus additional attention on these practical applications.

UNDERLYING FACTORS FOR SUCCESS

The next section of this report includes a detailed discussion of the specific successes and areas needing improvement for each of the four main components undertaken in the Safe Drinking Water Program. In the space below, the evaluation team discusses some of the overarching factors that contributed to the success of some components and then to those impediments that limit the program component’s ability to achieve greater success.

Looking across the four program components it is evident that time spent early on identifying and cultivating relationships (as detailed above) is critical to both the short and long-

term success of program initiatives. Local involvement not only ensures interested participants but also helps direct program activities to areas of greatest importance and contributes to long-term interest and commitment to the project. Associated with this is the need to understand and be sensitive to cultural differences and how they might impact participants' views towards elements of the project.

We also learned of the importance of integrating program components to the maximum degree possible. In El Salvador, the treatment plant optimization and laboratory capacity-strengthening program components were conducted simultaneously, increasing the transfer of information among the individuals able to share ideas and collaborate on plans. Participants in Honduras indicated that holding the workshops of safe drinking water and source water protection while conducting one of the pilot projects (conducting sanitary surveys), helped convey lessons and increased the visibility of the efforts among senior officials. In addition, the results from the interviews indicated that participants benefited from having the pilot projects discussed during the training workshops, enforcing the applicability of what they were learning to ongoing problems. The value of the workshops and trainings was greatly enhanced by hands-on activities such as the technical assistance provided to build lab capacity or to conduct pilot projects on source water protection or treatment facility development.

IMPEDIMENTS TO SUCCESS

As an initial matter, the lack of sufficient resources to fund the purchase of laboratory equipment for all labs, finance pilot projects, or make training more widely available limited the ability of the Program to achieve greater progress toward its goals. In addition, the absence of a strong drinking water regulatory framework in each country limited the degree to which program components gained sufficient visibility to garner enough resources to continue. For example, improvements in the reliability of analytical data produced by key water laboratories in El Salvador and Nicaragua were limited by the lack of resources needed to develop quality control manuals and inadequate staffing, equipment, and supplies within most laboratories. In addition, the lack of personnel at some laboratories limited their ability to participate in the laboratory training. These impediments contributed to limiting progress toward accreditation at the labs.

The lack of trust between organizations such as the MOH and ANDA at the senior management level also limited the ability to share lessons learned among programs and subsequently limited the value of the workshops. While the workshops made progress toward increasing understanding of issues such as source water protection, the lack of widespread technical expertise in the host countries limited the degree to which new ideas or concepts could be institutionalized.

Finally, as noted earlier, the relatively short period of time (approximately 2 ½ years) during which the Program has been up and running obviously impacts the progress made toward longer-term goals and objectives.

RECOMMENDATIONS FOR SUSTAINABILITY

- Decision-makers at the institutions responsible for drinking water quality should be made more aware of the programs their staff is involved in so that staff support can be garnered to make necessary changes, institutionally or otherwise. For example, managers should be aware of training opportunities for their staff as well as possible pilot studies they could participate in. To help foster this awareness EPA, or others, could work with local agencies to publicize workshops in advance or prepare a briefing for decision makers on the goals of the project and planned milestones.

- International organizations should continue to work with local Ministries, municipalities and organizations to help institutionalize drinking water quality programs at the Federal, regional and local levels. Local agencies need to commit to implementing lessons learned from training or pilot projects to ensure that time and resources are being spent most efficiently. For example, staff that attend training workshops need to demonstrate how they will use the information and share it with other individuals. As part of this, EPA and others providing support need to ensure that they are responding to local needs in what they are making available.

- Sufficient resources are needed by the labs to buy the equipment and retain the staff necessary to ensure accreditation. This will help establish credibility of a lab to produce reliable and valid data and give more status to the lab as a whole. Lab managers need to make significant commitments to creating budget allocations for equipment purchase and maintenance.

- Local trainers and experts should be encouraged to take responsibility for conducting future sessions of the workshops, but more importantly for institutionalizing the technical lessons learned. This will increase the credibility and utility of the training activities. When someone from a lab participates in a course or series of courses, the information they learn should be incorporated into the management or methodology being used in the lab.

- Additional support should be provided to strengthen the technical capacity of key drinking water analytical laboratories and assist these laboratories in achieving accreditation for analyses of critical importance to public health.

- Efforts should be made to work with Federal and municipal governments to incorporate additional water quality issues (e.g., source water protection) into the legal framework.

- U.S. government agencies should continue to provide resources to help address safe drinking water concerns in Central America. These resources could provide additional trainings, demonstration projects, and equipment that help to enhance water quality.

This page intentionally left blank.

SECTION III: INDIVIDUAL PROGRAM COMPONENTS

A. LABORATORY CAPACITY-STRENGTHENING IN EL SALVADOR AND NICARAGUA

Background

A key objective of the evaluation was to better understand the connection between analytical laboratory data quality and drinking water quality or, more concretely, the potential for drinking water analytical laboratories to positively affect drinking water quality in El Salvador and Nicaragua. This linkage is constrained in El Salvador and Nicaragua[8] by the lack of effective, enforceable safe drinking water laws and the lack of clearly defined roles for the laboratories within the national laboratory network. To effect fundamental change in these areas would require a type of government-to-government consultation that was clearly beyond the scope of EPA's Program. Nonetheless, opportunities exist for effecting smaller change within these broader institutional constraints. Most importantly, change could be effected by strengthening two elements: 1) the physical, organizational, and human capacity of the key analytical drinking water laboratories; and 2) the legal, intra-organizational, and inter-organizational links between the analytical laboratories and those responsible for water treatment decisions that affect drinking water quality.

The capacity of drinking water laboratories to positively affect drinking water quality given existing institutional constraints depends on both of these elements, as follows:

- *The ability of the drinking water laboratories (as determined by their physical, organizational, and human capacity) to produce analytical data of known quality will determine the extent to which their data are <u>useful</u> for water quality decision-making*. Without reliable analytical data, water utilities cannot know with any certainty the quality of the water they produce and regulators cannot produce the evidence needed to compel utilities to improve their operations. Analytical data of known quality is a prerequisite for well-informed decisions about water quality, including those decisions that balance water quantity and water quality needs. In this context, data quality can be divided into two components:

[8] The laboratory component involved a comprehensive range of key laboratories in El Salvador and Nicaragua (i.e., water utility, MOH, and university laboratories) and a single laboratory in Honduras (the SANAA laboratory). Because of the critical interdependence of the success of the component and the institutional structure of the national laboratory networks, this component has been evaluated primarily based on its successes in El Salvador and Nicaragua where change at the inter-organizational level would be reasonably expected.

reliability (e.g., accuracy, precision, sensitivity) and analyte[9] coverage. In other words, in order for analytical data to play a larger role in water treatment decisions, the data must not only provide accurate, reproducible measures of pollutant concentrations, it must also cover a wide enough range of analytes, or parameters, to ensure that pollutants of primary concern to public health are detected and measured.

- *The legal, intra-organizational, and inter-organizational links between the laboratories and water treatment decision-makers will determine the extent to which their data are actually used in water quality decision-making.* The links between the analytical laboratories and those directly responsible for water quality decisions must require or at least encourage the use of the analytical data in water treatment decisions that affect water quality. As the evaluation team questioned interviewees, we identified the following informal and formal links:

–Non-legal mechanisms (e.g., intergovernmental contacts between the utility and MOH or intra-organizational contacts between utility laboratory personnel and treatment plant operators) provide an avenue by which laboratories could inform and/or influence treatment plant operations *(informal link*).

–Existing (general environmental) laws pertaining to drinking water quality provide an avenue by which the Ministries of Health in El Salvador and Nicaragua could enforce drinking water standards *(formal link).*

The evaluation team focused much of the in-country interviews on gathering information to help evaluate the extent to which EPA's activities strengthened the capacity of key drinking water analytical laboratories to produce data of known quality and the informal and formal links between improvements in analytical data quality and drinking water quality. Focusing on a goal of accreditation provided a clear roadmap for further improvements in laboratory operations. If the laboratories were able to achieve accreditation, this would increase the stature of the laboratories within their individual organizations, with the courts, within the water treatment community, and with the public. This promises to strengthen the links between laboratories and water quality decision-makers, provide a structure for sustained improvements in data reliability (to maintain accreditation) and, as a result, increase the potential that laboratories will increasingly influence meaningful improvements in drinking water quality.[10]

In addition, the evaluation team posed questions designed to gather information useful in developing recommendations for sustaining the initial successes of this component of the program and for transferring the program to other countries.

[9] The term "analyte" refers to the target of the analytical procedure, which could include a single chemical compound (e.g., benzo(a)pyrene) or a class of compounds (e.g., polynuclear aromatic hydrocarbons).

[10] To view an example of how evaluation questions were used to measure outcomes for this program component see Appendix D.

A description of component activities, the component evaluation, and recommendations for sustaining initial program successes and transferring the program are presented below.

Program Component Activities and Outputs

Initially, the laboratory component of the program was focused on strengthening the capacity of drinking water analytical laboratories in El Salvador and Nicaragua. This scope was eventually expanded to include Honduran laboratories after they showed great interest.[11] A fundamental aspect of this component was to work in tandem with CEPIS (PAHO's technical center based in Lima, Peru) to support the laboratories in taking initial steps to achieve accreditation. This decision was based in great part on the existence of PAHO's Regional Plan of Action to Improve Access to and Quality of Drinking Water. This long-term commitment on behalf of PAHO was deemed favorable by EPA in building in sustainability.

To accomplish this goal, EPA pursued the following activities:

- EPA organized and participated in visits to water utility and MOH drinking water laboratories in El Salvador and Nicaragua and attended meetings with PAHO to assess laboratory capabilities, gather input from the laboratories about their training and equipment needs, and develop the laboratory-strengthening program.

EPA provided funding through a cooperative agreement with PAHO to develop, provide financial support for participation, and deliver training to laboratory personnel from El Salvador, Nicaragua, and Honduras.

conduct laboratory evaluations in El Salvador, Nicaragua, and Honduras (initial evaluations were conducted in June 2001; follow-up evaluations were conducted in February 2002].

procure laboratory equipment for key drinking water laboratories in El Salvador and Nicaragua.

- EPA oversaw program implementation by CEPIS and assisted developing and delivering selected courses and evaluating laboratory performance.

The program component produced the following key outputs:

- Development and delivery of a comprehensive training course, consisting of one or more training session on each of the following topics: laboratory management; trace metals analysis; microbiological methods; equipment calibration and maintenance and laboratory safety; analysis of physical/chemical parameters; laboratory accreditation and certification;

[11] During the course of program activities in Honduras, the opportunity to leverage the laboratory training by enabling SANAA to participate was identified. PAHO funds supported participation by personnel from El Salvador and Nicaragua. Hondurans participated at their own cost. Although not part of the original component goal, delivery of training to the Hondurans was an important output achieved with little or no change in component costs or activities.

quality control; trace organics analysis (two courses); and data handling and analysis. The management course consisted of training at the CEPIS laboratory in Lima, Peru and a visit to drinking water laboratories in Puerto Rico. Other courses were delivered at the CEPIS laboratory in Lima. Approximately 50 laboratory professionals were trained in total, with several professionals taking part in multiple courses.

- Development and distribution of training and reference materials in Spanish.

- Laboratory evaluation results, documenting areas for improvement in quality control (QC) program documentation, data handling and analysis, and laboratory performance.

- Technical assistance to laboratory personnel regarding laboratory organization and specific analytical procedures.

- Procurement and delivery of laboratory equipment for the Ministry of Health and ANDA drinking water laboratories in El Salvador and the ENACAL laboratory in Nicaragua.[12]

Program Outcomes

Given the scope and resources available for this evaluation and the lack of quantitative data measuring baseline conditions, the evaluation team based its conclusions on qualitative information gathered through interviews. The team measured the extent of success in terms of the extent to which the program component achieved outcomes that would reasonably be expected given the resources available and the institutional context (i.e., the institutional resources readily available to be leveraged and the institutional impediments that were outside of EPA's control).

The evaluation team found that the program design successfully identified key elements of the lab program to address in order to reach the objectives. The program appropriately focused on helping labs achieve accreditation and engaged an appropriate set of key laboratories in the (originally) targeted countries. The inability to generate reliable data has also undercut the MOH laboratories' ability to enforce existing laws pertaining to drinking water quality.[13] As such, laboratory data has played little role in water treatment decision-making. The evaluation team also found that despite the well-conceived overall scope, the component did not focus enough attention on strengthening key inter-organizational relationships among senior managers, primarily between the Ministries of Health and utilities, but also among these organizations and

[12] This activity was ongoing and the output had been only partially achieved as of the writing of this report.

[13] For example, a manager at the Ministry of Health in El Salvador noted that the Ministry had brought alleged violations of drinking water standards against ANDA several times. The interviewee noted, however, that the Ministry had never been successful in a suit against ANDA because the Ministry could not defend the accuracy of its analytical data.

key university laboratories.[14] More resources could have been devoted to facilitating a dialogue and agreement among senior managers within the laboratories' organizations regarding their roles relative to drinking water quality and procedures for effectively fulfilling these roles. Significant additional resources will also be required to progress toward and achieve laboratory accreditation. Therefore, more focus on achieving "buy-in" from senior managers with budget authority may have resulted in better leveraging of EPA resources, more successful short-term outcomes, and a better chance for sustainability.

Substantively, the evaluation team found that the program component, in aggregate, exceeded expectations for improvements in the operations of the participant laboratories. Qualitative data suggests that these improvements have and will continue to result in improvements in the reliability of analytical data produced by the laboratories. Interview data suggests that better quality data (with or without accreditation) has and will continue to address the underlying credibility issue and strengthen the position of analytical laboratories relative to treatment plant operations.

The evaluation team found that the focus of the component on building the capacity of laboratory personnel tapped into and leveraged the laboratories' most valuable assets – their people. The energy and enthusiasm engendered by the program resulted in significant advances in laboratory QC programs, beyond what would be reasonably expected, and promises to sustain and build on initial program successes into the future.

Despite these overall achievements, the program component would have benefited from a more systematic focus on the issue of analyte coverage and laboratory throughput capacity. The evaluation team noted a lack of specificity in interviewees' understanding of the relationship between the analytical methods on which they were focused and the pollutants of greatest concern to the drinking water supply. The team also noted that laboratory managers did not have a good sense of the throughput capacity that would be required to adequately monitor drinking water quality. This left unanswered the question of whether the program targeted its capacity-strengthening activities on the pollutants of primary concern to public health.

The evaluation team measured the extent of success of this component in terms of the extent to which the program component achieved outcomes that would reasonably be expected given the resources applied by EPA to this component and given the institutional context (i.e., the institutional resources readily available to be leveraged and the institutional impediments that were outside of EPA's control).

The program resulted in improvements in the reliability of analytical data produced by key water utility, Ministry of Health, and university drinking water laboratories in El Salvador, Nicaragua, and, to a more limited extent, Honduras. Although data quantifying

[14] The evaluation team found that the program in El Salvador, where EPA supported both the laboratory capacity-strengthening and treatment plant optimization components, the program resulted in stronger ties at the technical level between the MOH and utility (ANDA). The foregoing conclusion is based on an evaluation of just the laboratory component. The effectiveness of implementing both components in tandem is evaluated in Section III of this report.

these improvements were not collected as part of the evaluation, this outcome is supported by the following findings.

- All of the analytical laboratories that participated in the program have developed QC manuals based on materials provided by CEPIS during laboratory training. Individual laboratories estimate that the manuals are from 50% to 100% complete.

- All of the analytical laboratories have improved their analytical procedures and have begun to implement QC programs to different degrees as a result of their participation in the program. Laboratories have modified methods to conform with ISO standards, are analyzing quality control samples (i.e., blanks and duplicates), and have implemented improved sample receiving, data validation, corrective action, calibration, instrument maintenance, and performance evaluation procedures. Documentation has been improved and some laboratories are implementing new chain of custody procedures.

- Most of the laboratories have observed a significant change in the attitudes of laboratory personnel as a result of the program. Personnel are more motivated. They see QC as a responsibility of their job, proactively work to solve problems, are open to constructive criticism, are more confident in their work, and take more care in performing analyses. Laboratory technicians have sought to take on more responsibility and are motivated to continue learning and improving their interpretation skills.

- Some of the laboratories have reorganized and/or have created documentation of personnel roles and responsibilities. The ANDA laboratory in El Salvador has hired a QC manager to oversee QC program development and implementation.

- Most of the laboratories have improved their physical space as a result of the program. Laboratories have changed instrument and materials storage locations to comply with QC requirements, improved the appearance of the laboratory (e.g., painting), and labeled work areas and materials. The design of the ANDA central laboratory in El Salvador (currently under construction) was influenced by information received as a result of the program.

- In some cases, the influence of the program has extended beyond the confines of the laboratories and has resulted in improvements in sample collection. For example, the ANDA laboratory in El Salvador has trained their inspectors to use better sampling procedures.

- Based on interviews across different organizations, the evaluation team concluded that internal training was a key determinant of the extent to which the concepts taught by CEPIS were transferred to those that did not attend the CEPIS training. At those laboratories where internal training was not implemented, not all personnel have been adequately trained.
- Because QC training was limited to a single course, most of the laboratory personnel did not receive first-hand training by CEPIS in this critical area. Even at those laboratories that had implemented internal training, not all personnel have been adequate trained in QC concepts.

CEPIS plans to complete initial evaluations of the drinking water analytical laboratories during Spring 2002. This outcome should be refined based on the quantitative results and other findings of that evaluation.

The program did not impart a clear vision of the analytical methods and laboratory throughput capacity needed to monitor drinking water quality for the pollutants of greatest concern to public health. This outcome is supported by the following findings.

- Based on responses to interview questions, it appeared that many of the laboratories have not developed a clear vision of the types of chemical analyses that are most critical and the laboratory throughput capacity needed to assess drinking water quality, given the types and variability of pollutant loadings. Without this, it is hard to evaluate the extent to which the program has improved the capacity of the laboratories to analyze for pollutants of greatest concern. It should be mentioned, however, that the quality of analyses to detect microbiological contaminants, which are the most immediate concerns to public health, was strengthened.

- This conclusion is tempered by the finding that although it is unclear whether the program addressed *all* of the pollutants of primary concern, it is clear that the analytical methods that were the focus of the program do address pollutants critical to public health (i.e., the training did not focus on non-critical methods).

- This conclusion is further tempered by the finding that some laboratories have begun to develop new procedures in response to demand, which, it is assumed, reflects a concern for public health. For example, the National University laboratory in El Salvador is developing new procedures for fluoride and arsenic analyses.

The program has helped key water utility, Ministry of Health, and university drinking water laboratories in El Salvador, Nicaragua, and, to a more limited extent, Honduras take initial steps toward accreditation. This outcome is supported by the following findings.

- All of the analytical laboratories have made significant strides in implementing QC programs (see above) as a result of the program. For example, the ANDA laboratory in El Salvador estimates that they have completed about 70% to 80% of the activities necessary to comply with accreditation requirements.

- The program has raised the level of awareness of the laboratories' staffs with regard to the benefits of accreditation. Some laboratories indicated that they had not been considering accreditation prior to their participation in the program but have now identified it as a priority.

- Several of the laboratories noted that the program has provided them with a clear roadmap for achieving accreditation. The program has helped them identify weaknesses and prioritize resources. The training provided materials outlining the steps to accreditation. Some of the laboratories noted that they have developed a strategic plan for achieving accreditation.

- The program has helped establish a relationship between the water laboratories and the CEPIS laboratory, a similar size laboratory that has achieved accreditation, creating an avenue for dialogue and possible future technical assistance.

The program generally resulted in a more constructive relationship between drinking water laboratories and those responsible for water treatment decisions, although the extent of success in this area was limited. This outcome is supported by the following findings.

- The program has resulted in increased level of awareness among water utility managers in El Salvador and Nicaragua regarding the importance of water quality and the role of the water laboratories. Communications between the laboratories and senior utility managers have improved. Also, as a result of improvements in data quality and documentation, communications between the laboratories and treatment plant managers have improved.

- In El Salvador, where some laboratory personnel participated in both the laboratory and treatment plant optimization components, increased awareness of treatment operations has enabled the laboratory personnel to take a more constructive role in helping plants respond to water quality problems.

- In El Salvador, where the MOH participated in both the laboratory and treatment plant optimization programs, the program has helped build trust between these institutions at the technical level. The program has also increased awareness on the part of the MOH of treatment operations and has enabled the MOH to take a more constructive role in helping plants respond to water quality problems.

- The PAHO representative in El Salvador noted that although trust had been established between the MOH and ANDA at a technical level, similar trust was not established between the organizations at a policy, or senior management, level. Based on information collected through interviews, it appears that the program did not result in a better relationship between the MOH and ENACAL in Nicaragua. This limited the extent to which this outcome was achieved.

The program laid the groundwork for future sustainability. This outcome is supported by the following findings.

- Most of the laboratories have taken significant steps toward achieving accreditation as a result of participation in the program. As noted above, accreditation could be a key determinant of sustainability.
- The program has resulted in increased level of awareness among water utility managers in El Salvador and Nicaragua regarding the importance of water quality and the role of the water laboratories. This has helped the water utility laboratories garner more resources and suggests the possibility for increased support in the future. Nonetheless, the general lack of systematic focus on this issue may limit the sustainability of the program.

- The program has resulted in better working conditions for laboratory personnel, which will help address the issue of work force retention. All of the laboratories noted significant improvements in laboratory safety, including improvements in the supply and use of protective clothing and equipment, better ventilation, materials storage, and fire preparedness. Several laboratory technicians noted the self-satisfaction that they have received as a result of participation in the program. Others have noted that, regardless of participation in the program, the laboratory technicians are pleased to have the opportunity to work with advanced equipment and analytical methods. The ANDA laboratory noted that a proposal has been made to increase the salaries of laboratory personnel.

- All of the analytical laboratories have developed QC manuals based on material provided by CEPIS during laboratory training (see above). Some of the laboratories indicated that they have developed internal training programs using the materials obtained and techniques learned during the CEPIS training. The utility laboratories noted that they have instituted training for both the central and regional laboratories. All of these outcomes will help maintain institutional knowledge in the case of work force turnover.

- The program has helped establish relationships at the technician level between analytical laboratories. For example, ANDA personnel maintained relationships with MOH personnel in El Salvador, and have visited the MOH laboratory to practice using the AA for metals analysis. The utility laboratories in El Salvador and Nicaragua have also maintained contact with the university laboratories in those countries.

- The program has provided the laboratories with new equipment that will enable them to expand their range of analytical capabilities. The laboratories have also been trained in analytical methods that they currently do not perform. This will enable the laboratories to grow in the scope of analyses as the needs of the country dictate without having to turn to outside laboratories for support.

- This outcome is tempered by the fact that some of the laboratories clearly do not believe that they will achieve accreditation in the near future and some do not believe that accreditation is attainable even in the long term. Based on this, it does not appear that the program set clear interim goals that could help focus the resources of laboratories that face greater impediments to accreditation. This will likely limit the effectiveness of the program in creating a roadmap for certain laboratories to strengthen their capacity in the future.

In addition, personnel from all of the laboratories indicated that it would be very useful to maintain a network of contacts within the laboratory community. Based on this evaluation, however, it appears that this was not achieved as a result of the program. This may limit the extent to which a self-sustaining mechanism for training and information sharing emerges in the region.

Impediments to Success

The evaluation team identified five key impediments that limited the extent to which EPA met its objectives for this component of the Program: 1) inadequate staffing in the MOH

laboratories; 2) resignation of trained personnel from analytical laboratories and consequent loss of institutional knowledge; 3) inadequate equipment and supplies; 4) the lack of resources to support participation on the part of laboratory personnel in non-training aspects of the component; and 5) inability to deliver and install equipment in a timely manner relative to the training.

The lack of personnel at the MOH laboratories clearly limited their ability to participate in the laboratory training and take advantage of the program. Although the laboratories did send personnel to the courses, the lack of adequate staff clearly limited their ability to share what they learned among other key staff, develop QC manuals, install and start-up new equipment, and begin to improve laboratory operations. This may also affect the sustainability of the program as a whole given the role that the MOH laboratories could play in drinking water decision-making.

Several interviewees noted the issue of employee retention as a key determinant of the sustainability of the program. The impacts of this were most evident at the MOH laboratory in El Salvador where, according to interviews with MOH laboratory personnel, a key program participant had left the laboratory without imparting much of the information gained during training.[15] The impacts of this impediment on the success of the program (past and future) is related to the resource impediment identified above in that if adequate resources are applied to internal training, the impacts of employee turn-over can be minimized.

The evaluation team also noted a general theme among laboratories was the lack of adequate supplies, particularly reagents, reference materials, and glassware, to perform analysis of a caliber that would be required for accreditation. The maintenance of adequate supplies will require an ongoing influx of funds and, as such, could be a key determinant of sustainability.

Over the course of the interviews, the evaluation team learned that significant additional resources outside of those provided by EPA were required of the laboratories to fully benefit from the program. These included resources required to prepare QC manuals, implement new QC programs, share information among key laboratory personnel, and install and start-up new equipment. All of these are critical steps in improving data quality and achieving accreditation. The extent to which this impediment impacted the success of the component appeared to be highly correlated with the level of laboratory staffing and funding (i.e., the most poorly staffed and funded laboratories showed the least improvement), although mid-level management buy-in also seemed to play a significant role.[16]

Finally, the evaluation team noted a lack of coordination between the sequencing of training and receipt and installation of laboratory equipment. As a result, some laboratory

[15] The impacts of employee retention on the MOH laboratory in El Salvador were further exacerbated by the fact that the MOH decided not to hire an new employee to replace the one who left, resulting not only in a loss of institutional knowledge but also more acute under-staffing.

[16] For example, at the ANDA laboratory in El Salvador, although the laboratory did not have adequate resources to devote staff to develop a QC manual, the managers overseeing laboratory operations clearly inspired enthusiasm for the program among laboratory personnel. As a result, the ANDA laboratory made significant strides in developing its QC manual, mainly through voluntary contributions by the staff on unpaid overtime.

personnel were unable to practice the concepts learned during training and, according to interviewees, will need refresher training when the equipment is installed and operational. At the ANDA laboratory in El Salvador, the laboratory was under construction during the course of the training; therefore, the issue of sequencing was beyond the program's control. At other laboratories, however, it appeared that the problems with sequencing were a result of contractual issues.

Sustainability Recommendations

OIA is interested in ensuring that its efforts result in permanent, sustainable improvements in drinking water quality. Over the course of the interviews, the evaluation team identified three conditions that are important to reaching this goal: 1) key drinking water laboratories must achieve accreditation for analysis of pollutants of primary public health concern; 2) links between drinking water laboratories and water quality decision-makers must be strengthened; and 3) a sustainable source of funding must be available to operate the laboratories at a level necessary to maintain accreditation.

The laboratory component of the EPA's drinking water program helped key analytical laboratories take initial steps toward accreditation and supported more constructive relationships between drinking water laboratories and those responsible for water treatment decisions, though primarily at the technical level. The program also helped some of the laboratories (primarily the water utility laboratories) garner more operating funds from their organizations. Accordingly, the evaluation team has concluded that additional support would leverage the initial successes of this component with a strong potential for achieving sustainable improvements in drinking water quality.

The evaluation team believes that additional, short-term donor funds could most effectively be applied to help key laboratories achieve international accreditation and to engage key decision-makers to help facilitate development of a sustainable source of funding for the laboratories. Specifically, the evaluation team recommends the following.

Additional support should be provided to strengthen the technical capacity of key drinking water analytical laboratories and assist these laboratories in achieving accreditation for analyses of critical importance to public health. This could include technical assistance to the analytical laboratories to set-up and stabilize instrumentation and other equipment and to support the assessment and/or documentation of the pollutants of greatest concern and the laboratory throughput capacity needed to effectively monitor these pollutants. In addition, supplemental training on topics including more advanced uncertainty and statistical analysis, analytical methods for parasites, water treatment processes, and internal laboratory auditing should be provided to reinforce the training provided to date. Training should include hands-on operation, calibration, and maintenance training at individual laboratories.

Regular accreditation-focused laboratory evaluations and follow-up and technical assistance should be provided for at least 1 to 2 years to help laboratories identify weaknesses and prioritize resources to achieve accreditation. For those laboratories that are furthest from

achieving accreditation, interim quality goals should be established. For those laboratories that meet the requirements for accreditation, funds should be provided to cover accreditation costs. **Senior decision-makers in the Ministries of Health, Ministries of the Environment, water utilities, and other critical institutions should engage in a dialogue to raise their awareness of the role of water analytical laboratories in protecting public health, facilitate structural changes that would strengthen the links between laboratory data and water quality decisions, and create a sustainable source of funding for the laboratories.** This dialogue could facilitate agreements among the organizations regarding their respective roles, identify current capacity and funding gaps, and facilitate agreements to create a sustainable source of funds to cover these gaps.

Among the topics appropriate for inclusion in these dialogues, the participants could investigate development of alternative rate structures that would more fully cover the costs of drinking water production, including oversight by key ministries and development of policy mechanisms that would create a demand for laboratory services and generate a revenue stream to better align laboratory capacity with demand.

Finally, these dialogues with senior decision-makers should address the internal accounting and budget processes that would need to be in place to ensure that earmarked funds are used for laboratory capacity-building, operation, and maintenance.[17] Such processes could be identified as conditions for support from donors.

Additional support should be provided to further strengthen the links among key drinking water laboratories at the technical level. This will complement efforts to strengthen the policy-level links described above. Inter-organizational links at the technical level could be strengthened by supporting access to Internet-based resources and participation in regional organizations of laboratory professionals.

Opportunities should be explored for strengthening the public understanding of solutions to water quality problems and for supporting a stronger voice for the public in water quality decision-making. This could help ensure that water utilities get clearer feedback from consumers regarding their priorities and could provide support for policy reform (e.g., more targeted drinking water laws). Opportunities in this area could include supporting environmental education, helping to strengthen key non-governmental organizations (NGOs) in the region, and supporting investigations by NGOs and universities into the links between drinking water quality and public health.

Transferability Recommendations

In addition to evaluating the success of the program and developing recommendations for sustaining initial successes, the evaluation team was asked to use its findings to identify issues to

[17] For example, a key impediment to the sustainability of the National University laboratory in El Salvador is that any income generated by the laboratory goes to the University's general operating fund and is not returned to the laboratory's operating budget.

be considered when transferring the program to another to another country or region. In general, based on feedback received from program component participants, the evaluation team recommends that if this component of program is to be implemented in other countries, it follow the same general model with modifications to address country-specific needs.

As discussed above, the evaluation team found that the scope of the program was well conceived. EPA focused significant effort on assessing the needs of individual countries prior to implementing the program. This important step should be integral to all future programs. The goal of accreditation was effective and could serve as a model for future programs. Future programs, however, would likely benefit from:

- **More focused, strategic discussions with key organizations and laboratories on identifying priority analytical methods to be targeted for accreditation, considering the pollutants of primary concern to public health**
- **More attention to engaging senior decision-makers from key organizations to help strengthen inter-organizational relationships.** This will help raise awareness of the important function of analytical laboratories to the delivery of drinking water, and increase the commitment of resources by these organizations to support participation in the program.

In terms of program implementation, the evaluation team found that the laboratory training, laboratory evaluation, and equipment procurement were effective in generating the desired outcomes. The training provided an integrated suite of courses and, together with the laboratory evaluations, focused considerable energy on building the human capacity of key drinking water laboratories. The equipment procurement helped build the physical capacity. **This well-balanced approach to institutional capacity building (i.e., focusing on both human and physical capacity) should be used as a model for future programs.**

In the future, program implementation could be improved by integrating QC concepts throughout the courses (rather than or in addition to having a separate course on this topic); allocating more resources to the development of a network of laboratory professionals; creating opportunities for more personalized training (e.g., by reducing class size or offering different courses for participants with different levels of experience); supplementing performance evaluation visits with hands-on training in the logistical aspects analytical procedures; and, to the extent possible, more carefully coordinating the sequencing of equipment delivery and laboratory training.

This page intentionally left blank.

B. SOURCE WATER PROTECTION PROGRAM IN NICARAGUA AND HONDURAS

Background

The source water protection program was focused on strengthening the capacity of national and local drinking water specialists in Nicaragua and Honduras[18] to protect source water from contamination. EPA recognized that Nicaragua and Honduras did not have governmental programs designed to protect their sources of drinking water. In turn, there was a significant degree of contamination in these water bodies, which affected the quality of drinking water in both countries. Moreover, most water officials - as well as the public - in Nicaragua and Honduras were not familiar with the concept of source water protection. While some watershed protection programs existed in Nicaragua prior to EPA's involvement (e.g., erosion control), few, if any, of these programs directly addressed source water protection.

At the outset of this program component, EPA recognized that it was beyond the scope of the program to support development of an integrated national source water protection program. Rather, EPA focused on trying to communicate critical concepts and techniques to key water supply specialists and community leaders who were in a position to implement, transfer, and begin to institutionalize these concepts and techniques. EPA also focused on facilitating the initial transfer of these concepts and techniques to the greater professional and stakeholder communities. The program consisted of developing a workshop training manual, holding workshops to review the key elements contained in the guidance document, and conducting pilot projects designed to highlight specific elements of SWP in the communities. Further, through the demonstration projects EPA expected to generate experiences and lessons specific to Central America that would enable the establishment of more effective source water protection programs.

The team conducted interviews and gathered and analyzed additional information to determine the extent to which the SWP program has:

- Effectively communicated critical concepts and techniques – source water delineation, public participation, and education and outreach - to key water supply specialists and community leaders in Nicaragua and Honduras;
- Resulted in the initiation of source water protection activities; and
- Planted the seeds to sustain initial program successes by:
- Raising awareness of source water protection issues among the greater professional and stakeholder communities;

[18] The majority of the work conducted on source water protection occurred in Nicaragua; in Honduras, source water protection efforts were limited to the delivery of workshops.

- Augmenting the network of drinking water professionals, officials, and other source water protection decision-makers; and

- Helping to build the capacity necessary to develop and implement critical source water protection concepts and techniques.

Program Component Activities and Outputs

EPA and its contractor, Horsley & Whitten, organized and participated in meetings with AID, PAHO, ENACAL, community leaders, and representatives of the Ministry of Natural Resources to assess key source water protection issues and develop the source water component of the program. EPA then supported development of a source water protection training manual that covered the key elements of developing an effective SWP plan, participated in the development and delivery of workshops and training courses on source water protection, and helped develop and supported implementation of pilot projects to demonstrate important source water protection program tools. These include watershed delineation, developing inventories, ranking pollutant sources, and establishing partnerships.

More specifically, implementing the program led to the:

- Development of a training workshop, including a training manual that identifies the key components necessary to develop a successful source water protection program. The program and manual address technical and policy aspects of source water protection such as delineation of source water protection areas, identification of potential contaminants, and how to involve the public in source water protection activities. The two-day workshops were based on EPA source water protection training, and the manual was adapted from EPA training material. The workshops included information specific to Nicaragua, including a description of the three demonstration projects. The workshop included a "train-the-trainer" component whereby EPA helped prepare a subset of the attendees to redeliver the training in other regions of Nicaragua, Honduras, and other countries in Central America.

- Delivery of the training workshop, including distribution of the training manual:

- *Nicaragua* – During October of 2001, the source water protection workshop was delivered three times in Nicaragua.[19] Workshops were held in Esteli, Matagalpa, and Managua and were attended by national and municipal governmental officials, water utility officials, Nicaraguan and international NGO representatives, local businesses, and university students and professors. A total of 106 participants attended the source water protection workshops

- *Honduras* – From October through December of 2001, the source water protection workshop was delivered five times in Honduras. Attendees of these workshops included national and municipal governmental officials, water utility officials, NGO representatives, and university

[19] Details of the source water protection workshops held in Honduras are included in the drinking water section of this report.

students and professors. A total of 155 participants attended the source water protection workshops.

- Completion of three demonstration projects, addressing watershed delineation, education and outreach, and public participation.

- *Esteli* – The Esteli project focused on delineating source water protection areas around the city of Esteli's wells, developing inventories of potential contaminant sources within those protection areas, and ranking key pollution sources. In addition, this project focused on developing relationships and regular coordination on source water protection among the mayor's office, the local university, and other local organizations.

- *Matagalpa* – The Matagalpa project focused on incorporating public participation into the management and protection of source waters in the city of Matagalpa. Moreover, it focused on building and enhancing local source water management and constructing a local washing station to prevent contamination caused by washing clothes in the river.

- *Ocotal* – The Ocotal project focused on increasing public awareness and stakeholder involvement in source water protection in and around the city of Ocotal, particularly among nearby coffee and cattle farmers. This effort involved the distribution of three public outreach brochures, disseminated by university students, providing an introduction to source water protection concepts and implementation. In addition, towns upstream of Ocotal were involved in the project to demonstrate that sedimentation and other sources of contamination in one area can affect towns that lie downstream.

Program Outcomes

In conducting the evaluation of this component, the evaluation team recognized that the Program was trying to introduce a number of new concepts to local water quality professionals and other members of the community. Accordingly, the team analyzed the outcomes in terms of what might be expected for a new program like this.

In Honduras, source water protection training was provided within the context of a more broad-based safe drinking water program component, discussed in section II C. This section focuses on key outcomes observed in Nicaragua. In general, the evaluation team found that the program has succeeded in introducing the general concepts and techniques for source water protection, increasing awareness about the relationship between source water and safe drinking water quality, and augmenting the network of drinking water officials involved in source water protection. People are continuing to use the workshop manual as source of information and ideas. In addition, a limited number of source water protection activities have been initiated or the concepts have been incorporated to some degree into existing projects. On the other hand, the interviews demonstrated that program participants still lack sufficient knowledge to adequately address source water problems. With regard to the pilot projects, external factors, time constraints, and a lack of funding prevented the completion of some key activities (e.g., the failure to complete the washing station in Matagalpa). In addition, a lack of early communication limited the sharing of lessons learned among those participants in the pilot

projects. Specific outcomes along with the supporting information culled from our interviews follow.

The program effectively communicated critical concepts and techniques – source water delineation, public participation, and education and outreach - to key water supply specialists and community leaders in Nicaragua.

- Most participants indicated that EPA provided useful technical assistance on source water protection during the workshops and demonstration projects. In particular, the workshops provided new concepts and ideas to people who were generally aware that source water problems existed but did not know how to evaluate or address them.

- Participants noted that the distribution of the source water protection manual and the use of the manual during workshops boosted participants' understanding of key concepts and provided some skills needed to continue with source water protection efforts**.** Most participants indicated that the source water protection manual is an excellent resource that they would continue to use when developing plans for source water protection. Moreover, participants indicated that the manual allows for a "train-the-trainer" approach whereby workshop participants can use the manual as a guide when they train other parties on source water protection.

- Nicaraguans from the demonstration project communities indicated that they are more knowledgeable of and interested in source water protection.

- Some municipalities and universities are continuing discussions and planning with regard to source water protection. For instance, CIRA-UNAN, the university in Esteli, held a meeting with ENACAL on source water protection issues in mid-March, 2002.

- **Although the program led to the initiation of some source water protection activities, the short time frame and funding limitations hindered the completion of some pilot projects.**

- Some stakeholders in the demonstration project communities are incorporating source water protection into their day-to-day responsibilities. However, the team saw no evidence that the information is being used by local decision-makers.

- The Matagalpa demonstration project helped the community incorporate public participation into the management and protection of source waters and enhanced local source water management.

- The Matagalpa demonstration project spawned efforts to divert water from the river to a small clothes-washing station away from the river. However, due to funding issues and the conclusion of the EPA/AID Source Water Protection Project in the midst of the November elections, the demonstration project has not been completed.

- During the Estelí demonstration project, participants located public supply wells, gathered information about the pumping rates of those wells, and delineated protection areas for all of

the wells in the town. Participants completed inventories of potential contamination sources within the protection areas and began ranking the potential sources. However, the participants did not have sufficient funds to develop a short or long-term plan for source water protection.

The program raised awareness of source water protection issues among the drinking water professional and stakeholder communities but has not led to widespread implementation of these activities.

- Participants noted that the workshops in particular allowed representatives from governmental agencies, municipalities, Nicaraguan and international NGOs, local businesses, and universities to share ideas and experiences.

- Several participants in the demonstration project communities stated that EPA's activities have begun to change public attitude**s** towards water quality and water bodies in general. For example, in Matagalpa, public participation at community source water meetings increased throughout the course of the demonstration project.

- The educational effort in Ocotal heightened awareness of water quality issues among a broad spectrum of stakeholders with an interest in water resources and their management, including businesses, residents, farmers, transient and permanent farm workers, local government representatives, water treatment and delivery managers, non-government organizations and students ranging from elementary to high school levels. Increased awareness on the part of the upstream communities that their activities could affect the water quality of downstream communities supports the prospect of continued progress in watershed protection for the Rio Dipilto area. As a result, students, coffee workers, coffee farmers, cattle farmers, and their families have an increased understanding of the primary health issue in their community: drinking water quality.

- The team learned that since the concepts introduced at the workshops and demonstration projects were new to participants, they have not been adopted into most ongoing activities.

EPA's efforts helped to enhance the network of drinking water professionals, officials, and other source water protection decision-makers in Nicaragua.

- Participants noted that the workshops in particular allowed representatives from governmental agencies, municipalities, Nicaraguan and international NGOs, local businesses, and universities to establish relationships.

- Workshop participants indicated that the workshops helped improve coordination among institutions, and between institutions and the community. Indeed, one participant noted that, "The richest part of the program was the exchange of experiences between people in the environmental field."

- Several participants noted that it was important that the universities were involved in the program because they are a key stakeholder in source water protection programs (and similar

environmental initiatives), providing research expertise and the energy and interest of the students and professors.

- The educational effort in Ocotal brought together a variety of stakeholders in water resources and their management, including businesses, residents, farmers, transient and permanent farm workers, local government representatives, water treatment and delivery managers, non-government organizations, and students.

- Several participants indicated that it would have been useful to bring other pilot project leaders together earlier in the program to discuss project plans, implementation, and lessons learned.

Impediments to Success

While the source water protection program achieved several program objectives, overall program success was limited by a number of factors. These include ***the relatively short time that the program operated, the range of experience among program participants, the lack of existing source water protection laws or programs, and the lack of sufficient resources.***

The program got off to a slow start and only ran from January 2000 to December 2001 with the workshops taking place late in 2001. Many of the interviewees noted that this did not provide them with enough time to take lessons learned from the workshops and pilot projects and integrate them into their ongoing activities. Although elements of the program have begun to change public attitudes towards water quality and water bodies, large-scale attitude change will take longer to achieve. Several participants indicated that Federal agencies and municipalities do not yet have the technical or policy expertise to develop source water protection plans. Moreover, they lack access to laws or programs that could serve as effective models for developing and implementing plans. The lack of available funds is a problem faced by virtually every program. In this case, the limited resources hampered the ability to complete some of the pilot project activities and implement tools learned from them.

In addition, it is important to note that other events and activities beyond the control of project planners or participants can negatively impact project success. For example, the elections taking place in Nicaragua in November led to turnover in the Ministries of Environment and Health and limited participation of key officials in the workshops. In addition, the timing of the elections was a factor in the failure to complete the Matagalpa demonstration project.

Sustainability Recommendations

EPA is interested in ensuring that the work done thus far to establish source water protection programs in Nicaragua and Honduras is sustained. The evaluation team has identified the following recommendations to support this goal.

Communities or municipalities need to develop their own source water protection strategies that include the elements learned in the demonstration projects and highlighted at the workshops. This should be done through stakeholder meetings so that community members, politicians, farmers and others have equal say in the outcome.

EPA and other international supporters should continue to support and expand training opportunities, targeting the key stakeholders responsible for decision-making on water quality protection activities. Appropriate topics for additional workshops include identifying the effects and toxicity of contaminants, involving the public in source water protection, delineation of protection areas, soil conservation, and water treatment. In particular, workshops aimed specifically at municipal water and environmental committees, government agencies, and universities would increase the technical and policy expertise of these parties and decision-makers.

Support for efforts to institutionalize source water protection into environmental activities in Nicaragua at the Federal and municipal level should be continued. This could include technical or training support towards helping municipalities, in concert with community development groups, generate water quality plans that address source water protection. In addition to the environmental municipal department, the economic and social departments should be involved when developing plans. In addition, **Technical assistance on data collection efforts aimed at assessing water quality in source water protection areas, as well as analyses that link water quality and public health should be provided.** In general, source water protection efforts in Nicaragua may not garner significant attention or support from the government or the public until source water quality issues are linked to public health. Providing technical assistance with monitoring, database development, and data analyses would support development of these linkages.

Efforts should be made to work with Federal and municipal governments to incorporate source water protection into the legal framework. Laws in the U.S. and other countries' laws as models for this approach; because of unique source water issues in Nicaragua, these laws should be used as a guide, not as a directly transferable rule. Alternatively, municipalities could be encouraged to incorporate source water protection guidelines at the local level (e.g., through municipal committee plans).

Transferability Recommendations

The evaluation team has reviewed the outcomes realized by this component of the Program and believes that the general approach incorporating training with selected demonstration projects serves as an appropriate model for implementing this component elsewhere in Central America. In order to build on what was learned from this component, we recommend that in beginning implementation in other countries or regions that the project team be sure to **make early and effective use of local stakeholders, work to tailor the workshops and projects as much as possible to address local concerns, focus on the technical aspects of the training as the most transferable elements, and work to coordinate the demonstration projects as closely as possible with the training activities.**

Future programs should be sure to address the technical elements of SWP such as the wellhead mapping and contaminant inventory exercise. Although it was only demonstrated in one community, Esteli, due to time and resource restraints, it makes sense to either do this in a variety of communities or to include key community members from a variety of communities in the exercise. This will help ensure that the communities feel comfortable with the most technical or complicated elements of SWP

Future source water activities (e.g., demonstration projects or workshops) should be closely and explicitly linked so that parties can share ideas, information, and critical analyses throughout the planning and implementation stages of each project. Local stakeholders can work together to identify source water problems and develop potential remedies monthly meetings be held among demonstration project coordinators to discuss, for example, activities to date, next steps, problems that need resolution, and innovative approaches to source water protection. Because each demonstration project can demonstrate a different aspect of source water protection, the different participants could benefit from having the opportunity to learn about each unique experience.[20]

[20] For example, participants in the Matagalpa demonstration project noted that their watershed plan could have benefited from additional exposure to the mapping and inventory exercise in Esteli.

C. TREATMENT PLANT OPTIMIZATION IN EL SALVADOR

Background

Under the treatment plant optimization component of the program, EPA focused its activities on building the capacity of ANDA, the main water utility serving the urban and peri-urban population in El Salvador, to evaluate its water treatment plants. Improvements in the quality of water produced by ANDA have the potential to directly affect thousands of Salvadorans. The critical issue in this area is the balance between the competing demands of drinking water quantity and quality; the balance between reaching as great a population as possible and ensuring that the drinking water supply is not a conduit for disease. A key objective of the evaluation, therefore, was to develop an institutional framework to better understand the key factors affecting the balance between drinking water quality and quantity in El Salvador.

Like the other sectors subject to this program, the ability to effect improvements in drinking water quality via the water treatment sector is constrained by the lack of effective, enforceable safe drinking water laws. The potential impacts of efforts to improve drinking water quality are further constrained by the decentralized nature of drinking water production in rural areas of El Salvador. About 75% of the population lives outside of the urban/peri-urban area served by ANDA. In a country like El Salvador, where the potential is great for improvement in both urban and rural water quality, limited resources can generally have a greater impact (in terms of population affected) when directed toward a centralized utility.

Within ANDA itself, the ability to effect water quality improvements is further constrained by the resources available to address the increasing urbanization of the population, the effects of urbanization on drinking water demand and source water quality, limitations of the potable water distribution system, and environmental factors such as seasonal variations in surface water flow and turbidity and accessibility of good quality ground water to supplement surface water supplies.

Broad-based policy reform, outreach to rural populations, and the level of capital investment needed to comprehensively improve drinking water quality in El Salvador were clearly beyond the scope of this program. Nonetheless, opportunities exist for effecting smaller change within these broader institutional constraints. Most importantly, change could be effected by: 1) strengthening the capacity of ANDA to collect and analyze information needed to make sound decisions regarding existing plant operations and priorities for plant improvements; and 2) improving the inter-organizational links between those responsible for regulating water quality and ANDA.

The increased capacity on the part of ANDA to collect and analyze information regarding plant operations will help both managers and operators make better decisions affecting water quality. Prior to the program, ANDA did not systematically collect information regarding water treatment plant performance. The lack of this information necessarily leads to a bias in favor of investments in increased quantity, as issues associated with inadequate quantity are, by their nature, more evident. Therefore, the collection and analysis of this information can only help managers more effectively balance quantity and quality in their investment decisions.

In the case of operators, the connection between better information and improved treatment plant performance is clear. Without good information, operators cannot know how their actions affect water quality, cannot identify poorly functioning unit processes, and cannot implement sound solutions to improve plant performance.

Improvements in information about plant performance will almost surely lead to better operational decisions and higher quality water. Nonetheless, these improvements will be constrained by the existing plant infrastructure. Greater improvements in water quality will depend on changes in the manner in which investment decisions are made. Although improvements in information will lead to more effective consideration of water quality issues, because the water utility is a natural monopoly, it will, nonetheless, maintain a bias toward increased production. A regulatory presence is necessary to ensure that water quality concerns are addressed. As such, improvements in the capacity of key ministries to compel ANDA to more effectively consider water quality in its decision-making.

Program Component Outputs and Activities

The treatment plant optimization component of the program focused on improving drinking water quality in El Salvador by strengthening the capacity of the major water utility (ANDA) to more effectively use existing treatment plants to protect the potable water supply from microbial pathogens. This component was designed around the use of Comprehensive Performance Evaluation (CPE). CPE is one step in the Composite Correction Program (CCP) approach used as a model in the U.S. for the optimization of surface water treatment plants. The CCP approach includes two steps, CPE and Comprehensive Technical Assistance (CTA). The objective of the CPE is to identify whether significant improvements in treatment plant performance can be achieved without major capital expenditures. A CTA is conducted to achieve and sustain optimized performance goals by addressing performance-limiting factors identified during the CPE. This component of the program included the following activities:

- EPA organized and participated in treatment plant visits and meetings with PAHO, USAID, ANDA, and the Ministry of Health in El Salvador to assess treatment plant capabilities, gather input about treatment plant needs, engage support from key decision-makers at ANDA and the Ministry, organize in-country trainers, and develop the treatment plant optimization component of the program.

- EPA developed, provided financial support for participation, and conducted and/or oversaw the conduct of CPE demonstrations in El Salvador.

- EPA provided turbidimeters to the treatment plants for monitoring turbidity prior to and after the CPE demonstrations.

The program component produced the following key outputs:

- Agreement on the part of the Vice-Minister of the Ministry of Health and the President of ANDA to support efforts to improve treatment plant performance.

- Creation of a working group on water treatment (COPAS) comprised of representatives of the Ministries of Health and Environment, ANDA, PAHO, and USAID (the EPA program served as the catalyst for the creation of this group).

- Development and delivery of a training program, presenting the concepts of CPE through a combination of classroom work and actual CPE demonstrations. CPE demonstration-based training was provided at the Chain of Rocks water treatment plant in St. Louis, Missouri, and at five plants in El Salvador. Approximately 32 water professionals were trained, including 28 from ANDA, two from the Ministry of Health, and two from PAHO. Four ANDA personnel participated as trainers.

- Development and distribution of training and reference materials in Spanish, including the CPE workshop materials.

- Evaluations of four surface water treatment plants, including analysis of turbidity data, review of major unit processes, identification of performance limiting factors, and assistance in the identification of critical plant design and operation issues.

Program Outcomes

Given the scope and resources available for this evaluation and the lack of quantitative data measuring baseline conditions, the evaluation team based its conclusions on qualitative information gathered through interviews. The evaluation team measured the extent of success of this component in terms of the extent to which the program component achieved outcomes that would reasonably be expected given the resources applied by EPA to this component and given the institutional context (i.e., the institutional resources readily available to be leveraged and the institutional impediments that were outside of EPA's control).

The evaluation team found that the program component was well conceived. The use of CPE demonstrations effectively communicated the tools necessary for ANDA to collect and analyze information needed to make sound decisions regarding existing plant operations and priorities for plant improvements. In addition, the program was insightful in that it engaged not only the water utility but also its principal regulator under the current system, the Ministry of Health. The evaluation team found that despite the well-conceived overall scope, the impact of the program would have been greater if it had included follow-up technical assistance to address key design and other performance limiting factors identified through the CPE demonstrations.

Substantively, the evaluation team found that the program exceeded expectations in the extent to which it strengthened the capacity of ANDA to more effectively use its existing treatment plants. We found that the program resulted in plant operations that have a direct connection and can be expected to result in improvements in drinking water quality, provided useful decision-making information by helping to identify problems with major unit processes and performance limiting factors, and planted the seeds to sustain initial program successes.

The evaluation team concluded that due to infrastructure limitations identified during the CPEs in El Salvador, the plants will be unable to achieve the goal of "optimum performance"

without significant investment. The team concluded that a goal of "best possible" performance was appropriate, and that the treatment plant component of the program provided a necessary platform from which the ANDA plants can achieve that goal.

The program has resulted in improved confidence in the quality of drinking water produced by ANDA. Although data quantifying these improvements were not systematically collected as part of the evaluation, this more general outcome can be inferred from the following specific outcomes.

- The treatment plants have developed or are in the process of developing operations manuals.

- Treatment plants have improved operational practices including the use of jar tests and the calibration of chemical feed rates, the adoption of more stringent performance targets, more frequent and more distributed water quality monitoring, improved data recording and analysis procedures, more uniform plant management shift-to-shift, and improved sampling techniques.

- Treatment plant personnel have become more aware, proactive, and motivated. Operators have a greater awareness of the importance of their role in protecting public health and have an increased sense of responsibility. Operators are calmer in addressing water quality issues and are more open to constructive criticism.

- The roles and responsibilities of different personnel in the utility have changed. Responsibility for addressing operational issues has devolved from a more centralized management function to the individual plant managers. In addition, laboratory personnel and plant operators have developed more direct, constructive relationships in assessing and adjusting plant operations.

- Facility improvements have been achieved, including improvements in chemical storage, chemical feed operations, filter backwash procedures, and physical appearance.

- Improvements instituted at the surface water treatment plants (e.g., developing of operations manuals, water quality monitoring, facility improvements) are also being instituted at ground water treatment plants.

- The effect of these improvements on water quality is reinforced by statements from plant managers. For example, the manager for the Santa Ana plant indicated that finished water turbidity has been reduced from 5 to 8 ntu prior to the program to 0.3 to 0.5 ntu, and complaints from the public about water quality have decreased substantially.

- This conclusion was tempered by statements by interviewees that the CPE demonstrations, in general, covered the right topics, but more time could have been devoted to training in chemical treatment methods.

- In addition, laboratory personnel who participated in the treatment plant optimization component of the program indicated the great value they derived from learning about treatment processes and the benefits that have accrued as a result of their greater participation

in operational decisions. These benefits could have been more systematically realized by encouraging greater participation of laboratory personnel in the program.

The program has helped ANDA identify key factors limiting further improvements in ability to protect drinking water from microbial pathogens and has helped ANDA develop strategic priorities.

- The CPE demonstrations helped to identify major operational and design problems, including problems with sludge re-suspension, chemical dosing, flow distribution across parallel settling basins, and filter media.

- Prior to the program, ANDA had identified some performance limiting factors (e.g., intake fouling) and had begun to plan plant upgrades. Participation in the CPE demonstration program significantly focused plant upgrade priorities and influenced plant upgrade design.

- This conclusion is tempered by the finding that once operational and design factors were identified, ANDA personnel had to seek other avenues for technical assistance to address these issues. The program would likely have achieved greater success in capacity-building if follow-up technical assistance had been included as an integral aspect of this component.

The program has planted the seeds for sustainability.

- The program fostered an increased level of awareness among water utility managers.

- The program served as a catalyst for the creation of COPAS and COPAS initiatives that promise to be important determinants of sustainability. COPAS has conducted an analysis of operator training requirements, developed a training program, and trained surface water treatment plant personnel. COPAS plans to extend training to ground water treatment plant personnel and continue to offer annual training. COPAS also plans to shift its focus to design issues and evaluation of health indicators.

- Some plants have realized savings in chemical feed costs (others have seen increased costs, as, previously, they had been under-dosing). Also, improved operations will result in economic savings in terms of more efficient equipment depreciation (i.e., the costs of depreciation will more closely align with productive output).

- The development of operations manuals will help ensure the retention of institutional knowledge.

- Better working conditions promises to foster greater personnel retention.

- The program has helped establish relationships among operators who work different shifts at the same plant and who work at different plants.

- This conclusion is tempered by interview data that suggested that at least two managers were unfamiliar with the contents and potential benefits of the CPE program.[21] The effectiveness and promise for sustainability of the program would have been enhanced by encouraging participation of these key decision-makers.

- In addition, plant managers indicated their desire to enter into technical partnerships with regional universities to provide an ongoing source of technical capacity-building for its personnel (in exchange for offering universities a chance to provide students with hands-on experience). These partnerships would have been facilitated by including university personnel in the CPE demonstrations and would have improved the promise for sustainability.

Impediments to Success

The evaluation team found that the broad constraints identified above constituted the key impediment that limited the extent to which EPA met its objectives for this component of the program. The team found that although significant resources were required of ANDA to fully participate in the program, ANDA personnel generally felt that they were provided the time and resources needed to meet the demands of the program.

Sustainability Recommendations

The treatment plant optimization component of the EPA's drinking water program in Central America clearly achieved substantial success in building the capacity of ANDA to collect and analyze information needed to make sound decisions regarding existing plant operations and priorities for plant improvements. Given this analysis, the evaluation team has concluded that additional support would leverage the initial successes of this component with a strong potential for achieving sustainable improvements in drinking water quality.

Therefore, the evaluation team recommends that additional resources be applied to this component of the program. The evaluation team believes that additional, short-term donor funds could most effectively be applied to helping ANDA institutionalize a Composite Correction Program (CCP) program and to engaging key decision-makers to help facilitate structural changes that would encourage a stronger consideration of water quality in future decisions and create a sustainable source of funding for further plant improvements. The evaluation team recommends that

Additional support should be provided to help institutionalize a CCP program in El Salvador. Specifically, we recommend that support be provided to the COPAS committee to assist COPAS in raising awareness of water quality issues; further developing and implementing

[21] One of the managers was very new to ANDA, having been there for only a few months. The other manager was higher-up in the organization and less involved in daily operations. This conclusion suggests that more focus on awareness-raising would have been an effective use of program resources.

training programs; maintaining the critical relationship between ANDA and MOH; expanding membership to include other key institutions (e.g., universities) and other staff (e.g., laboratory personnel). Support should be provided to encourage the institutionalization of COPAS either as an ANDA entity or interagency group (ANDA and MOH). This would give the members more credibility in addressing needs of the treatment plants and allow for them to leverage support from the authorities as a recognized entity.

In addition, technical assistance should be provided in the area of facility design, focused on those unit processes that were identified as marginal or inadequate. Outstanding training needs should be identified and support should be provided for supplemental training. Ideas for supplemental training received from ANDA personnel include watershed management, basin monitoring, treatment process design, activated carbon filtration, alternative treatment chemicals, and laboratory training for operators.

Additional support should be provided to maintain an ongoing CPE program. Support could include technical assistance during CPEs and support for the purchase of monitoring and record-keeping equipment (based on need) and decision software. A dialogue should be facilitated (separate from or in tandem with COPAS) to explore opportunities for technical assistance partnerships between ANDA, MOH, and Salvadoran universities. Technical assistance partnerships would offer university students the opportunity to experience treatment plant operations and CPE first-hand and would offer a source of ongoing training for plant personnel.

Senior decision-makers in government ministries, ANDA, and other critical institutions should be engaged in a dialogue to raise their awareness of the accomplishments achieved by the program and benefits for public health and water treatment operations (e.g., prioritizing capacity improvements, maintaining long-term operability). Discussions should be pursued with ANDA and key ministries (MOH and MOE) to facilitate agreements among these organizations regarding their respective roles in the production and regulation of drinking water, identify current capacity and funding gaps, and facilitate agreements to create a sustainable source of funds to cover these gaps. The discussion of organizational roles should consider approaches for standard setting, water quality monitoring and reporting, and enforcement.

Additional support should be provided to assist in the development of policies to underpin agreements among the key institutions to create more sustainable funding for the treatment plant operations and upgrades. Depending on specific agreements, this could include support for development of alternative rate structures that would more fully cover the costs of drinking water production and support for establishing alternative funding mechanisms such as a trust fund as a source of revenue for operation and maintenance costs and serving as equity for infrastructure development loans.

Transferability Recommendations

Based on the results of this evaluation, the evaluation team has concluded that the CPE demonstration model is a robust model for building capacity for treatment plant optimization.

The model focuses on building the evaluation tools needed to get the best performance from existing treatment plants (a relatively low-cost approach to performance improvements) to prioritize infrastructure investments. Future programs, however, would likely benefit from more emphasis on operational design issues, integration of follow-up technical assistance as an integral aspect of this component, encouragement of greater participation on the part of key treatment plant decision-makers and laboratory personnel, and inclusion of regional universities in the CPE demonstrations.

In addition, the evaluation team recognized the importance of COPAS to the success of the program. Support for development of similar institutions in other countries receiving treatment plant optimization support would likely improve the sustainability of those efforts. Participation of members of COPAS on the implementation team might also be considered, as this would enable the team to communicate the real results of the program through first-hand accounts.

D. DEVELOPMENT OF SAFE DRINKING WATER PROGRAMS IN HONDURAS

Background

The Honduras safe drinking water program was developed to build capacity and provide technical assistance to water specialists and public officials at the national and municipal level in order to facilitate the development of effective safe drinking water systems. EPA recognized that the water system infrastructure in Honduras was not sufficient to reliably provide safe drinking water to the public. Moreover, water officials in Honduras required significant technical assistance in order to develop effective safe drinking water plans at national and local governmental agencies.

Unlike those program components which focused on a specific sector (analytical laboratories, water treatment plants) or issue (source water protection), the safe drinking water component was intended to provide a broader overview and increase awareness of a number of drinking water issues in Honduras. As a first step in this effort, EPA and its partners worked with the Grupo Colaborativo de Agua to identify key safe drinking water issues in the country that would benefit most from EPA's involvement and expertise. Using this input, EPA then designed this component to address the following priorities:

- Capacity building in the conduct of drinking water system sanitary surveys and source water protection.
- Raising awareness among key Honduran agencies and organizations about the importance of and issues associated with protecting and managing drinking water quality.

The evaluation team conducted interviews, reviewed available documents and the results of demonstration projects in an attempt to determine the extent to which this component has:

- Effectively communicated critical concepts and techniques and helped build the capacity among key water supply specialists and community leaders in to conduct sanitary surveys and source water protection activities;
- Resulted in the initiation of activities to improve safe drinking water programs in Honduras;
- Raised awareness among key Honduras agencies and organizations about the importance of and issues associated with protecting and managing drinking water quality; and
- Provided useful materials and augmented existing networks of drinking water professionals, officials, and other source water protection decision-makers to sustain initial successes.

Program Component Activities and Outputs

EPA organized and participated in meetings with AID, PAHO, and in-country governmental and professional organizations to assess key drinking water issues and capacity-building needs and develop the safe drinking water component of the program. EPA provided funding to PAHO through a cooperative agreement and worked with AID, PAHO, and the Grupo Colaborativo de Agua to develop and deliver workshops on key safe drinking water issues. In addition to the workshops, EPA worked with the Grupo Colaborativo de Agua, and identified pilot projects, and supported implementation of pilot projects designed to demonstrate innovative approaches to protect and manage water systems in Honduras.

The program component produced the following key outputs:

- Development of two training workshops in addition to the workshop developed under the source water protection component of the program, including development of training materials. The workshops included a "train-the-trainer" component whereby EPA helped prepare a subset of the attendees to redeliver the training in other regions of Honduras or Central America.

- Delivery of training workshops, including distribution of the training manual:

- *Sanitary Survey* – During 2001, EPA and PAHO conducted five sanitary survey workshops. The focus of these workshops was to train attendees in conducting sanitary surveys of urban and rural drinking water systems. Attendees of these workshops included national and municipal governmental officials, water utility officials, NGO representatives, and university students and professors. The workshops included a theoretical component where participants worked through an EPA training guide on sanitary surveys, as well as a field component where participants visited a drinking water system and assessed its capacity to treat and distribute potable water. Overall, approximately 175 participants - including water officials from El Salvador, Guatemala, and Nicaragua - attended the five sanitary survey workshops. In addition, approximately 30 local professionals were trained to present the sanitary survey workshop throughout the country and Central America.

- *Source Water Protection* – From October through December of 2001, five source water protection workshops were delivered in Honduras.[22] These workshops, which are discussed in more detail in the source water section of this evaluation, primarily used the EPA/PAHO manual that delineates the key components necessary to develop a successful source water protection program. Attendees of these workshops included national and municipal governmental officials, water utility officials, NGO representatives, and university students and professors. A total of 155 participants attended the source water protection workshops.

- *Fundamentals of Drinking Water Programs* – During the summer of 2001, EPA delivered three trainings of the Fundamental of Drinking Water Programs. These workshops were

[22] Note that this information is also reported as an output under the source water protection component. This is the same output. It is presented in both sections for completeness and clarity.

intended to serve as an introduction to drinking water concepts and were aimed at senior level personnel at governmental organizations, mayors of municipalities, and the media. Approximately 55 participants attended these workshops. The participation of the media was to begin outreach and awareness raising to the public.

- Implementation of four pilot projects, addressing innovative approaches to protect and manage water systems in Honduras, and a seminar to discuss the projects.

- *Agua Para el Pueblo (APP)* – The purpose of this project was to develop capacity within selected communities by using and testing sanitary surveys to ensure the quality of water in local drinking water systems. As part of this effort, APP generated several local sanitary survey sheets and a training manual. The manual primarily focuses on the inspection of rural drinking water systems. As part of this project, the sanitary survey sheets and the manual were field tested and finalized.

- *DIMA* – This project analyzed the effect of coffee production on surface water quality in the Merendon Watershed. In addition, DIMA, the local water utility, evaluated the abatement processes being developed and implemented to reduce the impact of coffee production on water quality.

- *Save the Children* **–** This project involved conducting sanitary research and an evaluation of the water system sources in the San Lorenzo municipality of Honduras. The primary activities in this region that negatively affect water quality include: agriculture, livestock production, aquaculture, and salt extraction.

- *Catholic Relief Services* – This effort included a water quality monitoring project in the Department of Lempira in Honduras[23]. As part of the monitoring project, CRS received, set up, and utilized portable laboratory equipment to collect and perform physical, chemical and bacteriological monitoring of drinking water contaminants.

- *Seminar* – In December of 2001, EPA organized a seminar where the pilot project managers discussed the objectives, activities, results, achievements, and problems associated with each pilot project.

[23] The Departments in Honduras are similar to States in the United States

Program Outcomes

In general, we found that the workshops and pilot projects did help build capacity among water supply professionals and communities and spawned several safe drinking water activities at the local system level meeting program component objectives. However, since the activities (for example the sanitary survey) were focused on large systems, they did not effectively address some local concerns. In addition, the evaluation team found that there has not yet been widespread adoption of the tools discussed during the workshops and illustrated by the pilot projects. Key outcomes and observations supporting these conclusions are presented below.

The workshops and pilot projects effectively communicated critical concepts and techniques and helped build the capacity among key water supply specialists and community leaders to conduct sanitary surveys and source water protection activities. However, the component activities have not yet lead to a wide spread adoption of water protection tools and approaches.

- Numerous participants noted that their technical understanding of drinking water treatment was significantly enhanced.[24] These participants noted that the visits to the treatment plants during the sanitary survey workshops were particularly useful in that they provided a hands-on review of water treatment methods. Most participants also indicated that EPA's sanitary survey training material**,** which was adapted by PAHO and the Grupo Colaborativo de Agua, augmented participants' knowledge of and ability to conduct sanitary surveys.[25] Participants also noted that the CD-ROM containing workshop materials and the community outreach materials distributed during the Fundamentals of Safe Drinking Water workshop were particularly useful.

The program resulted in the initiation of activities to improve safe drinking water programs in Honduras.

- Several participants are actively applying sanitary survey techniques learned in the workshops to improve drinking water quality. SANAA, the national water utility, employees noted that they are using these techniques to identify strengths and vulnerabilities of their water systems. One organization noted that it used the techniques learned during the sanitary survey workshop to identify wells that show potential for contamination.

- SANAA employees noted that they are incorporating some of the source water protection concepts into its programs.

- A DIMA employee reported that, spurred by EPA's activities, his organization is developing a plan to conduct advanced chemical analyses at its lab. Moreover, the organization has now developed QA/QC manuals. In addition, SANAA labs are now analyzing more contaminants

[24] One participant indicated that he was affected enough by the treatment course that he "didn't want to drink the water after the course."

[25] Some participants noted, however, that some of the material in the manual was somewhat outdated.

as a result of the technical assistance from the workshops (see previous section for a description of Honduran participation in the laboratory-strengthening component of the program).

- Certain aspects of the pilot projects resulted in substantial public participation. For instance, as part of the CRS pilot project, community members became involved in the lab analyses of water samples from local drinking water sources.[26]

The program has raised awareness among key Honduran agencies and organizations about the importance of and issues associated with protecting and managing drinking water quality.

- The workshops in particular allowed representatives from governmental agencies, municipalities, Honduran and international NGOs, local businesses, and universities to share ideas and experiences.

- A manager at the Honduran Ministry of Health noted that the cross-representation of institutions at the workshops created a unique opportunity to comprehensively analyze the Honduran water sector.

EPA's efforts provided useful materials and augmented existing networks of drinking water professionals, officials, and other source water protection decision-makers to sustain initial successes.

- Most participants indicated that EPA's sanitary survey material augmented participants' knowledge of and ability to conduct sanitary surveys. Furthermore, a few participants noted that they have continued to study the concepts introduced in the workshops through use of a CD-ROM distributed by the Honduran program coordinator, which included most of the workshop materials.

- The workshops in particular allowed representatives from governmental agencies, municipalities, Honduran and international NGOs, local businesses, and universities to establish relationships. Several participants noted that the community outreach materials from the Fundamentals of Safe Drinking Water workshop were particularly useful.

- SANAA employees have trained their colleagues on the use of sanitary survey techniques and source water protection concepts.

- The sanitary survey and source water protection workshops have reportedly served as the impetus for a water conference currently being organized at one of Honduras' universities.

Impediments to Success

[26] On the other hand, the results from one of the pilot projects was delayed and somewhat limited due to the merging of two organizations that operate a treatment plant.

By achieving the principal outcomes noted above, the safe drinking water component of the program helped address some of the critical needs identified by the Honduran water supply community. Over the course of the interviews, the evaluation team noted the following impediments that hindered further success.

Because the program lasted for only two years, drinking water programs have not yet been institutionalized in Honduran agencies and organizations. Several participants indicated that Federal agencies and municipalities do not yet have the technical or policy expertise to develop drinking water plans. EPA's work effectively conveyed critical concepts related to drinking water through use of the workshops and demonstration projects. However, it is less clear whether the tools and approaches discussed and explored as part of the workshops and pilot projects will be broadly adopted

Although component activities have helped raise awareness about safe drinking water, the activities might not remain sustainable without additional follow-up and technical assistance from EPA. Honduran governmental and private agencies have historically focused on water quantity; however, EPA's activities have raised awareness of and interest in water quality issues. In turn, participants noted that decision-makers could begin to increase their focus on drinking water issues when developing environmental or health plans.

Lack of funding limited ability to expand workshop coverage. Several participants noted that the workshops would have been improved by incorporating field exercises, similar to those included in the sanitary survey workshops.

Sustainability Recommendations

To help ensure that a drinking water quality program will remain sustainable in Honduras, the evaluation team recommends

Training should continue with Honduran water professionals (e.g., at NGOs and universities) and governmental officials (e.g., Ministries of Health and the Environment, municipal committees). Moreover, the training should take place in various regions of the country, including rural areas, to reach a wide and diverse audience. Workshop topics might include: analyses of potential contaminants in drinking water (e.g., heavy metals), possible impact of pesticides and hazardous wastes on drinking water sources, the further training of technicians in the use of the sanitary surveys, and community outreach and involvement. Field exercises should be a central component of any future workshops.

Support should be provided to help the Ministries, municipalities and organizations such as SANAA institutionalize drinking water quality programs at the Federal, regional and local level in Honduras. Numerous participants indicated as a priority the institutionalization of sanitary surveys at water agencies. These participants stressed that EPA's continued support in this effort would help attain regulatory and political support.

EPA can play a key role by providing technical assistance to municipalities, in concert with community development groups, to generate drinking water plans. In addition to the environmental municipal department, the economic and social departments should be involved when developing plans.

Future assistance efforts should focus on monitoring efforts aimed at assessing the quality of drinking water sources, as well as analyses that link water quality and public health. Drinking water programs would garner additional attention from the government and the public if water quality issues were directly linked to public health. EPA could provide support towards establishing these linkages by providing technical assistance with monitoring, database development, and data analyses. In addition, generation of a national database that includes information on water quality, contaminants in drinking water, and waterborne diseases would be helpful.

Drinking water protection provisions should be incorporated into the legal framework. For instance, EPA could help facilitate discussions at the national and municipal level towards strengthening drinking water components of the national water law. EPA could use the U.S. and other countries' laws as models for this approach.

Future drinking water activities (e.g., workshops and pilot projects) should be closely linked so that parties can share ideas, information, and critical analyses throughout the planning and implementation stages of each project. If additional pilot projects are developed in Honduras, monthly meetings should be held among pilot project coordinators to discuss, for example, activities to date, next steps, problems that need resolution, and innovative approaches to improve drinking water quality.

Transferability Recommendations

The evaluation team has reviewed the outcomes realized by this component of the Program and believes that the general approach incorporating training with selected demonstration projects serves as an appropriate model for implementing this component elsewhere in Central America. In order to build on what was learned from this component, we recommend that in beginning implementation in other countries or regions that the project team be sure to **make early and effective use of local stakeholders, work to tailor the workshops and projects as much as possible to address local concerns, hold workshops across the country and work to coordinate the demonstration projects as closely as possible with the training activities.** As well as involving stakeholders early in the process, frequent meetings should be held to discuss activities to date, next steps, and problems that need resolution. To the extent possible, workshops should be designed so they include hands-on exercises or are closely linked with ongoing demonstration projects.

See also the next section of the report that addresses lessons learned for future program development.

This page intentionally left blank.

SECTION IV: LESSONS LEARNED FOR FUTURE PROGRAM DEVELOPMENT

OVERVIEW

This section of the report is for agency staff and manager and other parties who anticipate, or are currently involved in, the development of an international aid program focused on protecting public health and the environment. In addition to the specific recommendations identified in Section III for each of the four components of the Safe Drinking Water Program, the evaluation identified a number of issues applicable to both future activities in this program and to other international support programs. Specifically, this section focuses on recommendations for improving future program planning and program implementation.

KEY RECOMMENDATIONS

Be culturally sensitive. From the beginning of its involvement in Central America, EPA strived to create a program that would be sensitive to people's beliefs about drinking water, their work ethic, and existing relationships among people, particularly the employee-employer relationship. This was done through the use of regional and in-country partnerships, enlisting experts with international experience, ties to Central America, and/or who spoke Spanish. Program managers need to remain attentive to this not only at the beginning of a program but throughout its implementation as well. Take advantage of the experience of your in-country support staff as well as your partners in ensuring that your activities are consistent with local norms and expectations.

Work with regional and in-country partners to assess needs. Active participation of and coordination with local agencies during program development and implementation is critical for both the short and long term success of these programs. Local groups can help identify the environmental priorities of each region or country as well as the barriers that exist to improved program implementation. At the beginning of EPA's involvement, the agency initiated discussions with USAID Missions, water utilities, ministries of health, and water professional groups and associations in countries impacted by Hurricane Mitch to determine how EPA could be of most assistance. EPA's conversations with local agencies allowed the countries themselves, not EPA, to direct how assistance should best be focused. This not only better ensured that EPA would help to address problems relevant to the country of concern, it also helped ensure better on-going support of these programs during program implementation, and provided for greater likelihood that the programs would continue once the initial work was complete. In the future, EPA would try to be even more inclusive from the beginning. Certain

government agencies such as the Ministry of Environments might have been more involved had their role been more clearly articulated.

Develop aid programs through use of partnerships rather than top-down approaches. One of the strengths of EPA's Safe Drinking Water Program was that the agency, although perceived as the team captain, tried to develop and implement programs through use of a partnership approach, treating in-county entities as equals in helping solve problems. This approach has several advantages. The partnering approach generated strong enthusiasm and support for the programs in the host-countries, and garnered support for these programs during implementation. Since EPA was working with several different entities, EPA alone did not need to spread the word of these programs, and instead could rely on the in-country partners. Third, this approach will help better ensure that aid programs become institutionalized once EPA commitments are complete. Although partnerships were key, EPA could even do a better job in the future to strengthen these throughout the course of the program…

Make use of in-country and regional expertise. EPA relied upon PAHO, particularly PAHO's technical branch located in Peru, to design, deliver, and conduct follow-up of most of the laboratory training courses. Reliance on regional expertise helped ensure that the laboratory trainings would be better tailored to meet unique cultural needs. Further, it allowed EPA to make more efficient use of resources, since it would be easier for PAHO to deliver trainings, interact with participants during follow-up conversations via email or phone, and then conduct audits of the laboratories. Third, this style encourages locally-based problem solving. In addition, PAHO's credibility is strong in the region and therefore was important particularly in bringing these programs to the attention of decision makers.

Design program components to work together in an integrated manner. It is important for specific program components, such as laboratory capacity building activities and the training and pilot programs, to collaborate and support each other. This can help generate a larger network of personnel across policy and technical areas that might otherwise remain separate. Also, because labs are crucial to monitoring WQ data, it is important that treatment plants understand the importance of producing valid lab data. For instance, in the drinking water program in El Salvador, EPA conducted the treatment plant optimization and lab capacity building components simultaneously. Since representatives from agencies such as the Ministry of Health and ANDA participated in the workshops for both components, management and technical staff from these agencies were able to share ideas and collaborate on plans and programs for improving drinking water quality.

In addition, combining or sequencing program components increases senior level buy-in and support. For instance, in EPA's drinking water program in Honduras, the Agency and PAHO held workshops on safe drinking water, sanitary surveys, and source water protection. Participants in Honduras indicated that the concurrence of these three workshops raised awareness and dialogue among senior officials at the Ministry of Health and the Finance Ministry. These participants also noted that additional funds and programs have been dedicated to source water protection and drinking water protection in Honduras, in part because of the significant level of training and the demonstration projects that EPA conducted.

Finally, planning and implementing program components simultaneously can save EPA resources through logistical efficiencies. Meetings and workshops can perhaps address more than one component at a time, allowing EPA technical staff to make fewer trips abroad and use their time more efficiently in-country.

Recognize and capitalize on your strengths. The EPA Safe Drinking Water program managers sought to build a very effective EPA Safe Drinking Water Team. This meant finding EPA staff that were experts in their field, and if possible, had cultural ties to the region, and spoke Spanish. By spending time to do this, EPA built a team that was culturally sensitive, and able to build very positive relationships with host-country partners. Second, EPA sought to actively involve its own staff only in those interests where there was a discernible need. As noted above, laboratory expertise in laboratory capacity building was already available locally, so direct EPA involvement was not as critical in this program. However, for treatment plant optimization and source water protection, only limited expertise was available in the region on these topics, so EPA's expertise in these areas was critical.

Allow sufficient time for programs to develop, and plan follow-up activities from the beginning. An inter-governmental and inter-agency undertaking such as the Safe Drinking Water Program requires a significant period of time to plan and implement. Thoroughly developed work plans can take several months to develop and initial programmatic activities are often not completed for up to two years. Participants in the drinking water program indicated that, while EPA's efforts resulted in significant progress, the program activities only began to address what is clearly a pressing environmental issue and public health problem.

This page intentionally left blank.

SECTION V: IMPROVING THE FUTURE CAPACITY TO CONDUCT EVALUATIONS

This section focuses on how to build evaluation components in at the beginning of a program to better assess overall program effectiveness.

When environmental programs, domestic or international are developed, little attention is usually given to how these programs might best be monitored and evaluated to determine success. However, developing a monitoring and evaluation plan prior to initiating a program can yield real benefits. First, use of a program evaluation framework can help guide overall program implementation, ensuring that partners, funders, and supervisors understand what the program seeks to address, why certain activities are to be implemented, and what they can realistically expect those activities will achieve. Second, it can enable program managers to better understand if their activities are having the intended effects and whether or not different actions need to be taken. Without use of an evaluation framework, it can be very difficult to understand if real progress toward the key goals is being achieved. This can lead to lost resources and lost opportunities. Finally, use of an evaluation framework can help communicate to institutions, countries, and communities the effects of program implementation. Project managers should be sure to involve important stakeholders in developing the framework to gain buy in and ensure that key issues are not being missed.

A well-developed evaluation plan can also help identify important information that might be needed for comparison purposes. The evaluation team found that the absence of good baseline data, both in terms of environmental monitoring and programmatic infrastructure, limited our ability to quantify change between the beginning and the end of the Program. If, for example, better data existed on the effectiveness of treatment plants prior to initiation of the Program, that could be compared to current activities and provide a more substantial evaluation of the program's success. We recommend that EPA develop and implement a more systematic effort to collect quantitative and qualitative information before, during, and after major program activities.

By determining early on the type of data that will be needed to report on progress, the project team can be sure to make resources available to collect this information. In addition, this discussion can help set reasonable expectations and goals for the project. Quantitative results of environmental change are likely to be expensive and difficult to develop, especially over the short term. Recognizing this, project managers can identify reasonable interim measures of success and be sure to set up mechanisms to collect data on them. The project managers might also conclude that some resources should be developed to collecting baseline data, prior to program implementation, to facilitate an evaluation of project impacts.

This page intentionally left blank.

SECTION VI: CONCLUSIONS

Since 1999, EPA has been working with USAID and several agencies in Central America on a Safe Drinking Water Program designed to improve the quality of drinking water in El Salvador, Honduras, and Nicaragua. The short-term focus of the Program has been on strengthening the capacity of institutions - particularly the water utilities and the ministries of health - responsible for providing safe drinking water in targeted rural and key urban/periurban areas in the three countries. With the completion of the Program at the end of 2001, OIA undertook this evaluation in order to determine how effective the Program had been in meeting its goals.

Overall, the Program has made good progress toward several of the short-term goals, and effectively addressed different aspects of safe drinking water - from source water protection to drinking water treatment. Much of the success achieved was at the technical level, especially with the lab capacity and treatment components, and more needs to be done to follow-up with senior decision-makers, show them what can be achieved, and provide assistance to help them develop a more comprehensive policy platform to support sustainable improvements. It is clear that continued external support, including funds and technical resources, will be needed to facilitate this follow-up work necessary if the Program is to succeed in its long-term goal; to help improve drinking water quality in the Region.

The incremental approach to capacity-building that EPA is following - starting with small steps, assessing accomplishments, providing additional support in neglected areas or those that show promise - appears to be an effective way to proceed. Looking ahead, EPA and other international groups need to identify the best use of their resources. For example, should the Program provide financial assistance to help the laboratories develop QC programs or should that be a responsibility of the labs? The results of this evaluation indicate that donor organizations should carefully assess the entire cost of program participation and determine how best local parties can contribute and if they have the capacity to do so. Otherwise, if some organizations do not have the resources for follow-through, the donor's funds may not be efficiently utilized.

This page intentionally left blank

APPENDIX A

LIST OF INTERVIEWEES

This page intentionally left blank.

LIST OF INTERVIEWEES[27]	
Name	**Affiliation**
Background Interviews	
Mark Rogers~ Esa Chamberlin	EPA (laboratory-strengthening component)
Eric Bissonette~ Dave Visintainer	EPA (treatment plant component) City of St. Louis (treatment plant component)
Marilyn Ginsberg	EPA (source water protection component)
Jorge Martinez	EPA (safe drinking water program development component)
Carlos Ramos	EPA (safe drinking water program development component)
Laboratory-Strengthening Component in El Salvador	
Reyna Jovel	Ministry of Health, El Salvador
Margarita Ayala	Ministry of Health, El Salvador
Blanca Somoza de Flamenco + four staff	FUSADES (La Fundacion Salvadoreño para el Desarrollo Economica y Social)
Gloria Ruth Calderon~ Norma Molina Odette Rauda	University of El Salvador
Jasmina Turcios	ANDA (public water utility)
Mercedes de Hernandez~ Patricia de Ayala	ANDA
Magdalena de Aguilar	ANDA
Carmen Aida de Rugamas	ANDA
Douglas Ernesto Garcia	ANDA
Treatment Plant Optimization Component in El Salvador	
Nelson Coto	ANDA
Thelma Sandoval De Arevalo	ANDA
Armando Jacinto Nevas	ANDA
Nestor Calderon	ANDA
Edwin Cisneros	ANDA
Aristides Hernandez	ANDA
Juan Antonio Madrid	ANDA
Cross-cutting Interviews in El Salvador (Lab and Treatment Plant Components)	

[27] ~ denotes group interview.

LIST OF INTERVIEWEES[27]	
Name	**Affiliation**
Jorge Jenkins	PAHO, El Salvador
Julio Alvarado	Ministry of Health, El Salvador
Guillermo Rodriguez	ANDA
Carlos Herrera	ANDA
Laboratory-Strengthening Component in Nicaragua	
Carlos Morales	Ministry of Health, Nicaragua
Amparo Peñalba~ Carmen Lanuza Emilio Saballos	Ministry of Health, Nicaragua
Maria Luisa Esparza~ Carman Vargas Marie Wong	PAHO/CEPIS
Sergio Gamez Guerro	UNI-PIDMA Lab (Universidad Nacional de Ingenieria in Nicaragua)
Lua Toruño	UNI PIDMA Lab
Elda Escobar~ Francisco Ramirez Rodolfo Jaon	UNI PIDMA Lab
Jorge Pitty~ Marrisa Espinoza Argentina Soleria Junette Monedes Heyenas Halayas	CIRA-UNAN (La Universidad Nacional Autonoma de Nicaragua – Centro para la Investigacion de Recursos Aquaticos de Nicarauga)
Luis Ventura (Head of Planning)~ German Padilla (Lab coordinator)	ENACAL (Nicaragua water utility)
Martin Gonzalez (subdirector of water quality division) Evelyn Rodriguez (chemist) Aurora Perez (microbiologist)	ENACAL
Laboratory-Strengthening Component in Honduras	
Mirna Argueta (chief of WQ Assurance)	SANAA (Honduran water utility)
Source Water Protection Component in Nicaragua	
Danillo Hernandez	Isolux Company (in-country pilot coordinator)
Melvin Diaz	former Director of Planning in Ocotal (within Mayor's Office); now working in Managua with UN.
David Valdivia~ Ramona Rodriguez	CIRA-UNAN; Esteli pilot project (ex-mayor of Esteli) CIRA-UNAN; Esteli pilot project (professor of

LIST OF INTERVIEWEES[27]	
Name	**Affiliation**
	environmental sciences)
Deyanera Valenzuela	CIRA-UNAN; Esteli pilot project (professor of geography)
Edgar De Leon	Matagalpa Director of Project Watersheds *(*Proyecto Cuencas)
Luis Ventura	ENACAL -director of planning
Safe Drinking Water Component in Honduras	
Sam Dickerman	PAHO consultant
Marianna Luna	Student - Catholic University
Arturo Diaz	Agua Para el Pueblo
Francisco Zepeda	SANAA (El Progreso)
Olga Servillon	Finance Ministry, Health Sector
Osman Antonio Paredes	SANAA
Fatima Flores	SANAA
Herb Caudill	USAID
Javier Rosales	Save the Children
Ernesto Vargas	DIMA (municipal water utility, San Pedro Sula)
Benjamin Rivera	Ministry of Health, Environmental Division.
Mirna Argueta (chief of WQ Assurance)	SANAA (Honduran water utility)
Irasema Montoya	UNAH (Universidad Nacional Autonoma de Honduras)

This page intentionally left blank.

APPENDIX B

INTERVIEW GUIDES

This page intentionally left blank.

QUESTIONS ON SOURCE WATER PROTECTION PROGRAMS IN NICARAGUA

Background

1. What is your job?

2. Are source water protection issues relevant to your work? If so, how?

3. How did you get involved in the source water protection training program?

4. How much did you know about source water protection prior to the training?

General

5. Was EPA's introduction to source water protection sufficient? If not, what else should have been addressed?

6. Do you think the appropriate Nicaraguan and international parties were included in EPA's source water protection program? If not, who should have been there?

7. Did EPA sufficiently alert people about the source water protection program?

8. Were the objectives of program clear? What do you see as the objectives?

9. Were workshops and pilot projects good ideas to introduce source water protection?

    a. If so, were the appropriate workshops and pilot projects selected to develop source water programs? If not, what might have been a different approach?

    b. Were the appropriate communities selected for the pilot projects and workshops?

    c. Which pilot project do you believe was the most effective?

    d. Are there any ways the initiation of the program could have been improved?

WORKSHOPS

1. Which workshop(s) did you attend? How did you hear about the workshop(s)?

2 What was your overall impression of the workshops?

3. Did you understand the purpose of the workshops beforehand? Is there a clear relationship between the workshops and your job?

4. Were the appropriate parties involved in the workshops? If not, who else?

5. Was the format of the workshop appropriate?

    a. Was the balance between classroom and on-site time sufficient?

    b. Were the materials provided helpful? Would you have liked additional/other materials?

6. What did you think of the training manual provided in the workshops? Is the technical level of the training manual appropriate?

7. Did you find the trainers for the workshop to be effective?

8. How might you implement what you have learned in the workshop? What, if any, follow-on information would you need for help with implementation?

9. Were there other topics that should be covered or covered in more detail during the workshop?

10. Are there other ways, other than workshops, that EPA can convey information concerning improving source water protection in your area?

Pilot Projects

[The purpose of the pilot projects is to highlight key aspects of the source water protection program. There are three pilot projects:

Esteli: Source mapping: Develop an inventory of and rank key pollution sources; develop relationships among mayor's office, students, and other organizations.

Matagalpa: Public outreach: gather community support and build local relationships for source water management..

Ocotal: Increase public awareness and stakeholder involvement (e.g., coffee and cattle farmers); develop partnership with upstream neighbors.

Esteli

1. How did you find out about the Esteli pilot project?

2. Did EPA and other organizations provide sufficient information about the purpose of this project?

    a. What do you think the objectives of the project were and how were they developed?

3. Were the appropriate parties invited to participate in this project?

4. Was the community aware of and interested in the pilot project?

    a. Did the pilot project activities have a positive effect on the community?

5. How was the coordination between the parties on the project (e.g., universities and the mayor's office, students and ENACAL)?

6. How were the training sessions on how to delineate the protection areas? Any potential improvements?

7. How effective was the inventory and ranking of the potential contaminant sources at wells? Were the key high-risk sources of pollution identified? Any potential improvements to this process?

8. Do you expect the relationships and efforts developed during this project to continue? If not, why? If so, what are the key next steps?

    a. Is EPA or other support necessary to continue project activities?

9. Were the objectives of the project met? Please explain.

10. What were the most/least useful aspects of this pilot project?

Matagalpa

1. How did you find out about the Matagalpa pilot project?

2. Did EPA and other organizations provide sufficient information about the purpose of this project?

    a. What do you think the objectives of the project were and how were they developed?

3. Were the appropriate parties invited to participate in this project?

4. Was the community aware of and interested in the pilot project?

    a. Did the pilot project activities have a positive effect on the community?

5. Did you attend the initial public meeting in Matagalpa? What were the most and least useful aspects of this meeting? Were follow-up activities made clear at the meeting?

6. Is building a clothes washing and shower station a priority for water quality in Matagalpa? If not, what might be other alternatives?

7. Did the pilot project increase public awareness of and interest in source water protection issues? Please explain.

8. Were effective relationships among local parties developed through this project?

9. Do you expect the relationships and efforts developed during this project to continue? If not, why? If so, what are the key next steps?

    a. Is EPA or other support necessary to continue project activities?

10. Were the objectives of the project met? Please explain.

11. What were the most/least useful aspects of this pilot project?

Ocotal

1. How did you find out about the Ocotal pilot project?

2. Did EPA and other organizations provide sufficient information about the purpose of this project?

    a. What do you think the objectives of the project were and how were they developed?

3. Were the appropriate parties invited to participate in this project?

4. Was the community aware of and interested in the pilot project?

a. Did the pilot project activities have a positive effect on the community? In particular, did public awareness about source water protection increase?

5. Were effective partnerships within Ocotal and with upstream neighbors established through this project? Please explain.

6. Was the student survey effort of coffee and cattle farmers effective? What did we learn from these interviews?

7. Do you expect the relationships and efforts developed during this project to continue? If not, why? If so, what are the key next steps?

a. Is EPA or other support necessary to continue project activities?

8. Were the objectives of the project met? Please explain.

9. What were the most/least useful aspects of this pilot project?

Sustainability/Transferability

1. Do you think any of the source water protection efforts begun will now continue?

a. Are decision-makers becoming more aware of the importance of source water protection?

b. Will there be public or governmental support for source water protection?

c. What might be the appropriate next steps to enhance source water protection in your country (e.g., data collection efforts)?

d. What type of EPA support, if any, would be necessary?

2. Do you plan to stay involved in source water protection efforts? How so?

3. Do you have any ideas for short and long term plans for source water protection in Nicaragua?

4. If a source water protection program was introduced in a new region, what type of suggestions would you make for any changes in the process?

Wrap-up

5. What were the most and least useful aspects of the source water protection program?

6. Do you have any other suggestions for EPA or other national or international organizations (e.g., PAHO) in developing source water protection programs?

QUESTIONS ON DRINKING WATER PROGRAMS IN HONDURAS

Background

1. What is your job?

2. Are drinking water issues relevant to your work? If so, how?

3. How did you get involved in the drinking water program?

4. How much did you know about drinking water issues prior to the training?

General

5. Was EPA's introduction to the drinking water program sufficient? If not, what else should have been addressed?

6. Do you think the appropriate Honduran and international parties were included in EPA's program? If not, who should have been there?

   a. Was the Grupo de Collaborativo an effective partner? PAHO?

7. Did EPA sufficiently notify people about the drinking water program?

8. Were the objectives of the program clear? What do you see as the objectives?

9. Were the initial planning meetings and workplans effectively developed?

10. Were you involved with workshops, pilot projects, or both? Were the pilot projects and workshops effectively linked? Was the timing appropriate (e.g., should projects occur before workshops or vice versa)?

11. Were workshops and pilot projects good ideas to introduce drinking water issues?

    a. If so, were the appropriate workshops and pilot projects selected? If not, what might have been a different approach?

    b. Were the appropriate communities selected for the pilot projects and workshops?

    c. Which pilot project do you believe was the most effective?

d. Are there any ways the initiation of the program could have been improved?

12. Was UNICEF's involvement in the drinking water program beneficial? Please explain?

Workshops

1. Which workshop(s) did you attend? How did you hear about the workshop(s)?

2 What was your overall impression of the workshops?

3. Did you understand the purpose of the workshops beforehand? Is there a clear relationship between the workshops and your job?

4. Were the appropriate parties involved in the workshops? If not, who else?

5. Was the format of the workshop appropriate?

a. Was the balance between classroom and on-site time sufficient?

b. Were the materials provided helpful? Would you have liked additional/other materials?

6. What did you think of the training manuals provided in the workshops? Is the technical level of the training manual appropriate?

7. Did you find the trainers for the workshop to be effective?

8. How might you implement what you have learned in the workshop? What, if any, follow-on information would you need for help with implementation?

9. Were there other topics that should be covered or covered in more detail during the workshop?

10. What do you think was the best workshop? Why?

11. Are there other ways, other than workshops, that EPA can convey information concerning improving drinking water in your area?

Sanitary Survey Workshop

1. How useful is the Sanitary Survey student training manual? How might you use this manual?

2. Were in-country facilitators for sanitary courses appropriately selected and trained?

3. How useful are the sanitary surveys? Would you recommend changing anything significant with regard to the surveys?

Fundamentals Workshop

1. Were the appropriate decision-makers invited to this workshop?

2. Was the workshop practical?

3. Were budget issues effectively dealt with?

Pilot Projects

1. Which project were you involved in?

2. Was the planning process to develop the pilot projects effective? Right number of projects? Any potential improvements?

3. What do you think was the best pilot project?

4. Was there enough time to undertake the pilot projects?

5. Are any presentation slides or final reports available for the pilot projects?

APP

1. How did you find out about the APP pilot project?

a. What is/was your role in the APP?

2. Did EPA and other organizations provide sufficient information about the purpose of this project?

a. What do you think the objectives of the project were and how were they developed?

2. Were the appropriate parties invited to participate in this project?

3. Was the scope of the project appropriate?

4. Was the community aware of and interested in the pilot project?

a. Did the pilot project activities have a positive effect on the community?

Were the sanitary surveys developed as part of APP useful?

5. How was the coordination between the parties on the project?

6. Did EPA provide sufficient technical assistance on this project? If not, what else should they have provided?

7. Do you expect the relationships and efforts developed during this project to continue? If not, why? If so, what are the key next steps?

a. Is EPA or other support necessary to continue project activities?

8. Were the objectives of the project met? Please explain.

9. What were the most/least useful aspects of this pilot project?

ASC

1. How did you find out about the ASC pilot project?

a. What is/was your role in the ASC project?

2. Did EPA and other organizations provide sufficient information about the purpose of this project?

a. What do you think the objectives of the project were and how were they developed?

2. Were the appropriate parties invited to participate in this project?

3. Was the scope of the project appropriate?

4. Was the Quality Assurance Plan that was developed useful?

5. Was the community aware of and interested in the pilot project?

b. Did the pilot project activities have a positive effect on the community?

6. How was the coordination between the parties on the project?

7. Did EPA provide sufficient technical assistance on this project? If not, what else should they have provided?

8. Do you expect the relationships and efforts developed during this project to continue? If not, why? If so, what are the key next steps?

a. Is EPA or other support necessary to continue project activities?

9. Were the objectives of the project met? Please explain.

10. What were the most/least useful aspects of this pilot project?

CRS

1. How did you find out about the CRS pilot project?

a. What is/was your role in the CRS project?

2. Did EPA and other organizations provide sufficient information about the purpose of this project?

a. What do you think the objectives of the project were and how were they developed?

2. Were the appropriate parties invited to participate in this project?

3. Was the scope of the project appropriate?

4. Was useful information on contaminants and other biological data collected in this project?

5. Was the community aware of and interested in the pilot project?

b. Did the pilot project activities have a positive effect on the community?

6. How was the coordination between the parties on the project?

7. Did EPA provide sufficient technical assistance on this project? If not, what else should they have provided?

8. Do you expect the relationships and efforts developed during this project to continue? If not, why? If so, what are the key next steps?

a. Is EPA or other support necessary to continue project activities?

9. Were the objectives of the project met? Please explain.

10. What were the most/least useful aspects of this pilot project?

DIMA

1. How did you find out about the DIMA pilot project?

a. What is/was your role in the DIMA project?

2. Did EPA and other organizations provide sufficient information about the purpose of this project?

a. What do you think the objectives of the project were and how were they developed?

3. Were the appropriate parties invited to participate in this project?

4.Was the scope of the project appropriate?

5. Was the community aware of and interested in the pilot project?

a. Did the pilot project activities have a positive effect on the community?

6. How was the coordination between the parties on the project?

a. How did the privatization of DIMA affect the project?

7. Did EPA provide sufficient technical assistance on this project? If not, what else should they have provided?

8. Do you expect the relationships and efforts developed during this project to continue? If not, why? If so, what are the key next steps?

a. Is EPA or other support necessary to continue project activities?

9. Were the objectives of the project met? Please explain.

10. What were the most/least useful aspects of this pilot project?

Sustainability/Transferability

1. Do you think any of the drinking water efforts begun will now continue? If so, how?

a. Are decision-makers becoming more aware of the importance of safe drinking water?

b. Will there be public or governmental support for drinking water programs? Did EPA provide enough of a start to keep organizations going on drinking water? Are you aware of any funding support at agencies?

c. What might be the appropriate next steps or activities to enhance safe drinking water in your country (e.g., data collection efforts)?

d. What type of EPA support, if any, would be necessary to support these efforts?

2. Do you plan to stay involved in source water protection efforts? How so?

3. Are you aware of any short or long term plans for drinking water programs in Honduras?

a. Do you have any ideas about how to increase interest in safe drinking water?

b. Is there an opportunity for the new drinking water trainers in Honduras? What might the Grupo de Collaborativo continue to work on?

c. What are the obstacles to developing drinking water programs and obtaining safe drinking water in Honduras?

4. If a drinking water program was introduced in a new region of Honduras or in a different country, what type of suggestions would you make for any changes in the process?

Wrap-up

1. What were the most and least useful aspects of the drinking water program?

2. Do you have any other suggestions for EPA or other national or international organizations (e.g., PAHO) in developing drinking water programs in Central America?

Outline of Interviews with Program Team Leaders and Technical Advisors
Laboratory Capacity-Building in El Salvador and Nicaragua
Program Evaluation Support
EPA s Safe Drinking Water Program in Central America
EPA Office of International Activities

This aspect of our program evaluation will consider the progress made towards strengthening analytical laboratory capacity in Nicaragua and El Salvador. Specifically, we would like to evaluate the realized and potential impacts of the training courses, equipment purchase, and laboratory evaluation trips on the ability of the laboratories in these countries to produce valid and reliable water quality data. We will review the goals and activities associated with the program, as well as the prospects for sustainability and potential applicability of the program in other regions. Toward this end, we will gather information from the EPA program team leaders and technical advisors, PAHO, in-country participants, and other partners in this program component.

With the EPA program team leaders and technical advisors, we would like to discuss at least the following topics:

Background information regarding the program (e.g., what was your understanding of the goals of the program, how would you characterize laboratory capacity prior to program implementation, what activities were carried out, how was EPA involved).

Your experience with program planning and implementation, and recommendations for potentially developing the program at other sites (e.g., was the component well conceived, how was your experience with EPA accreditation programs useful in this effort, how effective was the partnership with PAHO).

Your experience with and assessment of the effectiveness of the laboratory capacity-building program in the following areas:

Short-term improvements in laboratory operations and analytical data quality
Prospects for further improvement
Key determinants of and impediments to the success of the program
Potential next steps
Transferability of the program to other Central American countries

Your recommendations regarding the best sources of information, performance targets, and timeframes to be used to evaluate the program.

Your recommendations regarding key people to interview about the laboratory capacity-building program.

Following the interviews with program team leaders and technical advisors, we will prepare draft interview questions to be used for in-country interviews and information collection. We appreciate your input regarding these questions to help ensure that in-country information collection activities are as effective as possible.

Questionnaire for In-Country Interviews (Consolidated)
Laboratory Strengthening in El Salvador and Nicaragua
Program Evaluation Support

EPA's Safe Drinking Water Program in Central America

Note: This questionnaire can be used to interview lab managers and lab technicians from ENACAL or the universities. A note has been provided before each question indicating for which interviewees the question is applicable.

- **$** "All" means applicable for all interviewees regardless of organization or role.
- **$** "Mngmt" means applicable for managers at ENACAL or the university labs.
- **$** "Tech" means applicable for technicians at ENACAL or the laboratories.
- **$** If the question is only applicable to one of the organizations, the organization is noted.

1. *(all)* What is your role within your organization and what was your role in the laboratory program?

   a. *(all)* In how many of the training sessions did you participate?

   b. *(mngmt)* What was you role in planning your staff's participation in the training?

   c. *(all)* Did you help identify the equipment and instrumentation needs of your laboratory?

2. *(all)* What changes have you seen in the laboratory as a result of the laboratory program?

   a. *(all)* Has the laboratory developed a QC manual? Are the SOPs being used in the lab now?

   b. *(all)* Have data recording procedures improved?

   c. *(all)* How has the program changed how the lab staff approach their work?

   d. *(all)* Has the laboratory begun to perform new analytical methods? Is this planned?

   e. *(all)* Have you seen measurable improvements in analytical methods? For example, are the analyses more often within QC specifications?

   f. *(all)* Can the lab process more of fewer samples as a result of the new focus on quality? Has the number of samples being processed changed?

g. *(all)* Has the lab changed its physical space as a result of the program?

h. *(all)* Is their more focus on safety? *(all)* What was the most useful part of the laboratory training?

i. *(tech)* Were the training materials helpful? How have you used the materials since the training?

j. *(tech)* What was the most useful topic?

k. *(tech)* Was there a good mix of classroom time and laboratory time?

l. *(tech)* Was there enough time to cover the topics?

m. *(all)* Was it useful to conduct the training in Lima? Please explain.

n. *(all)* Relative to other participants, did you feel well prepared for the training? Do you think that the training took into account the level of experience of different participants?

o.*(note: it would be useful to draw direct comparisons to participants from El Salvador so we can cross-link any observations regarding differences in responses)*

p. *(all)* Did CEPIS ask you to prepare a QC plan before the accreditation planning? Were you able to do this? Please explain.

q. *(tech)* Was the QC training clear regarding the use of statistics and uncertainty?

3. *(all)* What equipment and instrumentation did you receive or do you expect to receive as a result of this program?

a. *(tech)* Were all of your requests met?

b. *(tech)* Is the equipment currently being used? If not, why not and when do you plan to put it to use?

4. *(all)* Were the CEPIS visits to your laboratory useful? Please explain.

a. *(tech)* Were preparations for the evaluation visits given high priority?

b. *(tech)* What, if anything, about the approach to these visits could be modified to better meet your needs?

c. *(tech)* Are there other types of follow-up that would be useful?

5. *(mngmt)* Please describe the system for ensuring water quality in Nicaragua and the roles of ENACAL relative to MINSA.

a. *(ENACAL mngmt)* Does ENACAL provide enough quantity for its users?

b. *(ENACAL mngmt)* Is there pressure to increase capacity at the expense of quality?

c. *(mngmt)* Do the universities have a role to play in water quality management? Please explain.

d.*(note: depending on response, prompt lab to evaluate whether they see a role for themselves in education, methods research, and/or water quality investigation)*

e. *(mngmt)* What role could these different organizations play in auditing each other in the future?

6. *(ENACAL mngmt/tech)* What is the relationship between the treatment plant managers and the laboratory?

a. *(ENACAL mngmt)* Have you seen any changes in this relationship as a result of the program? Please explain.

b. *(ENACAL mngmt)* Are there more frequent discussions between the lab and the treatment plant managers?

c. *(ENACAL mngmt)* Are the treatment plant managers more responsive to lab results as a result of the program?

7. *(all)* Was it useful to be trained side-by-side with people from MINSA and (ENACAL/the universities)? Please explain.

a. *(tech)* Have you stayed in touch with people from other laboratories and CEPIS?

b. *(tech)* Has this been or would this be useful?

c. *(tech)* How could this interaction be facilitated (e.g., use of CEPIS Listserver)?

8. *(all)* Is accreditation the right goal for the laboratory program?

a. *(all)* Would improved data quality without accreditation be enough of an accomplishment? Please explain.

b. *(mngmt)* How will accreditation help improve the quality of the country's drinking water?

9. *(mngmt)* What are the primary contaminants of concern for the potable water supply?

a. *(mngmt)* Does the laboratory hope to be accredited in the methods required to analyze samples for these contaminants?

b. *(mngmt)* Combined, will the training and equipment obtained as a result of this program meet all of the priority needs for accreditation in these areas?

c. *(mngmt)* Are there areas not covered (e.g., parasites) that you would like to address?

10. *(all)* What are the most important challenges to be overcome in order to be accredited?

a. *(all)* How much effort has been required to develop the QC manual and implement changes in the laboratory?

   i. *(all)* Has your organization supported these efforts on the payroll or has this work been done on people's own time?

   ii. *(all)* How much more work will be needed? Do you expect that your organization will provide the resources to accomplish this work?

b. *(all)* Does the laboratory have adequate staff?

   i. *(mngmt)* Does the laboratory have trouble retaining trained staff?

   ii. *(mngmt)* What steps, if any, have been taken to improve staff retention?

c. *(all)* Does the laboratory have adequate equipment, instrumentation, and supplies?

   i. *(mngmt)* Will it be expensive to purchase the supplies (e.g., reference standards) and maintain the equipment once accreditation has been achieved?

   ii. *(mngmt)* Will your organization budget for this?

d. *(all)* Has the information obtained as a result of the program been shared with all staff?

   i. *(mngmt)* How do you plan to maintain the current level of staff training?

   ii. *(mngmt)* Do you plan additional or ongoing training for existing staff?

   iii. *(mngmt)* How will you train new laboratory staff?

11. *(all)* What changes would you make to the laboratory program before it is implemented again?

12.*(all)* Could anything be done with this type of program to increase the level of management support?

Questionnaire for In-Country Interviews
Laboratory Strengthening in El Salvador and Nicaragua
Program Evaluation Support
EPA s Safe Drinking Water Program in Central America

Background

1. How did you determine the design of the laboratory program?

Outcomes

2. What are the most significant improvements you have seen in the laboratories as a result of the program? Are any of the improvements quantifiable? If so, please explain.

Transferability

3. Have some laboratories improved more than others? What are the key factors that led to these differences?

4. What follow-up that was provided by CEPIS after training? Do you think might have been helpful? If so, what additional follow-up would you suggest, when should this be done, and by whom? How would you address the situation where the lab equipment arrived several months after the training?

5. Were the levels of experience of the trainees generally comparable? If not, how did the course address this? What else could have been done to address this situation?

6. Some trainees have suggested that it would have been helpful to have the concepts of QC incorporated into all of the analysis courses, in addition to having it taught as a separate course. Is this an accurate assessment of how QC was taught? Do you agree with this idea? Why or why not?

7. Were trainees asked to draft QC plans after the management course? *(Assuming yes)* some trainees have suggested that it would have been useful to provide the management and accreditation courses closer together so that they would have better guidance before drafting their QC plans. Do you agree? Why or why not?

Sustainability

8. What are the key factors that will affect whether some of the labs will be accredited? Is accreditation the key to sustainability? What are the keys to sustainability of the improvements brought about by the laboratory program?

9. Do you have any suggestions for increasing management s understanding of the importance of quality control and obtaining greater management buy-in?

Questionnaire for In-Country Interviews - *Guillermo Rodriguez (ANDA)*
Treatment Plant Optimization in El Salvador
Program Evaluation Support
EPA's Safe Drinking Water Program in Central America

1. What is your job?

2. How did you become involved with the treatment plant CPE training program?

3. What was your role in the treatment plant CPE training program?

Note: "planning" includes decisions regarding how many demonstrations to hold, where, over what period, who should participate, general content, training approach, etc.

a. Did you help develop the plan for conducting the CPE demonstrations? If so,

i. What was your understanding of the goals of the program?

ii. Please describe your role in the planning.

iii. Did ANDA support your participation in the program?

iv. Did the final plan include your suggestions?

b. Did you help identify people to be involved in the CPE demonstrations? If so,

i. How did you identify them?

ii. Were people from all of the surface water treatment plants included?

iii. Do you think that these were the right people? Please explain.

c. In how many of the CPE demonstrations did you participate? At which plants?

d. Did you participate as a trainer? If so, at which plants?

4. Was the CPE demonstration program useful for you?

   a. What was the most useful part of the CPE program?

   b. What was missing from the CPE program that would have made it more useful for you?

5. How has participation in the program changed your approach to your work?

   a. Do you have new responsibilities within ANDA as a result of your participation? If so, what are they?

   b. Have you been involved in any other new initiatives, for example, with COPAS? If so, please explain.

6. Did the CPE training include the right participants - ANDA, MINSA, PAHO, and EPA?

a. Who else would you have included?

b. Was it useful for ANDA and MINSA to participate together in this program? Why?

add note identifying possible performance goals

7. What are ANDA's treated water performance goals?

a. Are some of the plants meeting these goals? If so, how many?

b. What performance improvements have you seen?

c. Why are some plants closer to meeting their goals than others?

i. Will you be able to meet your performance goals without capital improvements?

(1) Do the plants have adequate capacity to meet drinking water needs?

(2) When do you anticipate needing additional capacity?

ii. What improvements will you need to make?

iii. What other actions can you take to help you meet your performance goals?

d. How has the CPE program helped you get closer to meeting your performance goals?

8. Other than treatment plant performance, what improvements have you seen in plant operations?

a. Has the frequency and quality of turbidity monitoring improved?

b. Have the plants developed new operating procedures?

c. Have the plants developed new operation and maintenance manuals?

d. Are the plants more responsive to results received from the analytical laboratories?

add note identifying possible performance limiting factors

9. What were the key performance limiting factors identified during the demonstration CPEs?

a. Have additional performance limiting factors been identified since the CPEs?

b. What actions have been taken to address these factors?

c. What actions are planned?

d. What will be the most difficult performance limiting factor to overcome?

10. What actions do you plan to take to continue improvements in treatment plant performance?

a. Do you plan to conduct periodic CPEs at the ANDA plants?

b. Have all of the existing plant managers and operators been trained?

c. Have CPE concepts been incorporated into training for new employees?

d. Have you developed a written CPE plan?

11. As a result of the CPE program, is the country better prepared to handle natural disasters and accidents?

a. What have you done to address these situations?

b. What more do you plan to do to address these situations?

12. What was the most significant contribution of the CPE program to the quality of drinking water in El Salvador?

13. What changes would you make to the CPE program before it is implemented again?

Questionnaire for In-Country Interviews
Treatment Plant Optimization in El Salvador
Program Evaluation Support
EPA's Safe Drinking Water Program in Central America

1. What is your job?

2. How did you become involved with the treatment plant CPE training program?

3. What was your role in the treatment plant CPE training program?

   a. Did you help develop the plan for conducting the CPE demonstrations? If so,

      i. What was your understanding of the goals of the program?

      ii. Please describe your role in the planning.

      iii. Did MINSA support your participation in the program?

iv. Did the final plan include your suggestions?

   b. Did you help identify people to be involved in the CPE demonstrations? If so, how?

   c. In how many of the CPE demonstrations did you participate? At which plants?

   d. Did you participate as a trainer? If so, at which plants?

Note: "planning" includes decisions regarding how many demonstrations to hold, where, over what period, who should participate, general content, training approach, etc.

4. What is the role of MINSA in improving drinking water quality in El Salvador?

   a. How has MINSA's participation in the CPE training helped it in this role?

   b. What was the most useful part of the CPE program?

   c. What was missing from the CPE program that would have made it more useful?

Note: Depending on response, ask interviewee whether subject matter was helpful; whether collaboration with ANDA was helpful...

5. How has participation in the program changed your approach to your work?

   a. Do you have new responsibilities within MINSA as a result of your participation? If so, what are they?

   b. Have you been involved in any other new initiatives, for example, with COPAS? If so, please explain.

6. Did the CPE training include the right participants - ANDA, MINSA, PAHO, and EPA?

   a. Who else would you have included?

   b. Was it useful for ANDA and MINSA to participate together in this program? Why?

7. What performance goals has MINSA set for treated water?

   a. How does MINSA monitor treatment plant performance?

   b. Are some of the plants meeting these goals? If so, how many?

   c. What water quality improvements have you seen?

   d. Are you aware of other improvements in treatment plant operations? Please explain.

add note identifying possible performance goals, other types of improvements, and possible performance limiting factors

8. What were the key performance limiting factors identified during the demonstration CPEs?

   a. What is MINSA's role in addressing these factors?

   b. Has MINSA taken any actions to address these factors? Are any planned?

   c. From your perspective, what will be the most difficult performance limiting factor to overcome?

9. Would it be useful for MINSA to participate in future CPEs at the ANDA plants?

10. Have CPE concepts been incorporated into training for new employees?

11. As a result of the CPE program, is the country better prepared to handle natural disasters and accidents?

   a. Please explain.

   b. What else could be done to improve preparedness?

12. What was the most significant contribution of the CPE program to the quality of drinking water in El Salvador?

13. What changes would you make to the CPE program before it was implemented again?

Questionnaire for In-Country Interviews - *Treatment Plant Managers*
Treatment Plant Optimization in El Salvador
Program Evaluation Support
EPA's Safe Drinking Water Program in Central America

Background

1. What is your job?

2. Please briefly describe the major unit processes used by your plant.

   Note: "major unit processes" include flocculation, sedimentation, filtration, disinfection

   a. What is the plant's capacity

   b. Is the plant operated near capacity?

3. What is your role in meeting the performance goals for your treatment plant?

4. What was your role in the treatment plant CPE training program?

   a. Did you help plan your staff's participation in the program?

      i. Did you identify people from your plant to be involved in the CPE demonstrations?

      ii. Did you help identify who would be involved in which demonstrations?

   b. In how many of the CPE demonstrations did you participate? At which plants?

   c. Did you participate as a trainer? If so, at which plants?

Program Implementation

5. How did you become involved with the treatment plant CPE training program?

6. Were the CPE demonstrations useful for you?

   a. How have the demonstrations helped you in your job?

   b. Did you understand the purpose of the workshops beforehand? Was there a clear relationship between the workshops and your job?

   c. What was the most useful part of the CPE demonstrations?

      i. Were the CPE demonstration materials helpful? How could they have been improved?

      ii. Did the CPE demonstrations cover the right topics? What topics would

you have liked to spend more or less time on?

iii. Was there a good mix of classroom time and time in the plants? Would you suggest any changes?

v. Did the trainers have the right backgrounds? Would you have liked to have trainers with different backgrounds?

7. Was it useful to participate in the program with people from MINSA? Please explain.

8. How has participation in the CPE program changed your approach to your work?

9. Did ANDA support your participation and the participation of your staff in the program? How?

Note: "support" could come in the form of time off to participate, new instrumentation...

10. Would you have liked have been more involved in the design of the CPE program?

11. Would you have liked to have been more involved in the training?

12. What changes would you make to the CPE program before it is implemented again?

Outcomes/Measures

13. What are your plant's treated water performance goals? Have these goals changed as a result of the CPE program?

add note identifying possible performance goals

14. Since the CPE training, have you met or come closer to meeting these goals?

a. What improvements have you seen? Are data available?

b. How has the CPE program helped you get closer to meeting your performance goals?

15. Will you be able to meet your performance goals without capital improvements?

a. If yes, what are the key factors limiting your ability to meet the goals now?

i. Are these factors within your control?

ii. What actions to you plan to take to address these factors?

b. If no,

i. Does your plant have adequate capacity to meet drinking water needs, now and in the future? How did you come to this conclusion?

ii. When do you anticipate needing additional capacity?

iii. What improvements will you need to make?

iv. Will these improvements be enough or will other actions be required?

c. Did the CPE demonstration help you evaluate your needs for capital improvements? How?

16. How has your approach to water quality monitoring changed as a result of the CPE training?

a. How was turbidity monitored prior to the CPE training? How is it monitored now?

Note: turbidity monitoring details: instrumentation, frequency, location (raw, settled, finished)

b. Please characterize your raw water turbidity - is it consistently high, consistently low, or highly variable?

c. Does the plant monitor microbiological or chemical contamination?

i. Has your approach changed as a result of the CPE training?

ii. Who analyzes your water samples?

d. How do you use turbidity measurements and laboratory data to adjust plant operations?

i. Has your approach changed as a result of the CPE training? Please explain.

ii. Are the lab results useful in helping you improve treatment plant performance?

17. What were the key performance limiting factors identified during the CPE demonstration at your plant?

add note identifying possible performance limiting factors

a. Have additional performance limiting factors been identified since the CPEs?

b. Which of these factors can you control? Which factors will require support from others? Who?

c. What actions have you taken to address performance limiting factors? Have they been successful?

d. What actions do you plan to take?

e. What will be the most difficult performance limiting factor to overcome?

18. Has the CPE program had an effect on the documentation and use of standard operating procedures?

a. How are treated water performance goals communicated to plant operators? Has this changed as a result of the CPE program?

b. What QA/QC procedures have been implemented as a result of the program? How often are instruments calibrated?

19. Has the CPE program had an effect on the plant's maintenance plan? Please explain.

20. As a result of the CPE program, is your plant better prepared to handle natural disasters and accidents?

a. What have you done to address these situations?

b. What more do you plan to do to address these situations?

21. **Sustainability/Transferability**

22. Do you plan to conduct future CPEs at the plant?

a. Have you developed a written CPE plan?

b. What other types of documentation have you developed?

23. Have all plant personnel been trained in the concepts of a CPE?

a. Please explain.

b. Do you plan to conduct additional training?

Wrap-up

24. What was the most significant contribution of the CPE program to the quality of drinking water at your plant?

Questionnaire for In-Country Interviews - *Treatment Plant Operators*
Treatment Plant Optimization in El Salvador
Program Evaluation Support
EPA's Safe Drinking Water Program in Central America

Background:

1. What is your job?

2. In how many of the CPE demonstrations did you participate? At which plants?

3. Did you participate as a trainer? If so, at which plants?

Note: "major unit processes" include flocculation, sedimentation, filtration, disinfection

Program Implementation

4. How did you become involved with the treatment plant CPE training program?

5. Were the CPE demonstrations useful for you?

   a. How have the demonstrations helped you in your job?

   b. Did you understand the purpose of the workshops beforehand? Was there a clear relationship between the workshops and your job?

   c. What was the most useful part of the CPE demonstrations?

      ii. Were the CPE demonstration materials helpful? How could they have been improved?

      iii. Did the CPE demonstrations cover the right topics? What topics would you have liked to spend more or less time on?

      iv. Was there a good mix of classroom time and time in the plants? Would you suggest any changes?

      v. Did the trainers have the right background? Would you have liked to have trainers with different backgrounds?

6. Was it useful for you to participate in the program with people from MINSA? Please explain.

7. How has participation in the CPE program changed your approach to your work?

8. Would you have liked have been more involved in the design of the CPE program?

Note: "support" could come in the form of time off to participate, new instrumentation...

9. Would you have liked to have been more involved in the training?

10. What changes would you make to the CPE program before it is implemented again?

Outcomes/Measures

11. What are your plant's treated water performance goals?

add note identifying possible performance goals

    a. Have these goals changed as a result of the CPE program?

    b. What is your responsibility for meeting these goals?

    c. How are the goals communicated? Has this changed as a result of the CPE program?

12. Since the CPE training, has the plant met or come closer to meeting these goals?

    a. What improvements have you seen?

    b. How has the CPE program helped you get closer to meeting your performance goals?

13. What are the key factors limiting your ability to meet the goals now?

    a. Does the plant have adequate capacity to meet drinking water needs, now and in the future?

    b. What improvements will need to be made?

    c. Did the CPE demonstration help you evaluate whether the plant has enough capacity?

14. How has your approach to water quality monitoring changed as a result of the CPE training?

    a. How was turbidity monitored prior to the CPE training? How is it monitored now?

Note: turbidity monitoring details: instrumentation, frequency, location (raw, settled, finished)

    b. Please characterize your raw water turbidity - is it consistently high, consistently low, or highly variable?

    c. Does the plant monitor microbiological or chemical contamination?

        i. Has your approach changed as a result of the CPE training?

        ii. Who analyzes your water samples?

    d. How do you use turbidity measurements and laboratory data to adjust plant operations?

        i. Has your approach changed as a result of the CPE training? Please explain.

ii. Are the lab results useful in helping you improve treatment plant performance?

15. What were the key performance limiting factors identified during the CPE demonstration at your plant?

add note identifying possible performance limiting factors

a. Have additional performance limiting factors been identified since the CPEs? What actions have been taken to address performance limiting factors?

i. By whom?

ii. Have they been successful?

b. What input do you have in identifying and solving performance limiting factors?

c. What will be the most difficult performance limiting factor to overcome?

16. Has the CPE program improved the documentation of standard operating procedures?

a. Do you find the documentation useful?

b. How do you use it?

c. Have new QA/QC procedures have been implemented as a result of the program? How often are instruments calibrated?

17. Has the CPE program had an effect on the plant's maintenance plan? Please explain.

18. How does the plant respond to natural disasters and accidents? Will the information learned during the CPE demonstrations improve the response to these situations.

Sustainability/Transferability

19. What do you think is the most important action that the plant can take to make sure that the lessons learned during the CPE program will have a lasting effect on plant operations?

Outline of Questions for Interview with Program Team Leaders
Treatment Plant Optimization in El Salvador
Program Evaluation Support
EPA s Safe Drinking Water Program in Central America
EPA Office of International Activities

In general, the evaluation of the treatment plant optimization component of EPA s safe drinking water program in Central America will consider the short-term effects of the CPE training and related activities on treatment plant optimization, prospects for further success and sustainability of initial successes, and applicability of this approach to other sites around the world. Toward this end, we will gather information from the program team leaders, in-country participants in the CPE training, and other partners in this program component.

From the program team leaders for this component, we would like to explore the following:

Context/baseline - Background information regarding the program...

What was your understanding of the goals of the program?
What activities were conducted (CPE training, instrumentation)?
Who was involved in the training (team leaders, facilitators, trainees)?

Process evaluation - Your experience regarding aspects of program planning and implementation in which you were involved and recommendations for improving the future implementation of the program at other sites.

Did you have a clear understanding of the goals of the program at the outset?
How did the selected approach align with these goals?

Measures of success - Your impressions regarding the effectiveness of this program component along the following dimensions:

How it has already improved treatment plant operations
Prospects for further improvement
Key determinants of and impediments to the short- and long-term success of the program (e.g., organizational factors; existing infrastructure/capacity; need and funding for equipment, parts, and supplies; etc.)
Improvements in preparedness for natural disasters and accidents

Evaluation resources - Your recommendations regarding the best sources of information to be used to evaluate the above-mentioned dimensions.

Following the interview with program team leaders, we will prepare draft interview questions to be used for in-country interviews and information collection. We look forward to your input on the interview questions to help ensure that in-country information collection activities are as effective as possible.

This page intentionally left blank.

APPENDIX C

CENTRAL AMERICA
SAFE DRINKING WATER PROGRAM
PARTNERS

This page intentionally left blank.

PARTNERS IN THE SAFE DRINKING WATER PROGRAM IN CENTRAL AMERICA

DONORS

EPA
USAID

IMPLEMENTORS

EPA
PAHO/CEPIS
Horsley and Witten (EPA consultant)

KEY IN-COUNTRY PARTNERS

EL SALVADOR: ANDA, MOH, Ministry of Environment, National University of El Salvador, COPAS, FUSADES.

HONDURAS: SANAA, MOH, Ministry of Environment, Grupo Colaborativo de Agua, DIMA, CRS, Agua Para el Pueblo, Save the Children.

NICARAGUA: ENACAL, MOH, Ministry of Environment, CIRA-UNAN, UNI PIDMA, City of Ocotal, City of Matagalpa, City of Esteli.

OTHER PARTNERS

UNICEF, other universities, other NGOs.

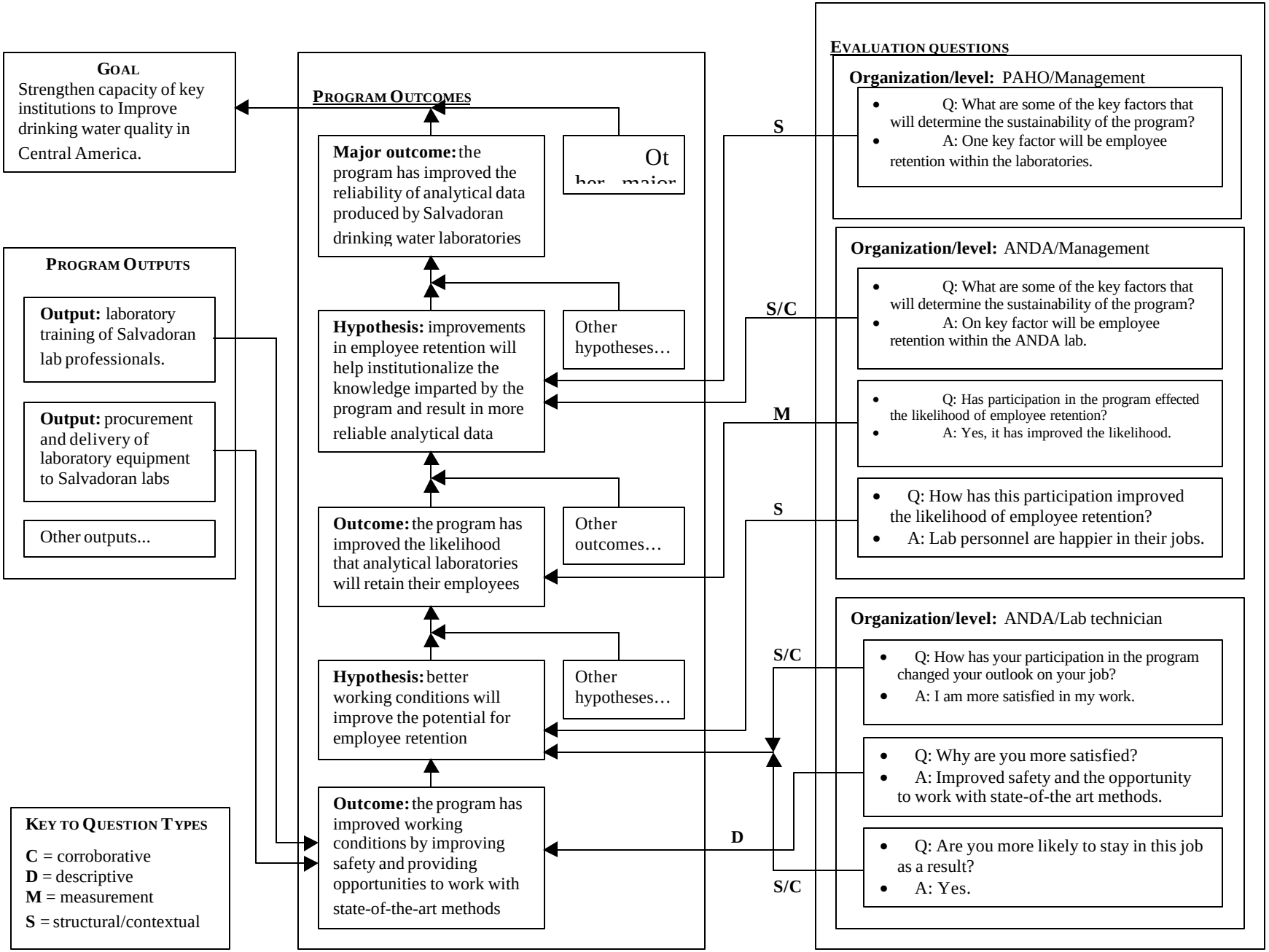
This page intentionally left blank.

APPENDIX D

Example of Use of Evaluation Questions to Measure Program Outcomes

This page intentionally left blank.

Example of Use of Evaluation Questions to Measure Program Outcomes (Laboratory-Strengthening Component)



This page intentionally left blank.