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DEMDESS SUMMARY 1993

DANUBE EMISSIONS MANAGEMENT DECISION SUPPORT SYSTEM

WATER AND SANITATION FOR HEALTH PROJECT

EUROPE BUREAU

WASH Field Report No. 412

DEMDESS SUMMARY 1993

DANUBE EMISSIONS MANAGEMENT DECISION SUPPORT SYSTEM

Prepared for the Europe Bureau,
U.S. Agency for International Development,
under WASH Task No. 420

by

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September 1993

Water and Sanitation for Health Project
Contract No. 5973-Z-00-8081-00, Project No. 936-5973
is sponsored by the Office of Health, Bureau for Research and Development
U.S. Agency for International Development
Washington, DC 20523

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PREFACE

The Danube Emissions Management Decision Support System (DEMDESS) project was conducted in two phases from 1991-93 in cooperation with the governments of Bulgaria, the Czech and Slovak Republics (primarily Slovakia), Hungary, and Romania and with technical assistance from the Bureau for Europe (EUR) of the U.S. Agency for International Development (A.I.D.). A.I.D. assistance was provided through the Water and Sanitation for Health (WASH) Project, which is operated by Camp Dresser & McKee International, Inc. and associated firms for A.I.D.'s Bureau for Research and Development (R&D).

The DEMDESS project team included Timothy Bondelid (task leader), Craig Hafner (project manager), Teresa Sarai and Jonathan Darling (logistical support), Kathy Alison and Lee Jennings (training experts), and John Tippett (programming support). Valuable and patient oversight was provided by James Taft of A.I.D.

Phase one of the project took place from September 1991 to July 1992. This work resulted in a four-volume set of reports, "Point Source Pollution in the Danube Basin," and the *DEMDESS User Manual,* all published in July 1992.

Phase two of the DEMDESS project was conducted from September 1992 to July 1993. Its goal was to institutionalize DEMDESS in Bulgaria, Hungary, Romania, and Slovakia. "Institutionalizing" DEMDESS means assisting the four countries in making DEMDESS an operational system responsive to their emissions management and decision-making needs. This project was performed in conjunction with basin pre-investment and prefeasibility studies WASH conducted in each of the four countries. The results of these studies are documented in a five-volume set of reports, "Water Quality Pre-Investment Studies in Four Danube River Tributary Basins," published in July 1993. A second edition of the *DEMDESS User Manual,* published in September 1993, supplements the reports. It reflects the changes DEMDESS underwent during phase two of the project.

The major tasks in phase two of the project were the following:

- continue technical development of DEMDESS;
- strengthen central technical "ownership" of the system in each country;
- build support with key decision-makers; and
- provide training and outreach, particularly via workshops in Budapest and Sofia.

This report comprises the WASH team's presentation of the DEMDESS project's results, including conclusions and recommendations. Although the project was conducted in close cooperation with the governments of Bulgaria, Hungary, Romania, and Slovakia and other entities (see "Acknowledgments"), the findings and recommendations reported herein are those

of the WASH team; they do not necessarily represent official positions of the governments of the four assisted countries nor of the United States.

ACKNOWLEDGMENTS

DEMDESS is the result of the dedication, hard work, and creative input of many individuals. Particular thanks are due the following, among many others.

Phase I (1991-92) WASH team: Max S. Clark (computer specialist/engineer), Daniel Edwards (institutional specialist), Dr. William Lord (economist), Tarik Pekin (engineer), and Robert H. Thomas (team leader).

WASH trainers: Kathy Alison (phases I and II [1992-93]) and Lee Jennings (phase II).

WASH project manager: Craig Hafner (phases I and II).

WASH logistical support: Teresa Sarai (phases I and II) and Jonathan Darling (phase II).

WASH phase II basin study team "A" (Hungary and Slovakia): James McCullough (team leader/financial expert), Tarik Pekin (engineer), and David Horsefield (engineer).

WASH phase II basin study team "B" (Bulgaria and Romania): Max S. Clark (team leader/engineer), David Laredo (engineer/financial expert), and Bill Hogrewe (engineer).

In Bulgaria: Eng. Damyan Boytchev, Eng. Ivan Milushev, and Ms. Vanya Radeva of the Laboratory and Information Center; and Dr. Ilya Natchkov and Deputy Minister Branimir Natov of the Ministry of Environment.

In Hungary: Eng. Sándor Kisgyörgy of the Ministry of Environment and Regional Planning, and Eng. János Fehér of the Vituki Water Research Centre.

In Romania: Dr. Vladimir Rojanschi and Eng. George Dulcu of the Research and Engineering Institute for Environment.

In Slovakia: Ing. Milan Matuska, Dr. Ivan Zavadsky, and Ing. Vladimir Matus of the Ministry of Environment; and Ing. Boris Minarik of the Hydrometeorological Institute.

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ACRONYMS

A.I.D.	Agency for International Development
DEMDESS	Danube Emissions Management Decision Support System
EBRD	European Bank for Reconstruction and Development
GIS	geographic information systems
ICIM	Engineering and Research Institute on the Environment (Romania)
LIC	Laboratory and Information Center (Bulgaria)
MERP	Ministry of Environment and Regional Planning (Hungary)
MOE	Ministry of Environment
PC	personal computer
PCU	Program Coordination Unit
PHARE	Poland-Hungary Aid for Restructuring of Economies
USAID	United States Agency for International Development (overseas missions)
USEPA	United States Environmental Protection Agency

EXECUTIVE SUMMARY

The countries of central and eastern Europe have been collecting water quality data for quite some time, but their governments have not used the information in formulating related policies. However, recent dramatic changes in these countries have placed new demands on the data; consequently, these statistics are now forming a necessary component of important decision-making processes concerning water and wastewater investments. Country officials also are recognizing that they will need to use new and different types of data not previously collected, especially data regarding regulations and costs. The U.S. Agency for International Development (A.I.D.) began the Danube Emissions Management Decision Support System (DEMDESS) project to address such informational needs.

The DEMDESS project was conducted in two phases from 1991-93 in cooperation with the governments of Bulgaria, the Czech and Slovak Republics (primarily Slovakia), Hungary, and Romania. Technical assistance was provided by A.I.D.'s Bureau for Europe (EUR) through the Water and Sanitation for Health Project (WASH), which is operated by Camp Dresser & McKee International, Inc. and associated firms for A.I.D.'s Bureau for Research and Development (R&D).

Bulgaria, Hungary, Romania, and Slovakia have enthusiastically embraced DEMDESS because they recognize it to be a technically sound approach to using both old and new data in the new decision-making modes the countries' governments require. In addition, they recognize that DEMDESS is a very open approach to water quality information management that will not become obsolete as new data and analysis requirements evolve.

A.I.D.'s overall objective with the DEMDESS project is to institutionalize DEMDESS; that is, to help the Danubian countries develop and use DEMDESS as an operational tool for water pollution decision support. DEMDESS is highly desirable as an operational tool because it can address several key technical and policy issues related to water quality and pollution control that face the environmental ministries of the Danubian countries.

Making DEMDESS operational requires efforts at both the technical and institutional levels. Technical activities have emphasized database and applications development, while institutional activities have focused on training and outreach to build the proper environment for using DEMDESS.

Institutionalizing DEMDESS requires that several simultaneous and parallel activities take place. First, DEMDESS's database and software must be developed further. Also, the system needs to be loaded with sufficient detail and quality of data to provide accurate answers. Second, the central technical "owner" of the system in each country must be supported through training, probably at the technical-institute level. Third, support must be sought from key decision-makers, especially at the countries' respective environmental ministries. Finally, training and outreach for users must be provided in order to build the technical and institutional environment for using DEMDESS.

From September 1992 to July 1993, phase two of the project, 10 separate activities were performed in order to institutionalize DEMDESS:

1. continued assistance in interfacing DEMDESS to country-specific water databases;
2. direct technical training of experts in each country;
3. coordination with related activities, especially those of the Program Coordination Unit (PCU) Subgroup on Monitoring, Laboratory, and Information Management;
4. development of a "user-friendly" version of DEMDESS with routine reporting and decision support applications;
5. revision of the *DEMDESS User Manual*;
6. application of DEMDESS in WASH prefeasibility studies;
7. a regional DEMDESS training workshop held in May 1993 in Budapest;
8. a Bulgaria-specific workshop, held in Mt. Vitosha, Bulgaria, in late June and early July 1993;
9. provision of computers and software to each country for using DEMDESS; and
10. participation in the closeout prefeasibility study meetings held in each country in May 1993.

The institutional status of DEMDESS has been significantly enhanced by this phase of the project. Technical and institutional development of DEMDESS in Bulgaria has continued at a very high level. The Bulgaria-specific workshop in late June and early July 1993 initiated integrated use of DEMDESS at the inspectorate, Laboratory Information Center (LIC), and ministry levels, with a very strong commitment of resources from the Bulgarian government. Hungary, through its Ministry of Environment and Regional Planning (MERP) and Vituki (an institute within MERP), has become a strong supporter and active user of DEMDESS for integral use in the country's national water quality management planning. In Slovakia, after phase one of the project in 1991-92, DEMDESS's implementation was expanded to include the Hornad River basin. Slovakia has now instituted plans for continuing technical support at its Hydrometeorological Institute. In Romania, DEMDESS has been completed for the Arges River basin and is currently being used by the country's Research and Engineering Institute for Environment. Strategies have recently been developed with ministry staff to expand DEMDESS use to the basin authorities and county environmental protection offices. Additionally, the PCU staff recognizes DEMDESS is a valuable tool that can be used for various data management tasks in implementing the Danube Program.

Some general conclusions can be drawn from DEMDESS's development so far:

- DEMDESS needs support and activity at both the ministry and technical-institute levels.

- Technical training workshops emphasizing hands-on experience are very effective and productive.
- For a relatively small "investment" in computer equipment and software, DEMDESS will produce significant benefits.
- There has been a general growth in understanding of the decision-making components of water quality management, especially the importance of collecting reliable financial data and performing accurate analyses.

Some of the problems identified in the course of DEMDESS's development are outlined below.

- Consistent technical support from host country experts has sometimes been difficult to attain, primarily because of overwhelming, competing demands within the countries.
- Some important data gaps prevail in the different country implementations of DEMDESS. Some of these gaps are simply a matter of insufficient resources being made available to interpret and load data, others are short-term problems being addressed by the country experts, and some pertain to longer-term issues.
- Changing political and institutional conditions in some countries have in turn led to some confusion concerning the role and "home" for DEMDESS. This problem is being resolved as conditions stabilize.

Below are some suggestions for DEMDESS related follow-on activities. These suggestions are based on the current understanding of A.I.D.'s priorities regarding Danube area assistance, the needs and desires expressed by the user countries, and an aim toward closure of A.I.D.'s support for DEMDESS.

Activity 1: Continued training, especially country-specific information management workshops.

Activity 2: Continued assistance with prefeasibility and feasibility studies.

Activity 3: Coordination with and support of the Danube Environmental Program.

Activity 4: Assistance in developing basin and country water quality management plans.

Activity 5: Technology transfer support to user countries.

Activity 6: Assistance in using modeling techniques.

DEMDESS has been carefully designed for the future so that the ultimate goals for its development include the following:

- Implement DEMDESS basinwide. The system has been designed to allow this, and it can unify all of the technical country and donor activities related to cleanup of the Danube. To the best of the WASH team's knowledge, DEMDESS is the only practical

water quality information management system available that has the capacity to unify all Danubian country and donor technical data.

- Implement DEMDESS as one of a number of tools of the PCU's Data Management Activity. Currently, DEMDESS is a single system operating in four Danubian countries, with preliminary preparations being made for its use in Ukraine and Moldova. DEMDESS can readily meet many of the PCU's immediate and ultimate needs regarding water information systems.

- Expand DEMDESS to emergency and early-warning applications. This capability has been inherent, albeit latent, within the system. The developer of DEMDESS has not emphasized this aspect, but several country users have suggested it as a desirable option. Using one system for both routine water management and emergencies merits consideration because much of the same basic data and relationships are required in both applications.

Chapter 1

INTRODUCTION

1.1 Background

The countries of central and eastern Europe have been collecting water quality related data for quite some time, but their governments have not used the information in formulating related policies. However, recent dramatic changes in these countries have placed new demands on the data; consequently, these statistics are now forming a necessary component of important decision-making processes concerning water and wastewater investments. Country officials also are recognizing that they will need to use new and different types of data not previously collected, especially data regarding regulations and costs. To address these concerns, from fall of 1991 to summer of 1992, a multidisciplinary WASH team assisted experts in Bulgaria, Hungary, Romania, and Slovakia to develop a computer-based water emissions management system, which is now named the Danube Emissions Management Decision Support System (DEMDESS).

DEMDESS is a comprehensive water pollution data management environment/system. It does not fit into traditional slots such as "computer model" or "pollution management program." These traditional slots can be incorporated into DEMDESS, however, and as such they are optional components of the system. DEMDESS can meet basic information management and reporting requirements while operating with a wide array of models as needed. Using modern information management techniques, DEMDESS is suitable both for beginners, who may be most comfortable with simple, menu-driven programs, and experts, who may prefer sophisticated applications.

Although technical experts in the DEMDESS countries are inexperienced in building and applying water data in the decision- making modes now required, they are very proficient in the basics of computer software development and water engineering. DEMDESS builds on these existing strengths while providing a tool for training in the new analytical environment in which individuals must operate. Through DEMDESS development and training, country experts can "test" their existing data for sufficiency in addressing current analytical requirements, identify deficiencies, and modify their data collection procedures accordingly. The institutional impacts of DEMDESS go beyond simply the application of a computer analysis system to basic data collection procedures, staff training, and decision-making criteria.

In terms of DEMDESS's development, the key activities and outcomes of the multidisciplinary work done during 1991-92 were as follows:

1. Development of a conceptual framework for management of water pollution decision-making. This framework formed the macro-level requirements for DEMDESS.

2. An initial prototype of DEMDESS built using Bulgarian data, because the technical and institutional conditions for developing DEMDESS were most favorable in Bulgaria.

3. A workshop, held in December 1991, in Visegrad, Hungary, with representatives of the four Danubian countries to be assisted with DEMDESS. In this workshop, the country representatives were shown the conceptual framework and prototype DEMDESS as starting points for developing a full decision support system. They reacted quite favorably and supported continuing DEMDESS's development. Participants agreed on a strategy in which one major basin in each country would be targeted for full development of DEMDESS.

4. Technical development in the selected basins in each country continued through the spring of 1992. Significant progress was made in each country, with the fullest development occurring in Bulgaria.

5. A closeout workshop in May 1992 held near Bratislava, Slovakia. A "treatment policy" analysis using all of the major components of DEMDESS was used to demonstrate its decision-making capabilities. All of the countries expressed a strong desire to continue DEMDESS's development.

6. A user manual and country-specific versions of the "initial DEMDESS" were completed and delivered in summer 1992.

Bulgaria, Hungary, Romania, and Slovakia have enthusiastically embraced DEMDESS because they recognize that it is a technically sound approach to using both old and new data in the new decision-making modes being required. In addition, they recognize that DEMDESS is a very open approach to water quality information management that will not become obsolete as new data and analysis requirements evolve.

The computer revolution of the last few years has completely changed the way computer systems are developed and has even blurred certain fundamental concepts, such as "computer programs." It is difficult at best to use standard terminology to define "DEMDESS." To provide an analogy, "Lotus" can be thought of as several different things. To the program developer, Lotus is a "computer program." To the average user, Lotus is a "spreadsheet." To a sophisticated user, Lotus is a "software development environment." Similarly, DEMDESS can mean different things to different people.

1.2 Objectives

The overall objective of the DEMDESS project has been to institutionalize DEMDESS; that is, to help the Danubian countries develop and use DEMDESS as an operational tool for water pollution decision support. DEMDESS is highly desirable as an operational tool because it can address several key technical and policy issues related to water quality and pollution control that face the environmental ministries of the Danubian countries.

Making DEMDESS operational requires efforts at both the technical and institutional levels. Technical activities have emphasized database and applications development, while institutional activities have focused on training and outreach to build the proper environment for using DEMDESS.

Chapter 2

OVERVIEW OF DEMDESS

2.1 Requirements for Decision-Making

As noted in Section 1.1, a comprehensive conceptual framework for emissions decision-making was developed in the first phase of the DEMDESS project in 1991-92. Figure 1 shows a simplified version of this framework; this simplification has proven useful during this project in communicating the essential requirements and scope of DEMDESS. The essential requirements are that the user consider a possible policy, action, or alternative regarding emissions management. This in turn affects the polluter/emissions, thereby affecting water quality and costs. These effects must then be evaluated, which leads to acceptance of or a change in the alternative.

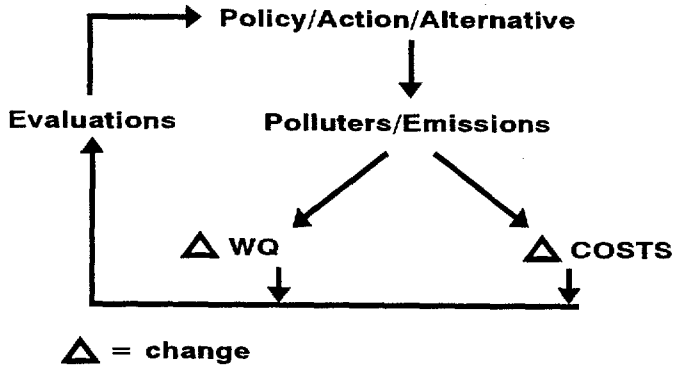

Figure 1
Conceptual Framework for Emissions Decision-Making

It must be emphasized that each step in this process can involve complex and intensive technical considerations. Also, the process must start with a clear definition of existing conditions.

In order to implement the process shown in Figure 1, several components are needed for analysis. Starting at the top of the figure, the DEMDESS user must be able to incorporate various policies and alternatives, including regulatory changes (taxes, fines, emission standards, and so on), specific treatment actions, and prioritization of problems. Moving down the figure, the system must able to incorporate an inventory and characterization of existing and future polluters. (A key to the system is that existing conditions are fully represented as much as possible, because virtually all decision analyses start with changes to current or near-future

situations.) Treatment-costing components, such as costs for construction and operation of primary and secondary treatment facilities, are needed to evaluate costs. Also required are regulatory costs such as taxes and fines. Additionally, an integrated river framework is needed that includes emissions, water quality monitoring, and hydrologic data to evaluate changes in water quality. Finally, all of the components should be compatible with one another, that is, be located in one "place" so that comprehensive evaluations of alternatives are readily feasible.

2.2 Scale of the Decision-Making Process

The scale of the decision-making process is an important consideration. This process can occur at many levels, including local, basin, national, and international levels. In the past, quite different systems were usually used at each level. Such systems were developed primarily because the computer requirements and capabilities varied at each level. For example, micro- or minicomputers were used at lower levels, and mainframe computers were employed (and needed) at national and international levels.

Another factor of scale has been that, previously, the level of detail and resolution tended to decline as the level of decision-making increased. Thus, at a local or basin level, highly detailed data would be used, while at a national level more general data would be used. This resulted because of the burden of managing and integrating the volumes of data involved.

The use of different computer systems and databases at different levels of use, while historically necessary, has created difficulties in developing water pollution control strategies. At higher levels, the lack of detailed data can create deficiencies in evaluating existing conditions and policies to improve water quality. Discrepancies can occur between conclusions reached at local and regional levels versus decisions reached at the national level. Another serious problem has been that the essential linkages between different types of data, e.g., in-stream monitoring and emissions, are difficult to maintain across different systems. This can obviously lead to analytical problems, because the conceptual framework for decision-making, as shown in Figure 1, requires these linkages.

DEMDESS is designed to be usable at any scale. In fact, DEMDESS is designed to enable users to be able to move up and down the different decision-making levels. This is possible because of the personal computer (PC) power "revolution," the power of modem PC databases, and the essential similarity in information requirements at each level.

2.3 System Components

The fundamental requirements for emissions management decision-making discussed in Section 2.1 have been implemented in the DEMDESS database design. The basic system organization is shown in Figure 2. Below is a brief discussion of each of the DEMDESS "building blocks," or subsystems.

1. The **Regulatory Subsystem** contains separate databases describing in-stream and emission standards, tax schedules, fines schedules, and permit limits. These databases tie to dischargers, river reaches, and monitoring stations as appropriate. Any number of alternative sets of regulations can be included so that the effects of future or proposed regulations can be evaluated.

2. The **Institutional Subsystem** is incorporated throughout the databases in the other five subsystems and includes information on the various levels of agencies responsible for monitoring and control functions.

3. The **Emissions Subsystem** contains detailed data on each discharger and its emissions. This subsystem is designed to be able to contain several complete alternative emissions scenarios for evaluation. In all user countries, this subsystem is built from the country's existing administrative, routine emissions monitoring system; this ensures that emissions data can be kept current.

4. The **Treatment Subsystem** consists of data on pollutant removals and costs for different treatment plants, either in general or applicable to a specific plant. The subsystem is designed to work in concert with the Emissions Subsystem to evaluate various treatment options, such as universal secondary treatment or specific treatment options at specific sites.

5. The **Reach Subsystem** is modeled on the United States Environmental Protection Agency's (USEPA's) River Reach file and serves as a central river network organization for linking stream standards, emissions, and in-stream monitoring data.

6. The **Water Quality Subsystem** consists primarily of in-stream ambient water quality monitoring data, built from the user country's existing administrative monitoring system so that it can be kept current easily.

A key to DEMDESS is that each of the individual subsystems is specifically designed to integrate easily with all of the other subsystems as needed. Also, the Regulatory, Emissions, and Treatment subsystems are designed to be able to contain any number of alternatives or scenarios.

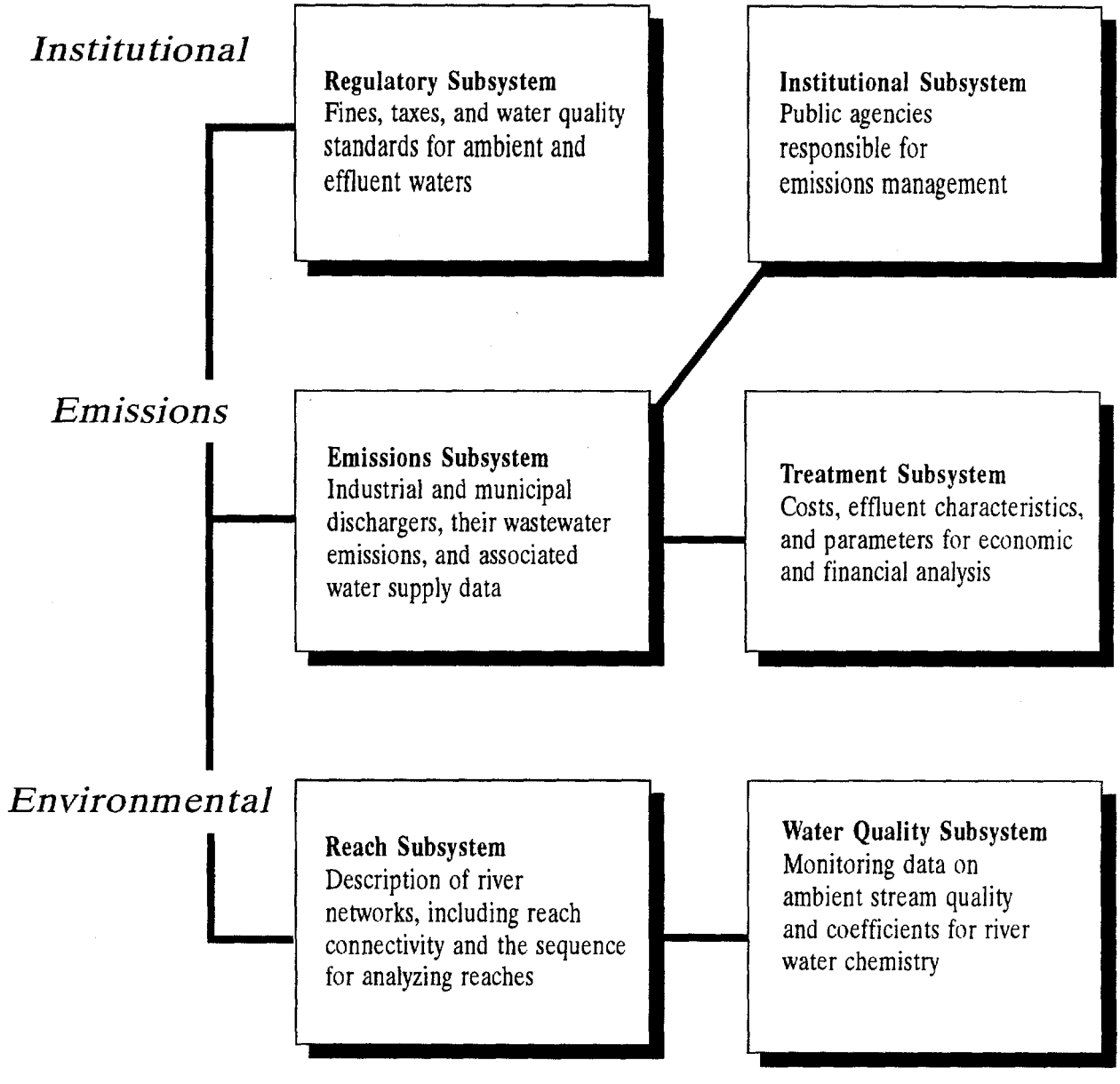

Figure 2
Organization of DEMDESS Database System

2.4 DEMDESS Development Strategy

DEMDESS has been developed using a prototype approach, with an emphasis on database design to meet the system's requirements. With this strategy, preliminary versions of the system are brought up and running quickly, reviewed with user country experts, and then enhanced and expanded as needed. This is an iterative process that provides for rapid, powerful system development. The result is a system that is verified to meet user needs with a powerful and flexible database design. This approach does place some extra burdens on users because it requires that the system evolve almost constantly, but this disadvantage is offset by DEMDESS's ability to respond quickly to new user requirements.

With the prototype approach, most of the system's development work occurs in database design and data loading. The development of applications is relatively quick.

Another aspect of the DEMDESS development strategy is the process of building "bottom up" using the most detailed data available, especially existing administrative databases. One example that shows the importance of this procedure involves water quality data. To evaluate accurately the effects of various pollution scenarios, one must examine the specifics of who does the polluting and where they are located along the body of water being polluted.

2.5 Computer Requirements

DEMDESS uses current relational database standards that are employed across the computer industry. It is implemented in Paradox® 4.0, a PC-based data management/programming package. Paradox® was selected because it is particularly amenable to the prototype approach described above, and because it provides excellent support for scientific and engineering applications. DEMDESS's database design and implementation are fully compatible with various alternative data management packages, such as DBase, Clipper, and Foxpro.

Chapter 3

SUMMARY OF ACTIVITIES SUPPORTING THE INSTITUTIONALIZATION OF DEMDESS

3.1 General Activities

Institutionalizing DEMDESS requires that several simultaneous and parallel activities take place.

First, DEMDESS's database and software must continue to be developed. Also, in order to provide accurate solutions, DEMDESS must be loaded with sufficient detail and quality of data. In all countries, work has continued to improve and expand this effort.

Second, the central technical "owner" of the system in each country must be supported through training, probably at the technical- institute level. Thus far, the technical owners have been supported primarily via one-on-one training (see Section 3.2.2).

Third, support for DEMDESS must be sought from key decision-makers, especially at the countries' respective environmental ministries. Several briefings and demonstrations have been given to these key people throughout the project (see Section 3.2.3).

Fourth, training and outreach for DEMDESS users must be provided in order to build the technical and institutional environment for using the system. Two training workshops were held and a DEMDESS brochure developed in 1993 to support this effort (see Sections 3.2.7 and 3.2.8 for more details on the workshops). The workshops emphasized hands-on computer practice, which afforded training of many users at national and local levels. The brochure was widely distributed and helped build further support for DEMDESS.

3.2 Specific Activities

From September 1992 to July 1993, 10 separate activities were performed in phase two of the DEMDESS project in order to institutionalize DEMDESS. These are described below.

3.2.1 Continued Assistance in Interfacing DEMDESS to Country-Specific Water Databases

DEMDESS relies on the detailed emissions and water quality data collected and maintained in each user country. Thus, it is essential that DEMDESS keep up with this data. Enabling the system to do so is an ongoing process that can be turned over to country experts as they become more familiar with DEMDESS.

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During phase one of the project, work continued in this activity in each country. In Slovakia, emissions and water quality data loading was expanded to include the Hornad basin. Also, the Reach file was expanded to cover the entire country.

In Hungary, improvements were made in the loading and quality control of water quality data. The emissions data loading was expanded and enhanced based on the country's new emissions databases. The system was expanded to include the Sajo-Hernad basin.

In Romania, the Arges basin data loading was completed using the country's new emissions data system. The full water quality database was also loaded.

In Bulgaria, a completely new emissions data entry and editing system was implemented within DEMDESS; this system is quite extensive, with numerous look-up and quality control functions. Additionally, a national water quality monitoring system was incorporated, and a national standard river kilometer network was added.

In all four countries, progress was made in manually loading regulatory data. In most cases, this represents the first systematic computerization of such data.

3.2.2 Direct Technical Training of Experts in Each Country

One of the most effective DEMDESS training techniques has been one-on-one training with designated experts in each user country. The technical details in DEMDESS are quite complex, necessitating tailored training. During the past year, the WASH team spent several days in each country covering topics such as Paradox® basics, Reach file concepts and use, DEMDESS data linkages, and development and enhancement of user-friendly applications.

3.2.3 Coordination with Related Activities, Especially Those of the PCU Subgroup on Monitoring, Laboratory, and Information Management

DEMDESS is one part of the Agency for International Development's (A.I.D.'s) Danube Program, providing a tool that can be used to address several aspects of emissions and water quality issues affecting the river. It is important for the Program Coordination Unit (PCU) and others to be kept informed of DEMDESS so that the system can be properly considered along with the other activities taking place in the Danube basin.

During the project, the PCU has been kept apprised of DEMDESS's status via several specific actions. First, the PCU was briefed in Brussels at the start of phase two of the project. Second, in December 1992, DEMDESS staff participated in the PCU's Bucharest Workshop for the Subgroup on Monitoring, Laboratory, and Information Management. Third, several memos and status reports were sent to the PCU. Fourth, PCU staff were invited and participated in two DEMDESS workshops, one in Budapest in May 1993 and the other in Mt. Vitosha, Bulgaria, in late June and early July 1993.

Coordination activities were performed with several other organizations working in the Danube basin. For example, DEMDESS briefings were given to contractors of the European Bank for Reconstruction and Development (EBRD). A presentation on DEMDESS was also given at the USAID Environmental Training Project workshop in January 1993, in Kosice, Slovakia. Additionally, WASH team members met with representatives of the Foundation Cousteau in April 1993 to discuss how to approach pollution problems in the Danube.

3.2.4 Development of a "User-Friendly" Version of DEMDESS with Routine Reporting and Decision Support Applications

DEMDESS has two operational modes: an expert ad hoc analysis mode, and a menu-driven user-friendly mode. The user-friendly mode is important so that nonexperts can use DEMDESS. It has been implemented in each country version of DEMDESS and includes several primary analytical routines, among them the performance of water quality profiles and loadings rankings analyses. Training in and practice using the User-friendly DEMDESS was given at the Budapest DEMDESS workshop held in May 1993.

The basic capabilities of the User-friendly DEMDESS include the following:

- editing and basic reporting of each separate component;
- reports on emissions violations, taxes, and fines;
- in-stream water quality time series plots;
- in-stream water quality profile plots;
- emissions loadings analyses and rankings; and
- cumulative loadings analyses and profile plots.

These capabilities were developed in conjunction with user country requests and WASH prefeasibility study requirements.

3.2.5 Revision of the *DEMDESS User Manual*

DEMDESS underwent many changes and enhancements during phase two of the project. As a result, the *DEMDESS User Manual* has been almost completely rewritten since its first edition in 1992, and will be available in September 1993.

The new user manual contains a description of the User-friendly DEMDESS, expanded treatment of some of its subsystems, a standardized methodology for documenting DEMDESS programs, and an updated database dictionary.

3.2.6 Application of DEMDESS in WASH Prefeasibility Studies

DEMDESS was used in the four WASH prefeasibility studies conducted in Bulgaria, Hungary, Romania, and Slovakia from September 1992 to May 1993 (see "Water Quality Pre-Investment Studies in Four Danube River Tributary Basins: 1993 Summary Report" WASH Field Report No. 407). The system was used primarily in the studies' basin analyses and priority ranking tasks.

Participation in the prefeasibility studies provided an excellent opportunity to try DEMDESS in "real world" applications. Also, several very useful DEMDESS applications were developed in response to requests from the WASH prefeasibility teams. In Slovakia and Hungary, for instance, DEMDESS was expanded to the Hornad and Sajo-Hernad basins, respectively, because the initial DEMDESS implementations in those countries were in different basins.

Also during this phase of the project, preliminary work was begun to use DEMDESS to perform risk assessments. It was determined that data were insufficient to complete this work, but what was done showed that DEMDESS is readily amenable to implementing risk assessment methodologies.

3.2.7 A Regional DEMDESS Training Workshop Held in May 1993 in Budapest

Technical managers and users of water information systems from Bulgaria, Hungary, Romania, and Slovakia met from May 11-14, 1993, at Vituki Water Resources Research Centre in Budapest, Hungary, for a workshop on water quality information management and the use of DEMDESS. The workshop was an important step toward institutionalizing DEMDESS as a key water quality management tool in each of the participating countries.

During the workshop, which included a significant amount of hands-on computer practice, participants learned a conceptual framework for water quality information management, and then applied these principles within DEMDESS to address key water quality questions. In doing so, they used actual data from their countries. The participants then learned to convert their applications into the User-friendly DEMDESS, which allows the applications to be used by users who are not computer specialists.

For a complete summary of the workshop proceedings, see Appendix A.

3.2.8 A Bulgaria-Specific Workshop Held in Mt. Vitosha, Bulgaria, in Late June and Early July 1993

Bulgaria is the first country to undertake the establishment of DEMDESS as its data management system for pollution control within its overall national water quality information management system. The first step toward countrywide institutionalization of DEMDESS in Bulgaria was an intensive, three-day hands-on training workshop on the basics of the system, the first country-specific DEMDESS workshop ever held. The event took place from June 29

to July 2, 1993, on Mt. Vitosha, near Sofia. Attendants included 25 participants representing the Ministry of Environment, the Laboratory and Information Center (LIC) in Sofia, and five Bulgarian inspectorates bordering the Danube River.

The overall purpose of the workshop was to institutionalize DEMDESS further so that it can be applied as part of an overall water quality information system at both the national and inspectorate levels.

For a complete summary of the workshop proceedings, see Appendix B.

3.2.9 Provision of Computers and Software to Each Country for Using DEMDESS

In order to support and encourage DEMDESS use, each user country has been provided with three computers, a laser printer, and software. The computers consist of a 386 PC, a 486 PC, and a 386 laptop. The printer is an HP Laserjet IIP. The software includes three copies of Paradox® 4.0 and WordPerfect 5.1. The computers have proven to be invaluable in DEMDESS's development and use because they have circumvented the potential problem of maintaining a computer "home" for DEMDESS, while ensuring that country experts have a computer available for their DEMDESS-related use. Shortages of PCs continue in the user countries, however (some more severe than others).

3.2.10 Participation in the Closeout Prefeasibility Study Meetings Held in Each Country in May 1993

Closeout prefeasibility meetings in Bulgaria, Hungary, Romania, and Slovakia served as effective forums for presenting an overview and status report on DEMDESS to several levels of interested parties in each country. Other topics included specific uses for DEMDESS and desired future steps involving its further development. In each meeting, a user country DEMDESS expert gave the DEMDESS presentation in the local language. Briefings were based on the presentations developed during the Budapest DEMDESS workshop. Arranging for the presentations to be given by the user countries' own experts served to emphasize the countries' "ownership" of DEMDESS.

The success of the briefings varied somewhat across countries, with Hungary and Bulgaria enjoying the most success. In all countries, the briefings were successful in communicating the essential elements of DEMDESS and making many potential users aware of its power.

Chapter 4

INSTITUTIONAL STATUS OF DEMDESS

The activities described in Chapter 3 produced several positive results and identified some additional problems. Major positive outcomes are summarized below.

- Technical and institutional development of DEMDESS in Bulgaria has continued at a very high level. The Bulgaria-specific workshop in late June and early July 1993 initiated the integrated use of DEMDESS at the inspectorate, LIC, and ministry levels, with a very strong commitment of resources by Bulgaria. The workshop served as a prototype for possible training in the other user countries and demonstrated the value of country-specific DEMDESS training.

  DEMDESS is being expanded to include all of the Danube basins, and plans are for its use throughout the entire country. The Bulgaria LIC staff is actively developing DEMDESS applications on its own. One particular achievement has been the development of a full user-friendly DEMDESS in Bulgarian Cyrillic, including graphics and help text. DEMDESS implementation in the Yantra basin has been greatly refined, implementation in the Iskar basin has begun, and use in all other Danube inspectorates has been initiated. The simultaneous use of DEMDESS at the Ministry of Environment, LIC, and inspectorates represents a significant overall advance in how water quality information management systems are applied.

- Hungary, through its Ministry of Environment and Regional Planning (MERP) and Vituki (an institute within MERP), has become a strong supporter and active user of DEMDESS for integral use in the country's national water quality management planning. Vituki is using DEMDESS and developing its own analytical routines and sophisticated applications. MERP's support of DEMDESS is particularly high at this time. After phase one of the DEMDESS project in 1991-92, DEMDESS was expanded to the Sajo-Hernad basin.

- In Slovakia, after phase one, DEMDESS implementation was expanded to include the Hornad River basin. Training activities were expanded to include staff from the Ministry of Environment as well as the Hydrometeorological and Water Research institutes. During this task, support from the technical institutes was identified as a shortcoming; consequently, Slovakia has now instituted plans for continuing technical support at the Hydrometeorological Institute.

- In Romania, DEMDESS has been completed for the Arges River basin and is currently being used by the Research and Engineering Institute for Environment (ICIM). The results demonstrate that DEMDESS can work well in conjunction with existing national-level data systems. Support from the Ministry of Waters, Forests, and Environmental Protection was lacking, owing primarily to continuing major changes

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the ministry is undergoing. Strategies have recently been developed with ministry staff to expand DEMDESS use to the basin authorities and county environmental protection offices.

- The PCU staff recognizes DEMDESS is a valuable tool that can be used for various data management tasks in implementing the Danube Program. As such, the PCU has requested increased participation by WASH DEMDESS experts in meetings of the PCU's Subgroup on Monitoring, Laboratory, and Information Management.
- The computers and software supplied to each country have provided valuable assistance in support of pollution control activities in general, as well as of DEMDESS in particular.
- There has been a general growth in understanding of the decision-making components of water quality management, especially the importance of collecting reliable financial data and performing accurate analyses.
- DEMDESS made a positive contribution to the WASH prefeasibility studies, which provided a forum for developing several important analytical routines that are now incorporated into DEMDESS.
- The Budapest workshop was very successful, with significant advances made in technical capabilities among participants, sharing between country and WASH experts, growth of a sense of "user community," and enhanced presentation skills.

Chapter 5

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

Three general conclusions can be drawn from DEMDESS's development so far. They are as follows:

- Support and activity for DEMDESS are needed at two levels: ministries of environment and relevant technical institutes. If only the ministry level participates, the necessary technical development of DEMDESS will suffer. If only the technical institute level lends support, the institutional environment for DEMDESS will be insufficient to develop the user base.
- Technical training workshops emphasizing hands-on experience are very effective and productive. The two workshops noted above generated a high level of excitement and in some cases renewed commitment to DEMDESS. The hands-on experience proved quite effective in making DEMDESS "real" for participants and served as an excellent training forum.
- For a relatively small "investment" in computer equipment and software in support of DEMDESS, the system will produce significant benefits. The strategy of using some equipment for the prefeasibility studies before turning it over to the host (user) countries has been cost-effective, and has worked to maximum advantage for the countries themselves. By associating the computers with DEMDESS, they became targeted to specific users directly involved in solving water quality problems.

5.2 Identified Problems

Some of the problems identified in the course of DEMDESS's development are outlined below.

- Consistent technical support from host country experts has sometimes been difficult to attain, primarily because of overwhelming, competing demands within the countries. Officials have recognized, however, that consistent technical support is necessary for DEMDESS to become fully operational, and most of the countries are working on this problem.
- Some important data gaps prevail in the different country implementations of DEMDESS. Some of these gaps are simply a matter of insufficient resources being made available to interpret and load the data, others are short-term problems being addressed by the country experts, and some gaps pertain to longer-term issues. The

identification and resolution of information gaps are integral to the development of a comprehensive system such as DEMDESS.

- Changing political and institutional conditions in some countries have in turn led to some confusion concerning the role and "home" for DEMDESS. This problem is being resolved as conditions stabilize.

5.3 Recommendations for Follow-On Activities

Below are some suggestions for DEMDESS related follow-on activities. These suggestions are based on the current understanding of A.I.D.'s priorities regarding Danube area assistance, the needs and desires expressed by the user countries, and an aim toward closure of A.I.D.'s support for DEMDESS.

Activity 1: Continued training, especially country-specific information management workshops.

Country-specific workshops are directed at effecting sound, integrated water information management procedures (including DEMDESS) at the inspectorate, basin, and national levels. The Budapest regional and Bulgaria country-specific workshops held in 1993 were set up in direct response to user country requests. Hungary and Slovakia have also requested country-specific workshops, and ICIM/Romania has supported the idea as well.

In addition to formal workshops, ad hoc one-on-one training has proven very effective in transferring the skills necessary to use and support DEMDESS. Support for such training will continue to be very effective and efficient.

Activity 2: Continued assistance with prefeasibility and feasibility studies.

DEMDESS is, in part, designed to address many of the information management and analysis requirements needed in prefeasibility and feasibility studies. As noted previously, DEMDESS has been used effectively in direct support of the WASH Danube basin prefeasibility studies. More can be done, especially in improving the incorporation of financial analysis components and refining basin assessment/prioritization analyses. This activity can be highly useful in the basin studies being conducted by the other donor organizations. Also, it will help alleviate the burdens being placed on the user countries to support these basin studies.

Activity 3: Coordination with and support of the Danube Environmental Program.

DEMDESS fits in with several DEP goals and activities, especially the monitoring, laboratory, and information subgroup. Specific areas of coordination and support include promoting information sharing through a common information structure, strengthening country information management systems, and supporting evaluation and updates of monitoring networks. DEMDESS coordination and cooperation with other donor

organizations help A.I.D. "leverage" its assistance by extending support to other basin studies.

Activity 4: Assistance in developing basin and country water quality management plans.

This is a specific request for support from Bulgaria and Hungary, with likely application in Slovakia and Romania. All of the countries need to develop continuing water quality management plans for use at the basin, ministry, and legislative levels. The user countries consider DEMDESS an essential tool for integrating the varied information sources needed to develop comprehensive water quality management plans. While the countries have access to many of the technical resources required to develop these plans, they could use some supplemental technical assistance to implement the plans.

Activity 5: Technology transfer support to user countries.

DEMDESS can be viewed as a "technology transfer" effort because its essential elements came from USEPA experience. Several other fruitful technology transfer techniques relate to DEMDESS as well. These include in-stream water quality modeling, nonpoint-source analysis, health and environmental risk assessment, and effective use of geographic information systems (GISs).

A particular opportunity presents itself to "leverage" the USEPA's and PHARE's existing GIS activities with DEMDESS. GIS activities are resource intensive, typically experiencing long lead times from start-up to meaningful application. DEMDESS has incorporated elements that permit "links" to GIS technology that can be implemented in a short to medium time frame. These elements and links have been developed in the U.S. at significant expense and over a period of several years. Support in this area could help encourage timely and efficient use of the GIS technologies being provided.

Activity 6: Assistance in using modeling techniques.

An important component in DEMDESS's design is the system's ability to incorporate a wide variety of models. The types of models considered in DEMDESS's design include the following:

- in-stream water quality,
- nonpoint-source loadings,
- cost and financial impacts, and
- the effects of national, regional, or sectoral economic activity.

Analysts require models to predict the effects certain actions would have. Decisions frequently are made based on such analyses.

Much of the data in DEMDESS are used as input to the above models or in conjunction with model outputs for analyses. User country technical representatives have requested assistance in enabling DEMDESS to use established models (e.g., USEPA's QUALL II) and/or in incorporating those models' modeling techniques directly into the DEMDESS software. Most of the preparatory steps to implement full-scale modeling capabilities in DEMDESS were taken in the project's previous phases. Additional technical assistance in this area will be very effective in enhancing DEMDESS's modeling capacity.

DEMDESS has been carefully designed for the future so that the ultimate goals for its development include the following:

- Implement DEMDESS basinwide. The system has been designed to allow this, and it can unify all of the technical country and donor activities related to cleanup of the Danube. To the best of the WASH team's knowledge, DEMDESS is the only practical water quality information management system available that has the capacity to unify all Danubian country and donor technical data.

- Implement DEMDESS as the cornerstone of the PCU's Data Management Activity. Currently, DEMDESS is a single system operating in four Danubian countries, with preliminary preparations being made for its use in Ukraine and Moldova. DEMDESS can readily meet many of the PCU's immediate and ultimate needs regarding water information systems.

- Expand DEMDESS to emergency and early-warning applications. This capability has been inherent, albeit latent, within the system. The developer of DEMDESS has not emphasized this aspect, but several country users have suggested it as a desirable option. Using one system for both routine water management and emergencies merits consideration because much of the same basic data and relationships are required in both applications.

APPENDIX A

Regional Workshop on Water Quality Information Management

May 11-14, 1993
Budapest, Hungary

by

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USAID Europe Bureau/Water and Sanitation
for Health Project

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ACKNOWLEDGMENTS

On behalf of USAID and the WASH Project, the authors would like to express their appreciation to Vituki Water Resources Research Centre and the Hungarian Ministry of Environment and Regional Planning (MERP) for hosting the workshop. The comfortable, professional setting at Vituki allowed a great deal to be accomplished. The authors would also like to thank the governments of Bulgaria, Hungary, Romania, and Slovakia, for dedicating valuable time and technical resources to the workshop.

ACRONYMS

A.I.D.	Agency for International Development (Washington, D.C.)
CASE	computer aided software engineering
DEMDESS	Danube Emissions Management Decision Support System
EPDRB	Environmental Program for the Danube River Basin
GIS	geographic information system
ISPAN	Irrigation Support Project for Asia and the Near East
MERP	Ministry of Environment and Regional Planning (Hungary)
MOE	Ministry of Environment
NGO	nongovernmental organization
PAL	Paradox® Application Language
PCU	Danube Program Coordination Unit of the Commission of the European Communities
USAID	United States Agency for International Development (overseas mission)
WASH	Water and Sanitation for Health Project
WQ	water quality

EXECUTIVE SUMMARY

Technical managers and users of water information systems from Bulgaria, Hungary, Romania, and Slovakia met from May 11-14, 1993, at Vituki Water Resources Research Centre in Budapest, Hungary, for a workshop on water quality information management and the use of the Danube Emissions Management Decision Support System (DEMDESS). A session was also offered on general presentation skills, followed by the drafting of outlines for presentations about DEMDESS to be made to senior-level decision-makers in each country.

The workshop was an important step toward institutionalizing DEMDESS as a key water quality management tool in each of the participating countries. Participants from the four countries included water quality managers from the environment ministries, representatives of water resource institutes, and staff from regional water quality or environmental inspectorates. A representative of the Danube PCU in Brussels participated as an observer, as did two water quality professionals from Poland.

During the workshop, which included a significant amount of hands-on computer practice, participants learned a conceptual framework for water quality information management, and then applied these principles within DEMDESS to address key water quality questions, using actual data from their countries. The participants then learned to convert these applications into the User-friendly DEMDESS, which allows the applications to be used by people who are not computer specialists.

Key outcomes of the workshop included the identification of future training and technical support needs in each of the countries and specific proposals for future collaboration among the countries that use DEMDESS. New potential applications identified by the participants include the following:

- inclusion of a mathematical model within the program;
- linkages with geographic information systems (GISs) or development of other mapping capabilities;
- national development of DEMDESS within each country to link with existing systems and involve more institutions and technicians; and
- adaptation of DEMDESS so that CASE (computer aided software engineering) tools can be used to develop new applications.

The following were among the agreements reached to establish continued regional user group activities and information sharing:

- Form a "DEMDESS community," association, or club.
- Request that the PCU of the Environmental Program for the Danube River Basin (EPDRB) play a role in the coordination regarding DEMDESS development and evolution.

- Have WASH prepare a one-page status report on DEMDESS, including anticipated future developments, which would be distributed by the PCU.
- Distribute the *DEMDESS User Manual* on disk so it can be easily modified as user countries develop new applications.
- Develop a method so that new applications, along with documentation, can be shared on disk among user countries.

The participants' overall evaluation of the workshop was quite positive. In fact, the workshop received an average rating of 4.76 on a scale of 1 to 5.

Section 1

PREPARATION OF THE WORKSHOP

1.1 Background

WASH is actively involved in assisting the governments of Bulgaria, Hungary, Romania, and Slovakia in the assessment and control of water pollution, especially in the Danube basin. This work started in the fall of 1991 with a project that achieved the following:

- developed the Danube Emissions Management Decision Support System (DEMDESS);
- performed "hot spot" analyses in all four countries to identify their major water pollution sources;
- developed institutional analyses of the countries' water quality management sectors;
- produced countrywide studies of the current status of water quality and emissions; and
- conducted two workshops on emissions management with participation from all four countries plus donor representatives, nongovernmental organizations (NGOs), and representatives from other Danubian countries.

One clear conclusion from the above work is that the four countries have a need for assistance in the development of water quality information management tools. The countries need this assistance because of the dramatic changes taking place in their institutions that result in changes in decision-making processes related to water pollution control. The WASH projects in central and eastern Europe have been directly addressing this need through development and support of DEMDESS.

The current WASH project in central and eastern Europe includes support for institutionalizing DEMDESS in the aforementioned four countries. All the countries have committed, to some degree, to using DEMDESS as a continuing central water quality planning and management tool. Plans include centralized Ministry of Environment (MOE) use as well as distributed use at the level of the water quality or environmental inspectorates.

In the course of this work, MOE staff in Bulgaria, Hungary, Romania, and Slovakia have independently identified similar training needs in water quality and emissions management techniques. The training needs expressed by the countries are particularly oriented toward managing water quality and emissions data for routine monitoring, problem identification, and methodologies for integrated analysis and decision-making support.

Two levels of training have been identified by the countries: training at the central level for MOE and national technical institute staff, and training at the regional or inspectorate level.

The first level of training is essential for developing a comprehensive, responsive national-level water quality management system. The second level of training is needed to make the system fully operational; data collection and primary data analysis are first performed at the regional or inspectorate levels and then transferred to the MOE.

1.2 Workshop Overview

This workshop was designed to address the first level of training noted above, central-level training, through a regional format that included participants from all four countries plus selected observers. Addressing central-level training with one regional workshop promised to hold significant advantages. First, efficiency would be gained in meeting the needs of all four countries with one workshop. Second, a regional workshop would promote cooperation among the attendants as well as encourage consistency in approach. Third, the participants expected to attend the workshop all have excellent technical capabilities, and it was expected that there would be positive synergistic effects in the sharing of experiences.

The workshop was designed to apply the principles of water quality information management to country-specific problems using DEMDESS. This approach would allow technical advances in DEMDESS in each country, as well as help the participants determine their most pressing needs regarding water information. By the end of the workshop, it was hoped all participants would understand the principles and be able to demonstrate them to others by using DEMDESS. The workshop was also designed to help participants prepare presentations to senior-level decision-makers about the importance of, and current needs for, water quality information management. Effective presentations are essential for obtaining the financial and institutional support necessary to develop and maintain properly an effective water quality information system.

1.3 Logistical Arrangements

While the idea for a technical workshop on water quality data management was being formulated, the Vituki Water Resources Research Centre in Budapest was identified as an ideal site to hold the event. It offered ample conference and meeting facilities along with sufficient computer hardware and other technical resources to support such a workshop.

The WASH team developed an initial participant list based on two years of working with water quality managers in each of the four countries. The final participant list, which included three people from Hungary, Romania, and Slovakia, and two people from Bulgaria, was produced in consultation with the environment ministry in each of the countries. A representative of the Danube Program Coordination Unit (PCU) in Brussels participated as an observer, as did two water quality professionals from Poland. (See Chapter 4 for the complete participant list.) The number of participants was intentionally limited, to allow maximum involvement and hands-on practice with using DEMDESS.

1.4 Team Planning Meetings

Three members of the WASH team met at the WASH Operations Center in Arlington, Va., on March 12 and March 16, 1993, for initial planning of the workshop. WASH's director of Danube activities provided the necessary background information, and human resource development specialist for the Irrigation Support Project for Asia and the Near East (ISPAN), who previously had served as a facilitator for other Danube program workshops, shared her experience regarding the design and delivery of similar workshops. By the end of these two days, the WASH team reached agreement on the overall purpose of the assignment and the workshop's objectives, and prepared an initial draft workshop design.

The full WASH team then met at the WASH Operations Center May 3-4, 1993, to finalize the workshop's design, prepare all relevant materials, agree on specific roles and responsibilities, develop a work plan for the assignment, and agree on a table of contents for the final report of the workshop.

1.5 Computer Support

As a technical workshop including a significant amount of hands-on computer practice, this workshop presented special challenges for its organizers and opportunities for its participants. As a part of its overall Danube activity, USAID's Europe Bureau, through the WASH Project, had provided three computers, including two desktop systems and one laptop, to each of the four countries. A laser printer was also provided to each country. During the workshop, the entire set of equipment sent to Hungary was used. In addition, each of the other country teams brought with it the laptop computer provided by USAID. This allowed participants to use actual data from their home countries during the workshop, and to take with them applications developed during the workshop practice sessions.

Additional computer resources were available in anticipation of technical difficulties, but none was experienced. Computer demonstrations were made in the workshop's plenary sessions through the use of a data display board attached to an overhead projector.

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Section 2

IMPLEMENTATION OF THE WORKSHOP

2.1 Objectives and Expected Outcomes

The purpose of the workshop was to provide technical training on water quality information management to water quality managers from Bulgaria, Hungary, Romania, and Slovakia. DEMDESS was used an example of a support tool that is based on basic water quality data management principles. The workshop's goal was that by the end of the workshop, all participants would understand these principles and be able to demonstrate them to others using DEMDESS. Particular emphasis was placed on being able to make presentations on the importance and value of DEMDESS to senior-level decision-makers in each country.

2.1.1 Learning Objectives

At the end of the workshop, participants were expected to be able to do the following:

- understand and explain the principles and concepts of information management for water quality management;
- evaluate whether specific water quality questions can be answered from currently available information, and, if not, be able to identify information needs and steps required to provide answers;
- use DEMDESS to respond to specific water quality questions and issues; and
- explain the importance of water quality information management systems, such as DEMDESS, to senior government officials.

2.1.2 Outcomes

The Budapest regional workshop is seen as a key step toward establishing a national water quality information management system in each of the four participant countries. Significant outcomes of the workshop include the following:

- a common understanding of the importance of a national water quality information management system;
- A strategy for securing the support of higher-level government officials in each of the countries for establishing such a system;

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- identification of the next steps needed to institutionalize a water quality information management system in each country; and
- a collaborative working relationship among those responsible for water quality information management in each of the countries.

2.2 Workshop Agenda

Tuesday, May 11, 1993	Wednesday, May 12, 1993	Thursday, May 13, 1993	Friday, May 14, 1993
	Morning ■ Session 1: Water Quality Management Status in Each Country ■ Session 2: Water Quality Information Management Principles	**Morning** ■ Session 4: Understanding and Using the User-friendly DEMDESS	**Morning** ■ Explanation of DEMDESS costing model ■ Session 5: Presentation Techniques ■ Session 6: Designing Presentations for Senior Officials
	Afternoon ■ Session 3: Introduction/ Demonstration of DEMDESS	**Afternoon** ■ Sharing of DEMDESS solutions among countries ■ Plenary discussion	**Afternoon** ■ Session 7: Practice of Draft Presentations by Each Country ■ Session 8: Discussion of Future Training and Technical Support Needs ■ Session 9: Closing and Evaluation
Evening ■ Introduction ■ Icebreaker ■ Reception	**Evening** ■ Optional session on computer viruses and electronic data transfer		

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Section 3

WORKSHOP RESULTS

3.1 Status of Water Quality Information Management in Each Country

During the workshop, each country presented its current major initiatives in water quality management, and identified key information and decision support questions that need to be addressed. There were many common elements among the countries. Among these were the need to protect groundwater, as this represents the primary source of drinking water throughout the region. All the participant countries are in the process of adopting or are planning to adopt new water quality standards as a part of broader environmental legislative actions. A common decision support need among the countries involves the comparison and prioritization of pollution control measures based on cost, impact on water quality, and feasibility under current conditions.

3.1.1 Hungary

Presented by the head of the Department for Water Quality, Ministry of Environment and Regional Planning, Budapest

Under the new minister of environment and regional planning, Hungary is in the process of developing a new water quality information strategy to help address numerous problems in the country. The priorities identified are as follows:

- Protection of groundwater. Sixty-five percent of drinking water in Hungary comes from groundwater sources.
- Protection of Hungary's large lakes. Many of Hungary's large, shallow lakes have suffered during the last 10 years because of pollution combined with low rainfall levels. These include Lake Balaton, the largest lake in central Europe.
- Protection of surface waters that originate within the country.
- Protection of rivers of foreign origin. Improving such resources is difficult because they lie largely outside Hungary's control—20 million inhabitants of the Danube River basin live upstream of Hungary's borders.
- Protection of smaller lakes and groundwater sources not used for drinking water.

To address these priorities, Hungary has developed the following plan.

- Survey of contamination sources. There are many new dischargers in Hungary, including industry and other sources, and therefore a much broader understanding of their impact is needed.

- Establishment of a system of water quality objectives. Based on the British model, it includes the implementation of effluent standards.
- A large program for construction and improvement of sewer systems and wastewater treatment plants. Currently only one-half of the wastewater in Hungary is collected; of that, only one-half is treated.
- A program to reduce nonpoint-source pollution. This would include institutionalization of incentives for adopting environmentally sound practices in the country's agricultural sector.

Additional measures being considered include the following:

- The use of new tools, including a permit system involving incentives and disincentives for dischargers.
- The use of environmental fees rather than environmental fines. Fines are currently the only system for assessing financial penalties for overpolluting, and they are an important funding source for the agencies responsible for water quality. However, due to changing procedures, the unpredictable nature of revenue from fines, and delays in reaching the institutions, this system does not allow appropriate planning or budgeting.
- Increased effectiveness of control systems, especially self-control and monitoring by the industries themselves.
- A special program is also needed on the use of pesticides and fertilizers. The use of chemical fertilizers and pesticides has fallen off dramatically due to poor market conditions in Hungary's agricultural sector. While this has improved surface water quality, a program must be implemented to control the use of these chemicals as market conditions improve.
- A program for industry that includes the following:
  - a longitudinal survey of current river conditions, focusing on contaminant loads;
  - a survey of land uses, identifying nonpoint- and point-source dischargers;
  - based on the U.S. model, water quality objectives for each river or reach, and the tolerable levels of pollutant load;
  - emission standards for industry based on tolerable pollutant loads; and
  - the return to the watershed every five years to decide whether to maintain or change objectives, tolerable load, standards, and load allocations.

A key question with which Hungary is currently grappling is how the total allowable load for a given river should be allocated among pollution dischargers. Also, how do costs compare

for the various pollution reduction methods? Hungary hopes to use DEMDESS to answer these questions.

One primary goal of the project is to build a partnership with industries to manage pollution, and move away from the "cat and mouse" scenario in which industries discharge at night or on holidays while the monitoring agencies try to catch them.

At this point, water quality objectives have been established for one-third of Hungary.

3.1.2 Slovakia

Presented by a representative of the Ministry of Environment, Bratislava

In early 1993, a new department was set up in the Ministry of Environment in Slovakia to address the policy on protecting the country's water quality. In Slovakia, drinking water quality is seen as one of the most important public health issues. Groundwater is the inhabitants' primary source of drinking water, and surface water pollution is the primary source of groundwater contaminants. Therefore, a comprehensive plan is needed to improve in-stream water quality.

New water quality standards have been established on a scale of one to five; three is seen as the minimum standard for any body of water.

In conjunction with the water section of the Ministry of Soil Management, the Ministry of Environment is pursuing the following priorities for improving water quality:

- Decrease organic pollution.
- Decrease nutrient discharges.
- Decrease emission of toxic micropollutants.
- Decrease emission of heavy metals.

To meet these goals, the following measures have been identified:

- Construct new and improve existing wastewater treatment plants.
- Increase the level of industrial pretreatment, especially to reduce heavy-metal emissions.
- Reduce nonpoint-source pollution.
- Reduce the overall level of water consumption.

The Ministry of Environment sees new environmental legislation as an important tool in this process. Among the legislative actions will be improved emission standards, a new permit and fine structure for water quality, and a new administrative structure within the government organizations responsible for water quality. The legislation will also introduce more effective

economic tools for the organizations responsible for water quality, including taxes and payments for drinking water and the use of wastewater treatment plants.

The water protection department of the MOE, with bilateral assistance from the Netherlands, is working to establish a water quality model to simulate in-stream pollution. In addition, as part of the Environmental Program for the Danube River Basin, there are several prefeasibility/diagnostic programs being conducted in basins throughout Slovakia.

Key questions Slovakia hopes to address using DEMDESS are the following:

1. If new standards are established for water quality in a given river, exactly how much must the upstream dischargers reduce their emissions in order to reach this goal?
2. If emissions levels are reduced, what will the savings be in relation to the lower demand on wastewater treatment plants?

A representative of the Slovak Hydrometeorological Institute then raised an issue that each of the countries has had to address: Should water quality data be available to the public free of charge, or should the institutes involved charge a fee for such information?

3.1.3 Romania

Presented by the head of water statistics and environment, Economy Research Department, Research and Engineering Institute for Environment (ICIM), Bucharest

Romania has many of the same water quality priorities as the other participant countries. Among its major problems in water quality information management is the lack of funding for adequate technical resources to manage data, including basic hardware and software. Current initiatives and goals include new legislation, a program in risk assessment, a new system of water quality standards, and improved inspection methodologies.

The presenter then outlined the following detailed list of water quality priorities for Romania:

1. An inventory of current conditions
   a. emissions
   b. water quality in specific river cross-sections
2. Improved monitoring and information systems
3. A program for self-monitoring
4. Production of large data reports
5. Production of smaller data reports for public information
6. A planning activity to define "water quality balance," for example, determining a definition of acceptable water quality in a developed river basin

7. A plan for handling incidental pollution
   a. risk assessment
   b. warning system

8. Introduction and implementation of environmental legislation

9. New water quality standards
   a. limits
   b. laboratory determination

10. Improvement of regulatory activity
    a. impact assessment
    b. permits

11. Inspection

12. Real-time information systems

13. Hardware and spare parts for
    a. metering
    b. laboratory
    c. computers

14. Software
    a. terminology
    b. methodologies
    c. models
    d. computer programs

15. Training

16. Routine operations systems

3.1.4 Bulgaria

Presented by an expert with the Ministry of Environment, Sofia

The current water quality monitoring system in Bulgaria was established in 1972. Under this system, in-stream water quality information and emissions are measured via monthly sampling.

Bulgaria has 300 monitoring stations. Based on their information, the Ministry of Environment prepares standard quarterly and annual reports showing analysis, trends, and more detailed statistics.

The current objectives of Bulgaria's water quality managers are as follows:

- to provide reliable information on current ambient conditions, accounting for the dynamic nature of in-stream water quality;

- to support industries and municipalities in the control of their own emissions;
- to project long- and short-term trends in water quality; and
- to support management at local and national levels.

Some of Bulgaria's current problems are these:

- Although Bulgaria operates enough monitoring stations, there are questions regarding the reliability of the data they collect.
- There is a lack of uniformity in methodology among the country's water quality institutions.
- New water quality legislation is needed to reflect current conditions and objectives.
- Greater frequency of sampling is needed—monthly sampling is insufficient because of wide fluctuations in measurements due to weather, incidental emissions, and so on.
- Better information management capacity is needed; as the monitoring system is improved, the amount of data to be handled will increase significantly.

Key water quality information needs in Bulgaria include the following:

- Information supporting new water quality legislation, which, based on the European model, will change the river classification system to include five rather than three standards.
- Support for implementing the standards at the local level, including information on pollution loads, dischargers, the link between emissions and water quality parameters, violators of emission standards, and the calculation of taxes, fees, and fines.

Other potential uses of DEMDESS include producing routine reports: annual/quarterly/daily, with built-in data analysis; and managing data related to incidental pollution.

3.2 Key Decision Support Questions from Each Country and Steps Taken to Address These Questions

Each group was assigned the task of identifying and presenting the key water quality decision support questions concerning its country. After presenting these questions in a plenary session, the groups moved to the computer workstations and were requested to develop an ad hoc solution using DEMDESS. (An ad hoc solution is one that is developed using Paradox® and is designed to answer a specific question quickly. It does not include the development of a user-friendly interface, data entry screens, and so on.) Later in the workshop, the participants were asked to develop user-friendly versions of their solutions and incorporate them into the User-friendly DEMDESS menu. Summarized below are the key questions each country addressed, along with the ad hoc and user-friendly applications developed to answer them.

3.2.1 Slovakia

The Slovakia work group posed the following questions:

1. What effluent limits need to be issued for individual polluters in order to meet in-stream water quality limits?
2. What types of data must be collected in order to determine the required emission limits?
3. What is the average efficiency of current wastewater treatment processes for the Nitra River, by parameter?

The following key data types were identified for answering these questions:

- Low flow data (Q_{355})
- Water quality monitoring data
- Municipal and industrial dischargers and their emissions
- Legislative rules, acts, and orders

The group determined that the third question was the most tractable, given the time and available data. The appropriate flow data were unavailable at the workshop site to answer the question on emissions limits. Other data gaps included insufficient effluent monitoring data and incomplete information on standards.

The group's ad hoc approach was to develop a report based on data for the Nitra River. The group applied previously developed DEMDESS routines to compute treatment plant pollutant removal efficiency. Next, it used the Paradox® Report Designer to group records by parameter and to calculate average pollutant reduction efficiency by parameter. The report and a corresponding table were then formatted for clarity and linked into the User-friendly DEMDESS as a menu option.

3.2.2 Romania

The Romanian group posed the question of how to determine fines on dischargers who violate emissions standards. It identified the following key data sources needed to answer this question:

- dischargers and emissions data
- reach file network
- fines data
- water quality standards

Since this information was readily available in the DEMDESS system, the group proceeded to develop an ad hoc solution through the use of a Paradox® query. The query involved linking the dischargers, emissions, fines, Reach file, and standards tables. It included a calculation statement that determined the degree of violation and then multiplied it by the appropriate fine rate. The group then developed a second routine to display only those dischargers whose violations exceeded one million lei. Due to time limitations, the group did not implement a user-friendly version of its solution.

3.2.3 Hungary

Hungary is developing total allowable loads for a basin or river reach. It wants to use DEMDESS to develop alternatives for meeting these total allowable loads. This will include development of alternative treatment/reduction scenarios, including costs. DEMDESS will be used to help select the most efficient (minimum-cost) alternative.

The problem was broken out into the following steps for DEMDESS:

1. Determine the dischargers that are affected by a particular total allowable load criterion for a particular pollutant.
2. For those dischargers, compute the total existing load.
3. Compare the total existing load with the total allowable load. If the total existing load exceeds the allowable load, it becomes the "reducible load," which is the reduction target. If the existing load is already less than allowable, no further action is needed.
4. Given a best available treatment (BAT) concentration, determine if the reducible load target can be met.
5. If the reducible load target can be met, develop a "universe" of treatment alternatives for all dischargers, including pollution load reductions.
6. Compute annualized costs for each treatment alternative for each discharger. These costs include annualized capital costs plus annual operation and maintenance costs.
7. Develop a set of least-cost treatment alternatives that meet the allowable load criteria.

It was determined that the primary input information is pollutants, dischargers or river reaches affected, and allowable loads. For the purposes of the workshop, the group arbitrarily selected total dissolved solids (TDS) as the pollutant, and the list of dischargers in the Sajo basin. DEMDESS was used to compute the total existing TDS load. An allowable load of half the existing load was arbitrarily selected. DEMDESS queries were built to evaluate five treatment options for each discharger and to compute data on pollutant removal and annualized costs. A preliminary strategy was developed to determine a least-cost alternative from the extremely large number of possible alternatives. This strategy will be followed up after the workshop.

A user-friendly version of DEMDESS was implemented by building an input data table and input form, generalizing the queries, incorporating a treatment costing procedure, and writing a Paradox® Application Language (PAL) script that ran sequentially through all steps. A key information gap identified in this process was Hungary-specific treatment plant costing data.

3.2.4 Bulgaria

The Bulgaria group posed the general question, "What if we implement a new policy for river pollution reduction to achieve a given level of improvement?" The group identified the data requirements to address this question and further identified key data gaps. Also, it identified a specific example of the general question as "to achieve Class II standards in five years in the Yantra basin." Some of the key data gaps identified were hydrologic data, permits, costs, best available treatment technologies, and linkages between data.

To address the question, the following analysis steps for DEMDESS were identified:

1. Define the current situation.
2. Define required levels of improvement in terms of existing standards.
3. Define alternatives/scenarios.
4. Evaluate the alternatives in terms of their
    a. environmental impact
    b. water quality impact
    c. cost implications
5. Choose an alternative.
6. Develop a program of implementation/an action plan.

The key information/analysis gaps were identified as Bulgaria-specific, treatment cost information and the link between changes in emissions and in-stream water quality (i.e., water quality modeling).

The approach to answering the question was to use the User-friendly DEMDESS to evaluate current conditions and continue with the treatment policy analysis developed in DEMDESS last year. The treatment policy analysis was expanded to include user-friendly options for further defining and evaluating specific treatment scenarios. Ad hoc analyses to compare alternatives were begun, including costs and water quality effects.

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3.3 Outlines of Presentations for Senior Government Officials

Each country team prepared draft outlines of the DEMDESS presentations to be made during the final review meetings for the prefeasibility studies that WASH conducted in each of the participant countries. These day-long meetings, held during the last two weeks of May in the capital city of each country, would be attended by senior officials from the Ministry of Environment, other ministries, and additional local officials. The purpose of the DEMDESS presentations was to introduce the system to the officials, give an idea of its uses, provide a report on the status of DEMDESS in the country, and propose future development of the system. The draft outlines of these presentations were put on transparencies and presented during the workshop.

3.4 Future Training and Technical Support Needs Identified by Participants

- New techniques and applications should be developed within DEMDESS so that the system's scope can be broadened. These might include the following:
  - inclusion of a mathematical model within the program,
  - linkages with GIS or development of other mapping capabilities, and
  - further conceptual development.
- Additional training to introduce DEMDESS should be provided to more water quality technicians within each country.
- DEMDESS should be developed within each country to link with existing systems and involve more institutions and technicians.
- DEMDESS should be adapted so that CASE (computer aided software engineering) tools can be used to develop new applications.
- The overall scope of DEMDESS should be more specific (so as not to be limited to emissions), and the name of the system should be changed to reflect this.

3.5 Agreements Concerning Continued Regional User Group Activities and Information Sharing

- Form a "DEMDESS community," association, or club.
- Request that the PCU of the Environmental Program for the Danube River Basin play a role in the coordination regarding DEMDESS's development and evolution.
- Direct the WASH team to prepare a one-page status report on DEMDESS, including anticipated future developments, that would be distributed by the PCU.

- Distribute the *DEMDESS User Manual* on disk so it can be easily modified as countries develop new applications.
- Develop a method so that new DEMDESS applications, along with corresponding documentation, can be shared on disk among the user countries.

3.6 Summary of Workshop Evaluation Results

Overall, participants' evaluation of the workshop were quite positive. The aspects that received the highest ratings (on a scale of 1 [not achieved or inadequate] to 5 [very well achieved or adequate]) included the following:

■ Overall appreciation of the value of the workshop:	4.76
■ Effectiveness of WASH training team:	4.76
■ Choice of hotel:	4.69
■ Preworkshop communication from WASH:	4.54
■ Understanding and explanation of the principles and concepts of water quality information management:	4.38

The aspects that received the lowest ratings included the following:

■ Evaluate whether specific water quality questions can be answered from currently available information; if they cannot be, be able to identify information needs and steps required to find an answer:	3.84
■ Explain the importance of water quality information management systems such as DEMDESS to senior government officials:	3.91

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Section 4

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APPENDIX B

Bulgaria Workshop on DEMDESS
in the National Water Quality
Information Management System

June 29-July 2, 1993
Mt. Vitosha, Bulgaria

by

Kathy Alison

USAID Europe Bureau/Water and Sanitation
for Health Project

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ACKNOWLEDGMENTS

On behalf of USAID and the WASH Project, the author would like to express her appreciation to the staff of both the Ministry of Environment and the Laboratory and Information Center in Sofia for the dedication and enthusiasm with which they delivered the training course. Without their devotion to DEMDESS and their valuable contribution of time and resources, the workshop would not have been the success it proved to be. The author would also like to thank the staff of Water Engineering for ably assisting the WASH team in coordinating the logistics for the workshop.

ACRONYMS

A.I.D.	Agency for International Development (Washington, D.C.)
DEMDESS	Danube Emissions Management Decision Support System
LIC	Laboratory and Information Center
MOE	Ministry of Environment
NGO	nongovernmental organization
USAID	United States Agency for International Development (overseas missions)
WASH	Water and Sanitation for Health Project

EXECUTIVE SUMMARY

Since the fall of 1991, the countries of Bulgaria, Hungary, Romania, and Slovakia have been working with the Water and Sanitation for Health (WASH) Project and the U.S. Agency for International Development (USAID) to develop a system of assessing and controlling water pollution in the Danube River basin and its tributaries. So far, these efforts have accomplished the following:

- development of the Danube Emissions Management Decision Support System (DEMDESS);
- "hot spot" analysis used to identify major water pollution sources in each country;
- institutional analysis of the water quality management sectors in each country;
- countrywide studies of the current status of water quality and emissions;
- two workshops (December 1991 and May 1992) on emissions management with participation from all four countries, plus donor representatives, nongovernmental organizations (NGOs), and representatives from other Danubian countries; and
- a regional training workshop (May 1993) for representatives from the ministries of environment and national institute staff from Bulgaria, Hungary, Romania, and Slovakia that focused on DEMDESS as a tool for country-specific water quality information management.

Bulgaria is the first country to undertake the establishment of the Danube Emissions Management Decision Support System (DEMDESS) as its data management system for pollution control within its overall national water quality information management system.

The first step toward countrywide institutionalization of DEMDESS in Bulgaria was an intensive, three-day hands-on training workshop on the basics of the system, the first country-specific DEMDESS workshop ever held. The event took place from June 29 to July 2, 1993, on Mt. Vitosha, near Sofia. Attendants included 25 participants representing five Bulgarian inspectorates bordering the Danube River, the Ministry of the Environment, and the Laboratory and Information Center (LIC) in Sofia.

The overall purpose of the workshop was to institutionalize DEMDESS further so that it can be applied as part of an overall water quality information system at both the national and inspectorate levels.

The workshop was designed to provide training for the Bulgarian national-, regional-, and inspectorate-level staff in the basics of the DEMDESS system (Reach files; its regulatory, emissions, and water quality components; and how the pieces all fit together). The workshop was also critical in gaining the commitment of inspectorate-level staff to provide data for use in DEMDESS, and in enabling all participants to understand their roles in the system. National-

level staff also increased their knowledge of DEMDESS and expressed a greater commitment to integrate the system into Bulgaria's national water quality information management system.

As a result of the workshop, the participants developed a working knowledge of DEMDESS, its application to the Bulgarian national water quality information management system, and how DEMDESS fits into national- and inspectorate-level needs. During the workshop, the group reached agreement on specific next steps that would be needed to complete implementation of DEMDESS as part of the national water quality information system at the ministry, LIC, and inspectorate levels.

Section 1

PREPARATION OF THE WORKSHOP

1.1 Background

Since the fall of 1991, the countries of Bulgaria, Hungary, Romania, and Slovakia have been working with the Water and Sanitation for Health (WASH) Project and the U.S. Agency for International Development (USAID) to develop a system of assessing and controlling water pollution in the Danube River basin and its tributaries. So far, these efforts have accomplished the following:

- development of the Danube Emissions Management Decision Support System (DEMDESS);
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- a regional training workshop (May 1993) for representatives from the ministries of environment and national institute staff from Bulgaria, Hungary, Romania, and Slovakia that focused on DEMDESS as a tool for country-specific water quality information management.

One of the overall objectives of the DEMDESS project has been to help each Danubian country develop and use DEMDESS as an operational tool for water pollution decision-making support.

As part of the process to institutionalize DEMDESS, each country has identified the need to train its regional- and inspectorate-level staff in water quality and emissions management techniques. Specific training needs that have been identified include methods for managing water quality and emissions data for routine monitoring and problem identification, and ways to integrate analyses and decision-making support at the local, regional, and national levels.

This workshop, held June 29 to July 2, 1993, in Mt. Vitosha, Bulgaria, was designed to address Bulgaria's training needs. Its purpose was to provide training for Bulgarian national-, regional-, and inspectorate-level staff in the basics of DEMDESS (Reach files; its regulatory, emissions, and water quality components; and how the pieces all fit together). Bulgaria was chosen from the group of four countries participating in the USAID DEMDESS project because it was the first of the four to undertake the establishment of DEMDESS as its data

management system for pollution control. Bulgaria has adopted DEMDESS within its overall national water quality information system.

1.2 Workshop Overview

As noted above, DEMDESS is now being implemented as the data management system for pollution control within the Bulgarian national water quality information management system. The overall purpose of the workshop was to further institutionalize DEMDESS so that it can be applied as part of an overall water quality information system at both the national and inspectorate levels. The workshop was also critical in gaining the commitment of inspectorate-level staff to provide data for use in DEMDESS, and in enabling all participants to understand their roles in the system.

As a result of the workshop, the participants developed a working knowledge of DEMDESS, its application to the Bulgarian national water quality information management system, and how DEMDESS fits into national- and inspectorate-level needs. During the workshop, the group reached agreement on specific next steps that would be needed to complete the implementation of DEMDESS as part of Bulgaria's national water quality information system at the ministry, LIC, and inspectorate levels.

1.3 Logistical Arrangements

The workshop was held at the Hotel Prostor on Mt. Vitosha outside Sofia. A total of 25 participants were identified by the Bulgarian training team and included water quality engineering experts, chemists, and computer program developers and operators from five inspectorates that oversee tributaries running into the Danube River (see Chapter 4 for a list of participants). The group also included Ministry of Environment (MOE) representatives, and Laboratory and Information Center (LIC) specialists and computer program developers. The training staff was composed of seven trainers and staff from the MOE, LIC, and WASH.

1.4 Team Planning Meetings

The planning meetings were held in Washington, D.C., Budapest, and Sofia to design the workshop. The initial design meetings were held at the WASH Operations Center. A preliminary workshop design was sent to the Bulgarian team for review and input, and was discussed in detail with a representative of the MOE at the Regional Workshop on Water Quality Information Management held in Hungary in May of this year. Upon arrival in Sofia, WASH and Bulgarian team members met to review and finalize the workshop design and develop the individual workshop sessions.

1.5 Workshop Delivery

The workshop was conducted in Bulgarian by the Bulgarian training team. A team of interpreters provided simultaneous translation for the non-Bulgarian members of the training team and other guests who were present. Each evening, the team reviewed the results of the day and practiced its sessions for the next day, in addition to making the technical preparations and producing all the visuals needed for the next day's sessions.

Each of the workshop's technical sessions was designed to provide a technical overview of the particular part of DEMDESS being discussed, followed by a brief demonstration on computer. The group asked clarification questions if necessary and then went immediately to the computer room, where each participant had an opportunity to work with DEMDESS. Following the practice session, the group was asked to comment on what it found useful and what more it needed to work effectively with the system.

1.6 Computer Support

The Bulgarian training team arranged to transport its computers from the MOE and LIC to the training site. The Veliko Tarnovo inspectorate also provided its computer, so that in all, five complete systems were available as workstations during the workshop. (Veliko Tarnovo will be the first inspectorate to implement DEMDESS, beginning in September 1993.) Availability of the computers allowed those attending to use actual data from their inspectorates.

A workstation was set up for each inspectorate and the MOE and LIC representatives responsible for that inspectorate. This arrangement helped develop a closer working relationship between the regional- and national-level staff working on the institutionalization of DEMDESS.

Section 2

IMPLEMENTATION OF THE WORKSHOP

2.1 Objectives and Expected Outcomes

The purpose of the workshop was to provide an opportunity for Bulgarian national staff members to introduce DEMDESS to five Bulgarian regional inspectorates and representatives from both the MOE and the LIC, and to secure the commitment of those individuals to work with the national staff to institutionalize DEMDESS as the water pollution data management system within Bulgaria's water quality information system.

2.1.1 Learning Objectives

The objectives of the workshop were as follows:

- increase the MOE's commitment to use the advances of DEMDESS in the Bulgarian national water quality information management system;
- gain commitment to and begin implementation of the Bulgarian national water quality information management system at the inspectorate level and the LIC using DEMDESS;
- identify benefits and constraints to the system and develop the next steps necessary for effective institutionalization of DEMDESS at the MOE, LIC, and inspectorate levels;
- strengthen the participants' ability to apply DEMDESS in their everyday work; and
- strengthen the ability of the Bulgarian training team to design and implement a participatory workshop and to demonstrate the value of that type of approach to those participating.

2.1.2 Outcomes

The Bulgarian workshop was critical in helping the national team that has been working on the Bulgarian DEMDESS system to gain the support of the country's regional inspectorates and their counterparts in the MOE and LIC to implement DEMDESS nationally. The expected workshop outcomes were as follows:

- a working knowledge of DEMDESS and its application to the Bulgarian national water quality information management system: specifically, DEMDESS's overall strategy and how it fits into national- and inspectorate-level needs;

- initial implementation of DEMDESS at the inspectorate, LIC, and ministry levels through hands-on experience with each information system component;
- agreement on specific steps needed to complete DEMDESS's implementation in the Bulgarian national water quality information management system at the MOE, LIC, and inspectorate levels; and
- increased cooperation between and among the MOE, LIC, and inspectorates to institutionalize DEMDESS further in the Bulgarian national water quality information management system.

2.2 Workshop Agenda

Tuesday, June 29, 1993	Wednesday, June 30, 1993	Thursday, July 1, 1993	Friday, July 2, 1993
	Morning ■ Water quality information management principles ■ Ministry of Environment and inspectorate briefings ■ Demonstration of DEMDESS	**Morning** ■ Session 2: Primary Inspectorate Data □ The emissions component □ The water quality component	**Morning** ■ Reports from each working group ■ Response from Ministry of Environment ■ Next steps ■ Workshop evaluation and closing
	Afternoon ■ Session 1: Integrated Water Quality Management	**Afternoon** ■ Session 3: Synthesis of the Components—Putting It All Together	
Evening ■ Introduction ■ Icebreaker ■ Reception		**Evening** ■ Preparation of presentations	

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Section 3

WORKSHOP RESULTS

The first national workshop on DEMDESS proved to be very successful, both for the participants and those who organized and delivered it. Those attending gained a new understanding of DEMDESS and how it can be used to strengthen the Bulgarian national water quality information management system. They left the workshop committed to installing the system in their inspectorates and in providing more accurate, detailed data to the LIC. This was a major breakthrough, since prior to the workshop, most inspectorates did not take seriously the need for accurate data. After seeing how that data was useful to them at the local level, they enthusiastically agreed to work more closely with the LIC and the MOE on supplying data.

The Bulgarian trainers gained a hands-on working understanding of how to design and conduct a participatory workshop. Their efforts and hard work paid off in the results they were able to achieve. The technical sessions were well designed and focused and did not last too long. The primary objective was to give an overview of the topic and then get the teams to their workstations to practice. Those attending the workshop continually commented on how exciting and engaging the workshop was and how much they appreciated the efforts of the trainers to get them involved in actually working with DEMDESS firsthand.

Relationships between and among the inspectorates themselves were also strengthened, resulting in a suggestion that the group meet on a regular basis to share information about water quality and to receive additional in-service training.

The workshop was also rewarding for those attending from the United States, because it represented the accomplishment of a long-standing objective to begin institutionalizing DEMDESS within a national system. It was extremely rewarding to participate in a country-specific workshop carried out by a country team, and to see that workshop succeed.

It is hoped that the Bulgarian DEMDESS team will continue to receive support from the MOE to carry out its plans to institutionalize the system throughout Bulgaria.

Section 4

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