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UKRAINE Potential Lviv Water Service Improvement Demonstration Projects

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For the New Independent States of the former Soviet Union

A USAID Project Consortium Led by CH2M HILL

PREFACE

Under the 1992 Freedom Support Act, the United States Congress initiated a program to provide various forms of assistance to new independent states (NIS) of the former Soviet Union. Cooperative Agreements were signed between representatives of the U.S. government and each country in which assistance was to be undertaken. The U.S. Agency for International Development (USAID) was given the responsibility to coordinate all U.S. government assistance to the NIS under the Act.

Through competitive bidding, USAID awarded a multi-year contract to a team managed by CH2M HILL International Services, Inc. (CH2M HILL) to support implementation of an environmental assistance program to republics of the former Soviet Union. Under this contract, termed the Environmental Policy & Technology (EPT) Project, CH2M HILL is to assist USAID's missions in Moscow, Kyiv, and Almaty undertake a program to promote environmental improvements in the NIS. The USAID mission in Kyiv supports environmental, and other, assistance programs to Ukraine, Belarus, and Moldova. CH2M HILL established an office in Kyiv from which to perform services in these countries under the EPT Project.

This report was prepared as a contractually required deliverable under a contract between USAID and CH2M HILL. Although work on this report was conducted in cooperation with the assisted governments and USAID, the findings and recommendations are those of the CH2M HILL team. They do not necessarily represent official positions of the governments of the assisted countries nor of the United States of America.

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- Consortium for International Development
- Ecojuris
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NOTE ON TRANSLITERATION

Ukrainian personal, institutional, and place names used in this report have been transliterated into English from the Ukrainian (not Russian) language, according to the modified U.S. Library of Congress standard for Ukrainian-to-English transliteration that has been adopted by many Western organizations and publications, including the *Encyclopedia of Ukraine*, (University of Toronto Press, 5 vols. 1984-1993) and O. Subtelny's authoritative *Ukraine: A History* (University of Toronto Press, 1994, 2nd Edition), as well as the Ukrainian Commission on Legal Terminology (Resolution No. 9, dated 19 April 1996).

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ABBREVIATIONS, ACRONYMS & GLOSSARY

CH2M HILL	CH2M HILL International Services, Inc., which is a U.S.-based international environmental engineering consulting firm under contract to USAID to implement a large component of the EPT Project.
DO	Delivery Order.
EPT	Environmental Policy & Technology (Project). A USAID-funded program to provide environmental assistance to New Independent States of the former Soviet Union.
LVK	Lviv Vodokanal
NIS	New Independent States (of the former Soviet Union)
oblast	A government territorial-administrative unit in the former Soviet Union that is still in use following Ukraine's independence. A U.S. analogue would be something between a state and a county.
USAID	U.S. Agency for International Development
vodokanal	A quasi-government agency responsible for municipal water supply and wastewater collection and treatment. A U.S. analogue would be a water utility.

Section 1

INTRODUCTION

1.1 OVERVIEW

As part of a United States government bilateral assistance program, the U.S. Agency for International Development (USAID) is supporting environmental management in Ukraine. Under direction from USAID, a consortium led by CH2M HILL International Services, Inc. (CH2M HILL), is implementing part of USAID's Environmental Policy & Technology (EPT) Project by undertaking various tasks that have been agreed to by representatives of the governments of both countries.

USAID authorized CH2M HILL to perform a series of tasks in Ukraine under Delivery Order (DO) No. 15. Task 4 is to continue providing assistance to the water utility (vodokanal) in the west Ukrainian city of Lviv that was initiated during DO #s 5 and 9. This task includes a requirement (Subtask 4A) for CH2M HILL to assist Lviv Vodokanal (LVK) by providing ... *engineering support, equipment installation, and project management as part of a demonstration project improves water service to residential consumers in one section of Lviv.* As part of this assistance, CH2M HILL is to ... *conduct a field assessment [of potential water service improvement projects and] ... submit a proposed project design to USAID for approval that provides an overall scheme ... [and] ... a cost estimate for equipment recommended to implement the demonstration ... Subject to availability of funds ... for the recommended equipment, [and] upon approval [by USAID] of the design, the contractor shall conduct the demonstration project ...*

This report provides USAID with the results of the assessment of potential projects in a section of Lviv which, if implemented, would demonstrate improvements in water service that can be replicated in other parts of the city as well as elsewhere in Ukraine.

The section of Lviv in which the assessment of potential water service improvements was largely undertaken is the area known as Pasichna district. This district is the area served by the Pasichna pump station improvements, undertaken as part of DO #s 5 and 9 efforts, and documented in several reports by CH2M HILL to USAID, including: *Ukraine: Proposal to Demonstrate an Improvement to Water Supply Operations in the City of Lviv*, dated August 1996.

1.2 APPROACH

To prepare this report, CH2M HILL undertook the following approach:

- conducted an assessment, including use of information obtained during performance of DO #9 activities and supported by field verification, of the Lviv water distribution system with LVK staff, in order to identify major problem areas
- assessed potential projects that would demonstrate improvements to the water system

- discussed potential projects with senior representatives of LVK and obtained their concurrence regarding those of priority to the water utility.

1.3 EQUIPMENT FUNDING

The scope of DO #15 Task 4A was to identify potential projects that would demonstrate improvements in water service to residential customers in one part of Lviv. As stated in Section 1.1 above, DO #15 did not provide any funds for the actual procurement and installation of equipment under Task 4A. In conducting its work under Task 4A, CH2M HILL focussed on identifying demonstration projects that could be funded from the following available sources:

- **DO #9, Modification 5:** This modification increased the "equipment" budget by \$350,000 by transferring a corresponding amount from the "other direct costs" and "travel and transportation" budgets. The increase in equipment budget is to allow funding of the implementation of some demonstration projects identified as part of DO #15, Task 4A.
- **DO#15, Task 6:** Improvements to water service in the Pasichna district of Lviv was commenced under DO #9, and the first phase of equipment funded under DO #5. DO #15 provided for the continuation of water service improvements in the Pasichna district, involving the following:
 - ▶ completion of the Dovha pump station
 - ▶ rehabilitation of well fields that provide water to the Pasichna district
 - ▶ improving the water pipe delivery system within the Pasichna district.

Some \$377,000 was allocated under DO #15 Task 6 for procurement and installation of equipment associated with these improvements.

Therefore \$727,000 is available to procure and install equipment for projects identified during Task 4A that demonstrate improvements in water service to Pasichna district residents. Of this amount, some \$100,000 is required for items already identified and approved, such as office equipment and furniture, additional office space, diesel generator, and transformer, leaving \$627,000.

DO #15 also allocated, under Task 5, up to \$1,000,000 for equipment that would demonstrate to LVK, and other vodokanals, means of saving energy during the course of delivering water to their customers. In the course of its Task 4A activities, CH2M HILL also considered projects that would jointly save energy and improve water service, thereby being eligible for partial or full funding under Task 5. As part of Task 5A of DO #15, CH2M HILL will evaluate opportunities for LVK to conserve energy. This evaluation will include consideration of projects that will also result in direct improvements to water service in the Pasichna area.

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Hence, \$627,000 is available for equipment identified as part of Task 4A, together with some portion of \$1,000,000 from Task 5 for projects that combine the demonstration of both energy savings and direct water service improvements.

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Section 2

PASICHNA WATER SERVICE DISTRICT

2.1 BACKGROUND

The Pasichna water service district is located in the southwestern part of the City of Lviv, and has a population of about 35,000 people. Most of the area was developed after the Second World War, and the majority of people live in 9-12 story apartment buildings. Usually these buildings were established in groups of five or six, and served by a central heating facility where circulated superheated water from the district boiler station is used, via a heat exchanger, to provide hot water and radiated heat for individual apartments.

Ground elevation of the Pasichna area is about 370 m above sea level. Until 1996, the only active LVK water facilities in the area was a 10,000 m³ storage tank located at an elevation of about 378 m at a site referred to as Dovha. This Dovha tank was generally filled from the Vynnyky pump station, although it could be filled from other pump stations such as Syhiv III. Water from the tank was fed by gravity into the distribution system for the Pasichna area, some of the adjacent Sykiv area, and into lower regions to the north and west of the tank site.

For the higher areas of Pasichna, water had insufficient pressure to adequately serve consumers much above the first or second floors. The high-rise apartments which had central heating stations could count on slightly better water service since the stations usually had booster pumps, but even these could not always obtain sufficient water from the system due to the low pressure.

In the 1980s a plan was made whereby a large pump station and storage facility was to be constructed at Dovha, as part of an overall scheme to improve supplies of water to the city from expanded well fields. The scheme consisted of new well fields, transmission pipe lines, and pump stations. Due to funding difficulties the well field was never expanded and only a portion of the other facilities were completed.

Partially constructed at Dovha were two 10,000 m³ concrete tanks and a pump station building. They lay abandoned for about six or seven years and could not be used in the city's water system.

2.2 PASICHNA PHASE 1 PROJECT

As part of a cooperative venture between USAID, the City of Lviv, and LVK, a water distribution subsystem was established in the Pasichna area to improve water service. This was accomplished by completing the two 10,000 m³ tanks, building a small temporary pump station and blocking-off a portion of the distribution system to allow water from the pump station to build-up pressure in a defined area.

The city funded completion of the tanks, some site work and the sealing of the roof and installation of windows and doors on the partially build pump house. USAID funded the

pumps, electrical controls, construction of a small pump building, and procurement of 1.5 km of high-voltage cable and a transformer with switching gear. LVK assisted with equipment installation.

The temporary pump station was completed in December 1996 and is now in service. The pump station is operated about ten hours a day and is designed to pump up to 750 cubic meters per hour at a head of 30 m.

2.3 PASICHNA PHASE 2 PROJECT

The initial plan for Pasichna Phase 2 was for another partnership between USAID, the City of Lviv, and LVK, to complete the pump house at the Dovha site and install several additional pumps. In order for this project phase to be completed within the framework of DO #15, work needs to start as soon as possible. At the time of report preparation, City officials indicated that they would not know until at least May or June, 1997, as to whether the City could commit funds for this task. The total cost of the City's contribution to completion of the Pasichna project, being full construction of the permanent pump house, is expected to be in the range of \$400,000.

The overall Pasichna water improvement project and alternatives were discussed with LVK representatives. They have been very pleased with Phase 1 results, and recognized that completion of the Dovha pump house, with additional pumps, would not significantly improve water service in the area of Pasichna now being served by the Phase 1 pump station. Instead, modifications to the Phase 1 pump station were identified that would enhance its performance. Expenditure by the City to complete the permanent pump house was seen as unwarranted, in view of other activities that could result in more significant overall improvements to water service.

A stated goal by the administration for the City of Lviv is to increase the water delivery time from the present average of six hours to 24 hours per day. Insufficient water currently reaches the overall distribution network from the supply and transmission systems to allow this to happen. In the case of the Pasichna Phase 1 project, no additional water was supplied by LVK to the city. Water for the new tanks at Dovha was diverted from some other areas to accomplish a longer service period (now about ten hours) for Pasichna.

In discussions with LVK representatives, it was agreed that additional water could be made available for consumers in the Pasichna district by reducing leakage in the existing piping, improving the management of water so that it is delivered with less pressure and hence less leakage, better planning, and finally, by rehabilitating existing well fields to allow them to increase production up to their design capacity.

A group of interconnected small projects were reviewed and agreed upon with LVK that would demonstrate means of increasing the level and extent of service in the southwestern part of Lviv. These are outlined in Sections 3 and 4 herein.

2.4 ADJACENT SERVICE AREAS

The Lviv water supply, transmission, and distribution system is heavily interconnected. Water is supplied to the city from remote well fields. It is conveyed to pump stations on the edge of the distribution network and then pumped into the city. Although the network was designed to have distribution subsystems, they were not really established. The subsystem in Pasichna is one of the few that has been clearly delineated. Because of this interconnection of pipes and distribution areas, what occurs in one area usually affects the adjacent ones. Thus when Pasichna received more water, some other part of the city received less.

With this interconnectivity, one way to improve water service in Pasichna is to make adjustments in adjacent areas. This could improve service both in adjacent areas as well as the Pasichna subsystem established during Phase 1 of the project. Adjacent areas that have been identified for further investigation and possible improvements are Syhiv, the remainder of Pasichna, and the area served by the Vynnyky and Kryvchytsi pump stations (Galytsky and Lychakivsky districts).

Section 3

POTENTIAL WATER SERVICE IMPROVEMENT DEMONSTRATION PROJECTS

To further the goal of demonstrating means of improving water service in a portion of Lviv, by undertaking activities associated with the Pasichna district, seven interrelated projects have been proposed. In keeping with the sources of funds (see Subsection 1.3), the projects have been grouped into two categories: (i) those that are strictly water service improvement projects, and (ii) those are combined water service improvement and energy efficiency projects.

- **Water Service Improvement Projects:**
 - (1) improve the Phase 1 Pasichna pump station
 - (2) install and operate water meters in the Pasichna district
 - (3) improve pipeline hydraulics
 - (4) rehabilitate well fields

- **Combined Water Service Improvement and Energy-Efficiency Projects:**
 - (5) reduce leakage from water distribution pipes by applying an internal lining
 - (6) repair and/or replace booster pumps
 - (7) eliminate the Miska Smuha pump station.

These projects are to be conducted both inside and outside the Pasichna area, and because of the interlocking nature of the Lviv water system, each would have some affect on the service in Pasichna.

3.1 WATER SERVICE IMPROVEMENT PROJECTS

3.1.1 Improve the Phase 1 Pasichna Pump Station

As discussed in Section 2, the permanent pump station is not to be completed as part of Phase 2; instead, certain modifications are proposed to the temporary pump station built in Phase 1. These would enable the temporary station to better-function until the city or LVK decides that they really need, and can fund, completion of the permanent station.

These improvements to the Phase 1 pump station would include installation of a fourth pump (on a skid), for use as a standby pump and to meet special demands on the system. This would also include providing and installing two motor-control center panels (one active and one standby). In addition, the pump station could use a small portable winch to enable the pumps and motors to be easily removed and some miscellaneous gauges, meters and tools to improve operations and maintenance.

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3.1.2 Metering the Pasichna District

To demonstrate improving data on water consumption, and so enable better management of water use and billing of water users, it is proposed that meters be installed on all the direct connections (kontos) to the water distribution system in the Pasichna area. Although about 30,000 to 35,000 people live in this area, there are only about 350 direct connections to the system. Most people live in large multi-family apartment buildings, which have only one water connection. Installation of meters will enable the LVK, for the first time, to have a good understanding of the amount of consumption and leakage in a section of Lviv. This estimate is extremely important when making decisions relative to the amount of pipe replacement (in order to overcome the leakage problem) that may be funded from a loan by an international financial institution. Fully metering of input and consumption to this zone will allow vital experiments to take place relative to leakage, effectiveness of pipe lining, pressure regimes, and billing procedures.

3.1.3 Improve Pipeline Hydraulics

Once the temporary pump station at Dovha was completed and operating in December 1996, it became apparent that some of buildings in the Pasichna district were not receiving water at the pressure that was expected based on computer modeling of the area. Initial investigations indicated that some of the smaller water mains in the district, or connections to specific buildings, had hydraulic problems associated with them. Typically, these problems could be partially closed valves, undersized piping, or blocked piping, that prevented the appropriate pressure from being obtained.

It is proposed to hydraulically model, using the "EPANet" software developed on behalf of the U.S. Environmental Protection Agency, areas around Pasichna, conduct field investigations to identify problems, and then remove or reduce (by modifying the piping and/or valves) selected hydraulic problems in the system in Pasichna or the adjacent areas of Galytsky and Lychakivsky. This will demonstrate the usefulness of using basic hydraulic modeling combined with field investigations to solve real problems in the distribution network.

3.1.4 Well Field Rehabilitation

A number of the 20 well fields serving the city provide water to the Pasichna district. Although water that directly feeds the Dovha tanks (No. 2 and 3) which service the Phase 1 pump station, is from the eastern well fields, the amount that is needed in Dovha tank No. 1 (also supplied from the east) is inversely proportional to the water sent from the south to serve the Sykiv area. If more water came to Sykiv from the south, then less water would need to be supplied from Dovha tank No. 1. In addition if more water could be supplied to the Lychavkivsky area of the city from the north then it could be possible to shift more water from the Vynnyky pump station to the Dovha tanks.

It is therefore proposed to assist LVK by supplying materials and equipment to enable them to increase water production from their existing wells in the north, east and south. This would include two portable ultrasonic meters for use in optimizing the performance of

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existing wells, check valves to prevent the backflow of water down wells (which seems to be a common problem), well-cleaning equipment, and tools to aid in restoring individual well performance and new piping to eliminate some of the hydraulic bottlenecks that adversely affect well efficiency in the Stryi well fields in the south. This work will be documented in more detail in the report associated with Task 6B of DO #15.

3.2 COMBINED WATER SERVICE IMPROVEMENT AND ENERGY-EFFICIENCY PROJECTS

3.2.1 Lining of Pipes

As stated in Section 1.3, consideration was given during the identification and implementation of energy-saving projects undertaken as part of DO #15 Task 5 to those that would also directly improve water service in the Pasichna district. One such project that has been identified is the reduction of leakage from the water distribution pipeline system by internally lining these pipes. The loss of water through leakage in the pipes, which may be as high as 30 percent (if not more) of the total water introduced into the distribution system, is very wasteful of energy, as much of the water pumped from the ground and into the water transmission and distribution pipelines is not delivered to the consumers.

Applying cement-mortar linings to the inside of existing steel and cast iron pipelines in Lviv would be a very cost-effective method to improve water service and reduce energy consumption. This project was also identified in the DO #15, Task 5A investigation, as documented in the CH2M HILL report *Lviv Vodokanal Energy Audit and Potential Energy-Savings Demonstration Projects*. This project would procure a cement mortar lining machine, provide training by a U.S. contractor, and line a portion of selected water distribution pipes in the Pasichna and adjacent areas of Galytsky and Lychakivsky. The length of pipe to be lined would depend on the amount of money that USAID wishes to make available from DO #15, Tasks 5 and 6.

3.2.2 Repair or Replace Booster Pumps

There are ten main water-heating stations in the Pasichna area. They serve the major apartment complexes where about 80-85 percent of all residents in Pasichna live. These heating stations use high-pressure high-temperature water from the district boiler stations to heat water (using a heat exchanger) for use in the apartments as heating and hot water. In these local heating stations both hot and cold water is boosted in pressure to move the water to upper floors of the high-rise buildings.

Pumps used in these heating stations are not always matched to the flow and pressure which are appropriate for the application. This often means that the pump uses too much energy and will deliver water at too high a pressure, resulting in excessive leakage in faulty fixtures.

It is proposed to assist LVK by supplying new pumps which are better matched to their application. This also be a project that demonstrates both improvements in water service as well as savings in energy.

3.2.3 Eliminate the Miska Smuha Pump Station

The Miska Smuha pump station is located about 3 km from the Dovha pump station, and serves small portions of Lviv adjacent to the Pasichna district on Zelena Street. At present the Miska Smuha pump station is used to transfer water from a lower set of tanks to a tank about 28 m higher in elevation and about 0.5 km further up the street. Water for the pump station comes from a pipeline that passes by the upper tank. Energy that is used to pump the water back up the hill could be saved by tapping-off the pipeline as it passes the tank in the first place.

It is proposed to assist LVK by supplying them the materials and partial help with installation to connect the tank to the pipeline and devise a manner for water to be regulated remotely so that the pump station could be eliminated. The LVK has agreed that if the tank could be connected, then they would establish a new water distribution subsystem on Tolotoho hill that would be fed by gravity from the upper tank.

This project was also identified in the DO #15, Task 5A investigation, as documented in the CH2M HILL report *Lviv Vodokanal Energy Audit and Potential Energy-Savings Demonstration Projects* (April 1997), as it will reduce energy usage as well as provide better quality service for the area. However its position in the funding priorities for Task 5 make it last to be funded. If there are sufficient funds available in Task 6, then this project should be considered.

3.3 OPINION OF COST

Table A-1 in Appendix A presents a list of the seven projects, together with their objective, major components, and required assistance from the City of Lviv (including LVK). Included in the list is a preliminary opinion of cost, together with the funding source. In some cases, a wide range of cost is provided, due to the nature of the project. For example, the cost of cement-lining of water pipes is dependent on the length and diameter of pipe to be lined, as well as the complexities of the pipe network with regard to the number of bends, joints, street-crossings, other utility lines, etc., encountered during the pipe-lining process.

The costs generally include equipment, materials, spares, service, tools, packing, shipping, installation, and fees.

Table A-2 in Appendix A provides a preliminary generalized list of equipment associated with each of the seven projects.

The cost opinions provided herein are only at the planning level in accuracy. They are based on information gathered to date. It is expected that the final costs will differ from those used in this report due to market forces, changes in conditions, changes in availability, political climate, additional data, the degree to which the LVK commits to assist in the projects, inflation, and the unpredictability of risk and conditions for firms bidding from the USA or outside of Lviv.

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Section 4

CONCLUSIONS

The following conclusions can be made:

1. At this point in time, due to its funding calendar, there is no assurance of obtaining any commitment from the City of Lviv for funding the completion of the permanent pump station at the Dovha site.
2. Therefore, in lieu of building the permanent pump station with only USAID funding, CH2M HILL has discussed with LVK the proposal of undertaking a series of smaller projects, in which they can participate, that will improve water service in the Pasichna and adjacent areas.
3. The overall quality of water service to the Pasichna district can be improved by an integrated approach with a number of different projects which will address sustainability, metering, leakage, supply, wastage, and energy savings.
4. Except for the specific improvements to the temporary (Phase 1) pump station, each of the proposed projects will demonstrate one or more concepts that are not only applicable to the Pasichna district but could be used in other parts of Lviv and elsewhere in Ukraine.
5. There are more projects proposed than there are funds available for equipment in DO #15 Task 6 and DO #9 modification 5. Additional funding was therefore sought from Task 5 of DO #15.
6. The total cost of the proposed projects as listed in Table 3-1 can be adjusted by changing the quantities requested or undertaken. This would be applicable to projects like hydraulic improvements, well field rehabilitation, and pipe lining.

Appendix A

DO #15, TASK 4 PROJECT SUMMARIES AND COST OPINIONS

This appendix provides a summary on each proposed water service improvement project, including an opinion regarding the cost and sources of funds.

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Table A-1. Proposed Water Service Improvement Demonstration Projects

Project	Objective	Major USAID-funded Components	Assistance Needed from LVK	Anticipated Schedule	Cost Opinion and Funding Sources	
					DO 9, Mod 5; DO 15, Task 6	DO 15 Task 5 (Energy)
Water Service Improvement Projects:						
<u>Pasichna</u> (Dovha) - Make further improvements to the Dovha pump station.	Increase the reliability of the temporary pump station operations until a permanent pump station can be funded by the City of Lviv.	1. Additional pump (1) on skid 2. Motor control centers (2) 3. Winch for motors & pumps 4. Spare parts & tools 5. Instrumentation	1. Assist with installing pump and power connections.	Start - 5/97 Finish - 10/97	\$110,000	N/A
<u>Meters</u> - Install meters on major connections (kontos) to the network in the Pasichna district.	Provide LVK with a means to use metering for measuring consumption and leakage in a controlled area.	1. Meters (350) 2. Valves, fittings, pipe	1. Supply some meters and undertake some installation. 2. Read meters regularly and use the information.	Start - 6/97 Finish - 12/97	\$100,000	N/A
<u>Hydraulics</u> - Change or install some short lengths of pipe, fittings, pumps, and valves in the network in Pasichna, Sykiv, and adjacent areas.	Use EPANet to evaluate problems then make improvements to the hydraulics of the distribution systems through minor changes in piping, valves, etc.	1. Pipe, valves, pumps, and fittings 2. Gauges	1. Install valves, pipes, pumps, and fittings. 2. Create additional distribution subsystems adjacent to Pasichna district.	Start - 5/97 Finish - 3/98	\$50,000 See Note 1	N/A
<u>Wells</u> - Rehabilitate existing well fields.	Increase yields in well fields to design capacity through cleaning, equipment modification and upgrading piping and fittings.	1. Well-cleaning tools 2. Portable flow meters (2) 3. Valves, fittings, screens, and pipe	1. Install materials and equipment. 2. Provide trainees for the flow meters.	Start - 7/97 Finish - 10/97	\$80,000 See Note 1	N/A
Combined Water Service Improvement and Energy-Efficiency Projects:						
<u>Internal coating of pipes</u> - Purchase equipment and provide training to line existing pipe with cement mortar.	To reduce leakage (and wasted pumping energy) from existing pipes in the system.	1. Lining equipment 2. Training 3. Lining materials 4. Bypass piping	1. Trucks and construction equipment. 2. Staff to be trained. 3. Excavation, fill, and road-patching. 4. Installation of bypass piping.	Start - 8/97 Finish - 3/98	\$240,000 See Note 1	\$350,000
<u>Booster pumps</u> - Upgrade pumps located in the major Pasichna district heating stations.	Match pumps and loads in the stations to improve pressure and reduce energy consumption.	1. Pumps (up to 10), controls, fittings, and wiring 2. Installation	1. Coordinate installation of booster pumps.	Start - 6/97 Finish - 9/97	\$10,000	\$20,000
<u>Miska Smuha pump station</u> - Remove from service.	Using the upper Zelena tank for gravity flow, thereby saving energy.	1. Valves, sensors, control cable, piping, and construction materials	1. Install valves.	Start - 6/97 Finish - 12/97	\$37,000	\$40,000
TOTAL: Includes equipment, materials, spares, services, tools, packing, shipping, installation, training, and fees					\$627,000	\$410,000

Note 1: These projects consist of incremental units, and therefore can be expanded or reduced depending on available funds. For example, lining of water pipe can be accomplished over a longer or shorter distance.

Table A-2. Preliminary List of Equipment Associated with Proposed Water Service Improvement Demonstration Projects

Project	Quantity	Description
Water Service Improvement Projects:		
Pasichna	1	Pump skid with pump, motor, and piping to match existing units
	2	Motor control center units for above pump, and a standby
	1	Winch (portable) to service motors and pumps
	1 lot	Spare parts and tools (for pumps, motors, and motor control centers)
Meters	350	Meters with valves, fittings and pipe and installation
Hydraulics	1 lot	Pipes, valves, and fittings
Wells	1 lot	Well cleaning tools and fittings
	2	Portable ultrasonic flow meter with accessories
	1 lot	Pipe, valves, motors and fittings
Combined Water Service Improvement and Energy-Efficiency Projects		
Internal Coating of Pipes	1	Lining machine and services to operate it, and training LVK personnel in the lining of pipe. Complete cement mortar lining system, including tools, generator, air compressor, cables, cement mixers, hoses, accessories, disinfection equipment, and spare parts, including packing and unpacking setup, startup, operation, and training of local staff.
	1	Services (local) for assisting with lining, excavation, hauling materials, paving, etc.
	1 lot	Bypass lines and taps
	1 lot	Fittings, cement, mortar, paving, backfill
Booster Pumps	10	Pumps with controls, fittings, wiring, and installation
Miska Smuha Pump Station	1 lot	Pipe, valve and fittings
	1 lot	Cable (electrical and control)
	3	Meters/sensors (water flow, level and/or pressure)

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