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Wastewater Project Analysis With Recommendations for The Municipality of Święta Katarzyna, Poland

Local Environmental Management (LEM) Project

October 1993

Prepared by:
Research Triangle Institute (RTI)
Research Triangle Park, NC 27709

Funded by:
U.S. Agency for International Development
Washington, DC 20523
Contract No. EUR-0039-C-00-2065-00

Cover photo: Typical open wastewater ditch in Poland, of the type to be replaced by LEM-assisted solutions.

Photo by Al Sharp

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WASTEWATER PROJECT ANALYSIS WITH RECOMMENDATIONS

FOR

THE MUNICIPALITY OF ŚWIĘTA KATARZYNA, POLAND

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RFD

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ABBREVIATIONS

BOD_5	5-day carbonaceous biochemical oxygen demand
CEE	Central and Eastern Europe
ELBAN	[private water company]
ENR	Environment and Natural Resources Division, USAID
EUR	Europe
F/M	food-to-microorganism [ratio]
HRT	hydraulic residence time
IOŚ	Environmental Protection Institute
LEM	Local Environmental Management [project]
O&M	operations and maintenance
PERT	Program Education and Review Technique
PHARE	Poland/Hungary Aid for Restructuring of Economies
PLC	programmable logic controller
Q	total inflow; capacity
RAS	return activated sludge
RTI	Research Triangle Institute
SBR	sequencing batch reactor
SRT	solids residence time
SS	suspended solids
STP	sewage treatment plant
SVI	sludge volume index
TN	total nitrogen
TP	total phosphorus
USAID	United States Agency for International Development
WTP	water treatment plant

EXECUTIVE SUMMARY

The need for improvements in environmental management in Central and Eastern Europe has gained the attention of development organizations worldwide in recent years. Furthermore, in light of the scarcity of resources at the national level, efforts to assist local governments in the design and implementation of environmental projects have become increasingly important as development strategies. Through such assistance, municipalities can learn to discern appropriate technologies, develop proposals for procuring funding, coordinate training for operation and management of new infrastructure, and design "outreach" programs that foster education and involvement of citizens. In addition, successful local environmental projects serve as models for other municipalities to follow in addressing their own environmental problems.

The Local Environmental Management (LEM) project, supported by the U.S. Agency for International Development, is working with small municipalities in Poland (and Hungary) to strengthen their abilities to manage environmental problems. On the basis of a pre-developed set of criteria and consultations with national and local officials, three municipalities or gminas were chosen to participate in the LEM project in Poland. All three gminas expressed a desire for assistance with wastewater collection and treatment projects. LEM survey teams comprised of consultants with expertise in wastewater engineering, municipal finance, and utility management were sent to each gmina to assess the current situation and provide recommendations regarding the design and implementation of the proposed wastewater project.

As one of the participating LEM municipalities, Święta Katarzyna was visited between May 5 and May 28, 1993, by a team of three consultants who reviewed the existing wastewater plan and assessed the organizational and financial structure of the gmina. In order to comply with legislation designed to protect the drinking water supply of the adjacent city of Wrocław, Święta Katarzyna proposes to build a new sewage treatment plant (STP) that will serve the gmina's three main villages, thereby preventing further discharge of raw sewage into the Oława drainage basin. The purpose of this report is to present: (1) the results of the survey team's analysis and recommendations regarding the technical, managerial, financial, and training aspects of this project's implementation, and (2) potential options for handling wastewater resulting from new water connections in the southern part of the gmina.

According to the preliminary design, the proposed STP would be implemented in two stages. Stage I would include construction of an STP to treat the wastewater from the village of Radwanice and part of Siechnice as well as sewage that is now illegally draining into a surface "creek" called Koci Rów. In Stage II, the wastewater from all the villages in the gmina as well as from the vegetable co-op housing currently being treated in an activated sludge plant in Siechnice would be connected to the treatment plant.

Evaluation of this plan led the survey team to suggest several viable design options intended to reduce the long-term burden of operation and maintenance while expanding coverage in the gmina through use of a less complex system. Option 1 uses the preliminary design technology with the addition of a contractual clause making the designer responsible for operations, personnel training, and long-term support, and protecting the gmina in the event that the design office is dissolved. In Option 2, building on the preliminary design, an alternative is presented that uses a sequencing batch reactor technology more suited to highly variable flows from small municipalities, requires less maintenance, and is transferable to other gminas. Option 3 is a compromise between the original design and the LEM alternative designs and represents a partial move toward more automated treatment operation and simplification of the wastewater treatment system.

The team also proposed that the new system be constructed in stages in order to facilitate financing, simplify the plant design, lower the operating costs, and improve operation and maintenance. Regarding the new water connections in the southern part of the gmina, the team advised that a study be conducted to determine the feasibility of building treatment plants in the area versus transportation of sewage to Siechnice through the Święta Katarzyna sewer system.

The current lack of adequate sewage treatment poses a serious threat, not only to the water supply of Wrocław but also to the public health situation in Święta Katarzyna as well. Raw sewage that is illegally discharged into creeks and ditches such as Koci Rów is easily accessible to children or domestic animals. In addition, risks to public health will intensify as the result of the development of Święta Katarzyna as a bedroom community for Wrocław. Increases in population density from the migration of people out of the city will provoke an accompanying increase in demand for homes with more accessible water facilities, thus generating more sewage. The optimal technical solution proposed by LEM would immediately improve public health in a large part of the gmina by providing area-wide sanitation, optimizing sewage treatment processes, and facilitating financial restructuring to allow better use of existing resources.

The management analysis revealed a situation that is currently in flux. The proposed development of new water supplies in various parts of the gmina will inevitably increase the need for wastewater treatment and place pressure on the gmina to develop the capacity to manage the resulting systems and problems. In addition, the central government's plan to reintroduce the "powiat" (similar to the county in the United States) as a new governmental level between the gmina and the voivodship may lead to the city of Wrocław absorbing all or part of the current management functions of Święta Katarzyna.

In light of these facts, the team suggested that a more detailed examination of the management problems related to wastewater and water operations be conducted to allow the gmina to thoroughly analyze both current and future probabilities and prepare a management plan. The study should include a review of the type of water management that is now in place and its relationship to the wastewater management needs of the gmina, particularly in the area of environmental protection. It should also examine in detail the process of capital budgeting and management and, if possible, be coordinated with the work that the Poland/Hungary Aid for Restructuring of Economies (PHARE) project is undertaking.

After analyzing the fiscal situation of Święta Katarzyna over the last five years, the survey team concluded that the combination of general budget tax base and projected income from water and sewer rates cannot sustain the level of debt required to construct Stage I. Neither can the two sources of borrowing currently available to the gmina, commercial banks and the Environmental Protection Bank, provide the funds needed to supplement the gmina's investment input. However, coordinating project financing with the staged construction proposed by the survey team would allow the gmina to best allocate currently available funds while saving additional funds for subsequent stages. The team also recommended that several other financing options be investigated: (1) "packaging" the three Polish projects in an overall business plan to be submitted to central government ministries, (2) exploring the possibility of funding from the World Bank Office in Warsaw, and (3) evaluating the feasibility of using existing Polish law to issue municipal bonds in the future.

Finally, the survey team identified general training and outreach needs including: (1) introductory and advanced courses in treatment plant operations, (2) management and operations of water and wastewater organizations, (3) financial administration of water/wastewater organizations, (4) planning for water/wastewater management, (5) developing and writing a project business plan, (6) management of infrastructure projects, and (7) design and implementation of environmental public information programs.

A draft written report containing the analysis and recommendations of the survey team was submitted to the municipality and provided the "baseline" data for a regional planning workshop held in Wrocław from July 14 to 16, 1993. Over 100 people attended the workshop, including representatives of many municipalities in the Wrocław voivodship and other voivodships in southwestern Poland; local, regional, and national levels of government; and nongovernmental organizations. The results of workshop discussions held by LEM consultants and Święta Katarzyna officials were incorporated into the final survey team report and submitted to Święta Katarzyna and USAID.

1 INTRODUCTION

1.1 LEM Project Overview

Local Environmental Management (LEM) is a project of the US Agency for International Development/Washington (USAID/W) based on a contract between Research Triangle Institute (RTI) and the USAID/Europe (EUR) Environmental and Natural Resources (ENR) Division. The contract is for 3 years, beginning in July 1992 and ending in July 1995.

Originally the LEM project began as a USAID effort to coordinate and/or operate through a variety of environmental projects at the subnational/local level throughout most of the countries of Central and Eastern Europe (CEE); however, USAID program reconsideration narrowed the project focus. RTI and USAID/EUR/ENR agreed to focus LEM on specific municipal government environmental projects in Poland and Hungary.

RTI undertook preliminary field trips to Poland in September and November 1992, which included members of RTI, USAID/ENR, USAID's Office of Housing and Urban Programs, and the USAID Representative's Office in Poland. These field trips confirmed the need and importance of working with "local" environmental projects as well as the necessity of narrowing the focus to three or four municipalities and establishing a set of criteria for setting both the project focus and the choice of specific municipalities to be included in LEM.

The LEM project purpose in Poland is threefold: (1) to demonstrate the extent to which local governments can effectively manage their environmental problems if given adequate and consistent support; (2) to assist project municipalities, or gminas, in producing reliable and technically acceptable proposals for the funding of environmental projects for presentation to national and international funding agencies; and (3) to make available for use to other municipalities the replicable details as a result of the former two activities. A project subpurpose is to act as liaison by matching municipal requests for technical assistance not supplied by LEM with various USAID-supported projects that may be able to provide information, data, or assistance.

The overall strategy is to implement project activity in three municipalities in Poland, each of which has the specific focus of sewage collection and wastewater treatment systems.

Municipality	Population
Miedźna	14,500
Święta Katarzyna	12,000
Ziębice	20,400

Poland's project may be expanded to include a second tier of municipalities based on the experience with the first group.

Municipality	Population
Nowa Sól	43,000
Namysłów	15,000

1.2 Profile of Święta Katarzyna

The gmina of Święta Katarzyna is situated in the Wrocław Voidvodship adjacent to the southwest border of the city of Wrocław (see Figures 1 and 2). The gmina population numbers 12,000, 70% of which are located in four villages containing over 1,000 inhabitants each; the remainder of the population inhabit small agricultural hamlets of less than 500 residents. There is no dominant town center, probably due to the proximity of Święta Katarzyna to the municipality of Wrocław. Siechnice and Radwanice are the largest villages, with populations of 4,000 and 2,000 respectively, followed by the city of Święta Katarzyna, which is the seat of local government.[1]

Sixty-eight percent of the 9,857 hectares occupied by Święta Katarzyna is arable land. About 5,000 hectares are concentrated in small, private farms averaging 3.5 hectares each. Nonprivate farms include the Zootechniczny Zakład Doświadczalny (Zootechnics Experimental Plant), which is affiliated with the Zootechnics Institute in Kraków, and the Zakład Ogrodniczy (Vegetable and Flower Production Enterprise) in Siechnice; the latter is currently being privatized. White sugar beets and wheat are the dominant agricultural crops with a lesser emphasis on market gardening and fruit farming.

Riparian forests, predominating in oaks, occupy 11% of the gmina land area. The forests near Kotowice contain breeding grounds for birds such as the merganser. In recent years, a decline in the oak stands has been observed, possibly due to a lowering of the ground water level from decreases in rainfall. Both the Odra and Oława Rivers, with their numerous tributaries, cross the gmina and supply potable water by way of intakes (in the region of Mokry Dwór village and further down) for the city of Wrocław.

The two largest industrial operations include a heat and power generation plant and an ironworks producing iron-chromium, both in Siechnice. The Siechnice Ironworks was closed in 1990 due to concern over contamination of the agricultural areas with heavy metals. Small commercial plants and service businesses, located mainly in the largest villages, are beginning to play a more important

[1]The term "gmina" refers to the entire group of villages within a geographical area, similar to the concept of a township in the US or a commune in France.

WROCŁAW

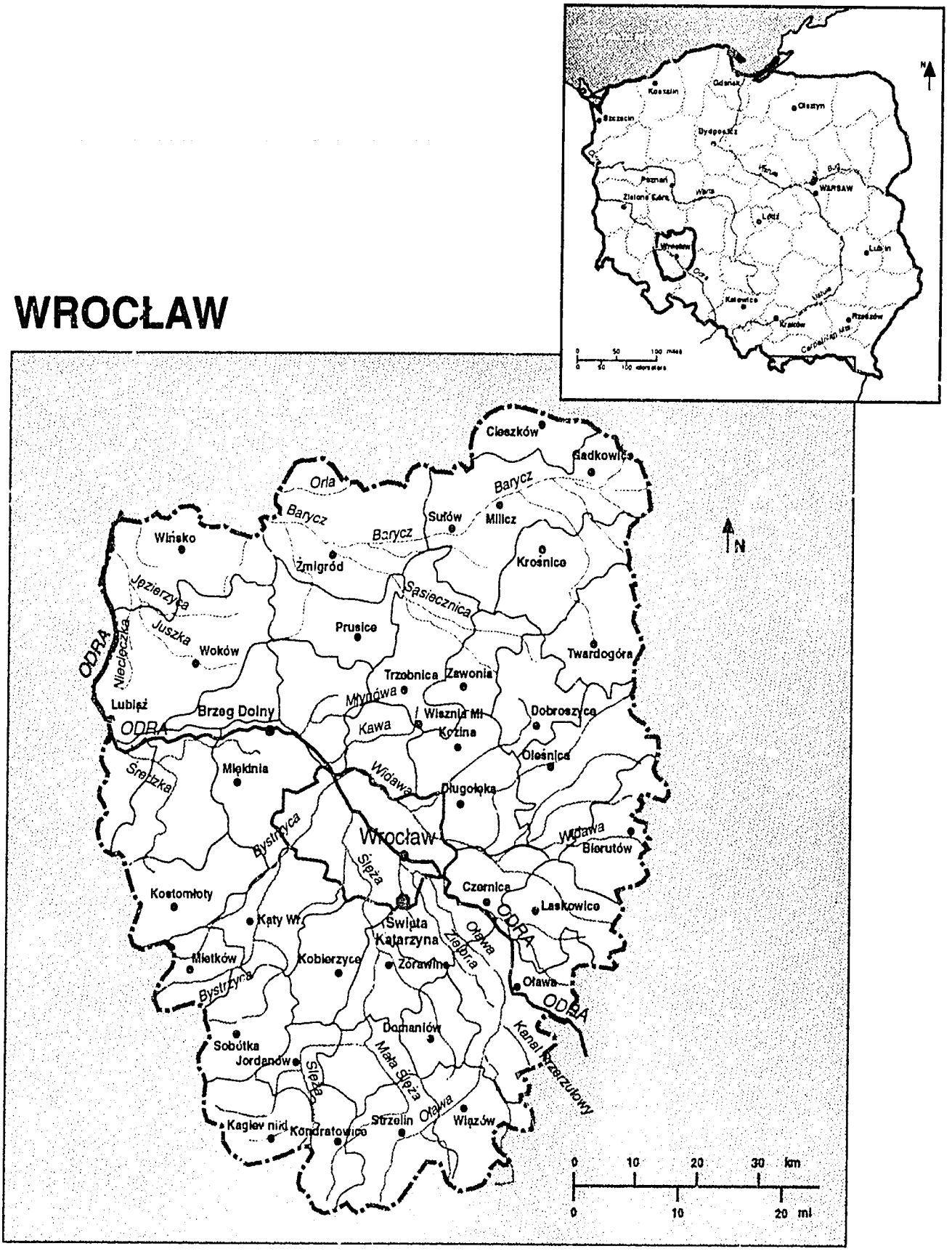

Figure 1
Map of the Wrocław Voidvodship

ŚWIĘTA KATARZYNA

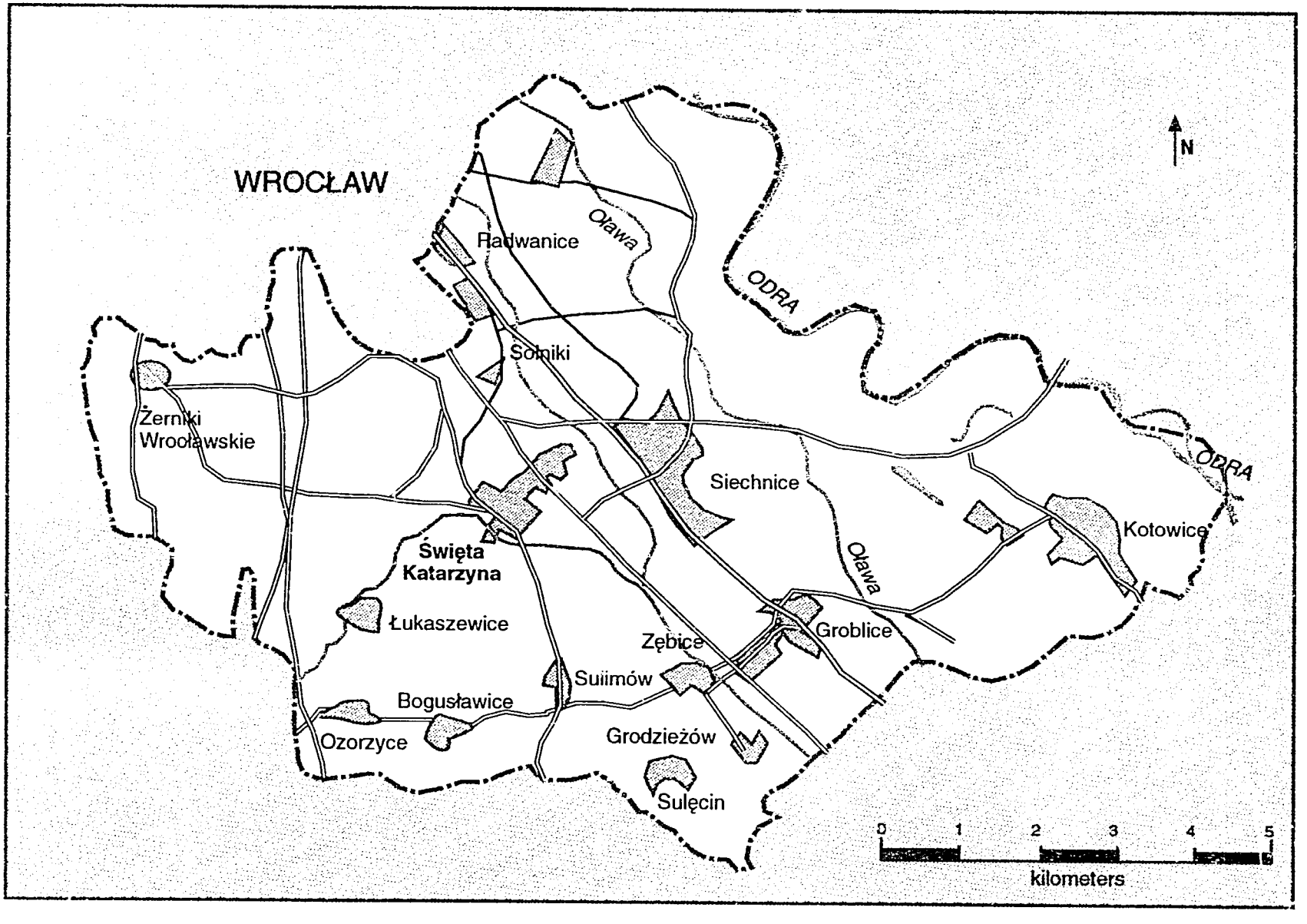

Figure 2
Map of the Gmina of Święta Katarzyna

role in the economy of the gmina. There are currently about 400 of these enterprises, and while many cater to local markets, a growing number are operating in partnership with foreign concerns.

1.3 Święta Katarzyna Survey Objectives

Święta Katarzyna faces a dilemma in meeting local goals and regional mandates regarding the gmina's lack of reliable wastewater treatment. The gmina's existing treatment plant is inadequate for treating all of the sewage (design capacity — 800 m^3/d) and treats sewage that is collected from only a part of the Siechnice village. The rest of Siechnice as well as the remaining villages, lacking sewerage systems, are discharging untreated wastewater into ditches and streams that eventually find their way to the Oława river. Because these practices threaten the drinking water supply of Wrocław, the city has passed legislation that requires the gmina to prevent further pollution of the Oława. However, Wrocław is not willing to contribute financially to the design and construction of the new wastewater collection and treatment system for the gmina, which is the most pressing as well as costly area of improvement for reducing pollution.

Święta Katarzyna intends to build a new wastewater treatment plant that will serve Siechnice, Radwanice, and the city of Święta Katarzyna. To that end, the gmina has applied for and received siting and administrative approval and is currently working with a technical review committee appointed by the Mayor to move quickly into the construction design and bidding phase (see Appendix A for copies of approval documents). Local officials have also appealed to the Regional Water Management Authority in Wrocław for support. The gmina will need, however, to research external sources of funding and acquire additional skills in the areas of management, operations, and maintenance in order to bring its wastewater project to completion. In addition, Święta Katarzyna will need to develop a long-term plan that includes servicing the outlying villages of the gmina.

In response to a request for technical assistance in addressing its wastewater problems, the LEM project sent a team of three consultants to Święta Katarzyna with expertise in wastewater engineering, utility administration, and municipal finance. The scope of work for the Święta Katarzyna survey team is provided in Appendix B. The objectives of the Święta Katarzyna survey included: (1) review of the current wastewater plan, including consultation with the technical committee regarding the bidding process, in order to provide recommendations for improvements in system design and technology, (2) financial analysis of the community's fiscal needs, available local resources for the project, and potential sources and instruments for external funding, (3) development of a "business plan" to use in applying for funding from central government ministries and international agencies, and (4) identification of the particular training necessary for the gmina to carry out the overall wastewater plan.

The achievement of these objectives should result in the development of a long-range plan for wastewater improvement in the rural villages as well as the central area. In addition, the survey team consulted with the Director of the Regional Water Management Authority regarding the nonpoint source pollution of water resources in Święta Katarzyna through agricultural runoff.

1.4 Survey Methodology

Under the direction of the LEM Resident Project Manager, team members met with local officials in Święta Katarzyna to gather technical, organizational, and financial data regarding the current wastewater situation. The team also conducted meetings with the technical review committee and representatives from the Regional Water Management Authority in Wrocław. The team was assisted by a local financial expert and local sanitary/environmental engineering experts who supplied direct technical translations and interpretation services.

Before departure from Poland, the team orally presented their recommendations to Święta Katarzyna officials in order to solicit feedback. Within two weeks of their return to the US, the team members drafted a written report for translation into Polish and submission to the gmina. The Święta Katarzyna report, as well as the reports from the two other Polish municipalities participating in the LEM project, provided "baseline" data for a regional planning workshop held in Wrocław from July 14-16, 1993. Over 100 people attended the workshop, including representatives of many municipalities in the Wrocław voivodship and other voivodships in southwestern Poland; local, regional, and national levels of government; and nongovernmental organizations.

The two major goals of the workshop were: (1) to obtain feedback from participating LEM municipalities on the analysis and recommendations of the survey teams (as found in the submitted draft reports) as well as ideas for future technical assistance and training; and (2) to provide information to participants on technical and financial issues concerning wastewater management. The results of the workshop discussions held by LEM consultants and Święta Katarzyna officials were incorporated into the final survey team report and submitted to Święta Katarzyna and USAID.

1.5 Survey Team Profile

The Święta Katarzyna survey team consisted of (1) Mr. Jan Oleszkiewicz, a wastewater specialist and professor of Environmental Engineering, (2) Mr. Ray Shaw, a US public utilities management specialist, and (3) Mr. Don Ammons, a US municipal finance specialist. The team arrived in Kraków on April 27 and met with the LEM Resident Project Manager before traveling to Święta Katarzyna on May 5. Mr. Oleszkiewicz and Mr. Ammons worked in Święta Katarzyna and Wrocław until May 28. Mr. Shaw completed his assignment on May 22.

Mr. Oleszkiewicz provided technical expertise in evaluation of the proposed plan, including the design and technology of the new system and the bid evaluation process, as well as recommendations regarding improvements in design, operations and maintenance, and the use of construction stages. Mr. Oleszkiewicz physically inspected the current treatment facility, and points of entry of wastewater into drainage ditches and creeks.

Mr. Shaw assessed the organizational and management aspects of current plant operations in Święta Katarzyna, including an analysis of the application of current rates and surcharges to future capital and operations and maintenance (O&M) costs. Mr. Shaw also provided recommendations regarding

proposed changes to the organizational structure in the areas of daily operations, training opportunities, construction practices, bill collection, and user fees.

Mr. Ammons performed an analysis of the gmina's current financial structure as a basis for developing a financial plan to support the proposed wastewater improvement program. Using data for projected increases in customers, rates, and O&M costs, Mr. Ammons provided several options for financing the wastewater project, including the possibility of using construction stages to spread out project capital costs.

Dr. Andrzej Jodłowski, Professor of Sanitary Engineering, Technical University of Łódź, provided considerable technical input and guidance as a member of the technical consulting team, visiting Święta Katarzyna in company with the team. Dr. Marek Łyszczak, financial consultant and professor at the Wrocław School of Management, participated in discussions on the financial aspects of the projects as well as on the fiscal capacity of local governments; he also prepared a report on the implications of Polish law with respect to the bonding authority accorded local governments in Poland.

The Regional Water Management Authority headquartered in Wrocław provided considerable coordination, office space and technical consultation through its director, Mr. Andrzej Nalberczyński and the deputy director, Dr. Halina Szymańska.

2 TECHNICAL ANALYSIS

2.1 Existing Conditions

Gmina Święta Katarzyna is a suburban community of 12,000 people immediately adjacent to the southeastern perimeter of the city of Wrocław. The gmina has distinct economic ties to the city — e.g., vegetable industry, heat supply to one-fourth of Wrocław residents — and has been adversely affected by the city's interest in minimizing development in the vicinity of its water intake. The negative effect was further accentuated with the completion of the "Mokry Dwór" direct Oława River water intake, which is located within the gmina's area. In addition, ground water infiltration intakes are located at the water treatment plant "Na Grobli" further downstream. Through by-laws and the use of existing legislation, the city has bound the gmina to clean up its pollution sources, at the same time restricting any economic development that could bring possible revenue to cover the expenditures. The situation is compounded by the city's refusal to contribute to the clean-up costs. A cursory examination of the quality of shallow ground water in the vicinity of the intake has revealed concentrations of metals and organics often exceeding drinking water standards. But these pollutants probably originate from industrial activities rather than from inappropriate domestic sewage discharges.

The gmina has decided that its only way out of Wroclaw's tightening restrictions is to build a sewage treatment plant (STP) for the three main villages. At the same time, a program of water supply has been implemented with the construction of a new water treatment plant in Suchy Dwór and upgrading of the existing plant in Łukaszewice — both in the southern part of the gmina. The program was not coordinated with the handling of wastewater from the villages connected to the water main; moreover, it appears likely that the financial returns from the program will not support treatment of the resultant sewage. In addition to its main focus of reviewing the proposed treatment plant, LEM was also asked to look at the potential options for sanitation of the southern part of the gmina.

2.2 Technical-Economic Analysis

2.2.1 Evaluation of the Proposed Sewage Treatment Plant Design

The gmina has developed a preliminary design for solving the problems of wastewater collection and treatment in the northern part of the gmina in at least two stages. Figures C-1 and C-2 in Appendix C present the two stages. In Stage I, the gmina has obtained a permit for discharge of 1,800 m^3/d of wastewater to the Odra River until the year 2010, with the following parameters (26 February 1993, Department of Environmental Protection, WOŚ, Voivodship):

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- 30 milligrams per liter (mg/L) biochemical oxygen demand, 5-day test (BOD_5),
- 50 mg/L suspended solids (SS),
- 30 mg/L total nitrogen (TN), and
- 5 mg/L total phosphorus (TP).

The first stage is designed to construct an STP that will treat the wastewater from the village of Radwanice (695 m^3/d) and part of Siechnice (357 m^3/d), some 90 m^3/d of sewage, and the water from the Koci Rów — a surface "creek" collecting illegally draining sewage, which will be intercepted at the plant site (see Figure C-1, Appendix C). The wastewater from Święta Katarzyna would continue to flow to the Szalona River (see photographs in Appendix D) and further, through Brochówka "River" to the Oława River. The Brochówka is a poorly defined channel on the topographical maps, verified with the Institute of Meteorology and Water Resources as flowing to the Oława River. In the process the Szalona/ Brochówka system flows beside, rather than through, the water intake area.

In Stage II (see Figure C-2, Appendix C), the designers propose to connect all villages to the treatment plant: (Radwanice, 772 m^3/d; Siechnice, 750 m^3/d; Święta Katarzyna, 656 m^3/d; other villages in the vicinity, 500 m^3/d; and sewage at 90 m^3/d). The design would also include the wastewater from the vegetable co-op housing (800 m^3/d) that is presently treated in the BIOBLOK activated sludge plant. The flow of the new STP would be increased to 3,600 m^3/d, and would have to meet the expected standards for the year 2000 for plants larger than 2,000 m^3/d. These effluent requirements are BOD_5, 15 mg/L; SS, 50 mg/L; NH_4-N, 6 mg/L; and TP, 1.5 mg/L.

Figure C-1 (Appendix C) shows the scenario that has been presented in the preliminary design. The result is partial protection of the Oława, huge expenditures on the pipeline to Odra (zl 11 billion) and continuing pollution of Szalona River through Święta Katarzyna's ditch "sewer." This solution satisfies the requirements of the Environmental Authorities, which forbid any discharges to the Oława river drainage basin in the vicinity of the water-bearing aquifer.

While it is our immediate aim to evaluate the proposal on the design of the two-stage treatment plant, two issues of a somewhat larger scope are worth discussing at this point:

1. The first concerns the probability of enforcement of future nutrient standards of 1.5 mg/L TP and 6 mg/L NH_4-N for small treatment plants (total inflow, or Q, < 4,000 m^3/d). There is considerable debate about this change in Poland, while in neighboring Germany, there are four categories of plants based on size (less than 60 kg/d of BOD_5, less than 300, less than 1,200, and less than 6,000 kg/d). The regulation of the nitrogen concentration has begun to be enforced in Germany for plants of capacity 300-1,200 kg/d BOD_5, i.e., supporting approximately 5,000-20,000 inhabitants. Phosphorus limitations of 2 mg/L and 10 mg/L of NH_4-N in the effluent are for plants serving 20-100,000 inhabitants. There are good technical reasons for this variation. The removal of phosphorus to levels below 2 mg/L is a very difficult task requiring continuous qualified operation and maintenance — the weakest link in water quality engineering in Poland. Chances are that Poland will relent on this penalizing requirement when the discharged volume is small and not into eutrophic water,

e.g., the Odra River, particularly since most wastewater point sources in the country receive less than secondary treatment.

2. If the Oława is to be protected at all costs, then available funds might be better spent for the completion of the sewers in Święta Katarzyna; the effluent could then be transported to a simplified treatment plant in Siechnice or receive local treatment. One could envisage partial treatment of all wastewater in the northern part of the gmina in the new treatment plant and the discharge of primarily treated effluent through the pipeline to the Odra River. Secondary treatment (biological treatment with nitrogen removal) could then commence as soon as funds were available. Appropriate permits could be obtained taking into account the water quality status of the Odra rather than the requirement for secondary treatment. Unfortunately, initial investigation with the voivodship authorities and legislators has revealed that there is no way to obtain a permit for discharge of primary effluent to the Odra river, even as a transition stage only.

2.2.2 Evaluation of the Proposed Technology

Stringent nutrient (N, P) effluent requirements expected in the future for a plant of this size impose restrictions on the selection of the process and the type of reactor in Stage I, upgradable in Stage II. For example, lagoon-based systems are eliminated if year-around N and P limits are to be enforced and if chemical treatment is to be avoided.

The preliminary design (see Figure E-1, Appendix E) represents a miniaturization of the ODRA-3 concrete plant operating in Polanica (currently underloaded, with nominal capacity of 12,500 m^3/d). The survey team inspected this site. The reactor arrangement technology is also used in a different structural configuration in Kłodzko and a number of other cities which, it should be noted, are all much larger than the Siechnice plant. The plant in Kłodzko suffered from huge sludge volume indices (SVI 250 to over 400 mL/g) and shock loads due to batch septage[2] disposal. Because maintenance of SVI, and thus settleability, are the most vital issues in an activated sludge plant, this points to the first major criticism of the Siechnice STP: being much smaller, the plant will be affected by the variability to a greater degree than the plants built so far. From the standpoint of the requirement for a rural treatment plant, the selected process presented in the preliminary design is the least technically appropriate while requiring the most from the operator. It uses proprietary, nontransferable technology (i.e., the proposed aeration device) in a configuration not applicable to N and P removal.

Given these preliminary statements, we conclude our analysis of the proposed technology with the following itemized comments:

[2]"Septage" refers to the contents of holding tanks and septic tanks, collected by trucks from individual homes.

1. The plant is not well equipped to handle the flow variability inherent in small plants and the shocks due to batch discharge of septage, particularly in Stage I. An equalization tank is provided for treated wastewater but there is a need to protect the process from the variability of the raw waste input. Some equalization of sewage discharge would also help.

2. The process selected is a long hydraulic residence time (HRT), long solids residence time (SRT), activated-sludge system with a clarifier. Such systems have been shown to work well in larger plants that had well-defined, and relatively small, variability. Because in Stage I, variability will be the dominant feature of the operation (i.e., batch addition of septage, unknown connected quantities, variability in the Koci Rów "creek"), the plant will be under continuous stress, which will not allow attainment of steady-state operation.

3. It is not clear how the grit chamber and the primary clarifier will work. They seem to be of the same size and connected in series, etc. This means that the flow velocity will be the same, hence there will be no separation of grit from sludge.

4. The return activated sludge (RAS) is returned to the grit chamber/primary clarifier. This may lead to overloading of the already abbreviated primary facilities and elimination of the recycled sludge from the system.

5. The plant is quite complex in design, with a scraper in the clarifier, a nontypical aeration device, potential hydraulic and sludge settleability problems in the aeration tank, etc. This complexity will only add to existing problems caused by batch variability of the raw waste.

6. The aeration system uses 30 kW per 940 m^3 of the reactor volume, which is theoretically adequate, 20-40 kW/1,000 m^3 being the norm. Because that requirement is dictated by the need to keep the solids in suspension, an excess of oxygen will always be present. This excess will make the anoxic denitrification questionable, resulting in the need for installation of additional stirrers or modification of the proprietary aeration device. Thus, the proprietary aeration device and the shape of the aeration tank are, to say the least, questionable.

7. Assuming that the aeration system uses 30 kW installed and neglecting the other power uses, the energy factor is 0.40 kWh/m^3. This factor is within the range found in other plants in Poland (Miodoński, 1990). By comparison, a similar plant in Polanica has 1 kWh/m^3 and has experienced settling of solids with dissolved oxygen levels in the aeration tank well above the limit of optimum performance.

8. The low food-to-microorganism (F/M) ratio may lead to excessive bulking and poor effluent quality. This issue of "extended aeration" plants being difficult to operate due to the bulking sludge has already been raised in several recent reviews of the performance of the treatment plants operating in Poland (Przewlocki, IOŚ Review 1992).

9. The fact that the ODRA-3 system uses a complete mix rather than a plug flow means that it does not readily lend itself to upgrading for biological P removal. P removal is best executed in modular systems working as a series of complete mix reactors (such a series is a crude

approximation of plug flow), as a single baffled reactor, or as a sequencing batch reactor where the operator can enforce a considerable concentration gradient.

2.2.3 Operations and Maintenance (O&M)

Aware of the problems with operation and realizing the budgetary burden of permanent employees, the gmina has considered a contractual agreement with a company specializing in the operation of municipal facilities. The gmina could also create such a facility that would be run on a for-profit basis and therefore would be most concerned with providing service at the lowest possible cost. The facility planned for Siechnice (Section 2.2.1) should require no more than six permanent employees, and in fact should be automated enough (a simple computer linkage could be established through a programmable logic controller [PLC]) to warrant only four permanent employees and an alarm system. Under a contractual arrangement, there would be need for only two gmina employees, who would be responsible for visiting the plant from time to time and closely monitoring the company. The company would be responsible for maintenance and process adjustment.

2.2.4 Generation of Wastewater from New Water Connections

The southern part of the gmina is currently being connected to the water system; however, there has been no resolution of how the sewerage will be handled. The Suchy Dwór Water Treatment Plant (WTP) was not the concern of this survey team because the gmina has a separate contract on the solution of the wastewater problem from the Żerniki area. The Łukaszewice WTP (Zaklad Uzdatniania Wody) has been modernized to 1,200 m^3/d and will result in generation of wastewater from the villages of Sulimów, Ozorzyce, Łukaszewice, Bogusławice, and others.

As observed this and other gminas, expanding water service to new areas — especially when neither old nor new areas have proper sewage disposal systems — invariably leads to pollution of creeks and irrigation ditches. Because the villages all drain towards the Szalona and Oława Rivers, there is a need to attenuate such discharges from the newly connected villages. A cursory look at the distances and costs involved appears in Figure F-1 (see Appendix F). The gmina has approximately 12,000 inhabitants and the preliminary design authors have proposed including the whole population in the collection area of the Siechnice STP. The STP is designed for 3,600 m/d or 300 L/cap•d — a rather high assumption for a rural gmina with rudimentary sanitary facilities (150-200 L/cap•d is more realistic). Even though the cost of the whole plant is mentioned in the preliminary design, there are no provisions for the cost of sewering the individual villages.

The numbers in Figure F-1 were derived by LEM on the basis of unit costs (1992-1993 zlotys) of installed pipe, concrete and equipment. It follows from analyzing these data that it may be quite advantageous to build several small treatment plants to serve one or more villages, depending on the outcome of the cost-effectiveness analysis. The alternatives are: (1) pumps and pipelines, which cost up to zł 0.7 million/m when installed with nonspecialized equipment, available in the gmina, to a 1.5-m depth in IIIrd category soil; or (2) on-site treatment, calculated as either a simple aerated lagoon/settling lagoon system or a concrete sequencing batch reactor, which will also depend on the

type of service/maintenance contract developed by the gmina. If an independent, reliable service company (not a "budgetary" unit of the gmina) is hired, then the calculated costs of the operator (full-time at zł 55 million/year) will be considerably reduced and the cost of on-site treatment may become very attractive.

Two STPs (labeled with question marks in the figure) were sketched in Figure F-1 as an example of the analysis that should be conducted. The initial analysis, performed without comprehensive plans for the development of the gmina, highlights the attractiveness of the local treatment plants versus transportation to Siechnice through the Święta Katarzyna sewer system.

This conclusion is based on a comprehensive look at the financing available for sewerage, house connections that may cost up to zł 1,000,000/m and are usually the sole responsibility of the homeowner, and collectors and pressure mains, in comparison with the costs and benefits of on-site treatment. One other benefit of on-site treatment is that phosphorus removal will be necessary only to 5 mg/L. This will not be as easy as in North America since the phosphorus level is at least double, at 10 to 12 mg/L. The anticipated new Water Act (requiring plants larger than 2,000 m^3/d to remove P) will, inadvertently, **promote** construction of smaller local facilities.

The STP designed for the villages in Figure F-1 are sequencing batch reactors in an earthen or concrete construction that have been over-designed for total flow of 300 m^3/d. The total cost of zł 1,500,000,000 was calculated from data gathered in 1992/early 1993. Since that time, inflation in Poland has affected these costs considerably. The annual O&M costs are estimated at approximately zł 150,000,000.

An alternative to the above is an aerated pond system designed for potential utilization in agriculture. This system would require minimum maintenance and would retain water for periods of drought. The system includes a screen, an optional clarifier, and three ponds in series (each 5d HRT with the first two aerated), followed by a rock filter and a storage lagoon (2d HRT). Under this arrangement, algae blooms in the summer would be controlled by sunlight-blocking plants (e.g., *Lemna giga, Lemna minor*) as well as by additional removal of nutrients (N and P). Careful consideration should be given to the power costs, however. Some technologies, including the system of aeration ponds and lagoons, consume power at a rate of 0.40 $kWh/(m^3/d)$, which is equal to, or larger than, the power consumption of many so-called mechanical plants boasting 0.25 to 0.5 $kWh/(m^3/d)$.

2.3 Health Situation in Gmina Święta Katarzyna

In the whole of gmina Święta Katarzyna, only a part of the large village of Siechnice has water/wastewater services. These services consist of an incomplete sewer system and a package secondary treatment plant that discharges to the Odra River. The rest of the houses in the gmina are "serviced" by individual holding tanks, or have illegal direct connections to the nearest ditch. Many tanks probably have illegal pipes extending from them to a ditch or creek. Some tanks are emptied (irregularly), but because there are few—if any—septage receiving stations, the contents of the septage transport trucks probably end up in the nearby ditches. The septic tank-distribution/leaching field solution, such as that practiced in the US, is virtually unknown. Cursory inspection of the

gmina revealed raw sewage in Koci Rów and other ditches, easily accessible to children or domestic animals. Two photographs in Appendix D illustrate discharge of raw waste from a ditch that runs along the main street—near the gmina's main office—to the Szalona River. Topographically, the entire gmina is drained by creeks that feed tributaries (e.g., Szalona and Brochówka) to the Oława River, and thus raw sewage continuously enters the water supply area for the city of Wrocław. The public health threat is quite substantial; with the gmina developing as a bedroom community for Wrocław, the population density is increasing and there is pressure to build homes with access to water facilities, which generates more sewage. Until recently, many homes had gray-water holding tanks and pit privy toilets. The change in living standards, coupled with increased numbers of people migrating out of the larger city, creates a new and intense threat not only to the water supply for Wrocław but also to the Święta Katarzyna community as well.

The solution negotiated by LEM would address all point-source discharges and collect all wastewater from the northwestern part of the gmina into a separate sewer system. Rather than addressing sanitation in individual homes, the proposed system would impound the biggest offender—Koci Rów—and direct its water to the newly constructed sewage treatment plant. Construction of the new facility, although staged for financial reasons, would immediately improve public health in a part of the gmina that is even larger than the drainage area of Koci Rów. This is because the plant would immediately begin receiving sewage from the individual holding tanks, using water from Koci Rów for dilution. The STP would provide secondary treatment with elements of tertiary removal of nitrogen and even phosphorus. The final effluent would be removed from the Olawa basin and discharged into the Odra River instead. LEM's contribution was: structuring of the financing, thereby allowing better compatibility of the plans and resources available; proposal for area-wide sanitation; optimization of the sewage treatment process to accommodate the tremendous variability of flow and quality; and introduction of a sequential process that would partially remove nitrogen without additional expenditures.

2.4 Recommendations

2.4.1 Alternatives to the Proposed System Design

The recommendations in this report are made after a thorough review of the level of expertise available for design in Poland and the presence of demonstrated technology already working in Poland. There are many activated sludge plants in Poland using the configuration of the oxidation ditch, complete mix basins and sequencing batch reactors. All were designed and built locally; therefore, experience should be readily available for this technology. However, most of these plants have proprietary hardware and/or elements of design. There is a tendency to provide a series of modules to be put together as needed and generally there is little automation. Often operators of small plants are left with a complex facility with neither training nor support from the designer. In several presentations the gminas were cautioned by LEM against complex package plants, which seem to proliferate in Poland in contrast to current trends in America. The LEM team strongly promoted the sequencing batch reactor technology housed in concrete or earthen tanks.

In what follows, the survey team has suggested three viable options from which the gmina can choose based on its own evaluation of the possibilities. The options are presented with the aim of reducing the long-term burden of operation and maintenance while, at the same time, expanding coverage in the gmina with a simpler, less complicated treatment system.

OPTION 1

The technology suggested in the preliminary design is too complex for a small facility, requiring very careful operation by educated and highly trained personnel. Further, the plant proposed does not lend itself easily to the requirements of upgrading for nutrient (N, P) removal because of the one-basin design of the activated sludge process. All of the comments in this evaluation and in the Environmental Protection Institute's (IOŚ) Opinion of March 1993 should be explicitly addressed at the stage when working drawings are being prepared. The items referring to nutrient removal in the IOŚ Opinion are very important and vital to the performance of the STP. They may not be easily corrected without **major changes** to the current design.

A visit to the Kłodzko facility revealed a sludge volume index of 300%+ outside its recommended design value for proper operation. The team also observed the activity of operators at several other plants which indicated that a significant level of dedication and activity is required if the plants are to be effectively operated and maintained. This required level was not always met in practice; the team's general impression was that the proposed facility in Siechnice, although relatively modest, will require an inordinate amount of O&M, which is not likely to be undertaken. It should be reiterated that the questions of poor reactor hydraulics, sludge deposition, and poor control of dissolved oxygen and the consequent oxidation-reduction potential can only be addressed through radical changes in the reactor design.

If the gmina elects this technology, it will be of the utmost importance to make the designer responsible for operation and personnel training after operation begins and not just during the start-up period. This responsibility should be explicitly written into a binding warranty contract that would help protect the gmina from fines and would provide support long after the plant has been forgotten by the taxpayers. The warranty should also protect the gmina in case the selected design office is dissolved.

In reviewing this design, as well as others of a similar nature, the team found that designers were not always close to the practical problems of actual operations. There is an urgent need to impress upon them (1) the importance of ease of operation or "foolproofing," and (2) the need to employ automation, thus reducing manpower requirements and lowering O&M costs.

OPTION 2

The STP in Siechnice could be designed alternatively to avoid most of the pitfalls mentioned above. The sequencing batch reactor (SBR) or intermittently discharged, continuously fed batch reactor are examples of technologies best suited to highly variable flows from small municipalities. These plants

require less maintenance and benefit from the "automatic" anoxic denitrifying fill period, usually producing nonbulking sludge due to the existing concentration gradient. These technologies are in the **public domain**, i.e., transferable to other gminas.

For the new Siechnice STP, a number of changes could be made. Using the preliminary design data and assuming that both the initial and primary facilities are the same and the concrete outside shells are unchanged, the simplest SBR-type plant, with minimum changes to the preliminary design, might be as described below (see Figure E-2 in Appendix E).

The left chamber in the preliminary design proposal (their Figure 7.23) could be divided in the most cost-effective way to provide room for sludge storage and stabilization (designated as "ZDO" in the original drawings) with the volume as in the preliminary design. The storage for the **primary** effluent wastewater could be distributed into the two SBR chambers built into the right-hand tank, denoted "OWT" and "KN" in the preliminary design proposal drawings. The comparison is presented graphically in Figure E-1 (see Appendix E: preliminary design flow diagram) and Figure E-2 (see Appendix E: SBR modification). The right-hand tank would be split into two equal compartments, each equipped with an aeration device, a stirrer for anoxic mixing, and a decanting device — floating weir or fixed solenoid valves, etc.

The savings here would involve:

- Elimination of the clarifier hardware and the center well,
- Elimination of the RAS pumping station and pipes, and
- Provision of the equalization necessary in this batch-variable stage.

The new items that would have to be added include:

1. A programmable logic controller for level and time (there is at least one manufacturer in Wroclaw). Also, some sensors for automation, i.e., level sensors for liquid and sludge and/or timers.

2. Decanters or floating pumps that could be designed for specific application in this plant (from scratch).

3. A small wet well for the final pumping station that takes the treated effluent to Odra River.

The above modification would not change the basic character of the STP, but should considerably simplify the operation and start eliminating the nitrogen species almost immediately. It should be noted that this modification will allow for even longer retention in the aeration tank as the settling period will be considerably reduced from the original design, yet the gradient of concentration will not allow for development of filamentous organisms. The cost savings from the elimination of the final clarifier structure are approximately zł 1 billion per unit. Even with the additional equipment needed, substantial benefits will remain.

The benefits of the SBR technology for small plants such as the Siechnice STP are:

- An SBR acts as an equalization tank, which is of particular importance in the smaller facilities such as in Siechnice;
- There is no final clarifier and no recirculation system and, thus, less concern with settleability;
- The settling occurs in laminar conditions;
- Biomass "selection" (for floc-forming microbes) is automatic due to the concentration gradient;
- The process is easily automated;
- Nutrient (N, P) removal can be easily built into the operating cycle in Stage I; and
- Denitrification will decrease oxygen requirement -- compared with nitrifying activated sludge — by 20%, and will produce lower sludge yields.

OPTION 3

LEM's suggestions for a change in the treatment technology (Option 2) were discussed with the concerned officials during several meetings in Św. Katarzyna as well as at the regional workshop in July 1993. As a result, a compromise (Option 3) was reached between the LEM and the preliminary designs that incorporated elements of both. It was agreed that the plant could be designed in one stage as indicated in the preliminary design; the construction phase and bidding process for the work would also begin as defined in the preliminary design. However, the bidding advertisement would specify construction without the scrapers in the clarifiers and with the necessary changes in piping, as well as inclusion of the PLC needed to operate in the sequencing batch reactor mode — first, in the clarifier compartments and then, as more wastewater is connected, in the outer structure. (The PLC will be an innovation that will change the treatment operation from supervision-intensive to more automated — something critical to staff morale and the quality of the operation.) The designer reserved the option of changing the clarifier technology back to the original arrangement — with alternating regimes and continuous flow — if wastewater volume were to increase dramatically.

Option 3 is a partial move toward improvement and simplification of the complex process proposed in the preliminary design. The first-stage design modifications for Option 3 are the same as those for Option 2, as shown in Figure E-2 (see Appendix E). It is possible that with the successful operation of this first-stage modification, Stage II will be designed with a full SBR operation. The designers in Poland are becoming aware that the SBR is a far superior and less expensive solution

to treatment of sewage from small and medium-sized communities (recently two plants have been constructed in Rabka and Nowy Targ, with capacity exceeding 10,000 m^3/d).

2.4.2 Use of Staged Construction

In the "Unlimited Funds" scenario shown in Figure G-1 (see Appendix G), everything possible would be done to protect the Oława by (1) combining the sewage from all sources regardless of the cost and (2) offering secondary/tertiary treatment for wastewater that is taken out of the Oława catchment and pumped into the Odra River. However, the gmina's financial status is such that a much more cost-effective way is needed. To effect savings, it was initially proposed (see Figure G-2, Appendix G) that the gmina create a substage: treat the sewage in the new Siechnice plant, and discharge it back to the Koci Rów, thereby meeting the standards for a plant smaller than 2,000 m^3/d. This substage would be used only until funds were obtained for the pipeline. Święta Katarzyna village would be sewered as funding became available. A local treatment plant would then be built for Święta Katarzyna that would also service nearby villages. This proposal (individual treatment plants) could only be implemented after an in-depth analysis of cost-effectiveness is carried out and after administrative issues of discharge permits are resolved. The pipeline to the Odra would be postponed. The "savings" obtained by not transporting the sewage to the Odra would be zl 11,000,000,000, the Oława would be protected, there would be no open sewer in front of the gmina's office, and the plant's costs could be further reduced by eliminating the pumping station and the holding reservoir.

Talks with the Voivodship indicated that by-laws exist forbidding the discharge of any sewage, treated or untreated, into the Oława or any of its feeder streams in the vicinity of the water intake. The suggestion offered here is to apply for a permit for temporary discharge of the treated effluent to Koci Rów and to appeal all the way up the hierarchy as needed. This staging approach seems to be the only way to build the needed facility in the gmina, particularly since the city of Wroclaw does not want to help. If the permit is denied, the plant should be built under the existing permit to discharge to the Odra and then the gmina should proceed to build the pipeline. Should the plant be built before the pipeline, **treated** effluent could be discharged to the Koci Rów, with the gmina intentionally suffering the penalties for the interim period. Such a solution appears to be ethically and technically correct and economically justifiable. The gmina could easily argue that the penalties (for essentially correcting the situation in the Koci Rów!) would be contrary to the welfare of the people the legislation is supposed to serve.

The real-life financial situation in Święta Katarzyna has not been examined by either the design engineer or the gmina. There is pressure to build something as soon as possible and it appears almost too late to make any changes. Unfortunately, the financial situation is such that the gmina cannot afford both the STP and the sewerage systems feeding it, as in Stage I of the original design. A realistic alternative would be to stage the work so that the improvement becomes feasible, technically and economically. However, the designer did not tailor his process to stages and insists on building the whole plant; in fact, the reactor volume to be built is for both stages (3,600 m^3/d). In the end, economics probably will determine the absolute minimum level of construction.

It is LEM's opinion that the initial-stage flow diagram for the treatment plant should include pumping from Koci Rów, primary treatment, a sequencing batch reactor, and temporary gravity discharge to Koci Rów (essentially Figure E-2 in Appendix E except for the pumping of final effluent and disinfection). The cost of such a plant is shown in Table 2.1.

Table 2.1

CONSTRUCTION COSTS FOR STAGE I (2 Years)
(in billions of zlotys)
On the assumption that zł 8 billion of funding is available

Material/Service	Cost
Screen	0.25
Pumps and associated equipment	0.75
Primary treatment (grit and settling tank)	1.50
Activated sludge tank SBR (1,800 m^3)	3.30
Equipment, PLC, auxiliary	1.50
Fees, contingency	0.70
TOTAL	8.00

Remaining items for financing include construction of the sewers in Radwanice, the pipeline from Siechnice, and a system for treating raw sewage from Święta Katarzyna discharged to the Szalona River. These construction projects should be gradually addressed as funding becomes available.

2.4.3 Summary of Recommendations

The analysis of the situation in the three major municipalities of Siechnice, Radwanice, and Święta Katarzyna has revealed an immediate need for an STP and for sewer systems to prevent raw wastewater from flowing into the Oława drainage basin. The partial costs of sewering Siechnice and Radwanice, including the transfer pipelines to the STP and discharge pipeline to the Odra River, will be on the order of zł 58 billion. This sum will not completely solve the wastewater problems of Święta Katarzyna. Measuring the costs involved against existing credit indicates that the work needs to be staged to facilitate financing, simplify the plant design, lower the operating costs, and improve operation and maintenance.

It is proposed that a "cost-effective" staging scenario be implemented (see Figure G-2, Appendix G) that will allow for collection of all wastewater from Radwanice, Siechnice, and Koci Rów. Additionally, Święta Katarzyna village should be sewered and a simple-construction STP should be built for its wastewater, provided the economic analysis proves it to be less expensive than the pipeline to the new STP in Siechnice. This substage will cut off all wastewater draining into the

Oława. The pipeline to the Odra River should be built immediately after funding is arranged within the first stage. The **treated** effluent will be temporarily discharged to Koci Rów, which will therefore no longer be a conduit for raw sewage. The gmina must apply for an unconventional **temporary** permit for that discharge by indicating to the authorities that its application is specifically for improving the quality of water in the vicinity of the intake and that rejection of the application would amount to approval of continued contamination. This solution, however, will require a substantial infusion of grant money, as noted in the financial analysis (Chapter 4).

The technology of the proposed treatment plant has been reviewed by LEM and others, and criticized for its complexity, inflexibility as to staging, poor applicability to flow variability, and inability to remove N and P. An alternative strongly recommended by the LEM survey team (Option 2) includes **converting the plant to a sequencing batch reactor** by modifying the aeration equipment, adding a simple decantation system, and providing for the equalization of the raw wastewater and sewage discharges. LEM has indicated to the gmina what was inappropriate about the design and what could be done to improve it without disturbing the design/approval process that has already taken place. The discussions with the design engineer indicated inflexibility regarding change in the shape of the reactors as well as a reluctance to change the mode of operation. The reluctance is based on information about some negative experience with prefabricated Polish SBRs; however, both the gmina and the designer have agreed to include SBR operation in Stage I. A bid competition for working designs and construction will specify those changes and the need to include the PLC in the offers.

A realistic appraisal of the gmina's ability to pay forced the team to scale down the treatment plant to bare bones, which, in this case, included pumping, screening, sedimentation, and an SBR tank, at a cost of zł 8 billion, constructed over 2 years. No sewers would be built during this period.

The situation in the southern part of the gmina was reviewed; the cost calculations, based on 1992/1993 price indicators obtained from the local design office, indicated that it may be more advantageous to construct local treatment plants than to pump to a central facility (see Figure F-1, Appendix F). The expectation that large plants will be required to remove N and P to a greater degree further supports this concept. "Natural" methods of aerated/facultative lagoons, operated in an SBR mode to reduce the size, designed in series, and offering retention and equalized secondary effluent quality, are preferred and will fit the landscape. This design will fit in, as well, with the kind of supervision/operation planned by the gmina.

3 MANAGEMENT ANALYSIS

3.1 Existing Conditions

Gmina Święta Katarzyna operates within an organizational pattern similar to those demonstrated by the other two gminas in the LEM program. It has a 23-person elected council, which performs a variety of policy and outreach functions; the principal role of the council, however, is to pass the annual gmina budget, to generally supervise the operation of the gmina, and to investigate and act upon general policy for the gmina. The gmina council appoints a gmina executive council, which comprises the Mayor, Deputy Mayor, and (currently) three members of the gmina council. The Mayor, who is at the same time chairman of the executive council, is supported in his executive capacity by the gmina office. The office employs a total of 32 people. An organization chart depicting the executive side of the governmental operation is shown in Appendix H.

The Mayor is assisted by the Deputy Mayor, whose responsibilities include municipal economics and investment as well as agriculture, land surveying, public grounds management and, of crucial importance to the LEM project, environmental protection. Święta Katarzyna is one of the few gminas in the area to have defined an environmental protection role and delegated it to a particular person and/or department within the municipal organization.

Much of the policy and managerial effort of Święta Katarzyna is bound up with the problems arising from its being a small suburb of Wrocław. This relationship affects nearly all aspects of management, administration and operations. The gmina once employed many more people than it does now, especially in the massive steel mill that physically dominates much of the center of the gmina, Siechnice village. The mill was closed a few years ago because of its insolvable environmental problems. This closing caused a rise in unemployment and consequent economic problems. However, the gmina has, with determined leadership, gradually turned to other sources and other methods in attempting to alleviate unemployment.

At the same time, Święta Katarzyna has development potential as a quiet, semi-rural, suburban area where people can live and commute to work in Wrocław; there is still a good deal of land that can be developed. Because most of this land will need a change in use designation, applications for the change must go to the voivodship office for approval. Unfortunately, the voidvodship office that handles these applications is overwhelmed with a 2-year backlog. Moreover, the city of Wrocław has not taken kindly to the possibility of Święta Katarzyna's expanding as a "bedroom" community or to Wrocław's potential loss of taxable land from the movement to the suburbs. As a result, the gmina's development potential is, for now, being held in abeyance.

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As noted in the technical portion of this report, the city of Wrocław, together with the voivodship, has come down hard on Święta Katarzyna because of its sewer problems (i.e., dumping of raw effluent into the Oława drainage basin, which, in turn, is the major source of Wrocław's water supply). Thus, the smaller suburb is under considerable pressure to come up with a solution. Whereas the voivodship has tried to assist the gmina in the search for a solution, Wrocław has shown no desire to contribute financially to Święta Katarzyna's treatment system upgrade — even though the city has much to gain from such an upgrade. This unenviable situation has forced the gmina to take immediate action to develop a wastewater treatment project, even though it cannot afford to fund the whole project. It also has necessitated the delaying of attention to pressing sanitary problems in other parts of the gmina.

3.2 Current Water/Wastewater Management Practices

As part of its development agenda, the gmina has encouraged the extension of potable water systems to many of its 22 villages. A water treatment plant has been built at Łukaszewice that serves three villages and also sells water to three villages in an adjoining gmina; similar water supply systems have been built or rehabilitated in Suchy Dwór and Święta Katarzyna. The village of Siechnice gets its water directly from the city of Wrocław. Except for Siechnice, the water systems are managed under a private water company called ELBAN, which has, in effect, an operating franchise from the gmina. All water maintenance operations, including billing and collection, are handled by the company; capital expansion, however, is undertaken by the gmina itself. Thus, the water operation and its administration are a "mixed" system with part of the responsibility being assumed by a private company, part by the gmina, and part (the village of Siechnice) by the city of Wrocław.

The development of water supplies in various parts of the gmina is part of a program to make the area attractive for residential and commercial development. But parallel to this development is the increasing necessity for sanitary sewers: the increase in water use inevitably increases the pressure to provide sewers to take away the liquid waste. And without the management capacity and the financial strength to cope with the resultant problems, the gmina faces an increase in the pressure for solutions.

As if these management problems were not enough, the gmina may be faced with another serious problem, the full definition of which is yet to come. If the central government goes through with its plan to reorganize local government (and administration), significant changes could come to Święta Katarzyna. The implications of these changes have not escaped gmina officials. One version of the government's plan would be to reduce the number of voivodships and reintroduce the "powiat" or "county" system that was in effect as an administrative device in 1975. The powiats would be placed between the gmina and the voivodships; they would, presumably, have more authority and responsibility for the operation of local governments, i.e., gminas, within each powiat. The position of Święta Katarzyna as one of the constituent gminas within the Wrocław powiat may lead to the city of Wrocław absorbing the whole or a part of the community. Its doing so would leave the gmina in a veritable quandary with respect to the organization and management of, among other things, its wastewater problems.

3.3 Conclusions and Recommendations

Officials of the gmina have approached their problems with vigor and determination; they have tried to move as swiftly as events, technical condicitions, and fiscal constraints will allow. They have requested inclusion in the LEM program, as this report indicates; the gmina has also enlisted the assistance of the Poland/Hungary Aid for Restructuring of Economies (PHARE) program of the European Community to develop a plan for managing the privatization program that Polish municipalities are under some pressure to undertake. At the same time, gmina officials have yet to spell out for themselves and their constituencies the overall management plan that must, under the circumstances, be prepared in parallel with their attempt to start up the wastewater program.

Although it is possible to list a substantial collection of recommendations basic to the improvement of environmental management in Święta Katarzyna, we suggest that a more detailed examination of the management problems related to wastewater and water operations be conducted so that gmina officials could unfold their own plans after carefully analyzing current and future probabilities. This study could be undertaken by LEM through additional technical assistance, if requested by Święta Katarzyna; it should include a review of current water management and its relationship to the wastewater management needs that will occur as the gmina becomes more involved in this area of environmental effort. The study should also examine in detail the whole process of capital project management that will continue to occupy gmina officials for some time to come.

It would also be of great value if the environmental management study suggested above were coordinated with the work that PHARE is undertaking so that the gmina could benefit from a unified approach to these important problems.

4 FINANCIAL ANALYSIS

4.1 Existing Conditions

Before we enter into a discussion of the specifics of financing Stage I of Święta Katarzyna's wastewater project, it might be of interest to set the context of the gmina's fiscal situation.

Święta Katarzyna, like most units of local self-government in Poland, has only recently entered the difficult arena of financial and managerial decentralization. This fact can be illustrated by a review of the budget numbers for the years 1989 to 1993 (contained in Table 4.1). Because Polish law requires that budgets must be balanced when passed, it is sufficient for our purpose to use the one figure.

Table 4.1

ŚWIĘTA KATARZYNA BUDGET
(1989 - 1993)

Year	Zlotys
1989	877,273
1990	12,592,075
1991	10,415,929
1992	13,958,000
1993	34,839,000

While some semblance of financial self-government appeared in 1990, another look at the budget for that year reveals that over zł 10 billion were held back by the voivodship to cover expenses unrelated to the gmina's budgetary needs. It was only in 1992 that recognition of a more decentralized fiscal structure was emerging; this is borne out in the budget of 1993, which nearly tripled over 1992.

An examination of the 1993 budget, details of which are shown in Appendix I, reveals that zł 7.6 billion have been received as a redistribution of the personal and corporate income taxes heretofore reserved exclusively for central government use. At the same time all is not perfectly well with the local budget. Only zł 19 billion of the zł 34 billion in total revenues are considered "local revenue" while the difference of zł 15 million is based on the redistributed revenue noted plus central subsidies

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received for specific tasks. Moreover, the single largest share of the locally raised revenue comes from the sale and lease of gmina property, an income that is neither steady nor self-perpetuating.

Turning then to the point of our inquiry, namely, the financial basis for the construction of Stage I of the upgraded sewer system, we consider next the fiscal state of the fledgling water and wastewater enterprises now operating within the gmina. According to recent data, there are some 809 water customers in four villages, including 366 in Święta Katarzyna and 105 in Siechnice. However, the Siechnice customers receive their water directly from the city of Wrocław's water system, so presumably their payments would not enter into fiscal calculations of utility payments.

The remaining 704 customers, although under the management of a gmina-authorized company, would be considered in the analysis of rate-produced financing. Water rates are set at zł 4,500/m^3. Whereas it was not possible for the team to get accurate figures to determine the average daily usage of water, if we use the figure of 2,000 m^3/day as used in Ziębice, the annualized income is zł 506,880,000. With planned increases in the water rates and the addition of new customers, it is likely that income will be more than enough to operate and maintain the system; the "surplus" can be used to help finance the Stage I wastewater improvement. However, this finding should be verified through additional studies based on the maintenance/capital improvement agreement between the gmina and the ELBAN water company discussed in the management section of the report (Chapter 3).

4.2 Project Financial Analysis

4.2.1 Available Local Resources

Appendix J shows the annual projections of income and expense through the year 2000 using the following customer and water/sewer rate assumptions. Sewer rates are projected to begin in 1996 at zł 5,200/m^3, which is approximately the same as the projected 1996 water rate. For the years 1997 through 2000, the water and sewer rates are projected to increase 5% per year. The number of sewer customers in 1996 is estimated at 1,000. The number of sewer customers is projected to grow at the rate of 10% per year through the year 2000. Based on these projections, the Święta Katarzyna water/sewer system could produce zł 0.5 billion for debt service in 1995 through 1997, zł 1 billion in 1998, and from 1999 on, zł 2 billion/year.

The Święta Katarzyna annual budget can provide about zł 2 billion and, after completion of the project, the sewerage system could provide up to zł 2 billion/year.

4.2.2 Project Capital Costs

Under the initial proposal submitted by Święta Katarzyna, Stage I is estimated to cost zł 58 billion. As noted, the gmina has budgeted zł 2 billion based on an Environmental Protection Bank loan for 1993, reducing the amount of the offsetting credits against the construction cost to zł 56 billion. In addition, the gmina should be able to contribute zł 2 billion/year out of its operating budget. The

balance for full construction of Stage I would then have to be funded through credits obtained outside of the gmina's immediate resources; these credits would need to be available in the first 2 to 3 years of the award of the construction bid in order to pay for the construction of Stage I, which may take from 2 to 3 years.

4.2.3 Available External Resources

The combination of Święta Katarzyna's general budget tax base and the income from water and sewer rates cannot sustain the level of debt required to construct Stage I. If full funding of the project were to occur, it would require considerable borrowing. Only two sources of borrowing are currently available to the gmina: commercial banks and the Environmental Protection Bank. Unfortunately, these two sources cannot provide the funds needed to supplement the gmina's input.

Commercial banks currently restrict loans to about 3 years and annual interest rates are 30% and higher. If this type of financing were used, the annual debt service would be as high as zł 21.5 billion. This amount is about two-thirds of the total Święta Katarzyna annual budget. Appendix K projects the funds flow for commercial bank financing.

The Environmental Protection Bank makes loans whose typical terms include favorable interest rates, a 6-month interest-free period, capitalization of interest for 2 years, and a 3-year repayment schedule. Assuming that the Environmental Protection Bank, at 10% annual interest, would loan the full amount of funds needed for construction, the debt service would be as high as zł 15 billion in the fourth through sixth years. This is about half of the total 1993 Święta Katarzyna annual budget. Appendix L projects the funds flow for Environmental Protection Bank financing.

In order to further illustrate the difficulties faced by Święta Katarzyna in attempting to finance the full scope of Stage I, it is well to consider a third possibility, one that is presently more theoretical than practical but, at the same time, a method that has potential for future use. This is the use of a bond issue based on the ability to pay the principal and interest out of current and projected revenues over a period of 7 to 15 years. The use of bonds to finance infrastructure construction has the added feature of intergenerational sharing of the costs. That is, the generation that uses the facilities participates in the payment of the costs of the facilities. The longer terms for which bonds are issued increase the intergenerational sharing of costs.

Municipal bonds are not currently an element in local government financing in Poland. But Polish law does allow municipalities to go out into the national and international bond markets to seek funds for capital projects. The law has a series of detailed safeguards through which the municipalities must pass before the bonds can be issued. Our report does pose an option based on the potential, though not the actuality, of such a bond issue. It is done not in the immediate expectation that the Polish municipal bond law/laws will be revised; rather, it is to show alternate means that, in time, should be considered for use by municipalities that (1) have a good financial standing, and (2) have urgent environmental capital needs. It should also be noted that LEM would provide technical assistance in working out the details of the potential operation of the Polish bond law and the

marketability of such bonds internationally, focusing on the municipal bond market in the United States.

Thus, issuing bonds to be paid over 15 years theoretically could be a method of financing the undertaking. Annual debt service (payments) for the 15-year period would be zł 6.5 billion. Bond financing is a way to borrow money by pledging certain revenues of the gmina and part of the funds generated by the water/sewer system. Bonds typically are issued in specific amounts (denominations) that earn interest at a specified rate each year until the year they mature (i.e., are paid off by the gmina). The interest rates for bonds maturing at different times usually vary according to market conditions at the time the bonds are issued.

Appendix M shows a schedule for zł 50 billion of 7-year through 15-year bonds. In this situation, the 7-year bonds earn interest at 14%, the 8-year bonds earn 13.75%, and for each added year in the schedule, the interest rate is reduced until it reaches the level of 10% for the 15-year bonds. The schedule shows the amount of interest due each year for each of the maturities. These interest obligations are added to show the total bond interest payable each year.

Reserve funds are usually established to insure the gmina and the bond holders against some unforeseen catastrophe that would prevent the gmina from making the annual payments. These funds accumulate in the early years of payments and are kept available to handle emergency situations. They would be under the control of a trustee whose responsibility would be to make sure that a real unforeseen emergency existed before releasing the funds to be used by the gmina. The reserve fund for this issue would build to zł 5 billion in the fifth year of the debt service schedule. Interest from the reserve fund would be used to make the annual debt service payments. In the year 15, when the final bonds were being paid off, the balance in the reserve fund would be used to pay off the last zł 5 billion of outstanding bonds. Table 4.2 compares the three funding mechanisms.

Nevertheless, considering all three methods of financing, we come back to the same conclusion, namely, that Święta Katarzyna does not have the fiscal capacity to fully fund Stage I at the estimated cost of zł 58 billion.

As pointed out in Chapter 2 of this report, the project can be staged and implemented in such a way as to save additional funds or use allotted funds to allow for more benefits. The gmina's 1993 budget includes funds to begin the development and construction of the Stage I program: zł 2 billion from budgeted funds and an additional zł 2 billion of loan money from the Environmental Protection Bank. If annual loans of zł 2 billion plus local budgetary support of zł 2 billion annually could be arranged, construction amounts as shown in Table 4.3 could be provided. Appendix N details the flow of funds under this strategy.

Table 4.2

COMPARISON OF ANNUAL DEBT SERVICE REQUIREMENTS
(in millions of zlotys)

Year	Commercial	National	Bonds
1	2,000	2,000	6,500
2	2,000	2,000	6,500
3	21,500	8,000	6,500
4	21,500	15,000	6,500
5	21,000	15,000	6,500
6	16,000	15,000	6,500
7	2,125	7,900	6,500
8	0	2,240	6,500
9	0	0	6,500
10	0	0	6,500
11	0	0	6,500
12	0	0	6,500
13	0	0	6,500
14	0	0	6,500
15	0	0	6,500

Table 4.3

CONSTRUCTION COSTS FOR STAGED CONSTRUCTION
(in thousands of zlotys)

Year	Amount	Year	Amount
1	4,000,000	8	4,000,000
2	4,000,000	9	3,000,000
3	2,000,000	10-14	0
4	0	15	6,000,000
5	3,000,000	16-18	0
6	2,500,000	19	7,000,000
7	0		

This funding strategy would require the loans in years 1, 2, 5, 6, 8, 9, and 15. The first 9 years of this strategy would rely heavily on loans in order to get the most construction done at the earliest possible time. These loans would be repaid in years 11 through 14. After year 15, no further loans would be used. The best use of money would be to save for 2 years and, in the third year, contract for construction. The construction schedule shown in Table 4.4 could be sustained by the gmina using this strategy.

Table 4.4

CONSTRUCTION SCHEDULE FOR STAGED CONSTRUCTION
(in thousands of zlotys)

Contract Year	Amount
1	8,000,000
5	7,500,000
8	7,000,000
15	6,000,000
19	7,000,000
Total	35,500,000

This funding strategy shows that the amount of money Święta Katarzyna is able to provide for sewerage system development is sufficient immediately to undertake only portions of the overall project. Additional portions of the project can be undertaken in years 5, 8, 15, and 19. The engineers retained for design and construction of the project can be charged with breaking it up into fundable segments.

4.3 Conclusions and Recommendations

1. Święta Katarzyna officials should work out the staged construction of Stage I with the designers, consistent with both the financial requirements and the best use of resources in the design and construction of the initial effort.

2. LEM should make every effort to "package" the three Polish projects in an overall business plan that will be submitted to central government ministries (e.g., the Ministry of Environmental Protection), to call attention to and seek additional assistance in the overall funding of the LEM wastewater projects in Poland.

3. Every effort should be made to explore the feasibility of using existing Polish law to issue municipal bonds in the future.

4. LEM, together with its participating municipalities — particularly Święta Katarzyna — should make a concerted effort to engage the attention of the World Bank Office in Warsaw to explore the possibility of project funding.

5 TRAINING AND OUTREACH NEEDS

The general training and outreach needs identified in this chapter are based on the LEM consultant suggestions as revised — and added to — by the Święta Katarzyna representatives during the LEM Project Workshop held in Wrocław on 14, 15, and 16 July, 1993. The list of courses presented here will be further refined as a result of the development of a LEM training plan for Poland.

5.1 Training Course for Treatment Plant Operators

This course should be a two-tiered training program. The first tier should be a basic introduction into the practice of treatment plant operations and the background essentials needed to operate successfully; the second tier should build on the introductory course with a more detailed, technical application of processes and systems.

These two courses should be developed within the Polish context but with attention to practical new developments and techniques that could applied in Poland. The courses could be given to all LEM cities at once, or in stages; the courses might also be repeated for other gmina representatives who are interested in the LEM program, particularly those who attended the Wrocław Workshop in July 1993.

5.1.1 Introduction to Treatment Plant Operations

This course should cover introductory information on the topic of municipal wastewater, including collection systems, piping, valves, tanks and pumps, the essentials of wastewater treatment processes and systems, sludge treatment and disposal, mechanical and chemical treatments, lagoon treatment systems, essentials of laboratory sampling and techniques, laws and regulations, and administrative record keeping. It may be necessary to include rudiments of math, chemistry, biology, hydraulics, applied electricity, health, safety, and environmental best management practice. The course should be designed to be specific to Polish practice and to the types of equipment currently being used, especially in the LEM cities.

5.1.2 Advanced Course in Treatment Plant Operations

This course would expand upon the basic course but with much more emphasis on the details of wastewater treatment processes and systems. Examples of topics are screening, grit removal, trickling filters, activated sludge, disinfection, lagoon systems, and similar technologies appropriate

to small, rural communities; sludge treatment and removal; sampling and laboratory operations; laws and regulations; plant housekeeping; and the need for and best methods of keeping records.

5.2 Training in Management and Operations of Water and Wastewater Organizations

This training program should focus on improving management practices and introducing systematic administrative processes within the organization charged with the water/wastewater operations in the gmina. It should review the various options for such management (e.g., independent units, privatized companies, and joint public and private companies). The course should include a general overview of best management practices relating to operations, personnel administration, and problem solving, to name a few. Emphasis should be put on the need and methods for determining rates, budgeting for operations and maintenance, assessing capital needs, keeping effective records, writing reports, billing and collecting fees, setting rates, and understanding the close relationship between water and wastewater functions. All of this training should be designed within the framework of existing Polish law and regulations on water and wastewater treatment and operations.

5.3 Financial Administration of Water/Wastewater Organizations

This may be considered an advanced course growing out of the previously described management course; at the same time it could also be designed, in part, to be introductory and specific to managers, bookkeepers, and other employees assigned to financial functions within the gmina, or within the water/wastewater organization or company serving the gmina. It should cover in some detail the basis for water/wastewater rates; the design of rate structures; the detail of billing, collection, and accounting; and the relationship between operations and maintenance accounting and accounting for capital expenditures. Best accounting practices in compiling a full annual budget and a capital expenditure budget should be integral to this course.

5.4 Planning for Water/Wastewater Management

This course should be considered a continuation of the training on management and financial administration in which the elements of short- and long-range planning for water/wastewater needs are combined. It would deal with such items as planning as a technique to improve management and financial operations; setting priorities; and estimating costs while taking into account likely changes, contingencies, and practical realities. Emphasis should be put on capital budgeting as a focus of practical planning. Such devices as PERT (Program Education and Review Technique) charting, planning maps, etc., could be introduced as techniques for illustration.

5.5 Developing and Writing a Project Business Plan

This course would be given to top-ranking municipal officials and their consultants, if appropriate. The course focus would be putting together a "pre-feasibility" study (i.e., a project business plan) for an infrastructure project for which the gmina would like to attract other-source funding (e.g., from the central government, private investors, foreign banks, and foreign development lending institutions). The first part of the course would review the possible sources for outside funding and their requirements along with the "business plan" formats required by these agencies. The second part would then review the data needed; the manner in which it should be presented in the report; and finally, the writing, editing, and publication of the report. The course would also discuss methods for presenting the report in summary form to the various institutions interested in funding this kind of project.

5.6 Management of Infrastructure Projects

One of the most important training courses to be given to all cities is one that involves project management. This course should be available to high-level managers and decision makers in the gmina. The course would take a proposed project through the major stages of the project management cycle: preparing a project proposal, completing preliminary studies on design and coverage (with emphasis on appropriate technology as well as operations and management when the project is finished), assessing finances, hiring a design firm, approving the design, preparing detailed project specifications, bidding, awarding the bid, negotiating the contract, administering the contract, inspecting the project, receiving the completed project, and beginning operations. Within each of these steps, best practices would be discussed. A particular project would be employed as a case study for taking participants through the project management procedures. Again, the course would have to be practical and consistent with Polish law.

5.7 Design and Implementation of Public Information Programs on the Environment

The object of this training course would be to assist the gmina in designing and implementing various outreach information programs that are concerned with the environment; a secondary object would be to improve communications among the gmina executives, the gmina council, the nongovernmental organizations in the gmina, and the citizens. The course would first introduce the participants to the basic psychology of public information programs (i.e., who is the audience, what is the message, what is the best way to get the message across, what results do you want to achieve). It would also give background on the various written and visual techniques available and when to use which technique for which audience, message, etc. The course would then choose a particular municipality that has some public information or outreach need, and go through the steps from idea to result. Emphasis should be placed on using available resources and not relying too much on high-tech methods that are costly and impractical to implement.

APPENDIX A

Approval Documents of Wrocław Voidvodship Regarding Święta Katarzyna's STP Proposal

DISTRICT COUNCIL OFFICE
55 - 010 ŚW. KATARZYNA
Voivodship of Wrocław

Ref. No. ZI-2211/241/93

31st March 1993

In accordance with the distribution index I hereby invite you to attend and take part in the meeting of the Advisory Council (Rada Konsultacyjna) for the assessment of the preliminary technical and economic design (założenia techniczno-ekonomiczne, henceforth abbr. ZTE) for the district sewage and effluent treatment plant at Siechnice.

The Advisory Council Meeting will take place on 16th April 1993 at 9 a.m. in the District Council Office in Św. Katarzyna.

I enclose a copy of the paper on the design compiled by the Institute for the Protection of the Environment in Wrocław. Please do not fail to attend this session of the Advisory Council.

[Obliterated stamp and initialled signature, apparently reading]

DISTRICT COUNCIL.....

Copies sent to:

1. Department for the Protection of the Environment, Office of the Wrocław Voivodship Council, Wrocław
2. Environmental Protection Institute (IOŚ) (compiler)
3. Inż. - Bud. Ltd., Wrocław (project designer of ZTE)
4. Mr. William Sommers, U.S. Agency for International Development
5. Voivodship Melioration and Water Installations Board, Wrocław
6. The Mayor of the City of Wrocław
7. The Regional Water Management Authority (RZGW), ulica Norwida 34, 50 - 375 Wrocław
8. The Chairman of the Gmina Council, Św. Katarzyna
9. Members of the Gmina Council, Św. Katarzyna

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[Official Stamp]
Wrocław Voivodship Council Office,
Department for the Protection of the Environment,
Plac Powstańców Warszawy 1,
50-951 Wrocław
8515377 - 1

Ref. No. OS.I.6210/116/92/93

26th February, 1993

[Stamp with inscription
"Received 1st March 1993,
Ref. No. 779"]

Decision

On the grounds of Articles 20, 21, 31 and 53 of Paragraph 2, Point 2; and 3, 55, 57, 63 and 82 of Paragraph 1, Point 5 of the Water Act 1974 (24th October, 1974, see *Dziennik Ustaw [Journal of the Statutes of the Polish People's Republic/Republic of Poland,* hereafter Dz.U.] No. 38, Item 230 with later amendments) and of the decisions by the Minister for the Protection of the Environment, Natural Resources, and Forestry of 5th November 1991, on the matter of the classification of waterways and the conditions on effluent disposed into rivers or into the ground (Dz.U. No. 116, Item 503), and Article 104 of the Administrative Code, the application made by the Przedsiębiorstwo Uspołecznionego Budownictwa Inżynieryjnego "Inż-Bud" Spółka z o.o. (Inż-Bud Public Engineering Company Ltd.) of Wrocław, ulica Strzegomska 55, for the issue of a legal and hydro-engineering permit for the disposal of effluent from the gmina effluent processing station at Siechnice in the gmina of Św. Katarzyna, into the River Odra and for the construction of the effluent treatment installation has been considered and the following decisions are hereby ruled:

I. The Gmina Council at Św. Katarzyna is hereby granted a legal and hydro-engineering permit for the disposal of effluent from parts of Siechnice and Radwanice in Św. Katarzyna, and also of sewage transported by container trucks from other villages in the gmina of Św. Katarzyna to the treatment plant, in the following quantity:

$$Qd = 1800\ m^3/d,$$

into the Odra River at the 237.7th kilometer (by a pressure pipeline), after prior treatment in the biological and mechanical processing plant which at target capacity will be working in an anaerobic - aerobic mode with the removal of nutrients and segregated phosphate removal from the sludge, localized at ulica Opolska in Siechnice.

The condition and composition of the effluent in the first sink basin on the exit route for the treated effluent from the plant, where probes of the effluent composition shall be made, shall not exceed the following parameters (in milligrams per cubic decimeter [mg/dm^3]):

Biochemical oxygen demand (BOD_5; O_2)	30 mg/dm^3
Chemical oxygen demand (dichromate method; O_2)	150 mg/dm^3
Total suspended solids	50 mg/dm^3
Total nitrogen (N)	30 mg/dm^3
Total phosphorus (P)	5 mg/dm^3
Total organic carbon (C)	40 mg/dm^3

The remaining pollutant indices shall not exceed the levels laid down in Annex No. 2 to the decision by the Minister for the Protection of the Environment, Natural Resources, and Forestry of 5th November, 1991.

II. The permit valid for the above range is issued for a fixed period, that is until 31st December 2010, and it shall hold subject to the following conditions:

1. the equipment for effluent treatment and the sewerage network together with the effluent exit shall be used and kept at the required technical level of maintenance;

2. a logbook shall be kept to record the running of the effluent treatment plant, in which the amounts of effluent discharged shall be registered;

3. periodic quality control of the effluent discharged shall be conducted, at a frequency determined by the technological requirements of the plant;

4. a set of instructions for the running of the effluent treatment plant shall be compiled and presented in this Department within six months of the completion of the plant's technological start-up;

5. a legal and hydro-engineering permit for the operation of the effluent treatment plant shall be obtained within six months of the completion of the plant's technological start-up;

6. the edge of the receiving body of water shall be maintained over a section 10 m above and 10 m below the effluent discharge point;

7. the investor shall provide for a technically suitable method for the exploitation of the sediment layers during the operation of the treatment plant; and

8. any potential compensation claims lodged as a result of the issue of this permit shall be adequately settled.

III. The permit for the special use of water in the above-described way is simultaneously a legal and hydro-engineering permit issued to the Gmina Council at Św. Katarzyna for the construction of an effluent treatment plant, in accordance with the attached documents, and in particular for:

- the main pumping station;

- the mechanical grid system (two arch grids);

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- the two sand traps, primary settling tanks designed for a shortened flow time;
- the distribution chamber;
- two active sedimentation tanks for the treatment of effluent with low load levels;
- two secondary settling tanks, with 15 m diameter and 353 m^3 active volume;
- the equalizing tank for the effluent after treatment;
- the pumping station for the return and excessive sludge;
- the second pump and pressure discharge pipeline into the Odra; and
- the sedimentation part of the plant, targeted to use mechanical sludge dewatering and phosphate removal.

The treatment plant consists of two independent technological systems; in Stage I, one of the active sludge chambers will fulfill the function of the settling tank, while one of the secondary settling tanks will act as an equalizing tank for the processed effluent. Two unloading points have been designed in the plant's technological building for the waste removal vehicles. Compressed air will be fed into the sewage collection containers. The quantities of waste material discharged will be measured by means of a flow-meter in No. 2 pumping station.

IV. The above permit for the construction of waterwork amenities is issued for a fixed period of time, viz. until 31st December 1997, and it shall be valid subject to the following conditions:

1. that the buildings and installations be set up in accordance with the design documentation and without exposing people or property to any risks, and with the observance of all the necessary agreements entered into with interested parties;
2. that this Department be informed 14 days before the start and completion of work; and
3. that any losses or damage caused during the work subject to this permit be compensated adequately.

Justification

Inż-Bud Ltd. of Wrocław submitted an application for the issue of a legal and hydro-engineering permit for the discharge of effluent from the planned sewage treatment plant at Siechnice in the gmina of Św. Katarzyna, and a permit for the construction of the processing plant installations. A paper titled "Preliminary Technical and Economic Design and Materials for the Legal and Hydro-engineering Survey," compiled by Inż-Bud, Wrocław, was enclosed. This documentation constitutes the technical basis for the decision and is also an integral part of that decision.

This decision was issued on the basis of the formal and material legal regulations cited in the introduction to the decision and after a legal and hydro-engineering inquiry had been carried out on 17th February 1993, attended by the interested parties.

Following the analysis of the documentation and all of the materials collected during the legal and hydro-engineering procedure, the possibility was confirmed of the issue of a decision on the above-described terms and conditions.

In view of the fact that Stage II of the building of the gmina effluent treatment plant at Siechnice with a proposed capacity of up to 3,600 m^3/d, and involving the building of a sewage system in Św. Katarzyna and the other villages in the gmina, is a long-term project, this permit concerns only the construction plans for the next few years.

The detailed conditions in the decision were determined in accordance with the applicable legal regulations and with reference to the following:

- the guarantee of adequate protection of the watercourses against pollution;
- the insurance of the suitable construction of the installations for the effluent treatment plant;
- the suitable maintenance and running of the waterworks installations; and
- the safeguarding of the lawful interests of all parties concerned.

In consideration of all the above points, the decision was issued as recorded above. The parties concerned have the right to appeal against this decision to the Minister for the Protection of the Environment, Natural Resources, and Forestry (Department for the Protection of the Environment) within 14 days of the date of receipt.

[Official stamp and signature]
Stanisław Zięba [/]
Department Head
Acting on behalf of the Voivod

Copies sent to:

1. Przedsiębiorstwo Uspołecznionego Budownictwa Inżynieryjnego "Inż-Bud" Spółka z o.o. [Inż-Bud Public Engineering Co. Ltd.], Wrocław, ul. Strzegomska 55; plus one copy of the documentation
2. Św Katarzyna Gmina Council
3. Wojewódzka Stacja Sanitarno-Epidemiologiczna we Wroclawiu, [Wrocław Voivodship Sanitary and Epidemiological Station], ul. Skłodowskiej-Curie 75/77

4. Okręgowa Dyrekcja Gospodarki Wodnej [Regional Water Management Authority (RZGW)], ul. Norwida 34, 50-950 Wrocław

5. Regionalny Zarząd Gospodarki Wodnej [Regional Water Management Authority], ul. Norwida 34, 50-950 Wrocław

6. Wojewódzki Zarząd Melioracji i Urządzeń Wodnych [Voivodship Land Improvement and Water Installations Board], ul. Matejki 5, 50-333 Wrocław

7. Wojewódzki Inspektorat Ochrony Środowiska [Voivodship Inspectorate for the Protection of the Environment], plac Powstańców Warszawy 1, 50-951 Wrocław

8. Urząd Rejonowy we Wrocławiu, Oddział Ochrony Środowiska [Wroclaw Regional Office, Department for the Protection of the Environment], plac Powstańców Warszawy 1, 50-951 Wrocław

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WROCŁAW BRANCH

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SUBJECT: Report on the Preliminary Technical and Economic Design for the Biological Sewage Treatment Plant for the gmina of Św. Katarzyna

Authors of report:

1. Mr. J. Miodoński, M. Eng. [initialled signature]

Project Director:

Mr. J. Miodoński, M. Eng. [initialled signature]

Plenipotentiary for Director of Institute:

Dr. J. Przewłocki [signature]

Department Head

Mr. K. Szczęsny [signature]

Wrocław, March 1993

SUBJECT OF REPORT

The subject of this report is the mechanical and biological sewage treatment plant to serve Siechnice, Radwanice and Św. Katarzyna, as presented in the paper titled "Preliminary Technical and Economic Design with Materials for Legal and Hydro-engineering Survey," produced by Inż-Bud Public Construction Engineering Company Ltd., Wrocław, in June 1992, and compiled by Mr. S. Gdula and Mr. W. Rupnowski.

2. TECHNICAL CONCEPT AND TECHNICAL SOLUTION FOR THE SEWAGE TREATMENT AND SLUDGE PROCESSING PLANT

The processing plant is envisaged as a complex to be constructed in stages, in line with the development of the sewerage systems in the localities it will serve. In Stage I [to which the preliminary design chiefly refers] it is assumed that the complex will take about 1,800 m^3/d of effluent from the sewerage system of Siechnice and Radwanice and of sewage transported in waste removal vehicles. The magnitude of the complex in Stage I will be RLM = 6,200 M (for BOD_5).

In view of the nearness of the water-bearing areas of MPWiK [the Municipal Water and Sewerage Plant] in Wrocław, and of the gravitational flow directions from the local watercourses, it has been assumed that the processed effluent will have to be discharged into the Odra River.

According to the authors, the proposed technical solution for the treatment plant will ensure a quality of the final discharge in accordance with the regulations laid down in the Order issued by the Minister for the Protection of the Environment, Natural Resources, and Forestry of 5th November 1991, both for the construction and operation of Stage I (with the quantity of effluent under 2,000 m^3/d), and for the target stage after the year 2000, after development, when Q for the effluent will exceed 2,000 m^3/d, and hence the criteria for the quality of the effluent discharged will be more stringent (BOD_5 at O_2 15 g/m^3; total phosphorus to 1.5 g/m^3). The effluent processing system will consist of the following:

<u>a mechanical part,</u> consisting of arch grids, type KL 900A (1 section plus 1 reserve); width (B) = 900 mm; depth (Hz) = 1,200 mm; bore (b) = 10 mm; capacity (Q) = up to 480 m^3/h installation; power (N) = 0.6 kW

primary settling tanks - multi-shaft sand traps, with a shortened flow time (2 sections of dimensions L = 5.3 m, F = 10.6 m^2, V1 = 56.2 m^3), sedimentation time (Stage 1) T = 1.5 h

<u>a biological part,</u> consisting of AN anaerobic chambers, to be constructed in Stage II of the project (V = 375 to 450 m^3, T = 2.5 to 3.0 h), with stirrers of power N = 21 x 2 kW

ODRA-3 type biological block reactors (2 sections), consisting of an <u>aeration chamber</u> (V1 = 940 m^3, T = 12.5 h, chamber load (A) = BOD_5 0.33 kg/m^3 d, sludge load (A') = BOD_5 0.12 kg/kg s.d. Expected unit sludge increase (m) = 0.7 kg s./kg BOD5 us.; WO [?] = about 14

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days; coefficient of oxygen supply (OC/L) = 2.5. Aeration by oxygenating and mixing shafts in the ODRA system (2 sections), fed by air from DR-126 blowers (2 sets in Stage I, N1 = 15kW); a radial secondary settling tank (D = 15 m, Hc = 2.6 m, P1 = 176.6 m^2, V1 = 353 m^3), located inside activated sludge chamber. Working parameters T = 4.7 h, Oh = 0.42 m^3/m^2 h, Osm. = 30.6 kg s/m^2.d

excess and return sludge pumping station, with Flygt CT 3127 pumps (Q = 30 l/s, H = 5 m H_2O, N = 4.0 kW) - 2 sets (one reserve)

The sludge treatment system for the plant is based on the prolonged sludge aeration method (with partial simultaneous oxygen stabilization of excess sludge) and further stabilization in an open tank. A specified thickener is to be used for consolidating the sediments before storage and a portable installation, equipped with a ROTAMAT type press or a centrifuge, for dehydration. In Stage I of operations, the aeration chamber of the second ODRA-3 block (not yet in use) will perform the function of a sludge collector. The construction of a separate sludge collector and (if the need arises) of a stationary installation for mechanical dehydration is targeted.

The daily volume of consolidated sludge for Stage I operations is expected to be 3 to 6 m^3/d (250 to 500 kg s/d), and about 350 m^3/year after mechanical dehydration (two campaigns per year).

The ultimate location of the sludge will be disposal at the gmina waste tip.

3. DETAILED REMARKS ON THE PRELIMINARY TECHNICAL AND ECONOMIC DESIGN SOLUTION FOR THE PROCESSING PLANT

3.1 The effluent balance, which determined the plant dimensions, was estimated using various sources (Wodrol, BIPROWOD). The estimates for the quantity of effluent were based on various development forecasts for the gmina to the year 2030. The resulting unit coefficients for effluent discharge per resident, on the order of 270 - 370 dm^3/Res. d., are quite high. The recommendations of NFOŚ [National Foundation for the Protection of the Environment], and also of the Wrocław Department for the Protection of the Environment, which determine the allocation of credit or investment grants, allow a maximum coefficient of 200 dm^3/Res. d. This requirement avoids unnecessary oversizing of sewage plants, and hence also the freezing of funds.

Recent experience shows that water consumption in small communities, even with full sanitary installations in the buildings and local household water heating systems, is in the region of 120 - 160 dm^3/Res. d., viz. well below the recommended value.

However, a close analysis of the balance estimates (bearing in mind the likely development model for the gmina, which is a large, urban area) confirms the proposed coefficients, since they take into consideration the following:

- variations in daily discharge, expressed by a coefficient Nd. max = 1.1;
- high proportions of effluent from institutions and public amenities, concentrated in some areas, on the order of 25% with respect to private households,
- proportion of effluent from farms;
- occurrence of incidental and infiltration water in the network, at a level of 15% of Q; and

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- prospective development of the gmina, both in terms of population and economy in the next 40 years, marked by a coefficient of 1.15.

Taking into consideration the above-described constituents of the balance, the real coefficient for unit discharge for the areas under consideration amounts to about 220 dm^3/Res. d, and is thus fully justified for the suburbs of Wrocław. Moreover, the gmina is expected to follow a trend of residential development, with more detached single-family housing being built, and hence also with the population growth exceeding the hypothetical 15%.

The reserve thus created allows for the consideration of a target sewerage construction project and inclusion in the network of other local, smaller, places. The cost estimates should also confirm this.

There are no reservations regarding the quality of the effluent and the unit pollutant loads presented in the paper. Hence the basis for the plant dimensions may be accepted.

3.2 The proposal to discharge the treated effluent into the direct drainage basin of the Odra is acceptable, given the proximity of the water-bearing areas of the Wrocław Municipal Water and Sewerage Plant. However, this arrangement will require installation of an initial power supply of 2 x 9 kW for Stage I operations, and a target of 2 x 13.5 kW for the 2nd-degree intermediate pumping station, which will no doubt affect the operating costs for the plant.

On the other hand, it is not altogether clear why there is a proposal to build a processed effluent retention tank with such a large capacity. The sewage transported by the cistern vehicles could easily be diluted by the running discharge of the treated effluent, especially at peak usage hours, which coincide with the peak operating times of the sewage transport vehicles.

A target operation that should also be considered is the regulation of the infrastructure on the Brochówka watercourse (the building of a distribution chamber), which should help direct low-level water from the stream straight into the Odra, such that the treated effluent from the plant could flow directly into the Brochówka stream.

3.3 There are no reservations about the effluent quality as proposed in the paper, especially for Stage I, with respect to the Minister's recommendations in the Order of 5th November 1991. Only the total phosphorus standard, at P 5 g/m^3, will have to be reduced below the proposed value of over 40%, which is not easy to maintain in a classical, oxygen processing system.

In Stage II there will be a more stringent standard for phosphorus, P 1.5 g/m^3. The construction of supplementary primary AN anaerobic chambers and the use of ODRA-3 blocks in a variable oxygenation system are envisaged for this step, to create the conditions required for biochemical phosphate removal. However, achieving optimum conditions for this kind of system is extremely time-consuming, and subsequent operation is difficult, as borne out by the experience of numerous foreign projects that have started up similar technological processes.

There are also doubts as to how easy it will be to remove over 80% of the total phosphorus load using the above-described technology Chemical phosphate removal using Fe salts, not merely in the above-sediment stream but also for the entire effluent, would seem a safer strategy.

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3.4 The proposed design for the technological system for the plant and the dimensions for its constituent parts are acceptable and take into account the necessary reserves and safety coefficients.

The use of primary sedimentation before removal to the biological reactor is fully justified on technological grounds. Apart from the partial elimination of the load, this procedure may also enhance phosphate removal (e.g., through periodic retention of the primary sludge and the recirculation of the decayed sludge into the settling tank from the collecting well for the sludge pump, etc.) as a result of the introduction into the anaerobic chamber of the Stage I fermentation products, volatile fatty acids, which are also a source of easily accessible organic carbon.

3.5 The ODRA-3 type block biochemical reactor which is to be the main constituent of the complex is well known for its operational characteristics. Unfortunately not all of them may be called assets.

A series of conformity-to-standards tests conducted on a similar reactor at Polanica-Zdrój disclosed numerous flaws in the plumbing for the circulating flow for the activated sludge around the central secondary settling tank. Areas of sludge deposition also were noted. This was a result of difficulties with keeping it in suspension. Similar experiences were recorded during the start-up of an analogous complex at Wołowo near Wrocław.

Periodic aeration of the reactor has been proposed for the plant at Św. Katarzyna, for creating anoxic zones and hence for carrying out the biochemical denitrification and phosphate removal. This use of the aeration chamber will enhance sedimentation and cause sludge to deposit on the reactor base all the more readily, since the installation has no autonomous stirring system independent of the aeration mechanism.

This drawback is one of the "personal traits" of the reactor under discussion. It could be eliminated by a fundamental alteration of the aeration and mixing process in the activated sludge chamber, possibly by the application of energy-saving hydrovanes for mixing the contents of reactors coupled with the aerating system augmented by a fine-bubble grate. Such a solution would precisely control the oxygen quantity and location within the chamber and maintain the biomass in suspension. Another need is for the use of deflector current drivers to prevent the formation of dead zones and the sedimentation of the biomass in the reactor.

3.6 The design idea for the sedimentation management in the plant is acceptable as regards size. The partial oxygen stabilization in the simultaneous system and further stabilization under natural conditions are justifiable for this size of plant. Mechanical dehydration using the portable installation is a modern solution, mature in organization, fully justified economically, and sensitive to the technological needs of the plant.

There is a certain degree of doubt as to the rather high value for the gravitational effect of the consolidation of surplus sludge - 96-95%. But even if the effect were any worse, the only consequence would be a quicker filling up of the sludge container, eventually requiring an extra dehydrating campaign. This should not be of very great significance in the annual balance of operational costs.

3.7 The figure quoted in Chapter 16 of the preliminary design for the energy consumption coefficient, 0.25 - 0.2 kWh/^{3} effl., is considered fairly low in Poland, whereas by Western standards

it is regarded as an optimal value. However, practical experience hitherto has shown that, especially for relatively small complexes in which the activation process is accompanied by nitrification and partial stabilization of the excess sludge, this coefficient may well turn out to be as much as two or three times as high.

4. CONCLUDING REMARKS

The technical design proposed for the sewage treatment plant for the gmina of Św. Katarzyna should be accepted as suitable. The division of the investment into stages in the context of the expected development of the sewerage system in the area and also of the future, more stringent criteria for the quality of the final discharge should also be recognized as viable. The design for the organization of sediment management in the plant is very modern

In order to ensure the required quality of the discharge, especially in Stage II (the target stage), it will be necessary to modify the technology, taking into account the possibility of a periodic or emergency application of chemical assistance to improve the discharge as regards phosphorus, if there are any difficulties with the process optimalization for the A2/O system, which is complicated to run.

The hydraulic defects in the flow in ODRA-3 reactors may be removed by the additional use of mixers in the activated sludge chamber. This may be done even at the start-up stage, should there be a need.

Taking the above remarks into consideration, the Preliminary Technical and Economic Design should be directed to the next planning stage, and the complex should be targeted for implementation.

APPENDIX B

Scope of Work: Święta Katarzyna, Poland

APPENDIX B

Scope of Work: LEM Advisory Team for Święta Katarzyna (Wrocław Voivodship) and Ziębice (Wałbrzych Voivodship)

1. Background

The two municipalities (gminas) of Święta Katarzyna and Ziębice are situated on the Oława River, which connects with the Odra River at Wrocław. Święta Katarzyna has a population of about 15,000 and is a suburb of Wrocław; Ziębice has nearly 21,000 people and lies 90 kilometers south of Wrocław. Both have urban centers with rural villages. The two towns have ineffective, undersized, and very old primary wastewater treatment plants that dump into the Oława River and contribute substantially, but not solely, to its contamination. The lack of reliable wastewater treatment in both gminas is a source of extreme difficulty and this environmental problem ranks at the top of the list in each community for immediate action. In addition, the gmina of Wrocław (750,000 inhabitants) takes a large amount of its drinking water from the Oława; thus, improvement in the Oława is as much a regional concern as it is a local one.

Both communities are committed, insofar as their resources will allow, to solving the problem. Św. Katarzyna has moved with dispatch toward the design of a new wastewater treatment plant that will, in stages, take care of its three urban centers: Siechnice, Radwanice, and Święta Katarzyna village. It has received approval for the location of its proposed treatment plant; has produced the required technical and economic analysis of its proposal to gain additional approvals; and is moving, through a local "technical review committee" appointed by the Mayor, into the construction design and bidding process. At the same time, its financing plan is well short of the estimated Zl 60 billion (US $3,750,000) cost of the first phase. The eventual organization of the new system — management, operations, and maintenance — is unclear. Moreover, the gmina will need a longer-range plan to incorporate the wastewater needs of outlying villages that may see the initial expenditures for the urban areas as a one-sided accommodation for those who work in Wrocław and sleep in Św. Katarzyna. Training and public information are also needed, albeit not immediately.

Ziębice has already expended great cost and effort to modernize the wastewater system in its older and famous "baroque village" of Henryków; at the same time the problems of the Ziębice center are pressing and difficult. Gmina officials are committed to solving the wastewater problem but they are beset with financial problems and high unemployment and are thus proceeding more cautiously than Św. Katarzyna. A preliminary study of needs and a general design have been completed; in April 1993, the gmina officials expect, through competitive bids, to hire a design engineer to assemble the required documentation for technical and economic analysis so that it can be submitted (1) to the voivodship for locational approval and (2) to the regional construction authority for preliminary site construction.

Although Święta Katarzyna and Ziębice are in different voivodships, they come under the same Regional Water Management Authority, headquartered in Wrocław. This is a new — and fledgling — organization with a small budget and staff who, under a director with positive attitudes,

are attempting to make a difference. LEM is working with the Authority as well as the voivodship to assist the focused gminas in promoting both local and regional improvement.

2. Scope of work

Święta Katarzyna and Ziębice, with the support of the voivodship and the Regional Water Management Authority, are seeking technical assistance through LEM and, given their individual circumstances, are ready to work. Their needs are generally as follows:

(1) design and construction assistance to review their immediate plans and to suggest ways to improve their approach (this would include, particularly in the case of Św. Katarzyna, working with the technical committee in determining how best to approach the bidding process; in Ziębice the same advice is needed but at an earlier stage in the process);

(2) a financial analysis of the fiscal needs of both communities that will:

- determine what can be paid for locally, what additional funding is needed, and whether it can be paid for out of extended rate revenue dedication over time, etc., and
- result in the production of a rational, acceptable "business plan" to convince central government ministries and/or international funding agencies to assist;

(3) a management plan for the organization of the system so that the gmina will be able to carry on the operation and maintenance once the facility is built; and

(4) a longer-range plan that will incorporate the rural villages into a feasible technical, managerial, and fiscal program.

In addition, some technical assistance should be given to the Regional Water Management Authority, in the area of agricultural runoff (fertilizer, etc.), which is a nonpoint source of pollution for which the Director of the Authority has specifically asked for assistance.

The technical assistance team should consist of (1) an experienced wastewater design engineer familiar with relatively small-scale design and construction of wastewater treatment plants; (2) an experienced wastewater administrator who has handled the design, construction, management, and operation of small-scale and medium-sized wastewater treatment plants and their collection systems, and is also familiar with the application of rates towards the financing of these systems; and (3) a financial/organizational analyst who has had sufficient experience in municipal finance, in the US and abroad, to make a careful analysis of the financial structure of the two gminas and to produce a financial plan supporting the wastewater improvement programs. It is expected that the three experts assembled will be able to devise long-range plans for wastewater improvement for the central areas as well as the most rural villages. They may also be able to draw upon the parallel work being done in Miedźna by another LEM team with respect to variations in wastewater treatment within a

single gmina. The team should also define, insofar as possible, potential training needs as well as public information requirements of the work being undertaken by Św. Katarzyna and Ziębice. Members of the team should be mature, experienced, patient, and professional advisers in a situation where the host government and its technicians already have demonstrated their own technical professionalism.

The team will be complemented by one or two local sanitary/environmental engineering experts who will supply direct technical translations and interpretation as well. LEM also plans to recruit or make available a local financial expert. As necessary, the LEM/Kraków Office will make available interpreters and/or translators. LEM/Kraków will, as necessary and possible, arrange for secretarial, translation, and communication support in Wroclaw for the working team.

LEM/Kraków would like for the team to be in Kraków on or about April 16th with briefings to take place on the weekend, and transport to Wroclaw for preliminary meetings at the beginning of the week. The team will work out of Wroclaw and reside at the Panorama Hotel. This location will accommodate contact with the Water Authority, the voivodship, and Św. Katarzyna; there are also acceptable hotel accommodations in Ziębice. For the most part, transportation will be by taxis, which are plentiful and not unreasonably expensive. A team leader should be designated by RTI/NC and the team should be assembled and briefed together in NC before arriving in Kraków. It should be understood that the team leader, and the team members, will perform their task at the highest professional standard in collegial relationship with Polish professionals and government officials under the direction of the LEM project manager.

The team will produce reports on both cities and a composite on the overall wastewater project with respect to Św. Katarzyna and Ziębice, consistent with what has been described in the Scope of Work. This report, in English, should be given to the LEM/Kraków project manager before the team's departure. The work of the team will be facilitated if RTI/NC can provide the team members with laptop computers that can print in Wroclaw and/or Kraków. At the same time, team members should be attentive to related requests for advice and assistance that can be managed within the time frame of their work. A briefing session on the findings and recommendations with officials of both Św. Katarzyna and Ziębice should be held at least one week before departure; briefings should also be scheduled at some point toward the end of the team's service with the Water Authority and the voivodship. The USAID Office/Warsaw may also request a final debriefing.

The estimated length of this team's consultancy will be 6 weeks. It may also be augmented as necessary and possible with the inclusion of Nowa Sól (Zielona Góra Voivodship) in the project; this addition will be determined after a trip to Nowa Sól scheduled for the latter part of March.

RTI/NC should also recruit a consultant to work with the Water Authority on nonpoint pollution related to agricultural/chemical fertilizer runoff and to advise the Authority on proper steps to be taken, particularly in public education, in attempting to reduce this element of pollution in the Olawa/Odra Rivers.

The project manager shall give additional direction and guidance to the team members as they work together to undertake, and complete, their field work.

APPENDIX C

Preliminary Wastewater Treatment and Collection Design

Stage I in Preliminary Design (Figure C-1)

Stage II in Preliminary Design (Figure C-2)

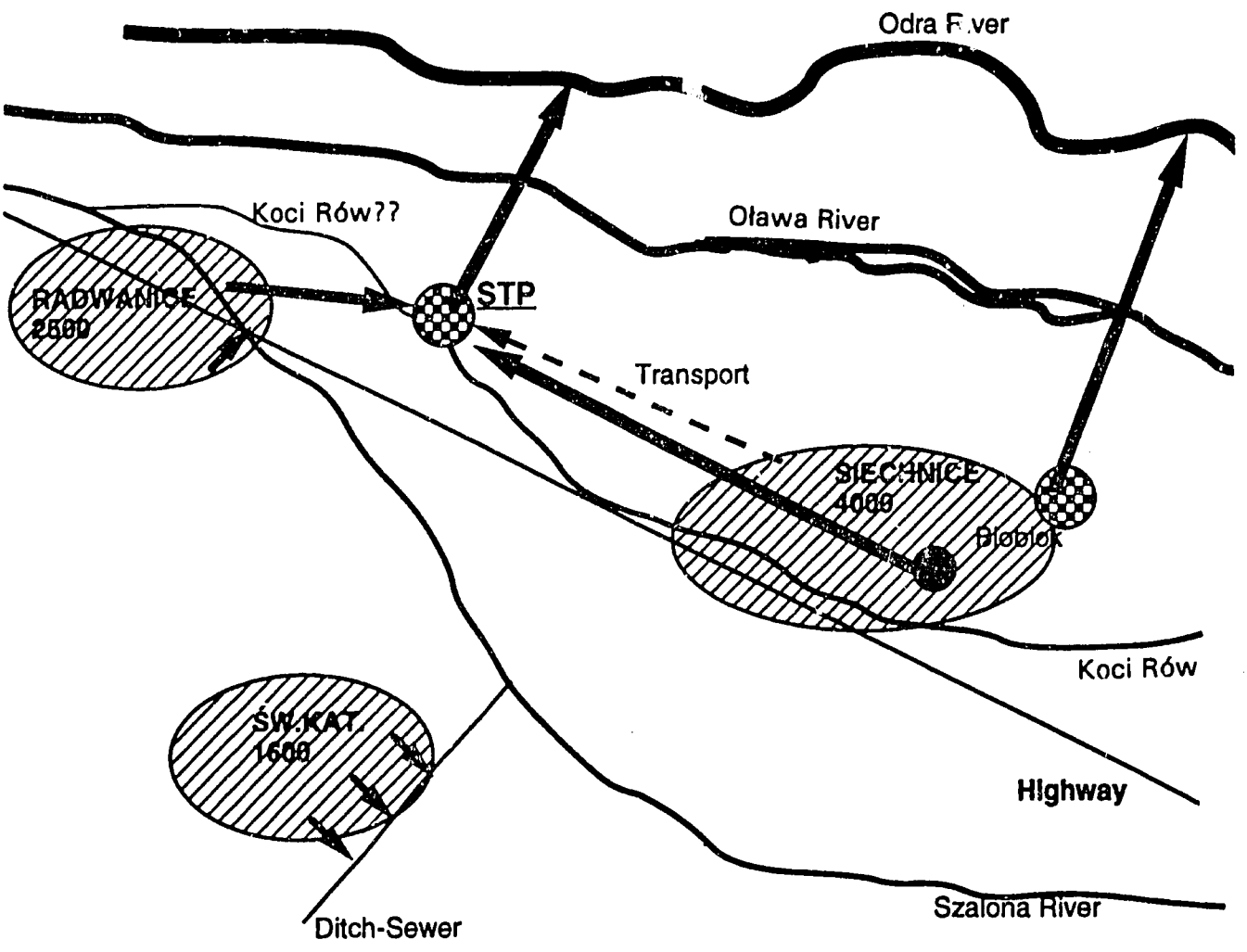


FIGURE C-1

STAGE I in preliminary design: Trucking of waste to STP and intake of Koci Rów and 90% of Radwanice. (Q = 1800 m^3/d). Siechnice continues the BIOBLOK. 10% of Radwanice and 100% of ŚWK still contribute to Oława's pollution. Raw sewage in the area of water intake. Discharge of treated sewage to Odra River.

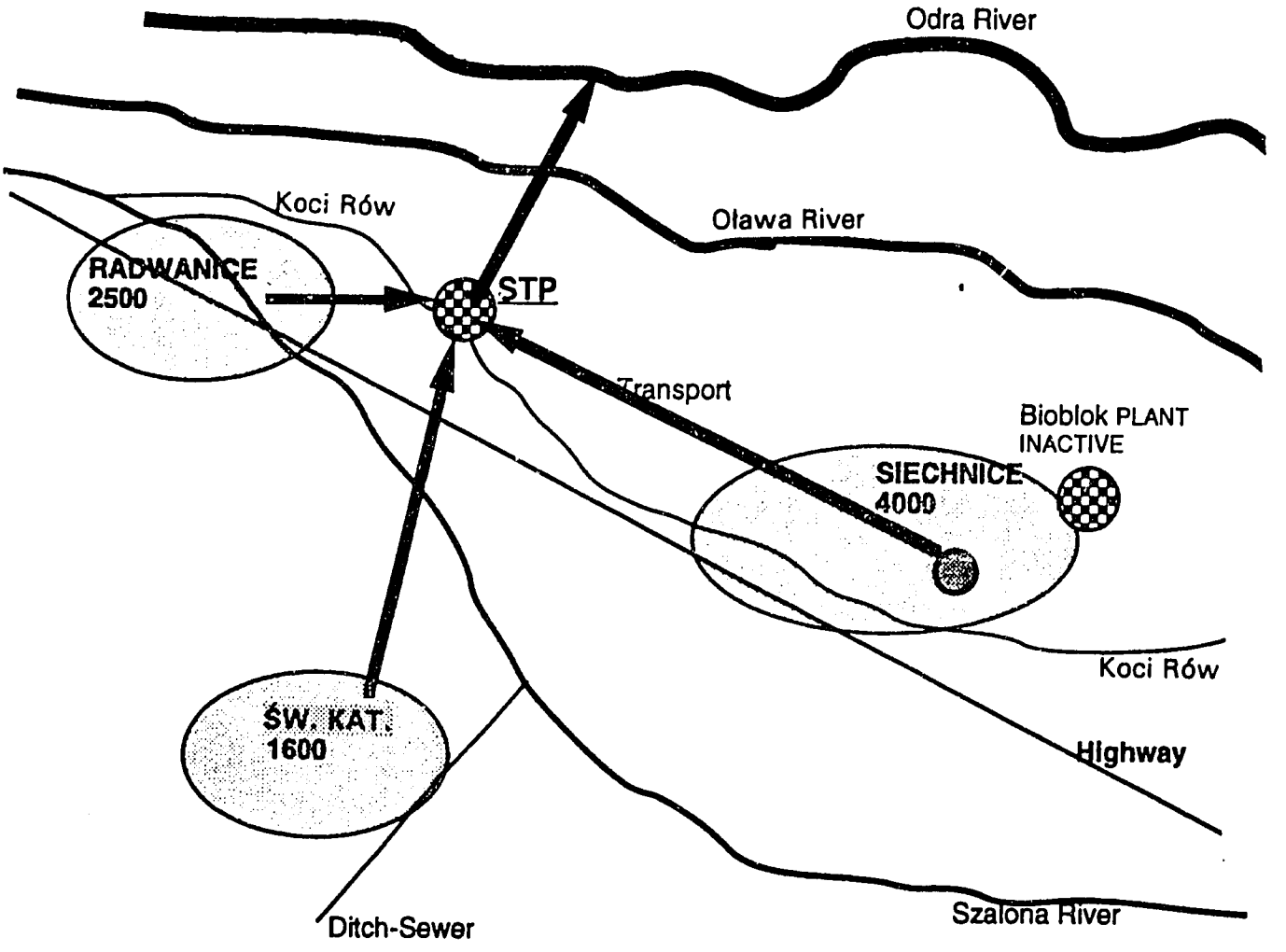


FIGURE C-2

STAGE II in preliminary design: All villages and towns sewered. (Q = 3600 m^3/d). Secondary and tertiary treatment. Additional villages can be connected; total costs beyond zł. 60 billion, year 2010.

APPENDIX D

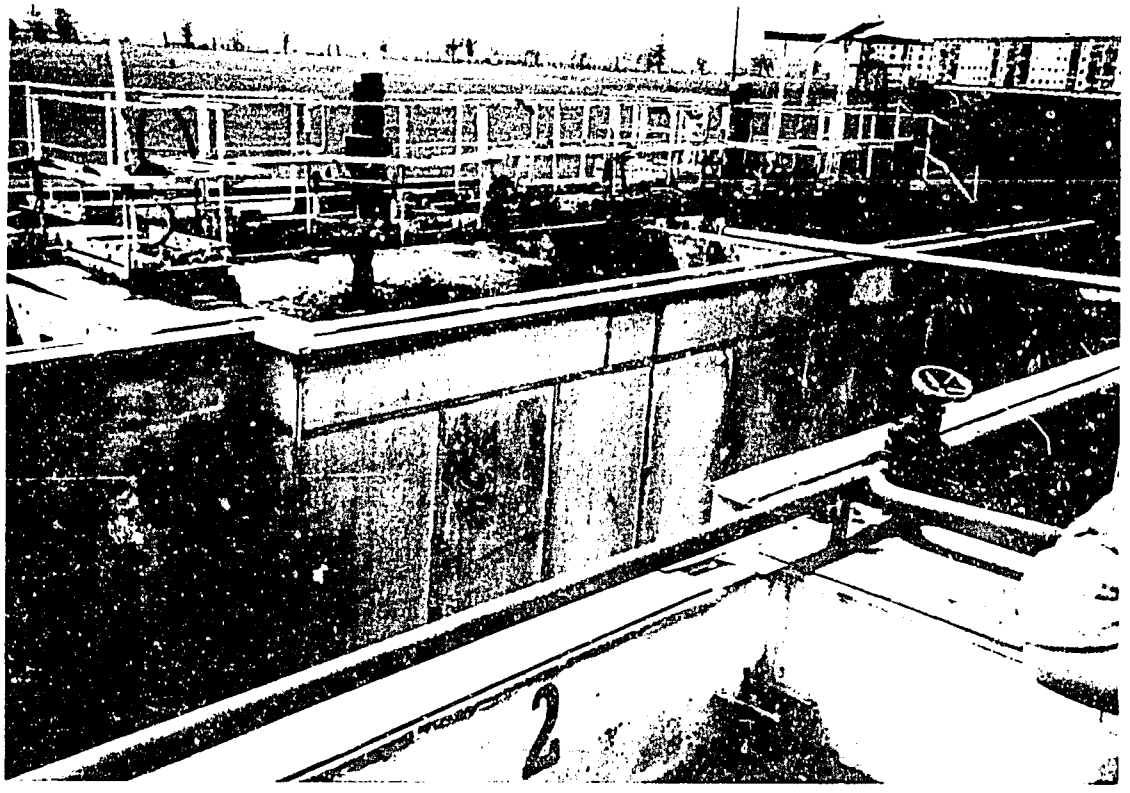
Site Photographs

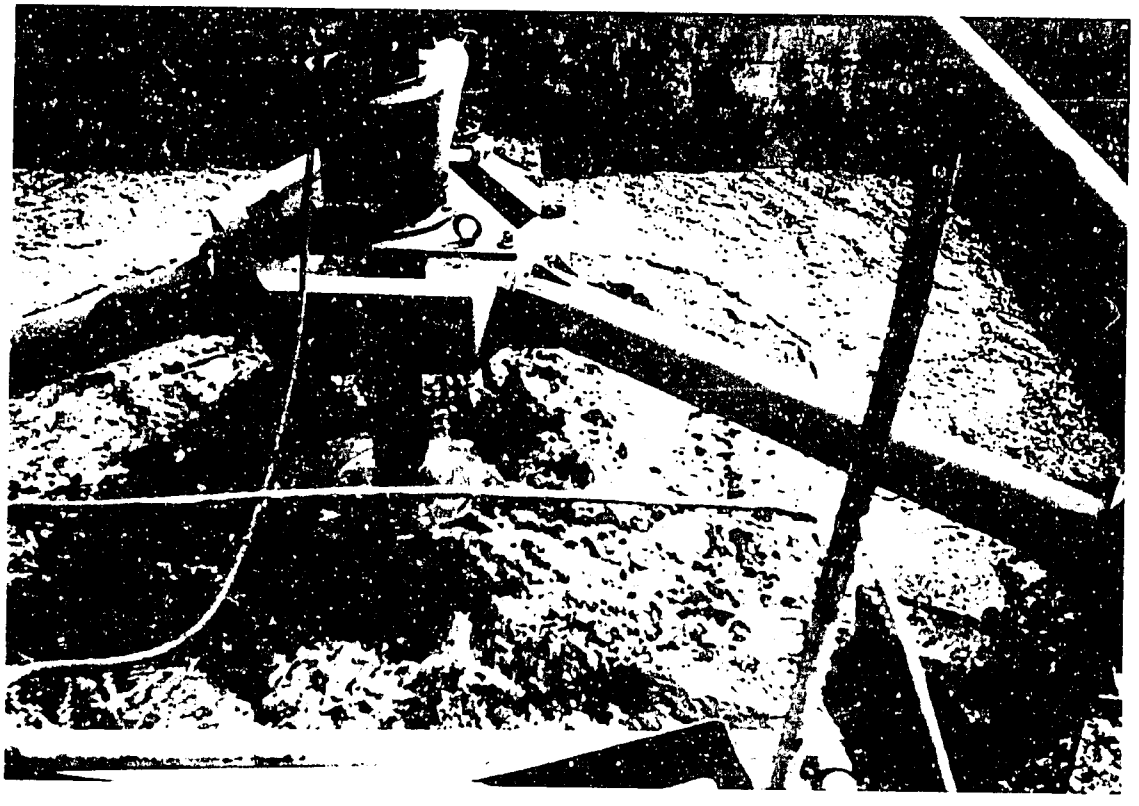
Discharge of wastewater from Święta Katarzyna to Szalona River

BIOBLOK Treatment Plant in Siechnice

A ditch/open sewer discharging septic wastewater from the village of Św. Katarzyna to Szalona River. This source was not included in the first stage of the investment planned.

Rów wprowadzający zagniłe ścieki surowe ze Św. Katarzyny do rzeki Szalonej, tuż powyżej mostu. Ten wylot nie został ujęty w pierwszej fazie proponowanej inwestycji.





The existing BIOBLOK plant for 800 m^3/d serves the Siechnice fruit and vegetable complex employees and discharges by a pipeline to the Odra River. The plant appears to work well but needs service and maintenance (employs 6 people who also service the water system). The plant will be scrapped in 2010 and waste will be pumped to the new plant.

Istniejąca oczyszczalnia BIOBLOK w Siechnicach dla pracowników Kombinatu Ogrodowego, o pojemności 800 m^3/d, przerzuca ścieki do Odry. Pracuje dobrze (zatrudnia 6 ludzi, obsługujących też system podaży wody), choć wymaga serwisu i konserwacji. W planie zamknięcie w r. 2010 i przerzut ścieków do nowej oczyszczalni.

APPENDIX E

Design of Siechnice STP

Preliminary Design Flow Diagram (Figure E-1)

SBR Modification (Figure E-2)

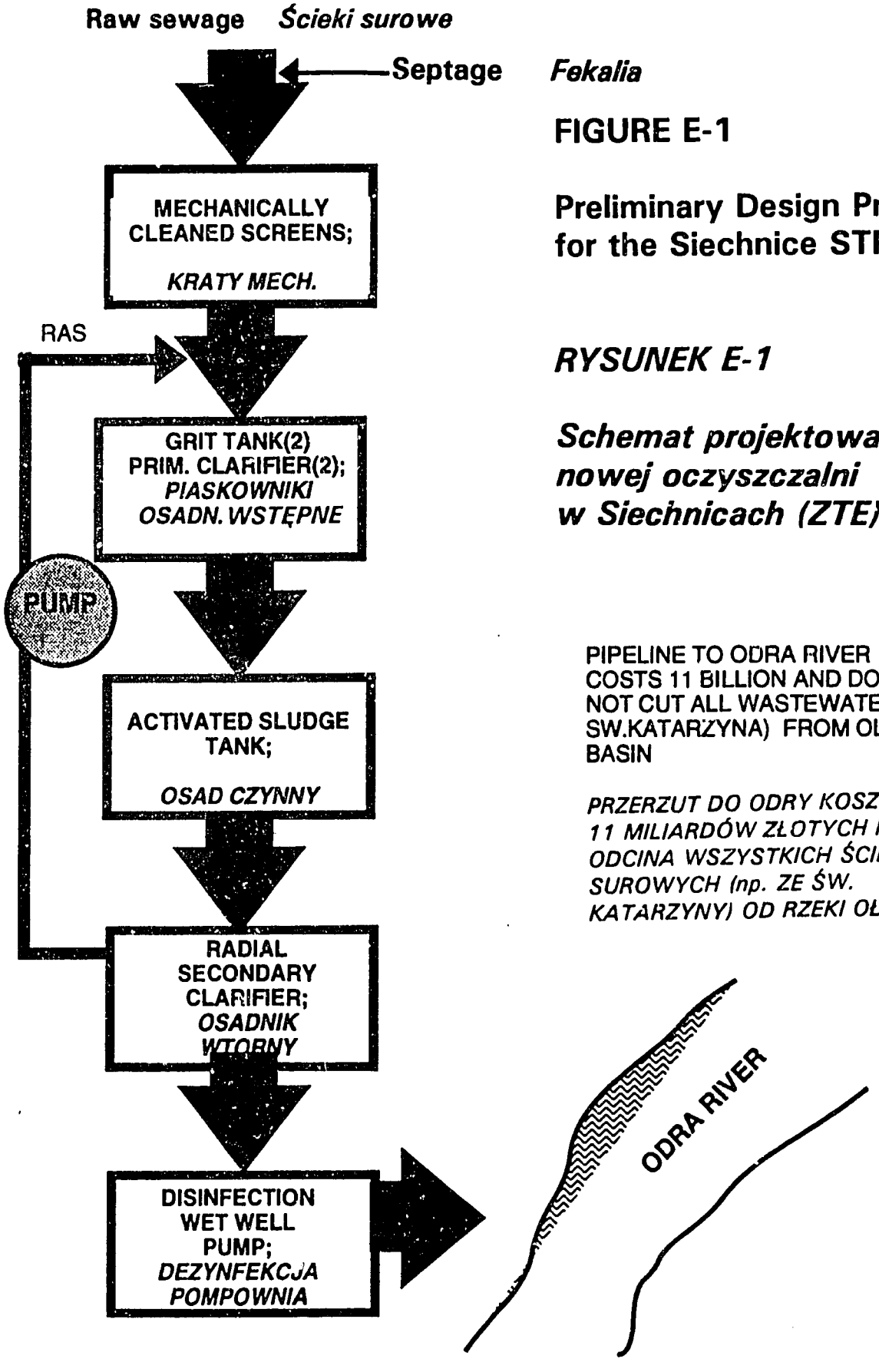


FIGURE E-1

Preliminary Design Proposal for the Siechnice STP

RYSUNEK E-1

Schemat projektowanej nowej oczyszczalni w Siechnicach (ZTE).

PIPELINE TO ODRA RIVER COSTS 11 BILLION AND DOES NOT CUT ALL WASTEWATER (e.g. SW.KATARZYNA) FROM OLAWA BASIN

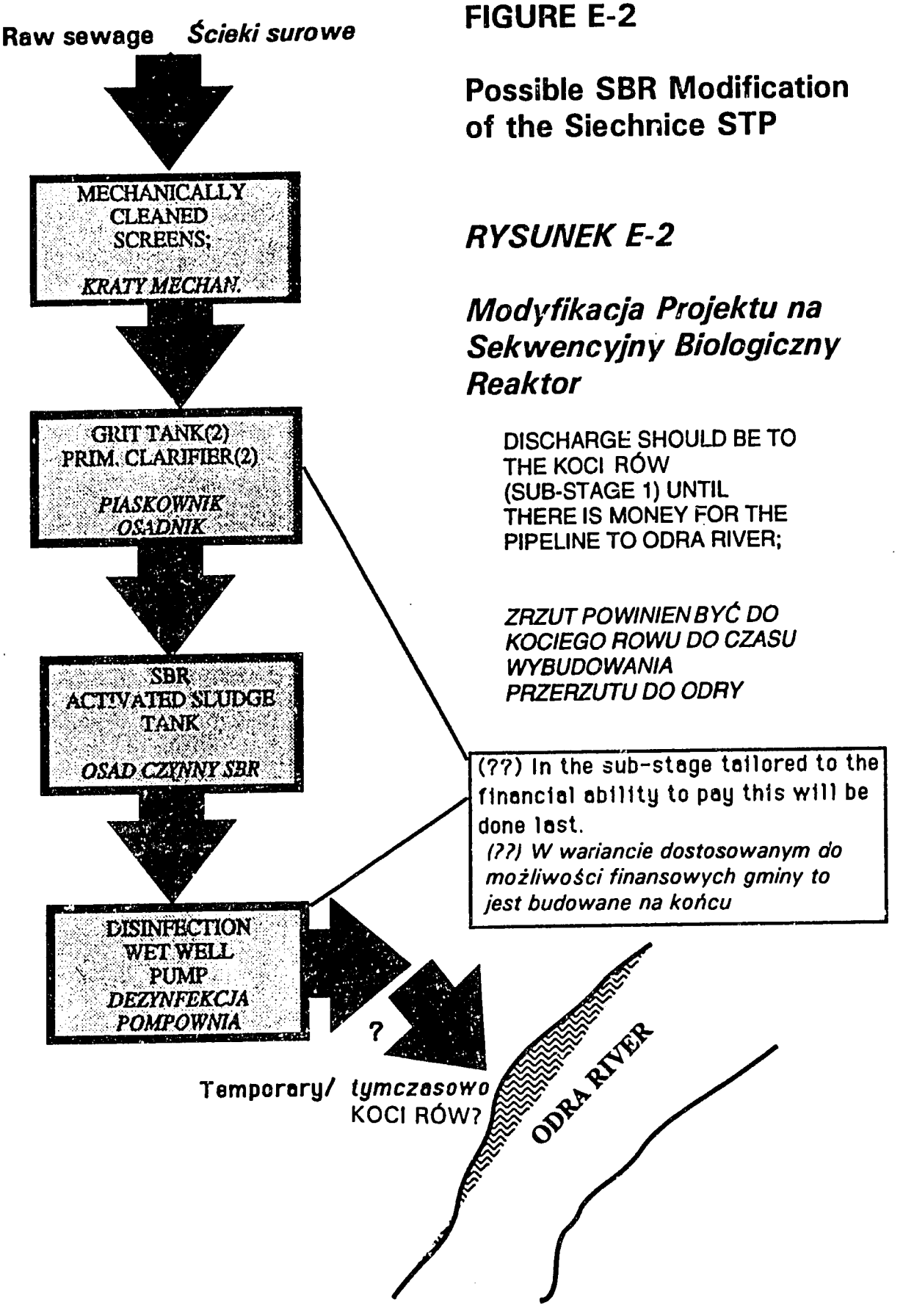
PRZERZUT DO ODRY KOSZTUJE 11 MILIARDÓW ZŁOTYCH I NIE ODCINA WSZYSTKICH ŚCIEKÓW SUROWYCH (np. ZE ŚW. KATARZYNY) OD RZEKI OŁAWY.

FIGURE E-2

Possible SBR Modification of the Siechnice STP

RYSUNEK E-2

Modyfikacja Projektu na Sekwencyjny Biologiczny Reaktor



APPENDIX F

Costs and Distances from Villages to Siechnice STP

(Figure F-1)

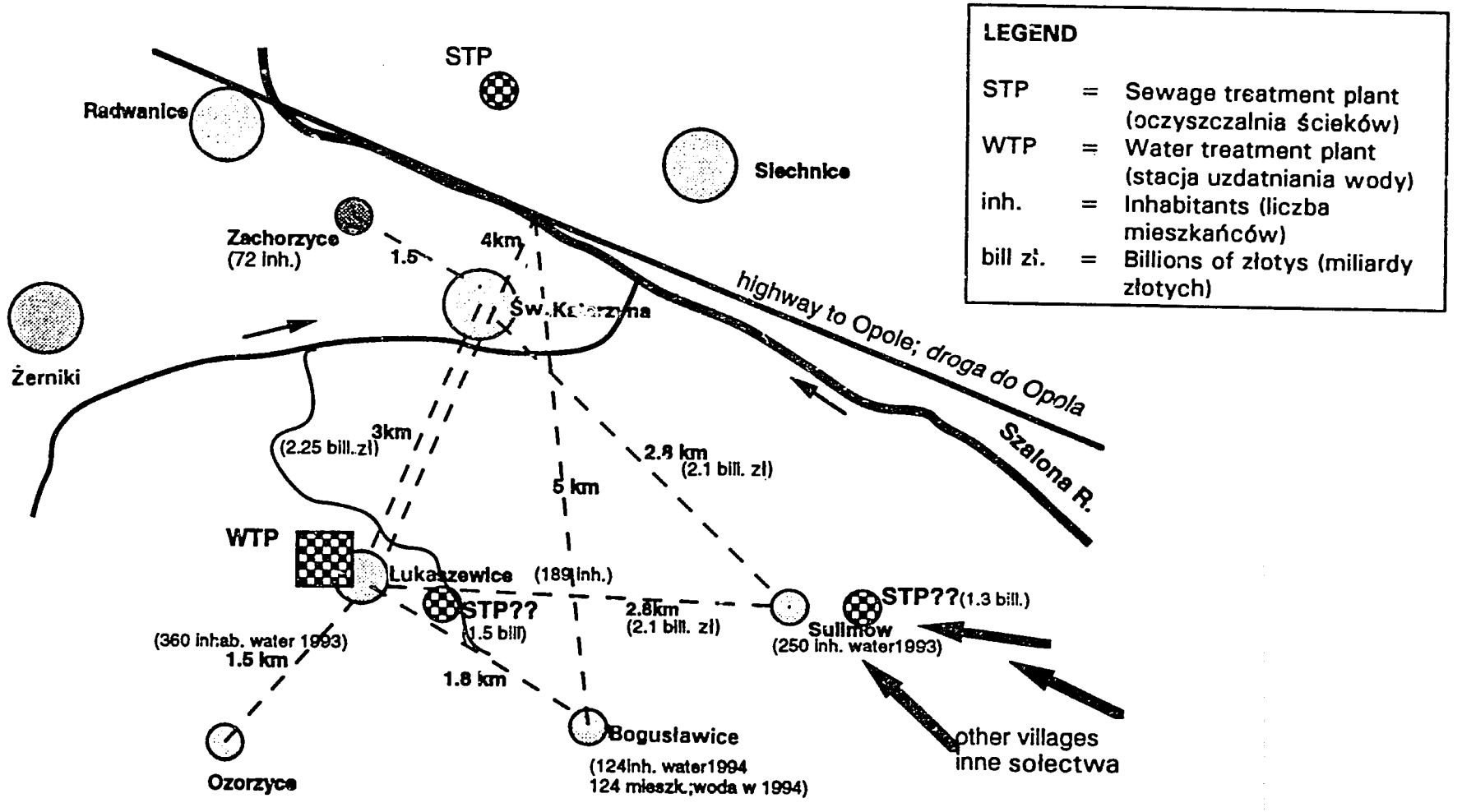


FIGURE F-1
Approximate Situation in Southern Part of Gmina Święta Katarzyna

APPENDIX G

LEM Proposals

"Unlimited Funds" Solution
(Figure G-1)

Cost-Effective Solution
(Figure G-2)

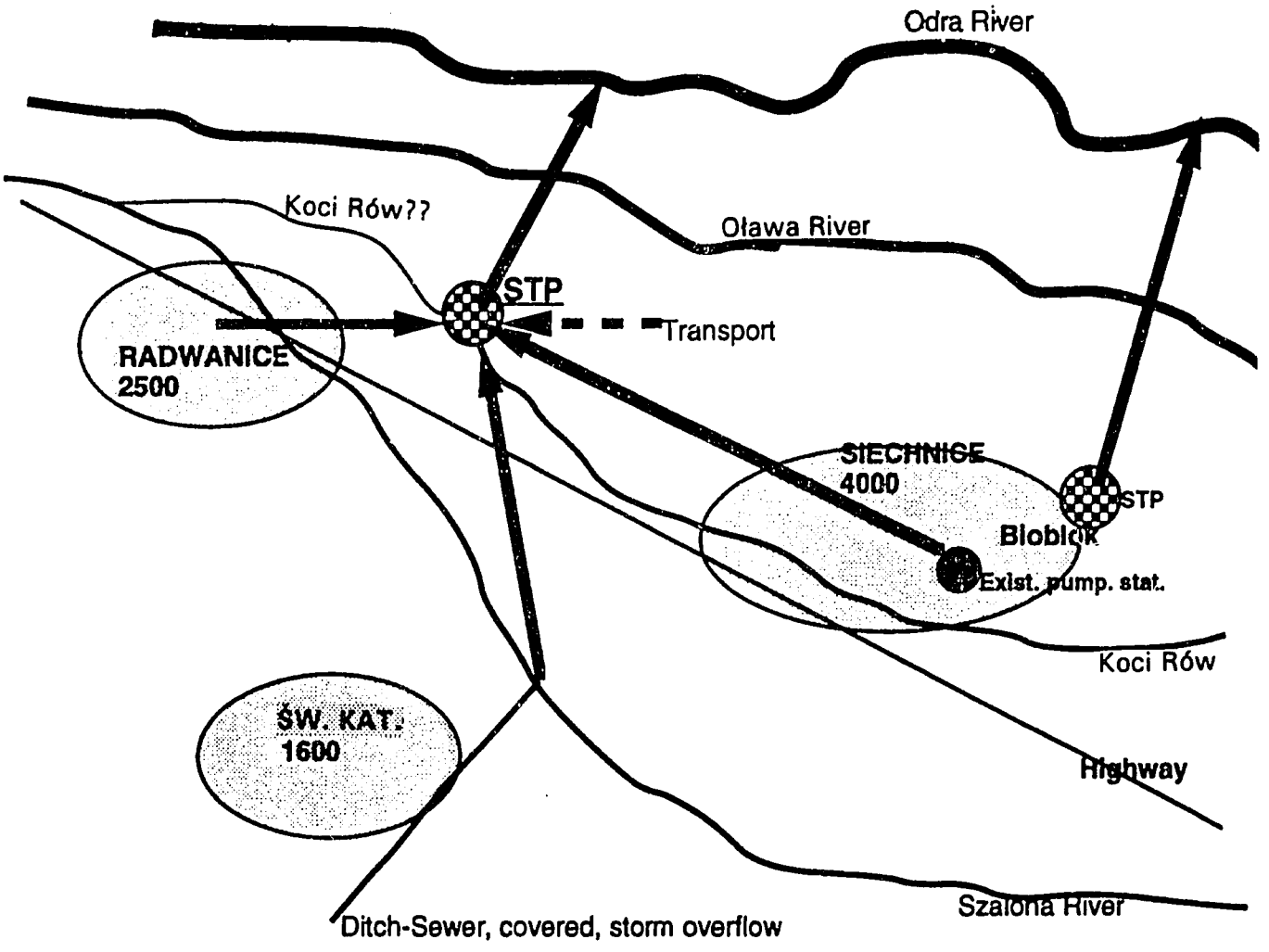


FIGURE G-1

LEM PROPOSAL•THE UNLIMITED FUNDS SOLUTION

STAGE I: TRUCKING OF WASTE TO S.T.P., INTAKE OF KOCI RÓW, Part of SIECHNICE, ŚWK & RADWANICE (Q=1800 cu.m/d).
Siechnice continues the BIOBLOK; Radwanice and ŚWK do not contribute to Oława's pollution. Secondary/tertiary effluent to Odra River

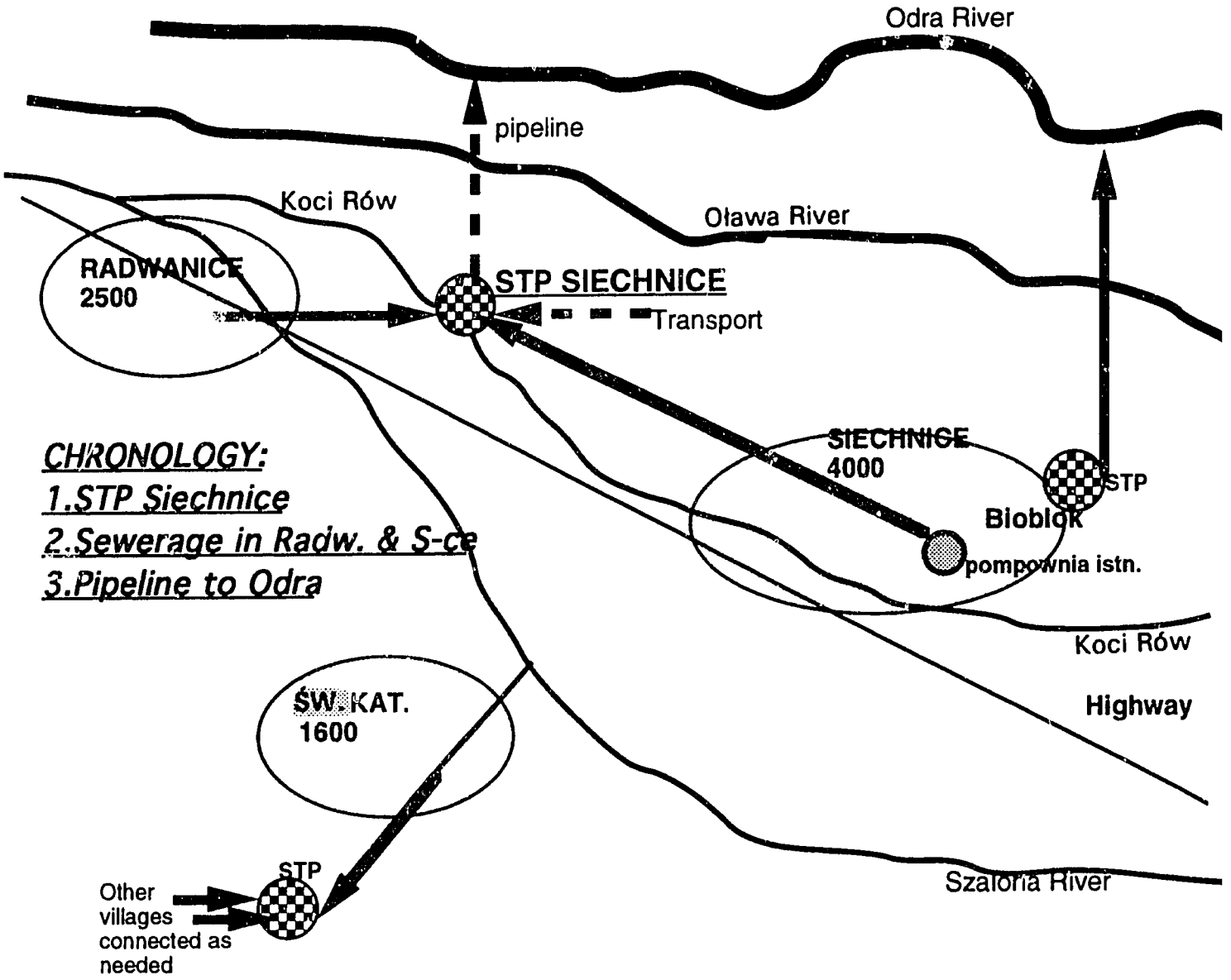


FIGURE G-2

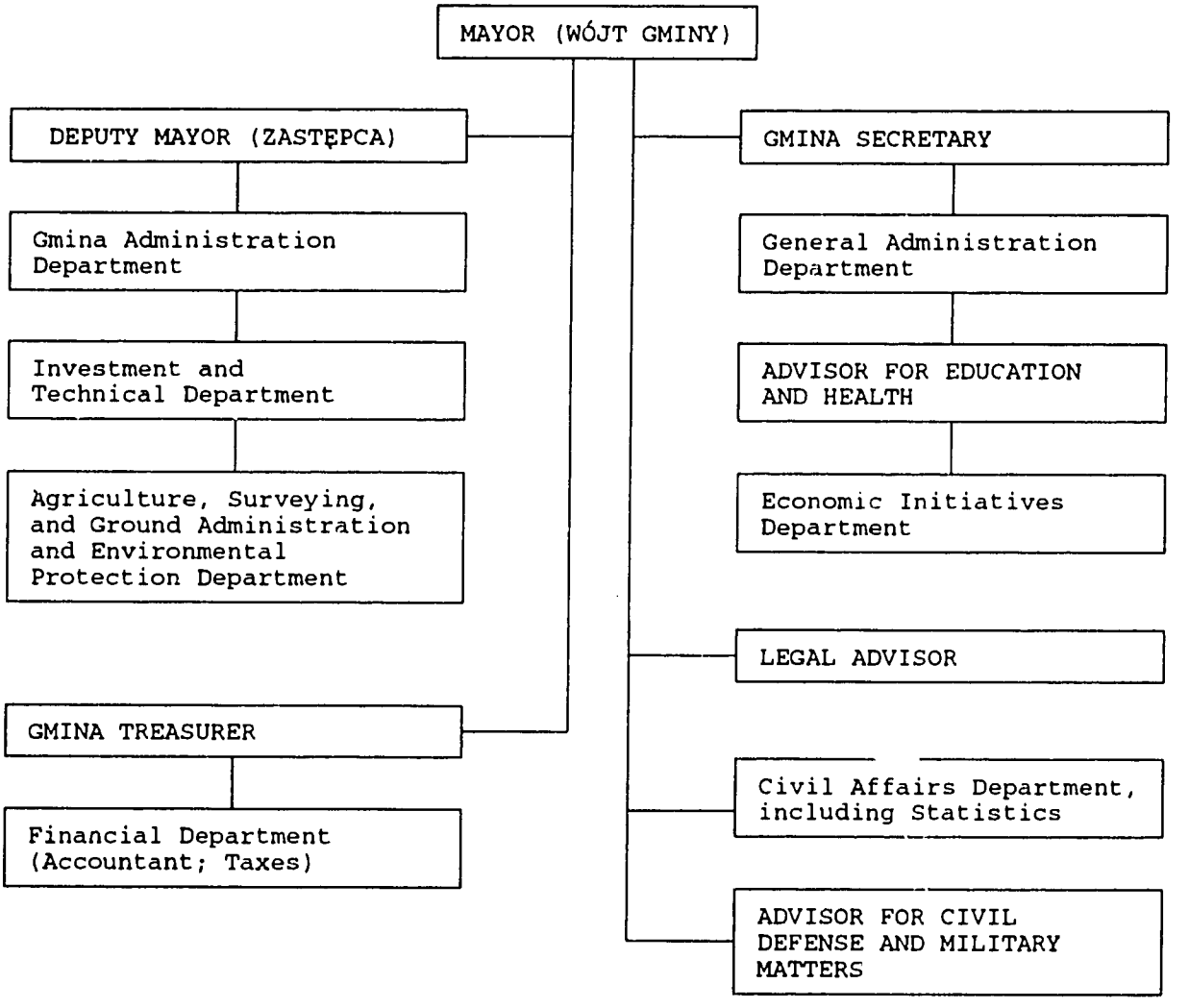
LEM: COST-EFFECTIVE SOLUTION
Staging the construction of the treatment plant, sewers and the pipeline to Odra River

TRUCKING AND INTAKE OF KOCI RÓW. Św KATARZYNA HAS OWN PLANT OR PUMPS TO THE TREATMENT PLANT. ALL RAW WASTE CUT OFF THE DRAINAGE BASIN. STAGING OF CONSTRUCTION AS PER AVAILABLE CREDIT IN SEQUENCE: STP SIECHNICE SBR MODE--SEWERS-PIPELINE TO ODRA RIVER.

APPENDIX H

Organization of Gmina Administration

Święta Katarzyna Management
and Organizational Structure



Gmina budgetary units:

Kindergartens — Siechnice, Święta Katarzyna, Zerniki
Gmina Cultural Center
Gmina Social Welfare Center

APPENDIX I

1993 Budget for Święta Katarzyna

Appendix for Resolution of Święta Katarzyna Gmina Council dated March 26, 1993: Budget for 1993

GMINA BUDGET REVENUE FOR THE YEAR 1993

Pos.	Specification	Plan for 1993 (in millions of zl)
[1]	[2]	[3]
	TOTAL REVENUE	34,332
I.	Local Revenue	19,046
1.	Agriculture and forestry tax	2,900
2.	Fixed assets tax	7,000
3.	Transportation means tax	962
4.	Free enterprise chart tax	1,455
5.	Inheritance and donation tax	100
6.	Other revenue: penalties, interest, etc.	1,283
7.	Treasury fees	730
8.	Administrative fees, etc.	490
9.	Sales and lease of gmina property	3,656
10.	Revenue from investment of capital	470
II.	Participation in Revenue from National Budget	7,600
1.	Personal income tax	7,200
2.	Corporate income tax	400
III.	Settlement of Various Accounts	6,911
1.	Inter-municipal budgetary settlement	400
2.	Revenues from gmina residents	600
3.	Subsidies for "ordered" and "contracted" tasks	1,711
4.	Subsidies for investments	4,200
IV.	General Subsidies	775

GMINA BUDGET EXPENDITURES FOR THE YEAR 1993

Section	Chapter	Specification	Plan for 1993 (in millions of Zl)
[1]	[2]	[3]	[4]
		TOTAL EXPENDITURES	34,839
40		Agriculture	450
	4406	Maintenance of irrigation systems	450
45		Forestry	40
	4995	Other activities	40
50		Transportation	1,230
	5613	Maintenance of public roads	1,230
70		Gmina administration	18,818
	7221	Cleaning of cities	250
	7262	Street lighting	1,300
	7395	Other activities, including:	17,268
		Gmina administrative operating costs	1,220
		Repairs to gmina infrastructure	100
		Preventive maintenance	150
		Gmina property management costs	1,500
		Investments	14,298
74		Housing administration and nonstructural gmina services	450
	7523	Volunteer fire brigades	450
79		Education	2,870
	7911	Primary schools	420
	8211	Kindergartens	2,300
	8241	Recreational activities and orphanages	150
83		Culture	1,340

Section	Chapter	Specification	Plan for 1993 (in millions of Zl)
[1]	[2]	[3]	[4]
	8332	Cultural centers - subsidies for gmina cultural centers (CCC)	1,340
85		Health protection	100
	8595	Other activities - subsidies	100
86		Social welfare	2,111
	8613	Relief funds and material contributions	1,802
	8615	Local social welfare centers	309
87		Sports	250
	8795	Other activities - subsidies for clubs	250
89		Various activities	1,680
	8995	Other activities, including:	1,680
		Participation in consortium	1,220
		Local press	60
		Tax collectors' commission	135
		Village administrative offices	25
		Parliamentary self-government	40
		Deduction for village councils	200
91		National and self-government administration	4,650
	9144	Gmina council	100
	9145	Gmina management	50
	9146	Gmina office	4,500

Section	Chapter	Specification	Plan for 1993 (in millions of Zl)
[1]	[2]	[3]	[4]
97		Settlement of various accounts	850
	9718	General and specific task reserves, including:	850
		General reserve account (1% of expenditures)	348
		Task reserve (up to 4% of expenditures)	502

APPENDIX J

Income and Expense Projections for Water/Sewer System (1993-2000)

APPENDIX J

SWIETA KATARZYNA WATER/SEWER SYSTEM

INCOME AND EXPENSE PROJECTIONS FOR WATER / SEWER SYSTEM - 1993 THROUGH 2000

AVERAGE WATER CONSUMPTION RATES FOR SWIETA KATARZYNA WATER/SEWER SYSTEM -- cubic meters per month

	1993	1994	1995	1996	1997	1998	1999	2000
RESIDENTIAL	15.0	16.5	18.2	20.0	22.0	24.2	26.6	29.2
RESIDENTIAL - SIECHNICE	15.0	16.5	18.2	20.0	22.0	24.2	26.6	29.2
COMMERCIAL/INDUSTRIAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INSTITUTIONAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SEWER	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8

SEWER CUSTOMERS OF THE SWIETA KATARZYNA WATER/SEWER SYSTEM

	1993	1994	1995	1996	1997	1998	1999	2000
RESIDENTIAL	0	0	0	1000	1100	1210	1331	1464
RESIDENTIAL - SIECHNICE	0	0	0	0	0	0	0	0
COMMERCIAL/INDUSTRIAL	0	0	0	0	0	0	0	0
INSTITUTIONAL	0	0	0	0	0	0	0	0
TOTAL CUSTOMERS	0	0	0	1000	1100	1210	1331	1464

SEWER RATES OF THE SWIETA KATARZYNA WATER/SEWER SYSTEM -- Zlotys per cubic meter

	1993	1994	1995	1996	1997	1998	1999	2000
RESIDENTIAL	0	0	0	5,200	5,460	5,733	6,020	6,321
RESIDENTIAL - SIECHNICE	0	0	0	0	0	0	0	0
COMMERCIAL/INDUSTRIAL	0	0	0	0	0	0	0	0
INSTITUTIONAL	0	0	0	0	0	0	0	0

PROJECTED SEWER INCOME OF THE SWIETA KATARZYNA WATER/SEWER SYSTEM -- (000) Zlotys

	1993	1994	1995	1996	1997	1998	1999	2000
RESIDENTIAL	0	0	0	996,653	1,266,247	1,608,767	2,043,939	2,596,824
RESIDENTIAL - SIECHNICE	0	0	0	0	0	0	0	0
COMMERCIAL/INDUSTRIAL	0	0	0	0	0	0	0	0
INSTITUTIONAL	0	0	0	0	0	0	0	0
TOTAL SEWER INCOME	0	0	0	996,653	1,266,247	1,608,767	2,043,939	2,596,824

APPENDIX J

SWIETA KATARZYNA WATER/SEWER SYSTEM

INCOME AND EXPENSE PROJECTIONS FOR WATER / SEWER SYSTEM - 1993 THROUGH 2000

WATER CUSTOMERS OF THE SWIETA KATARZYNA WATER/SEWER SYSTEM

	1993	1994	1995	1996	1997	1998	1999	2000
RESIDENTIAL	260	386	550	578	606	637	669	702
RESIDENTIAL SIECHNICE	113	226	226	226	226	226	226	226
COMMERCIAL/INDUSTRIAL	0							
INSTITUTIONAL	0							
TOTAL CUSTOMERS	373	612	776	804	832	863	895	928

WATER RATES OF THE SWIETA KATARZYNA WATER/SEWER SYSTEM -- Zlotys per cubic meter

	1993	1994	1995	1996	1997	1998	1999	2000
RESIDENTIAL	4,500	4,725	4,961	5,209	5,470	5,743	6,030	6,332
MULTI-FAMILY	4,500	4,725	4,961	5,209	5,470	5,743	6,030	6,332
COMMERCIAL/INDUSTRIAL	4,500	4,725	4,961	5,209	5,470	5,743	6,030	6,332
INSTITUTIONAL	4,500	4,725	4,961	5,209	5,470	5,743	6,030	6,332

PROJECTED WATER INCOME OF THE SWIETA KATARZYNA WATER/SEWER SYSTEM -- (000) Zlotys

	1993	1994	1995	1996	1997	1998	1999	2000
RESIDENTIAL	210,600	361,122	594,308	720,747	874,086	1,060,048	1,285,573	1,559,079
RESIDENTIAL - SIECHNICE	91,530	211,434	244,207	282,059	325,778	376,273	434,596	501,958
COMMERCIAL/INDUSTRIAL	0	0	0	0	0	0	0	0
INSTITUTIONAL	0	0	0	0	0	0	0	0
TOTAL WATER INCOME	302,130	572,557	838,515	1,002,806	1,199,864	1,436,321	1,720,169	2,061,037
TOTAL INCOME	302,130	572,557	838,515	1,999,459	2,466,111	3,045,089	3,764,108	4,657,861

APPENDIX J

SWIETA KATARZYNA WATER/SEWER SYSTEM

INCOME AND EXPENSE PROJECTIONS FOR WATER / SEWER SYSTEM - 1993 THROUGH 2000

EXPENSE OF THE SWIETA KATARZYNA WATER/SEWER SYSTEM -- (000) Zlotys

	1993	1994	1995	1996	1997	1998	1999	2000
PERSONNEL				144,000	151,200	158,760	166,698	175,033
CONTRACTUAL SERVICES	48,000	78,000	85,800	480,094	528,104	580,914	639,006	702,906
ENERGY	73,710	132,412	207,536	623,704	660,858	703,772	753,336	810,583
MATERIALS & SUPPLIES	12,000	18,000	19,800	81,780	89,958	98,954	108,849	119,734
WATER EXTRACTION CHARGE	90,310	198,681	218,549	240,404	264,445	290,889	319,978	351,976
DEBT SERVICE	0		500,000	500,000	500,000	1,000,000	2,000,000	2,000,000
DEPRECIATION COSTS	0							
TOTAL COSTS	224,020	427,093	1,031,685	2,069,983	2,194,565	2,833,289	3,987,867	4,160,232
INCOME LESS EXPENSE	78,110	145,464	(193,171)	(70,524)	271,546	211,800	(223,759)	497,629
CUMULATIVE BALANCE	78,110	223,574	30,404	(40,120)	231,426	443,226	219,467	717,096

BASIS FOR PROJECTIONS:

1. Average water consumption projected to increase 5% annually.
2. Water rates are projected to increase 5% per year to 2000.
3. Sewer rates commence in 1996 and increase 5% per year thru 2000.
4. Sewer customers begin in 1996 at 1000 - thereafter increase 10% year to 2000.
5. Water customers increase based on 11 persons per hook-up - after 1995 increase at 5% per year.
6. Personnel is based on six employees at 24,000,000 Zlotys per year -- increased 10% per year thru 2000.

APPENDIX K

Commercial Bank Financing Projections

APPENDIX K

SWIETA KATARZYNA - SEWERAGE SYSTEM FINANCE PROJECTION

COMMERCIAL BANK FINANCING PROJECTIONS

	INCOME (000 Zlotys)					EXPENSE (000 Zlotys)			BALANCE
Year	From Gmina	From Loans	From Grants	From Interest		Construction Payments	Loan Payments		Fund Balance
1	2,000,000	24,000,000	0	0		24,000,000	0		2,000,000
2	2,000,000	23,000,000	0	160,000		23,000,000	0		2,160,000
3	21,500,000	5,000,000	0	172,800		5,000,000	13,200,000		10,632,800
4	21,500,000	0	0	850,624		0	25,850,000		7,133,424
5	21,000,000	0	0	570,674		0	28,660,000		44,098
6	16,000,000	0	0	3,528		0	15,457,500		590,126
7	2,125,164	0	0	47,210		0	2,762,500		(0)
8	0	0	0	(0)		0	0		(0)
9	0	0	0	(0)		0	0		(0)
10	0	0	0	(0)		0	0		(0)
11	0	0	0	(0)		0	0		(0)
12	0	0	0	(0)		0	0		(0)
13	0	0	0	(0)		0	0		(0)
14	0	0	0	(0)		0	0		(0)
15	0	0	0	(0)		0	0		(0)
16	0	0	0	(0)		0	0		(0)
17	0	0	0	(0)		0	0		(0)
18	0	0	0	(0)		0	0		(0)
19	0	0	0	(0)		0	0		(0)
20	0	0	0	(0)		0	0		(1)
Total	86,125,164	52,000,000	0	1,804,835		52,000,000	85,930,000		

Cash Flow Projections - based on the following assumptions :

1. Commercial Bank or banks provide the following loans:
   24,000,000,000 Zlotys in year 1,
   23,000,000,000 Zlotys in year 2 and
   5,000,000,000 Zlotys in year 3
2. The Gmina budget provides Zl. 2 Bil. each year through year 2 and thereafter provides annual payments necessary to meet debt service requirments
3. Loan terms: a)interest rates are 30%; b)two years interest to be capitalized; c) annual loan payments are made at beginning of year;
   d) payment terms are for three years.

APPENDIX K

SWIETA KATARZYNA - SEWERAGE SYSTEM FINANCE PROJECTION

COMMERCIAL BANK FINANCING PROJECTIONS

LOAN SUMMARY (000 Zlotys)

Year	Loan Draw	Interest	Loan Payments	Total Debt Outstanding
1	24,000,000	0	0	24,000,000
2	23,000,000	7,200,000	0	54,200,000
3	5,000,000	12,300,000	13,200,000	58,300,000
4		9,735,000	25,850,000	42,185,000
5		4,057,500	28,660,000	17,582,500
6		637,500	15,457,500	2,762,500
7		0	2,762,500	0
8		0	0	0
9		0	0	0
10		0	0	0
11		0	0	0
12		0	0	0
13		0	0	0
14		0	0	0
15		0	0	0
16		0	0	0
17		0	0	0
18		0	0	0
19		0	0	0
20		0	0	0

LOAN ONE SCHEDULE

Year	Principal	Interest	Payments	Balance
1	24,000,000			24,000,000
2	24,000,000	7,200,000		31,200,000
3	31,200,000	5,400,000	13,200,000	23,400,000
4	23,400,000	3,060,000	13,200,000	13,260,000
5	13,260,000	0	13,260,000	0
6	0	0	0	0
7	0	0	0	0
8	0	0		0
9	0	0		0
10	0	0		0
11	0	0		0
12	0	0	0	0
13	0	0	0	0
14	0	0	0	0
15	0	0		0
16	0	0		0
17	0	0		0
18	0	0		0
19	0	0		0
20	0	0		0

LOAN TWO SCHEDULE

Year	Principal	Interest	Payments	Balance
1	0			0
2	23,000,000	0		23,000,000
3	23,000,000	6,900,000		29,900,000
4	29,900,000	5,175,000	12,650,000	22,425,000
5	22,425,000	2,932,500	12,650,000	12,707,500
6	12,707,500	0	12,707,500	0
7	0	0	0	0
8	0	0	0	0
9	0	0		0
10	0	0		0
11	0	0		0
12	0	0	0	0
13	0	0	0	0
14	0	0	0	0
15	0	0		0
16	0	0		0
17	0	0		0
18	0	0		0
19	0	0		0
20	0	0		0

LOAN THREE SCHEDULE

Year	Principal	Interest	Payments	Balance
1	0			0
2	0	0		0
3	5,000,000	0		5,000,000
4	5,000,000	1,500,000	0	6,500,000
5	6,500,000	1,125,000	2,750,000	4,875,000
6	4,875,000	637,500	2,750,000	2,762,500
7	2,762,500	0	2,762,500	0
8	0	0	0	0
9	0	0	0	0
10	0	0	0	0
11	0	0		0
12	0	0	0	0
13	0	0	0	0
14	0	0	0	0
15	0	0		0
16	0	0		0
17	0	0		0
18	0	0		0
19	0	0		0
20	0	0		0

APPENDIX L

National Environmental Bank Financing Projections

APPENDIX I.

SWIETA KATARZYNA - SEWERAGE SYSTEM FINANCE PROJECTION

NATIONAL ENVIRONMENTAL BANK FINANCING PROJECTIONS

	INCOME (000 Zlotys)					EXPENSE (000 Zlotys)			BALANCE
Year	From Gmina	From Loans	From Grants	From Interest		Construction Payments	Loan Payments		Fund Balance
1	2,000,000	24,000,000	0	0		24,000,000	0		2,000,000
2	2,000,000	23,000,000	0	160,000		23,000,000	0		2,160,000
3	8,000,000	5,000,000	0	172,800		5,000,000	0		10,332,800
4	15,000,000	0	0	826,624		0	13,000,000		13,159,424
5	15,000,000	0	0	1,052,754		0	25,000,000		4,212,178
6	15,000,000	0	0	336,974		0	19,308,400		240,752
7	7,900,000	0	0	19,260		0	8,154,300		5,712
8	2,240,000	0	0	457		0	2,238,500		7,869
9	0	0	0	614		0	0		8,283
10	0	0	0	663		0	0		8,945
11	0	0	0	716		0	0		9,661
12	0	0	0	773		0	0		10,434
13	0	0	0	835		0	0		11,269
14	0	0	0	901		0	0		12,170
15	0	0	0	974		0	0		13,144
16	0	0	0	1,052		0	0		14,195
17	0	0	0	1,136		0	0		15,331
18	0	0	0	1,226		0	0		16,557
19	0	0	0	1,325		0	0		17,882
20	0	0	0	1,431		0	0		19,313
Total	67,140,000	52,000,000	0	2,580,513		52,000,000	67,701,200		

Cash Flow Projections - based on the following assumptions

1. The National Environmental Bank provides the following loans:
   23,000,000,000 Zlotys in year 2 and
   5,000,000,000 Zlotys in year 3
2. The Gmina budget provides Zl. 2 Bil. each year through year 2 and thereafter provides annual payments necessary to meet debt service requirements.
3. Loan terms: a)interest rates are 10%; b)first 6 months of loan period are interest free; c) two years interest to be capitalized; d) annual loan payments are made at beginning of year.

APPENDIX L SWIETA KATARZYNA - SEWERAGE SYSTEM FINANCE PROJECTION

NATIONAL ENVIRONMENTAL BANK FINANCING PROJECTIONS

LOAN SUMMARY (000 Zlotys)

Year	Loan Draw	Interest	Loan Payments	Total Debt Outstanding
1	24,000,000	0	0	24,000,000
2	23,000,000	2,400,000	0	49,400,000
3	5,000,000	4,940,000	0	59,340,000
4		4,634,000	13,000,000	50,974,000
5		2,597,400	25,000,000	28,571,400
6		926,300	19,308,400	10,189,300
7		203,500	8,154,300	2,238,500
8		0	2,238,500	0
9		0	0	0
10		0	0	0
11		0	0	0
12		0	0	0
13		0	0	0
14		0	0	0
15		0	0	0
16		0	0	0
17		0	0	0
18		0	0	0
19		0	0	0
20		0	0	0

LOAN ONE SCHEDULE

Year	Principal	Interest	Payments	Balance
1	24,000,000	0	0	24,000,000
2	24,000,000	2,400,000	0	26,400,000
3	26,400,000	2,640,000	0	29,040,000
4	29,040,000	1,604,000	13,000,000	17,644,000
5	17,644,000	464,400	13,000,000	5,108,400
6	5,108,400	0	5,108,400	0
7	0	0	0	0
8	0	0	0	0
9	0	0	0	0
10	0	0	0	0
11	0	0	0	0
12	0	0	0	0
13	0	0	0	0
14	0	0	0	0
15	0	0	0	0
16	0	0	0	0
17	0	0	0	0
18	0	0	0	0
19	0	0	0	0
20	0	0	0	0

LOAN TWO SCHEDULE

Year	Principal	Interest	Payments	Balance
1	0	0	0	0
2	23,000,000	0	0	23,000,000
3	23,000,000	2,300,000	0	25,300,000
4	25,300,000	2,530,000	0	27,830,000
5	27,830,000	1,583,000	12,000,000	17,413,000
6	17,413,000	541,300	12,000,000	5,954,300
7	5,954,300	0	5,954,300	0
8	0	0	0	0
9	0	0	0	0
10	0	0	0	0
11	0	0	0	0
12	0	0	0	0
13	0	0	0	0
14	0	0	0	0
15	0	0	0	0
16	0	0	0	0
17	0	0	0	0
18	0	0	0	0
19	0	0	0	0
20	0	0	0	0

LOAN THREE SCHEDULE

Year	Principal	Interest	Payments	Balance
1	0	0	0	0
2	0	0	0	0
3	5,000,000	0	0	5,000,000
4	5,000,000	500,000	0	5,500,000
5	5,500,000	550,000	0	6,050,000
6	6,050,000	385,000	2,200,000	4,235,000
7	4,235,000	203,500	2,200,000	2,238,500
8	2,238,500	0	2,238,500	0
9	0	0	0	0
10	0	0	0	0
11	0	0	0	0
12	0	0	0	0
13	0	0	0	0
14	0	0	0	0
15	0	0	0	0
16	0	0	0	0
17	0	0	0	0
18	0	0	0	0
19	0	0	0	0
20	0	0	0	0

APPENDIX M

Bond Financing Projections

APPENDIX M

SWIETA KATARZYNA - SEWERAGE SYSTEM FINANCE PROJECTION

BOND FINANCING PROJECTIONS

	INCOME (000 Zlotys)				EXPENSE (000 Zlotys)					BALANCE
Year	From Gmina	From Loans	From Bonds	From Interest	Construction Payments	Loan Payments	Bond Interest	Bonds Redeemed	Reserve Fd. Pmts.	Fund Balance
1	6,500,000	2,000,000	50,000,000	1,500,000	18,000,000	0	5,540,000	0	1,000,000	35,460,000
2	6,500,000	0		2,836,800	18,000,000	0	5,540,000	0	1,000,000	20,256,800
3	6,500,000	0		1,620,544	15,000,000	0	5,540,000	0	1,000,000	6,837,344
4	6,500,000	0		546,988	0	850,000	5,540,000	0	1,000,000	6,494,332
5	6,500,000	0		519,547	0	850,000	5,540,000	0	133,400	6,990,478
6	6,500,000	0		959,238	0	964,700	5,540,000	0		7,945,016
7	6,500,000	0		1,035,601	0		5,400,000	1,000,000		9,080,618
8	6,500,000	0		1,126,449	0	0	5,265,000	1,000,000		10,442,067
9	6,500,000	0		1,235,365	0	0	4,875,000	3,000,000		10,302,433
10	6,500,000	0		1,224,195	0	0	4,250,000	5,000,000		8,776,627
11	6,500,000	0		1,102,130	0	0	3,650,000	5,000,000		7,728,758
12	6,500,000	0		1,018,301	0	0	3,075,000	5,000,000		7,172,058
13	6,500,000	0		973,765	0	0	2,525,000	5,000,000		7,120,823
14	6,500,000	0		969,666	0	0	2,000,000	5,000,000		7,590,489
15	6,500,000	0		1,007,239	0	0	0	20,000,000		(4,902,272)
Total	97,500,000	2,000,000	50,000,000	17,675,828	51,000,000	2,664,700	64,280,000	50,000,000	4,133,400	

Cash Flow Projections - based on the following assumptions

1. The National Environmental Bank provides Zl. 2 Bil. loan in year 1.
2. The Gmina budget will provide Zl. 2 Bil. each year.
3. Water/Sewer rates will provide Zl. .5 billion in 1996 - 1997, Zl. 1 billion in 1998 and Zl.2 billion 1999 on.
4. Loan terms: a)interest rates are 10%; b)first 6 months of loan period are interest free; c) two years interest to be capitalized; d) annual loan payments are made at beginning of year.
5. Bond interest rates range from 10% for 15 year bonds to 14% for 7 year bonds.

APPENDIX M

SWIETA KATARZYNA - SEWERAGE SYSTEM FINANCE PROJECTION

BOND FINANCING PROJECTIONS

DEBT STATUS (000 Zlotys)

Year	Bonds Redeemed	Bond Interest	Loan Payments	Total Debt Outstanding
1	0	5,540,000	0	52,000,000
2	0	5,540,000	0	52,200,000
3	0	5,540,000	0	52,420,000
4	0	5,540,000	850,000	51,727,000
5	0	5,540,000	850,000	50,964,700
6	0	5,540,000	964,700	50,000,000
7	1,000,000	5,400,000	0	49,000,000
8	1,000,000	5,265,000	0	48,000,000
9	3,000,000	4,875,000	0	45,000,000
10	5,000,000	4,250,000	0	40,000,000
11	5,000,000	3,650,000	0	35,000,000
12	5,000,000	3,075,000	0	30,000,000
13	5,000,000	2,525,000	0	25,000,000
14	5,000,000	2,000,000	0	20,000,000
15	20,000,000	0	0	0

LOAN SCHEDULE (000 Zlotys)

Year	Principal	Interest	Payments	Balance
1	2,000,000			2,000,000
2	2,000,000	200,000		2,200,000
3	2,200,000	220,000		2,420,000
4	2,420,000	157,000	850,000	1,727,000
5	1,727,000	87,700	850,000	964,700
6	964,700	0	964,700	0
7	0	0		0
8	0	0		0
9	0	0		0
10	0	0		0
11	0	0		0
12	0	0		0
13	0	0		0
14	0	0		0
15	0	0		0

APPENDIX M

SWIETA KATARZYNA - SEWERAGE SYSTEM FINANCE PROJECTION

BOND FINANCING PROJECTIONS

BOND INTEREST AND REDEMPTION SCHEDULE

Bond Interest	Bonds Redeemed	Year	7 Year Bonds	8 year Bonds	9 Year Bonds	10 Year Bonds	11 Year Bonds	12 Year Bonds	13 Year Bonds	14 Year Bonds	15 Year Bonds
5,540,000	0	1	140,000	135,000	390,000	625,000	600,000	575,000	550,000	525,000	2,000,000
5,540,000	0	2	140,000	135,000	390,000	625,000	600,000	575,000	550,000	525,000	2,000,000
5,540,000	0	3	140,000	135,000	390,000	625,000	600,000	575,000	550,000	525,000	2,000,000
5,540,000	0	4	140,000	135,000	390,000	625,000	600,000	575,000	550,000	525,000	2,000,000
5,540,000	0	5	140,000	135,000	390,000	625,000	600,000	575,000	550,000	525,000	2,000,000
5,540,000	0	6	140,000	135,000	390,000	625,000	600,000	575,000	550,000	525,000	2,000,000
5,400,000	1,000,000	7	1,000,000	135,000	390,000	625,000	600,000	575,000	550,000	525,000	2,000,000
5,265,000	1,000,000	8	0	1,000,000	390,000	625,000	600,000	575,000	550,000	525,000	2,000,000
4,875,000	3,000,000	9	0	0	3,000,000	625,000	600,000	575,000	550,000	525,000	2,000,000
4,250,000	5,000,000	10	0	0	0	5,000,000	600,000	575,000	550,000	525,000	2,000,000
3,650,000	5,000,000	11	0	0	0	0	5,000,000	575,000	550,000	525,000	2,000,000
3,075,000	5,000,000	12	0	0	0	0	0	5,000,000	550,000	525,000	2,000,000
2,525,000	5,000,000	13	0	0	0	0	0	0	5,000,000	525,000	2,000,000
2,000,000	5,000,000	14	0	0	0	0	0	0	0	5,000,000	2,000,000
0	20,000,000	15	0	0	0	0	0	0	0	0	20,000,000

RESERVE FUND

Year	Income	Interest @ 8%	Paid Out	Balance
1	1,000,000		0	1,000,000
2	1,000,000	80,000	0	2,080,000
3	1,000,000	166,400	0	3,246,400
4	1,000,000	259,712	0	4,506,112
5	133,400	360,489	0	5,000,001
6	0	400,000	400,000	5,000,001
7	0	400,000	400,000	5,000,001
8	0	400,000	400,000	5,000,001
9	0	400,000	400,000	5,000,001
10	0	400,000	400,000	5,000,001
11	0	400,000	400,000	5,000,001
12	0	400,000	400,000	5,000,001
13	0	400,000	400,000	5,000,001
14	0	400,000	400,000	5,000,001
15	0	400,000	400,000	5,000,001

APPENDIX N

Funding Projections for Staged Construction

APPENDIX N

SWIETA KATARZYNA - SEWERAGE SYSTEM FINANCE PROJECTION

FUNDING PROJECTIONS FOR STAGED CONSTRUCTION

	INCOME (000 Zlotys)					EXPENSE (000 Zlotys)			BALANCE
Year	From Gmina	From Loans	From Grants	From Interest		Construction Payments	Loan Payments		Fund Balance
1	2,000,000	2,000,000	0	0		4,000,000	0		0
2	2,000,000	2,000,000	0	0		4,000,000	0		0
3	2,000,000	0	0	0		2,000,000	0		0
4	2,000,000	0	0	0		0	850,000		1,150,000
5	2,000,000	2,000,000	0	92,000		3,000,000	1,700,000		542,000
6	2,000,000	2,000,000	0	43,360		2,500,000	1,814,700		270,660
7	2,000,000	0	0	21,653		0	964,700		1,327,613
8	2,000,000	2,000,000	0	106,209		4,000,000	850,000		583,822
9	2,000,000	2,000,000	0	46,706		3,000,000	1,700,000		(69,472)
10	2,000,000	0	0	(5,558)		0	1,814,700		110,270
11	2,000,000	0	0	8,822		0	1,814,700		304,391
12	2,000,000	0	0	24,351		0	1,700,000		628,743
13	2,000,000	0	0	50,299		0	1,814,000		864,342
14	2,000,000	0	0	69,147		0	964,700		1,968,789
15	2,000,000	2,000,000	0	157,503		6,000,000	0		126,293
16	2,000,000	0	0	10,103		0	0		2,136,396
17	2,000,000	0	0	170,912		0	0		4,307,308
18	2,000,000	0	0	344,585		0	850,000		5,801,892
19	2,000,000	0	0	464,151		7,000,000	850,000		416,044
20	2,000,000	0	0	33,283		0	964,700		1,484,627
	40,000,000	14,000,000	0	1,637,526		35,500,000	18,652,200		

Cash Flow projections - based on the following assumptions:

1. Environmental Protection Bank loans of Zl 2 bn in yrs 1, 2, 5, 6, 8, 9, and 15.
2. The gmina budget provides Zl 2 bn each year.
3. Loan terms: A) interest rates are 10%; b) first 6 months of loan period are interest free; c) two years interest to be capitalized; d) annual loan p

APPENDIX N SWIETA KATARZYNA - SEWERAGE SYSTEM FINANCE PROJECTION

FUNDING PROJECTIONS FOR STAGED CONSTRUCTION

LOAN SUMMARY (000 Zlotys)

Year	Loan Draw	Interest	Loan Payments	Total Debt Outstanding
1	2,000,000	0	0	2,000,000
2	2,000,000	200,000	0	4,200,000
3	0	420,000	0	4,620,000
4	0	377,000	850,000	4,147,000
5	2,000,000	244,700	1,700,000	4,691,700
6	2,000,000	287,700	1,814,700	5,164,700
7	0	420,000	964,700	4,620,000
8	0	377,000	850,000	6,147,000
9	0	444,700	1,700,000	6,891,700
10	0	507,700	1,814,700	5,584,700
11	0	377,000	1,814,700	4,147,000
12	0	244,700	1,700,000	2,691,700
13	0	87,700	1,814,000	964,700
14	0	0	964,700	0
15	0	0	0	2,000,000
16	0	200,000	0	2,200,000
17	0	220,000	0	2,420,000
18	0	157,000	850,000	1,727,000
19	0	0	850,000	964,700
20	0	0	964,700	0

LOAN ONE SCHEDULE

Year	Principal	Interest	Payments	Balance
1	2,000,000			2,000,000
2	2,000,000	200,000		2,200,000
3	2,200,000	220,000	0	2,420,000
4	2,420,000	157,000	850,000	1,727,000
5	1,727,000	87,700	850,000	964,700
6	964,700	0	964,700	0
7	0	0	0	0
8	0	0	0	0
9	0	0	0	0
10	0	0	0	0
11	0	0	0	0
12	0	0	0	0
13	0	0	0	0
14	0	0	0	0
15	0	0	0	0
16	0	0	0	0
17	0	0	0	0
18	0	0	0	0
19	0	0	0	0
20	0	0	0	0

LOAN TWO SCHEDULE

Year	Principal	Interest	Payments	Balance
1	0			0
2	2,000,000	0		2,000,000
3	2,000,000	200,000		2,200,000
4	2,200,000	220,000	0	2,420,000
5	2,420,000	157,000	850,000	1,727,000
6	1,727,000	87,700	850,000	964,700
7	964,700	0	964,700	0
8	0	0	0	0
9	0	0	0	0
10	0	0	0	0
11	0	0	0	0
12	0	0	0	0
13	0	0	0	0
14	0	0	0	0
15	0	0	0	0
16	0	0	0	0
17	0	0	0	0
18	0	0	0	0
19	0	0	0	0
20	0	0	0	0

LOAN THREE SCHEDULE

Year	Principal	Interest	Payments	Balance
1	0			0
2	0	0		0
3	0	0		0
4	0	0	0	0
5	2,000,000	0	0	2,000,000
6	2,000,000	200,000	0	2,200,000
7	2,200,000	220,000	0	2,420,000
8	2,420,000	157,000	850,000	1,727,000
9	1,727,000	87,700	850,000	964,700
10	964,700	0	964,700	0
11	0	0	0	0
12	0	0	0	0
13	0	0	0	0
14	0	0	0	0
15	0	0	0	0
16	0	0	0	0
17	0	0	0	0
18	0	0	0	0
19	0	0	0	0
20	0	0	0	0

APPENDIX N

SWIETA KATARZYNA - SEWERAGE SYSTEM FINANCE PROJECTION

FUNDING PROJECTIONS FOR STAGED CONSTRUCTION

LOAN FOUR SCHEDULE

Year	Principal	Interest	Payments	Balance
1	0			0
2	0	0		0
3	0	0		0
4	0	0	0	0
5	0	0	0	0
6	2,000,000	0	0	2,000,000
7	2,000,000	200,000	0	2,200,000
8	2,200,000	220,000	0	2,420,000
9	2,420,000	157,000	850,000	1,727,000
10	1,727,000	87,700	850,000	964,700
11	964,700	0	964,700	0
12	0	0	0	0
13	0	0	0	0
14	0	0	0	0
15	0	0		0
16	0	0		0
17	0	0		0
18	0	0		0
19	0	0		0
20	0	0		0

LOAN FIVE SCHEDULE

Year	Principal	Interest	Payments	Balance
1	0			0
2	0	0		0
3	0	0		0
4	0	0	0	0
5	0	0	0	0
6	0	0	0	0
7	0	0	0	0
8	2,000,000	0	0	2,000,000
9	2,000,000	200,000	0	2,200,000
10	2,200,000	220,000	0	2,420,000
11	2,420,000	157,000	850,000	1,727,000
12	1,727,000	87,700	850,000	964,700
13	964,700	0	964,700	0
14	0	0	0	0
15	0	0		0
16	0	0		0
17	0	0		0
18	0	0		0
19	0	0		0
20	0	0		0

LOAN SIX SCHEDULE

Year	Principal	Interest	Payments	Balance
1	0			0
2	0	0		0
3	0	0		0
4	0	0	0	0
5	0	0	0	0
6	0	0	0	0
7	0	0	0	0
8	0	0	0	0
9	2,000,000	0	0	2,000,000
10	2,000,000	200,000	0	2,200,000
11	2,200,000	220,000	0	2,420,000
12	2,420,000	157,000	850,000	1,727,000
13	1,727,000	87,700	850,000	964,700
14	964,700	0	964,700	0
15	0	0		0
16	0	0		0
17	0	0		0
18	0	0		0
19	0	0		0
20	0	0		0

LOAN SEVEN SCHEDULE

Year	Principal	Interest	Payments	Balance
1	0			0
2	0	0		0
3	0	0		0
4	0	0	0	0
5	0	0	0	0
6	0	0	0	0
7	0	0	0	0
8	0	0	0	0
9	0	0	0	0
10	0	0	0	0
11	0	0	0	0
12	0	0	0	0
13	0	0	0	0
14	0	0	0	0
15	2,000,000	0	0	2,000,000
16	2,000,000	200,000	0	2,200,000
17	2,200,000	220,000	0	2,420,000
18	2,420,000	157,000	850,000	1,727,000
19	1,727,000	87,700	850,000	964,700
20	964,700	0	964,700	0