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PRIDE Project in Development and the Environment

FY 1995-4 -WBG

Environmental Assessment for American Near East Refugee Aid (ANERA) Project on Ramallah's Wastewater Treatment Plant Complex

October 1994

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Submitted by:
PRIDE

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and its associates

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The objective of the Project in Development and the Environment (PRIDE) is to help the U.S. Agency for International Development (AID) design and implement programs that foster the agency's environmental and natural resources strategy for sustainable economic growth in the Near East and Eastern Europe.

PRIDE provides AID and participating countries with advisory assistance, training, and information services in four program areas: (1) strategic planning, (2) environmental policy analysis, (3) private sector initiatives, and (4) environmental information, education, communication, and institutional strengthening.

The project is being implemented by a consortium selected through open competition in 1991. Chemonics International is the prime contractor; subcontractors include RCG/Hagler, Bailly, Inc.; Science Applications International Corporation; Capital Systems Group, Inc.; Environomics, Inc.; Industrial Economics, Inc.; Lincoln University; and Resource Management International, Inc. In addition, AID has entered into a cooperative agreement with the World Environment Center to support implementation of PRIDE.

The opinions expressed in this paper are those of the author(s) and do not necessarily reflect the positions of the sponsoring agency or contractors.

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ANE FY 1995-4-WBG

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Sorry for the delay in getting back to you all on the Ramallah EA and three PVO EAs, but the process of reviewing these documents has consumed a great deal more time than I had anticipated. Now that my own review is completed, I'd like to propose the following:

Ramallah WWTP EA. This EA is in good shape, i.e., approvable contingent upon a commitment by USAID and ANERA to adhere to select conditions during Project implementation. I'm currently doing a reality check on those recommended commitments, and hope to have them "finalized in draft" by the end of the week. At that time, I'll e-mail them to you all as an attachment for Mission and ANERA review, and ask Dwight Walker to hand-carry a copy of the draft EA with him to pass on to you next week. The next steps are for the Mission to: (1) review the commitments; (2) get ANERA to review the commitments; and (3) either fax back to me the "Record of Decision" signed by the Mission and ANERA, or get back to me with any questions/issues/problems you and/or ANERA may have.

The Three PEAs. The situation is less sanguine with the three PEAs for the three PVO/NGO projects (ANERA, SCF and CRS). Basically, they're not approvable as regulatory documents as currently written. The problem is structural (not superficial), and what I plan to do is this:

I've prepared, for each of these projects, a "Record of Decision" (ROD) which technically neither approves nor disapproves the PEAs. What these RODs do--based on the information provided in the draft documents and other information--is revise the threshold decision for each of the three projects down to a negative determination (i.e., "no significant adverse environmental impact"). As with the Ramallah EA, my approval (as Bureau Environmental Officer) of these revised threshold decisions would also be contingent upon a commitment by USAID and the respective PVOs to adhere to select conditions (as articulated in the RODs) during project implementation.

Also as with the Ramallah EA, the three RODs for the three PVO projects are currently undergoing "reality checks" and I hope to have them in "final draft" by the end of the week and e-mailed out to you as attachments. The Mission's procedure for the RODs for the three PEAs would be the same, then, as for Ramallah: Check 'em out; have the respective PVOs check 'em out; and either come back with a signed copy of the RODs or come back with changes which you and/or the PVOs feel need to be made before signing.

The only difference is that as of this point in time, the three draft PEA documents are NOT approved and are NOT ready for circulation. The PVOs will therefore NOT have the documents for review in conjunction with the records

of decision. The RODs are pretty transparent, though, and in cases where reference is made to something specific in the draft PEA document then I'll fax copies of those pages. The PVOs may (e.g., SCF) or may not (e.g., CRS) have a problem with not having the draft EA documents to review, but in any case I wouldn't recommend waiting for those documents to be revised before finalizing the Records of Decision. I strongly recommend, conversely, that we: (1) go ahead and get the RODs finalized and signed now; (2) get our regulatory responsiblities taken care of; and (3) let the PVOs "carry on" with what they're doing. We can then worry about the backup documents to the extent necessary, feasible and advisable.

Please let me know if you all have any questions or comments on this approach. I'll go out to you all via e-mail on Thursday or Friday in any case with the draft Records of Decision attached.

All the best, hope you had a good turkey day, and happy hannukah.

Jeff Goodson.

Environmental Assessment for American Near East Refugee Aid (ANERA) Project on Ramallah's Wastewater Treatment Plant Complex

By:

Jack Farmer	Team Leader, Water Engineer/Water Resources Management Specialist
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PREFACE

USAID's Asia/Near East Bureau requested that the Project for Development and the Environment (PRIDE) conduct an Environmental Assessment (EA) for the Ramallah Wastewater Systems project, a project of American Near East Refugee Aid (ANERA), as well as three Programmatic Environmental Assessments (PEAs) for: (1) West Bank Integrated Rural Development/Capacity Building, a Catholic Relief Services (CRS) project; (2) Institutional Development project, Save the Children Federation (SCF); and (3) Cooperative and Municipal Development project, ANERA.

The team included:

Jack Farmer	Team leader, water engineer/water resources management specialist
Joseph Karam	Environmental engineer/waste management specialist
Nader Al-Khatib	Municipal/industrial wastewater engineer
Ramez El-Titi	Water resources management specialist
Lena Dajani	Project administrator

A Scoping Session for CRS's Institutional Development project was conducted in September 1993. The PRIDE team implemented three remaining scoping sessions for SCF and the two ANERA projects on July 25 and 27, 1994, with the assistance of Paul des Rosiers of the ANE Bureau of USAID. The Scoping Statements were approved by USAID, allowing the PRIDE team to proceed with the EA and the three PEAs.

The four assessments were conducted from July 13 through September 30, 1994. This was during the transfer of limited authority for many government departments by Israel to the new Palestinian National Authority (PNA) in the West Bank and Gaza. During this period, as well as when this report was being written, the West Bank and Gaza environmental department was still under Israeli control. Due to various political factors it is uncertain when, and to what degree, environmental authority will pass from Israel to the PNA and what the new institutional structure will become. As a result of these conditions, this report will reflect the status at that time.

Data Collection

Some of the information and data collected was still in the form of Jordanian (for West Bank) and Egyptian (for Gaza) policies, rules, and regulations. The costs of water, services, etc., were converted to New Israeli Shekels. Much of the Israeli data was very sparse, sometimes incomplete, and of little hard statistical value. However, it was sufficient, in most cases, to confirm the need for continuing with various ongoing programs and the starting of new programs and activities while putting into place substantive monitoring and data collection activities.

To help offset the lack of hard data, the PRIDE team developed a large photographic file as an additional reference base. This file also reflects the magnitude of the existing environmental status.

Workshops

Five workshops were conducted. The first was an Overview Workshop on USAID Environmental Procedures. The results indicated that most private voluntary organization (PVO) personnel were not familiar with USAID general requirements nor with the technical aspects of the word "environment."

Therefore, the four individual PVO project workshops were revised to a more "open hearing" type format. These workshops were conducted mostly in Arabic, with both English and Arabic translations written on flip charts for complete understanding and acceptance of impacts, mitigation, monitoring, and management related to environmental issues and concerns.

The workshops were facilitated by Joseph Karam with support from other team members, Nader Al-Khateeb and Ramez El-Titi, and the PRIDE home-office project administrator, Lena Dajani.

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ACRONYMS

ANERA	American Near East Refugee Aid
ARIJ	Applied Research Institute of Jerusalem
AWCSW	Association of Women's Committees for Social Work
BEO	Bureau Environmental Officer (USAID)
BOD	Biochemical Oxygen Demand
CARE	Cooperative for Assistance and Relief Everywhere
CBS	Central Bureau of Statistics
CDP	Cooperative Development Project
CEOHS	Center for Environmental and Occupational Health Sciences
CIDA	Canadian International Development Agency
CIVAD	Israeli Civil Administration
CRS	Catholic Relief Services
EA	Environmental Assessment
EC	European Community
ECPD	Engineering Center for Planning and Design
FC	Fecal Coliform
GDP	Gross Domestic Product
GEF	Global Environment Facility
GNP	Gross National Product
HDPE	High Density Polyethelyene
HTH	High Test Hypochlorite
IA	Impact Areas
IDA	International Development Agency
IEE	Initial Environmental Examination
IMP	Integrated Pest Management
IRD	Integrated Rural Development
JD	Jordanian Dinar
JWU	Jerusalem Water Undertaking
MCM	Million Cubic Meters
MOI	Ministry of the Interior
NGO	Non-Governmental Organization
NIS	New Israeli Shekel
NPA	National Palestinian Authority
O&M	Operations and Maintenance
PARC	Palestinian Agricultural Research Center
PEA	Programmatic Environmental Assessment
PHG	Palestinian Hydrology Group
PRA	Participatory Rapid Appraisal
PRIDE	Project for Development and the Environment
PVC	Polyvinyl Chloride
PVO	Private Voluntary Organization

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SAR	Semi-Annual Report
SCF	Save the Children Federation
SDT	Subsurface Draining Techniques
SS	Suspended Solids
TC	Total Coliform
TDI	Toluene Diisocyanate
TDS	Total Dissolved Solids
UAWC	Union of Agricultural Work Committees
UNDP	United Nations Development Program
UNRWA	United Nations Relief and Works Agency
USAID	United States Agency of International Development
USEPA	United States Environmental Protection Agency
VAD	Village Affairs Department
VDC	Village Development Committees
WHO	World Health Organization
WRAP	Water Resources Action Programme
WWTP	Wastewater Treatment Plant

EXECUTIVE SUMMARY

A. Background and Objectives

The American Near East Refugee Aid (ANERA) has submitted a proposal to the United States Agency for International Development (USAID) for the engineering design and construction of a sewage collection, treatment, and reuse system in Ramallah, West Bank. The ANERA proposal is subject to USAID environmental procedures pertaining to USAID funding of projects and programs overseas.[1] Based on these requirements, the need to conduct an environmental assessment (EA) was established as a result of a positive threshold decision resulting from an Initial Environmental Examination (IEE).

As an initial component of the EA, and in accordance with the USAID Environmental Procedures (22 CFR 216), a scoping session was held on July 27, 1994, in Ramallah. A Scoping Statement Summary and a Scoping Session Report were prepared after the scoping session and submitted to the Bureau Environmental Officer (BEO) of USAID Asia/Near East for review and approval.

This EA was conducted by a team of experts from the Project for Development and the Environment (PRIDE) comprised of three international experts and two local experts. PRIDE team members were in the field in the West Bank and Gaza between July 17 and September 14, 1994. During this period, the PRIDE team conducted all field investigations necessary to complete this EA (plus three programmatic environmental assessments—PEAs—of other projects.)

B. Project Description

Ramallah's existing wastewater treatment plant (WWTP) was built in the mid-1970s and is now severely underdesigned due to population and industrial growth. The plant is located in the southwestern part of Ramallah near the industrial area and has a treatment and removal efficiency of less than 20 percent. Minimally-treated effluent from the existing treatment plant is discharged into the Betunia wadi downstream through a 2-km underground pipeline.

The proposed wastewater management system consists of building a new biological treatment plant and reusing the treated wastewater to irrigate at least 2,000 dunums (1 dunum = 0.1 hectares) of agricultural land (currently rain-fed) in four villages near Ramallah. The proposed treatment plant will be built in the same location as the existing treatment plant but will require expanding the plant site from 30 dunums to 70 dunums. The treatment plant design—anaerobic ponds, aerated lagoons, maturation ponds, and a stabilization reservoir

[1] 22 CFR 216 (Code of Federal Regulations, AID Environmental Procedures).

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about 1 km downstream—was selected over other alternatives primarily because it requires relatively less energy and maintenance and can sustain moderate wastewater shock loads.

C. Industrial Survey

Except for a few light industries scattered in residential areas, most industrial plants are located in the industrial area of Ramallah and typically are connected to the sewer network. Because industrial wastewater discharges may upset the proper functioning of the proposed WWTP, the PRIDE team conducted a survey of industrial plants in Ramallah.

The PRIDE team visited 14 out of about 40 industries in the Ramallah industrial area and filled out a questionnaire prepared specifically for the survey. None of the industries surveyed had previously characterized its wastewater. There were no meters on wastewater discharges to the sewer network, and no sampling and analysis of wastewater was ever conducted. Industrial wastewater represented about 10 percent of total wastewater generated in Ramallah in 1993. Very few industries have on-site wastewater pretreatment or recycling.

Under normal operating conditions, most industries would not discharge wastewater that would pose a threat to the proposed wastewater management system. Proper operation of the WWTP will require that the Municipality of Ramallah monitor and control industrial wastewater discharges into the sewer network.

D. Environmental Setting

Ramallah has a moderate semiarid Mediterranean climate. The proposed stabilization reservoir and irrigation area are in a sensitive zone geologically, and irrigation should be confined to the zone designated KCY on the maps of the Hydrological Services, corresponding to the Yatta geologic formation. Ramallah is located in an area where one earthquake with intensity 7 or more on the Mercalli-Cancani Scale is expected to occur within a given 50-year period.

Water supply in Ramallah is the responsibility of the Jerusalem Water Undertaking (JWU), which mines water from the Ein Samia wells, far from Ramallah, or buys it from Mekorot or the Municipality of Jerusalem. There are five small springs near Ramallah, but they produce extremely small quantities during the summer. The proposed wastewater management system will be located over the western aquifer system (Yarkon Tananim Aquifer) of the West Bank. There are no known groundwater wells in the Ramallah area. Almost all households in the city are connected to the water distribution network. Average annual consumption was about 100 per person per day in 1993.

Exact population figures for Ramallah are not known. Estimates ranged from 24,000 to 26,000 people in 1991-93 and are projected to 40,000 to 47,000 people for the years 2010-2015. There are no known endangered species affected by the proposed wastewater management system, and there are no known archaeological or historical sites.

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E. Environmental Impacts

Minimally treated wastewater in 1994 is currently discharged directly into the Betunia wadi, where it flows westward polluting the western aquifer of the West Bank. Animal wildlife (gazelles, hares, and birds) and livestock (sheep and goats) in the wadi drink from this black, minimally-treated wastewater. In addition, significant losses of agricultural lands and olive orchards in the Betunia wadi are reported due to irrigation with quasi-raw sewage. Also, by discharging wastewater in to the wadi, a precious water resource is being wasted in an area that suffers from severe water shortages and scarcity. Farmers are limited to low-income rain-fed agriculture (olives, wheat, and barley). Many landowners have abandoned cultivating the land and turned to other, more income-generating activities such as urban activities, trade, and work abroad. This leads to more soil erosion due to neglect of the land and exacerbates urban environmental problems as a result of rural-urban migration.

F. Monitoring Measures

The PRIDE team recommends monitoring environmental parameters both inside and outside the wastewater treatment and reuse system. To ensure proper operation of the plant, plant operators should monitor operating parameters according to standard operating procedures for a plant of this type. In addition to standard operating and monitoring requirements, the team recommends specific monitoring and mitigation measures at different stages of the proposed wastewater management system: wastewater inflow, effluent from last maturation pond, and effluent from the stabilization reservoir. At each of these points, wastewater that does not meet certain prescribed guidelines should be either discharged into the emergency pipeline or chlorinated (effluent from the stabilization reservoir).

In addition, the Ramallah Agricultural Marketing Cooperative should monitor the reuse of treated wastewater for irrigation. The cooperative should work closely with the municipality and the plant operator, with technical assistance from ANERA, to each year predict the effluent quality that can be expected on a "sustainable" basis. The cooperative then should advise farmers well in advance of the planting season of the kinds of crops they can safely plant. The cooperative also should work with the Agricultural Department to monitor the quality of crops irrigated with treated wastewater.

In addition to internal monitoring measures, the PRIDE team proposes monitoring external environmental indicators. Monitoring environmental indicators will satisfy the USAID environmental procedures [22 CFR §216.3(a)(8)]; it will require recording baseline data at the start of the project and tracking the values of these indicators over time (e.g., monthly, semiannually, or annually). Monitoring should include environmental indicators such as spring water quality and soil contamination, quality of crops, plant performance, fee collection coverage, and cost recovery. ANERA should work with USAID, the Municipality of Ramallah, the Ramallah Agricultural Cooperative, and regional or national departments to decide on a final external monitoring program and assign responsibilities for monitoring different indicators.

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G. Conclusions and Management Measures

This assessment indicates that the proposed wastewater management system for Ramallah will not pose any major adverse environmental impacts, provided appropriate mitigation, monitoring, and management measures are implemented, as discussed in this report. Implementation of the project with the recommended measures will protect the environment, improve the well-being of the population, and promote sustainable development of the Ramallah area.

The assessment recommends management measures to be implemented by ANERA, the Municipality of Ramallah, the Ramallah Agricultural Marketing Cooperative, and USAID. As the primary recipient of USAID funding to implement the proposed Ramallah wastewater management system, ANERA bears ultimate responsibility for ensuring that the proposed system is built and operated in an environmentally-sound manner.

ANERA should implement the following management measures:

- Ensure that the final design reflects the mitigation and monitoring measures recommended in this EA report.
- Recruit an experienced full-time local project manager to oversee implementation of the project.
- Contract out plant operations for the first few years.
- Provide technical assistance to the municipality and the cooperative.

The Municipality of Ramallah should:

- Expropriate the land required to build the expanded treatment plant, including the stabilization reservoir.
- Enter into agreements with neighboring municipalities for regional wastewater management.
- Develop and enforce local industrial wastewater effluent guidelines.
- Develop cost recovery mechanisms to ensure long-term sustainability of the project.
- Conduct awareness campaigns.

The Ramallah Agricultural Marketing Cooperative should:

- Educate farmers about irrigation with treated wastewater.

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- Monitor effluent quality and advise farmers about allowable crops.

- Study treated wastewater rates to be charged to farmers.

- Monitor the quality of crops.

USAID should:

- Attach certain Conditions Precedent (CP) to the proposed project, namely:

  Require ANERA to demonstrate that there are sufficient (at least 1,000 dunums) agricultural lands in the four neighboring villages to Ramallah that fall within the Yatta formation. A certificate to that effect from the Hydrological Services would be highly desirable.

  Require the Municipality of Ramallah to expropriate the land required to expand the existing treatment plant site (40 additional dunums) and build the stabilization reservoir (60 dunums), and the Ramallah Agricultural Marketing Cooperative to obtain rights-of-way for all irrigation pipelines.

- Form and participate in an interagency committee to oversee the implementation of recommendations.

- Require ANERA to report on environmental performance of the proposed project.

- Ensure that ANERA recruits an experienced project manager with an engineering design and wastewater treatment facility operational background.

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SECTION I

BACKGROUND AND OBJECTIVES

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SECTION I
BACKGROUND AND OBJECTIVES

This introductory section presents an overview of project setting, discusses the objectives of the environmental assessment, and describes the report organization.

A. Project Background and Objectives

The American Near East Refugee Aid (ANERA) has submitted a proposal to the United States Agency for International Development (USAID) for the engineering design and construction of a sewage collection, treatment, and reuse system in Ramallah, 16.5 km northwest of Jerusalem in the West Bank (USAID Project Number 294-0014).[1] Annex A contains a map of the West Bank showing the location of Ramallah (Map A-1).

The Municipality of Ramallah will be responsible for operation and maintenance of the wastewater treatment plant (WWTP). The Ramallah Agricultural Marketing Cooperative will purchase the treated wastewater from the city and sell the water for irrigation purposes to farmers in the neighboring villages of Al-Jeeb, Al-Jdeirah, Betunia, and Rafat.

The major purpose of this project is to improve the environment and economy of Ramallah and its neighboring villages. The objectives are to:

- Furnish more than 665,000 m^3 of treated wastewater per year as irrigation water to four villages having more than 2,000 dunums (10 dunums = 1 hectare) of agricultural land currently producing rain-fed crops.
- Test and evaluate a novel system of water conservation and recycling/reuse for West Bank communities.
- Improve sanitary conditions in Ramallah and nearby villages and protect groundwater quality in the impacted watershed.
- Strengthen the financial self-sufficiency and institutional capacity of the Ramallah municipality.
- Increase the technical capacity and experience of Palestinian consulting engineers, and support contractors and agricultural cooperatives in wastewater treatment and reuse, including operations and maintenance (O&M) and reuse/irrigation systems.

[1] ANERA, "Ramallah Municipality Wastewater Collection, Treatment, and Reuse System Development," Revised Proposal, November 1993.

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B. USAID Environmental Requirements

The ANERA proposal is subject to USAID Environmental Procedures pertaining to USAID funding of projects and programs overseas.[2] Based on these requirements, the need to conduct an environmental assessment (EA) was established as a result of a positive threshold decision resulting from the Initial Environmental Examination (IEE).

B1. Initial Environmental Examination

The USAID West Bank/Gaza Strip Infrastructure and Core Working Groups met in Washington, DC, on December 7, 1993, and recommended an IEE with a positive threshold decision. The IEE was prepared and submitted to the Bureau's Environmental Officer (BEO) for approval, which was obtained on February 3, 1994.

The positive threshold decision recognized that the Ramallah Wastewater Management System could result in potentially significant environmental impacts due to certain aspects of the project's conceptual design and the monitoring ability of local contractors. Furthermore, the ANERA proposal includes (1) irrigation or water management projects and (2) sewerage projects, both of which are designated as Classes of Actions Normally Having a Significant Effect on the Environment [22 CFR 216.2(d)]. Moreover, the potential for pesticide use by farmers irrigating with treated wastewater—even pesticides approved by the United States Environmental Protection Agency (USEPA) or the World Health Organization (WHO)—requires additional examination of potential adverse impacts.

On May 24, 1994, USAID/Washington issued a Project Implementation Order/Training (PIO/T), which included a Scope of Work for Environmental Assessments for West Bank/Gaza PVO Community Development and Environmental Infrastructure Activities, including the ANERA proposal for the Ramallah wastewater system project.

B2. Scoping Session

As an initial component of the EA, and in accordance with the USAID Environmental Procedures, a scoping session was held on July 27, 1994, in the Municipality of Ramallah building. Participants included Private Volunteer Organizations (PVOs), Nongovernmental Organizations (NGOs), Ramallah municipality officials and staff, and residents of neighboring villages where the treated wastewater would be reused for irrigation. The purpose of the scoping session was to inform interested parties of the purposes of the EA of the ANERA project and to solicit their assistance in identifying any significant environmental or social issues concerning the proposed project.

[2] 22 CFR 216 (Code of Federal Regulations, AID Environmental Procedures).

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As required by the USAID Environmental Procedures, a Scoping Statement Summary and a Scoping Session Report were prepared after the scoping session.[3] The Scoping Statement Summary was submitted to the USAID Asia/Near East Bureau's environmental officer for review and approval, which was obtained on August 1, 1994.[4] The Scoping Statement Summary synthesizes issues and concerns raised during the scoping session. The Scoping Session Report documents in detail the issues and concerns raised at the scoping session and provides abbreviated minutes of the meeting. Exhibit I-1 outlines the major issues and concerns raised at the scoping session.

C. Environmental Assessment Objectives

The objectives of this EA are to:

- Satisfy the USAID procedures for funding of USAID programs and projects overseas (see Section B).
- Address issues and concerns raised by the IEE (see subsection B1.) and during the scoping session (see subsection B2.).
- Conduct a survey of Ramallah industries to evaluate the potential for dangerous wastewater discharges that could upset the operations of the WWTP and to recommend pollution prevention alternatives.
- Identify other environmental impacts of the proposed wastewater management system, during both construction and operation.
- Propose specific mitigation, management, and monitoring measures to reduce or control those environmental impacts.

[3] Letter from Karen D. Turner, USAID Affairs Officer, Jerusalem, to Jeff Goodson, BEO, Bureau for Asia and the Near East, "Scoping Statement Summary for the American Near East Refugee Aid (ANERA) Ramallah Wastewater System Project (294-0014)," July 28, 1994; and "Scoping Session Report, Environmental Assessment—Industry Survey, Ramallah Wastewater Systems Project (USAID Project Number 294-0014), ANERA," Jerusalem and West Bank/Gaza Strip, July 28, 1994.

[4] Letter from Jeff Goodson, BEO, Bureau for Asia and the Near East, to Karen D. Turner, USAID Affairs Officer, Jerusalem, "Environmental Scoping Statement Summary for the American Near East Refugee Aid (ANERA) Ramallah Wastewater System Project (294-0014)," August 1, 1994.

Exhibit I-1
Major Issues and Concerns Raised at the Scoping Session

- Collection, treatment, and disposal of household and industrial solid waste/debris and wastewater
- Soil erosion and storm water runoff
- Environmental effects of pesticides planned for use (herbicides and insecticides)
- Destruction/disruption of aquatic and terrestrial habitats
- Potential for toxic industrial waste discharges into the treatment system
- Disinfection options when treated effluent quality exceeds prescribed standards for fecal coliforms and helminths
- Improper sitting of solid waste landfills or proposed stabilization reservoirs
- Increased use of electricity
- Worker accidents during construction and operations
- Potential seismic and flooding hazards of interventions
- Health effects of the reuse of treated wastewater on agricultural communities
- Acceptance of treated wastewater for irrigation of crops by farming communities
- Conduct of educational campaigns through extension services
- Availability of sufficient land for drying sludge
- Quality of dried sludge for soil amendment purposes (sufficient nutrient content)
- Regional planning for water and wastewater and related sitting issues
- Regulation and enforcement of industrial waste discharge permits at municipal and regional levels
- Sampling and analysis requirements for industrial waste surveys
- Cost recovery: water/wastewater charges to cover O&M and depreciation
- Treatment facility design based on current, not expected, population
- Odors and groundwater contamination due to improper solid waste disposal and sitting

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D. Environmental Assessment Methodology

This section presents the Project in Development and the Environment (PRIDE) team members and the methodology they used for this EA.

D1. The PRIDE Team

The PRIDE team included three international experts and two local experts. PRIDE team members were in the field in the West Bank and Gaza between July 17 and September 14, 1994. During this period, team members conducted all field investigations necessary to complete the EA as well as three programmatic environmental assessments (PEAs) for USAID-funded projects—ANERA, Save the Children Federation (SCF) and Catholic Relief Services (CRS). On its return to Washington, the PRIDE team worked through September to complete this EA report as well as the three PEA reports. The three PEA reports are available under separate cover.

D2. Meetings or Site Visits with Concerned Parties

The PRIDE team met with representatives of all parties concerned with the proposed Ramallah wastewater management system project. They held several meetings with ANERA staff to discuss the project's background and gather data on alternatives considered. The team met with the Municipality of Ramallah engineers several times and worked with them to identify the industrial survey sample and conduct the site visits for the industrial survey. Team members met with the Ramallah Agricultural Marketing Cooperative and discussed their interest and preparedness for managing the sale of treated wastewater to farmers for irrigation. The team also met with representatives from the four neighboring villages and reviewed their interest in purchasing treated wastewater for reuse in irrigation. Team members also toured the agricultural land most likely to be irrigated with treated wastewater.

D3. Data Collection from Research Institutes and NGOs

The PRIDE team also collected data on environmental characteristics and potential impacts from various local research institutes and NGOs as well as from international publications. In particular, PRIDE team members obtained basic environmental data from the Jerusalem Water Undertaking (JWU) on water consumption in Ramallah and from the Applied Research Institute of Jerusalem (ARIJ) on water supply and demand (current and projected) in the Ramallah district.

D4. Workshops

The PRIDE team organized two half-day workshops:

- One half-day workshop with ANERA staff and staff from the other two PVOs (SCF and CRS) to review USAID Environmental Procedures.

- One half-day workshop (September 8, 1994) with ANERA staff and representatives from the Municipality of Ramallah, the Ramallah Agricultural Marketing Cooperative, and neighboring villages to discuss

preliminary findings of the field investigations and exchange ideas about potential environmental impacts and possible mitigation, monitoring, and management measures. Annex B provides a summary of this midcourse evaluation workshop.

Both workshops provided an excellent opportunity for ANERA staff and municipality/cooperative representatives to appreciate the purpose and methodology of USAID PEAs and for the PRIDE team to learn about local experiences in wastewater management and agricultural practices.

E. Organization of the Report

This report is organized in eight sections:

(1) **Background and Objectives** is this introductory section;

(2) **Project Description** describes the existing and proposed wastewater management system and discusses system alternatives;

(3) **Industrial Survey** presents the scope, methodology, and findings of the industrial survey;

(4) **Environmental Setting** describes the environmental setting of Ramallah and neighboring villages, including physical environment, cultural and archaeological setting, socioeconomic environment, and institutional setting;

(5) **Environmental Impacts and Mitigation Measures** discusses likely environmental impacts of the project during construction and operation and describes specific mitigation measures to reduce, control, or eliminate those impacts;

(6) **Monitoring Measures** discusses in-plant environmental monitoring measures to ensure that the treatment plant is operating properly and that the treated wastewater meets targeted guidelines for wastewater reuse. This section also describes possible monitoring of outside environmental indicators (e.g., water quality and plant performance);

(7) **Management Measures** identifies specific management measures to be undertaken by ANERA, the Municipality of Ramallah, and the Ramallah Agricultural Marketing Cooperative to ensure that the necessary mitigation and monitoring measures are being implemented; and

(8) **Conclusions and Recommendations** presents a summary of major findings and recommendations.

It also contains three annexes:

- Annex A contains base maps showing the location of Ramallah in the West Bank, the location of the existing treatment plant and the proposed plant within the Municipality of Ramallah, the layout of the existing WWTP, and the design of the proposed WWTP.

- Annex B provides a summary of the Midcourse Evaluation Workshop held at the Municipality of Ramallah on September 8, 1994.

- Annex C provides a synopsis of individual site visits to Ramallah industries and the industrial survey questionnaire.

In addition, a separate annex volume contains references, a list of contacts, photographs, and other pertinent information.

SECTION II

PROJECT DESCRIPTION

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SECTION II
PROJECT DESCRIPTION

This section describes the existing and proposed wastewater management systems for Ramallah city, as well as alternative systems that were considered. For information on project background and objectives, see Section I, A. of this report.

A. Existing Wastewater Management System

Most domestic and industrial wastewater generated in the city of Ramallah currently is:

- Collected in a municipal sewer network.
- Minimally treated at a WWTP.
- Discharged into a wadi through a 2-km underground pipeline.

Map A-2 (Annex A) shows the location of the WWTP relative to the Ramallah industrial area, new residential areas in Ramallah, and neighboring villages.

A1. Wastewater Collection

Initially built in the mid-1970s, the Ramallah municipal sewer network has been expanded to accommodate the city's growth. Municipal and industrial wastewater, septage from cesspits, and a portion of the city's storm water runoff are collected in the sewer network.

A1a. Municipal Wastewater

As of mid-1994, about 70 percent of households in Ramallah city are connected to the sewerage system. Main sewer lines do not extend to several parts of the city, notably the north, south, and northwest (new housing area). Household connections are expected to reach 100 percent by the year 2015.

The existing sewerage includes pipes ranging in diameter from 6" in the lateral lines to 12" in the main line leading to the treatment plant. Because of the hilly topography of Ramallah, six pumping stations are installed throughout the network to pump sewage to the main lines leading to the existing WWTP. Also, based on an agreement between the municipalities of Ramallah and neighboring Al-Bireh, a small portion of Ramallah territory discharges its sewage into the sewage collection network of Al-Bireh for gravity reasons, and vice-versa.

A1b. Industrial Wastewater

As discussed in Section III, there is a growing number of small- and medium-sized industrial plants discharging wastewater into the municipal sewers of Ramallah. Almost all

factories in the city's industrial area are connected to the WWTP, except those located in the northern part of the industrial area, which is not served by the sewer network. Only a few industries have some form of pretreatment or wastewater recycling on-site. Existing industries include:

- Food processing and soft drinks
- Pharmaceuticals
- Detergents
- Stone cutting and concrete mixing
- Handicrafts
- Plastics
- Textile dyeing.

The main slaughterhouse in Ramallah is not connected to the sewer network or the WWTP. However, small slaughterhouses (e.g., chicken) discharge blood waste into the sewer network.

A1c. Septage

As mentioned, only 70 percent of households in Ramallah city are currently connected to the sewerage network. The remaining 30 percent of households use percolating pits and septic tanks (rarely). Septage from these pits and tanks is pumped periodically using vacuum tankers. Septage is then disposed of on agricultural lands, in nearby wadis, into the sewer system through manholes, or directly into the aerated lagoons at the WWTP. Daily, 10 to 15 trucks discharge about $5m^3$ of septage on average per truck directly at the WWTP (ANERA revised proposal, November 1993).

A1d. Storm Water Runoff

There is no separate storm water drainage system in Ramallah in 1994. Storm water runs off into different wadis surrounding Ramallah as well as into the sewer system. An experiment conducted on January 8, 1993, confirmed that part of the storm water runoff is discharged into the sewer network of Ramallah. A significant rise in the wastewater flow was observed at the entrance of the WWTP two hours after the start of precipitation (10 percent increase in flow, even before the main showers) (ANERA revised proposal, November 1993).

A1e. Wastewater Characteristics

Table II-1 summarizes the characteristics of wastewater received at the WWTP as reported in ANERA's revised proposal (November 1993). According to that proposal, the average daily wastewater flow was estimated at 1,140 m^3/day for 1993. This flow estimate assumed 93 l per capita per day and a total population of 21,940, of whom 70 percent were connected to the sewer network. These figures were based on water consumption quantities and discharge measurements for 1992.

Wastewater quality estimates in Table II-1 result from the analysis of seven samples taken at four different composite locations at the WWTP. These samples were taken

between November 7, 1992, and March 17, 1993, and analyzed by the Center for Environmental and Occupational Health and Safety at Bir Zeit University. Suspended Solids (SS) were not measured. Septage characteristics were not investigated or directly measured.

Table II-1
Wastewater Characteristics

Parameter	Measured Value
Average daily flow	1,140 m^3/day
Average BOD* (BOD5)	820 mg/l
Average COD**	1,650 mg/l
Average salinity	770 mg/l
Average pH	7.0
Average conductivity	1,500 μs

Source: ANERA, "Ramallah Municipality Wastewater Collection, Treatment, and Reuse System Development," Revised Proposal, November 1993.
* Biological oxygen demand.
** Chemical oxygen demand

A2. Existing Wastewater Treatment

The existing WWTP is located in the southwestern part of Ramallah near the industrial area. Because incoming wastewater by far exceeds the design capacity of the plant, the plant is not performing the intended function of treating incoming wastewater. Treatment efficiency does not exceed 20 percent. The municipality has one part-time employee at the plant for basic operations (cleaning the bar rack, directing incoming wastewater to one pond or the other).

The existing plant consists of a bar rack and parshall flume, two aeration ponds in parallel, and two stabilization ponds in series (see Map A-3, Layout of Existing Wastewater Treatment Plant in Ramallah, Annex A). A bar rack is installed at the entrance of the treatment plant. Under normal conditions, incoming wastewater passes through the bar screen into the parshall flume. The parshall flume is 9" wide and is designed for a maximum flow of 480 m^3/hr.

Sewage then enters two identical circular aeration ponds in parallel, each with a volume of 3,800 m^3. When maintenance is carried out in one pond, all of the sewage is directed to the other pond while sewage from the first pond is pumped out to the other pond using a mobile submersible pump. A 20-hp aerator is installed on a reinforced concrete platform in the middle of each pond. A bridge facilitates access to the aerator for maintenance. Minimum retention time in the aeration pond is designed for six days. However, because one aerator has been out of order since April 1994 and current wastewater

flow by far exceeds the design capacity, actual retention time in the aerator pond is about one day.

After aeration, the wastewater flows successively into two stabilization ponds in series with a combined surface area of about 10,000 m^2 and a combined volume of about 10,000 m^3. Neither concrete nor masonry was used to line the bottom surface or the embankments of the ponds. According to the geotechnical report of the original design, the silty fat clay of the valley would be sufficient to prevent seepage. No information is available to support or refute this assertion.

A3. Disposal of Treated Wastewater

Wastewater effluent from the second stabilization pond overflows into a 12" underground pipeline. The pipeline extends for about two kilometers south of the treatment plant before discharging the effluent into a wadi, where it flows westward.

A4. Sludge Disposal

There are no sludge treatment facilities. Accumulated sludge is pumped every six months from each stabilization pond and piled up next to the ponds where it is left to dry. The municipality uses this dry sludge material as soil conditioner and fertilizer for landscaping throughout the city.

A5. Storm Water Disposal

As mentioned in subsection A1d., there is no separate storm water collection system in Ramallah. A considerable portion of storm water runoff flows to the nearby wadis. Another portion is discharged with the municipal wastewater. Inside the WWTP, a catchment channel drains storm water falling on the plant site and disposes it directly to the wadi through a 10" pipeline.

B. Wastewater Management System Alternatives

The Municipality of Ramallah, in cooperation with ANERA, entered into an agreement with the Engineering Center for Planning and Design (ECPD) at Bir Zeit University for a conceptual and detailed design of a new WWTP for Ramallah city.

B1. Planning Basis for Development of Alternatives

The ECPD was contracted by ANERA to:

- Evaluate existing treatment facilities.
- Identify and evaluate wastewater management system alternatives that would:
  - be in the same location as the existing treatment plant
  - modify and/or add new techniques and systems of treatment

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- supply nearby villages with treated wastewater for irrigation that meets "international guidelines"

- cope with the incoming wastewater flow for the next 20 years (i.e., up to year 2015).

Table II-2 shows the basic design criteria established for all wastewater treatment alternatives.

Table II-2
Basic Design Criteria for all Alternatives Considered

Parameter	Assumption
Population to be served	40,000 people
Average water consumption	115 l/c/d
Average wastewater production	92 l/c/d
Average wastewater flow	3,680 m^3/d (154 m^3/h)
Peak wastewater flow	540 m^3/h
Plus septage	40 m^3/d
Average BOD5 and SS loadings (without septage)	60 g/c/d 2,400 kg/d 652 mg/l
Septage BOD5 loading	240 kg/d 6,000 mg/l
Total average BOD5 loading (with septage)	2,640 kg/d 717 mg/l*

* The design assumes a Biological Oxygen Demand ("BOD") loading of 717 mg/l, which is less than the average Ramallah wastewater BOD content (820 mg/l), as measured between November 1992 and March 1993 (see subsection A1e., and Table II-1). The rationale is that over time, the population of Ramallah will consume more water (see Section V, A1.), and the BOD level in municipal wastewater will decrease. In the short term, although Ramallah wastewater has a higher BOD content, it is generated in smaller quantities (1,140 m^3/day—see Table II-1) than the design wastewater flow (3,680 m^3/day—see above table).

B2. Alternatives Considered

Several alternatives were investigated and reviewed several times by ECPD and ANERA and its consultants. Table II-3 describes the various alternatives considered in successive ANERA reports and provides comments on each alternative.

Table II-3
Alternative Wastewater Treatment Systems Considered

Alternative Systems	Basic Elements	Comments
1. Aeration Ponds Followed by Stabilization Ponds ECPD, August 1993	• Screen Unit • Primary Sedimentation Tank • Aeration Lagoon • Stabilization Pond • Sludge Drying Bed • Sludge Processing Pond • Slow Sand Filter	• Requires large area • Would not easily meet effluent guidelines
2. Extended Aeration ECPD, August 1993	• Aeration Reactor • Sedimentation Tank • Stabilization Pond • Sludge Processing Pond • Sludge Drying Bed	• Requires high energy input
3. Waste Stabilization Ponds ANERA, October 1993	Stage I: To year 2005 • Two Anaerobic Ponds • Three Facultative Ponds • Three Maturation Ponds Stage II: To year 2015 • Three Anaerobic Ponds • Two Aerated Lagoons • Two Facultative Ponds • One Maturation Pond	• Temperature dependent • Requires large area • Would not easily meet effluent guidelines • Likely odor problem
4. Aerated Lagoons Preceded by Anaerobic Ponds ANERA Revised Proposal, November 1993	• Two Anaerobic Ponds • Two Aerated Lagoons • Two Sedimentation Basins • Sludge Drying Beds • Polishing Ponds	• Would produce lots of sludge • Odor problem
5. Modified Stabilization Ponds ECPD & Arabtech-Jardaneh, June 1994	• Septage Unloading Station • Two Anaerobic Ponds • Two Aerated Lagoons • Four Maturation Ponds • Stabilization Reservoir	• Sludge minimal • Better effluent characteristics • Reservoir is part of treatment • Accepts chock loads • Odor problem

B3. Rationale for Selection of the Proposed System

The modified stabilization ponds system (Alternative 5) was selected over the other alternatives for the following reasons:

- Limitation of land area available for treatment facilities. After expropriating 30 dunums to add to the existing 40 dunums, the total area available for the WWTP would be 70 dunums. Wastewater stabilization ponds (Alternatives 1 and 3, Stage I) were excluded because they would require a larger surface area in order to produce effluent that meets the quality guidelines.

- Need to minimize energy use and costs. Alternative 2 was excluded because it would require the most energy.

- Fluctuation in temperatures in Ramallah from 8°C in the winter to 23°C in summer. This is not in favor of Alternative 3, which is temperature dependent.

- Alternative 4 would produce large amounts of sludge.

- Alternative 5 will meet most effluent guidelines for reuse of effluents in irrigation.

C. Proposed Wastewater Management System

The proposed wastewater management system consists of two subsystems:

- Treatment of municipal wastewater.
- Distribution of treated wastewater for irrigation.

The sewerage network remains the same initially and continues to be expanded until it covers the entire city of Ramallah by 2015.

C1. Proposed Wastewater Treatment Subsystems

Located on the same site (but expanded) as the existing treatment plant, the proposed wastewater treatment system uses two anaerobic ponds followed by two aerated lagoons in parallel, then a series of four maturation ponds. Wastewater effluent from the fourth maturation pond flows into a stabilization reservoir, where the treatment process is completed. A general description of each component of the treatment subsystem is given below. See Map A-4, Design for Proposed Wastewater Treatment Plant in Ramallah, Annex A, for the proposed layout. Table II-4 summarizes the design criteria for each of the system components.

C1a. Anaerobic Ponds

Two anaerobic ponds will achieve organic removal through anaerobic digestion. Anaerobic ponds are especially effective in bringing about the rapid stabilization of strong organic wastes. According to the design firm of Arabtech-Jardaneh (June 1994), anaerobic ponds only require sludge pumping every two or three years.

Table II-4
Design Criteria for the Proposed Treatment System Components

Characteristic	Wastewater Inflow	Anaerobic Ponds	Aerated Lagoons	Maturation Ponds	Stabilizat. Reservoir
Average daily flow (m^3/day)	3,680	3,680	3,667	3,639	-*
Effluent BOD5 (mg/l)	717	466	20	-*	-*
Effluent fecal coliform** (FC/100ml)	-*	-*	-*	8.5×10^2 **	2×10^2
Number of units	NA	2	2	4	1
Depth (m)	NA	4-7	3	1-8	4
Total volume (m^3)	NA	19,400	15,400	38,308	350,000
Total surface area (m^2)	NA	-*	7,300	-*	91,000
Total detention time (days)	NA	5	4	10	100

NA—Means not applicable.
* Not supplied by the design engineer.
** The designer used Jordanian assumptions regarding fecal coliform contents of wastewater inflow.

C1b. Aerated Lagoons

In the proposed two aerated lagoons, wastewater will be treated by supplying oxygen mechanically using surface aerators. The action of the aerators and that of the rising air bubbles from the diffusers are used to keep the contents of the lagoon in suspension.

C1c. Maturation Ponds

Four maturation ponds (large aerobic ponds) will remove fecal bacteria. Organic loading on these ponds is light because most of the organic load is removed in the anaerobic ponds and aerated lagoons. Maturation ponds have the capacity to operate for more than 20 years before sludge needs to removed.

C1d. Sludge Drying Beds and Sludge Disposal

For this type of treatment plant, where sludge is pumped from anaerobic ponds having a holding capacity of several years, the beds are sized for an evacuation every six to 12 months. Annual quantities of sludge are expected to reach 1,600 to 3,200 m^3 late in the project. An area of about 2,700 m^2 is provided for the sludge drying beds.

The design proposal suggests dumping the sludge before six to twelve months periodically to a fenced selected site in the mountains where it can dry far from inhabited areas. However, the sludge dumping site has not yet been identified.

The existing 12" discharge pipeline will continue in use, but a split box will be installed on the line outside the adjacent military installation to divert the water to the stabilization reservoir. The rest of the pipeline will serve as an emergency line when the reservoir is in maintenance or repair or when the quality of the treated water fails to meet the effluent guidelines.

C1e. Stabilization Reservoir

Located at some distance downstream from the current plant location, the stabilization reservoir will complete the fecal removal process. The reservoir is designed to reduce fecal coliform (FC) levels from 8.5×10^2 FC/100 ml (fecal coliform counts per 100 ml) to 2×10^2 FC/100 ml. The detention time in the reservoir is 100 days. The reservoir may be one cell or two cells, but if it is one cell, the hydraulic design should ensure that the influent water will stay the full detention time before it is released from the reservoir. The total reservoir area is about 91 dunums, having a total volume of about 350,000 m^3. The reservoir will be located between Betunia and Rafat downstream from the WWTP. The bottom of the reservoir will be lined by either clay (permeability 10^{-7} cm/sec.) or 1.5 mm high density polyethylene (HDPE) liner.

C2. Proposed Wastewater Reuse Subsystem

The proposed wastewater reuse subsystem consists of the small distribution reservoir and the irrigation pipelines that will distribute treated wastewater to farmers in the villages of Al-Jeeb, Betunia, Rafat, and Al-Jdeira. It is proposed that one irrigation pipeline will be installed directly from the stabilization reservoir to irrigate the agricultural lands in Rafat wadi. The following is a description of the proposed wastewater reuse subsystem.

C2a. Distribution Reservoir

The distribution reservoir is a four-meter high circular concrete reservoir, having a volume of 1,000 m^3. This reservoir will serve as a distribution reservoir for agricultural lands that are higher than the stabilization reservoir. It will be located on the top of the hilly area adjacent to the stabilization reservoir. Water will be pumped to this reservoir from the stabilization reservoir and then distributed by gravity to farmers.

C2b. Irrigation Pipelines

The treated wastewater will reach the distribution reservoir through a 10" force pipeline. Water will be distributed from that reservoir by three or four gravity pipelines starting from 6" and then gradually decreasing to 2" at the farthest farm inlets. Water meters will be installed at each farm turnout. Farmers are expected to supply and install their own irrigation networks.

C3. Construction Activities

The project is split into two packages for two construction contracts because the designer believes that no qualified contractor is available in the West Bank to build the entire project. Moreover, the Bill of Quantities is prepared in lump sum bases—each work activity will be priced as one unit—to avoid the variation orders.

C3a. Description of Activities

Construction activities initially will focus on building the two anaerobic ponds, the new headworks, the septage station, and the new pipe connecting the external manhole to the headworks. The existing plant will continue to operate during the initial construction phase. After completion of the initial phase, wastewater flow will be transferred to the new headworks, slowly over a 10-day period filling the anaerobic ponds.

As the anaerobic ponds are being filled, a temporary effluent line will be installed, clearing the site to enable the excavation of the second aeration pond (AR2). Then AR2 will be excavated and the flow diverted to it.

The first aeration pond (AR1) and the four maturation ponds can then be executed according to precise schedule. The contractor is expected to stick to this program to maintain plant operation owing to the continuous flow of wastewater. According to ANERA documents, the contractor is expected to:

- Import the aerators as soon as possible.
- Apply for electric power and do all that is required to operate the aerators.

C3b. Project Execution Schedule

According to the latest report (June 1994), construction of the WWTP and irrigation system is due to start at the beginning of December 1994 and be completed 19 months later at the end of June 1996.

C3c. Labor and Housing Requirements

During the project execution, proper technical support, especially at supervisory and project management levels, will be absolutely vital to its success. Highly qualified contractors will be needed for the execution of this project. Only contractors with previous experience in implementing similar works will be invited to tender. No temporary housing is expected to be required for construction workers. The only temporary buildings required are the site office and the guard room.

C4. Operation and Maintenance

The WWTP will be attended reliably 24 hours per day. The main tasks for the operating personnel are:

- Clean the screen.

- Measure the flow at regular intervals.
- Provide preventive and corrective maintenance to civil, mechanical, and electrical equipment.
- Keep the plant clean and well kept.
- Take composite samples of flows and analyze these samples based on common parameters.
- Arrange for timely removal of sludge and desludging of the stabilization ponds.
- Keep records of O&M activities.
- Receive plant visitors.
- Liaise with municipal authorities.

C4a. Labor Requirements

In general, staffing a WWTP is a function of plant size (both capacity and site), process type, mechanical complexity, process control requirements, influent characteristics, etc. According to the design firm, the Ramallah WWTP requires the following staff:

- **Operations superintendent.** An experienced individual who has overall responsibility for supervising the operation and maintenance of the entire plant, sewage collection system, and pump stations.

- **Engineer.** A degreed electromechanical engineer who is responsible for day-to-day process and electrical troubleshooting at the plant, and plant equipment preventive maintenance and testing.

- **Operations assistant.** An individual who is primarily responsible for providing routine operation, maintenance, sampling, and testing duties. Duties also include assisting the engineers in process control and equipment testing.

- **Laboratory analyst.** An individual who is primarily responsible for providing laboratory results used for process control and monitoring.

- **Truck driver.** A person whose major responsibility is driving the sludge truck.

- **Utility man, operator assistant trainee(s).** Persons who are responsible for building and grounds maintenance, painting, and assisting in routine plant operations.

C4b. Materials Requirements

Main tools required for plant operation are such simple equipment as sludge gauge, boat, refrigerator, rakes, skimmers, movable pumps, shovels, etc. In addition, the proposed design calls for on-site laboratory capabilities to monitor operating parameters and check treatment plant performance. Tests required for monitoring plant performance are BOD, suspended solids (SS), and FC. Equipment required for such tests includes a vacuum pump, dilution bottles, autoclave, water bath, BOD bottles, pipets, burets, flasks, chemicals, pH

meter, DO meter, etc. Other tests, such as those required by governmental regulations (current or future), should be done by an external laboratory, such as a university laboratory (e.g., Bir Zeit University). Off-site tests include analyses for heavy metals.

SECTION III

INDUSTRIAL SURVEY

SECTION III
INDUSTRIAL SURVEY

Except for a few light industries scattered in residential areas, most industrial plants are located in the industrial area of Ramallah and are connected to the sewer network. Because industrial wastewater discharges may upset the proper functioning of the proposed WWTP, the EA includes a survey of industrial plants in Ramallah. This section reviews the scope and objectives of the Ramallah industrial survey, describes the methodology used, and summarizes survey findings. Annex C presents a synopsis of site visits and the industrial survey questionnaire used.

A. Survey Scope and Objectives

Industrial activity in Ramallah has increased from only a handful of industries in 1974 to an industrial park of more than 40 industrial operations in 1994. Table III-1 provides a list of existing industries, grouped according to type of industry and product. This list contains all industrial plants in the industrial area; it may not include certain small light industries scattered throughout residential areas of Ramallah. Map A-2 (Annex A) shows the Municipality of Ramallah and the location of the industrial area relative to the existing WWTP and the city of Ramallah.

The objectives of the industrial survey were to:

- Evaluate the quantity and quality of industrial wastewater discharges to the Ramallah municipal sewer network.
- Identify industries that may discharge undesirable wastewater into the municipal sewer network.
- Inform industries of the Ramallah Municipal Wastewater System development project and start a dialogue between industries and the municipality to ensure the success of that Palestinian Project.
- Assess the effort required by the Ramallah municipality to monitor and control industrial wastewater discharges into the sewer network.
- Assess efforts and opportunities for water and energy conservation, waste minimization, and pollution prevention by industries in Ramallah.

Table III-1
Industries and Products in Ramallah

Industry and Product	No. *	Company Name
Food and Drink		
Sweets and chocolates	6	Silvana Co.
	36	Sunukrot Sweets Industry Co.
	37	Al Sha'rawi Food Industry Co.
Soft drinks	29	Modern Beverage Co. Ltd. (Club)
	2	Al Nasr Industrial Commercial Co.
Dairy products	12	The National Dairy Co.
Halva (sesame-based sweets)	16	Halva Co.
	18	Abu Al Itham Factory
Animal feed	20	Animal Feed Factory
	35	The Poultry Coop Society
Food canning	25	Al Mahseeri Co.
	26	Al Qaisi Canning Factory
Plastics		
PVC pipes and fittings	7	Ramallah Plastic Pipe Manufacturing Co.
	33	The Arab United Plastic Industry Co.
	27	Ramallah Industrial Plastic Co.
Plastic bags	1	Rabah Plastic Company
Plastic boxes	13	United Production Co.
	17	Plastic Boxes Co.
Plastic items	-	Al-Salam Plastic Industries

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Industry and Product	No. *	Company Name
Stone and Concrete		
Stone cutting	22	Modern Saw
	34	Izmekna Stone Cutting Co.
Local marbles and tile	30	Modern Saw Co.
Concrete mixes and blocks	32	United Concrete Industry Co.
	3	Samir Karam Factory
Paper and Cardboard		
Toilet paper	4	Tako Factory
	-	Reema Factory
Manufacturing and marketing paper	9	The National Co. for Paper
Cardboard boxes	14	Dalia Carton Manufacturing Co.
Furniture		
Foam	28	International Foam Manufacturing Co.
	8	Al Jolani Foam Co.
Mattresses	5	Nasco Co. for Spring Mattresses
Furniture	39	Al Ameen Furniture Co.
Metals		
Electrical switchboards	10	Engineering Manufacturing Co.
	11	Ma'ayah Manufacturing Co.
Solar boilers	19	Abu Nahleh Factory

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Industry and Product	No. *	Company Name
Pharmaceuticals		
Pharmaceuticals	31	Balsam Pharmaceutical Co.
	38	Birzeit/Palestine Co.
Miscellaneous		
Detergents and cleaning items	24	The Arab Manufacturing Co.
	15	Surda Detergents Co.
	-	Karim Industrial and Commercial Co.
Ceramic tiles	23	Rabah Ceramics Co.
Cosmetics	21	The Middle East Co.
Textile dyeing	**	Nasim Textile Dyeing Co. Ltd.
Other Miscellaneous		
	-	Nablus Garage (carburetors)
	-	Auto Body Shop
	-	Flash Car Wash
	-	Othman's Car Wash

* Numbers used by municipality on its maps.
** Not licensed by the municipality.

B. Survey Methodology

The PRIDE team designed a survey questionnaire to serve as a guide for site visits to selected industries. The questionnaire was designed to be simple yet provide basic information on the quantity and quality of industrial wastewater discharges into the Ramallah municipal sewer network. Annex C contains the survey questionnaire.

Owing to time limitations, the industrial survey focused on a sample of industries in Ramallah, chosen by a workgroup of PRIDE team members and Ramallah municipality engineers (the survey team). To identify this sample, the survey team first grouped Ramallah industries according to industry type and product.

The survey team visited one or two plants in each industry group, except in the paper and cardboard group. According to municipality engineers, all three plants in that category (toilet paper, paper manufacturing, and marketing, and cardboard boxes) manufacture paper and cardboard products by cutting imported paper and cardboard materials. Therefore, the survey team concluded that those three plants do not generate significant wastewater quantitatively or qualitatively.

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All other industry groups may or may not generate wastewater of potential concern due to presence of toxic chemicals, high temperature, high BOD content, etc. The survey team chose the largest plant in each industry group, based on the quantity of water used (according to the JWU data) or suspected production output. Table III-2 shows the industrial plants visited.

In each plant, the survey team toured the facility to observe operations and discuss waste generation and management issues with the plant manager and/or engineer. The survey team filled out the questionnaire at each plant visited.

C. Survey Results

Using the survey questionnaire as a guide, the survey team visited the industries in the sample. Annex C provides a synopsis of each site visit. Overall findings are:

- All industries in Ramallah use water supplied by the JWU (see Section IV, D2d.). Two of the plants visited (Izmekna Stone Cutting Factory and Rabah Plastic Company) supplement this public water supply with rainwater collected in cisterns or tanks. Water consumption is metered at the plant level.

- Almost all industries in Ramallah are connected to the municipal sewer network. Exceptions include a few industries (e.g., Rabah Plastic Company) located in the northwestern part of the Ramallah industrial area, where in 1994 there were no sewer lines.

- No industry surveyed has previously characterized its wastewater. There are no meters on wastewater discharges to the sewer network, and no sampling and analysis of wastewater has been conducted. Therefore, hard data were not available on either wastewater quantity or quality.

- According to the JWU, Ramallah industries consumed a total of about 127,000 m^3 in 1993, or 22 percent of total (domestic and industrial) water consumption in Ramallah (~700,000 m^3 in 1993, see Table V-1). Given the industrial profile of Ramallah, the PRIDE team estimated that about 40 percent of water consumed by industries becomes wastewater, or about 51,000 m^3 in 1993. Industrial wastewater represents about 10 percent of total wastewater generated in Ramallah in 1993 (see Table V-1).

- Few industries have on-site wastewater pretreatment or recycling. One example is the Arab Manufacturing Company, which produces detergents, washing powders, and disinfectants. The company has just finished installing a closed-loop in-plant wastewater recycling system that will cut water consumption to at least one-third of current water consumption rates. When this recycling system becomes operational, no industrial wastewater will be discharged into the municipal sewer network.

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Table III-2
Industrial Plants Visited

Industry and Product	No. *	No. **	Company Name
Food and Drink			
Sweets and chocolates	3	6	Silvana Co.
Soft drinks	4	29	Modern Beverage Co. Ltd. (Club)
Plastics			
PVC pipes and fittings	1	7	Ramallah Plastic Pipe Manufacturing Co.
Plastic bags	6	1	Rabah Plastic Company
Stone and Concrete			
Stone cutting	10	34	Izmekna Stone Cutting Co.
Furniture Items			
Foam	2	28	International Foam Manufacturing Co.
Metals			
Electrical switchboards	12-3	10	Engineering Manufacturing Co.
Pharmaceuticals			
Pharmaceuticals	9	31	Balsam Pharmaceutical Co.
Miscellaneous			
Detergents	7	24	The Arab Manufacturing Co.
Ceramic tiles	6	23	Rabah Ceramics Co.
Textile dyeing	8	***	Nasim Textile Dyeing Co. Ltd
Other Miscellaneous			
	12-1	-	Nablus Garage (carburetors)
	12-3	-	Auto Body Shop
	11	-	Flash Car Wash

* Numbers of plants visited (see Annex C for description).
** Initial numbers provided by the municipality.
*** Not licensed by the municipality.

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- In the absence of hard data, the survey team estimated wastewater quantities as a fraction of water use (provided by the water bill). The team assessed the potential impacts of the wastewater on the WWTP using a combination of best engineering and professional judgement and discussions with the plant engineer.

- Industries contribute an estimated 10 percent of the total quantity of wastewater discharged into the municipal sewer network of Ramallah (see Table V-1).

- In general, industrial wastewater currently generated should not upset the operations of the WWTP under normal circumstances. Exceptions include the textile dyeing company that usually discharges about 6,000 m^3 monthly of hot and colored wastewater (temperature not disclosed) containing dye chemicals.

- In addition, certain industries may discharge occasional or accidental shock loads, such as the two pharmaceutical companies (discharge of defective batch of antibiotics) and the foam manufacturing company (accidental discharge of Toluene DiIsocyanate, or TDI). The proposed biological treatment plant may not be able to sustain such shock loads.

D. Recommendations

Proper operation of the WWTP will require that the Municipality of Ramallah monitor and control industrial wastewater discharges into the sewer network. With technical assistance from ANERA and USAID, the Municipality of Ramallah should undertake the following five recommendations.

D1. Conduct a Selective Wastewater Sampling and Analysis Program

Given the total absence of hard data on wastewater quantity and quality, the Municipality of Ramallah should conduct wastewater sampling and analysis targeted at a subset of Ramallah industries, including industries not visited. This subset should include, at a minimum:

- Food and drink: e.g., Silvana Co. and the Animal Feed Factory.
- Foam manufacturing: e.g., the International Foam Manufacturing Co.
- Pharmaceuticals: e.g., Balsam Pharmaceutical Co.
- Detergents and cleaning items: e.g., The Arab Manufacturing Co.
- Ceramic tiles: Rabah Ceramics Co.
- Textile dyeing: Nasim Textile Dyeing Co. Ltd.
- Miscellaneous: e.g., Flash Car Wash.

The analysis program should be targeted at specific pollutants likely to be found in the wastewater generated by each industry, as suggested by USEPA industry profiles.

D2. Develop and Enforce Industrial Wastewater Discharge Regulations and Standards, Establish a Strict Monitoring Program for Potentially Dangerous Facilities—Including Site Visits and Inspections—and Link Licensing to Wastewater Discharges

Based on the results of the sampling and analysis program, the municipality should require select facilities to monitor their wastewater effluents (quantity and quality) on a regular basis (frequency is facility specific). Plants that routinely discharge dangerous wastewater should be required to install pretreatment equipment. Plants that occasionally or accidentally may discharge shock loads should be required to notify the WWTP as quickly as possible of any emergency shock loads. The municipality and plant operators should prepare an emergency response plan (see recommendation D3.), including 24-hour emergency response capabilities at the WWTP. This will require equipping the plant with a cellular telephone because there are no telephone lines near the plant.

D3. Review Plant Design to Incorporate an Emergency By-Pass Pond

The design engineer should revise the plant design to incorporate an emergency by-pass pond at the entrance of the WWTP. According to the emergency response plan (see recommendation D2.), plant operators would direct emergency shock loads to this emergency by-pass pond and away from the treatment plant. The revised engineering designs also should include an emergency pipeline to discharge effluents from the emergency by-pass pond into the wadi. The same emergency pipeline would be used to discharge effluents that do not meet specific quality guidelines inside the treatment plant (see recommended monitoring program in Section VI, A. and Figure VI-1).

D4. Conduct an Awareness Campaign and Training Programs for Ramallah Industries

The Municipality of Ramallah, with technical support from ANERA, should conduct campaigns to raise the level of awareness among Ramallah residents (including housewives) about environmentally-sound wastewater disposal practices (use of biodegradable detergents, etc.). In addition, the municipality and ANERA should train select industries in safe and environmentally-sound wastewater disposal practices. The municipality, through economic incentives and positive publicity, should encourage industries to recycle wastewater and pretreat wastewater on site.

D5. Study the Feasibility of Separate Centralized Treatment of Industrial Wastewater

In the long term, the municipality should study the technical and economic feasibility of building a separate collection and treatment system for industrial wastewater. This option may be feasible because major industries are located within the same industrial area. It would require separating the industrial wastewater collection network from the municipal sewer network and building an industrial WWTP. Technical and economic feasibility of this option would depend on the degree of cooperation and participation of all industries in the Ramallah industrial area.

SECTION IV

ENVIRONMENTAL SETTING

SECTION IV
ENVIRONMENTAL SETTING

This section presents the environmental setting of the proposed wastewater management system. It describes the physical, socioeconomic, and institutional environment associated with the proposed treatment and reuse of wastewater generated in Ramallah.

A. Physical Environment

This section describes the physical environment of the Ramallah area, including physiography, climate and meteorology, soils and geology, air quality and noise, water resources, and terrestrial and aquatic resources. Unless otherwise noted, data on the physical environment are extracted from Ramallah municipality and ANERA reports and documents.

A1. Physiography

This section describes the geography and topography of the Ramallah area.

A1a. Geography

The city of Ramallah is located 16.5 km north of Jerusalem and 54 km south of Nablus in the central region of the West Bank (see Map A-1, Annex A). Ramallah is accessible from Nablus or Jerusalem by paved roads. The area within municipal boundaries is 17,000 dunums, of which 3,800 dunums are residential or industrial areas.

A1b. Topography

Ramallah is located on the West Bank mountain ridge at an altitude range of 780 to 880 meters above sea level.

A2. Climate and Meteorology

Ramallah has a moderate semiarid Mediterranean climate with little difference between day and night temperatures. The average 24-hour temperature ranges from 8° C (46° F) in winter to 24° C (75° F) in summer.

Westerly winds prevail in the area, although southwesterly winds occur in winter and easterly winds in summer. Average wind velocities in the summer are about 15 km/hr between 9:00 am and 9:00 pm, increasing up to 27 km/hr by 3:00 pm. In winter, average velocities are about 20 km/hr between 6:00 pm and 9:00 am, increasing up to 26 km/hr by noon. During January, the average monthly velocity is about 27 km/hr.

The average rainfall in Ramallah is approximately 600 mm per year and occurs almost entirely during the winter season. The potential annual water evaporation rate is about 160 cm ranging from 5 cm in January to 18 cm in July. The average relative humidity

varies from 51 percent in May to 76 percent in January. Humidity is at its highest in the early morning and lowest in the early afternoon.

The amount of energy radiated by the sun varies during the year; it peaks in June at 7 calories/cm^2/day and averages about 18,000 calories/cm^2 per year. The average annual number of hours of sunshine is about 3,300 hours out of a total of 4,400 hours.

A3. Soils

Soil composition in the Ramallah area is mainly shallow layers of clay and silt with some chalk. The depth of these topsoil deposits usually does not exceed two meters.

A4. Geology and Earthquakes

The geologic formations of the central mountainous regions of the West Bank are mainly karstic limestone/dolomite formations of the Cenomanian and Turonian-aged geologic strata. Areas targeted for irrigation are in the Yatta formation and the Upper Beit Kahil formation.[1] The Upper Beit Kahil formation is regarded as the upper part of the Lower Cenomanian strata. The marls and marly limestones in this formation render it an aquiclude. The Upper Beit Kahil formation has the following generalized succession:[2]

- A prominent top bed of hard limestone, somewhat dolomitic, showing karst weathering, varying in thickness from one to 20 meters, may be silicified in places;
- A main body of marly limestone with locally thick beds and marly partings. Some of the marl units reach a thickness of 20 to 30 meters; and
- A base of marly limestones, with marly partings; the rounded topography is in strong contrast to the underlying cliff-forming limestones.

The Yatta formation is related to the lower part of the Middle Cenomanian of world stratigraphy, so far as can be ascertained. It is mainly of chalk and marl with a fairly thick soil cover and a gentle topography. The Yatta formation acts as a minor aquifer, and the Beit Kahil formation is an aquiclude as water movement is limited.

Because no geological survey has been conducted in the Ramallah area and agricultural lands are not well delineated in existing maps, it is difficult to specify readily the geologic formations corresponding to different agricultural lands in the neighboring villages of Betunia, Rafat, Al-Jdeira, and Al-Jeeb. Such an assessment is important, however, because the Hydrological Service of the Ministry of Agriculture of Israel would restrict irrigation with treated wastewater to agricultural lands located in the Yatta formation.

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[1] Assaf et al., 1993.

[2] For information on these two geologic formations, see: Rofe and Raffety Consulting Engineers, "Geological and Hydrological Report," prepared for the Jerusalem and District Water Supply, 1963.

According to a 1978 report by the Building Research Establishment (BRE), Ramallah is located in an area where one earthquake with intensity 7 or more on the Mercalli-Cancani Scale (basically the same as the MM scale) is expected to occur within a given 50-year. Actually, an earthquake shook the West Bank on Friday, September 16, 1994 (5:13 am). The earthquake measured 4.17 on the Richter open scale, was epicentered in the Jordan valley, and was felt throughout the West Bank. No damages or injuries were reported.

A5. Air Quality and Noise

A5a. Regulatory Framework

Air quality and noise are regulated by the Environmental Department of the Israeli Civil Administration CIVAD—(see subsection D2c.).

A5b. Air Quality and Noise Conditions

Although monitoring of air quality and noise conditions have not been undertaken to date, field observations indicate air and noise levels generally within acceptable limits. Main sources of air pollution include solid waste dumps in Ramallah, El-Bireh, and Betunia (all often on fire), certain industries that emit suspended particulate matter (stone cutting factories) or burn their own wastes on-site (e.g., Sunukrot Sweets Industry Co.), and cars and trucks in "downtown" Ramallah during rush hour. Air pollution is exacerbated during the hot and still summer days due to temperature inversion.

Odors from burning solid waste and uncontrolled effluent discharges add to the degradation of air quality. Noise pollution is associated with traffic, new construction, and infrastructure rehabilitation. Traffic is permanent, but the other causes of noise pollution are temporary. Air and noise pollution may become a problem in the future due to population increase, traffic congestion, and industrial development.

A6. Water Resources

This section describes the institutional framework for water resource management in Ramallah and the West Bank. It then describes surface water and groundwater resources as well as water supply and water quality in Ramallah.

A6a. Institutional Framework

Exploitation of water resources in Ramallah, as elsewhere in the West Bank, remains under the strict control of the Water Department of the CIVAD, (see subsection D2b.). Although water supply in Ramallah is the responsibility of the JWU, an administratively independent utility serving the Ramallah district (see subsection D2b.), the Water Department of CIVAD, determines pumping quotas for existing wells and grants permits with quotas for new wells. Palestinians have been permitted to drill only about three new wells in the West Bank since 1967, including a well drilled by JWU (see subsection A6d.), resulting in a scarcity of water for Palestinian villages.

A6b. Surface Water

Springs are the only surface water resources in the Ramallah area. According to Isaac et al. (1994), the total annual quantity of water piped from springs in the Ramallah district is 100,000 m^3. Springs in the Ramallah area include:

- In Rafat—Ein Bir Eddeir and Ein Um Eisheh.
- In Betunia—Ein Sirris, Ein Wadi el-Namel, and Ein El-Jenan.

In the summer, these springs produce small amounts of water.

A6c. Groundwater

Ramallah lies on the groundwater divide between the Eastern and Western aquifers of the West Bank. The Ramallah WWTP, including the stabilization reservoir and the nearby agricultural areas of Rafat, Betunia, Al-Jeeb, and Al-Jdeira, are located over the Western aquifer system, which flows toward the Mediterranean Sea to outlets at the Rosh Ha'ayin (Ras el Ein) springs, which feed the Yarkon (el Uja) River near Tel Aviv/Jaffa. There are no known groundwater wells in the Ramallah area.

The Eastern basin consists of the Upper Cenomanian and the Lower Cenomanian aquifers, which are separated by an impermeable strata several hundred meters thick. The upper aquifer is a relatively thin strata, typically 60 meters deep, which drains to the east to a series of springs (Uja, Samiya and Wadi Kilt), which are in use. The lower aquifer, typically 600 meters deep, also drains to the east where it mixes with saline groundwater in the Jordan Valley [Assaf et al., 1993].

A6d. Water Supply

Water supply to Ramallah is provided by JWU (see subsection D2d.). The Jerusalem Water Undertaking produces water from four wells in Ein Samia and buys supplemental water from Mekorot, the Israeli Water Company, and the Municipality of Jerusalem. The Ein Samia wells are not affected by the present WWTP and will not be affected by the future WTTP in Ramallah, including the proposed stabilization reservoir and irrigation system.

In 1993 there were three wells in Ein Samia supplying 2.8 million m^3 (see Table IV-1). Mekorot supplied 3.9 million m^3 and the Municipality of Jerusalem supplied 0.6 million m^3 in 1994. A fourth Ein Samia well was placed in service in 1994. The four Ein Samia wells have a combined average productivity of 370 to 425 m^3/hr (see Table IV-2).

Almost all households in the city are connected to the water distribution network. Table IV-3 indicates the number of subscribers (industrial and domestic combined) and annual water consumption from 1988 to 1993 in Ramallah. Because there are only about 40 industries in Ramallah, the number of households is approximately the same as the number of subscribers in Table IV-3. Assuming 5.5 persons per household (see subsection C1a.), average annual consumption in 1993 was about 100 l per person per day (i.e., 699,791 m^3/year divided by 365 days/year, divided by 3,367 subscribers, divided by 5.5 persons/subscriber, and multiplied by 1,000 l/m^3).

Table IV-4 shows bimonthly water consumption quantities by Ramallah residences and industries (combined) during 1993. It shows a peak in water consumption during the months of September and October.

Table IV-1
Water Production Rates 1992 and 1993

Water Source	1992 (million m^3)	1993 (million m^3)
Pumped from Ein Samia Wells		
Well 1	1.2	1.3
Well 2	0.3	0.3
Well 3	1.2	1.2
Total Ein Samia wells	2.7	2.8
Purchased from Mekorot	3.7	3.9
Purchased from Jerusalem Municipality	0.5	0.6
Total water production	6.9	7.3

Source: Engineer Husni Sari, Jerusalem Water Undertaking, August 1994.

Table IV-2
Productivity of Ein Samia Wells (m^3/hr)

Well No.	Summer	Winter	Average
1	80-100	150-200	120-150
2*	NA	NA	35-40
3	NA	NA	150-170
4**	NA	NA	65
Total	NA	NA	370-425

NA—means not available.
* In late 1994 under expansion.
** This is a new well (1994). Projected productivity is 120-150 m^3/hr.
Source: Engineer Husni Sari, Jerusalem Water Undertaking, August 1994.

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Table IV-3
Number of Subscribers and Annual Water Consumption
In Ramallah City, 1988 through 1993 *

Year	Number of Subscribers	Annual Water Consumption (m3)
1988	3,068	568,899
1989	3,112	570,657
1990	3,105	529,273
1991	3,190	518,399
1992	3,328	588,454
1993	3,367	699,791

* Both domestic and industrial subscribers and consumption.
Source: Jerusalem Water Undertaking

Table IV-4
Bimonthly Consumption in Ramallah City, 1993

Months	Two-Month Consumption (m3)
January-February	83,934
March-April	87,679
May-June	110,211
July-August	120,226
September-October	161,556
November-December	136,185
Total *	699,791

* Total does not add due to rounding

A6e. Water Quality

The Department of the Environment of the CIVAD conducts routine weekly water-quality tests from the distribution network (total and fecal coliform). During the first six months of 1994, there were 328 samples of water tested for bacterial contamination from Ramallah city (primarily from the JWU distribution network). Thirty-six of these samples (or 17 percent) were found to contain total coliform levels greater than the Israeli standard of 3 TC/100ml for drinking water [CIVAD, 1994]. In addition, physical and chemical analyses were performed recently at the Center for Environmental and Occupational Health Sciences at Bir Zeit University (see Table IV-5). Table IV-5 also indicates relevant WHO or U.S. drinking water quality standards or guidelines. For all contaminants but lead, contaminant concentrations are well within both U.S. and WHO drinking water standards or guidelines. Lead concentrations in Ramallah water sources range between 0.09 mg/l and 0.13 mg/l and thus are higher than U.S. and WHO guidelines for lead (both equal to 0.05 mg/l). Given the overall good quality of water sources used, only chlorination is required and undertaken by JWU before distribution to consumers.

A7. Terrestrial and Aquatic Resources

There are no studies or documentation on terrestrial and aquatic resources in and around Ramallah. There are no permanent surface water sources and hence no known aquatic resources in the Ramallah area. According to the map of the Nature Reserves Authority of Israel, there are no nature conservation areas located in close proximity to the proposed WWTP and the agricultural areas targeted for irrigation. The closest nature reserve is located north of Beit El, which is approximately 7 km north of the plant site.

A7a. Wildlife

According to Betunia farmers, wildlife—gazelles, hare, and birds—reportedly live in the Betunia wadi in which minimally treated wastewater is currently discharged. This pollutes critical water holes for both animal wildlife and livestock (goats and sheep).

There are also many wildflowers in the outlying area around Ramallah, 80 percent of which bloom from February to May; some flowers reach their peak as late as July. The rains transform what looks like desert most of the year into green and colored fields with many kinds of wildflowers. Without an awareness campaign, however, some of these flowers, plants, and trees, some indigenous to the West Bank area, will disappear. Factors of degradation include open grazing for sheep and goats, expansion of agricultural and housing areas, and lack of designated wildlife conservation areas.

Table IV-5
Quality of Water Sources Used by the Jerusalem Water Undertaking

Test	Ein Samia Wells				Mekorot	Munic. of Jerusalem	International Guidelines *
	1	2	3	4			
Physical Tests							
Turbidity (NTU)	1.2	0.05	0.09	1.0	0.08	0.05	1 **
Conductivity (μ mhos/cm)	480	464	535	680	516	514	NA
TDS (mg/l)	240	232	263	339	258	257	500 ***
pH	7.8	7.7	7.8	7.2	7.8	7.7	6.5-8.5 **
Chemical Tests							
Hardness $CaCO_3$ (mg/l)	271	256	304	354	323	292	NA
Ca (mg/l)	65	59	65	81	68	71	NA
Mg (mg/l)	23	22	32	38	27	29	NA
F^- (mg/l)	0.17	0.18	0.24	NA	0.21	0.19	1.5 **
Cl^- (mg/l)	19.4	21.5	20.5	26	20.5	21.5	250 **
Li (mg/l)	0.00	0.01	0.01	NA	0.01	0.01	NA
Mn (mg/l)	0.01	0.00	0.00	0.03	0.00	0.00	NA
Na (mg/l)	18.3	19.4	18.6	22.6	19.5	20.5	NA
K (mg/l)	4.47	2.88	1.86	5.19	1.99	2.12	NA
Fe (mg/l)	0.25	0.00	0.01	0.21	0.01	0.01	0.3 **
Pb (mg/l)	0.11	0.09	0.13	NA	0.12	0.13	0.05 **
Zn (mg/l)	0.00	0.03	0.01	NA	0.01	0.02	5 **

* The International Guidelines column shows lowest guideline values when two or more guideline values (U.S. MCL, U.S. SMCL, and WHO) are available. When guideline values from different sources are the same, WHO is referenced as the guideline source.
** WHO Guidelines.
*** U.S. Secondary Maximum Contaminant Level (SMCL), related to aesthetic qualities and public acceptance.
**** U.S. Maximum Contaminant Level (MCL): health-related maximum permissible level.

Source: Bir Zeit University, "Physical and Chemical Analyses of All Water Sources Used by the Jerusalem Water Undertaking/Ramallah District," prepared by the Center for Environmental and Occupational Health Sciences, May and June 1994.

A7b. Migratory Birds

The West Bank is an historical transmigratory resting stop for a number of birds on their way to and from the continents of Europe, Asia and Africa. Migratory birds that rest in the West Bank area are European goldfinch, heron, storks, kingfishers, yellow and white wagtails along with ducks, pelicans, and vultures, many of which stay in the West Bank throughout the year. In the future, some of these birds may choose to stop over and rest near the proposed stabilization reservoir.

A7c. Endangered Species

Many animals, birds, reptiles, and insects are on the decline in the West Bank, but due to the lack of formal studies and any real designated areas dedicated to wildlife protection, it is difficult to obtain any reliable data. Plant life has also suffered, and the following should be placed on the endangered list in the West Bank: sumac, salvia (sage), thyme, Palestinian pistachio trees, carob trees, fichus trees, wild orchids, iris, crocus, mountain lily, and desert tulip. Although endangered species in and around Ramallah are not known, the proposed wastewater management system clearly will improve the environmental situation for all wildlife, by treating wastewater that is currently discharged with minimal treatment into the Betunia wadi.

B. Cultural and Archaeological Conditions

There are no known archaeological or historical sites in the vicinity of the proposed WWTP or in the general area encompassing the proposed stabilization reservoir, storage reservoir, irrigation pipelines, and the land area to be irrigated.

As elsewhere in the West Bank, past generations have built terraces for agriculture on the hilly slopes of Rafat, Betunia, Al-Jeeb, and Al-Jdeira. For centuries, these terraces have helped slow down soil erosion caused by rainwater runoff. Olive, vine, and plum orchards prosper on some of these terraces. But most of the terraces suffer from neglect and are rundown because the population of these villages has turned to other sources of income (trade, work overseas, emigration, etc.).

Aesthetic pollution of the natural and man-made landscape is evident: piles of construction and excavation debris litter country roads. The main solid waste dump in Ramallah lies on the edge of the industrial area on the hillside overlooking the WWTP. Smoke from small fires at the dump site can be seen from certain parts of Ramallah and nearby villages.

C. Socioeconomic Conditions

This section describes demography, general land use, economy and employment, transportation and power networks, public and occupational health and safety, and industrial and agricultural activities in Ramallah.

C1. Demography (Ramallah City)

Accurate data on actual population size and trends generally are not available in the West Bank. No population census has been conducted since 1967. Palestinian demography has changed dramatically with the influx of Palestinian refugees who fled from their villages and towns in 1948. In Ramallah, refugee camps house thousands of refugees who have gradually integrated into the socioeconomic life of Ramallah. Many refugees have moved to Ramallah and settled there.

At the same time, a large proportion of the original inhabitants of Ramallah has emigrated to the United States and other countries. Also, many families from Ramallah have one or more members working and living in the Persian Gulf countries. These professionals generally visit Ramallah at least once a year to renew their identity cards and register newborn children.

Ramallah has become the center of activities for the Ramallah district. People from rural areas and other parts of the West Bank come daily to Ramallah to work, trade, study, and engage in various activities. As a result, the population of Ramallah varies significantly between day and night.

C1a. Population Size and Trends

Exact population figures for Ramallah are not known. As indicated in Table IV-6, different sources provide different estimates of current and projected population size. The latest ANERA proposal (November 1993) assumed 24,000 people in 1993 and estimates 40,000 people for the year 2015. In contrast, the Ramallah Town Planning Scheme (see subsection C2.) estimated the population of Ramallah at 26,000 people in 1991 and projects it to reach 47,000 by the year 2010.

Due to the daily influx of workers and visitors from rural areas, the daytime population of Ramallah can reach 32,000 to 35,000 persons. The population of Ramallah has grown by 2.7 percent since 1983; this growth rate is expected to drop to 2.5 percent in 2010. According to municipal officials, the average family size is 5.5 persons, and most of the population is less than 19 years old. The Palestinian population became younger during the 1980s because of increased fertility and declining child mortality [Town Planning Scheme, 1991].

Table IV-6
Population Estimates for Ramallah According to Source

Source	Year	Population Estimate
ANERA, October 1993	1993	30,000
ANERA, November 1993	1993	24,000
	2015*	40,000
Town Planning Scheme, 1991 (see subsection 4.3.2.1)	1991	26,000
	2010*	47,000

* Projected

C1b. Tourism and Recreation

The tourism industry in Ramallah declined dramatically after 1967. A majority of tourists are summer visitors, primarily immigrants from abroad who return to Ramallah to spend part of the summer in their place of origin. There are three parks in Ramallah: one is owned by the municipality but operated by the private sector under a lease arrangement with the municipality; the other two parks are privately owned and are part of two restaurants.

According to the municipality, Ramallah lacks hotels with proper services. The 1991 Ramallah Town Planning Scheme did not allocate land for building hotels owing to the fact that Jerusalem is close to Ramallah. Rather, the town planning scheme left the initiative to the private sector for constructing any hotels in town. Recently, because of the political changes in the Occupied Territories, the private sector has shown interest in the tourism industry, and some companies have sought permits from the municipality to build hotels.

C2. General Land Use (Ramallah)

The last town planning scheme to be approved for Ramallah dates back to 1960. Since then, the municipality has worked hard to establish a new Town Planning Scheme, but the 1991 proposed Town Planning Scheme has not been approved yet by CIVAD. According to this proposed scheme, land use in Ramallah will proceed according to the schedule in Table IV-7.

Table IV-7
Proposed Land Use in Ramallah

Land Use	Surface Area (dunums)	Percent of Total
Residential	6,209	69.5
Commercial	198	2.2
Industries	904	10.1
Existing public buildings	339	3.8
Existing institutions	207	2.3
Sports center	65	0.7
Cemeteries	23	0.3
Open parks	43	0.5
Sedimentation pools *	28	0.3
Roads	924	10.3
Subtotal	8,940	100.0
Future development	558	NA
Agricultural	1,540	NA
Total area of scheme	11,038	NA

NA—means not applicable.
* Sedimentation pools refer to the existing WWTP. The 1991 Town Planning Scheme does not reflect current plans for expanding the WWTP site.

Residential and industrial use will occupy more than 80 percent of land use in Ramallah. Paved and unpaved roads will cover another 10 percent of land. Remaining land uses are for public buildings and religious institutions (6.1 percent), commercial activities (2.2 percent), the sports center (0.7 percent), open parks (0.5 percent), cemeteries (0.3 percent), and the sedimentation pools of the WWTP (0.3 percent).

The northwestern side of Ramallah is planted with olive orchards. The land area designated for growing vegetables is relatively small because most of the town is hilly. The bare land is concentrated on the southwestern and northeastern parts of town. The industrial area is in the southwestern part of the town (see Map A-2, Annex A).

C3. Economy and Employment

The economy of Ramallah, like that of the West Bank, is in crisis. Real per capita income levels in 1990-1991 were only marginally higher than in 1980-1981. Economic hardships were brought about by two major events. First, the "Intifada" (or uprising) has resulted in a loss of revenue due to strikes, curfews, and a general reduction in labor exported to Israel. Second, the 1991 Persian Gulf War has resulted in a substantial loss in remittances sent by Palestinians who used to live and work in Kuwait to their families back home.

Municipal records indicate that 60 percent of the population of Ramallah are more than 14 years old, and 37 percent represent the labor force. Table IV-8 shows the labor force distribution by economic sector, for 1984 and 2005, for the combined towns of Ramallah and Al-Bireh. According to these projections, agriculture will play an even smaller role in the economy of Ramallah and Al-Bireh in 2005 (down from 2.4 percent to 1 percent), while the public services sector (municipality, administration) will rise from 23.5 percent to 30 percent of the economy.

C4. Transportation, Telecommunications, and Power Networks

The existing road network in Ramallah is not developed and cannot cope with future developments. Entrance to Ramallah is through the town of Al-Bireh from the Jerusalem-Nablus road. No other lateral roads connect the towns of Ramallah and Al- Bireh. Traffic congestion and parking problems are frequent in the center of Ramallah.

Electricity is supplied to Ramallah by a Palestinian company, the Jerusalem District Electricity Co. LTD, which buys electricity from the Israeli Electricity company. All telecommunications services are provided by an Israeli company called BEZEK.

C5. Public and Occupational Health and Safety

Generally speaking, the population of Ramallah enjoys above-average standards of public health compared to the rest of the West Bank due to extended provision of basic infrastructure services and better public health services.

About 86 percent of the population of the Ramallah area are connected to piped drinking water distribution networks. In the city of Ramallah, close to 100 percent of the population are connected to piped water, while about 70 percent of the population are connected to the sewerage network and treatment facilities. The city of Ramallah has its own solid waste dump where garbage is burnt in the open air.

Health services in Ramallah are provided by CIVAD Health Services and several NGOs through preventive services, primary health care, and hospital services. Ramallah has one main public hospital with a total capacity of 136 beds. The private Abu Rayya Rehabilitation Center has 34 beds. There is also a private maternity hospital in Ramallah city. Ramallah has one hospital bed on average per 1,050 inhabitants.

Table IV-8
Labor Force Distribution in Ramallah and Al Bireh Towns

Sector	1984*	2005*
Agriculture	2.4	1.0
Industry	27.3	26.0
Construction	12.8	10.0
Trade	20.5	22.0
Transportation	6.3	7.0
Public Services	23.5	30.0
Others	7.7	4.0
Total	100	100

* In percent.
Source: Shlomokhayat, "Town Planning Scheme," Municipality of Ramallah, 1991.

There are no reliable statistical data on the incidence of water-borne diseases in Ramallah. However, the West Bank has experienced an increase in certain specific communicable disease infections such as Brucellosis, Hepatitis A and B, Typhoid, and Meningitis.[3] Typhoid and Hepatitis A are water-borne diseases.

Basic occupational health and safety guidelines and procedures in industrial and agricultural activities are commonly ignored. Workers are subject to many occupational health hazards, including:

- Noise, high temperature, and humidity.
- Dust, fumes, smoke, gases, and vapor.
- Biological hazards, such as bacteria and viruses.

Many workers and farmers are unaware of the hazards associated with their occupations, such as handling and spraying pesticides, or the disposal of medical and household waste in solid waste dumps.

C6. Industrial Activities

Industrial activity in Ramallah has increased from only a handful of industries in 1974 to an industrial park of more than 40 industrial operations in 1994 (see Section III and Annex C). It is projected that the industrial sector will employ 26 percent of the labor force of Ramallah and Al-Bireh in 2005 (see Table IV-8).

[3] Communication with M. Barghouty, August 1994.

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C7. Agricultural Activities

Although the agricultural sector is not significant in Ramallah and Al-Bireh (projected 1 percent of labor force in 2005), it plays an important role in the nearby villages of Betunia, Rafat, Al-Jeeb, and Al-Jdeira. There is no irrigated agriculture in the Ramallah area. Table IV-9 indicates the surface area of land cultivated with different rain-fed crops and production output in 1994 in each of these villages. Areas cultivated with rain-fed wheat, barley, and vegetables are the prime candidates for shifting to irrigated practices; they have a total surface area of 1,955 dunums.

D. Institutional Setting

This section describes local and municipal institutions as well as regional and national institutions.

D1. Local and Municipal Institutions

This subsection describes the Municipality of Ramallah, the Ramallah Agricultural Marketing Cooperative, and the four neighboring villages of Betunia, Rafat, Al-Jdeira, and Al-Jeeb.

D1a. Municipality of Ramallah

The Municipality of Ramallah was founded in 1908. It provides services to about 24,000 people living within the municipal boundaries. The municipality provides solid waste collection and disposal, transportation, building permits, wastewater collection and disposal, support to light industries, health, and fire extinguishing services.

According to Jordanian laws prevailing before the occupation of the West Bank in 1967, the Mayor and Municipal Council are elected every four years. However, no elections have been held since 1976. The municipality is organized into seven departments: General Administration, Financial, Health, Town Planning, Fire Brigade, Auto Mechanic Shop, and Library. Average monthly salaries of municipal employees range from US$300 to US$700.

D1b. Ramallah Agricultural Marketing Cooperative

The Ramallah Agricultural Marketing Cooperative was established in 1985 with 40 members and has increased to 1,500 members, including 14 local agricultural cooperatives. Total membership in the 14 local cooperatives exceeds 3,000 farmers. To become a member of the cooperative, farmers or local cooperatives must purchase a minimum of 30 shares, at a price of 1 Jordanian Dinar (JD1) per share, plus contribute JD5 as a subscription fee.

The Board of Directors of the Ramallah Agricultural Marketing Cooperative is elected for three years and consists of nine members, including a president and a secretary general. Three elections of the Board of Directors have been held. The Ramallah Agricultural Marketing Cooperative employs five professionals: a director, an accountant, two agricultural engineers, and a controller/credit officer. In addition, the Cooperative employs three drivers for its bulldozer and two tractors. The Ramallah Agricultural Marketing

Table IV-9
Agriculture in the Four Neighboring Villages

Village	Olives	Vines	Plums	Wheat	Barley	Vegetables
Betunia						
Dunums Cultivated	1,725	275	220	235	- *	120
Metric Tons Produced (1994)	276	138	110	42	- *	60
Al-Jeeb						
Dunums Cultivated	550	130	100	700	150	140
Metric Tons Produced (1994)	88	65	50	140	23	70
Al-Jdeira						
Dunums Cultivated	250	30	25	150	50	100
Metric Tons Produced (1994)	40	15	13	30	8	50
Rafat						
Dunums Cultivated	200	45	15	200	50	60
Metric Tons Produced (1994)	32	23	8	50	8	30
Four Villages Combined						
Dunums Cultivated	2,725	480	360	1,285	250	420
Metric Tons Produced (1994)	436	241	181	262	39	210

* Data provided for wheat and barely are combined for the village of Betunia. Also, Betunia cultivated legumes in 1994: 50 dunums produced 7.5 metric tons of legumes.

Source: Ramallah Agricultural Marketing Cooperative, August 1994

Cooperative is a member of the Association of Agricultural Cooperatives in the West Bank (one per district); it currently serves as secretary on the Board of that association.

The cooperative owns and manages a revolving loan of US$250,000, funded by ANERA, which has benefited 100 farmers by providing loans for land reclamation (6,000 dunums), agricultural roads (200 km), milk cows, sheep, laying chickens, agricultural equipment, bee hives, water cisterns, water catchment ponds, and irrigation systems. Loan applications from the farmers are reviewed and approved initially by the cooperative and require final approval from ANERA.

The cooperative has an agricultural supply center that provides advice and sells equipment (e.g., hoses and sprayers) and supplies (e.g., pesticides and fertilizers) to member farmers at competitive rates. The cooperative also runs an origin certification program for exporting produce to Jordan. It charges farmers JD25 per certified shipment.

D1c. Villages of Betunia, Rafat, Al-Jeeb, and Al-Jdeira

Betunia (population 10,000) has a municipality with a mayor and municipal council. The other three villages targeted by the proposed irrigation system (Al-Jdeira, Al-Jeeb, and Rafat) have a mukhtar (village head or spokesperson) but no municipality or village council.

D2. Regional and National Institutions

This section describes ANERA, the nascent Palestinian Authority (PA), and the JWU.

D2a. American Near East Refugee Aid

ANERA is a nongovernmental voluntary development organization formed in 1968 as a response to the Palestinian refugee crisis after the 1967 war. Since then, economic development has been ANERA's key priority. In recent years, 50 to 60 percent of ANERA's funding has been from USAID. ANERA has two main offices: one in Washington, D.C., and the other in East Jerusalem. It also has a small office in Gaza. ANERA's Board of Directors is comprised of Americans concerned about the Palestinian cause as well as Palestinians living in the U.S.

Currently ANERA's main objective is to strengthen the economic and service capabilities of such Palestinian institutions as cooperatives, municipalities, and charitable, health, and educational societies. ANERA provides financial and technical support to these institutions to implement projects in agriculture, industry, public health, education, and social welfare. The ultimate objective of these projects is to enhance the standard of living and self-sufficiency of Palestinian beneficiaries.

D2b. Palestinian Authority

The PA is the Palestinian Liberation Organization's (PLO's) administrative authority over all matters that fall within its territorial and functional jurisdiction. According to the Declaration of Principles signed in September 1993 in Washington, D.C., the PA exercises its authority over the Gaza Strip and Jericho Area. In addition, during the month of August 1994, it has signed agreements with the Israeli government to take over responsibility for administering certain departments in the West Bank, including education and health but not environment.

Territorial jurisdiction includes land, subsoil, and territorial waters but does not include foreign relations, external security, internal security, public order of settlements, the Military Installation Areas, and Israelis.

The PA has administrative as well as limited executive and judicial powers and responsibilities. It consists of a 24-member body, of which only 18 members have been designated thus far (e.g., economy, health, municipal affairs, etc.). The PA administers those sectors transferred to it by CIVAD and may establish within its jurisdiction other departments and subordinate administrative units necessary to fulfill its responsibilities. The PA has no environmental department, but the Health Services of the Agricultural Department

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in the Gaza Strip has an Environmental Health Unit through which environmental affairs are handled.

D2c. Israeli Civil Administration

CIVAD is a branch of the Israeli Military responsible for administering civil affairs in the West Bank except for the Jericho Area (since the Declaration of Principles). It is headed by the chairman of the CIVAD in the West Bank. CIVAD provides civil services to West Bank inhabitants through about 35 departments. Each department is headed by an Israeli officer, but services and activities are undertaken by Palestinian employees.

CIVAD has an environmental department responsible for all environmental affairs within its jurisdiction area including monitoring the performance of WWTPs, water quality control, food quality control, noise and air pollution problems, and industrial activity control. The Environmental Department of CIVAD has a main office and six district offices. It employs 52 employees, including engineers, inspectors, and administrative staff.

D2d. Jerusalem Water Undertaking

The JWU is a public nonprofit institution, with independent financial and administrative authority, whose main objective is to supply the population with drinking water.

Pursuant to the agreement made between the Jordanian Government and the International Development Agency (IDA), Law No. 9 for the year 1966 was issued and provided for the establishment of an undertaking under the name Jerusalem Water Undertaking. The JWU was empowered to develop new water sources and control all water projects in the area, and provide the population with all their water needs for drinking and other municipal and domestic purposes.

According to the said law and the regulations made thereunder:

- Ownership of all existing water projects in the area—including Ein-Samia Water Project—and all their assets, liabilities, and obligations were transferred to JWU.

- JWU was authorized to prescribe water tariffs, cost of services, collection procedures, and other matters relating to its activities.

JWU supplies water from its own water sources at Ein-Samia site where the water is pumped from four groundwater wells, in addition to water purchased from Mekorot, the Israeli water company, and the Municipality of Jerusalem.

SECTION V

ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

SECTION V
ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

This section examines the potential environmental impacts of the proposed Ramallah wastewater management system and recommends specific measures to mitigate those environmental impacts. Before discussing the environmental impacts of the proposed wastewater management system, Exhibit V-1 reviews the environmental impacts of existing wastewater treatment and disposal practices.

A. Physical Environmental Impacts and Mitigation Measures

This section addresses environmental impacts and mitigation measures related to physiography, climate and meteorology, soil and geology, air quality and noise, water resources, and terrestrial and aquatic resources.

A1. Impacts on Physiography

There are no known impacts on geography. Site topography will be altered locally with excavations and fills to build the new WWTP, stabilization and distribution reservoirs, and pumping station. Total area affected will be about 130 dunums, which excludes the pumping station and distribution reservoir but includes the current site of the existing treatment plant (30 dunums).

A2. Climate and Meteorology Impacts

Storms occur frequently during the rainy season in the Ramallah area. As discussed in Section II, A1d., there is no separate storm water drainage system in Ramallah, and a potentially significant portion (reliable data are not available) of the storm water falling on Ramallah eventually finds its way to the WWTP. An increase in wastewater flow of 10 percent has been observed during one test, but greater surges are possible after sustained and intense storms. Variations in the quantity and quality of wastewater received at the WWTP may affect the proper operation of the plant.

Recommendations

Plant operators should receive training in the proper measures to take in response to sustained storms. As in the existing WWTP, the plant design should include a catchment channel around the new WWTP to drain storm water that falls on the plant site and dispose of it directly to either the stabilization reservoir or to the wadi. In the long run, the municipality should evaluate the feasibility of a separate storm water drainage system.

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Exhibit V-1
Summary of Key Environmental Impacts of
Existing Wastewater Treatment and Disposal Practices

Now severely underdesigned due to population and industrial growth, the existing WWTP achieves less than 20 percent treatment and removal efficiency. Minimally treated wastewater is discharged directly into the Betunia wadi, where it flows westward polluting the western aquifer (Yarkon Tananim Aquifer) of the West Bank. Animal wildlife (gazelles, hares, and birds) and livestock (sheep and goats) in the wadi drink from this black, minimally-treated wastewater. In addition, Betunia farmers report significant losses of agricultural lands and olive orchards in the Betunia wadi downstream from the treatment plant due to irrigation with quasi-raw sewage.

At the same time, by discharging wastewater into the wadi, a precious water resource is being wasted into an area that suffers from severe water shortages and scarcity. Farmers are limited to low-income rain-fed agriculture (olives, wheat, and barley). Many landowners have abandoned cultivating the land and turned to other, more income-generating activities such as urban activities, trade, and work abroad. This leads to more soil erosion due to neglect of the land and exacerbates urban environmental problems as a result of rural-urban migration.

A3. Soil Impacts

Soil erosion due to storm water runoff may occur as a result of construction activities required to build the proposed wastewater management system. Soil erosion may threaten the integrity of the engineering works (ponds, reservoirs, and pipelines). To minimize erosion, permanent storm water drainage channels should be built around major engineered facilities such as the entire WWTP (see Recommendations under subsection A2.).

Soil erosion also may occur as a result of shifting to irrigated agriculture. However, such soil erosion should be minimized with the use of drip irrigation techniques and with proper plowing techniques. Farmers should be educated about agricultural practices that conserve the soil.

A4. Geological Impacts

According to Dror Gilad, Chief of the Hydrological Service of the Israeli Ministry of Agriculture, the stabilization reservoir and irrigation area are in a very sensitive zone geologically, and irrigation should be confined to the zone designated KCY, corresponding to the Yatta geologic formation.[1] As discussed in Section IV, A4., it is not clear which agricultural lands near Ramallah fall within the Yatta geologic formation and which ones do not. Without this information, treated wastewater may be used to irrigate agricultural land outside the Yatta formation, which may contaminate the underground aquifers.

[1] Kazuyoshi Kawata, P.E., "Assignment Report", West Bank-Gaza, July 12-27, 1994.

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Also, as indicated in Section IV, A4., the proposed project is located in an area in which an earthquake with an intensity of 7 or greater on the Mercalli-Cancani scale is expected to occur within a 50-year period. In the event of an earthquake, both the treatment plant and the stabilization reservoir could be damaged, and sewage and effluent could flood downstream areas. This could create health and environmental hazards. Sewage could infiltrate to the ground and pollute the groundwater.

Recommended Mitigation Measures

- Work with the Hydrological Service to ensure that there are sufficient agricultural lands in the Yatta formation, and limit irrigation to those agricultural lands.

LIMIT APPLICATION RATE TO 5/5 MM/DAY BY [illegible]

- Design all engineered facilities to withstand an earthquake of intensity 7 on the Mercalli-Cancani scale.

? HDPE LINER (KK; 5-3)

A5. Impacts on Air Quality and Noise

Construction activities will generate localized, temporary air and noise pollution in the vicinity of the treatment plant and reservoir sites.

According to Gedallah Shelef of the Israel Institute of Technology, anaerobic ponds may produce bad odors unless they are covered. Shelef recommends covering the anaerobic ponds at the Ramallah treatment plant with a plastic membrane, a submerged tent, or a floating cover. He also suggests further dividing the ponds (e.g., three to four ponds instead of two) and deepening them to provide more volume for bottom sludge.

Recommended Mitigation Measures

- Revise the plant design to deepen the anaerobic ponds and allow for covering them with a plastic membrane, a submerged tent, or a floating cover. Study the feasibility of different cover types and learn from similar experiences in Israel, the U.S. and Canada, before covering anaerobic ponds using any one technique.

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A6. Water Resources Impacts

Wastewater treated at the Ramallah WWTP is currently disposed of into the Betunia wadi after traveling through a 2-km underground discharge pipeline (see Section II, A.). As wastewater flows westward down the wadi, it infiltrates the ground and pollutes the groundwater of the western aquifer.

Because wastewater is only minimally treated at the existing plant (plant efficiency does not exceed 20 percent), current wastewater disposal practices are suspected of polluting both surface water and groundwater in the western side of the West Bank. However, no information was available on the extent of water contamination. Effluents from the proposed WWTP will not be discharged into the Betunia wadi (under normal operating conditions) but will be used to irrigate agricultural lands in nearby villages. In the future, therefore,

pollution of the Betunia wadi and surface water and groundwater resources along or underneath the wadi will be reduced (emergency discharges may occur) if not eliminated. Groundwater pollution may occur, however, due to irrigation with treated wastewater. If irrigation is limited to the Yatta formation, then groundwater pollution risks may be significantly reduced (see Section V, A4.).

Potential groundwater contamination also may occur due to ground infiltration of raw or partially treated wastewater inside the WWTP, in particular from the stabilization reservoir. Ground seepage from the stabilization reservoir should be kept to a minimum, however, if the stabilization reservoir is lined with clay or HDPE, as called for in the project design.

Recommended Mitigation Measures

- Limit irrigation to agricultural lands falling within the Yatta formation.
- Line the stabilization reservoir as called for in the proposed design.

A7. Terrestrial and Aquatic Resources Impacts

Current wastewater discharges may affect animal and plant wildlife along the Betunia wadi bed, but no information is available to corroborate or refute this hypothesis. In any case, the proposed WWTP will reduce significantly the potential for wildlife exposure to raw or poorly treated sewage. Moreover, irrigation with properly treated wastewater should not have any significant impacts on wildlife because no new agricultural land will be reclaimed or developed; rather, existing land will be cultivated with irrigated crops instead of rain-fed crops.

B. Cultural and Archaeological Impacts and Mitigation Measures

There are no known archaeological or historical sites in the vicinity of the proposed wastewater management project.

Recommended Mitigation Measures

- In the event that archaeological sites are discovered during construction, appropriate authorities should be notified.

C. Socioeconomic Impacts and Mitigation Measures

This section addresses environmental impacts and mitigation measures related to demography, land use, economy and employment, transportation and utilities, public and occupational health and safety, and industrial and agricultural activities.

C1. Demographic Impacts

Population and industrial growth in Ramallah may reduce the projected life of the proposed wastewater management system. Table V-1 shows the PRIDE team's estimates of current (1993) and projected (2000, 2010, and 2020) water and wastewater generation quantities in Ramallah. Baseline water consumption figures for 1993, both domestic and industrial, are based on water consumption data provided by JWU.

The PRIDE team assumed that domestic and industrial water consumption in Ramallah city would grow at the same rates as in the District of Ramallah overall. The team obtained estimates of domestic and industrial water consumption for the District of Ramallah from the Harvard Middle East Water Project.[2]

In addition, the PRIDE team assumed that 90 percent (in volume) of domestic water and 40 percent of industrial water becomes wastewater. The percent of industrial wastewater is based on the existing industrial profile in Ramallah city.

Wastewater received at the WWTP is projected to increase from about 397,000 m^3 in 1993 to about 4.11 million m^3 by the year 2020 (see Table V-1). The proposed WWTP is designed for an annual wastewater flow of 1.34 million m^3 (or an average daily flow of 3,680 m^3 per day). Table V-1 indicates that actual wastewater flow will exceed the design capacity of the plant in the first few years of the twenty-first century. This would bring the effective life of the project from 20 years down to 10 years.

The proposed WWTP and expansion of the sewerage network will have a positive overall impact on tourism in Ramallah. The proposed WWTP will be able to treat wastewater during peak season, which occurs in the summer due to the arrival of tourists and the increase in domestic water consumption. This will lead to a reduction in the breeding of mosquitoes and insects on sewage flooding from cesspits, which creates a nuisance to the public.

Recommendations

Although land is not available for further plant expansion after the end of this project, the proposed lifetime of the plant (20 years) can be maintained through regional planning. Specifically, the Municipality of Ramallah should enter into an agreement with the Municipality of Betunia for municipal wastewater exchanges to take advantage of gravity and reduce pumping costs. For example, the Municipality of Betunia could accept responsibility for treating sewage generated in new residential areas in the northwestern part of Ramallah, which drains naturally into an area where Betunia plans to build its future WWTP. Such an arrangement would eliminate a significant fraction of the sewage loads going to the Ramallah treatment plant. Also, existing similar arrangements with the neighboring Municipality of El-Bireh should be expanded.

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[2] Harvard Middle East Water Project, "Water Supply and Demand in Palestine: 1990 Baseline Estimates and Projections for 2000, 2010, and 2020, Appendix A," prepared by Applied Research Institute of Jerusalem and Harvard Institute for International Development, January 19, 1994, Table 2.

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Table V-1
Current (1990) and Projected (2000, 2010, 2020)
Water and Wastewater Quantities in Ramallah City

Parameter	1993	2000	2010	2020
Water Consumption in Ramallah District *				
Domestic	10.96 MCM	27.6 MCM	50.3 MCM	80.5 MCM
Industrial	0.79 MCM	1.5 MCM	3.0 MCM	5.0 MCM
Water Consumption in Ramallah City **				
Domestic	573 TCM	1,443 TCM	2,630 TCM	4,209 TCM
Industrial	127 TCM	241 TCM	482 TCM	803 TCM
Wastewater Generation in Ramallah City				
Domestic (90 percent)	516 TCM	1,299 TCM	2,367 TCM	3,788 TCM
Industrial (40 percent)	51 TCM	96 TCM	192 TCM	321 TCM
Total Generation	567 TCM	1,395 TCM	2,559 TCM	4,109 TCM
Connected to the Sewer Network (in percent)				
	70	80	90	100
Total Annual Quantity of Wastewater Reaching the WWTP				
	397 TCM	1,116 TCM	2,303 TCM	4,109 TCM

Note: MCM = million cubic meters; TCM = thousand cubic meters.
*Figures from the Harvard Middle East Water Project report, Annex A, Table 2.
**Based on JWU data for 1993.

C2. Land Use Impacts

Implementing the proposed project will require acquisition of land to:

- Build the new treatment plant (40 additional dunums).
- Build the stabilization reservoir (60 dunums).
- Build the irrigation network—pumping station, distribution reservoir, and distribution pipelines (rights-of-way).
- Dispose of the dry sludge (if not used in agriculture).

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Exhibit V-2
Land Expropriation Procedures

(1) The municipality conducts a detailed survey of the land for expropriation and submits the survey with a request for expropriation for the public benefit to the Land Use Officer at CIVAD. According to CIVAD rules, the survey must show the location and boundaries of the land in an appropriate scale.

(2) The Land Use Officer sends copies of the request to various concerned departments at CIVAD—water, archeology, health, environment, public works, and planning—and informs them of his intent to expropriate the land. Each of these departments inspects the site, and if it does not conflict with their regulation and demands, they give their approval to the Land Use Officer. Otherwise, they demand a change in location.

(3) On receiving approval from all concerned departments, the Land Use Officer advertises in local newspapers his intent to expropriate the designated land. This advertisement serves as a notice to those who may object to the expropriation and gives them two months to submit a written objection to the expropriation sought.

(4) Two months after the advertisement first appears, the Land Use Officer investigates any and all objections received. If the objections are not found satisfactory, the officer issues the expropriation order according to the CIVAD regulations. The landowner(s) are then informed officially of the expropriation order by the Municipality of Ramallah, which must compensate them for expropriating the land. The land value is appraised by a committee from the Municipality of Ramallah and the Financial Department responsible for collecting taxes.

Only the additional land required to build the proposed WWTP is known with precision. All other locations are known with a degree of uncertainty. In all cases, however, the land required is privately owned and will need to be expropriated to implement the project. Exhibit V-2 summarizes the procedures to follow for land expropriation. Of all the land expropriations required for the proposed project, only expropriation procedures for the expanded new WWTP site have been started.

Land owners and neighboring communities may object to the construction of the stabilization reservoir fearing it may become a suitable breeding environment for mosquitoes and other insects. Local communities may also be concerned about children playing near and swimming in the reservoir. However, the Israeli authorities are likely to facilitate the expropriation of land because effluents from the existing treatment plant are polluting precious surface and ground resources (see Section V, A6.).

— Failure to acquire these lands in a timely fashion will lead to serious delays in project implementation and could have serious environmental impacts. If the stabilization reservoir or irrigation facilities are not built, a primary objective of the project (reuse of treated

wastewater for irrigation) will not be fulfilled. Precious treated wastewater will be wasted down the wadi or in the fields, unless it is used by industries, in grazing, or in a reforestation program.

Land availability may also hinder plant expansion in the future. Any expansion of the plant in the future will require enlarging the plant site either upstream or downstream from the current location. There is very little land available for expansion upstream, especially if an emergency pond is built as a by-pass line for accidental industrial discharges (see Section III). Also, upstream expansion will require relocating the existing water pumping station upstream from the WWTP (this station currently receives water from Mekorot and distributes it to Ramallah town). Moreover, land upstream is in the industrial area and is expensive. Further expansion downstream can only be achieved by acquiring land that is currently part of the military camp bordering the site from the south. Also, the site does not allow for any further horizontal expansion to accommodate more sludge drying beds, which could create future difficulties for safe sludge disposal.

Recommendations

The municipality needs to expropriate land to expand the existing treatment plant (40 additional dunums) and build the stabilization reservoir (60 dunums). The cooperative also needs to buy land to build the distribution reservoir and acquire rights-of-way for the distribution pipelines. Any delays in expropriating the required land may cause significant impacts on the environment or, at a minimum, create an opportunity cost due to wasting an invaluable water resource. Expropriating all necessary lands should be a Condition Precedent (CP) attached to this project. OK

C3. Economic and Employment Impacts

The proposed wastewater management project will create jobs and economic opportunities through improved, irrigated agricultural practices. According to reports by ANERA and the design engineer, the proposed project will provide 12,200 person-days of construction jobs. In addition to these temporary jobs, the project will create the following full-time jobs:

- 18 jobs for operation and maintenance of the WWTP, including municipal positions.
- Three jobs at the Ramallah Agricultural Marketing Cooperative.
- 200 agricultural laborers, assuming 2,000 dunums are irrigated having an average of one laborer per 10 dunums.

The project also will create business opportunities for laboratories in the area.

The Municipality of Ramallah collects sewage connection and maintenance fees from land and property owners in Ramallah. Sewage connection fees are assessed once and are equal to:

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- JD2 (or US $3) per m^2 of built-up area; plus
- JD0.2 (or $0.30) per m^2 of total land area; plus
- JD0.2 (or $0.30) per m^2 of unbuilt land area.

Maintenance sewage fees are assessed yearly on the basis of JD0.2 ($0.3) per m^2 of built-up area per year.

According to municipal records, sewage-related municipal expenses amounted to $137,519 in 1993, compared to only $45,839 in sewage-related revenues (sewage connection and maintenance fees). Hence, sewage-related revenues in 1993 covered only one-third of the municipality's sewage-related expenses. The municipality covered the deficit between revenues and expenses by drawing on its general fund. Sewage expenses represented about 5.6 percent of total expenses incurred by the municipality in 1993.

In the future, the municipality is expected to raise sufficient funds for operation and maintenance of the proposed WWTP by:

- Increasing sewage connection and maintenance fees.
- Charging the Ramallah Agricultural Marketing Cooperative for the supply of treated wastewater for irrigation.

The cooperative in turn will sell the treated wastewater to farmers.

Recommendations

- Revise the economic assessment of the proposed wastewater management project to reflect the costs of recommended mitigation, monitoring, and management measures.
- Provide treated wastewater for free to farmers the first year as an incentive to use it for irrigation.
- Use the first year of operation of the WWTP to calibrate the sewage fees and water charges that will be assessed in the future in order to recover at least the costs of operating and maintaining the proposed wastewater management system.

DESIGN ISSUE (TFR)

FOR THE WORKSHOOT. (FINANCE)

HOW ISSUE (FINANCE)

C4. Transportation, Telecommunications, and Power Network Impacts

C4a. Transportation

During construction of the WWTP, transportation trucks will make several trips a day to and from the site. Trucks will bring to the site excavation equipment and construction materials (cement, aggregate, sand, steel, HDPE liners, etc.). Trucks also will remove excavation equipment and excavated surplus materials and debris. Truck traffic will create

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temporary air pollution (dust, and exhaust emissions) along the roads leading to the WWTP, especially in the vicinity of the WWTP.

During operation and maintenance of the WWTP, transportation will be limited primarily to trucks bringing septage to the plant or removing dry sludge and cars transporting employees, laboratory technicians, and visitors. Septage shipments to the WWTP initially will be as frequent in 1994 but will become infrequent in the future until they are no longer necessary on a routine basis in 2015.

C4b. Telecommunications

Like most locations in the Ramallah industrial area, the existing WWTP does not have any telephone lines. This may hamper the capability of plant personnel to:

- Notify appropriate institutions in case of an emergency; e.g., notifying the municipality's fire department in case of fire at the plant.

- Respond to certain emergencies; e.g., being informed about an accidental discharge at an industrial plant and taking appropriate measures at the WWTP (see Section III).

In either case, communication delays could have serious implications on the plant or the quality of its effluents.

Recommended Mitigation Measure

- Equip the WWTP with around-the-clock emergency response capabilities, including a cellular telephone and on-call staff.

No KK 5-16. 5-12

C4c. Power Network

The proposed design minimizes the use of energy by placing the aeration lagoons after the anaerobic ponds and relying on maturation ponds to reduce the BOD content of the effluent. Nevertheless, the new WWTP will have six aerators, three times as many as in the existing plant. Hence, power consumption by the Municipality of Ramallah will increase.

Also, a new power supply will be needed to pump treated wastewater from the stabilization reservoir to the distribution reservoir. The distribution reservoir will serve to irrigate by gravity agricultural lands that are at higher elevations than the stabilization reservoir.

Recommendation

Building the distribution reservoir and pumping station should be deferred to a later stage because there are good agricultural lands downstream from the stabilization reservoir. This will minimize environmental impacts and reduce investment costs initially.

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C5. Public Health and Safety Impacts

Public health and safety impacts may occur both during construction and during O&M. Impacts during O&M are associated with either the WWTP or the use of treated wastewater in irrigation.

C5a. Public Health and Safety Impacts During Construction

Construction of the WWTP will pose the same standard accident hazards associated with any construction activity. In addition, because construction activities will be carried out at the same location as the existing WWTP while it is in operation, construction workers may be exposed to health risks due to direct contact with contaminated soil, raw sewage, wastewater aerosols—because of aerator operation—etc. Health risks include the possibility of infection by communicable diseases and hazardous wastes from industrial discharges.

C5b. Public Health and Safety Impacts During O&M

During the O&M phase, both positive and negative health impacts may be expected. Positive health impacts can be expected once the new, better functioning WWTP becomes operational. Although an overall increase in infectious communicable diseases recently has been reported in the West Bank,[3] communicable disease infection rates are likely to decrease downstream from the WWTP because of the decrease in raw (or poorly treated) sewage discharges.

Negative health and safety impacts are usually linked to either improper operation of the WWTP generally or to irrigation with raw sewage or poorly treated wastewater. Although these adverse health impacts are not anticipated if the project is implemented as planned, it is useful to list the potential health impacts that have been well-documented in various international reports.[4]

- If irrigated with raw or poorly treated wastewater, salad crops and other vegetables that are regularly eaten uncooked (especially if not washed properly) can transmit the helminth (worm) diseases caused by Ascaris and Trichuris, as well as typhoid fever and cholera.

- Cattle grazing on pastures irrigated with partly treated wastewater can become infected with Taenia saginata—the beef tapeworm—and humans who consume raw or undercooked meat of such infected animals can become infected with tapeworms.

- Farmworkers who walk barefoot in irrigated fields can become infected with Ancylostoma—hookworm disease—and long-term repeated exposure to such an environment results in high worm loads with severe debilitating

[3] No hard data, personal communication with M. Barghouty.

[4] World Bank technical paper number 51.

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effects, including anemia and reduced ability to work. Note, however, that walking barefoot in agricultural fields is not a common practice in the West Bank.

- Population groups or family contacts residing in the vicinity of farms irrigated with this wastewater may be negatively affected either by direct contact with the soil or, indirectly, by contacts with the farmers.

- Under certain circumstances, enteric viruses in the aerolized wastewater from sprinkler irrigation may be transmitted to the neighboring community. Note, however, that sprinkler irrigation is not expected in this project.

- Treated wastewater effluents having uncontrolled heavy metals contents may lead to accumulation of those heavy metals in the soil, which are then easily transmitted to the food chain and reach crop consumers. Heavy metals contents depends on the types of industries discharging wastewater into the sewer network. Given the existing industrial profile of the Ramallah industrial area, however, heavy metals are not likely to be found in above-trace levels in the treated wastewater.

In addition, fire hazards may be posed by reactive chemicals potentially discharged by industries or by methane gas formation in the anaerobic ponds, but this is a rare occurrence. Also, site intruders may be exposed to health and accident hazards, especially children trying to enter the stabilization reservoir site and swim in it.

The design proposal suggests that produced sludge will be dried and disposed of in a fenced-off mountainous area east of the city. If the sludge is not well stabilized and is used as a soil conditioner, health risks to farmers or people who come in contact with soil or plants may occur.

Also, mosquito problems may arise at the site of the stabilization reservoir, where there were no problems before. These problems may be minimal, however, if the level of water changes constantly as a result of using the treated wastewater for irrigation. Indeed, that situation would offer less than ideal conditions for mosquitoes to breed.

Recommended Mitigation Measures

- Implement an appropriate monitoring program with by-pass and chlorination options to ensure that final effluent will meet the guidelines for irrigation (see Section VI).

- Educate farmers about proper agricultural practices: types of crops, plowing methods, and drip irrigation methods.

- Ensure full "stabilization" of the dry sludge before reuse.

- Implement an environmentally-sound mosquito control program: cut weeds and plants regularly and cultivate fish in stabilization ponds.

No. See KK 5-15...

DESIGN/TRNG ISSUE. NOT IMPLEMENTATION

(?) See KK 5-18

OK except fish. See KK 5-8 + 5-15

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- Educate plant employees about sound health and safety practices, vaccinate employees against certain diseases such as hepatitis and cholera, and monitor the health of employees on a regular basis.

OK

C6. Industrial Activity Impacts

Industrial wastewater discharges may upset the proper functioning of the proposed WWTP. For this reason, the EA includes a survey of industrial plants in Ramallah. Recommendations are contained in Section III, and Annex C presents a synopsis of individual site visits and the survey questionnaire.

C7. Agricultural Activity Impacts

Irrigation with treated wastewater should not contaminate groundwater if irrigation is confined to the Yatta formation (see subsection A4.). Also, as discussed in subsection A7., irrigation with properly treated wastewater should not have any significant impacts on wildlife because no new agricultural land will be reclaimed or developed; rather, existing land will be cultivated with irrigated crops instead of rain-fed crops. Shifting to irrigated practices, however, is likely to be accompanied with an increase in pesticide use. Excessive pesticide use may lead to groundwater contamination and affect the health of produce consumers (if edible crops are cultivated). Moreover, specific procedures should be used if pesticides are to be procured and/or used with USAID funds, as spelled out in 22 CFR 216.3(b).

Table V-2 summarizes key environmental impacts and recommended mitigation measures.

Table V-2
Key Environmental Impacts and Recommended Mitigation Measures

Environmental Impacts	Mitigation Measures
Earthquake Risks. Potential for one earthquake of intensity 7 or greater on the Mercalli-Cancani scale every 50 years	• Design all facilities for an earthquake of intensity 7 or greater on the Mercalli-Cancani scale
Odors. Potential for occasional bad odors from the anaerobic ponds	• Revise plant design to deepen the anaerobic ponds and allow for covering them if odors present a problem • Study the feasibility of different cover types; learn from similar experiences in Israel, Canada, and the U.S.
Groundwater Pollution. Groundwater may be polluted if treated wastewater is used to irrigate land outside the Yatta formation	• Require ANERA to demonstrate that there are sufficient agricultural lands within the Yatta formation (CP) • Limit irrigation to agricultural lands falling within the Yatta formation
Potential Need for Plant Expansion. Population and industrial growth, coupled with limited land availability for further plant expansion in the future, could reduce the life of the project from 20 years to 10	• Plan for regional wastewater management. For example, the municipalities of Ramallah and Betunia should enter into an agreement for municipal wastewater exchanges to take advantage of gravity and reduce pumping costs
Delays in Project implementation. Implementation may be delayed by: - lengthy expropriation of private land for various facilities - opposition by local communities to the stabilization reservoir, due to perceived risks of mosquitoes, flooding, and odors	• Identify precisely all land expropriation needs and start the expropriation process immediately (CP) • Educate local communities about environmental and other benefits of the stabilization reservoir
Emergency Preparedness. Lack of telephone lines may hamper emergency response and notification capabilities at the WWTP	• Equip plant with cellular telephone 24 hours a day, plus on-call staff
Electricity. The proposed system will require more energy to operate six aerators. Also, water will need to be pumped to the distribution reservoir to irrigate elevated lands by gravity	• Obtain all power supply permits • Defer building the distribution reservoir and pumping station to a later stage, and focus initially on irrigating agricultural lands downstream from the stabilization reservoir
Forestation. The Ramallah area is dry, and the land bare and severely eroded. Also treated wastewater should not be wasted under any circumstance	• Explore all possible reuses of the treated wastewater, including reuse by industry and for grazing • Plan for both routine and emergency reuse of the treated wastewater in a pilot reforestation project
Sludge Disposal. Disposal of sludge ignores its value as a potentially good soil conditioner	• Plan to use the sludge in the pilot reforestation program

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Environmental Impacts	Mitigation Measures
Public Health and Safety at the WWTP. Construction workers are exposed to: - the same standard accident hazards posed by any construction activity - health risks from direct contact with contaminated soil, raw sewage, and wastewater aerosols due to aerators	• Construction workers should follow standard health and safety measures for construction sites • To the extent possible, construction workers should avoid direct contact with soil, sewage, and sludge
WWTP employees may be exposed to communicable diseases infections and potential hazards associated with uncontrolled industrial waste discharges	• Plant employees should wear protective clothing and follow standard health and safety procedures • The health of plant employees should be monitored regularly
Fire hazards. Plant employees may be exposed to fire hazards due to methane gas formation in the anaerobic ponds (very unlikely because ponds are open) or in laboratory tests due to the potential presence of reactive chemicals discharged by industries	• Place fire extinguishers in different key locations at the site • Plant employees should follow standard health and safety procedures for on-site lab tests
Site Intruders. Intruders into the WWTP or stabilization reservoir sites may be exposed to health or accident risks, especially children who may try to swim in the stabilization reservoir	• Fence the WWTP site and the stabilization reservoir site
Reuse of Treated Wastewater for Irrigation. Irrigation with poorly treated wastewater will pose significant health risks to farmers and consumers	• Establish an appropriate effluent quality monitoring program with by-pass and chlorination options to ensure that final effluent will meet irrigation guidelines (see Section VI)
Contaminated Crops. Consumers may be exposed to health risks due to ingestion of contaminated crops	• Farmers should not use the treated wastewater to irrigate vegetables or crops that are eaten raw
Use of Sprinklers. Nearby populations may be at risk due to exposure to aerolized wastewater (if sprinklers are used)	• Prohibit use of sprinklers for irrigation (also to conserve water). Drip irrigation should be encouraged and measures taken to reduce clogging
Mosquitoes. Mosquitoes and other insects may thrive near the maturation ponds and the stabilization reservoir, thus continuing to cause a nuisance to local populations and tourists	• Implement environmentally sound mosquito control program: cut weeds and plants regularly, cultivate fish

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SECTION V
ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

This section examines the potential environmental impacts of the proposed Ramallah wastewater management system and recommends specific measures to mitigate those environmental impacts. Before discussing the environmental impacts of the proposed wastewater management system, Exhibit V-1 reviews the environmental impacts of existing wastewater treatment and disposal practices.

A. Physical Environmental Impacts and Mitigation Measures

This section addresses environmental impacts and mitigation measures related to physiography, climate and meteorology, soil and geology, air quality and noise, water resources, and terrestrial and aquatic resources.

A1. Impacts on Physiography

There are no known impacts on geography. Site topography will be altered locally with excavations and fills to build the new WWTP, stabilization and distribution reservoirs, and pumping station. Total area affected will be about 130 dunums, which excludes the pumping station and distribution reservoir but includes the current site of the existing treatment plant (30 dunums).

A2. Climate and Meteorology Impacts

Storms occur frequently during the rainy season in the Ramallah area. As discussed in Section II, A1d., there is no separate storm water drainage system in Ramallah, and a potentially significant portion (reliable data are not available) of the storm water falling on Ramallah eventually finds its way to the WWTP. An increase in wastewater flow of 10 percent has been observed during one test, but greater surges are possible after sustained and intense storms. Variations in the quantity and quality of wastewater received at the WWTP may affect the proper operation of the plant.

Recommendations

Plant operators should receive training in the proper measures to take in response to sustained storms. As in the existing WWTP, the plant design should include a catchment channel around the new WWTP to drain storm water that falls on the plant site and dispose of it directly to either the stabilization reservoir or to the wadi. In the long run, the municipality should evaluate the feasibility of a separate storm water drainage system.

Exhibit V-1
Summary of Key Environmental Impacts of
Existing Wastewater Treatment and Disposal Practices

Now severely underdesigned due to population and industrial growth, the existing WWTP achieves less than 20 percent treatment and removal efficiency. Minimally treated wastewater is discharged directly into the Betunia wadi, where it flows westward polluting the western aquifer (Yarkon Tananim Aquifer) of the West Bank. Animal wildlife (gazelles, hares, and birds) and livestock (sheep and goats) in the wadi drink from this black, minimally-treated wastewater. In addition, Betunia farmers report significant losses of agricultural lands and olive orchards in the Betunia wadi downstream from the treatment plant due to irrigation with quasi-raw sewage.

At the same time, by discharging wastewater into the wadi, a precious water resource is being wasted into an area that suffers from severe water shortages and scarcity. Farmers are limited to low-income rain-fed agriculture (olives, wheat, and barley). Many landowners have abandoned cultivating the land and turned to other, more income-generating activities such as urban activities, trade, and work abroad. This leads to more soil erosion due to neglect of the land and exacerbates urban environmental problems as a result of rural-urban migration.

A3. Soil Impacts

Soil erosion due to storm water runoff may occur as a result of construction activities required to build the proposed wastewater management system. Soil erosion may threaten the integrity of the engineering works (ponds, reservoirs, and pipelines). To minimize erosion, permanent storm water drainage channels should be built around major engineered facilities such as the entire WWTP (see Recommendations under subsection A2.).

Soil erosion also may occur as a result of shifting to irrigated agriculture. However, such soil erosion should be minimized with the use of drip irrigation techniques and with proper plowing techniques. Farmers should be educated about agricultural practices that conserve the soil.

A4. Geological Impacts

According to Dror Gilad, Chief of the Hydrological Service of the Israeli Ministry of Agriculture, the stabilization reservoir and irrigation area are in a very sensitive zone geologically, and irrigation should be confined to the zone designated KCY, corresponding to the Yatta geologic formation.[1] As discussed in Section IV, A4., it is not clear which agricultural lands near Ramallah fall within the Yatta geologic formation and which ones do not. Without this information, treated wastewater may be used to irrigate agricultural land outside the Yatta formation, which may contaminate the underground aquifers.

[1] Kazuyoshi Kawata, P.E., "Assignment Report", West Bank-Gaza, July 12-27, 1994.

Also, as indicated in Section IV, A4., the proposed project is located in an area in which an earthquake with an intensity of 7 or greater on the Mercalli-Cancani scale is expected to occur within a 50-year period. In the event of an earthquake, both the treatment plant and the stabilization reservoir could be damaged, and sewage and effluent could flood downstream areas. This could create health and environmental hazards. Sewage could infiltrate to the ground and pollute the groundwater.

Recommended Mitigation Measures

- Work with the Hydrological Service to ensure that there are sufficient agricultural lands in the Yatta formation, and limit irrigation to those agricultural lands.

- Design all engineered facilities to withstand an earthquake of intensity 7 on the Mercalli-Cancani scale.

A5. Impacts on Air Quality and Noise

Construction activities will generate localized, temporary air and noise pollution in the vicinity of the treatment plant and reservoir sites.

According to Gedallah Shelef of the Israel Institute of Technology, anaerobic ponds may produce bad odors unless they are covered. Shelef recommends covering the anaerobic ponds at the Ramallah treatment plant with a plastic membrane, a submerged tent, or a floating cover. He also suggests further dividing the ponds (e.g., three to four ponds instead of two) and deepening them to provide more volume for bottom sludge.

Recommended Mitigation Measures

- Revise the plant design to deepen the anaerobic ponds and allow for covering them with a plastic membrane, a submerged tent, or a floating cover. Study the feasibility of different cover types and learn from similar experiences in Israel, the U.S. and Canada, before covering anaerobic ponds using any one technique.

A6. Water Resources Impacts

Wastewater treated at the Ramallah WWTP is currently disposed of into the Betunia wadi after traveling through a 2-km underground discharge pipeline (see Section II, A.). As wastewater flows westward down the wadi, it infiltrates the ground and pollutes the groundwater of the western aquifer.

Because wastewater is only minimally treated at the existing plant (plant efficiency does not exceed 20 percent), current wastewater disposal practices are suspected of polluting both surface water and groundwater in the western side of the West Bank. However, no information was available on the extent of water contamination. Effluents from the proposed WWTP will not be discharged into the Betunia wadi (under normal operating conditions) but will be used to irrigate agricultural lands in nearby villages. In the future, therefore,

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pollution of the Betunia wadi and surface water and groundwater resources along or underneath the wadi will be reduced (emergency discharges may occur) if not eliminated. Groundwater pollution may occur, however, due to irrigation with treated wastewater. If irrigation is limited to the Yatta formation, then groundwater pollution risks may be significantly reduced (see Section V, A4.).

Potential groundwater contamination also may occur due to ground infiltration of raw or partially treated wastewater inside the WWTP, in particular from the stabilization reservoir. Ground seepage from the stabilization reservoir should be kept to a minimum, however, if the stabilization reservoir is lined with clay or HDPE, as called for in the project design.

Recommended Mitigation Measures

- Limit irrigation to agricultural lands falling within the Yatta formation.
- Line the stabilization reservoir as called for in the proposed design.

A7. Terrestrial and Aquatic Resources Impacts

Current wastewater discharges may affect animal and plant wildlife along the Betunia wadi bed, but no information is available to corroborate or refute this hypothesis. In any case, the proposed WWTP will reduce significantly the potential for wildlife exposure to raw or poorly treated sewage. Moreover, irrigation with properly treated wastewater should not have any significant impacts on wildlife because no new agricultural land will be reclaimed or developed; rather, existing land will be cultivated with irrigated crops instead of rain-fed crops.

B. Cultural and Archaeological Impacts and Mitigation Measures

There are no known archaeological or historical sites in the vicinity of the proposed wastewater management project.

Recommended Mitigation Measures

- In the event that archaeological sites are discovered during construction, appropriate authorities should be notified.

C. Socioeconomic Impacts and Mitigation Measures

This section addresses environmental impacts and mitigation measures related to demography, land use, economy and employment, transportation and utilities, public and occupational health and safety, and industrial and agricultural activities.

C1. Demographic Impacts

Population and industrial growth in Ramallah may reduce the projected life of the proposed wastewater management system. Table V-1 shows the PRIDE team's estimates of current (1993) and projected (2000, 2010, and 2020) water and wastewater generation quantities in Ramallah. Baseline water consumption figures for 1993, both domestic and industrial, are based on water consumption data provided by JWU.

The PRIDE team assumed that domestic and industrial water consumption in Ramallah city would grow at the same rates as in the District of Ramallah overall. The team obtained estimates of domestic and industrial water consumption for the District of Ramallah from the Harvard Middle East Water Project.[2]

In addition, the PRIDE team assumed that 90 percent (in volume) of domestic water and 40 percent of industrial water becomes wastewater. The percent of industrial wastewater is based on the existing industrial profile in Ramallah city.

Wastewater received at the WWTP is projected to increase from about 397,000 m^3 in 1993 to about 4.11 million m^3 by the year 2020 (see Table V-1). The proposed WWTP is designed for an annual wastewater flow of 1.34 million m^3 (or an average daily flow of 3,680 m^3 per day). Table V-1 indicates that actual wastewater flow will exceed the design capacity of the plant in the first few years of the twenty-first century. This would bring the effective life of the project from 20 years down to 10 years.

The proposed WWTP and expansion of the sewerage network will have a positive overall impact on tourism in Ramallah. The proposed WWTP will be able to treat wastewater during peak season, which occurs in the summer due to the arrival of tourists and the increase in domestic water consumption. This will lead to a reduction in the breeding of mosquitoes and insects on sewage flooding from cesspits, which creates a nuisance to the public.

Recommendations

Although land is not available for further plant expansion after the end of this project, the proposed lifetime of the plant (20 years) can be maintained through regional planning. Specifically, the Municipality of Ramallah should enter into an agreement with the Municipality of Betunia for municipal wastewater exchanges to take advantage of gravity and reduce pumping costs. For example, the Municipality of Betunia could accept responsibility for treating sewage generated in new residential areas in the northwestern part of Ramallah, which drains naturally into an area where Betunia plans to build its future WWTP. Such an arrangement would eliminate a significant fraction of the sewage loads going to the Ramallah treatment plant. Also, existing similar arrangements with the neighboring Municipality of El-Bireh should be expanded.

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[2] Harvard Middle East Water Project, "Water Supply and Demand in Palestine: 1990 Baseline Estimates and Projections for 2000, 2010, and 2020, Appendix A," prepared by Applied Research Institute of Jerusalem and Harvard Institute for International Development, January 19, 1994, Table 2.

Table V-1
Current (1990) and Projected (2000, 2010, 2020)
Water and Wastewater Quantities in Ramallah City

Parameter	1993	2000	2010	2020
Water Consumption in Ramallah District *				
Domestic	10.96 MCM	27.6 MCM	50.3 MCM	80.5 MCM
Industrial	0.79 MCM	1.5 MCM	3.0 MCM	5.0 MCM
Water Consumption in Ramallah City **				
Domestic	573 TCM	1,443 TCM	2,630 TCM	4,209 TCM
Industrial	127 TCM	241 TCM	482 TCM	803 TCM
Wastewater Generation in Ramallah City				
Domestic (90 percent)	516 TCM	1,299 TCM	2,367 TCM	3,788 TCM
Industrial (40 percent)	51 TCM	96 TCM	192 TCM	321 TCM
Total Generation	567 TCM	1,395 TCM	2,559 TCM	4,109 TCM
Connected to the Sewer Network (in percent)				
	70	80	90	100
Total Annual Quantity of Wastewater Reaching the WWTP				
	397 TCM	1,116 TCM	2,303 TCM	4,109 TCM

Note: MCM = million cubic meters; TCM = thousand cubic meters.
*Figures from the Harvard Middle East Water Project report, Annex A, Table 2.
**Based on JWU data for 1993.

C2. Land Use Impacts

Implementing the proposed project will require acquisition of land to:

- Build the new treatment plant (40 additional dunums).
- Build the stabilization reservoir (60 dunums).
- Build the irrigation network—pumping station, distribution reservoir, and distribution pipelines (rights-of-way).
- Dispose of the dry sludge (if not used in agriculture).

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Exhibit V-2
Land Expropriation Procedures

(1) The municipality conducts a detailed survey of the land for expropriation and submits the survey with a request for expropriation for the public benefit to the Land Use Officer at CIVAD. According to CIVAD rules, the survey must show the location and boundaries of the land in an appropriate scale.

(2) The Land Use Officer sends copies of the request to various concerned departments at CIVAD—water, archeology, health, environment, public works, and planning—and informs them of his intent to expropriate the land. Each of these departments inspects the site, and if it does not conflict with their regulation and demands, they give their approval to the Land Use Officer. Otherwise, they demand a change in location.

(3) On receiving approval from all concerned departments, the Land Use Officer advertises in local newspapers his intent to expropriate the designated land. This advertisement serves as a notice to those who may object to the expropriation and gives them two months to submit a written objection to the expropriation sought.

(4) Two months after the advertisement first appears, the Land Use Officer investigates any and all objections received. If the objections are not found satisfactory, the officer issues the expropriation order according to the CIVAD regulations. The landowner(s) are then informed officially of the expropriation order by the Municipality of Ramallah, which must compensate them for expropriating the land. The land value is appraised by a committee from the Municipality of Ramallah and the Financial Department responsible for collecting taxes.

Only the additional land required to build the proposed WWTP is known with precision. All other locations are known with a degree of uncertainty. In all cases, however, the land required is privately owned and will need to be expropriated to implement the project. Exhibit V-2 summarizes the procedures to follow for land expropriation. Of all the land expropriations required for the proposed project, only expropriation procedures for the expanded new WWTP site have been started.

Land owners and neighboring communities may object to the construction of the stabilization reservoir fearing it may become a suitable breeding environment for mosquitoes and other insects. Local communities may also be concerned about children playing near and swimming in the reservoir. However, the Israeli authorities are likely to facilitate the expropriation of land because effluents from the existing treatment plant are polluting precious surface and ground resources (see Section V, A6.).

Failure to acquire these lands in a timely fashion will lead to serious delays in project implementation and could have serious environmental impacts. If the stabilization reservoir or irrigation facilities are not built, a primary objective of the project (reuse of treated

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wastewater for irrigation) will not be fulfilled. Precious treated wastewater will be wasted down the wadi or in the fields, unless it is used by industries, in grazing, or in a reforestation program.

Land availability may also hinder plant expansion in the future. Any expansion of the plant in the future will require enlarging the plant site either upstream or downstream from the current location. There is very little land available for expansion upstream, especially if an emergency pond is built as a by-pass line for accidental industrial discharges (see Section III). Also, upstream expansion will require relocating the existing water pumping station upstream from the WWTP (this station currently receives water from Mekorot and distributes it to Ramallah town). Moreover, land upstream is in the industrial area and is expensive. Further expansion downstream can only be achieved by acquiring land that is currently part of the military camp bordering the site from the south. Also, the site does not allow for any further horizontal expansion to accommodate more sludge drying beds, which could create future difficulties for safe sludge disposal.

Recommendations

The municipality needs to expropriate land to expand the existing treatment plant (40 additional dunums) and build the stabilization reservoir (60 dunums). The cooperative also needs to buy land to build the distribution reservoir and acquire rights-of-way for the distribution pipelines. Any delays in expropriating the required land may cause significant impacts on the environment or, at a minimum, create an opportunity cost due to wasting an invaluable water resource. Expropriating all necessary lands should be a Condition Precedent (CP) attached to this project.

C3. Economic and Employment Impacts

The proposed wastewater management project will create jobs and economic opportunities through improved, irrigated agricultural practices. According to reports by ANERA and the design engineer, the proposed project will provide 12,200 person-days of construction jobs. In addition to these temporary jobs, the project will create the following full-time jobs:

- 18 jobs for operation and maintenance of the WWTP, including municipal positions.
- Three jobs at the Ramallah Agricultural Marketing Cooperative.
- 200 agricultural laborers, assuming 2,000 dunums are irrigated having an average of one laborer per 10 dunums.

The project also will create business opportunities for laboratories in the area.

The Municipality of Ramallah collects sewage connection and maintenance fees from land and property owners in Ramallah. Sewage connection fees are assessed once and are equal to:

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- JD2 (or US $3) per m^2 of built-up area; plus
- JD0.2 (or $0.30) per m^2 of total land area; plus
- JD0.2 (or $0.30) per m^2 of unbuilt land area.

Maintenance sewage fees are assessed yearly on the basis of JD0.2 ($0.3) per m^2 of built-up area per year.

According to municipal records, sewage-related municipal expenses amounted to $137,519 in 1993, compared to only $45,839 in sewage-related revenues (sewage connection and maintenance fees). Hence, sewage-related revenues in 1993 covered only one-third of the municipality's sewage-related expenses. The municipality covered the deficit between revenues and expenses by drawing on its general fund. Sewage expenses represented about 5.6 percent of total expenses incurred by the municipality in 1993.

In the future, the municipality is expected to raise sufficient funds for operation and maintenance of the proposed WWTP by:

- Increasing sewage connection and maintenance fees.
- Charging the Ramallah Agricultural Marketing Cooperative for the supply of treated wastewater for irrigation.

The cooperative in turn will sell the treated wastewater to farmers.

Recommendations

- Revise the economic assessment of the proposed wastewater management project to reflect the costs of recommended mitigation, monitoring, and management measures.
- Provide treated wastewater for free to farmers the first year as an incentive to use it for irrigation.
- Use the first year of operation of the WWTP to calibrate the sewage fees and water charges that will be assessed in the future in order to recover at least the costs of operating and maintaining the proposed wastewater management system.

C4. Transportation, Telecommunications, and Power Network Impacts

C4a. Transportation

During construction of the WWTP, transportation trucks will make several trips a day to and from the site. Trucks will bring to the site excavation equipment and construction materials (cement, aggregate, sand, steel, HDPE liners, etc.). Trucks also will remove excavation equipment and excavated surplus materials and debris. Truck traffic will create

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temporary air pollution (dust, and exhaust emissions) along the roads leading to the WWTP, especially in the vicinity of the WWTP.

During operation and maintenance of the WWTP, transportation will be limited primarily to trucks bringing septage to the plant or removing dry sludge and cars transporting employees, laboratory technicians, and visitors. Septage shipments to the WWTP initially will be as frequent in 1994 but will become infrequent in the future until they are no longer necessary on a routine basis in 2015.

C4b. Telecommunications

Like most locations in the Ramallah industrial area, the existing WWTP does not have any telephone lines. This may hamper the capability of plant personnel to:

- Notify appropriate institutions in case of an emergency; e.g., notifying the municipality's fire department in case of fire at the plant.

- Respond to certain emergencies; e.g., being informed about an accidental discharge at an industrial plant and taking appropriate measures at the WWTP (see Section III).

In either case, communication delays could have serious implications on the plant or the quality of its effluents.

Recommended Mitigation Measure

- Equip the WWTP with around-the-clock emergency response capabilities, including a cellular telephone and on-call staff.

C4c. Power Network

The proposed design minimizes the use of energy by placing the aeration lagoons after the anaerobic ponds and relying on maturation ponds to reduce the BOD content of the effluent. Nevertheless, the new WWTP will have six aerators, three times as many as in the existing plant. Hence, power consumption by the Municipality of Ramallah will increase.

Also, a new power supply will be needed to pump treated wastewater from the stabilization reservoir to the distribution reservoir. The distribution reservoir will serve to irrigate by gravity agricultural lands that are at higher elevations than the stabilization reservoir.

Recommendation

Building the distribution reservoir and pumping station should be deferred to a later stage because there are good agricultural lands downstream from the stabilization reservoir. This will minimize environmental impacts and reduce investment costs initially.

C5. Public Health and Safety Impacts

Public health and safety impacts may occur both during construction and during O&M. Impacts during O&M are associated with either the WWTP or the use of treated wastewater in irrigation.

C5a. Public Health and Safety Impacts During Construction

Construction of the WWTP will pose the same standard accident hazards associated with any construction activity. In addition, because construction activities will be carried out at the same location as the existing WWTP while it is in operation, construction workers may be exposed to health risks due to direct contact with contaminated soil, raw sewage, wastewater aerosols—because of aerator operation—etc. Health risks include the possibility of infection by communicable diseases and hazardous wastes from industrial discharges.

C5b. Public Health and Safety Impacts During O&M

During the O&M phase, both positive and negative health impacts may be expected. Positive health impacts can be expected once the new, better functioning WWTP becomes operational. Although an overall increase in infectious communicable diseases recently has been reported in the West Bank,[3] communicable disease infection rates are likely to decrease downstream from the WWTP because of the decrease in raw (or poorly treated) sewage discharges.

Negative health and safety impacts are usually linked to either improper operation of the WWTP generally or to irrigation with raw sewage or poorly treated wastewater. Although these adverse health impacts are not anticipated if the project is implemented as planned, it is useful to list the potential health impacts that have been well-documented in various international reports.[4]

- If irrigated with raw or poorly treated wastewater, salad crops and other vegetables that are regularly eaten uncooked (especially if not washed properly) can transmit the helminth (worm) diseases caused by Ascaris and Trichuris, as well as typhoid fever and cholera.

- Cattle grazing on pastures irrigated with partly treated wastewater can become infected with Taenia saginata—the beef tapeworm—and humans who consume raw or undercooked meat of such infected animals can become infected with tapeworms.

- Farmworkers who walk barefoot in irrigated fields can become infected with Ancylostoma—hookworm disease—and long-term repeated exposure to such an environment results in high worm loads with severe debilitating

[3] No hard data, personal communication with M. Barghouty.

[4] World Bank technical paper number 51.

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effects, including anemia and reduced ability to work. Note, however, that walking barefoot in agricultural fields is not a common practice in the West Bank.

- Population groups or family contacts residing in the vicinity of farms irrigated with this wastewater may be negatively affected either by direct contact with the soil or, indirectly, by contacts with the farmers.

- Under certain circumstances, enteric viruses in the aerolized wastewater from sprinkler irrigation may be transmitted to the neighboring community. Note, however, that sprinkler irrigation is not expected in this project.

- Treated wastewater effluents having uncontrolled heavy metals contents may lead to accumulation of those heavy metals in the soil, which are then easily transmitted to the food chain and reach crop consumers. Heavy metals contents depends on the types of industries discharging wastewater into the sewer network. Given the existing industrial profile of the Ramallah industrial area, however, heavy metals are not likely to be found in above-trace levels in the treated wastewater.

In addition, fire hazards may be posed by reactive chemicals potentially discharged by industries or by methane gas formation in the anaerobic ponds, but this is a rare occurrence. Also, site intruders may be exposed to health and accident hazards, especially children trying to enter the stabilization reservoir site and swim in it.

The design proposal suggests that produced sludge will be dried and disposed of in a fenced-off mountainous area east of the city. If the sludge is not well stabilized and is used as a soil conditioner, health risks to farmers or people who come in contact with soil or plants may occur.

Also, mosquito problems may arise at the site of the stabilization reservoir, where there were no problems before. These problems may be minimal, however, if the level of water changes constantly as a result of using the treated wastewater for irrigation. Indeed, that situation would offer less than ideal conditions for mosquitoes to breed.

Recommended Mitigation Measures

- Implement an appropriate monitoring program with by-pass and chlorination options to ensure that final effluent will meet the guidelines for irrigation (see Section VI).

- Educate farmers about proper agricultural practices: types of crops, plowing methods, and drip irrigation methods.

- Ensure full stabilization of the dry sludge before reuse.

- Implement an environmentally-sound mosquito control program: cut weeds and plants regularly and cultivate fish in stabilization ponds.

- Educate plant employees about sound health and safety practices, vaccinate employees against certain diseases such as hepatitis and cholera, and monitor the health of employees on a regular basis.

C6. Industrial Activity Impacts

Industrial wastewater discharges may upset the proper functioning of the proposed WWTP. For this reason, the EA includes a survey of industrial plants in Ramallah. Recommendations are contained in Section III, and Annex C presents a synopsis of individual site visits and the survey questionnaire.

C7. Agricultural Activity Impacts

Irrigation with treated wastewater should not contaminate groundwater if irrigation is confined to the Yatta formation (see subsection A4.). Also, as discussed in subsection A7., irrigation with properly treated wastewater should not have any significant impacts on wildlife because no new agricultural land will be reclaimed or developed; rather, existing land will be cultivated with irrigated crops instead of rain-fed crops. Shifting to irrigated practices, however, is likely to be accompanied with an increase in pesticide use. Excessive pesticide use may lead to groundwater contamination and affect the health of produce consumers (if edible crops are cultivated). Moreover, specific procedures should be used if pesticides are to be procured and/or used with USAID funds, as spelled out in 22 CFR 216.3(b).

Table V-2 summarizes key environmental impacts and recommended mitigation measures.

Table V-2
Key Environmental Impacts and Recommended Mitigation Measures

Environmental Impacts	Mitigation Measures
Earthquake Risks. Potential for one earthquake of intensity 7 or greater on the Mercalli-Cancani scale every 50 years	• Design all facilities for an earthquake of intensity 7 or greater on the Mercalli-Cancani scale
Odors. Potential for occasional bad odors from the anaerobic ponds	• Revise plant design to deepen the anaerobic ponds and allow for covering them if odors present a problem • Study the feasibility of different cover types; learn from similar experiences in Israel, Canada, and the U.S.
Groundwater Pollution. Groundwater may be polluted if treated wastewater is used to irrigate land outside the Yatta formation	• Require ANERA to demonstrate that there are sufficient agricultural lands within the Yatta formation (CP) • Limit irrigation to agricultural lands falling within the Yatta formation
Potential Need for Plant Expansion. Population and industrial growth, coupled with limited land availability for further plant expansion in the future, could reduce the life of the project from 20 years to 10	• Plan for regional wastewater management. For example, the municipalities of Ramallah and Betunia should enter into an agreement for municipal wastewater exchanges to take advantage of gravity and reduce pumping costs
Delays in Project implementation. Implementation may be delayed by: - lengthy expropriation of private land for various facilities - opposition by local communities to the stabilization reservoir, due to perceived risks of mosquitoes, flooding, and odors	• Identify precisely all land expropriation needs and start the expropriation process immediately (CP) • Educate local communities about environmental and other benefits of the stabilization reservoir
Emergency Preparedness. Lack of telephone lines may hamper emergency response and notification capabilities at the WWTP	• Equip plant with cellular telephone 24 hours a day, plus on-call staff
Electricity. The proposed system will require more energy to operate six aerators. Also, water will need to be pumped to the distribution reservoir to irrigate elevated lands by gravity	• Obtain all power supply permits • Defer building the distribution reservoir and pumping station to a later stage, and focus initially on irrigating agricultural lands downstream from the stabilization reservoir
Forestation. The Ramallah area is dry, and the land bare and severely eroded. Also treated wastewater should not be wasted under any circumstance	• Explore all possible reuses of the treated wastewater, including reuse by industry and for grazing • Plan for both routine and emergency reuse of the treated wastewater in a pilot reforestation project
Sludge Disposal. Disposal of sludge ignores its value as a potentially good soil conditioner	• Plan to use the sludge in the pilot reforestation program

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Environmental Impacts	Mitigation Measures
Public Health and Safety at the WWTP. Construction workers are exposed to: - the same standard accident hazards posed by any construction activity - health risks from direct contact with contaminated soil, raw sewage, and wastewater aerosols due to aerators	• Construction workers should follow standard health and safety measures for construction sites • To the extent possible, construction workers should avoid direct contact with soil, sewage, and sludge
WWTP employees may be exposed to communicable diseases infections and potential hazards associated with uncontrolled industrial waste discharges	• Plant employees should wear protective clothing and follow standard health and safety procedures • The health of plant employees should be monitored regularly
Fire hazards. Plant employees may be exposed to fire hazards due to methane gas formation in the anaerobic ponds (very unlikely because ponds are open) or in laboratory tests due to the potential presence of reactive chemicals discharged by industries	• Place fire extinguishers in different key locations at the site • Plant employees should follow standard health and safety procedures for on-site lab tests
Site Intruders. Intruders into the WWTP or stabilization reservoir sites may be exposed to health or accident risks, especially children who may try to swim in the stabilization reservoir	• Fence the WWTP site and the stabilization reservoir site
Reuse of Treated Wastewater for Irrigation. Irrigation with poorly treated wastewater will pose significant health risks to farmers and consumers	• Establish an appropriate effluent quality monitoring program with by-pass and chlorination options to ensure that final effluent will meet irrigation guidelines (see Section VI)
Contaminated Crops. Consumers may be exposed to health risks due to ingestion of contaminated crops	• Farmers should not use the treated wastewater to irrigate vegetables or crops that are eaten raw
Use of Sprinklers. Nearby populations may be at risk due to exposure to aerolized wastewater (if sprinklers are used)	• Prohibit use of sprinklers for irrigation (also to conserve water). Drip irrigation should be encouraged and measures taken to reduce clogging
Mosquitoes. Mosquitoes and other insects may thrive near the maturation ponds and the stabilization reservoir, thus continuing to cause a nuisance to local populations and tourists	• Implement environmentally sound mosquito control program: cut weeds and plants regularly, cultivate fish

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SECTION VI

MONITORING MEASURES

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SECTION VI
MONITORING MEASURES

The PRIDE team recommends monitoring environmental parameters both inside and outside the wastewater treatment and reuse system. "Internal monitoring" measures are intended to ensure that the treatment plant functions as planned and provides treated wastewater suitable for reuse in irrigation. "External monitoring" tracks general environmental indicators (e.g., quality of spring water and quality of crops) over time in order to evaluate the environmental impacts of the proposed project. Also, monitoring the reuse of treated wastewater in irrigation is recommended.

A. Internal Monitoring

Internal monitoring measures are intended to ensure that the WWTP operates properly and that the treated wastewater meets targeted guidelines for wastewater reuse in irrigation. By providing early information on the quality of wastewater effluents inside the WWTP, internal monitoring measures allow plant operators to take corrective measures when the effluent does not meet certain quality benchmarks.

To ensure proper operation of the plant, plant staff will monitor operating parameters according to standard operating procedures for a plant of this type. In addition to the standard operating and monitoring requirements, the team recommends specific monitoring and mitigation measures at different stages of the proposed wastewater management system. Figure VI-1 shows a schematic of the proposed wastewater management system and the locations of recommended monitoring measures. Table VI-1 summarizes the specific monitoring measures and follow up actions. Both Figure VI-1 and Table VI-1 illustrate the proposed monitoring program. The plant designer should revise the plant design to incorporate the basic ideas in Figure VI-1 (with technical adjustments as appropriate), and the plant operator should complete, refine, and finalize the monitoring program proposed in Table VI-1 after the plant has been commissioned and has operated for a period of time (e.g., three months).

A1. Monitoring of Wastewater Inflow

Plant employees should monitor wastewater inflow daily for SS and weekly for pH and BOD. If SS, pH, or BOD exceed certain maximum acceptable values, then direct incoming flow to the emergency pond. Maximum acceptable values can be set only after the plant has been commissioned and operated for a period of time. Plant operators should determine these cutoff values through an iterative process by observing wastewater influent and effluent quality over a period of time (e.g., three months). Also, incoming flow should be directed to the emergency by-pass pond in response to emergency notifications of shock loads by industries (extremely high temperatures, etc.).

Figure VI-1
Schematic of Wastewater Management System Showing Locations of Monitoring Measures

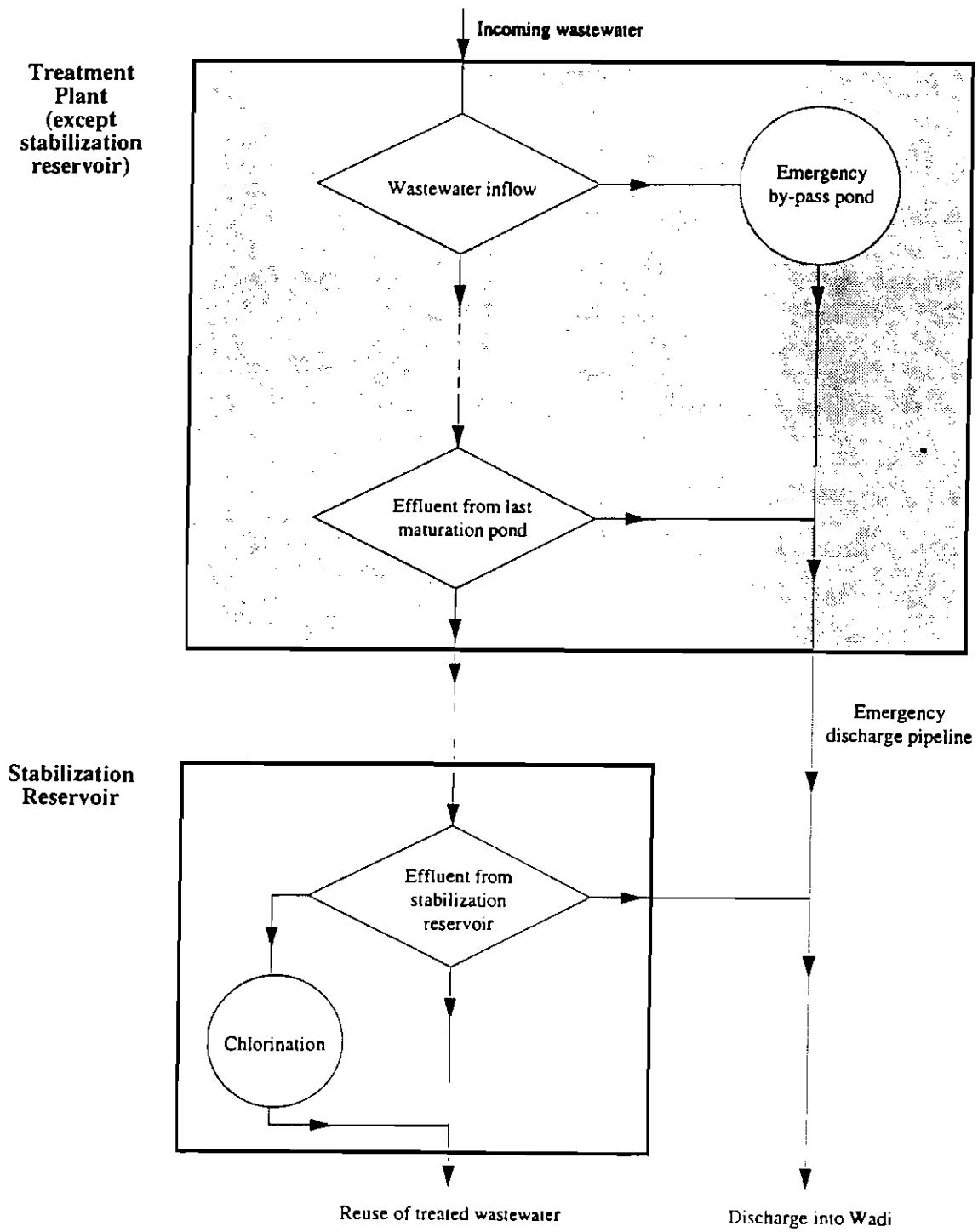

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Table VI-1
Tentative Internal Monitoring Program

Location of Sample	Frequency of Monitoring	Water Quality Test	Follow-Up Action if Water Fails Test
Wastewater influent	• pH - weekly • BOD - weekly • SS - daily	To be determined after the plant is commissioned	If wastewater fails test or in case of emergency (industrial shock load), direct wasteflow to emergency pond
Effluent from last maturation pond	• pH - weekly • BOD - weekly • SS - daily • FC - daily	• pH = 6 - 9 • $\leq$ 20-25 mg/l BOD * • $\leq$ 30 mg/l SS • $\leq$ TBD FC/100ml **	If pH, BOD, SS, or FC exceed prescribed values, direct effluent to emergency discharge pipeline
Effluent from stabilization reservoir	• pH - weekly • BOD - weekly • SS - daily • FC - daily	• pH = 6-9 • $\leq$ 20-25 mg/l BOD * • $\leq$ 30 mg/l SS • $\leq$ 250 FC/100ml ***	If treated wastewater fails pH, BOD, or SS test, direct overflow to emergency discharge pipeline. Otherwise, either use the treated wastewater directly or after chlorination, or direct to emergency pipeline, depending on FC level (see Table VI-2)
Effluent from chlorine contact basin	• Cl_2 residual - continuous	• 1 mg/l Cl_2 residual (minimum) ****	If chlorine residual is less than 1mg/l (min.), do not reuse for irrigation; otherwise see Table VI-3 for types of crops

*As determined from the five-day BOD test.
**TBD = to be determined. Maximum acceptable levels of FC at this stage TBD should be set by plant operators only after the plant has been commissioned and operated for a period of time (e.g., three months).
***Recommended FC limits are median values for test results over last seven days. Either the membrane filter or fermentation tube technique may be used. No sample should have more than 800 FC/100ml.
****Total chlorine residual after a minimum contact time of 30 minutes.

Source: Based on U.S. Environmental Protection Agency and U.S. Agency for International Development, "Manual, Guidelines for Water Reuse," EPA/625/R-92/004, September 1992.

A2. Monitoring of Effluent from Last Maturation Pond

Plant operators should monitor wastewater effluent from the last maturation pond:

- Daily for SS and FC
- Weekly for pH and BOD

If SS, pH, BOD, or FC exceed prescribed values (see Table VI-1), then direct the effluent to the emergency discharge pipeline. Note that the maximum acceptable FC levels in effluents from the last maturation pond (TBD) may not be defined until the plant has been commissioned and operated for a period of time. Plant operators should determine this level using an iterative process, beginning with relatively low levels of fecal coliform (e.g., 10 x 10^2 FC/100ml).

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A3. Monitoring of Effluent from the Stabilization Reservoir

Plant operators should monitor effluent from the stabilization reservoir:

- Daily for SS and FC
- Weekly for pH and BOD

If SS, pH, or BOD exceed prescribed values, then discharge the effluent into the emergency discharge pipeline. If SS, pH, and BOD are within prescribed values and:

- FC levels exceed 250 FC/100ml, then direct the effluent to the chlorine contact basin before reusing it for irrigation.

- FC levels are less than or equal to 250 FC/100ml, then by-pass the chlorine contact basin and reuse treated wastewater directly for irrigation (see Table VI-2).

Plant operators should keep a log of all tests, monitoring results, and decisions concerning wastewater flow direction.

B. Monitoring of Reuse for Irrigation

The Ramallah Agricultural Marketing Cooperative should monitor the reuse of treated wastewater for irrigation. The cooperative should work closely with the municipality and the plant operator, with technical assistance from ANERA, to predict each year the effluent quality that can be expected on a "sustainable" basis. The cooperative should then advise farmers well in advance of the planting season of the kinds of crops they can safely plant.

Treated wastewater may be used to irrigate different types of crops depending on FC levels. A tentative decision diagram is in Table VI-2. For example, if "sustainable" FC levels are greater than 50 FC/100ml but less than 250 FC/100ml, as anticipated, then treated wastewater may be used to irrigate olive and citrus orchards and vineyards and animal feed crops (alfalfa, clover, barley, and corn).

In addition to the standard guidelines for BOD, SS, pH, and FC the cooperative may want to monitor other physical and chemical parameters. Table VI-3 provides international guidelines for reuse in irrigation and fish propagation for a select list of parameters. International guidelines for coliform, BOD, pH, and SS are included for information purposes.

The cooperative also should work with the Agricultural Department to monitor the quality of crops irrigated with treated wastewater.

Table VI-2
Tentative Uses of Treated Wastewater as a Function of "Sustainable" Fecal Coliform Levels *

FC Levels	Treated Wastewater Use
Less than 50 FC/100ml	Irrigate vegetables
Between 50 and 250 FC/100ml	Irrigate olive and citrus orchards, and animal feed crops
Between 250 and 1,000 FC/100ml	Reuse in forestation, or by certain industries
Greater than 1,000 FC/100ml	Find acceptable alternative uses or else discharge in wadi

*Assuming BOD, pH, and SS levels are met (see Table VI-I).

Table VI-3
International Guidelines for Treated Wastewater Reuse for Fish Propagation and Irrigation

Characteristics		Fish Propagation	Irrigation		
			Truck Garden Vegetables	Citrus Fruits	Other Crops
Bacteria - per ml					
FC	(opt.)	10	1	10	100
	(max.)	100	10	100	100
Organic - ppm					
BOD	(opt.)	10			
	(max.)	30	NA	NA	NA
Oil	(opt.)	none	none	none	none
	(max.)	5	5	5	5
Reaction					
pH	(opt.)	6.5-8.5	6.5-8.5	6.5-8.5	6.5-8.5
	(critical)	6.5-8.5	6.0-9.0	6.0-9.0	6.0-9.0
Physical - ppm					
SS	(opt.)	10			
	(max.)	20	NA	NA	NA
Chemical - ppm					
Total solids	(opt.)	1,000	500	500	500
	(max.)	5,000	1,500	1,500	2,000

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Characteristics		Fish Propagation	Irrigation		
			Truck Garden Vegetables	Citrus Fruits	Other Crops
Cl	(opt.) (max.)	1,000 2,500	200 750	100 500	250 750
F	(opt.) (max.)		0.5-1.0 5		
Toxic metals	(opt.) (max.)	0.5 10	0.1 2.5		
Phenol	(opt.) (max.)	0.1 1	5 20		
Boron	(opt.) (max.)			0.5 1	1 5
Na ratio	(opt.) (max.)		35-50 80	35-50 75	35-50 80
Odor		M	O	O	O
Taste		M			

Source: Water and Sanitation for Health Project, "Guidelines for Improving Wastewater and Solid Waste Management, WASH Technical Report No. 88," sponsored by the USAID, Operated by CDM and Associates, August 1993, Table VI-3.

C. External Monitoring

In addition to internal monitoring measures, the team proposes monitoring external environmental indicators. Monitoring environmental indicators will satisfy USAID Environmental Procedures (22 CFR 216), which call for "measur[ing] any change in environmental quality, positive or negative, during [project] implementation" [§216.3(a)(8)]. Monitoring environmental indicators will require recording baseline data at the start of the project and tracking the values of these indicators over time (e.g., monthly, semiannually, or annually).

Environmental indicators cover the physical environment (water resources), socioeconomic environment (income levels and sources of income), and institutional environment (fee collection recovery and cost recovery). Table VI-4 presents a suggested external monitoring program. ANERA should work with USAID, the Municipality of Ramallah, the Ramallah Agricultural Cooperative, and regional or national departments to decide on a final external monitoring program and assign responsibilities for monitoring different indicators.

Table VI-4
Suggested Environmental Monitoring Program

Environmental Indicator	Description of Indicator	Frequency of Monitoring
Physical Environment		
Springs	Measure bacteriological and chemical pollution in spring water (see Section IV, A6b for a list of downstream springs)	Semiannually (winter and summer)
Soil	Measure contamination of agricultural soil, especially accumulation of heavy metals	Semiannually
Socioeconomic Environment		
Sewerage connections	Measure number and percentage of household and industrial connections	Monthly, Bimonthly, or annual
Quality of crops	Measure bacteriological and chemical contamination of crops and fish (if cultivated in stabilization reservoir)	On harvesting
Institutional Capabilities		
Plant performance	Measure properly treated wastewater as a percentage of total wastewater treated	Monthly or quarterly
Collection coverage	Measure the percentage of households paying sewage charges	Monthly or bimonthly
Cost recovery	Measure collected sewage charges as a percentage of O&M costs	Bimonthly or semiannually

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SECTION VI
MONITORING MEASURES

The PRIDE team recommends monitoring environmental parameters both inside and outside the wastewater treatment and reuse system. "Internal monitoring" measures are intended to ensure that the treatment plant functions as planned and provides treated wastewater suitable for reuse in irrigation. "External monitoring" tracks general environmental indicators (e.g., quality of spring water and quality of crops) over time in order to evaluate the environmental impacts of the proposed project. Also, monitoring the reuse of treated wastewater in irrigation is recommended.

A. Internal Monitoring

Internal monitoring measures are intended to ensure that the WWTP operates properly and that the treated wastewater meets targeted guidelines for wastewater reuse in irrigation. By providing early information on the quality of wastewater effluents inside the WWTP, internal monitoring measures allow plant operators to take corrective measures when the effluent does not meet certain quality benchmarks.

To ensure proper operation of the plant, plant staff will monitor operating parameters according to standard operating procedures for a plant of this type. In addition to the standard operating and monitoring requirements, the team recommends specific monitoring and mitigation measures at different stages of the proposed wastewater management system. Figure VI-1 shows a schematic of the proposed wastewater management system and the locations of recommended monitoring measures. Table VI-1 summarizes the specific monitoring measures and follow up actions. Both Figure VI-1 and Table VI-1 illustrate the proposed monitoring program. The plant designer should revise the plant design to incorporate the basic ideas in Figure VI-1 (with technical adjustments as appropriate), and the plant operator should complete, refine, and finalize the monitoring program proposed in Table VI-1 after the plant has been commissioned and has operated for a period of time (e.g., three months).

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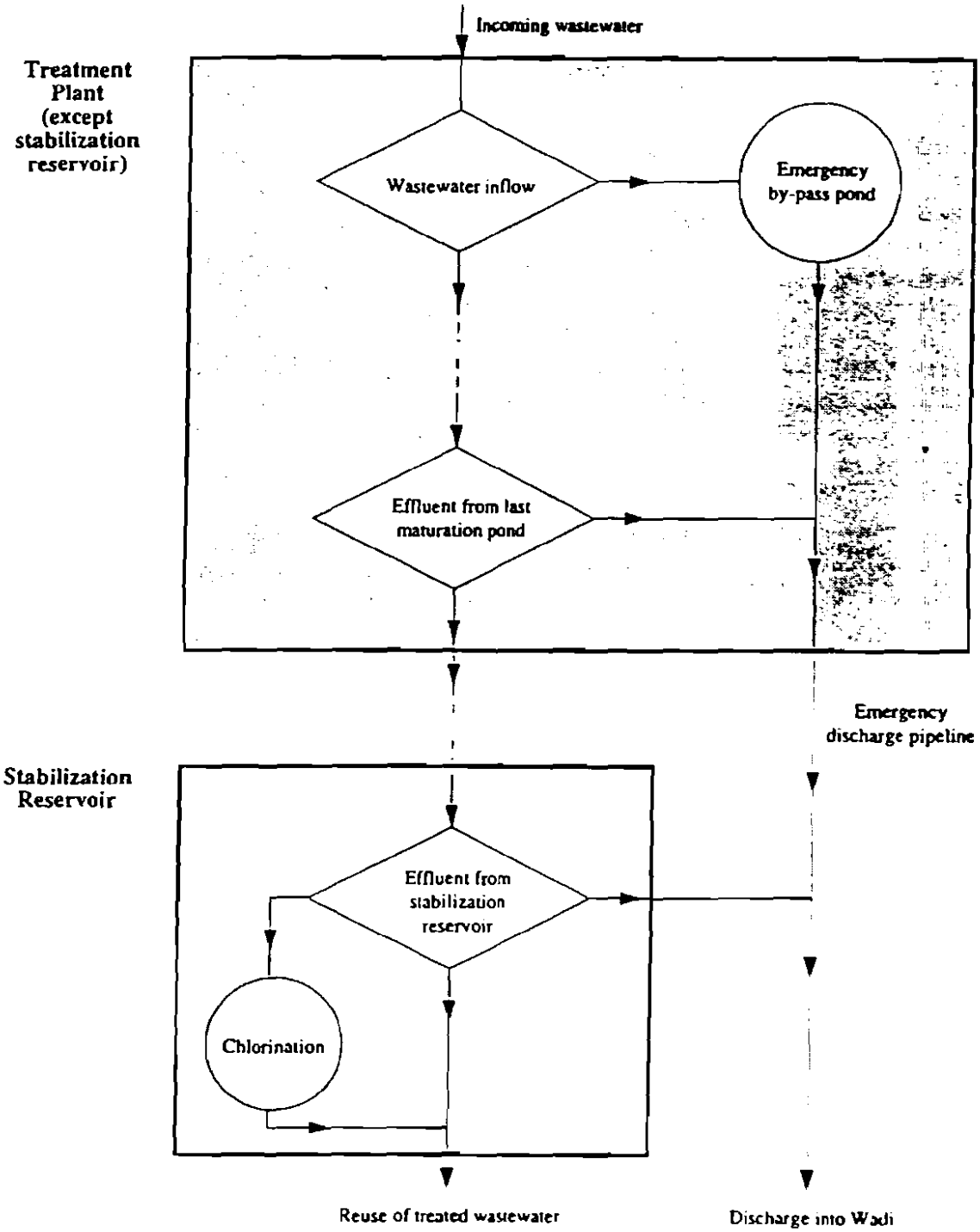

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Effluent from chlorine contact basin ?	• Cl_2 residual - continuous	• 1 mg/l Cl_2 residual (minimum) ****	If chlorine residual is less than 1mg/l (min.), do not reuse for irrigation; otherwise see Table VI-3 for types of crops

no Cl2 necessary

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- Weekly for pH and BOD

If SS, pH, or BOD exceed prescribed values, then discharge the effluent into the emergency discharge pipeline. If SS, pH, and BOD are within prescribed values and:

- FC levels exceed 250 FC/100ml, then direct the effluent to the chlorine contact basin before reusing it for irrigation.

- FC levels are less than or equal to 250 FC/100ml, then by-pass the chlorine contact basin and reuse treated wastewater directly for irrigation (see Table VI-2).

Plant operators should keep a log of all tests, monitoring results, and decisions concerning wastewater flow direction.

B. Monitoring of Reuse for Irrigation

The Ramallah Agricultural Marketing Cooperative should monitor the reuse of treated wastewater for irrigation. The cooperative should work closely with the municipality and the plant operator, with technical assistance from ANERA, to predict each year the effluent quality that can be expected on a "sustainable" basis. The cooperative should then advise farmers well in advance of the planting season of the kinds of crops they can safely plant.

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	(max.)	30	NA	NA	NA
Oil	(opt.)	none	none	none	none
	(max.)	5	5	5	5
Reaction					
pH	(opt.)	6.5-8.5	6.5-8.5	6.5-8.5	6.5-8.5
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Physical - ppm					
SS	(opt.)	10			
	(max.)	20	NA	NA	NA
Chemical - ppm					
Total solids	(opt.)	1,000	500	500	500
	(max.)	5,000	1,500	1,500	2,000

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Toxic metals	(opt.) (max.)	0.5 10	0.1 2.5		
Phenol	(opt.) (max.)	0.1 1	5 20		
Boron	(opt.) (max.)			0.5 1	1 5
Na ratio	(opt.) (max.)		35-50 80	35-50 75	35-50 80
Odor		M	O	O	O
Taste		M			

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Table VI-4
Suggested Environmental Monitoring Program

Environmental Indicator	Description of Indicator	Frequency of Monitoring
Physical Environment		
Springs	Measure bacteriological and chemical pollution in spring water (see Section IV, A6b for a list of downstream springs)	Semiannually (winter and summer)
Soil	Measure contamination of agricultural soil, especially accumulation of heavy metals	Semiannually
Socioeconomic Environment		
Sewerage connections	Measure number and percentage of household and industrial connections	Monthly, Bimonthly, or annual
Quality of crops	Measure bacteriological and chemical contamination of crops and fish (if cultivated in stabilization reservoir)	On harvesting
Institutional Capabilities		
Plant performance	Measure properly treated wastewater as a percentage of total wastewater treated	Monthly or quarterly
Collection coverage	Measure the percentage of households paying sewage charges	Monthly or bimonthly
Cost recovery	Measure collected sewage charges as a percentage of O&M costs	Bimonthly or semiannually

SECTION VII

MANAGEMENT MEASURES

SECTION VII
MANAGEMENT MEASURES

This section describes proposed environmental management measures for the proposed Ramallah wastewater management system. It distinguishes among measures that will be implemented by ANERA, the Municipality of Ramallah, the Ramallah Agricultural Marketing Cooperative, and USAID.

A. Management Measures for ANERA

As the primary recipient of USAID funding to implement the proposed Ramallah wastewater management system, ANERA bears ultimate responsibility for ensuring that the proposed system is built and operated in an environmentally-sound manner. ANERA should implement the following management measures:

A1. Ensure that the Final Design Reflects the Mitigation and Monitoring Measures Recommended in this Environmental Assessment Report

ANERA should make sure that the final design of the Ramallah wastewater management system incorporates the mitigation measures recommended in this EA.

A2. Recruit an Experienced Full-Time Local Project Manager to Oversee Implementation of the Project

ANERA should recruit an experienced environmental engineer to oversee implementation of the proposed project. This environmental engineer will be responsible for:

- Approving engineering designs revised to incorporate necessary mitigation and monitoring measures.
- Liaising with the municipality, the cooperative, and USAID to ensure that construction activities meet environmental specifications.
- Overseeing monitoring activities conducted by the municipality and the cooperative (note—actual monitoring should be conducted by cooperatives and municipalities themselves, as described in Section VI).
- Preparing environmental reports to USAID.

A3. Contract Out Plant Operations for the First Few Years

Although the proposed plant uses a low-technology design, the Municipality of Ramallah currently does not have the qualified staff to operate and maintain such a plant. Three options are possible to ensure proper operation and maintenance of this plant:

(1) The municipality hires new staff and trains them to operate the plant, with technical assistance from ANERA and a specialized firm;

(2) ANERA and the municipality enter into an agreement with a specialized firm to operate the plant for a period of time (e.g., three years) for a fee; or

(3) ANERA and the municipality enter into a Build-Own-Operate-Transfer agreement with a specialized firm for a period of time (e.g., five to ten years).

The PRIDE team recommends the second or third option, primarily to allow the municipality to initially focus its resources on developing and enforcing local industrial wastewater discharge regulations and collecting increased sewage fees from residences and industries. As the municipality makes progress in these two areas, it can shift its attention and resources to operating the treatment plant. Options 2 and 3 should therefore be accompanied with measures to ensure smooth transfer of operations to the municipality at the end of the agreement. Also, these options should provide sufficient funding to interested qualified firms to bid on the construction and/or operation contracts.

A4. Provide Technical Assistance to the Municipality and the Cooperative

ANERA should provide technical assistance support to the municipality in the area of developing and enforcing local standards and regulations for industrial wastewater discharges. ANERA should also provide technical assistance support to the cooperative in the reuse of treated wastewater for irrigation.

B. Management Measures for the Municipality of Ramallah

B1. Expropriate the Land Required to Build the Expanded Treatment Plant, Including the Stabilization Reservoir

The municipality needs to expropriate land to expand the existing treatment plant (40 additional dunums) and build the stabilization reservoir (60 dunums). Expropriating all necessary lands should be a CP attached to this project.

B2. Enter into Agreements with Neighboring Municipalities for Regional Wastewater Management

Specifically, the Municipality of Ramallah should enter into an agreement with the Municipality of Betunia for municipal wastewater exchanges to take advantage of gravity and reduce pumping costs. For example, the Municipality of Betunia could accept responsibility for treatment of sewage generated in new residential areas in the northwestern part of Ramallah, which drains naturally into the wadi where Betunia plans to build its future WWTP. Such an arrangement would eliminate a significant fraction of the sewage loads going to the Ramallah treatment plant. Similar arrangements currently exist with the neighboring Municipality of El-Bireh and should be expanded.

B3. Develop and Enforce Local Industrial Wastewater Discharge Regulations

The municipality should develop and enforce local industrial wastewater discharge regulations and standards, establish a strict monitoring program—including site visits and inspections—for potentially dangerous facilities and link licensing to wastewater discharges. The municipality should study the feasibility of building a separate collection and treatment system for industrial wastewater. The municipality should require select facilities to monitor their wastewater effluents (quantity and quality) on a regular basis (frequency is facility specific). Plants that routinely discharge dangerous wastewaters should be required to install pretreatment equipment. Plants that occasionally or accidentally may discharge shock loads should be required to notify the WWTP as quickly as possible of any emergency shock loads. The municipality and WWTP operators should prepare an emergency response plan, including 24-hour emergency response capabilities at the WWTP.

B4. Develop Cost Recovery Mechanisms to Ensure Long-Term Sustainability of the Project

The municipality should use the first year of operation of the WWTP to calibrate new sewage fees and water charges (to the cooperative) that need to be assessed in order to recover at least the costs of operation and maintenance of the proposed wastewater management system.

B5. Conduct Awareness Campaigns

The municipality should conduct an awareness campaign explaining to the population and industries of Ramallah the benefits of the new wastewater management system and seeking their participation in making sure the project succeeds.

C. Management Measures for the Cooperative

C1. Educate Farmers about Irrigation with Treated Wastewater

With the assistance of ANERA, the cooperative should develop an aggressive campaign aimed at encouraging farmers to shift to irrigated agricultural practices and educating them about environmentally-sound practices. This campaign should include:

- Demonstration projects showing the benefits of irrigation with treated wastewater.
- Organized tours and visits to agricultural areas that successfully use treated wastewater for irrigation, in particular in Israel.
- Training programs on sound irrigation techniques (including drip irrigation), improved plowing methods, and decreased use of pesticides, including Integrated Pest Management (IPM) practices.

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C2. Monitor Effluent Quality and Advise Farmers about Allowable Crops

The Ramallah Agricultural Marketing Cooperative should monitor the reuse of treated wastewater for irrigation. The cooperative should work closely with the municipality and the plant operator, with technical assistance from ANERA, to predict each year the effluent quality that can be expected on a "sustainable" basis. The cooperative then should advise farmers well in advance of the planting season of the kinds of crops they can safely plant (see Section VI, B.).

C3. Study Treated Wastewater Rates to be Charged to Farmers

The cooperative should provide treated water to farmers free of charge or at a subsidized rate the first year, as an added incentive for farmers. The cooperative should be careful to explain that this is only a temporary one-year measure. During this first year, the cooperative should work with the municipality to study the economic rate at which treated wastewater should be sold to farmers in the future. Rates should be high enough to pay the fees charged by the Municipality plus the services provided by the cooperative.

C4. Monitor the Quality of Crops

The cooperative should work with the Agricultural Department to monitor the quality of crops irrigated with treated wastewater and advise consumers.

D. Management Measures for USAID

D1. Attach Certain CP to the Proposed Project

USAID should attach at least the following CP to the proposed project:

- Require ANERA to demonstrate that there are sufficient (at least 1,000 dunums) agricultural lands in the four neighboring villages to Ramallah that fall within the Yatta formation. A certificate to that effect from the Hydrological Services is highly desirable.

- Require the Municipality of Ramallah to expropriate the land required to expand the existing treatment plant site (40 additional dunums) and build the stabilization reservoir (60 dunums), and the Ramallah Agricultural Marketing Cooperative to obtain rights-of-way for all irrigation pipelines.

D2. Form and Participate in an Interagency Committee to Oversee the Implementation of Recommendations

The PRIDE team recommends that a technical committee form, grouping representatives from USAID (Jerusalem, Tel Aviv, and Washington), ANERA, the Project Consulting Engineer, the Municipality of Ramallah, and the Ramallah Agricultural Marketing Cooperative, to oversee the implementation of the recommendations contained in this EA.

D3. Require ANERA to Report on Environmental Performance of the Proposed Project

USAID should require ANERA to report regularly on the environmental performance of the proposed project. This reporting may be as part of the Semi-Annual Reports (SARs) submitted by ANERA to USAID or on a more frequent basis.

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SECTION VII
MANAGEMENT MEASURES

This section describes proposed environmental management measures for the proposed Ramallah wastewater management system. It distinguishes among measures that will be implemented by ANERA, the Municipality of Ramallah, the Ramallah Agricultural Marketing Cooperative, and USAID.

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ANERA should make sure that the final design of the Ramallah wastewater management system incorporates the mitigation measures recommended in this EA.

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A2. Recruit an Experienced Full-Time Local Project Manager to Oversee Implementation of the Project

ANERA should recruit an experienced environmental engineer to oversee implementation of the proposed project. This environmental engineer will be responsible for:

- Approving engineering designs revised to incorporate necessary mitigation and monitoring measures.
- Liaising with the municipality, the cooperative, and USAID to ensure that construction activities meet environmental specifications.
- Overseeing monitoring activities conducted by the municipality and the cooperative (note—actual monitoring should be conducted by cooperatives and municipalities themselves, as described in Section VI).
- Preparing environmental reports to USAID.

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A3. Contract Out Plant Operations for the First Few Years

Although the proposed plant uses a low-technology design, the Municipality of Ramallah currently does not have the qualified staff to operate and maintain such a plant. Three options are possible to ensure proper operation and maintenance of this plant:

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(1) The municipality hires new staff and trains them to operate the plant, with technical assistance from ANERA and a specialized firm;

(2) ANERA and the municipality enter into an agreement with a specialized firm to operate the plant for a period of time (e.g., three years) for a fee; or

(3) ANERA and the municipality enter into a Build-Own-Operate-Transfer agreement with a specialized firm for a period of time (e.g., five to ten years).

The PRIDE team recommends the second or third option, primarily to allow the municipality to initially focus its resources on developing and enforcing local industrial wastewater discharge regulations and collecting increased sewage fees from residences and industries. As the municipality makes progress in these two areas, it can shift its attention and resources to operating the treatment plant. Options 2 and 3 should therefore be accompanied with measures to ensure smooth transfer of operations to the municipality at the end of the agreement. Also, these options should provide sufficient funding to interested qualified firms to bid on the construction and/or operation contracts.

A4. Provide Technical Assistance to the Municipality and the Cooperative

ANERA should provide technical assistance support to the municipality in the area of developing and enforcing local standards and regulations for industrial wastewater discharges. ANERA should also provide technical assistance support to the cooperative in the reuse of treated wastewater for irrigation.

B. Management Measures for the Municipality of Ramallah

B1. Expropriate the Land Required to Build the Expanded Treatment Plant, Including the Stabilization Reservoir

The municipality needs to expropriate land to expand the existing treatment plant (40 additional dunums) and build the stabilization reservoir (60 dunums). Expropriating all necessary lands should be a CP attached to this project.

B2. Enter into Agreements with Neighboring Municipalities for Regional Wastewater Management

Specifically, the Municipality of Ramallah should enter into an agreement with the Municipality of Betunia for municipal wastewater exchanges to take advantage of gravity and reduce pumping costs. For example, the Municipality of Betunia could accept responsibility for treatment of sewage generated in new residential areas in the northwestern part of Ramallah, which drains naturally into the wadi where Betunia plans to build its future WWTP. Such an arrangement would eliminate a significant fraction of the sewage loads going to the Ramallah treatment plant. Similar arrangements currently exist with the neighboring Municipality of El-Bireh and should be expanded.

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B3. Develop and Enforce Local Industrial Wastewater Discharge Regulations

The municipality should develop and enforce local industrial wastewater discharge regulations and standards, establish a strict monitoring program—including site visits and inspections—for potentially dangerous facilities and link licensing to wastewater discharges. The municipality should study the feasibility of building a separate collection and treatment system for industrial wastewater. The municipality should require select facilities to monitor their wastewater effluents (quantity and quality) on a regular basis (frequency is facility specific). Plants that routinely discharge dangerous wastewaters should be required to install pretreatment equipment. Plants that occasionally or accidentally may discharge shock loads should be required to notify the WWTP as quickly as possible of any emergency shock loads. The municipality and WWTP operators should prepare an emergency response plan, including 24-hour emergency response capabilities at the WWTP.

B4. Develop Cost Recovery Mechanisms to Ensure Long-Term Sustainability of the Project

The municipality should use the first year of operation of the WWTP to calibrate new sewage fees and water charges (to the cooperative) that need to be assessed in order to recover at least the costs of operation and maintenance of the proposed wastewater management system.

B5. Conduct Awareness Campaigns

The municipality should conduct an awareness campaign explaining to the population and industries of Ramallah the benefits of the new wastewater management system and seeking their participation in making sure the project succeeds.

C. Management Measures for the Cooperative

C1. Educate Farmers about Irrigation with Treated Wastewater

With the assistance of ANERA, the cooperative should develop an aggressive campaign aimed at encouraging farmers to shift to irrigated agricultural practices and educating them about environmentally-sound practices. This campaign should include:

- Demonstration projects showing the benefits of irrigation with treated wastewater.
- Organized tours and visits to agricultural areas that successfully use treated wastewater for irrigation, in particular in Israel.
- Training programs on sound irrigation techniques (including drip irrigation), improved plowing methods, and decreased use of pesticides, including Integrated Pest Management (IPM) practices.

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C2. Monitor Effluent Quality and Advise Farmers about Allowable Crops

OK

The Ramallah Agricultural Marketing Cooperative should monitor the reuse of treated wastewater for irrigation. The cooperative should work closely with the municipality and the plant operator, with technical assistance from ANERA, to predict each year the effluent quality that can be expected on a "sustainable" basis. The cooperative then should advise farmers well in advance of the planting season of the kinds of crops they can safely plant (see Section VI, B.).

C3. Study Treated Wastewater Rates to be Charged to Farmers

The cooperative should provide treated water to farmers free of charge or at a subsidized rate the first year, as an added incentive for farmers. The cooperative should be careful to explain that this is only a temporary one-year measure. During this first year, the cooperative should work with the municipality to study the economic rate at which treated wastewater should be sold to farmers in the future. Rates should be high enough to pay the fees charged by the Municipality plus the services provided by the cooperative.

C4. Monitor the Quality of Crops

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The cooperative should work with the Agricultural Department to monitor the quality of crops irrigated with treated wastewater and advise consumers.

D. Management Measures for USAID

D1. Attach Certain CP to the Proposed Project

USAID should attach at least the following CP to the proposed project:

- Require ANERA to demonstrate that there are sufficient (at least 1,000 dunums) agricultural lands in the four neighboring villages to Ramallah that fall within the Yatta formation. A certificate to that effect from the Hydrological Services is highly desirable.

No 3. Small

- Require the Municipality of Ramallah to expropriate the land required to expand the existing treatment plant site (40 additional dunums) and build the stabilization reservoir (60 dunums), and the Ramallah Agricultural Marketing Cooperative to obtain rights-of-way for all irrigation pipelines.

OK+

D2. Form and Participate in an Interagency Committee to Oversee the Implementation of Recommendations

The PRIDE team recommends that a technical committee form, grouping representatives from USAID (Jerusalem, Tel Aviv, and Washington), ANERA, the Project Consulting Engineer, the Municipality of Ramallah, and the Ramallah Agricultural Marketing Cooperative, to oversee the implementation of the recommendations contained in this EA.

No USAID PO Responsible

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D3. Require ANERA to Report on Environmental Performance of the Proposed Project

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USAID should require ANERA to report regularly on the environmental performance of the proposed project. This reporting may be as part of the Semi-Annual Reports (SARs) submitted by ANERA to USAID or on a more frequent basis.

USAID PO prepare

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SECTION VIII

CONCLUSIONS AND RECOMMENDATIONS

SECTION VIII
CONCLUSIONS AND RECOMMENDATIONS

This assessment indicates that the proposed wastewater management system for Ramallah will not pose significant adverse environmental impacts, provided appropriate mitigation, monitoring, and management measures are implemented, as discussed in this report. Implementation of the project with the recommended measures will protect the environment, improve the well-being of the population, and promote sustainable development in the Ramallah area.

The assessment identified environmental impacts and recommended mitigation, monitoring, and management measures for the three components of the proposed wastewater management system:

- Collection of wastewater
- Treatment of wastewater
- Reuse of treated wastewater

This section reviews key findings and recommendations for each of these three project components plus a general recommendation for monitoring implementation.

A. Collection of Wastewater

Key impacts and recommended measures concern plant design capacity, potential need for expansion, and industrial wastewater discharge.

A1. Plant Design Capacity and Potential Need for Expansion

The sewer network currently covers about 70 percent of households in Ramallah and is expected to reach 100 percent by the year 2015. In light of projected population and industrial growth in Ramallah, wastewater quantities generated within the Ramallah municipal boundaries are expected to reach the plant design capacity by the year 2005. Although land is not available for further plant expansion after this project, the proposed lifetime of the plant (20 years) can be maintained through regional planning. Specifically, the Municipality of Ramallah should enter into an agreement with the Municipality of Betunia for municipal wastewater exchanges to take advantage of gravity and reduce pumping costs. For example, the Municipality of Betunia could accept responsibility for treatment of sewage generated in new residential areas in the northwestern part of Ramallah, which drains naturally into the wadi where Betunia plans to build its future WWTP. Such an arrangement would eliminate a significant portion of the sewage loads going to the Ramallah treatment plant. Similar arrangements currently exist with the neighboring Municipality of El-Bireh and should be expanded.

A2. Industrial Wastewater Discharges

The industrial area of Ramallah is located just upstream of the WWTP site. Most industries are currently connected to the sewer network without any pretreatment of their wastewater. A rapid industrial survey of Ramallah industries indicated that under normal (routine) operating conditions, most industries would not discharge wastewater that would pose a threat to the proposed wastewater management system. Exceptions include the textile dyeing company, which usually discharges about 6,000 m^3 monthly of hot (temperature not disclosed) and colored wastewater containing dye chemicals. In addition, certain industries may discharge occasional or accidental shock loads, such as the two pharmaceutical companies (discharge of defective batches of antibiotics) and the foam manufacturing company (accidental discharge of TDI).

Proper operation of the WWTP will require that the Municipality of Ramallah monitor and control industrial wastewater discharges into the sewer network. The municipality should develop and enforce industrial wastewater effluent guidelines, establish a strict monitoring program for potentially dangerous facilities— including site visits and inspections—and link licensing to wastewater discharge and pollutant concentration. The municipality should require selected facilities to monitor their wastewater effluents (quantity and quality) on a regular basis (frequency is facility specific). Plants that routinely discharge potentially toxic wastewaters should be required to install pretreatment equipment. Plants that occasionally or accidentally may discharge shock loads should be required to notify the WWTP as quickly as possible of any emergency shock loads. The municipality and plant operators should prepare an emergency response plan, including 24-hour emergency response capabilities at the WWTP (e.g., equipping the plant with a cellular telephone given the absence of telephone lines near the plant). The plant design should be reviewed to incorporate an emergency by-pass pond at the entrance of the WWTP. The municipality should conduct an awareness campaign and training programs for Ramallah industries, with technical support from ANERA and USAID.

B. Treatment of Wastewater

The proposed design uses a low-tech biological treatment process that can sustain moderate wastewater shock loads, requires minimum maintenance, and keeps energy costs to a minimum. If properly operated, the proposed plant will deliver effluents of good quality (according to WHO guidelines) for irrigation purposes.

B1. Odors from the Anaerobic Ponds

The two anaerobic ponds are expected to produce nauseous odors that may reach neighboring inhabited areas. To mitigate this impact, the design should be revised to reduce the surface area of the anaerobic ponds, increase their depth, and provide for covering them with floating materials.

B2. Monitoring of Effluents Inside the Plant

The plant operator should follow strict monitoring measures to ensure that the treatment plant (including the stabilization reservoir) is operating properly and that the treated

wastewater will meet targeted guidelines for wastewater reuse. At a minimum, the operator should monitor effluents at the entrance of the plant, from the last maturation pond, and from the stabilization reservoir. The operator should take appropriate measures depending on monitoring results, including directing the wastewater to the emergency by-pass pond or emergency discharge pipeline, and chlorinating effluents. Section VI outlines these monitoring measures.

B3. Plant Construction and Operation

Although the proposed plant uses a low-technology design, the Municipality of Ramallah currently does not have the qualified staff to operate and maintain such a plant. Three options are possible to ensure proper operation and maintenance of this plant:

(1) The municipality hires new staff and trains them to operate the plant, with technical assistance from ANERA and a specialized firm;

(2) The municipality enters into an agreement with a specialized firm to operate the plant for a period of time (e.g., three years) for a fee; or

(3) The municipality enters into a Build-Own-Operate-Transfer agreement with a specialized firm for a period of time (e.g., five to ten years).

The PRIDE team recommends the second or third option, primarily to allow the municipality to initially focus its resources on developing and enforcing industrial wastewater discharge regulations and collecting increased sewage fees from residences and industries. As the municipality makes progress in these two areas, it can shift its attention and resources to operating the treatment plant. Options 2 and 3 should therefore be accompanied with measures to ensure smooth transfer of operations to the municipality at the end of the agreement. Also, these options should provide sufficient funding to interested qualified firms to bid on construction and/or operation contracts.

B4. Land Acquisition

The municipality needs to expropriate land to expand the existing treatment plant (40 additional dunums) and build the stabilization reservoir (60 dunums). The cooperative needs to buy land to build the distribution reservoir (if one is to be built—see Section VIII, C5.) and acquire rights-of-way for the distribution pipelines. Any delays in expropriating the required land may cause significant impacts on the environment or at a minimum create an opportunity cost due to wasting an invaluable water resource. Expropriating all necessary lands should be a CP attached to this project.

C. Reuse of Treated Wastewater

If properly operated, the proposed WWTP will deliver effluents of sufficiently good quality to irrigate at least 2,000 dunums of agricultural land in 1994 irrigated with rain-fed crops (olives, wheat, and barley). The Ramallah Agricultural Marketing Cooperative will be responsible for providing treated wastewater to farmers by buying treated wastewater from the Municipality of Ramallah and selling it to them.

C1. Limiting Irrigation to the Yatta Geological Formation

Irrigation should be restricted to agricultural lands falling within the Yatta formation. USAID should require ANERA to demonstrate that there are sufficient (at least 1,000 dunums) agricultural lands in the four neighboring villages to Ramallah that fall within the Yatta formation. A certificate to that effect from the appropriate Hydrological Services would be highly desirable.

C2. Encouraging Reuse for Irrigation

Targeting reuse for irrigation is sensible because neighboring villages have prime agricultural land that lacks irrigation water. However, farmers may hesitate to buy the water for irrigation purposes. With the assistance of ANERA, the Cooperative should develop an aggressive campaign aimed at encouraging farmers to shift to irrigated agricultural practices. This campaign should include:

- Demonstration projects showing the benefits of irrigation with treated wastewater.
- Organized tours and visits to agricultural areas that successfully use treated wastewater for irrigation, in particular in Israel.
- Free or subsidized water the first year, as an added incentive for farmers (be sure to explain that this is only a temporary one-year measure).

C3. Decreasing Use of Pesticides

The shift to irrigated agricultural practices is likely to be accompanied by an increase in pesticide use. Excessive use of pesticides will have significant impacts on the environment (e.g., groundwater and spring contamination, and impacts on wildlife). USAID funds should not be used to procure pesticides. If such use is contemplated, then USAID's environmental regulation 22 CFR 216.3(b) applies and only USEPA-registered pesticides can be employed. In addition, ANERA and the cooperative should train participating farmers in safe and environmentally-sound pesticide use, including IPM practices.

C4. Alternative Uses of the Treated Wastewater

Treated wastewater is a valuable resource that should not be wasted under any circumstances. In addition to irrigation, the municipality should explore all possible uses for the treated wastewater, including reuse by industry, for grazing, and in a reforestation program.

C5. Distribution Reservoir and Pumping Station

The proposed system calls for building a 1,000 m^3 distribution reservoir and a pumping station between the stabilization reservoir and the distribution reservoir. The distribution reservoir will serve to irrigate by gravity agricultural lands that are at higher elevations than the stabilization reservoir. Building the distribution reservoir and pumping

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station should be deferred to a later stage, however, because there are good agricultural lands downstream from the stabilization reservoir. This will minimize environmental impacts and reduce investment costs initially.

D. Interagency Technical Committee

The PRIDE team recommends that a technical committee be formed, grouping representatives from USAID (Jerusalem, Tel Aviv, and Washington), ANERA, the Project Consulting Engineer, the Municipality of Ramallah, and the Ramallah Agricultural Marketing Cooperative, to oversee the implementation of the recommendations contained in this EA.

SECTION VIII
CONCLUSIONS AND RECOMMENDATIONS

This assessment indicates that the proposed wastewater management system for Ramallah will not pose significant adverse environmental impacts, provided appropriate mitigation, monitoring, and management measures are implemented, as discussed in this report. Implementation of the project with the recommended measures will protect the environment, improve the well-being of the population, and promote sustainable development in the Ramallah area.

The assessment identified environmental impacts and recommended mitigation, monitoring, and management measures for the three components of the proposed wastewater management system:

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- Treatment of wastewater
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This section reviews key findings and recommendations for each of these three project components plus a general recommendation for monitoring implementation.

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A1. Plant Design Capacity and Potential Need for Expansion

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OKay Tae, KK modify wording

NO. KK

B. Treatment of Wastewater

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B1. Odors from the Anaerobic Ponds

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No KK

B2. Monitoring of Effluents Inside the Plant

The plant operator should follow strict monitoring measures to ensure that the treatment plant (including the stabilization reservoir) is operating properly and that the treated

wastewater will meet targeted guidelines for wastewater reuse. At a minimum, the operator should monitor effluents at the entrance of the plant, from the last maturation pond, and from the stabilization reservoir. The operator should take appropriate measures depending on monitoring results, including directing the wastewater to the emergency by-pass pond or emergency discharge pipeline, and chlorinating effluents. Section VI outlines these monitoring measures.

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B4. Land Acquisition

The municipality needs to expropriate land to expand the existing treatment plant (40 additional dunums) and build the stabilization reservoir (60 dunums). The cooperative needs to buy land to build the distribution reservoir (if one is to be built—see Section VIII, C5.) and acquire rights-of-way for the distribution pipelines. Any delays in expropriating the required land may cause significant impacts on the environment or at a minimum create an opportunity cost due to wasting an invaluable water resource. Expropriating all necessary lands should be a CP attached to this project.

C. Reuse of Treated Wastewater

If properly operated, the proposed WWTP will deliver effluents of sufficiently good quality to irrigate at least 2,000 dunums of agricultural land in 1994 irrigated with rain-fed crops (olives, wheat, and barley). The Ramallah Agricultural Marketing Cooperative will be responsible for providing treated wastewater to farmers by buying treated wastewater from the Municipality of Ramallah and selling it to them.

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C1. Limiting Irrigation to the Yatta Geological Formation

Irrigation should be restricted to agricultural lands falling within the Yatta formation. USAID should require ANERA to demonstrate that there are sufficient (at least 1,000 dunums) agricultural lands in the four neighboring villages to Ramallah that fall within the Yatta formation. A certificate to that effect from the appropriate Hydrological Services would be highly desirable.

No. △

C2. Encouraging Reuse for Irrigation

Targeting reuse for irrigation is sensible because neighboring villages have prime agricultural land that lacks irrigation water. However, farmers may hesitate to buy the water for irrigation purposes. With the assistance of ANERA, the Cooperative should develop an aggressive campaign aimed at encouraging farmers to shift to irrigated agricultural practices. This campaign should include:

- Demonstration projects showing the benefits of irrigation with treated wastewater.
- Organized tours and visits to agricultural areas that successfully use treated wastewater for irrigation, in particular in Israel.
- Free or subsidized water the first year, as an added incentive for farmers (be sure to explain that this is only a temporary one-year measure).

up to farmers to make work. Not an EIV issue.

C3. Decreasing Use of Pesticides

The shift to irrigated agricultural practices is likely to be accompanied by an increase in pesticide use. Excessive use of pesticides will have significant impacts on the environment (e.g., groundwater and spring contamination, and impacts on wildlife). USAID funds should not be used to procure pesticides. If such use is contemplated, then USAID's environmental regulation 22 CFR 216.3(b) applies and only USEPA-registered pesticides can be employed. In addition, ANERA and the cooperative should train participating farmers in safe and environmentally-sound pesticide use, including IPM practices.

OK

C4. Alternative Uses of the Treated Wastewater

Treated wastewater is a valuable resource that should not be wasted under any circumstances. In addition to irrigation, the municipality should explore all possible uses for the treated wastewater, including reuse by industry, for grazing, and in a reforestation program.

OK

C5. Distribution Reservoir and Pumping Station

The proposed system calls for building a 1,000 m^3 distribution reservoir and a pumping station between the stabilization reservoir and the distribution reservoir. The distribution reservoir will serve to irrigate by gravity agricultural lands that are at higher elevations than the stabilization reservoir. Building the distribution reservoir and pumping

△ OK

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station should be deferred to a later stage, however, because there are good agricultural lands downstream from the stabilization reservoir. This will minimize environmental impacts and reduce investment costs initially.

D. Interagency Technical Committee

The PRIDE team recommends that a technical committee be formed, grouping representatives from USAID (Jerusalem, Tel Aviv, and Washington), ANERA, the Project Consulting Engineer, the Municipality of Ramallah, and the Ramallah Agricultural Marketing Cooperative, to oversee the implementation of the recommendations contained in this EA.

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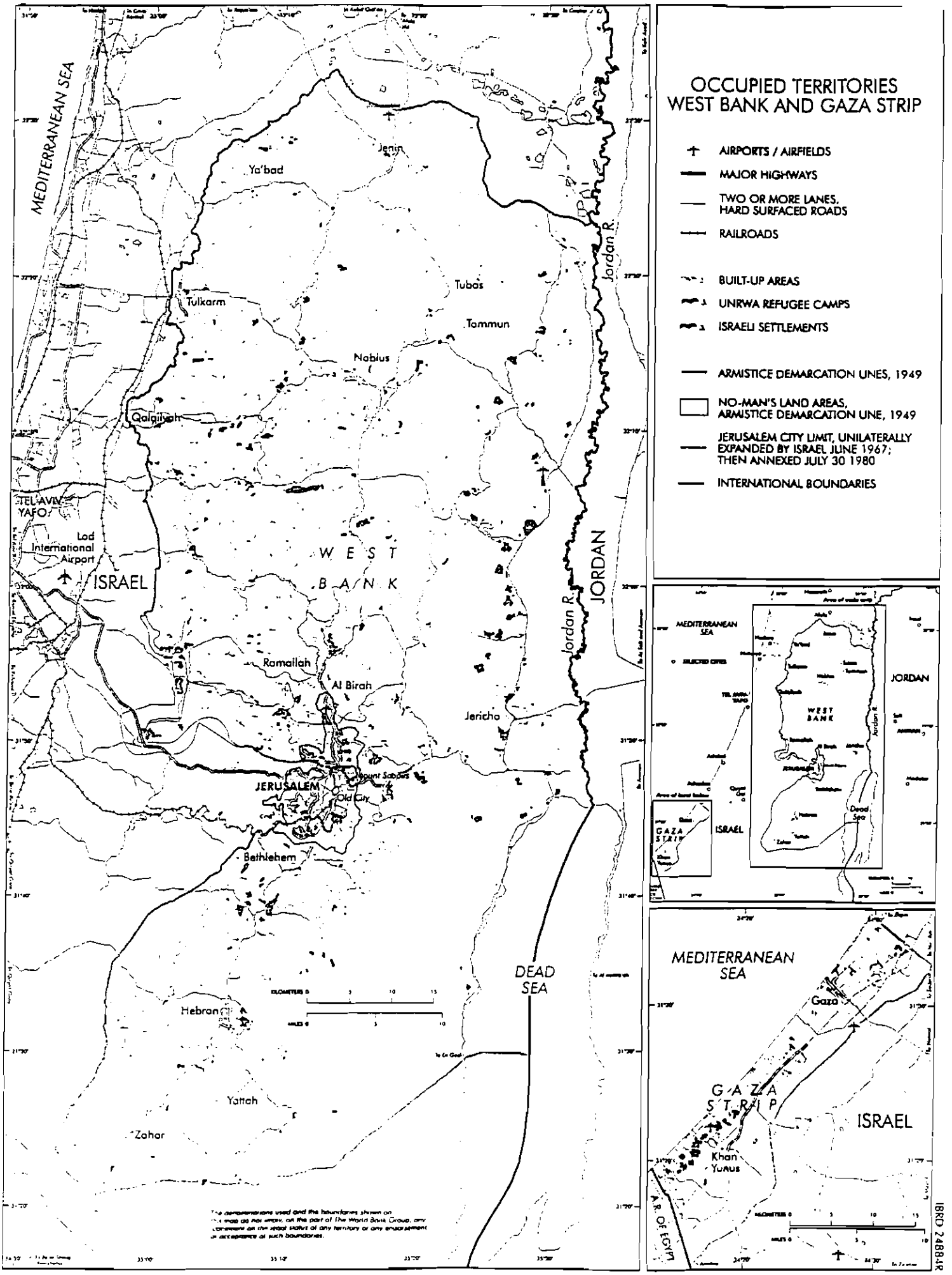
ANNEX A

BASE MAPS

ANNEX A
BASE MAPS

This annex contains the following four maps:

- Map A-1: Location of Ramallah on the West Bank
- Map A-2: Municipality of Ramallah
- Map A-3: Layout of Existing Wastewater Treatment Plant in Ramallah
- Map A-4: Design for Proposed Wastewater Treatment Plant in Ramallah



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Map A-1

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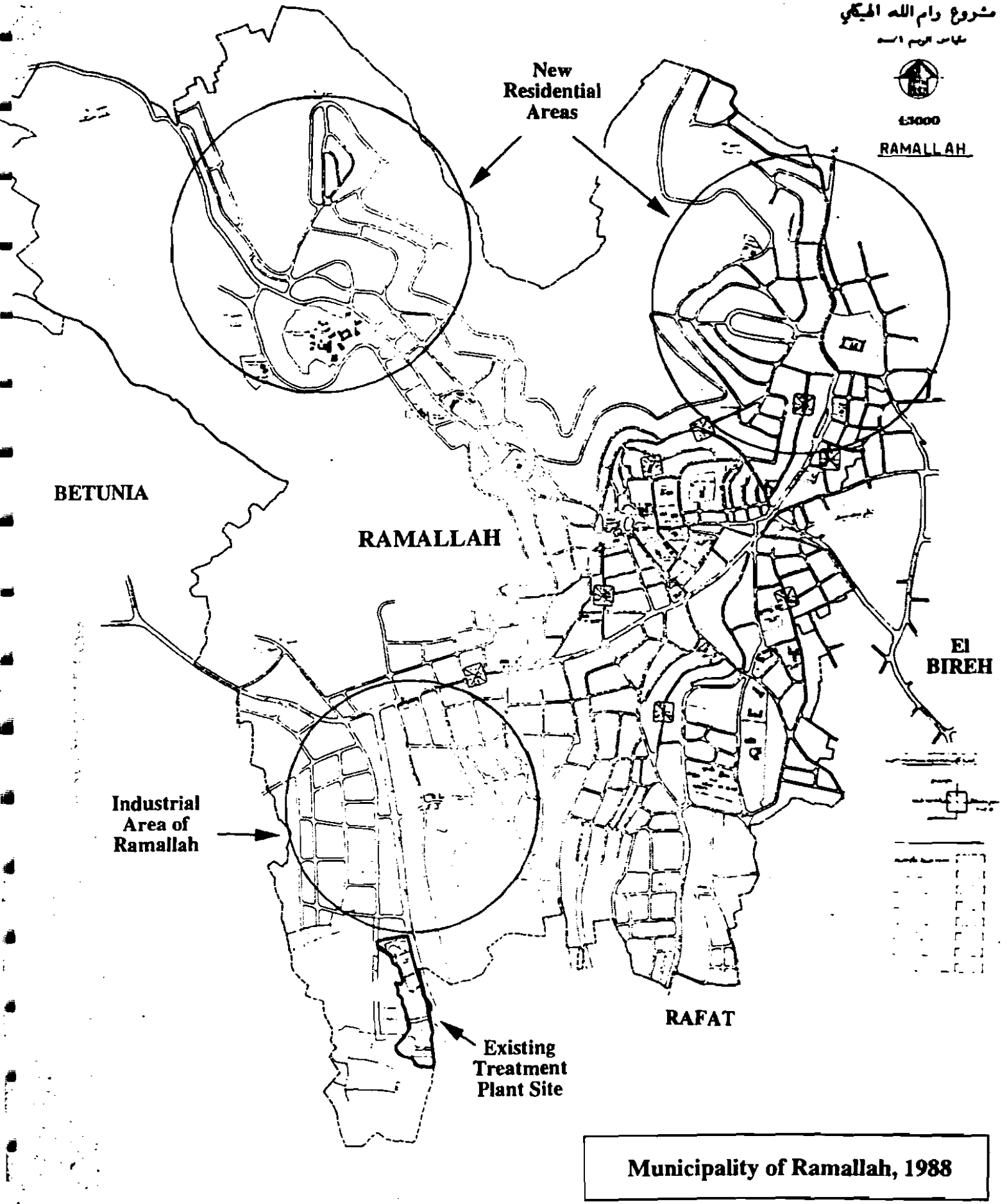

Map A-2

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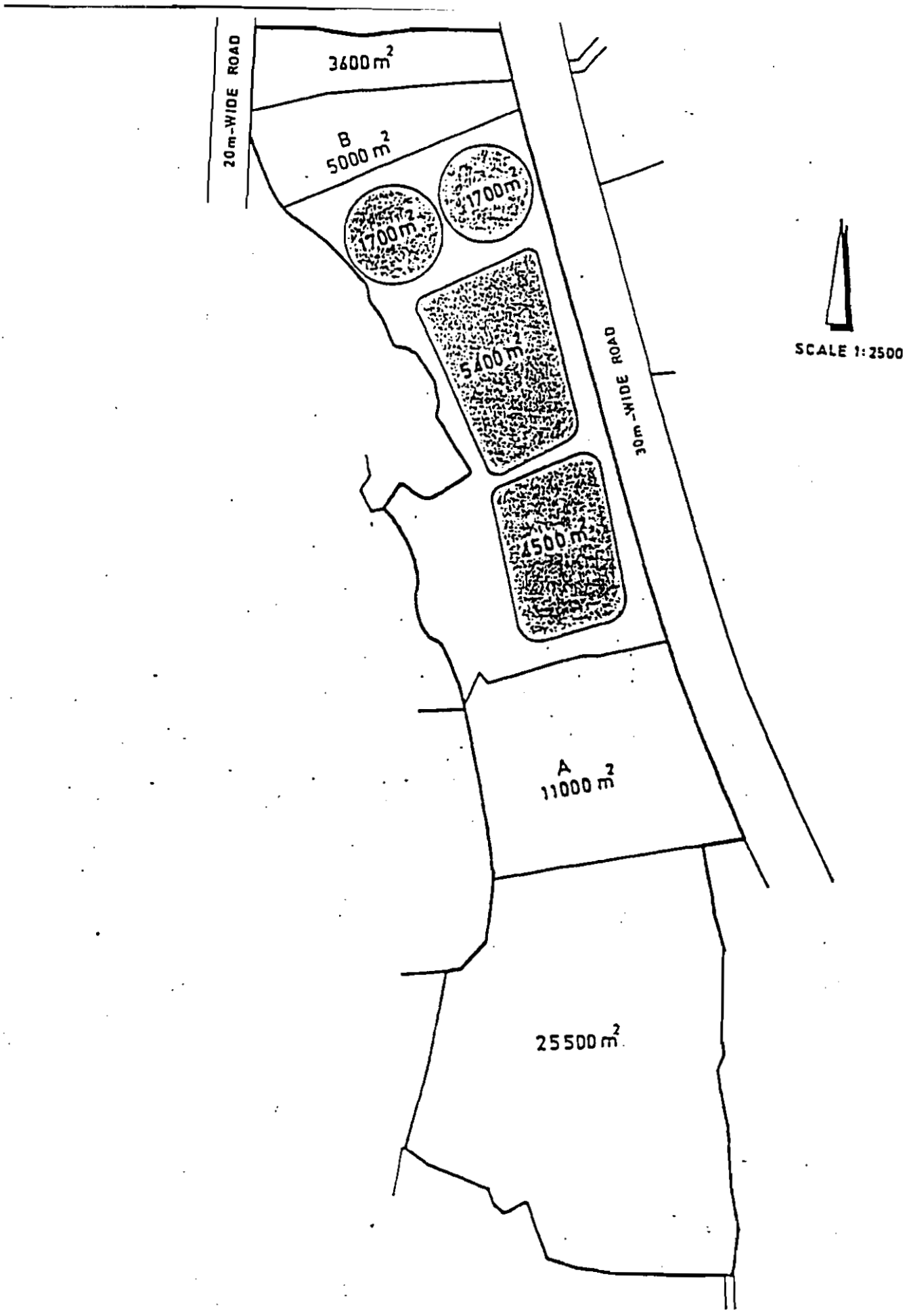

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Map A-3

Existing Waste Water Treatment Plant in Ramallah

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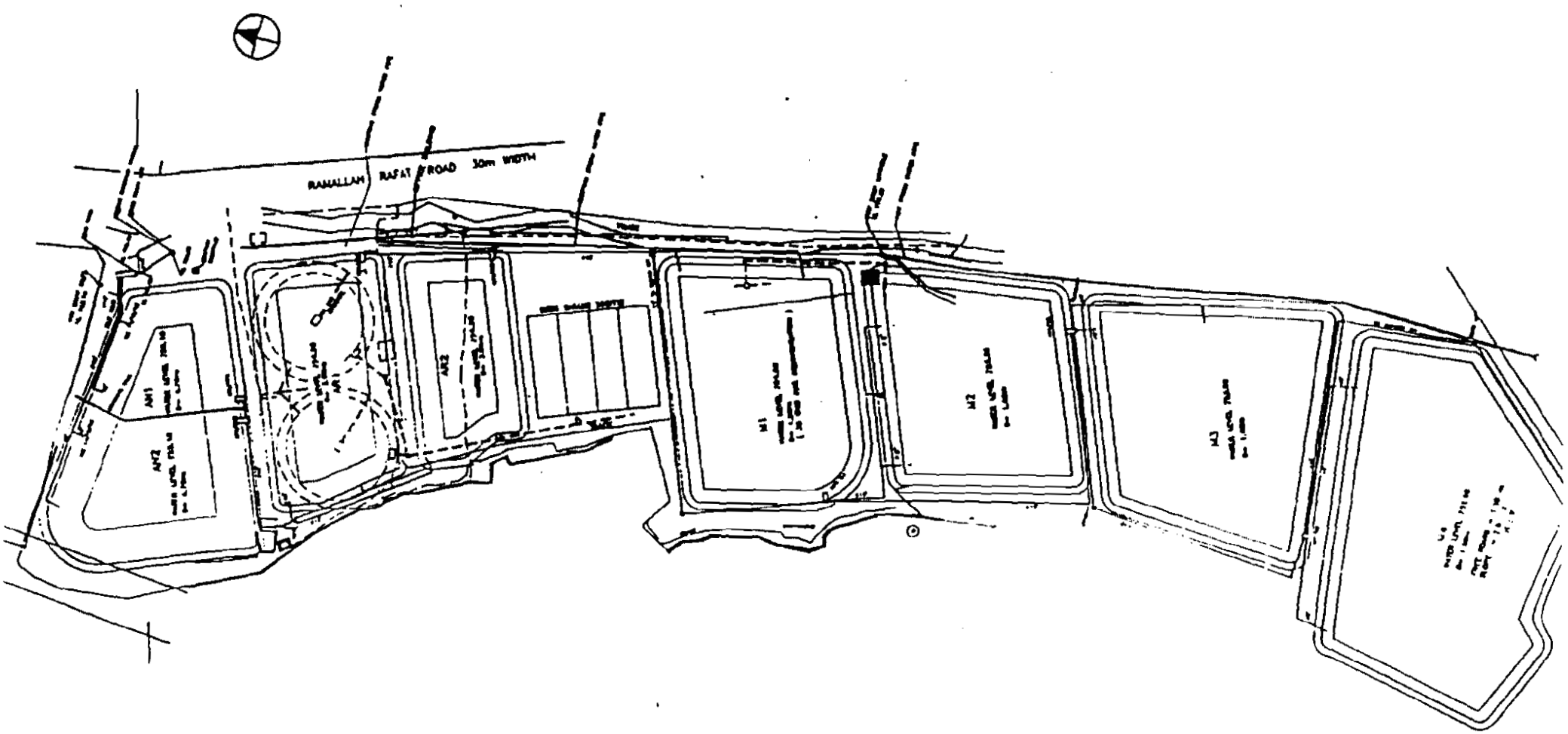

Map A-4

Design for Proposed Waste Water Treatment Plant in Ramallah

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ANNEX B

MIDCOURSE EVALUATION WORKSHOP

ANNEX B
MIDCOURSE EVALUATION WORKSHOP

A one-half-day workshop was held at the Municipality of Ramallah on Thursday, September 8, 1994, to discuss preliminary findings of the environmental assessment. The workshop objectives were to:

- Follow-on to workshop on USAID environmental procedures held earlier.
- Work together to ensure the success of the Ramallah wastewater project.
- Identify environmental safeguards for the Ramallah wastewater project.
- Discuss major environmental impacts.
- Examine possible mitigation, monitoring, and management measures.
- Get feedback from ANERA and its partners on impacts and measures.
- Identify new sources of information.

Workshop participants included ANERA, USAID, and PRIDE team staff, as well as representatives from the Municipality of Ramallah and the Ramallah Agricultural Marketing Cooperative (see end of this Annex B for a list of participants).

The workshop was interactive and participatory, was conducted in English and Arabic, and relied on brainstorming techniques to capture a variety of ideas from all participants. Following is an unedited reproduction of flipcharts produced by the participants during the workshop brainstorming sessions (all except a few flipcharts that were prepared by the facilitator). The last flipchart is an evaluation of the workshop by all participants.

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ENVIRONMENTAL ASSESSMENT OF RAMALLAH WASTEWATER PROJECT

MID-COURSE EVALUATION WORKSHOP

ORGANIZED BY

ANERA AND PRIDE

AT THE

MUNICIPALITY OF RAMALLAH

September 8, 1994

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Brainstorming

تنشيط الأذهان

PURPOSE:

- Capture a variety of ideas

CRITERIA:

- Define subject precisely
- Limit time
- Note ideas without criticizing them
- Ask questions only to clarify
- Conclude with synthesis

الهدف:

- تحصيل مجموعة من الآراء المختلفة

المعايير:

- عرّف الموضوع
- حدد الزمن
- سجّل الأفكار بدون إنتقادها
- وجّه أسئلة بهدف التوضيح فقط
- لخّص بشكل مختصر

Brainstorming Example

مثال على عملية تنشيط الأذهان

"What objectives will the Ramallah project help achieve?"

"ما هي الأهداف المتوخاة من مشروع تنقية المياه العادمة لمدينة رام الله؟"

الأهداف من المشروع

- منع تلوث المياه الجوفية.
- إعادة استعمال المياه في الزراعة للتغلب على مشكلة النقص في المياه.
- توفير المياه الباقية للحاجات الأخرى.
- تخفيف الضرر على الإنسان.
- منع تلوث التربة بالمواد الكيماوية.
- تحسين الوضع الصحي والتخفيف من الأعباء المادية على البلدية.
- زيادة الإنتاج الزراعي وتحقيق الأمن الغذائي.
- معالجة مشكلة البعوض.
- في رافات صودرت الأرض من قبل الجيش وليس هناك مصلحة للقرية في إنشاء الخزان فيها.
- زيادة من فرص العمل وتخفيف البطالة.
- ايجاد بدائل للمياه المسروقة سياسيا.
- توسيع شبكة المجاري في رام الله.
- تقوية المؤسسات البلدية والتعاونية والوطنية وتشجيع التعاون بينها.
- الأهداف يجب أن تكون مقاسة.
- توفير مساحات إضافية للسكن بدل من الحفر الصحية.
- تحسين مستوى حياة الإنسان.

PROJECT OBJECTIVES

- Prevent ground water pollution.
- Reusing water to fight water scarcity.
- Reuse of wastewater for agriculture.
- Reduce human health impacts.
- Prevent soil contamination by chemicals.
- Improve health and reduce cost to the Municipality.
- Increase agricultural product and achieve food security.
- Help the farmers to stay in the land.
- Control mosquitoes and insects.
- In Rafat agricultural land confiscated by Israeli Army and no room for reservoirs and no benefit is expected for Rafat.
- Create jobs and reduce unemployment.
- Find alternatives to stolen water.
- Expand the sewerage coverage.
- Strengthen institutional capacity among the Municipality and other institutions.
- Objectives should be measurable.
- Increase space available for housing (less pits).
- Better human life.

"What are the environmental impacts of the project?"

"ما هي الآثار البيئية للمشروع؟"

ENVIRONMENTAL IMPACTS

- 80% of the argicultural/land owned by Betunia. Most involve the Municipality of Betunia in the project.
- Farmers are leaving their land: need to motivate them to returnto the land.
- Any odor problems for Betunia land that is expensive urban land??
  - Land is agricultural land located outside the Town Scheme.
- Soil contamination with chemicals.
- Industrial wastewater will be a disaster unless the Municipality sets and enforces rules and standards.
- Management and administration challenges (operation of plant, tariff setting and collection, relationship between Municipality and Cooperative, etc.)
- Enforcement of irrigation rules by cooperative and concerned departments.
- Lack of awareness among farmers to reuse effluent.
- Increased environmental impacts for Betunia if the project fails.
  (1 km pipe and 4 km open in the valley)
- Environmental impacts in Rafat due to flooding of manholes (spring pollution, odor due to lack of proper maintenance by Municipality).
- Chemical contamination for wildlife, (birds, rabbits, antelopes)
- Confusion over government jurisdiction due to changing political situation. (enforcement, planning, etc.,)
- Impacts to livestock (25 herds)
- Impacts to existing springs: (Bir Eddir, and Um Eisheh springs in Rafat, Ein Surris, Ein wadi Al-Namel, Ein Al-Jenan in Betunia)
  (No existing borehole wells)

الاثار البيئية

- ٨٠٪ من المياه ستستعمل في بيتونيا (٨٠٪ من الأراضي). لذلك يجب إشراك بلدية بيتونيا في المشروع.
- الحاجة الى إقناع المزارعين بالعودة الى الزراعة لإستغلال المياه.
- مشكلة الرائحة في بيتونيا؟؟
  - معظم الأراضي في بيتونيا سكنية.

  (جواب: معظم الأراضي التي يتحدثث عنها هي أراضي خارج حدود السكن)
- تلوث التربة نتيجة تراكم المواد الكيماوية.
- المياه العادمة الصناعية ستسبّب كارثة للمشروع اذا لم تقم البلدية بوضع قوانين بيئية وتطبيقها.
- تحديات إدارية تواجه المشروع:
  - تشغيل المحطة والمشروع
  - فرض الرسوم وجمعها
  - العلاقة بين البلدية والجمعية التعاونية
- تطبيق المعايير الخاصة بالزراعة بالتعاون بين الجمعية التعاونية والدوائر المعنية.

- إزدياد الآثار السلبية الحالية في بيتونيا حالة فشل المشروع.
  - ١ كم مغطى من المجاري و ٤ مكشوف في العراء
- آثار بيئية سلبية في رافات بسبب استمرار فيضان المجاري (تلوث ينابيع، روائح وقلة العناية بشبكة المجاري العامة)
- تعرض الحيوانات والنباتات للتلوث الكيماوي مثل الغزلان، الأرانب والطيور البرية.
- غموض فيما يتعلق بالسلطة القانونية نتيجة للتغيرات السياسية الحاصلةوإمكانية فرض القوانين البيئية والتخطيط البيئي.
- الآثار على الماشية (حوالي ٢٥ قطيع).
- إحتمال تلوث حياة الينابيع
  - بير الدير (رافات)
  - عين إم عيشة (رافات)
  - عين سيريس (بيتونيا)
  - عين وادي النمل (بيتونيا)
  - الجنان (بيتونيا)

(لا توجد آبار مياه جوفية)

PROPOSED MITIGATION, MONITORING, AND MANAGEMENT MEASURES

- Use proper agricultural practices:
  - Cultivation
  - Ploughing
  - Crop selection
  - Land leveling
  - Reduce pesticide use
- Establish agricultural research center for the project.
- Establish laboratory to monitor the project from environmental perspective.
  - Distinguish between monitoring for plant operations and monitoring for environmental quality.
- Training of plant operators on site.
- Training of extension agents.
- Establish technical and administrative unit at the cooperative.
- Monitor and project health of employees.
- Census of farmers and lands that will benefit from the project and preparation of integrated program by the cooperative.
- Maintenance of the sewerage system by the Municipality.
- Motivate farmers to accept the project by providing:
  - seeds, credit and loans, agricultural inputs, and marketing facilities.
- Increase women participation in particular and community participations in general.
- Increase environmental awareness through cooperation among relevant departments (health and environment, education, agriculture, justice, media and local institutions)
- Encourage industries to use biodegradable materials.
- Important to create a mechanism for implementation.
- Clarify role of each partner in contractual form.
- Improve awareness among consumers to accept the products irrigated with effluent.

الإجراءات الممكنة

- إستعمال أساليب زراعية مناسبة:
  - ري
  - حراثة
  - إختيار المحصول
  - معاملة الأرض (تسوية الأرض)
  - تخفيف إستعمال المبيدات
- إنشاء مركز أبحاث زراعي متخصص تابع للمشروع.
- إنشاء مختبر لمتابعة المشروع من الناحية البيئية.
  - التمييز بين التحاليل لمتابعة كفاءة عمل المحطة والتحاليل الخاصة بمتابعة المؤشرات البيئية.
- تدريب الفنيين في الإدارة وتشغيل المشروع في الموقع.

- تدريب مرشدين زراعيين لمساعدة المزارعين.
- إيجاد جهاز فني وإداري في جمعية التسويق الزراعي لإدارة المشروع.
- وقاية ومتابعة صحة العاملين.
- على الجمعية القيام فورا بحصر المزارعين الذين يمكن أن يستفيدوا من المشروع واعداد برنامج متكامل للجمعية.
- على بلدية رام الله القيام بالصيانة الدورية ليس فقط للمحطة ولكن أيضا للشبكة الواصلة للمحطة.
- ايجاد حوافز للمزارع لقبول المشروع والإستمرارية فيه.
  - توفير بذور، قروض، تسويق. (توفير مستلزمات الإنتاج والتسويق).
- زيادة مشاركة النساء بشكل خاص والمجتمع بشكل عام.
- التوعية البيئية عن طريق التعاون بين المؤسسات ذات العلاقة كالصحة والبيئة.
  والتربية والاعلام والعدل والزراعة والمؤسسات المحلية
- حث الصناعيين على إنتاج مواد قابلة للتحليل ومراقبة التطبيق.
- وجود آلية لتطبيق الإجراءات اللازمة.
- توضيح دور كل طرف في المشروع ضمن اتفاقيات رسمية.
- توعية المستهلكين على استعمال المنتجات الزراعية المروية.

MITIGATION

أساليب فنية

MONITORING

مراقبة المؤشرات

MANAGEMENT

الأساليب الإدارية والقانونية

WORKSHOP EVALUATION

- Gave a boost to participants to start thinking seriously.
- Positive session, helped identify impacts and find measures.
- Felt at ease with moderators..
- Good moderation and working method.
- Benefit from multidisiplinary participation.
- Participation from everybody contributed to the success of the workshop.
- Need to disseminate flipcharts to all participants.
- Prepare agenda and program in Arabic next time and distribute before meeting.
- Follow up on recomendations.
- Identified the environmental importance of project as well as administrative difficulties and weakness in implementation mechanism.
- Bridged gap in project understanding among participants.
- Need to ensure human and financial resources for project sustainability.
- Seriousness of participation.

تقييم ورشة العمل

- الجلسة ايجابية، عرفت على المشاكل وأعطت الحلول والأجوبة.
- طريقة إدارة الجلسة ممتازة جدا.
- الشعور بالإرتياح من الأشخاص الذين أثاروا الجلسة.
- وجود أشخاص بتخصصات مختلفة أعطت فكرة جيدة عن المشروع وأفادت النقاش.
- إعطاء المشاركين دفعة للتفكير والعمل بجدية لتنفيذ المشروع.
- مشاركة الجميع أدت الى نجاح الجلسة.
- المطالبة بتوزيع النتائج على المشاركين.
- تحضير برنامج باللغة العربية وتوزيعه مسبقا في المرات القادمة.
- تطبيق المقترحات.
- برزت أهمية المشروع من الناحية البيئية والحضارية، كما برز بوضوح الصعوبات الإدارية وضعف آلية التطبيق.
- جسر الفجوة بين المشاركين حول مفهوم المشروع.
- يجب تأمين الإمكانيات المادية والبشرية لضمان إستمرارية المشروع وعمله.
- جدية المشاركين في النقاش وورشة العمل.

RAMALLAH MUNICIPALITY WASTEWATER - WORKSHOP

September 8, 1994 at Ramallah Municipality

NAME	ORGANIZATION
Jack Farmer	PRIDE Team Leader
Nader El-Khatib	PRIDE
Sharon Fee	AID
Kamal Khreisheh	ANERA
Gabi Abboud	USAID
Adnan Obeidat	ANERA
Ramez El-Titi	PRIDE
Mohammad Nimer Ismael	Ramallah Agricultural Cooperative
Khalil Mousa	Mayor of Ramallah Municipality
Lance Matteson	ANERA
Dr. Wahib Tarazi	ANERA
Ibrahim Matar	ANERA
Carl F. Maxwell	AID
Ata Naser	
Adnan Sa'ed Shahin	
Nader Jalal	Ramallah Agricultural Cooperative
Fahim Abdul Majeed	Ramallah Agricultural Cooeperative
Ya'coub Al-Taher	Ramallah Agricultural Cooperative
Nouh Anbar	Farmer/Betunia
Salam Majaj	Ramallah Municipality
Joseph Karam (Moderator)	PRIDE

ANNEX C

SYNOPSIS OF SITE VISITS AND INDUSTRIAL SURVEY QUESTIONNAIRE

ANNEX C
SYNOPSIS OF SITE VISITS AND INDUSTRIAL SURVEY QUESTIONNAIRE

Annex C presents a synopsis of individual site visits conducted in the Ramallah Industrial Area. Figure C-1 provides the survey questionnaire completed during each site visit. Completed survey questionnaires are available on file.

A. The Ramallah Plastic Pipe Manufacturing Company

The Ramallah Plastic Pipe Manufacturing Company produces PVC pipes of various diameters (from 1 1/4" to 8") and polypropylene pipe fittings such as elbows and tees. The plant produces about 180 metric tons of plastic pipes and fittings per month. In addition to PVC powder and polypropylene, which are imported from Israel and Holland, the production process uses such additives as calcium carbonate (Israel and France), stabilizers (Holland), and colorants. Average water consumption is about 15 m^3 per month. In addition to basic sanitary purposes, the plant uses water for washing and cleaning and in the cooling process. Water used in the cooling process is recycled in a closed-loop system. The plant employs 30 people on three eight-hour shifts.

At the plant, PVC powder is mixed with calcium carbonate, stabilizer, and colorant. This mix is heated and shaped into pipes of different diameters using three extruders. Pipes are cut according to the required length, and each end of pipe is shaped for fitting purposes. Defective pipes are ground and processed again, unless they burn due to high temperatures, in which case they are disposed of as solid waste. A fraction of the raw materials is wasted on the floor as it is transported from shipment trucks to the storage area and from the storage area to the mixing tank. These wasted raw materials are collected and stored in the original bags for accounting and tax purposes. Eventually, they are disposed of in the solid waste dump. The plant generates about 2 metric tons of solid waste per month, consisting primarily of pipe cuttings, nonrecycled defective pipes, and paper and plastic bags.

The factory generates less than 15 m^3 of wastewater per month. Because of the process used by this plant, the wastewater will have a negligible effect on the WWTP, both quantitatively and qualitatively.

B. International Foam Manufacturing Company

The International Foam Manufacturing Company produces about 60 metric tons of foam per month for different uses: mattresses, seats, pillows, etc. Raw materials are Toluene DiIsocyanate (TDI), amine, silicon, methylene chloride, and catalysts. Monthly water consumption is about 50 m^3, of which an estimated 70 percent is discharged to the municipal sewer network. The plant employs 15 people and operates one eight-hour shift per day.

The mixing of raw materials is computerized. The foam machine is operated for thirty minutes per day and produces large blocks of foam of different densities. Foam is cured for 24 hours before cutting. Several different machines are used for cutting the foam into different sizes and shapes, depending on market demand. Foam cuttings are reformed to produce foam of different qualities.

Daily washing of the foam machine may introduce traces of the raw materials into the municipal sewage network. These trace amounts should not affect the operations of the WWTP. However, if relatively large shock loads of TDI were discharged into the municipal sewage network over a short time frame, WWTP operations may be affected, and wastewater reuse may become hazardous. TDI is a volatile, combustible, and hazardous material; hence, precaution must be taken to prevent worker exposure and minimize fire hazards during storage and use.

C. Silvana Company

The Silvana Company produces chocolates, wafers, chocolate wafers, chewing gum, and toffee on its five production lines. Overall quantity produced is about 23 metric tons per day. Raw materials are flour, sugar, milk powder, cocoa powder, and artificial colorants and flavors. The average water consumption is about 800 m^3 per month. Because most of the water ends up in the product, only an estimated 5 percent of the water used is discharged to the sewers (i.e., 40 m^3 of wastewater per month). Silvana employs about 200 people, a decrease of about 250 employees from a few years ago. Silvana suffers from both a sharp decrease in income and employment (people have less money to spend) and stiff competition from foreign chocolate producers, especially from Egypt and Turkey.

High fats, oil, and grease (FOG) contents are found in the wastewater discharged by the plant. Grease traps were installed recently after the sewer lines were clogged. Nevertheless, the plant can be expected to continue to discharge wastewater with a high FOG content. FOG is harmful to the wastewater treatment process because it coats microorganisms and prevents the transfer of oxygen required for growth and respiration. FOG also poses an aesthetic problem (it creates unsightly floating matter and film) and is a nuisance in plant operation. Therefore, WWTP should include appropriately designed and operated FOG skimming equipment and facilities.

D. Modern Beverage Company Ltd. (Club)

The Modern Beverage Company Ltd. produces carbonated soft drinks (cola, orange, and lemon), nectars (mango, peach, orange, grapefruit, and grape), and light drinks (orange, grapefruit, and grape). Management did not provide information on production levels. Average water consumption is about 100 m^3 per day, with peak levels of 200 m^3 per day in a three-month period (June, July, and August).

The plant employs 150 people on average, working in three eight-hour shifts. Bottling and packing are fully automated. Water is purified by adding lime and liquid

chlorine. Pure water is used not only as a product ingredient, but also to wash machines and equipment. Water quality is monitored by an on-site laboratory.

No wastewater analyses were performed. According to the plant's chemical engineer, however, the wastewater is likely to have a pH of 8 to 9 due to the addition of lime and a sodium hydrochloride content of 4 to 8 mg/l due to chlorination. Because water treatment uses liquid chlorine, the plant is not likely to generate wastewater loads with high levels of chlorine (this situation would occur when gas chlorine is used because it is more difficult to control, leading to the possibility of high-chlorine content water that would need to be discarded). Therefore, the plant, as designed, should not pose a threat to the WWTP. However, procedures must be established to alert the municipality should the plant be forced to discharge wastewater with high levels of chlorine (e.g., greater than 10 mg/l).

E. Rabah Plastic Company

The Rabah Plastic Company produces 550 metric tons per year of HDPE and LDPE plastic bags and plastic rolls for agricultural uses. Raw materials are primarily HDPE and LDPE granules (97 percent) plus inks and dyes (3 percent). Fifteen persons work at the plant. The plant uses rainwater (collected in a cistern) for cooling and water supplied by the municipality for sanitation.

HDPE or LDPE granules are mixed with inks (dyes) and then extruded into bags. A special printing machine is used to stamp these bags based on demand. Ten percent of the production output (55 metric tons per year) is lost, primarily in the printing process. Defective bags are sold to a local company that produces plastic-coated electric conduits.

Cooling water is recycled in a closed-loop system whereas sanitary wastewater is currently discharged into the nearby wadi due to the absence of sewer lines in the vicinity of the plant. Even when the plant is connected to the sewer network in the future, only sanitary wastewater will be discharged into the sewer network.

F. Rabah Kerameka Company

The Rabah Kerameka Company produces glazed ceramic tiles. The ceramic tiles (unglazed) are locally manufactured whereas the lead-containing glaze is imported from Italy. Plant management did not disclose information on quantities produced. The plant uses 50 m^3 of water per month, primarily for washing finished tiles. It employs eight persons working two shifts.

The glaze is ground, heated until it becomes liquid, then poured over the ceramic tiles. Glazed tiles are then cured (dried) in a gas-fired kiln.

The wastewater resulting from the washing process has a cloudy appearance due to its high solid content (primarily limestone resulting from the manufacturing process). This wastewater (about 50 m^3 per month) is collected in a sump through an open channel. The supernatant is then discharged to the public sewer; the sludge is removed periodically and

dumped in the municipal solid waste landfill. Although solids may not upset the operation of the WWTP, solids—in particular lead from the glaze—in the wastewater stream eventually will be present in the sludge produced by the WWTP. Hence, lead concentration in the sludge needs to be monitored if reuse as a soil amendment agent is anticipated.

G. The Arab Manufacturing Company

The Arab Manufacturing Company produces different types of detergents, washing powders, and disinfectants. Total production output ranges from 200 to 280 metric tons per month. Current water consumption rates range from 15 to 40 m^3 per month. The plant employs 100 persons and operates on a one-shift-per-day basis.

The plant has just completed installing a closed-loop in-plant wastewater recycling system. Three separate piping networks are installed for: (1) recycling of industrial wastewater; (2) discharging sanitary sewage to the municipal sewer network; and (3) collecting rainwater for use either in the industrial process or for sanitation purposes. Water consumption will decrease to 5 m^3 per month once the recycling system is fully operational.

Without the recycling system, the plant could have presented a real danger to the WWTP due to the phosphorus content of the wastewater, which would affect the bacterial activity in the treatment process. In-plant recycling of the industrial wastewater should significantly reduce the phosphorus content of the wastewater discharged to the municipal sewer network. A follow-up audit of the plant is required to assess the effectiveness of the recycling system installed.

H. Nassim Textile Dyeing Company Ltd.

The Nassim Textile Dyeing Company Ltd. dyes textiles for industrial customers who supply the plain color (beige) textile. Plant output is three metric tons of dyed textile per day. Raw materials for the dyeing process are dye pigments, softeners, sodium chloride, soda ash, sodium sulfate, and water.

The dyeing process uses 6,000 to 6,500 m^3 of water per month and produces about the same amount of wastewater per month. Wastewater temperature is high: it ranges from 60°C to 90°C, according to the plant's engineer. The wastewater is likely to contain relatively high levels of dye pigments and other chemicals used in the dyeing process. According to the plant engineer, dyeing 1 kg of textile requires 12 l of water and less than 1 g of dye. Assuming about 1 g of dye per 10 l of water implies a maximum dye concentration of 100 ppm in the wastewater, which is high.

The plant does not recycle the water or the heat contained in the wastewater. Wastewater is currently discharged directly into the sewer network, although attempts are made at cooling the wastewater before discharge by increasing the length of the wastewater pipeline inside the plant. Due to the quantity and quality of wastewater discharged by this plant, close follow-up and monitoring of the plant's wastewater will be required in the future to ensure that the proposed WWTP will function properly and that treated wastewater will

meet acceptable guidelines for irrigation. Also, the plant will be required to meet effluent guidelines for color. Pollution prevention measures need to be put in place.

I. Balsam Pharmaceutical Company

The Balsam Pharmaceutical Company plant formulates pharmaceutical products such as tablets, capsules, and syrups (60,000 units per day). It has ceased producing penicillin and antisporine because it does not meet Good Management Practices (GPM) criteria. This is partly because of ambient air pollution due to close proximity to the Ramallah solid waste dump (about 900 meters) and a large concrete factory (about 400 meters). The plant consumes about 300 m^3 of water per month. It employs about 45 persons working one shift.

The plant formulates products by mixing base medical materials. Plant equipment includes a water purification apparatus, mixers, coating machines, capsule fillers, and packaging equipment. The plant generates an estimated 100 m^3 of wastewater per month, consisting primarily of washwater, backwash from the water treatment plant, and ordinary sanitary wastes. This wastewater is discharged into the public sewer network.

This plant was of concern because discharge of defective batches of antibiotics into the sewer system could shut off the WWTP for weeks—perhaps months. Wastewater discharged by the plant in 1994 does not pose an immediate threat to the WWTP for two main reasons: (1) the plant is not producing penicillin and antisporine; and (2) the plant produces and tests laboratory-sized samples before mass production. Therefore, defective batches are generally small in size and should not hamper proper functioning of the WWTP if discharged into the sewer system. The municipality should monitor the pharmaceutical plant for product or process changes (e.g., resumption of the production of penicillin, antisporine, and other antibiotics).

J. Izmekna Stone Cutting Factory

The Izmekna Stone Cutting Factory produces 50 m^2 of stone building tiles per day. It employs 25 people who cut large blocks of limestone (10 m^3 per day) using different cutting machines to obtain building tiles of different sizes. Cutting operations require large amounts of water, but because the water is recycled on-site, actual water consumption is only between 150 and 200 m^3 per month. Municipal water is used only eight months per year, and rainwater is used during the four rainy months.

Wastewater from the cutting operations is laden with limestone dust and particles. It is collected by concrete canalizations leading to a series of eight interconnected concrete basins (2m x 2m x 2m = 8 m^3). Most of the limestone dust settles in the first three basins and has to be pumped once every three months into an on-site pit nearby, where it dries in the sun. The only wastewater discharged into the sewer system is ordinary sanitary wastewater, at a rate of about 1 m^3 per day.

The plant generates limestone dust at a rate of 8 m^3 per month. Limestone dust has been left to pile up at the plant since it started operations. Although a Swiss process would

allow the use of this limestone dust as raw material for the production of lightweight building stones, no such plants exist in the West Bank and Gaza due to security restrictions imposed by Israel (such plants do exist in Israel). The limestone scraps produced in the cutting process are taken—free of charge—by an aggregate-making factory that converts them into construction gravel.

K. Flash Car Wash

Flash Car Wash provides car washing, oil changing, lubrication, and engine-cleaning services. The facility processes about 20-25 cars per day on average, performing a mix of these services, and employs five persons full time. On a monthly basis, the facility consumes 150 m^3 of water (primarily for car washing), 20 kg of soap detergent, 20ℓ of motor oil, and 10ℓ of diesel fuel for engine cleaning (used in conjunction with hot water at close to 100°C).

All the water used for car washing and engine cleaning drains to the sewer system. Used motor oil is collected in drums and sold for 15 NIS a drum to a bakery as fuel or to contractors who use it to paint wood panels used in concrete constructions. Solid waste is generated at a rate of one dumpster per week, consisting mostly of cartons and metal containers. It is collected by the municipality. (Note that due to its heavy metals content, used motor oil should not be used as either a direct fuel or an augmented fuel source.)

L. The Municipal Industrial Building

The Municipal Industrial Building was built in 1992 to create job opportunities by providing low-cost workshop space to light industries in Ramallah. It houses 12 small workshops forming an "L". Although the workshops have water supply and are connected to the sewer network, the workshop floors have no drainage system. Washwater and other liquid spills run off to the front yard, which also is not drained and is flooded in the rainy season. Workshops include an automotive carburetor cleaner, an auto body shop, and an electric switchboard manufacturer, which are described below.

L1. Nablus Garage

The Nablus Garage specializes in automotive carburetor cleaning and repair. The facility is a one-man operation and processes about 10 carburetors per month. Water consumption is minimal. The garage uses carburetor cleaning solvent (Chimgat K-57 brand, made in Israel) at a rate of one 20ℓ container per month. The solvent waste is disposed of in the sink sewer. Empty metallic solvent containers and rags are disposed of in the municipal dumpster.

L2. Auto Body Shop

The body shop repairs automobile body parts involved in fender benders. The shop handles about eight-10 cars per month and employs three people. The raw materials on a monthly basis are 10 m^3 of water, 20 kg of automobile body filler, and 20 kg of auto paint.

The facility uses body filler as paste, sands it to obtain the right shape and texture, and finally spray paints the car. Water, used in the sanding operation, as well as paint waste drip on the floor and run off to the front yard. Sandpaper, metal containers, and rags are disposed of in the municipal dumpster (about 0.5 m^3 per month).

L3. Engineering Manufacturing Company

The workshop produces electrical switchboards and employs six full-time employees. In the workshop, steel frames are assembled by spot welding electrically. Powdered plastic paint is then applied electrostatically to the assembled steel frames, which are then introduced in a preheated oven to melt the plastic paint powder. The electronic switches and other related components are then assembled to the boards.

The workshop uses 50 kg of plastic paint powder per month and generates no liquid waste. Solid wastes generated are mainly the empty paint cartons disposed of in the municipal dumpster at a rate of two cartons per month.

Figure C-1
Ramallah Industrial Survey Questionnaire

Prepared by: _____

Date: / /

Industry Name: _____

Plant Location: _____

Contact Name: _____

Contact Position: _____

Contact Phone #: _____

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1. What are the products made at your plant? and in what quantities?

Products	Quantities (units, such as tonnes/year)
A.	
B.	
C.	

2. What are the raw materials used by your plant? and in what quantities?

Raw Materials	Quantities (units, such as tonnes/year)
A. Water	
B.	
C.	
D.	

3. How many people are employed by your plant?

_____ persons full-time _____ persons part-time

4. Please describe the process used by your plant.

_____

_____

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Figure C-1
Ramallah Industrial Survey Questionnaire (continued)

Page 2 Date: / /
Industry:_____ Prepared by: _____

5. Is your plant connected to the sewer network?

____ Yes_____ No

6. How much liquid waste does your plant generate? Please specify unit

_____

7. Could you describe the liquid waste generated by your plant (color, smell, density, water-like, etc.)?

_____

_____

8. How do you dispose of liquid waste generated by your plant?

_____

_____

9. How much solid waste does your plant generate? Please specify unit

_____

10. Could you describe the solid waste generated by your plant (composition, dry or wet, bulky materials, etc.)

_____

_____

11. How do you dispose of solid waste generated by your plant?

_____

_____

12. Do you have any recycling or waste minimization program in place? Any other comments?

_____

_____

THANK YOU