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PROJECT PAPER AMENDMENT

AQABA WASTEWATER PROJECT

Loan No. 278-K-026
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should provide sufficient capacity until sometime in the 1990's, when the population nears 60,000. Total estimated project cost is $15.5 million. The project represents the first in a series of planned investment phases which, when completed, will provide wastewater services to an ultimate Aqaba population of 82,000. The Project will include the following three major elements:

a. Installation of a sewage collection system serving all developed areas of the City of Aqaba. While largely involving new construction, where practicable the new collection system will incorporate parts of the limited existing collection network, which will be upgraded to the standards of the new system;

b. Construction of a sewage treatment plant designed to provide secondary treatment of up to 9,000 cubic metres of raw sewage per day, and

c. Installation of an irrigation system to use effluent from the treatment plant to irrigate a belt of trees between the treatment plant site and Aqaba and for commercial farming when a sufficient amount of effluent becomes available.

Design of the wastewater facilities has been based on increased water availabilities to Aqaba, to be provided by $42.5 million water supply and distribution project. Construction of the water project began in mid-1979 and completion is scheduled for early- to mid-1981. (The basic project description remains essentially unchanged; only the location of the treatment plant and the methods of treatment and irrigation are changed).

6. Summary Findings:

a. Technical: Revised feasibility studies completed in June 1980 indicate that the proposed changes in treatment plant location, treatment method and ancillary facilities will provide wastewater services in Aqaba in a manner at least as sound technically as the scheme originally proposed. Indeed, the revised scheme is judged to be more sound technically in that it will provide the same quantity and quality of services as the original proposal at a lower operating cost since it

SUMMARY AND RECOMMENDATIONS

1. Background:

In August 1979 AID approved a loan from FY-1979 funds to assist in funding materials and construction services for the facilities necessary to provide a sewage collection system, a sewage treatment plant and an effluent irrigation system under the Aqaba Wastewater Project. The Loan Agreement was signed between AID and the Hashemite Kingdom of Jordan on August 30, 1979. After the loan was signed and initial implementation actions were underway, the Jordanian Government decided to review the location of the sewage treatment plant and the method of treatment to be employed under the Project. This review convinced senior officials that moving the proposed treatment plant location and changing the method of treatment would lead to significant long term cost savings, particularly operation and maintenance costs, while affecting the environment in ways which, overall, can be judged to be beneficial in comparison with the previous plans. This report reviews the background of the proposed changes, details the proposed changes themselves and provides an updated analysis of the Project in the context of the changes.

2. Borrower:

The Borrower is the Government of the Hashemite Kingdom of Jordan which will make the proceeds available to the Implementing Agency, the Water Supply Corporation (no change).

3. The Loan Amount:

$ 7,500,000 (no change).

4. Loan Terms:

The Loan will be repayable over a period of 40 years, including a 10-year grace period, with interest at 2% during the grace period and 3% thereafter (no change).

5. Description of the Project:

The proposed project will provide wastewater (sewage) collection and treatment facilities for the City of Aqaba which

will have less electrical and mechanical equipment and will be simpler to operate and maintain. In the original studies, the Consultants proposed an elaborate project for the irrigation of parks and ornamental greenery in downtown Aqaba. In the revised project the effluent from the Wadi Araba site will be used initially to irrigate trees to form a green belt between the treatment plant and Aqaba and the balance, as it becomes available, will be used for commercial farming, according to a scheme that will be developed by the Ministry of Agriculture.

b. Financial Analysis: The revised project provides a significant reduction in the financial costs of providing wastewater services. This reduction results from operating costs (particularly for energy) and easier long term financial terms of the relending agreement than were originally contemplated.

The basic conclusion of the Project Paper that the Project would be affordable to the "average resident of the city" can thus be expanded to state that the revised project should be affordable to most residents of Aqaba.

c. Economic Analysis: The Project Paper represented the then-existing least-cost solution to the provision of wastewaater services in Aqaba, given the constraints on the treatment plant location. The Project Committee believes that the revised Project now represents the single least-cost solution for the provision of wastewater services in Aqaba.

d. Social Analysis: Remains unchanged from original Project Paper.

e. Environmental Considerations: The proposed changes in the Project have both positive and negative consequences for the overall environmental assessment of the project. But, because the positive consequences are certain while the negative consequences represent only possibilities-and easily controlled ones at that-on balance the changes are judged to be positive. The positive consequences include the elimination of the need ever to dispose of effluent in the Gulf and a reduction by half of the amount of sewage which must be disposed of there during power outages (because half the sewage in the revised project will flow to the plant by gravity and

will not need pumping.) The possible negative consequences are two: (i) enchanced risk of odor nuisance in Aqaba and (ii) increased chances for the breeding of noxious insects (particularly mosquitos) and snails. As indicated earlier, all of the possible negative consequences can be controlled relatively easily (see Section III.E below).

7. Statutory Checklist:

Unchanged -- See Annex G of original Project Paper.

8. AID Funding Source:

Unchanged - Economic Support Fund, FY 1979.

9. Mission's Views:

The USAID Mission supports the proposed Project changes fully because they will lead to an overall better project at significantly reduced costs.

10. Issues:

There are no issues.

11. The revised Project will accomplish the same purpose and make the same contribution to the project goal as the original project. It is technically sound and is not as expensive or difficult to operate and maintain as the originally proposed project. No addition conditions precedent or covenants are required. However, because of the change in location and type of wastewater treatment, the irrigation system for use of the effluent will not be required for several years and will not be as complicated as proposed in the original Project.

We recommend:

a. That the Project Description, Annex 1 to the Loan Agreement be amended by implementation letter. (See Annex N).

b. That in fulfillment of Condition Precedent, Section 5.1(g), be met by a statement from the GOJ that the irrigation system will not be required until sufficient effluent becomes

available and that when it can be predicted that effluent will be available the necessary system will be constructed recognizing that Special Covenant 6.4 appropriately covers the GOJ commitment to effectively use the effluent.

c. That the terminal date for meeting Condition Precedent, Section 5.1(g) be extended to January 31, 1981.

d. That the Project Assistance Completion Date (PACD), Section 3.3(a) of the Loan Agreement, be extended to December 31, 1983.

I. BACKGROUND OF REVISED PROJECT

A. Introduction

The purpose of this review of revisions to the Aqaba Wastewater Project (278-0206) is to describe and analyze proposed changes in the sewage collection and treatment facilities which were previously approved for AID financing in August 1979 on the basis of the Project Paper submitted in July 1979. The proposed changes include (i) moving the location of the treatment plant from Wadi Jushiya south of Aqaba to Wadi Araba north of the city; (ii) changing the treatment method from the "oxidation ditch" (or "extended aeration") process (planned for the Wadi Jushiya location) to the "waste stabilization pond" process (to be used in the Wadi Araba location); (iii) discarding plans for use of the sewage effluent for irrigation in the City of Aqaba and instead providing facilities for use of the effluent for tree belts and commercial agriculture in the Wadi Araba; and (iv) making necessary changes in the layout of the sewage collection system to accommodate the new location of the treatment plant.

The basic intent of the proposed changes is to provide the same sewage treatment services -- in terms of both quality and quantity -- as previously contemplated, but at reduced annual operating costs (particularly for energy).

Essentially, much of the analysis in the Project Paper is still applicable to the present proposal. Thus, this report deals only with those sections of the original analysis which have been significantly affected by the proposed changes. In each case when a section in the following analysis is meant to replace or to modify significantly a section in the Project Paper as a result of the proposed changes in Project design, a notation in parenthesis citing section and page number in the Project Paper will following the section heading.

B. Background & Current Status of Proposed Project Changes:

At the time of the original comprehensive feasibility studies for the Aqaba Wastewater Project, the consultants, Howard Humphreys and Sons of the United Kingdom, and the Jordanian engineering firm, Arabtech, considered some ten

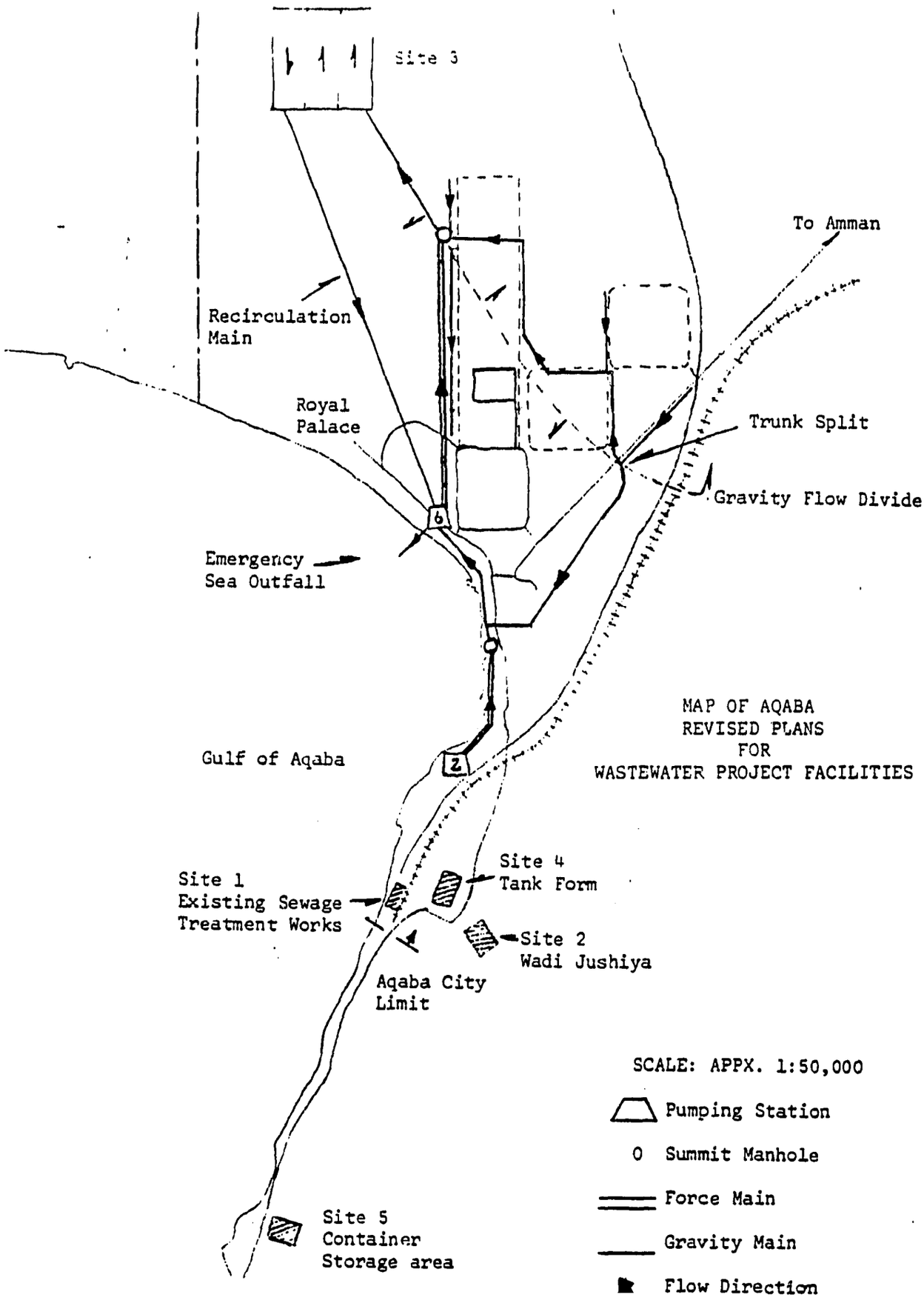
different schemes for the treatment plant involving seven different sites in and around Aqaba. The previously proposed scheme of locating the treatment plant in Wadi Jushiya south of Aqaba, as described and analyzed in the original AID Project Paper, was chosen by the Consultants over two other schemes known to be cheaper, after extensive conversations with all involved Jordanian organizations indicated to the consultants that the Jordanian Government's primary goal with regard to the sewage treatment scheme was to reduce the risks of environmental pollution in Aqaba to a minimum, even if achievement of this goal would entail increased costs.

The two alternative schemes found to be cheaper during the original feasibility study were (i) extended aeration treatment at the site of the existing primary treatment plant in the port area and (Site 1 on Figure II, Page 7a) (ii) treatment in waste stabilization ponds at a site about 4 kilometers north of Aqaba in the Wadi Araba (Site 3 on Figure II Page 7 a). The scheme for a plant at the site of the existing plant was rejected because it would interfere with on-going extension of the port facilities. The Wadi Araba scheme was rejected because responsible Jordanian officials indicated to the consultants that the Government desired to eliminate completely any risk that the prevailing northerly winds in Aqaba would blow objectionable odors from the plant into the city, particularly the tourist areas and the Royal Palace, which are almost directly south of the Wadi Araba location.

Changes in the Government of Jordan at the end of 1979 and in the administration of the implementing agency for the Aqaba Wastewater Project, the Water Supply Corporation, brought with them a change in philosophy with regard to the amount of risk of odor pollution which would be acceptable in Aqaba. Accordingly, in early 1980 the new Director General of the WSC ordered a review of the location decision for the sewage treatment plant at Aqaba and this was completed by the Consultants in March (See Annex M).

The Consulant's basic finding after this review was that the proposed change of location of the sewage treatment plant and method of treatment, i.e., waste stabilization ponds, would entail somewhat greater risk of odor pollution, but would be substantially cheaper to operate. Other major advantages of the currently proposed scheme, in addition to cheaper

FIGURE II



MAP OF AQABA
REVISED PLANS
FOR
WASTEWATER PROJECT FACILITIES

operation, include the need for much less mechanical equipment and less sophistication in the equipment which is employed, both of which will make the Wadi Araba plant technically simpler to operate and easier to maintain than the Wadi Jushiya plant. The major disadvantage associated with the Wadi Araba scheme is a delay in the startup of sewage treatment services by about one year. A full comparison of the advantages and disadavantages of the Wadi Araba and Wadi Jushiya schemes is found in Section II.D under "Project Description" below.

After weighing the advantages and disadvantages of the two schemes in question and particularly after noting that in their opinion the greater odor pollution risks entailed in the Wadi Araba scheme would be minimal, given the relatively great distance between the treatment plant and the closest habitation, the consultants concluded that "serious consideration should be given to relocating the treatment works at the Northern (Wadi Araba) Site and redesigning the sewage scheme accordingly". After studying the review findings, the WSC ordered the consultants to revise the feasibility study and preliminary design to effect the proposed relocation of the treatment plant to the Wadi Araba site. Appropriate revision involved essentially a rewriting of Chapter 10, "Proposed Scheme," and Chapter 11, "Stage I Project" of Volume 2 of the consultants' "Aqaba Water Distribution and Sewerage" report. This rewriting has been completed in draft and reviewed and approved by the WSC and USAID and will be provided to AID/W when printed in final form.

In the previous scheme for a treatment plant in Wadi Jushiya, the consultants planned to issue two tenders for the Wastewater project, one for Civil Works and one for Electrical and Mechanical Components (E & M). At the time of the WSC decision to reconsider the location of the treatment plant (early 1980), WSC had already invited pre-qualification data from interested contractors (December 1979) and the consultants were well into final preparation of the required bid documents. Because of the relatively small E & M elements required for the now-proposed waste stabilization ponds, the consultants have decided to include all elements of the Wastewater Project facilities in one contract. Because of this decision, the previously received prequalification questionnaires will not be considered and an invitation for new prequalification questionnaires have been issued.

C. Current Status of Aqaba Water Supply Project (Supplements Section I.C. beginning on Page 9 of original PP)

As of the end of July 1980, the project to supply water to Aqaba from a well field at Qa Disi is on the schedule predicted on page 11 of the Project Paper, i.e., completion in the first half of 1981. WSC confidently believes that progress on all contracts is sufficient to allow it to provide water to the fertilizer plant by the time it is scheduled to start in February 1981. Delays encountered by the contractor for the distribution system might push its completion back from the originally scheduled early-1981 to mid-1981 or so, but based on progress to date, it is likely than the water supply project contracts will be completed by that time.

II. REVISED PROJECT DESCRIPTION

A. Introduction:

Examination of the work done to date on the revised scheme for the Aqaba Wastewater project indicates that the consultants are following the same "conservative" (in the sense of "safe") design philosophy and design parameters as they employed during design of the original scheme (these are as set out in the last paragraph of Section II.C -- on page 16 -- of the original Project Paper). Thus, the consultants believe that, as was the case with the original facilities, the redesigned Stage I facilities should provide adequate capacity for the City of Aqaba until sometime between 1990 and 2000. As noted earlier, the revised treatment scheme should provide equivalent treatment services -- in terms of both quality and quantity -- as the original scheme. Finally, again as with the original plans, wherever warranted in the revised plans the consultants are including facilities in Stage I plans which will not be used until full expansion to the Stage II capacity has been completed but which will be more economical to construct now with the Stage I facilities than later with the Stage II facilities.

B. Proposed Project
(Replaces Section II.C, beginning page 15, and Annex B of original PP).

The proposed revised Aqaba Wastewater Project will have three principal elements, a sewage collection system, a sewage treatment plant and an irrigation system. Following is a description of the major components of these elements. Figure II, on page 7a, provides a basic schematic overview of the revised project. (A useful companion to Figure II which will provide some idea of the elevations cited in the discussion below is Figure I.B. "GENERAL MAP OF AQABA," found on page 6 of the Original PP.).

B.1. Treatment Plant

The treatment plant will be located at Site 3 (see Figure II) in the broad, mostly flat Wadi Araba (which is part of the Great Rift depression forming the Jordan Valley north of

the Dead Sea). The treatment plant location is adjacent to the cease-fire line and about 4 kilometres from the Gulf of Aqaba and it has an average elevation of about 20 metres.

The treatment plant will utilize the waste stabilization pond process to provide secondary treatment of up to 9,000 cubic metres of raw sewage per day. The heart of the treatment plant will be a dual series of "facultative" and "maturation" ponds which are large, shallow (1.5 metres deep) ponds in which the incoming raw sewage will be stabilized by the natural processess of algae production by photosynthesis and bacterial "digestion". Also included in the treatment plant design will be (a) a series of inlet works; (b) a recirculation pumping station (to recirculate the effluent from the end of the maturation ponds back to the beginning of the facultative ponds when the average temperature drops below the level at which the ponds can operate safely on one "pass through" of sewage); (c) pumping facilities to an irrigation system being developed by the Ministry of Agriculture; (d) an effluent disposal lagoon in which effluent can be disposed of safely through the processes of evaporation and ground seepage when it is not needed for irrigation and an effluent recirculation main discharging by gravity to Pump station No. 6 to provide adequate flow to eliminate the possibility of septage in the primary force main.

B.2 Sewage Collection System

The major components of the revised sewage collection system to be constructed under the Aqaba Wastewater Project ("Stage I") are the following:

a. New Force Main. An 800 mm force main will be the carrier of raw sewage from Pump Station ("PS") No. 6 to Summit Manhole ("MH") 22 from where it will flow on to the treatment plant by gravity (major project components are represented in schematic fashion on Figure II). All raw sewage from areas to the south-west of the "gravity flow divide" will be collected at PS No. 6 for transmission to the treatment plant. This will represent approximately 50% of the total raw sewage generated in Aqaba.

A second force main will be installed from PS No. 2 to MH 230 from where it will flow by gravity to PS No. 6. PS No. 2 is presently the collection point for the existing sewerage system.

b. Pumping Stations.

-- Upgrading of PS No. 2 to handle increased flow by replacing pumps with pumps of greater capacity.

-- Reconstruction of PS No. 6, equipping it with three -duty pumps, one -standby pump and an emergency generator. Plans include an emergency outfall pipeline to convey sewage aproximately 250 M to sea (depth approximately 15 M).

c. Other Main Sewers. Two trunk sewers will be installed. One will flow by gravity from the " trunk split" to PS No. 6. The second will flow by gravity to MH 22 and on to the treatment plant. As can be seen in Figure II, the sewerage needs of most of the areas planned for expansion will be met by the second trunk sewer which operates by gravity flow to the treatment plant. This fact effectively limits future loads on PS No. 6 to predictable levels.

d. Effluent Recirculation Main. A 400 MM main will be installed from the treatment plant to permit the flow by gravity of effluent to PS No. 6. The effluent will be combined with the raw sewage collected at PS No. 6 and returned to the treatment plant. The purpose of this recirculation is to prevent the occurrence of septage in the force main during low load periods, e.g., during the night. This main will be valved to prevent the possibility of effluent discharge to the sea.

e. Other Sewers. The function of the other Stage I sewers will be to deliver sewage (by gravity or with the help of PS No. 2) to PS No. 6 or (by gravity alone) to the trunk to the north-east of the "gravity flow divide". As with the original plans, the existing sewerage networks will be incorporated into the planned system whenever feasible and some of the remedial work to the present system to make it acceptable for incorporation in the Stage I system.

B.3 Irrigation System

Because there is ample open space around the proposed site, the development of an irrigation system to dispose of the effluent is much less complex than it was for the former project, which involved irrigation within the City of Aqaba. WSC entrusted the responsibility for any irrigation scheme that may be required to the Ministry of Agriculture. Although details of the scheme are not yet available, it is expected that it will include, primarily, a tree belt between the treatment plant and the City of Aqaba. In Section 5.1(g) of the Loan Agreement, the Borrower has agreed to furnish to AID a final design report for the sewage effluent irrigation system, a financial plan for construction and operation, and an operating plan, including a staffing plan of the organization that will have ultimate operating authority. In Section 6.4 the Borrower covenants to continue development and expansion of the irrigation system in such a manner that all effluent produced by the sewage treatment plant at Aqaba will be used for irrigation purposes in a manner posing no significant health or other hazards to the city's inhabitants. Because the final design and operation report of the Ministry of Agriculture on the irrigation project may not be available before initial disbursements and since, with the effluent storage lagoon, no effluent will reach the Gulf, USAID proposes to modify Section 5.1(g) by Implementation Letter to require evidence that the irrigation system will be designed and constructed so that it will be in place when sufficient effluent becomes available. The special covenant will remain in force.

C. Major Changes Between Original & Current Project Proposals

Following is an expanded discussion of the major changes involved in the revised project proposal (which were first mentioned in Section I.A. above).

(i) Location of Treatment Plant. The treatment plant has been moved from Site 2 in the steep-sided Wadi Jushiya about 1.5 kilometres south of the built-up area of Aqaba to Site 3 in the Wadi Araba near the ceasefire line about 4 kilometres north of the Gulf of Aqaba (and at least 2 kilometres from any signifiant planned habitation). The Wadi Jushiya treatment plant site was at about 65 metres elevation while the Wadi Araba site will be at about 20 metres elevation.

(ii) Method of Treatment. Because the Wadi Jushiya site had severely limited space, the choice of treatment method was necessarily also restricted. The method originally proposed --the oxidation ditch method -- was, in fact, about the only method possible in Wadi Jushiya because it needs relatively little space. As there is a great deal of available space at the proposed Wadi Araba site, there is an almost unrestricted choice of treatment methods. The consultants have chosen the waste stabilization pond method because while requiring a great deal of space this method is highly effective and comparatively inexpensive with regard to both initial capital cost and annual operating costs (see Section III.D below)

(iii) Effluent Irrigation System. Virtually any other locale (except the currently proposed Site 3) in or around Aqaba which was suitable for consideration as a possible site for the sewage treatment plant would require some sort of irrigation system to obviate the need to dispose of the sewage effluent in the Gulf. (As noted in the original PP, avoidance of any disposal of sewage effluent in the Gulf is a primary objective of the Government of Jordan and of Aqaba officials and residents -- see discussion in Section III.A beginning on page 21). Utilization of the Wadi Araba site, however, could make it possible to eliminate the requirement for an effluent irrigation system because the sewage plant effluent can be disposed of safely through evaporation and seepage from a relatively simply constructed "effluent disposal lagoon". The Consultants have, in fact, recommended this method of effluent disposal. WSC, however, feels that, given the water shortage in the Aqaba region, the effluent should be used for irrigation. It has asked the Ministry of Agriculture to develop a scheme for its use. Thus, the difference between the original and the current project proposal is that the original proposal was an elaborate one to irrigate ornamental greenery within the city whereas the current proposal is a much simpler one to grow trees in an open desert and to provide water for commercial farming. The effluent disposal lagoon will be retained to store water when irrigation demand is low or when there is an electrical failure. Sludge builds up in the facultative ponds gradually and needs to removed only once every ten years or so. This sludge is stable and can be used for agricultural purposes.

(iv) Sewage Collection System. With the selection of the proposed Wadi Araba site instead of that at Wadi Jushiya, the main sewers of the sewage collection system had to be redesigned to, in effect, "reverse the flow" of collected sewage from south to northwest. On the one hand, the distance to the Wadi Araba site from major inhabited and commercial industrial areas of Aqaba is greater than that to Wadi Jushiya, so the revised project will require significantly greater amounts of sewer pipe and civil works for its collection system. On the other hand, as discussed earlier, while for the Wadi Jushiya site all raw sewage had to be pumped against a static head of 65 metres, for the Wadi Araba site roughly half the raw sewage will flow by gravity to the treatment plant. Furthermore, the half which will not flow by gravity will only have to be pumped against a head less than half as great as that for Wadi Jushiya -- 27 metres as against 65 metres. Thus, over the long run, the amount of energy saved in running the Wadi Araba collection system instead of that for Wadi Jushiya will be large.

D. Comparison of Wadi Araba and Wadi Jushiya Alternatives

The last table in the consultants' "Discussion Paper on Location of Treatment Works" (Annex M) provides a fairly concise comparison of the advantages and disadvantages of choosing Wadi Araba or Wadi Jushiya for a treatment plant site for the Aqaba Wastewater project. This is a very useful summary of the various factors involved in the consultants' recommendation to move the site to Wadi Araba and accordingly is reproduced here (in slightly altered form) for ready reference.

Wadi Jushiya	Wadi Araba ("Northern Site" or "Site 3")
Minimum length of sewers.	Long and consequently expensive main collector sewer. (May be useful in future if Wadi Araba developed for residences or commerce/industry.)
All raw sewage gravitates to sea level and must be pumped to treatment plant at elevation of 65 metres.	50% of raw sewage will gravitate to treatment plant. Remaining 50% must be pumped from sea level to elevation of only 27 meters.

Constricted site, limiting type of treatment available.	Large open site with virtually unrestricted choice of treatment method.
Expensive embankments and earth training construction required; limited room for expansion.	Virtually no off-site construction work required; virtually unlimited room for expansion.
Only possible treatment method requires high proportion of E & M equipment with relatively high operation and maintenance costs	Abundant space allows utilization of waste stabilization pond treatment method which utilizes relatively simple E & M equipment with low O & M costs.
Good effluent for irrigation.	Good effluent for irrigation.
Effluent must be utilized in irrigation system; all effluent available for irrigation.	Effluent need not be utilized for irrigation; some loss of effluent through seepage and evaporation.
Site is also used for solid waste disposal and has accompanying unpleasant odor and fly nuisance; however, all environmental pollution contained within Wadi	Open site with possible odor problem in the area of treatment plant, but risk of nuisance in Aqaba considered very slight despite fact that plant is upwind (many waste stabilization plants operate in similar environments with no odor problems).
Emergency disposal of effluent into Gulf.	No need for emergency disposal of effluent.
Emergency pumping station outfall to Gulf.	Emergency pumping station outfall to Gulf.
Wastewater project completed 7 months to one year sooner.	Wastewater project completed 7 months to one year later.

Much higher power costs.	Much lower power costs.
Higher maintenance costs	Lower maintenance costs.

E. Project Costs & Financing

1. Construction Cost Estimates

Total estimated costs of construction of the revised Aqaba Wastewater Project facilities are U.S. $15.5 million equivalent. Table II.A. gives the breakdown by component and foreign exchange and local estimated costs at October 1980 prices. Table II.B. gives a comparison of the costs of the original and revised project. The original, which was estimated in June 1979 dollars, has been inflated to October 1980 dollars to permit comparison. As may be seen, the construction costs are only about U.S. $485,000 more for the revised project (U.S. $ 14.138 million) than the original project (U.S. $13.654 million). The cost increase results from the need for a longer total sewer system. USAID believes that the revised project estimates are cautiously conservative.

It should be noted tht the Consultants estimates for line item 7 of Table II.A. differ from those presented. The Consultant has estimated foreign exchange costs at U.S. $7.598 million and local currency at U.S. $ 6.533 million. The Consultant has assumed the maximum usage of imported materials, e.g., vitrified clay pipe, while USAID has assumed greater usage of locally available materials based upon our previous experiences.

2. Financing Plan

a. Capital Costs

The proposed Government and AID contributions to the project costs are also set out in Table II.A. The AID Loan may be used to pay for all foreign exchange costs of the project except the foreign exchange component of the consultants' contract. Foreign exchange costs not financed from the loan will be financed by the Government.

Under the terms of the original loan agreement, the Government has reloaned the amount of the AID Loan to the implementing agency, the Water Supply Corporation, for constructing the project. The earlier USAID understanding was that the standard terms for such reloans were 20 years for repayment, 5-year grace period and 6% annual interest on the unpaid balance of capital. The actual terms of the reloan agreement are considerably different, however; 37 years for repayment, 6 1/2 year grace period and 8% annual interest (with the spread between the reloan agreement's interest rate of 8% and the AID Loan's rate of 2% to be deposited in a special account by the National Planning Council (NPC) to be used "to finance other water projects agreed upon by the NPC and WSC").

The Loan agreement has the standard AID requirement committing the Government to provide all financing required by the Project not available from other sources (in the case, only the AID Loan).

b. Annual Costs Financing

There is no appreciable change from the section in the PP concerning the financing of annual costs. It can be noted, however, that the actual reloan agreement financing terms represent an initial slight increase in annual financing costs, but that this cost will decline and drop below the originally projected costs after approximately eleven years.

In addition, the operating costs themselves - particularly for energy - are expected to be significantly lower under the proposed project. These lower costs will tend to lighten the overall financial load on Aqaba residents for wastewater services and will allow the implementing agency to consider financing at least part of the "on-going development" program from current revenues. This subject is discussed in greater detail in the financial analysis section below (See Section III.D.).

TABLE II.A

ESTIMATED REVISED PROJECT CONSTRUCTION COSTS AND PROPOSED FINANCING

	Amount 1/ FX	LC	Totals	(Percentages)
A. Costs				
1. Main Sewers and Pumping Stations	2.972	4.091	7.063	(45.6%)
A. (Civil Works)	(0.278)	(3.855)	(4.133)	
B. (Pipe Supply)	(2.108)	(0.184)	(2.292)	
C. (Pumps & Accesories; Electrical & Mechanical)	(0.586)	(0.052)	(0.638)	
2. Treatment Plant	2.069	2.191	4.260	(27.5%)
A. (Civil Works)	(1.554)	(2.147)	(3.701)	
B. (Electrical & Mechanical)	(0.515)	(0.044)	(0.559)	
3. Effluent Disposal Lagoon	0.035	0.049	0.084	(0.5%)
4. Irrigation Facilities	0.654	0.792	1.446	(9.4%)
5. Expected Bid Prices	5.730	7.123	12.853	83.0%
6. Contingency (10%)	0.573	0.712	1.285	8.4%
7. Estimated Project Facilities Total	6.303	7.835	14.138	91.4%
8. Consultant Supervision	0.495	0.141	0.636	4.1%
9. Estimated Direct Project Cost	6.798	7.976	14.774	95.5%
10. Interest During Construction	-0-	0.705	0.705	4.5%
11. Estimated Total Project Costs	6.798	8.671	15.479	100.0%
B. Financing				
AID	6.303	1.197	7.500	48.5%
GOJ	0.495	7.474	7.979	51.5%
TOTAL	6.798	8.671	15.479	100.0%

1/ In Millions of U.S. Dollars converted at the rate Jordan Dinar 1.0=$3.34 ($1.0 = JD 0.300)

TABLE II.B

COMPARISON OF ORIGINAL AND REVISED PROJECT COSTS
($ 000)

		Original Project (6/79 dollars)	Original Project (10/80 dollars)1/	Revised Project (10/80 dollars)
1.	Main Sewers and Pumping Stations	4,132	4,806	7,063
2.	Treatment Plant	5,050	5,874	4,260
3.	Effluent Disposal Lagoon	-	-	- 84
4.	Irrigation Facilities	1,490	1,733	1,446
	Subtotal	10,672	12,413	12,853
5.	Contingency (10%)	1,067	1,241	1,285
	Subtotal	11,739	13,654	14,138
6.	Consultant Supervision	514	598	636
7.	Interest during construction	427	497	705
	PROJECT TOTAL	12,680	14,749	15,479

1/ Inflated at 12% annual rate

III. REVISED PROJECT ANALYSIS

A. Technical Feasibility (Replaces or supplements Section III.A beginning on Page 21 of original PP).

The revised project proposal represents a technically sound solution to the problems of wastewater collection and treatment at Aqaba. It is, if anything, more sound technically than the previous proposal because of the reduced amount of E and M equipment employed in the collection system and in the waste stabilization ponds method of treatment and the lesser sophistication of that which is employed. These reduced E & M requirements result in a need for fewer technically skilled personnel to operate the system. The waste stabilization ponds method of treatment itself is ideally suited to the conditions of the revised treatment plant site, i.e., large amounts of available space, few cloudy days and high average ambient temperatures.

Given the limited possibilities for dispersion of effluent, and particularly the absence of any possibility for safe dispersion in a water body, the case for provision of secondary treatment is still valid (see P. 22 of original PP). (The environmental analysis below - see Section III.E.2 discusses the issue of effluent disposal for the present scheme in more detail.)

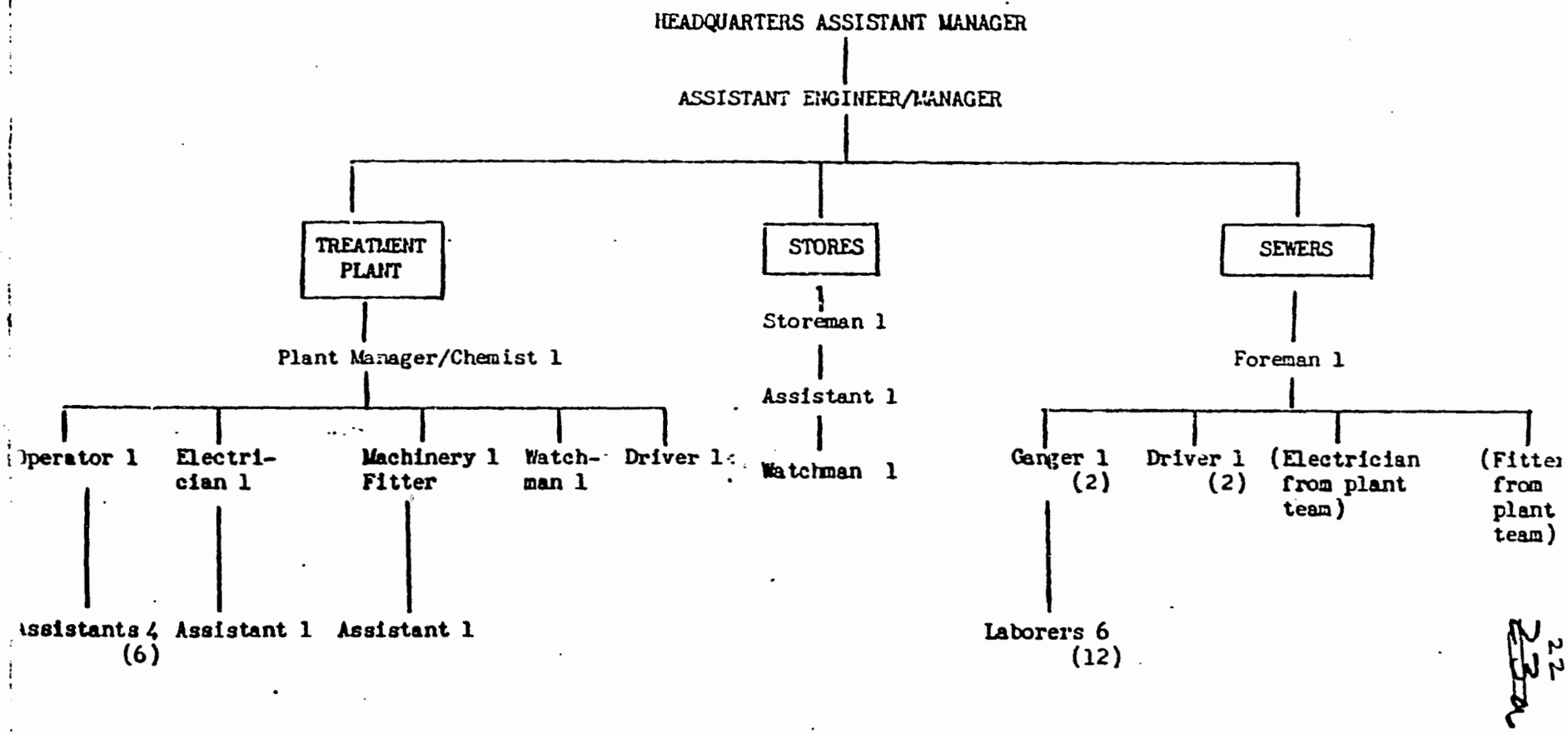
B. Administrative Analysis (Supplements Section III.B. on page 24 of original PP).

The administrative burden to WSC has been lightened significantly by two aspects of the revised project: (a) the reduction and simplification of the E & M equipment and (b) the expectation that effluent disposal will primarily be the responsibility of others.

The decrease in the personnel requirements for the revised treatment plant are reflected in the revised recommended staff organization chart (Figure III). As can be seen, the provision for a separate chemical section for the treatment plant has been eliminated with responsibility for the limited chemical analysis required for the currently proposed

FIGURE III

REVISED STAFF ORGANIZATION CHART AQABA SEWAGE TREATMENT PLANT STAGES I AND II



Note: Figures in brackets apply to Stage II requirements

plant devolving on the plant manager (compare with Figure III.A., Page 27 of original PP). Similarly, the number of machinists has been reduced. While the number of operators has been increased, their required level of training is reduced. The personnel requirements for the sewers remain unchanged. Overall, the effect is a modest reduction in the number of personnel required and a greater reduction in the qualifications of those who are required.

The performance of the WSC in administering the Project to date has been good, considering the constraints on the organization discussed in the original PP. CP submissions for the original PP have been satisfactory with the exception of that for the effluent irrigation system. Preparation of the bid documents and, consequently, the entire bidding process is behind the originally planned schedule because of the change in the location of the treatment plant and method of treatment. For its training program, the WSC, (which has been assigned responsibility for overseeing the project through the construction stage and for developing and implementing a training program for project personnel when required,) has developed a concept of a core of highly qualified technicians (the latter will be supplemented by equipment suppliers' training programs as appropriate). In the meantime, the NPC is developing a national training program which is conceived as being able to supply appropriate training required by technicians in all facets of water sector operations in the country. Thus, based on the WSC's performance to date and the increasing awareness among high-level GOJ officials of the rapidly growing requirements for technical personnel in the water sector, USAID believes that overall chances for satisfactory administration of the proposed Project are, if anything, improved over those estimated at the time of the original analysis. Further grounds for optimism can be found in the fact tht it was the WSC itself which raised the question of re-examining the decision on the treatment plant site, and once WSC management was convinced that the site should be changed, necessary GOJ approval was obtained.

C. <u>Economic Analysis</u> (Supplements Section III.C. beginning on page 28 of original PP.)

The basic conclusion remains unchanged that a rigorous economic evaluation of the project is not possible because of

the inability to quantify benefits. It can be noted, however, that while no actual benefit/cost ratio can be computed, the economic attractiveness of the project has been enhanced because of the fact that the (uncalculable) benefits remain the same while the cost has been reduced by virtue of the decreased operating costs of the revised Project.

The previous Project represented the least-cost solution to the problem of providing sanitary services in Aqaba, given the limiting constraints on treatment plant location. The revised Project now undoubtedly represents the single least-cost solution for providing Aqaba with sanitary services of the quality and magnitude desired.

D. Financial Analysis (Supplements Section II.D.1., beginning of original PP)

1. General

As noted earlier, there have two significant positive effects on the financial situation facing Aqaba as a result of the revision of Project: (a) annual project costs have been reduced considerably by the specification of a less expensive scheme for collection and treatment of sewage and (b) the extended repayment terms provided in the relending agreement for the AID will lead to lightened annual financial costs.

The basic effect of the altered relending terms is favorable even though the increased interest rate (from 6% to 8%) will proportionately increase the costs of interest during construction. The increase in such interest costs is relatively in significant. On the other hand, the extended repayment period (from 20 to 37 years) and grace period (from 5 to 6.5 years) make the annual financial costs of any given investment about 86% of those incurred under the previous terms.

The approximate resultant of the combination of the above two effects is that annual financial costs to the city of Aqaba for wastewater collection and treatment services under the revised Project will be about 75% of annual costs anticipated under the original proposal.

The total effect obviously is a significant reduction in the financial burden for wastewater services, the "saving" from which either can be passed on directly to Aqaba's residents in the form of lower tariffs or can be used to finance at least part of the "on-going development" program from current revenues (see Section II.D of original Project Paper).

2. Repayment Prospects

The analysis of repayment prospects remains essentially unchanged from that in the original Project Paper (Page 34).

E. Environmental Analysis (Supplements Section III.F., beginning on page 38 of original PP).

1. General

The proposed revised project has some aspects which will increase, and others which will decrease, the chances of environmental pollution in Aqaba. The proposed project will increase the chances of pollution in two signigicant instances. First, because the location of the treatment plant has been moved from downwind to upwind of the city with regard to prevailing winds, there is an increased likelihood of the project being the cause of odor pollution in Aqaba. Second, the large, relatively still ponds involved in the revised treatment method provide a potentially better environment for breeding of mosquitos, flies and snails. On the other hand, the proposed project will also significantly reduce the chances of pollution, primarily by virtue of the fact that relocation of the treatment plant will absolutely eliminate the need to dispose of effluent into the Gulf (which would have been necessary under emergency conditions -- primarily power outages -- if the original project had been implemented). In addition, the amount of raw sewage which it will be necessary to dispose of in the Gulf from pumping stations during emergency conditions will be reduced to half of what it would have been under the previous project, because about half of the sewage will flow by gravity to the treatment works under the revised project and will not require pumping.

The possible negative environmental impacts mentioned above can be mitigated relatively easily. With regard to the possibility of an odor nuisance in the city, the best countermeasure is to maintain correct operation of the treatment plant. (It can be noted that a plant of the same type has been operating on the other side of the cease-fire line for a number of years with no noticeable odor pollution in the city downwind -- or in Aqaba which is often downwind because the prevailing winds in the Wadi Araba tend to come from somewhat west of north.) A secondary countermeasure will be a series of tree belts downwind from the plant which will increase the probability of dispersion of any odors that are formed. Such tree belts have been proposed by WSC and will be irrigated with treatment plant effluent. As has been noted before, the climate in Aqaba for most of the year is ideally suited to ensure effective operation of waste stabilization ponds. Based on experience with similar plants in similar environments elsewhere, it can be concluded that the chances for increased odor pollution in Aqaba from the treatment plant are relatively low if the plant is operated properly.

With regard to the breeding of mosquitos and other insects and snails, the chances of such breeding occurring will be mitigated by proper design and operation of the facilities. The design criteria proposed by the consultants will include: proper depth (1.5 metres) and side slopes (1:3), concrete protection of the pond sides at the normal operating water level to prevent wave erosion and plant growth, and fencing and gating of the whole site to keep the general public totally out of the area. The design criteria will enhance the operator's ability to keep the ponds free of weeds, which are breeding places for insects and snails. The concrete slabs or cement stabilization of the pond sides will provide a less attractive habitat for any snail population that may develop. All persons will be prohibited from swimming in the ponds and the works staff will be instructed on keeping clean, dry and out of the water. The effluent from the ponds that is used for irrigation will be chlorinated and conveyed to the irrigated area by pipe, thus minimizing the risk of snail breeding enroute.

The proposed site is at least two kilometres from the nearest proposed housing. Thus, if a tree belt barrier is planted between the ponds and the city, the likelihood of

nuisance mosquitos and flies reaching inhabited areas is considerably reduced. Malaria has essentially been eradicated from Jordan; the only cases reported are imported. There is no indigenous schistosomiasis. There is an excellent Malaria Control Unit in the Minsitry of Health, which has recently been given charge of schistosomiasis control. This unit will monitor mosquito and snail breeding in all bodies of open water in the Kingdom, including the waste stabilization ponds at Aqaba.

Given on the one hand the relatively small risk of odor nuisance incurred as a result of revisions to the Project and the relatively easily controllable nature of insect and snail breeding and, on the other hand, the significant increases in environmental protection provided by the elimination of the need ever to dispose of effluent in the Gulf and the reduced need to dispose of raw sewage there during emergency conditions, the overall assessment is that the proposed revised project will provide enhanced protection of the environment in comparison with the original Project.

2. Effluent Irrigation System

Given the confined nature of the original treatment plant site, an effluent irrigation system was mandatory in order to obviate the need to dispose of effluent into the Gulf (except during emergencies). With regard to the revised project, the situation as seen by the consultants is that while an effluent irrigation system would be desirable -- particularly if the effluent were used to irrigate tree belts downwind from the treatment plant -- it is in no way necessary because the effluent can be disposed of safely by evaporation (mostly) and seepage from a large lagoon to be built on the site. The WSC feels, however, that the development of the tree belt should begin as soon as possible after the plant goes into operation. It also feels that the increasing cost of water, combined with increasng demand for food and successful examples elsewhere, will make a scheme to use the effluent for commercial irrigation an attractive proposition. Indeed, it seems quite possible that the effluent from the proposed Wadi

Araba treatment plant will become a source of significant income for the implementing agency, income which could be used to offset the costs of providing wastewater services in Aqaba. The WSC has asked the Ministry of Agriculture to prepare such a scheme.

3. Annex O provides the Environmental Clearance by Bureau Environmental Coordinator.

IV. REVISED PROJECT IMPLEMENTATION & EVALUATION

(The follwoing paragraphs replace the same paragraphs as those found in Section IV of the original PP, which begins on page 40).

A. Revised Project Implementation Schedule

Table IV. A is a revised summary schedule for the implementation of the AID-financed wastewater project. This schedule is considered to be extremely "tight," but fully possible of being adhered to in the absence of significant administrative delays.

B. AID Loan and Disbursement Schedules

The revised AID Loan Implementation Schedle is found in Table IV. B and the revised AID Loan Disbursement Schedule is found in Table IV. C (The methodology employed in developing the latter schedule is discussed briefly in Section III. D above.)

TABLE IV.A.

REVISED

IMPLEMENTATION SCHEDULE FOR AID-FINANCED WASTEWATER PROJECT

ACTIVITY	DATE
1. Contract for consulting engineering services signed	6/79
2. CBD notices for contractor pre-qualification published	11/26/80
3. Consultant submits revised draft bid documents for contract	8/80
4. Detailed revised bid documents completed	12/80
5. Revised documents issued to prequalified firms	2/81
6. Bid opening	4/81
7. Contract approved	5/81
8. NTP to contractor delivered	6/81
9. Electrical and mechanical equipment delivery begins	10/81
10. Equipment installation (including suppliers' training programs) begins	4/82
11. WSC accounting and administration training program begins	Mid-1982
12. WSC wastewater facilities operations and maintenance (on-the-job training) programs begins	Mid-1982
13. E&M equipment installation completed	11/82
14. Construction work completed	1/83
15. Beginning of full operations	2/83

TABLE IV. B

REVISED

AID LOAN SCHEDULE

Original Loan Authorization	August 22, 1979
Original Loan Signing	August 30, 1979
Implementation Letter No. 5 issued amending project description	December 17, 1980
Initial Conditions Precedent Met	January 31, 1981
PACD	December 31, 1983
First in-depth AID Evaluation	November, 1983

TABLE IV. C.

REVISED

AID LOAN DISBURSEMENT SCHEDULE

	1981	1982	1983	Totals
Foreign Exchange	2,569	3,096	638	6,303
Local Currency	501	615	81	1,197
TOTALS	3,070	3,711	719	7,500

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The Director General
Water Supply Corporation
Amman

7/3/1980

Excellency,

Aqaba Sewerage Project : Possible Re-Location of Treatment Works

Following your request at the meeting in your offices on 14 February we have prepared a discussion paper on considerations regarding the relocation of the proposed sewage treatment works following the decision to use the sewage effluent for irrigation in Wadi Araba and not in Aqaba as originally specified.

We trust that this gives you sufficient information for your submission for ministerial consideration but we should of course be prepared to participate in any ensuing discussions to assist in reaching a conclusion.

Yours sincerely
FOR HOWARD HUMPHREYS LTD

J. M. Reid
Resident Associate

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1. INTRODUCTION.

The Aqaba Regional Water Supply Project at present under construction will abstract water from wells at Qa Disi and transmit it by pipeline to Aqaba. The waste water from Aqaba city is to be treated and the sewerage system and treatment facilities have been designed and draft contract documents submitted for approval. Pre-qualification of contractors is under way.

The groundwater resources at Qa Disi are finite, that is, they are not replenished, and when they are exhausted, further and more expensive means of obtaining municipal water supplies will be necessary. Consequently it has been accepted as a matter of principle that the best use should be made of these resources and that specifically, the effluent from the sewage treatment works should be used for irrigation. As a corollary it is necessary to provide secondary treatment. Howard Humphreys were commissioned as an extension of their duties, to prepare a report on the re-use of effluent for irrigation and this was done on the basis of a sewage treatment works in Wadi Jushiya and in accordance with the requirements of the Aqaba Town Planning Committee to irrigate the verges and central reservations in the town. The resulting scheme however was relatively expensive in capital outlay and in operating costs and required a considerable labour force to operate it.

Consequently at a meeting in W.S.C. offices on 14th February, 1980, it was suggested that a simpler and cheaper solution would be to transfer most of the effluent to Wadi Araba in the north of the town and use it for the development of a tree belt and for certain agricultural produce. If such a solution were to be adopted it is possible that a more suitable location for the treatment works would be in the Wadi Araba area as had been proposed by Howard Humphreys during the study stage.

Consequently the Director-General, W.S.C., wishes now to review the whole situation and requested Howard Humphreys to prepare a discussion paper to assist in formulating a policy which will ensure that the most satisfactory scheme is adopted. The following sections summarise the background to the present proposals, discuss new developments and make recommendations regarding immediate and future action.

2. LOCATION OF TREATMENT WORKS.

2.1. GENERAL.

During the study and preliminary engineering stage considerable difficulty was experienced in locating a treatment works site which was acceptable to all authorities concerned.

Continued.....

2.1. GENERAL. (Continued)

Seven sites were considered* but after preliminary economic analysis and discussions with Government Departments, the choice narrowed to three:-

Site 1 - the area of the existing sewage treatment works in the port area,

Site 2 - the low part of Wadi Jushiya,

Site 3 - immediately north of the proposed Oasis Project.

The most economical solution was Site 1 but it was rejected because of the obstruction it would present to extensions of the port facilities. Although a limited economic analysis showed Site 3 to be the next most attractive, this site also was rejected because of possible odour nuisance with the prevailing offshore winds. There are however considerable advantages in this site and a detailed comparison of Site 2 (Wadi Jushiya) and Site 3 (Northern Site) is presented below.

2.2. WADI JUSHIYA SITE.

With the siting of the works in Wadi Jushiya all sewage is gathered in a main pumping station at the entrance to the port area and from there lifted to the works at a level of 66 m. The Wadi Jushiya site is cramped and is currently used for the excavation of concrete aggregates and for the tipping of solid waste collected from Aqaba. The present methods used for both of these operations are insufficiently controlled and create an untidy, dirty atmosphere and considerable smell and fly nuisance. Fortunately the isolated nature of the wadi confines the nuisance and so far have had no bad effects on the environment. Under proper control it would be sensible to use the upper part of the wadi for sanitary land disposal of solid wastes and the lower section for sewage treatment. Neither operation is offensive if properly controlled.

The limited area available for the works restricts the method of treatment to the extended aeration process where air is introduced to the sewage by large electrically driven multi-blade rotors. Although the system is well tried and robust, it nevertheless requires the care and maintenance of large and important electro-mechanical units with relatively high power consumption and running costs. The system however is flexible and can treat sewage having a BOD loading substantially higher than the design loading, by increasing the immersion depth of the rotors, and as necessary, recirculating the effluent.

* Howard Humphreys "Aqaba Water Supply and Sewerage Project: Sewage Treatment Works: Report on Alternative Location of Works".

2.2. WADI JUSHIYA SITE. (Continued)

As noted above and discussed in detail in Section 3, it is envisaged that all of the effluent will be disposed of by irrigation but in the event of a breakdown in the irrigation system, the effluent would be piped to the Gulf.

The main pumping station would be powered from the public supply but would also have standby generation which would start automatically in the event of a failure in the public supply. Provision would also be made for discharging untreated sewage into the Gulf in the event of a complete failure of all power sources, but this is considered as a rare emergency.

Sludge would be digested, dried in beds, and disposed of by truck to farmers or to selected disposal areas.

2.3. NORTHERN SITE.

The proposed northern site is 4 km from the Gulf and near the cease fire line. It therefore lies at a considerable distance from any planned urban development and on land which is un-used. Sewage would be transported to the works by a main collector sewer 900 - 1000 mm diameter, traversing Aqaba at an elevation of about 30 m. Sewage from approximately half of the first stage population would therefore drain directly into the main sewer, the remainder being pumped from stations near sea level. The collector sewer would also traverse the flat terrain of Wadi Araba thus providing the opportunity for long term development in the area to drain directly into the sewer.

The type of treatment proposed, namely stabilisation ponds is relatively simple to operate, has a minimum of electro-mechanical equipment, and consequently minimum maintenance requirements. The process is flexible and can readily be uprated if required to suit changed circumstances. The quality of the effluent is to secondary standard and suitable for irrigation. In this respect however it should be noted that there would be a loss of effluent during treatment due to percolation and evaporation, but this should not amount to more than 35% in the hottest months.

No regular sludge disposal is necessary.

3. IRRIGATION.

3.1. GENERAL.

Treatment of sewage is to be to secondary standard and following chlorination will therefore be suitable for irrigation. Howard Humphreys were requested in November, 1978 to prepare a master plan for irrigation utilising all available effluent, and also to prepare detailed designs for the first

3.1. GENERAL. (Continued).

Discussions were held with W.S.C., N.P.C., Department of Agriculture, Aqaba Municipality and Aqaba T.P.C. and, based largely on the latter Authority's requirements a scheme was prepared for improving the city's appearance by irrigation of the verges and central reservations, with surplus effluent in the later development stages being used for a forest area in Wadi Araba. The scheme developed to satisfy these requirements is the most economical, but because of the nature of the scheme the capital investment and running costs per unit area irrigated are high when compared with the irrigation of large agricultural or forest areas.

Consequently it was decided, at a meeting in the W.S.C. offices on 14th February, 1980, where all the above mentioned authorities were represented, to use the effluent almost wholly in Wadi Araba for the development of tree belts and for agricultural use.

With such a change in policy it is now advisable to reconsider the basic concepts of the whole project, in particular the siting of the treatment works, to ensure that the scheme finally adopted is the most suitable, efficient and economical.

3.2. REVISION OF IRRIGATION SCHEME IN CONJUNCTION WITH WADI JUSHIYA WORKS.

The present irrigation scheme proposed, is based on disposing of 9000 m^3/day during a period of 6 hours each day (or 18000 m^3/day over 12 hours in Stage 2). It was necessary therefore to construct a balancing reservoir at the works to accept a steady discharge but to instal a large enough trunk main through Aqaba (600 mm dia) to dispose of the effluent in the necessary period.

If all irrigation were to be carried out in Wadi Araba however the most economic solution would be:-

1. Omit balancing reservoir at treatment works.
2. Construct a 350 mm dia. gravity main 7 km long from the treatment works to the irrigation area.
3. Construct a balancing reservoir at a level of 30 m at the irrigation area. The size of this reservoir would depend on the system adopted for irrigation but assuming that this is carried out for 18 hours every day then the capacity of the stage 1 reservoir would be about 2300 m^3.

The terminal reservoir would command sufficient area to utilise all the Stage 2 effluent (18000 m^3/day) although pressure would be insufficient for the operation of sprinklers without boosting. However, pressure in the main through the town would exceed 30 m and could be used for irrigating selected areas of shrubs either from sprinklers or by hoses as practicable throughout

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3.3. IRRIGATION FROM NORTHERN SITE WORKS.

The treatment works at the Northern Site would be at an elevation of about 20 m and so would command, by gravity, areas only below this level. Nevertheless there is potential in the immediate vicinity of the works for utilising all the effluent. The Oasis Scheme is 1 km south of the works, and tree belts between the works and the Oasis Project would:-

1. Provide a screen round the city sides of the works.
2. Dissipate odours and encourage them to rise with convection currents.
3. Provide wind breaks for sheltering irrigated agricultural areas.

The effluent could also be used for irrigating the golf course proposed as part of the Oasis Project.

Irrigation would constitute the principal means of disposing of the effluent so that a reliable irrigation system all year round would be an essential part of the works operation. This may be problematical should the Authority for operating the irrigation scheme not also be the Authority responsible for the treatment.

It is expected that irrigation would be by gravity and consequently not be reliant on electro mechanical equipment. However it would still be necessary to provide some means of emergency disposal of the effluent should for some reason the irrigation be stopped. There are two possible systems of emergency effluent disposal. The first would be an outfall sewer to the Gulf comprising a pipe 900 mm diameter and 4 km long. The disadvantage of such a solution is that the prevailing currents in the Gulf would tend to carry the effluent along the coast where the tourist hotels and beaches are situated, although this could be mitigated to a large extent by proper dissipaters.

An alternative solution would be to discharge the effluent on the surface of Wadi Araba and in view of the high quality of the effluent it is felt that this could be done for a short period in an emergency without a serious nuisance being created.

4. COST ESTIMATES.

The estimated capital and annual costs of the sewerage and irrigation schemes are summarised in Table 1 for works locations at Wadi Jushiya and the Northern Site. The costs of irrigation include all works only up to the balancing reservoir in Wadi Araba since

(1) costs of irrigation works downstream of the balancing reservoir would be the same for both alternatives and so do not affect the comparison.

(2) these costs would not be a charge on the W.S.C. but on the responsible irrigation Authority or on private users.

5. COMPARISON OF ALTERNATIVES.

The relative advantages of each scheme are summarised in Table 2.

The overall cost of the Northern Site Alternative is J.D. 919,000 less than that of the Wadi Jushiya Scheme.

The major advantage of the Northern Site Scheme however is in the absence of major electro-mechanical equipment whereas the Wadi Jushiya Scheme requires a very high proportion of such equipment with high power and maintenance costs and associated maintenance responsibilities. The power cost factor will become increasingly important as fuel costs continue to rise. From Table 1 it will be seen that the annual power and maintenance costs for the Northern Site Scheme are J.D. 160,900 less than for the Wadi Jushiya Alternative. In addition the staffing costs for the Northern treatment works will be less than for the Wadi Jushiya works. Probably of more importance, the labour necessary for the Northern works would be largely unskilled, whereas a high proportion of semi-skilled personnel, in short supply in Jordan, would be necessary to operate the Wadi Jushiya works.

From the point of view of the use of effluent for irrigation, the Wadi Jushiya Scheme has three advantages over the Northern Site Scheme.

(1) The terminal reservoir would be at a higher level and so would command a larger area for irrigation by gravity.

(2) The treatment losses would be less and consequently more effluent would be available for irrigation.

(3) It would be possible to irrigate parts of Aqaba in the vicinity of the main either by sprinkler or hose.

These advantages, however, are of a minor nature and should not have a large influence on the selection of the better scheme.

The major advantage of the Wadi Jushiya Scheme is the complete lack of risk of environmental pollution whereas there is always some element of risk from works situated at the Northern Site. It is important to note in this context, however, that works of a similar type are situated on the western side of the cease fire line in the vicinity of the proposed Northern Site and no odour nuisance is experienced from there.

The choice of works site - and consequently of scheme - can be narrowed down to two main factors:

(1) The Northern Site Scheme would be much simpler to operate, is cheaper in initial capital outlay and very considerably more economical in running costs. Consequently on engineering and economic grounds it is to be recommended.

(2) There is, however, a slight risk of environmental pollution from the Northern Site works. These would be 4 km away from the nearest area of habitation and it is unlikely that odour nuisance would be experienced in Aqaba.

Should the Northern Site be adopted it would be necessary to re-design not only the works but the whole sewerage system, thus incurring additional design costs and delaying the start of construction by six months. This should not deter the Government from selecting the scheme which is best in the long run.

6 CONCLUSIONS

It has been accepted in principle by the Government that the effluent should be used for furrow irrigation in Wadi Araba. Under these circumstances there are substantial technical and economic advantages in locating the treatment works at the Northern Site, particularly with regard to ongoing costs. There is, however, a risk of odour nuisance in the town but with proper planning of tree belts and bearing in mind the distance from the nearest inhabited area, this risk is thought to be minimal.

It is recommended that serious consideration should be given to re-locating the treatment works at the Northern Site and re-designing the sewage scheme accordingly.

TABLE 1 - Cost Comparison of Alternatives.

Description.	Costs (J.D.) Wadi Jushiya Alternative.	Northern Site Alternative.	
CAPITAL COSTS.			
Treatment Works			
- civil works	1,436,000	1,190,000	(1)
- electro-mechanical	827,000	180,000	
Sewerage			
- civil works	710,000	1,241,000	
- electro-mechanical	520,000	123,000	
Irrigation (2)	260,000	100,000	
Total capital costs	JD 3,753,000	JD 2,834,000	30%
ANNUAL COSTS. (3)			
Power at 35 fils/unit			
- sewerage and treatment	200,000	70,200	
- irrigation	nil	nil	
Maintenance			
- civil works	8,000	7,200	
- electro-mechanical	37,800	7,500	
Total power and maintenance	JD 245,800	JD 84,900/annum	

NOTES:

1. This capital cost excludes the emergency outfall sewer 4400 m long to the Gulf, cost J.D. 630,000.

2. These capital costs include only for transporting effluent to the irrigation area in Wadi Araba (Wadi Jushiya alternative only) and for irrigation headworks. They do not include the cost of irrigation which is common to both.

3. Annual costs include here only power and maintenance costs. The numbers of staff required to operate the works would be similar but whereas semi-skilled persons would be required for the Wadi Jushiya treatment works, only unskilled labour would be required at the Northern Site.

TABLE 2 - Comparison of Alternatives

Wadi Jushiya	Northern Site
Minimum length of sewers	Long expensive collector sewer. May be useful in future if Wadi Araba is developed above collector level.
All sewage gravitates to sea level and must be pumped to works at level 65 m.	50% of sewage gravitates to collector. Remainder pumped from sea level to a level of 35 m.
Restricted site, type of treatment limited.	Easy open site, suitable for stabilisation ponds.
Expensive wadi training works. No room for expansion after Stage 2.	Unlimited area for expansion and modification.
Treatment requires high proportion of electro-mechanical equipment with relatively high running costs.	Works mechanically simple with minimum maintenance requirements.
Good effluent for irrigation.	Good effluent for irrigation but tendency for algal growth.
All effluent available for irrigation.	Loss of effluent by seepage and evaporation max. 35% in summer months.
Site also used for solid waste disposal; unpleasant smell and fly nuisance. Environmental problems contained within wadi.	Open site; may be odour problem in area of works but ready dissipation expected and risk of nuisance in Aqaba very slight.
Irrigation by gravity in Wadi Araba possible below terminal reservoir level of 30 m.	Irrigation by gravity in Wadi Araba possible below reservoir level of 20 m.
Irrigation in town possible by hose or sprinklers from trunk main.	No irrigation possible in town from effluent system without additional pipework.
Emergency disposal of effluent into Gulf.	Emergency disposal of effluent into Gulf. Possibility of emergency disposal into Wadi Araba.

(contd./)

TABLE 2 - Comparison of Alternatives (contd.)

Wadi Jushiya	Northern Site
Contract documents available March 1980.	Requires complete re-design of sewerage project and preparation of new contract documents.
Higher capital cost.	Lower capital cost.
Much higher power costs.	Much lower power costs.
Higher maintenance costs.	Lower maintenance costs.

A N N E X N

UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT
AMERICAN EMBASSY
AMMAN — JORDAN

وكالة الولايات المتحدة للانماء الدولي
السفارة الاميركية
عمان - الاردن

OFFICE OF THE DIRECTOR

مكتب المدير

Excellency:

Subject: AID Loan 278-K-026
Aqaba Wastewater Project
Implementation Letter No. 5

In reference to the revised Aqaba Wastewater Project design, USAID is pleased to advise that having reviewed the design revisions we hereby approve all modifications as proposed and, by this implementation letter, incorporate all such modifications into the subject Loan Agreement and make such other changes as are necessary for timely implementation of the subject project.

Attached hereto (Attachment No. 1) is a revised Annex I, Project Description, to the subject Loan Agreement which reflects the various modifications made to the project design.

The terminal date for satisfying the one remaining condition precedent to disbursement, Section 5.1(g), is hereby extended from June 25, 1980 to January 31, 1981. We would like to advise that as a result of the design revision this remaining condition precedent can be satisfied by a statement to the effect that the irrigation system will not be required until sufficient effluent becomes available and, that when it can be predicted that effluent will be available, the necessary system will be constructed in recognition that Special Covenant 6.4 commits the Government to effective effluent utilization.

His Excellency
Hanna Odeh, President
National Planning Council
Amman, Jordan

The "Project Assistance Completion Date" (PACD), as defined in Section 3.3(a), is hereby extended from December 31, 1982 to December 31, 1983 with the terminal date for requesting disbursements, Section 3.3(c), concurrently extended until September 30, 1984.

Please indicate your acceptance of the actions contained herein by returning one signed copy of this implementation letter to this office.

Very truly yours,

Edgar C. Harrell
Director

Signature: _____
Hanna Oden
President

ANNEX I
REVISED
PROJECT DESCRIPTION

1. OBJECTIVE:

The objective of the project is to provide wastewater services (sewage collection and secondary treatment) to the residents of the City of Aqaba at rates which are affordable with an environmentally safe means of disposing all effluent from the sewage treatment plant.

2. PROJECT COMPONENTS

(a) The project comprises the following two major elements:

(i) Supply of materials for and construction of a sewage collection system serving all developed area of the City of Aqaba. (While largely involving new construction, where practicable in certain instances the new collection system will incorporate parts of the limited existing collection network, which will be upgraded to the standards of the new system); and,

(ii) Supply of equipment for and construction of a sewage treatment plant designed to provide secondary treatment of up to 9,000 cubic meters of sewage per day.

(b) The project will be implemented by the Water Supply Corporation acting on behalf of the Government. In addition to the construction program, it will include appropriate training to insure the proficiency of the WSC staff members responsible for project administration and operations.

3. EVALUATION

Project evaluation will verify achievement of the project objectives and analyze the social and equity impacts of the project. The following should be included among the indicators of project achievement and effect:

(a) Are all residents and businesses in Aqaba City connected to a fully functioning sewage collection system?

(b) Is the sewage treatment plant operating within acceptable standards with regard to quality of effluent?

(c) Is the sewage treatment plant usually operating without producing noticeable amounts of unpleasant odors?

(d) What has been the incidence of pest breeding (particularly mosquitos and snails) within the confines of the treatment plant? How successful have countermeasures been to eliminate any such breeding?

(e) Who are the project's beneficiaries?

(f) What problems have been encountered in connecting all users to, or otherwise in effecting full utilization of, the system?

(g) What has been the impact of imposing user tariffs on residential consumers of water and sewer services and what problems have occurred as the result of imposing such tariffs?

(i) Is there a need for health and sanitary training and education in the project area?

A.I.D. will make its best efforts to fund project evaluation, either from Project funding (if sufficient funds remain unexpended after Project completion) or from other sources.

4. COST ESTIMATE:

The total cost of the project as described above is estimated at $15,479,000 including supervision, contingencies and interest during construction. Of this amount $7,500,000 is to be financed by the A.I.D. Loan and the remaining $7,979,000 by the Government, through the Water Supply Corporation. The expected disbursement schedule for foreign exchange and local currency costs is as follows:

ESTIMATED DISBURSEMENT SCHEDULE

($000.)

	A.I.D.		G.O.J.		TOTALS	
	FX	LC	FX	LC	FX	LC
1979-80	0	0	68	20	68	20
1981	2,569	501	116	2,255	2,685	2,756
1982	3,096	615	130	3,362	3,226	3,977
1983	638	81	49	1,289	687	1,370
1984	0	0	132	548	132	548
Totals	6,303	1,197	495	7,474	6,798	8,671
Combined	7,500		7,979		15,479	

5. PROJECT SCHEDULE

The following are estimated dates for significant project activities:

a.	Contract for consulting engineering services signed	June, 1979
b.	CBD notices for contractor prequalification published	November 26, 1980
c.	Consultant submits draft bid documents for contract	August, 1980
d.	Detailed bid documents completed	December, 1980
e.	Bid documents issued to prequalified firms	February, 1980
f.	Bid opening	April, 1981
g.	Contracts approved	May, 1981
h.	NTP to construction contractor delivered	June, 1981
i.	Electrical and mechanical equipment delivery begins	October, 1981
j.	Equipment installation (including suppliers' training programs) begins	April, 1982
k.	Training programs begin for (i) administration and (ii) operations	Mid-1982
l.	Contract completion and plant start-up	February, 1983
m.	Evaluation begins	November, 1983
n.	Evaluation report completed and submitted	February, 1984

A N N E X O

UNITED STATES GOVERNMENT

Memorandum

TO : NE/PD/SLIJO, Robert Fedel, Project Chairperson DATE: July 11, 1980

FROM : NE/PD/EDS, Stephen F. Lintner, Bureau Environmental Coordinator

SUBJECT: JORDAN - Aqaba Wastewater Project - Design Modification (278-0205) Environmental Clearance

I have reviewed the documentation concerning the proposed design modification to the project and find that it does not change the status of the previous environmental clearance. The design modification will result in significant environmental improvement in the project due to the selection of Wadi Araba site, particularly through the elimination of the potential need for emergency disposal of effluent into the Gulf of Aqaba.

It should be noted that the use of any portion of the treated effluent for commercial cultivation of agricultural crops presents a potentially major risk to environmental health, therefore, it is essential that an understanding be reached between USAID and the Government of Jordan which will result in a program of systematic monitoring on a regular basis. Such an understanding should identify the party responsible for monitoring and specify the form and interval of monitoring reports. In addition provisions should be made to for monitoring of odor, insect and snail control activities as outlined in the document reviewed. Copies of such monitoring reports should be provided to my office for inclusion in the files.

cc: GC/NE, S. Carlson
USAID/Amman, R. Cline, Mission Environmental Officer
USAID/Amman, J. Cassanos, Sanitary Engineering Advisor
USAID/Amman, G. Davidson, Regional Legal Advisor

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