

JAPAN INTERNATIONAL COOPERATION AGENCY  
MINISTRY OF WATER AND IRRIGATION  
THE HASHEMITE KINGDOM OF JORDAN

**THE STUDY ON  
WATER RESOURCES MANAGEMENT  
IN  
THE HASHEMITE KINGDOM OF JORDAN**

**FINAL REPORT VOLUME IX**

**SUPPORTING REPORT  
FOR**

**PART-B PRE-FEASIBILITY STUDY ON  
PRIORITY PROJECTS**

- CHAPTER 1 REHABILITATION AND EXTENSION OF MA'AN  
WASTEWATER TREATMENT PLANT AND TREATED  
WASTEWATER REUSE OF FIVE EXISTING  
TREATMENT PLANTS**
- CHAPTER 2 WADI ZARQA TREATMENT PLANT CONSTRUCTION**
- CHAPTER 3 NATIONAL WATER CONTROL SYSTEM**
- CHAPTER 4 MUNICIPAL WATER NETWORK REHABILITATION**
- CHAPTER 5 WEHDA-IRBID WATER SUPPLY**

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**The Study on Water Resources Management in the Hashemite Kingdom of Jordan**

**FINAL REPORT VOLUME IX  
SUPPORTING REPORT  
FOR**

**PART-B “PRE-FEASIBILITY STUDY ON PRIORITY PROJECTS”**

**Chapter 1 Rehabilitation and Extension of Ma’an Wastewater Treatment  
Plant and Treated Wastewater Reuse of Five Existing Treatment  
Plants**

**Chapter 2 Wadi Zarqa Treatment Plant Construction**

**Chapter 3 National Water Control System**

**Chapter 4 Municipal Water Network Rehabilitation**

**Chapter 5 Wehda-Irbid Water Supply**

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**SUPPORTING REPORT  
FOR**

**CHAPTER 1**

**Rehabilitation and Extension of  
Ma'an Wastewater Treatment Plant  
and  
Treated Wastewater Reuse of  
Five Existing Treatment Plant**

**Supporting Report for Chapter 1**  
**“Rehabilitation and Extension of**  
**Ma’an Wastewater Treatment Plant and**  
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**Five Existing Treatment Plant”**

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**ANNEX to 1.2**  
**Existing System**

**BASIC DATA OF TREATMENT PLANT:**

**Ma'an**

(Data of 1999, if not another year indicated)

10

<b>Town:</b>	Ma'an
<b>Governorate:</b>	Ma'an
<b>Treatment plant:</b>	Ma'an
<b>Date of visit:</b>	3.4.2000
<b>Responsible engineer:</b>	Haidar Ali Raswashdeh
<b>Contacted person:</b>	Mohammed Mefleh Qtieshat
<b>Telephone:</b>	none

**Population**

Tot.population living in towns with sewerage:	inhabitants	27.200
Population growth	%	3,6

**Wastewater disposal**

Public system	%	54
Cesspools	%	46
Others	%	0

**Wastewater collection**

Towns/villages connected (the most important)	-	Ma'an
Population connected (as coverage treatment)	c	14.700
Coverage	%	54
Important industries	-	no important water polluting industries connected
Number of stormwater overflows works	no.	none
Length of sewers	km	52,8
Length per connected capita	m/c	3,6
House connections	h.c.	871
Capita per house connection	c/h.c.	16,9
Return factor (acc. to Design Report)	-	0,85
Monthly peak factor	-	1,25
Employees for wastewater collection	E	4
Factor: Sewer length per connected capita/coverage		6,6





**BASIC DATA OF TREATMENT PLANT:**

**Ma'an  
10**

**Cost of wastewater treatment**

Operation and maintenance cost	JD/a	46.350
Operation/maintenance cost related to influent	JD/m <sup>3</sup>	0,073

**Performance of wastewater collection**

Employees for wastewater collection	E	4
Number of employees per 1,000 house conn.	E/1000 h.c.	4,6
Recommended number of employees	E/1000 h.c.	2 - 4
Number of employees per km sewer	E/10km	0,8
Average number of complaints per month	1/month	85
Average number of complaints per km sewer	1/month/km	1,6

**Performance of wastewater treatment**

Treatment efficiency (BOD <sub>5</sub> acc.to WAJ data)	%	79
Expected efficiency (acc.to experience)	%	80 - 90
Used treatment capacity (hydraulic)	%	109
Odor problems	-	minor (particularly in summer)
Specific treatment problems		no laboratory available at plant
Power-cuts		1 per month (1-2 h), no generator available
Operation/maintenance arrangement available		none
Employees for wastewater treatment	E	15
Recommended number of employees (WWTP)	E	5

**Environmental impacts of effluent**

Discharge of effluent into	Wadi Al Hamam
Requirements acc. to JS 893/1995 (according to WAJ data)	not respected

**Reuse of effluent for agricultural irrigation**

Possible reuse (acc. to JS 893/1995)	restricted irrigation only
Practice of restricted irrigation	in summer: 500 m <sup>3</sup> /d, in winter 200 m <sup>3</sup> /d
Practice of unrestricted irrigation	no
Irrigation near treatment plant	donums 120

**ANNEX to 1.5.2.2**

**Preliminary Design of**

**Treatment Plant**

## SUMMARY OF DIMENSIONING TREATMENT PLANT Ma'an

Horizon of dimensioning: **2015**

Component	Unit	Required in 2015	Existing in 2000
Influent discharge	m <sup>3</sup> /d	3.765	1.890
BOD <sub>5</sub> - load	kg/d	2.559	1.290
Concentration BOD <sub>5</sub>	mg/l	680	685
Min.average temperature (water)	°C	16,0	16,0
Fecal coliforms	col/100ml	1,00E+07	1,00E+07
<b>Influent at treatment plant (PHASE 1)</b>			
Pump station at entrance (Qmax)	m <sup>3</sup> /h	0	0
Screening (width 0.5 m)	-	1	1
Grit chamber (surface)	m <sup>2</sup>	0,0	0,0
<b>Anaerobic ponds (PHASE 1)</b>			
Number of ponds	-	4	2
Retention time	d	6	12
Total surface at mi-depth	ha	0,690	0,320
Depth	m	3,50	5,00
<b>Facultative ponds (PHASE 1)</b>			
Number of ponds	-	7	3
Retention time	d	25	23
Total surface at mi-depth	ha	7,787	1,740
Depth	m	1,20	2,50
<b>Maturation ponds (PHASE 1)</b>			
Number of ponds in series	-	3	1
Number of ponds in parallel	-	1	1
Retention time	d	6	6
Total surface at mi-depth	ha	1,483	0,750
Depth	m	1,25	1,25
All ponds (anaerobic, facultative and maturation)			
Total net surface at mi-depth (PHASE 1)	ha	9,961	2,810
Total retention time	d	37	41
Effluent discharge	m <sup>3</sup> /d	2.961	1.500
BOD <sub>5</sub> -load at effluent	kg BOD <sub>5</sub> /d	40	190
Concentration of BOD <sub>5</sub> at effluent	mg BOD <sub>5</sub> /l	14	128
Fecal coliforms at effluent	col/100ml	4,45E+02	1,00E+06
Add.surface for pretreatment (op.building, headworks)	ha	1,00	
Surface sludge drying beds	ha	0,53	
<b>Surface of the treatment plant</b>			
Factor taking into account additional surfaces		1,20	
Total gross surface for treatment plant	ha	13,80	13,80

## PRELIMINARY DIMENSIONING OF THE TREATMENT PLANT OF Ma'an

**Horizon de dimensioning: 2015**

### Screening

Component		Dimension	Horizon 2015
Max. discharge	Qmax	m <sup>3</sup> /s	0,104
Max. velocity at screen	v	m/s	1,00
Inclination of bars (H : V)	1	:	3
Bar size	s	mm	10
Space between bars	e	mm	20
Degree of covering	eta	-	60%
Required width of screen	Bg	m	0,39
Proposed width of screen channel	Bg	m	0,50
Required number of units	Nb	-	0,8
Chosen number of units	Nb	-	1
Annual quantity of screening chosen (2 - 5 l/c/a)			5
Annual quantity to sanitary landfill		m <sup>3</sup> /a	197

### Sludge drying beds

Component		Dimension	Horizon 2015
Specific sludge quantity		m <sup>3</sup> /c/a	0,040
Total connected population (incl. pop.equ.)	c	-	39.375
Annual sludge quantity	Qs	m <sup>3</sup> /a	1.575
Daily sludge quantity	Qsj	m <sup>3</sup> /d	4,3
Interval of desludging activity (intermittent)		a	1,0
Sludge quantity per desludging action	Qs	m <sup>3</sup>	1.575
Chosen depth of drying beds	h	m	0,30
Required surface	S	m <sup>2</sup>	5.250
<b>Dimension of beds:</b>			
Length		m	25
Width		m	5
Number of required beds	Nb	-	42
Required surface	S	m <sup>2</sup>	5.250
Gross surface (+25%)	S	m <sup>2</sup>	6.563

**ANAEROBIC PONDS**

**Ma'an**

Horizon of dimensioning:

**2015**

**PHASE 1**

Component	Unit			
<b>Basic parameters</b>				
Discharge	Q	m <sup>3</sup> /d		3.765
Influent BOD <sub>5</sub> -load	Ca	kg/d		2.559
Total connected population	c+eq	c		39.375
Concentration BOD <sub>5</sub>	CBOD <sub>5</sub>	mg/l	CBOD <sub>5</sub> = Ca / Q <sub>max</sub> * 1000 =	680
Production of sludge	Pb	m <sup>3</sup> /(c*a)		0,04
Chosen interval of desludging	lb	1/a		1,00
Average minimum air temperature	T	°C		8,0
Average min. sewage temperature		°C		<b>16,0</b>
Chosen retention time	t <sub>R</sub>	d		6,0
<b>Dimensioning</b>				
Coefficient of BOD <sub>5</sub> -elimination	K <sub>T</sub>	d <sup>-1</sup>	K <sub>T</sub> = 1,2/(1,085 <sup>(35-t<sub>R</sub>)</sup> ) =	0,25
Volume of sludge	Vb	m <sup>3</sup>	Vb = Pb * EH * (1 / lb) =	1.575
Depth of sludge layer	Hb	m	Hb = Vb / F =	0,23
Volume of water	Ve	m <sup>3</sup>	Ve = Q * t <sub>R</sub> =	22.591
Required volume	Vn	m <sup>3</sup>	Vn = Vb + Ve =	24.166
Chosen depth of ponds	H	m		3,50
Required total surface (at mid-depth)	F (at)	ha	F = Vn / H / 10.000 =	0,690
Volumetric load	Cv	kg/(m <sup>3</sup> *d)	Cv = Ca / Vn < 0,25 =	0,11
Surface load	Cs	kg/(ha*d)	Cs = Ca / F > 1000 =	3.707
Number of basins	Nb	Nb		4
Volume per basin	V	m <sup>3</sup>	V = Vn / Nb =	6.042
Length (at mi-depth)	L1	m		42
Width (at mi-depth)	B1	m		42
Angle of slope	I		1 : 3,0	
Length of water surface	L2	m		52
Width of water surface	B2	m		52
Length of bottom	L3	m		31
Width of bottom	B3	m		31
Free bord		m		0,50
Length including free board	L4	m		55
Width including free board	B4	m		55
Effluent load	Che	kg/d	Che = Ca / (Kt * t <sub>R</sub> + 1) =	1.012
Effluent concentration BOD <sub>5</sub>	Ce	mg/l	Ce = Che / Qmax * 1000 =	269

**FACULTATIVE PONDS**

**Ma'an**

Horizon of dimensioning:

**2015**

**PHASE 1**

Component		Unit		
<b>Basic parameters</b>				
Discharge	Q	m <sup>3</sup> /d		3,765
Influent BOD <sub>5</sub> -load	Ca	kg/d		1,012
Total connected population	c+eq	c		39,375
Concentration BOD <sub>5</sub>	CBOD <sub>5</sub>	mg/l		269
Production of sludge	Pb	m <sup>3</sup> /(c*a)		0,01
Chosen interval of desludging	lb	1/a		0,10
Average minimum air temperature	T	°C		8,0
Average minimum sewage temperature	T	°C		16,0
Evaporation (aver.) - Precipitation (aver.)	Ev	mm/d		8,7
Fecal coliforms	Cf	col/100ml		1,00E+07
<b>Dimensioning</b>				
Surface load permitted (Arthur)	Cs	kg/(ha*d)	$Cs = 20 * T - 60$	100
Surface load permitted (McGarry & Pescod)	Cs	kg/(ha*d)	$Cr = 60,3 * 1,0993^{19a} / 1,5$	100
Chosen surface load	Cs	kg/(ha*d)	=	130
Total required surface	Freq	ha	$Freq = Ca / Cs$	7,787
Depth	H	m		1,20
Volume of sludge	Vb	m <sup>3</sup>	$Vb = Pb * EH * (1 / lb)$	3,938
Depth of sludge layer	Hb	m	$Hb = Pb * EH / F * (1/lb)$	0,05
Total volume of basins	Vt	m <sup>3</sup>	$Vt = F * H$	93,448
Existing number of basins	Nexist	-		3
Existing width per exist.basin (at mid-depth)	B	m	=	40
Existing length per exist.basin (at mid-depth)	L	m	=	150
Existing surface	Fexist.	ha		1,800
Required additional surface	Fadd.	ha	$Fadd = F req - Fexist$	5,987
Chosen number of new parallel basins	Nnew	-	=	4
Required surface per new basin	Fnew	ha	$Fnew = Fadd / Nnew$	1,50
Chosen width per new basin (at mid-depth)	B	m	=	100
Length per basin (at mid-depth)	L	m	=	150
Retention time	tR	d	$tR = Vt / Q$	25
Coefficient of BOD <sub>5</sub> -elimination	K <sub>T</sub>	d <sup>-1</sup>	$K_T = 1,2 / (1,085^{(35-t_R)})$	0,13
Water losses due to evaporation	Pe	m <sup>3</sup> /d	$Pe = Ev * F$	676
Effluent discharge	Qe	m <sup>3</sup> /d	$Qe = Q - Pe$	3,089
Effluent BOD <sub>5</sub> -load	Che	kg/d	$Che = Ca * 1 / (Kt * tR + 1)$	236
Effluent concentration BOD <sub>5</sub>	Ce	mg/l	$Ce = Che / Qe * 1000$	76
Coeff. for reduction of coliforms	Crf	[-]	$Crf = 1 + K * tR$	33
Where	K	d <sup>-1</sup>	$K = 2,6 * (1,19)^{T - 20}$	1,30
coliforms in effluent	Col	col/100ml	$Ne = Ni / Crf$	3,01E+05

**MATURATION PONDS**

Ma'an

Horizon of dimensioning:

2015

PHASE 1

Component		Unit		
<b>Basic parameters</b>				
Discharge	Q	m <sup>3</sup> /d		3.089
Influent BOD <sub>5</sub> -load	Ca	kg/d		236
Total connected population	c+eq	c		39.375
Concentration BOD <sub>5</sub>	CBOD <sub>5</sub>	mg/l		76
Average min. air temperature	Ta	°C		8,0
Average min. sewage temperature	Tw	°C		16,0
Evaporation (aver.) - Precipitation (aver.)	Ev	mm/d		8,7
Coefficient of elimination				
Fecal col. at the effluent of fac. ponds	Col	col/100ml		3,01E+05
Requi. conc. of coliforms at effluent	Cole	col/100ml		1.000
Chosen retention time of each basin	tR	d		6,0
<b>Dimensioning</b>				
Surface load permitted (Arthur)	Cs	kg/(ha*d)	Cs = 20 * T - 60	100
Surface load permitted (McGarry & Pescod)	Cs	kg/(ha*d)	Cr = 60,3 * 1,0993 <sup>Ta</sup> / 1,5 =	100
Coefficient of elimination	K	d <sup>-1</sup>	K = 2,6 * 1,19 <sup>T-20</sup> =	1,30
Required number of basins	Nb	Nb	Nb = log (Col/Cole) / log(K * tR + 1) =	3
Chosen number of basins in series	Nb	Nb		3
Chosen depth	H	m	between 1.0 et 1.5 m	1,25
Required surface (total)	S	ha	S = V / H / 10.000 =	1,483
Required volume (total)	V	m <sup>3</sup>	V = Q * tR =	18.536
Chosen surface of 1st basin	S1	ha		0,750
Surface load in 1st basin		kg/(ha*d)		315
Width 1st basin (at mid-depth)	W1	m		74
Length 1st basin (at mid-depth)	L1	m		101
Retention time	tR	d	tR = V / Q =	6
No. of parallel basins	Np	Nb		1
Width 2nd/3rd basins (at mid-depth)	W2	m		50
Length 2nd/3rd basins (at mid-depth)	L2	m		73
Coefficient of elimination BOD <sub>5</sub>	K <sub>T</sub>	d <sup>-1</sup>	K <sub>T</sub> = 1,2 / 1,085 <sup>35-T</sup> =	0,25
Water losses due to evaporation	Pe	m <sup>3</sup> /d	Pe = Ev / 1000 * S =	129
Effluent discharge	Qe	m <sup>3</sup> /d	Qe = Q - Pe =	2.961
Effluent concentration BOD <sub>5</sub>	Ce	mg/l	Ce = Ca / (Kt * tR * Nbs + 1) =	14
Effluent BOD <sub>5</sub> -load	Che	kg/d	Che = Ce * Qe * 1000 =	40
Coliforms in effluent	Colm	col/100ml	Colm = Col / (1 + K * tR) <sup>Nbs</sup> =	4,5E+02

**ANNEX to 1.12.3.1**

**Operation and Maintenance  
Cost for Sewage System and  
Treatment Plant (Ma'an)**



**Operation cost for wastewater disposal system (Ma'an)**  
**Staff cost (for existing and proposed facilities)**

**2005**

Staff member	Treatment plant			Sewerage system		
	No.requ.	Level	Salary	No.requ.	Level	Salary
Chief engineer	1	19	6.000	0	19	0
Chief of system	0	18	0	0	18	0
Technician/Chief of crew	1	17	3.500	0	17	0
Technician laboratory	0	17	0	0	17	0
Skilled worker	2	11	6.000	1	11	3.000
Driver	0	5	0	1	5	2.500
Unskilled worker	2	4	4.000	2	4	4.000
Guard	2	4	4.000	0	4	0
Technician (resp. for pumps)		17	0	0	17	0
<b>TOTAL</b>	<b>8</b>		<b>23.500</b>	<b>4</b>		<b>9.500</b>
<b>SUB-TOTAL (technical staff)</b>						<b>33.000</b>
<b>Required Technical Staff</b>	<b>12</b>					
Cost for administration (30%)						9.900
<b>TOTAL COST (JD/a)</b>						<b>42.900</b>

**2015**

Staff member	Treatment plant			Sewerage system		
	No.requ.	Level	Salary	No.requ.	Level	Salary
Chief engineer	1	19	6.000	0	19	0
Chief of system	0	18	0	0	18	0
Technician/Chief of crew	1	17	3.500	0	17	0
Technician laboratory	0	17	0	0	17	0
Skilled worker	3	11	9.000	2	11	6.000
Driver	0	5	0	1	5	2.500
Unskilled worker	3	4	6.000	2	5	4.000
Guard	2	4	4.000	0	5	0
Technician (resp. for pumps)		17	0	0	17	0
<b>TOTAL</b>	<b>10</b>		<b>28.500</b>	<b>5</b>		<b>12.500</b>
<b>SUB-TOTAL (technical staff)</b>						<b>41.000</b>
<b>Required Technical Staff</b>	<b>15</b>					
Cost for administration (30%)						12.300
<b>TOTAL COST (JD/a)</b>						<b>53.300</b>

**Operation cost for wastewater disposal system (Ma'an)**  
**Maintenance cost (for existing and proposed facilities)**

**2005**

Component	Percentage	Unit	Costs
<u>Investment cost:</u>			
- Civil works WWTP (existing)	-	JD	240.000
- Civil works WWTP (extension)	-	JD	660.721
- Equipment E&M (existing)	-	JD	11.950
- Equipment E&M (extension)	-	JD	10.278
- Sewers (existing)	-	JD	2.650.000
- Sewers (extension)	-	JD	920.000
- Cars, machines	-	JD	50.000
<u>Maintenance</u>			
- Civil works (treatment plant)	0,5%	JD/a	4.504
- Equipment E&M	2,0%	JD/a	445
- Sewers (network)	0,5%	JD/a	17.850
- Cars, machines	5,0%	JD/a	2.500
<b>Total maintenance cost:</b>	<b>0,6%</b>	<b>JD/a</b>	<b>25.298</b>

**2015**

Component	Percentage	Unit	Costs
<u>Investment cost:</u>			
- Civil works WWTP (existing)	-	JD	240.000
- Civil works WWTP (extension)	-	JD	660.721
- Equipment E&M (existing)	-	JD	11.950
- Equipment E&M (extension)	-	JD	10.278
- Sewers (existing)	-	JD	2.650.000
- Sewers (extension until 2015)	-	JD	1.840.000
- Cars, machines	-	JD	50.000
<u>Maintenance</u>			
- Civil works (treatment plant)	0,5%	JD/a	4.504
- Equipment E&M	2,0%	JD/a	445
- Sewers (network)	0,5%	JD/a	22.450
- Cars, machines	5,0%	JD/a	2.500
<b>Total maintenance cost:</b>	<b>0,5%</b>	<b>JD/a</b>	<b>29.898</b>

**Operation cost for wastewater disposal system (Ma'an)**  
**Cost for consumables (for existing and proposed facilities)**

2005/2015

Component		Unit	Costs	
			2005	2015
<u>Fuel</u>				
Daily quantity	Q <sub>j</sub>	l/d	30	40
Annual quantity 1)	Q	l/a	6.000	8.000
Unit price	C'	JD/l	0,30	0,30
Annual cost	C <sub>a</sub> '	JD/a	1.800	2.400
<u>Lubricants</u>				
Annuals cost	C <sub>l</sub>	JD/a	200	300
<b>Total cost:</b>	<b>C<sub>c</sub></b>	<b>JD/a</b>	<b>2.000</b>	<b>2.700</b>

1) 200 working days per year

**Operation cost for wastewater disposal system (Ma'an)**  
**Cost for desludging of ponds (for existing and proposed facilities)**

2005/2015

Component		Unit	Costs	
			2005	2015
<u>Desludging of anaerobic ponds</u>				
Production of sludge	Q <sub>b</sub>	m <sup>3</sup> /PE/a	0,040	0,040
No. of population equivalentents	H	PE	27.980	39.375
Production of sludge	P <sub>b</sub>	m <sup>3</sup> /a	1.119	1.575
Frequency of desludging	f	1/a	1	1
Unit cost	C'	JD/m <sup>3</sup>	5	5
<b>Total cost:</b>	<b>C<sub>d</sub></b>	<b>JD/a</b>	<b>5.596</b>	<b>7.875</b>

PE = population-equivalentents

**Operation cost for wastewater disposal system (Ma'an)**  
**Energy cost (for existing and proposed facilities)**

2005/2015

Component	Unit	Costs	
		2005	2015
<u>Required energy Treatment Plant</u>	kWh/d	140	180
-Lifting station (H=0m)	kWh/d	0	0
-Lighting, sludge pumping etc.	kWh/d	140	180
<u>Required energy Sewerage System</u>			
Required energy Pumping Station	kWh/d	0	0
Total daily required energy	kWh/d	140	180
Annual required energy	kWh/a	51.100	65.700
Unit price	JD/kWh	0,023	0,023
<b>Total cost:</b>	<b>JD/a</b>	<b>1.175</b>	<b>1.511</b>

**Operation cost for wastewater disposal system (Ma'an)**

**Total operation cost (for existing and proposed facilities)**

Component	Unit	Costs	
		2005	2015
Staff cost	JD/a	42.900	53.300
Maintenance cost	JD/a	25.298	29.898
Cost for consumables	JD/a	2.000	2.700
Energy cost	JD/a	1.175	1.511
Desludging of ponds	JD/a	5.596	7.875
<b>Total cost:</b>	<b>JD/a</b>	<b>76.970</b>	<b>95.284</b>

**ANNEX to 1.12.3.2**

**Operation and Maintenance**

**Cost for Reuse System**

**Cost estimation for wastewater reuse facilities**

**Abu Nuseir**

Investment cost (Target year 2010)

(Price basis 2001)

Component	Unit	Quantity	Unit cost (JD/unit)	Total Cost (JD)		
				Foreign	Local	Total
Land acquisition (for transmission line/reservoir)	ha	0,48	30.000	0	14.400	14.400
Pump station (Q = 0 m <sup>3</sup> /h, H = 0 m)						
Civil works	m <sup>3</sup> /h	0		0	0	0
Electromechanical equipment	m <sup>3</sup> /h	0		0	0	0
Transmission main DN 300, Concr.	m	900	69	0	62.100	62.100
Transmission main DN 0,	m	0		0	0	0
Reservoir 6000 m <sup>3</sup>	m <sup>3</sup>	1	103.000	33.990	69.010	103.000
Distribution network	ha	80	not considered			0
Others						
<b>Subtotal I (base cost for infrastructure)</b>				<b>33.990</b>	<b>145.510</b>	<b>179.500</b>
Administration cost	5% of base cost			0	8.975	8.975
Engineering cost	10% of base cost			14.360	3.590	17.950
<b>Subtotal II (indirect cost)</b>				<b>14.360</b>	<b>12.565</b>	<b>26.925</b>
Physical contingencies	10% of total above			4.835	15.808	20.643
<b>Total</b>				<b>53.185</b>	<b>173.883</b>	<b>227.068</b>
Specific investment cost (JD/1000m <sup>3</sup> /a effluent)						214

**Operation and maintenance cost (Target year 2010)**

Maintenance cost	Percentage	Invest .cost	Cost
	%	JD	JD/a
Civil works	0,5	103.000	515
Electromechanical equipment	2,0	0	0
Mains, distribution network	0,5	62.100	311
<b>Subtotal (maintenance cost)</b>			<b>826</b>
Staff cost	Number	Staff cost	Cost
		JD/a	JD/a
Required staff	1	3.500	3.500
Energy cost	Discharge	Height	Cost
	m <sup>3</sup> /a	m	JD/a
Pumping	1.060.250	0	0
Chemical cost	Quantity	Unit price	Cost
	kg/a	JD/kg	JD/a
Chlorine 2mg/l		0,0	0

**Cost estimation for wastewater reuse facilities**

**Fuhis**

Investment cost (Target year 2010)

(Price basis 2001)

Component	Unit	Quantity	Unit cost (JD/unit)	Total Cost (JD)		
				Foreign	Local	Total
Land acquisition (for transmission line/reservoir)	ha	0,4	30.000	0	12.000	12.000
Pump station (Q = 0 m <sup>3</sup> /h, H = 0 m)						
Civil works	m <sup>3</sup> /h	0		0	0	0
Electromechanical equipment	m <sup>3</sup> /h	0		0	0	0
Transmission main DN 200, Concr.	m	2.000	50	0	100.000	100.000
Transmission main DN 0,	m	0		0	0	0
Reservoir 0 m <sup>3</sup>	m <sup>3</sup>	0	0	0	0	0
Distribution network	ha	85	not considered			0
Others						
Subtotal I (base cost for infrastructure)				0	112.000	112.000
Administration cost	5% of base cost			0	5.600	5.600
Engineering cost	10% of base cost			8.960	2.240	11.200
Subtotal II (indirect cost)				8.960	7.840	16.800
Physical contingencies	10% of total above			896	11.984	12.880
<b>Total</b>				<b>9.856</b>	<b>131.824</b>	<b>141.680</b>
Specific investment cost (JD/1000m <sup>3</sup> /a effluent)						190

**Operation and maintenance cost (Target year 2010)**

Maintenance cost	Percentage %	Invest .cost JD	Cost JD/a
Civil works	0,5	0	0
Electromechanical equipment	2,0	0	0
Mains, distribution network	0,5	100.000	500
Subtotal (maintenance cost)			500
Staff cost	Number	Staff cost JD/a	Cost JD/a
Required staff	1	3.500	3.500
Energy cost	Discharge m <sup>3</sup> /a	Height m	Cost JD/a
Pumping	744.741	0	0
Chemical cost	Quantity kg/a	Unit price JD/kg	Cost JD/a
Chlorine 2mg/l		0,0	0
Total operation and maintenance cost			4.000
Specific operation cost (JD/m <sup>3</sup> )			0,005

**Cost estimation for wastewater reuse facilities**

**Ma'an**

Investment cost (Target year 2010)

(Price basis 2001)

Component	Unit	Quantity	Unit cost (JD/unit)	Total Cost (JD)		
				Foreign	Local	Total
Land acquisition (for transmission line/reservoir)	ha	0,39	30.000	0	11.700	11.700
Pump station (Q = 150 m <sup>3</sup> /h, H = 10 m)						
Civil works	m <sup>3</sup> /h	150	380	5.700	51.300	57.000
Electromechanical equipment	m <sup>3</sup> /h	150	320	43.200	4.800	48.000
Transmission main DN 200, DI	m	700	75	36.750	15.750	52.500
Transmission main DN 0, Concr.	m	0	60	0	0	0
Reservoir 5000 m <sup>3</sup>	m <sup>3</sup>	1	126.000	41.580	84.420	126.000
Distribution network	ha	65	not considered			0
Others						
Subtotal I (base cost for infrastructure)				127.230	167.970	295.200
Administration cost	5% of base cost			0	14.760	14.760
Engineering cost	10% of base cost			23.616	5.904	29.520
Subtotal II (indirect cost)				23.616	20.664	44.280
Physical contingencies	10% of total above			15.085	18.863	33.948
<b>Total</b>				<b>165.931</b>	<b>207.497</b>	<b>373.428</b>
Specific investment cost (JD/1000m <sup>3</sup> /a effluent)						429

**Operation and maintenance cost (Target year 2010)**

Maintenance cost	Percentage %	Invest .cost JD	Cost JD/a
Civil works	0,5	183.000	915
Electromechanical equipment	2,0	48.000	960
Mains, distribution network	0,5	52.500	263
Subtotal (maintenance cost)			2.138
Staff cost	Number	Staff cost JD/a	Cost JD/a
Required staff	2	3.500	7.000
Energy cost	Discharge m <sup>3</sup> /a	Height m	Cost JD/a
Pumping	870.677	10	781
Chemical cost	Quantity kg/a	Unit price JD/kg	Cost JD/a
Chlorine 2mg/l		0,0	0
Total operation and maintenance cost			9.918
Specific operation cost (JD/m <sup>3</sup> )			0,011



**Cost estimation for wastewater reuse facilities**

**Tafielah**

Investment cost (Target year 2010)

(Price basis 2001)

Component	Unit	Quantity	Unit cost (JD/unit)	Total Cost (JD)		
				Foreign	Local	Total
Land acquisition (for transmission line/reservoir)	ha	0,91	30.000	0	27.300	27.300
Pump station (Q = 0 m <sup>3</sup> /h, H = 0 m)						
Civil works	m <sup>3</sup> /h	0	0	0	0	0
Electromechanical equipment	m <sup>3</sup> /h	0	0	0	0	0
Transmission main DN 200, concr.	m	3.800	50	0	190.000	190.000
Transmission main DN 0,	m	0				
Reservoir 3000 m <sup>3</sup>	m <sup>3</sup>	1	126.000	41.580	84.420	126.000
Distribution network	ha	50	not considered			0
Others						
<b>Subtotal I (base cost for infrastructure)</b>				<b>41.580</b>	<b>301.720</b>	<b>343.300</b>
Administration cost	5% of base cost			0	17.165	17.165
Engineering cost	10% of base cost			27.464	6.866	34.330
<b>Subtotal II (indirect cost)</b>				<b>27.464</b>	<b>24.031</b>	<b>51.495</b>
Physical contingencies	10% of total above			6.904	32.575	39.480
<b>Total</b>				<b>75.948</b>	<b>358.326</b>	<b>434.275</b>
Specific investment cost (JD/1000m <sup>3</sup> /a effluent)						826

**Operation and maintenance cost (Target year 2010)**

Maintenance cost	Percentage %	Invest .cost JD	Cost JD/a
Civil works	0,5	126.000	630
Electromechanical equipment	2,0	0	0
Mains, distribution network	0,5	190.000	950
<b>Subtotal (maintenance cost)</b>			<b>1.580</b>
Staff cost	Number	Staff cost JD/a	Cost JD/a
Required staff	1	3.500	3.500
Energy cost	Discharge m <sup>3</sup> /a	Height m	Cost JD/a
Pumping	525.600	0	0
Chemical cost	Quantity kg/a	Unit price JD/kg	Cost JD/a
Chlorine 2mg/l		0,0	0
<b>Total operation and maintenance cost</b>			<b>5.080</b>
Specific operation cost (JD/m <sup>3</sup> )			0,010