Annex to 3.4.1 Description Of Proposed Measures For Wastewater Collection, Treatment And Disposal

Contents

11. MADABA TREATMENT PLANT

Madaba Treatment Plant receives its wastewater from the town of Madaba only (for details of the existing system refer to Section 11 of Annex 3.1). The sewered area is shown in Figure 11.1

Due to the fact that Madaba's existing Wastewater Treatment Plant is overloaded by 80 % a Feasibility Study was prepared to upgrade and expand the treatment capacity. The Consultant proposes to improve the treatment system by upgrading the plant utilizing an extended aeration process. The treatment facilities will consist of equalization ponds, primary treatment, extended aeration basins, secondary settling tanks, maturation ponds (using existing ponds), filtration and chlorination system. Sludge treatment and disposal includes gravity sludge thickeners, drying beds and disposal to land fill (see Figure 11.2).

According to the Consultant the existing collection system is in a rather good condition and requires no improvements.

With respect to the projection of the wastewater production the Consultant has chosen a capacity of 7,600 m^3/d for the new plant, which will be reached in about 2010 (see following table).

At present about 40 ha are irrigated by the treated wastewater of the existing plant (see schematic layout in Figure 11.3a). One main (Line B) irrigates areas (operated by Corporation Society and Military Retired Corporation) within the treatment plant boundary. The main (Line A) irrigates agricultural land outside of the plant area (Hyasat farm and Fakhry farm). Irrigation is done by flood irrigation.

The existing effluent reuse system shall be improved. Reuse areas are southwest of the existing treatment plant (see Figure 11.3b). The effluents may supply irrigation water for an area of about 300 ha in 2020 taking into account sudan grass and alfalfa as summer crops as well as barley and rye-grass as winter crops (see following table). A pump station is required to pump the effluent of the treatment plant to the about 10 m higher located proposed reservoir.

As the additional area to be irrigated by the effluent from the treatment plant is not yet defined, the extended irrigation area is probably located near the existing irrigated area.

Investment cost for proposed measures for improvement of treatment plant and of reuse system were estimated to 5.65 mio. JD (constant prices of 1996). Costs for operation and maintenance were found to be 196,000 JD per year.

Construction work is tendered in 2000.

Consultant's Study Report:
Hyundai Engineering Co., Ltd.: "Feasibility study and detailed design on the expansion development of the existing wastewater systems of Madaba and Ramtha. Feasibility study report. Madaba", February 1996

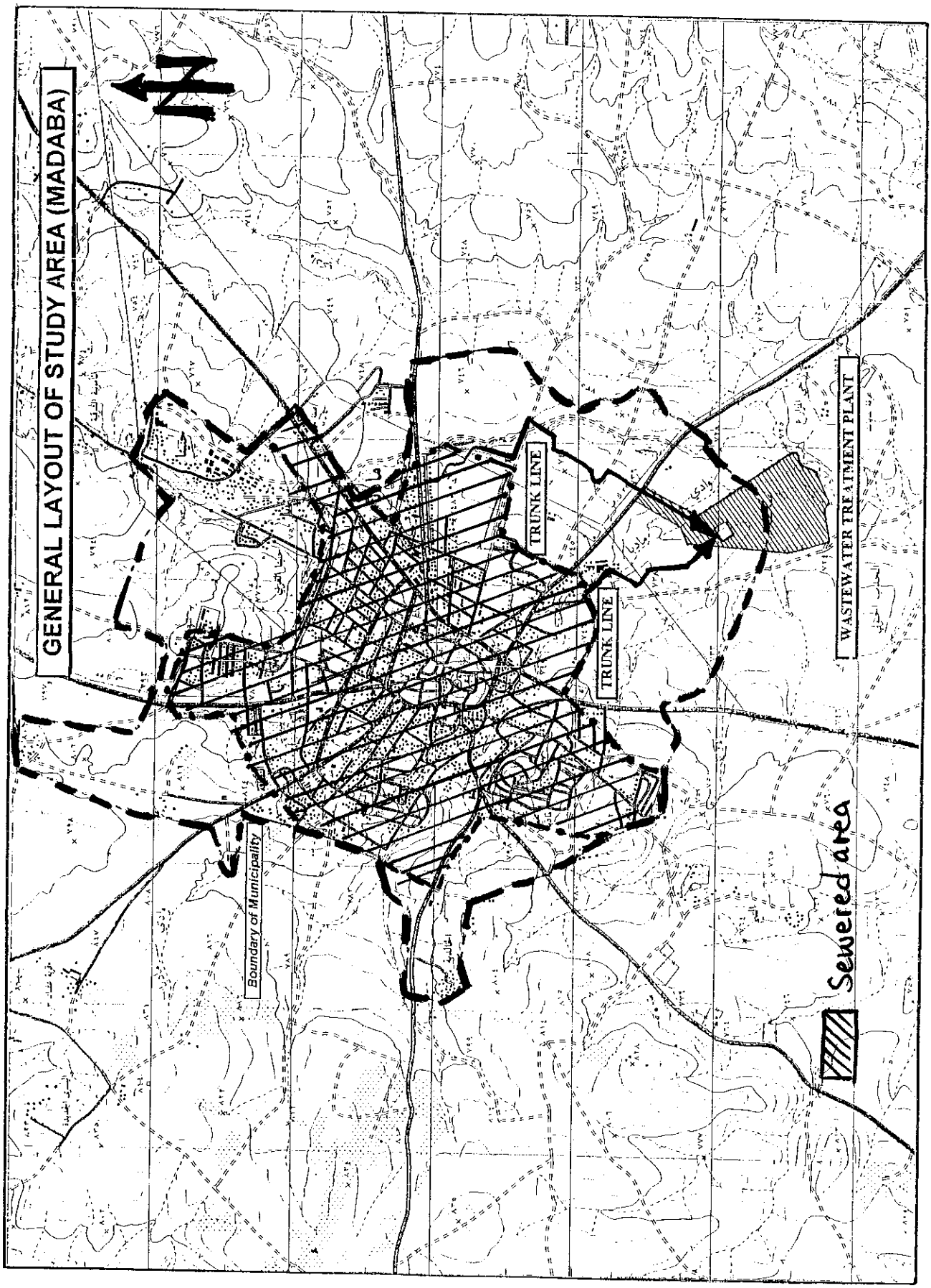

FIGURE 11.1: General Layout of Proposed Sewerage System - MADABA

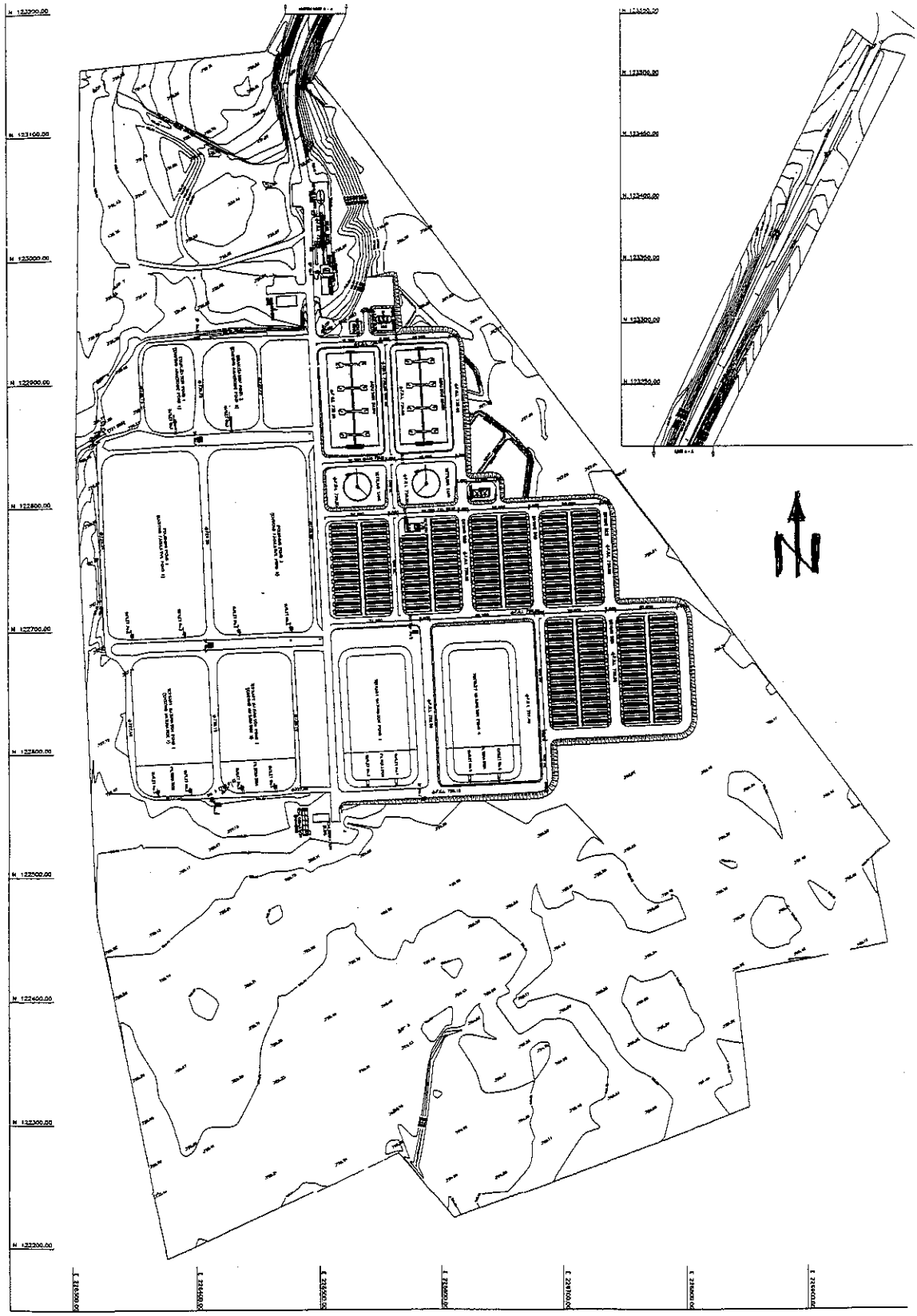

FIGURE 11.2: **Layout of Proposed Wastewater Treatment Plant - MADABA**

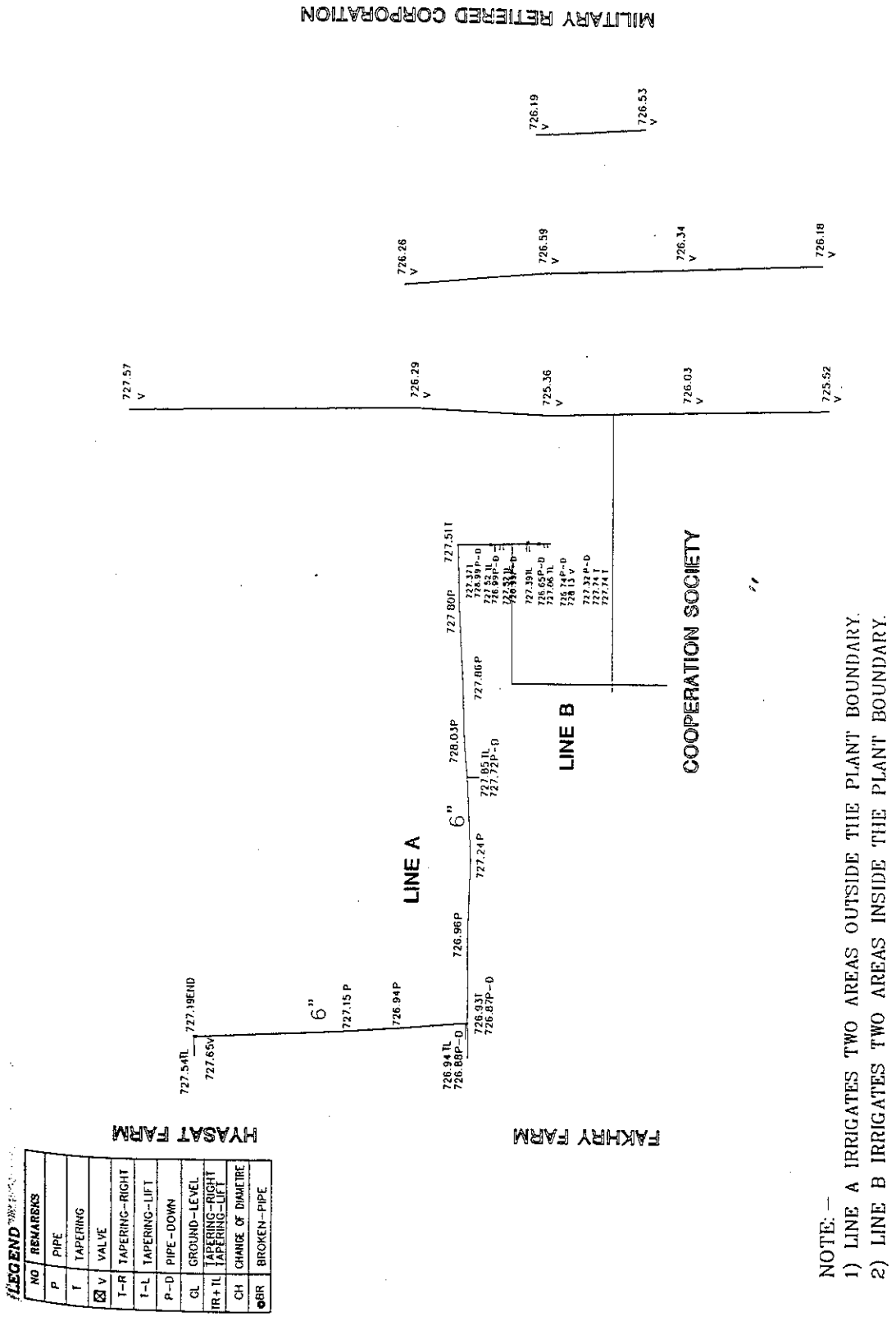

FIGURE 11.3a: Existing Reuse System – MADABA (Schematic Layout)

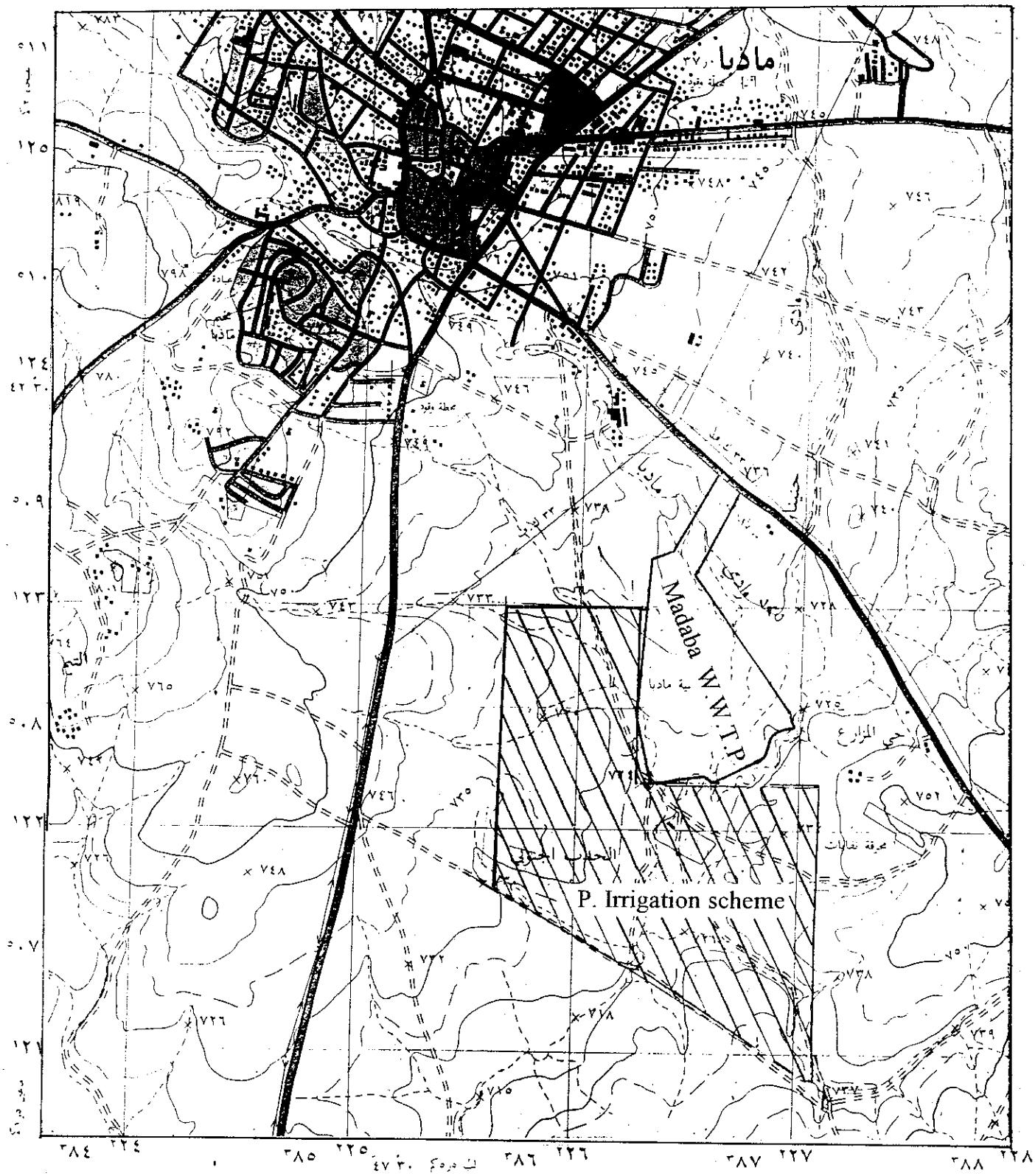

FIGURE 11.3b: Proposed Reuse Areas – MADABA

PROJECTION OF WASTEWATER PRODUCTION OF TREATMENT PLANT: 11 MADABA

SCENARIO 0 "Consultants' Study" (acc. to Consultant's Study Report)

Basic data:

Population in 1994 51.606

	Unit	1994	2000	2005	2010	2015	2020
Growth rate (previous period)	%	-	3,6	3,6	3,6	3,6	3,6
Spec.water demand	l/c/d	85	100	105	120	125	125
Commercial demand	m³/d						
Small industrial demand	m³/d						
Pastoral demand	m³/d						
Coverage	%	60	75	75	85	88	90
Return factor	-	0,8	0,8	0,8	0,8	0,8	0,8
Losses/inflow	%	0	0	0	0	0	0
Specific pollutional load	$gBOD_5/c/d$	65	65	65	65	65	65

	Unit	1994	2000	2005	2010	2015	2020
Population	c	51.606	63.806	76.148	90.877	108.456	129.436
Connected (sewerage)	c	30.964	47.854	57.111	77.246	95.442	116.492
Not connected (sewerage)	c	20.642	15.951	19.037	13.632	13.015	12.944
Water demand							
Domestic demand	l/c/d	85	100	105	120	125	125
	m³/d	4.387	6.381	7.996	10.905	13.557	16.179
Commercial demand	m³/d						
Small industrial demand	m³/d						
Pastoral demand	m³/d						
Total	m³/d	4.387	6.381	7.996	10.905	13.557	16.179
Wastewater production							
Return flow (w.demand)	m³/d	2.106	3.828	4.797	7.416	9.544	11.649
Losses/inflow	m³/d	0	0	0	0	0	0
Total	m³/d	2.106	3.828	4.797	7.416	9.544	11.649
	m³/month	63.166	114.850	143.919	222.468	286.325	349.476
	m³/a	768.517	1.397.342	1.751.019	2.706.695	3.483.619	4.251.960
Pollutional load							
Poll. load (dom.demand)	$kgBOD_5/d$	2.013	3.111	3.712	5.021	6.204	7.572
Poll. load (com.demand)	$kgBOD_5/d$						
Poll. load (small ind.)	$kgBOD_5/d$						
Others	$kgBOD_5/d$						
Total load	$kgBOD_5/d$	2.013	3.111	3.712	5.021	6.204	7.572
Reuse of wastwater							
Inflow to the treatment plant	m³/a	768.517	1.397.342	1.751.019	2.706.695	3.483.619	4.251.960
Losses in treatment plant	%	25	25	10	10	10	10
(due to infiltr./evap.)	m³/a	192.129	349.336	175.102	270.669	348.362	425.196
Effluent of treatment plant	m³/a	576.387	1.048.007	1.575.917	2.436.025	3.135.257	3.826.764
Net water demand per ha	m³/d/ha		35	35	35	35	35
Irrigable reuse area	ha	0	82	123	191	245	300

Water demand for irrigation Barley, rye grass 35 m³/d/ha

12. MAFRAQ TREATMENT PLANT

Mafraq disposes already of a wastewater collection, treatment and disposal system. (for details refer to Section 12 of Annex 3.1). After completion of proposed measures of rehabilitation and extension of the existing Mafraq Scheme the following communities will be connected: Mafraq, Mansoura, Aidoon Bani Hasan, Um Naam Ash Sharqi, Um Naam Al Garbi, Mezzeh, Al Ghadeer Alabyad, Tayeb Esem and Rajem Sabea Ash Shamali. Figure 12.1 shows the layout of the proposed sewerage system (TYPSA Study).

In 1999 an additional report was prepared by J.M.Eller & Associates concerning the rehabilitation and extension of the treatment plant. Primary treatment will be provided by covered anaerobic lagoons, while secondary treatment will be based on sequencing batch reactors (SBRs). The anticipated effluent quality from the SBRs coupled with the additional treatment provided by deep reservoir treatment (DRT) storage for reuse shall eliminate the need of tertiary filtration or other types of polishing. Produced sludge will be digested in the anaerobic ponds and then dried in sludge drying beds. Figure 12.2 shows the proposed treatment system after extension. The projection of the wastewater production is shown in the following table (acc. to Eller Study). Final capacity of the treatment plant will be reached

in 2020: 4,500 m³/d (34,000 connected inhabitants)

At present, treated effluent is used for agricultural irrigation for fodder production inside the treatment plant. Future additional reuse area is identified northwest of the existing treatment plant (see Figure 12.3). A small pump station of low pump head is required to overcome the low geodetic height (1 – 5 m) and the pressure losses. Due to increasing effluents about 140 ha of land could be irrigated in 2020 taking into account alfalfa as summer crops and barley as winter crops (see following table)..

The investment costs (for proposed extension and upgrading measures) based on preliminary design and 1999 prices (Eller Study) are:

Treatment plant	5.00 million JD
Distribution to irrigation	0.57 million JD
Total base costs	5.57 million JD
Physical contingencies (15 %)	0.84 million JD
Engineering (15 %)	0.84 million JD
Total investment costs	7.25 million JD

A Feasibility Study for the sewerage system of Mafraq will be prepared by USAID. Terms of Reference were prepared in 2000.

Consultant's Study Report:

TYPSA, Symonds Travers Morgan and Universal Engineering Consulting: "Wastewater collection, treatment, disposal and/or reuse systems project for the catchment area of Yarmouk River and Jordan River. Final Report", December 1998

DAR: "Report on the rehabilitation and extension of the wastewater treatment plants Karak, Kufranja, Ma'an, Mafraq", July 1999

J.M.Eller & Associates: "Assessment of integrated wastewater treatment/reuse system for three candidate sites: Kufranja, Mafraq and Ma'an", October 1999.

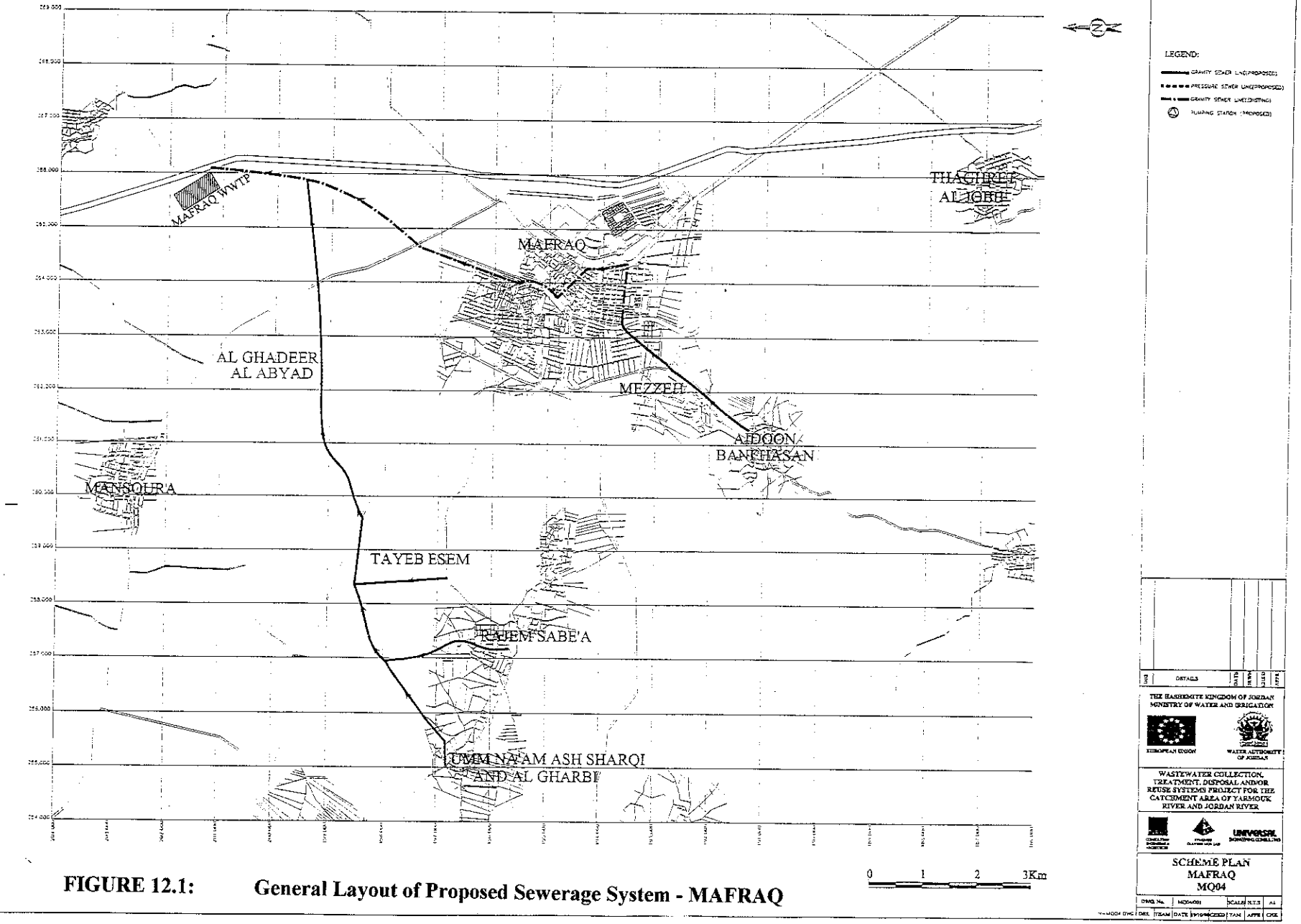

FIGURE 12.1: General Layout of Proposed Sewerage System - MAFRAQ

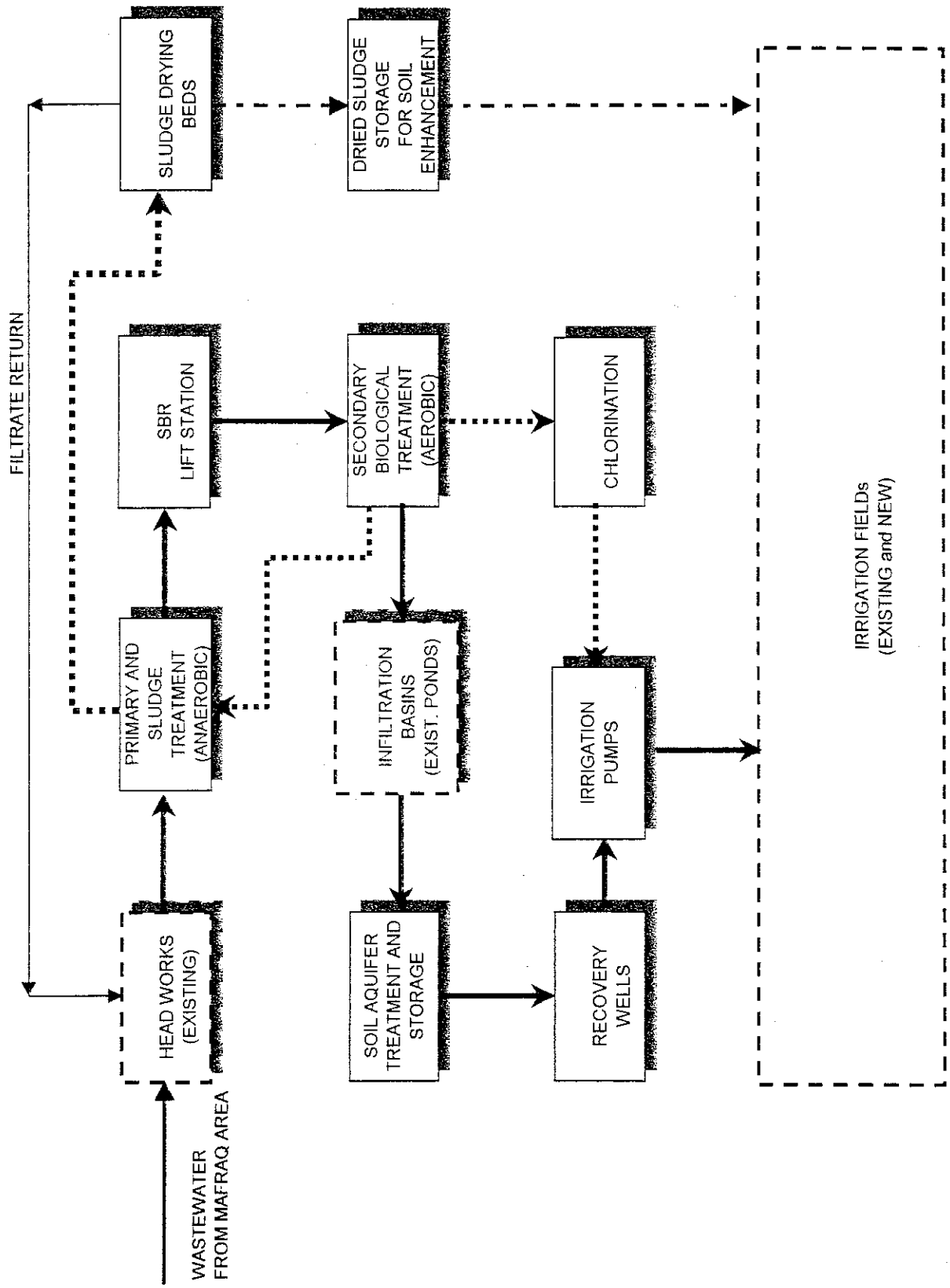

FIGURE 12.2: Layout of Wastewater Proposed Treatment Plant - MAFRAQ

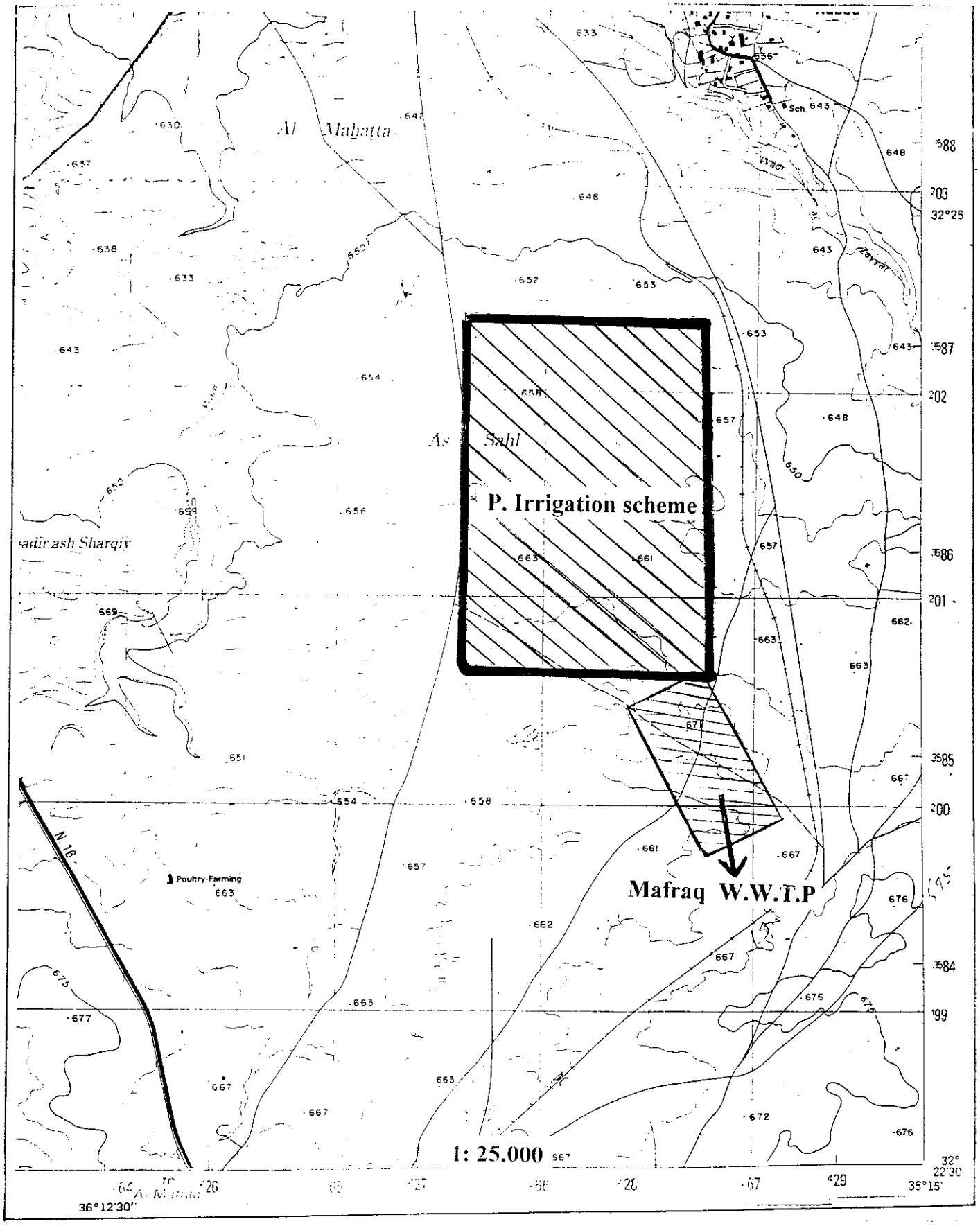

FIGURE 12.3: Potential Reuse Areas - MAFRAQ

PROJECTION OF WASTEWATER PRODUCTION OF TREATMENT PLANT: 12 MAFRAQ

SCENARIO 0 "Consultants' Study" (acc. to Consultant's Study Report)

Basic data:

Population in 1994 32.193

	Unit	1994	2000	2005	2010	2015	2020
Growth rate (previous period)	%	-	2,9	2,9	2,9	2,9	2,9
Spec.water demand	l/c/d	80	130	145	150	157	165
Commercial demand	m³/d						
Small industrial demand	m³/d						
Pastoral demand	m³/d						
Coverage	%	50	50	50	50	50	50
Return factor	-	0,8	0,8	0,8	0,8	0,8	0,8
Losses/inflow	%	0	0	0	0	0	0
Specific pollutional load	$gBOD_5/c/d$	65	65	65	65	65	65

	Unit	1994	2000	2005	2010	2015	2020
Population	c	32.193	38.217	44.089	50.864	58.679	67.696
Connected (sewerage)	c	16.097	19.108	22.045	25.432	29.340	33.848
Not connected (sewerage)	c	16.097	19.108	22.045	25.432	29.340	33.848
Water demand							
Domestic demand	l/c/d	80	130	145	150	157	165
	m³/d	2.575	4.968	6.393	7.630	9.213	11.170
Commercial demand	m³/d						
Small industrial demand	m³/d						
Pastoral demand	m³/d						
Total	m³/d	2.575	4.968	6.393	7.630	9.213	11.170
Wastewater production							
Return flow (w.demand)	m³/d	1.030	1.987	2.557	3.052	3.685	4.468
Losses/inflow	m³/d	0	0	0	0	0	0
Total	m³/d	1.030	1.987	2.557	3.052	3.685	4.468
	m³/month	30.905	59.618	76.715	91.555	110.552	134.038
	m³/a	376.014	725.354	933.365	1.113.914	1.345.045	1.630.790
Pollutional load							
Poll. load (dom.demand)	$kgBOD_5/d$	1.046	1.242	1.433	1.653	1.907	2.200
Poll. load (com.demand)	$kgBOD_5/d$						
Poll. load (small ind.)	$kgBOD_5/d$						
Others	$kgBOD_5/d$						
Total load	$kgBOD_5/d$	1.046	1.242	1.433	1.653	1.907	2.200
Reuse of wastwater							
Inflow to the treatment plant	m³/a	376.014	725.354	933.365	1.113.914	1.345.045	1.630.790
Losses in treatment plant	%	25	25	5	5	5	5
(due to infiltr./evap.)	m³/a	94.004	181.338	46.668	55.696	67.252	81.539
Effluent of treatment plant	m³/a	282.011	544.015	886.697	1.058.218	1.277.793	1.549.250
Net water demand per ha	m³/d/ha		30	30	30	30	30
Irrigable reuse area	ha	0	50	81	97	117	141

Water demand for irrigation Alfalfa, barley 30 m³/d/ha

13. RAMTHA TREATMENT PLANT

Due to the fact that Ramtha's existing Wastewater Treatment Plant is overloaded a Feasibility Study was prepared to upgrade and expand the treatment capacity (for details of the existing system refer to Section 13 of Annex 3.1). The Consultant proposes to improve the treatment system by upgrading the plant utilizing an extended aeration process. The treatment facilities will consist of equalization ponds, primary treatment, extended aeration basins, secondary settling tanks, maturation ponds (using existing ponds), filtration and chlorination system. Sludge treatment and disposal includes gravity sludge thickeners, drying beds and disposal to land fill (see Figure 13.1).

According to the Consultant the existing collection system is in a rather good condition and requires no improvements.

With respect to the projection of the wastewater production the Consultant has chosen a capacity of 5,400 m^3/d for the new plant, which will be reached in about 2010 (see following table).

At present about 37 ha are irrigated by the treated wastewater of the existing plant (see schematic layout in Figure 13.3a). One main (Line D) is used to irrigate about 7 ha within the treatment plant boundary. The mains outside of the plant area irrigate about 8 ha (Line C), 7 ha (Line B) and 15 ha (Line C) respectively. Irrigation is done either by drip or flood irrigation. It seems that the current mode of operation of the irrigation system is not as efficient as it could be.

The existing effluent reuse system shall be improved. Presently irrigated area will be kept and supplied in the future. A pump station is required to pump the effluent of the treatment plant to the proposed reservoir. Excess water shall be discharged by a pipeline to the Campus of Science and Technology University for irrigation of irrigation of trees and bushes within the campus. If the treated effluent will not be used at the campus, alternative irrigable area is available north of the wastewater treatment plant (see Figure 13.3b). The effluents could supply irrigation water for an area of about 180 ha in 2020 taking into account alfalfa as summer crops and barley as winter crops (see following table).

Investment cost for proposed measures for improvement of treatment plant and of reuse system were estimated to 4.395 mio. JD (constant prices of 1996). Costs for operation and maintenance were found to be 156,000 JD per year.

Construction work is tendered in 2000.

Consultant's Study Report:

Hyundai Engineering Co., Ltd.: "Feasibility study and detailed design on the expansion development of the existing wastewater systems of Madaba and Ramtha. Feasibility study report. Ramtha", February 1996.

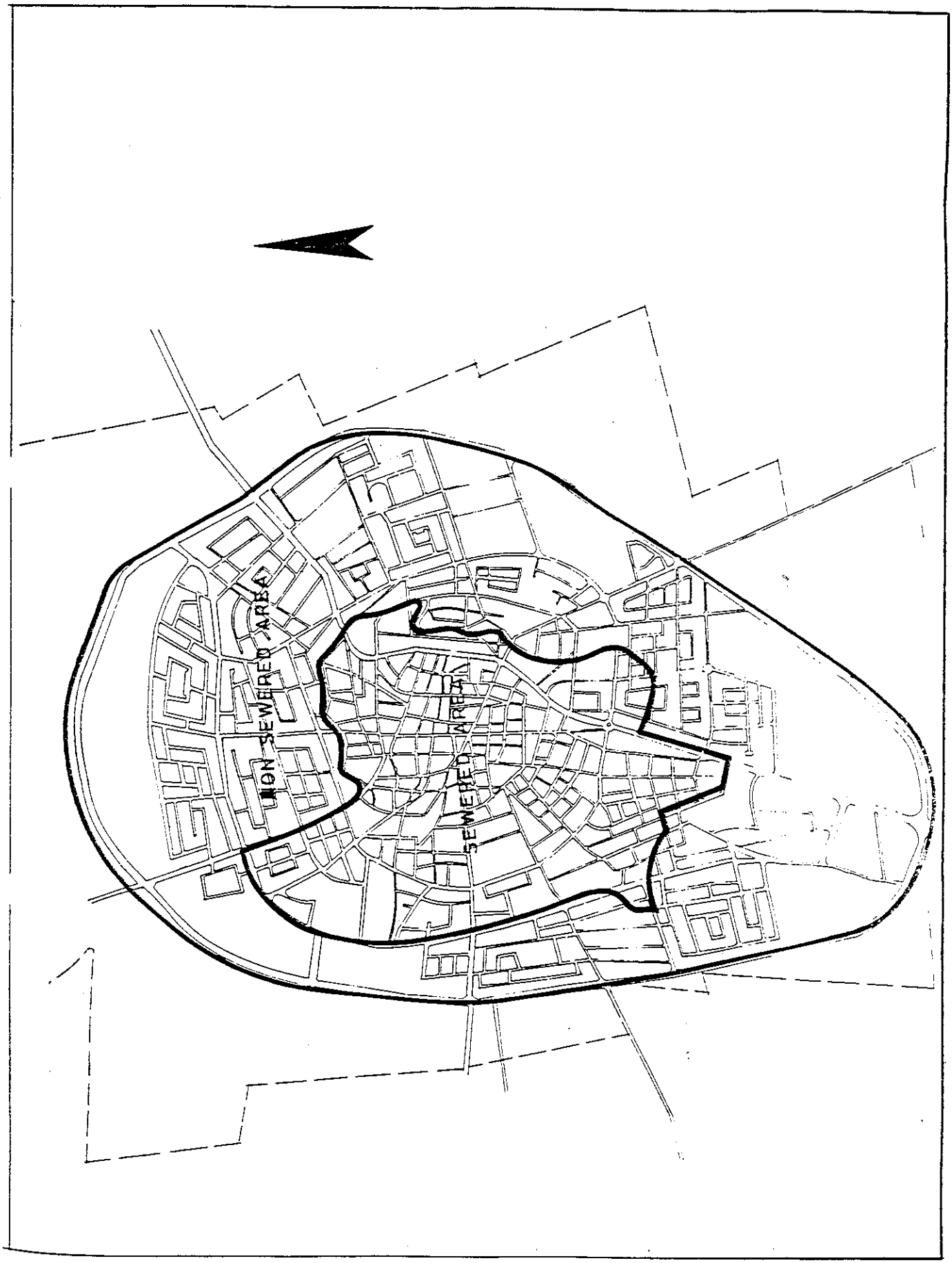

FIGURE 13.1: General Layout of Proposed Sewerage System - RAMTHA

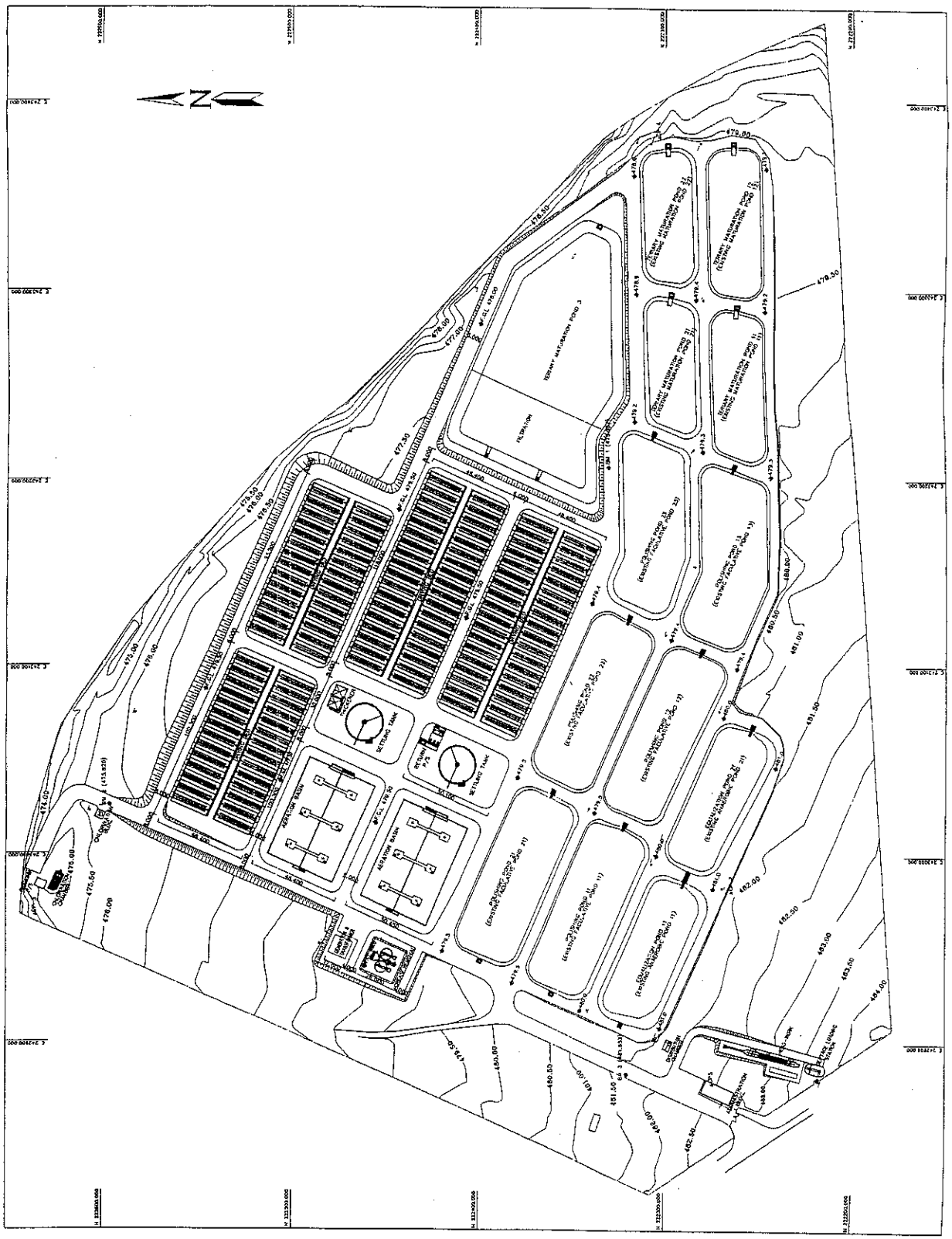

FIGURE 13.2: Layout of Proposed Wastewater Treatment Plant - RAMTHA

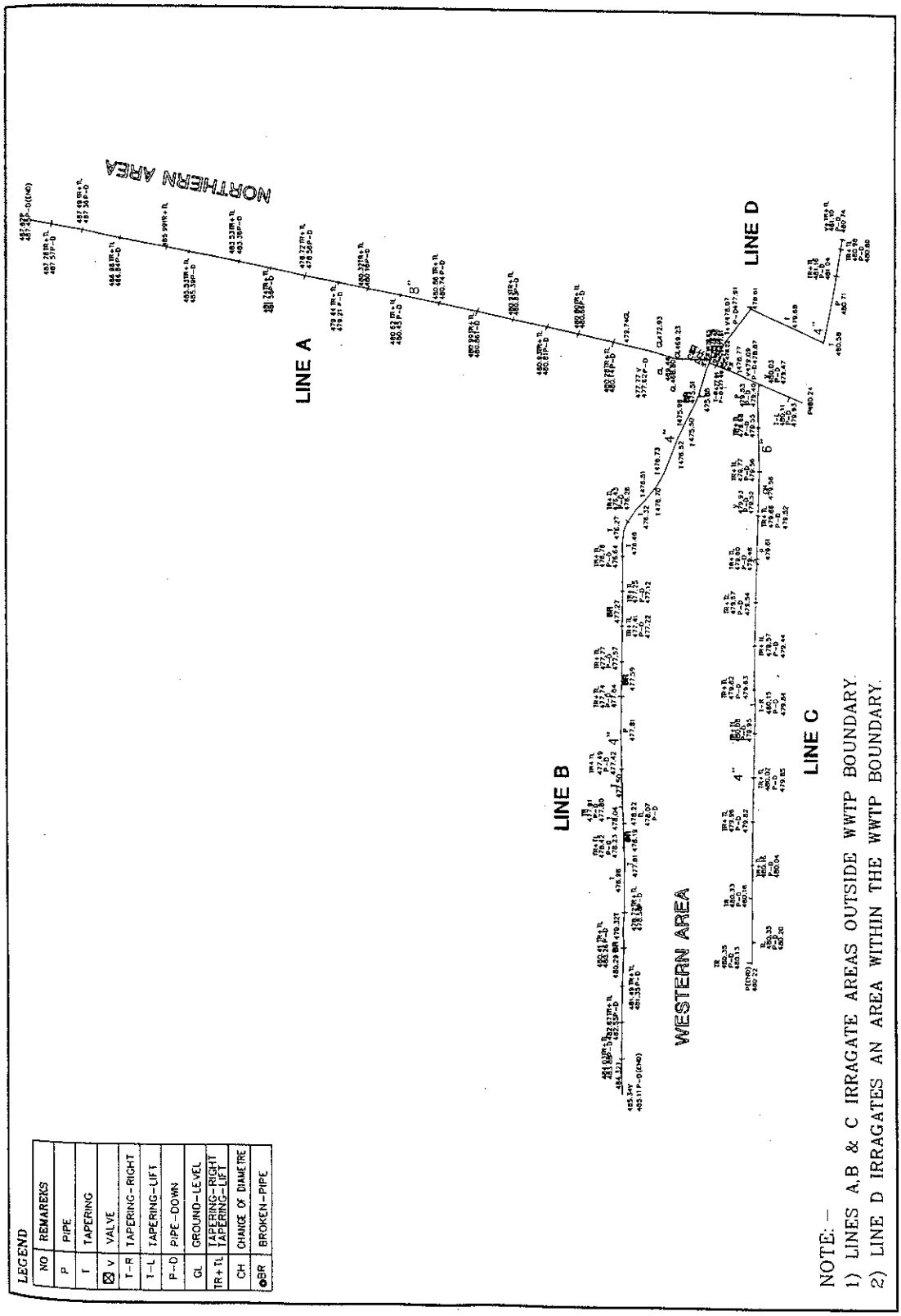

FIGURE 13.3a: Existing Reuse System – RAMTHA (Schematic Layout)

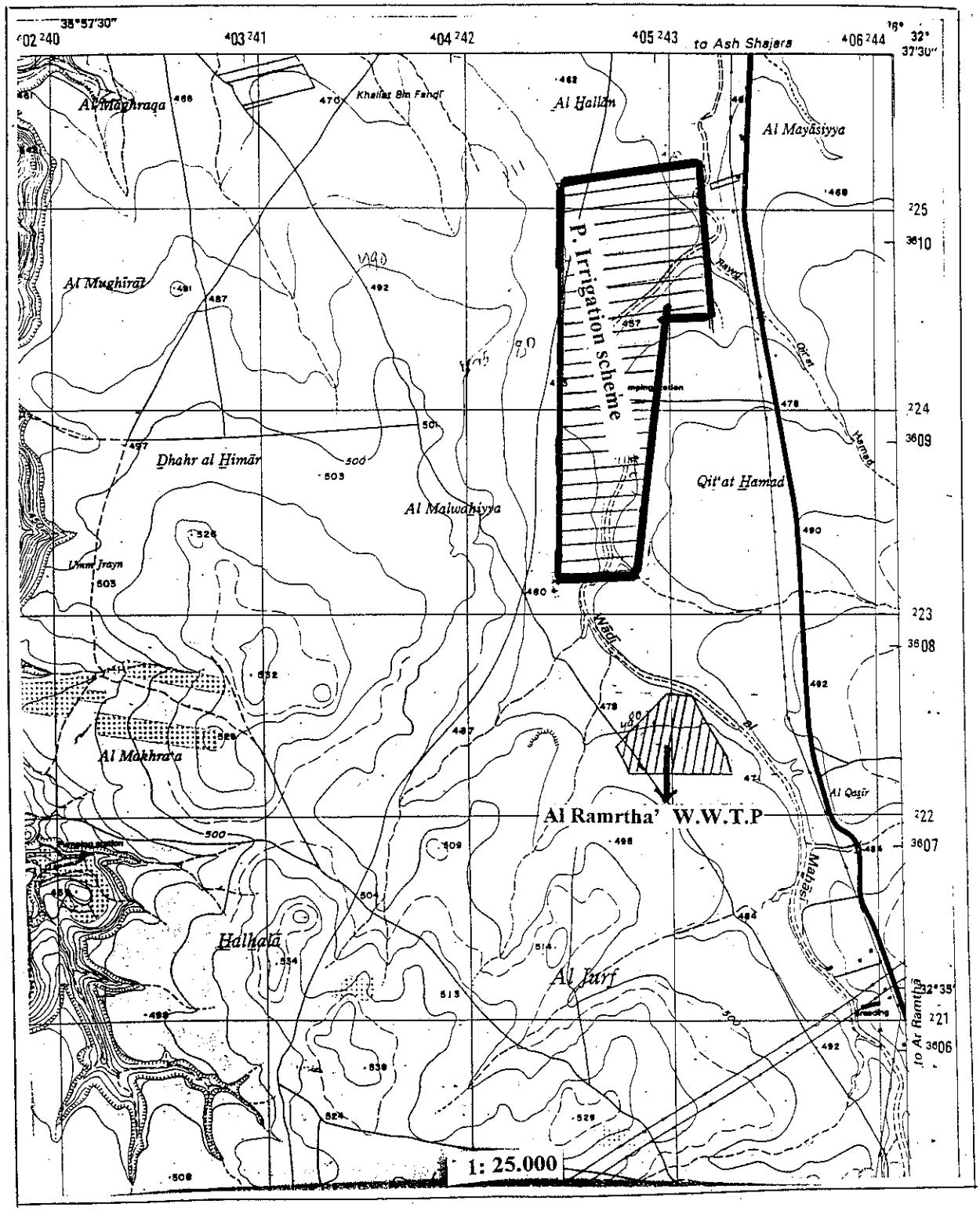

FIGURE 13.3b: Proposed Reuse Areas – RAMTHA

PROJECTION OF WASTEWATER PRODUCTION OF TREATMENT PLANT: 13 RAMTHA

SCENARIO 0 "Consultants' Study" (acc. to Consultant's Study Report)

Basic data:

Population in 1994 47.488

	Unit	1994	2000	2005	2010	2015	2020
Growth rate (previous period)	%	-	3,4	3,4	3,4	3,4	3,4
Spec.water demand	l/c/d	65	75	90	100	105	110
Commercial demand	m³/d						
Small industrial demand	m³/d						
Pastoral demand	m³/d						
Coverage	%	50	65	70	80	85	90
Return factor	-	0,8	0,8	0,8	0,8	0,8	0,8
Losses/inflow	%	0	0	0	0	0	0
Specific pollutional load	$gBOD_5/c/d$	65	65	65	65	65	65

	Unit	1994	2000	2005	2010	2015	2020
Population	c	47.488	58.037	68.598	81.080	95.833	113.271
Connected (sewerage)	c	23.744	37.724	48.018	64.864	81.458	101.944
Not connected (sewerage)	c	23.744	20.313	20.579	16.216	14.375	11.327
Water demand							
Domestic demand	l/c/d	65	75	90	100	105	110
	m³/d	3.087	4.353	6.174	8.108	10.062	12.460
Commercial demand	m³/d						
Small industrial demand	m³/d						
Pastoral demand	m³/d						
Total	m³/d	3.087	4.353	6.174	8.108	10.062	12.460
Wastewater production							
Return flow (w.demand)	m³/d	1.235	2.263	3.457	5.189	6.842	8.971
Losses/inflow	m³/d	0	0	0	0	0	0
Total	m³/d	1.235	2.263	3.457	5.189	6.842	8.971
	m³/month	37.041	67.904	103.720	155.673	205.274	269.131
	m³/a	450.661	826.161	1.261.924	1.894.023	2.497.504	3.274.432
Pollutional load							
Poll. load (dom.demand)	$kgBOD_5/d$	1.543	2.452	3.121	4.216	5.295	6.626
Poll. load (com.demand)	$kgBOD_5/d$						
Poll. load (small ind.)	$kgBOD_5/d$						
Others	$kgBOD_5/d$						
Total load	$kgBOD_5/d$	1.543	2.452	3.121	4.216	5.295	6.626
Reuse of wastwater							
Inflow to the treatment plant	m³/a	450.661	826.161	1.261.924	1.894.023	2.497.504	3.274.432
Losses in treatment plant	%	25	25	10	10	10	10
(due to infiltr./evap.)	m³/a	112.665	206.540	126.192	189.402	249.750	327.443
Effluent of treatment plant	m³/a	337.996	619.621	1.135.732	1.704.621	2.247.754	2.946.989
Net water demand per ha	m³/d/ha		45	45	45	45	45
Irrigable reuse area	ha	0	38	69	104	137	179

Water demand for irrigation Alfalfa, barley 45 m³/d/ha

14. SALT TREATMENT PLANT

Salt disposes already of a wastewater collection, treatment and disposal system (for details of the existing system refer to Section 14 of Annex 3.1). According to the proposed measures of extension the Salt Scheme will be limited to the town of Salt as it is presently. Figure 14.1 shows the layout of the proposed sewerage system (TYPSA Study).

The project (TYPSA Study) foresees the extension of the existing Salt Treatment Plant designed for the wastewater production in 2020. The existing treatment process based on extended aeration will be applied also in future. Slow sand filtration will be added as tertiary treatment. Existing maturation ponds will serve as additional treatment downstream of the slow sand filters. Produced sludge will be treated by gravity thickeners, unheated anaerobic sludge digestion and decanter centrifuges. Figure 14.2 shows the proposed treatment system after extension. The projection of the wastewater production is shown in the following table (acc. to TYPSA Study). Final capacity of the treatment plant will be reached

in 2020: 11,700 m³/d (105,000 connected inhabitants)

The flanks of the Wadi Shua'ab valley are rather steep. Due to missing sufficient areas suitable for agricultural irrigation in the vicinity of the plant it is recommended to discharge the treated effluent into the Wadi Shua'ab mouthing into the Wadi Shua'ab Reservoir. From there water will flow to the Jordan Valley for ultimate reuse.

The investment costs (for future extension measures) based on preliminary design and 1998 prices (TYPSA Study) are:

Treatment plant (primary and secondary treatment)	4.12 million JD
Networks	4.56 million JD
Tertiary treatment and pipeline (reuse system)	1.31 million JD
Dam/storage (pond for reuse)	0 million JD
Total base costs	9.99 million JD
Physical contingencies	1.00 million JD
Engineering	1.10 million JD
Total investment costs	12.10 million JD

According to the TYPSA Study Report proposed extension measures will be implemented between 2004 and 2005.

Consultant's Study Report:
TYPSA, Symonds Travers Morgan and Universal Engineering Consulting: "Wastewater collection, treatment, disposal and/or reuse systems project for the catchment area of Yarmouk River and Jordan River. Final Report", December 1998

GWE: "Expansion and upgrading of the wastewater treatment plant at Salt. Design Report", 1991

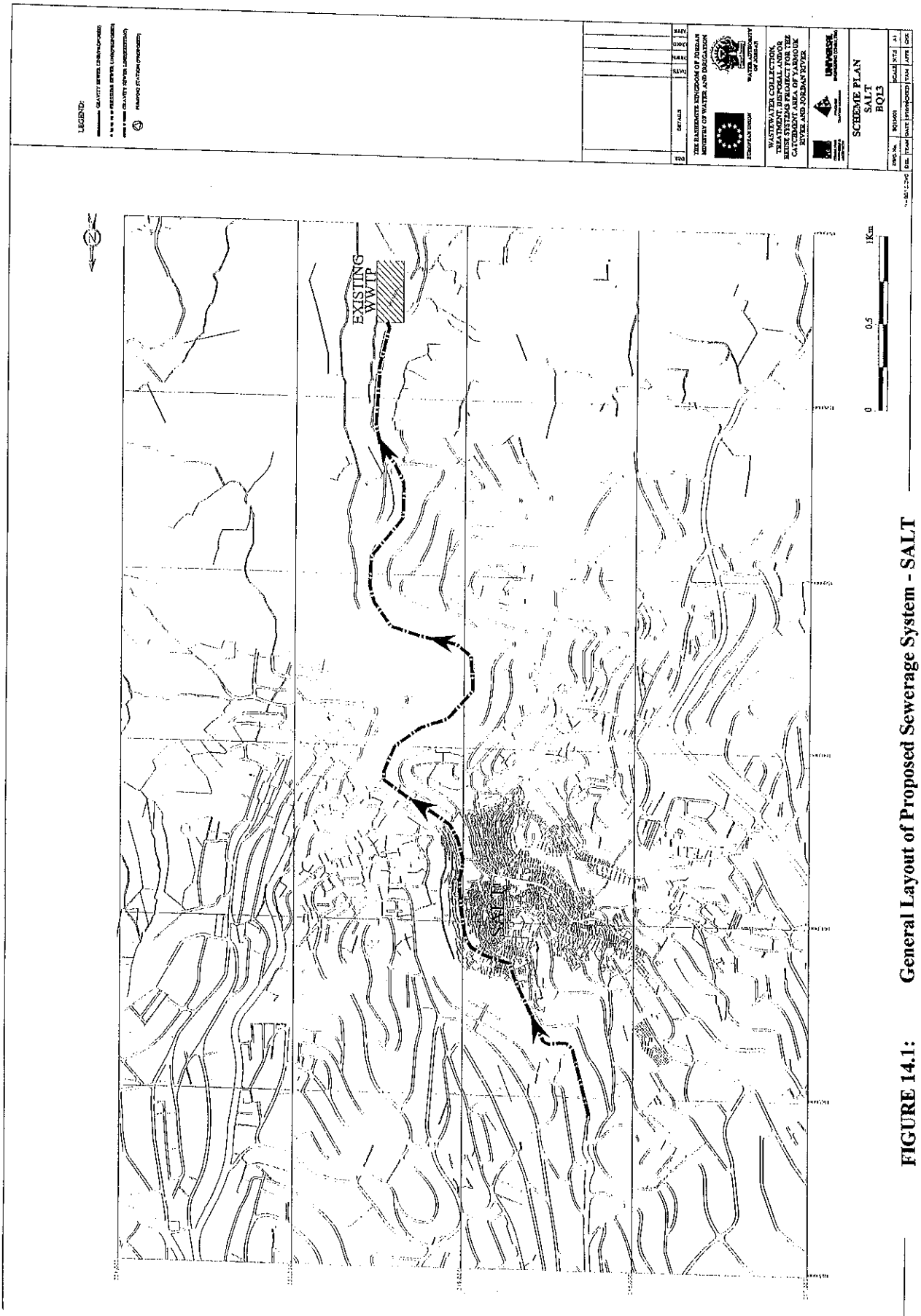

FIGURE 14.1: General Layout of Proposed Sewerage System - SALT

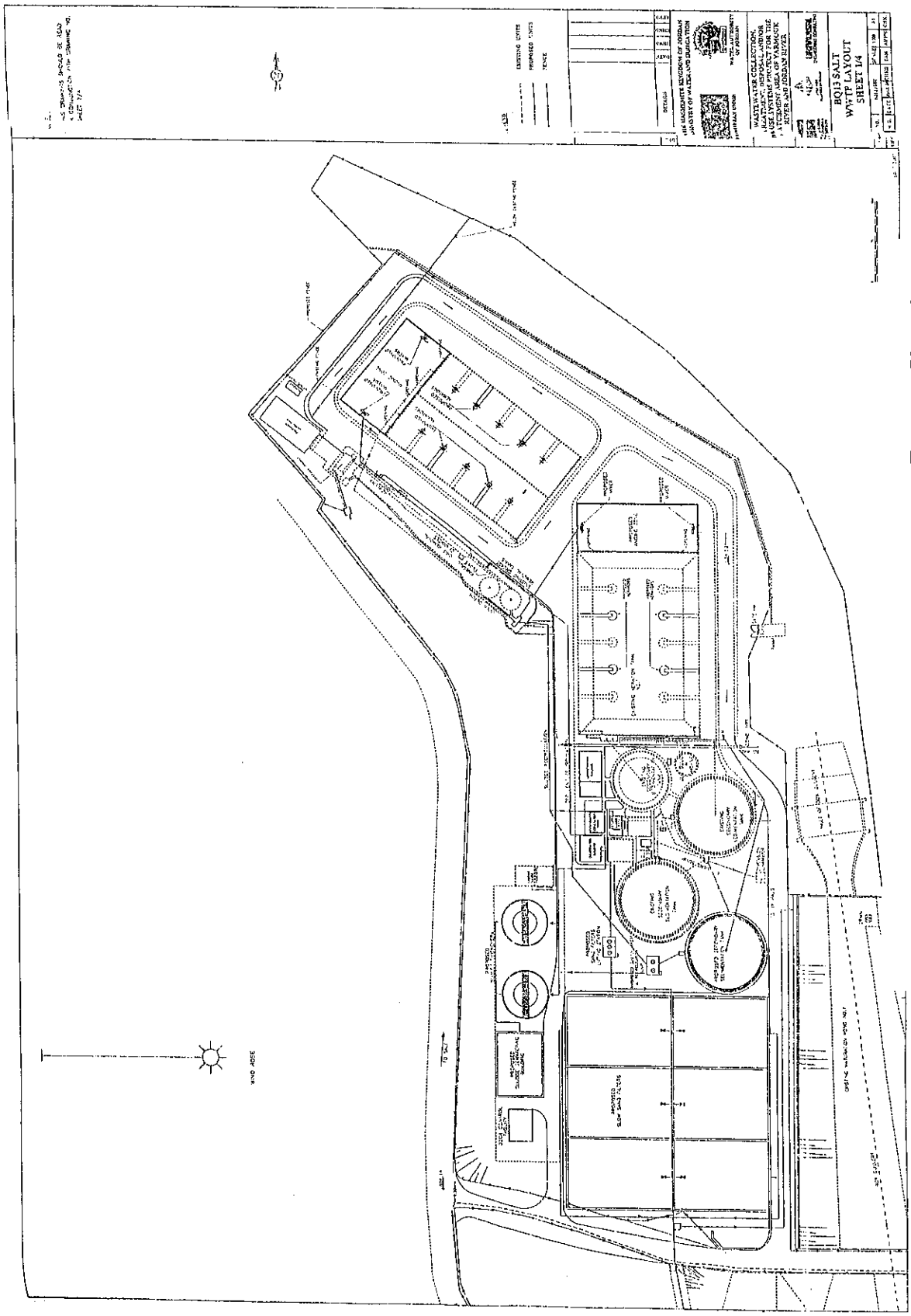

FIGURE 14.2: Layout of Proposed Wastewater Treatment Plant - SALT

PROJECTION OF WASTEWATER PRODUCTION OF TREATMENT PLANT:
14 SALT

SCENARIO 0 "Consultants' Study" (acc. to Consultant's Study Report)

Basic data:

Population in 1994: 56.720

	Unit	1994	2000	2005	2010	2015	2020
Growth rate (previous period)	%	-	3,02	3,02	3,02	3,02	3,02
Spec.water demand	l/c/d	100	100	120	130	140	140
Commercial demand	m³/d						
Small industrial demand	m³/d						
Pastoral demand	m³/d						
Coverage	%	60	60	85	85	85	85
Return factor	-	0,8	0,8	0,8	0,8	0,8	0,8
Losses/inflow	%	0	0	0	0	0	0
Specific pollutional load	$gBOD_5/c/d$	65	65	65	65	65	65

	Unit	1994	2000	2005	2010	2015	2020
Population	c	56.720	67.806	78.682	91.302	105.947	122.941
Connected (sewerage)	c	34.032	40.683	66.879	77.607	90.055	104.500
Not connected (sewerage)	c	22.688	27.122	11.802	13.695	15.892	18.441
Water demand							
Domestic demand	l/c/d	100	100	120	130	140	140
	m³/d	5.672	6.781	9.442	11.869	14.833	17.212
Commercial demand	m³/d						
Small industrial demand	m³/d						
Pastoral demand	m³/d						
Total	m³/d	5.672	6.781	9.442	11.869	14.833	17.212
Wastewater production							
Return flow (w.demand)	m³/d	2.723	3.255	6.420	8.071	10.086	11.704
Losses/inflow	m³/d	0	0	0	0	0	0
Total	m³/d	2.723	3.255	6.420	8.071	10.086	11.704
	m³/month	81.677	97.640	192.613	242.133	302.585	351.119
	m³/a	993.734	1.187.954	2.343.453	2.945.955	3.681.446	4.271.951
Pollutional load							
Poll. load (dom.demand)	$kgBOD_5/d$	2.212	2.644	4.347	5.044	5.854	6.792
Poll. load (com.demand)	$kgBOD_5/d$						
Poll. load (small ind.)	$kgBOD_5/d$						
Others	$kgBOD_5/d$						
Total load	$kgBOD_5/d$	2.212	2.644	4.347	5.044	5.854	6.792
Reuse of wastwater							
Inflow to the treatment plant	m³/a	993.734	1.187.954	2.343.453	2.945.955	3.681.446	4.271.951
Losses in treatment plant	%	0	10	10	10	10	10
(due to infiltr./evap.)	m³/a	0	118.795	234.345	294.595	368.145	427.195
Effluent of treatment plant	m³/a	993.734	1.069.159	2.109.108	2.651.359	3.313.302	3.844.756
Net water demand per ha	m³/d/ha	-	-	-	-	-	-
Irrigable reuse area	ha	-	-	-	-	-	-

Water demand for irrigation

15. TAFIELAH TREATMENT PLANT

Tafielah disposes already of a wastewater collection, treatment and disposal system (for details refer to Section 15 of Annex 3.1). At present, there are no particular measures of extension of the existing facilities proposed. Figure 15.1 shows the layout of the sewerage system.

Downstream of the headworks of the treatment plant two parallel trains exist for secondary treatment: Settling of solid matter of sewage takes place in the Imhoff tanks. Trickling filters and solid contact channels followed by secondary settling do biological treatment. Chlorination facilities are located upstream of the maturation pond. Figure 15.2 shows are other resources than treated wastewater are scarce.

It is expected that existing design capacity will be reached after

in 2005: 1,600 m^3/d

At that time rehabilitation and extension measures for the existing treatment plant will be required.

The effluents may supply irrigation water for an area of about 50 ha in 2020 taking into account the demand for irrigation of eucalyptus/olives trees (see following table). A pump station is required to pump the effluent of the treatment plant to the about 20 m higher located proposed reservoir. Proposed wastewater reuse areas are presented in the Figure 15.3.

Consultant's Study Report:
J.M.Montgomery: "Municipal water distribution improvements and sewerage and stormwater drainage systems in Tafielah. Feasibility Study Report", March 1983

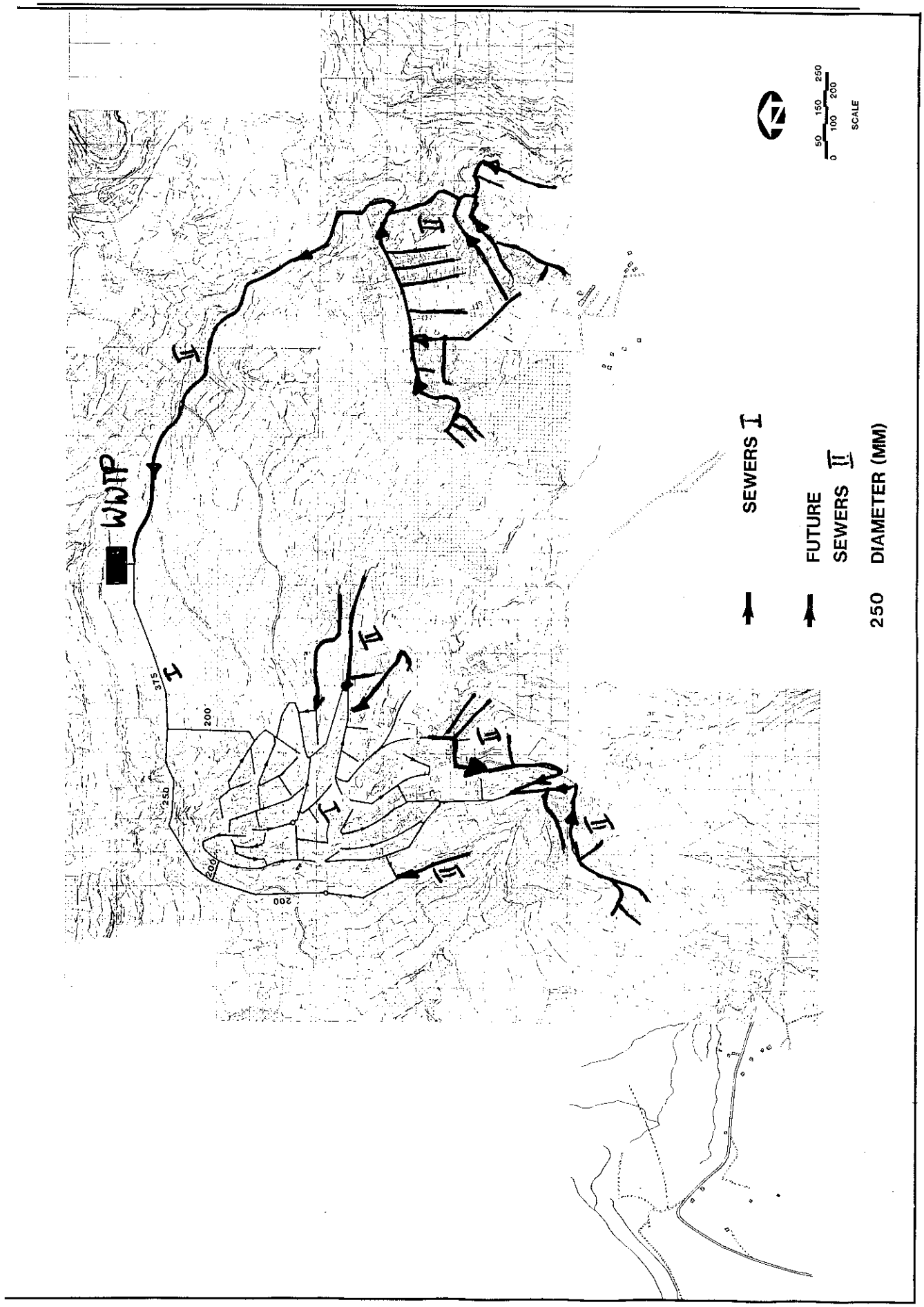

FIGURE 15.1: General Layout of Proposed Sewerage System - TAFIELAH

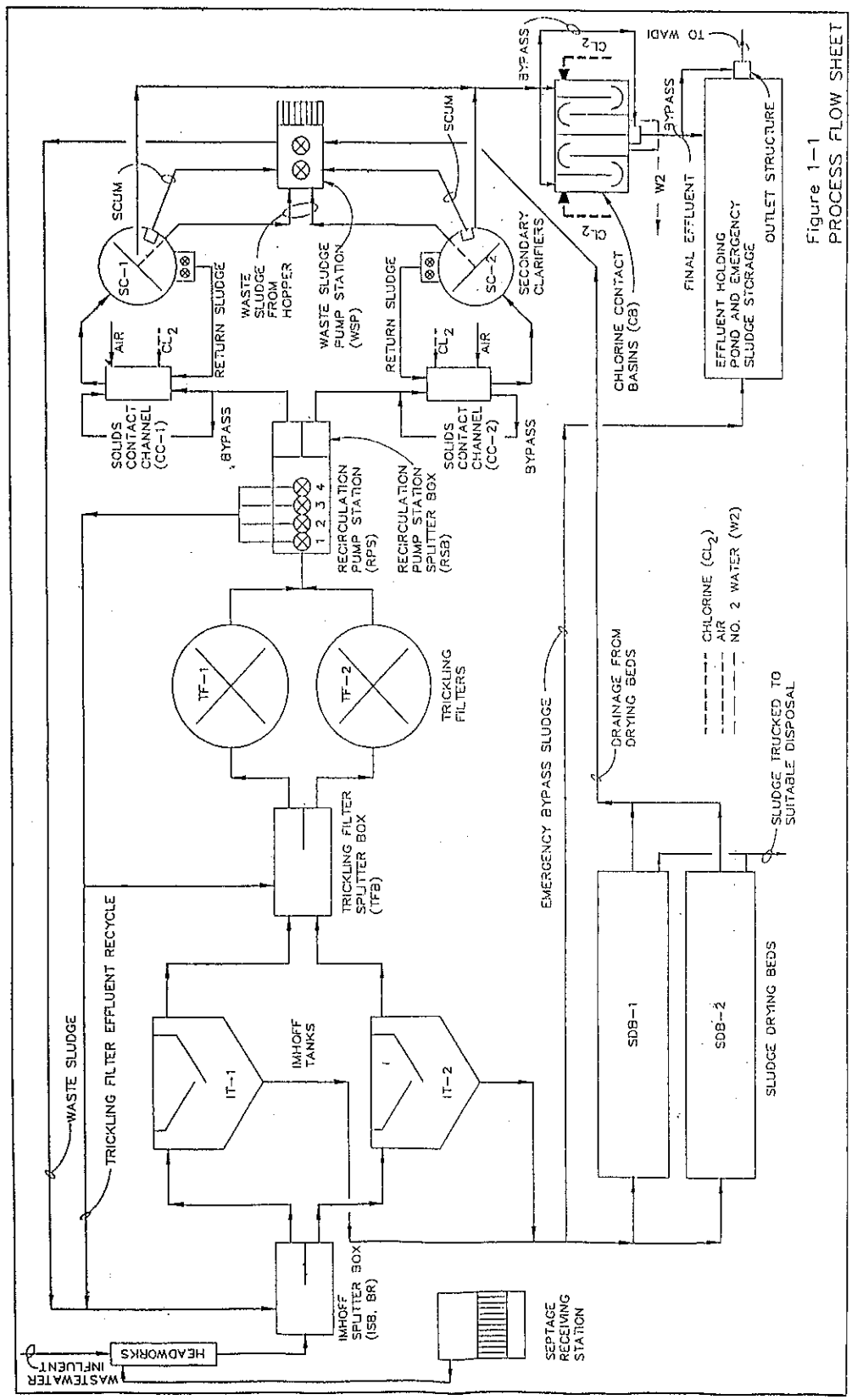

FIGURE 15.2: **Layout of Existing and Future Wastewater Treatment Plant - TAFIELAH**

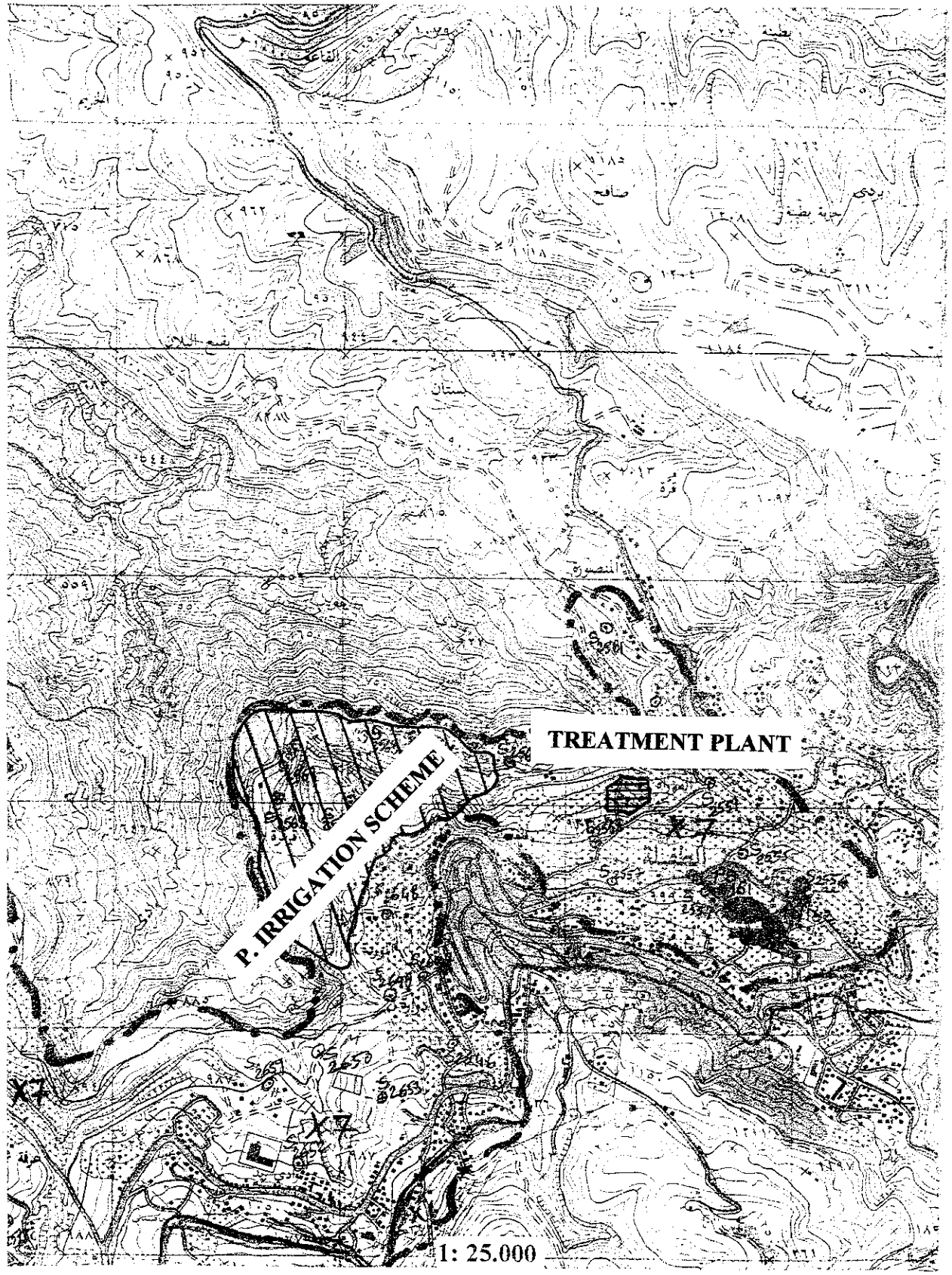

FIGURE 15.3: Potential Reuse Areas - TAFIELAH

PROJECTION OF WASTEWATER PRODUCTION OF TREATMENT PLANT:
15 TAFIELAH

SCENARIO 0 "Consultants' Study" (acc. to Consultant's Study Report)

Basic data:

Population in 1994: 20.850

	Unit	1994	2000	2005	2010	2015	2020
Growth rate (previous period)	%	-	3,30	3,30	3,30	3,30	3,30
Spec.water demand	l/c/d	100	90	120	130	130	130
Commercial demand	m³/d						
Small industrial demand	m³/d						
Pastoral demand	m³/d						
Coverage	%	50	50	55	70	70	70
Return factor	-	0,8	0,8	0,8	0,8	0,8	0,8
Losses/inflow	%	0	0	0	0	0	0
Specific pollutional load	$gBOD_5/c/d$	65	65	65	65	65	65

	Unit	1994	2000	2005	2010	2015	2020
Population	c	20.850	25.334	29.800	35.052	41.230	48.497
Connected (sewerage)	c	10.425	12.667	16.390	24.536	28.861	33.948
Not connected (sewerage)	c	10.425	12.667	13.410	10.516	12.369	14.549
Water demand							
Domestic demand	l/c/d	100	90	120	130	130	130
	m³/d	2.085	2.280	3.576	4.557	5.360	6.305
Commercial demand	m³/d						
Small industrial demand	m³/d						
Pastoral demand	m³/d						
Total	m³/d	2.085	2.280	3.576	4.557	5.360	6.305
Wastewater production							
Return flow (w.demand)	m³/d	834	912	1.573	2.552	3.002	3.531
Losses/inflow	m³/d	0	0	0	0	0	0
Total	m³/d	834	912	1.573	2.552	3.002	3.531
	m³/month	25.020	27.361	47.202	76.553	90.046	105.917
	m³/a	304.410	332.892	574.297	931.398	1.095.562	1.288.661
Pollutional load							
Poll. load (dom.demand)	$kgBOD_5/d$	678	823	1.065	1.595	1.876	2.207
Poll. load (com.demand)	$kgBOD_5/d$						
Poll. load (small ind.)	$kgBOD_5/d$						
Others	$kgBOD_5/d$						
Total load	$kgBOD_5/d$	678	823	1.065	1.595	1.876	2.207
Reuse of wastwater							
Inflow to the treatment plant	m³/a	304.410	332.892	574.297	931.398	1.095.562	1.288.661
Losses in treatment plant	%	10	10	10	10	10	10
(due to infiltr./evap.)	m³/a	30.441	33.289	57.430	93.140	109.556	128.866
Effluent of treatment plant	m³/a	273.969	299.603	516.867	838.258	986.006	1.159.795
Net water demand per ha	m³/d/ha		64	64	64	64	64
Irrigable reuse area	ha	0	13	22	36	42	50

Water demand for irrigation Olives 64 m³/d/ha (peak period)

16. WADI ARAB TREATMENT PLANT

Wadi Arab Treatment Plant is part of the sewerage system considered by the long-term development in Greater Irbid Area (compare description of the Treatment Plant Irbid Central under Section 6).

The plant was completed recently (in 1999). Presently the design capacity of the treatment plant is used to about 30 % only (for details of the existing system refer to Section 16 of Annex 3.1)..

The projection of the wastewater production shows that the capacity of the plant (21,000 m^3/d) will be reached in about 2010 (acc. to Consultant's Study Report, see following table).

Presently, the effluent is discharged by a 15 km long pipeline (together with the effluent of Central Treatment Plant of Irbid) to the Jordan Valley for irrigation purposes. This long pipeline was constructed to protect the aquifer and groundwater resources located downstream of the plant, which are exploited for municipal water supply.

There are no appropriate areas available for agricultural irrigation along the narrow valley of Wadi Arab reusing the quantities of the plant's treated effluent.

It is proposed to reuse the treated effluent of Irbid Central Plant together with Wadi Arab Plant (compare Section 6) in Jordan Valley to produce mixed crops (see Wadi Arab Irrigation Complex, Figure 16.3).

In July 2000 the Ministry of Water and Irrigation prepared Terms of Reference for a study for reuse of treated wastewater for the Greater Irbid Area. It is proposed that the German Development Bank (Kreditanstalt fuer Wiederaufbau, KfW) will finance this study.

Consultant's Study Report:
RRI, DAR and Sigma: "Technical, economical and financial Feasibility Study. Phase B. Feasibility study of preferred alternatives for wastewater collection and treatment systems in the Greater Irbid area.", March 1992

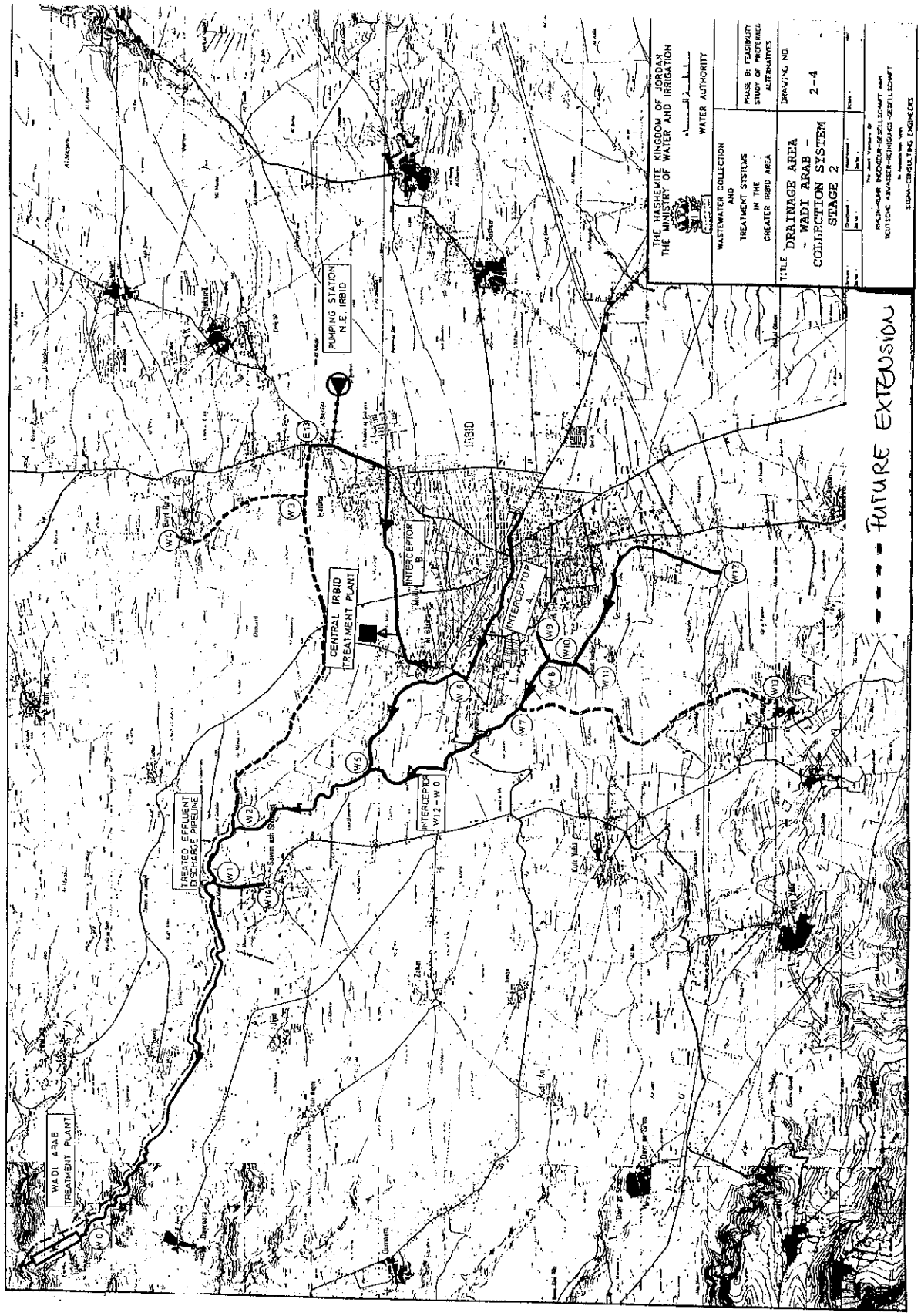

FIGURE 16.1: **General Layout of Proposed Sewerage System - WADI ARAB**

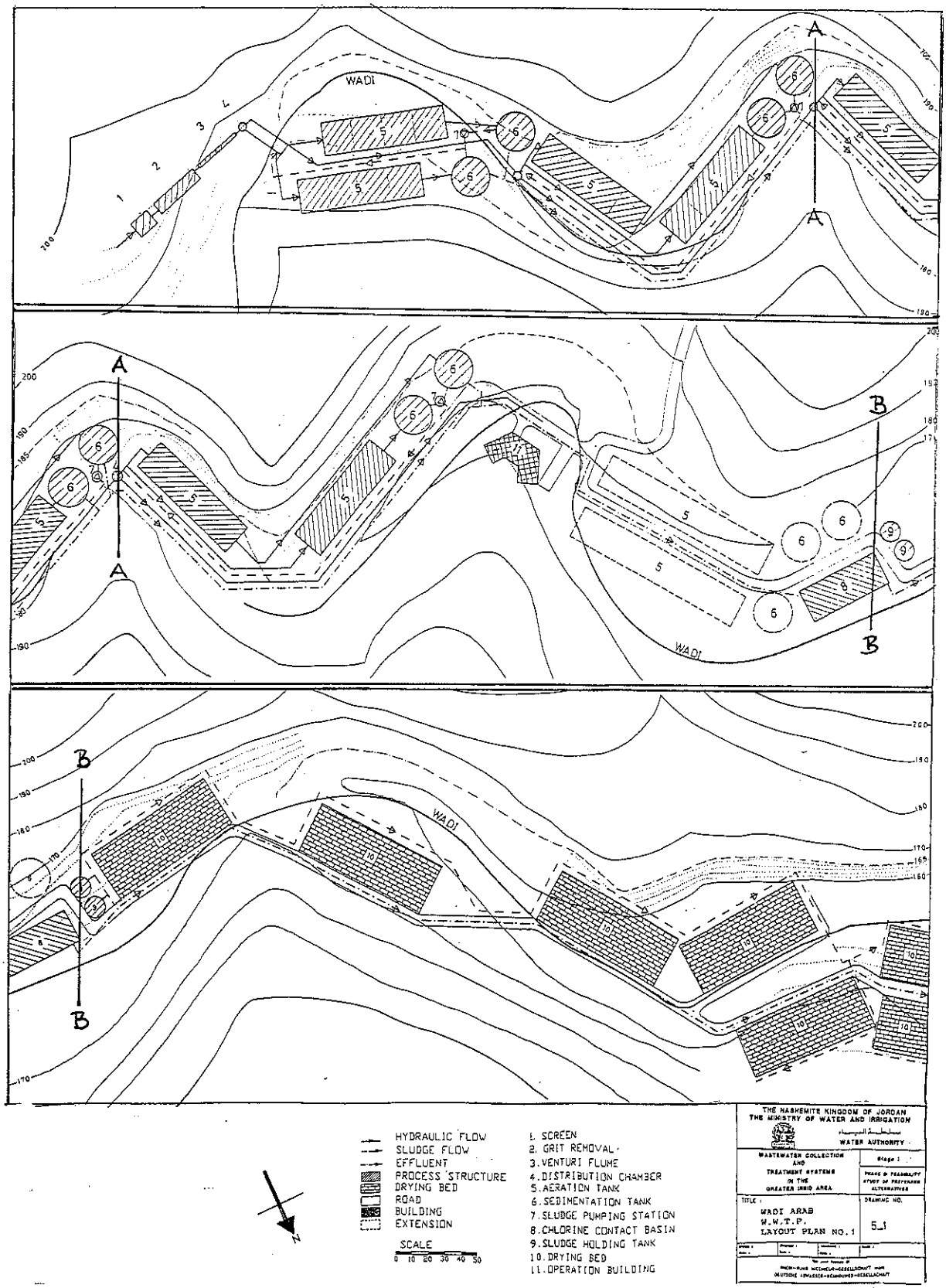

FIGURE 16.2: Layout of Existing and Future Wastewater Treatment Plant - WADI ARAB

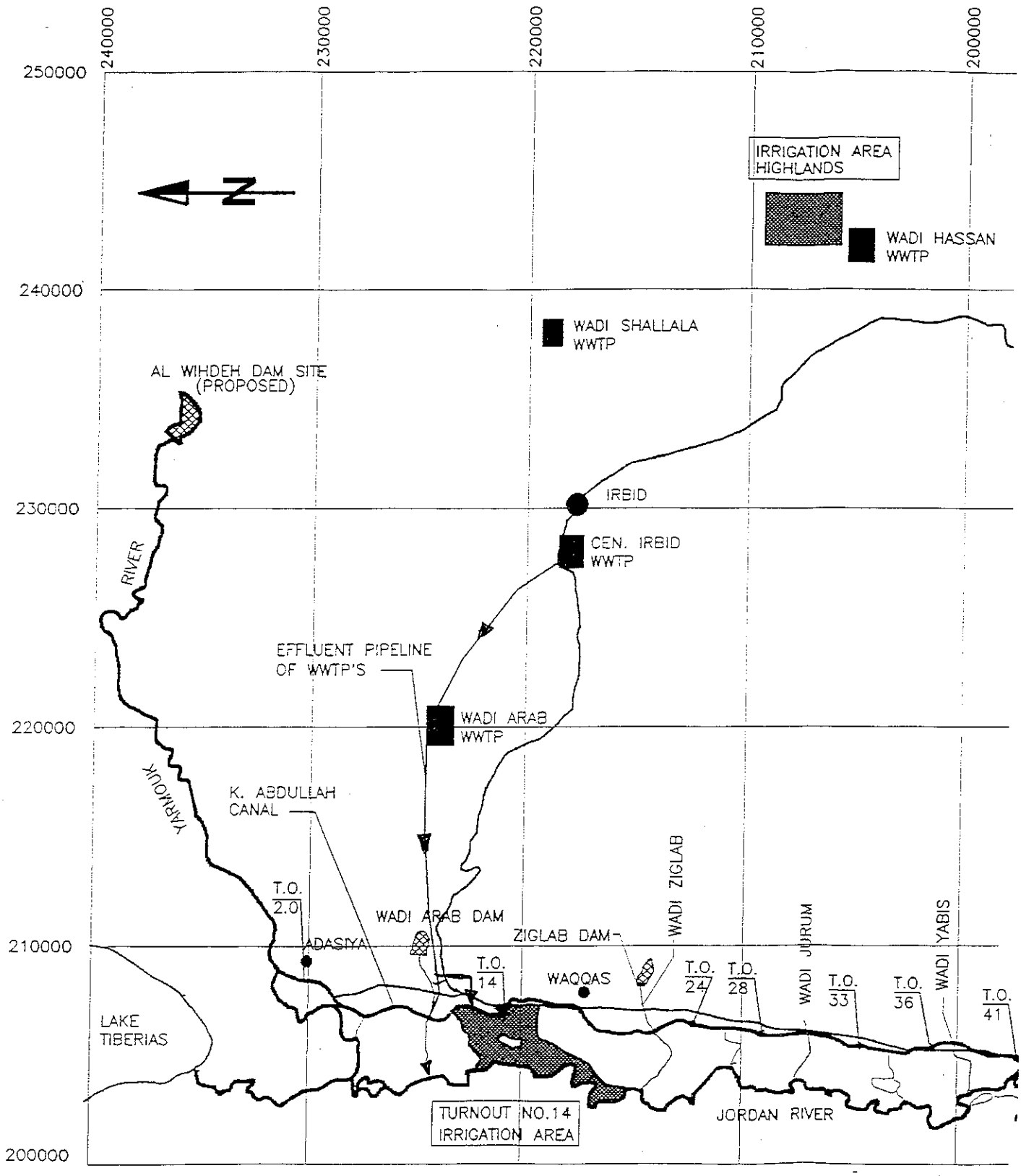

FIGURE 16.3: **Potential Reuse Areas – (WADI ARAB)**
WADI ARAB IRRIGATION COMPLEX

PROJECTION OF WASTEWATER PRODUCTION OF TREATMENT PLANT:
16 WADI ARAB

SCENARIO 0 "Consultants' Study" (acc. to Consultant's Study Report)

Basic data: since 2010 the capacity of TPIrbid Central is reached and add.sewage flows to Wadi Arab

Population in 1994: 0 Population in 2000: 150.320

	Unit	1994	2000	2005	2010	2015	2020
Growth rate (previous period)	%	-	-	4,45	3,80	4,40	4,40
Spec.water demand	l/c/d	-	110	128	130	130	130
Commercial demand	m³/d						
Small industrial demand	m³/d						
Pastoral demand	m³/d						
Coverage	%	0	50	70	90	90	90
Return factor	-	0,8	0,8	0,8	0,8	0,8	0,8
Losses/inflow	%	0	0	0	0	0	0
Specific pollutional load	$gBOD_5/c/d$	65	65	65	65	65	65

	Unit	1994	2000	2005	2010	2015	2020
Population	c	0	150.320	186.878	225.188	279.285	346.378
Connected (sewerage)	c	0	75.160	130.815	202.669	251.357	311.741
Not connected (sewerage)	c	0	75.160	56.064	22.519	27.929	34.638
Water demand							
Domestic demand	l/c/d	-	110	128	130	130	130
	m³/d	0	16.535	23.920	29.274	36.307	45.029
Commercial demand	m³/d						
Small industrial demand	m³/d						
Pastoral demand	m³/d						
Total	m³/d	0	16.535	23.920	29.274	36.307	45.029
Wastewater production		From Irbid Central:		0	0	1.365	3.426
Return flow (w.demand)	m³/d	0	6.614	13.395	21.078	26.141	32.421
Losses/inflow	m³/d	0	0	0	0	0	0
Total	m³/d	0	6.614	13.395	21.078	27.506	35.847
	m³/month	0	198.422	401.863	632.329	825.169	1.075.398
	m³/a	0	2.414.139	4.889.336	7.693.332	10.039.562	13.084.010
Pollutional load		From Irbid Central:		0	0	853	2.141
Poll. load (dom.demand)	$kgBOD_5/d$	0	4.885	8.503	13.174	16.338	20.263
Poll. load (com.demand)	$kgBOD_5/d$						
Poll. load (small ind.)	$kgBOD_5/d$						
Others	$kgBOD_5/d$						
Total load	$kgBOD_5/d$	0	4.885	8.503	13.174	17.191	22.404
Reuse of wastwater							
Inflow to the treatment plant	m³/a	0	2.414.139	4.889.336	7.693.332	10.039.562	13.084.010
Losses in treatment plant	%	0	5	5	5	5	5
(due to infiltr./evap.)	m³/a	0	120.707	244.467	384.667	501.978	654.201
Effluent of treatment plant	m³/a	0	2.293.432	4.644.869	7.308.665	9.537.584	12.429.810
Net water demand per ha	m³/d/ha		22	22	22	22	22
Irrigable reuse area	ha	0	286	578	910	1.188	1.548

Treated effluents discharged together with the one of Treatment Plant Irbid Central into Jordan Valley and reused by common reuse areas

Water demand for irrigation Mixed crop pattern 22 m³/d/ha
(demand as for "North Jordan Valley", no.29 reuse areas)