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1.10 Reuse of Effluent in Tafielah

1.10.1 Existing System of Wastewater Collection, Treatment and Disposal (Tafielah)

The Tafielah Wastewater Treatment Plant is located in some hundred meters distance to the build-up areas of Tafielah town in a very steep area belonging to the Wadi Al Ghweir. The plant receives sewage from the town of Tafielah only. Present inflow has reached only half of the hydraulic capacity of the plant (1,600 m³/d), which is rather low taking into account that the plant was put in operation in 1989. There are two reasons for this: There is some evidence that farmers use raw sewage for irrigation upstream of the treatment plant and, therefore, the influent to the plant is low. In addition, the present number of house connection could be increased from 1,200 to 2,000 with respect to the existing collection network. Figure 1.10.1-1 shows the sewerage system of Tafielah.

The incoming flow to the treatment is screened. The downstream located facilities are arranged in two parallel trains: Settling of solid matter of sewage takes place in the Imhoff tanks. Biological treatment is based on trickling filter technology and solid contact channels followed by secondary settling (see Figure 1.10.1-2). Chlorination facilities are located upstream of the maturation pond.

Sludge of the secondary settling tanks is pumped to the Imhoff tanks, where sludge is decomposed in a chamber below the settling volume. From there, excess sludge is discharged to the drying beds. After sun drying during 3 – 6 weeks in winter and 2 – 3 weeks in summer dried sludge is transported by trucks to the solid waste dumping ground Jorf Al Darawesh.

Main receiving water is Wadi Al Ghweir flowing down to the Jordan Valley. The effluent's quality (35 mg BOD₅/l) does meet the requirements according to the relevant Jordanian Standard 893/1995 for discharge into wadis and catchment areas. The fecal coliform count at the outflow of the plant does not allow unrestricted agricultural irrigation.

Presently, treated wastewater is used for restricted irrigation inside the treatment plant only (15 donums) but not downstream of the plant. Due to topographical reasons there are almost no appropriate areas for agricultural irrigation in the valley of Wadi Al Ghweir, which is very steep.

The design criteria for Tafielah Wastewater Treatment Plant are as follows:

| Influent | | Effluent |
|----------------------------|-------------------------|-------------------------|
| Inflow (m ³ /d) | BOD ₅ (mg/l) | BOD ₅ (mg/l) |
| 1,600 | 1,050 | 30 |

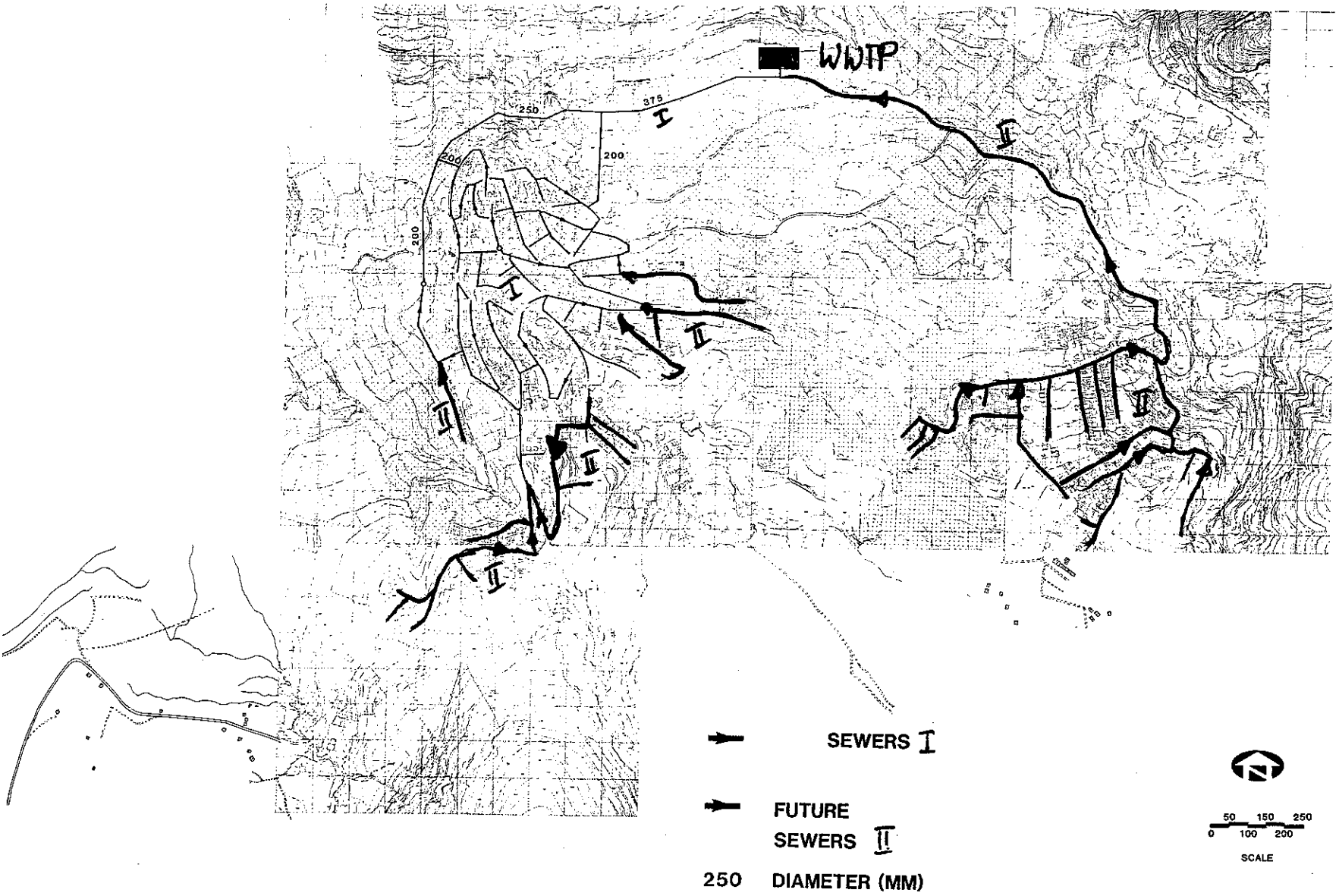


Figure 1.10.1-1

Layout of Tafelah Sewerage System

Figure 1.10.1-2: Schematic Layout of Tafelalah Wastewater Treatment Plant

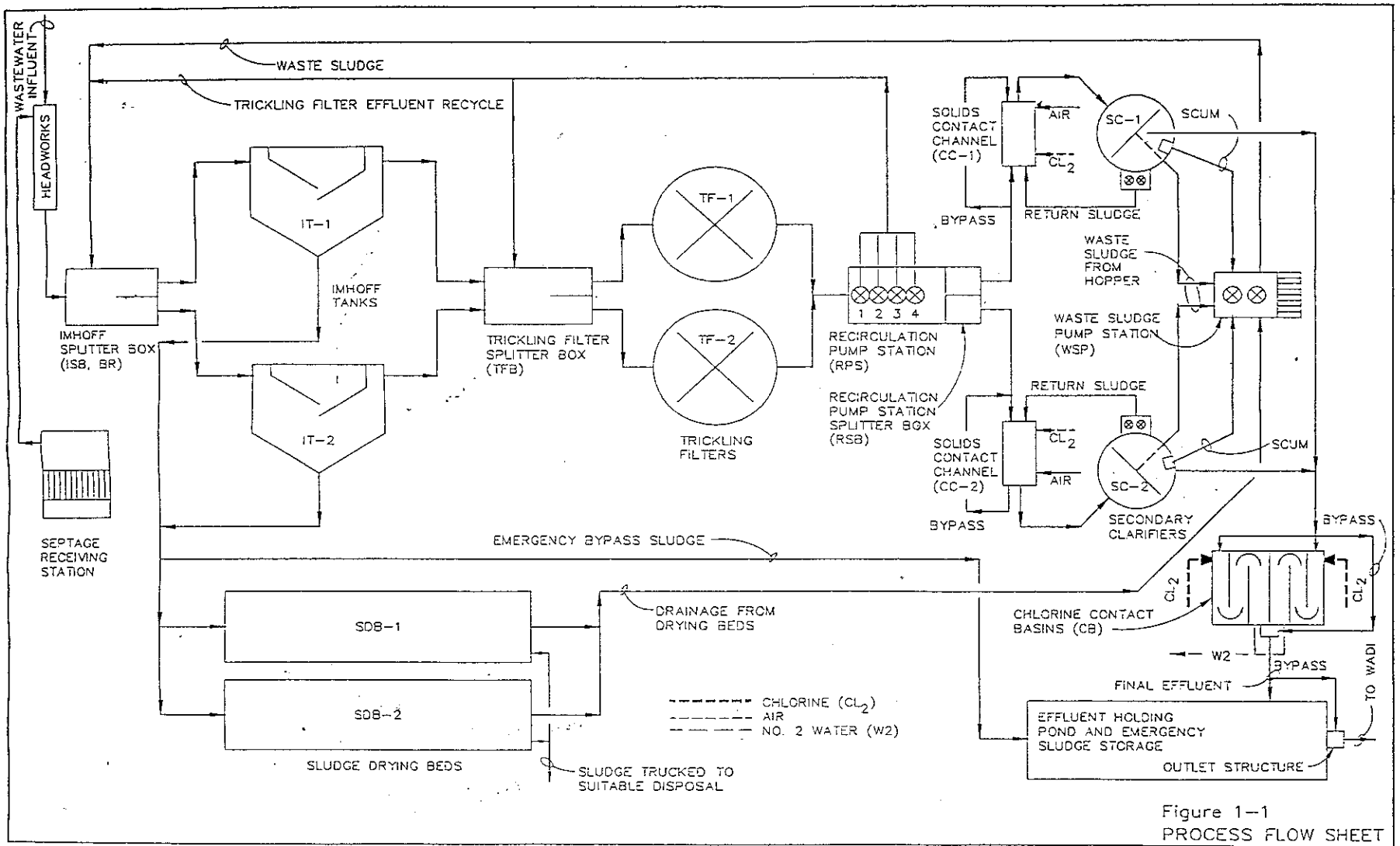


Figure 1-1
PROCESS FLOW SHEET

1.10.2 Wastewater Quantity and Quality (Tafielah)

The quantity of influent to the treatment plant is still far below the design capacity, which is 1,600 m³/day. As it becomes evident from Table 1.10.2-1 there was a gradual increase in the influent quantity to the treatment plant till the year 1995. After that the quantity went up and down, because farmers upstream of Tafielah plant take raw sewage from the sewerage network and manholes in order to irrigate their trees, especially olives during the summer droughts.

Table 1.10.2-1 Development of the Influent Quantity of Tafielah Wastewater Treatment Plant

| Year | Influent (m ³ /day) |
|------|--------------------------------|
| 1989 | 199 |
| 1990 | 345 |
| 1991 | 537 |
| 1992 | 625 |
| 1993 | 754 |
| 1994 | 936 |
| 1995 | 1,013 |
| 1996 | 966 |
| 1997 | 762 |
| 1998 | 862 |
| 1999 | 851 |
| 2000 | 707 |

The coverage percentage is around 50 %, it is expected to increase to around 70 % by the year 2010. According to the wastewater projection (see Table 1.10.2-2) the expected influent quantity to the treatment plant till the year 2020 will increase to about 3,500 m³/day or 1.29 MCM/a. Design capacity of the plant would be reached in about 2005.

For the extension of the existing wastewater treatment capacity for Tafielah it has to be carefully studied, where and how the required facilities have to be created. The land at the existing site is quite limited. Alternative sites for the treatment plant should be investigated. Therefore, the reuse schemes as pre-designed in section 1.10.4 take into account the design capacity of the existing facilities only.

The BOD₅ level of Tafielah WWTP in the year 2000 is around 650 mg/l, which is far below the design capacity of 1,050 mg/l. Tafila WWTP is considered to be under the design capacity in terms of organic load. Table 1.10.2-3 shows the quality of influent and effluent for the treatment plant. An efficiency of about 95 % can be concluded from the table.

Table 1.10.2-2 Projection of the Influent to Tafielah Wastewater Treatment Plant

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 | m ³ /d | | | | | | |
| Small industrial demand | m ³ /d | | | | | | |
| Pastoral demand | m ³ /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 |
| | m ³ /d | 2,085 | 2,280 | 3,576 | 4,557 | 5,360 | 6,305 |
| Commercial demand | m ³ /d | | | | | | |
| Small industrial demand | m ³ /d | | | | | | |
| Pastoral demand | m ³ /d | | | | | | |
| Total | m ³ /d | 2,085 | 2,280 | 3,576 | 4,557 | 5,360 | 6,305 |
| Wastewater production | | | | | | | |
| Return flow (w.demand) | m ³ /d | 834 | 912 | 1,573 | 2,552 | 3,002 | 3,531 |
| Losses/inflow | m ³ /d | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | m ³ /d | 834 | 912 | 1,573 | 2,552 | 3,002 | 3,531 |
| | m ³ /month | 25,020 | 27,361 | 47,202 | 76,553 | 90,046 | 105,917 |
| | m ³ /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 wastewater | | | | | | | |
| Inflow to the treatment plant | m ³ /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.) | m ³ /a | 30,441 | 33,289 | 57,430 | 93,140 | 109,556 | 128,866 |
| Effluent of treatment plant | m ³ /a | 273,969 | 299,603 | 516,867 | 838,258 | 986,006 | 1,159,795 |
| Net water demand per ha | m ³ /d/ha | | 64 | 64 | 64 | 64 | 64 |
| Irrigable reuse area | ha | 0 | 13 | 22 | 36 | 42 | 50 |

Table 1.10.2-3 Quality of Influent and Effluent of Tafielah WWTP for the Period (1989-2000)

| Year | Influent (mg/l) | | | Effluent (mg/l) | | | |
|------|------------------|-------|-------|------------------|-----|-----|-----|
| | BOD ₅ | COD | TSS | BOD ₅ | COD | TSS | TDS |
| 1989 | 646 | 1,276 | 885 | 43 | 170 | 18 | * |
| 1990 | 860 | 1,828 | 934 | 50 | 200 | 45 | 903 |
| 1991 | 1,014 | 1,939 | 1,100 | 49 | 163 | 48 | 836 |
| 1992 | 1,832 | 837 | 757 | 39 | 161 | 46 | 863 |
| 1993 | 878 | 1,724 | 623 | 53 | 166 | 48 | 725 |
| 1994 | 840 | 1,690 | 659 | 43 | 181 | 59 | 871 |
| 1995 | 892 | 1,595 | 665 | 39 | 129 | 55 | 918 |
| 1996 | 846 | 1,592 | 528 | 43 | 185 | 43 | 803 |
| 1997 | 1,143 | 1,646 | 730 | 34 | 156 | 33 | 748 |
| 1998 | 1,090 | 1,576 | 638 | 34 | 140 | 23 | 739 |
| 1999 | 942 | 1,538 | 700 | 35 | 138 | 47 | 798 |
| 2000 | 650 | 1,338 | 663 | 28 | 127 | 32 | 685 |

1.10.3 Reuse of Effluent (Tafielah)

1.10.3.1 Present Reuse Practice

There are about 360 springs in the Tafielah region. Recently, these springs become depleted during summer time because of the increase of pumping from the groundwater wells in order to meet the municipal demand.

There are two places where unplanned reuse in Tafielah is practiced. The first place is downstream of the treatment plant, where farmers divert the treated effluent to irrigate olives mainly - the dominant crop in Tafielah. The second place, which is upstream of the treatment plant location, where farmers take raw sewage from the sewerage network for irrigation. For this purpose they throw stones into the sewer lines and the manholes and break the pipe. This practice leads to a raise of the level of sewage, which then is directed by the farmers to irrigate their olives.

1.10.3.2 Proposed Cropping Pattern

The cropping pattern proposed is based on the existing cultivation (olives) and the introduction of fodder crops, grains and date palms. Treated wastewater could be used to irrigate fodders (alfalfa, sudan grass, sorghum, and barley) and grains (wheat and barley).

1.10.3.3 Water Demand for Irrigation

According to the proposed crop pattern, the effluent projection (see Table 1.10.2-2) the water demand (see Table 1.10.3-1 and Table 1.10.3-2) was established applying net water demand figures of agrozone 8. In this context it shall be mentioned that considered effluent quantities are limited to design capacity due to the fact that extension of the treatment capacity can most probably not assured at the given plant location.

As Figure 1.10.3-1 reveals treated effluent can be reused in total between February and November. During remaining months (December and January) a surplus in the quantity of effluent (about 26,000 m³/a) is generated. This excess water will be discharged to the

wadi for other uses along the wadi or for irrigation of the winter crops in the Southern Ghors.

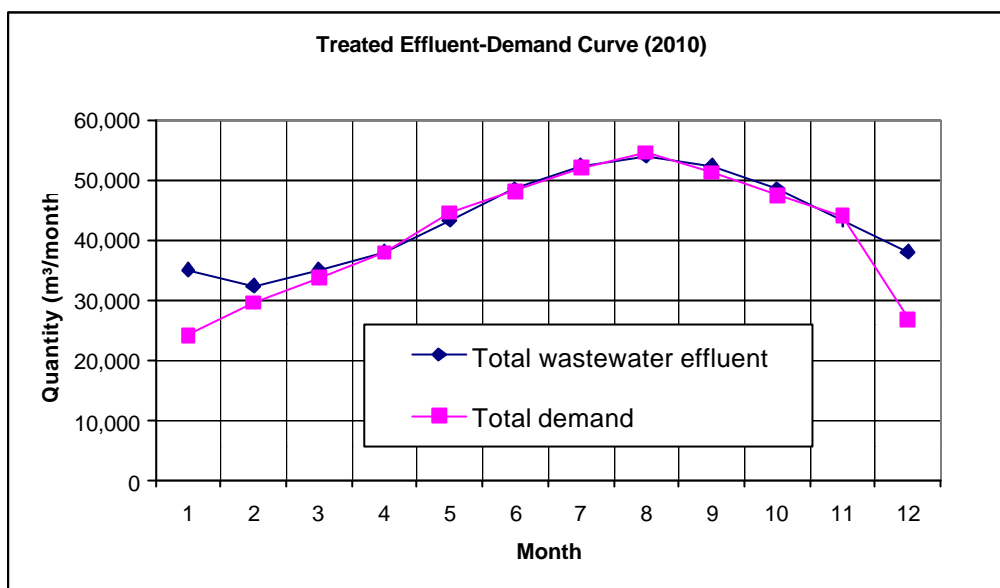


Figure 1.10.3-1 Seasonal Treated Effluent and Demand for Irrigation (Tafielah)

1.10.3.4 Area Proposed for Irrigation

Figure 1.10.3-2 depicts the proposed area (agrozone 8) that might be used for future irrigation by treated effluent. The land areas that could be exploited till the years 2010 and 2020, depending on the quantity of effluent (see Tables 1.10.3-1 and 1.10.3-2), are about 940 donums. Proposed areas are North of the existing treatment plant and below a contour line of 890 m a.s.l.. Under these conditions all effluent may be discharged by gravity to the reuse areas. In addition, it was respected that the irrigation land will be out of the steep valley of Wadi Al Ghweir. Figure 1.10.3-1 shows the location of the treatment plant and the main reuse facilities. Due to the mentioned conditions for the selection of future reuse areas, the proposed areas are quite longish following the limit of the steep part of the valley.

1.10.4 Preliminary Design of Facilities (Tafielah)

Required facilities include a transmission main line from the outlet of the treatment plant to the proposed reservoir site. The reservoir will be built upstream of the proposed reuse areas. Pumping is not necessary because effluent will flow downwards through the distribution lines by gravity.

Transmission Facilities

Proposed transmission line (DN 200, 3,800 m) conveys the effluent from the treatment plant outlet to a storage reservoir (west of the plant). From there effluent is discharged to the reuse areas in north-western direction of the Tafielah WWTP.

Storage Facilities

The storage reservoir is designed to accommodate two days flow (3,000 m³). It will be constructed in an elevation of 900 m to supply proposed reuse areas by gravity.

Table 1.10-1 Water Demand for Irrigation of Proposed Crops and Treated Effluent Supplied from Tafielah Wastewater Treatment Plant (2010)

| | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. | Total |
|--|---------------|--------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|--------------|--------------|----------------|
| Available wastewater | | | | | | | | | | | | | |
| Seasonal factor of treated effluent (wastewater) | 0,81 | 0,75 | 0,81 | 0,88 | 1,00 | 1,12 | 1,21 | 1,25 | 1,21 | 1,12 | 1,00 | 0,88 | - |
| Total wastewater effluent (m ³ /month) 2) | 34.992 | 32.400 | 34.992 | 38.016 | 43.200 | 48.384 | 52.272 | 54.000 | 52.272 | 48.384 | 43.200 | 38.016 | 520.128 |
| 1 OLIVES | | | | | | | | | | | | | |
| Net irrigation demand (m ³ / donum/ month) | 50 | 30 | 60 | 121 | 131 | 135 | 145 | 132 | 111 | 30 | - | - | 946 |
| Irrigation efficiency | 0,84 | 0,84 | 0,84 | 0,84 | 0,84 | 0,84 | 0,84 | 0,84 | 0,84 | 0,84 | 0,84 | 0,84 | |
| Gross irrigation demand (m ³ / donum/ month) | 60 | 36 | 72 | 144 | 156 | 160 | 173 | 157 | 133 | 36 | 0 | 0 | 1.126 |
| Chosen area (donum) | 180 | 180 | 180 | 180 | 180 | 180 | 180 | 180 | 180 | 180 | 180 | 180 | |
| Demand (m ³ /month) 1) | 10.714 | 6.509 | 12.943 | 25.841 | 28.133 | 28.879 | 31.143 | 28.190 | 23.876 | 6.447 | 0 | 0 | 202.675 |
| 2 WHEAT & BARLEY | | | | | | | | | | | | | |
| Net irrigation demand (m ³ / donum/ month) | 14 | 36 | 77 | 162 | 17 | - | - | - | - | - | 100 | 10 | 416 |
| Irrigation efficiency | 0,6 | 0,6 | 0,6 | 0,6 | 0,6 | 0,6 | 0,6 | 0,6 | 0,6 | 0,6 | 0,6 | 0,6 | |
| Gross irrigation demand (m ³ / donum/ month) | 23 | 59 | 129 | 271 | 28 | 0 | 0 | 0 | 0 | 0 | 167 | 17 | 694 |
| Chosen area (donum) | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | |
| Demand (m ³ /month) 1) | 463 | 1.186 | 2.580 | 5.412 | 567 | 0 | 0 | 0 | 0 | 0 | 3.333 | 336 | 13.877 |
| 3 DATE PALM | | | | | | | | | | | | | |
| Net irrigation demand (m ³ / donum/ month) | 21 | 29 | 63 | 140 | 171 | 184 | 197 | 179 | 151 | 109 | 66 | 26 | 1.337 |
| Irrigation efficiency | 0,84 | 0,84 | 0,84 | 0,84 | 0,84 | 0,84 | 0,84 | 0,84 | 0,84 | 0,84 | 0,84 | 0,84 | |
| Gross irrigation demand (m ³ / donum/ month) | 25 | 35 | 75 | 167 | 204 | 220 | 235 | 213 | 180 | 129 | 79 | 31 | 1.592 |
| Chosen area (donum) | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | |
| Demand (m ³ /month) 1) | 986 | 1.397 | 3.010 | 6.661 | 8.151 | 8.784 | 9.392 | 8.502 | 7.201 | 5.176 | 3.164 | 1.253 | 63.677 |
| Total demand for crops no. 1 - 3 (m³/ month) | 12.164 | 9.092 | 18.533 | 37.914 | 36.850 | 37.662 | 40.535 | 36.692 | 31.076 | 11.623 | 6.497 | 1.590 | 280.228 |
| Remaining effluent (m ³ /month) | 22.828 | 23.308 | 16.459 | 102 | 6.350 | 10.722 | 11.737 | 17.308 | 21.196 | 36.761 | 36.703 | 36.426 | |
| 4 ALFALFA | | | | | | | | | | | | | |
| Net irrigation demand (m ³ / donum/ month) | 10 | 18 | 45 | 116 | 153 | 179 | 197 | 179 | 151 | 107 | 64 | 22 | 1.242 |
| Irrigation efficiency | 0,6 | 0,6 | 0,6 | 0,6 | 0,6 | 0,6 | 0,6 | 0,6 | 0,6 | 0,6 | 0,6 | 0,6 | |
| Gross irrigation demand (m ³ / donum/ month) | 17 | 29 | 76 | 193 | 256 | 298 | 329 | 298 | 252 | 179 | 107 | 36 | 2.070 |
| Required area of alfalfa (donum) | 1.326 | 797 | 217 | 1 | 25 | 36 | 36 | 58 | 84 | 205 | 342 | 1.011 | |
| Selected area of alfalfa (donum) | 700 | 700 | 200 | 0 | 30 | 35 | 35 | 60 | 80 | 200 | 350 | 700 | |
| Demand for selected area of alfalfa (m ³ /month) | 12.053 | 20.470 | 15.152 | 0 | 7.665 | 10.438 | 11.505 | 17.854 | 20.162 | 35.825 | 37.569 | 25.215 | 213.908 |
| Water Balance | | | | | | | | | | | | | |
| Total demand (m ³ /month) | 24.217 | 29.562 | 33.685 | 37.914 | 44.515 | 48.100 | 52.040 | 54.546 | 51.238 | 47.448 | 44.066 | 26.805 | 494.136 |
| Total wastewater effluent (m ³ /month) 2) | 34.992 | 32.400 | 34.992 | 38.016 | 43.200 | 48.384 | 52.272 | 54.000 | 52.272 | 48.384 | 43.200 | 38.016 | 520.128 |
| Excess-/deficit+ (m ³ /month) | 10.775 | 2.838 | 1.307 | 102 | -1.315 | 284 | 232 | -546 | 1.034 | 936 | -866 | 11.211 | 25.992 |

Remarks:

1) Based on irrigation time:24 hours/day

2) Wastewater effluents of treatment plant **1.440** m³/day in 2010 and 525.600 m³/annum

3) Irrigation surface (donums):

| | | | | |
|---------------|--------|----------------|-----------|---------|
| | OLIVES | WHEAT & BARLEY | DATE PALM | ALFALFA |
| Total (min.): | 240 | 180 | 40 | 0 |
| Total (max.): | 940 | 180 | 40 | 700 |

Table 1.10.4-2 Water Demand for Irrigation of Proposed Crops and Treated Effluent Supplied from Tafielah Wastewater Treatment Plant (2020)

| | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. | Total |
|---|---------------|--------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|--------------|--------------|----------------|
| Available wastewater | | | | | | | | | | | | | |
| Seasonal factor of treated effluent (wastewater) | 0,81 | 0,75 | 0,81 | 0,88 | 1,00 | 1,12 | 1,21 | 1,25 | 1,21 | 1,12 | 1,00 | 0,88 | - |
| Total wastewater effluent (m ³ /month) 2) | 34.992 | 32.400 | 34.992 | 38.016 | 43.200 | 48.384 | 52.272 | 54.000 | 52.272 | 48.384 | 43.200 | 38.016 | 520.128 |
| OLIVES | | | | | | | | | | | | | |
| Net irrigation demand (m ³ / donum/ month) | 50 | 30 | 60 | 121 | 131 | 135 | 145 | 132 | 111 | 30 | - | - | 946 |
| Irrigation efficiency | 0,84 | 0,84 | 0,84 | 0,84 | 0,84 | 0,84 | 0,84 | 0,84 | 0,84 | 0,84 | 0,84 | 0,84 | |
| Gross irrigation demand (m ³ / donum/ month) | 60 | 36 | 72 | 144 | 156 | 160 | 173 | 157 | 133 | 36 | 0 | 0 | 1.126 |
| Chosen area (donum) | 180 | 180 | 180 | 180 | 180 | 180 | 180 | 180 | 180 | 180 | 180 | 180 | |
| Demand (m ³ /month) 1) | 10.714 | 6.509 | 12.943 | 25.841 | 28.133 | 28.879 | 31.143 | 28.190 | 23.876 | 6.447 | 0 | 0 | 202.675 |
| WHEAT & BARLEY | | | | | | | | | | | | | |
| Net irrigation demand (m ³ / donum/ month) | 14 | 36 | 77 | 162 | 17 | - | - | - | - | - | 100 | 10 | 416 |
| Irrigation efficiency | 0,6 | 0,6 | 0,6 | 0,6 | 0,6 | 0,6 | 0,6 | 0,6 | 0,6 | 0,6 | 0,6 | 0,6 | |
| Gross irrigation demand (m ³ / donum/ month) | 23 | 59 | 129 | 271 | 28 | 0 | 0 | 0 | 0 | 0 | 167 | 17 | 694 |
| Chosen area (donum) | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | |
| Demand (m ³ /month) 1) | 463 | 1.186 | 2.580 | 5.412 | 567 | 0 | 0 | 0 | 0 | 0 | 3.333 | 336 | 13.877 |
| DATE PALM | | | | | | | | | | | | | |
| Net irrigation demand (m ³ / donum/ month) | 21 | 29 | 63 | 140 | 171 | 184 | 197 | 179 | 151 | 109 | 66 | 26 | 1.337 |
| Irrigation efficiency | 0,84 | 0,84 | 0,84 | 0,84 | 0,84 | 0,84 | 0,84 | 0,84 | 0,84 | 0,84 | 0,84 | 0,84 | |
| Gross irrigation demand (m ³ / donum/ month) | 25 | 35 | 75 | 167 | 204 | 220 | 235 | 213 | 180 | 129 | 79 | 31 | 1.592 |
| Chosen area (donum) | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | |
| Demand (m ³ /month) 1) | 986 | 1.397 | 3.010 | 6.661 | 8.151 | 8.784 | 9.392 | 8.502 | 7.201 | 5.176 | 3.164 | 1.253 | 63.677 |
| Total demand for crops no.1 - 3 (m³/ month) | 12.164 | 9.092 | 18.533 | 37.914 | 36.850 | 37.662 | 40.535 | 36.692 | 31.076 | 11.623 | 6.497 | 1.590 | 280.228 |
| Remaining effluent (m ³ /month) | 22.828 | 23.308 | 16.459 | 102 | 6.350 | 10.722 | 11.737 | 17.308 | 21.196 | 36.761 | 36.703 | 36.426 | |
| ALFALFA | | | | | | | | | | | | | |
| Net irrigation demand (m ³ / donum/ month) | 10 | 18 | 45 | 116 | 153 | 179 | 197 | 179 | 151 | 107 | 64 | 22 | 1.242 |
| Irrigation efficiency | 0,6 | 0,6 | 0,6 | 0,6 | 0,6 | 0,6 | 0,6 | 0,6 | 0,6 | 0,6 | 0,6 | 0,6 | |
| Gross irrigation demand (m ³ / donum/ month) | 17 | 29 | 76 | 193 | 256 | 298 | 329 | 298 | 252 | 179 | 107 | 36 | 2.070 |
| Required area of alfalfa (donum) | 1.326 | 797 | 217 | 1 | 25 | 36 | 36 | 58 | 84 | 205 | 342 | 1.011 | |
| Selected area of alfalfa (donum) | 700 | 700 | 200 | 0 | 30 | 35 | 35 | 60 | 80 | 200 | 350 | 700 | |
| Demand for selected area of alfalfa (m ³ /month) | 12.053 | 20.470 | 15.152 | 0 | 7.665 | 10.438 | 11.505 | 17.854 | 20.162 | 35.825 | 37.569 | 25.215 | 213.908 |
| Water Balance | | | | | | | | | | | | | |
| Total demand (m ³ /month) | 24.217 | 29.562 | 33.685 | 37.914 | 44.515 | 48.100 | 52.040 | 54.546 | 51.238 | 47.448 | 44.066 | 26.805 | 494.136 |
| Total wastewater effluent (m ³ /month) 2) | 34.992 | 32.400 | 34.992 | 38.016 | 43.200 | 48.384 | 52.272 | 54.000 | 52.272 | 48.384 | 43.200 | 38.016 | 520.128 |
| Excess-/deficit+ (m ³ /month) | 10.775 | 2.838 | 1.307 | 102 | -1.315 | 284 | 232 | -546 | 1.034 | 936 | -866 | 11.211 | 25.992 |

Remarks:

- 1) Based on irrigation time:24 hours/day
- 2) Wastewater effluents of treatment plant **1.440** m³/day in 2020 and 525.600 m³/annum

| | | | | | |
|---------------------------------|-----|--------|----------------|-----------|---------|
| 3) Irrigation surface (donums): | | OLIVES | WHEAT & BARLEY | DATE PALM | ALFALFA |
| Total (min.): | 240 | 180 | 20 | 40 | 0 |
| Total (max.): | 940 | 180 | 20 | 40 | 700 |

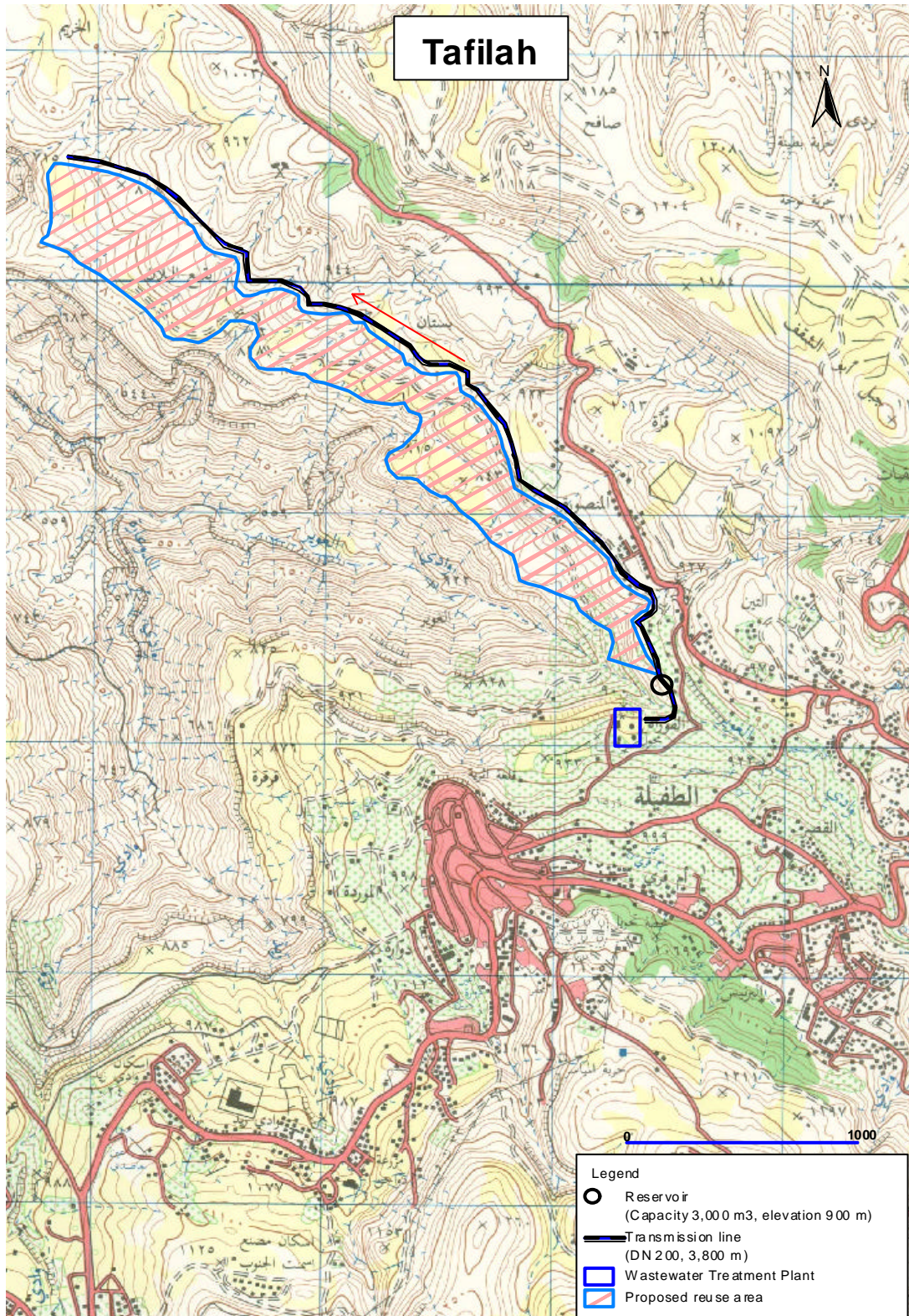


Figure 1.10.4-1 Location of Tafilah Wastewater Treatment Plant and Proposed Site for Effluent Reuse