WATER USE STRATEGY

NORTH JORDAN

1978

VOLUME 3
DOMESTIC AND INDUSTRIAL WATER DEMAND

HOWARD HUMPHREYS AND SONS

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DOMESTIC AND INDUSTRIAL WATER DEMAND

Prepared for
The Government of
THE HASHEMITE KINGDOM OF JORDAN

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H.E. President,
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Excellency,

North Jordan Water Use Strategy:
Volume 3, Domestic and Industrial Water Demand

We have pleasure in submitting the final version of Volume 3 of our report on the North Jordan Water Use Strategy. The report comprises five volumes in all and this volume assesses municipal water demands with projections up to the year 2002.

This final version supersedes the draft Volume 3 submitted in February and takes into consideration the Jordanian Government's comments on the draft.

Yours sincerely,
for HOWARD HUMPHREYS & SONS

Redacted for privacy

J.M. Reid
Associate

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ABBREVIATIONS

JEA	Jordan Electricity Authority
WSC	Water Supply Corporation
EGMC	East Ghor Main Canal
mm	millimetres
m	metres
km	kilometres
s	seconds
min	minutes
hr	hours
d	days
a	years
l/s	litres per second
m/s	metres per second
m^3/d	cubic metres per day
l/h/d	litres per head per day
M	million
Mm^3/a	million of cubic metres per year
^oC	degrees Celsius
MW	megawatt
KWh	Kilowatt-hour
dia.	diameter
%	parts per hundred
mg/l	milligrammes per litre
TDS	total dissolved solids
DN	nominal diameter (in millimetres)
BH	borehole
No.	number
JD	Jordanian Dinars
CIF	cost insurance freight
MS	mild steel
HTS	high tensile steel
DI	ductile iron
GL	ground level
IL	invert level
BWL	bottom water level
TWL	top water level
min	minimum
max	maximum
RO	reverse osmosis
PS	pumping station
GDP	gross domestic product

CHAPTER 1 - INTRODUCTION

1.1 TERMS OF REFERENCE

In July 1977, the UK Ministry of Overseas Development, under British technical co-operation arrangements, engaged Howard Humphreys and Sons in association with Peat, Marwick, Mitchell and Company and Minster Agriculture, to prepare for the Government of Jordan a domestic and industrial water use strategy for the northern part of the Kingdom. The Terms of Reference are set out fully in the General Report which forms Volume 1 of a series of reports associated with the Study.

Volume 3 of this series, entitled Domestic and Industrial Water Demand, is associated in particular with para. 3(i) of the Terms of Reference which requires the consultant to:

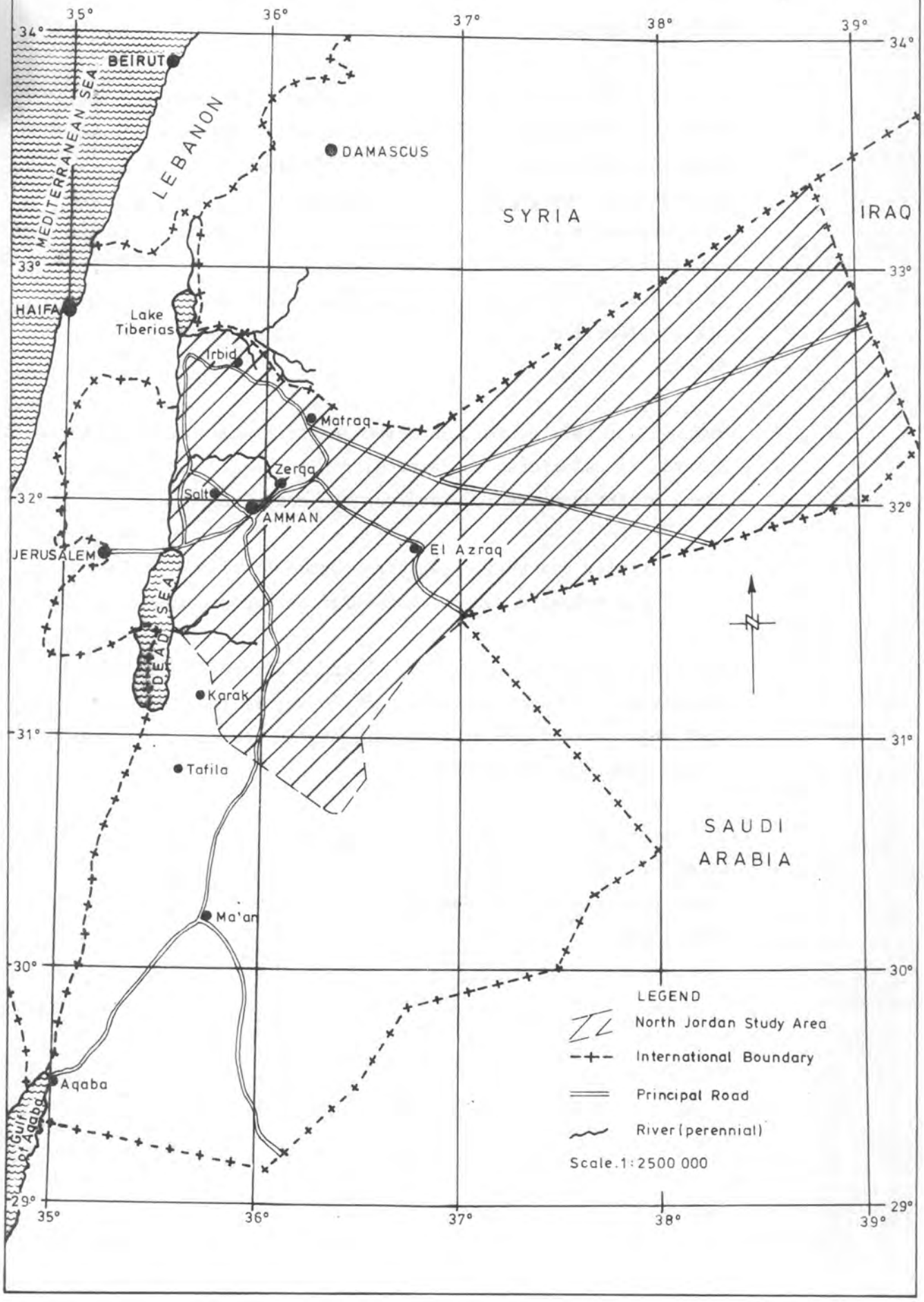
- review and refine existing forecasts of industrial and domestic water demands for northern Jordan.

For the purposes of this study northern Jordan is defined broadly as that part of the Kingdom lying to the north of Wadi Mujib, exclusive of that part of the Jordan Valley south of the Dead Sea. (Ref. Figure 1)

The report that follows examines the present and probable future demand for water among domestic, commercial, industrial and other non-agricultural consumers over the period up to the year 2002.

Figure 1

LOCATION MAP



In line with the overall scope of the North Jordan Water Use Strategy studies, the analysis presented in this report is based essentially upon a review of the data contained in recent reports relating to the development of Jordan's water resources and water supply systems. These data have however been supplemented by and interpreted in the light of certain additional information obtained from our own discussions with key officials and organisations in Jordan.

1.2 EXISTING PROJECTIONS OF WATER DEMAND

Estimates of future non-agricultural water demands are contained in six recent studies:

- An Outline for Water Planning In East Jordan, W.Barber (1975)
- Water Supply Corporation - Northern District. Financial Review. F. Clapham, under UK Technical Co-operation (1976)
- Yarmouk River Development, Irbid Water Supply Feasibility Study. Crown Agents (1977)
- Jordan Valley Irrigation Project Stage II, Draft Feasibility Report, Harza Overseas Engineering Company/Dar Al-Handasah Consultants (1977)
- Water Resources Study for Amman Water Supply and Feasibility Studies for the Amman Water Supply and Sewerage System. VBB (1976)
- National Water Master Plan of Jordan. Agrar und Hydrotechnik (1977).

The reports by Barber and Clapham are, however, of rather limited use in the context of the present analysis of water demands. The estimates given in the Barber report are "orders of magnitude" only, whilst those presented in the Clapham report are a straight extrapolation of past production and consumption trends and,

particularly bearing in mind recent water supply constraints, may give a misleading picture of potential demands.

At this stage in our analysis, therefore, our attention is focussed principally upon the remaining four studies.

The projections of demand presented in all these studies are based essentially upon forecasts of future population numbers, together with estimates of per capita levels of demand. The latter cover domestic as well as smaller-scale industrial, commercial and other similar needs and include allowances for supply system losses. Certain additional allowances have been included in a number of instances to cover the needs of specific and identifiable large scale users such as major industries.

The report by the Crown Agents presents estimates of water demands covering the period 1974 - 2010 for the area served by the Water Supply Corporation's Northern District supply system. Three alternative sets of demand projections are given (a high, an intermediate and a low projection), a reflection of the uncertainties surrounding the future rate of development of the region and its population growth.

The VBB studies, on the other hand, confine themselves to one single set of projections of water demands covering the period 1975 - 2005. A year-by-year forecast is given for both the Amman-Zerqa basin (an area which broadly corresponds with the Amman-Zerqa conurbation and immediately surrounding villages) and the City of Amman alone.

The Jordan Valley Irrigation Project Feasibility Report and the National Water Master Plan also restrict their analysis to a single set of projections. The former report is concerned primarily with the provision and use of water for agricultural purposes in the Jordan Valley. It therefore only briefly considers potential domestic and industrial demands in the Valley and in Irbid (which could in future be supplied from the Yarmouk River), primarily as a means of establishing the balance of water available for irrigation.

By far the most comprehensive analysis of domestic, commercial and industrial water demands, particularly in terms of geographical coverage, is that presented in the National Water Master Plan. The latter covers the period 1975 - 2000 and presents a set of projections for the whole of Jordan, subdivided into sixty separate areas. Forty of these fall within our own study area. The projection also offers the considerable advantage of having been prepared for all areas on a consistent basis. Because of this and the detail of coverage, we have tended to adopt them as the principal basis for our own analysis.

1.3 DATA AVAILABILITY

Preparation of water demand projections in all the studies referred to above was clearly hampered quite seriously by lack of adequate data, both with regard to estimates of population and to unit or per capita levels of water consumption.

The problems with regard to population estimates essentially stem from the fact that the last complete Census of Population was conducted as long ago as 1961. Registration of subsequent births and deaths is known to be incomplete, and no statistics are available on rates of internal migration.

In the case of per capita demands, reliable information on past levels of production and consumption is limited due either to an actual lack of meters or to faulty and inaccurate meters where the latter have been installed. The problem is compounded by the fact that in many instances consumption has been and is now seriously constrained by water supply shortages. Hence, existing levels of consumption may be a very poor guide as to the quantities of water consumers would use, given an adequate standard and level of supply. Furthermore, there is little historical data from which to establish possible trends in growth of consumption and production.

Figure 2

DEFINITION OF CATCHMENT AREAS

1.4 PROJECTIONS OF DEMAND FOR NORTH JORDAN WATER USE STRATEGY

In preparing projections of water demands for the purposes of the present study, not only have we had to contend with similar data deficiencies but, owing to the nature of our brief, we have also had to rely to a considerable extent upon the results of detailed fieldwork and data collection undertaken as part of earlier studies. Inevitably, this has led us to adopt a somewhat pragmatic approach in preparing our own projections of demand.

Owing to the extent of the particular data limitations compounded with the usual uncertainties about the future, any set of projections of water demands must, in the present instance, be subject to a considerable margin of error. With this in mind, our general approach has first been to establish a central set of projections which, in the light of the available information, appears to us to form a reasonable initial basis for formulation and analysis of alternative schemes and for overall water resource and supply project planning. We have then proceeded to examine the principal factors that could result in variations in demand from the levels projected and the possible scale of such variations. The results of this latter analysis have then been utilised as a basis for testing how sensitive our recommended strategy of water supply development might be to unforeseen variations in projected levels of demand and what would be the general implications of such variations for water resource planning.

In line with the general approach adopted elsewhere in the North Jordan Water Use Strategy Report, our projections relate to the same sub-division of our study area into the surface water catchment areas utilised as a basis for analysis in the National Water Master Plan. The general coverage and boundaries of these latter areas are shown in figure 2.

1.5 STRUCTURE OF REPORT

The following chapters of this report present our analysis and projections of domestic, commercial and industrial water demands.

Chapter 2 presents a summary of our principal findings and conclusions.

Chapter 3 provides a broad analysis of general national and regional development prospects in so far as these are likely to have a significant effect on the level and regional distribution of water demands.

In Chapter 4, the available data relating to present and future levels of population is examined, while in Chapter 5 per capita levels of demand, inclusive of the needs of the domestic, commercial and small-scale industrial user, are analysed. In this context we consider the consumers' ability to pay.

Chapters 6 and 7 respectively examine the foreseeable water needs of major industrial and "other" bulk consumers, the latter comprising principally government institutions such as army camps.

Finally, Chapter 8 presents our overall projections of water demands for the period 1977 to 2002.

1.6 ACKNOWLEDGEMENTS

Throughout our work we received invaluable assistance from the officials of the National Planning Council, the Natural Resources Authority and representatives of many other government departments and other organisations listed in detail in Volume 1, the General Report. They gave of their time freely in providing information and in discussing aspects pertinent to the study, for which we are very grateful. We should also like to acknowledge the very considerable cooperation we received from members of the National Water Master Plan study team.

CHAPTER 2 - SUMMARY AND CONCLUSIONS

2.1 DEVELOPMENT PROSPECTS

The Jordanian economy has recently been experiencing a period of rapid growth, and this seems likely to continue in the foreseeable future. At the regional level, the main impetus to development has fallen on the Amman-Zerqa conurbation, which has attracted a constantly increasing proportion of the country's population.

The current National Five Year Plan calls for a major expansion of the commodity producing sectors of the economy - agriculture, mining and manufacturing - together with the development of the country's tourism potential. The Plan also aims at encouraging growth in the regions in an attempt to spread more evenly the gains of economic development.

However, despite policies and prospects for regional growth the Amman-Zerqa conurbation still seems likely to command a major position in the national economy and to continue to attract further development and population. Irbid, too, seems well placed to attract additional development in its capacity as a regional centre in the middle of a prosperous farming area (Chapter 3).

2.2 POPULATION GROWTH

Jordan is currently experiencing a rapid rate of population growth, estimated at approximately 3½% per annum. The available statistics indicate a continuing fall in mortality rates, and although there are signs of growing awareness of family planning methods which could lead to a decline in fertility rates, the age-structure of the population is such that no significant reduction is envisaged in national population growth rates over the next few years at least. This national rate of growth is likely to be coupled at the local level with a general migration away from the rural areas to the towns.

The principal exception is perhaps the Jordan Valley, where there are considerable plans for agricultural development with an associated increase in manpower requirements (Chapter 4).

2.3 PRESENT WATER SUPPLY SITUATION

At the present time, a number of areas in northern Jordan are experiencing considerable water shortages, shortages which are particularly acute during the hotter summer months. These shortages have been caused by a rapid and sustained increase in demands resulting from economic development and population growth, an increase with which investment in new water supply capacity has been unable to keep pace (Chapter 5).

The National Water Master Plan, produced in 1977, for example, suggested that within our northern Jordan study area potential demand for water for domestic, commercial, industrial and other non-agricultural uses could have amounted to some 75.1 Mm^3 in 1975 compared with an actual quantity supplied of 40.7 Mm^3, leaving an unsatisfied demand of 34.4 Mm^3. Our review of the available data and reports broadly confirms these conclusions, since our own estimates of potential demand in 1975 amount to some 71 Mm^3.

2.4 FUTURE LEVELS OF DEMAND FOR WATER

The expected increase in population coupled with rising standards of living, increasing levels of per capita domestic demand for water (Chapter 5) and growing industrial needs stemming from Government's policy of promoting the commodity producing sectors of the economy (Chapter 6) seems bound to lead to a considerable further growth in total water requirements.

Our own estimates indeed suggest that within our study area, potential demand for water for domestic, commercial, industrial and other non-agricultural uses may increase from a level of some 87 Mm^3 in 1978 to one of 146 Mm^3 in 1987 and 286 Mm^3 in 2002, an overall rate of growth of approximately 5.1% per annum over the total period in question (Chapter 8).

2.5 THE REGIONAL PATTERN OF WATER DEMANDS

The other principal feature of potential water demands, as indicated by the estimates, is the concentration of non-agricultural water requirements within the northern part of the Kingdom in two main areas - the Amman-Zerqa conurbation and Irbid.

In 1978, for example, we estimate that potential demands within the conurbation and the city of Irbid could amount to some 63 Mm^3, 73% of our estimate for the whole of our study area. The figure is higher still if the immediately surrounding towns and villages are included. Of this total, the major proportion of demand is centered on the Amman-Zerqa conurbation where for 1978 we estimate potential non-agricultural water requirements at some 58 Mm^3.

Over time, the concentration of demands in these two areas is likely to increase due to migration of population from the rural areas to the main towns, the higher standards of living and per capita levels of water demand generally prevailing in the latter, and the tendency for industry, commerce and services to gravitate towards the main centres of population, in particular the Amman-Zerqa conurbation.

In 1987, for example, we estimate that potential non-agricultural demands for water in the Amman-Zerqa conurbation could amount to some 103 Mm^3, those in the city of Irbid to a further 10 Mm^3, nearly 78% of the estimated total for our study area. By the year 2002, we estimate that those particular demands could have risen to 224 and 22 Mm^3/a respectively, approximately 85% of the estimated total for our study area (Chapter 8).

Whilst the requirements of other areas clearly cannot be neglected, the scale of demands is in general of relatively small proportions, and it is the situation in the main cities which appears to be of major significance from the point of view of the water resources and supply system planning and development.

CHAPTER 3 - GENERAL DEVELOPMENT PROSPECTS

3.1 AGRICULTURE

The present plans and prospects for agricultural development are discussed in detail in a separate volume.

In the foreseeable future, the main developments seem likely to comprise the extension of irrigation schemes in the Jordan Valley (areas AB12, AB13, AB14 and AB15) and certain adjacent areas such as the Zarqa triangle (AL0) and the Kafrein - Hisban project area (AP1/2 and AN); implementation of desert irrigation schemes at Qatrana, Ghuweir Adr, Wadi Abyad and Sultani (CD11 and CD82); and development of dry-land farming around Irbid (AE and the western part of AD 52) and to a more limited extent in the area between Amman and Zerqa (AL32) and to the west and north-west of Dhuleil (AL73).

At the present time, no major development schemes are envisaged in the various highland areas, although given sufficient water a number appear to offer some potential. However, in terms of their possible effects upon population distribution and domestic water demands, agricultural development schemes, if implemented, seem likely to result in an increase in agricultural incomes rather than in a major increase in employment and population levels.

3.2 INDUSTRIAL DEVELOPMENT

The industrial sector in Jordan is still at a relatively early stage in its development. In 1975, total employment in the mining, quarrying, manufacturing and electric power sectors was estimated to amount to no more than some 27 000 jobs, with output contributing approximately only 15% of gross domestic product (GDP).

At the present time, the major share of employment in the industrial sector is concentrated in and around the Amman - Zerqa conurbation. The 1974 Industrial Census, for example, indicates that nearly 85% of manufacturing employment was located in this area, presumably on account of the resulting proximity to the main centres of domestic consumption and the availability of labour, business services and basic infrastructure such as power, water, transport and communications.

The industrial sector is also characterised by the relatively small number of large industries or establishments and the correspondingly large proportion of small and handicraft enterprises. Once again, data collected from the 1974 Industrial Census indicated that some 92% of manufacturing establishments were small firms employing less than 5 persons. These firms, however, only produced an estimated 8% of the country's manufacturing output.

Despite its relatively small share of total national output and employment, the industrial sector has been experiencing rapid development in recent years. Output, according to the index of production, increased at a rate of some 9% per annum between 1972 and 1975, whilst statistics presented in the National Five Year Plan indicate an increase in the sector's share of GDP from around 11% to 15% over this period. This latter increase was in part due to the substantial rise that occurred in world phosphate prices, but notwithstanding, the industrial sector as a whole appeared buoyant.

The present Five Year Plan (1976 - 1980) states that "high priority should be given to commodity producing sectors in order to correct the imbalance in the structure of the national economy and to disperse economic activity outside the densely populated areas". Emphasis is placed on the need to develop and diversify the minerals sub-sector and to develop import-substitution and export-oriented manufacturing industry. Consequently, the Plan envisages a major direction of funds towards the industrial sector and a continued rapid rate of industrial development and growth in output. Indeed, the initial targets presented in the Plan suggested an increase of some 26% per annum in mining and manufacturing output compared with a target rate of growth in GDP of 12% per annum. The latter target has, however, since been revised to one of 8% per annum, and this seems likely to

be reflected to some extent in the performance of the industrial sector, with certain identified projects perhaps taking slightly longer to come to fruition.

Much of the planned increase in industrial output seems likely to be generated by a relatively small number of major projects which are identified in the Five Year Plan. Many of these projects are outside our study area and include, for example, the proposed phosphate fertiliser plant at Aqaba, the Dead Sea potash project, cement production in southern Jordan, copper production at Fainan, and much of the planned development of phosphate mines in the El Hasa area - although the Wadi Abyad phosphate deposits north of El Hasa fall just within our study area. The major industrial developments planned within our area comprise expansion of the refinery and textile production at Zerqa, and an increase in cement production at Fuheis.

Also within our study area, however, there are plans to develop industrial estate facilities - in the Amman - Zerqa region and at Irbid - to encourage the growth of light manufacturing and commercial activities. It is also intended to make provision for free-zone facilities at Amman and to develop a free trade zone on the Syrian - Jordanian border at Jabr, jointly with the Syrian authorities.

As far as general manufacturing activities are concerned, it seems to us probable that the rate of growth will be significantly below that planned for the industrial sector as a whole, with much of the target increase in output coming from the major capital intensive projects referred to previously.

A report produced in 1976 by R D Scott and Co on development prospects for manufacturing industry in Jordan, for example, suggested that taking a slightly longer-term view of prospects, manufacturing employment might increase to a level of 54 000 by 1985, equivalent to an average annual rate of growth of approximately 6½% over the period in question.

To the extent that growth can be encouraged among larger establishments, which have, according to the results of the Industrial Census, exhibited higher rates of productivity than smaller businesses, the rate of increase in output could of course be somewhat above that suggested for employment.

Given Jordan's favourable geographic location relative to many Middle East markets, its membership of the Arab Common Market, its transport infrastructure and links with neighbouring countries which are constantly being improved, Government's policy of encouraging international investment, and the country's rapidly growing population and hence domestic market for many commodities, it might be considered that the assumption of a rate of growth in employment of 6½% per annum is pessimistic. Indeed the authors of the Scott report themselves consider that it may be conservative.

However, it must not be forgotten that many other countries in the region are also attempting to diversify their economies and expand their manufacturing sectors, which may result in increasing levels of local competitiveness. Jordan too has been an exporter of skilled labour, and industry has certainly experienced difficulties in recruiting sufficient labour of the required calibre and skill. This problem is recognised by the authorities who are taking measures to rectify the situation. Nevertheless, training takes time, and labour shortages may for some time to come impose a degree of constraint upon industrial growth.

Beyond the mid-1980's, industrial prospects become increasingly uncertain. At the present time, the general situation would appear to favour a continued but steady rate of growth. In percentage terms, we would anticipate a gradual reduction in the rate of increase as the industrial base of the country becomes established. The discovery of hydrocarbons in Jordan, or, for that matter, any other unforeseen development of similar importance could of course transform such a situation.

Reference has already been made to the Government's declared intention to promote regional development and to encourage the dispersal of industry away from the Amman-Zerqa region. Apart from specific developments linked to the location of natural resources (for example, the Dead Sea potash project). the main centres of industrial growth outside the Amman - Zerqa region at present seem likely to comprise Aqaba which is outside our study area - and Irbid, together possibly with the area set aside for the Syrian - Jordanian free trade zone.

Other towns in general seem likely to have too small a population and to lack the necessary infrastructure and services to attract industry on any significant scale. Any attempt to effect large scale development in such centres by means of major state investment in infrastructure, housing and services seems unlikely to prove an attractive economic proposition. As far as the small towns are concerned, therefore, we envisage that in the foreseeable future industrial growth will be confined principally to small-scale development of local service industries and agro-industry. A case in point may be Salt, where we understand the Municipality plans to develop a small estate.

Even in the case of Irbid, where development of manufacturing activities may make an important contribution to regional employment opportunities, it is difficult to anticipate this occurring on a scale sufficient to alter fundamentally the concentration of manufacturing industry in the Amman - Zerqa region, again at least in the foreseeable future.

Experience elsewhere in the world has underlined the considerable difficulties that can be encountered in implementing successful policies of industrial dispersal, and it would be unwise to underestimate the likely magnitude of the task facing the Jordanian planning authorities. The strength of market forces influencing industrial locations within the country is, for example, already apparent with the major demand for new sites in and around the Amman - Zerqa conurbation. The Ministry of Industry also informed us of a recent case where one manufacturer had established operations in Irbid but has subsequently had reservations about the move because of communications difficulties.

The report by R D Scott and Company presents two possible alternative scenarios of regional manufacturing employment growth. The first assumes that the market forces acting to centralise manufacturing activities in Amman (administrative) district will continue and that the district will account for a similar proportion of total manufacturing employment in 1985. Under this scenario, the report suggests that manufacturing employment in Irbid (administrative) district might increase by some 2 400 jobs over the period 1974 - 1985, or by approximately 220 jobs per annum. In the case of Balqa district the suggested increase amounts to some 400 jobs over the same period.

The alternative scenario adopted in the Scott report assumes that attempts to decentralise general manufacturing activities will prove successful and that by 1985, the proportion of manufacturing employment located in Amman district will have fallen to 80% compared with the 85% level indicated by the 1974 Industrial Census. Under such an assumption, manufacturing employment in Amman district would increase at an annual rate of some 6% per annum, compared with the national rate of approximately 6½% suggested in the report. Employment in Irbid district might then be expected to increase by some 3 500 jobs, according to the report, and that in Balqa district by some 800 jobs, equivalent to annual rates of increase of some 8%.

Within Irbid district, Irbid itself represents the natural centre for industrial development due to the size of its population, the range of services, and its location in relation to present and planned road links with Amman, Syria and Iraq. Within the framework of national planning policies, the other main centre seems likely to comprise the proposed Jordanian - Syrian free trade zone.

We were informed that plans for this free zone have yet to be finalised and at this stage it is difficult to anticipate the scale of development. To an extent, the zone would clearly be in competition with those planned for Amman and Aqaba, although each will offer a particular set of advantages. The Syrian - Jordanian zone would probably be particularly suited to accommodate joint Syrian - Jordanian ventures to serve northern markets and perhaps process materials imported via Syria.

The Scott report suggests that of the increase in manufacturing employment suggested for Irbid district by 1985, up to 30% or 1000 jobs might be located on the proposed zone and that any significant increase above this level would be dependant upon considerable success in attracting major international investment.

Clearly the actual scale of national and regional manufacturing growth and employment is subject to many uncertainties, particularly in the longer-term. The preceding estimates must be viewed in this light. However, we consider that they serve to give a reasonable indication of the likely broad scale and pattern of development.

3.3 COMMERCE AND SERVICES

The country's commerce and services are not unnaturally centred on Amman, where all the major government buildings, embassies and national and international company offices are located. The city is based at the hub of the nation's transport and communication system, and as a result not only provides commercial and service facilities to its own population, but also to many of those living in other parts of the Kingdom.

Commercial activities, services and government offices located in towns and villages elsewhere in the Kingdom are geared principally towards meeting the needs of the local population and, in the case of the larger towns, also certain of the requirements of the surrounding regions.

The commercial and service sectors have recently been experiencing a period of considerable growth, with a number of international companies establishing regional offices in Amman, doubtless encouraged by improvements in international transport and communications links, the various privileges afforded to foreign companies by Government, and the political stability of the country. The disturbances in Beirut also undoubtedly acted to strengthen the development of Jordan as a commercial centre.

Looking to the future, we would anticipate some reduction in the rate of expansion of commercial and service sectors, particularly in view of Government's declared intention to diversify the country's economic base and strengthen the role of the production sectors - agriculture, mining and manufacturing. Nevertheless, the prospects for a continued, steady development of the tertiary sector of the economy at present appear sound.

Once again, it is difficult to envisage in the foreseeable future any radical change in the general distribution of commerce, services and government activities within our study area.

Certainly, as the population of individual towns grows, some increase in the level and range of local services is to be expected. Irbid, in particular, seems likely to develop further in the coming years as a regional commercial and service centre, and the development of the new Yarmouk University should help to strengthen the region's tertiary base. Even the villages too may benefit to a degree through provision of better public services (health, education etc.), one of the objectives of the Five Year Plan being the distribution of economic activities, public services and ensuing gains on a more equitable basis among the various regions of the Kingdom. However, given the existing concentration of commerce and services in Amman, the many forces that will continue to attract such activities towards the nation's capital and the present and future proportion of the country's population likely to be resident in the Amman region, the increase in the level of commerce and services envisaged elsewhere in the Kingdom seems likely to modify rather than fundamentally change the balance of these activities between the capital and the provinces.

3.4 TOURISM

The prospects for developing tourism on the East Bank appear bright. Although Jordan lost control of her Holy Land tourist sites on the West Bank during the 1967 war, access to these sites is still possible from the East Bank. Furthermore, while the East Bank

tourist attractions are perhaps less well known than those of the West Bank, there are many - for example, Petra, Jerash, Amman, Madaba, Karak, Wadi Rum and the desert castles - which, given appropriate promotion and development, could bring many more visitors to the country.

Communications are good and constantly improving. A number of international airlines serve Amman, and Alia, the Royal Jordanian airline, has been experiencing substantial growth in its operations and has plans for a considerable future expansion of its fleet and network. The new international airport, currently under construction to the south of Amman, will be capable of handling all types of aircraft.

Projecting tourist growth on the basis of past trends is difficult because of the effects of previous hostilities in the region on numbers of visitors coming to Jordan. However, the past few years have witnessed a strong recovery from a total of 308 000 visitor arrivals in 1973 to more than one million in 1976, well in excess of the earlier 1966 peak of 617 000. A study, commissioned by the World Bank in 1976, suggested that this growth could be expected to continue, possibly resulting in as many as 2¼ million visitor arrivals by 1985. This would represent an annual increase of some 9% over the 1976 level, and hence a significant increase in the ratio of total visitors to population.

The majority of business and tourist visitors to the East Bank at present stay in Amman. Information published by the Ministry of Tourism, for example, indicated that in mid-1977 nearly 85% of all hotel rooms were located in the capital, the remainder being situated in Aqaba. Similarly, the major proportion of other types of accommodation rented by visitors to Jordan appears to be located in and around Amman, although there are no statistics available to confirm this.

This situation is one that in general seems likely to continue. With the exception of Aqaba, which may experience some increase in non-Jordanian business visitors, the majority of business visitors can be expected to stay in Amman.

Similarly, we envisage that Amman will remain host to the majority of tourist and transit visitors. Jordan is a relatively small country, and most of the tourist sites are accessible from Amman. The only East Bank sites which are not easily seen by day trip from Amman are Petra, Wadi Rum and Aqaba although notwithstanding day trips are arranged from the capital to Petra. These sites are, in any event outside our study area, and any development of local facilities will not have a direct impact on water requirements in the north of the country.

The remaining tourist sites are conveniently reached from Amman by road, and the capital is the obvious stopping-over place for visitors moving from or to the West Bank. As tourism develops, it can be expected that lodging and other tourist facilities will be provided at certain tourist sites, for example at the Dead Sea, Jerash, Azraq and Debbin. However, the scale of such developments is in general unlikely to be sufficient to generate significant local water demands in the north or to reduce appreciably the rate of growth in hotel and other tourist accommodation in Amman with its attendant need for water.

CHAPTER 4 - POPULATION

4.1 EXISTING DATA ON POPULATION LEVELS

The absence of reliable up-to-date estimates of Jordan's population by area has already been noted.

The last national Census of Population was conducted as long ago as 1961, since when there have been considerable population changes. There have subsequently been a number of head counts in certain cities and towns, conducted primarily for municipal planning purposes, but the data so gathered present a far from complete picture of population growth and the degree of accuracy attained is open to some doubt.

In estimating total population, the Department of Statistics has in recent years been forced to rely upon the available information relating to births and deaths, projecting forward from a 1961 Census base figure. Since, however, it is known that not all births and deaths are recorded, it has also been necessary to estimate the extent of this under-registration. In consequence, the Department accepts that the resulting population figures are subject to a margin of error. The Department informed us that, again owing to inadequate data, it is not certain how accurately its population estimates reflect the effects of external migration since 1961.

At the community level, the problems have been compounded by the absence of statistics on internal migration, a situation not aided by the inflow and settlement of large numbers of refugees on the East Bank since 1961. Consequently, the Department of Statistics has had to confine itself to producing broad estimates of population numbers in the main towns based on nationally estimated growth rates, observed general patterns of migration and on the limited data obtained from specific head counts. Inevitably, such estimates have involved a considerable degree of intuitive judgement.

In 1975, however, the problems of data availability were partially alleviated by the Agricultural Census which included a population head count for individual communities. Unfortunately, the Department of Statistics has reservations about the accuracy of the latter, having noted certain anomalies between the results obtained and other available information and estimates relating to population numbers.

Doubtless these discrepancies stem from the fact that the head count was essentially a by-product of the Agricultural Census rather than a carefully prepared and controlled population census and was conducted on a de facto basis. The discrepancies may also, however, reflect inaccuracies in the existing population data base attributable to the various factors noted earlier.

Nevertheless, the Agricultural Census head count does provide some valuable additional data, and using the latter in conjunction with its existing information, the Department of Statistics has produced a revised set of population estimates for 1975 for some 42 administrative areas, together with separate totals for the larger villages and towns.

4.2 PROJECTIONS OF FUTURE POPULATION IN NORTH JORDAN - THE NATIONAL WATER MASTER PLAN.

The Department of Statistics itself has no official, comprehensive long-term projections of population for individual communities in Northern Jordan, but various estimates have been prepared during recent water supply studies.

The most comprehensive of these estimates are those presented in the National Water Master Plan.

The Master Plan projections relate to 1985 and 2000, using 1975 as a base. They utilise the Department of Statistics' recent population estimates prepared in the light of the Agricultural Census head count results.

In order to arrive at base-year population estimates for the (hydrological) areas chosen as a basis for analysis in the Master Plan, the Plan team worked initially from crude Agricultural Census population data given in the Ministry of Interior's "General Survey of Social Services 1975". The figures cover some 750 individual communities and relate to end 1974.

Individual communities were then located and assigned to the areas chosen for analysis in the Master Plan. The resulting estimates were then adjusted to bring them into line with the Department of Statistics official totals for 1975. This was done by means of "correction factors" which reflected the ratio of the crude population totals for the 42 administrative units to the adjusted official Department of Statistics figures. The "correction factor" for a Master Plan area would be the average of the individual correction factors for the administrative units or parts of units covered by that Master Plan area weighted by the share of that area's population falling into each administrative unit.

The correction factors effectively adjust the crude population data on four separate counts:-

(1) They adjust 1974 totals to a 1975 basis, thus allowing for population growth over that period,

(2) They allow for the fact that the Agricultural Census results took no account of scattered dwellers,

(3) They take into account the various other information on population in the hands of the Department of Statistics considered by the latter to be relevant in preparing its estimates for 1975,

(4) They allow for the fact that the Master Plan team was unable to locate precisely the position of a small number of settlements and hence include them in its initial estimates.

The correction factors for administrative units show a fairly wide deviation between the crude population totals for 1974 and the 1975 Department of Statistics estimates - from a positive deviation of 99.1% to a negative one of 58.3%. The Master Plan, however, states that these extremes were due to a relatively high number of unlocated settlements within the areas concerned, and that if these two areas are excluded, the correction factors range between +27.4% and -11.4%. In the majority of instances the difference amounts to less than 10% and is usually of the order of 4% to 6%.

The Master Plan's population projections are essentially based on previous population trends, modified to take account of general future development expectations.

Specifically, the approach adopted comprised three distinct stages:-

(1) The estimation of earlier relative rates of regional population growth using 1961 Census data and the results of the Agricultural Census head count,

(2) The selection of a future rate of national population growth and the subsequent application of a scaling factor to the earlier relative regional rates of growth, so that when applied to the 1975 estimates of population by area, they would produce an overall rate of national population growth equivalent to the pre-selected rate,

(3) Further adjustment to the resulting rates for certain centres of development - Amman, Zerqa, Irbid and the Jordan Valley - to take full account of development plans and prospects and the likely effects on population migration, with a corresponding, offsetting adjustment to the rates of growth in other areas so as to maintain the selected rate of national population growth. The principle here being that an inflow of population to one area must be offset by an outflow from another. For the purposes of this latter adjustment, centres of development were matched with likely migration hinterlands.

The specific rates of growth adopted nationally and for the main centres of development were as follows:-

	1975 - 1985 (percentage rates per annum)	1986 - 2000 (percentage rates per annum)
National rate of growth	3.46	3.25
Amman municipality	5.0	4.5
Irbid municipality	4.5	4.0
Zerqa municipality	4.0	3.5
Jordan Valley	7.0	3.5

The approach clearly has its limitations. The initial data base, for example, posed problems with regard to establishing previous rates of population growth by area. Because there are no statistics on rates of internal migration or local rates of natural population increase, the Master Plan team analysed the available Agricultural Census data and 1961 Population Census results in an attempt to establish previous rates of growth for broad areas.

However, because of changes in administrative boundaries, changes in the names of certain communities, establishment of new settlements and the limitations of the Agricultural Census head count, it proved impossible to draw direct comparisons between census aggregates for given areas. The team had, as a result, to resort to establishing relative rates of growth for the 42 administrative units referred to earlier by means of comparing population changes in some 430 communities, statistics for which could be clearly identified in both censuses.

The approach also assumes implicitly that past trends will be a relatively good guide to future development patterns, although it does attempt to modify these trends in the light of current development policies and prospects by establishing "autonomous" rates of population growth for Amman, Zerqa, Irbid and the Jordan Valley, as well as selecting a future national rate of population growth. This clearly involves a substantial degree of intuitive judgement.

The national rate of population growth of approximately 3.5% adopted for the period 1975 to 1985 is the rate of growth officially stated in the national Five Year Plan.

The Department of Statistics informed us that it has been working recently on the basis of an annual rate of growth of 3.4%, but that the indications are of a slight upward movement in the annual rate over the last few years. The Department further informed us that it does not envisage any immediate reduction in the current rate. Mortality rates are at present falling, and although there are signs of a growing awareness of family planning methods,the age structure of the population - an estimated 50% are under the age of 15 - seems likely to prevent a major decline in the gross fertility rate in the next few years at least.

Between 1985 and 2000, the Master Plan adopts a lower average rate of population growth of some 3¼% per annum - implying a post-1985 decline in the rate of growth to a level somewhat below that figure by the year 2000.

In the light of the available data, the overall rates adopted in the Plan do not appear to us unreasonable. They are slightly above the medium population projections prepared by the U.N. in the earlier 1970's - which showed an increase of some 3.4% per annum between 1975 and 1985 and 3.1% per annum between 1985 and 2000, but are, however, within the U.N.'s upper variant.

In the case of the Jordan Valley, the Plan's assumed rate of growth pre-1985 is based on the Jordan Valley Development Plan's targets and estimated manpower and population requirements, but allows for the fact that there may be some delays in implementation of programmes. Specifically it is assumed that the suggested 1982 levels of population will not be reached until 1985.

Previous rates of population growth for Amman appear to have been substantial. The available statistics suggest a rate of increase of some 11% per annum between the mid-1960's and mid-1970's.

Whilst this increase was clearly in part due to the influx of refugees, Amman has proved to be the major focal point for development on the East Bank and has undoubtedly attracted population from elsewhere in the country on a substantial scale.

It would be unreasonable to envisage a similar rate of increase in future years, both on account of the scale of migration that would be involved, the rate of national population growth implied and Government's policies towards development of the regions. For reasons discussed in Chapter 3, however, Amman is still likely to continue to exert a major influence on the country's economy and attract substantial development. With these factors in mind, the National Water Master Plan has adopted a rate of growth of 5% per annum for the Municipality of Amman for the period of 1975 - 1985.

In the case of Zerqa, a rather lower rate of growth of 4% per annum has been selected on the basis that, whilst Zerqa is likely to be a significant centre of growth and attract a net inward migration of population, it offers a less attractive residential environment than Amman.

The resulting rate of growth for the Amman-Zerqa conurbation as a whole (areas AL32 and AL41/42) for the period 1975 - 1985 amounts to some 4.6% per annum, which, given the development prospects for the area, does not strike us as unreasonable in relation to the nationally assumed rate of population growth of 3.5% per annum.

It is perhaps of interest in this context that the Department of Statistics is currently estimating population levels in the towns of Amman and Zerqa as the basis of annual population growth rates of 6% and 5.5% respectively. Assuming some reduction in percentage rates of inward migration over time for reasons discussed below, the National Water Master Plan's estimates do not appear to us unrealistic in relation to these latter figures.

In the case of Irbid, the Master Plan adopts a 4.5% rate of population growth for the period 1975 to 1985. Once again, given an assumed national rate of population growth of 3.5% per annum, together with Irbid's role in the regional economy and general development prospects, such a rate appears to us quite reasonable. It is incidentally in line with that currently being adopted by the Department of Statistics.

In arriving at its estimate of 4.5%, the Master Plan has specifically taken into account the planned improvements in the area's infrastructure, the opening of the Yarmouk University and the proposed Jordanian-Syrian free trade zone. The latter two developments in particular warrant a brief word of comment.

The new Yarmouk University commenced operations in 1976 on a temporary site to the south of Irbid. It is planned, however, that a new, permanent campus should be developed on a site to the east of Irbid (which lies at the junction of the Mafraq-Irbid and Ramtha-Jerash roads). The present plans call for an ultimate capacity of 20 000 students and 2 000 staff, to be attained by 1987/8. Of the total students, it is anticipated that half would commute each day from the surrounding towns and villages. The remainder would come from outside the region and be resident during term-time.

The National Water Master Plan takes the view, and it is one with which we would concur, that the University will not result in a major in-migration of population, certainly not on a scale sufficient to modify the population growth rates projected by them for the area. For although the University could create valuable employment in the service sector, this is likely to provide jobs for the growing local population. The rate of development of the University may also be slower than envisaged, for the programme of development is a very ambitious one, as the authorities acknowledge.

In the case of the proposed Jordanian-Syrian free trade zone, the National Water Master Plan notes that this has still to prove itself as a major source of employment. It takes the view that the scale of development will again be such as to provide valuable employment for the community living in the surrounding towns and villages rather than lead to major net inward migration to the region as a whole. This view is consistent with that expressed in the Scott report on industrial development (Chapter 3) and is one to which we too would subscribe.

The post-1985 rates of growth adopted by the Master Plan are not specifically discussed. In the case of the Jordan Valley, the underlying assumption appears to be that the major development effort will occur pre-1985, as is indeed currently planned. In the case of Amman, Zerqa and Irbid, the lower rates must reflect both the reduction in the national rate of population growth assumed and a levelling-off in percentage rates of internal migration. These assumptions do not appear unrealistic.

The overall results of the Master Plan's population projections are perhaps best judged by relating them to the broad development prospects of the areas being considered.

The overall rates of population growth for the period 1975 to 2000 are shown area by area in Table 1 which also indicates the main settlements within each region. The areas themselves are shown in figure 2., and a comprehensive list of villages included in each is given in Appendix A (which reproduces the Master Plan's village index).

The National Water Master Plan's projections indicate an overall rate of national population growth between 1975 and 2000 of a little over 3.3% per annum.

TABLE 1 - National Water Master Plan Estimates of Population by Area 1975-2000
(applicable to the North Jordan Study area)

Area Number	Main towns and settlements	Population numbers (thousands)*			Increase in population 1975-2000	
		1975	1985	2000	Number (thousands)	Per cent per annum
AB12	Esh-Shunah Esh Shamaliya, Wadi El-Yabis	33.7	66.4	111.2	77.5	5.0
AB13	Kreimah/Sleikhat,W	11.9	23.4	39.2	27.3	5.0
AB14		4.9	9.6	16.1	11.2	5.0
AB15		10.3	20.3	34.0	23.7	5.0
ALO	Deir'Alla	14.2	28.0	46.8	32.6	5.0
AL41/42	Amman El-Quweisma	656.6	1 063.4	2 045.6	1 389.0	4.7
AL32	Zarqa, Ruseifa	283.0	416.8	700.9	417.9	3.7
AE	Irbid	170.0	243.1	407.0	237.0	3.6
AL31		0.2	0.2	0.4	0.2	3.5
CDB1/82		6.3	8.9	13.4	7.1	3.0
AN	Na'ur, Wadi Es Sir,	24.5	33.2	50.8	26.3	3.0
AL72		2.4	3.3	4.9	2.5	2.8
AL73	Ed-Dhuleil	25.2	30.5	45.8	22.6	2.7
CA1		3.0	3.9	5.4	2.4	2.4
F+H	Azraq	11.4	14.1	18.3	6.9	1.9
AB26		2.2	2.6	3.1	0.9	1.4
CC	Madaba	32.5	38.4	46.3	13.8	1.4
CD11		19.9	23.1	28.1	8.2	1.4
AP1/AP2		3.0	3.5	4.1	1.1	1.3
AM	Suweileh, Salt, El Fuheis	51.4	58.6	68.2	16.8	1.1
AD52	Ramtha, Mafraq, Husu, Aidun, Hawwara, Esh-Sarih, Sakhra	148.7	166.9	193.6	44.9	1.1
AL11	Jarash, Suf	71.0	76.4	90.3	19.3	1.0
AD21	Kufur Saum	15.1	16.9	18.5	3.4	0.8
AD23		9.0	10.0	11.0	2.0	0.8
AB22	Deir Abe Sa'id	11.8	13.2	14.4	2.6	0.8
AB23		6.8	7.5	8.2	1.4	0.8
AG		1.4	1.6	1.7	0.3	0.8
AB21	Et-Taiyiba	10.7	11.8	12.8	2.1	0.7
AF	El-Mazar Esh-Shamaliya	20.5	22.4	23.9	3.4	0.6
AL21	Abu-Nuseir/Baqa'a	51.9	56.0	58.5	6.6	0.5
AB25		1.2	1.3	1.4	0.2	0.5
AB24		6.0	6.1	6.5	0.5	0.3
CD31		0.9	0.9	0.9	-	-
CD32		6.0	6.2	5.8	-0.2	-0.1
CA2		0.6	0.6	0.6	-	-0.1
CD4	Um Quseir and Muqabilein, Sabah, El Jiza	44.9	42.2	41.8	-3.1	-0.3
AH	Judeita	14.5	14.3	13.4	-1.1	-0.4
AL22/23		12.7	11.8	10.5	-2.2	-0.8
AK		1.5	1.4	1.2	-0.3	-1.0
AJ	Ajlun, Kufranja	17.5	16.2	13.3	-4.2	-1.1
		1 952.0	2 743.0	4 445.3	2 493.3	+3.3

The highest average rates indicated are those for the Jordan Valley and Zerqa Triangle (areas AB12, AB13, AB14, AB15 and AL0), a reflection of the official development plans for the Valley.

Four other areas are shown as having above average rates of population growth, area AL41/42 (the Amman area), AL32 (Zerqa-Ruseifa), AE (Irbid and the surrounding prosperous dry-land farming area) and AL31. The latter is an area immediately adjacent to Amman, but which contains an insignificant number of inhabitants.

Department of Statistics figures show an increase in the proportion of the East Bank's total population living in Amman, Zerqa and Irbid from an estimated 43% in 1961 to nearly 53% in 1975. The Master Plan's population projections show a continuation, albeit at a somewhat reduced rate, of these earlier trends resulting in a figure of nearly 66% in the year 2000.

The growth prospects for these towns and areas have already been discussed at length, and the rates of population increase indicated in the Master Plan appear to conform broadly with development expectations.

The above-average rates of population growth in these areas and resulting inward nettmigration imply a corresponding outflow of population from the predominantly rural areas of the country.

The Master Plan projections indicate five areas as having an average annual rate of population increase in the order of 2½% to 3%, a little below the national rate of growth adopted. These areas comprise CD81/82, AN, AL72, AL73 and CA1. In each area, there are reasons for anticipating continued population growth.

Area CD81/82 contains phosphate deposits and a number of planned desert irrigation projects, all of which should generate local employment. Area AN contains the town of Wadi Es Sir and is likely to benefit from the continued growth of Amman owing to its close proximity to the area. It also contains part of the Kafrein-Hisban agricultural project area. Area AL73 contains the Dhuleil agri-

cultural developments, and although water shortages are likely to constrain further expansion of irrigation (and may even require some reduction), the area offers certain prospects for additional dry-land farming. The area also stands to benefit from the continued development of Zerqa, much of it being within commuting distance. The remaining two areas, CA1 and AL72, have relatively small populations and the absolute increases indicated in the Master Plan are not of significant proportions within the national context. Area CA1 is at the southern end of the Jordan Valley project and may benefit indirectly.

There are then a number of areas exhibiting overall rates of population growth of between 1% and 2% per annum. Development prospects in these areas in general seem to be more limited than those in the preceding ones, but at the same time offer some growth potential.

This group contains area AD52 (with the towns of Ramtha, Mafraq, Husn and Aidun), AL11 (which contains Jerash and Suf), AM (which contains Suweileh, Salt and Fuheis), CC (the main centre of population comprising Madaba), CD11 (which includes a number of the projected desert irrigation schemes) and F/H (which contains Azraq). The remaining two areas, AP1/2 and AB26, have very small populations and the absolute level of growth projected is negligible. Area AB26 may benefit indirectly from developments in the Jordan Valley, and area AP1/2 from the Kafrein-Hisban project part of which falls within the latter.

Area AD52 stands to benefit principally from the establishment of the new Yarmouk University campus and the proposed Jordanian-Syrian free trade zone, as agricultural prospects in the area are limited. Towns such as Mafraq may also benefit from the improvement of road links with Syria and the increased level of traffic that is likely to result. Similarly Azraq and area F/H as a whole may benefit from the construction of the new road links with Iraq and Saudi Arabia and the possible demand for local service facilities. Azraq, like Jerash in area AL11, offers certain limited potential for tourism development.

Area AM, on the other hand, seems likely to benefit from its proximity to Amman. At first sight, a higher rate of population growth might be expected. However, the area contains a significant highland zone where prospects for development are limited.

The remaining areas show relatively small rates of population change, ranging downwards from a modest rate of increase of a little below 1% to an actual decline of similar proportions. Many of these areas have very small populations, and the absolute changes predicted are relatively insignificant, particularly in the context of strategic water use planning.

The principal exceptions are area CD4 to the south of Amman and area AL21 which contains the Baqa'a refugee camp. The remaining areas are in general highland regions to the north of Amman or desert areas to the south. The higher rates of growth indicated within this group tend to be the highland areas bordering the Jordan Valley and Irbid region, which may benefit to a limited extent from developments in these areas. The lower rates of growth, on the other hand, tend to centre on the central highland areas and desert areas where development prospects in general appear poor.

Considered in their entirety, the Master Plan's population projections appear broadly consistent with national and regional development expectations. However, we feel that there is one potential limitation which should be taken into account in utilising the figures.

In the case of the Amman-Zerqa area, the major growth is projected as occurring in areas AL41/42 and AL32, where development is at present concentrated. Particularly in the longer-term there is likely to be an element of overspill into surrounding areas which, we feel, may not fully be reflected in the projections. For example, the new international airport is currently being constructed to the south of Amman in area CD4, and the proposed new industrial estate may similarly be located to the south of the city at Sahab. Such developments could clearly attract additional commercial, service and housing developments. A new town development is also being considered to the north-west of Amman.

In the case of Irbid, it is possible that some of the development projected for area AE might be diverted to the adjacent region AD52 should the new University or free trade zone develop on a major scale.

Whilst these considerations are not perhaps of major import at the strategic water planning level where demands in adjacent sub-areas are frequently subject to aggregation, they nevertheless need to be taken into account in considering local transfer schemes.

4.3 COMPARISON WITH OTHER PROJECTIONS

The VBB Projections

The VBB population projections for the Amman-Zerqa basin are based on the results of their earlier 1972 report on Amman's water supplies. The latest projections adopt the previous rates of growth for Amman and assume that these can be regarded as indicative of the level of population growth likely to be experienced in the Amman-Zerqa basin as a whole. Broadly speaking, the latter coincides with the Amman-Zerqa conurbation or the areas defined as AL32 and AL41/42 in the National Water Master Plan.

The VBB projections, which at the time they were prepared took account of national population growth rate expectations and assumed a declining rate of inward migration to the area, adopt a rate of 5.0% per annum in 1972 declining to 3.0% per annum by the year 2005. Over the period 1975-2000, this equates with an annual rate of growth of some 3.9%, which compares with one of nearly 4.4% implied by the Master Plan projections (for areas AL32/AL41/42).

Within the confines of the available data and the many uncertainties surrounding the future, it is impossible to say which of these two projections will prove to be the more accurate. Our own feeling is that on the basis of the currently available data, the decline in rates indicated by the VBB projections (from 4.5% in 1978 to 3.8% in 1985) may be a little rapid.

Jordan Valley Irrigation Project Stage II Study Projections

The National Water Master Plan's population projections for the Jordan Valley are broadly similar to those given in the Jordan Valley Irrigation Project Stage II report, both sets of estimates being based on the Jordan Valley Development Plan.

In the case of Irbid, we are unable to draw any direct comparison, as we have not been able to establish precisely to which area the Jordan Valley Irrigation report figures relate. The report adopts a 3% rate of annual population growth for Irbid Governorate, but applies this rate to a 1976 population base of only 150 000. According to the Department of Statistics population estimates, this latter figure is slightly above that for Irbid itself, but approximately only one-quarter of that for the Governate as a whole.

The Irbid Water Supply Feasibility Study Projections

In the case of the Irbid Water Supply Feasibility Study exact comparisons with the National Water Master Plan estimates are difficult to draw because the two documents adopt different sets of areas as a basis for their projections.

The Irbid Water Supply Feasibility Study relates to the area served by the Water Supply Corporation's Northern District System (which covers a major part of the Governorate of Irbid). The study's population projections show an upper rate of growth of 4.2% per annum between 1975 and 2000, an intermediate rate of 3.8%, and a lower rate of 3.4%. In the case of Irbid, for which separate figures are given, the assumed rate of population growth varies between some 3.2% and 3.7% per annum over this same period. For the period 1975 to 1985, however, the growth rates adopted for Irbid range from between 4.3% and 4.5% per annum.

It is clear that the projections for Irbid itself tie in closely with those of the Master Plan for the period 1975 to 1985, but are substantially lower for the subsequent fifteen years to 2000. For the region as a whole, the growth rates implied by the Feasibility Study's population projections seem to be substantially above those of the Master Plan.

The method adopted in estimating future population levels by the Irbid Water Supply Feasibility Study may be summarised as follows.

The authors of the report did not have the advantage of the Agricultural Census headcount results. They therefore had to work from the Department of Statistics population estimates for the Governorate of Irbid, Irbid Municipality, and the results of the 1961 Population Census in preparing their base-year population estimates for the area under study. In undertaking this exercise, it was assumed that the population growth rates for those communities with a population of 3 000 or more in 1961 were similar to that indicated for the Governorate as a whole (which reflected the Department of Statistics estimates). The balance of population, after allowing for Irbid's estimated population and that for the other communities with a population of more than 3 000 (calculated as described above), was then distributed pro rata amongst the communities with a population of less than 3 000 in 1961 according to their 1961 population levels.

In calculating future levels of population in the study area, it was initially assumed that all communities - urban and rural - would experience a similar rate of population growth equivalent to the national average. No allowance was made for internal migration because of the lack of any data on migration trends.

For the purposes of its high projection, the Irbid Water Supply Feasibility Study adopted an initial national growth rate of 3.3% per annum in 1974, increasing to 3.5% per annum by 1985 and thereafter remaining constant. Its intermediate projection adopted an initial rate of 3.3% per annum declining at a rate of 1 per 1 000 per quinquennium to a level of 2.7% by the year 2005. The low projection was again based on an initial rate of 3.3% declining subsequently at a rate of 2 per 1 000 per quinquennium to a level of 2.1% by 2005.

However, the report then proceeds to make additional allowance for the population and employment effects of the new Yarmouk University, the proposed Jordanian-Syrian free trade zone and the new Irbid industrial estate.

By means of a series of employment multipliers and worker-dependent ratios, the report estimates that development of the Irbid industrial estate could add another 18 500 persons to the population levels already projected by 1981, that the Yarmouk University development could similarly add a further 22 300 persons by 1983, and that the free trade zone could add an additional 55 350 to 110 700 persons depending upon the projection selected.

In our opinion, the report makes two basic mistakes. First, it over estimates the scale and rate of development of the proposed free trade zone and the Yarmouk University. The latter development has already been commented upon in relation to the Master Plan's projections.

In the case of the proposed free trade zone, the Irbid Water Supply Feasibility Study assumes a build-up of employment on the zone commencing 1982 to a level of 18 000 under its low projection by 1987, to 30 000 under its intermediate projection by 1989 and to 60 000 jobs under its high projection of 1994. These figures, it should be noted, relate purely to the Jordanian half of the zone, the implication being that the zone as a whole would be considerably larger. The Irbid study also assumes, incidentally, that the Irbid industrial estate will attract a further 3 000 new industrial jobs between 1977 and 1982.

These estimates are in sharp contrast to the opinions expressed in other reports. The scale of the assumed employment growth, which we also feel is far too high, is perhaps best put in perspective by remembering that in 1975 employment in the industrial sector (mining, quarrying, manufacturing and power production) in the whole of Jordan only amounted to an estimated 27 000 jobs and that the highly successful free trade zones in Hong Kong, Taiwan, and Korea typically employ some 60 000 to 90 000 persons. These zones are somewhat exceptional, and the majority of zones elsewhere in the world are much smaller.

The mistake which the Irbid Water Supply Feasibility Study appears to make is to estimate employment levels on the basis of the site areas provisionally set aside for industrial development together with assumed employment densities without apparently considering the realism of the implied employment growth.

The Irbid Feasibility Study's second error in our opinion is to add such a large proportion of the estimated employment/population generation

effects of these developments to its initial population projections. This we feel certain results in an element of double-counting. New jobs will be required to support the expected local population growth, and developments such as the University and free trade zone are likely to prove important in this respect. The Irbid study does not appear to take adequate account of this fact. Certainly, in-migration may result if the free trade zone is developed since, as the study rightly points out, not all the requisite skills may be available locally. However, unless there is an extremely large injection of new projects and jobs into the area, there is likely to be some off-setting outflow of local residents in search of jobs elsewhere in Jordan.

4.4 PROJECTIONS OF POPULATION FOR THE NORTH JORDAN WATER USE STRATEGY

Reference was made earlier to the potential weaknesses in the Master Plan's method of projecting population levels. However, given the present data constraints and the usual forecasting uncertainties, any approach is bound to have its limitations.

The Master Plan's projections, on the other hand,have their strengths. They offer the considerable advantage of being based on the latest available population data and provide a coherent and consistent set of projections for the whole country. The Irbid Water Supply Feasibility Study's population projections, in contrast, imply a considerable net inflow of population to the northern region without considering precisely from where this is to come and what will be the implications on other parts of the Kingdom.

Furthermore, while there are potential dangers in the Master Plan's approach of using past trends to forecast future regional population movements, particularly in a case such as Jordan which has experienced major inflows of refugees and is currently undergoing rapid development, it does have the advantage of taking account of regional differences in population growth. It must also be recognised that the Plan does indeed attempt to modify these past trends in the light of current development prospects and that the method does appear to yield plausible results.

While we could clearly prepare a further set of population projections for use in the present sutdy, we doubl whether they would be very different from those in the National Water Master Plan. Certainly, we do not feel that we could claim that they would be any more realistic or accurate. For this reason, we have adopted the Master

Plan's population projections as a basis for our own estimates of water requirements.

The Master Plan makes a division between consumers enjoying piped supplies and those unconnected to mains systems. The estimated breakdown for 1975 and assumptions regarding future rates of system extensions were based on the results of detailed discussions with the water supply authorities. Within the time constraints of the present study, we have no means of checking this information. However, the overall estimates appear to imply reasonable planning targets for system development. They show a reduction in the national percentage of consumers not connected to a mains supply from 21% in 1975 to 8% in 1985 and some 4% by 2000. We have, therefore, again adopted the Master Plan's estimates.

A detailed breakdown of the population projections for 1975, 1985 and 2000 is given in Appendix C, based on the results of the Master Plan's calculation of population growth rates.

These have subsequently been applied to our own estimates of per capita demands for water in the years in question (see Chapter 5 below). Estimates of water demands for intervening years have been obtained by interpolation of the figures for 1975, 1985 and 2000.

Finally, in utilising these estimates in our analysis of water resources development, we have taken into account our qualifications regarding possible overspill from the Amman-Zerqa region and the effects of a major free trade zone development in the north on the growth of Irbid.

CHAPTER 5 - PER CAPITA LEVELS OF WATER DEMAND

5.1 INTRODUCTION

Estimating future levels of per capita water consumption and demands in Jordan poses considerable difficulties, first because of the absence of reliable records of past consumption due to lack of meters or faulty or inaccurate meters, and secondly because of the water shortages which have existed in recent years and which have undoubtedly imposed a significant constraint upon potential demand.

These difficulties are reflected in all recent water studies, where the per capita consumption estimates used in the projections of potential demand rely on a considerable degree of judgement as to how much water consumers would use, were an unconstrained supply to be available.

Exactly the same data limitations have confronted us in the present study, and inevitably the per capita consumption estimates proposed as a basis for the ensuing analysis of water demands and water supply projects equally involve a not inconsiderable degree of subjective judgement. In formulating our estimates we have, however, reviewed and appraised the data and estimates presented in the other reports and have attempted to develop and refine the arguments on which those estimates are based.

In projecting future levels of consumption, we have taken the term 'consumption' as relating to the amount of water consumers would actually use given an unconstrained supply. To these figures, we have added a further allowance to cover system losses in arriving at an overall estimate of water demand.

5.2 ESTIMATES OF EXISTING LEVELS OF CONSUMPTION AND DEMAND

In considering existing levels of consumption, it must again be stressed that potential demand is at present,and has been in the past, frequently suppressed by lack of adequate supplies.

The available data on water consumption and production is most fully documented in the National Water Master Plan. In the case of Amman an analysis of data provided by AWSA and covering the period 1962-1975 is given, but the Plan is unable to draw any firm conclusions as to potential levels of demand. Production per capita for example, apparently fluctuated between 55 and 95 litres per day over this period, as is also indicated in a report undertaken by VBB in 1972 on Amman's water supplies. It appears to us that this apparent variation was due to a combination of factors - changes in the severity of water shortages, inaccuracies in production data and also in population estimates, including perhaps insufficient allowance for the effects of hostilities in the region on both permanent and temporary levels of population in the city.

The data for 1975, which reflects a constrained supply situation, suggest a per capita production level of 76 litres per day, of which 38 litres per day was billed to consumers. An enquiry conducted by VBB, however, suggests that the true level of average consumption was considerably more than the figure of 38 litres, the high proportion of 'unaccounted for' water being in large part due to under-recording by consumers' meters. Indeed in the light of the VBB findings, the National Water Master Plan estimates true consumption at around 63/1/h/d. These figures, incidentally, include the requirements of commerce, services and small-scale industry. They do not, however, include the consumption of major industrial and other users having their own private wells.

No data is available on the proportions of total consumption accounted for by the domestic user, commercial user and small-scale industrial user. However, on the assumptions that 98% of connections (having a metered consumption of up to 260 m^3/quarter) are domestic consumers, that those with consumption levels of between 260 and 600 m^3/quarter represent commercial and small-scale industrial users, and that those with a consumption of over 600 m^3/quarter represent larger industrial consumers drawing water from the public system, the National Water Master Plan estimates from consumption

data supplied by AWSA that some 79% (50 1/h/d) of its 1975 per capita consumption figure of 63 1/h/d represents domestic consumption, some 11% (7 1/h/d) consumption by commerce and small industries, and 10% (6 1/h/d) consumption by larger industries.

Our own view, to which we return later, is that the preceding consumption breakdown probably under-estimates the domestic component and correspondingly over-estimates that attributable to other users. There can be relatively few domestic consumers with a metered consumption of over 260 m^3/quarter (nearly 3 m^3/day, equivalent to some 475 1/h/d for a six-person household), but bearing in mind the large number of small businesses in Amman, it does seem likely that there are a large number of non-domestic consumers with a level of consumption below this figure.

No detailed analysis of production and consumption data has been undertaken for Zerqa. The Master Plan estimates production in 1975 at 52 1/h/d, billed consumption at about 30 1/h/d. Consumption by major users having their own supply source is excluded. Estimates of per capita usage by different categories of consumer are given, but these are based on the same assumptions regarding "unaccounted for water" and consumption patterns as were adopted in the Plan's estimates for Amman.

The National Water Master Plan also provides estimates of production and per capita consumption in 1975 for a number of other towns in Jordan having their own municipal supply systems and for the Water Supply Corporation's systems. These estimates are presented in tables 2 to 4 for the towns and systems within our study area.

The Master Plan is careful to stress the potential margin of error to which the estimates are subject. In some instances, the data obtained was incomplete or of dubious accuracy, and estimates of production had to be based on pump capacities and number of hours operated on the assumption of a constant head and flow. Estimates of populations served, provided by the municipalities and Water Supply Corporation and adjusted where considered necessary by the

Master Plan team in line with their own estimates of population (discussed earlier), are also considered subject to some uncertainity.

Estimates for a number of municipalities are given in Table 2. The Master Plan provides estimates of domestic per capita consumption, and these are shown in the table. However, the latter are based on the assumption that the ratio of domestic consumption by commerce and small industry is 88 : 12 (similar to that in Amman, exclusive of the consumption of larger industries) and that "unaccounted for water" amounts to 35% of total consumption (or approximately 26% of production).

Because of the uncertainty surrounding these latter assumptions, we have calculated the estimated level of production per capita. This ranges from 21 l/h/d in the case of Suf to around 100 l/h/d in the case of Wadi Sir, Suweileh, Jerash and Ajlun. The latter are of particular interest in that supplies are drawn from local springs and, we understand, are generally sufficient to meet local needs.

TABLE 2 - Estimated Levels of per capita Production and Consumption for Municipal Water Supply Systems - 1975

System	Population served $\times 10^3$	Water Production ($m^3 \times 10^3$)	Production per capita (l/h/d)	Estimated domestic consumption(1) (l/h/d)
Ruseifa	43.0	500.0	32	21
Salt	29.0	550.0	52	34
Suf	15.0	117.0	21	14
Wadi Sir	15.0	566.0	103	68
Suweileh	15.0	597.0	109	71
Jerash	11.0	365.0	91	59
Ajlun	4.0	146.0	100	65

Source: National Water Master Plan

(1) Domestic consumption only, based on assumption that 88% of total consumption is domestic, and that "unaccounted for water" amounts to 35% of total consumption (approx. 26% of production).

Estimates of quantities of water produced and delivered by Water Supply Corporation systems are given in Table 3. The quantities delivered relate to amounts sold to village communities for distribution and hence include local system losses. Estimates of per capita production levels, inclusive of bulk transmission losses, are also given.

Quantities delivered per capita in general range from 18 to 26 litres per day, per capita production levels from about 25 to 32 litres per day. The main exception is the Summaya area of the Northern District system where quantity delivered per capita is estimated at 50 litres per day. The latter figure, however, appears to be primarily a reflection of consumption levels in the town of Mafraq (discussed below) which apparently constitutes the major component of demand in the Summaya area.

The main Water Supply Corporation systems have, however, experienced major supply shortages, and the estimates quoted above may understate potential levels of demand by a significant margin. In the case of the Northern District System, we were also unable to reconcile fully the production estimates of 4.8 Mm^3/yr quoted in the Financial Review of the Northern District System, and one of 6.2 Mm^3/yr given in the Crown Agents Feasibility Study. We were unable to establish the precise cause of the discrepancies, but they appear to stem from differences in assumptions made in estimating output from non-metered sources and from local supply sources in Irbid and Ramtha. The Crown Agent's estimate in particular appears to relate to productive capacity rather than actual output. The differences do, however, underline the potential margin of error surrounding the figures given.

The National Water Master Plan also provides estimates of per capita water consumption in the northern municipalities of Irbid, Mafraq, Ramtha and Husn (which draw their supplies principally from the Water Supply Corporation's Northern District system) and these are reproduced in Table 4. The basis of these particular figures is not explicitly stated in the Master Plan, but they appear to be based on a set of assumptions relating to system losses similar to that adopted in calculating per capita consumption levels in other municipalities.

TABLE 3

Water Supply Corporation Systems
Water Produced and Delivered 1975

System	Population served in communities $x10^3$	Quantity delivered to communities(1) ($m^3 x10^3$)	Quantity delivered per capita (l/h/d)	Equivalent quantity produced per capita (l/h/d)
Northern District				
Azraq area	13.2	104.7	22	
Summaya area	18.9	337.7	50	
Western area	334.6	2244.2	18	
Total	366.7	2686.6	20	27
Tannour System	28.0	238.5	23	28
Ain Deek System	5.2	50.0	26	32
Wadi Rajib System	6.9	63.0	25	30
South of Amman System	96.5	836.6	24	27

Source: National Water Master Plan

(1) Excludes quantities delivered to bulk consumers (such as army camps) whose requirements are separately accounted for. Includes system losses within local community distribution systems. Excludes bulk transmission losses.

(2) Includes estimate for transmission system losses from source to point of delivery to communities.

TABLE 4

Estimated Water Production and Consumption
Northern Municipalities - 1975

Municipality	Population served (1) $x10^3$	Production/ purchases (2) ($m^3 \times 10^3$)	Quantities billed to consumers (3) ($m^3 \times 10^3$)	Production per capita (2) (l/h/d)	Quantities billed per capita (3) (l/h/d)	Water accounted for per capita (1) (l/h/d)
Irbid	119.1	1421.0	891.0	33	20	20
Mafraq	17.0	331.0	176.0	53	28	50
Ramtha	25.4	379.0	190.0	41	20	28
El Husn	10.0	96.6	66.8	27	18	31

Sources: (1) National Water Master Plan

(2) Water Supply Corporation - Northern District - Financial Review

(3) Based on production and sales data, as quoted in Financial Review of Northern Districts System, and on National Water Master Plan estimates of population served.

We have therefore compared the Master Plan figures with ones calculated by ourselves using the Plan's estimates of populations served and on data quoted in the Financial Review of the Northern District's System relating to quantities of water delivered to local distribution systems and quantities actually billed to consumers. Again there are inconsistencies between the two sets of figures, which can only reflect the shortcomings of the data base. Quantities supplied to local distribution systems, however, appear to range between 27 and 53 1/h/d. The figures are substantially below those quoted earlier for the towns of Wadi Sir, Suweileh, Jerash and Ajlun and undoubtedly reflect - at least in part - the serious water shortages that have prevailed in the Northern District. where some consumers have only received supplies on certain days of the week.

In this particular context, it is of interest that of the four northern municipalities, Mafraq apparently enjoyed the highest level of per capita consumption. The supply for Mafraq was drawn from the transmission main between Summaya and Zaatri and as a result there have not been the same periodic restrictions or termination of supplies experienced by the other three municipalities. There have still, however, apparently been complaints of insufficient water.

Finally, in the case of unpiped supplies, the National Water Master Plan notes that quantities consumed from unimproved sources (rivers, water holes and springs) will depend upon such factors as availability, distance from source, climatic conditions and population habits. The Plan continues by quoting a figure of 15 1/h/d as being a typical average (exclusive of water used for laundering) established in a number of surveys conducted in countries with similar climates. Bearing in mind the habit in Jordan of carrying water for laundering to the home, the Plan considers that a consumption figure of 35 1/h/d would be a reasonable estimate of the average needs of the population not served by a piped water supply.

Our own view is that this figure is perhaps a little on the high side. As an average, it represents a substantial volume of water to carry. In the case of Baqa'a camp, for example, where the population draw water from standpipes, data collected during the course of our own enquiries suggests a per capita consumption of some 15 litres per day. Admittedly, the supply to the camp is restricted to nine hours per day, and hence cannot be regarded as completely unconstrained. At the same time, we did not see evidence of significant queues for water suggesting a serious shortage.

5.3 EXISTING FORECASTS OF PER CAPITA LEVELS OF DEMAND

The National Water Master Plan

The National Water Master Plan study adopts four different sets of per capita water demand estimates in projecting future water requirements in the northern part of the Kingdom:-

(i) for the cities of Amman, Zerqa and Irbid;

(ii) for towns and communities with a population of between 3,000 and 50,000 inhabitants;

(iii) for rural communities with less than 3,000 inhabitants;

(iv) for un-piped supplies.

The estimates themselves are given in Table 5. They are based on the Plan's review of data relating to existing levels of production and consumption, taking into account the various limitations of the latter and, according to the authors of the Plan, on consideration of the following factors - the size of communities, the expected improvement in living standards, the specific climatic conditions, the habits of the population, the standard of distribution systems, and the standard of sanitary facilities. The discussion of these factors in the report is mainly conducted in qualitative terms, presumably because of

TABLE 5

National Water Master Plan for Jordan

Estimated Unit Water Demands 1975 - 2000

litres/head/day

Consumer Group	Demand	Year 1975	1985	2000
Amman, Zerqa, Irbid	domestic use	85.0	110.0	120.0
	commerce, small industries	11.9	15.4	16.8
	sub-total	96.9	125.4	136.8
	water losses	33.9	31.4	20.5
	total *	131.0	157.0	158.0
Towns and communities with a population of between 3,000 and 15,000 inhabitants	domestic use	65.0	90.0	110.0
	commerce, small industries	6.5	9.0	11.0
	sub-total	71.5	99.0	121.0
	water losses	21.5	19.8	18.1
	total*	93.0	119.0	139.0
Rural communities with less than 3,000 inhabitants	domestic use	65.0	85.0	100.0
	commerce, small industries	3.3	4.3	5.0
	sub-total	68.3	89.3	105.0
	water losses	20.5	17.8	15.8
	total*	89.0	107.0	121.0

Source: National Water Master Plan for Jordan, 1977

* Totals rounded up in Plan

the lack of statistical data on factors such as income levels.

It will be recalled that the specific needs of major industrial and certain other bulk consumers (such as army camps) are allowed for separately in the Plan's projections of water demands.

In the case of Amman, Zerqa and Irbid, the domestic consumption estimates of 85 l/h/d in 1975 increasing to 120 l/h/d by the year 2000 are defined qualitatively in terms of existing living standards, anticipated improvements in the latter, expected improvements in standards of water supply and sanitary facilities and consumption levels in other unspecified cities of similar size in Europe and the Mediterranean which are stated in many instances to exhibit levels of demand above those projected. A further allowance of 14% of projected domestic consumption levels is made to cover the needs of commerce and small industries (including government and municipal institutions, schools, public utilities, etc.), reflecting the Plan's estimated breakdown of present consumption in Amman between major categories of user. Water losses are taken at 35% of projected consumption (equivalent to 26% of production) in 1975 reducing to 25% of projected consumption (20% of production) in 1985 and 15% of projected consumption (13% of production) in the year 2000.

The second category of communities - those having a population of between 3,000 and 50,000 - was chosen because of their relatively uniform standard of housing, the present standards of water supply and sewerage facilities and "the common desire for an improvement in standards of living". Domestic needs in 1975 are estimated at 65 l/h/d, slightly below that for the large cities, and projected to increase to 90 l/h/d in 1985 and 110 l/h/d in 2000. The latter increase anticipates improvements in living conditions, up-grading of housing standards, and existence of modern sanitary installations. The allowance for the needs of commerce and small-scale industry amounts to 10% of the projected domestic consumption levels. System losses are put at 30% of consumption (23% of production) in 1975, reducing to 20% of consumption in 1985 and 15% in 2000.

The per capita demand estimates for the smaller communities housing a population of less than 3,000 are not dissimilar, but assume a slightly lower build-up in domestic consumption from 65 l/h/d in 1975, to 85 l/h/d in 1985, and to 100 l/h/d in 2000, together with an additional allowance equivalent to only 5% of domestic consumption to cover the needs of commerce and small-scale industry.

The estimate of 35 l/h/d for consumers on unpiped supplies has been taken as a constant throughout the period of study and does not include a separate allowance for system losses.

Any comments upon the above projections must to a degree be subjective because of the lack of data on which to base consumption estimates. However, in the light of our own enquiries and analysis of the available data, we have a number of comments which are subsequently reflected in our own projections.

First, for reasons noted earlier, we consider that in the case of Amman, and to a lesser extent Zerqa and Irbid, the National Water Master Plan underestimates the demand for water by commerce, small-scale industry and other users such as schools, hospitals, government offices and hotels.

Secondly, even bearing in mind data limitations, we feel that there is a case for allowing for some small variation in per capita levels of domestic consumption between the three main towns which although all apparently prosperous, have somewhat different economic bases and appear to exhibit some differences in standards of living. This situation seems likely to continue in the foreseeable future at least, even if Government regional policy is successful in promoting development in centres such as Irbid.

Thirdly, bearing in mind both probable levels of income and the scale of development of commerce and services and their associated water needs, we have reservations as to whether water demands in the larger rural villages will be quite on a scale comparable

to that of the smaller towns such as Jerash, Suweileh and Wadi Sir. Similarly, we have some reservation as to whether, given an unconstrained supply, domestic consumption levels now would be as high in the small villages as in the larger villages.

Finally, the projected increase in per capita consumption levels needs to be carefully considered. Increases in per capita consumption levels among individual groups of consumers over time are likely to arise as a result of increases in real incomes and improvements in water supply and sanitation facilities. The National Water Master Plan shows considerable increases for all communities on account of these factors.

Our own opinion is that the likely effect is overstated, particularly in the case of the smaller rural communities where in many instances it is difficult to foresee a major improvement in living standards and water and sanitation facilities, at least on a scale sufficient to produce an average per capita domestic consumption level of 100 litres per day by the year 2000, only some 16½% (20 l/h/d) below that predicted for Amman.

In this context, it should be noted that if water supply systems can be improved sufficiently to meet even the domestic consumption levels adopted for 1975, the majority of consumers, especially those in the rural areas, would enjoy a considerable increase in standards of supply.

It must also be remembered that the population projections indicate a movement from the villages to the towns and an increase in the proportion served by piped water supplies. This in itself implies an increase in living standards and average per capita levels of consumption over time. At the individual town or city level, the effect of inward migration from the poorer rural areas should be to depress the average level of per capita consumption, thereby tending to offset increases in consumption levels among existing residents as their standards of living improve.

The VBB Projections for Amman

The National Water Master Plan's estimates of potential demand (inclusive of "unaccounted for water") in Amman of 131 l/h/d in 1975 increasing to 158 l/h/d by the year 2000 compare with figures of 77 l/h/d and 130 l/h/d respectively adopted as a basis for the VBB forecasts of water requirements.

The latter forecasts are, however, in our opinion deficient as estimates of potential demand in that the base figure of 77 l/h/d relates to the quantity actually produced and delivered to the system in 1975 and makes no allowance for the shortages of water that existed then and now. Such a level of supply is clearly totally inadequate to meet potential demands at the present time.

In the longer term, however, the subsequent rate of growth assumed by VBB in their per capita consumption estimates probably goes some way towards reducing this initial deficiency.

The Jordan Valley Irrigation Project Report Projections

Little analysis of per capita domestic and municipal water demands is provided in the Jordan Valley Irrigation Project Draft Feasibility Report for reasons discussed earlier.

The report's projections of domestic and industrial needs in the Jordan Valley are based on a 1976 estimate of per capita use of 70 litres per day provided by the Jordan Valley Authority and assume an increase of 1 l/h/d per year to a figure of 94 l/h/d in the year 2000.

In the case of Irbid, the report adopts a set of demand estimates based on per capita allowances 10 l/h/d above those assumed for the Valley. No source or justification for the latter is given. The figures are substantially below those adopted in the Water Master Plan which, for example, estimates potential demand in 1975 at 131 l/h/d for Irbid, 93 l/h/d for large villages and 89 l/h/d for small villages.

The Irbid Water Supply Feasibility Study Projections

The method adopted in estimating per capita demands in the Irbid Water Supply Feasibility Study is similar to that used in the National Water Master Plan in so far as the demands are derived from separate estimates of domestic consumption, the requirements of commerce and small-scale industry and system losses.

The domestic components of demand are estimated using 1961 Census data relating to type of water supply connection, type of toilet facilities and numbers of houses having baths. Houses were subdivided into five main types (depending upon the combination of water and sanitary fittings) and estimates were then made of overall water usage based on the unit quantities which the authors of the study considered were likely to be required for cooking, drinking, dishwashing, cleaning, laundering, personal bathing, toilet flushing and other miscellaneous uses, taking into account for each house type the facilities and amenities available. In estimating future average per capita levels of domestic water consumption, allowance is made for a general improvement in housing standards, particularly in the larger towns and in the villages around Irbid.

The resulting domestic consumption estimates are shown in Table 6.

Provision is also made for trade consumption which, in the words of the Feasibility Study report, covers "the more modest requirements of trade, commerce and light industry in the urban areas and small-scale processing, horticultural and animal husbandry requirements in rural areas". The report envisages that "Irbid will become a centre of trade business and industrial activity, but none of the developments under consideration or foreseen is expected to need very large quantities of water and, consequently, no bulk water supplies for commerce or industry have been included in these forecasts." The report continues to state that "experience in other countries shows that except for the special requirements of irrigation and intensive agriculture, trade consumption (as defined above) varies between 25 and 50 per cent of total consumption, or 15 to 30 litres per head per day. On this basis it is estimated

TABLE 6 - Summary of Estimates of Per Capita Demands
Yarmouk River Development : Irbid Water Supply Feasibility Study

Year	Component of demand	Unit	Irbid	Ramtha Samh, Husn Aidun	Mafraq	Plateau Area Villages	Southern Area Villages	Eastern Area Villages	University Complex	Free Trade
1979 - 2000 High, intermediate and low projections										
1979	Domestic consumption	l/h/d	78	78	78	41	37	30	113	
	Trade consumption	l/h/d	20	14	14	5	5	--	---	
	Total consumption	l/h/d	98	92	92	46	42	30	113	119
	Losses as a percentage of production (%)		(25)	(30)	(30)	(25)	(30)	(30)	(15)	(15)
	Total production	l/h/d	130	130	130	61	60	43	130	140
1984	Domestic consumption	l/h/d	88	88	88	52	50		113	140
	Trade consumption	l/h/d	40	14	19	20	20		---	
	Total consumption	l/h/d	128	102	107	72	70		113	119
	Losses as a percentage of production (%)		(20)	(25)	(25)	(20)	(25)		(15)	(15)
	Total production	l/h/d	160	135	140	90	93		130	140
1989	Domestic consumption	l/h/d	98	98	98	71	57	37	113	
	Trade consumption	l/h/d	72	14	24	30	23	3	--	
	Total consumption	l/h/d	170	112	122	101	80	40	113	119
	Losses as a percentage of production (%)		(15)	(20)	(20)	(15)	(20)	(20)	(15)	(15)
	Total production	l/h/d	200	140	150	118	100	50	130	140
2000	Total production	l/h/d	200	140	150	118	100	50	130	140
Long-term estimate: 2010										
	Intermediate/low projections									
	Total production	l/h/d	200	140	150	118	100	50	130	140
	High projection									
	Total production	l/h/d	250	200	200	150	120	80	130	140

that 72 litres per head per day in 1989 should be sufficient to satisfy the trade and commercial water requirements of Irbid. It is to be expected that trade consumption on this scale will occur only in Irbid and to a lesser degree perhaps in Mafraq. Neither Ramtha,Sarih, Husn and Aidun, nor the Free Trade Area are expected to require provision on this scale". Again, the actual allowances made are shown in Table 6.

The trade allowances made in the case of the rural areas are intended to cover principally requirements for horticulture and animal husbandry. Specific developments foreseen include "an increase in numbers of sheep with a corresponding reduction of goats being raised in the Northern Plateau area; encouragement for farmers to keep one or two dairy cows ..... and improvements in the quality of livestock rather than increases in their numbers." Reference is also made to the establishment of a dairy herd at Dhuleil and proposals for an olive oil extraction plant north of Irbid. With these considerations in mind, an allowance of 5 l/h/d in 1979 increasing to 40/1/h/d in 1989 is made for the Northern Plateau area, 5 l/h/d in 1979 increasing to 23 l/h/d for the Southern area villages, with only a nominal allowance of 3 l/h/d in 1989 for the Eastern area villages where there is virtually no scope for agricultural development.

Agricultural requirements for water, including those for horticulture and animal husbandry, are discussed in a separate volume of our report. They are not included within the projections presented later in this volume.

In the case of domestic consumption, the unit estimates adopted in the Feasibility Study amount to 78 l/h/d for the towns in 1979 and 30 to 41 l/h/d for the villages, increasing by 1989 to a level of 98 l/h/d for the towns and between 37 and 71 l/h/d for the villages.

The estimates for the towns are not dissimilar from those used in the National Water Master Plan for the period 1979 to 1984, but over the period 1984 to 1989 assume a more rapid rate of increase.

The estimates for the villages in 1979, however, are approximately half those adopted in the Master Plan. Once again, though, with the exception of the eastern area villages, they show a very rapid build up in consumption levels over the period to 1989 - at an annual rate of 3 1/h/d for the northern villages.

For reasons noted earlier, we consider that such a rate of growth in per capita consumption is unrealistic. However, beyond 1989 the Irbid Water Supply Feasibility Study makes no provision for further increases in per capita consumption in projecting water demands - the overall unit rates adopted for the year 2000 being the same as those for 1989. Considered over the longer term, the growth in unit levels of consumption appears to us more realistic. The particular assumptions adopted in the Feasibility Study, however, may give a somewhat erroneous view of the phasing of increases in water demands.

In the case of 'trade' consumption, we cannot but feel that the growth suggested for Irbid in particular is unrealistic - from 14 1/h/d in 1979 to one of 72 1/h/d in 1989, equivalent to nearly three-quarters of the projected unit level of domestic consumption. Even taking a longer term view, the figure of 72 1/h/d appears very high in relation to Irbid's probable economic base and mix of activities.

Finally, the Irbid Water Supply Feasibility Study considers briefly the effect upon total water requirements of a total per capita demand ranging from 80 1/h/d in the case of the eastern area villages up to 250 1/h/d in the case of Irbid. Little use is made of these estimates, however, in the project evaluation presented in the Feasibility Study, and we do not therefore comment upon them further.

5.4 SUMMARY OF PREVIOUS ESTIMATES OF PER CAPITA DEMANDS

The available data suggests that existing average levels of water usage, inclusive of system losses but exclusive of the requirements of major bulk users, typically range between 25 and 35 l/h/d in the case of the rural villages, between 30 and 50 l/h/d for the smaller towns and up to nearly 80 l/h/d in the case of Amman. In all instances, however, these figures relate to areas where serious supply shortages have been encountered, and in the case of a number of smaller towns which draw water from local sources and apparently enjoy a relatively high standard of supply, total usage appears to average around 100 l/h/d.

Studies recently undertaken in relation to the planning and development of water supply systems for northern Jordan show a wide range of estimates of potential levels of present and future consumption and demand, largely a reflection of the various data limitations discussed earlier.

For example, in the case of domestic consumption estimates for the villages range between an initial 30 and 65 l/h/d, those for the towns and cities between 65 and 85 l/h/d. By the year 2000, the estimates vary between 37 l/h/d and 110 l/h/d for the villages, 98 l/h/d and 120 l/h/d for the towns.

In the case of overall demands, inclusive of system losses, estimates for the villages range between an initial 43 l/h/d and 93 l/h/d, increasing to between 50 l/h/d and 139 l/h/d by the year 2000. For the towns and cities, the respective figures are 93 l/h/d to 131 l/h/d and 130 l/h/d to 200 l/h/d.

5.5 ABILITY TO PAY FOR WATER

In considering future levels per head consumption, it must not be forgotten that water in Jordan has not been in plentiful supply and that people in general are accustomed to being sparing in its use.

Water is always likely to be relatively limited in its availability and in real resource terms can in general be expected to become increasingly costly as more expensive sources of supply are developed. Price may well act as a significant constraint on future consumption if realistic tariff policies are pursued, an objective the desirability of which is reflected in the Jordan Five Year Plan which states : "make the tariff on drinking water a progressive one in proportion to the volume of consumption.....such a measure would lead to lower water consumption and to an increase in Water Authority revenues, thus enabling the Authority to meet its current obligations and provide the necessary funds for the further development and proper distribution of water resources.....finalise measures enabling the Water and Sewerage Authority to conduct its activities on a commercial basis and become dependant on its own sources."

There are, however, a number of considerable difficulties in establishing the levels of consumption that different groups of consumers may be in practice be able to afford, again stemming principally from lack of adequate data.

Tariff requirements

First, the extent to which tariffs may be increased - particularly in relation to real income levels - is uncertain and will likely depend upon a combination of economic, financial, social and political objectives. A number of the recently conducted feasibility studies provide an indication of the scale of increases that may be necessary to ensure financial viability, although for reasons noted below the results need to be treated with an element of caution.

In the Water Supply Corporation's Northern District's area, for example, current retail water charges are around 110 fils/m^3, those in the villages 125 fils/m^3. In the majority of instances, the consumer is subject to a minimum monthly charge, generally for 5 m^3. The principal exception is Irbid, where the minimum charge is for 3 m^3 per month.

The recent Financial Review of the Northern District system, however, draws attention to the parlous financial situation with regard to the water supply operations in this area. It suggests that following the commissioning of the new Zaatri-Haufa pipeline scheme in mid-1977, the Water Supply Corporation's bulk tariff should be increased from the present 60 fils/m^3 to 180 fils/m^3 if sufficient revenues are to be raised to cover all operating and maintenance costs, depreciation and yield a return of around 8% on net assets employed. In the case of the retail tariff in the municipalities and villages, the report suggests a minimum monthly charge of JD 1.4 to cover up to the first 5 m^3 per month consumed, with a charge of 400 fils/m^3 on all consumption above 5 m^3/month. It is envisaged that increasing sales of water over the period up to 1981 (when the report envisages that the proposed Yarmouk supply scheme will be commissioned) should be sufficient to cover increases in costs inclusive of an allowance for inflation.

However, sales and operating costs are both projected on the basis of past trends and may prove to give a somewhat misleading indication of the actual situation. The report also assumes that some 40% of water produced will continue to be "unaccounted for" which must to a significant extent be due to faulty consumer metering. The effective charge per m^3 actually consumed would thus be less than the rate per m^3 billed. This must not be forgotten in considering the consumer ability to pay for predicted real levels of consumption (as against quantities recorded on meters). However, even taking into consideration such factors, there seems little doubt that a significant increase in real tariff levels will be required over the coming five years.

The situation with regard to the Amman water tariff is not dissimilar. The 1976 Feasibility Study produced by VBB indicates that in 1975 an average charge of some 93 fils/m^3 of water sold would have been required to cover operating costs, interest and depreciation. This compares with an actual average charge of 76 fils/m^3 in that year. The report suggests the need for an increase in the average unit charge to at least 125 fils/m^3 in 1977, over 300 fils/m^3 in 1980, and over 400 fils/m^3 by 1985 if these items of expenditure are to be covered.

These figures are, however, based on VBB's projections of demand and again assume continuation of substantial unaccounted for quantities of water over the period in question. They assume an annual inflation rate of 20% on local items of expenditure up to 1980, falling to 10% by 1985, and on an inflation rate of 10% on offshore items of expenditure in 1976 falling to only 5% by 1981.

The Amman water tariff has in fact recently been increased and is currently as follows:

Consumption level m^3/quarter	Rate per m^3
0 - 40	60 fils*
41 - 100	160 fils
over 100	225 fils

(* subject to a minimum charge for 10 m^3/quarter)

This increase will clearly go some way towards improving the financial viability of the system. However, even bearing in mind the limitations of the VBB analysis, some further real increase in tariff levels may well prove necessary in the not too distant future.

We understand in fact that water tariff levels in Jordan are currently under review and that a new national tariff may soon be introduced.

Cost of water to the consumer and capacity to pay

Table 7 indicates the monthly cost of water for a six-person household, given different levels of per capita consumption and average rates of charge. The 1961 Census of Population incidentally indicated an average household size of 6.5 persons for the whole of Jordan.

TABLE 7 - Monthly Cost of Water for a 6-person Household

Per capita consumption litres/day	JD/month Cost of water : fils/m^3 125	150	175	200	225	250
40	0.900	1.080	1.260	1.440	1.620	1.800
60	1.350	1.620	1.890	2.160	2.430	2.700
80	1.800	2.160	2.520	2.880	3.240	3.600
100	2.250	2.700	3.150	3.600	4.050	4.500
120	2.700	3.240	3.780	4.320	4.860	5.400

TABLE 8 - Monthly Income Required by Head of 6-person Household to Finance Given Levels of Water Consumption if 5% of Income is Expended on Water.

Per capita consumption litres/day	JD/month Cost of water : fils/m^3 125	150	175	200	225	250
40	18	22	25	29	32	36
60	27	32	38	43	49	54
80	36	43	50	58	65	72
100	45	54	63	72	81	90
120	54	65	76	86	97	108

Bearing in mind the limitations of the available data on future revenue requirements, we do not consider it unreasonable to think in terms of a possible real average rate of charge (that is, in relation to present income levels)in the immediate future of some 150 to 200 fils/m^3 when considering potential domestic demands. This would, for example, imply for a six-person household consuming say 80 l/h/d a monthly water charge of between JD 2.160 and JD 2.880.

The next question relates to the ability of the consumer to meet any given level of charges and sustain a particular level of consumption. Any yardstick of ability to pay can clearly only be of a very approximate nature. One that has frequently been applied and has its origin in World Bank practice is that no more than 5% of the wage of the head of a household should be expended on paying for water for that household.

Applying this standard to the monthly charges shown in Table 7, the minimum monthly wage required to sustain given levels of consumption can be calculated. These are shown in Table 8 for the six-person household. At an average level of consumption of 80 l/h/d, for example, the required monthly wage would be at least JD 50. For an eight-person household with a similar level of consumption, the required wage would be one-third greater, approximately JD 67 per month.

Unfortunately, there is no date relating either to average levels of income or to distribution of incomes in Jordan. The Department of Statistics does collect certain information on wages from employers, but it is thought to be inaccurate and is therefore not released.

National income statistics, however, suggest that in 1975, the latest year for which we were able to obtain figures, average per capita income on the East Bank amounted to some JD 190. The Department of Statistic's various cost of living indices suggest that between 1975 and mid-1977, prices in the main towns typically increased by some 35% to 50%. Assuming that per capita incomes moved accordingly, this would imply a 1977 level of average per capita income of between JD 250 and JD 285.

Translating such figures into an average wage presents certain difficulties because of the nature of the national income statistics on which they are based. The national income statistics, however, suggest that wages, salaries and

remuneration of working proprietors probably amounts to some 70% to 75% of GDP. Given this and an average national activity rate of some 20%, the suggested per capita annual income estimate of between JD 250 and JD 285 in 1977 would not seem inconsistent with an average monthly wage in that year of between JD 70 and JD 85. To the extent that the suggested rate of price increase in the towns overstates the position nationally or to the extent that incomes may have lagged behind prices, the average wage would be towards the lower rather than the upper end of this range.

At the sectoral level, the 1974 Industrial Census provides certain data on wages and salaries in mining, manufacturing and power production. It indicates an average wage of JD 27 per month for all establishments and one of JD 41 for those employing 5 or more persons. From an analysis of the available data sector by sector, however, it appears that the average wage for all establishments may have been depressed by the inclusion in the employment figures of smaller establishments certain unpaid family workers and possibly proprietors.

Allowing for subsequent inflation at the rate of between 50% and 70% indicated by the Department of Statistics cost of living indices for Amman and Zerqa, where most industry is located, the 1977 average industrial wage might reasonably be estimated at between JD 55 and JD 70 per month.

This latter estimate compares with rates quoted to us for construction workers in Amman of between JD 45 and JD 70 per month for labourers, JD 100 and JD 150 for plant operators and JD 100 and JD 125 for carpenters and other similar skills.

Government salary scales, on the other hand, commence at a basic monthly wage of JD 26, in addition to which certain allowances are payable. These include a general cost of living allowance and allowances for wives and children, which in most cases would

bring the starting salary up to around JD 40. We were informed, however, that relatively few employees earned the minimum. Only in the case of un-graded, unskilled workers such as office messengers might the wage fall as low as JD 30. Indeed, from what we were able to ascertain, JD 30 can probably be taken as a reasonable indication of the minimum wage.

As far as the service sector in general was concerned, we were unable to obtain any real indication of wage levels. Wages in the hotels, however, appear to start at around JD 40 per month.

At the other end of the scale, salaries for engineers and other professions of comparable standing appeared to amount to JD 500 to JD 600 per month and above for experienced individuals. However, the proportion of workers on such salary levels must be relatively few and mark the upper end of the income scale.

Finally, in the case of the agricultural sector information obtained on conditions in the Jordan Valley suggests that hired labourers are currently paid around JD 50 per month while tenant farmers typically enjoy incomes of around JD 80 per month. We were unable to obtain any specific information on other agricultural areas, but it would not seem unreasonable to assume that in general effective income levels are somewhat below those in the Valley, possibly by a substantial margin in the poorer rural areas.

Whilst it is impossible to draw any firm conclusions from the above earnings data, it does not appear to be inconsistent with the suggested average income estimate of between JD 70 and JD 85 per month. However, we would tend towards the view that the true figure lies towards the lower rather than the upper end of this range.

Average income levels will of course vary between areas and communities. Generally speaking, wage levels in the Amman area appear, job for job, to be slightly above those in the northern municipalities.

Bearing in mind this factor and the composition of employment, we would expect the average wage in Amman to be somewhat above the national average and above that in the other major towns in our study area. Conversely, we would expect the average wage in rural areas to be below the national average. This we have attempted to reflect in our subsequent estimates of domestic per capita water requirements.

The available data on average family size, incomes and possible tariff requirements points towards the tentative conclusion that given an overall average expenditure on water amounting to some 5% of the head of the household's wages it might be possible to sustain an average domestic consumption of around 100 to 120 l/h/d in the more wealthy centres such as Amman. However, the 5% standard is generally viewed as a reasonable upper limit on expenditure, and it seems unlikely that all consumers, particularly those in the higher income groups, would be willing to allocate such a high proportion of their incomes to water. In terms of ability and willingness to pay for water, it seems to us probable that the present average level of domestic consumption in Amman would be somewhat below the 100-120 l/h/d suggested above, given an unconstrained supply.

The future situation with regard to income levels, particularly as they may relate in real terms to water charges, is almost impossible to judge, given the information available.

Assessing future prospects on the basis of past trends poses considerable difficulties in the case of Jordan owing to the effect of previous hostilities in the area upon rates of economic growth. During the previous three-year plan period (1973-1975) GDP increased at a real rate of 5.9% per annum against a target of 8%, representing a real increase in per capita incomes of around 2.5% per annum. The authorities are currently planning for a similar 8% rate of growth in GDP over the current Five Year Plan period of 1976-1980 which, if achieved, would result

in a further significant increase in per capita incomes. The Plan suggests that private and public consumption should move broadly in line, which implies that the planned increase in per capita GDP should be reflected in wages. The Plan also aims at the "achievement of a better and more equitable distribution of national income" and at "developing economic and social activities in the various regions of the Kingdom through the development of social overhead facilities and the construction of development projects particularly in rural areas".

As noted in Chapter 3 of the report, the general prospects for the Jordanian economy at present appear bright, and as a basis for water resource and system planning and development, it would seem reasonable to assume a continued growth in real incomes in the longer term.

This increase is likely, at least in part, to be offset by increases in the real resource cost of making additional quantities of water available. Although we feel unable to quantify such movements in any certain terms, we consider that it would not be unrealistic to assume some upward movement in per capita domestic consumption levels over time, particularly in the larger towns, but at a relatively modest rate, say of the order of 1% to 2% per annum.

The preceding discussion has been framed in terms of domestic consumption levels since experience suggests that these are in general sensitive to income and price.

Commercial and industrial requirements on the other hand are unlikely to be price sensitive, since in the majority of instances the cost of water will be an extremely small component of total expenditure. The possible exceptions are the major bulk users whose needs are separately considered in Section 6 of this report.

5.6 PER CAPITA DEMAND ESTIMATES USED IN THE NORTH JORDAN WATER USE STRATEGY

Taking into account the preceding information and considerations, we have prepared a revised set of per capita demand estimates for the purposes of the present study.

Domestic Consumption

Estimates of potential domestic levels of consumption, given an unconstrained supply, were first prepared for application to the 1975 population base. Separate estimates were made for:

- Amman
- Zerqa
- Irbid
- Other towns and communities with a population of 15 000 or more (these include Husn, Jerash, Madaba, Mafraq, Ramtha, Ruseifa, Salt, Suf, Suweileh, Wadi Sir)
- the larger villages and small towns with a population of between 3 000 and 15 000 persons
- the smaller communities with a population of less than 3 000
- consumers relying on unpiped supplies

Referring back to the available data on patterns of economic activity, employment and incomes, it seemed reasonable to assume that the highest average per capita levels of domestic consumption would be experienced in the case of Amman, the lowest in the smaller rural villages and amongst consumers relying on unpiped supplies; and that levels of consumtpion in other communities would range between the two extremes broadly in the order indicated by the preceding list.

We have no clear indication of precisely how levels of consumption in Jordan might vary with income levels, given an unconstrained supply. Elsewhere in the world it has been observed that, with the possible exception of the extremities of the consumption scale, demand frequently bears a fairly direct proportionate relationship to income. Whilst in the case of Jordan, potential domestic demand might not necessarily relate precisely to income levels, the general relationship seems likely to be valid.

In the case of Amman, we were able to locate a complex of flats, occupied by professional engineers, which has its own storage tanks and according to the occupants consequently enjoys an unconstrained supply. We were able to calculate average consumption in this complex at 175 l/h/d. There will clearly be some houses with gardens which would exhibit much higher levels of consumption given a satisfied demand, but these are unlikely to account for a major proportion of the total housing stock and number of consumers in Amman. At the other end of the consumption scale, information obtained from the Baqaa refugee camp suggested that in cases where there is no individual house connection, consumption could be as low as 15 l/h/d.

Taking account of these figures, probable average levels of income and our earlier comments on ability to pay, we have adopted an initial domestic per capita consumption estimate of 80 litres per day for Amman.

It will be recalled that the data available on present levels of production suggested that in the smaller towns such as Wadi Sir, Suweileh and Jerash total per capita demand (inclusive of system losses and the requirements of local commerce and industry) could, in an unconstrained supply situation, amount to around 100 l/h/d. Allowing for some increase in real levels of tariff, we consider that a figure of 65 l/h/d would be a reasonable estimate of initial domestic consumption among communities with a population of more than 15 000, exclusive of Zerqa and Irbid. In the case of the latter two towns, consumption seems likely to lie between that of the smaller towns and Amman. We have therefore adopted estimates of 75 and 70 l/h/d respectively.

In the case of the villages, there is little data on which to base sound estimates of potential per capita consumption. Since the majority of these communities will rely principally upon the agricultural sector for their livelihood and having regard to probable income levels in the latter together with likely standards of household amenities, we have adopted initial domestic consumption levels of 55 l/h/d for the communities with populations of between 3 000 and 15 000 and 45 l/h/d for communities with populations of less than 3 000 persons. In formulating these estimates, we have taken into account the likelihood of a structured tariff with a below average rate of charge on the initial consumption band(s). Such a tariff would, of course, reduce the financial burden of water charges on poorer consumers and thus enhance their ability to sustain a reasonable, minimum level of consumption.

In the case of unpiped supplies, we have retained the National Water Master Plan's figure of 35 l/h/d. Although, as noted earlier, we feel this may slightly overestimate the true requirement, consumption from unimproved sources represents a very small and declining component of total demand.

The preceding estimates are summarised in Table 9.

It should be stressed that at the individual community level, per capita consumption is certain to vary from the average for the group. The available data does not, however, in our opinion justify any attempt at further refinement, certainly in the context of developing an overall water use strategy. At the area or regional level, variations in consumption levels between groups of communities and from the overall average should in general be less than those prevailing between individual communities. To the extent that variations may exist, they are best dealt with by considering the sensitivity of choice of schemes to possible changes in levels of demand from those projected.

TABLE 9

Estimates of Per Capita Water Demands used in North Jordan Water Use Strategy

all figures litres/head/day (l/h/d)

	1975					2000				
	Consumption			Losses % of demand	Demand	Consumption			Losses % of demand	Demand
	Domestic	Commercial	Total			Domestic	Commercial	Total		
Piped supplies										
Amman	80	30	110	20	138	105	45	150	20	188
Zerqa	75	20	95	20	119	100	30	130	20	162
Irbid	70	20	90	20	112	95	30	125	20	156
Other towns with a population of 15 000 or more	65	15	80	20	100	85	20	105	20	131
Communities with a population of between 3 000 and 15 000 persons	55	10	65	20	81	70	15	85	20	106
Communities with a population of less than 3 000 persons	45	5	50	20	62	55	10	65	20	81
Unpiped supplies	-	-	-	-	35	-	-	-	-	35

Regarding the future growth in consumption levels, we have already commented upon the effective increase in per capita consumption that will result from new villages being connected to piped supplies and from the rural-urban population drift.

At the individual village level, we would envisage that the principal increase in per capita consumption levels will result from the connection of additional villages to piped supplies. This is reflected in the demand projections through a reduction in numbers of persons relying on unpiped supplies.

Some increase in per capita consumption levels in the case of villages already connected to piped supplies is to be expected, but on a relatively modest scale. Particularly in the smaller villages, we find it difficult to envisage widespread introduction of facilities such as showers and flush toilets. Furthermore, experience elsewhere in the world suggests that when such facilities are installed, the additional demand so generated can often be relatively small. Toilets, for example, may only be flushed occasionally.

In the case of our demand projections, therefore, we have only allowed for an increase over the twenty-five year period up to 2000 of 10 l/h/d in domestic consumption among communities of less than 3 000 persons and 15 l/h/d in the case of those with a population of between 3 000 and 15 000 persons.

No increase has been allowed for in the levels of consumption of those persons continuing to rely on unpiped supplies.

It should, however, be noted that in a number of instances the projected growth in the populations of the smaller communities will result in their being transferred to the 3 000 - 15 000 population group for the purposes of estimating water demands. This too, is reflected in an effective increase in the per capita consumption levels allowed for their populations.

Taking this and the extension of piped supplies to additonal communities into account, the effective increase in per capita domestic consumption allowed for in our demand projections for many of the population remaining in the rural communities is of the order of 15 to 25 litres per day over the 25 year period under study.

In the case of the towns, more rapid increases in domestic consumption levels have been adopted.

Amman, Zerqa and Irbid are likely to be the major centres of growth in the northern part of Jordan, and this should be reflected in the general provision of amenities and in living standards. There are plans for extension and improvement of the water supply systems in these towns and for an increase in the proportion of houses with an individual direct connection to the mains. Amman is to have its sewerage system extended, and there are plans to install sewerage systems in Irbid and Zerqa. Although the inflow of poorer migrants to these towns is likely to depress any increase in average per capita consumption levels, we would nevertheless expect a significant increase in the latter. We have therefore allowed for an annual increase of 1 l/h/d, equivalent to 25 l/h/d over the period 1975 to 2000.

The increase in the smaller towns seems likely to be less than that for the main cities. Growth prospects are generally not of the same order of magnitude. Nevertheless we would expect some increase in average per capita consumption levels. Improvements in infrastructure and housing standards are to be anticipated. A new sanitary sewerage system is being installed in Salt, and there are plans to install such a system in Jerash. Similar systems may eventually be installed in other towns. Bearing these factors in mind, we have allowed for an increase in per capita domestic consumption levels of 20 l/h/d over the period 1975 to 2000 - between that allowed for the main cities and the communities with populations of between 3 000 and 15 000.

Taking account of the limited data we have with regard to income levels, prospects for growth in per capita incomes, policy towards charging for water and tariff structures, and costs of water, we consider that the per capita levels of consumption adopted as a basis for our demand projections should not pose an undue financial burden to the consumer.

Non-domestic Consumption Levels

As noted earlier, we consider that the allowance made in the National Water Master Plan to cover the needs of commerce, small-scale industry connected to the mains supply, services (including hotels), schools, hospitals, government offices and all similar users in the main cities is rather low.

Amman in particular has a wide range of shops, hotels, services, schools, medical facilities, small workshops etc., all of which consume water, some admittedly to cover what are essentially the personal needs of the workforce and cleaning, but others as a process input.

The analysis of meter records presented in the National Water Master Plan suggests to us that some 40% to 50% of billed consumption in Amman may well have represented non-domestic usage. In the case of the flats complex referred to earlier, quarterly consumption per connection amounted to only some 65 m^3. Whilst there are undoubtedly a number of domestic properties consuming quantities in excess of this figure, there are undoubtedly many commercial establishments consuming less. Similarly, there may be a significant number of properties owned by or rented to summer visitors to Amman in this latter category.

It will be recalled that only some 50% of water produced in 1975 was actually billed to consumers, but that an estimated two-thirds of the remainder was probably consumed and attributable to under-recording of consumers' meters. Bearing in mind the nature of the metering problem in Amman, much of this apparent loss is probably attributable to the smaller and hence primarily domestic consumer.

Taking this into account, it seems likely that non-domestic usage amounted to perhaps only some 25% to 30% of the total supplied to the system. This would, however, still imply a non-domestic per capita consumption in excess of 20 l/h/d.

There is also evidence of non-domestic users purchasing tankered water from private sources, and it appears that such supplies may not have been fully taken into account in the preceding estimates.

Furthermore, like the domestic consumer, the non-domestic user has suffered from water shortages, although the extent of these shortages may not have been as acute. The Downtown area, for example, is at a relatively low elevation and probably experiences better than average pressures in the system. The Jebel Amman commercial area, on the other hand, appears to have received some priority of supply.

Taking these various factors into account, we have adopted an initial non-domestic consumption estimate for Amman of 30 l/h/d.

In the case of Irbid and Zerqa, there is not the same concentration of offices and services, the same general standard of amenities in such buildings (Amman it will be remembered caters for the international community), nor are there any hotels of significance. Although there is a greater concentration of industry in the Zerqa area, this relies in the main on its own supply sources. We have therefore adopted a lower initial estimate of 20 l/h/d to cover the needs of commerce and small-scale industry in these two towns.

Similarly, the level of services and commerce found in the smaller towns such as Jerash, Salt, Wadi Sir and Madaba will be lower than that in Irbid and Zerqa, with corresponding effects on non-domestic water requirements. With this in mind we have adopted an initial estimate of 15 l/h/d.

These figures are significantly above the National Water Master Plan estimates of 12 l/h/d for Amman. Zerqa and Irbid and 6.5 l/h/d for communities with a population of between 3000 and 15 000 persons for reasons explained above and in Section 5.2.

In the case of the smaller communities with population of less than 15 000 we would in general expect the non-domestic component of consumption to be relatively small. Demands in these areas (other than those for agricultural needs) will be primarily of a domestic nature, the non-domestic needs being confined principally to consumption in local schools, shops and services. The standard of water supply and sanitary facilities is unlikely to lead to particularly high levels of consumption in such establishments. We have therefore allowed for non-domestic consumption at an initial rate of 10 l/h/d for communities with a population of between 3 000 and 15 000 persons and at a rate of 5 l/h/d for those having a population of less than 3 000.

Looking to the future, we anticipate an increase in commercial and small-scale industrial requirements in the cities, not only in absolute terms but also per head of population. The Five Year Development Plan, for example, envisages a growth in industry (small as well as large-scale) and tourism above the rate projected for the economy as a whole, and these are likely to be concentrated on the main cities, in the case of tourism around Amman. Amman will continue in the foreseeable future to be the main commercial centre and magnet for international business. Irbid, however, has prospects for developing into a flourishing regional centre.

The National Water Master Plan suggests an increase of some 40% in the per capita allowance for commercial and small-scale industrial consumption in the three main cities over the period 1975 to 2000. Although as with most of the estimates there must be a large degree of intuitive guesswork over such a figure, it does not seem to us unreasonable. In our own projections of consumption, we have in fact allowed for a slightly higher rate of increase; from 30 l/h/d in 1975 to 45 l/h/d in 2000 in the case of Amman, and from 20 l/h/d to 30 l/h/d in the case of Zerqa and Irbid. This we consider to be a realistic allowance, given a rate of growth of GDP in excess of population growth and a relatively more rapid expansion of activities than tend to have heavier demands on water relative to employment and output.

The prospects for a major increase in the per capita level of commercial consumption in the smaller towns and other communities seems rather more limited. In general, we would expect this to come about principally as a result of a general up-grading in amenities and Government investment in social infrastructure - such as schools and health clinics. We have therefore allowed for a uniform increase of 5 l/h/d over the period 1975 - 2000 to allow for a modest growth in non-domestic consumption on account of such factors.

Our estimates of non-domestic per capita requirements are summarised together with those of domestic consumption in Table 9 for the two years 1975 and 2000. In applying these estimates to the 1985 population figures, a straight linear rate of increase has been assumed between 1975 and 2000.

It should perhaps be reiterated that unlike the per capita estimates used in the Irbid Water Supply Feasibility Study, our own make no allowance for the needs of horticulture and animal husbandry. Such needs have been considered separately in relation to overall agricultural requirements.

System Losses

In estimating total demands, we have made an additional allowance to cover system losses that is the quantity of water lost or wasted from the system prior to reaching consumers' meters.

Our per capita consumption estimates relate to actual consumers' needs, that is the true quantities of water that will be required at the consumers' premises and will pass through the consumer's meter.

At present, there is evidence that many meters under-record true consumption. Until measures are taken to rectify present deficiencies in metering, the proportion of "unaccounted for" water can be expected to be significantly above the figure of 20% of production

(equivalent to 25% of consumption) and the revenue base correspondingly less.

Our estimate of 20% relates purely to actual system losses prior to the consumer's meter and is compatible with the nature of our consumption estimates. The choice of 20% loss factor is discussed in detail in the volume of our report which deals with system design parameters and engineering.

Total per capita Demand Estimates

Estimates of total per capita demands used in our projections of water requirements are shown in Table 9.

They are summarised in Table 10, where they are compared with those used in the National Water Master Plan.

The princpal differences are as follows. In the case of the main cities, Amman, Zerqa and Irbid, the Master Plan uses one set of projections. We have adopted slightly different sets of estimates for all three cities. In the case of Amman, our estimates are slightly above those of the Master Plan; in the case of Zerqa and Irbid slightly below.

Similarly, in the case of the 1975 estimates for communities with populations between 3 000 and 50 000, our estimate for towns with a population of more than 15 000 is greater than the uniform average allowed for all those communities in the Master Plan and below it in the case of those communities with a population of less than 15 000. However, we have assumed a somewhat slower growth in per capita consumption than has the Master Plan, such that by 2000 our estimates for all communities with a population of between 3 000 and 50 000 are below those of the Master Plan.

In the case of the communities of less than 3 000 persons both our initial estimates and subsequent growth of consumption are below those in the Master Plan.

TABLE 10

Comparison of National Water Master Plan and North Jordan Water Use Strategy Estimates of the Per Capita Demand

litres/head/day

	1975		2000	
	National Water Master Plan	North Jordan Water Use Strategy	National Water Master Plan	North Jordan Water Use Strategy
Amman	131	138	158	188
Zerqa	131	119	158	162
Irbid	131	112	158	156
Other towns, with a population of over 15 000	93	100	139	131
Communities with a population of between 3 000 and 15 000 persons	93	81	139	106
Communities with a population of less than 3 000 persons	89	62	121	81
Unpiped supplies	35	35	35	35

There are also some differences in the composition of demands which can be seen by reference to earlier tables. The principal ones are the substantially larger allowance made for the needs of the non-domestic consumer in the main towns and the different assumptions regarding system losses. The latter, it will be recalled, are assumed to remain at a constant 20% of total production.

It may be considered that the estimates are high in relation to current levels of production. However, it must not be forgotten that in many instances present supply shortages are quite severe. In the case of Amman, for example, some consumers only receive water once a week during the summer period - and in certain instances, less frequently than that. Few consumers have, we understand, been receiving supplies more than two days a week. Standards of supply in the northern districts vary with location, but in general we understand that shortages have been more acute than in the case of Amman.

International comparisons must always be treated with caution as so many factors can influence the overall level of water demands. It is, however, of interest to note the per capita levels of demand quoted in the National Water Master Plan for a number of cities in the Middle East and Mediterranean. The latter were in turn extracted from the earlier Aqaba Water Supply Feasibility Study. They are as follows.

TABLE 11 - Comparative unit water demands

City	Year	Demand (l/h/d)
Athens	1974	128
Suez	1975	130
Jerusalem	1965	146
Istanbul	1974	156
Beirut	1971	160
Baghdad	1965	160
Riyadh	1970	172

Compared against these figures, and taking account of the size of towns, climatic conditions and general availability and cost of water in Jordan, we do not consider our per capita consumption estimates for the main towns to be unrealistic.

In conclusion, it is of interest to note the levels of per capita demand (again quoted in the National Water Master Plan) adopted by the Water Supply Corporation for the purposes of system design. In 1975 consumption levels (inclusive of the needs of commerce and other such users) of 50 - 60 1/h/d were used for the smaller communities, 70-80 1/h/d for the larger communities. An average allowance of 30% was added to these figures to provide for transmission and distribution system losses. The latter figure is slightly above that adopted in this chapter to cover distibution system losses. The Water Supply Corporation consumption guidelines themselves tie-in closely with our independently derived estimates of 50 1/h/d for communities with populations of less than 3 000 persons, 80 1/h/d for smaller towns with a population of over 15 000 and 90 1/h/d for Irbid.

The Water Supply Corporation also makes provision for an annual increase in overall unit consumption levels of 1-2 1/h/d. This would imply a range of unit consumption levels of between 75 and 130 1/h/d by the year 2000, compared with our own estimates of 65 1/h/d for communities with a population of less than 3 000, 105 1/h/d for smaller towns with a population of over 15 000, and 125 1/h/d for Irbid. Our estimates thus imply a marginally slower rate of growth in consumption at the individual community level. However, as noted earlier, in estimating overall water requirements, the effective annual average increases per head of population are somewhat higher than is suggested by the preceding figures when allowance is made for extension of piped systems, the growth of smaller communities, and for the movement of population from the rural areas towards the towns.

CHAPTER 6 - INDUSTRIAL REQUIREMENTS

Specific allowance is made in the National Water Master Plan and in the recent VBB studies of water resources and needs in the Amman - Zerqa basin for the requirements of major industrial users having - or likely to have - their own bulk supply sources.

As far as our own study area is concerned, the demands identified fall principally in the Amman - Zerqa - Ruseifa area. The exceptions are the Fuheis cement factory and the Wadi-Abyad phosphate. mines north of El Hassa.

Our analysis of the data presented in the National Water Master Plan and VBB reports revealed a number of uncertainties and inconsistencies regarding the present consumption and anticipated future needs of the major industrial water users. Unfortunately, within the confines of the present study we were unable to conduct a detailed survey of all the industrial establishments in question in an attempt to resolve these apparent inconsistencies. We did, however, visit the major single users. For the remainder, we have been forced to adopt a somewhat pragmatic approach in allowing for existing and future growth in water requirements.

The VBB water resources study for the Amman - Zerqa basin makes reference to an inventory produced by the NRA in 1972 which indicated that of a total abstraction of some 37 Mm^3/yr from the two aquifers an estimated 4.5 Mm^3 was used to meet industrial needs. Data on borehole abstraction in 1976, presented as an annex to the VBB report, indicatesa not dissimilar rate of abstraction from the private wells of the major industrial users.

The VBB demand projections, however, are based on an estimate produced by AWSA in their 1974 report which predicted a total abstraction of 16 Mm^3/yr in 1975 for both industry and irrigation, and on an estimate made in 1973 (by Mudallal) that irrigation requirements in 1972 amounted to some 12.5 Mm^3. Specifically, VBB allow for an industrial consumption of 3 Mm^3 in 1975, increasing by 0.2 Mm^3/yr every year until 1995 and by 0.4 Mm^3/yr over the period 1995 - 2005, resulting in a total demand of 9 Mm^3 in the year 2000, 11 Mm^3 in 2005.

The National Water Master Plan, on the other hand, estimates industrial consumption in the Amman area in 1975 at 2.2 Mm^3 and at 2.4 Mm^3 in the Zerqa - Ruseifa - Awajan area, together with an additional 0.5 Mm^3 to cover the needs of the phosphate mines at Ruseifa - a total of 5.1 Mm^3.

In the Master Plan, the major single consumers were listed as being the Schneller School (1.7 Mm^3), the Zerqa refinery (1.2 Mm^3) and the phosphate mines (0.5 Mm^3).

The projected requirements of the main industrial users, together with their estimated existing levels of consumption, are shown in table 12. They indicate an overall increase of some 21 Mm^3 over the period 1975 to 2000 to a total of 26 Mm^3, equivalent to an annual increase of 0.84 Mm^3. These estimates are very considerably above those of VBB who allowed 9 Mm^3 for industrial users in the year 2000.

Interviews with the three main existing users identified in the National Water Master Plan broadly confirmed the estimates for the refinery and phosphate mines.

The anticipated increase in refinery requirements stems from the expansion programme currently in hand which should be completed by mid-1978. When fully operational, officials at the refinery anticipate that total water demands could amount to nearly 2.4 Mm^3/yr. No further expansion of the refinery beyond 1978 is currently envisaged.

The projected increase in the Ruseifa phosphate mines requirements (shown in the Master Plan as occurring in 1975 - that is, in the difference between the consumption and demand estimates for that year) reflects a change in the method of beneficiation of the Ruseifa phosphate deposits. The Jordan Phosphate Mines Company informed us that if the proposed change is implemented their present water consumption of some 0.5 Mm^3/yr could increase to at least

Table 12 - Projected Water Requirements of Industries with Independent Water Supplies in the Amman - Zerqa area.
(National Water Master Plan)

Name	Industry	Location	Consumption 1975	Demand 1975	Demand 1975	Demand 2000
Amman area				($m^3 \times 10^3$)		
Schneller	School	Marka	1700		5050	7200
Jordan Ice & Aerated Water Company	Soft drinks	Marka	270		550	1100
Rainbow	Poultry	Ain Ghaga	15		25	35
Jordan Electric Power Co.	Electrical works	Ain Ghaga	146		220	260
United Industry Corp.	Batteries	Marka	85		140	230
total			2216	(2216)	5985	8825
Zerqa-Ruseifa area						
Army factory	Textiles	Awajan	50		70	500
Jordan Paper & Cardboard	Paper	Awajan	210		300	400
7-Up Company	Soft drinks	Ruseifa	180		400	3900
Transjordan Minerals Research Co.	Mining	Ruseifa	75		300	700
Jordan Tanning Co.Ltd.	Tannery	Awajan	300		400	500
Jordan Wosted Mills Co.	Textiles	Ruseifa	120		150	180
Refinery		Zerqa	1150		2100	2100
Ceramic factory		Awajan	135		300	300
Jordan Dairy Co.	Milk	Ruseifa	15		130	220
J.I.A. Co.Ltd.	Various	Ruseifa	200		750	4500
sub-total			2435	(2435)	4900	13300
Jordan Phosphate Mines	Mining	Ruseifa	500	2000	4000	4000
total			2935	4435	8900	17300
Total Amman - Zerqa combined			5151	6651	14885	26125

1.5 Mm^3/yr in 1980, possibly more, when the new processing equipment is commissioned. Between 1983 and 1985, this latter figure could increase to 3 Mm^3/yr or more as the second stage of the proposed project is implemented. Taking these figures as minima, the Master Plan estimates seem reasonable, although it seems unlikely that additional quantities of water will be required much before 1980.

In the case of the Schneller School, however, there appears to be a substantial over-estimation of consumption. Information supplied to us by the school suggests that actual consumption is only about one-tenth of that indicated in the Master Plan, and that any future increase in requirements - although unquantified - seems likely to be of relatively small proportions.

Allowing for this apparent error, the Master Plan's estimates for industrial consumption in the Amman - Zerqa area in 1975 can be revised downwards to some 3.6 Mm^3 and the projected requirement for the year 2000 to around 19 Mm^3 - an increase of a little over 15 Mm^3. Of this latter figure, some 4.5 Mm^3 is accounted for by the projected increase in the requirements of the refinery and phosphate mines, leaving a projected increase in demands amongst the other industrial users of some 11 Mm^3/yr - from approximately 2 Mm^3 in 1975 to 13 Mm^3 in the year 2000.

Some of the individual components of this increase in demand (see table 12) may at first sight appear excessive. In fact, the figures for 1985 and 2000 in all probability represent little more than guideline estimates on the part of the industrialists who supplied them, since most industrial concerns will certainly not be planning their developments 10 to 25 years ahead.

We feel that rather than attach detailed significance to the individual components of demand, the estimates are better considered in their aggregate form as an overall provision for both growth in the water requirements of existing bulk users and for the needs of new firms or industries of a similar type not yet specifically identified.

Adjusting the National Water Master Plan's figures to take account of the information supplied to us by the Schneller School, the former indicate an increase of a little over 0.5 Mm^3/yr in the overall requirements of these major industrial users, equivalent to an annual rate of growth of approximately 7¾%. This does not seem unreasonable, given Government's declared policy of expanding the industrial sector. It is, however, slightly above the longer-term growth rate suggested earlier in Chapter 3.

Our own estimatese are summarised in table 13.

In the Amman - Zerqa area, we have allowed for an overall increase in bulk industrial requirements of some 17.5 Mm^3 between 1975 and 2000. Exclusive of the requirements of the refinery and phosphate mines, the increase amounts to some 12.8 Mm^3 - from an initial 2.8 Mm^3 in 1975 to a level of 15.6 Mm^3 in the year 2000, equivalent to an annual rate of growth of approximately 7%.

The rate of growth is slightly below that suggested in the National Master Plan and takes into account the data presented in chapter 3. The absolute increase in requirements is, however, slightly above that shown by the Master Plan figures given earlier and adjusted to take account of the corrected Schneller School consumption data. The reason for this is the use of a slightly higher initial base estimate. The latter has been adopted by us after a review of all the available data relating to bulk industrial requirements. In particular, our figures allow an additional margin to cover the needs of the new King Hussein power station at Zerqa which does not appear to have been specifically included in earlier estimates of demand.

In allowing for future increases in industrial requirements in the Amman - Zerqa area, we have allowed for a somewhat higher rate of growth in the Zerqa - Ruseifa area (AL 32) than in the immediate vicinity of Amman itself (AL 41/42), reflecting the general availability of land, location of existing enterprises and the results of the National Master Plan's survey of industrial establishments.

Table 13 - North Jordan Water Use Strategy -
Estimated Industrial Water Requirements

	Water Requirement (Mm^3)											
	1975	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	2002
Amman area (AL41/42) total	0.800	0.925	0.970	1.020	1.070	1.125	1.180	1.240	1.300	1.350	1.400	2.340
Zerqa - Ruseifa (AL32)												
Phosphate mines	0.500	0.500	0.500	2.000	2.000	2.000	2.000	3.000	4.000	4.000	4.000	4.000
Refinery	1.200	1.800	2.400	2.400	2.400	2.400	2.400	2.400	2.400	2.400	2.400	2.400
Other users	2.000	2.450	2.620	2.800	3.000	3.210	3.440	3.680	3.930	4.270	4.630	15.750
TOTAL	3.700	4.750	5.520	7.200	7.400	7.610	7.840	8.080	10.330	10.670	11.030	22.150
Amman - Zerqa - Ruseifa												
Combined total	4.500	5.675	6.490	8.220	8.470	8.735	9.020	9.320	11.630	12.020	12.430	24.490
Fuheis Cement Factory (AM)	0.300	0.350	0.500	0.500	0.600	0.600	0.600	0.600	0.600	0.600	0.600	0.600
Phosphate Mines												
Wadi Abyad (CD81/82)	-	1.500	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000*	

* up to 1992

Considering bulk industrial requirements in the Amman - Zerqa area as a whole, including the needs of the refinery and phosphate mines, we have also assumed a more rapid rate of increase prior to the mid - 1980's than thereafter, again for reasons discussed in Chapter 3.

CHAPTER 7 OTHER DEMANDS

An allowance is also made in the National Water Master Plan for the demand for water by other 'bulk' users not specifically covered elsewhere in its projections. These other users in the main constitute government institutions such as military camps.

Because of the nature of this demand, the National Water Master Plan team were unable to obtain any detailed information regarding its present composition and the likely extent of any future increase. The Plan's estimates for 1975 were based on quantities actually supplied to such users by the Water Supply Corporation and were assumed to remain unchanged in future years.

The allowances themselves are summarised in table 14 below.

In preparing our own projections of future water demands, we were faced with similar difficulties. We were, however, able to obtain some limited data from military sources regarding their own private wells and the possible requirements of new bases at present under construction. These estimates have been added to those given in the National Water Master Plan as a basis for projecting total water demands in the present study. The resulting estimates are given in table 15.

The higher estimates for area AL 32 result from inclusion in our figures of an allowance for the army's encampments in the Zerqa area, which do not specifically appear to be taken account of in the Master Plan, presumably because of the limitations on the data the latter was able to obtain. The increase shown in our figures for area F/H relates to the expected requirements of new bases currently under construction in that region.

TABLE 14 - National Water Master Plan

Water Requirements of "Other" (bulk) Consumers.

Area number	Demand 1975 - 2000 ($m^3 \times 10^3$)
AB21	26.0
AB22	8.0
AB23	5.0
AD21	29.0
AD23	3.0
AD52	441.0
AE	530.0
AF	33.0
AG	1.0
AH	7.0
AL11	121.0
AL32	3.0
AL41/42	20.0
AL72	10.0
AL73	70.0
AN	20.0
AP1/2	6.0
CA1	1.0
CD4	86.0
CD11	51.0
CD81/82	16.0
TOTAL	1487.0

TABLE 15 - North Jordan Water Use Strategy

Allowance for Demands of 'Other' (bulk water) Consumers.

	Total demand ($m^3 \times 10^3$)				
Area number	1977	1978	1979	1980	1981 - 2002
AB21	26	26	26	26	26
AB22	8	8	8	8	8
AB23	5	5	5	5	5
AD21	29	29	29	29	29
AD23	3	3	3	3	3
AD52	441	441	441	441	441
AE	530	530	530	530	530
AF	33	33	33	33	33
AG	1	1	1	1	1
AH	7	7	7	7	7
AL11	121	121	121	121	121
AL32	1300	1300	1300	1300	1300
AL41/42	20	20	20	20	20
AL72	10	10	10	10	10
AL73	70	70	70	320	320
AN	20	20	20	20	20
AP1/2	6	6	6	6	6
CA1	1	1	1	1	1
CD4	86	86	86	86	86
CD11	51	231	231	231	231
CD81/82	16	16	16	16	16
F/H	200	500	700	700	700
TOTAL	2984	3464	3664	3914	3914

CHAPTER 8 - TOTAL WATER REQUIREMENTS

8.1 WATER DEMANDS BY AREAS

Based on the population data and per capita demand estimates presented in Chapters 4 and 5 of the report, together with the estimated requirements of industrial and other bulk users given in Chapters 6 and 7, we have prepared estimates of overall water demands area by area and on a year-by-year basis covering the period up to the year 2002. The detailed year-by-year estimates are given in Appendix B. Summary figures are shown in table 16 for the three years 1978, 1987 and 2002.

The estimates point to the considerable shortages of water currently being experienced in many parts of the northern regions of the Kingdom.

The National Water Master Plan, for example, estimated the total non-agricultural potential demand for water in our study area in 1975 at 75.1 Mm^3, compared with an actual quantity supplied of 40.7 Mm^3, leaving an unsatisfied demand of some 34.4 Mm^3. Our own modified estimates of water requirements indicate a potential demand of some 71.1 Mm^3 in 1975, confirming the broad conclusions reached in the Master Plan.

Our estimates, together with those presented in other reports, point to a continued and substantial increase in the demand for water over the coming years.

In 1978, for example, we estimate that the potential non-agricultural demand within our study area could amount to approximately 87 Mm^3, increasing to 146 Mm^3 in 1987 and 286 Mm^3 by the year 2002, an overall rate of growth of 5.1% per annum over the total period in question.

The other principal feature of the figures shown in table 16 is the concentration of water demands in two main areas in particular - the Amman-Zerqa conurbation (areas AL32 and AL41/42) and in and around the city of Irbid (area AE). Between them, these areas account for some 75% of the estimated total potential non-agricultural demand for water in the study area in 1978 increasing to 86% by 2002 - or in terms of actual quantities of water from some 65 Mm^3 in 1978 to 245 Mm^3 in the year 2002.

TABLE 16 - North Jordan Water Use Strategy - Summary of Estimated Non-Agricultural Demands for Water

Area	Major towns	Demand (Mm^3/a) 1978	1987	2002
AB12		0.587	1.370	3.432
AB13		0.232	0.577	1.309
AB14		0.086	0.207	0.504
AB15		0.193	0.529	1.203
AB21		0.316	0.388	0.496
AB22		0.375	0.453	0.574
AB23		0.165	0.202	0.300
AB24		0.091	0.145	0.225
AB25		0.017	0.024	0.045
AB26		0.033	0.053	0.079
AD21		0.361	0.502	0.664
AD23		0.146	0.221	0.343
AD52	Mafraq, Ramtha	4.875	5.863	7.841
AE	Irbid	7.640	12.149	24.630
AF		0.515	0.666	0.832
AG		0.034	0.042	0.053
AH		0.291	0.371	0.413
AJ		0.332	0.446	0.413
AK		0.021	0.027	0.025
ALO		0.365	0.855	1.745
AL11	Jerash, Suf	2.034	2.586	3.661
AL21		0.828	1.429	1.764
AL22/23		0.183	0.246	0.274
AL31		0.003	0.004	0.009
AL32	Zerqa, Ruseifa	18.496	33.750	62.268
AL41/42	Amman	39.044	69.057	157.636
AL72		0.059	0.084	0.150
AL73		0.640	1.127	1.843
AM	Salt, Suweileh	2.190	2.907	3.774
AN	Wadi Sir	0.912	1.316	2.357
AP1/2		0.077	0.095	0.134
CA1		0.047	0.072	0.139
CA2		0.008	0.011	0.019
CC	Madaba	1.196	1.524	2.132
CD4		1.179	1.261	1.443
CD9		-	-	-
CD11		0.722	0.857	1.211
CD31		0.013	0.019	0.028
CD32		0.088	0.121	0.131
CD51/52		-	-	-
CD81/82		1.679	3.255	0.424
F & H		0.718	1.021	1.157
TOTAL		86.791	145.832	285.680

In the case of the Amman-Zerqa conurbation, the total non-agricultural potential demand for water in 1978 is estimated at 58 Mm^3, increasing to 103 Mm^3 in 1987 and 224 Mm^3 in 2002.

Of the total demands in the Irbid area (area AE) those of the city itself are estimated at 5.9 Mm^3 in 1978, 10.2 Mm^3 in 1987 and 22.1 Mm^3 in 2002.

Estimated requirements in other areas are in general relatively small in comparison, and while clearly they cannot be neglected, it is the needs of the major cities that are likely to prove to be of principal significance in the context of water resource and supply system planning and development.

Finally it should again be emphasised that particularly in the case of the Amman-Zerqa conurbation, certain of the demands indicated for areas (or demand nodes) AL32 and AL41/42 may in fact arise in the neighbouring areas, particularly in the longer-term. For as the cities grow in size, it is highly probable that there will be overspill of development to the adjacent areas. A new industrial estate, for example, may be constructed to the south of Amman at Sahab, while the new international airport may well attract a substantial amount of development from the Amman area in future years. Similarly, consideration is being given to the construction of a new town to the north-west of the city.

In the case of Irbid, it will also be recalled that if the proposed new Yarmouk University and Jordanian-Syrian free trade zone were both to develop rapidly and on a major scale, this could act as a constraint upon the growth of Irbid, attracting development which might otherwise have gravitated towards the city. This could in turn result in some reallocation of the projected water demands for the Irbid area (area AE) to the adjacent area (AD52).

These factors have subsequently been taken into account in our analysis of possible alternative water resource and supply system developments.

8.2 COMPARISON WITH EARLIER PROJECTIONS

It is perhaps of interest to note briefly how the present estimates of water requirements, prepared for use in the North Jordan Water Use Strategy studies, compare with those given in earlier reports.

Comparison with the estimates given in the National Water Master Plan is relatively easy, since the two sets of figures relate to similarly defined areas. They are summarised in table 17 for the years 1975, 1985 and 2000.

As will be seen, there are a number of differences at the individual area level, stemming principally from our different assumptions regarding present levels of potential per capita demand and rates of growth in the latter.

In general, our estimates for the urban areas are fairly close to those of the Master Plan, as can be seen from table 17. In the case of the Amman-Zerqa conurbation, our estimate for the year 2000 is a little above that of the Master Plan, that for the Irbid area slightly below.

In percentage terms, our estimates for the rural areas are in general significantly below those of the Master Plan for reasons explained earlier. However, in terms of absolute quantities of water, the differences are not that great and within the limits which we would place upon estimating accuracy, given the various data limitations and the length of period under review.

At the aggregate level, the estimates must be regarded as very close indeed. Our own indicate a slightly higher rate of growth over the period 1975-2000, a little over 5.3% per annum compared with 5.0% in the case of the Master Plan. Although in general we have allowed for a slower rate of growth in domestic consumption, we have on the other hand allowed for a somewhat higher rate of increase in commercial and small-scale industrial requirements. We have also assumed a slightly higher long-term level of system losses.

In the case of the other reports, comparison is a little more difficult owing to differences in definition of areas covered.

TABLE 17 - Comparison of Per Capita Demand Estimates National Water Master Plan Study and North Jordan Water Use Strategy.

Area	1975 National Water Master Plan Mm^3	1975 North Jordan Water Use Strategy Mm^3	1975 % Difference	1975 Absolute Difference Mm^3	1985 National Water Master Plan Mm^3	1985 North Jordan Water Use Strategy Mm^3	1985 % Difference	1985 Absolute Difference Mm^3	2000 National Water Master Plan Mm^3	2000 North Jordan Water Use Strategy Mm^3	2000 % Difference	2000 absolute Difference Mm^3
AB12	0.438	0.431	+ 1.6	0.007	1.444	1.211	+19.2	0.233	3.923	3.036	+29.2	0.887
AB13	0.180	0.165	+ 9.1	0.015	0.649	0.518	+25.3	0.131	1.538	1.172	+31.2	0.366
AB14	0.064	0.063	+ 1.6	0.001	0.250	0.184	+35.9	0.066	0.604	0.447	+35.1	0.157
AB15	0.134	0.132	+ 1.5	0.002	0.652	0.474	+37.6	0.178	1.475	1.078	+36.9	0.398
AB21	0.332	0.294	+12.9	0.038	0.481	0.376	+27.9	0.105	0.626	0.480	+30.4	0.146
AB22	0.406	0.351	+15.7	0.055	0.577	0.439	+31.4	0.138	0.730	0.556	+31.3	0.174
AB23	0.216	0.155	+39.4	0.061	0.287	0.192	+49.5	0.095	0.393	0.285	+37.9	0.108
AB24	0.078	0.077	+ 1.3	0.001	0.171	0.137	+24.8	0.034	0.282	0.212	+33.0	0.070
AB25	0.016	0.015	+ 6.7	0.001	0.027	0.022	+22.7	0.005	0.062	0.042	+47.6	0.020
AB26	0.029	0.028	+ 3.6	0.001	0.068	0.050	+ 2.0	0.018	0.106	0.075	+41.3	0.031
AD21	0.401	0.319	+25.7	0.082	0.670	0.484	+38.4	0.186	0.862	0.639	+34.9	0.223
AD23	0.134	0.125	+ 7.2	0.009	0.271	0.209	+29.7	0.062	0.437	0.324	+34.9	0.113
AD32 Mafraq, Ramtha	5.104	4.582	+11.4	0.522	6.965	5.643	+23.4	1.322	9.310	7.542	+23.4	1.768
AE Irbid	7.625	6.537	+16.6	1.088	13.514	11.064	+22.1	2.450	23.328	22.394	+ 4.2	0.934
AF	0.566	0.468	+20.9	0.098	0.890	0.647	+37.6	0.243	1.099	0.808	+36.0	0.291
AG	0.043	0.031	+38.7	0.012	0.061	0.041	+48.8	0.020	0.076	0.051	+49.0	0.025
AH	0.293	0.264	+11.0	0.029	0.509	0.366	+39.1	0.143	0.563	0.407	+38.3	0.156
AJ	0.312	0.291	+ 7.2	0.021	0.594	0.451	+31.7	0.143	0.546	0.417	+30.9	0.129
AK	0.020	0.019	+ 5.3	0.001	0.036	0.027	+33.3	0.009	0.034	0.026	+30.8	0.008
AL0	0.300	0.264	+13.6	0.036	1.024	0.777	+31.8	0.247	2.132	1.585	+34.5	0.547
AL11 Jerash Suf	1.986	1.873	+ 6.0	0.113	2.887	2.469	+16.9	0.418	4.024	3.494	+15.2	0.530
AL21	0.675	0.663	+ 1.8	0.012	1.744	1.391	+25.4	0.353	2.207	1.716	+28.6	0.491
AL22/23	0.165	0.162	+ 1.9	0.003	0.338	0.242	+39.7	0.096	0.386	0.269	+43.5	0.117
AL31	0.003	0.003	-	-	0.005	0.004	+25.0	0.001	0.011	0.008	+37.5	0.003
AL32 Zerqa Ruseifa	14.273	15.260	- 6.5	-0.987	31.308	31.160	-	0.148	56.236	60.121	- 6.5	-3.885
AL41/42 Amman	33.764	32.060	+ 5.3	1.704	66.586	61.863	+7.6	4.723	126.658	141.189	-10.3	-14.531
AL72	0.065	0.053	+22.6	0.012	0.105	0.078	+34.6	0.027	0.195	0.138	+41.3	0.057
AL73	0.785	0.579	+35.6	0.206	1.182	1.061	+11.4	0.121	2.066	1.719	+20.2	0.347
AN Salt Suweileh	1.892	1.701	+11.2	0.191	2.961	2.811	+ 5.3	0.150	3.864	3.642	+ 6.1	0.222
AN Wadi Sir	0.841	0.806	+ 4.3	0.035	1.416	1.217	+16.4	0.199	2.498	2.180	+14.6	0.318
AP1/2	0.098	0.071	+38.0	0.027	0.132	0.091	+45.1	0.041	0.187	0.128	+46.1	0.059
CA1	0.042	0.040	+ 5.0	0.002	0.083	0.066	+25.8	0.017	0.177	0.127	+39.4	0.050
CA2	0.008	0.008	-	-	0.013	0.010	+30.0	0.003	0.026	0.018	+44.4	0.008
CC Hadaba	1.127	1.098	+26.4	0.029	1.656	1.458	+13.6	0.198	2.296	2.038	+12.7	0.258
CD4	1.423	1.155	+23.2	0.268	1.688	1.239	+36.2	0.449	1.912	1.418	+34.8	0.494
CD9	-	-	-	-	-	-	-	-	-	-	-	-
CD11	0.698	0.505	+38.2	0.193	0.952	0.821	+16.0	0.131	1.358	1.156	+17.5	0.202
CD31	0.012	0.012	-	-	0.025	0.018	+38.9	0.007	0.040	0.027	+48.1	0.013
CD32	0.078	0.077	+ 1.3	0.001	0.164	0.120	+36.7	0.044	0.178	0.130	+36.9	0.048
CD51/52	-	-	-	-	-	-	-	-	-	-	-	-
CF41/42	0.219	0.159	+37.7	0.060	3.353	3.238	+ 3.6	0.115	0.577	0.396	+45.7	0.181
FA1	0.230	0.188	+22.3	0.042	0.441	1.007	-77.9	-0.566	0.612	1.136	-46.1	0.524
TOTAL FOR STUDY AREA	75.075	71.084	+5.6	3.991	146.179	133.676	+ 9.4	12.503	253.635	262.626	- 3.4	-8.991

In the case of the VBB reports, projections of non-agricultural water demands are given for the Amman-Zerqa basin, an area that in fact approximately equates with our areas AL32 and AL41/42. The VBB projections estimate demand in this area at 37 Mm^3 in 1975, increasing to 67 Mm^3 in 1985 and 179 Mm^3 in 2000, compared with our own estimates of 47 Mm^3, 93 Mm^3 and 201 Mm^3 respectively.

The VBB estimates for 1975 are very considerably below our own, and those of the National Water Master Plan, but as noted earlier the principal reason for this is that VBB have made no allowance for the present element of unsatisfied demand.

The VBB projections, however, assume a more rapid rate of increase in per capita levels of consumption, and consequently by the year 2000 the percentage difference between the various estimates is substantially reduced.

In the case of the Irbid Water Supply Feasibility Study prepared by Crown Agents, the projections of demand relate to the area served by the Water Supply Corporation's Northern District system . Again this does not correspond exactly with the areas adopted in our own study. However, an approximate comparison may be drawn.

The Northern District supply system at present serves communities in areas AB21, AD21, AD23, AD52, AE, AL72, AL73, F and parts of areas AF, AH and AL11. Quantities of water supplied to the latter three areas from the Northern District system in fact account to only some 7% of the total quantity supplied by that system and about one-third of the total supplies from the Northern and other supply systems. Thus, taking our estimated future demands for areas AB21, AD21, AD23, AD52, AE, AL72, AL73, F together with one-third of those for areas AF, AH and AL11 should provide an approximate basis for comparison with the Crown Agents' figures.

The various estimates, so adjusted, are shown in table 18. Our own estimates are slightly below those of the National Water Master Plan which are in turn a little below the low projection of demand given in the Irbid Water Supply Feasibility Study.

TABLE 18 - Approximate Comparison of Estimated Water Demands for Area Served by Northern District System(1)

	Demand (Mm^3/a)				
Year	North Jordan Water Use Strategy	National Water Master Plan	Irbid Water Supply Feasibility Study		
			High Projection	Intermediate Projection	Low Projection
1975	13.55	15.62	n.a	n.a	n.a
1979	16.51	n.a	15.24	15.24	14.98
1985	21.08	25.06	27.73	27.41	26.78
2000	35.94	39.33	51.60	47.02	43.10

(1) See text for explanation of figures.

The reasons for this are several. Part of the difference may be explained by the inclusion in the Irbid Study figures of an allowance to cover the needs of animal husbandry in rural areas. Much of the difference, however, appears to be due to the high levels of per capita consumption adopted for the main towns, in particular the very substantial allowance for trade requirements, and the relatively high rates of population growth on which the Irbid Study's projections are based and which, for reasons explained earlier, we feel include an element of double-counting.

8.3 UPPER AND LOWER ESTIMATES OF DEMAND

The proceeding analysis has confined itself to the preparation of one single set of demand estimates. In the context of strategic water use planning, this serves as a convenient basis for an initial identification of regional water requirements, possible areas of conflicting demand and analysis of alternative water use strategies.

However, as noted in earlier sections of this report there are a number of uncertainties surrounding the demand estimates stemming both from the quality of the initial data base and from the usual

difficulties inherent in predicting future events.

In particular, the various uncertainties include:

(i) the size and distribution of the country's existing population. The differences between the Department of Statistics official population estimates and the crude Agricultural Census head count data for individual communities is in some instances considerable. Figures for groups of communities fortunately exhibit a higher degree of consistency, as might be expected. Nevertheless, there is still a potential degree of inaccuracy in the population data used in our estimates which could result in a divergence of actual demands from the levels projected

(ii) the future rate of national population growth. In the shorter-term, it is unlikely that deviations in rates of national population growth from the levels assumed could have any significant effect upon overall water requirements. Clearly, this might not be the case if, for example, there were to be renewed hostilities in the region and a further inflow of refugees to the East Bank. However, it would be unrealistic and impractical to attempt to make provisions for such factors in the population and water demand estimates.

In the longer-term, however, a deviation in the annual rate of population growth from the levels assumed would start to become more significant. For example, a 3% as against a 3.5% annual rate of increase in population over a twenty-five year period would result in a reduction of nearly 13% in the ultimate level of population.

(iii) the rates of internal migration and regional population growth. As already noted, there are no statistics on rates of internal population migration. In the case of individual communities or groups of communities, the potential source of forecasting error and hence the repercussions on the water demand estimates must be viewed as being much greater than that relating to

national rates of population growth. A difference of one percentage point per annum in the actual rate of population growth from that assumed for any area on account of internal migration could clearly have a substantial effect over a twenty-five year period.

(iv) the present and future levels of per capita demands. These have been discussed at considerable length. The existing data base gives little firm guidance as to what would be the true level of demand given an unconstrained supply. Clearly, the uncertainties here could lead to substantial deviations in actual levels of demand from those predicted.

(v) the requirements of major industrial and other bulk users. Twenty-five years is a long period in terms of industrial planning, and it is clearly possible that there could be significant developments of a type and form not yet envisaged.

Taken together, these individual factors could cumulatively result in a substantial margin of error in any water demand estimates, particularly for individual groups of communities. In practice, however, it is likely that to some extent any potential sources of error in the figures will offset each other rather than be cumulative. Notwithstanding, the overall margin of error in our estimates, particularly in the longer-term could prove to be substantial.

We have refrained from putting any firm upper and lower percentage limits to our figures because of the very uncertainties surrounding the extent of possible inaccuracies in the data base.

Instead, we have dealt with possible deviations in demand from the levels estimated in the form of a sensitivity analysis at the project analysis stage of our studies. This has been done by considering the effects upon choice and development of particular resources and supply projects of more or less rapid rates of growth in demands.

In this context, for example, an increase of 25% in the year-by-year levels of demand in the Amman-Zerqa conurbation (areas AL32 and AL41/42) would result in the estimated 2002 level of demand being attained in

1998, four years earlier. An increase of 50%, on the other hand, would make a difference of 7½ years, the estimated 2002 demand being reached in late 1994 or early 1995.

Similarly in the case of the Irbid area (area AE), a 25% increase in all demands would result in the estimated 2002 demands being attained in late 1997, 4½ years earlier, whilst a 50% increase would result in their being reached in early 1994, 8½ years sooner than envisaged.

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APPENDIX A

NATIONAL WATER MASTER PLAN

TOWN AND VILLAGE INDEX

(reproduced without alteration
from National Water Master Plan)

NATIONAL WATER MASTER PLAN

Town and Village Index

Introduction:

The Town and Village Index is a compilation of all officially known community names of the country (East Bank only). The community names are translated into index numbers that arrange them by administrative units. The index is presented

> as a list containing additionally the numbers of the water area/ sub-area and of the socio-economic region which each community is located in the numbers of inhabitants in 1961, and crude population numbers of 1974/75;

The sources for compiling the index list have been

a) the Town and Village Index 1972 as published in the "Official Gazette" No. 2397 of Dec. 31, 1972 (in Arabic language only), that is the latest published index of communities in Jordan;

b) the population section of the Agricultural Census 1975 as used for the "General Survey of Social Services 1975" of the Ministry of the Interior and

c) data sets for educational and health services, containing some village names not included in the official index of 1972;

The National Water Master Plan had to be prepared for regions that are completely different from statistical areas in Jordan (e.g. administrative units). Therefore, data and other information to characterize those regions under socio-economic aspects had to be collected on a spatial level low enough to make possible the data aggregations for the envisaged type of regions, for water balance regions (and, consequently, for any type of regions).

This had to be the town and village level because there is no spatial level of statistical data collection between the larger administrative units (governorates, districts, sub-districts, and nahiyas) and the communities.

To aggregate and to evaluate information of the community level by any type of regions we must have a map showing the locations of all towns and villages. As such a map, being sufficiently complete, was not available at the outset of the works for the National Water Master Plan, a town and village index map had to be prepared. By superimposition of maps showing the relevant borders, this map was used to aggregate local population by water catchment areas and all socio-economic data by water balance regions.

It can be used furthermore for other regional planning purposes. Hence, it is recommended further to supplement this index map, to correct so far unsure localizations of towns and villages in some cases as soon as the exact locations are known, and to publish it as an official town and village index map.

Index numbers have been entered on the map instead of town and village names to ease handling of local data for regionalized aggregations and evaluations and to unambiguously label all communities in view of changing English spelling of Arabic names.

The town and village index list is a mean of reference for the spatial identification of all local data where index numbers are used instead of town and village names for time saving and systematical data evaluation.

The numbering system of the index was chosen following the order of the officially published index. Supplements were made for gaps within the system found there and for villages not included there. Another, strictly decimal numbering system was introduced recently by the Department of Statistics. The system used here can easily be translated into the other one in case of need.

The efforts of localizations on the index map were concentrated on those towns and village for which socio-economic data (recent population number and/or other data included in this report) were given. Some further villages out of the index list can be identified on the existing official maps. But their entering on the index map would be of no advantage for the purpose under study.

The "1974/75" local population numbers cannot be regarded as reliable. These numbers are a by-product of the Agricultural Census 1975, dated back to the end of 1974 by the Department of Statistics. In this report they have been used as crude initial figures for the regionalized pupulation projections only. Their grand total does not amount to the population number officially published for Jordan (East Bank). They should not be applied for conclusions on the town and village level. Communities without population numbers of 1961 and/or 1974/75 were not counted in the 1961 Census on Population and/or the Agricultural Census 1975 respectively.

Communities without an indication of the surrounding water area could not be localized for the population estimates 1975 and the projections for 1985 in this report.

Town and Village Index

Index No	Area/ Sub-area	Soc-ec Region No	Name of Location	Population	
				1961	1974/75
1	2	3	4	5	6
1			Amman Governorate		
11A			Amman Sub-District		
11A1	AL4	11	Amman	246,475	606,570
11A2	AL31	11	Tabarbour	463	842
11A3	CD4	11	Um Quseir and Mugabilein	625	5,224
11A4	AL4	11	El-Quweisma		6,594
11A5	AL4	11	Irjan		512
11A6	AL4	11	Nuweijis	110	
11A7	AL39	11	'Utle Ruseifa		
11A8	CD4	11	Juweiyida	297	1,293
11A9	CD4	11	Khreibet Assouk and Jawa	445 251	3.700
11A10	CD4	11	El-Yaduda	254	277
11A11	CD4	11	Um El Kundum		108
11A12	AL4	11	Abu 'Alanda	492	3,012
11A13	CD4	11	Qaryat Nafi'		46
11A14			Er-Rashadiya (Zerbi previously)		
11A15	AM	11	Sweileh	3,457	15,203
11A16	AL4	11	El-Jubeiha	542	1,120
11A17	AM	11	El-Hummar		87
11A18	AL4	11	Khilda	228	812
11A19	AL4	11	Tila' El-'Ali	572	854
11A20	AL32	11	Um Zuweitina		98
11A21	AL32	11	Yajuz	204	616
11A22	AL4	11	'Abdun		245
11A23			El-Khaznah		299
11A24			Rujim El-Kharabsheh		
11A25	AL4	11	Ibraka		196
11A26	AL32	11	Es-Salihiya	174	
11A27	AL4	11	Et-Taiyba		2,033
11A28			En-Nasiriya		102
11A29	AL11	12	Badran	785	210
11A30		12	Hy Wadi El-Qatara		
11A31		11	El-Waseya		

Town and Village Index

Index No	Area / Sub-area	Soc-ec Region No	Name of Location	Population	
				1961	1974/75
1	2	3	4	5	6
11B			Na'ur Nahiya		
11B1	AN	11	Na'ur	2,382	5,004
11B2	AL4	11	Um Es-Summaq	190	745
11B3	CD4	11	El Hiniyat		616
11B4	AN	11	Bassat Na'ur	132	163
11B5	AN	11	El-'Amriyah	188	174
11B6			Dhiban		
11B7	AP	11	'Arquob Abu Raheel	259	379
11B8	CD4	11	Abu Nuqleh	100-	79
11B9	AN	14	El-'Adassiya	523	323
11B10	AP	11	El-Manshiya		66
11B11	An	14	Qaryat Turki		616
11B12	AP	14	Zabwoud and Seil Hisban		124
11B13	AN	11	Bil'as		126
11B14		11	El-Gulleh		
11C			Sahab Nahiya		
11C1	CD4	11	Sahab	2,580	9,832
11C2	AL32	11	Musheirfat Er-Raqqad	299	807
11C3	AL32	11	Er-Rajib		217
11C4	AL32	15	Zumlat El-'Alya		256
11C5	AL32	11	El-Khashafia	116	609
11C6	AL32	11	Abu El-Hayyat		38
11C7	AL32	11	Er-Ramdan		
11C8	AL32	11	El-Manakhir		77
11C9	F/H	15	Qa'four		
11C10	AL32	11	El-Madoula		
11C11		11	Nuzha		
11D			Muwaqqar Nahiya		
11D1	CD4	15	El-Muwaqqar	282	608
11D2	F/H	15	Maqayer Mihna		500
11D3	CD4	15	El-Faysaliyya		1,108
11D4	CD4	15	Dhabiyet Ed-Diham		1,005
11D5	CD4	15	Rujm Ashami El-Gharbi	366	1,115

Town and Village Index

Index No	Area / Sub-area	Soc-ec Region No	Name of Location	Population	
				1961	1974/75
1	2	3	4	5	6
11D6	CD4	15	Rujm Ashami Esh-Sharqu		167
11D7			El-Umori		
11D8			Mushash		
11D9			El-Mutilla	174	130
11D10	CD4	15	Um Butmeh (Previously En-Nafeer)		431
11D11	CD4	15	Dhabiyeh El-Gharbiyeh	362	331
11D12	CD4	15	Dhabiyeh Esh-Sharqiya	215	85
11D13	F/H	15	Manshiyat El-Quda		66
11D14	CD4	15	El-Yateemeh		178
11D15	CD4	15	El-Buweida		316
11D16			Ghazala		
11D17	F/H	15	El-Matabbeh		
11D18	CD4	15	Es-Mailat		129
11D19			Es-Somariyyeh		
11D20		15	Um Zabara		
11E			Jiza Nahiya		
11E1	CD4	61	El-Jiza	775	5,525
11E2	CD4	61	Um El-'Amad	231	326
11E3	CD4	11	Et-Tuneib	255	176
11E4	CD4	61	Esh-Shamd		51
11E5	CD4	61	Ez-Za'faran	184	318
11E6	CD4	61	Um El-Waleed	193	468
11E7	CC	61	Sufa	109	95
11E8	CD4	61	Zuweiza	126	36
11E9	CD4	61	Manja	353	226
11E10	CD4	62	Tur El-Hash-Shash		155
11E11	CD4	62	Jumaiyil		420
11E12	CD4	62	Thraya		162
11E13	CD4	61	Dab'a		282
11E14			Desert Area No. 78-170 (E. to Jordan Bdy.)		
11E15	CD4	61	Um Quseir	420	621
11E16	CD4	61	Jalloul	325	200
11E17	CD4	11	El-Lubban	122	392
11E18	CD4	61	Zeinab		122
11E19	CD4	61	Ureiniba Esh-Sharqiya		249

Town and Village Index

Index No	Area / Sub - area	Soc-ec Region No	Name of Location	Population	
				1961	1974 /75
1	2	3	4	5	6
11E20	CD4	61	Duleilat El-Muteirat	128	195
11E21	CD4	61	El-Hureij		28
11E22	CD4	61	Zabayir Et-Tiwal		35
11E23	CD4	61	Ez-Zaytouneh		264
11E24	CD4	62	Um Er-Risas	410	655
11E25	CD4	62	Musheirfat Saleet		298
11E26	CD1	62	Saliyah		314
11E27	CD4	61	Zabayir Ed-Reibi	129	104
11E28	CD4	61	El-Ghubeiya		197
11E29	CD4	61	El-Khadra'		150
11E30	CD4	61	El-Hiri		62
11E31	CD4	61	Ureiniba El-Gharbiya	247	248
11E32	CD4	61	Nitil	348	244
11E33	CD4	61	Hawarra		97
11E34	CD4	61	Um-Rummana	179	44
11E35	CD4	61	El-Qastal	310	270
11E36	CD4	62	Qaryat 'Layyan		282
11E37	CD1	62	El-Yahoun		203
11E38	CD4	61	Mzeer 'Alia		30
11E39	CD1	62	Er-Rama		803
11E40	CD4	11	Qaryat Salem		148
11E41	CD4	61	El-Quneitra		999
11E42	CD4	61	El-Hamman		85
11E43	CD4	62	Abu Huleileifa		93
11E44	CD4	62	El-Museitba	112	408
11E45	CD4	61	Zabayir El-Kunei'an		109
11E46	CD4	61	En-Nasiriya		86
11E47		62	Rujm El-Fehaid		
11F			<u>Wadi Es-Sir Sub-District</u>		
11F1	AN	11	Wadi Es-Sir	4,455	15,460
11F2	AN	14	El-Bassa	195	630
11F3	AN	14	Iraq El-Amir	983	483
11F4	AM	14	Zibda		198
11F5	AN	11	Er-Rabahiya	215	364
11F6	AN	14	Bilal	678	261
11F7	AN	14	El-Ghurous		563

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				1961	1974 / 75
1	2	3	4	5	6
11F8	AN	11	Um El-Usoud	274	690
11F9	AN	14	El-Hudeib		196
11F10			Abu El-Malib		
11F11	AN	11	Es-Sweisa		409
11F12	AN	11	Na'eer		219
11F13	AN	11	Abu Es-Sous		27
11F14	AL4	11	Dabuq	174	364
11F15	AL4	11	Um Es-Summaq	190	453
11F16	AN	11	El-Bahhath		225
11F17	AN	11	Wadi Esh-Shita		110
11F18	AM	14	Um 'Abhara	805	790
11F19	AN	14	El-Maniya	535	
11F20			Et-Tabaqa		
11F21	AN	14	Er-Rajjaha		157
11F22	AN	14	Ed-Dibbeh		94
11F23			Eth-Thughra		
11F24	AN	14	Marj El-Hamam/Um 'Ireiqat	113	1,030
11F25	AN	14	Abu El-Batayeh	267	361
11F26			Um Farwi		
11F27			El-Kaum		50
11F28			El-Zahri		71
11F29	AL22/23	12	Marj El-Farass		22
11F30	AL6	11	Tab Kira'		192
11F31	AL11	12	El-Miruj		39
11F32	AL21	12	Abu 'Alia		213
11F33	AL22/23	12	Um-Rugaba		238
11F34		14	El-Fuqaha		
12A			Zarqa District		
12A1	AL32	12	Zarqa	96,080	184,586
12A2	AL11	12	Es-Sukhna	649	4,510
12A3	AL32	12	Jureiba	367	157
12A4	AL32	12	Er-Ruseifa	6,200	43,128
12A5	AL32	12	Khaw		527
12A6	AL32	12	Er-Rahil		
12A7	AL32	12	Abu Ez-Zighan		114

Index No	Area / Sub-area	Soc-ec Region No	Name of Location	Population	
				1961	1974/75
1	2	3	4	5	6
12A8	AL32	12	Khirbat El-Batrawi		
12A9	AL11	12	Sayeb Athyab		151
12A10		12	Gana'at Ez-Zarqa		
12A11	AL32	12	Utle Ez-Zarqa and El-Ruseifa		
12A12		12	'Awajan		
12A13			Um Suweiwina		
12A14	AL11	12	Gharisa		227
12A15	AL11	12	Et-Tafeh		257
12A16		12	Ras El-'Ain		
12A17	AL11	12	El-Hashimmiya	559	2,535
12A18	AL73	12	Ed-Dhuleil		4,163
12A19	AL73	12	Um Es-Salih		782
12A20	AL11	12	Duqra and 'Ain En-Nimreh	136	360
12A21	AL73	12	Qasr El-Hallabat		1,534
12A22		12	El-Mazara'a		
12B			Azraq Haniya		
12B1	F	16	El-Azraq Esh-Shamaliya	1,089	1,631
12B2	F	16	El-Azraq El-Janoubiya		548
12B3	F	16	'Ain El-Beida		61
12B4			Um El-Masayel		
12C			Birain Nahiya		
12C1	AL11	12	Birain	298	365
12C2	AL31	12	Zeinar Er-Rubu'		10
12C3	AL32	12	Mirhab	104	56
12C4	AL11	12	Um Rummana	414	393
12C5	AL11	12	Rujm Esh-Shouk	119	247
12C6	AL11	12	Sarrut	537	444
12C7	AL11	12	El-Masarra Esh-Sharqiya	198	77
12C8	AL11	12	El-Mish-Sha (Kamsha)	442	3,781
12C9	AL11	12	El-'Alouk	190	438
12C10	AL11	12	El-'Araba		237
12C11	AL11	12	Tawahin El-'Adwan	216	147
12C12	AL11	12	El-?asarra El-Gharbiya		77
12C13	AL32	12	Sucmer		68
12C14	AL11	12	El-Sahara		37

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Index No	Area / Sub-area	Soc-ec Region No	Name of Location	Population	
				1961	1974/75
1	2	3	4	5	6
12C15	AL11	12	El-Beera		93
12C16		12	Um El-Oroaq		
13A			Madaba District		
13A1	CC	61	Madaba	11,224	25,391
13A2	CD4	61	El-'Al	492	1,239
13A3	CD4	61	Es-Samik	312	476
13A4	CC	61	Jarba		1,061
13A5	CA1	61	Kufur El-Wakhyan	730	1,880
13A6	CA1	61	El-Maslubiya	859	367
13A7	CC	61	Mureijimat Abu Shakhannab	136	245
13A8	CC	61	Gharnata (Qubur Abdalla)	483	658
13A9	AP	61	Hisban	718	1,202
13A10	CD4	61	Um El-Basatin	609	1,660
13A11	CC	61	Masuh		
13A12	AP	61	El-Mushaqqar	430	824
13A13	CC	61	Kufur Abu Sarbut (Kufur El-Wakhyan Esh-Sharqi previously)	140	304
13A14	CC	61	Hanina	122	558
13A15	CC	61	Ma'in	1,271	2,099
13A16	CC	61	Sathiya		26
13A17	CC	61	Um El-Birak	150	257
13A18	CC	61	Mureijimat Ibin Hamid	106	89
13A19	AB26	61	El-Rawda		2,120
13A20	AP	61	El-Mansoura		368
13A21	CC	61	El-'Areash	170	561
13A22	CC	61	Murahmat Alamat		139
13A23	CC	61	Haweyat El-Balawla		57
13A24	CC	61	Kufur El-Soyoof	112	216
13A25	CA1	61	El Yosra El-Jadeda		104
13A26		61	El-Khana		
13A27		61	Um El-Asaker		
13B			Dhiban Nahiya		
13B1	CD32	62	Dhiban	802	2,579
13B2	CD32	62	Wadi El-Wala	212	655
13B3	CD32	62	El 'Aliya	228	377

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Index No	Area / Sub-area	Soc-ec Region No	Name of Location	Population	
				1961	1974/75
1	2	3	4	5	6
13B4	CD31	62	Ed-Dhuheiba		200
13B5	CD31	62	El-Mathlutha	206	217
13B6	CD32	62	Barza	280	679
13B7	CD4	62	Ammuriya		21
13B8	CD4	62	El-Kaum		20
13B9	CD4	62	Um Shujeira Esh-Sharqiya		21
13B10	CD4	62	Rujm Salim		
13B11	CD4	62	El-Qibya		
13B12	CD4	62	Maq'adin Ibn Nasrallah		
13B13	CD31	62	Aqraba		
13B14	CD32	62	Lub	587	874
13B15	CD32	62	Duleilat El-Hamaiyda		244
13B16	CD4	62	Maldeh	905	1,367
13B17	CD32	62	'Ataruz	156	55
13B18	CA2	62	Mukawir	465	471
13B19	CA2	62	Ed-Deir	159	219
13B20	CD32	62	El-Qureiyat	634	399
13B31	CD32	62	El-Judeida	601	373
13B22	CD4	62	Qahqah		
13B23	CD31	62	'Ara'ik	174	30
13B24	CD4	62	Falha	239	695
13B25	CD4	62	Um Shuqeira El-Gharbiya		62
13B26	CD32	62	Esh-Shuqei	275	295
13B27	CD43	62	El-Musheirifa	140	588
13B28	CD42	62	El-Manshiya		169
13B29			El-Hiyas		
13B30	CD32	62	El-Buqeis		78
13B31		62	El-Namya		

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Index No	Area / Sub-area	Soc-ec Region No	Name of Location	Population	
				1961	1974/75
1	2	3	4	5	6
3			Irbid Governorate		
31A			Irbid Sub-District		
31A1	AE	31	Irbid	44,685	119,143
31A2	AD52	32	Khariga	1,058	2,200
31A3	AD52	32	El-Khureiba	383	563
31A4	AD52	31	El-'Al	1,029	2,089
31A5	AD52	31	Abu Lauqas	282	522
31A6	AD52	31	El-Qisfa	163	282
31A7	AD52	31	Harima	635	1,373
31A8	AE	31	Sama Er-Rusan	771	1,110
31A9	AE	31	Kufur Jayiz	639	1,207
31A10	AE	31	El-Barz		
31A11	AE	31	Beit Ras	1,280	3,403
31A12	AD52	31	El-Mughaiyir	1,891	3,585
31A13	AD13	31	Maru	449	896
31A14	AE	31	Tuqbul	231	314
31A15	AD52	31	Sal	1,626	2,903
31A16	AD52	31	Hakama	699	2,439
31A17	AD52	31	Bishra	1,560	3,574
31A18	AD52	31	Esh-Sarih	3,390	7,414
31A19	AD52	31	Hawwara	2,343	4,925
31A2¼	AD52	31	Aidun	1,700	3,921
31A21	AE	31	Zabda Farkuh	206	419
31A22	AE	31	Natifa	451	624
31A23	AE	31	Kufur Yuba	1,565	3,458
31A24	AE	31	Saum	1,192	2,462
31A25	AE	31	Jajeen	399	881
31A26	AE	31	Zahar	713	1,390
31A27	AE	31	Jumha	352	649
31A28	AE	31	Kufur 'An	483	1,035
31A29	AE	31	Qumeim	955	2,607
31A30	AE	31	Qam	239	399
31A32	AE	31	Kufur Harta	240	447
31A32	AE	31	Dauqara	730	1,607
31A33	AE	31	Haufa El-Wastiya	602	1,099
31A34	AE	31	Seidur	319	586

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1	2	3	4	5	6
31A35	AE	31	Kufur Asad	1,484	3,425
31A36	AE	31	El-Kharaj	404	829
31A37	AD52	31	El-Husn	3,728	17,825
31A38	AD52	4	Nu'eima	2,206	
31A39	AD52	4	Shatana	383	532
31A40	AD52	4	Kitim	1,026	2,203
31A41	AE	31	Ham	391	415
31A42	AD52	33	Um El-Biyar		
31A43			Qira		
31A44	AD52	4	Tamairah		
31A45	AE	31	Is'ara	155	343
31A46	AE	31	Fau'ara	634	1,368
31A47	AE	31	Hawar	475	815
31A48			Ez-Zawiya	132	174
31A49	AE	31	Beit Yafa	1,275	2,955
31A50	AE	31	Um El-Jadayel		146
31A51			El-Kheiriya		
31A52	AD52	31	'Izrit	228	369
31A53	AD52	31	Es-Sila	133	263
31A54		31	El-Bariha		
31A55=		31	Muthalath Zahar Saum		
31B			Taiyiba Nahiya		
31B1	AB21	31	Et-Taiyiba	2,606	5,468
31B2	AE	31	SAmma	1,649	3,064
31B3	AB21	31	Mandah	165	353
31B4	AB21	31	Zabda El-Wastiyah		178
31B5	AB21	31	Makhraba	372	728
31B6	AE	31	Deir Es-Si'na	816	1,887
31B7			Ays Abu-'Ali		146
31B8		31	Muthalath Haufa		
31C			Mazar Shamaliya Nahiya		
31C1	AF	35	El-Mazar Esh-Shamaliya	2,820	5,678
31C2	AB21	35	Deir Yusuf	1,455	2,983
31C3	AE	35	Huhfiya	349	842

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				1961	1974/75
1	2	3	4	5	6
31C4	AE	35	Habaka	428	824
31C5	AB21	35	SAmad	647	975
31C6	AF	35	Rihaba	1,505	2,836
31C7	AF	35	Zubiya	586	1,155
31C8	AF	35	'Inba	1,236	2,606
31C9	AE	35	Haufa (El-Mazar)		
31D			Kurah Sub-District		
31D1	AB22	34	Deir Abu Sa'id	1,927	4,096
31D2	AB21	34	Kufur Kifiya	195	357
31D3	AF	34	SAmmu'	942	2,276
31D4	AF	34	Zimal	806	1,414
31D5	AF	34	Es-Suwwan		86
31D6	AF	34	Jinin Es-Saffa	781	1,530
31D7	AF	34	Es-Samt	320	610
31D8	Ab22	34	Kufur Al Ma	1,517	3,306
31D9	AF	34	Rukheim		97
31D10	AF	34	Marhaba	277	602
31D11	AB22	34	Giffin	677	1,288
31D12	AF	34	Tibna	994	1,857
31D13	AB22	34	El-Ashrafiya	1,475	3,447
31D14	AB22	34	Abu El-Qein		180
31D15	AG	34	Kufur Rakib	662	1,502
31D16	AB23	34	BEit Idis	921	1,811
31D17	AH	34	Judeita	2,278	4,603
31D18	Ab23	34	Kufur 'Awan	1,480	2,908
31D19	AB23	34	Kufur 'Abel	1,178	2,436
31D20	AG	34	Et-Tatour		
31D21	AB22	34	Tabqat Fahl	387	233
31D22			Khirbat El-Hawi		96
31D23			Er-Rahwa		51
31D24			Deir El-'Asal		
31D25			Er-Riqqa		138
31D26			Es-Kayeen		
31D27			El-Ba'la		

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Index No	Area / Sub-area	Soc-ec Region No	Name of Location	Population 1961	Population 1974/75
1	2	3	4	5	6
31E			Bani Kinana Sub-District		
31E1	AD4	32	Ibdar	391	891
31E2	AD4	32	Um Qeis	1,196	2,471
31E3	AD52	32	Barashta		88
31E4	AE	32	Hatim	935	2,198
31E5	AD21	32	Hubras	396	1,039
31E6	AD21	32	Harta-	1,414	2,548
31E7	AD21	32	Er-Rafid	787	1,324
31E8	AD21	32	Saham	1,590	3,021
31E9	AD21	32	Samar	716	1,087
31E10	AD21	32	'Aqraba	529	956
31E11	AD21	32	Kufur Saum	1,439	4,341
31E12	AD23	32	Mukheiba El-Fauqa	707	1,049
31E13	AD23	32	Mukheiba Et-Tahta	534	991
31E14	AD23	32	Malka	1,634	3,180
31E15	AD23	32	El-Mansura	612	926
31E16	AD23	32	Yubla	600	1,407
31E17	AD52	32	El-Yarmouk		170
31E18	AD2	32	Muzeirib		268
32A			Jarash District		
32A1	AL11	4	Jarash	3,796	11,113
32A2	AD52	4	Balila	761	1,951
32A3	AD52	4	Qafqafa	702	1,172
32A4	AD52	4	Kufur Khall	1,159	2,259
32A5	AL11	4	Jaba		613
32A6	AL11	4	Khirbat Esh-Shawahid		
32A7	AL11	4	Muqbila	269	492
32A8	AL11	4	Deir El-Liyat	473	785
32A9	AL11	4	Suf	3,259	15,919
32A10	AL11	4	El-Kitta	987	1,825
32A11	AL11	4	Reimun	810	1,635
32A12	AL11	4	Sakib	1,552	3,191
32A13	AL11	4	Nahla	537	1,081
32A14	AL11	4	Dibbin		641

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				1961	1974 /75
1	2	3	4	5	6
32A15	AL11	4	El-Jazzaza	287	558
32A16	AK	4	El-Huseiniyat		150
32A17	AL22/23	4	Burma	1,155	2,326
32A18	AL11	4	Deir 'Ajlun		
32A19	AL11	4	El-Majdal	259	252
32A20	AL11	4	En-Nabi Hud	304	98
32A21	AL11	4	'Uneiba		
32A22	AL11	4	El-'Abbara		157
32A23	AL11	4	El-Kufeir	240	414
32A24	AL11	4	Um Qantara	160	191
32A25	AL11	4	Khu-Sheiba	315	285
32A26	AL11	4	El-Haddadeh	224	654
32A27	AK	4	Najda		95
32A28	AD52	4	Musheirifa	397	741
32A29	AL11	4	Jubba	370	216
32A30	AL11	4	El-Mastaba	525	1.010
32A31	AL11	4	Mursi	775	901
32A32	AL11	4	Er-Rashayda		404
32A33	AL11	4	'Asfur	124	286
32A34	AL11	4	El-Majer	286	358
32A35	AL11	4	Um Ez-Zaitun		143
32A36	AL11	4	El-Qira		196
32A37	AL11	4	Zaqrit		155
32A38	AL11	4	El-Mant	159	
32A39	AL11	4	Dhar Es-Saru		154
32A40	AL11	4	Salhuq		430
32A41	AL11	4	Jamla		84
32A42	AL11	4	'Amama		242
32A43	AL11	4	Er-Rayashi		320
32A44	AL11	4	Tal 'et Er-Ruz	103	273
32A45	AL11	4	Er-Rahmaniya		208
32A46	AL11	4	Um Kharruba		
32A47	AL11	4	Jarash Camp		
32A48		4	Mashtal Faysal		

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1	2	3	4	5	6
33A			Mafraq District		
33A1	AD52	51	El-Mafraq	9,499	17,026
33A2	AL73	51	Sabha	332	1,395
33A3	AL73	51	Subhiya	104	300
33A4	F/H	51	Deir El-Qin		189
33A5	F/H	51	Tell Er-Rimah		201
33A6	F/H	51	Deir El-Kahf		336
33A7	F/H	51	El-Habiba		215
33A8	F/H	51	El-Manara		234
33A9	F/H	51	Er-Rafa'iyat		957
33A10	F/H	51	Abu Lufart		259
33A11	F/H	51	El-Ashrafiya		351
33A12	F/H	51	El-Mukeifta		892
33A13	F/H	51	El-Hamdiyat Et-Tarabil		422
33A14	AL72	51	Um El-Quttein	553	1,297
33A15	AL72	51	Khisha' Sleitin		471
33A16			Manshiyet El-Qabalan		458
33A17	AL72	51	Ed-Difyaniyeh	353	611
33A18	AL73	51	Zumlat Ed-Dibs	104	334
33A19		51	Sabe" Seir	206	423
33A20	F/H	51	'Amra and 'Amira	140	
33A21	AL73	51	Rodet Um El-Jimal	296	532
33A22	AL73	51	Um El-Jimal		682
33A23			Hileiwat El-Masariha		140
33A24	F/H	51	Ez-Za'tari	172	796
33A25			El-Bashariya		238
33A26	AL73	51	El-Huseiniya		
33A27	AL73	51	El-Mabruka		820
33A28			El-Mufradat		375
33A29			Huweija		119
33A30	AD52	51	Ez-Beidiya		148
33A31			Mathnat Rajel		95
33A32	AL73	51	El-'Aqeb		245
33A33	AL73	51	El-Qom El-Ahmer	155	645
33A34	AL11	51	El-Jad'a		525
33A35	AL73	51	Qom Er-Raf		523
33A36	AL73	51	Rasm El-Hisan		87

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Index No	Area / Sub-area	Soc-ec Region No	Name of Location	Population	
				1961	1974/75
1	2	3	4	5	6
33A37	AL73	51	El-Khaldiya El-Jadida El-Gharbiya		475
33A38	AL73	51	El-Khaldiya Esh-Sharqiya		2,238
33A39	AD52	51	Manshiyet Bani Hasan	816	2,089
33A40	AD52	51	Rujm Es-Sabi'	364	95
33A41	AD52	51	Um En-Na'am Esh-Sharqiya	314	359
33A42	AD52	51	Um En-Na'am El-Gharbiya		335
33A43	AD52	51	Um El-Lulu	158	211
33A44	AL11	4	Buweidat El-'Leimat		236
33A45	AL11	4	Buweidat El-Gharbiya (Mashaqaba)		181
33A46	AD52	4	Deir El-Waraq		227
33A47	AD52	Surra			98
33A48	AD52	51	El-Fadin		913
33A49	AL11	4	Ed-Dajaniya	453	901
33A50	AL73	51	Aidun Bani-Hassan	399	898
33A51	AL73	51	El-Mazza		185
33A52	AL11	4	Nadira	194	502
33A53	AL73	51	Khirab El-Matwi including Sa'Ad and Um Rummaneh (Esh-Deiqat)		355
33A54	AL11	4	Dahal	411	123
33A55	AL11	4	El-Midawer	164	229
33A56	AL11	4	Khatla		47
33A57	AL11	4	Hamamet El-'Ammoush	385	336
33A58	AL11	4	Hamamet El-'Ileimat		53
33A59	AL11	4	Khnuneizir	138	229
33A60	AL73	51	Um Buteimeh		286
33A61			Huweishan		
33A62	AD52	51	Rihab	526	773
33A63	AL11	4	Hamid		16
33A64	AL11	4	El-Karm		343
33A65	AL11	4	El-Buweida Esh-Sharqiya (El-Hawamdeh)	161	76
33A66			Abu-Musa		60
33A67		4	Ed-Daqma		187
33A68	AD52	52	Es-Saha		99
33A69	AL73	51	Thaghrat El-Jub	267	896
33A70	AD52	51	Rujm Sabi' Esh-Shamali		95
33A71	AL73	51	Teib Ism		49

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Index No	Area / Sub - area	Soc-ec Region No	Name of Location	Population	
				1961	1974 / 75
1	2	3	4	5	6
33A72	AL73	51	Hayan El-Mishref	156	221
33A73	AL11	51	'Ain Mu 'ammariya	224	384
33A74	AL73	51	El-Mu'ammariya	221	229
33A75	AD52	52	El-Mansura	155	604
33A76			El-Mushref		
33A77			Raudet El-Wel'i		
33A78			En-Nahdha		
33A79		4	El-Qunaiya		
33A80		51	Um Surab		
33A81		51	El-Ba'ij		
33A82		51	Zumlat El-Effen		
33A83		51	Ain Bani Hasan		
33A84		51	El-Borge		
33A85		51	El-Saaidiya		
33A86		51	Sharafiya		
33A87		51	El-Jondi		
33A88		51	Ghasem		
33A89		52	El-Gadeer El-Abiyad		
33A90		51	En-Naseriya		
33B			Bal'ama Nahiya		
33B1	AL73	51	Bal'ama	769	1,339
33B2			El-Kh'an		
33B3	AL73	51	Haiyan Er-Ruweibid El-Gharbi	509	406
33B4	AL73	51	Haiyan Er-Ruweibid Esh-Sharqi		417
33B5	AL73	51	Um Es-Weisina		
33B6	AL11	12	El-Hasb		142
33B7	AL11	51	Hammala		
33B8	AL73	12	Khirbet Es-Samara	203	336
33B9	AL73	51	Ez-Zunaiya	803	928
33B10			En-Nuzha		95
33B11			Niyan		
33B12	AL11	12	En-Nimro	141	104

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Index No	Area / Sub-area	Soc-ec Region No	Name of Location	Population 1961	Population 1974/75
1	2	3	4	5	6
33C			Sama Sirhan Nahiya		
33C1	AD52	52	Sama Es-Sirhan	515	1,791
33C2	AD52	52	Sumaya Es-Sirhan	129	319
33C3	AD52	52	Raba'		402
33C4	AD52	52	Zumlat Et-Tarfi		336
33C5	AD52	52	Mughayer Es-Sirhan	740	2,172
33C6	AD52	52	Jaber	135	505
33C7	AD52	52	Manshiyet El-Ka'bir		167
33D			H.4 Nahiya		
33D1	H	53	H.4	860	1,707
33D2	H	53	El-Gheidha		164
33D3		53	Er-Reishe El-Gharbiya		450
33D4	H	53	Er-Reishe Esh-Sharqiya		544
33D5			El-Beika		
33D6	H	53	H.5	359	948
33D7	H	53	Jawa		158
34A			Ramtha District		
34A1	AD52	33	Er-Ramtha	10,791	25,404
34A2	AD52	33	Et-Turra	2,331	5,709
34A3	AD52	32	Edhneibeh	392	898
34A4	AD52	31	Esh-Shajara	1,970	4,231
34A5	AD52	32	'Amrawa	772	1,499
34A6	AD52	52	El-Buweida	476	1,681
34A7	AD52	52	Bureiqa	123	289
34A8	AD52	52	El-Khanasira	154	357
34A9	AD52	52	Es-Weilma		164
34A10	AD52	52	El-Musheirfeh		100
34A11	AD52	52	El-Akider		140
34A12	AD52	52	Hausha	361	795
34A13	AD52	52	El-Hamra	646	2,454
34A14	AD52	52	Fa'		430
34A15	AD52	52	El-Kursh	131	292

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Index No	Area / Sub-area	Soc-ec Region No	Name of Location	Population	
				1961	1974/75
1	2	3	4	5	6
35A			'Ajlun District		
35A1	AJ	4	"Ajlun	5,390	4,324
35A2	AD52	4	Sakhra	2,144	4,323
35A3	AD52	4	Samta		184
35A4	AH	4	'Afna	210	513
35A5	AD52	4	'Ibbin	1,364	3,760
35A6	AD52	4	"Ibillin	472	
35A7	AH	4	Rasun	672	1,175
35A8	AH	4	Irjan	1,123	1,925
35A9	AH	4	Ba'un	590	1,214
35A10	AH	4	O-Sara	430	770
35A11	AH	4	Halawa	972	1,836
35A12	AB24	4	Fara	1,105	
35A13	AJ	4	'Anjara	3,163	2,336
35A14	AJ	4	Kufranja	3,922	7,332
35A15	AK	4	Esh-Shakara	226	368
35A16	AK	4	Rajeb	645	135
35A17	AH	4	Mihna	247	437
35A18	AH	4	Ishtafeina	109	231
35A19	AH	4	Et-Taiyara		393
35A20	AH	4	Um El-Yanabi'		104
35A21	AK	4	Es-Sakhina	142	126
35A22			El-Hanash		
35A23	AK	4	Khirbet Es-Suq		47
35A24	AJ	4	Bilass	245	376
35A25	AK	4	Ez-Zira'a	160	206
35A26	AB24	4	Khirbet El-Wahadneh	1,096	4,146
35A27	AB24	4	Deir Es-Samadiyah	232	274
35A28	AK	4	Es-Safineh	183	209
35A29			Lash'ath		
35A30	AB24	4	Deir Es-Samadiyah El-Gharbi		117
35A31			Deir El-Burak		
35A32	AF	4	'Asim and Sunfar	124	620
35A33	AF	4	Bir Ed-Daliya		3
35A34	AJ	4	El-'Amiriya	170	378
35A35			Um Er-Rame1		64
35A36			Ras El-'Aqra'		

Index No	Area / Sub-area	Soc-ec Region No	Name of Location	Population 1961	Population 1974/75
1	2	3	4	5	6
35A37			El-Fakhira	121	157
35A38	AJ	4	Ez-Zeitun		21
35A39			Kufur Ed-Durra		
35A40			Khillet Es-Samra		
35A41			Khirbet Fara		
35A42			Es-Suwan		90
35A43			El-Jub		
35A44			El-Hizar		
35A45	AB21	31	El-Harth		105
35A46			El-Birkeh		4,236
35A47			Ez-Zeizafu meh		
35A48			Mureimin		
35A49			Es-Sarabis		
35A50		4	Marajam		
36A			El-Aghwar Esh-Shamaliya District		
36A1	AB12	21	Esh-Shunah Esh-Shamaliya	3,462	8,453
36A2	AB12	21	Ma'th	125	72
36A3	AB12	21	El-'Adasiya	920	1,674
36A4	AB12	21	El-Baqura		759
36A5	AB12	21	El-Manshiya	1,217	2,139
36A6	AB12	21	Tell El-Arba'in	973	655
36A7	AB12	21	El-Harawiya	382	
36A8	AB12	21	Buseila	189	260
36A9	AB12	21	Qulei'at	616	1,444
36A10	AB12	21	Esh-Sheikh Muhammad	197	759
36A11	AB12	21	El-'Iziya		
36A12	AB12	21	Abu Ziyad		
36A13	AB12	21	'Iraq Er-Rashdan		
36A14	AB12	21	Waqqass	2,321	3,265
36A15	AB12	21	Jisr El-Majami'		268
36A16	AB12	21	El-Mashari' (including El-Jurm, El-Auja Esh-Shamaliya and Es-Janoubiya, and Er-Rasiya)	1,730 1,188	7,813
36A17	AB24	21	Es-Beira	273	566
36A18	AB24	21	Karkama		88
36A19	AB13	21	Kreimeh (including Sleikhat)	2,204	8,035

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Index No	Area / Sub-area	Soc-ec Region No	Name of Location	Population	
				1961	1974/75
1	2	3	4	5	6
36A20	AB13	21	Abu 'Ubeida (including Ghor El-Balawneh and El-Wahadneh)		2,391
36A21	AB12	21	Ez-Mailiya		906
36A22	AB12	21	Wadi El-Yabis		5,779
36A23			El-Mirza	251	281
36A24	AB12	21	Es-Sukhneh	106	173
36A25	AB12	21	Himmat Ghor El-Arba'in		
36A26			Majed		
36A27	AB12	21	El-Madrasa	451	1,455
36A28			El-Midraj		312
36A29		21	El-Balawna		
36A30		21	Khazma		

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Index No	Area / Sub-area	Soc-ec Region No	Name of Location	Population 1961	Population 1974/75
1	2	3	4	5	6
6			Balqa Governorate		
61A			Salt Sub-District		
61A1	AM	13	Es-Salt	16,176	29,179
61A2	AL22/23	13	Er-Rumman	293	305
61A3	AL22/23	13	Mubis	194	408
61A4	AL21	13	Abu-Nuseir/baqa'a	573	55,311
61A5	AL21	13	'Ain El-Basha	764	2,057
61A6	AL21	13	Safut	421	645
61A7	AL22/23	13	Es-Salihi	220	227
61A8	AL21	13	Um Ed-Dananir	193	339
61A9	AL22/23	13	Abu Hamed		904
61A10	AM	13	El-Fuheis	2,946	4,930
61A11	AM	13	Mahis	1,154	3,201
61A12	AB25	13	'Eira	655	1,343
61A13	AM	13	Yarqa	461	1,522
61A14	AB25	13	Humrat 'Eira and Yarqa		
61A15	AL22/23	13	El-Madri		165
61A16			El-Hadib		432
61A17	AL22/23	13	Ez-Za'tari		138
61A18			El-Midmar		53
61A19	AL22/23	13	Es-Sahluliya	529	161
61A20	AL22/23	13	El-Yazidiya	164	382
61A21	AL22/23	13	Er-Rumeimin	490	878
61A22		13	Um Enjasa		
61A23		13	Wadi Shu'eib		
61B			Ardhah Nahiya		
61B1	AL22/23	13	Es-Beihi (Subeihi)	514	233
61B2	AL22/23	13	Meisara	594	231
61B3	AL22/23	13	El-Mansura		88
61B4	AL22/23	13	Bayuda Esh-Shamaliya		98
61B5	AL22/23	13	Bayuda El-Gharbiya	308	429
61B6	AL28		Bayuda Esh-Sharaiya		380
61B7	AL22/23	13	Khashafiya		192
61B8	AL22/23	13	Gureish		131
61B9		13	El-'Azab		

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Index No	Area / Sub-area	Soc-ec Region No	Name of Location	Population 1961	Population 1974/75
1	2	3	4	5	6
61B10		13	Qasib		
61B11			Buweib		
61B12			El-Haqawat		
61B13	AL22/23	13	Sihan	636	
61B14			'Ileiq-yun		
61B15			Ed-Reisat		
61C			Zay Nahiya		
61C1	AL22/23	13	'Allan	649	1,157
61C2	AL22/23	13	Ed-Dira Esh-Sharqiya	143	266
61C3	AL22/23	13	Ed-Dira El Gharbiya		
61C4	AL22/23	13	Um El-'Amad	182	368
61C5	AL22/23	13	Jal'ad	288	96
61C6			Er-Reishuni		
61C7	AL22/23	13	Zay		659
61C8	AL22/23	13	Um Jauza	582	1,117
61C9	AL22/23	13	Sal'uf		186
61C10	AL22/23	13	Da'am		
61C11			Um El-Wi'al		
61C12			Mushrifa		
61C13	AL22/23	13	Sumya	170	112
62			Deir 'Alla Sub-District		
62-1	AL0	21	Deir 'Alla	1,190	6,964
62-2		22	Er-Rabi	177	945
62-3			El-Mushahara		278
62-4			Ed-Dayat		2,361
62-5			Es-Salihiya		2,381
62-6	AB14	22	Damya	483	615
62-7			El-Yaquli		
62-8		El-Muhsen			
62-9	AL0	21	Mu'addi	938	636
62-10		21	Abu Ez-Zeighan		629
62-11	AB13	21	Dharar	650	1,364
62-12	AL0	21	Muthalath El-'Arda	274	1,364
62-13	AB14	22	Ghor Kabed		1,132

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Index No	Area / Sub - area	Soc-ec Region No	Name of Location	Population	
				1961	1974 /75
1	2	3	4	5	6
62-14		21	Et-Towal		
62-15		21	Ruweiha		
62-16		21	El-Eddab		
62-17		21	Sawalha		
63			Shunah Janoubiva Sub-District		
63-1	AB15	22	Esh-Shunah El-Janoubiya	1,082	1,992
63-2	AB14	22	El-Karama		2,427
63-3	AB15	22	Nimrin El-Gharbi	109	
63-4	AB15	22	Nimrin Esh-Sharqi		1,577
63-5	AB15	22	El-Kafrein	769	1,830
63-6	AB15	22	Er-Rama	1,3i7	1,950
63-7	CA1	22	Sweima	315	620
63-8	AB15	22	Er-Roda		1,961
63-9	AB15	22	Jau. Fat El-Kafrein		1,550
63-10	AB15	22	El-Hajajira		335
63-11	AB15	22	Saknet Esh-Shunah	1,007	
63-i2		22	Um El-Qottein		

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Index No	Area / Sub-area	Soc-ec Region No	Name of Location	Population	
				1961	1974/75
1	2	3	4	5	6
7			Karak Governorate		
71A			Karak Sub-District		
71A1	CE	71	El-Karak	7,422	12,557
71A2	CD11	71	El-Lajjun		60
71A3	CE	71	Samra	245	480
71A4	CE	71	'Az-Ra		133
71A5	CE	71	Esh-Habiya		1,558
71A6	CD11	71	Adir	1,278	2,204
71A7	CE	71	'Ainun	210	428
71A8	CE	71	Thaniya	457	1,100
71A9	CD11	71	Madin	328	1,030
71A10	CE	71	El-'Adnaniya (Mihna previously)	426	929
71A11		71	Murud		
71A12	CD11	72	El-Qatrana	224	3,196
71A13	CA4	71	Mumya	183	417
71A14			El-'Abdaliya (Um Ed-Dujaj previously)		
71A15			Kamanna		
71A16	CD11	71	El-Ghuweir	426	1,222
71A17			Buqei' El-Akhwat		221
71A18			El-'Abasiya		
71A19	CD11	71	Zah-hum	270	511
71A20	CE	71	El-Musheirfa	140	248
71A21	CE	71	Manshiyat Abu Hammur	243	1,884
71A22	CE	71	Bathan	306	921
71A23	CE	71	Sakka		549
71A24			Bani 'Atiya (Tribe)		
71A25			El-Hajaya (Tribe)		
71A26	CD11	71	Er-Rawda (prev. Um Habla and Mabruqat)		
71A27	CD11	71	El-Mureigha		
71A28	CD11	71	El-Mamuniya El-Janoubiya		250
71A29	CA3	71	Rakin	840	471
71A30	CA3	71	Battir	435	619
71A31	CA3	71	Wadi Ibn Hammad	123	348
71A32	CD11	72	Said El-Sultani		112
71A33	CD7	72	El-Mashroa El-Abyad		196
71A34	CA3	71	Um Romana		54

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Index No	Area / Sub-area	Soc-ec Region No	Name of Location	Population	
				1961	1974/75
1	2	3	4	5	6
71A35	CE	71	El-Haweya		125
71A36			Sahtor El-Mojeb		225
71B			'Aiy Nahiya		
71B1	CA4	71	'Aiy	1,935	3,693
71B2	CA4	71	Kathrabba	859	1,294
71B3	CA4	71	Goza El-Janoubiya	231	837
71B4	CA4	71	Goza Esh-Shamiliya		
71B5	CA4	71	El-'Imyan	323	
71B6	CA4	71	El-'Iraq	931	1,355
71B7		71	El-Dabaka		
71C			El-Qasr Sub-District		
71C1	CD11	71	El-Qasr	783	1,678
71C2	CD11	71	Er-Rabba	1,073	2,676
71C3	CD11	71	Es-Makiya	674	1,248
71C4	CD11	71	Humud	44-	588
71C5	CD11	71	El-Gadida	820	1,559
71C6	CA3	71	Faqqu'a	783	1,855
71C7	CA3	71	Imra	495	2,057
71C8	CA3	71	Sarfa	667	
71C9	CA3	71	El-Yarut	441	671
71C10	CD31	71	Ariha	203	392
71C11	CD11	71	Abu Turaba	221	
71C12	CD31	71	Mas'ar	125	147
71C13	CD11	71	Gad'a El-Gubur	123	273
71C14	CD11	71	Gad'a Es-Sayayda	440	92
71C15	CD11	71	Maghir	104	262
71C16			Ez-Zahra		231
71C17			El-Mujib		
71C18	CA3	71	Damna	146	253
71C19			Debat El-Ghorsheh		102
71C20			El-Gama's		27
71C21	CF2	71	Seil El-Hessa		707
71C22			Shagara		161
71C23	CA4	71	Mahara		419
71C24	CA4	71	Rajm Alanda and Mansheyat El-Mazar		285

Index No	Area / Sub-area	Soc-ec Region No	Name of Location	Population 1961	Population 1974/75
1	2	3	4	5	6
71D			El-Mazar El-Janoubiya Sub-District		
71D1	CA4	71	El-Mazar	1,568	3,643
71D2	CE	71	Mu'ta	1,106	2,098
71D3	CA4	71	Et-Taiyba (Khanzira prev.)	810	2,100
71D4		71	Israra		606
71D5	CA4	71	Um El-Khanazir		
71D6			Baqi' Israra		
71D7			El-'Ama'yshiya and En-Nahil Ed-Dibba	127	2,100
71D9			Khokha		
71D10	CA4	71	Ghara		256
71D11	CD11	71	El-'Amriya (Daliqa prev.)	410	764
71D13	CD11	71	Sul	522	707
71D14	CD11	71	Um Hamat	446	860
71D15	CD8	71	El-Khaldiya (Um Zabayer prev.)	389	282
71D16	CD8	71	El-Husseiniya (Rujm Es-Sughra prev.)	792	2,220
71D17	CD8	71	Dhat Ras	523	1,687
71D18	CF1	71	El-'Aina	285	41
71D19	CD8	72	Muhai	556	1,768
71D20	CF2	71	El-Hashimiya El-Janoubiya (Ed-Wukhla previously)	339	630
71D21			Esh-Sharifa		
71E			Es-Safi Sub-District		
71E1	DA11	71	Ghor Es-Safi	3,468	6,496
71E2	DA11	71	Ghor Feifa	777	505
71E3	CA4	71	Ghor Numeira	188	270
71E4	DA11		Ghor Khanzira		
71E5		78	El-Nagah		192
71E6			El-Tameen		270
72A			Tafila District		
72A1	DB	73	Et-Tafila	4,506	11,652
72A2	DB	73	'Aima	1,147	1,070
72A3	DB	73	Sinifha	548	693
72A4	CF1	74	El-'Ulaiya		254
72A5	DC	73	Es-Sila	625	688
72A6	DC	73	El-Mitin	244	133

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Index No	Area / Sub-area	Soc-ec Region No	Name of Location	Population	
				1961	1974/75
1	2	3	4	5	6
72A7	CF1	73	'Abur		
72A8	DB	73	El-'Ais		178
72A9	CF2	73	'Abel		189
72A10	CF2	73	Sheithem	150	237
72A11	DC	73	En-Namta	400	408
72A12			Audim		405
72A13	DB	73	Ed-Diba'a	175	146
72A14	CF2	73	Er-Rihab	115	331
72A15			'Af-ra		298
72A16			El-Barbitah		55
72A17	CF1	73	El-Jurf	193	1,301
72A18	CF1	73	El-Hasa	217	4,096
72A19	CF2	73	El-La'ban		
72A20	DB	73	'Arafa		169
72A21			Abu Banna		
72A22	CF2	73	'Ain El-Beida		1,146
72A23			'Ashayer El-Mana'in El-Hajaya		
72A24	CF2	73	El-Hanana		80
72A25	DB	73	Saawa		134
72A26	CF2	73	Suwameh		41
72A27			Majadel		73
72A28	CF1	73	El-Towaneh		290
72A29		73	El-Duwaikhla		
72A30		73	Erwhim		
72B			Buseira Nahiya		
72B1	DC	73	Buseira	1,219	1,990
72B2	DC	73	Er-Rashadiya	109	76
72B3	DE	73	Dana (and Kh. Dana)	1,229	674
72B4	DC	73	Gharandal	460	803
72B5	DE	73	Bir El-'Ata'ita		1,488
72B6	DC	73	Lahtha		165
72B7	CF2	73	Um Es-Sarab		127
72B8	DC	73	Seil Rab'a		62
72B9			Ed-Dahal		

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Index No	Area / Sub - area	Soc-ec Region No	Name of Location	Population	
				1961	1974 / 75
1	2	3	4	5	6
72E			Ghor El-Mazra a Nahiya		
72E1	CA3	71	Ghor El-Mazra'a	1,194	2,379
72E2	CA3	71	Ghor El-Haditha	703	1,101
72E3	CA4	71	Ghor 'Isal	227	317
72E4	CE	71	Ghor Edh-Dhira	214	323
72E5			Ghor El-Hanawa		

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Index No	Area / Sub-area	Soc-ec Region No	Name of Location	Population	
				1961	1974/75
1	2	3	4	5	6
8			Ma'an Governorate		
81A			Ma'an Sub-District		
81A1	G2	75	Ma'an	6,643	12,690
81A2	ED11	75	En-Naqb	223	341
81A3	G2	75	Wuheida		
81A4			Esh-Sharah El-Janoubiya		
81A5	DF1	77	Bir Hofa		15
81A6			El-Hayad		
81A7	EA1	77	Gharandal		146
81A8		77	Qa' Es-Sa'idiyin		
81A9	G2	75	Bir Madhkur		421
81A10	G2	75	Abu El-Lasan		295
81A11	G2	75	Sweimra		116
81A12	G2	75	Qurein		286
81A13	G2	75	Dur		131
81A14			Tasan		
81A15	CF1	74	El-Hasaniya		1,213
81A16			'Uneiza		
81A17		74	Maw-qe' Burma		
81A18	G2	75	Udhruh		367
81A19	G2	75	El-Garba El-Kabir		264
81A20	G2	76	El-Garba Es-Sagheera		25
81A21	G2	75	El-'Arja		
81A22			Et-Tami'a		
81A23			El-Hashimiya (El-Misbihim and Es-Samhiyin)		
81A24			Ed-Da'janiya		
81A25	G2	0	El-Jafr		781
81A26	I	0	Bayer		177
81A27	K	0	El-Mudawwara		328
81A28			El-Ash'ari		
81A29			Mul-Ghan		
81A30			Et-Tahuna		
81A31			El-'Uweina (El-Breika)		
81A32			Hittiya		
81A33			Hayid		

Town and Village Index

Index No	Area / Sub-area	Soc-ec Region No	Name of Location	Population	
				1961	1974/75
1	2	3	4	5	6
81A34	G2	75	El-Mureigha	618	240
81A35	DH	75	Dilagha		235
81A36	DH	75	Er-Ruseis		143
81A37			El-Muhammadiya		
81B			Esh-Shaubak Sub-District		
81B1	DE	75	Esh-Shaubak	462	1,306
81B2	G2	75	Najl		
81B3	DE	75	El-Jaya	237	271
81B4	DE	75	Abu Makhtub	418	393
81B5	DE	75	El-Maqar'iya		884
81B6	DE	75	El-Mansura (El-Khreiba prev.)	307	455
81B7	DE	75	El-Guheir	189	375
81B8	DF1	75	Shammakh	257	203
81B9	DF1	75	El-Ganina		62
81B10	G2	75	Bir Khidad	195	395
81B11	CF1	75	Hadira		
81B12	DF1	75	Magdas and Um Suwan		
81B13	G2	75	Rumeilat	137	
81B14	G2	75	Ifjeij		489
81B15	G2	75	Ez-Beiriya		296
81B16	DF1	75	Hawala	318	95
81B17	G2	75	Bir Abu 'Alaq	521	223
81B18	G2	75	Bir Ed-Dabbaghat	618	64
81B19	DF1	75	Beida		98
81B20			Badibda		
81B21	DH	75	El-Baq'a		104
81B22			El-Haddada		
81B23	G2	75	El-Manshiya		163
81B24	DE	75	Seihan		
81B25		75/77	Feihan		
81B26			Mudeibi'		
81B27			Bir Et-Tafi	119	
81B28			Biddya		
81B29			Bir Ibn Jazi		
81B30			El-Arza		
81B31	DE	75	Khirbat Es-Samra		

Town and Village Index

Index No	Area / Sub-area	Soc-ec Region No	Name of Location	Population	
				1961	1974/75
1	2	3	4	5	6
81C			Wadi Musa Sub-District		
81C1	DG11	75	Wadi Musa	654	3,906
81C2	DH	75	Et-Taiyiba	1,007	978
81C3	DG2	75	El-Haiy	610	352
81C4	G1	75	El-Farthakh		156
81C5	G2	75	Bir Abu Dana		59
81C6	G1	75	Basta	461	398
81C7	G1	75	Ail	416	99
81C8	DH	75	Er-Rajef	479	552
81C9	DG21	75	'Ain Amaun		39
81C10	DG21	75	El-Batra	=	540
81C11	ED1	75	Jil-Wakh	156	202
81C12			Khirbat En-Nawafta	233	200
81C13	G2	75	Es-Sadaqa		315
81C14	G2	75	Bir El-Bitar		
81C15	DH	75	Diba'a		315
81C16			'Ain Musa		
81C17			Khirbat Um Et-Tilyan		
81C18			Taur El-'Iraq	103	148
81C19			Ed-Dilba		
81C20			Eth-Tharwa		
81C21			Um Er-Rukhm		
81C22	G2	75	El-Qa'		
82A			'Aqaba District		
82A1	EA1	9	El-'Aqaba	8,908	16,804
82A2		9	Dura		
82A3			Nittin		
82A4			El-Yamaniya		
82A5			El-Labanan		
82A6			Malaqi El-Aiytam		
82A7		9	El-Bureij		
82A8			Es-Sarih		
82A9			El-Mileh		
82A10			Wadi El-Yutm		
82A11			Ras Aseimer		

Town and Village Index

Index No	Area / Sub-area	Soc-ec Region No	Name of Location	Population	
				1961	1974/75
1	2	3	4	5	6
82A12			'Ain El-Qattar		
82A13			'Arab El-Ahyawat		
82B			Qweira Nahiya		
82B1	ED11	8	El-Qweira	268	2,701
82B2	ED11	8	Rum		202
82B3	ED11	8	Ed-Disha		478
82B4	ED12	8	Et-Tweisa		328
82B5	ED12	8	El-Ghal		189
82B6	ED12	8	Muneishir		161
82B7	ED11	8	El-Humeima El-Qadima		105
82B8			El-Humeima El-Jadida		
82B9			Dabbat Hanut		
82B10	ED11	8	Hisma		111
82B11	ED2	8	Khirbat El-Khalidi		
82B12			'Ain El-Hiwara		
82B13			'Arab El-Qadaman (km 90)		
82B14			El-Mafraq Wadi Araba		
82B15	EA1	8	Sibgh Et-Taba Wadi Araba		1,045
82B16		8	Darb Wadi Araba		
82B17			Er-Ratma		
82B18			Um Ghudat		
82B19			Dilgha		
82B20			El-Hudeida		
82B21			'Ain El-Hajna		
82B22			Bir El-Bataiyihat		
82B23		8	Rahma		

APPENDIX B

NORTH JORDAN WATER USE STRATEGY

ESTIMATES OF NON-AGRICULTURAL WATER DEMANDS

Estimated Non-Agricultural Water Demands by Area

Area		1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
													$Mm^3/yr.$	
AB12	Total	0.529	0.587	0.651	0.722	0.801	0.888	0.985	1.092	1.211	1.288	1.370	1.455	1.547
AB13	Total	0.207	0.232	0.261	0.292	0.328	0.367	0.412	0.462	0.518	0.547	0.577	0.610	0.641
AB14	Total	0.078	0.086	0.096	0.107	0.120	0.133	0.148	0.165	0.184	0.195	0.207	0.220	0.233
AB15	Total	0.170	0.193	0.220	0.250	0.284	0.323	0.367	0.417	0.474	0.501	0.529	0.559	0.590
AB21	d/c	0.282	0.290	0.298	0.306	0.314	0.323	0.332	0.341	0.350	0.356	0.362	0.369	0.375
	Other	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026
	Total	0.308	0.316	0.324	0.332	0.340	0.349	0.358	0.367	0.376	0.382	0.388	0.395	0.401
AB22	d/c	0.359	0.367	0.376	0.385	0.393	0.403	0.412	0.422	0.431	0.438	0.445	0.452	0.460
	Other	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008
	Total	0.367	0.375	0.384	0.393	0.401	0.411	0.420	0.430	0.439	0.446	0.453	0.460	0.468
AB23	d/c	0.157	0.160	0.164	0.167	0.171	0.175	0.179	0.183	0.187	0.192	0.197	0.202	0.208
	Other	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
	Total	0.162	0.165	0.169	0.172	0.176	0.180	0.184	0.188	0.192	0.197	0.202	0.207	0.213
AB24	Total	0.086	0.091	0.097	0.102	0.109	0.115	0.122	0.129	0.137	0.141	0.145	1.150	0.154
AB25	Total	0.017	0.017	0.018	0.018	0.019	0.020	0.020	0.021	0.022	0.023	0.024	0.025	0.026
AB26	Total	0.032	0.033	0.035	0.037	0.040	0.042	0.045	0.047	0.050	0.051	0.053	0.054	0.056
AD21	d/c	0.317	0.332	0.347	0.363	0.380	0.392	0.416	0.435	0.455	0.464	0.473	0.483	0.492
	Other	0.029	0.029	0.029	0.029	0.029	0.029	0.029	0.029	0.029	0.029	0.029	0.029	0.029
	Total	0.346	0.361	0.376	0.392	0.409	0.426	0.445	0.464	0.484	0.493	0.502	0.512	0.521
AD23	d/c	0.135	0.143	0.150	0.158	0.167	0.176	0.185	0.195	0.206	0.212	0.218	0.225	0.231
	Other	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
	Total	0.138	0.146	0.153	0.161	0.170	0.179	0.188	0.198	0.209	0.215	0.221	0.228	0.234
AD52	d/c	4.334	4.434	4.537	4.642	4.747	4.859	4.971	5.086	5.202	5.311	5.422	5.536	5.652
	Other	0.441	0.441	0.441	0.441	0.441	0.441	0.441	0.441	0.441	0.441	0.441	0.441	0.441
	Total	4.775	4.875	4.978	5.083	5.190	5.300	5.412	5.527	5.643	5.752	5.863	5.977	6.093
AE	d/c	6.721	7.110	7.520	7.955	8.415	8.901	9.415	9.959	10.534	11.059	11.611	12.190	12.798
	Other	0.530	0.530	0.530	0.530	0.530	0.530	0.530	0.530	0.530	0.530	0.530	0.530	0.530
	Total	7.251	7.640	8.050	8.485	8.945	9.431	9.945	10.489	11.064	11.589	12.149	12.720	13.328
AF	d/c	0.466	0.482	0.499	0.517	0.535	0.554	0.573	0.593	0.614	0.624	0.633	0.643	0.653
	Other	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033
	Total	0.499	0.515	0.532	0.550	0.568	0.557	0.606	0.626	0.647	0.657	0.666	0.676	0.686
AC	d/c	0.032	0.033	0.033	0.034	0.035	0.036	0.038	0.039	0.040	0.041	0.041	0.042	0.043
	Other	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
	Total	0.033	0.034	0.034	0.035	0.036	0.037	0.039	0.040	0.041	0.042	0.042	0.043	0.044
AH	d/c	0.275	0.284	0.294	0.304	0.314	0.325	0.336	0.347	0.359	0.362	0.364	0.367	0.370
	Other	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007
	Total	0.282	0.291	0.301	0.311	0.321	0.332	0.343	0.354	0.366	0.369	0.371	0.374	0.377
AJ	Total	0.318	0.332	0.347	0.362	0.388	0.395	0.413	0.431	0.451	0.448	0.446	0.444	0.441
AK	Total	0.021	0.021	0.022	0.023	0.024	0.024	0.025	0.026	0.027	0.027	0.027	0.027	0.027
AL0	Total	0.328	0.365	0.407	0.453	0.505	0.563	0.622	0.698	0.777	0.815	0.855	0.897	0.940
AL11	d/c	1.858	1.913	1.969	2.028	2.088	2.150	2.214	2.280	2.348	2.406	2.465	2.525	2.586
	Other	0.121	0.121	0.121	0.121	0.121	0.121	0.121	0.121	0.121	0.121	0.121	0.121	0.121
	Total	1.979	2.034	2.090	2.149	2.209	2.271	2.335	2.401	2.469	2.527	2.586	2.646	2.707

d/c = domestic/commercial
Ind. = Industrial

TABLE B1 - Estimated Non-Agricultural Water Demands by Area

Estimated Non-Agricultural Water Demands by Area

$Mm^3/yr.$

Area		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
AB12	Total	1.645	1.749	1.860	1.977	2.102	2.235	2.396	2.526	2.686	2.856	3.036	3.228	3.432
AB13	Total	0.680	0.718	0.758	0.801	0.846	0.893	0.943	0.996	1.052	1.111	1.172	1.239	1.309
AB14	Total	0.247	0.262	0.279	0.296	0.314	0.333	0.358	0.375	0.398	0.422	0.447	0.475	0.504
AB15	Total	0.624	0.659	0.696	0.735	0.776	0.820	0.866	0.915	0.967	1.021	1.078	1.139	1.203
AB21	d/c	0.382	0.388	0.395	0.402	0.409	0.416	0.424	0.431	0.439	0.446	0.454	0.462	0.470
	Other	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.025
	Total	0.408	0.414	0.421	0.428	0.435	0.442	0.450	0.457	0.465	0.472	0.480	0.488	0.496
AB22	d/c	0.467	0.475	0.482	0.490	0.498	0.506	0.514	0.522	0.531	0.539	0.548	0.557	0.566
	Other	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008
	Total	0.475	0.483	0.490	0.498	0.506	0.514	0.522	0.530	0.539	0.547	0.556	0.565	0.574
AB23	d/c	0.214	0.219	0.225	0.231	0.238	0.244	0.251	0.258	0.265	0.272	0.280	0.287	0.295
	Other	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
	Total	0.219	0.224	0.230	0.236	0.243	0.249	0.256	0.263	0.270	0.277	0.285	0.292	0.300
AB24	Total	0.159	0.163	0.168	0.173	0.178	0.183	0.189	0.194	0.200	0.206	0.212	0.218	0.225
AB25	Total	0.027	0.028	0.029	0.031	0.032	0.034	0.035	0.037	0.038	0.040	0.042	0.043	0.045
AB26	Total	0.057	0.059	0.060	0.062	0.064	0.066	0.067	0.069	0.071	0.073	0.075	0.077	0.079
AD21	d/c	0.502	0.512	0.522	0.532	0.543	0.554	0.565	0.576	0.587	0.599	0.610	0.623	0.635
	Other	0.029	0.029	0.029	0.029	0.029	0.029	0.029	0.029	0.029	0.029	0.029	0.029	0.029
	Total	0.531	0.541	0.551	0.561	0.572	0.583	0.594	0.605	0.616	0.628	0.639	0.652	0.664
AD23	d/c	0.238	0.246	0.253	0.261	0.268	0.277	0.285	0.293	0.302	0.311	0.321	0.330	0.340
	Other	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
	Total	0.241	0.249	0.256	0.264	0.271	0.250	0.288	0.296	0.305	0.314	0.324	0.333	0.343
AD52	d/c	5.770	5.891	6.015	6.141	6.269	6.401	6.535	6.672	6.811	6.954	7.101	7.248	7.400
	Other	0.441	0.441	0.441	0.441	0.441	0.441	0.441	0.441	0.441	0.441	0.441	0.441	0.441
	Total	6.211	6.332	6.456	6.582	6.710	6.842	6.976	7.113	7.252	7.395	7.542	7.689	7.841
AE	d/c	13.437	14.107	14.811	15.550	16.326	17.140	17.995	18.893	19.835	20.825	21.864	22.955	24.100
	Other	0.530	0.530	0.530	0.530	0.530	0.530	0.530	0.530	0.530	0.530	0.530	0.530	0.530
	Total	13.967	14.637	15.341	16.080	16.856	17.670	18.525	19.423	20.365	21.355	22.394	23.485	24.630
AF	d/c	0.604	0.674	0.684	0.695	0.726	0.714	0.728	0.739	0.751	0.763	0.775	0.784	0.799
	Other	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033
	Total	0.697	0.707	0.717	0.728	0.739	0.750	0.761	0.772	0.784	0.796	0.808	0.820	0.832
AG	d/c	0.043	0.044	0.045	0.045	0.046	0.047	0.048	0.048	0.049	0.050	0.050	0.051	0.052
	Other	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
	Total	0.044	0.045	0.046	0.046	0.047	0.048	0.049	0.049	0.050	0.051	0.051	0.052	0.053
AH	d/c	0.372	0.375	0.378	0.380	0.383	0.386	0.389	0.391	0.394	0.397	0.400	0.403	0.406
	Other	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007
	Total	0.379	0.382	0.385	0.387	0.390	0.393	0.396	0.398	0.401	0.404	0.407	0.410	0.413
AJ	Total	0.439	0.434	0.433	0.432	0.430	0.428	0.426	0.423	0.421	0.419	0.417	0.415	0.413
AK	Total	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.025	0.025
AL0	Total	0.986	1.034	1.084	1.137	1.193	1.251	1.312	1.375	1.442	1.513	1.585	1.664	1.745
AL11	d/c	2.650	2.714	2.781	2.849	2.918	2.989	3.063	3.137	3.213	3.292	3.373	3.455	3.540
	Other	0.121	0.121	0.121	0.121	0.121	0.121	0.121	0.121	0.121	0.121	0.121	0.121	0.121
	Total	2.771	2.835	2.902	2.970	3.039	3.110	3.184	3.258	3.334	3.413	3.494	3.576	3.661

d/c = domestic/commercial
Ind. = Industrial

Estimated Non-Agricultural Water Demands by Area

$Mm^3/yr.$

Area	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
AL21 Total	0.769	0.829	0.892	0.960	1.034	1.114	1.199	1.291	1.391	1.410	1.429	1.450	1.470
AL22/23 Total	0.176	0.183	0.190	0.198	0.206	0.214	0.215	0.232	0.242	0.244	0.246	0.247	0.249
AL31 Total	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.004	0.004	0.004	0.004	0.005	0.005
AL32 d/c	11.670	12.446	13.273	14.155	15.096	16.100	17.170	18.312	19.530	20.453	21.420	22.432	23.492
Ind.	3.990	4.750	5.520	7.200	7.400	7.610	7.840	8.080	10.330	10.670	11.030	11.420	11.850
Other	1.300	1.300	1.300	1.300	1.300	1.300	1.300	1.300	1.300	1.300	1.300	1.300	1.300
Total	16.960	18.496	20.093	22.655	23.796	25.010	26.310	27.692	31.160	32.423	33.750	35.152	36.642
AL41/42 d/c	35.660	38.009	40.705	43.489	46.464	49.643	53.039	56.667	60.543	63.992	67.637	71.490	75.563
Ind.	0.880	0.925	0.970	1.020	1.070	1.125	1.180	1.240	1.300	1.350	1.400	1.450	1.500
Other	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020
Total	36.560	39.044	41.695	44.529	47.554	50.788	54.239	57.927	61.863	65.362	69.057	72.960	77.083
AL72 d/c	0.047	0.049	0.051	0.054	0.056	0.059	0.062	0.065	0.068	0.071	0.074	0.077	0.081
Other	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
Total	0.057	0.059	0.061	0.064	0.066	0.069	0.072	0.075	0.078	0.081	0.084	0.087	0.091
AL73 d/c	0.549	0.570	0.592	0.614	0.638	0.662	0.688	0.714	0.741	0.773	0.807	0.841	0.876
Other	0.070	0.070	0.070	0.320	0.320	0.320	0.320	0.320	0.320	0.320	0.320	0.320	0.320
Total	0.619	0.640	0.662	0.934	0.958	0.982	1.008	1.034	1.061	1.093	1.127	1.161	1.198
AM d/c	1.792	1.840	1.889	1.939	1.991	2.044	2.098	2.154	2.211	2.259	2.307	2.357	2.407
Ind.	0.300	0.350	0.500	0.500	0.600	0.600	0.600	0.600	0.600	0.600	0.600	0.600	0.600
Total	2.092	2.190	2.389	2.439	2.591	2.644	2.698	2.754	2.811	2.859	2.907	2.957	3.007
AN d/c	0.855	0.892	0.930	0.970	1.012	1.056	1.101	1.148	1.197	1.246	1.296	1.348	1.402
Other	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020
Total	0.875	0.912	0.950	0.990	1.032	1.076	1.121	1.168	1.217	1.266	1.316	1.368	1.422
AP1/2 d/c	0.069	0.071	0.072	0.074	0.076	0.078	0.080	0.082	0.085	0.087	0.089	0.091	0.094
Other	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006
Total	0.075	0.077	0.078	0.080	0.082	0.084	0.086	0.088	0.091	0.093	0.095	0.097	0.100
CA1 d/c	0.044	0.046	0.048	0.051	0.053	0.056	0.059	0.062	0.065	0.068	0.071	0.074	0.078
Other	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Total	0.045	0.047	0.049	0.052	0.054	0.057	0.060	0.063	0.066	0.069	0.072	0.075	0.079
CA2 Total	0.008	0.008	0.009	0.009	0.009	0.009	0.010	0.010	0.010	0.011	0.011	0.011	0.012
CC Total	1.162	1.196	1.230	1.266	1.302	1.340	1.378	1.418	1.458	1.491	1.524	1.559	1.594
CD4 d/c	1.085	1.093	1.101	1.110	1.118	1.127	1.135	1.144	1.153	1.164	1.175	1.187	1.198
ind./other	0.086	0.086	0.086	0.086	0.086	0.086	0.086	0.086	0.086	0.086	0.086	0.086	0.086
Total	1.171	1.179	1.187	1.196	1.204	1.213	1.221	1.230	1.239	1.250	1.261	1.273	1.284
CD11 d/c	0.475	0.491	0.504	0.518	0.531	0.546	0.560	0.575	0.590	0.608	0.626	0.645	0.665
Other	0.051	0.231	0.231	0.231	0.231	0.231	0.231	0.231	0.231	0.231	0.231	0.231	0.231
Total	0.529	0.722	0.735	0.749	0.762	0.777	0.791	0.806	0.821	0.839	0.857	0.876	0.896
CD31 Total	0.013	0.013	0.014	0.014	0.015	0.016	0.016	0.017	0.018	0.018	0.019	0.019	0.020
CD32 Total	0.084	0.088	0.092	0.096	0.100	0.105	0.110	0.115	0.120	0.121	0.121	0.122	0.123

d/c = domestic/commercial
Ind. = Industrial

Estimated Non-Agricultural Water Demands by Area

$Mm^3/yr.$

Area	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
AL21 Total	1.491	1.512	1.533	1.555	1.577	1.599	1.621	1.644	1.667	1.691	1.716	1.739	1.764
AL22/23 Total	0.251	0.253	0.255	0.256	0.258	0.260	0.262	0.264	0.266	0.268	0.269	0.272	0.274
AL31 Total	0.005	0.005	0.006	0.006	0.006	0.007	0.007	0.008	0.008	0.008	0.008	0.009	0.009
AL32 d/c	24.602	25.765	26.983	28.258	29.593	30.992	32.457	33.990	35.597	37.279	39.041	40.885	42.818
Ind.	12.320	12.820	13.360	13.960	14.600	15.300	16.050	16.870	17.760	18.730	19.780	20.910	22.150
Other	1.300	1.300	1.300	1.300	1.300	1.300	1.300	1.300	1.300	1.300	1.300	1.300	1.300
Total	38.222	39.885	41.643	43.518	45.493	47.592	49.807	52.160	54.657	57.309	60.121	63.096	66.268
AL41/42 d/c	79.867	84.417	89.226	94.309	99.681	105.360	111.362	117.706	124.411	131.498	138.989	146.907	155.276
Ind.	1.550	1.600	1.660	1.720	1.780	1.840	1.900	1.970	2.040	2.110	2.180	2.260	2.340
Other	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020
Total	81.437	86.037	90.906	96.049	101.481	107.220	113.282	119.696	126.471	133.628	141.189	149.187	157.636
AL72 d/c	0.084	0.088	0.092	0.096	0.100	0.104	0.109	0.113	0.118	0.123	0.128	0.134	0.140
Other	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
Total	0.094	0.098	0.102	0.106	0.110	0.114	0.119	0.123	0.128	0.133	0.138	0.144	0.150
AL73 d/c	0.916	0.956	0.997	1.040	1.085	1.132	1.181	1.232	1.286	1.341	1.399	1.460	1.523
Other	0.320	0.320	0.320	0.320	0.320	0.320	0.320	0.320	0.320	0.320	0.320	0.320	0.320
Total	1.236	1.276	1.317	1.360	1.405	1.452	1.501	1.552	1.606	1.661	1.719	1.780	1.843
AM d/c	2.459	2.512	2.566	2.621	2.678	2.735	2.794	2.854	2.915	2.978	3.042	3.107	3.174
Ind.	0.600	0.600	0.600	0.600	0.600	0.600	0.600	0.600	0.600	0.600	0.600	0.600	0.600
Total	3.059	3.112	3.166	3.221	3.278	3.335	3.394	3.454	3.515	3.578	3.642	3.707	3.774
AN d/c	1.458	1.517	1.578	1.641	1.707	1.775	1.846	1.920	1.997	2.077	2.160	2.247	2.337
Other	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020
Total	1.478	1.537	1.598	1.661	1.727	1.795	1.866	1.940	2.017	2.097	2.180	2.267	2.357
AP1/2 d/c	0.096	0.098	0.101	0.103	0.106	0.108	0.111	0.114	0.117	0.119	0.122	0.125	0.128
Other	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006
Total	0.102	0.104	0.107	0.109	0.112	0.114	0.117	0.120	0.123	0.125	0.128	0.131	0.134
CA1 d/c	0.081	0.085	0.089	0.093	0.097	0.101	0.106	0.111	0.116	0.121	0.126	0.132	0.138
Other	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Total	0.082	0.086	0.090	0.094	0.098	0.102	0.107	0.112	0.117	0.122	0.127	0.133	0.139
CA2 Total	0.012	0.013	0.013	0.014	0.014	0.015	0.015	0.016	0.017	0.017	0.018	0.018	0.019
CC Total	1.630	1.667	1.705	1.743	1.783	1.823	1.864	1.906	1.949	1.993	2.038	2.084	2.132
CD4 d/c	1.210	1.221	1.233	1.245	1.254	1.269	1.281	1.294	1.306	1.319	1.331	1.345	1.357
../other	0.086	0.086	0.086	0.086	0.086	0.086	0.086	0.086	0.086	0.086	0.086	0.086	0.086
Total	1.296	1.307	1.319	1.331	1.343	1.355	1.367	1.380	1.392	1.405	1.418	1.431	1.443
CD11 d/c	0.685	0.706	0.727	0.749	0.772	0.795	0.819	0.844	0.870	0.896	0.925	0.951	0.980
Other	0.231	0.231	0.231	0.231	0.231	0.231	0.231	0.231	0.231	0.231	0.231	0.231	0.231
Total	0.916	0.937	0.958	0.980	1.003	1.026	1.050	1.075	1.101	1.127	1.156	1.182	1.211
CD31 Total	0.021	0.021	0.022	0.022	0.023	0.023	0.024	0.025	0.025	0.026	0.027	0.028	0.028
CD32 Total	0.123	0.124	0.125	0.125	0.126	0.126	0.127	0.128	0.128	0.129	0.130	0.130	0.131

d/c = domestic/commercial
Ind. = Industrial

Estimated Non-Agricultural Water Demands by Area

Mm^3/yr

Area		1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
CD81/82	d/c	0.156	0.163	0.170	0.178	0.186	0.195	0.204	0.213	0.222	0.230	0.239	0.247	0.256
	Ind.	-	1.500	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000
	Other	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016
	Total	0.172	1.679	3.186	3.194	3.202	3.211	3.220	3.229	3.238	3.246	3.255	3.263	3.272
F/H	d/c	0.207	0.218	0.229	0.240	0.252	0.265	0.278	0.292	0.307	0.314	0.321	0.329	0.337
	other	.200	0.500	0.700	0.700	0.700	0.700	0.700	0.700	0.700	0.700	0.700	0.700	0.700
	Total	0.407	0.718	0.929	0.940	0.952	0.965	0.978	0.992	1.007	1.014	1.021	1.029	1.037

Key:
- d/c domestic, commercial, service, small-scale industrial and other non-agricultural users exclusive of major bulk consumers
- ind. bulk industrial requirements
- other non-industrial bulk requirements

Estimated Non-Agircultural Water Demands by Area

$Mm^3/yr.$

Area		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
CD81/82	d/c	0.266	0.275	0.285	0.296	0.307	0.318	0.329	0.341	0.354	0.367	0.380	0.394	0.408
	Ind.	3.000	3.000	3.000	-	-	-	-	-	-	-	-	-	-
	Other	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016
	Total	3.282	3.291	3.301	0.312	0.323	0334	0.345	0.357	0.370	0.383	0.396	0.410	0.424
F+H	d/c	0.345	0.353	0.361	0.370	0.379	0.388	0.397	0.407	0.416	0.426	0.436	0.447	0.457
	other	0.700	0.700	0.700	0.700	0.700	0.700	0.700	0.700	0.700	0.700	0.700	0.700	0.700
	Total	1.045	1.053	1.061	1.070	1.079	1.088	1.097	1.107	1.116	1.126	1.136	1.147	1.157

Key:
- d/c domestic, commercial, service, small-scale industrial and other non-agricultral users exclusive of major bulk consumers
- Ind. bulk industrial requirements
- other non-industrial bulk requirements

APPENDIX C

ESTIMATED POPULATION LEVELS
BY
AREA AND SIZE OF COMMUNITY

TABLE C1 - Estimated Population Levels by Area and Size of Community

All figures in thousands

Area number	Main towns (with population in excess of 15000)	1975				1985				2000			
		Towns with a population of over 15000 enjoying piped supplies	Communities with a population 3000-15000 enjoying piped supplies	Communities with a population of less than 3000 enjoying piped supplies	Population relying on unpiped supplies	Towns with a population of over 15000 enjoying piped supplies	Communities with a population of 3000-15000 enjoying piped supplies	Communities with a population of less than 3000 enjoying piped supplies	Population relying on unpiped supplies	Towns with a population of over 15000 enjoying piped supplies	Communities with a population of 3000-15000 enjoying piped supplies	Communities with a population of less than 3000 enjoying piped supplies	Population relying on unpiped supplies
AB12					33.7		14.0	5.9	46.5		49.0	20.2	42.0
AB13				1.3	10.6		8.9	2.8	11.7		20.5	8.2	10.5
AB14					4.9			4.8	4.8		5.0	6.6	4.5
AB15					10.3		4.3	9.9	6.1		15.0	15.0	4.0
AB21			7.4	0.6	2.7		9.2	0.8	1.8		10.0	1.8	1.0
AB22			10.9	0.8	0.1		12.1	1.1			13.2	1.2	
AB23				6.3	0.5			7.1	0.4		4.0	4.2	
AB24					6.0		2.5	0.6	3.0		4.0	1.5	1.0
AB25					1.2			0.4	0.9			1.4	
AB26					2.2			1.3	1.3			2.1	1.0
AD21			1.1	7.8	6.2		5.8	9.4	1.7		9.5	7.5	1.5
AD23				0.7	8.3		1.8	3.2	5.0		4.0	4.5	2.5
AD52	Mafraq/Ramtha	42.4	47.4	43.3	15.6	47.7	53.3	49.0	16.9	56.7	63.3	58.6	15.0
AE	Irbid	119.1	14.0	22.9	14.0	194.3	16.7	27.2	4.9	349.9	30.0	23.6	3.5
AF			5.9	7.3	7.3		9.0	11.2	2.2		11.0	10.9	2.0
AG				1.2	0.2			1.5	0.1			1.7	
AH			3.6	1.1	9.8		3.8	7.7	2.8		4.0	7.4	2.0
AJ			4.0		13.5		10.0	3.0	3.2		8.0	2.3	3.0
AK					1.5			0.7	0.7			0.6	0.6
AL0			3.9	1.7	8.6		17.2	5.2	5.6		29.0	13.8	4.0
AL11	Jerash/Suf	26.0	4.0	16.0	25.0	35.4	5.5	20.2	15.3	47.6	7.4	21.0	14.3
AL21					51.9		31.7	1.9	22.4		33.0	6.5	19.0
AL22/23					12.7			7.1	4.7			8.0	2.5
AL31					0.2			0.1	0.1			0.2	0.2
AL32	Zerqa/Ruseifa	184/43			56.0	333.2/60		15.2	8.4	658.3/100		35.1	7.5
AL41/42	Amman	606.6	9.0	0.5	40.5	1040.8	19.7	1.3	1.6	2014.2	25.0	5.4	1.0
AL72				1.2	1.2			2.0	1.3			3.9	1.0
AL73				21.2	2.0			27.5	3.0		10.0	32.8	3.0
AM	Salt Suweileh	44.0			7.4	50.9		1.8	5.9	60.0		3.7	4.5
AN	Wadi Es Sir	16.6		7.9		22.5		10.7		35.8		15.0	
AP1/2				2.7	0.3			3.1	0.4			4.1	
CA1				0.1	2.9			1.2	2.7			3.4	2.0
CA2					0.6			0.2	0.4			0.6	
CC	Madaba	27.3		3.5	1.7	32.3		4.2	1.9	38.3		6.0	2.0
CD4			17.6	19.7	7.6			20.2	4.7		18.3	19.0	4.5
CD9													
CD11				19.9				23.1			10.0	18.1	
CD31					0.9			0.5	0.4			0.9	
CD32					6.0			3.2	3.0			3.3	2.5
CD51/52													
CD81/82				6.2	0.1			8.5	0.4			12.4	1.0
F+H				4.2	3.2			9.9	4.2			12.0	6.3

Source: National Water Master Plan