# Water for Life

## Jordan's Water Strategy

## 2008-2022





"Our Water situation forms a strategic challenge that cannot be ignored. We have to balance between drinking water needs and industrial and irrigation water requirements. Drinking water remains the most essential and the highest priority issue ".

**H.M. King Abdullah II**

**November 7, 1999**

## *Foreword by:*

## *HRH Prince Feisal Ibn Al-Hussein*
***Head of the Royal Commission for Water***



The water scarcity in Jordan poses a serious challenge that will affect all sectors if not addressed with serious efforts. Water for Life is Jordan's Water Strategy that sets the pace for our efforts for the years upto 2022.

This is our Strategy that establishes our Vision for each of the major areas of the Water Sector. It also establishes the Actions required to achieve the Visions.

A sincere effort is required from all Jordanians to understand and join collectively to address the water issues that are explained in this Strategy report. It is all the more important to consider this Strategy report and the subsequent action plans as one of the highest priorities to perform on the national level.

The Ministry of Water and Irrigation has the major role to lead this initiative. I am confident that we have sufficient will and determination to succeed in achieving our goals.

Head of the Royal Commission for Water

*HRH Prince Feisal Ibn Al-Hussein*

February 2009

# *An Opening Statement by HE Raed Abu Saud*

***Minister of Water and Irrigation***



Jordan has very limited water resources. In 2007 the Demand exceeded Resources by 638 MCM/year and the Allocations exceeded Resources by 73 MCM. Annual per capita water availability is 145$m^3$/year. This is far below the international poverty line of 500 $m^3$/year.

Water is an essential commodity for Municipal, Industrial and Agricultural uses. The increasing water deficit year-on-year poses a serious future threat that will impact all sectors. A serious effort must be made at all levels; individuals, private and public sectors.

We have established a Strategy based on vision-driven change effort. This Water Strategy for Jordan identifies our plans for our future water and the actions that we will take to ensure that water is available for people, business and nature. It sets the vision of what we want to have by 2022. It looks at all aspects of the water cycle from rainfall to collection, treatment and discharge. The practical steps we will need to take include an effective Water Demand Management, an efficient Water Supply Operations and a well developed institutional reform.

We intend to reduce demand by raising awareness of the general public on the water condition in Jordan. We all agree that we need to value water more, use it more wisely and have every stakeholder to take his share of responsibility for protecting this vital resource.

We are taking on board serious important plans. By 2022, the Disi water conveyance and the Red-Dead Canal would be operational. By 2022, non revenue water (NRW) would not exceed 25%. By 2022, we should have cost reflective tariffs. The Ministry shall introduce a new Water Law, Water Regulatory body and a Water Council. We shall dispose off all non-Water functions from JVA. The Ministry shall have a streamlined structure by separating "wholesale" operations (National) and "retail" operations (Local Service Delivery). This will enhance and improve how the private sector could participate effectively.

Water for irrigation take 71% of the water demand. We plan to take all necessary actions to achieve His Majesty King Abdullah II vision to balance between drinking water needs and the industrial water and irrigation needs with drinking water to have the priority.

The unsustainable abstraction of groundwater and the depletion of groundwater aquifers are major problems facing the water sector in Jordan. We shall enforce stringent regulations to conserve and protect our Groundwater resources.

We are also planning to pace the development of the Greater Amman Municipality under the new Amman Master Plan. Codes and regulations for buildings including, High rise-High density, shall be set. Regulations for use of graywater shall be established.

This strategy aims to gear us all to reach our visions for Water by 2022.

My appreciation to all who assisted in preparing this Water Strategy. Particular appreciation is extended to our Water Strategy Consultant Mr. Izzat Sajdi of (CEC – Sajdi & Partners) and Eng. Maysoon Zoubi of the Royal Court.

Minister of Water and Irrigation
Raed Abu Saud

Raed Abu Saud

February 2009

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# *Chapter 1 – Executive Summary – Towards a Water Strategy for Jordan*

1. Jordan's vision for a water strategy is one whereby 2022, we have:

   - Adequate, safe and secure drinking water supply ;
   - Greater understanding and more effective management of groundwater and surface water;
   - Healthy aquatic ecosystems;
   - A sustainable use of water resources, and implemented fair, affordable and cost - reflective water charges;
   - Adaptation to increased population growth and economic development across the water sector and water users.

2. Water Management has been driven by the necessity to supply water. This Water Supply approach dominated the way water has been managed until now.

3. Groundwater levels have dramatically declined showing that groundwater exploitation in the past was unsustainable. The abstracted amounts in each area need to be limited to the long-term sustainable amount as defined in the Water Resources Management Plan.

4. Despite the huge improvements in infrastructure to supply water, we are facing a critical and serious supply-demand imbalance.

5. A sustainable water supply and demand balance must be secured. This means limiting and even reducing our water consumption, while not ruling out new supply infrastructure.

6. More pressure will be put on our water resources from changes in population, household formation and development, and lifestyles. The increase in demand is witnessed in areas where there is already a lot of pressure on our water resources.

7. The economic development of the past two decades has created enormous pressures on the quality of ground and surface water resources. The process of deteriorating water quality must be halted. This requires that water sources are actively protected from pollution through actions of the Ministry of Water and Irrigation and other involved Ministries/Agencies (i.e. Ministry of Environment), such as setting up and implementing groundwater and surface water protection zones as well as through appropriate landuse planning which takes the need for water resources protection into account.

8. This water strategy outlines a strategic and integrated approach to the sustainable management of our water resources, for the public water supply as well as for the provision of healthy ecosystems and the services they provide. Achieving the vision will have social, environmental and economic implications, which we need to address.

9. This water strategy sets out our vision and key priorities for water. This is a vision – driven effort.

10. The deficit between Supply from Demand in 2007 was 565 MCM.

11. The projected deficit between Supply from Demand in 2022 is estimated at 284 MCM.

12. The water resources of 2007 were 867 MCM and should be developed to 1632 MCM by 2022. The Dissi water conveyance is operational by 2013 and the Red Dead conveyance is operational by 2022 and treated wastewater effluent must be fully utilized by 2022. Extraction from groundwater should be drastically reduced.

13. In order to achieve the visions of this Water Strategy, the implementation are set under the foll0wing main themes:

    - An efficient and effective institutional reform.
    - A drastic reduction in the exploitation of the groundwater.
    - Efficient use of water resources.
    - Implementation of the Disi water conveyance and the Red Dead conveyance projects.
    - Irrigated agriculture in the highlands will need to be capped and regulated and the by-laws will need to be reinforced.
    - Appropriate water tariffs and incentives will be introduced in order to promote water efficiency in irrigation and higher economic returns for irrigated agricultural products

14. The following chapters contain statements that are articulated as goals and approaches for strategic management of the Kingdom's water resources. Each of these approaches needs to be elaborated in one or more action plans that will specify how the approach will be achieved. This will include more details on the specific approach, identification of the responsible party for implementation, a timeline, and, as appropriate, a geographic focus area.

## Core Principles

In addition to the importance of having a strong need for a Strategy for sustaining Jordan's Water Supply, a set of principles are recognized:

1. Jordanians must recognize that there are limits to the available water supply.

2. Citizens, Private and Public Sectors must share responsibility for water management and protection in Jordan and work together to improve conditions within their local watershed.

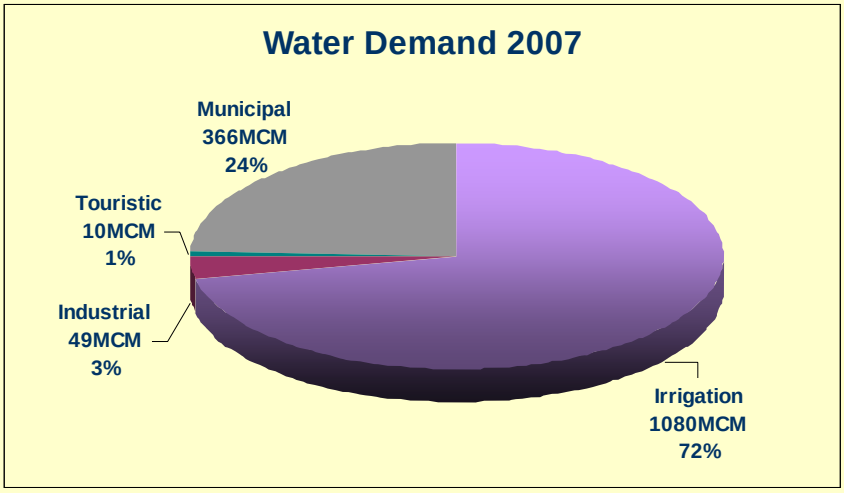
3. A deeper knowledge of the available amounts, actual quality and natural protection of Jordan's water resources is the foundation for effective decision making.

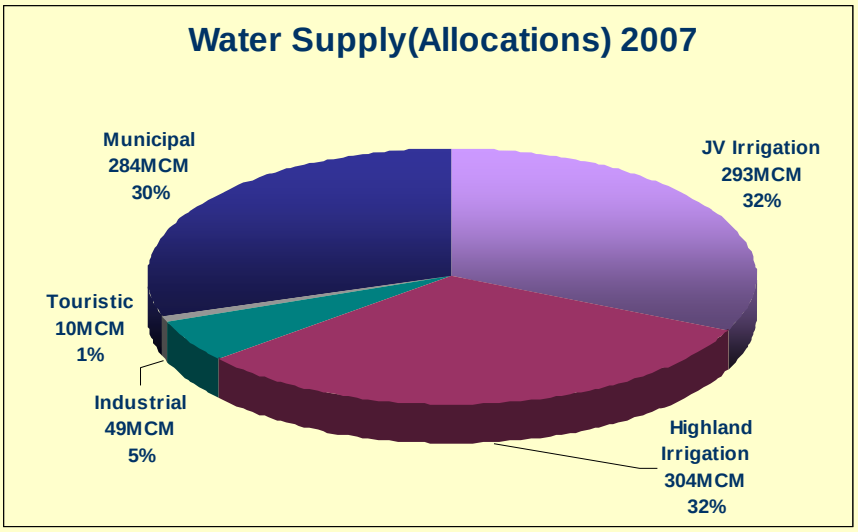
4. Jordanians must use water more effectively and efficiently and will use and reuse water wisely and responsibly.

5. Healthy aquatic ecosystems are vital to a high quality of life for Jordanians and must be preserved.

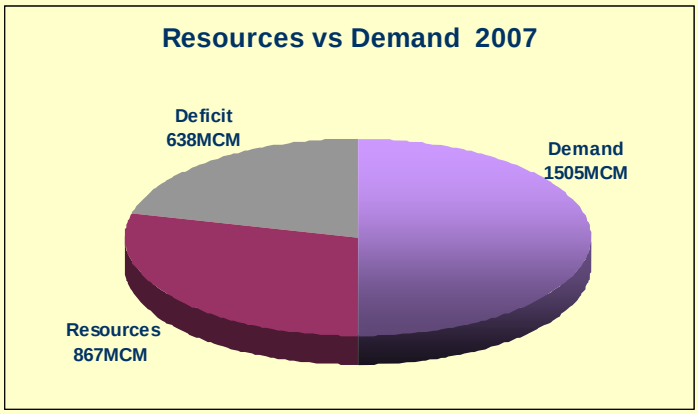
6. Groundwater and surface water quality must be preserved in pursuing economic and community development.

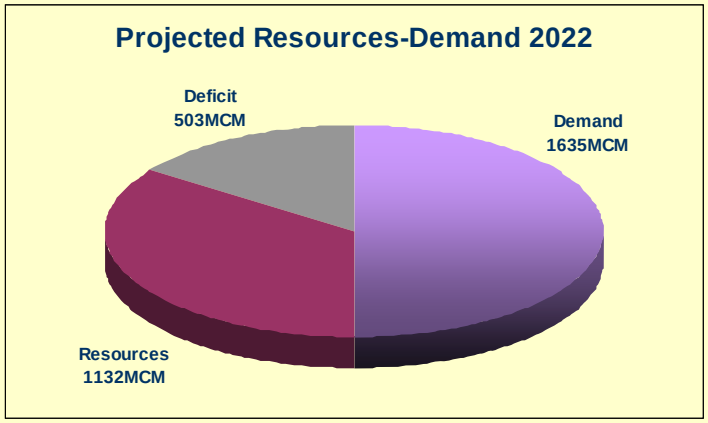
7. Jordan will take care of the drinking water quality and standards to ensure that Jordanians have safe and secure drinking water.



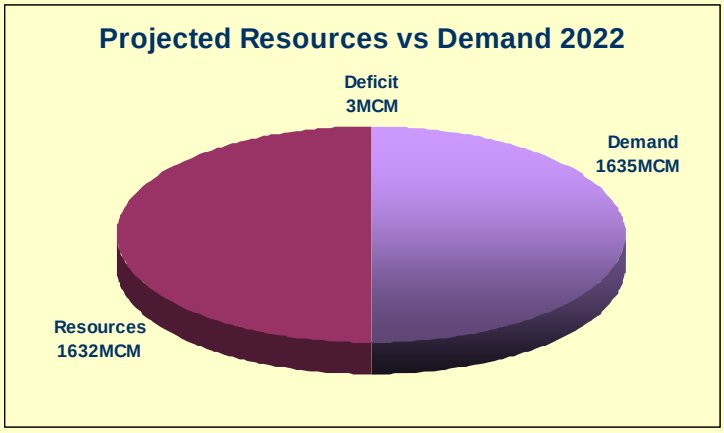




**Water Demand and Water Supply/Allocations 2007**



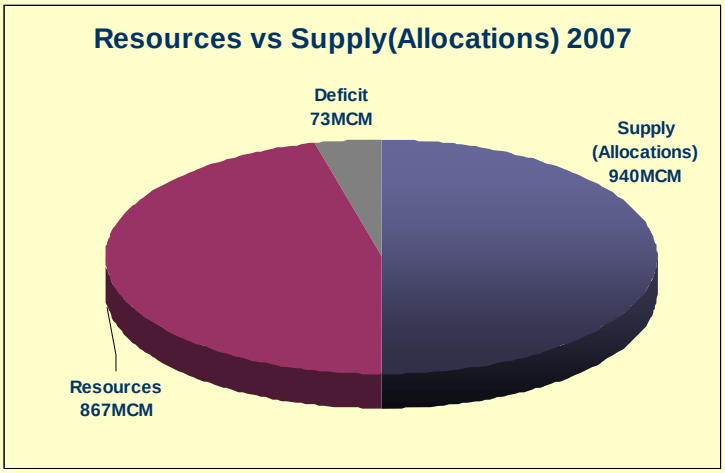



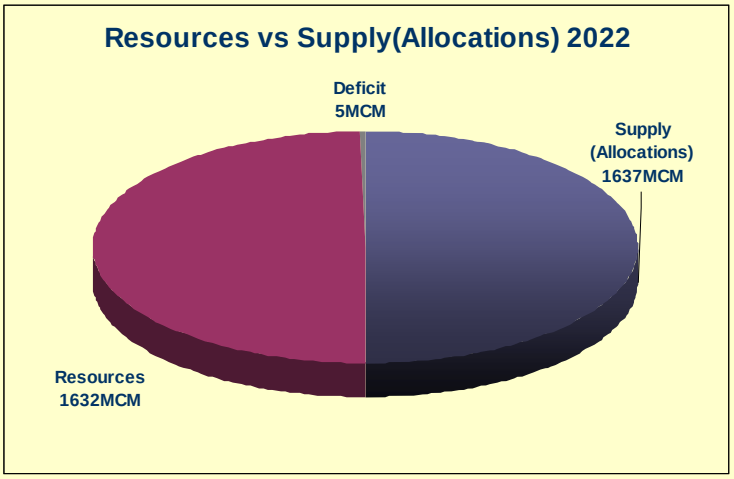

**Without Red Dead Conveyance**



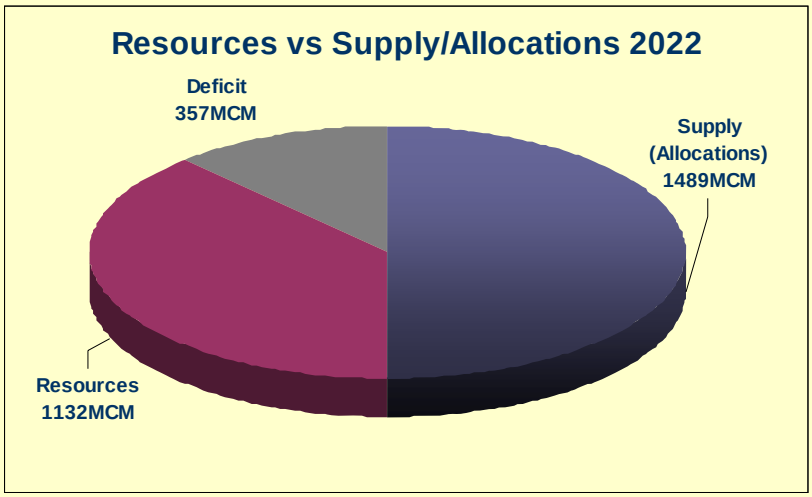

**With Red Dead Conveyance**

**Resources and Demand 2007 and 2022**



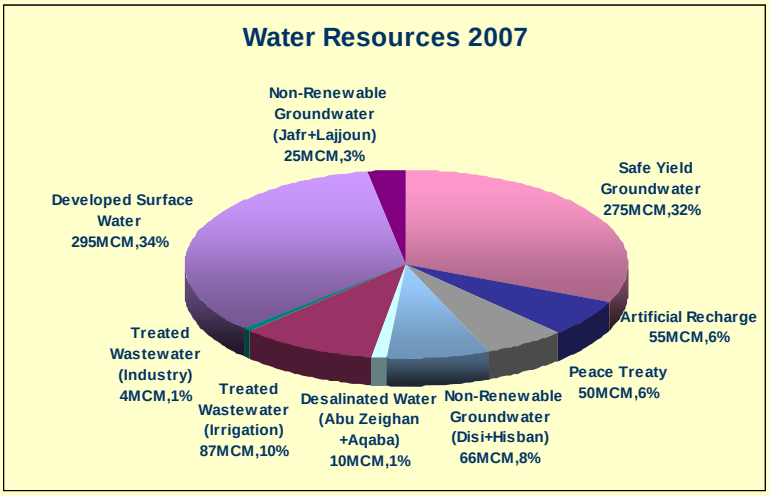



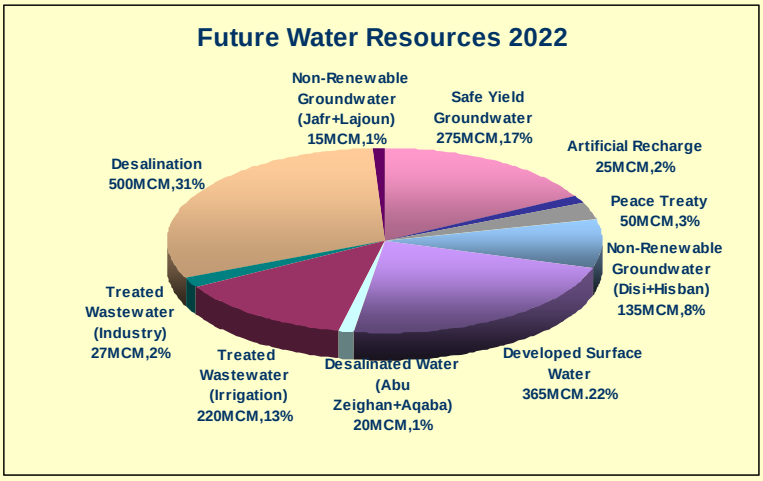

With Red Dead Conveyance




Without Red Dead Conveyance

**Resources vs Supply/allocations 2007 and 2022**




**Water Resources 2007 and 2022**

# *Chapter 2 – Water Demand*

## Current Status

1. Jordan is one of the fourth driest countries in the World. Demand for water exceeds Jordan's available water resources.

2. Access to a safe water supply is an essential requirement. It is not the intention to restrict water on essential uses, but in some areas, there are excessive claims on the available water resources.

3. Groundwater is being exploited at about twice its recharge rate. There are hundreds of illegal wells.

4. Annual per capita water availability has declined from 3600$m^3$/year in 1946 to 145 $m^3$/year today.

5. It is projected that the population will continue to grow from about 5.87 million in 2008 to over 7.80 million by 2022. Total projected water demand will be 1673 MCM by 2022.

6. Water for irrigation utilizes 71% of the water demand (2007) and 64% of water supply (2007). As municipal, industrial and tourism water use increases, irrigated agriculture in the highlands will need to be capped and regulated and the by-laws will need to be reinforced.

7. Groundwater extraction for agriculture is beyond acceptable limits resulting in a groundwater deficit of 151 MCM in 2007.

8. Non-revenue water remains high throughout the country, yet in places like Aqaba has declined significantly in recent years through improved management and capital investment.

## Future Challenges

The future challenges on water demand are enormous. Any unexpected population growth due to regional instability, as was the case during the past decades, would increase water demand and impact the plans to reach a balanced demand and supply.

Jordan must manage its water resources giving priority to municipal and industrial needs and cap agricultural use.

## Goals for Water Demand by 2022

1. Irrigated agriculture in the highlands will need to be capped and regulated and the by-laws will need to be reinforced.
2. Appropriate water tariffs and incentives will be introduced in order to promote water efficiency in irrigation and higher economic returns for irrigated agricultural products
3. Jordanians are well aware of water scarcity and the importance of conserving and protecting our limited water resources.
4. Viable options to reduce water demand within each sector are readily available.
5. Water tariffs within and outside the water sector should support water demand management.
6. Non-revenue water to be 25% by 2022.

## Approach to Achieve the Goals for Water Demand by 2022

### Awareness

1. **We will create awareness among the Jordanian public and decision makers as it is the first step towards behaviour change and lays the foundation for policy change.** For example, if a high percentage of the population knew that 64% of all water goes to agriculture, but contributes little to the country's economic growth, an increase in irrigation tariffs would receive more public support. The true value of water is not properly understood in Jordan, nor is the cost of water delivery, or the costs and benefits of alternative approaches to water management. Once a robust foundation of knowledge is created among all concerned parties, the challenges will be easier to manage and will be more likely to encourage prompt action. **(Goal #2)**

2. **We will target audiences to include public and private sectors and the general public.** The private sector includes farmers, industry leaders, small and medium sized businesses, associations, chambers and non-government organizations. **(Goal #2)**

3. **We will prepare and disseminate messages at multiple levels once audiences are identified and current levels of knowledge ascertained.** Messages can be both technical and non-technical. Delivery of messages can be through many avenues including mass media, associations, chambers, schools, universities and water delivery utilities. The impact of messages can be significantly enhanced through delivery by the highest levels of Jordanian Government. Messages can include, but are not limited to: **(Goal #2)**

   - The need to collaborate among all concerned ministries (Planning, Water and Irrigation, Agriculture, Environment, Tourism, Industry and Trade, and Health) on policy, economic, and social concerns related to water issues, especially for the inter-and intra-sectoral movement of water.

   - The relationship between water sustainability and cost, and social and economic development in Jordan, i.e. the impact of increased water scarcity on Jordanian's way of life.
   -
   - An understanding among water users about the relationship between water and pollution and the necessity to protect the scarce water resources.

   - An understanding among water users of existing water allocations and attendant problems. Maximum impact will be achieved if the background knowledge is packaged with clear concise information on what social, economic, and political actions are needed to cure the root causes of the problems.

   - Concrete suggestions on economically cost-efficient measures every individual can implement to reduce water demand.

   - The need to properly value and maximize the return from each cubic meter of water resources used. For example, what is the appropriate price for Jordan's groundwater applied for irrigation of local farms?

   - The need for consistent enforcement of regulations, policies and codes across all water users. This is essential for voluntary compliance to occur.

4. **We will work with the Ministry of Education to introduce Water Awareness programs in the form of events and curricula at all school grades. (Goal #2)**

## Policy and Regulation

Efficient water use will only become common practice when a strong consolidated water resources regulatory organization is in place to support compliance with the legal structure and there is a tariff schedule based on the true value of water. Stronger enforcement of laws and regulations can make a major contribution to relieving water shortages today.

5. Jordan must improve its policy to equitably allocate transferable surface and groundwater rights to farmers to permit intra- and inter-sectoral transfers of water. Jordan Valley farmers would know in advance their allocation for the crop season and plan accordingly, subject to contingency provisions for unanticipated drought. Farmers could sell part or all of their surplus annual water right to other farmers. **We could buy highland groundwater rights at market prices to reduce withdrawals from aquifers under stress. (Goal #1)**

6. Jordan must develop policy to provide incentives for farmers to grade agricultural produce by quality, sort by size and conformity, and practice proper post-harvest handling and transport, thereby increasing product quality and lengthening shelf life. This allow farmers to focus on high-quality crops and **will bring increases in profit thus enabling farmers to upgrade technology and better afford increased water tariffs that more truly represent the value of water consumed**. **(Goal #1)**

7. **Jordan must remove tariffs on imported crops to promote transition to crops with higher economic returns per unit of water used. For instance, growing bananas is a commonly cited but not unique example of an egregious waste of water to produce a crop that can be imported significantly cheaper than it can be produced in Jordan. Jordan can no longer afford such uneconomical use of scarce water supplies. (Goal #4)**

8. Jordan must encourage groundwater basin water users associations. **We will invite these associations to participate with the government in setting and implementing protection zones of surface and groundwater.** Practice has shown that local communities are in the best position to decide on the appropriate use of public goods. **(Goal #2)**

9. Jordan must stop unsustainable extraction of groundwater in order to prevent permanent economic and environmental harm. Jordan's groundwater by-law 85 was created to protect and monitor the country's precious groundwater resources. Under this by-law, we have certain responsibility to collect fees for legal wells. Yet fees from the majority of wells used for agriculture purposes are not collected. Without fees coming back into the sector from users, we will be subsidizing water in perpetuity. In addition, hundreds of illegal wells pump water daily in Jordan, which stresses the country's aquifers. The by-law also requires the government to establish appropriate pumping reduction plans for aquifers under stress; currently 10 out of Jordan's 12 groundwater basins are showing a deficit, the other two are close to their limit, and the situation will only get worse. **We will establish and implement Groundwater Management Plans in order to begin to slow this dramatic decline in groundwater.**

**We will revise by-law 85/2002 on groundwater to conserve and protect groundwater from illegal use and over extraction. (Goal #2)**

10. **We will revise the bulk tariff setting mechanism to reflect the real value of water. Low tariffs encourage waste and low-value uses and provide no incentive for efficient water distribution and use by water delivery authorities and customers.** As fiscal constraints reduce the level of public funding available for subsidies, users will have to pay a larger share of the costs of delivery. However, an efficient mechanism to supply water for low-income families should accompany any adjustment in municipal water tariffs. **(Goal #4)**

11. **We will adopt and enforce building and plumbing codes for buildings (including high rise – high density buildings) that set maximum water flow limits and minimum quality standards for plumbing fixtures.** Strict enforcement of the building code, particularly with regard to showerheads and toilet flush capacity, could save 10% of municipal water each year. New construction has recently added millions of square meters of floor space in Jordan and much has been built without these water conservation fixtures. Banning high water use fixtures will facilitate enforcement of the codes. **(Goal #3)**

12. **Jordan will implement regulations (incentive structures) to encourage rainwater harvesting. (Goal #3)**

13. **We will modify policy and regulation to facilitate water allocation among users in Jordan by considering return per cubic meter used while ensuring satisfaction of basic domestic water need.** This action will provide higher returns per cubic meter of water used, will increase ability to pay tariffs, reduce stress on the GOJ budget caused by high water subsidies. **(Goal #1)**

## Technology

14. **We will facilitate adoption of new innovative and proven technology to produce, distribute, and use and reuse water more efficiently and to increase economic productivity without increasing water use or waste.** Such technology coupled with proper training can increase levels of economic production without increasing water use or waste. Examples include new metering systems, electronic data acquisition for infrastructure management, systems to generate information for decision-makers, drip irrigation systems, brackish and seawater desalination systems, and water delivery schedules that fit the needs of customers. **(Goal #3)**

15. **Jordan will make readily available water saving fixtures and equipment for industries, municipalities, and homes and will structure incentive systems to promote their use. (Goal #3)**

16. **Jordan will continue expanding the use of treated wastewater, which shows great potential for agriculture, industry, and urban landscapes.** Treated wastewater should go to the use that demonstrates the highest social and economic return and can

reduce the demand for fresh water and reduce ultimate disposal costs. Where economically practical, treated wastewater can be used to replenish aquifers. Public education of using treated wastewater for possible aquifer recharge must begin now. **(Goal #3)**

## Non-revenue Water

17. **We will reduce non-revenue water to 25% by 2022 with technical losses below 15%.** To reach this goal will require the rehabilitation of water supply systems (including improved water meters), optimization of operation and management, and network restructuring. We will continue to focus on: **(Goal #5)**

    - Maintaining water quality in the networks within standards.
    - Increasing frequency of summer water supply.
    - Increasing frequency of winter water supply.
    - Reducing response time for repair of network leakages, pressure loss, and sewer blockage.
    - Reducing waiting time for water and wastewater connections.
    - Reducing waiting time for the resolution of customer complaints.

# *Chapter 3 – Water Supply*

## Current Status

Since the shortage of water resources in Jordan was first widely recognized in the early 1970s, many strategies and measures have been proposed to alleviate and overcome it. These have included supply augmentation measures involving the construction of various hydraulic structures and the development of groundwater. However, no single action can remedy the nation's water shortage. Rather, an integrated approach will be adopted to enhance water availability, suitability, and sustainability.

In the year 2008 the renewable freshwater resources available per capita in Jordan were about 145 cubic meters per year. This is less than one third of the widely recognized "water poverty line" of 500 cubic meters per capita per year. This sobering observation requires that water be well managed and used as efficiently as possible, that demand be proficiently managed, that all available sources of water be developed, and that adverse impacts be mitigated through measures of environmental protection.

The terms of "Water Supply" and "Water Resources" are used incorrectly to mean the same. When preparing the water budget figures, distinct differentiation must be made between Water Supply (Allocations) and Water Resources. Water Resources include both surface and groundwater. Management of each must be optimized.

Surface water supplies contribute approximately 37% to Jordan's total water supply. Developed surface water in Jordan is estimated at 295 MCM in 2007 and projected 365 MCM by 2022.

Groundwater contributes approximately 54% to total water supply. The unsustainable abstraction of groundwater largely due to population growth and agriculture expansion is a major problem today. This has been exacerbated by the lack of enforcement of regulations on private sector well drilling, and the near absence of controls on licensed abstraction rates. As water tables drop, pumping costs and salinity levels increase.

WAJ provides wastewater collection and treatment services to fourteen major populated areas. About 4 million people (62% of the population) are served by sewerage systems producing about 100 MCM of effluent per year that is being reused primarily in agriculture.

Several brackish springs have been identified in various parts of the country. Estimates of stored volumes of brackish groundwater for the major aquifers suggest immense resources, but not all of these quantities will be feasible for utilization.

Investments in municipal networks remain inadequate. Although the level of services in the water supply sector in Jordan is fairly high, with service to 97% of the population in the urban areas and 83% in the rural areas, distribution systems are still far from optimal and efficiencies are still low. The unaccounted for water in the municipal networks was estimated to be 55% of the quantity supplied in 1995.

## Future Challenges

Ten out of 12 water basins are over pumped; groundwater is used at twice the recharge rate. Demand far exceeds supply and the deficit is increasing. Even with additional planned projects, demand will still exceed supply through 2022.

The major future challenge is that traditional water resources will not meet water demand. Improvement in water supply management, influencing water demand behaviour, and optimizing water allocations as per the National Water Master Plan (NWMP) are the cornerstones towards reducing the water deficit.

The quality of the groundwater resources has deteriorated significantly with agricultural and industrial development. This development took place without careful planning so that many groundwater resources today are now threatened by pollution due to industrial loads, overuse of agrochemicals, drainage water, overloading of wastewater treatment plants, over pumping of aquifers, seepage from landfill sites and septic tanks, and improper disposal of dangerous chemicals, and general population pressure. Once there, this pollution is difficult and costly to reverse. Many precious resources are already lost due to high pollution levels. In order to halt this process, actions are required to actively protect Jordan's groundwater and surface water resources.

In view of the increasing population and the social and economic development of the country, the amount of treated wastewater is increasing. It is estimated that by 2022 the volume of treated wastewater will be 256 MCM. As available freshwater resources become increasingly limited in Jordan, treated wastewater will play an ever more important role.

Every single drop from every resource in Jordan must be collected. This is a precious commodity and the cost of replacing wasted resources is extremely high. Jordan cannot afford this option and will no longer entertain any irresponsible drain of our water resources.

## Goals for Water Supply By 2022

1. Uninterrupted safe and secure drinking water supply achieved including continuous flow in Amman, Zarqa, Irbid, and Aqaba.
2. Water supply from desalination is a major source.
3. Drinking water resources are protected from pollution.
4. Surface water is efficiently stored and utilized.
5. Treated wastewater effluent is efficiently and cost-effectively used.
6. Groundwater management plans to ensure safe yield are operational.
7. The concept of utilizing greywater and rainwater is fully embedded in the codes and requirements of buildings.
8. Our shared water rights are protected.

## Approach to Achieve the Goals for Water Supply by 2022

### Surface Water

1. **Jordan will continue to study opportunities for further investment in surface water facilities. We will schedule a plan to enhance the storage of dams by removing sediments that accumulated over the years. (Goal 4)**

2. In order to enhance surface water resources, **we will implement a comprehensive monitoring and assessment program for surface water quantity, quality, uses and protection as well as establish an integrated development and conservation program to increase the potential of surface water development in Jordan that will promote: (Goal 4)**
   - surface water systems in the Jordan Valley.
   - conversion of open canal systems to pressurized pipe system.
   - giving priority to modernizing and upgrading systems.
   - water projects which make significant contributions to meeting rising municipal and industrial demands.

## Groundwater

3. **We will support the enactment by-law 85/2008 and will implement a program that sets out legal and financial measures aimed at controlling and gradually reducing groundwater withdrawals with the final objective of maintaining the safe yield of aquifers**. Measures will also continue to be taken to protect the groundwater resources from all sources of pollution. Bylaw 85/2002 on groundwater abstraction shall be strictly followed and enforced. **(Goal 6)**

4. **We will upgrade an integrated program to assess the availability and exploitability of all resources at rates that can be sustained over time**. The mining of renewable groundwater aquifers will be reduced to sustainable extraction rates. We will continue to pursue planned and controlled groundwater mining from promising, extensive fossil aquifers as an option to secure incremental supplies for municipal and industrial uses. Groundwater use will take place conjunctively with surface water in places where such joint use has the potential for increasing the available supply. There will also be improvement and centralization of groundwater data collection, analysis, and monitoring. **(Goal 6)**

5. **We will continuously monitor the quality status of surface and groundwater and the impact of potentially polluting activities on water resources. We will initiate corrective measures to reduce the risk of pollution to a minimum including establishing protection zones for both surface and groundwater**. **We will make recommendations on what should be done to minimize pollution risks and implement them in coordination with other Ministries. (Goal 3)**

6. **We will actively participate in the process of land-use licensing in coordination with other Ministries in order to minimize negative impact on the groundwater and surface water resources from potentially polluting land-use activities. (Goal 3)**

7. **We will provide standards, guidelines for design and best management practices for potentially polluting activities, taking into consideration the need for water resources protection. (Goal 3)**

8. **We will rehabilitate springs and wells as well as the existing water supply infrastructure in order to better protect water sources from pollution. (Goal 3)**

9. **We will further encourage the application of applied research activities,** including artificial recharge to increase groundwater supplies, and new technologies that will optimize the operation and development of groundwater systems and promote more efficient and feasible use. **(Goal 6)**

## Wastewater

10. **We will continue to expand the safe use of treated wastewater by building new wastewater treatment plants and exploring productive uses in agriculture, industry, and urban landscapes. We will explore the potential for using treated wastewater for aquifer recharge as is done in other parts of the world. (Goal 5)**

## Brackish Water

11. **We will assess the potential of brackish water resources in terms of sound technical, economic and environmental feasibility in all groundwater basins within the Kingdom, and then conduct research and studies on desalination and on optimization of brackish water use in agriculture and industry.** Brackish water resources will be allocated, either desalinated or in their natural condition, to their best uses in order to provide additional water supply. When desalinated they can produce additional water for municipal, industrial and commercial consumption. **(Goal #2)**

12. **We will continue to encourage international cooperation for the promotion of research, development, information exchange, and training in the field of desalination and other non-conventional sources.** Therefore, technology transfer and advanced research in desalination engineering shall be introduced. **(Goal #2)**

## Water Quality, the Environment, and Human Health

13. **We will update standards for drinking water, for industrial wastewater discharges to sewers and for treated wastewater reuse and support its enforcement.** Jordan, has adopted and adapted international water quality standards or guideline values developed by the World Health Organization (WHO), the United States Environmental Protection Agency (EPA), and others. The guiding criteria shall always be the provision of safe drinking water and protection of the surface and groundwater. The quality of treated effluent and the performance of the wastewater treatment plants are greatly affected by the influent water quality which may be of domestic or industrial source. The use of treated effluent offers challenges as well as opportunities. Performance of some treatment plants is inadequate resulting in low quality effluent that could have an adverse effect on public health. We will carefully monitor and upgrade treatment plant capacity and establish monitoring protocols to ensure reuse standards are set and maintained for each economic use. Such a program requires that analytical methodology, equipped laboratories and qualified personnel be provided. Concerns for public health and the health of workers shall be a focus in the programs of reuse of treated wastewater. **(Goal #3)**

14. **We will continue to monitor all water resources to ensure that standards are met and that sufficient funding, facilities, training, and coordination occur.** Implementation of standards, including national health standards, for municipal

water supply and sanitation and their enforcement require facilities and expertise, which involve significant costs. Enforcement, particularly, requires commitment and coordination between many agencies and at many levels within the government. Laboratories for controls shall be maintained and properly equipped. It should be emphasized that considerations of policy and convenience must never be allowed to jeopardize public health. **(Goal #3)**

15. **We will give particular attention on adopting and enforcing effluent and sludge standards for municipal and industrial wastewater treatment plants and for discharge from laboratories, hospitals, slaughterhouses, and other businesses.** Concerns for public health and the health of workers shall be a focus in the programs of reuse of treated wastewater. Laboratories shall be maintained and properly equipped to provide reliable data needed to ensure safe supplies to the consumers. **(Goal #3)**

16. **We will implement an outreach program to ensure that awareness is created and people know how to properly maintain their rooftop storage tanks to reduce the possibility of contaminated water entering the household. (Goal #3)**

17. **We will ensure that all our projects have Environmental Impact Assessments during the planning and design stage and Environmental Management Plans during the construction stage. (Goal #3)**

## Service Levels

18. **Jordan must make a national effort to improve existing systems, expand them to cover areas not being served, and to improve technical and managerial capabilities. Policy issues related to water distribution should focus primarily on questions of efficiency and recouping investment. The general objective of any water distribution system is to distribute water to consumers in adequate quantity and quality and at the required time to meet the demand in the most efficient manner. (Goal #1)**

19. **Jordan must make improvements in water distribution systems including the removal of inadequacies in the various components of the existing systems, such as operational problems, metering problems, supply interruptions, undersized pipes, high water losses in the tertiary networks, lack of automated pressure management approaches leading to high operation pressures, and absence of pressure zones. (Goal #1)**

20. In conjunction with the above, **WAJ will continue with the enhancement of the operation and maintenance of the existing distribution systems and reservoirs, and the rehabilitation of old and damaged components. Conjunctively, WAJ will continue ensuring proper, safe, and high standards and specifications for pipe and other materials and for construction and operation and maintenance practices. In this regard, WAJ will increasingly make use of specifications focusing on lowest life-cycle costing instead of**

**lowest initial costs, since experience shows that cheap solutions often have much higher operation and maintenance costs. (Goal #1)**

21. Since efficient water distribution systems are vital to conserve water, provide better services to consumers, and reduce water costs, **we will improve the efficiency of water distribution through improved planning, better operation and maintenance, and strengthened technical, managerial, and financial capability of concerned departments.** Private sector participation will be sought, whenever possible. **(Goal #1)**

22. **Jordan will set aggressive targets to begin to move district by district towards continuous supply in major metropolitan areas including Amman, Zarqa, Aqaba, and Irbid. We will plug the distribution leaks and improve metering, billing, and collection systems. Studies have shown that in countries with limited water supplies, continuous supply is still possible. The eventual benefits from a continuous supply system are many including overall reduction in water losses, enhanced water quality, and reduced operation and maintenance issues. (Goal #1)**

23. The priority criterion for project implementation and for additional water allocation shall be based on economic, social and environmental considerations. **We will establish a critical path for the allocation of each new source of water**. Consideration shall be given to the sustainability of the allocation in the light of the national water balance situation and the economic, social and environmental opportunity cost of forgone alternative uses of water. **(Goal #1)**

24. **We will give first priority to allocation of the basic human needs, and as such, first priority is given to the allocation of a modest share of 100 liters per capita per day to domestic water supplies**. Expensive additional water has municipal purposes as a first priority in allocation, followed by tourism and industrial purposes. **(Goal #1)**

25. **We will increase the energy efficiency of the water supply and distribution systems and harness alternative energy sources to provide 20% of the power required to pump water throughout the Kingdom**. **(Goal #1)**

## Resource Development

26. **We will prepare and continuously update balancing and allocations plans as part of the NWMP. (Goal #1)**

27. **We will continuously update the Water Information System at the Ministry of Water and Irrigation.** It will be supported by a program of monitoring and a system of data collection, entry, updating processing and dissemination of information. **(Goal #1)**

28. **We will tap surface water and groundwater when shown to be economically, socially, and environmentally sound.** Investigation of deep aquifers shall be conducted to support development planning. **(Goal #1)**

29. **We will formulate a long-term plan for the exploitation of resources and a revolving five-year plan shall be extracted from it and updated as necessary.** The revolving plan shall be compatible with those formulated for the other sectors of the economy. A parallel investment plan shall accompany the development plan. **(Goal #1)**

## Resource Management

30. **Jordan will ensure that the guiding principle of water resource management focuses on economical, environmental, and social sustainability. (Goal #1)**

31. **We will review previously developed resources including resources mobilized for irrigated agriculture in the Jordan Valley and other established uses for confirmation of water allocation according to the sustainability principle.** Special care shall be given to the protection against pollution, quality degradation and depletion. **(Goal #1)**

32. **We shall continually aim at achieving the highest efficiency in water conveyance, distribution, and application and to minimize operation and maintenance costs.** Adequate balance shall be sought between demand management and supply management. The cost of production of future industrial, commercial, tourism and agricultural projects shall be measured also in terms of their requirements of units of water flow. Advanced technology shall be adopted to enhance resource management capabilities. The National Water Master Plan shall remain the basis for managing Jordan's water resource. **(Goal #1)**

33. **We will look to maximizing the use of alternative water sources including the use of greywater and rainwater harvesting.** Industries and buildings should have structures and incentives in place to significantly increase the use of and better manage this resource. **(Goal #7)**

## Shared Water Resources

34. **Jordan shall protect and defend the rightful shares of the Kingdom's water resources through bilateral and multilateral contacts, negotiations, and agreements. Opportunities for development of projects that provide multilateral or bilateral benefits shall be accorded special attention for construction, operation and maintenance. (Goal #8)**

35. **We will continue to give due respect to the provisions of international law as applicable to water sharing, protection and conservation, and those applicable to territorial waters. (Goal #8)**

36. **Bilateral and multi-lateral co-operation with neighboring states shall be pursued through a Regional Water Charter. (Goal #8)**

## Performance

37. **We will monitor and rate performance efficiency of water and wastewater systems and their management**. Improvements on performance shall be introduced with due consideration given to the sustainability principle. **(Goal #1)**

38. **We will continually appraise human resource performance to upgrade capabilities and sustain excellence**. Incentives for excellence shall be introduced in compliance with the needs for dedication. **(Goal #1)**

# *Chapter 4 – Institutional Reform*

## Current Status

The present structure of the water sector has resulted in a number of weaknesses which require institutional reform. In addition, the structure impedes efficient management to effectively address many of the sector's challenges. These weaknesses and challenges include:

- Water demand far exceeds supply and water allocation is unbalanced with 64% going to irrigation, 30% for municipal, 5% for industry, and 1% for tourism.
- Non-revenue water is over 50% in much of the country.
- Tariffs do not cover total costs. Accounting systems are weak.
- The Ministry of Water and Irrigation (MWI) is created by a "Bylaw" while the Water Authority of Jordan (WAJ) and the Jordan Valley Authority (JVA) are created by "Laws".
- Communication among the three entities (MWI, WAJ and JVA) is limited with each functioning in near isolation from the other.
- There is a lack of cohesiveness, integration of efforts and team work.
- A top-down approach is applied and stakeholders are normally not involved in the decision making process.
- Jordanian capability is not fully tapped to manage the country's water resources.
- The sector requires additional significant investment and new business models with private sector participation.
- There exists overstaffing of MWI, WAJ and JVA and an exodus of talent to the private sector.
- Conflicts of interest in the present set-up of the water sector among MWI, WAJ and JVA.
- There exists an overlap of responsibilities with other Ministries.

However, there are success stories as well to build upon. Enhancing the ability of water and wastewater operators to manage on a commercial business will reap benefits. With the Khirbet As-Samra Wastewater Treatment Plant, we have successfully introduced private sector

participation into the bulk water treatment market. Miyahuna and the Aqaba Water Company are bringing commercial business practices to the retail distribution and collection and treatment of wastewater market segments. In Aqaba, service has improved, losses reduced, and the company is making a profit, which it is using to further improve service and infrastructure. Lessons learned need to be incorporated to expand commercial business practices in water resources management.

## Future Challenges

The increase in water demand, the limited water resources and the increase in fuel and operating costs makes it all the more important to have a streamlined efficient operation through implementation of a good plan for institutional reform. The challenges cited in other chapters all support the need for greater efficiency within the institutional structure. This is arguably the most important area for reform and will set the foundation for many of the other goals articulated in this strategy.

## Goals for Institutional Reform By 2022

1. Water law is enacted and enforced.
2. Strong policy development and water resource planning strategies and capabilities forged.
3. Governance functions and operational functions are separated.
4. "Wholesale" operations (national infrastructure) and "retail" operations (service delivery) are separated.
5. A Water Council is operational allowing for broad stakeholder input into water management.
6. A Water Regulatory Commission of Jordan is established.
7. Commercial principles drive water management while the needs of the poor are supported.
8. Staff are trained, number of staff is optimized, conflicts of interests are eliminated, and a dynamic working environment is created that is responsive to the needs of the sector.
9. The National Water Master Plan is institutionalized

## Approach to Achieve the Goals for Institutional Reform by 2022

### Legislation

1. **We will prepare a new Water Law** that will define the structure and function of the institutions governing and managing the water sector and clarify the responsibilities of the different ministries involved in the water sector. The new law shall also define legal issues related to water. **(Goal #1)**

2. **We will revise Groundwater by-law 85/2002 to introduce stringent controls on the use of groundwater including the abolition of the free abstraction and limiting the abstraction quantity based on the aquifer safe yield.** Enforcement measures against illegal use, abuse and deteriorating groundwater conditions shall be introduced. **(Goal #1)**

3. **We will establish water resources protection legislation to legally implement water resources protection zones for drinking water resources. (Goal #1)**

4. **We will study traditional water rights in Jordan in order to develop legislation that balances traditional rights with State rights while moving towards market-based allocation mechanisms.** Development of appropriate legislation will require regular and systematic consultation with a diversity of stakeholders and water users. **(Goal #1)**

### Institutional Structure and Function

5. **We will enact institutional reform to restructure the water sector over the next two-five years based on functional roles to cover governance, regulation, supply, transmission, distribution and advisory services.** Each of these roles is described briefly below and no existing entity is specifically mentioned. This is purposeful to avoid presupposing that any one entity will exist in its present structure after the reform. The reform will structure opportunities for greater private sector engagement through various business models. The specific roles and responsibilities of these functional roles will be defined through legislation. The action plan that will follow adoption of this strategy will articulate the timing and sequencing for development of these new functional roles. **(Goal #2-Goal 6)**

- **A Ministry body will collect and analyze data, monitor sector performance, project and plan for future growth in water demand, put in place policy and draft laws to guide the sector, and ensure compliance with environmental and other cross-sector policy, law and regulations. These activities shall be shifted to the Regulator once it is established.(Goal #2 and Goal #3)**

- **This Ministry body will ensure that the National Water Master Plan (NWMP) remains a dynamic document. The NWMP shall include the identification and selection of capital projects and should link between water sector planning and national development planning. The Information Technology (IT) and Geographic**

**Information Systems (GIS) functions, including the maintenance of Geodata Inventories and relevant data handled via GIS, shall remain with the Ministry. Likewise, the Ministry will be responsible for maintaining a Water Information System (WIS)-function that will provide the required information products in support of business processes. (Goal #2 and Goal #9)**

- **The PMU shall transform into new Water Regulatory Commission needs to be established. This should be an independent body because it must be separated from political pressure and influence. If it is not separated from the government there is danger, and world experience shows this is very real, that the private sector components cannot function efficiently. Customers could suffer degraded service and ultimate failure of service through infrastructure neglect and deterioration. (Goal #6)**

- **Developers of bulk water supply will be private consortia or companies that are moving towards privatization. This responsibility could be severed from the government institutional water sector. This would bring in the rigor and resources of the private sector, both of which are needed for new and more efficient water supply systems. Management of bulk supply to retail users will be monitored by the Ministry and the Water Council to ensure equity, quantity, and quality is maintained. (Goal #4)**

- **Transmission will be the role of WAJ – a merger of all bulk water movement -- comprised of components of the current systems. Examples include: collection of water from the Yarmouk River and transmission via the King Abdullah Canal and Deir Alla – Zai pipeline to the Miyahuna operated Zai Water Treatment Plant, collection of water from Wadis Mujib, Zara, and Ma'in and conveyance to the Zara Ma'in Water Treatment Plant, pumping water from the Mafraq well fields with delivery to Amman, and delivery of bulk irrigation water to water user associations at head units. (Goal #4)**

- **Distribution will continue the reform already implemented among the privatizing water utilities. Jordan should be split into at least three distribution segments (North, Middle, and South) each managed by a distribution utility. Retail distribution of agriculture water would be with Water User Associations (WUAs). To make this work efficiently and prevent conflicts of interest, all government stock in the three water utility companies should be sold to the private sector. (Goal #4)**

- An advisory body, which could be known as a Water Council, would be an excellent way to ensure that water resource management includes views from different stakeholders so that governance can be inclusive and strategic. The Water Council will provide a forum for input from the various sectors (industry, domestic and agriculture) and also from other government institutions and ministries (environment, health, tourism). It will also provide a forum for input from the public. **The Water Council will analyze and endorse policies and regulations for the water sector and the Ministry will monitor and inform the Water Council on the implementation of these policies.** Though the idea can be contentious, a Water Council can serve a useful function if established and focused correctly. Functions could include resolving complaints from other sectors and advising the Ministry and Parliament on policy, planning, and legal issues. The Council

should restrict its role to that of high level advisor and not be involved in operations and management issues. It should include both public and private sector representation, and should not be dominated by a single institution. **(Goal #5)**

- **The Water Council** would have the following structure and characteristics:

- Chaired by the Minister of the body responsible for water.
- Members are appointed by the Council of Ministers.
- Members of the Council include high-level representatives from the water sector and from related government departments, and technical representation from water user groups including agriculture, industry and domestic users, members of academia and civil society, as well as financial and legal counsel.
- The Council appoints committees to deal with specific issues facing the sector (e.g. environment, allocations, etc.)
- The Council receives analytical and secretariat support from the Ministry responsible for water.

6. **As the transition from the current to the new structure takes place, we will be guided by the following principles: (Goal #3)**

- **separate bulk and retail operation;**
- **establish management or other contracts with Public Water Companies, supported by private sector companies and operators, for the delivery of retail water;**
- **develop new bulk supply projects through private sector mechanisms;**
- **strive to privatize or contract out some existing operational functions;**
- **disengage from all non-water functions such as, housing, and tourism issues;**
- **develop business plans and cost centers for the bulk and retail operations in order to identify true costs and revenues for the functions and clearly identify the subsidy levels at each of these levels;**
- **structure the process towards financial viability through cost savings and revenue generation, and,**
- **develop water user groups through training and technical assistance.**

## Commercial Practices

7. We will operate using best commercial practices within a regulated water market. More business-like approaches to water resources management will save water and reduce GOJ cost subsidies. Water utilities must run like businesses with a focus an customer service, providing a quality product that is properly valued and paid for by customers. The extremely high losses within Jordan's water distribution systems (up to 50% in some areas) must be drastically reduced and quickly brought in line with international best practices. It must be stressed that better commercial practices necessitates providing a better product to consumers. A partnership between consumers and utility companies must be forged where consumers can expect to receive improved service and utilities can expect to receive an adequate tariff for that service. **(Goal #7)**

8. **We will transition from subsidized and inefficient providers of a public service to a new structure that allows for commercial providers of a valuable commodity.** All

private and public operators need to be able to set tariffs for their customers, approved by a regulatory authority, while ensuring the poor receive water for basic needs. Benefits from adoption of commercial practices include: **(Goal #7)**

- Reductions in man-power required per unit of water delivered to customers.
- Increases in revenue from outsourcing billing, collection and customer service to private companies.
- Potential reduction in tariff rate increases due to reduced operating costs.
- Integration of technology into operations and management to substitute for labor, leading to increased efficiencies in water deliveries, reductions in water losses and reduced costs.
- Introduction of innovative approaches to reducing water demand, thereby increasing water supply, e.g., rebate programs for retrofitting low water use fixtures.
- Introduction of a tariff system that covers operation and maintenance.

9. **We will pay particular attention to the needs of the poor while improving commercial practices.** In an environment of increasing water tariffs, we need to be sure that the poor are not disadvantaged. Targeted subsidies within the water sector may be required to strengthen the social safety net. **(Goal #7)**

## Private Sector Participation

10. **We will expand the role of the private sector. Management contracts, concessions and other forms of private sector participation in water utilities shall be considered and adopted as appropriate.** Micro-PSPs, as in the example of Madaba, will be used for performance-based outsourcing of operational tasks to achieve rapid improvements. **(Goal #7)**

11. **We will encourage and expand the private sector's role in the distribution of retail water, wastewater, treated effluent and irrigated water**. Emphasis shall be placed on the social benefits in conjunction with the private investments. **(Goal #7)**

## Irrigation Water Pricing and Cost Recovery

12. **We will review the water tariff in order to facilitate behaviour change related to crop selection, cropping pattern, irrigation practices, and water conservation.** High volume water users should pay a higher fee more closely in line with actual costs of providing that water. Market forces should drive choices that farm families make in terms of crop selection and irrigation practices. **(Goal #7)**

13. **Concurrently, Jordan will work to reduce and remove tariffs and customs duties that make imported agricultural commodities less competitive in Jordan's markets.** This will also help influence choices farm families are making regarding competitive crops and agricultural practices. **(Goal #7)**

14. The water price shall partially cover the supply costs (cost of operation and maintenance, interest and depreciation). **We will establish the real cost of operation and maintenance**

**and charge for irrigation water accordingly.** Depreciation of assets on a yearly basis shall be added in calculating the irrigation water tariff. This additional cost is either added on each invoice using a factor or through the application of a one-time charge against irrigation rights. This would be applied as a rate per unit area of each farm with access to irrigation water. **(Goal #7)**

## Water Pricing and Cost Recovery

15. In view of the increasing marginal cost of supplying water in Jordan, the growing demand for water, the low rate of cost recovery and in line with the policy towards private sector participation and privatization, **we will set municipal water and wastewater charges at a level that will cover the cost of operation and maintenance.** We will also achieve the recovery of all or part of the capital costs of water infrastructure within five years. Until the cost recovery is full, and the national savings reach levels capable of domestic financing of development projects, project financing will depend on concessionary loans, private borrowing and BOT arrangements. **(Goal #7)**

**16.** The water tariffs mechanism shall be considered as a tool to promote cost recovery of water projects. However, profitable undertakings in industry, tourism, commerce and agriculture shall be made to pay the full costs incurred to supply water to them. **We will set differential prices for water based on water quality, the end users, and the social and economic impact of prices on the various economic sectors and regions of the country. We will also attempt to regularly review and adjust water tariffs based on the costs of supply, operations, and the comprehensive analysis of economic data**. **(Goal #7)**

**17. Furthermore, Jordan will structure water tariffs as a tool to drive water consumption behaviour change that should lead to more efficient use of water**. **(Goal #7)**

## Wastewater Pricing and Cost Recovery

18. In view of increasing marginal cost of wastewater collection and treatment**, Jordan will set wastewater charges, connection fees, sewerage taxes and treatment fees to cover at least the operation and maintenance costs plus part of the investment cost. The ultimate aim is for a full cost recovery to be achieved within five years. (Goal #7)**

**19. We will establish appropriate criteria in order to apply the "polluter pays" principle. (Goal #7)**

**20. We will structure different fees for different geographical areas. This shall be assessed for each geographical area as a function of the cost to deliver water to the area, end uses and effluent quality and will be subject to economic and social considerations. (Goal #7)**

**21. We will sell treated effluent at a price covering at least the operation and maintenance costs of delivery. (Goal #7)**

## Human Resources Management

22. **We will establish Human Resources (HR) Management as a key management function including HR Administration, HR Planning, HR Development & Training, and Labour Relations.** Such an integrated HRM structure will allow a comprehensive and coordinated approach to all staff issues. **(Goal #8)**

23. **Jordan will improve the capabilities of human resources in the management of water, wastewater, irrigation and dams through better vocational training and continuous education.** Standardised vocational training approaches, continuous education, on-the-job training and overseas training programs shall be organized and implemented in line with an comprehensive training needs assessment (TNA) undertaken for the whole water sector and a training plan derived from this TNA. Staff numbers shall be assessed and where necessary trimmed to reach optimum employment levels compatible with efficient management. **(Goal #8)**

24. **We will assess the working environment within the water sector and make adjustments by refocusing job descriptions and lines of authority, by striving to enhance communication and coordination among functional units, and by application of incentives.** This will help address efficiency concerns as well as the loss of talent to other sectors or countries. Staff performance will be systematically appraised in order to upgrade capabilities, sustain excellence and provide job security and incentives to qualified individuals with excellent performance. Salary scales and incentive structures will become more flexible. **(Goal #8)**

25. **We will set up a National Water Training Center for ongoing education and vocational training measures**. This will be accorded with adequate technical equipment and modern learning tools as well as dedicated and experienced trainers. Different models can be explored as to the most efficient type of institution required. Ongoing efforts to revitalize the Vocational Training Centers should be built upon. **(Goal #8)**

26. **We will set regulations for 'Utility Certification' according to defined standards to ensure delivery of high quality services to customers. This will be linked to certification of technical staff from water and wastewater treatment plants, pumping stations and networks**. Training will be based on national standards for operation and maintenance. Trained staff will ensure that water and wastewater facilities operate properly for their design lifetimes while delivering high quality service. **(Goal #8)**

27. We will establish a **unit in charge of 'Standardisation, Certification, Documentation & Quality Control'** to support the standardisation of our work processes. We will integrate this effort with the Ministry of Labor work. **(Goal #8)**

## Research and Development

28. We will encourage and enhance indigenous water research targeted at the improvement of resource management, resource economics, and adapting research findings to local conditions. Topics will include but not be limited to: crop water requirements, minimizing evaporation and controlling evapotranspiration, irrigation technologies and practices, retail irrigation management, and best practices for group farming. **We will establish a Water Research Unit within the Ministry** to take on this mandate and ensure that it complements other research institutions in the country. A narrow focus to define water research needs, track ongoing national and international research, and promoting extension of research to meet particular needs should be explored. **(Goal #8)**

29. **We will facilitate cooperation among specialized research institutions in the country as well as abroad.** Fund raising for this purpose shall be supported. Transfer of appropriate technology suited for local conditions will be a primary target for the development activities and for adaptive research. Emphasis will be placed on liaison with international institutions to keep abreast with modem technological advances and to facilitate technology transfer and adaptation. **(Goal #8)**

# *Chapter 5 – Irrigation Water*

## Current Status

The Hashemite Kingdom of Jordan has been facing a chronic imbalance in the population - water resources equation, which is manifested by a substantial imbalance in the foreign trade in food commodities, and by rationing of municipal water that is serviced to the population twice a week. The total renewable freshwater resources of the country amount to an average of 750 MCM per year. The population of 2008 is around 5.87 million people, growing at an annual rate of 2.2% (2008) to 1.9% (2022). The per capita share was 145 cubic meter per annum in 2007 and declines at a rate equal to that of the population increase.

The production of food in semi arid countries like Jordan is hardly possible without irrigation. The irrigated areas are located in the Jordan Valley (some 33,000 hectares), and in the Plateau (some 44,100 hectares). Some 400,000 hectares are fit for dry land farming, but it is practiced on half of this potential area because of the insecurity associated with erratic rainfall and other reasons. Irrigated agriculture, however, provides most of the agricultural production in the Kingdom and offers the higher percentage of agricultural jobs and other jobs in support services.

Because of the huge imbalance in the population - water resources equation, the treated wastewater effluent is added to the water stock for use in irrigated agriculture. It will constitute a substantial percentage of the irrigation water in future years, however, other uses of treated wastewater that demonstrate adequate social and economic returns will also be vigorously pursued.

The total area thus developed in the Jordan Valley, under the responsibility and supervision of successive Government agencies, is about 33,000 hectares. About 8,000 more hectares of arable lands remain to be irrigated north of the Dead Sea, and some 2,000 hectares south of the Dead Sea.

More development has taken place on the highlands using ground water sources. The private sector was behind all that development, with the exception of small and scattered irrigation projects supervised by Government agencies in the 1960's. The total area thus irrigated amounts to about 44,100 hectares. Irrigation practices in the highlands are not controlled and irrigation efficiency is poor.

A severe deterioration of water resources quality due to agricultural activities has been witnessed in many areas recently. In order to safeguard water quantities, improved agricultural practices should be applied and the government should establish a reduction of agricultural activities in areas important for drinking water supply.

## Future Challenges

- Irrigation consumes more than 64% (2007) of the total water used in Jordan while Agriculture's share of the GDP is 3%.
- Safe use of treated wastewater for irrigation in the Jordan Valley and its produce will need continuous monitoring and reinforcement.
- Irrigated agriculture in the highlands will need to be capped and regulated and the by-laws will need to be reinforced.
- The economic return of water in irrigated agriculture needs to be increased.
- Drought management and adaptation to climate change will need to be addressed through proper policies and regulations

## Goals for Irrigation Water by 2022

1. The annual water allocation for irrigation in the Jordan Valley will be reduced to 661 MCM in 2022 (293 MCM in 2007) and in the Highlands reduced to 191 MCM in 2022 (304 MCM in 2007).

2. Efficient bulk water distribution as well as efficient on-farm irrigation systems are established.

3. All treated wastewater generated will be used for activities that demonstrate the highest financial and social return including irrigation and other non-potable uses.

4. Jordan will have one service provider for irrigation water for the whole country, whereas the retail function for irrigation water will be privatized and/or handled by empowered farmers' associations.

5. Appropriate water tariffs and incentives will be introduced in order to promote water efficiency in irrigation and higher economic returns for irrigated agricultural products.

6. Alternative technologies such as rainwater harvesting for enhancing irrigation water supply will be promoted.

# Approach to Achieve the Goals for Irrigation Water by 2022

## Irrigation Water Conservation

1. **We will enhance on-farm irrigation efficiency in order to maximize the agriculture output of a unit of land area per unit flow of irrigation water. (Goal #2)**

2. **Irrigated agriculture in the highlands will need to be capped and regulated and the by-laws will need to be reinforced. . (Goal #1)**

3. **Appropriate water tariffs and incentives will be introduced in order to promote water efficiency in irrigation and higher economic returns for irrigated agricultural products**

## Irrigation Water Resources

4. **We will promote the use of rainfall harvesting methods for use in irrigation. (Goal #6)**

5. **We will use all treated wastewater for irrigation whenever safely possible while ensuring that health standards for farm workers as well as consumers are reinforced. (Goal #3)**

6. **We will limit the use of brackish water in irrigation in order to minimize soil salinity and conserve brackish water for other uses. (Goal #2)**

7. **We will reduce evaporation losses and pollution by conveying water through closed pipes networks and minimize energy costs through gravity flow systems. Supplementary pumping shall be used where needed. (Goal #2)**

## Irrigation Water Management

8. Under the new structural reform, **we will have one organisation responsible for bulk water supply in the Jordan Valley.** Farmers associations will be formed and empowered to handle retail water. For this purpose appropriate legislation will be introduced. (Goal #4)

9. For private farmers in the highlands, who abstract water from the groundwater through licensed permits, **we will establish a strict monitoring system and reinforce it rigorously in order to prevent illegal and/or over-exploitation of water wells. (Goal #4)**

10. **We will review, amend and reinforce rigorously by-law 85/2002. (Goal #4)**

11. **We will more clearly define, impart, and monitor training needs in order to improve the efficiency of bulk irrigation operations, forecasts and scheduling of irrigation services. (Goal #4)**

12. Over time, **we will redefine the role of the new institution responsible for irrigation in the Jordan Valley to focus on regulation and supervision of services. Involvement of stakeholders and the private sector in irrigation management shall be introduced and gradually promoted.** Care will be taken to monitor and supervise the use and distribution of water resources in that regard. (Goal #4)

13. **We will meter irrigation water at strategic locations. Digital meters shall be installed for volumetric measurement of in-flowing water. (Goal #2)**

14. **We will gradually phase-out of the business of irrigation water distribution.** The retail function shall be privatized through water users associations. Adequate tariffs and incentive systems will be developed and introduced (Goal #5)

15. **We will monitor abstraction from all groundwater wells periodically to assure conformity with the provisions of the abstraction permits. (Goal #4)**

16. **We shall strictly follow and implement Bylaw 85/2002 to close down any water wells which extract water from a deteriorating and depleted aquifer. (Goal #1)**

17. **We shall implement the bylaw to close down all illegal water (Goal #1)**

## On Regulation and Controls

18. **We will discourage planting crops with high water requirements through the use of market pressures by imposing higher water tariffs on irrigated agriculture. (Goal #5)**

19. **We will control planting of perennial crops through permits. This should be linked to water balance and stress. (Goal #5)**

## On Irrigation Efficiency

20. We shall encourage the private sector to increase irrigation efficiency in the highlands by introducing appropriate water tariffs and incentive systems (Goal #5)

21. **We shall encourage automation of irrigation networks.** Electronic surveillance and monitoring of irrigation networks shall be employed to reduce losses through leakage and breaks. (Goal #5)

22. **We will implement periodic preventive maintenance of pumps, motors and valves. Human resources for proper maintenance management shall be in place and properly trained. (Goal #4)**

# *Chapter 6 – Wastewater*

## Current Status

During the International Drinking Water and Sanitation Decade (1980-1990) the Government of Jordan carried out significant and comprehensive projects with regard to wastewater management primarily related to the improvement of sanitation. This has raised the sanitation level, improved public health, and strengthened pollution control of surface water and ground-water in the areas served by wastewater facilities.

Today, about 4 million people (nearly 62% of the population) are served by sewerage systems and the effluent quantity is estimated at about 100 million cubic meters for 2008. The treated wastewater is generated from 21 wastewater treatment plants and is being used primarily for irrigation purposes in the Jordan Valley. Most of Amman's treated wastewater is discharged in the Zarqa River and is stored in the King Talal Dam where it is blended with fresh surface water and is subsequently released for irrigation use in the Jordan Valley. Elsewhere treated wastewater is discharged in rivers where it represents a significant portion of the stream flow, since most streams in Jordan carry very little water, and the situation needs to be monitored carefully.

With the increase of the population, the increase in water use and the development of sewerage systems the quantity of wastewater is increasing. It is estimated that by the year 2022 when the population is projected to be about 7.80 million and when most of the townships and cities of the country will be connected to a wastewater system, about 247 MCM per year of wastewater is expected to be generated. When treated properly this water can be used for non drinking purposes and will thus represent an important water resource for the country.

## Future Challenges

The following main challenges will need to be addressed in the future:

1. The safe use of treated wastewater in activities that provide the greater return for the economy and society. In irrigated agriculture, a comprehensive risk management system must be established, in order to ensure the health of agricultural labor, the productivity of the soils and hygienically safe produce.

2. Control the illegal extraction of treated wastewater downstream of the treatment plants.

3. Control the very high BOD rates in the wastewater, which is due to insufficient quantities of water.

4. Promote the collection and use of greywater in high-rise buildings through adequate incentive systems.

5. Ensure that all major industries have their own wastewater treatment plant.

6. Explore decentralized treatment plants for new urban settlements.

7. Monitor wastewater and treated wastewater continuously.

## Goals for Wastewater by 2022

1. All the major cities and small towns in Jordan are provided with adequate wastewater collection and treatment facilities.

2. All major industries and mines have wastewater treatment plants.

3. New high-rise buildings use greywater for internal non drinking purposes.

4. Public health and the environment, in particular groundwater aquifers, are protected from contaminated wastewater in the areas surrounding wastewater treatment plants.

5. Treated wastewater is used for activities that provide the highest return to the economy. For irrigation use in the Jordan Valley and in the Highlands, a comprehensive risk management system is in place.

6. The quality of treated wastewater from all municipal and industrial wastewater treatment plants meets national standards and is monitored regularly.

7. Tariffs for wastewater collection are rationalized.

8. All treatment plants are operated according to international standards and our manpower is trained accordingly,

## Approach to Achieve the Goals for Wastewater by 2022

### Resource Development

1. **We will manage treated wastewater as a perennial water source which shall be an integral part of the national water budget. (Goal #5)**

2. **We will ensure that all wastewater from municipal or industrial treatment plants will be treated in such a way that the effluent meets the relevant national standard.** If treatment plants do not meet this standard they will be upgraded accordingly**. (Goals #6 and #8)**

3. **We will conduct regular monitoring of the quality of the effluent from every wastewater treatment plant in the country. (Goal #6)**

4. For every new wastewater project, **we will conduct an environmental impact assessment.** Such a project will only be executed if there will be no negative environmental impacts from the project in particular on groundwater**. (Goal #4)**

5. **We will maintain and upgrade where necessary existing levels of wastewater services to enhance public health and the environment. (Goal #1)**

6. **We will produce an effluent fit for reuse in irrigation in accordance with WHO and FAO guidelines as a minimum.** Reuse of treated wastewater in other purposes shall be subject to appropriate specifications. **(Goal #5 and #8)**

7. **We will coordinate with official bodies in charge of urban development to account for the treatment and disposal of liquid wastes.** Decentralized treatment plants shall be built to serve semi-urban and rural communities. **(Goal #4)**

8. **We will issue specifications and minimum standards for the use of septic tanks in rural areas.** Particular attention shall be paid to the protection of underlying aquifers. **(Goal #4 and #6)**

### Resource Management

9. **We will prioritize the use of treated wastewater for the activity that generates the highest social, environmental and economic return.** These activities shall be pursued with care whether for irrigated agriculture, industrial applications, urban landscaping, or aquifer recharge. **(Goal #5)**

10. **We will encourage industries through an appropriate incentive system to treat their wastewater and to meet standards set for ultimate wastewater**

**reuse or to meet the regulations set for its disposal through the collection systems and/or into the receiving environment.(Goal #2)**

11. **We will treat separately wastewater from industries with significant pollution to standards allowing its reuse. (Goal #2)**

- **<u>Wastewater Collection and Treatment</u>**

12. **We will give priority to protecting public health and water resources from chemical and microbiological pollutants. (Goal #6)**

13. **We will establish innovative approaches to wastewater treatment for the small municipal systems. Design criteria, performance specifications and guidelines for such systems shall be adopted and generalized. (Goal #1)**

14. **We will construct wastewater collection and treatment systems taking into consideration the need to protect groundwater and surface water resources from pollution by wastewater. (Goal #4)**

15. **We will standardize design and performance specifications of wastewater treatment plants.** Sufficient room in tendering for the construction of new plants shall be provided for competition to take place in both technologies and costs. **(Goal #8)**

16. To protect human health and the environment and to provide additional water supply that meets the approved standards for its use, **we will ensure that appropriate wastewater collecting systems and treatment facilities are provided for all sources of wastewater, wherever feasible. (Goal #4)**

17. **We will also ensure that wastewater is not managed as "waste" but is collected, treated, managed, and used in an efficient and optimized manner. We will also ensure that treated effluent complies with recently established national standards (JS893-2006) and that all treatment is to a quality appropriate for use in agricultural activities and other non-domestic purposes, including groundwater recharge. (Goal #6)**

18. **We will adopt appropriate wastewater treatment technologies with due consideration to sustainability, economy in energy consumption, and quality assurance of the effluent.** Consideration shall also be given to the blending of the treated effluent with fresher water for suitable reuse. **(Goal #1 and #5)**

19. In light of this**, we will formulate a Wastewater Master Plan**, which will establish targets for providing wastewater collection systems and treatment facilities to unserved areas throughout the country. **(Goal #1)**

20. **We will rehabilitate all sewerage pipes which are over 10 years old., (Goal #1)**

21. **We will treat sewage from un-served areas either in municipal or in well monitored and maintained facilities designed to receive that septage.** The use of greywater will be encouraged in areas not yet connected to the sewer. **(Goal #1)**

**Reuse of Treated Wastewater and of Sludge**

22. **We will encourage farmers to use modern and efficient irrigation technologies.** Protection of on-farm workers and of crops against pollution from treated wastewater shall be ensured. **(Goal #6)**

23. **We will conduct studies, design and implement projects to store the excess treated wastewater in surface reservoirs or in underground reservoirs. (Goal #5)**

24. **We will encourage power generation from sludge, if proven technically, economically and financially feasible with due attention to environment impacts (Goal #1)**

25. **We will process sludge produced from the treatment process so it may be used as fertilizer and soil conditioner. (Goal #1)**

26. **We will establish the institutional capability for monitoring, regulating and enforcing wastewater regulations. (Goal #8)**

27. **We will oblige industries to recycle part of their wastewater and to treat the rest to acceptable standards before it is discharged into the sewer systems or elsewhere.** This will help to ensure that the treated effluent quality exiting wastewater treatment plants conforms to water quality standards for reuse. **(Goal #5 and #8)**

28. **We will establish a reuse unit with well qualified staff to be responsible for the planning, design, construction and management of treated wastewater. (Goal #5 and #8)**

29. To the extent that design capacities of wastewater treatment plants permit, **we will give priority to collection and house connections to expansion of urban areas served by treatment facilities.** Users willing to contribute to the cost of the services in addition to fees and charges set by laws and regulations shall also be given priority. **(Goal #1)**

30. **We will give priority to situations and locations where wastewater disposal practices threaten the environmental integrity of freshwater resources and where performance of cesspools and percolation pits pollute underground water aquifers. (Goal #2)**

**Standards, Regulations and Quality Assurance**

31. **We will use Jordanian Standards JS893/95, JS202/91, JS1145/96, WAJ's regulations for the quality of industrial wastewater to be connected to the collection system, and WAJ's specifications for sewerage works as benchmarks against which plans and specifications of treatment plants and wastewater reuse will be evaluated. (Goal #8)**

32. **We will pay particular attention to adopting and enforcing effluent and sludge standards for municipal and industrial wastewater treatment plants and for discharges from industries, laboratories, hospitals, slaughterhouses and other businesses. (Goal #8)**

33. **We will develop extensive and comprehensive programs for monitoring the effluent from wastewater treatment plants.** Influent to and effluent from the plants and throughout watercourses shall be measured and monitored against all appropriate parameters to ensure that public health objectives and treatment efficiency goals are attained. **(Goal #6)**

34. **We will periodically analyze and monitor all crops irrigated with treated wastewater or mixed waters. (Goal #5)**

35. **We will install observation wells near the treatment plants to monitor whether there are changes in groundwater quality along the groundwater flow path and to mitigate adverse impacts where and when needed.** The data will be published regularly. **(Goal #4)**

36. **We will encourage collection of storm water from roof tops on an individual basis for domestic use.** If not treated, it will be used for gardening and if treated, it could be used for heating, washing and drinking. **(Goal #3)**

37. **We will maintain and properly equip laboratories as well as train staff** to provide services and reliable data needed to ensure enforcement of and adherence to standards and regulations. **(Goal #6)**

**Public Awareness**

38. **We will create awareness of the public through various means about the risks** associated with the exposure to untreated wastewater and the value of treated effluents for the different end uses. **(Goal #5)**

39. **We will design and conduct programs on public and farmer's awareness** to promote the reuse of treated wastewater, methods of irrigation, handling of produce. **(Goal #5)**

40. **We will begin to inform the public of use of treated wastewater for aquifer recharge as is done in other countries.** Only through gradual public education

will we be able to address the perception issues surrounding this potential use. **(Goal #5)**

# *Chapter 7 – Alternative Water Resources*

## Current Status

Jordan is a fast developing nation with a growing population and increasing drinking water demands. As a nation we feel that we have the intrinsic right for development which in the context of Jordan is linked to the availability of sufficient quantities of safe water for domestic, industrial and service sectors. Jordan's renewable water resources are limited and do not suffice, even under the current situation, to meet our water needs. Climate change scenarios all predict a further decline of our water resources. In order to protect our groundwater aquifers, we need to explore new water resources which will support Jordan's development. Also, these new water resources will need to strengthen and increase our self-reliance and avoid dependence on outside sources.

.In this context, alternative water resources may be defined as water resources that are not readily available and suitable for direct use and will include:

- Reuse of treated wastewater.
- Use of greywater.
- Desalination of brackish water and of seawater

## Future Challenges

1. Desalination is very energy intensive and hence a costly undertaking. On one side the capital costs need to be mobilised and on the other side, with the current water tariffs, the necessary subsidies will put a heavy burden on the national budget.

2. Necessary energy generation for large-scale desalination will need to be available.

3. Possible negative environmental impacts of large desalination projects will need to be mitigated.

4. The limitation of brackish water resources.

5. Lack of expertise in Jordan in the field of desalination.

6. Use of treated wastewater needs to be carefully monitored through a comprehensive risk management system.

7. Greywater and stormwater collection networks and treatment systems at both the building level and the municipal level need to be available.

## Goals for Alternative Water Resources by 2022

1. Treated wastewater will be used for the activity that provides the highest social and economic return and standards for use in agriculture will be introduced and reinforced.
2. Desalination projects at the Red Sea are operational
3. Rainwater harvesting is encouraged and promoted.
4. Infrastructure for desalination of sea and brackish water is sufficient.
5. An alternative energy source to keep the cost of desalination as low as possible is available.

## Approach to Achieve the Goals for Alternative Water Resources by 2022

1. **We will establish a program to desalinate brackish and sea waters on a short, medium and long-term basis.** Short term sources to include waters from Hisban, Kafrein, Faisal Greenery, Karamah, Abu Zighan, Deir Alla, Karamah Dam Water, Znia (Mafraq). Long term sources to include Wihda Dam, Red Sea Water, Red Sea-Dead Sea Conveyance Project. This approach will include adequate capacity building for staff to operate and maintain infrastructure resources. **(Goal #2 and Goal #4)**
2. **We will fully use the wastewater treated effluent for the activity that demonstrates the highest social and economic return to replace fresh water. (Goal #1)**
3. **We will put a comprehensive risk management system in place to monitor the reuse of treated wastewater (Goal #1)**
4. **We will enforce buildings codes to use greywater, stormwater storage and water saving fixtures in coordination with the Ministry of Municipalities. (Goal #3)**
5. We will work within the Government to find suitable sources of energy to keep the cost of desalination low. (Goal #5)

# *Chapter 8 – Summary of Goals and Actions*

## Chapter 2 Water – Demand

### Goals for Water Demand by 2022

1. Irrigated agriculture in the highlands will need to be capped and regulated and the by-laws will need to be reinforced.
2. Appropriate water tariffs and incentives will be introduced in order to promote water efficiency in irrigation and higher economic returns for irrigated agricultural products
3. Jordanians are well aware of water scarcity and the importance of conserving and protecting our limited water resources.
4. Viable options to reduce water demand within each sector are readily available.
5. Water tariffs within and outside the water sector should support water demand management.
6. Non-revenue water to be 25% by 2022.

## Goal No. 1

**5. We could buy highland groundwater rights at market prices to reduce withdrawals from aquifers under stress.**

**6. Will bring increases in profit thus enabling farmers to upgrade technology and better afford increased water tariffs that more truly represent the value of water consumed.**

**13. We will modify policy and regulation to facilitate water allocation among users in Jordan by considering return per cubic meter used while ensuring satisfaction of basic domestic water need.**

## Goal No. 2

**1. We will create awareness among the Jordanian public and decision makers as it is the first step towards behaviour change and lays the foundation for policy change.**

**2. We will target audiences to include public and private sectors and the general public.**

**3. We will prepare and disseminate messages at multiple levels once audiences are identified and current levels of knowledge ascertained.**

**4. We will work with the Ministry of Education to introduce Water Awareness programs in the form of events and curricula at all school grades.**

**8. We will invite these associations to participate with the government in setting and implementing protection zones of surface and groundwater.**

**9. We will establish and implement Groundwater Management Plans in order to begin to slow this dramatic decline in groundwater. We will revise by-law 85/2002 on groundwater to conserve and protect groundwater from illegal use and over extraction**

## Goal No. 3

**11. We will adopt and enforce building and plumbing codes for buildings (including high rise – high density buildings) that set maximum water flow limits and minimum quality standards for plumbing fixtures.**

**12. Jordan will implement regulations (incentive structures) to encourage rainwater harvesting.**

**14. We will facilitate adoption of new innovative and proven technology to produce, distribute, and use and reuse water more efficiently and to increase economic productivity without increasing water use or waste.**

**15. Jordan will make readily available water saving fixtures and equipment for industries, municipalities, and homes and will structure incentive systems to promote their use.**

**16. Jordan will continue expanding the use of treated wastewater, which shows great potential for agriculture, industry, and urban landscapes.**

## Goal No. 4

**7. Jordan must remove tariffs on imported crops to promote transition to crops with higher economic returns per unit of water used. For instance, growing bananas is a commonly cited but not unique example of an egregious waste of water to produce a crop that can be imported significantly cheaper than it can be produced in Jordan. Jordan can no longer afford such uneconomical use of scarce water supplies.**

**10. We will revise the bulk tariff setting mechanism to reflect the real value of water. Low tariffs encourage waste and low-value uses and provide no incentive for efficient water distribution and use by water delivery authorities and customers.**

## Goal No. 5

**We will reduce non-revenue water to 25% by 2022 with technical losses below 15%.** To reach this goal will require the rehabilitation of water supply systems (including improved water meters), optimization of operation and management, and network restructuring.

## Chapter 3 Water Supply

### Goals for Water Supply By 2022

1. Uninterrupted safe and secure drinking water supply achieved including continuous flow in Amman, Zarqa, Irbid, and Aqaba.
2. Water supply from desalination is a major source.
3. Drinking water resources are protected from pollution.
4. Surface water is efficiently stored and utilized.
5. Treated wastewater effluent is efficiently and cost-effectively used.
6. Groundwater management plans to ensure safe yield are operational.
7. The concept of utilizing greywater and rainwater is fully embedded in the codes and requirements of buildings.
8. Our shared water rights are protected.

## Goal No. 1

**18. Jordan must make a national effort to improve existing systems, expand them to cover areas not being served, and to improve technical and managerial capabilities. Policy issues related to water distribution should focus primarily on questions of efficiency and recouping investment. The general objective of any water distribution system is to distribute water to consumers in adequate quantity and quality and at the required time to meet the demand in the most efficient manner.**

**19. Jordan must make improvements in water distribution systems including the removal of inadequacies in the various components of the existing systems, such as operational problems, metering problems, supply interruptions, undersized pipes, high water losses in the tertiary networks, lack of automated pressure management approaches leading to high operation pressures, and absence of pressure zones.**

**20. WAJ will continue with the enhancement of the operation and maintenance of the existing distribution systems and reservoirs, and the rehabilitation of old and damaged components. Conjunctively, WAJ will continue ensuring proper, safe, and high standards and specifications for pipe and other materials and for construction and operation and maintenance practices. In this regard, WAJ will increasingly make use of specifications focusing on lowest life-cycle costing instead of lowest initial costs, since experience shows that cheap solutions often have much higher operation and maintenance costs.**

**20. We will improve the efficiency of water distribution through improved planning, better operation and maintenance, and strengthened technical, managerial, and financial capability of concerned departments.**

**22. Jordan will set aggressive targets to begin to move district by district towards continuous supply in major metropolitan areas including Amman, Zarqa, Aqaba, and Irbid. We will plug the distribution leaks and improve metering, billing, and collection systems. Studies have shown that in countries with limited water supplies, continuous supply is still possible. The eventual benefits from a continuous supply system are many including overall reduction in water losses, enhanced water quality, and reduced operation and maintenance issues.**

**23. We will establish a critical path for the allocation of each new source of water**.

**24. We will give first priority to allocation of the basic human needs, and as such, first priority is given to the allocation of a modest share of 100 liters per capita per day to domestic water supplies**.

**25. We will increase the energy efficiency of the water supply and distribution systems and harness alternative energy sources to provide 20% of the power required to pump water throughout the Kingdom**.

**26. We will prepare and continuously update balancing and allocations plans as part of the NWMP.**

**27. We will continuously update the Water Information System at the Ministry of Water and Irrigation.**

**28. We will tap surface water and groundwater when shown to be economically, socially, and environmentally sound.**

**29. We will formulate a long-term plan for the exploitation of resources and a revolving five-year plan shall be extracted from it and updated as necessary.**

**30. Jordan will ensure that the guiding principle of water resource management focuses on economical, environmental, and social sustainability.**

**31. We will review previously developed resources including resources mobilized for irrigated agriculture in the Jordan Valley and other established uses for confirmation of water allocation according to the sustainability principle.**

**32. We shall continually aim at achieving the highest efficiency in water conveyance, distribution, and application and to minimize operation and maintenance costs.**

**37. We will monitor and rate performance efficiency of water and wastewater systems and their management**.

**38. We will continually appraise human resource performance to upgrade capabilities and sustain excellence**.

## Goal No. 2

**11. We will assess the potential of brackish water resources in terms of sound technical, economic and environmental feasibility in all groundwater basins within the Kingdom, and then conduct research and studies on desalination and on optimization of brackish water use in agriculture and industry.**

**12. We will continue to encourage international cooperation for the promotion of research, development, information exchange, and training in the field of desalination and other non-conventional sources.**

## Goal No. 3

**5. We will continuously monitor the quality status of surface and groundwater and the impact of potentially polluting activities on water resources. We will initiate corrective measures to reduce the risk of pollution to a minimum including establishing protection zones for both surface and groundwater. We will make recommendations on what should be done to minimize pollution risks and implement them in coordination with other Ministries.**

**6. We will actively participate in the process of land-use licensing in coordination with other Ministries in order to minimize negative impact on the groundwater and surface water resources from potentially polluting land-use activities.**

**7. We will provide standards, guidelines for design and best management practices for potentially polluting activities, taking into consideration the need for water resources protection.**

**8. We will rehabilitate springs and wells as well as the existing water supply infrastructure in order to better protect water sources from pollution.**

**13. We will update standards for drinking water, for industrial wastewater discharges to sewers and for treated wastewater reuse and support its enforcement.**

**14. We will continue to monitor all water resources to ensure that standards are met and that sufficient funding, facilities, training, and coordination occur.**

**15. We will give particular attention on adopting and enforcing effluent and sludge standards for municipal and industrial wastewater treatment plants and for discharge from laboratories, hospitals, slaughterhouses, and other businesses.**

**16. We will implement an outreach program to ensure that awareness is created and people know how to properly maintain their rooftop storage tanks to reduce the possibility of contaminated water entering the household.**

**17. We will ensure that all our projects have Environmental Impact Assessments during the planning and design stage and Environmental Management Plans during the construction stage.**

## Goal No. 4

**1. Jordan will continue to study opportunities for further investment in surface water facilities. We will schedule a plan to enhance the storage of dams by removing sediments that accumulated over the years.**

**2. We will implement a comprehensive monitoring and assessment program for surface water quantity, quality, uses and protection as well as establish an integrated development and conservation program to increase the potential of surface water development in Jordan that will promote.**

## Goal No. 5

**10. We will continue to expand the safe use of treated wastewater by building new wastewater treatment plants and exploring productive uses in agriculture, industry, and urban landscapes. We will explore the potential for using treated wastewater for aquifer recharge as is done in other parts of the world.**

## Goal No. 6

**3. We will support the enactment by-law 85/2008 and will implement a program that sets out legal and financial measures aimed at controlling and gradually reducing groundwater withdrawals with the final objective of maintaining the safe yield of aquifers.**

**4. We will upgrade an integrated program to assess the availability and exploitability of all resources at rates that can be sustained over time.**

**9. We will further encourage the application of applied research activities.**

## Goal No. 7

**33. We will look to maximizing the use of alternative water sources including the use of greywater and rainwater harvesting.**

## Goal No. 8

**34. Jordan shall protect and defend the rightful shares of the Kingdom's water resources through bilateral and multilateral contacts, negotiations, and agreements. Opportunities for development of projects that provide multilateral or bilateral benefits shall be accorded special attention for construction, operation and maintenance.**

**35. We will continue to give due respect to the provisions of international law as applicable to water sharing, protection and conservation, and those applicable to territorial waters.**

**36. Bilateral and multi-lateral co-operation with neighboring states shall be pursued through a Regional Water Charter.**

# Chapter 4 - Institutional Reform

## Goals for Institutional Reform By 2022

1. Water law is enacted and enforced.
2. Strong policy development and water resource planning strategies and capabilities forged.
3. Governance functions and operational functions are separated.
4. "Wholesale" operations (national infrastructure) and "retail" operations (service delivery) are separated.
5. A Water Council is operational allowing for broad stakeholder input into water management.
6. A Water Regulatory Commission of Jordan is established.
7. Commercial principles drive water management while the needs of the poor are supported.
8. Staff are trained, number of staff is optimized, conflicts of interests are eliminated, and a dynamic working environment is created that is responsive to the needs of the sector.
9. The National Water Master Plan is institutionalized

## Goal No. 1

1. **We will prepare a new Water Law.**

2. **We will revise Groundwater by-law 85/2002 to introduce stringent controls on the use of groundwater including the abolition of the free abstraction and limiting the abstraction quantity based on the aquifer safe yield.**

3. **We will establish water resources protection legislation to legally implement water resources protection zones for drinking water resources.**

4. **We will study traditional water rights in Jordan in order to develop legislation that balances traditional rights with State rights while moving towards market-based allocation mechanisms. Development of appropriate legislation will require regular and systematic consultation with a diversity of stakeholders and water users.**

## Goal No. 2

5. **We will enact institutional reform to restructure the water sector over the next two-five years based on functional roles to cover governance, regulation, supply, transmission, distribution and advisory services.**

5. **A Ministry body will collect and analyze data, monitor sector performance, project and plan for future growth in water demand,**

5. **This Ministry body will ensure that the National Water Master Plan (NWMP) remains a dynamic document. The NWMP shall include the identification and selection of capital projects and should link between water sector planning and national development planning. The Information Technology (IT) and Geographic Information Systems (GIS) functions, including the maintenance of Geodata Inventories and relevant data handled via GIS, shall remain with the Ministry. Likewise, the Ministry will be responsible for maintaining a Water Information System (WIS)-function that will provide the required information products in support of business processes.**

## Goal No. 3

**5. A Ministry body will collect and analyze data, monitor sector performance, project and plan for future growth in water demand,**

**6. As the transition from the current to the new structure takes place, we will be guided by the following principles**

## Goal No. 4

**5. Developers of bulk water supply will be private consortia or companies that are moving towards privatization. This responsibility could be severed from the government institutional water sector. This would bring in the rigor and resources of the private sector,**

**both of which are needed for new and more efficient water supply systems. Management of bulk supply to retail users will be monitored by the Ministry and the Water Council to ensure equity, quantity, and quality is maintained.**

**5. Transmission will be the role of WAJ – a merger of all bulk water movement --comprised of components of the current systems. Examples include: collection of water from the Yarmouk River and transmission via the King Abdullah Canal and Deir Alla – Zai pipeline to the Miyahuna operated Zai Water Treatment Plant, collection of water from Wadis Mujib, Zara, and Ma'in and conveyance to the Zara Ma'in Water Treatment Plant, pumping water from the Mafraq well fields with delivery to Amman, and delivery of bulk irrigation water to water user associations at head units.**

**5. Distribution will continue the reform already implemented among the privatizing water utilities. Jordan should be split into at least three distribution segments (North, Middle, and South) each managed by a distribution utility. Retail distribution of agriculture water would be with Water User Associations (WUAs). To make this work efficiently and prevent conflicts of interest, all government stock in the three water utility companies should be sold to the private sector.**

## Goal No. 5

**5. The Water Council will analyze and endorse policies and regulations for the water sector and the Ministry will monitor and inform the Water Council on the implementation of these policies.**

## Goal No. 6

**5. We will enact institutional reform to restructure the water sector over the next two-five years based on functional roles to cover governance, regulation, supply, transmission, distribution and advisory services. Each of these roles is described briefly below and no existing entity is specifically mentioned. This is purposeful to avoid presupposing that any one entity will exist in its present structure after the reform. The reform will structure opportunities for greater private sector engagement through various business models. The specific roles and responsibilities of these functional roles will be defined through legislation. The action plan that will follow adoption of this strategy will articulate the timing and sequencing for development of these new functional roles.**

**5. The PMU shall transform into new Water Regulatory Commission needs to be established. This should be an independent body because it must be separated from political pressure and influence. If it is not separated from the government there is danger, and world experience shows this is very real, that the private sector components cannot function efficiently. Customers could suffer degraded service and ultimate failure of service through infrastructure neglect and deterioration.**

## Goal No. 7

**7. We will operate using best commercial practices within a regulated water market. More business-like approaches to water resources management will save water and reduce GOJ cost subsidies.**

**8. We will transition from subsidized and inefficient providers of a public service to a new structure that allows for commercial providers of a valuable commodity.**

**9. We will pay particular attention to the needs of the poor while improving commercial practices.**

**10. We will expand the role of the private sector. Management contracts, concessions and other forms of private sector participation in water utilities shall be considered and adopted as appropriate.**

**11. We will encourage and expand the private sector's role in the distribution of retail water, wastewater, treated effluent and irrigated water.**

**12. We will review the water tariff in order to facilitate behaviour change related to crop selection, cropping pattern, irrigation practices, and water conservation.**

**13. Concurrently, Jordan will work to reduce and remove tariffs and customs duties that make imported agricultural commodities less competitive in Jordan's markets.**

**14. We will establish the real cost of operation and maintenance and charge for irrigation water accordingly.**

**15. We will set municipal water and wastewater charges at a level that will cover the cost of operation and maintenance.**

**16. We will set differential prices for water based on water quality, the end users, and the social and economic impact of prices on the various economic sectors and regions of the country. We will also attempt to regularly review and adjust water tariffs based on the costs of supply, operations, and the comprehensive analysis of economic data.**

**17. Jordan will structure water tariffs as a tool to drive water consumption behaviour change that should lead to more efficient use of water.**

**18. Jordan will set wastewater charges, connection fees, sewerage taxes and treatment fees to cover at least the operation and maintenance costs plus part of the investment cost. The ultimate aim is for a full cost recovery to be achieved within five years.**

**19. We will establish appropriate criteria in order to apply the "polluter pays" principle.**

**20. We will structure different fees for different geographical areas. This shall be assessed for each geographical area as a function of the cost to deliver water to the area, end uses and effluent quality and will be subject to economic and social considerations.**

**21. We will sell treated effluent at a price covering at least the operation and maintenance costs of delivery.**

## Goal No. 8

**22. We will establish Human Resources (HR) Management as a key management function including HR Administration, HR Planning, HR Development & Training, and Labour Relations.**

**23. Jordan will improve the capabilities of human resources in the management of water, wastewater, irrigation and dams through better vocational training and continuous education.**

**24. We will assess the working environment within the water sector and make adjustments by refocusing job descriptions and lines of authority, by striving to enhance communication and coordination among functional units, and by application of incentives.**

**25. We will set up a National Water Training Center for ongoing education and vocational training measures**.

**26. We will set regulations for 'Utility Certification' according to defined standards to ensure delivery of high quality services to customers. This will be linked to certification of technical staff from water and wastewater treatment plants, pumping stations and networks**.

**27. Unit in charge of 'Standardisation, Certification, Documentation & Quality Control'**

**28. We will establish a Water Research Unit within the Ministry.**

**29. We will facilitate cooperation among specialized research institutions in the country as well as abroad.**

## Goal No. 9

**5. This Ministry body will ensure that the National Water Master Plan (NWMP) remains a dynamic document. The NWMP shall include the identification and selection of capital projects and should link between water sector planning and national development planning. The Information Technology (IT) and Geographic Information Systems (GIS) functions, including the maintenance of Geodata Inventories and relevant data handled via GIS, shall remain with the Ministry. Likewise, the Ministry will be responsible for maintaining a Water Information System (WIS)-function that will provide the required information products in support of business processes.**

# Chapter 5 - Irrigation Water

## Goals for Irrigation Water by 2022

1. The annual water allocation for irrigation in the Jordan Valley will be reduced to 661 MCM in 2022 (293 MCM in 2007) and in the Highlands reduced to 191 MCM in 2022 (304 MCM in 2007).

2. Efficient bulk water distribution as well as efficient on-farm irrigation systems are established.

3. All treated wastewater generated will be used for activities that demonstrate the highest financial and social return including irrigation and other non-potable uses.

4. Jordan will have one service provider for irrigation water for the whole country, whereas the retail function for irrigation water will be privatized and/or handled by empowered farmers' associations.

5. Appropriate water tariffs and incentives will be introduced in order to promote water efficiency in irrigation and higher economic returns for irrigated agricultural products.

6. Alternative technologies such as rainwater harvesting for enhancing irrigation water supply will be promoted.

**Goal No. 1**

**2. Irrigated agriculture in the highlands will need to be capped and regulated and the by-laws will need to be reinforced.**

**15. We shall strictly follow and implement Bylaw 85/2002 to close down any water wells which extract water from a deteriorating and depleted aquifer.**

**16. We shall implement the bylaw to close down all illegal water.**

**Goal No. 2**

**1. We will enhance on-farm irrigation efficiency in order to maximize the agriculture output of a unit of land area per unit flow of irrigation water.**

**5. We will limit the use of brackish water in irrigation in order to minimize soil salinity and conserve brackish water for other uses.**

**6. We will reduce evaporation losses and pollution by conveying water through closed pipes networks and minimize energy costs through gravity flow systems. Supplementary pumping shall be used where needed.**

**12. We will meter irrigation water at strategic locations. Digital meters shall be installed for volumetric measurement of in-flowing water.**

**Goal No. 3**

**4. We will use all treated wastewater for irrigation whenever safely possible while ensuring that health standards for farm workers as well as consumers are reinforced.**

**Goal No. 4**

**7. We will have one organisation responsible for bulk water supply in the Jordan Valley.**

**8. We will establish a strict monitoring system and reinforce it rigorously in order to prevent illegal and/or over-exploitation of water wells.**

**9. We will review, amend and reinforce rigorously by-law 85/2002.**

**10. We will more clearly define, impart, and monitor training needs in order to improve the efficiency of bulk irrigation operations, forecasts and scheduling of irrigation services.**

**11. We will redefine the role of the new institution responsible for irrigation in the Jordan Valley to focus on regulation and supervision of services. Involvement of stakeholders and the private sector in irrigation management shall be introduced and gradually promoted.**

**14. We will monitor abstraction from all groundwater wells periodically to assure conformity with the provisions of the abstraction permits.**

**21. We will implement periodic preventive maintenance of pumps, motors and valves. Human resources for proper maintenance management shall be in place and properly trained.**

**Goal No. 5**

**13. We will gradually phase-out of the business of irrigation water distribution.**

**17. We will discourage planting crops with high water requirements through the use of market pressures by imposing higher water tariffs on irrigated agriculture.**

**18. We will control planting of perennial crops through permits. This should be linked to water balance and stress.**

**19. We shall encourage the private sector to increase irrigation efficiency in the highlands by introducing appropriate water tariffs and incentive systems.**

**20. We shall encourage automation of irrigation networks.**

**Goal No. 6**

**3. We will promote the use of rainfall harvesting methods for use in irrigation. (Goal #6)**

## Chapter 6 - Wastewater

### Goals for Wastewater by 2022

1. All the major cities and small towns in Jordan are provided with adequate wastewater collection and treatment facilities.
2. All major industries and mines have wastewater treatment plants.
3. New high-rise buildings use greywater for internal non drinking purposes.
4. Public health and the environment, in particular groundwater aquifers, are protected from contaminated wastewater in the areas surrounding wastewater treatment plants.
5. Treated wastewater is used for activities that provide the highest return to the economy. For irrigation use in the Jordan Valley and in the Highlands, a comprehensive risk management system is in place.
6. The quality of treated wastewater from all municipal and industrial wastewater treatment plants meets national standards and is monitored regularly.
7. Tariffs for wastewater collection are rationalized.
8. All treatment plants are operated according to international standards and our manpower is trained accordingly.

**Goal No. 1**

**5. We will maintain and upgrade where necessary existing levels of wastewater services to enhance public health and the environment.**

**13. We will establish innovative approaches to wastewater treatment for the small municipal systems. Design criteria, performance specifications and guidelines for such systems shall be adopted and generalized.**

**18. We will adopt appropriate wastewater treatment technologies with due consideration to sustainability, economy in energy consumption, and quality assurance of the effluent.**

**19. We will formulate a Wastewater Master Plan.**

**20. We will rehabilitate all sewerage pipes which are over 10 years old.**

**21. We will treat sewage from un-served areas either in municipal or in well monitored and maintained facilities designed to receive that septage.**

**24. We will encourage power generation from sludge, if proven technically, economically and financially feasible with due attention to environment impacts**

**25. We will process sludge produced from the treatment process so it may be used as fertilizer and soil conditioner.**

**29. We will give priority to collection and house connections to expansion of urban areas served by treatment facilities.**

**Goal No. 2**

**10. We will encourage industries through an appropriate incentive system to treat their wastewater and to meet standards set for ultimate wastewater reuse or to meet the regulations set for its disposal through the collection systems and/or into the receiving environment.**

**11. We will treat separately wastewater from industries with significant pollution to standards allowing its reuse.**

**30. We will give priority to situations and locations where wastewater disposal practices threaten the environmental integrity of freshwater resources and where performance of cesspools and percolation pits pollute underground water aquifers. (Goal #2)**

**Goal No. 3**

**36. We will encourage collection of storm water from roof tops on an individual basis for domestic use.**

**Goal No. 4**

**4. We will conduct an environmental impact assessment.**

**7. We will coordinate with official bodies in charge of urban development to account for the treatment and disposal of liquid wastes.**

**8. We will issue specifications and minimum standards for the use of septic tanks in rural areas.**

**14. We will construct wastewater collection and treatment systems taking into consideration the need to protect groundwater and surface water resources from pollution by wastewater.**

**16. We will ensure that appropriate wastewater collecting systems and treatment facilities are provided for all sources of wastewater, wherever feasible.**

**35. We will install observation wells near the treatment plants to monitor whether there are changes in groundwater quality along the groundwater flow path and to mitigate adverse impacts where and when needed.**

**Goal No. 5**

**1. We will manage treated wastewater as a perennial water source which shall be an integral part of the national water budget.**

**6. We will produce an effluent fit for reuse in irrigation in accordance with WHO and FAO guidelines as a minimum.**

**9. We will prioritize the use of treated wastewater for the activity that generates the highest social, environmental and economic return.**

**18. We will adopt appropriate wastewater treatment technologies with due consideration to sustainability, economy in energy consumption, and quality assurance of the effluent.**

**23. We will conduct studies, design and implement projects to store the excess treated wastewater in surface reservoirs or in underground reservoirs. (Goal #5)**

**27. We will oblige industries to recycle part of their wastewater and to treat the rest to acceptable standards before it is discharged into the sewer systems or elsewhere.**

**28. We will establish a reuse unit with well qualified staff to be responsible for the planning, design, construction and management of treated wastewater. (Goal #5 and #8)**

**34. We will periodically analyze and monitor all crops irrigated with treated wastewater or mixed waters.**

**38. We will create awareness of the public through various means about the risks**

**39. We will design and conduct programs on public and farmer's awareness.**

**40. We will begin to inform the public of use of treated wastewater for aquifer recharge as is done in other countries.**

**Goal No. 6**

**2. We will ensure that all wastewater from municipal or industrial treatment plants will be treated in such a way that the effluent meets the relevant national standard.**

**3. We will conduct regular monitoring of the quality of the effluent from every wastewater treatment plant in the country**

**8. We will issue specifications and minimum standards for the use of septic tanks in rural areas.**

**12. We will give priority to protecting public health and water resources from chemical and microbiological pollutants.**

**17. We will also ensure that wastewater is not managed as "waste" but is collected, treated, managed, and used in an efficient and optimized manner. We will also ensure that treated effluent complies with recently established national standards (JS893-2006) and that all treatment is to a quality appropriate for use in agricultural activities and other non-domestic purposes, including groundwater recharge.**

**22. We will encourage farmers to use modern and efficient irrigation technologies.**

**33. We will develop extensive and comprehensive programs for monitoring the effluent from wastewater treatment plants.**

**37. We will maintain and properly equip laboratories as well as train staff.**

**Goal No. 8**

**2. We will ensure that all wastewater from municipal or industrial treatment plants will be treated in such a way that the effluent meets the relevant national standard.**

**6. We will produce an effluent fit for reuse in irrigation in accordance with WHO and FAO guidelines as a minimum.**

**15. We will standardize design and performance specifications of wastewater treatment plants.**

**26. We will establish the institutional capability for monitoring, regulating and enforcing wastewater regulations.**

**27. We will oblige industries to recycle part of their wastewater and to treat the rest to acceptable standards before it is discharged into the sewer systems or elsewhere.**

**28. We will establish a reuse unit with well qualified staff to be responsible for the planning, design, construction and management of treated wastewater.**

**31. We will use Jordanian Standards JS893/95, JS202/91, JS1145/96, WAJ's regulations for the quality of industrial wastewater to be connected to the collection system, and WAJ's specifications for sewerage works as benchmarks against which plans and specifications of treatment plants and wastewater reuse will be evaluated.**

**32. We will pay particular attention to adopting and enforcing effluent and sludge standards for municipal and industrial wastewater treatment plants and for discharges from industries, laboratories, hospitals, slaughterhouses and other businesses. (Goal #8)**

## Chapter 7 - Alternative Water Resources

### Goals for Alternative Water Resources by 2022

1. Treated wastewater will be used for the activity that provides the highest social and economic return and standards for use in agriculture will be introduced and reinforced.
2. Desalination projects at the Red Sea are operational
3. Rainwater harvesting is encouraged and promoted.
4. Infrastructure for desalination of sea and brackish water is sufficient.
5. An alternative energy source to keep the cost of desalination as low as possible is available.

**Goal No. 1**

**2. We will fully use the wastewater treated effluent for the activity that demonstrates the highest social and economic return to replace fresh water. (Goal #1)**

**3. We will put a comprehensive risk management system in place to monitor the reuse of treated wastewater (Goal #1)**

**Goal No. 2**

**1. We will establish a program to desalinate brackish and sea waters on a short, medium and long-term basis.**

**Goal No. 3**

**4. We will enforce buildings codes to use greywater, stormwater storage and water saving fixtures in coordination with the Ministry of Municipalities.**

**Goal No. 4**

**1. We will establish a program to desalinate brackish and sea waters on a short, medium and long-term basis.**

## Goal No. 5

5. **We will work within the Government to find suitable sources of energy to keep the cost of desalination low.**