Oman POWER & WATER Summit
22 - 25 May 2011
Muscat, Oman

وزارة البلديات الإقليمية و موارد المياه
Ministry of Regional Municipalities and Water Resources

Strategy For Sustainable Development, Management and Conservation of Water Resources In Oman

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Introduction

- Oman located within Arid and Semi-Arid regions where water resources are very scarce .
- Day time temperature are high, generally above 30 ºC and seasonally above 40 ºC .
- Rainfall varies, exceeding 350mm in the mountains, and less than 50mm in the desert(average 100mm)
- Evaporation varies from 1660 mm/yr in the Batinah plain to 2200 mm/yr in the interior .

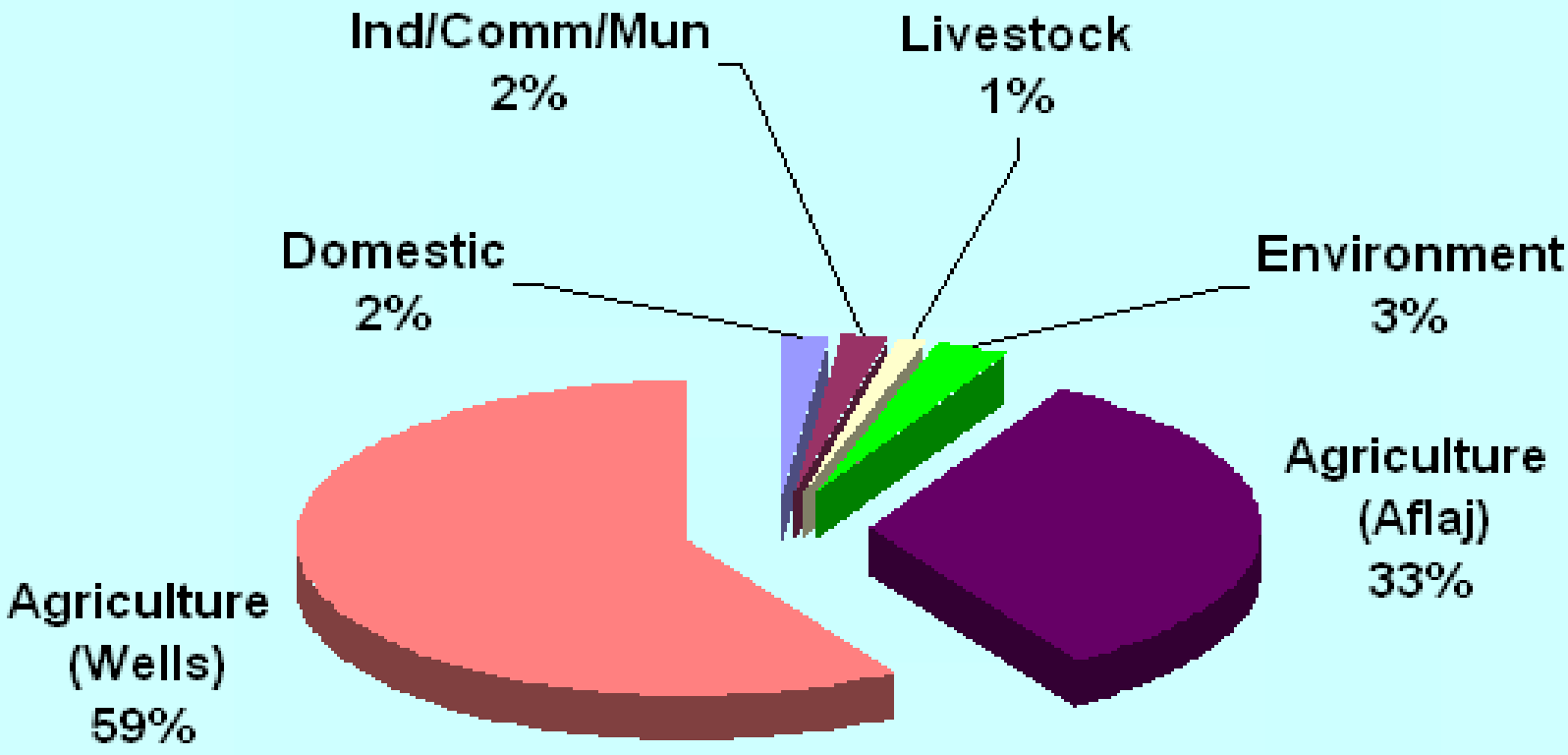
Water Resources

- Traditional Water Resources(Surface & Underground)
  - Groundwater – 130000 production wells
  - Aflaj - 4112 (3017 Flowing, 1095 Dry)
- Non- Traditional Water Resources
  - Desalination
  - Wastewater treatment
  - Virtual water

Present Water Situation

- Water availability = 500 m^3/capita;
  (~ 500 m^3/capita → extreme stress).
- Water levels and Aflaj flows are declining.
- Water demand exceeds renewable resources by 25% (378 Mm^3).
- intrusion in coastal aquifers.

Consumption of Water Resources



Agricultural Demand is about 92 % of available water

Water Resources Strategy

1. **Water Resources Conservation**

2. **Water Resources Development**

Water Resources Strategy

1. **Water Resources Conservation**
   - **Regulation and Legislation**
   - **Maintenance of water supply (Aflaj System)**
   - **Conservation**
   - **Integrated Water Resources Management**

Regulations and Legislation

- **Royal Decree 82/88 refer to "The water Resources is a National Resource.**
- **Royal Decree 29/2000 refer to "Water Protection Law"**
- **Ministral Decision 364/2000 Issuing the Regulations on Wells and Aflaj**

Maintenance of Water supply

Improvement in Aflaj System

- Routine maintenance and repairs of falaj
- Improve aflaj water irrigation system.
- Support dry aflaj with wells
- No new wells allowed within 3.5 km
- Activate water structure protection laws.
- Establishment of Sector Water Allocations
- Management of Aflaj Water Demand

Aflaj System

Falaj is a channel constructed above or below ground surface extending from the water source to the irrigated lands including water management and falaj administration.

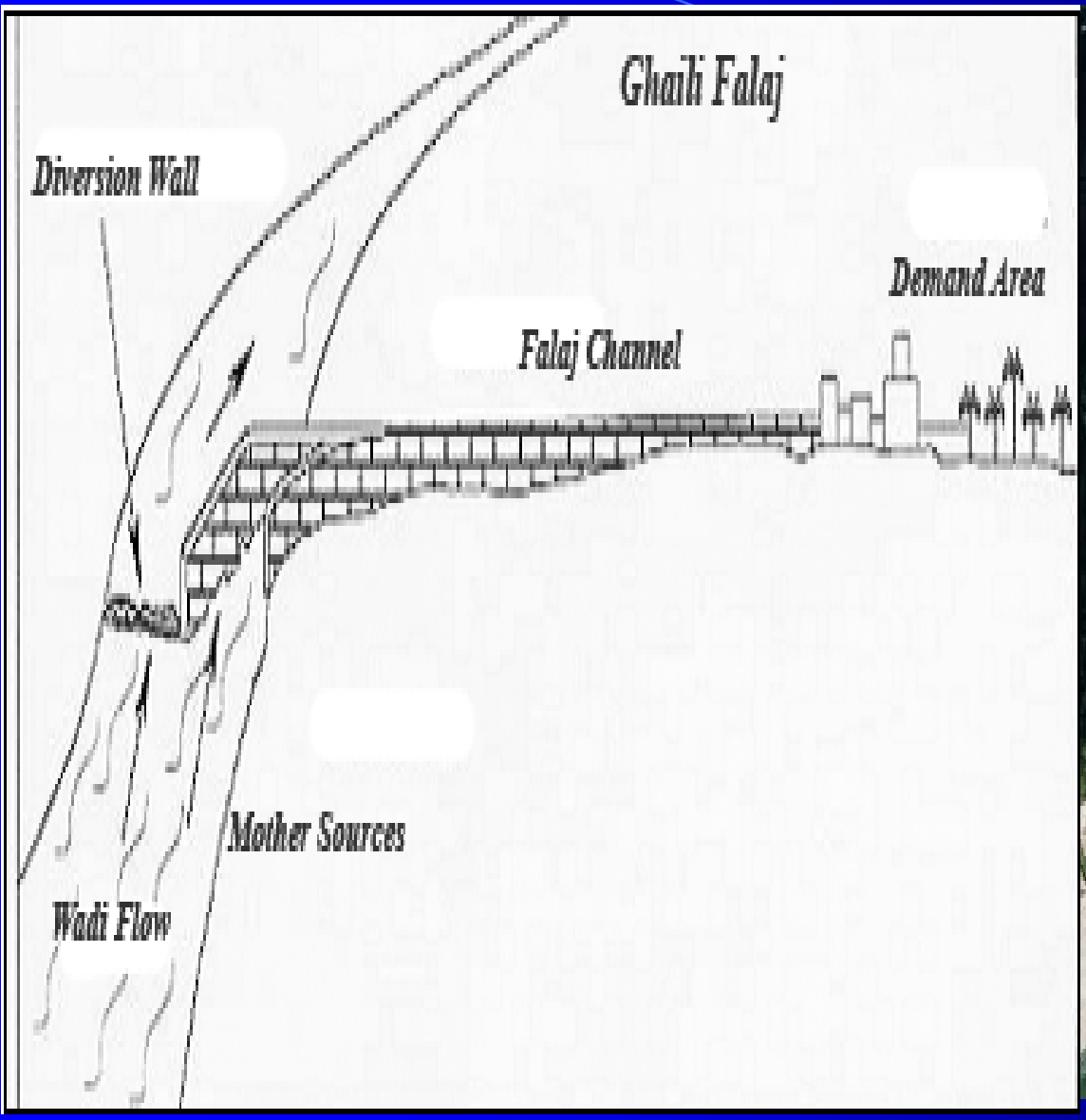
There are Three types of Aflaj;

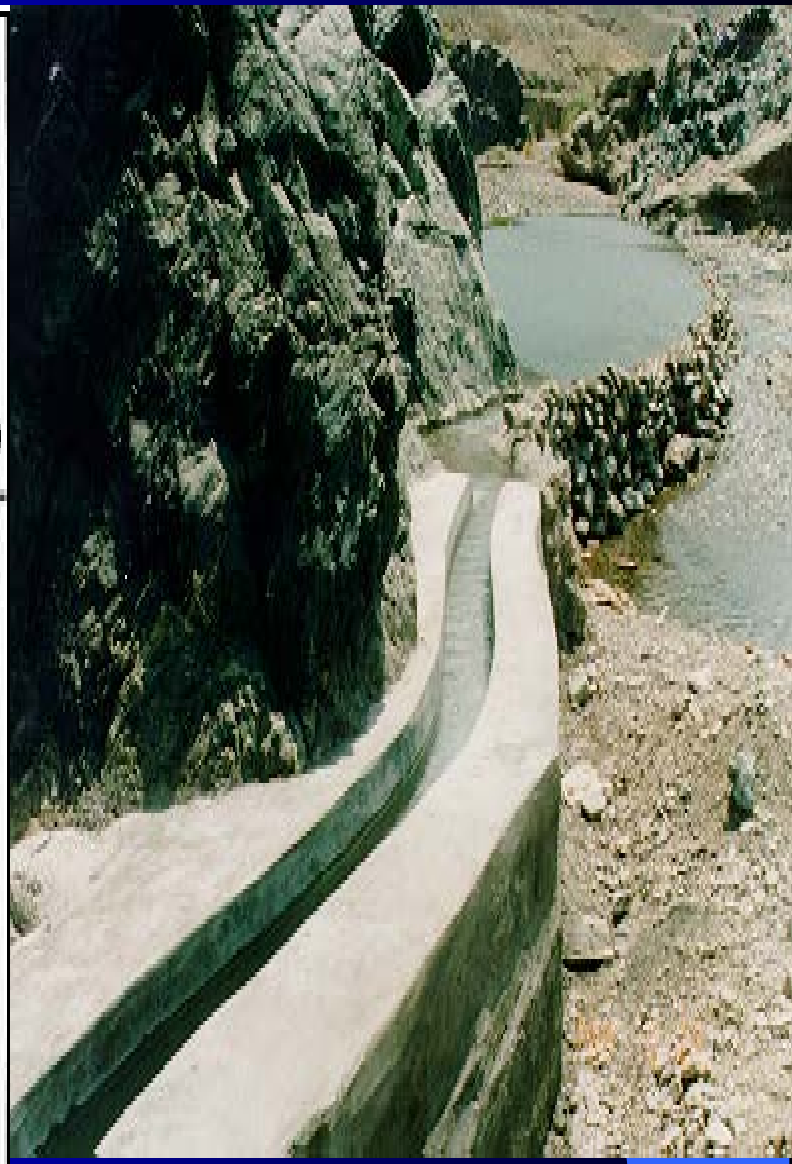
1- ***Ghaili***

2- ***Aini***

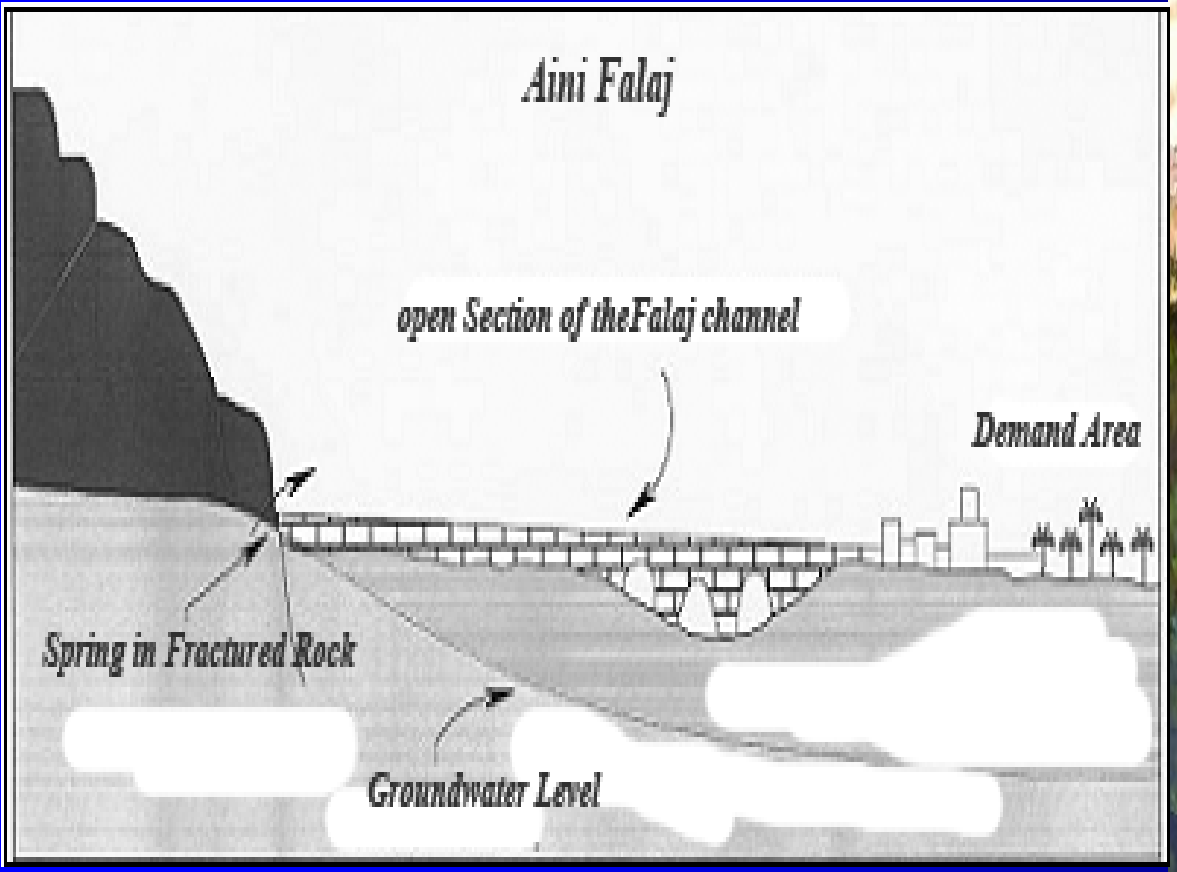
3- ***Dawoodi (Iddi)***

Ghaili Falaj : Fed From Surface Water

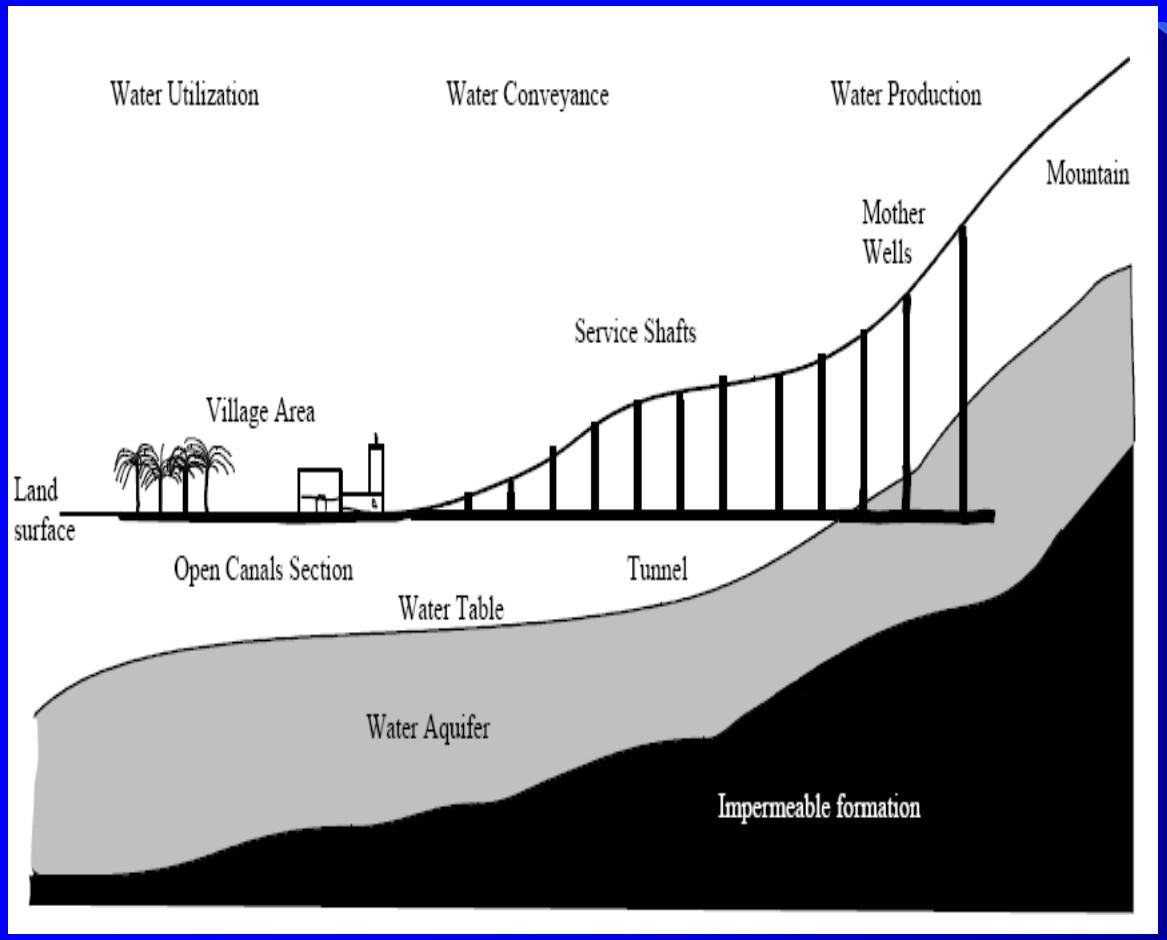




Aini Falaj : Fed From Spring



Daudi Falaj : Fed From Groundwater



3D Model For Aflaj Sytem

Underground Channel Construction

Construction Process

Surveying Process

Conservation

- **Awareness**

  - A lot of Awareness programmes are conducted to encourage water users to conserve water uses

- **Water Savers**

  -Modern irrigation techniques

  -Recycling of grey water (mosques ,…..)

  -Water savers in houses ,hotels ,schools and tourism locations

Integrated Water Resources Management

- There is increase in water demand by 50% till 2020.
- Target of management strategy:
- Ensure security and sustainability of supply for priority use.
- Maximize the use of natural water resources.
- Matching water use to water availability.
- Protecting water resources.
- Augmentation of water resources through:-
  1. Increase artificial recharge.
  2. Water conservation
  3. Demand management
  4. Increase use of non- conventional water resources

Water Resources Strategy

2. **Water Resources Development**
    - **Water Resources Assessment**
    - **Construction of Dams**
    - **Augmentation of Water Supply**

Water Resources Assessment

1. **Surface & Groundwater Assessment have been undertaken in all major catchments mainly through:**

- ❑ **Feasibility studies for recharge dams**
- ❑ **Hydrological studies**
- ❑ **Data collection and analysis**
- ❑ **Aquifer Test**
- ❑ **Geophysical and topographic survey**
- ❑ **Exploration**

Water Situation Monitoring

Today the Ministry operates 4680 different stations

- To obtain baseline data for resource assessment
- To observe unpredicted variations that may occur
- To observe effects of actions that have been taken
- To carry out regulatory or compliance control

Distribution of Monitoring Network

				Rain Gauges							Salinity		
Region	Wadi Flow	Peaks	Dams	STD	AUT.	Wells	Aflaj	Springs	Khawrs	Discharge	Well	Falaj	TOTAL
Muscat	16	6	1	5	24	173	70	5	0	0	45	75	420
S. Batinah	21	1	9	0	35	123	72	16	0	0	22	72	371
N. Batinah	28	10	5	17	25	228	24	0	0	0	38	24	399
Musandam	6	0	5	5	9	88	1	0	0	0	0	1	115
Al Buraimi	6	1	1	4	10	242	18				9	18	309
Ad Dhahirah	11	0	1	9	21	274	70	0	0	0	25	70	481
Ad Dhakhliyah	18	1	7	10	23	341	113	6	0	0	71	119	709
N. As Sharqiyah	13	3	0	3	41	206	116				15	116	513
S. As Sharqiyah	5	4	1	0	16	183	40	0	0	40	32	40	361
Salalah	6	0	1	18	15	170	0	37	11	139	353	48	798
Nejd	4	0	0	6	17	55	0	0	0	0	96	0	178
Al Wusta	0	0	0	2	0	24	0	0	0	0	0	0	26
TOTAL	134	26	31	79	236	2107	524	64	11	179	706	583	4680
				315							1289		

National Wells & Aflaj Inventory

The National Well Inventory Project: embarked in 1992, was initiated with a registration process (167,000 wells) and followed by field inspection that provided a comprehensive data set on water levels, water quality, pump types, water use and irrigated areas. The total number of active wells inventoried was 130,000.

National Aflaj Inventory Project: commenced in 1997, recorded a total of 4,112 *aflaj* of which 3,017 were found operational

Aflaj Registration in the World Heritage

In 2006 five aflaj has been registered in the World Heritage list. by UNESCO.

- **Falaj Daris in Nizwa**
- **Falaj Khatmain in Nizwa**
- **Falaj Al Mayser in Rustaq**
- **Falaj Al Malki in Izki**
- **Falaj Al Gailah in Sur**

National Water Resources Master Plan

provide a sound basis for development and management of the country's water resources. The plan formulated a number of principles and strategies including:

- **Potable water supply for towns and priority purposes.**
- **Increase in recovery and development of indigenous water resources.**
- **Improvement in aflaj .**
- **Establishment of sector water allocations**
- **Management of agricultural water demand**

Construction of Dams

- Recharge Dams (31) contribute 84 Mm^3 /yr.
- Small Storage Dams (72) supply remote villages in upper catchments areas.
- Potential to increase recharge in some areas with more 300 Mm^3/yr lost to sea or desert.

Dhaiqah Storage Dam

Main Dam	
Storage Capacity	100 MCM
Height	73.6 m
Dam Length	400 m
Crest Width	5 m
Foundation Width	55.4 m
Concrete Quantity	570,000 m3
Design Flood	18,398 m3/s
Spillway Length	189 m
Culverts	11

Augmentation of Water Supply

Construction of Desalination Plants to secure municipal water supply

(this will coverd by other papers)

Conclusion

- Water is, and will remain, one of the nation's most valuable resources and its importance in the development process has long been well recognised
- Water Users must cooperate to conserve limited water resources.
- Integrated water resources management should confine and implemented in all catchments in Oman.
- Aflaj system is regarded as an important part of the Sultanate's cultural heritage and an important source of water for a large segment of society and its preservation is priority commitment

- Maintenance Programmes of Aflaj should be continue to protect our ancient water resources structure .
- The most economic solutions to increase water availability lie in demand management (water “savings”)
- Constructing of more Dams is important to augment our water resources.
- Increase treatment and reuse of wastewater, desalination and the strategic use of non-renewable water reserves offer potential for significant additional contributions


Thank You For Your
Attention