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WASTE TO TAP-
ASR : A Viable Option

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“and we have made from water every living thing”.
– Surat Al Anbiya’- Ayat 30- The Holy Quran

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Water Situation in The Middle East & North Africa

Total Renewable Water Resource per Capita – by Country

Country	Total Renewable water per capita in MENA (m3/inhabitant/year)	
	2000	2008
Iraq	3,077.00	2,512.00
Iran	2,020.00	1,876.00
Syria	1,511.00	791.40
Lebanon	1,226.00	1,074.00
Morocco	964.00	917.50
Egypt	827.00	702.80
Tunisia	472.00	451.90
Algeria	458.00	339.50
Djibouti	433.00	353.40
Oman	356.00	502.70
West Bank and Gaza	268.00	n/a
Yemen	212.00	91.60
Jordan	165.00	152.70
Bahrain	164.00	149.50
Libya	110.00	95.30
Saudi Arabia	102.00	95.20
Qatar	88.00	45.30
UAE	51.00	33.40
Kuwait	8.00	6.80

*Source: FAO AQUASTAT DATA BASE

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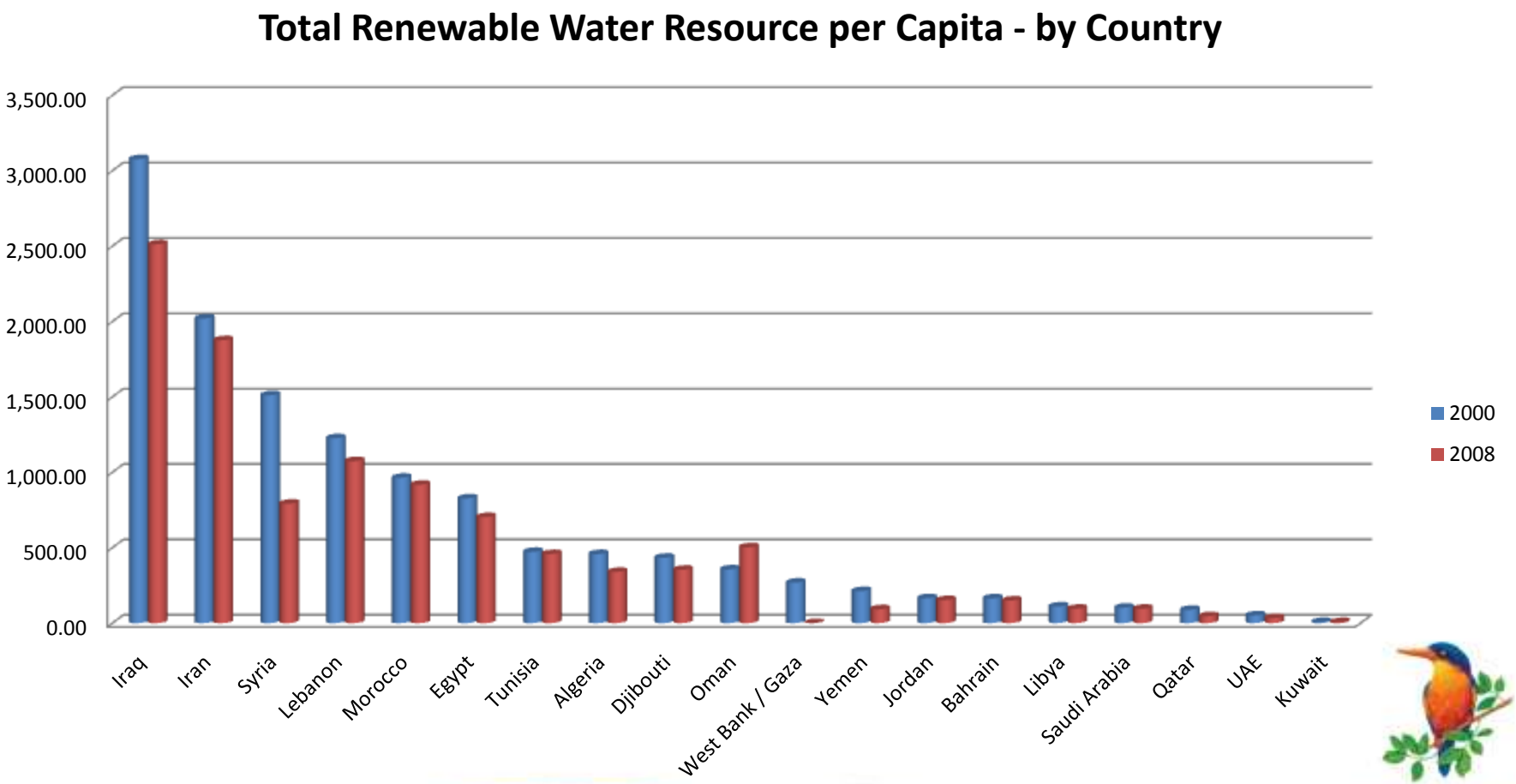
Water Situation in The Middle East & North Africa



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Water Situation in The Middle East & North Africa

Country	Total Water withdrawal as percentage of total renewable water resources		
	2000	2008	2008 Agriculture
Kuwait	2,200.00	2,460.00	2,075.00
UAE	1,533.30	1,867.00	2,208.00
Saudi Arabia	845.80	936.20	867.90
Libya	711.30	711.30	597.30
Qatar	547.20	381.00	451.70
Bahrain	258.60	205.80	173.20
Oman	138.10	83.93	83.43
Yemen	125.90	161.10	145.70
Egypt	117.20	94.70	103.00
Jordan	114.80	90.46	65.23
Syria	76.00	82.68	87.32
Tunisia	57.50	61.28	47.12
Iraq	56.60	67.70	62.55
Iran	53.00	85.30	68.77
Morocco	43.40	43.40	37.97
Algeria	42.40	51.80	33.76
Lebanon	31.30	28.00	17.30
Djibouti	6.30	6.30	1.00

***Source: FAO AQUASTAT DATA BASE**

***Values above 100 percent indicate withdrawal of non-renewable groundwater resources or use of desalinated and other supplemental water resources that are not included in the total annual water resources figure.**

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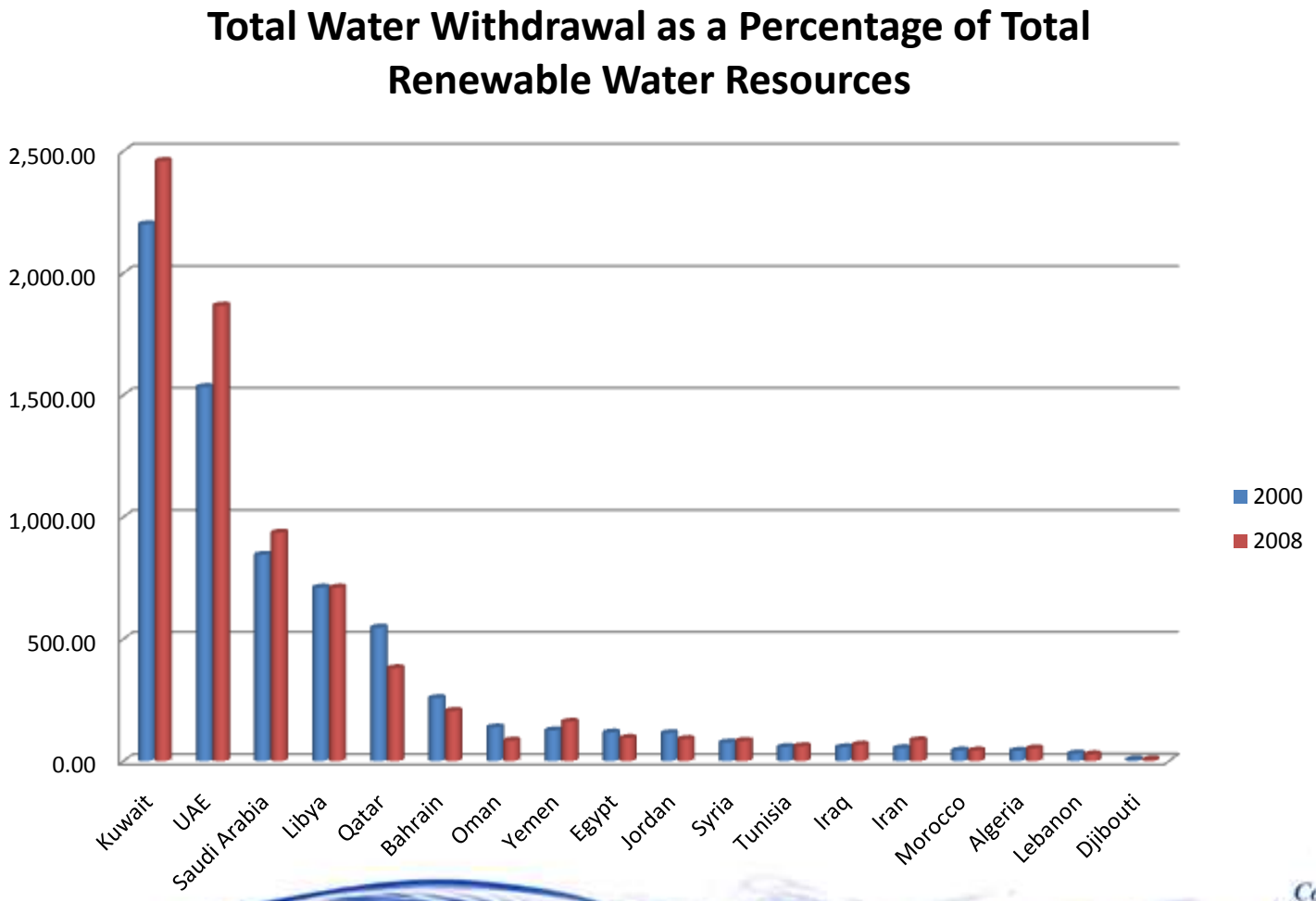
Water Situation in The Middle East & North Africa



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Water in Syria

✓**Damascus relies on al Fijeh springs for its potable water supplies**

- AlFijeh productivity : 220,000 m^3/d
- Barada wells productivity : 95,000 m^3/d
- Water deficit in Damascus estimated at : 46,000 m^3/d
- City is supplied with water 7 hours daily
- Network losses estimated at 20% (down from 60% - replacement of networks, new water meters, reducing illegal connections etc)

*** Source: local and online media**

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Water in Syria

In Reef Dimashq :

- Water needs estimated at 356,000 m^3/d
- Available water resources : 248,600 m^3/d
- Water deficit : 107,400 m^3/d
- Network losses estimated at 40%

✓ Total water needs for Damascus and Reef Dimashq : 791,000 m^3/d – could increase seasonally to 956,000 m^3/d

✓ Total available water resources for Damascus and Reef Dimashq: 637,600 m^3/d

✓ Total water deficit for Damascus and Reef Dimashq: 153,400 m^3/d

Water deficit will keep on increasing as water demand escalates and available water resources diminish

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Water Reclamation and Reuse

Conventional Applications:

- Irrigation, both restricted and unrestricted
- Industrial uses, for cooling purposes or as process water
- Recreational uses, involving non-potable uses like artificial lakes and foundations
- Non potable water reuse, like fire protection and toilet flushing

Non-conventional Applications:

- Aquifer recharge, through spreading basins or direct injection
- Potable use, through direct mixing with fresh water source

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Where Do We Go from Here?

ASR : Aquifer Storage and Recovery

It is a process whereby water is injected into an aquifer at a certain location and withdrawn later at a different point

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NEWater : Totally Recycled Wastewater

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NEWater : Totally Recycled Wastewater

Breaking the psychological barrier

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Sulaibiya Reclamation Plant in Kuwait

Plant Capacity: 375,000 m^3/d expandable to 600,000 m^3/d

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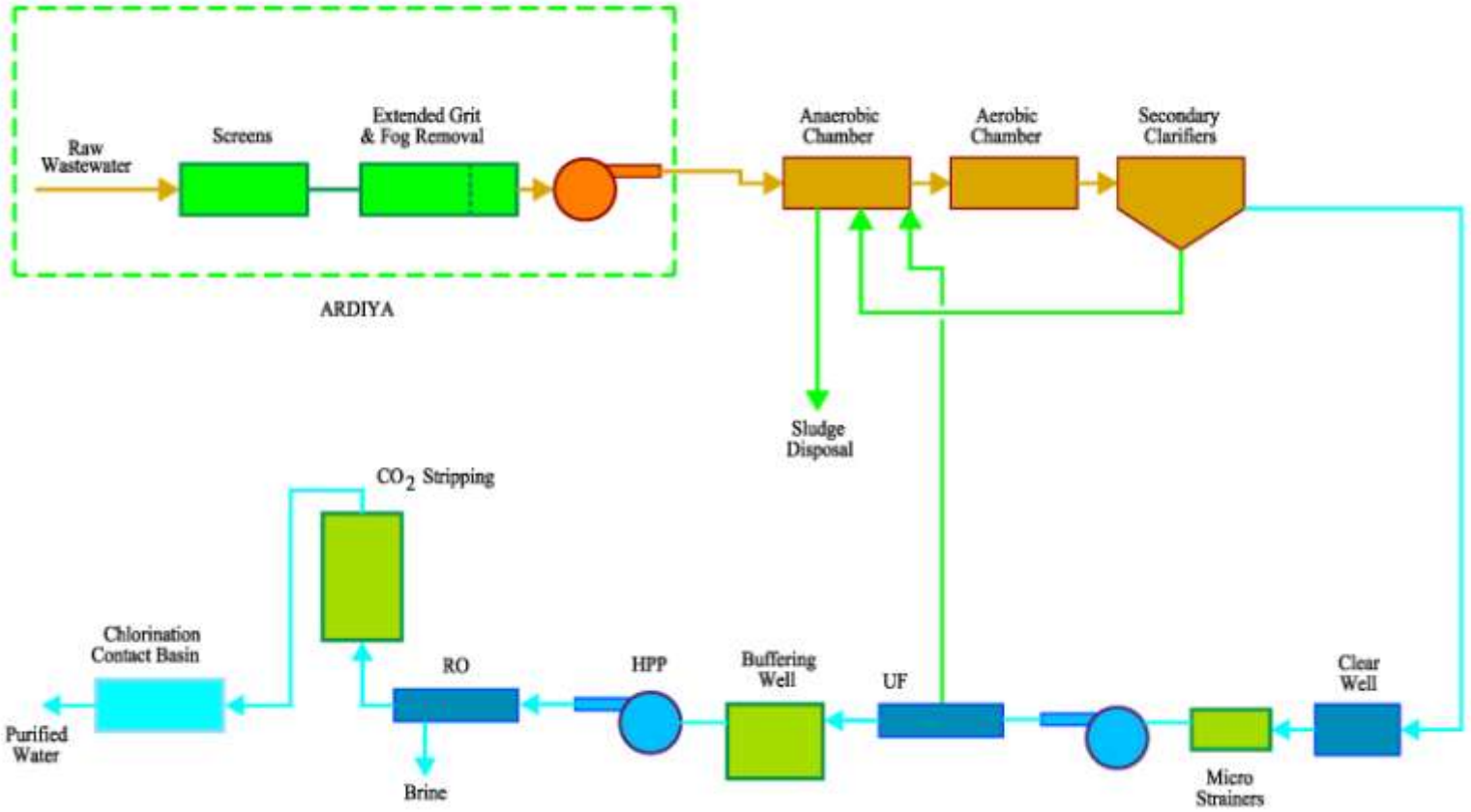
Sulaibiya Process Flow Drawing



*cost of water production using reclaimed wastewater was $ 0.47 per m^3

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Palm Jumeirah Reclamation Plant

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Palm Jumeirah Reclamation Plant

- Plant capacity 18,000 m3/d
- Feed is from MBR wastewater treatment plant and cooling towers blowdown
- Treated water intended to be used for district cooling

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Namibia Wastewater Recycling Initiative

- Sources of water: two rivers, one on the northern border and the other on the southern border
- The capital city of Windhoek relies for its water supplies on 3 dams built on rivers that run only for few days in the rainy season
- Evaporation rates were high, in the range of 35 Mm^3/year (95,890 m^3/d) · Utilized water was 15.7 Mm^3/year (43,000 m^3/d) only
- The authorities initiated in 1992 a water resources management program
- Four years later the demand was reduced to the 1989 level despite a 35% increase in population

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Windhoek Plant

New Goreangab Water Reclamation Plant (NGWRP)

- ✓ Plant Capacity: 21000 m^3/d
- ✓ Potable quality that would be suitable for aquifer recharge without creating any health hazards
- ✓ Water is blended with water in the Von Bach dam in a ratio not exceeding 35% of the mix
- ✓ High demand, high rate evaporation losses and excess water during the rainy days are pushing the local government towards the idea of "banking" water by injecting excess water from the dam into the aquifer

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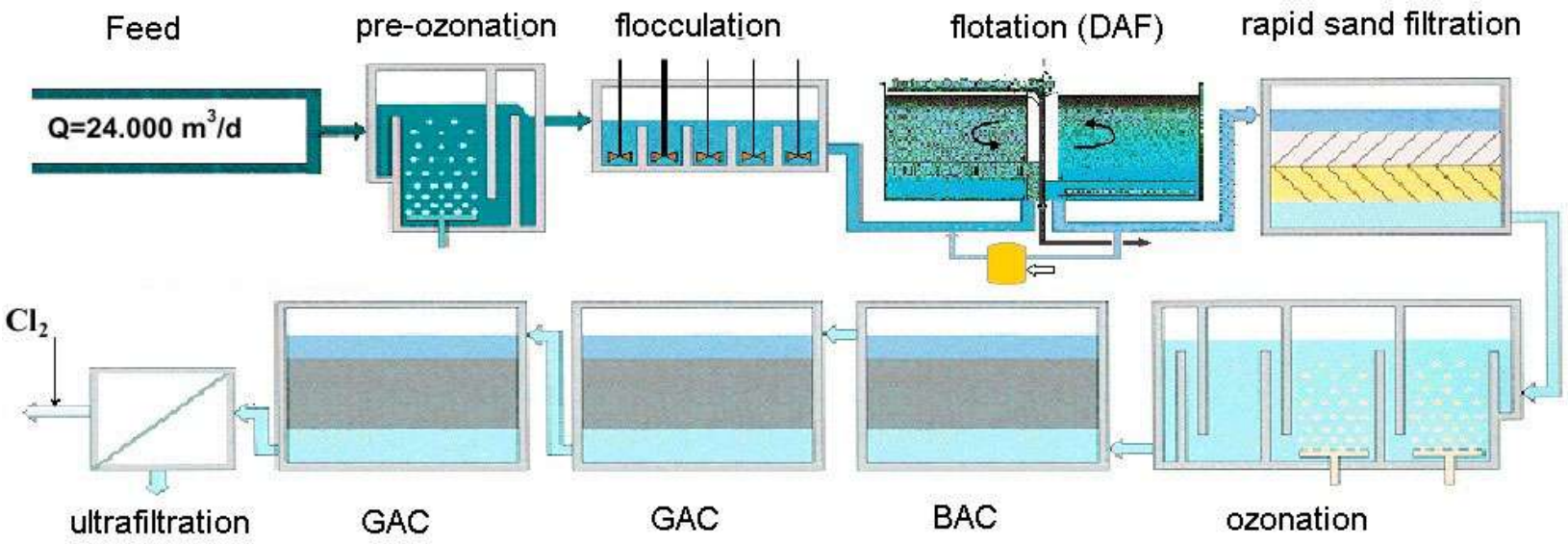
Namibia Wastewater Recycling Initiative



(DAF: dissolved air flotation, BAC: biological activated carbon-filter, GAC: granular activated carbon-filter)

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Namibia Wastewater Recycling Initiative

Major Quality Parameters for NGWRP

Parameters	Units	Raw water (design value)	Treated water (guarantee value)	WHO Guidelines	EU Directive	Results[1]
Physical & Chemical						
Turbidity	NTU	53	0.1	0.1[2]	[3]	0.08
DOC	mg/l	15	5			1.0
COD (dichromate)	mg/l	43	20			12.6
THM	µg/l	169	20	[4]	100	11[5]
Microbiological						
Giardia	per 100 ml	214	0 or log 6 removal			0
Cryptosporidium	per 100 ml	334	0 or log 6 removal			0
E. Coli	per 100 ml	20,347	0		0	0
Heterotrophic Plate Count (37°C)	per 1 ml	332,150	80			8
Elements						
Iron	mg/l	2.8	0.05		0.2	<0.05
Manganese	mg/l	0.9	0.005	0.4	0.05	<0.005

[1] Median at Performance Test
[2] Recommendation for Effective Disinfection
[3] No Abnormal Change
[4] Guideline Values: Chloroform 0.2 mg/l, Bromoform 0.1 mg/l, Dibromochloromethane 0.1 mg/l, Bromodichloromethane 0.06 mg/l
[5] Currently 4-6 µg/l have been accomplished

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El Paso Reclamation Plant - Texas

- The Fred Hervey reclamation plant, has a capacity of 38,000 m^3/day
- The plant treats waste water to a potable water quality, and then re-injects the major part of it into the Hueco basin aquifer
- Part of the water is recovered through wells

- The rest of the water is sold to the local electricity company for use in their cooling circuits, to a local golf course and to several other customers

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Qatar : Pilot Plant

- The government of Qatar, through the Public Works Authority, initiated a project for evaluating different membrane configurations for treatment of ***TSE***
- Metito designed and supplied a pilot plant for completing the desired study
- PWA contemplating the idea of ASR to create strategic storage facilities where fresh water can be withdrawn for future potable or other uses, thus adding to the renewable water resources of the country
- If implemented, it will be a pioneering project not only in the GCC but in the Middle East and all the Arab world

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Qatar : Pilot Plant

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Benifits of *ASR*

In addition to breaking the psychological barrier, aquifer recharge has several other advantages:

- Offers a secure water supply
- Recharge methods are environmentally attractive, particularly in arid regions
- Recharge can significantly increase the sustainable yield of an aquifer
- Aquifer water can be improved by recharging with high quality injected water
- Most aquifer recharge systems are easy to operate, and the technology is generally well understood
- Closing the loop in the water cycle

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Benifits of *ASR*

The location and extent of aquifers is dependent upon the geological conditions of the underlying rock. Careful selection of the aquifer and the related retention period achieves additional polishing features that include:

- ✓ Natural Remineralization: Soil layers may include certain minerals that could improve the quality of the water.

- ✓ Removal of Trace Organics: Certain natural soil aquifers are known to remove up to 99% of trace organic materials such as benzene, toluene and chloroform.

- ✓ Ion exchange: Some natural soils possess ion exchange characteristics that assist in the removal of certain ions like some heavy metals and ammonia.

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Benifits of *ASR*

Further benefits include:

- ✓ Natural filtration
- ✓ Reduction of nitrogen and phosphorus
- ✓ Denitrification

These features however are only applicable in the case where water is injected without the reverse osmosis advanced treatment

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Closing the Water Cycle Loop

Closing the Water Cycle Loop: Reclaimed Waste Water for Potable Use

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Closing the Water Cycle Loop

✓ Water supplies remain finite whilst water demands are on the increase

✓ Enhanced aquifer recharge with high quality reclaimed water is a viable option in the search for new potable water resources

✓ As more advanced technologies become available, potable quality reclaimed water can be made more affordable

✓Public authorities must embrace this option and work on a programme to increase public acceptance of such schemes

✓attempts should be made to break down the psychological barrier that exists in the waste-to-tap initiative

By implementing ASR, we could definitely close the water loop and preserve our precious water resources for the generations to come

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Thank you

Gracias

Grazie

Terima Kasih

ありがとう

Danke

Dank u

감사합니다

شكرا

Tashakkur

Merci

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