



King Abdullah Economic City (KAEC)

Pretreating Seawater with Ultrafiltration Membranes

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01 **Project Overview**

02 **Pretreatment Alternatives Analysis**

03 **Ultrafiltration System**

04 **Unique Project Challenges**

What is KAEC?





Suez Canal

Saudi Arabia

Red Sea

Yemen

Eritrea

Djibouti

Gulf of Aden

Kuwait

Persian Gulf

Bahrain

Qatar

Medina

المدينة المنورة

Abyar 'Ali

أبيار علي

المدينة المنورة

Yanbu

بيبع

Badr

بدر

Ar-Rayis

الرايس

Rabigh

رابع

Thuwal

نوال

Jeddah

جدة

Mecca

مكة

Taif

الطائف

Mahd Al Thahab

مهد الذهب

Al Henakiyah

الحياكية

EEC

King Abdullah Economic City

- Megaproject announced in 2005 by the late king.
- 70 mi² of new urban and industrial development.
- Project population of 1.75 million by 2075.

A New Model City



- Links to Regional and Global Trade
- Deep Water Port
 - Airport
 - Regional Rapid Transit System
 - Regional Freight Rail System

Growth Projections

Phase	Sub-phase	Minimum Potable Water Production Capacity (m ³ /day)	Minimum Installed Hydraulic Capacity (m ³ /day)	Estimated Year of Commissioning after Start of Phase 1A
1	1A	60,000	120,000	0
	1B	120,000	120,000	5
2	2A	180,000	240,000	9
	2B	240,000	240,000	13
3	3A	300,000	360,000	15
	3B	360,000	360,000	16
4 (Buildout)	-	600,000	600,000	23

160 MGD

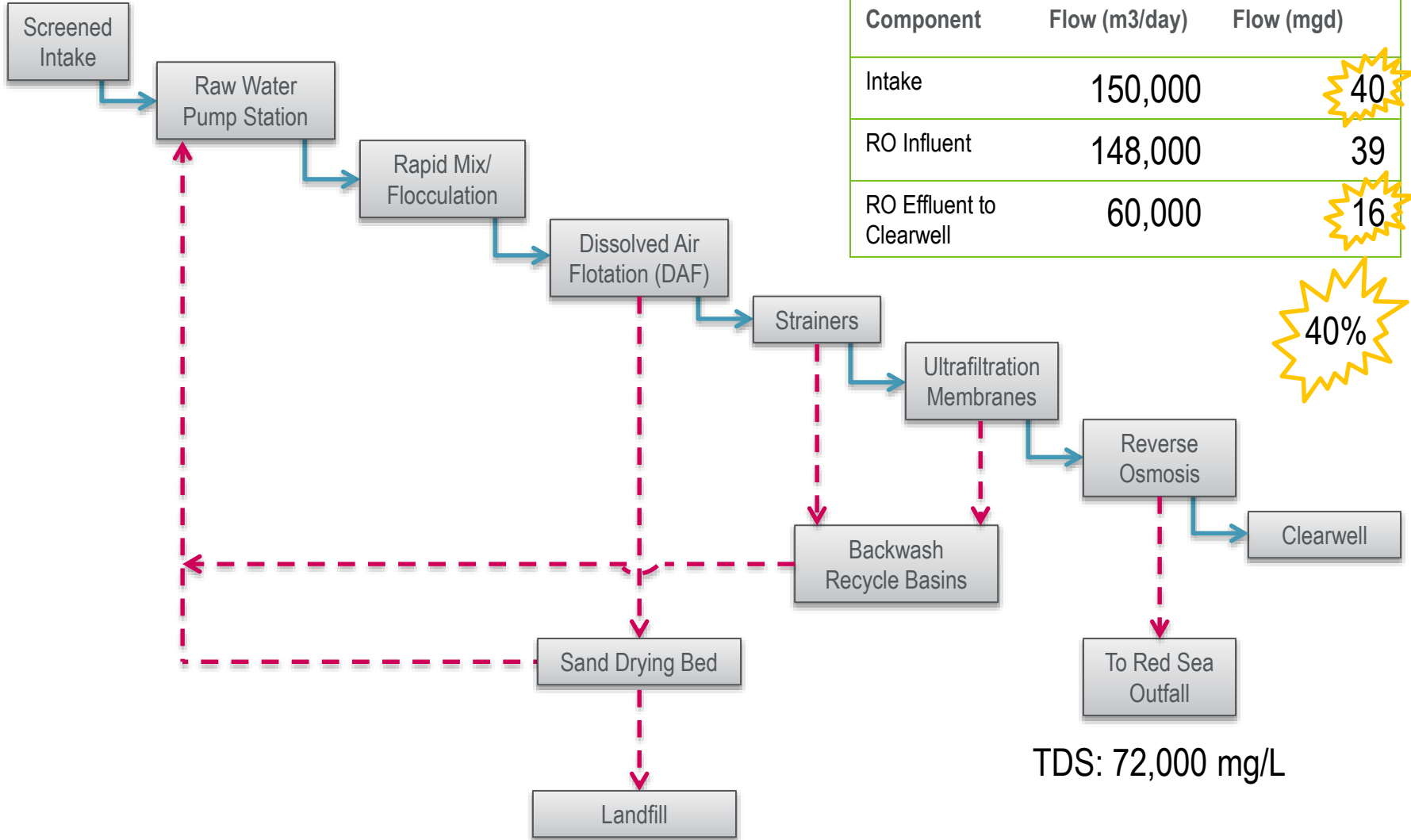


Water Quality

Parameter	2007	2008
pH	8.06 – 8.20	8
Temperature (°C)	28.4 – 29.7	N/A
Turbidity	5.2 – 6.6	0.5 – 1.0
TSS (mg/L)	2.2 – 2.8	1
TDS (mg/L)	39,000 – 42,000	42,000
Alkalinity (as CaCO ₃)	130 – 135	N/A
Silica (mg/L)	1.40-2.17	0.5
Hardness (mg/L)	N/A	7,400

Groundwater TDS in vicinity: Up to 91,000 mg/L

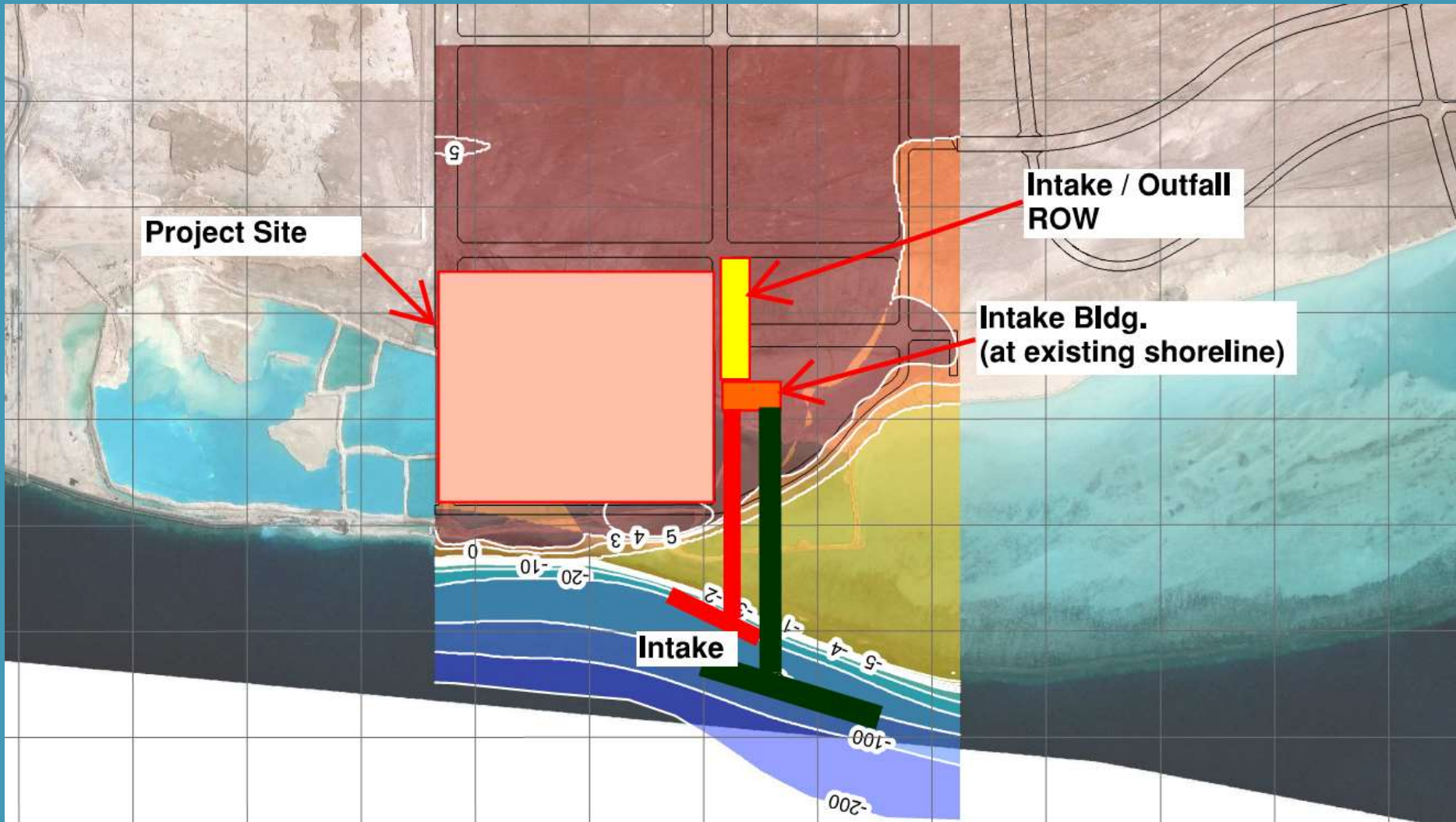
Process Flow Diagram



Phase 1		
Component	Flow (m3/day)	Flow (mgd)
Intake	150,000	40
RO Influent	148,000	39
RO Effluent to Clearwell	60,000	16

40%

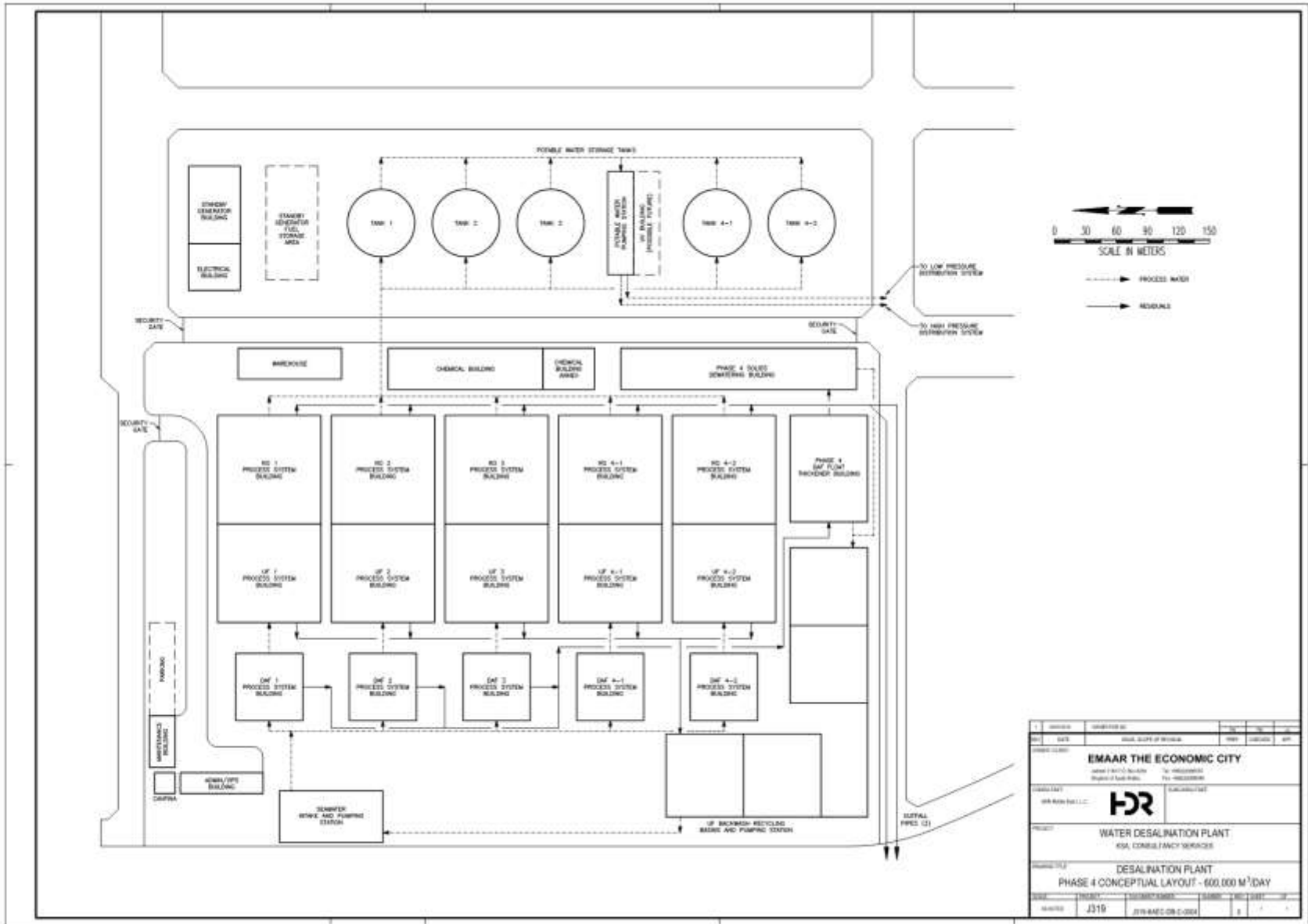
TDS: 72,000 mg/L



Approximately 120 acres.

Intake and Outfall approximately 800 LF.

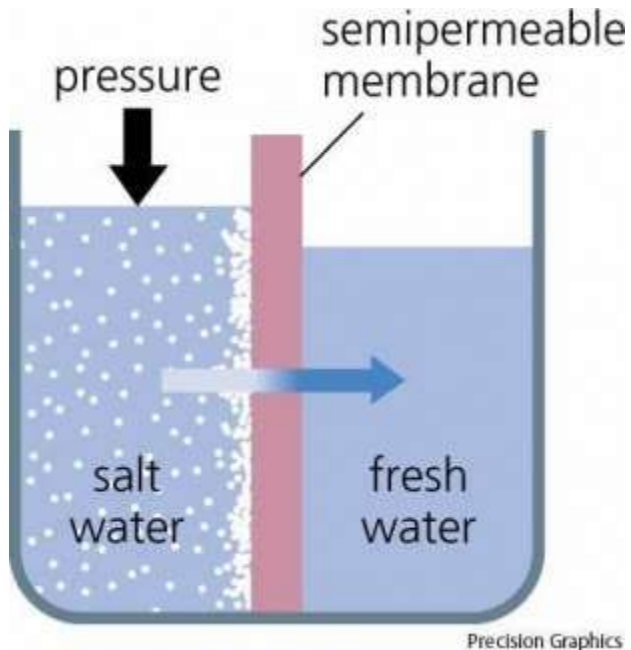
Site Plan Phase 4 – 23 Years After Phase 1 A



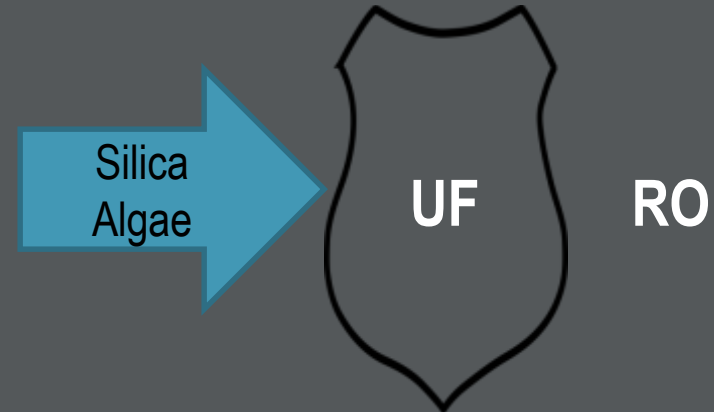
NO.	REVISION	DATE	BY	CHKD.	APP.
EMAAR THE ECONOMIC CITY					
KSA, CONSULTANCY SERVICES					
PROJECT		HR			
WATER DESALINATION PLANT					
KSA, CONSULTANCY SERVICES					
DESALINATION PLANT					
PHASE 4 CONCEPTUAL LAYOUT - 600,000 M ³ /DAY					
NO.	REVISION	DATE	BY	CHKD.	APP.
NO.					

Purpose of Pre-Treatment

- Protection of the reverse osmosis system.
 - Particulate or Colloidal Fouling.
 - Biological fouling.
- Target Silt Density Index (SDI) of 3

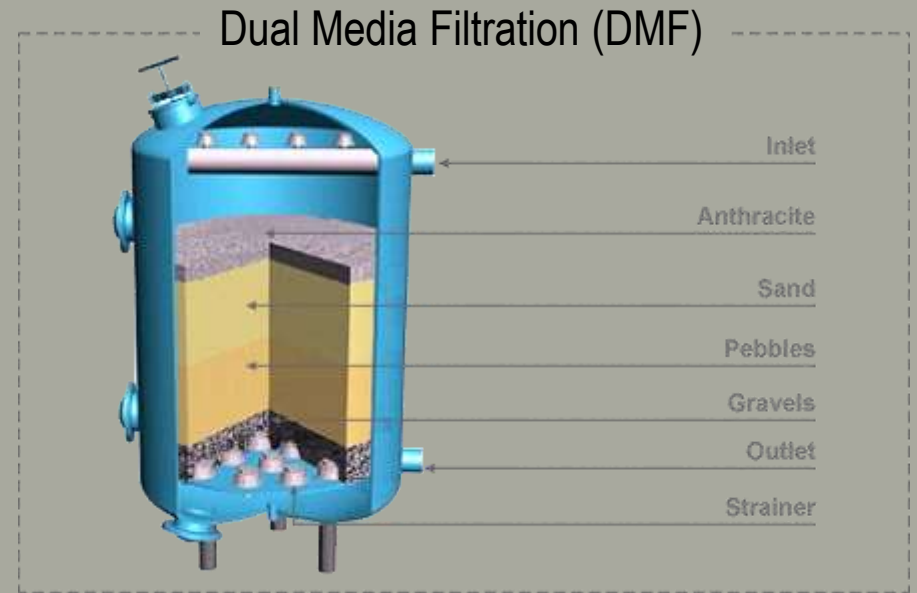


Reverse Osmosis



Pre-Treatment Alternatives

- Dual Media Filtration
 - Industry standard for years
- Ultrafiltration Membranes
 - Emerging leader in desalination



VS.



Ultrafiltration Membranes (UF)

Ultrafiltration Membranes

- Materials of Construction:
 - Hastelloy C
 - 316 Stainless Steel

Table 2: Design Water Quality - Filtrate

Constituent	Filtrate	MCL/Local Primary Agency
Turbidity, NTU	0.15	< 0.3 in 95 percent of samples
Silt Density Index 5 (SDI ₅)	≤ 3	
Giardia lamblia % removal	99.99	LRVOL = ****
Cryptosporidium % removal	99.99	LRVOL = ****
Minimum LRV	4	

Parameter	Minimum System Recovery	M ³ /D	@ Water Temp of DegC
Firm Permeate/Filtrate Capacity (N-2) ²	95	151,202	30

Notes:

² N = Total number of units being provided. N-1 means one(1) unit can be out of service or offline continuously.

Percent of Blank Spaces for Future Element Addition

Blank Space for future membrane element addition	10%
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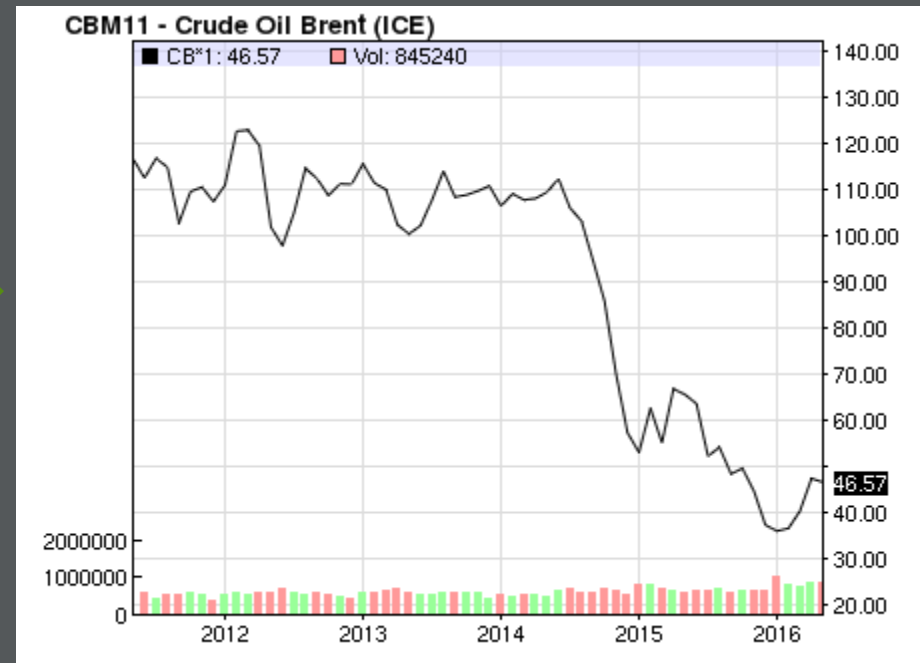
Maximum number of chemical cleanings allowed per unit per month	1
Maximum number of chemical washes or enhanced backwashes allowed per month per unit.	60



Example picture from the Jeddah desal WTP.

Other Project Challenges

- Metric
- Working days
 - Sunday – Thursday
- 10 hour time difference
- Languages
- External factors



Next Steps

- Engineer-Procure-Construct (EPC) Delivery Method
- Build-Own-Operate-Transfer (BOOT) Delivery Method
- Goes to bid in June.



And the weather in KAEC:



Thank you for your time!

Questions??