



**Metropolitan Area of Barcelona
Environmental Authority**

**The Prat del Llobregat regeneration
Plant**



**Àrea Metropolitana de Barcelona
Entitat del Medi Ambient**

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- Waste water regeneration in Barcelona
- Baix Llobregat waste and regeneration treatment plant
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 - **DMD** + EDR
 - **DMD** + Ultra filtration + Reverse Osmosis
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...Introduction to EMA-MAB
(Metropolitan Area of Barcelona Environmental Authority)

Metropolitan Area of Barcelona Environmental Authority (EMA-MAB)



- A local authority created under the Catalan Law 7/1987 of 4 April, which carries out specific public actions in the Barcelona conurbation
 - 33 municipalities
 - Surface area: 585.4 km²
 - Inhabitants: 3,126,294 (2007)
 - Population density: 5,340 inhab/km² (> 15,000 city of Barcelona)

...Introduction to EMA-MAB

- Foundation, government and administration

- The **Law 7/1987** of 4 April establishes and regulates specific public actions in the Barcelona conurbation and the districts within its sphere of influence
- **Government and administration** of the organization is performed by the Metropolitan Council, a public body which consists of mayors and representatives of all the municipalities (11 representatives from Barcelona, 3 from municipalities of >100,000 inhab. and 1 each from the remainder)



...Introduction to EMA-MAB (Metropolitan Area of Barcelona Environmental Authority)

Matters under jurisdiction of EMA-MBA

- **Supply of drinking water** is provided by specialized companies
- **Water transport through large pipelines and wastewater treatment** are carried out by EMSSA, a public corporation
- **Treatment of solid municipal waste** is made by EMA-MBA and through concessions with private companies



...Introduction to EMA-MBA

(Environmental Authority of the Metropolitan Area of Barcelona)

Waste water treatment and transport in Metropolitan Area of Barcelona

- More than 250 km of waste water sewers
- 29 waste water pumping stations
- 1 pipe line for sludge (5% water content) 8 km length
- 7 waste water treatment plants and 3 marine outfalls



- 1.200.000 m³/d
(55% Catalunya)
- 6 millions eq-hab



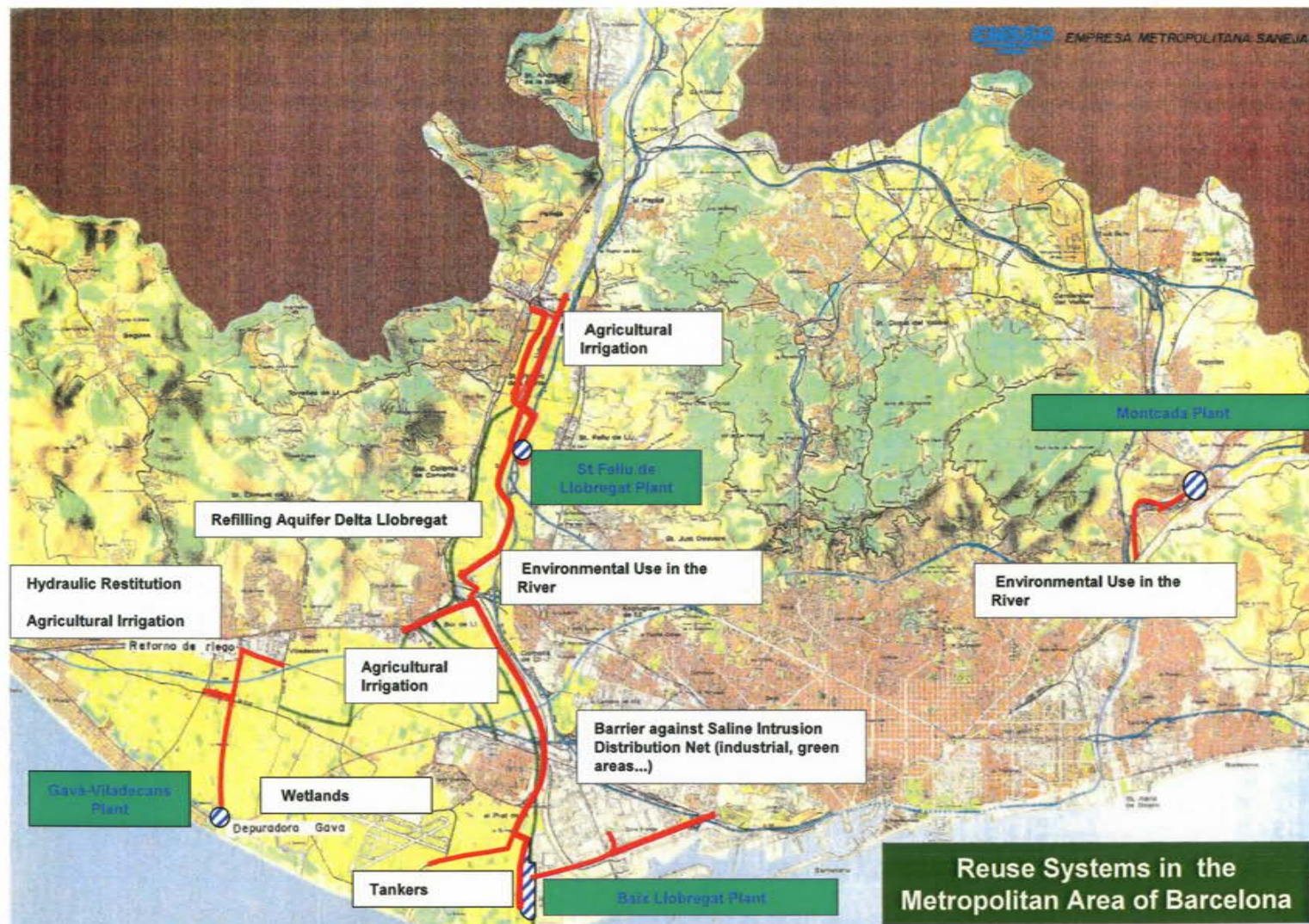
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...Introduction to EMA-MAB
(Metropolitan Area of Barcelona Environmental Authority)

- **Basic data for 2008**
 - **Solid waste production:**
1,633,284 Tons
 - **Drinking water billed:**
190 millions m³
 - **Volume of wastewater treated:**
280 millions m³
 - **2009 Budget:**
€ 249 million
 - **Staff:** 100 people



The Reuse in the Metropolitan Area of Barcelona



...The Reuse in the MAB

Flow of treated and regenerated water in m³/year, from 2004 to September 2008

Sewage treatment plant	Year 2004	Year 2005	Year 2006	Year 2007	Year 2008	Use /End
Gavà-Viladecans	11.260.765 4.055.000	9.977.770 4.585.000	9.790.802 4.747.000	10.684.599 3.843.000	11.581.707 3.450.000	Pond of La Murtra and sea Slides of the Delta
Begues	334.705 0	306.600 0	319.209 0	330.503 0	383.988 0	Stream of Begues Green areas (*)
Montcada i R.	20.422.945 1.000.000	17.830.350 1.000.000	19.105.941 1.000.000	18.333.285 1.000.000	17.875.535 1.000.000	Besós River Wetlands in Besós
Sant Feliu de Ll.	21.950.390 200.000	18.940.092 618.798	19.424.203 0	17.831.294 5.420	16.733.739 69.126	Side Channel A-2 road and river Agricultural irrigation channels
Vallvidrera	259.880	235.060	245.813	260.587	226.354	Stream of Vallvidrera
Besòs	138.702.555	134.687.920	131.020.000	124.498.000	131.284.000	Mediterranean Sea
Llobregat	104.755.730 0 0 0 0 0 0	107.959.700 0 0 0 0 0 0	99.773.683 0 1.500.000 3.000.000 0 0 0	84.417.300 134.454 2.017.927 12.941.461 0 0 0	68.906.063 473.798 2.970.965 22.799.777 2.386.985 0 3.681	Mediterranean Sea Barrier against Saline intrusion Wetlands Llobregat river Agricultural irrigation Industrial Other uses
REUSED	5.255.000	6.203.798	10.247.000	19.942.262	33.154.332	
NOT REUSED	297.686.970	289.937.492	279.679.651	256.355.568	246.991.386	
TOTAL	302.941.970	296.141.290	289.926.651	276.297.830	280.145.718	

(*) Still under study



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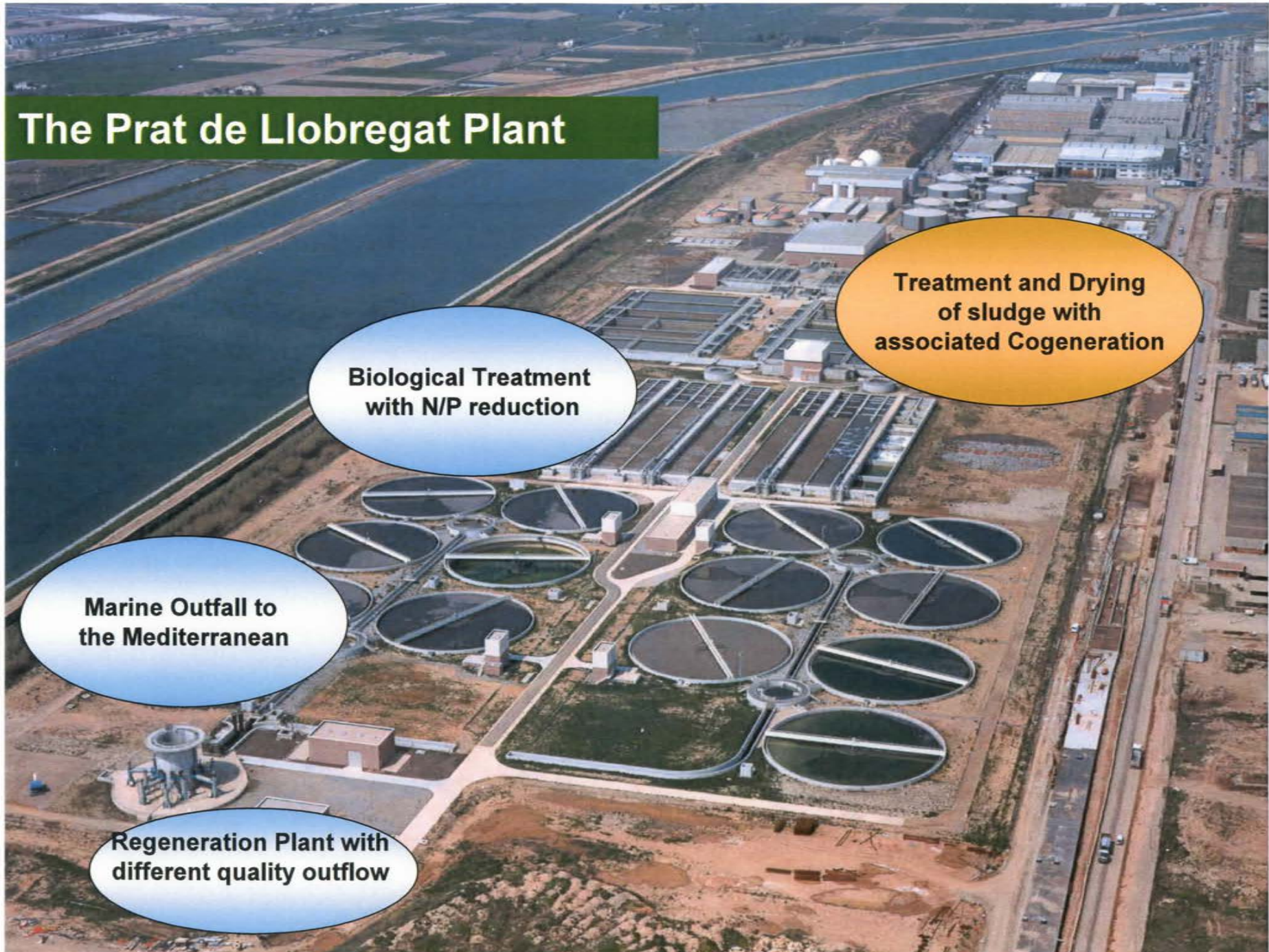
The Prat de Llobregat Plant

**Biological Treatment
with N/P reduction**

**Treatment and Drying
of sludge with
associated Cogeneration**

**Marine Outfall to
the Mediterranean**

**Regeneration Plant with
different quality outflow**



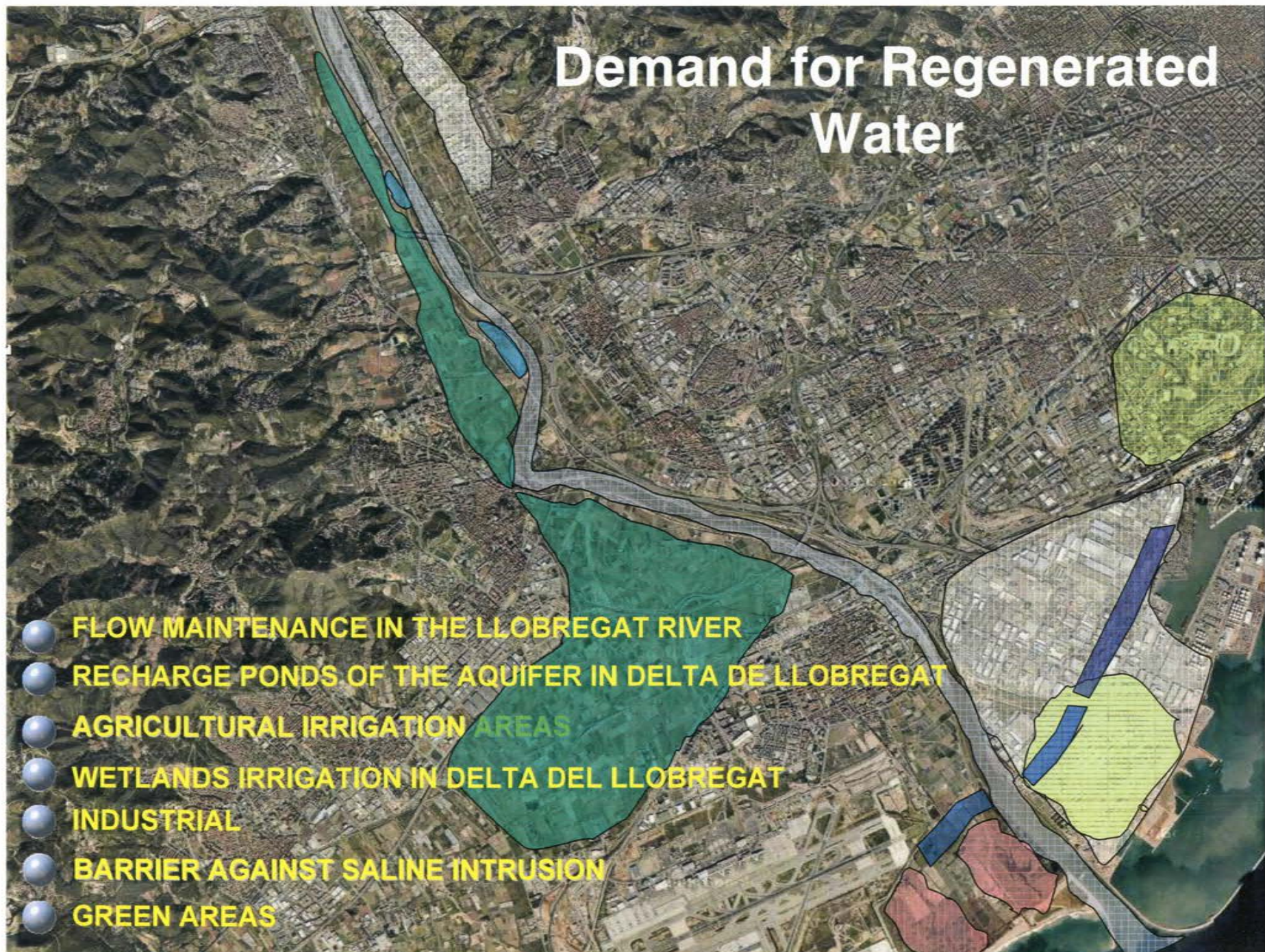
...The Prat del Llobregat Regeneration Plant

- Demand for Regenerated Water

	m ³ /s	m ³ /d
River Maintenance:	1,50	130.000
Recharge Ponds , Aquifer:	0,50	43.000
Agricultural Irrigation:	0,75	65.000
Wetlands:	0,40	35.000
Barrier against Saline Intrusion :	0,17	15.000
Green Areas, Hosing Down of streets ...	0,025	2.000
Industrial:	0,08	7.000

- Total Design Flow: 3,25 m³/s
- Expected Annual Demand: > 50 hm³/year
(seasonal demand)

Demand for Regenerated Water



...The Prat del Llobregat regeneration Plant

• Qualities of regenerated Water

- **Quality 1:** River maintenance
Recharge pond of the aquifer
Wetlands
Green Areas
Hosing down of streets
Sewers cleaning
Industries
 - **Quality 2:** Agricultural Irrigation
 - **Quality 3:** Barrier against Saline Intrusion
- } **Decantation,**
Micro filtration
10 um and
Disinfection
(UV and sodium hypochlorite)
- } **DMD + EDR**
- } **DMD +**
Ultra filtration
and Reverse
Osmosis

Description of the plant's facilities



...The Prat del Llobregat regeneration Plant

- **Regeneration Plant**

Physical-
Chemical



Micro filtration



UV Disinfection
and sodium hypochlorite



...The Prat del Llobregat regeneration Plant

- Reverse Osmosis

Ultra filtration



Reverse Osmosis



REUSE PIPES

PIPE FOR RIVER
MAINTENANCE (1,5 m³/s)
AND RECHARGE POND OF
THE AQUIFER (0,5 m³/s)

PIPE FOR GREEN
AREAS (0,025 m³/s)
AND INDUSTRIES (0,08
m³/s)

PIPES FOR THE BARRIER
AGAINST SALINE
INTRUSION (15.000 m³/d)

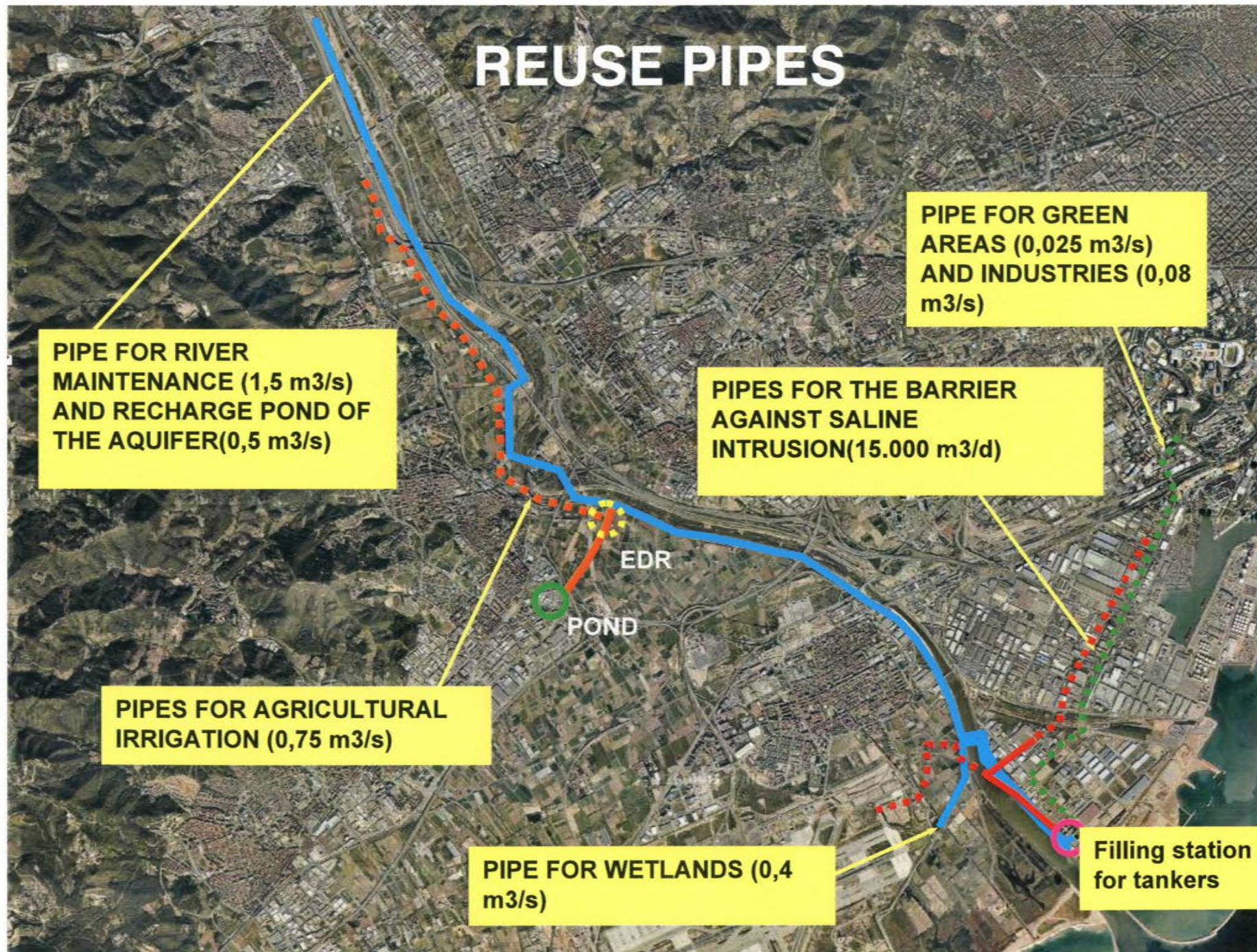
PIPES FOR AGRICULTURAL
IRRIGATION (0,75 m³/s)

PIPE FOR WETLANDS (0,4
m³/s)

Filling station
for tankers

EDR

POND

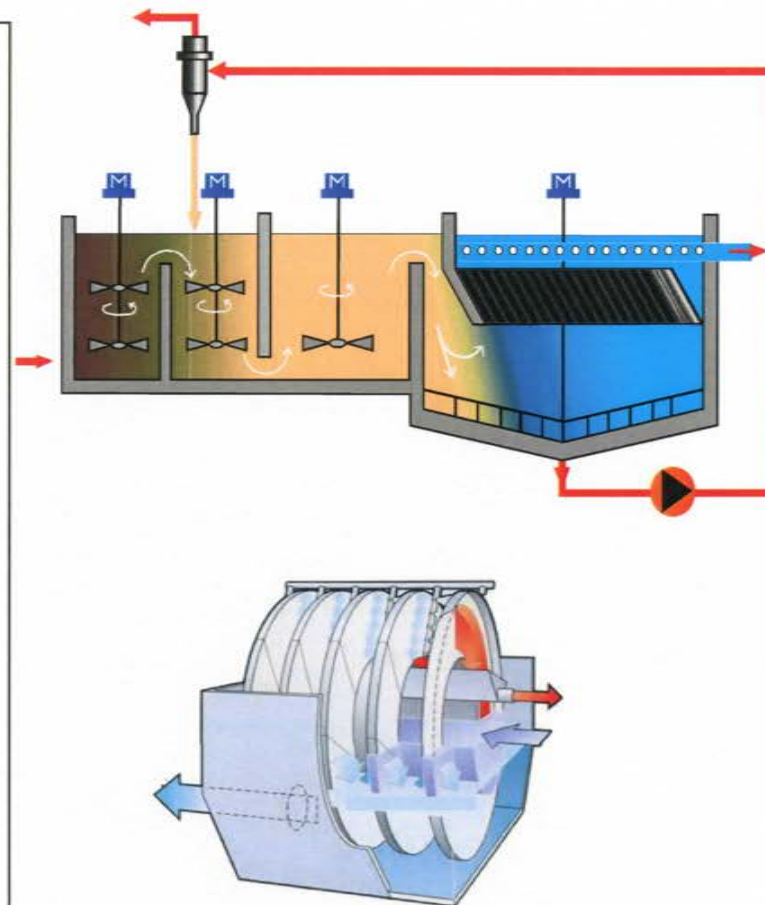


ACTIDisk[®] : Actiflo[®] + Hydrotech



Reuse at Prat del Llobregat regeneration Plant

- Applied Technologies:
 - Actiflo[®] Process:
 - Characteristics
 - Components
 - Hydrotech Process:
 - Characteristics

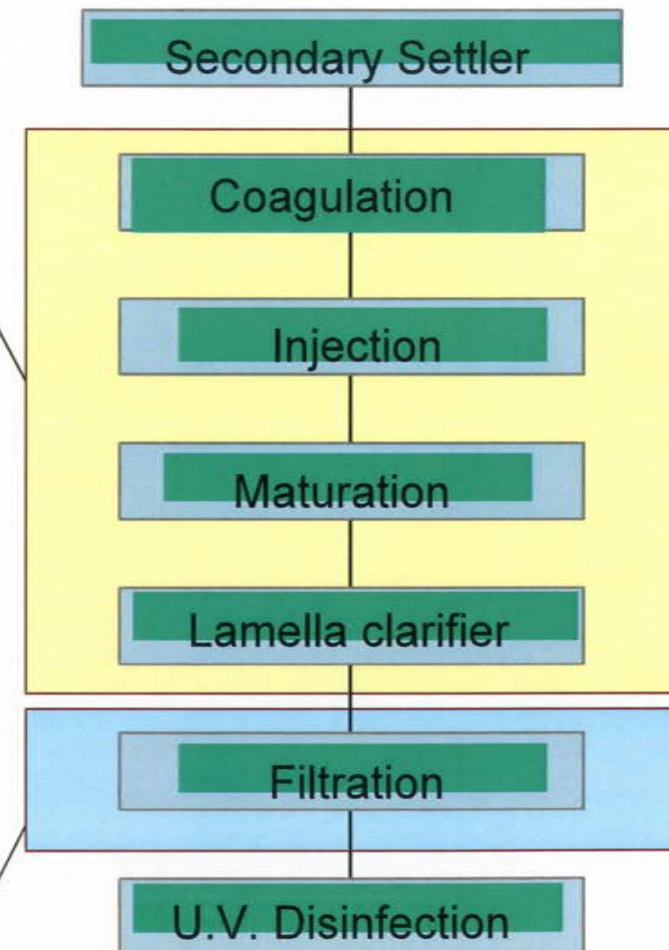


Reuse at Prat del Llobregat RP. ACTIdisk

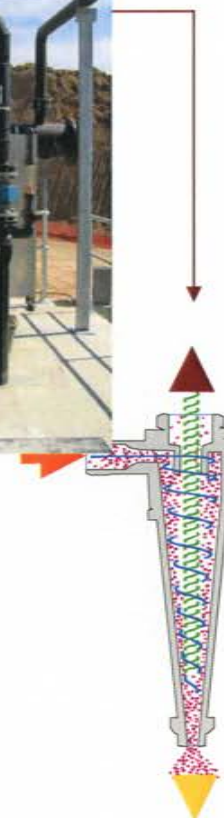
- **Final solution: ACTIDisk®**
- **ACTIFLO® (3 x 4.800 m³/h):**
 - Max. recirculation: 6 x 110 m³/h
 - Hydraulic load in settler: 120 m/h
- **HYDROTECH (2 x 5 lines, 10 unit.):**
 - Mesh size: 10 µm.
 - Number of discs: 18 disc/unit.
 - Unitary filter area: 100,8 m²
 - Back-washing pump: 8,4 l/s/unit.

ACTIFLO®

HYDROTECH



Specifics components: Actiflo



Hydrotech Discfilter

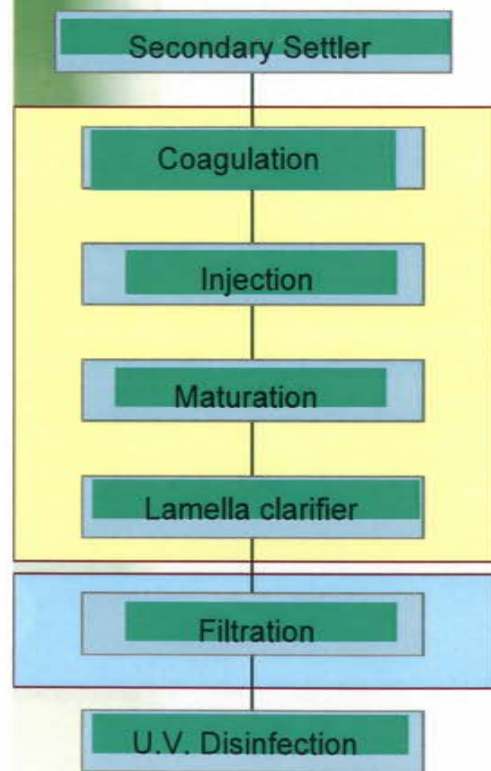


First Results

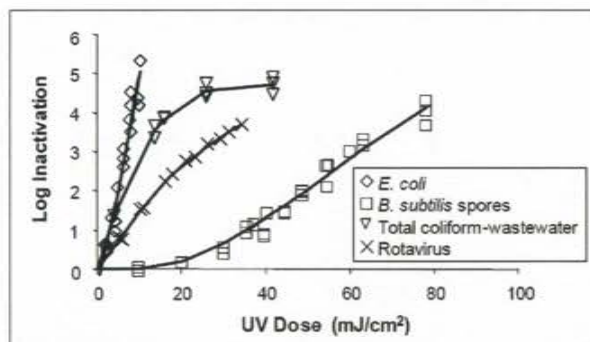
	Av. raw water	Max. Outlet	Av. Outlet	Min. Outlet	Removal (%)
pH	7,73	8,21	8,01	7,52	-
Turbidity (NTU)	34,7	2,37	1,29	0,83	96,3
SST (mg/l)	67	4,0	2,6	2,0	96,2
TP (mg /l)	3,41	1,66	0,90	0,33	73,5
COD (mg/l)	107	81	41	18	61,1
BOD5 (mg/l)	23	8	3	1	86,7

...The Prat del Llobregat Regeneration Plant

- Disinfection (UV + sodium hypochlorite)



- Four channels of UV, with 400 lamps each make the disinfection of regenerated water
- Additionally, between 2 and 4 ppm of hypochlorite are dosed to guarantee the disinfection during the transport of water



Source: Adapted from Chang et al. (1985)

PIPES OF REUSE OF QUALITY 1

EXPECTED USES

MAINTENANCE LLOBREGAT RIVER

RECHARGE POND OF AQUIFER DELTA LLOBREGAT

WETLANDS IRRIGATION RIEGO DELTA LLOBREGAT

INDUSTRIAL (possible additional treatment in the specific industry)

GREEN AREAS, STREET CLEANING AND SEWER SYSTEM



...The Prat del Llobregat Regeneration Plant

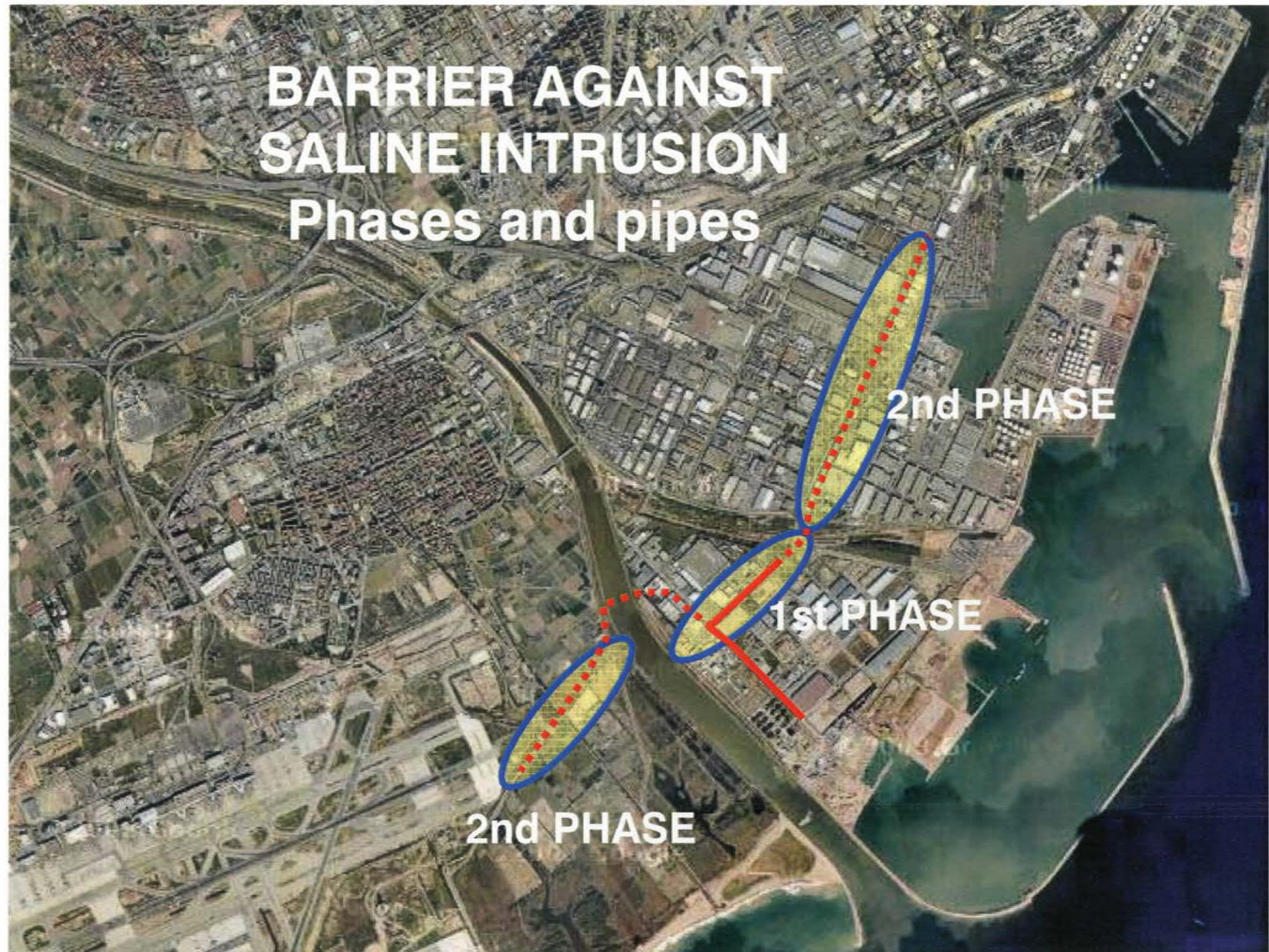
- EDR under construction



REUSE PIPES FOR AGRICULTURAL USE



BARRIER AGAINST SALINE INTRUSION Phases and pipes



...The Prat del Llobregat Regeneration Plant

- Qualities of Water



Characteristics of the inlet of WWTP

SS > 250 mg/L
BOD > 280 mg/L
N > 60 mg/L
P > 5 mg/L



The outlet of the WWTP, fulfils the quality Standard 91/271.

SS < 35 mg/L
BOD < 25 mg/L
QOD < 125 mg/L
N < 10 mg/L
P < 2 mg/L



After regeneration, water fulfils the Royal Decree RD1620 of reuse for agricultural and environmental uses. (Annex 1, qualities 2.1, 2.2, 2.3)

< 10 NTU
SS < 20 mg/L
E.c. < 100 ufc/100mL
Helminth eggs < 1/10 L



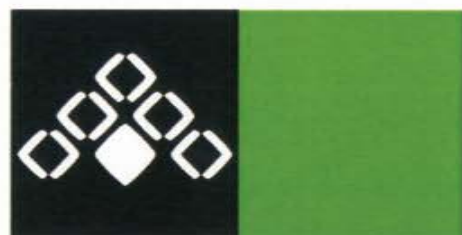
After reverse Osmosis water fulfils the Royal Decree RD1620 of reuse for direct injection/drive to the aquifer. (Anex 1 quality 5.2)

< 2 NTU
SS < 10 mg/L
N < 10 mg/L
E.c. < 0 ufc/100mL

Helminth eggs < 1/10 L

Conclusions

- The maximum regeneration flow in the Baix Llobregat plant is 320.000 m³/day
- The regeneration process made up to this moment, which fulfils the qualities specified in the Royal Decree RD1620/2007, is used for the following ends:
 - Re-establishment of the Llobregat River flow
 - Agricultural irrigation
 - Stabilization of wetlands of ecological/environmental interest
 - Avoidance of salt water intrusion in the aquifer of Delta del Llobregat
- From its starting, in June 2007, to December 2008, an amount of 43 hm³ of water has been regenerated, out of the total of 145 hm³ treated by EDAR, which means 28 %. Its distribution has been:
 - 35,5 hm³ (82%) To re-establish the Llobregat River flow
 - 2,4 hm³ (6%) For agricultural irrigation
 - 4,8 hm³ (11%) To stabilize the wetlands of ecological interest
 - 0,4 hm³ (1%) To avoid salt water intrusion in the aquifer



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Thank you for your attention