LAKE MANZALA ENGINEERED WETLAND A SUCCSSESFUL MODEL FOR THE METERRANIAN SEA PROTECTION

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Water Crisis In Arid Countries

Arid countries, such as Egypt (among other middle eastern countries), are facing a water scarcity crisis, which requires optimizing the use of all available water resources.

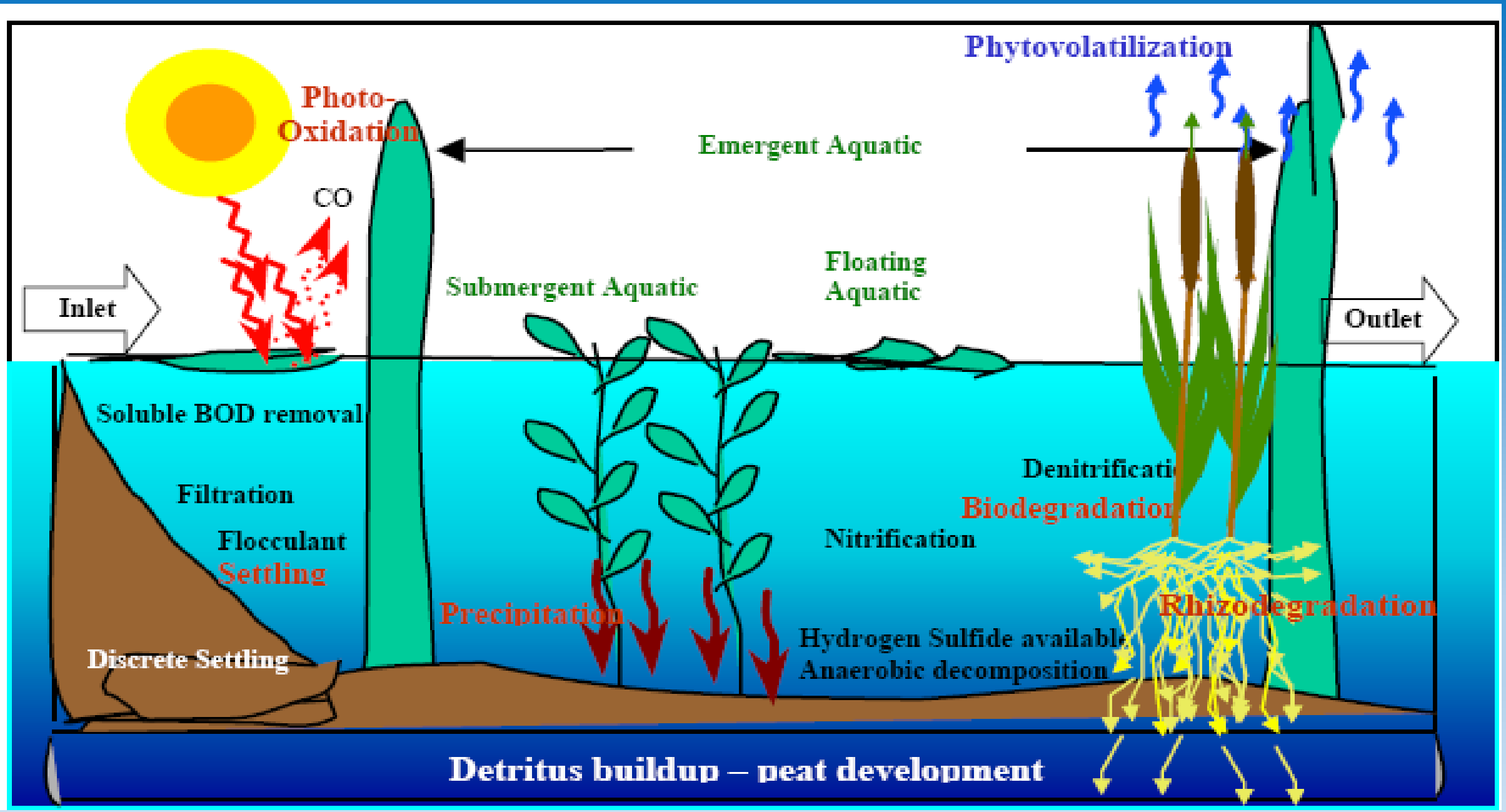
Reuse of Drainage Water

Due to water scarcity, reuse of drainage water is becoming an increasingly important water source. In Egypt, however, large portions of water in the drainage network can not be used as they contain high contaminant loads.

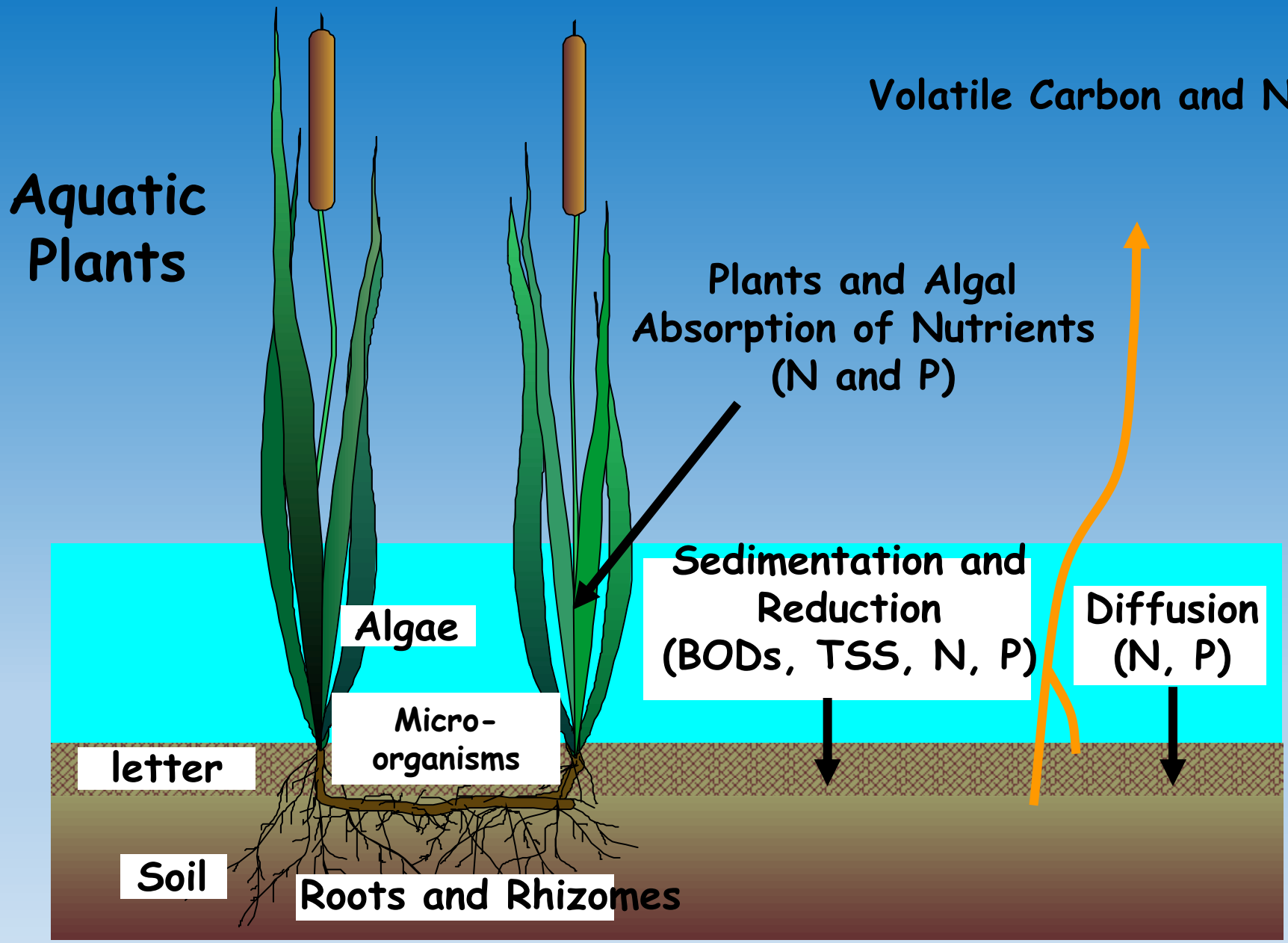
Wetlands for Drainage Water Treatment

Treatment Wetlands: Basins with shallow waters and substrate to support rooted vegetation. Plants, Biofilms, media/soil, water and letter are acting together to treat pollutants.

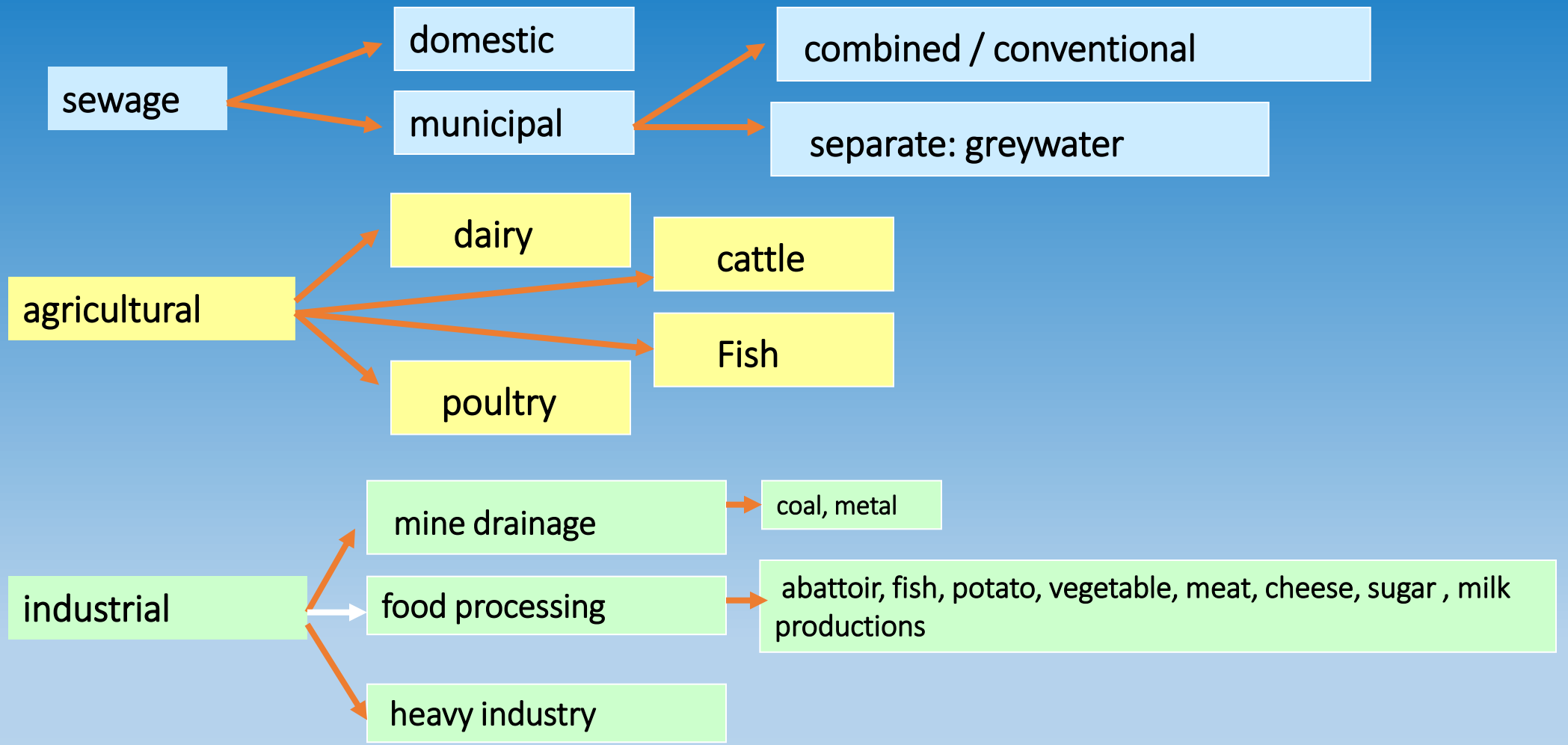
Treatment by Constructed Wetlands



Pollutants Removal Mechanisms



Applications – types of wastewater



Status of Northern Lakes

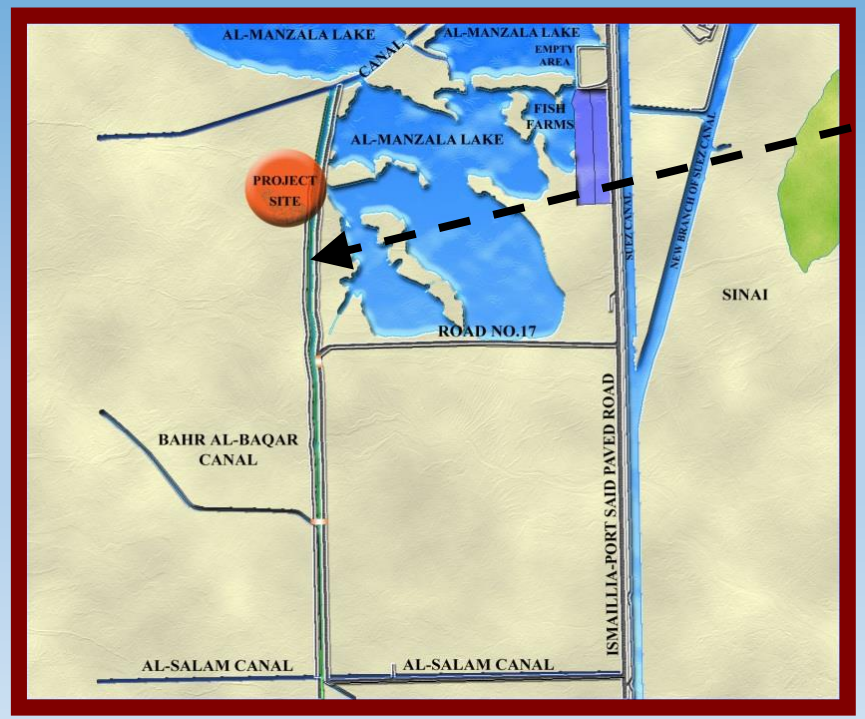
- Egyptian northern lakes have been regarded highly as fishery and a temporary sanctuary for winter migratin birds.
- While drainage water input to the northern lakes is important for maintaining their ecology, in some case, it is a source of serious pollution loads.

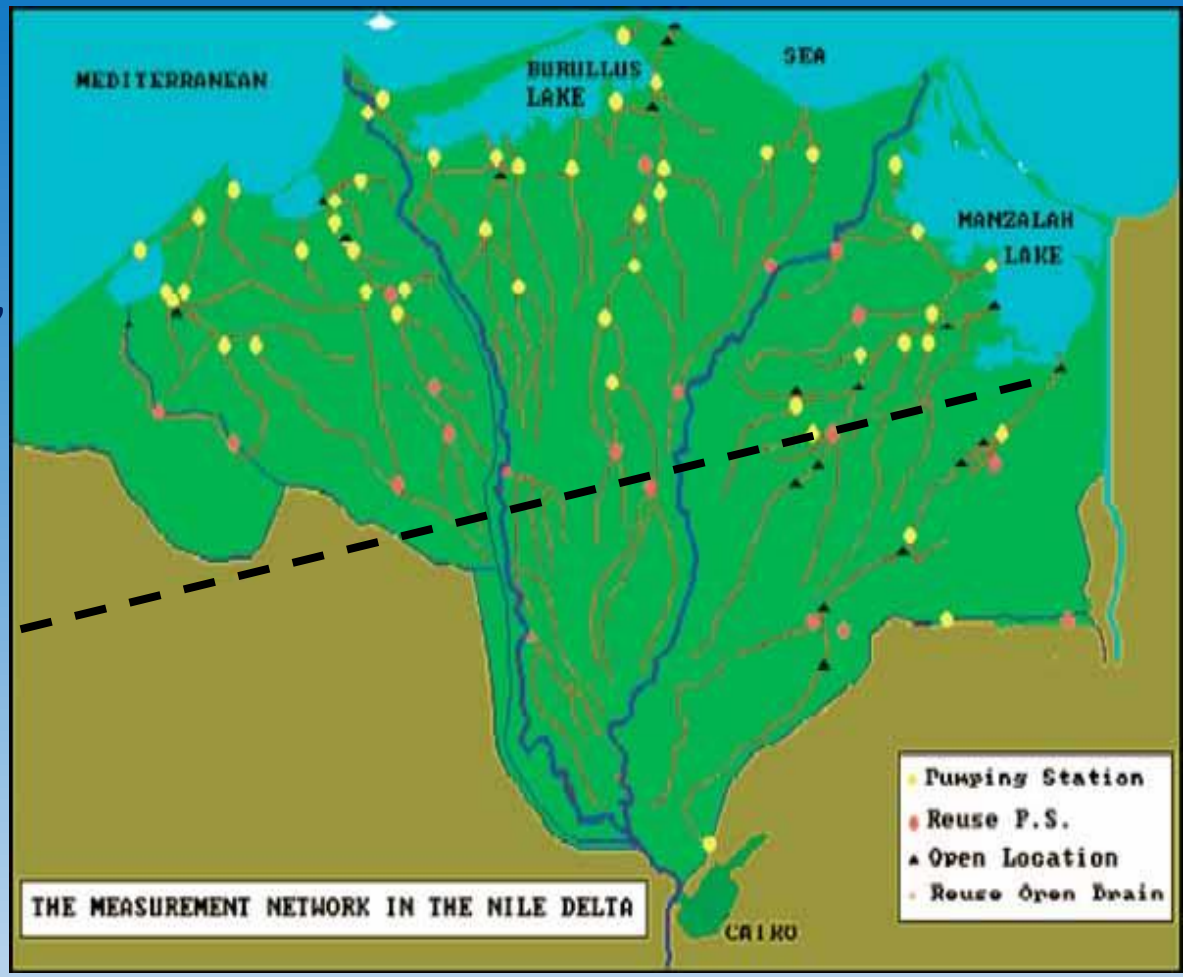
Lake Manzala and the Mediterranean Sea

- Located in the north eastern edge of the Nile Delta.
- Receives the highly polluted water of Bahr El-Baqr drain.
- Dissolved oxygen levels are depressed.
- Aquatic diversity has declined.
- Fish, produced by the lake or fish farms in the area, are not suitable for human consumption.

Bahr El-Baqar Drain

- Average flow = 5 *10^6 m^3/ day.
- carries large amounts of industrial, domestic and agricultural pollution loads.
- water quality is not suitable for reuse.





LMEWP History

- LMEWP is located in the NE edge of the Nile Delta, 170 km from Cairo and 15 km from Port Said city.
- The project was established by the Ministry of Environment, funded by the United Nations Development Program and the GEF.
- Since 2005, the (NWRC)/(DRI) had taken the full responsibilities of the LMEWP management, rehabilitation and research activities. Several research, agronomic and aqua cultural activities are ongoing.
- LMEWP has changed into the LM Water Research Station, (LMWRS).

LMEWP Objectives

- To construct and operate an engineered wetland to treat 25,000 m^3/d of Bahr El Baqar Drainage water.
- Assess feasibility of engineered wetland system to improve environmental conditions at Lake Manzala and the Mediterranean Sea.
- Assess feasibility of engineered wetland system to improve water quality so that it becomes suitable for different uses.
- Transferring wetland technology to Egypt and Middle East.
- Serve as training center for water management and wastewater treatment technologies.

LAKE MANZALA ENGINEERED WETLAND

Wetland Elements

Main Project
(25000m³/ Day)

1- INTAKE

2- PUMP STATION

3- SEDIMENTATION BASIN

4- DISTRIBUTION Channel

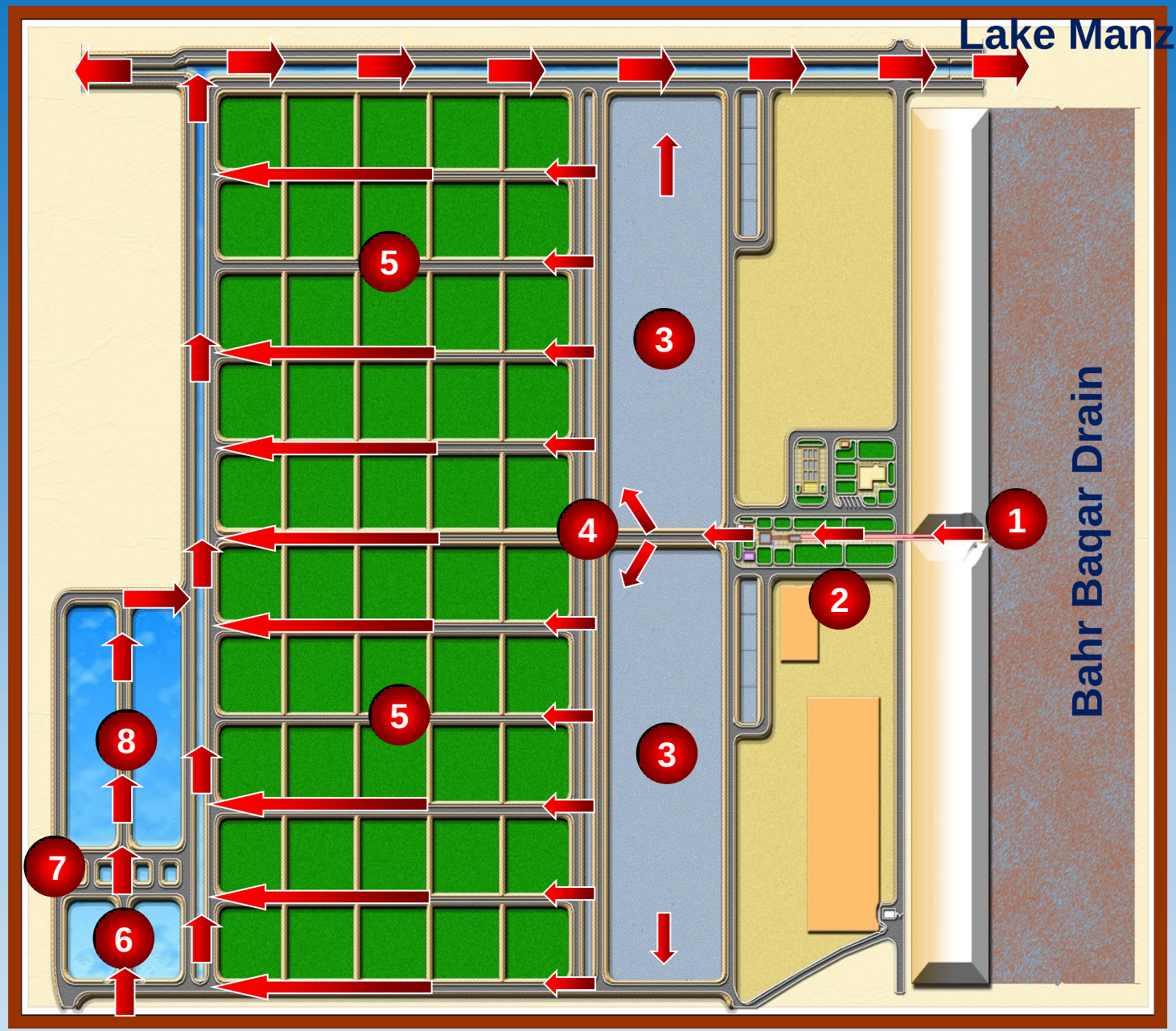
5- SURFACE FLOW BEDS

Secondary Project
(500m³/ Day)

6- RECIPROCATING CELLS

7- HATCHERY PONDS

8- FINGERLING PONDS



Pump Station on Drain

Reeds Treatment Cells

Primary treated Water

Average effluent concentration and removal efficiencies (2004-2016)

Bahr El Baqar drain Initial Conditions		Sedimentation Pond			Wetland Treatment System		
Parameter	**Influent Conc. mg/L**	Influent conc. mg/L	Effluent Conc. mg/L	Removal Efficiency %	Influent conc. mg/L	**Effluent Conc. mg/L**	**Removal Efficiency %**
TSS	**80-160**	80-160	32	80	32	**4.8 - 8.4**	**85 – 74**
BOD	**40-84**	40-84	24	40	24	**6.8 – 19.3**	**72 – 20**
Total P	**3-5**	3-5	4	25	4	**1.4 – 3.4**	**65 –15**
Total N	**12-30**	12-30	12	0	12	**3.9 - 10.3**	**68 – 14**
Organic-N	**4-15**	4-15	4	0	4	**1.9 - 3.8**	**53 – 5**
NH_4-N	**5-17**	5-17	5	0	5	**2 – 4.1**	**60 – 18**
F. Coliform MPN/100m	**4 E+05**	4 E+05	1.5E+05	61	1.5E+05	**150-1000**	**99.9**

Heavy Metals Treatment Efficiency

Metal	Influent mg/l	Effluent mg/l	Removal Efficiency %
Copper (Cu)	0.019	0.0006	**97**
Nickel (Ni)	0.012	0.0007	**94**
Lead (Pb)	0.05	0.0072	**87**
Zinc (Zn)	0.085	0.0009	**99**
Chromium (Cr)	0.007	0.0002	**97**
Mercury (Hg)	0.003	0.0022	**26**
Cadmium (Cd)	0.012	0.0018	**86**

Benefits, and Lessons Learned

- **Environmental Benefits.**
- **Scientific and Research Work.**
- **Socio-economic.**
- **Dissemination and replicating the technology.**
- **Institutional Sustainability and Capacity Development.**

Major benefits, and lessons learned

Environmental Benefits

1. Preserve/ restore the ecology of northern lakes via WQ Improvement.
2. Improve quality of drainage water so that it becomes suitable for different uses.
3. Reducing nutrient loads to LM and the Mediterranean. (61 % of BOD); 80 % of TSS; 15 % of TP; 51 % of TN; and more than 97 % of FC . Moreover, heavy metal improvement of the treated water was in the range of 26 % for Hg and 99 % for Zn.

Benefits, and lessons learned

Environmental Benefits

LM Restoration

1. Fish growth rates have improved by 50 percent due to the pollutants load reduction.
2. The economic efficiency of fisheries has improved by fourfold. due to the reduced need to replace water in ponds.
3. Freshwater use in irrigation has also been reduced through the use of reclaimed wastewater by nearby farmers.
4. The private fish farms established on the lake fringes had the opportunity to produce a better quality production due to the available LMEWP reclaimed water and the fish fingerlings they received free from the project.
5. Several bird species nesting/resident at the site, and fish growth rate improved by 50% due to the use of water with reduced BOD.

Benefits, and lessons learned

Improving the surrounding area

1. Electrical transformer.
2. Reinforced concrete bridge.
3. An elementary school is under construction.
4. Micro economic projects such as fish and fish-fingerlings market, grocery, workshops.
5. health care center is under construction.

Environmental Benefits

2016

Treated Water Reuse in Land Reclamation and Crops Production

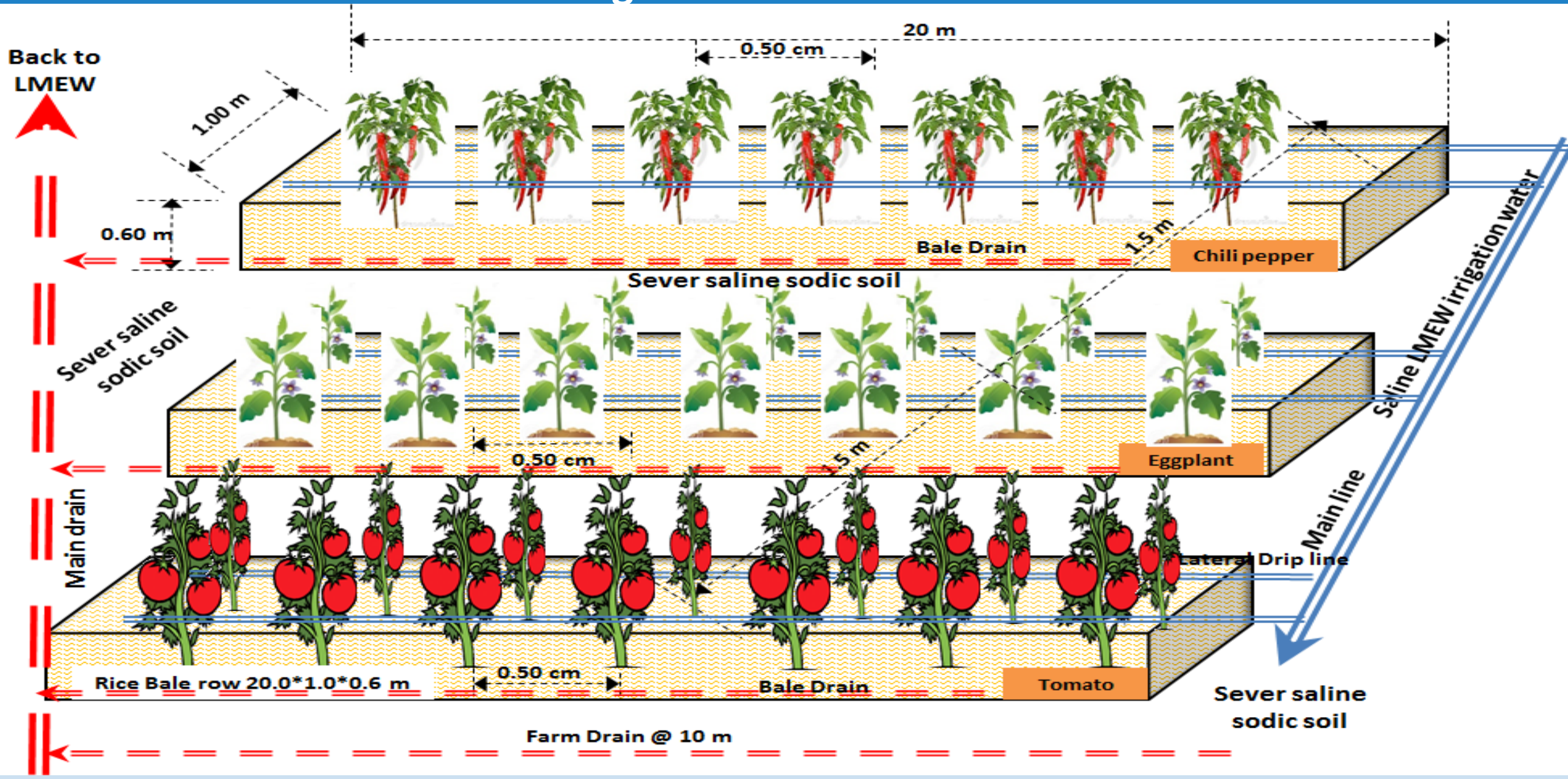

2012


2014


2016

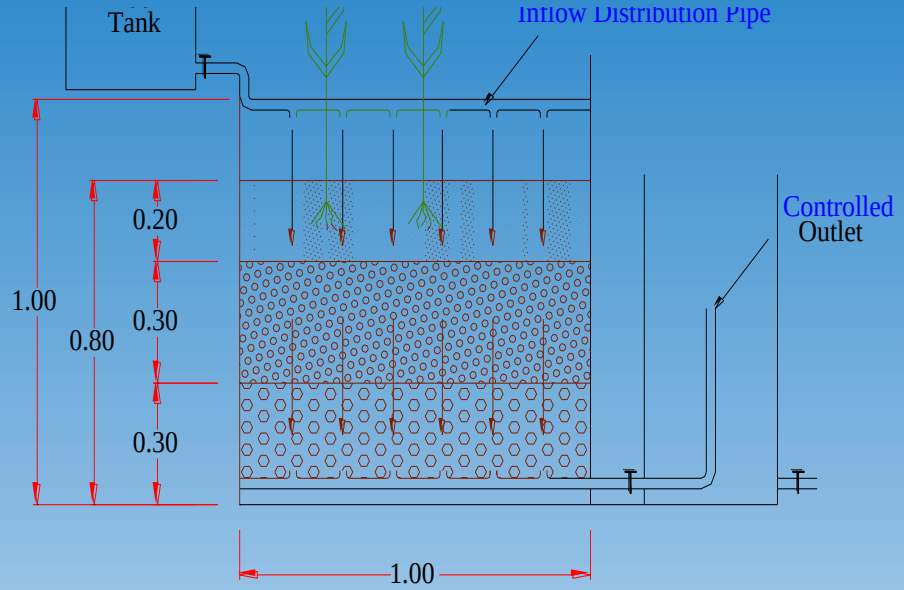
Scientific and Research Work

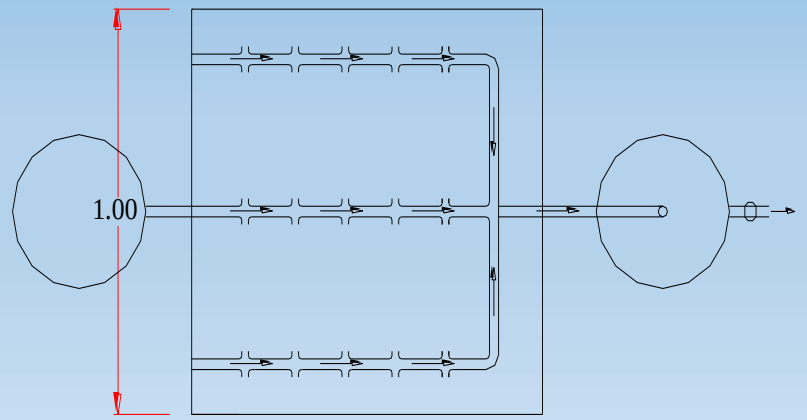
Treated Water Reuse Vegetables Production on Rice Straw Bales



Scientific and Research Work

Micro Wetland cells for El-Salam Canal Water Advanced Treatment





Influent and Collection Systems


Winter2016


Summer2015

Benefits, and lessons learned

Dissemination and replicating the technology

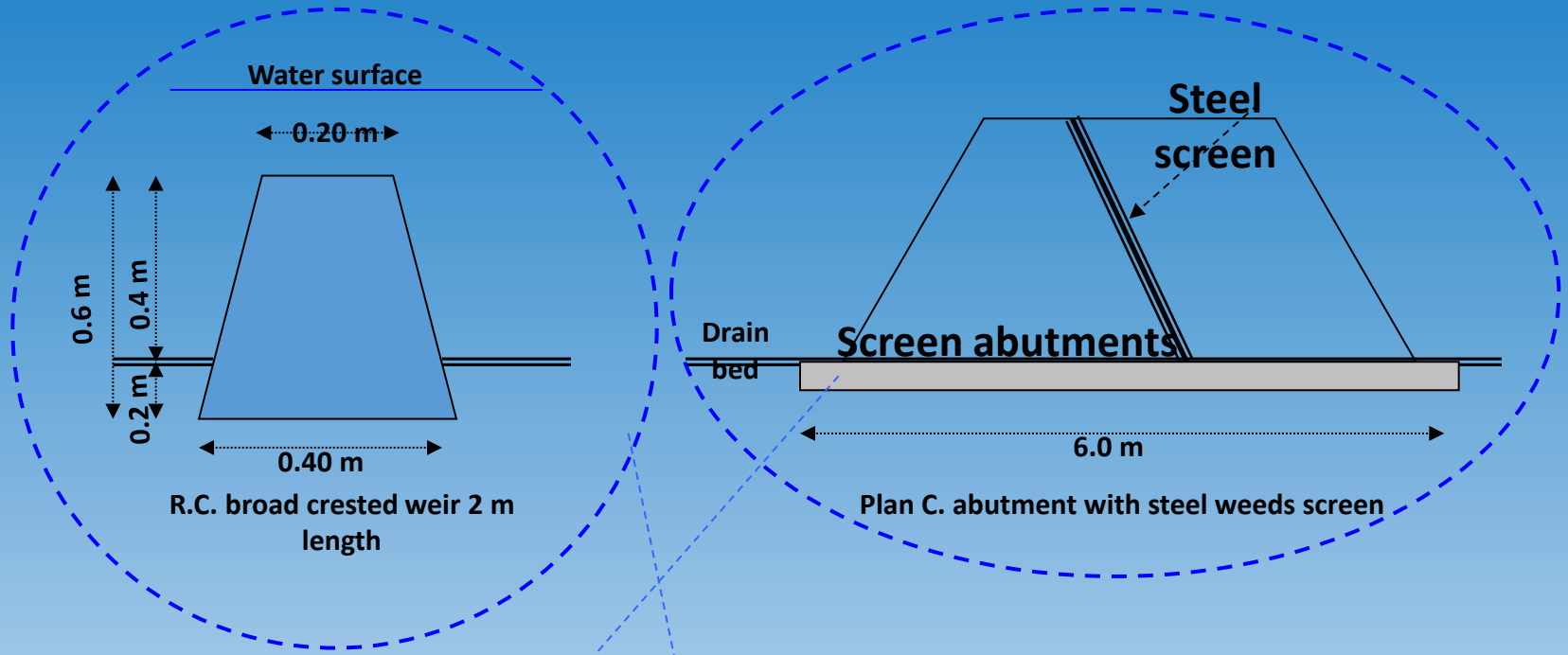
1. In-stream treatment of 3 polluted water agricultural drains in Bahow, Aysha, and Edfina in east, middle and west Nile Delta.

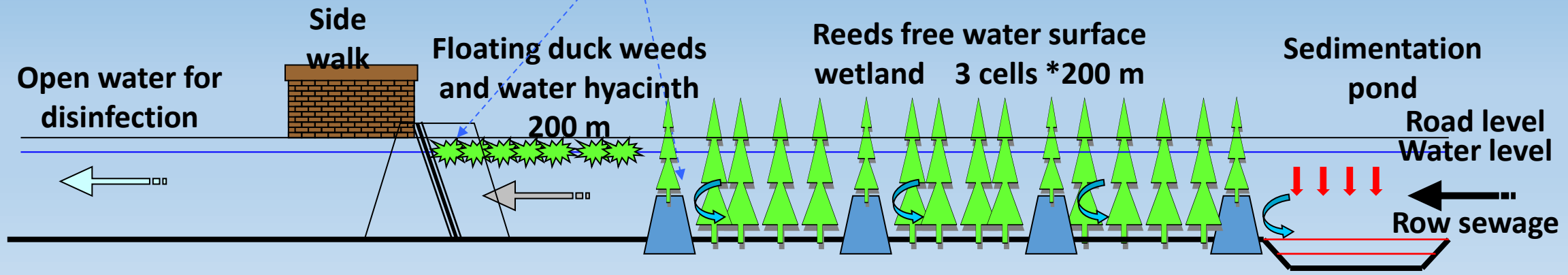
2. Improving WWTP an over-loaded municipal wastewater subsurface treatment wetland station in Samaha, Aga, Dakahliya governorate in Eastern Delta.

3. Small communities: LMEWP has advocated for the replication of the technology in Port Said villages for wastewater treatment and two engineered wetlands.

Dissemination and replicating the technology

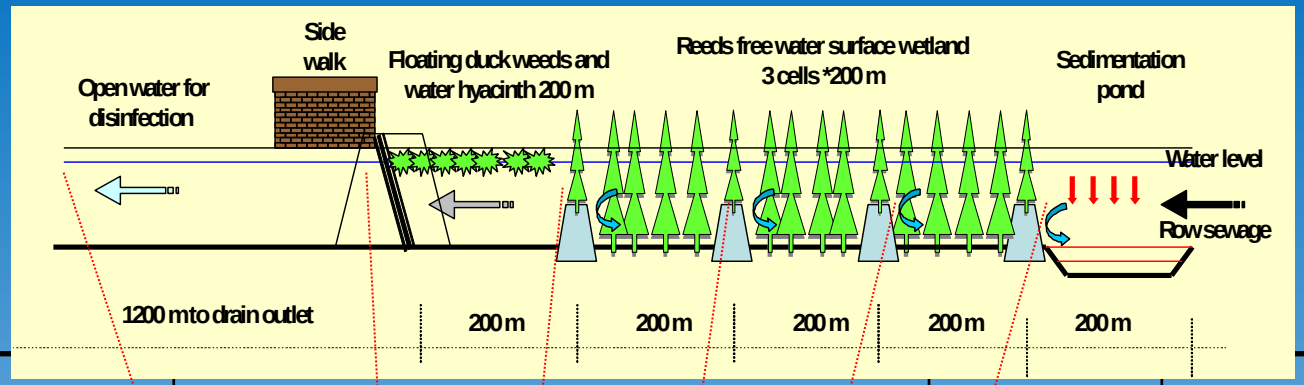
In-Stream Wetland for Drainage water Treatment





In-Stream Wetland for Drainage water Treatment

Performance of the In-stream Treatment Wetland through Drain path



Distance from point source	Treatment facility	TSS	BOD	FC	TC
		mg/l	mg/l	MPN/100 ml	MPN/100 ml
0	sedimentation pond	1500	400	1.06E+06	1.30E+06
200	reeds wetland cell 1	400	300	1.06E+06	1.30E+06
400	reeds wetland cell 2	300	200	5.00E+05	8.00E+05
600	reeds wetland cell 3	230	140	2.00E+05	3.30E+05
800	duckweeds wetland cell 4	175	100	8.00E+04	1.50E+05
1000	**open water disinfection**	110	80	3.50E+04	6.50E+04
1700		**50**	**38**	**3 E+02**	**2.00E+03**
Allowable water quality limits		**60**	**50**	**1.00E+03**	**5.00E+03**


0.800km


0.200km

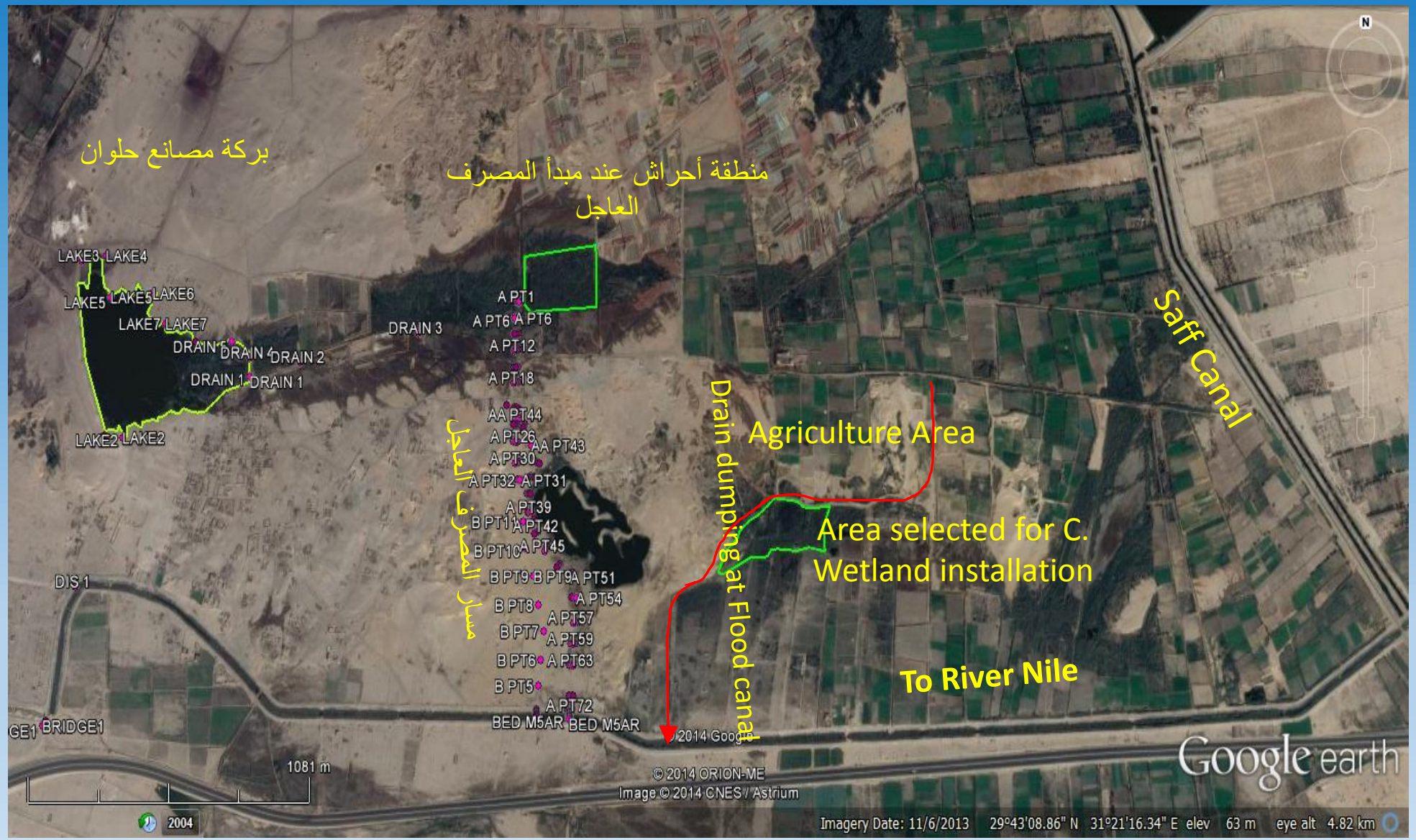

0.000km


2.000km


1.000km

Al Saff Canal Water Treatment Wetland Project

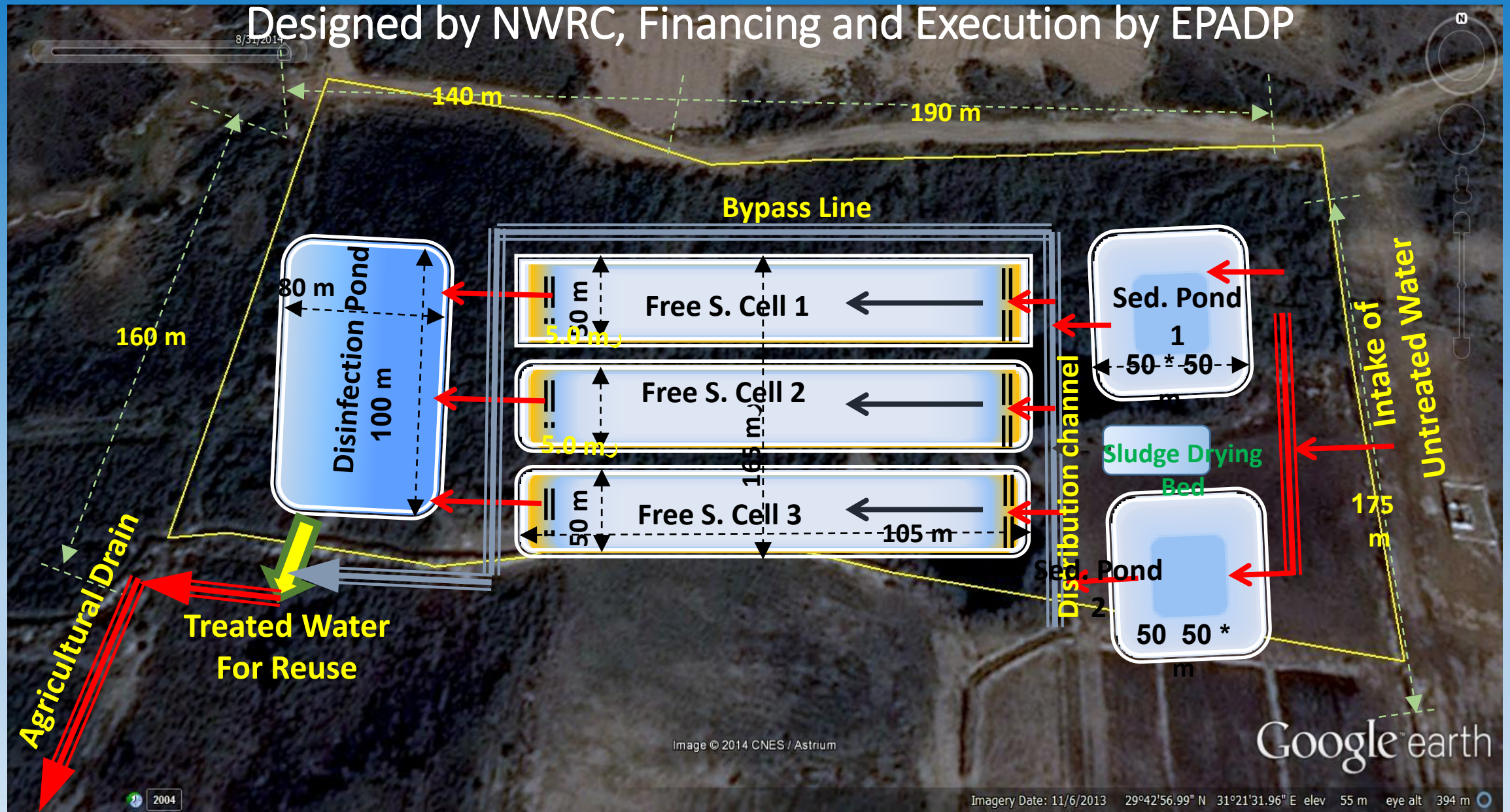
3800 m^3/day (Under construction)



Al Saff Canal Water Treatment Wetland Project

3800 m^3/day (Under construction)

Designed by NWRC, Financing and Execution by EPADP



Conclusions

- The LMEWP has helped Egypt in an ambitious and pioneering effort to clean and reuse agricultural drainage waters for productive purposes by developing an innovative approach and technology.
- Treatment of wastewater via engineered wetlands is a new low-cost technology to the Middle East, and the LMEWs are the first of their type in Egypt.
- The success of the technology in reducing water pollution has led national authorities to explore the reuse of treated water via engineered wetlands in irrigation, fish farming, and decentralized wastewater treatment technology in remote areas.

Conclusions

- The project carried out capacity building for sustainable development in managing LM, including local and national participation.
- Numerous national and international research and environmental organizations are currently sharing activities in LMWRS aiming to study, develop, and widespread the constructed wetland technologies in different wastewater treatment in the middle east, arid and semi-arid climate countries.
- Preserve/ restore the ecology and Reduce nutrient loads to LM and the Mediterranean.

THANKS