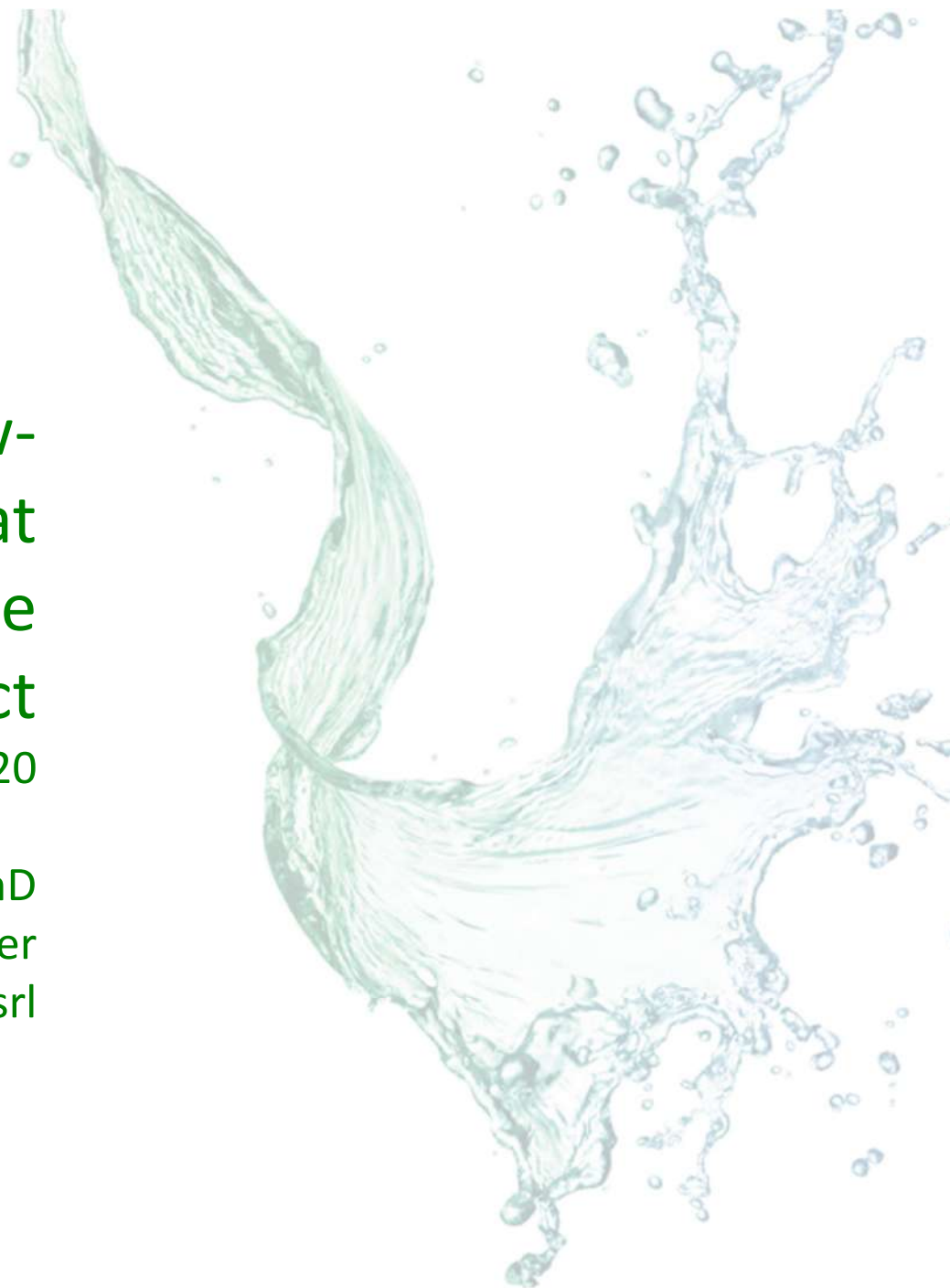




The Sustainable and Low-Cost Technologies to Treat Greywater targeted in the Nawamed project

Remote event - 16-12-2020

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Technical Director - R&D Manager
IRIDRA srl



Motivation

-
- The diagram illustrates a water reuse system in a city. It shows a cycle of water flow between various urban components. At the top, a yellow arrow labeled "energy - heat" points from a power source to a building labeled "ROOF CW". This building has a circular flow of "clean water" and "grey water". A "SHORT ROTATION PLANTATION" area provides "clean water" and "N, P" to a "CW" (Constructed Wetland) area. A "SUDS" (Sustainable Urban Drainage System) area receives "rain" and "black water" from the buildings. A "VERTICAL GARDEN" building has a circular flow of "clean water" and "grey water". A "POND" area receives "black water" and "overflow" from the "SUDS" and "VERTICAL GARDEN". The "POND" has an "overflow" that goes to a "RIVER". A "PARK" area receives "clean water" and "N, P" from the "POND" and "irrigation" from the "RIVER". A "CW" (Constructed Wetland) area receives "grey water" from the "VERTICAL GARDEN" and "rain" from the "POND". A "RIVER" area receives "overflow" from the "POND" and "clean water" from the "CW".

NAWAMED PILOTS



Expected results / Total flows to treat: 9.000 m³/year

	Italy  <small>COMPAGNIA REGIONALE DI SERVIZI PER LE INFRASTRUTTURE AGRICOLE</small>	Tunisia 	Jordan 	Lebanon  <small>AMERICAN UNIVERSITY OF BEIRUT الجامعة الأمريكية في بيروت</small>
Targeted flows	2.000 m ³ /year	1.100 m ³ /year	2.500 m ³ /year	3.300 m ³ /year
GW vertical surface	Ferla 64 m ²	Cité Jardin 120 m ²	Jerash 120 m ²	Amman 170 m ²
CW storm water	Latina 1000 m ²			
CW grey water horizontal + CW Aerated Vertical				Bekaa Valley 100 m ² Refugee camp portable system 12 m ²
Estimated costs (infrastructures)	€ 140.000 € 76.800	€ 60.000	€ 162.000	€ 231.000

Motivation



❑ Green walls:

- Nature-based solutions with multiple benefits (aesthetics, thermal regulation, noise reduction...)
- can be built on unused vertical surfaces (good for urban areas);
- require considerable amounts of water for irrigation;





Beirut, by Patrick Blanc

Greenwalls Functions

- Air filtration + O₂ production and CO₂ storage
- Reduced energy costs + positive microclimate effects
- Increased biodiversity
- Reduced noise pollution
- Increased building longevity
- Aesthetics
- ◆ Wastewater treatment?



IMAGINE IF TREES
GAVE FREE WIFI.
WE'D ALL BE PLANTING
LIKE CRAZY.
IT'S A PITY THEY ONLY
GIVE US THE OXYGEN
WE BREATHE.





3rd IWA Resource Recovery Conference

8 - 12 SEPTEMBER, 2019
VENICE, ITALY



Green Walls Optimized for Treatment and Reuse of Greywater

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CO-ORGANIZERS

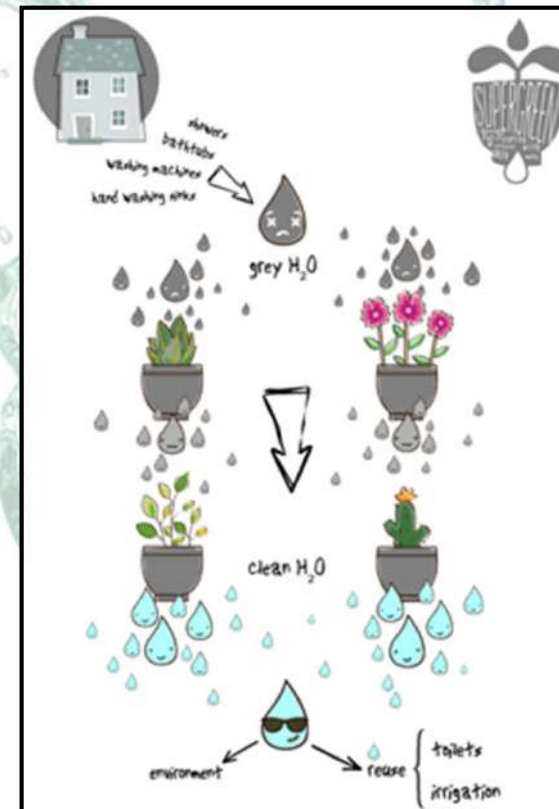


Objectives

- ❑ The idea of **SUPERGREEN** (*SUstainable Purification of greywatER with GREEN walls*) project is to test a system for treatment and reuse of greywater in urban areas.
- ❑ The system consists of **vertical green walls** composed of **modular panels** to exploit unused surfaces of buildings.
- ❑ Information on performance of green walls irrigated with GW is still limited



We performed **laboratory tests** at Politecnico di Torino aimed to **quantify the system performance in removing contaminants**.



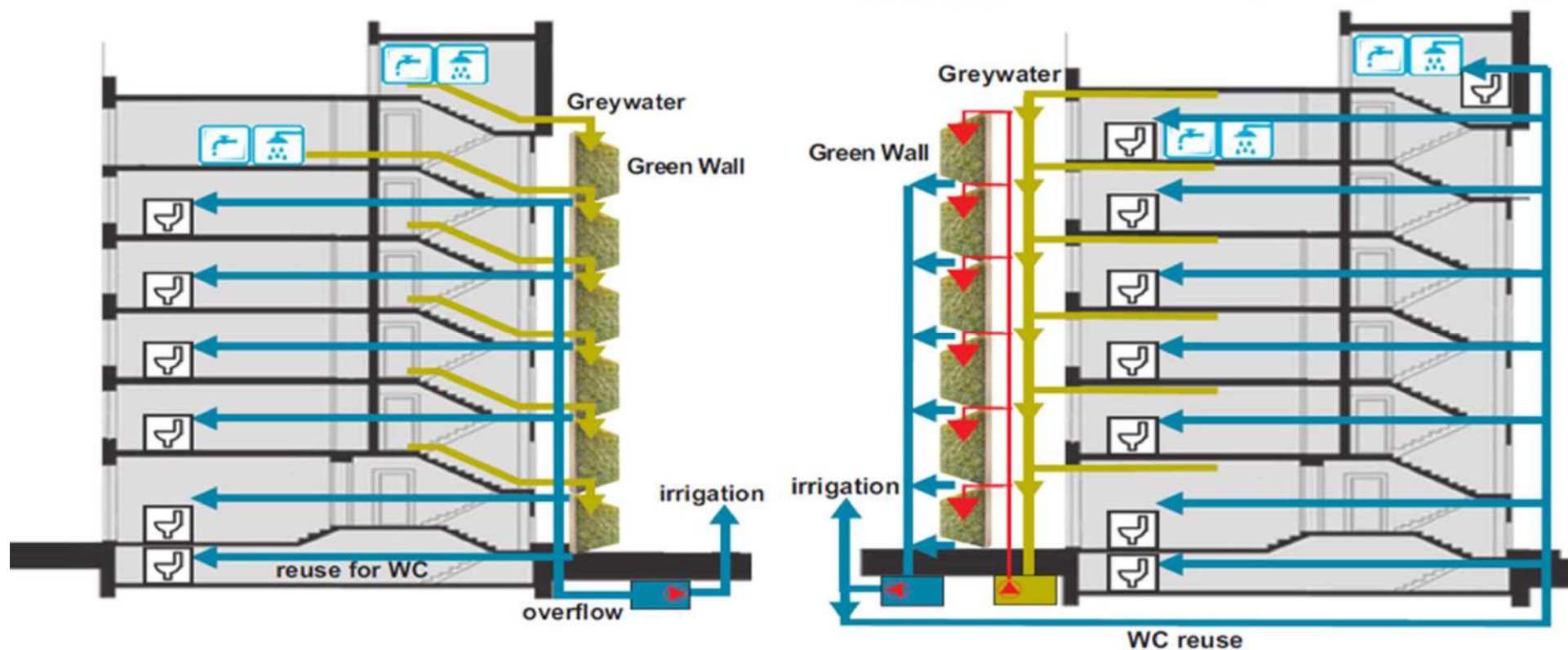


Conclusions



- ❑ Our pilot system was tolerant to GW up to $HLR=700 \text{ L/m}^2/\text{d}$ (very high, VF CW usually designed for $80 \text{ L/m}^2/\text{d}$)
- ❑ The best performance was achieved for BOD and E. coli, with removal efficiency close to 100%.
- ❑ COD removal was initially lower but increased over time (possibly due to biological effects).
- ❑ TN and TP show limited removed, but inflow concentrations were low.
- ❑ In view of Italian legislation limit
 - ❑ COD, BOD5, and TN met
 - ❑ E.Coli not met even with very high efficiencies → tertiary disinfection unit (e.g. UV lamp) needed, as usually done for reuse of wastewater treated by NBSs
 - ❑ TP peaks could be responsible of not fulfilling of reuse standard → possibility to use high-sorbent material need to be investigated
- ❑ COD, BOD5, TN, and TP releases must be properly accounted in the design phase if the proposed BM is used
- ❑ Removal efficiency (e.g., COD) may improve by adding biochar (and polyacrylates)

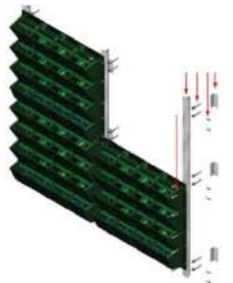
Possible implementation schemes



Social acceptance



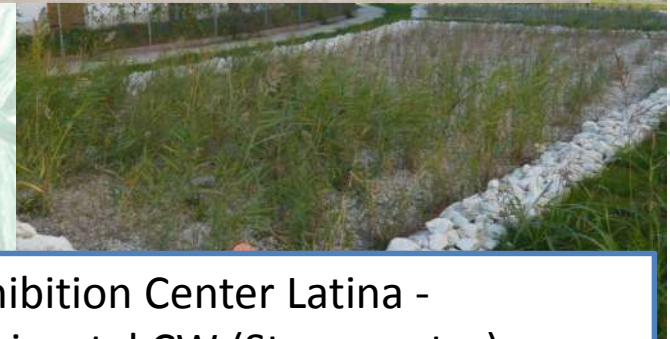
NAWAMED pilots ITALY



Ferla school Green Wall
+ green facades



Exhibition Center Latina -
Horizontal CW (Storm water)

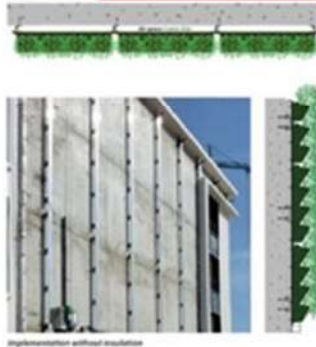




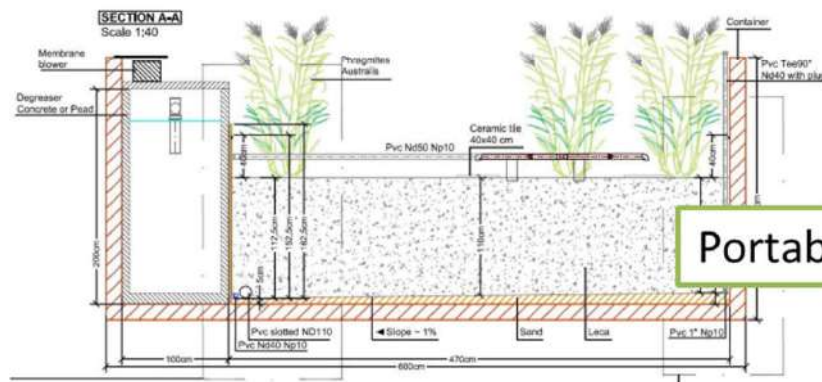
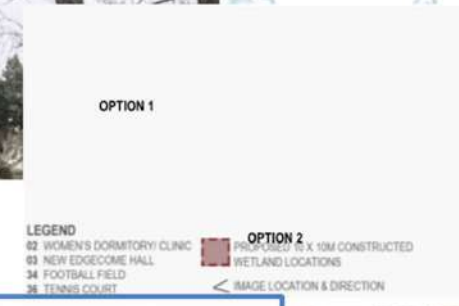
NAWAMED pilots LEBANON



Jewet Hall
Green
Wall



Bekaa Valley
Horizontal CW



Portable AEW for refugees camps





NAWAMED pilot TUNISIA



Cité Jardin -
Green walls
(anchored
modules)

Demonstration green walls to treat and reuse grey water:
from theory to practice





NAWAMED pilot 1

JORDAN



University of Jordan site Al-Zahra'a building

Information on the building

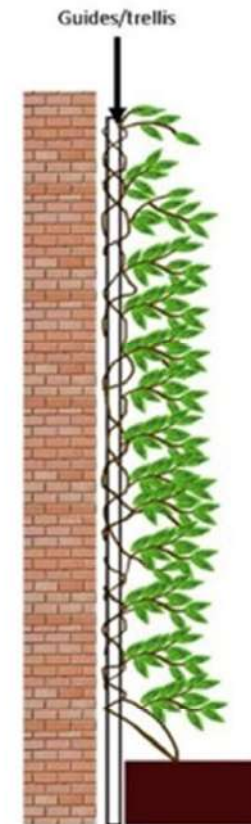
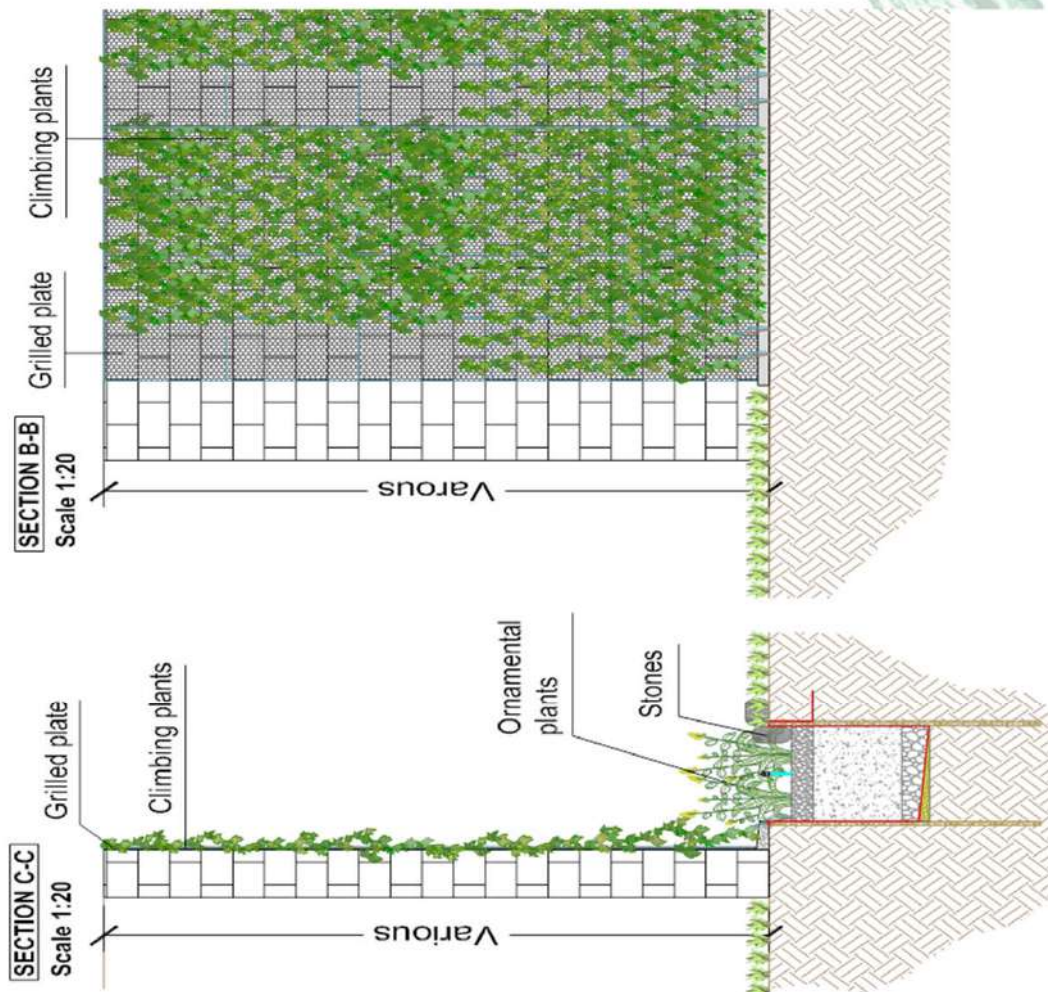
- full occupancy of the dormitory (in non-covid time) is around 300 students
- during the year the dormitory is occupied for 9-10 months

PILOT TECHNOLOGIES

- **Green facades** around building walls and toilet blocks - some 85 linear meters and a trench in the ground 50/60 cm width. **TREATED VOLUME: 4,5 m³/day that can be directly re-used in the toilets.**
- **Roof wetland** 10 square meters on the building roof. **TREATED VOLUME: 1,5 m³/day that can be directly re-used in the toilets.**
- **Green wall** anchored modules at the main entrance of the building. **TREATED VOLUME: 0,5 m³/day that can be directly re-used in the toilets.**



Al-Zahra'a building: Green facade

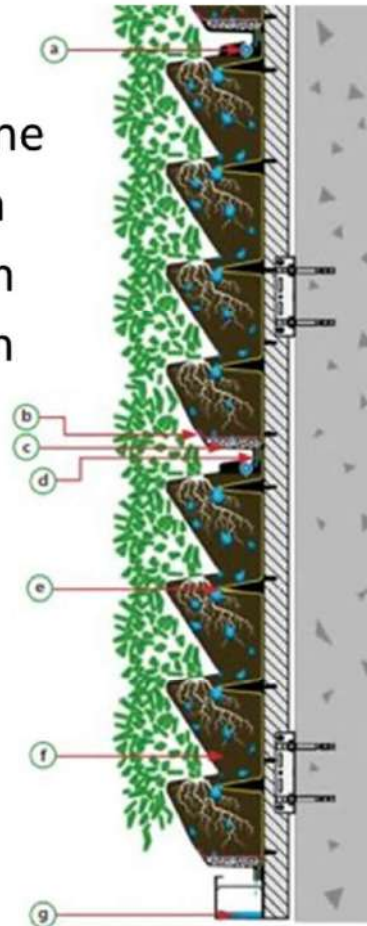


Source: Bustami et al. (2018)

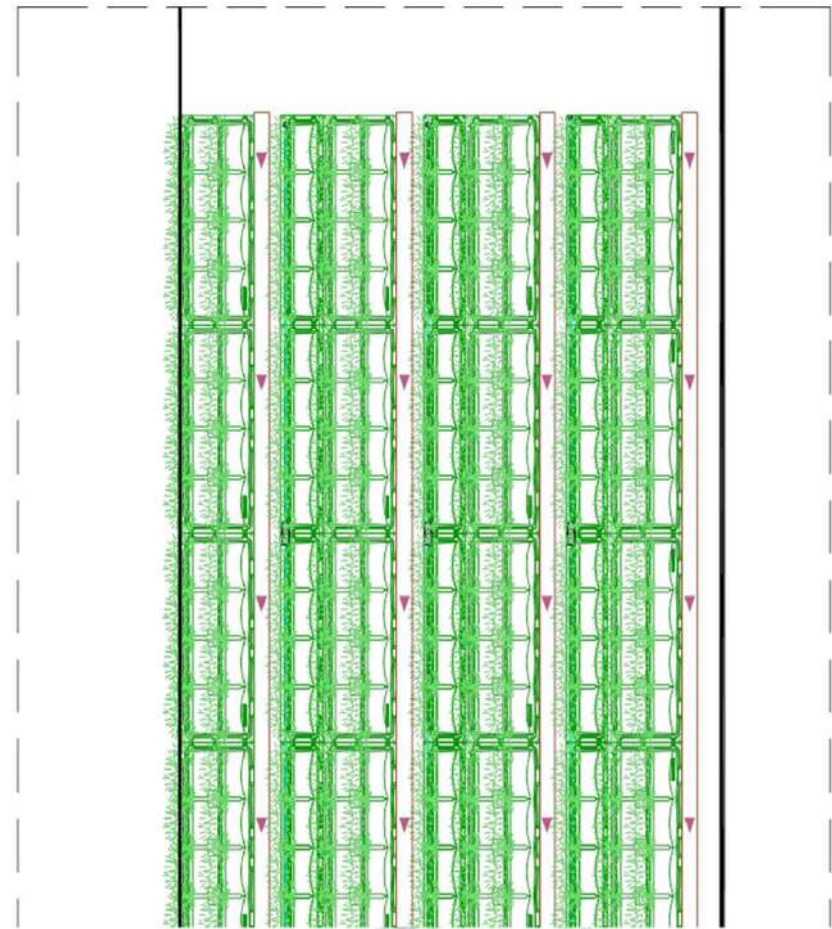


Al-Zahra'a building: Anchored green walls

- a - Regulating dripline
- b - growing medium
- c - drainage medium
- d - water evacuation
- e - internal water distribution
- f - growing medium
- g - water recovery

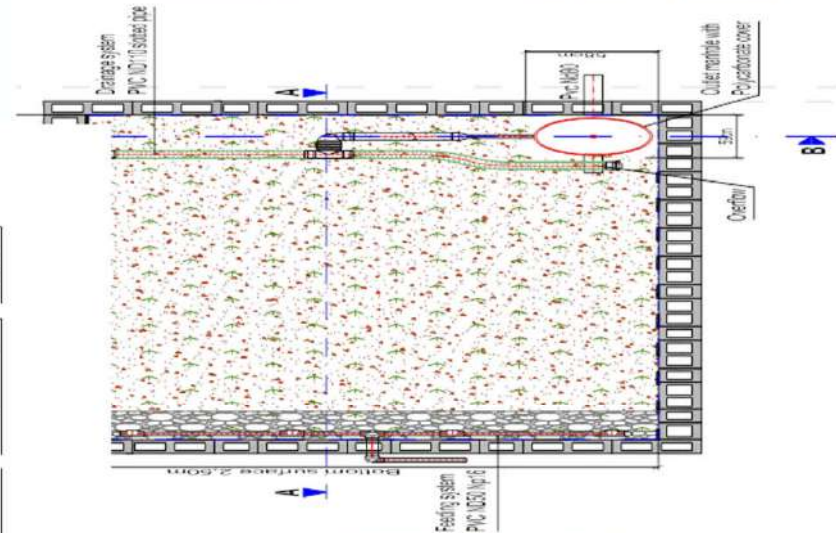
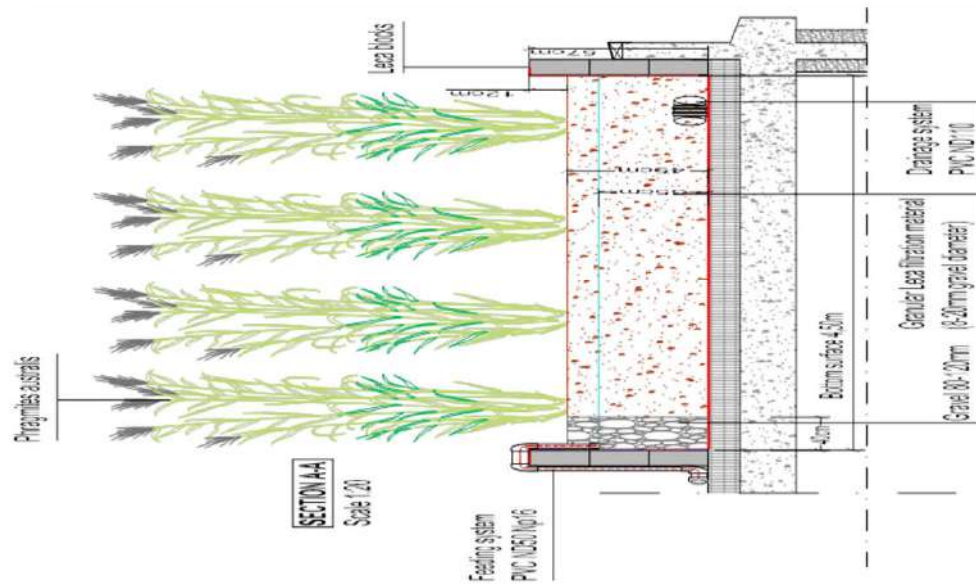


VIEW
20





Al-Zahra'a building: Roof Wetland





NAWAMED pilot 2 JORDAN



Jerash municipality Zaha Cultural Center Park

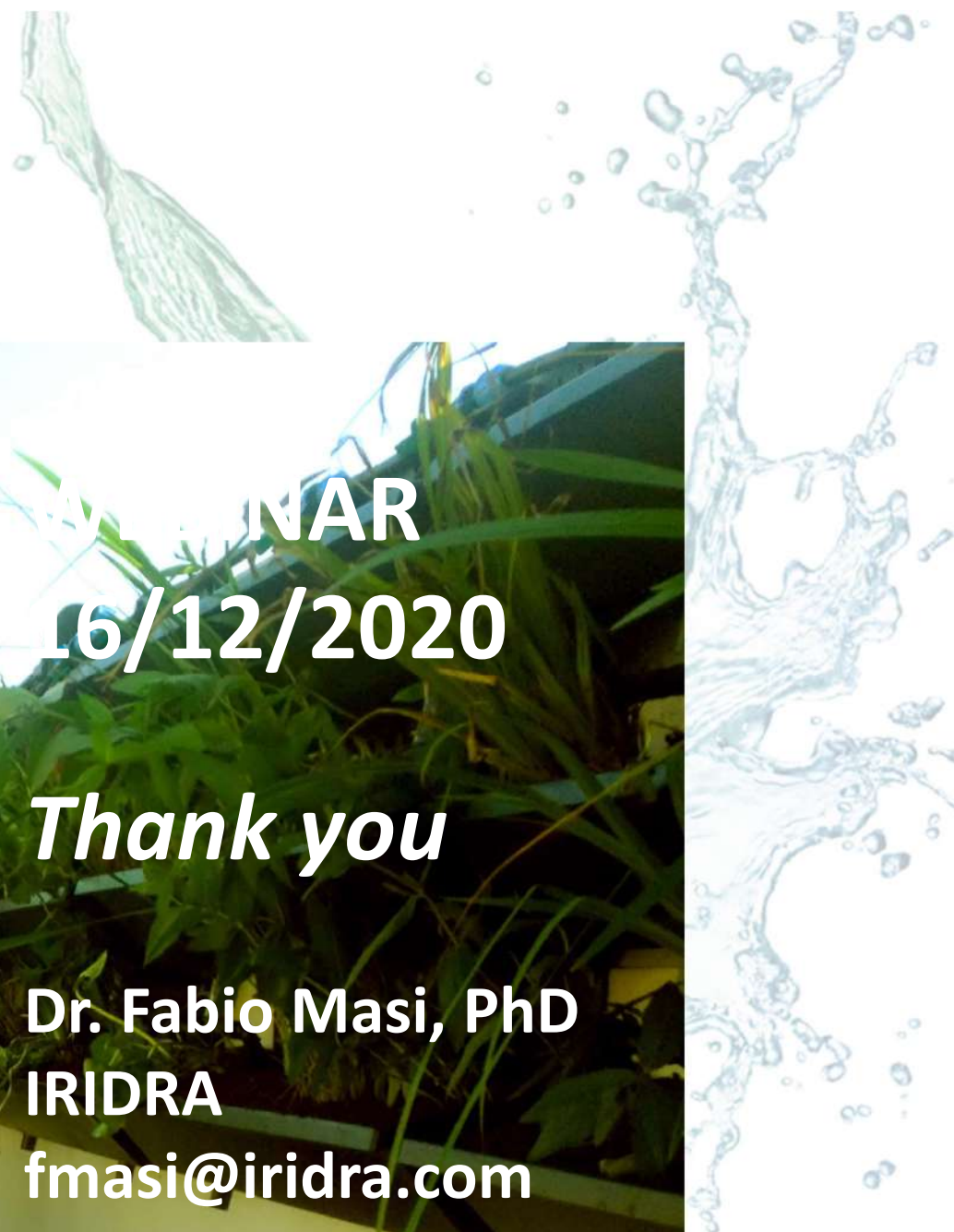
Foreseen technologies:

- Green facades
- Green walls (anchored modules)



Expected TREATED VOLUME:
3,5 m³/day to be re-used in
the toilets or for irrigation





SEMINAR
16/12/2020

Thank you

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