MABR AT WORK

Technology Evaluation, Design & Construction of the Full-Scale MABR System at the Hespeler Wastewater Treatment Plant

March 9, 2021

Look Who's Talking

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SUEZ – Water Technologies & Solutions

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Stantec Consulting, Ltd.

Agenda

1.	MABR Technology Overview	15 min
2.	Hespeler Case Study	20 min
3.	Q&A	10 min

1.

MABR Technology Overview

ZeeLung*

SIMPLE, SUSTAINABLE, PROCESS INTENSIFICATION

⇛ PROCESS INTENSIFICATION

Up to 50% more treatment capacity in existing tank volumes

⇛ PROCESS RESILIENCE

Resilience to upset conditions

⇛ SIMPLE SOLUTION

Installed in existing tanks, no civil works, fast implementation

⇛ ENERGY SAVINGS

Up to 50% less energy

ZeeLung **solves** treatment challenges

- Increase capacity
- Augment ammonia removal
- Implement nitrogen removal
- Implement biological phosphorous removal

How It Works

ZeeLung is a **biomass carrier** that supports the growth of a biofilm

the carrier material **“breathes”** and transfers oxygen to the biofilm at very **high efficiency** without the use of bubbles

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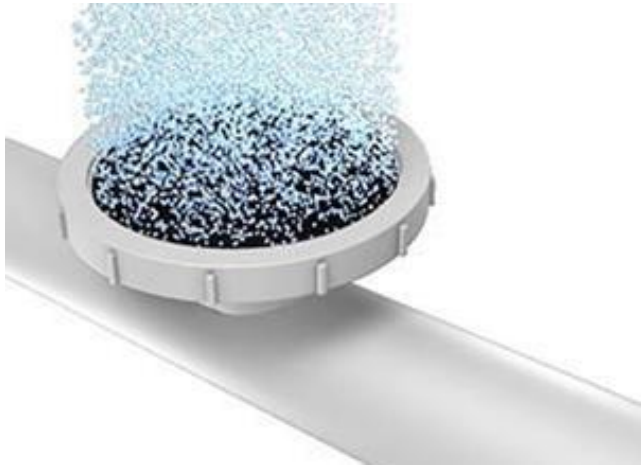
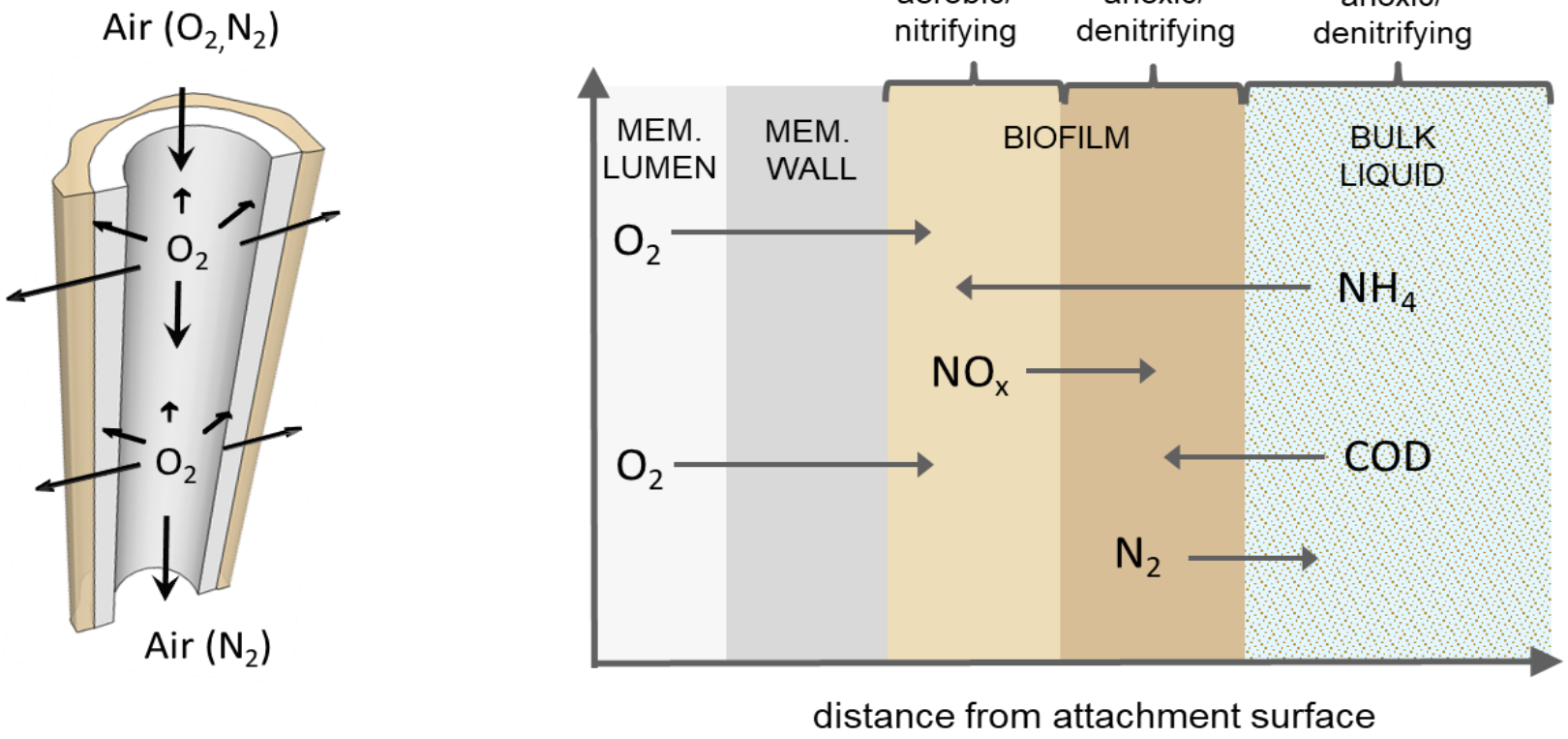
ZeeLung is not...

a filter



a fine bubble diffuser

What is MABR

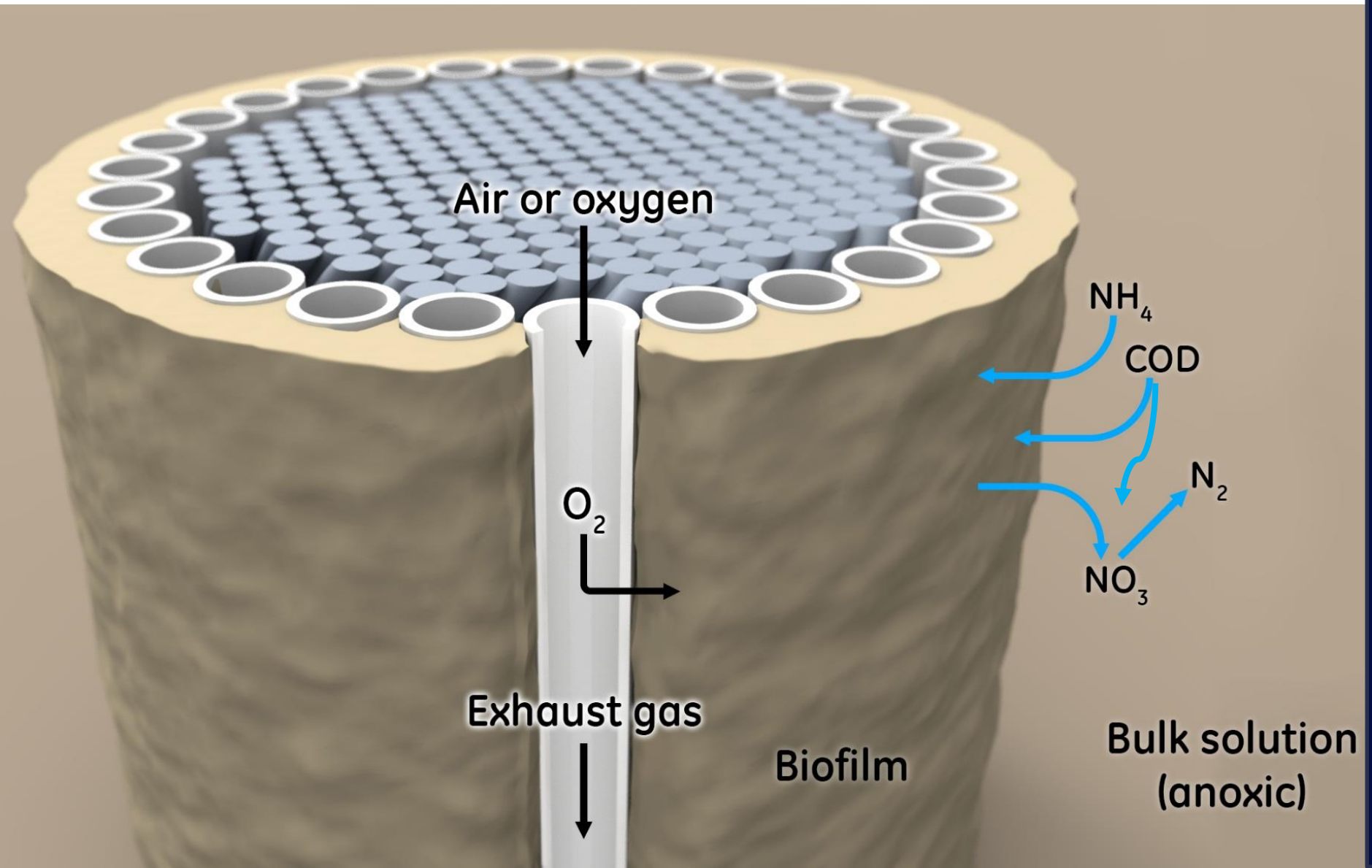


⇛ Media-supported biofilm with its own built-in O_2 supply

⇛ Counter-diffusional biofilm with "magical" properties

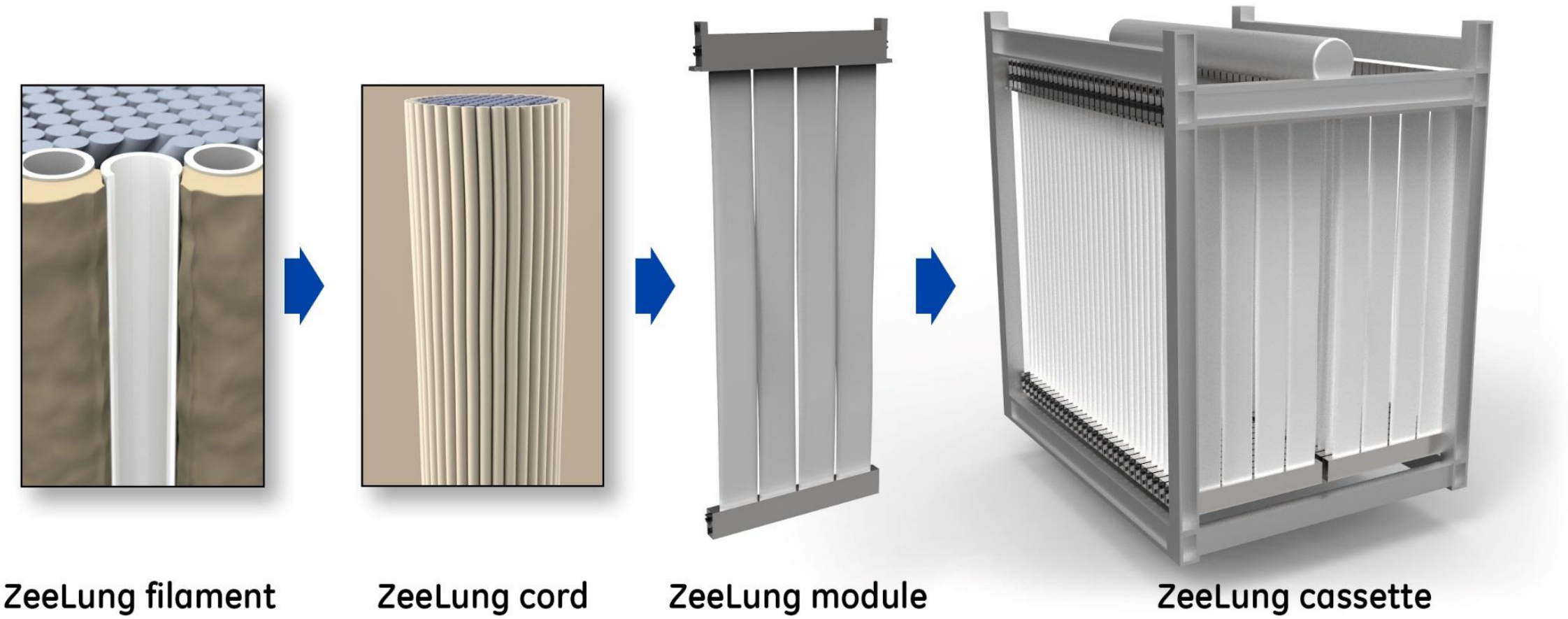
For more information on the unique properties of counter-diffusional biofilms see Downing and Nerenberg (2008) Applied Microbiology and Biotechnology, 81:153–162

ZeeLung process



Highest efficiency of oxygen transfer by diffusion of O_2 into a biofilm

ZeeLung product



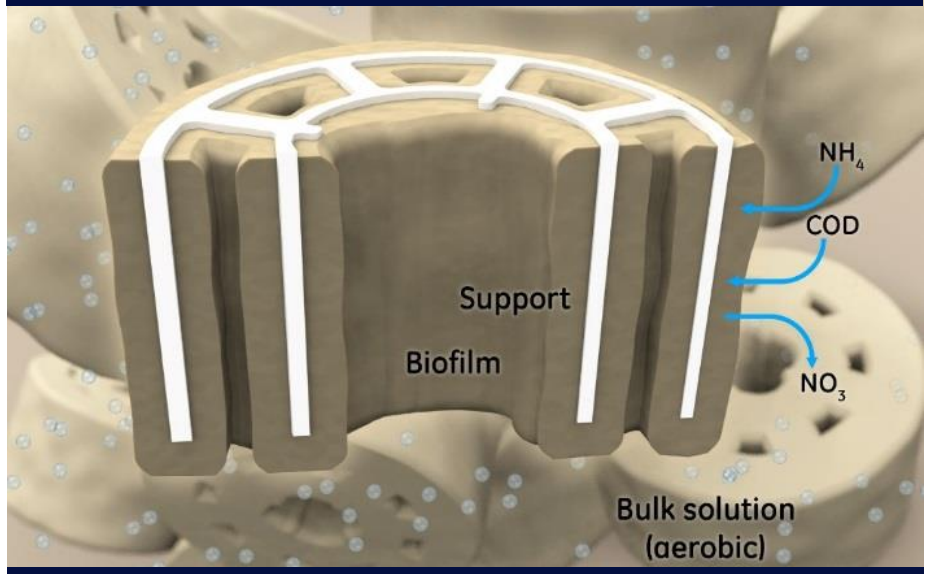

suez

ZeeLung enables process intensification

⇛ ↑ bacteria inventory = ↑ treatment capacity

⇛ plus… ZeeLung biofilm favors the growth of the bacteria we want – nitrifiers

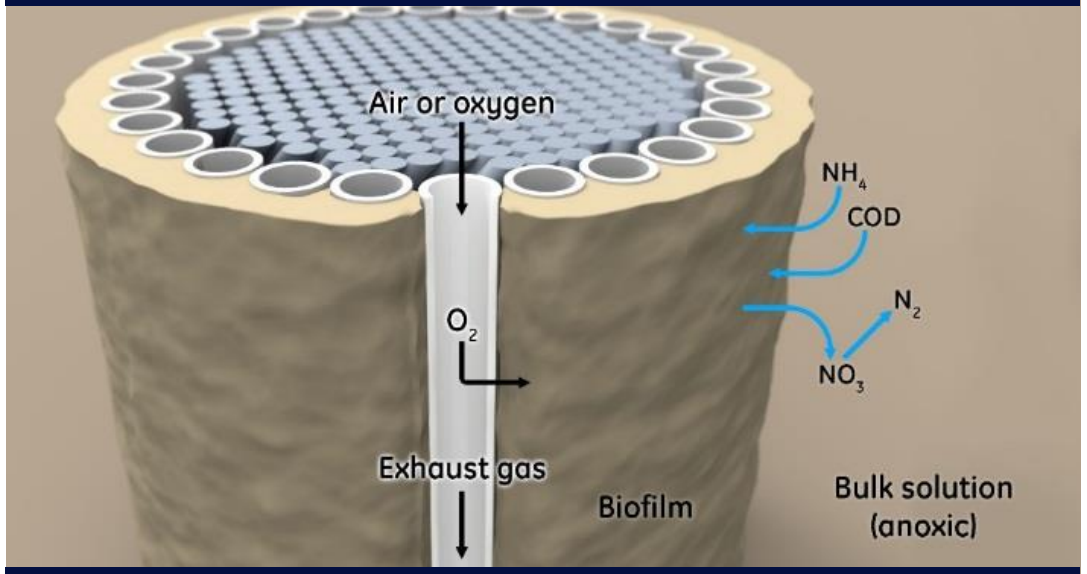
conventional



reaction occurs at the surface

competition for O_2 between heterotrophs & autotrophs

ZeeLung



reaction occurs in the biofilm

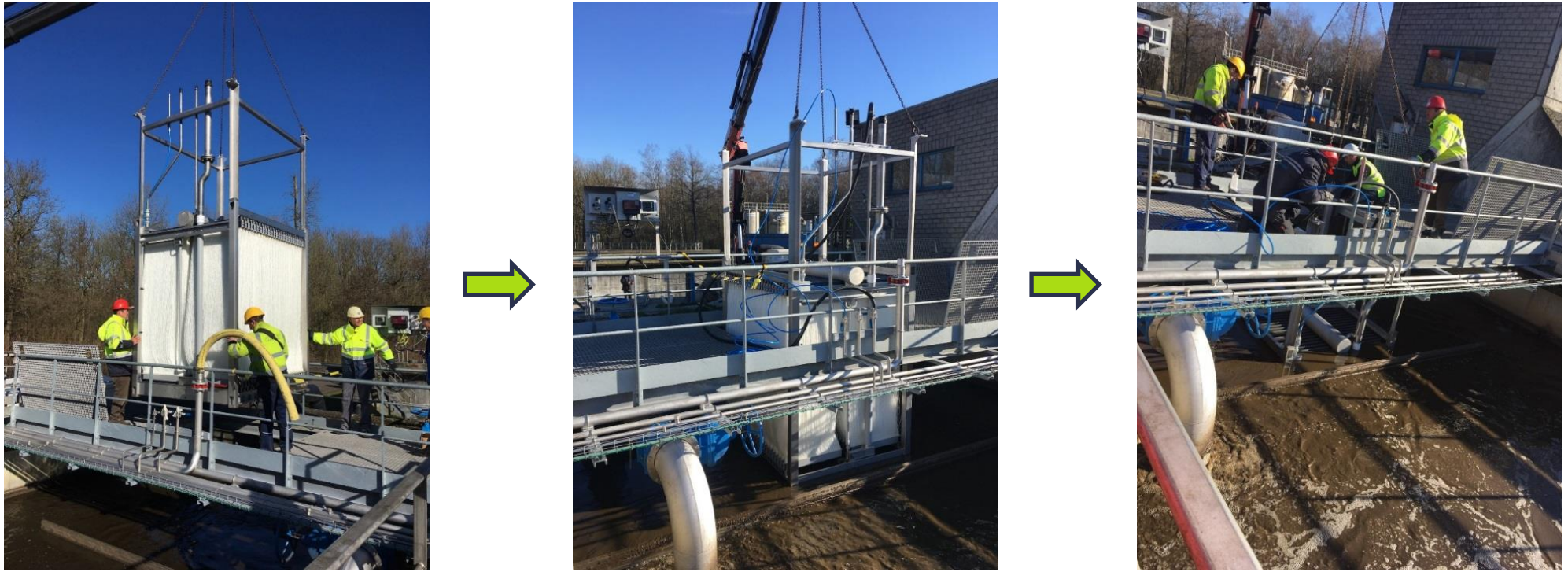
favors the growth of autotrophs (nitrifiers) at media surface

ZeeLung offers process resilience

- ⇛ Attached growth bacteria…not susceptible to washout
- ⇛ Rapid response to influent fluctuations
- ⇛ Stable cold temperature performance

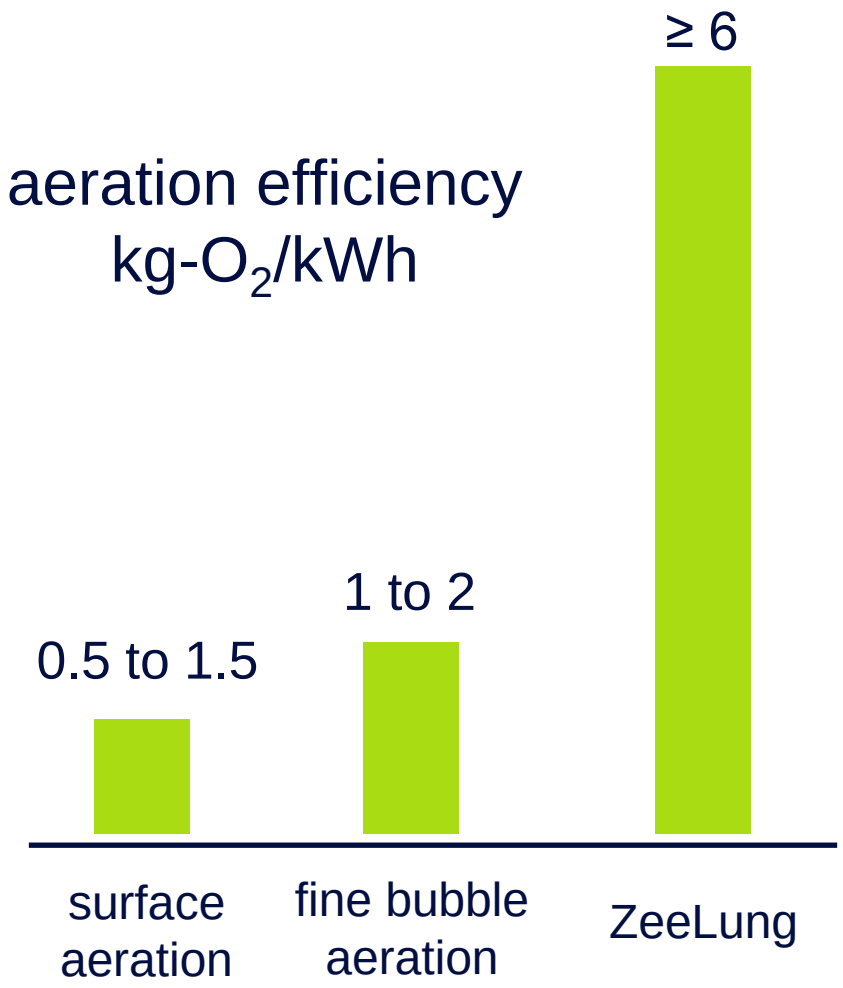
ZeeLung is a simple solution

- ⇛ Installed in existing tanks
- ⇛ Fast deployment
- ⇛ No impact on hydraulic gradeline



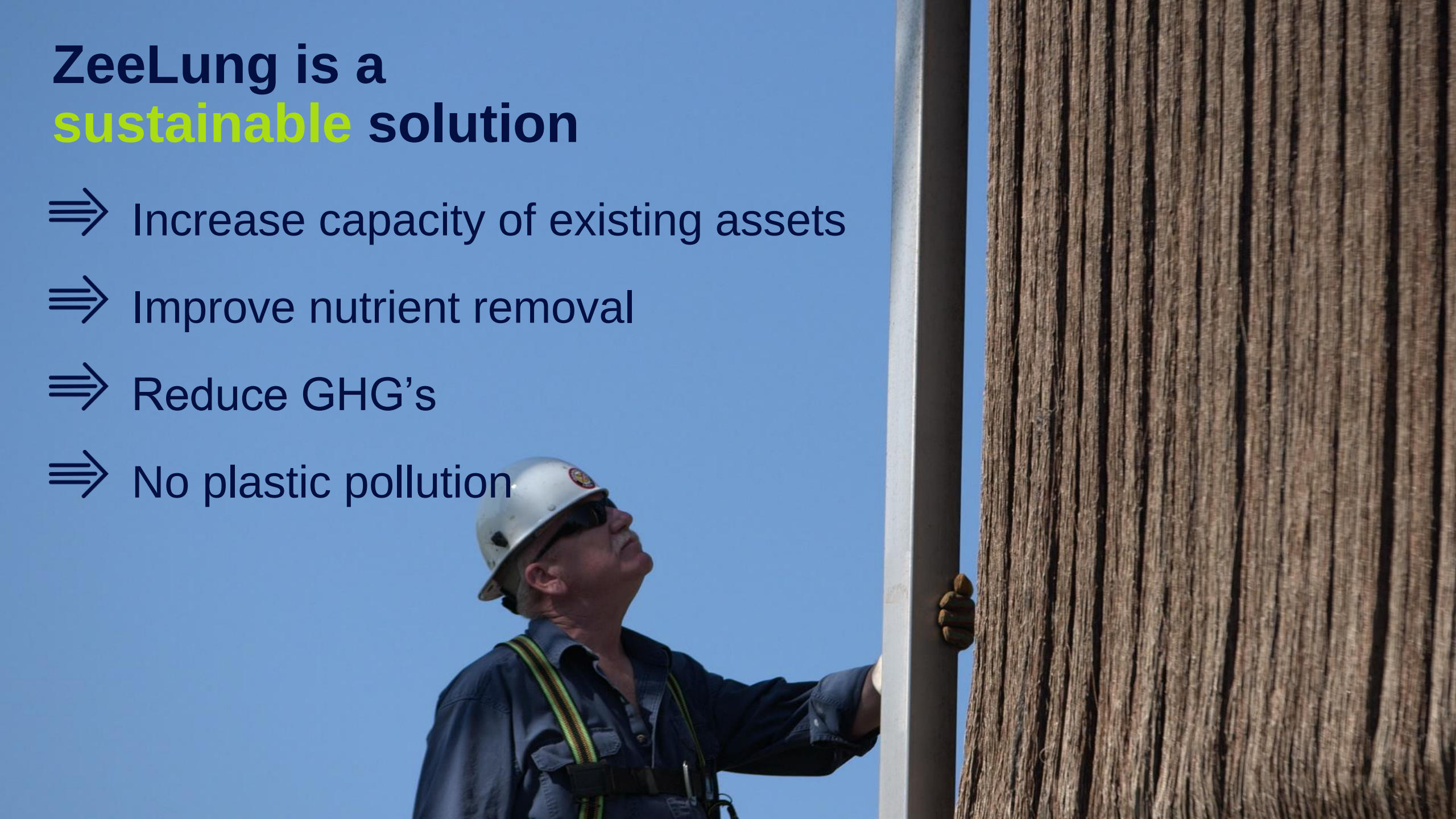
ZeeLung saves energy

- ⇛ Transfer O_2 without bubbles
- ⇛ 4X lower energy than bubble aeration
- ⇛ Reduce liquid pumping due to simultaneous nitrification & denitrification



ZeeLung is a sustainable solution

- Increase capacity of existing assets
- Improve nutrient removal
- Reduce GHG’s
- No plastic pollution



Innovative & proven

12 full-scale plants,
3 in operation for >2 years

>30 technology demonstrations

2.

Hespeler Case Study

Aerial View Before Upgrades:

- *Plant capacity = 9.32 MLD*
- *Undergoing upgrades: new headworks, sec clarifier, membrane WAS thickening, aerobic digestion, PAA disinfection, MABR*

MABR Integration at Hespeler WWTP - Ontario, Canada

Olav Natvik, M.Eng., P.Eng
Stantec Consulting Ltd.

March 9, 2021

Partner Acknowledgements:
Region of Waterloo
Ontario Clean Water Agency

Region of Waterloo

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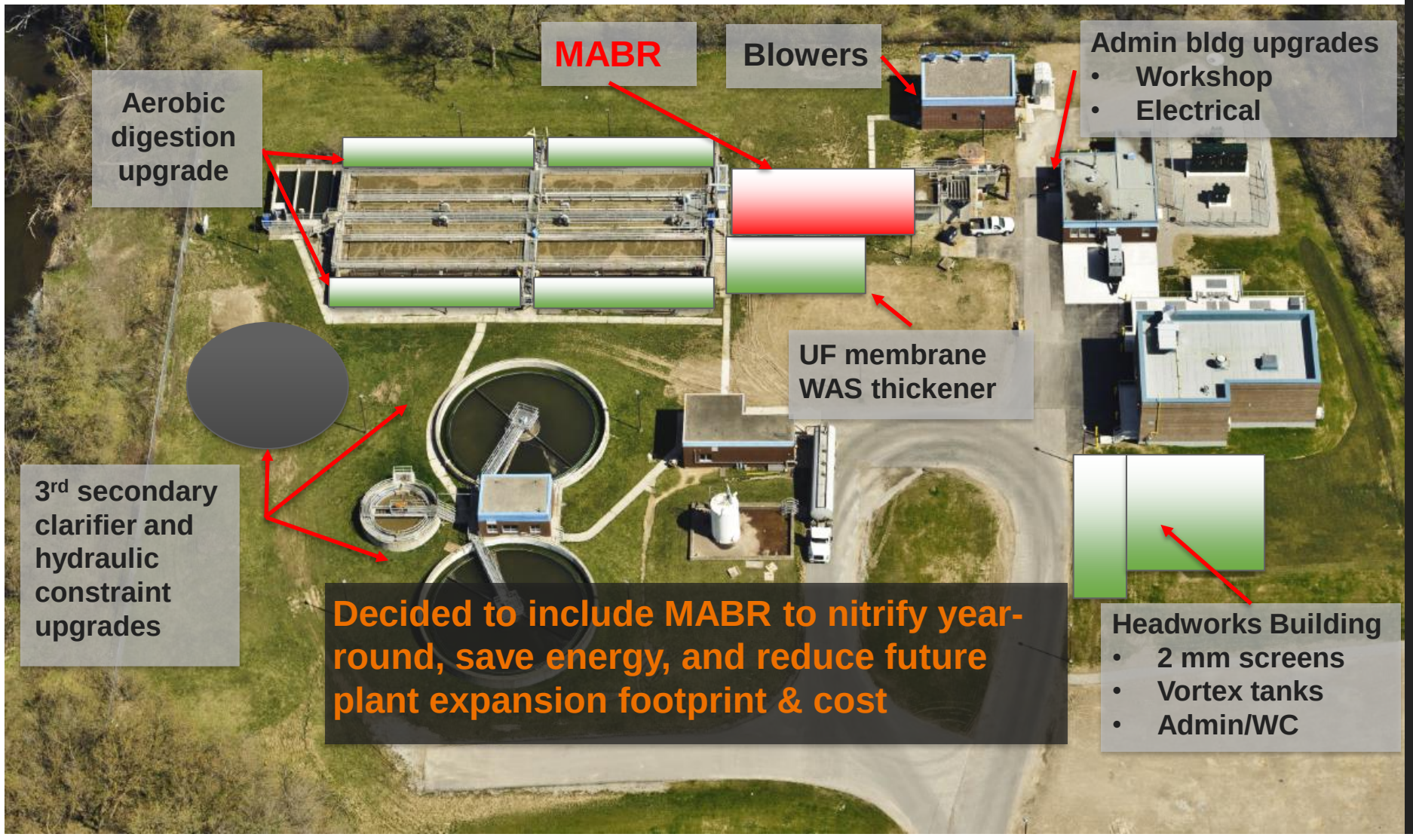
Background - Plant upgrades



Contract #1
3rd secondary clarifier – completed

Contract #2
Headworks, WAS thickener, digester upgrades – on-going

Contract #2
Change Order to add MABR – on-going with completion Q3, 2021

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MABR Drivers for Hespeler

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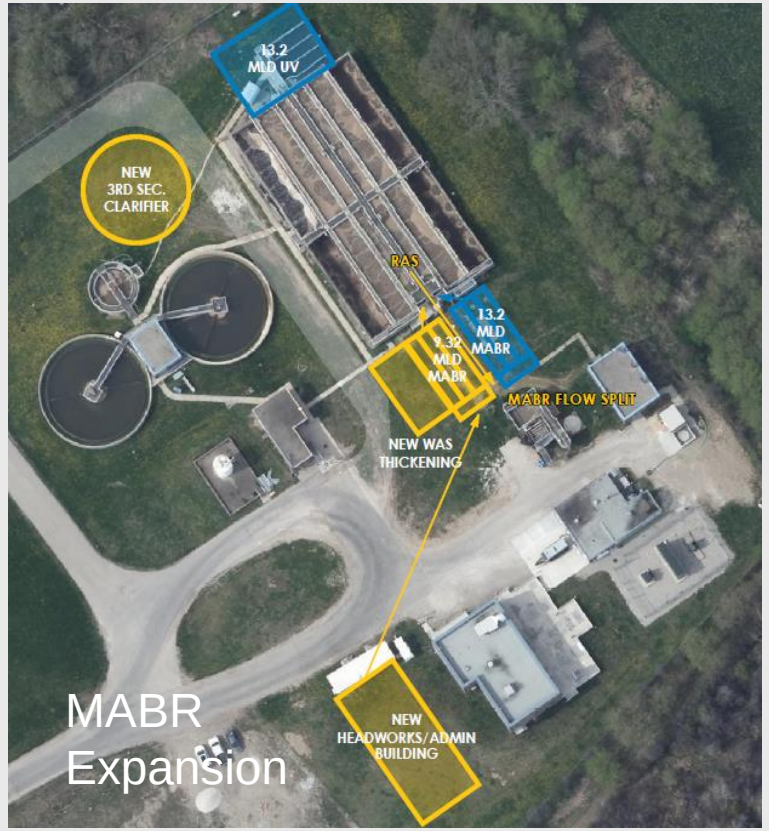
- Need for winter nitrification - *currently suffer winter nitrifier washout*
- MABR capital cost = half of CAS/EA expansion *($12M vs $25M for 13.5 MLD)*
- MABR compact footprint vs CAS/EA
- Energy saving >30% for aeration

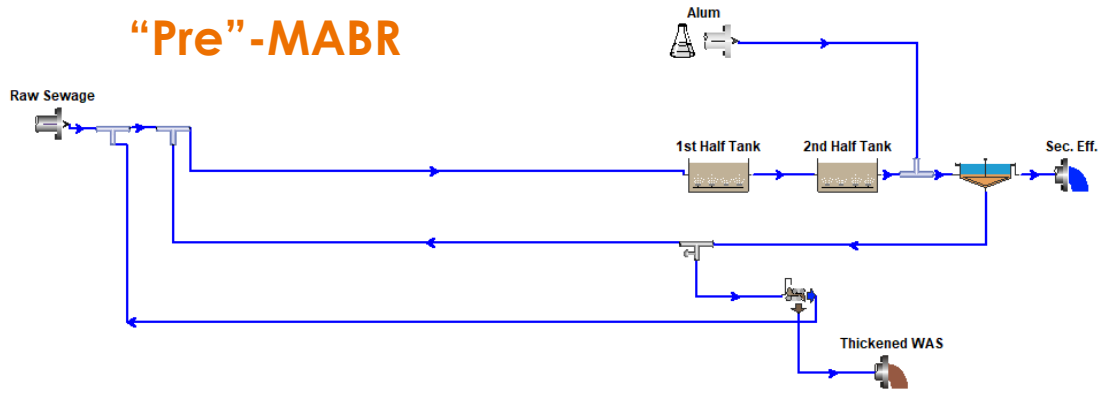
Vs



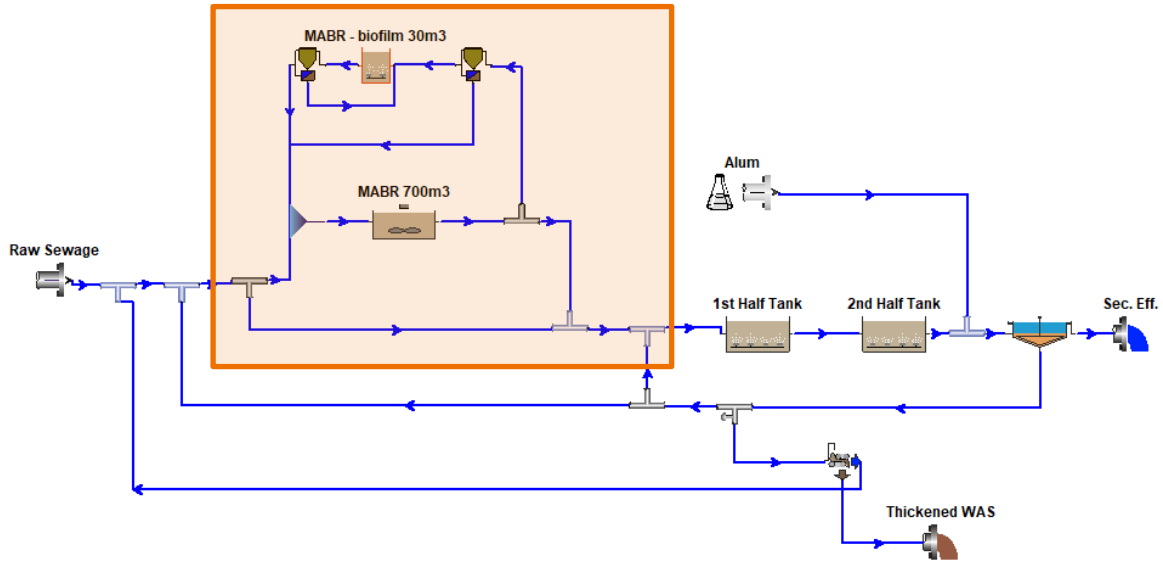
Hespeler MABR Design Basis

1. PFD – New purpose-built tanks to fit hydraulic profile & space constraints

"Pre"-MABR



"Post"-MABR



2. Modeling used as basis for estimating MABR effluent NH3 target = 12 mg/L & plant effluent = 5 mg/L, with worst case non-nitrifying ASP

Key model settings:

- Flow=9.32 MLD, annual average load equivalent, MLSS srt=4 days, biofilm srt=20 days
- Raw sewage characteristics per updated 2014-2018 data review
- WW temp = 10 C, Biofilm=100%, RAS=100%, alum dose = 700 L/d
- Modeling objective: To assess MABR performance.

Concentrations (mg/L):

Elements	Flow [m3/d]	CBOD - T [mg/L]	TSS [mg/L]	VSS [mg/L]	N - TKN - T [mgN/L]	S_NHx [mgN/L]	S_NO3 [mgN/L]	S_NO2 [mgN/L]	P - PO4 [mgP/L]	P - TP [mgP/L]
Raw Sewage	9320.00	205.97	216.12	166.12	42.00	27.72	0	0	2.90	5.80
Alum	0.70	0	0	0	0	0	0	0	0	0
To biofilm	9226.80	6.28	0.03	0.02	15.00	12.59	0.46	0.07	0.21	0.21
To biofilm (U)	93.20	99698.91	270686.38	177743.17	15158.42	12.59	0.46	0.07	0.21	6910.55
MABR - biofilm 30m3	9320.00	14879.69	31516.36	28141.72	2789.97	0.54	12.37	0.12	0.14	880.61
From biofilm	9226.80	3.22	2.55	2.27	3.00	0.54	12.37	0.12	0.14	0.21
From biofilm (U)	93.20	1487650.51	3151383.83	2813947.01	278700.29	0.54	12.37	0.12	0.14	88039.62
MABR 700m3	27900.43	1003.20	2706.89	1777.45	166.43	12.59	0.46	0.07	0.21	69.31
1st Half Tank	18580.43	980.38	2693.69	1761.98	164.40	9.78	1.40	0.90	0.02	69.31
2nd Half Tank	18580.43	959.91	2677.16	1743.81	162.84	7.92	2.15	1.48	0.00	69.31
Sec. Eff.	9261.13	6.04	10.77	7.00	10.80	7.92	2.15	1.48	0.00	0.28
Sec. Clarifier (U)	9320.00	1907.69	5338.86	3469.53	313.90	7.92	2.15	1.48	0.00	137.91
WAS splitter (U)	373.12	1907.69	5338.86	3469.53	313.90	7.92	2.15	1.48	0.00	137.91
Membrane WAS thickener	313.55	2.22	0.06	0.04	10.19	7.92	2.15	1.48	0.00	0.00
Membrane WAS thickener (U)	59.57	11936.51	33437.78	21729.98	1912.39	7.92	2.15	1.48	0.00	863.71
Thickened WAS	59.57	11936.51	33437.78	21729.98	1912.39	7.92	2.15	1.48	0.00	863.71

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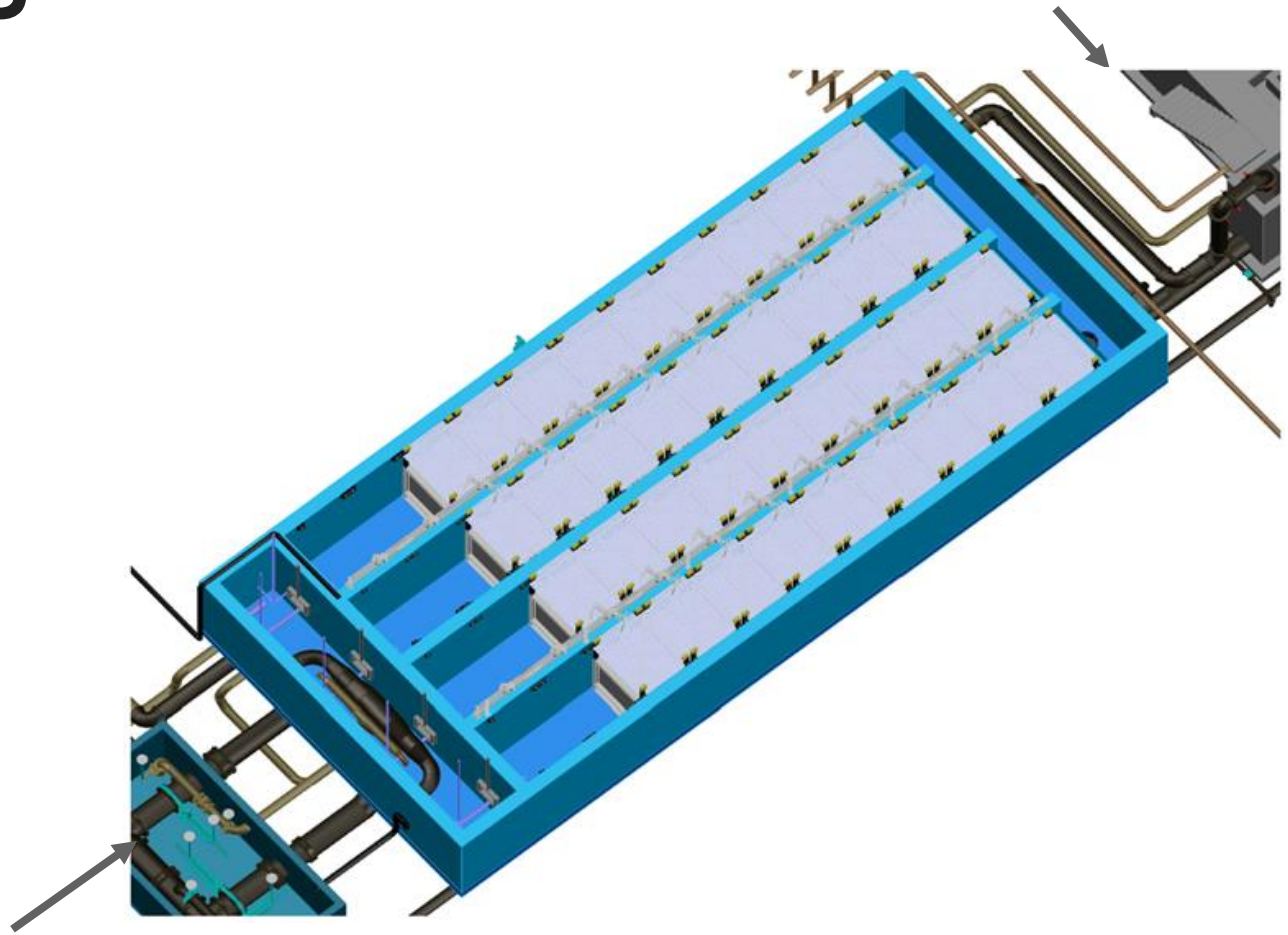
Hespeler MABR Design

Unique aspects

- Business case – MABR half cost vs CAS/EA expansion for nitrification
- Scale – Largest full-scale MABR plant in world with 36 cassettes
- Process design – ammonia removal by Zeelung; no MLSS nitrification credit in winter
- Implementation – purpose-built tanks to minimize disruption during construction
- Procurement – Competitively bid preselection
- Design considerations:
  - Headloss
  - Supplemental mixing
  - Testing flexibility – flow routing, instrumentation
  - Future expansions



Inlet Valve Chamber

- Screened sewage
- RAS
- MABR Bypass

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Hespeler MABR Design Plan View

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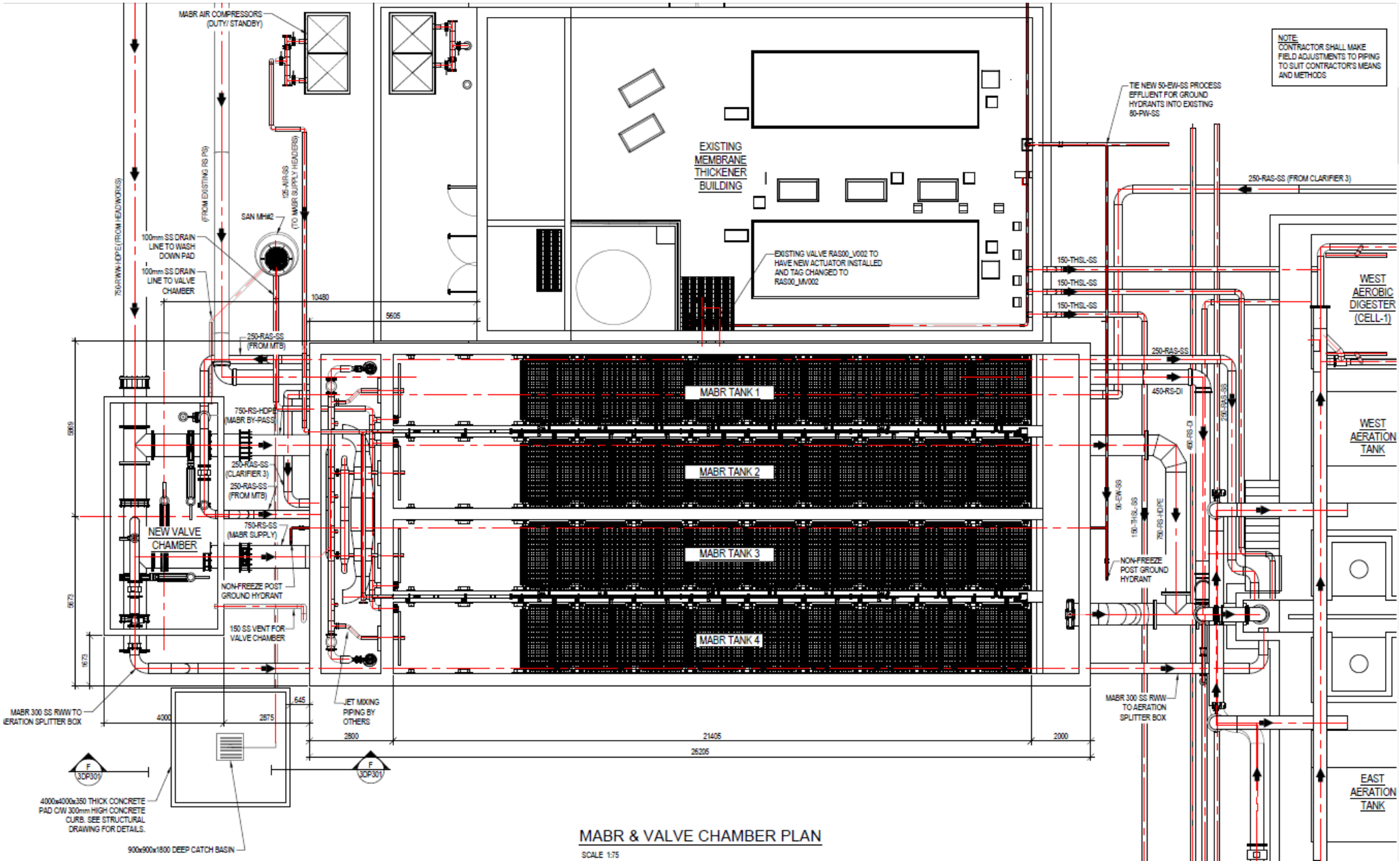
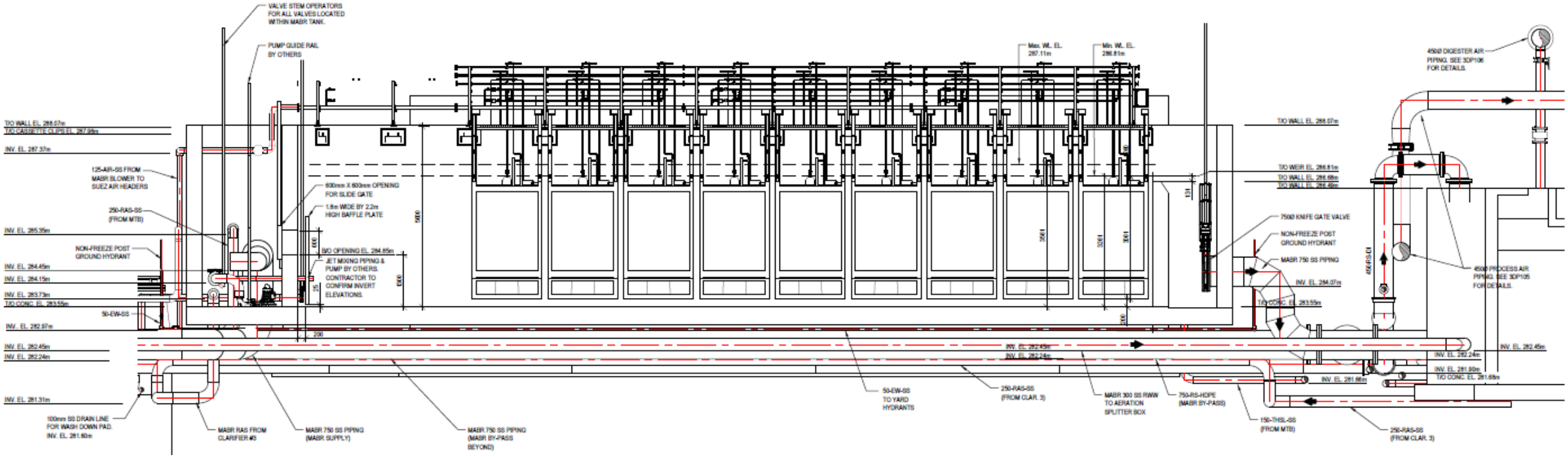
MABR INTEGRATION AT HESPELER WWTP



Hespeler MABR Design

Section View

MABR INTEGRATION AT HESPELER WWTP



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Hespeler MABR Design Project Status

- Construction complete Q3 – 2021
  - Concrete tanks completed
  - Suez equipment on-site Q2
- Biomass acclimatization Q4 – 2021
  - Start-up/transition plan to grow nitrifiers on cassettes
- Performance testing Q1 – 2022
  - 6-week monitoring/sampling period during coldest period of year (temp = 10-12 C)
  - Goal to reduce MLSS SRT=3 days & operate with nitrifier “washout” conditions & meet TAN<5 mg/L in final effluent.

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3.

Questions & Answers

Submit your questions via the chat function. You can address your questions to just the speakers or to the entire audience.

THANK YOU!

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