



3M Science.
Applied to Life.™

3M Belgium Zwijndrecht site

SEPTEMBER 3

We are working today to achieve our shared goals

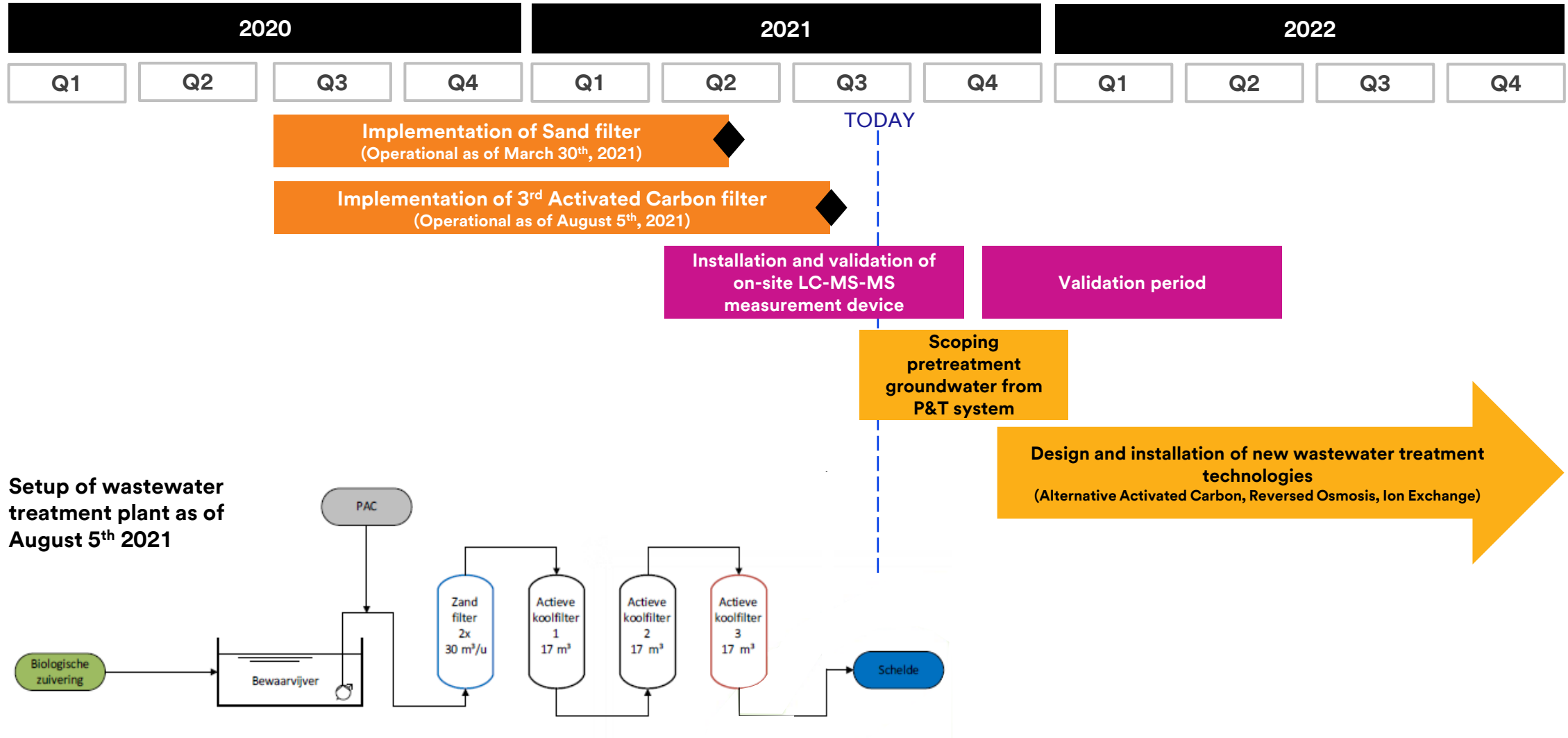


3M is Driving Solutions Today in Zwijndrecht

- 3M will continue to innovate essential modern products while managing our environmental footprint
- 3M is actively supporting a second descriptive soil investigation, in partnership with OVAM
- 3M has committed to remediation at global locations where we have produced PFAS
- 3M has supplied extensive information and will continue to do so

Reduction of PFAS components in wastewater: 3-year roadmap

Activities in support of proposed effluent limits effective July 1st 2022



Descriptive soil investigations (DSI) and remedial action plan

Scope DSI

Scope DSI 1999-2008:

- On-site contamination
- C8-chemistry (PFOS and PFOA)

Scope DSI 2020-2022:

- Update list of Chemicals of Concern (COC)
- Expanded scope of investigation
- Used to inform relevant authorities' risk assessment and selection of necessary remedial actions

Since 2010: First phase remedial measures

- Pump & Treat to capture and contain groundwater at source areas
- Groundwater at southern site boundary will be addressed in a 2nd phase remedial action plan (after Oosterweel construction works)



3M actively shares information

	Approach	Examples
Public & Media	<p>3M has and continues to respond to questions from residents, media, and others.</p> <p>We've created resources to help inform interested members of the public and are working today to address their needs.</p>	Public-facing website, planned community engagement efforts, media engagements
Scientists & Academics	<p>3M has placed thousands of documents in the public domain, including more than 150 published studies conducted by 3M and other researchers on potential environmental and health effects of PFAS.</p> <p>Furthermore, we have compiled research that 3M has conducted around PFAS testing, measurement and remediation best practices on our public website.</p>	3M research clearinghouse, ongoing collaboration with researchers, publication of peer-reviewed studies, ongoing research investments
Policymakers & Regulators	<p>3M shares perspective and scientific knowledge on PFAS and their important uses for critical modern industries.</p>	Engagement with regulators, public comments, public engagements, advocacy activities

3M is proactively addressing PFAS topics in Zwijndrecht



Remediation Activities

3M will implement appropriate remedial actions as identified by the ongoing soil and water investigations



Community Engagement

3M will engage with our neighbors in the near term to address their questions and needs, and do more in the future to share information



Future Research and Communication

3M will continue to advance the body of scientific evidence on PFAS, and we will openly share our technical knowledge and expertise

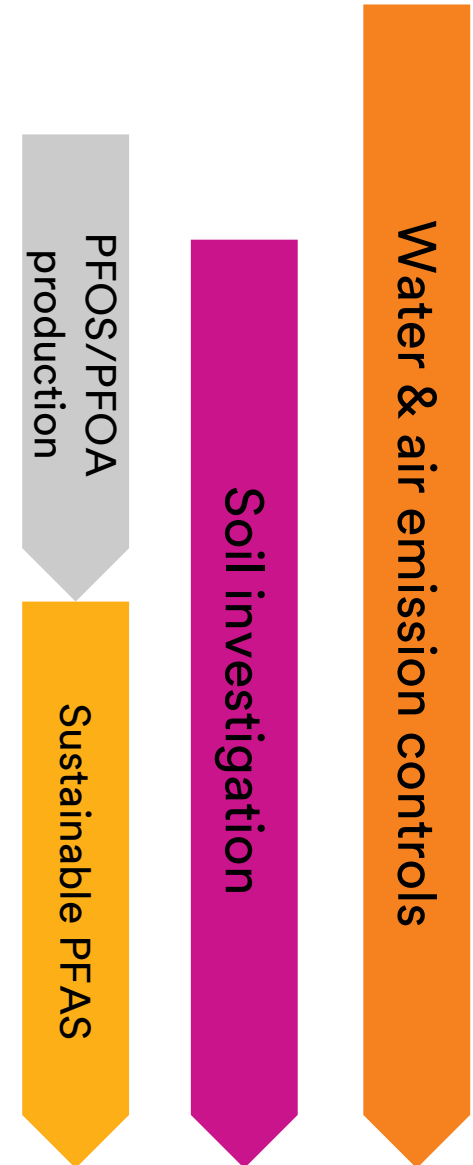




Support slides

PFAS history at Zwijndrecht

1970-1971:	Construction & Start-up Zwijndrecht factory
1974:	Production PFAS containing products
1976:	First Electrochemical Fluorination (ECF) unit operational
1994:	3M begins soil investigation
1997:	Second ECF unit operational Thermal oxidation unit operational
1999:	3M and OVAM initiate descriptive soil investigation
2000:	Announcement phase-out C8 (PFOS/PFOA) based chemistry
2002:	Stop PFOS production
2006:	Descriptive soil investigation completed
2008-2009:	Soil remediation plan completed
2010-2011:	Start groundwater remediation
2017-2018:	Start orientating soil investigation
2019:	Start update descriptive soil investigation
2021Q4:	Third ECF unit operational Second thermal oxidation unit



Situation soil and groundwater remediation on 3M site

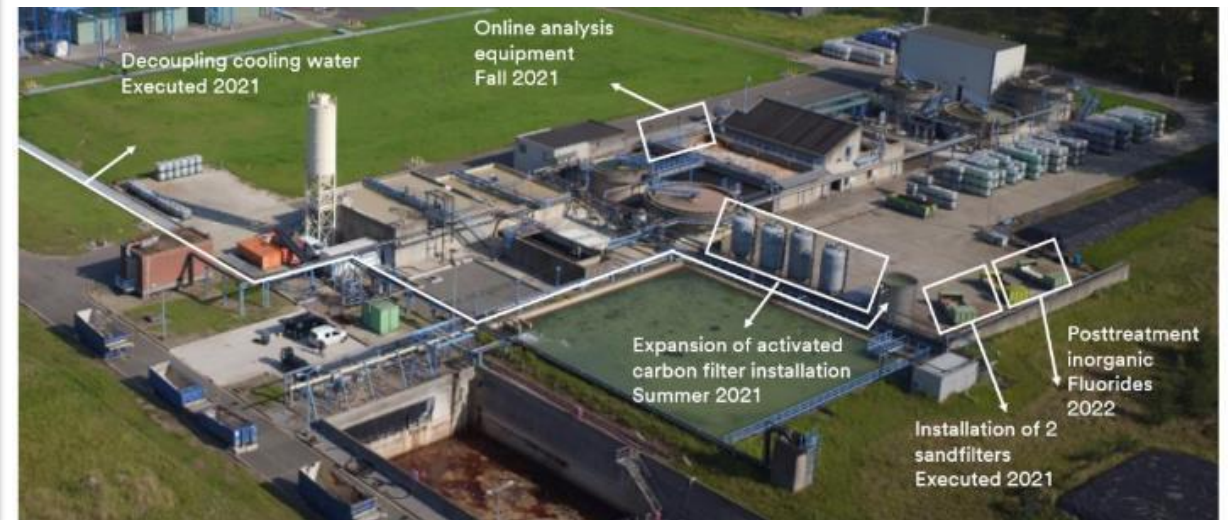
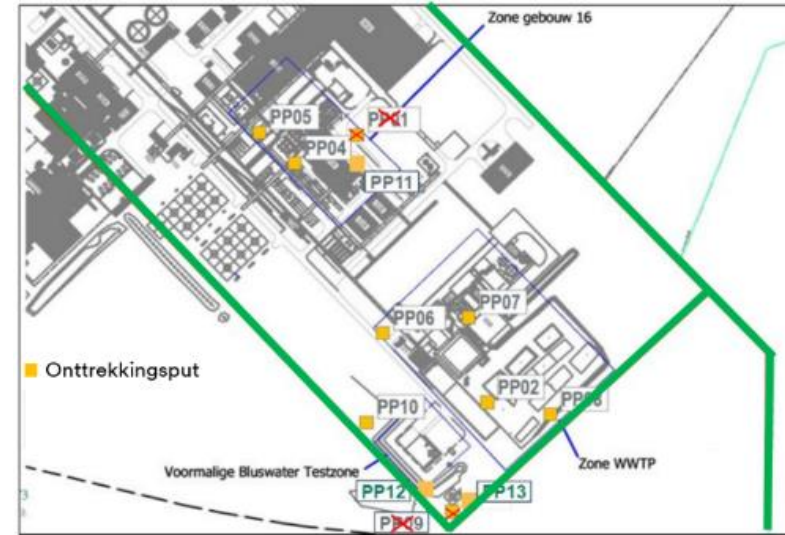
3M uses “Pump and Treat” to control PFAS in groundwater on the 3M site

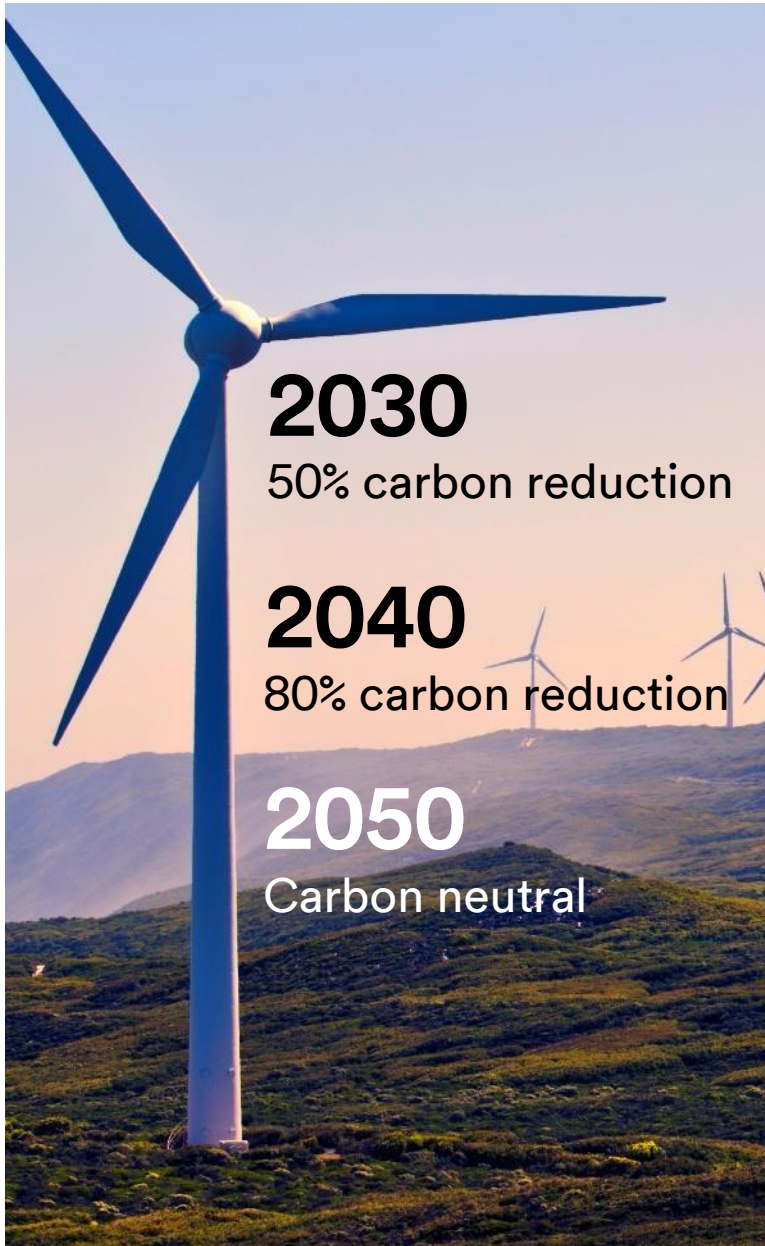
'Pump': Through 10 extraction wells

'Treat': Extracted groundwater is treated in the water treatment plant of the site

Monitoring

- Currently 64 monitoring locations
- Concentrations are measured and evaluated four times a year
- Data is reported to OVAM





3M expects
to invest
approximately

\$1 B

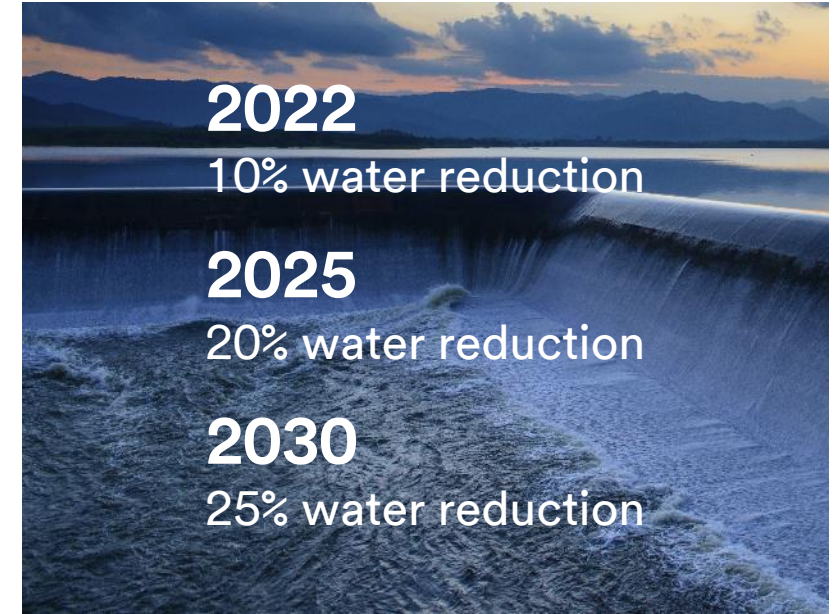
over the next 20 years to
**accelerate new environmental
stewardship goals**



Through these efforts,
3M expects to **reduce
its overall water usage**
by

2.5B

gallons per year



3M will install
state of the art
technology by
2023, and be fully
operational by
2024 to improve
water quality



3M continues to advance the science of PFAS remediation



Cap and Contain Systems

Proven approach that can help reduce surface runoff and prevent precipitation from reaching groundwater through soil.



Granular Activated Carbon

Effective technology for removing certain PFAS, such as PFOA and PFOS, from water through adsorption, commonly relied upon at 3M manufacturing facilities.



Reverse Osmosis/Ion Exchange

Promising and emerging technologies that 3M continues to pursue in advancing water treatment technologies that can be effectively and logistically brought to scale.



Future PFAS remediation technologies

3M continues to invest our time and resources to conduct our own research on PFAS remediation technologies and partnerships with academic institutions and professional organizations to investigate and understand this topic.

Proven Remediation Technologies at Scale

Long chain	Short chain	Flow rate	Reliability	Volume reduction
•		•	•	•



Granular Activated Carbon

Applicability:

- Effectively removes long chain species from water
- Ability to reactivate
- High volume reduction (100,000:1)

Limitations:

- Effectiveness decreases as chain length decreases
- Competition with natural organics and other contaminants
- Longer empty bed contact time (EBCT) requires large footprint

Emerging Technologies

Long chain	Short chain	Flow rate	Reliability	Volume reduction
•	•	•		•



Resin – Ion Exchange and Adsorption

Applicability:

- Effectively removes PFAS from water
- High volume reduction (300,000:1)
- Lower EBCT than GAC; smaller equipment footprints

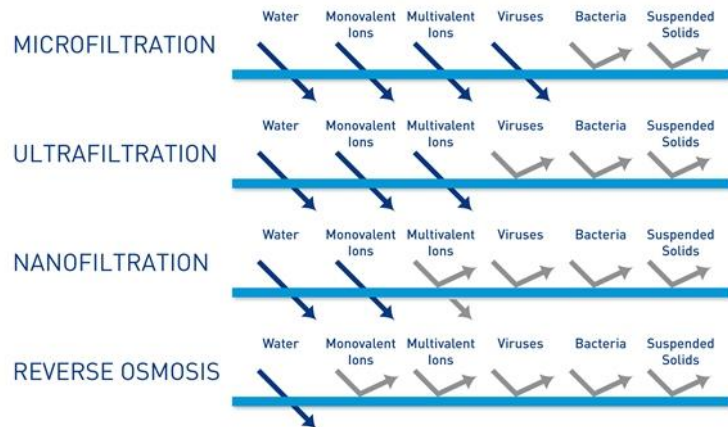
Limitations:

- More expensive media unit cost; Media density may result in higher pumping costs
- Sensitive to site-specific geochemistry
- Regeneration is not widely used for PFAS and often requires aggressive solvents or brine (or both)

Emerging Technologies

Long chain	Short chain	Flow rate	Reliability	Volume reduction
•	•	•	•	

TYPE OF MEMBRANES AND CHARACTERISTICS



Courtesy of Arcadis

Membrane Filtration

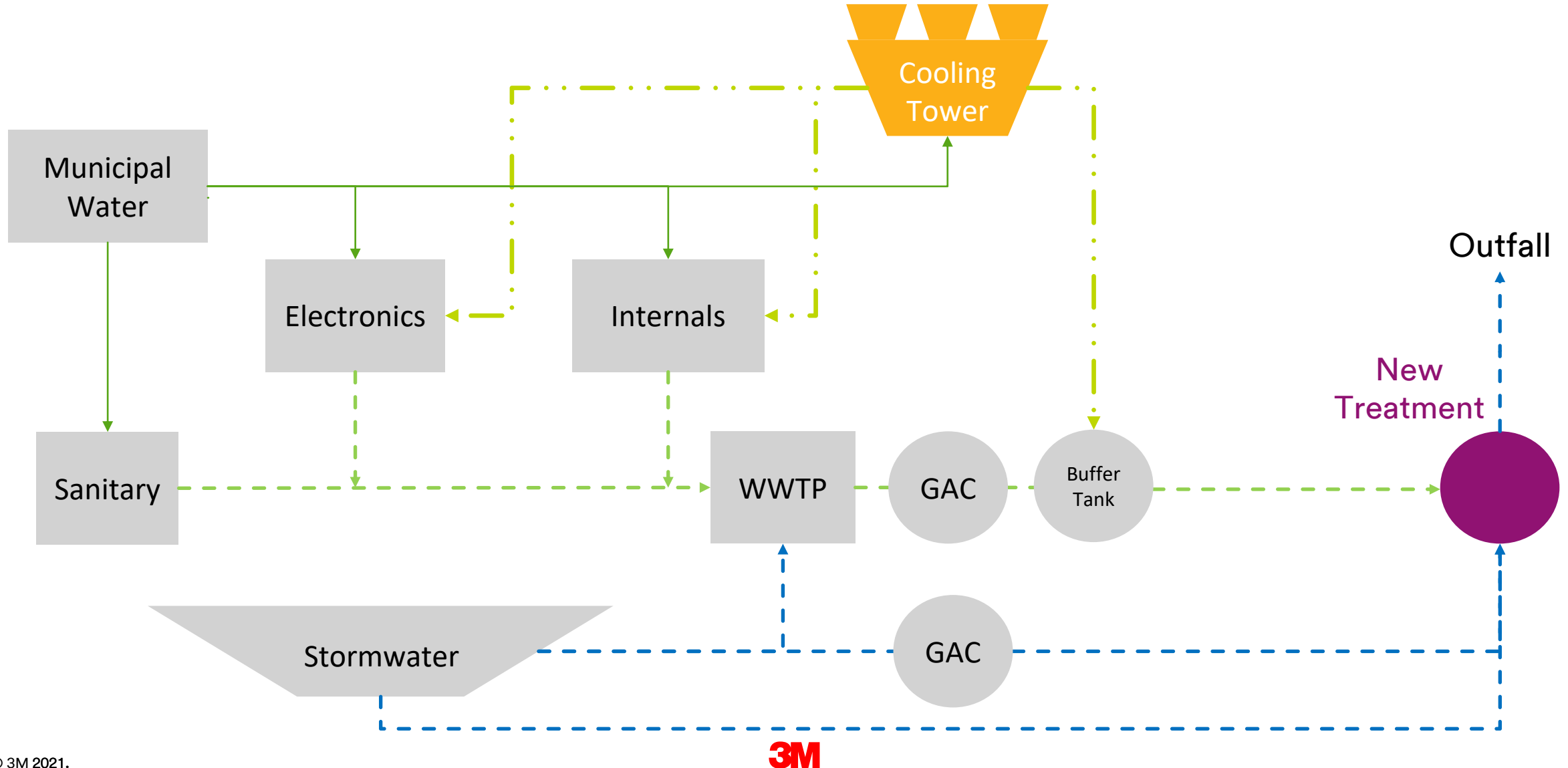
Applicability:

- Reverse osmosis (RO) proven for PFAS removal; Nanofiltration (NF) possible for PFAS removal
- High rejection of PFAS (~95-99+%)
- Equipment sizing not dependent on PFAS concentrations

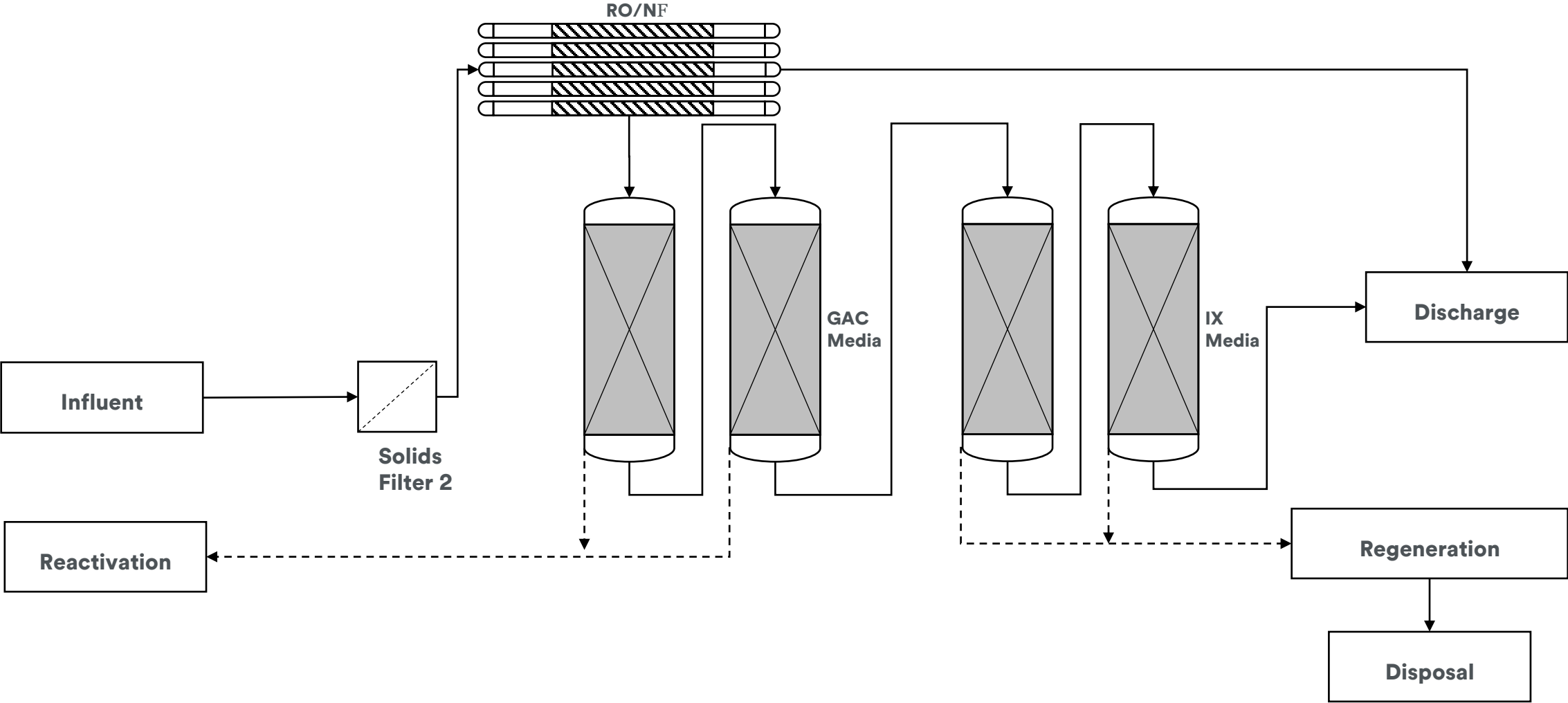
Limitations:

- Volume reduction is small compared to adsorption (3:1 to 5:1) depending on other constituents in the water
- Typically higher capital and operating costs
- Membranes are susceptible to fouling

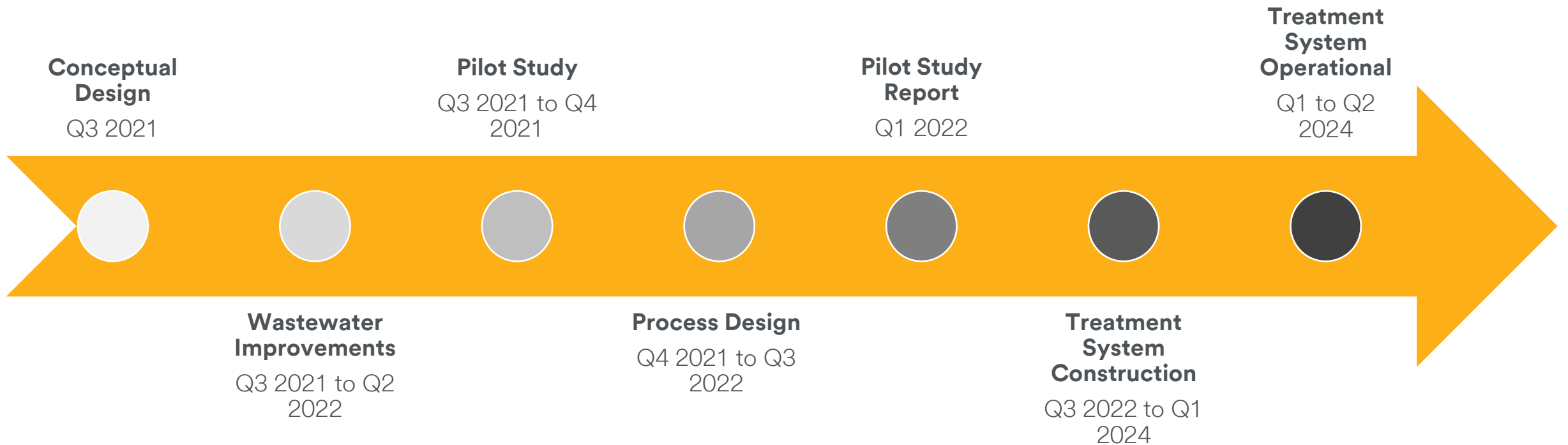
3M Zwijndrecht Treatment Concept



Concept of Future Zwijndrecht Water Treatment Technology



Zwijndrecht Wastewater Treatment Project Timeline



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DSI – Status



Sampling plan executed June 2020: 20 locations in 4 km radius around 3M site

1.1 PFOS

1.1.1 Toetsingswaarden voor het vaste deel

De voorgestelde bodemsaneringsnormen voor het vaste deel staan vermeld in Tabel 1.

Bestemmingstype	I/II	III	IV	V
Voorstel humaattox	3,1	205	1.949	1.949
Voorstel ecotox	3	18	110	9.100
Voorstel bodemsaneringsnorm (µg/kg ds)	3,8*	18	110	1.949

* Bijgestelde waarde op basis van de afleiding richtwaarde / waarde vrij gebruik

Standards published by OVAM in March 2021

Sampling Plan Executed June, 2021

Conducted at 20 locations in 4 km radius around 3M site

Results:

- All ground samples are below standard for residential use
- Results are well below those found in work zone for Oosterweel project
- Additional research needed to define area for which risk assessment should be carried out

3M continues to take action today

How is 3M addressing PFOS in the Commune of Zwijndrecht?

- Descriptive soil investigation builds on previous work, critical to understand and inform future action
- Preliminary results indicate ground samples within proposed human health guidance levels for residential areas
- 3M will collaborate with OVAM as additional information becomes available on next steps

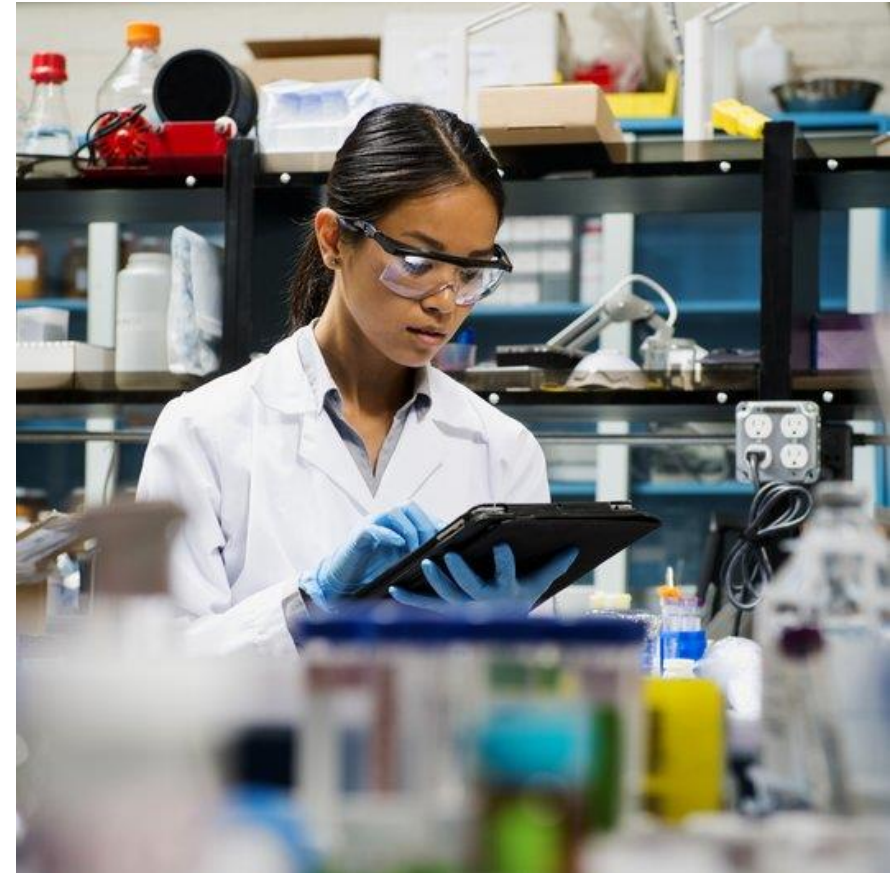


Sampling plan executed June 2020: 20 locations in 4 km radius around 3M site

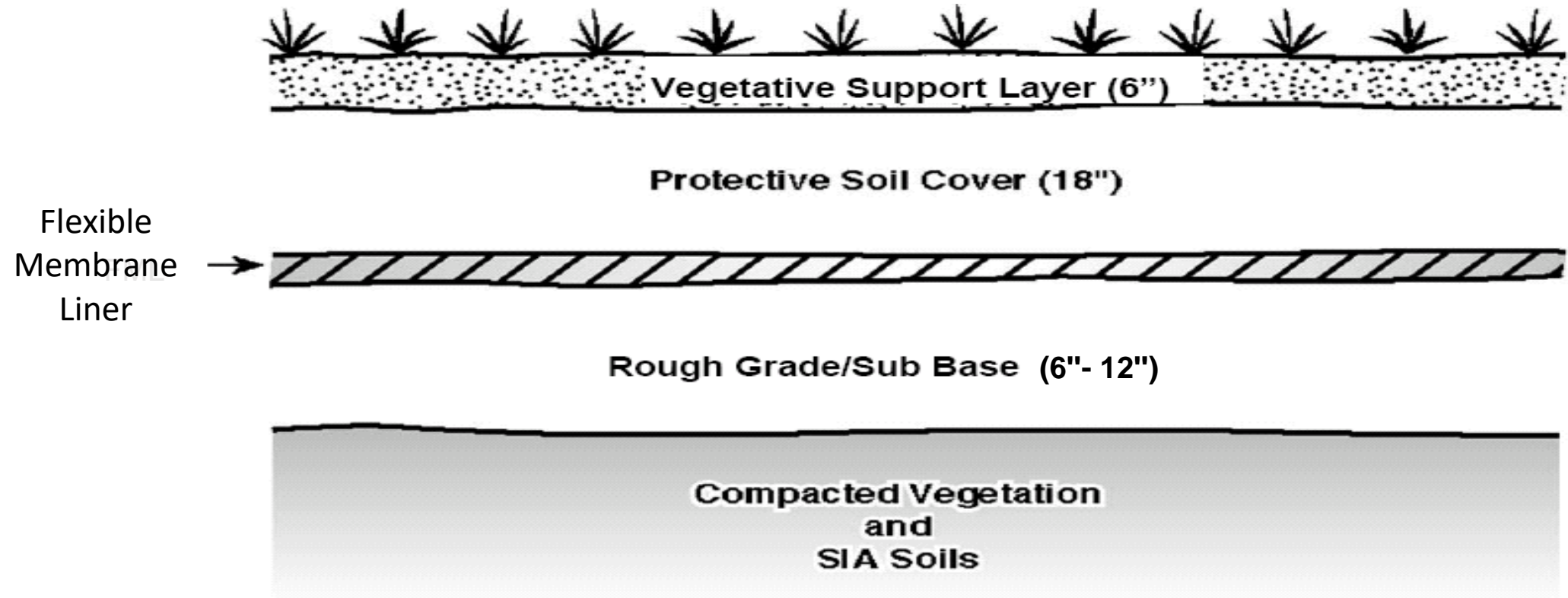
3M is managing PFOS near Oosterweel

How is 3M addressing PFOS near Oosterweel?

- Began in 2016-2017 with Lantis sampling findings, which were shared with OVAM, VMM, and Grondbank.
- 3M agreed to accept and manage 130,000 cubic meters of PFOS-impacted soil in an engineered soil berm.
- 3M will assume costs associated with management of the soil; installation and maintenance of associated technologies, and more.
- One of several 3M-led projects currently underway



Isolation - Engineered Cap Schematic



Picture of construction of the berm

