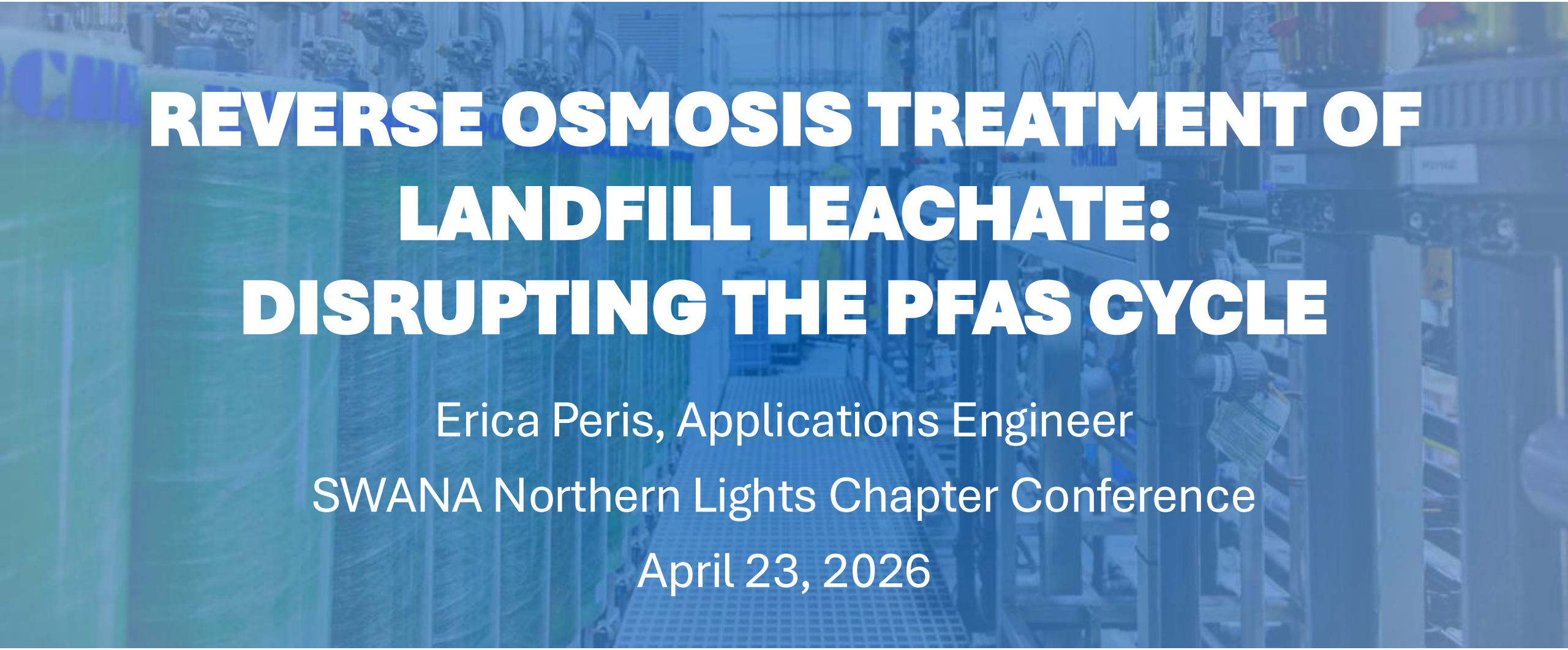

REVERSE OSMOSIS TREATMENT OF LANDFILL LEACHATE: DISRUPTING THE PFAS CYCLE

Erica Peris, Applications Engineer

SWANA Northern Lights Chapter Conference

April 23, 2026

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PRESENTATION SUMMARY

- Rochem Intro
- Leachate Management
- Reverse Osmosis Technology
- RO Performance for PFAS Removal

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ROCHEM OVERVIEW

RO-Based treatment for high strength wastewater

- Hamburg, Germany
- 1st system installed 1988 - Germany
- First leachate system in North America → 1998
- 16 operating systems in North America
  - 23,000 gpd – 400,000 gpd
- Multiple patents on RO module design

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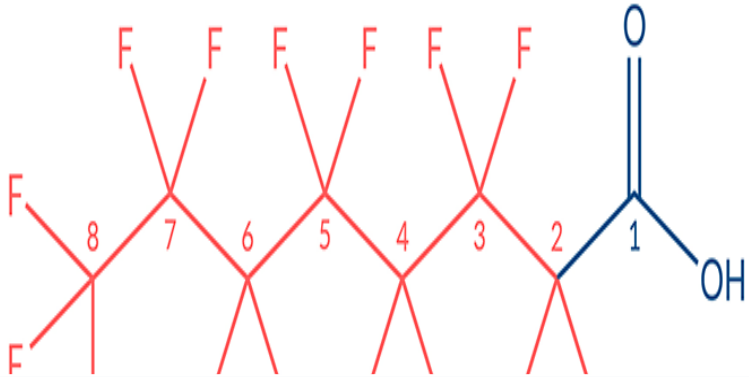
INTRO TO PFAS

Perfluorooctanesulfonic Acid
PFOS



Possible Health Impacts (US EPA)

- Reproductive effects
- Developmental effects/delays
- Increased cancer risk
- Compromised immune response
- Hormone interference

		Site						
		1	2	3	4	5	6	7
PFAS Constituent (ng/L)	PFOA	5,300	1,200	1,500	7,400	2,700	1,300	2,100
	PFOS	<1000	170	310	1,900	62	290	450
	PFBS	3,800	2,100	970	34,000	23,000	9,000	35,000
	Total	**26,500**	**11,861**	**18,150**	**241,371**	**119,572**	**50,348**	**46,980**

Rochem PFAS Data: 11,900 – 241,000 ppt

https://www.caymanchem.com/news/pfas-dilution-is-not-the-solution

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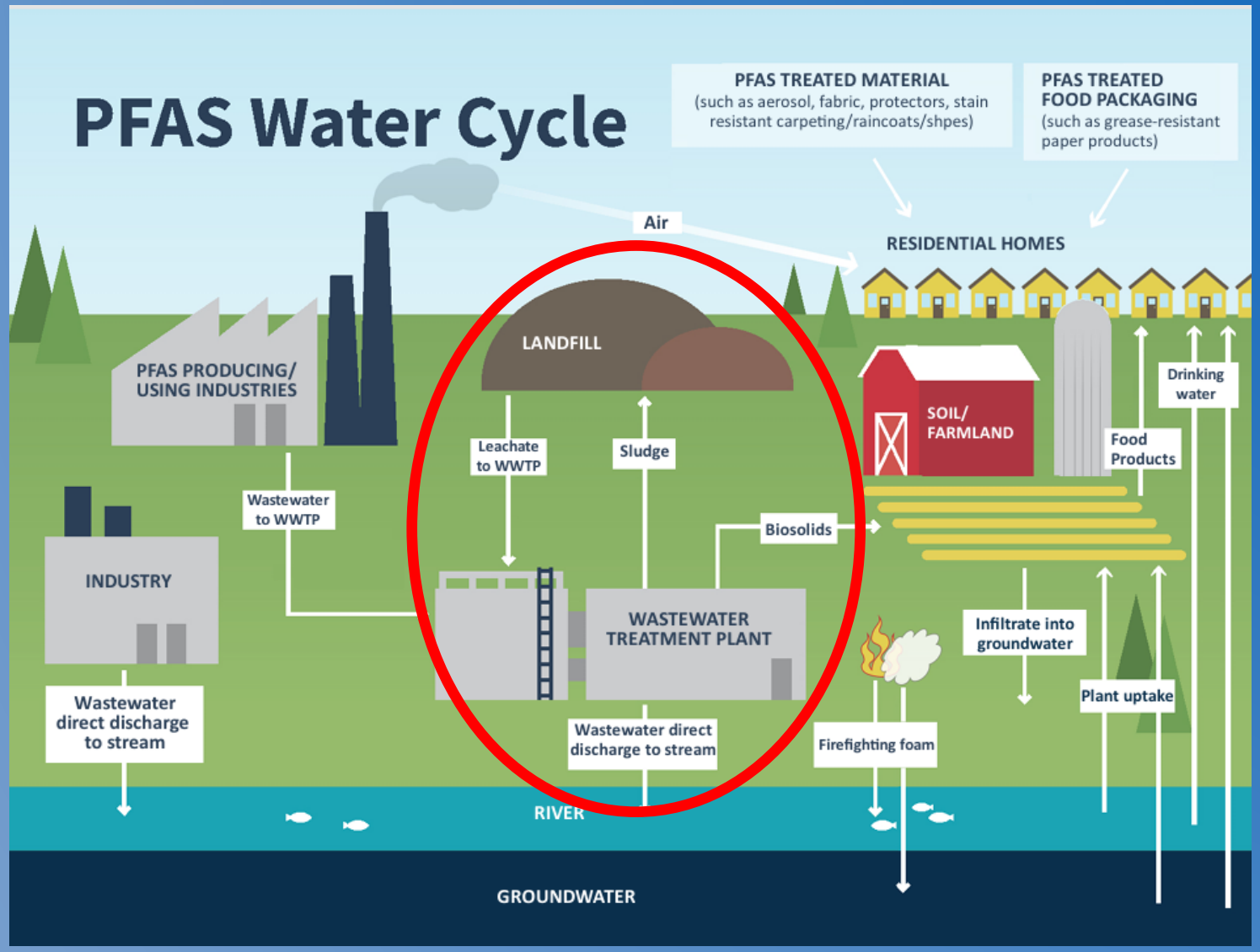
PFAS CYCLE



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WWTP-LANDFILL RELATIONSHIPS

Landfills commonly utilize WWTPs for leachate treatment.

LEACHATE

BIOSOLIDS

WWTPs often rely on landfills for biosolids disposal.

"The processes for managing leachate have implications on the ultimate fate and transport of PFAS."

-ITRC, 2023

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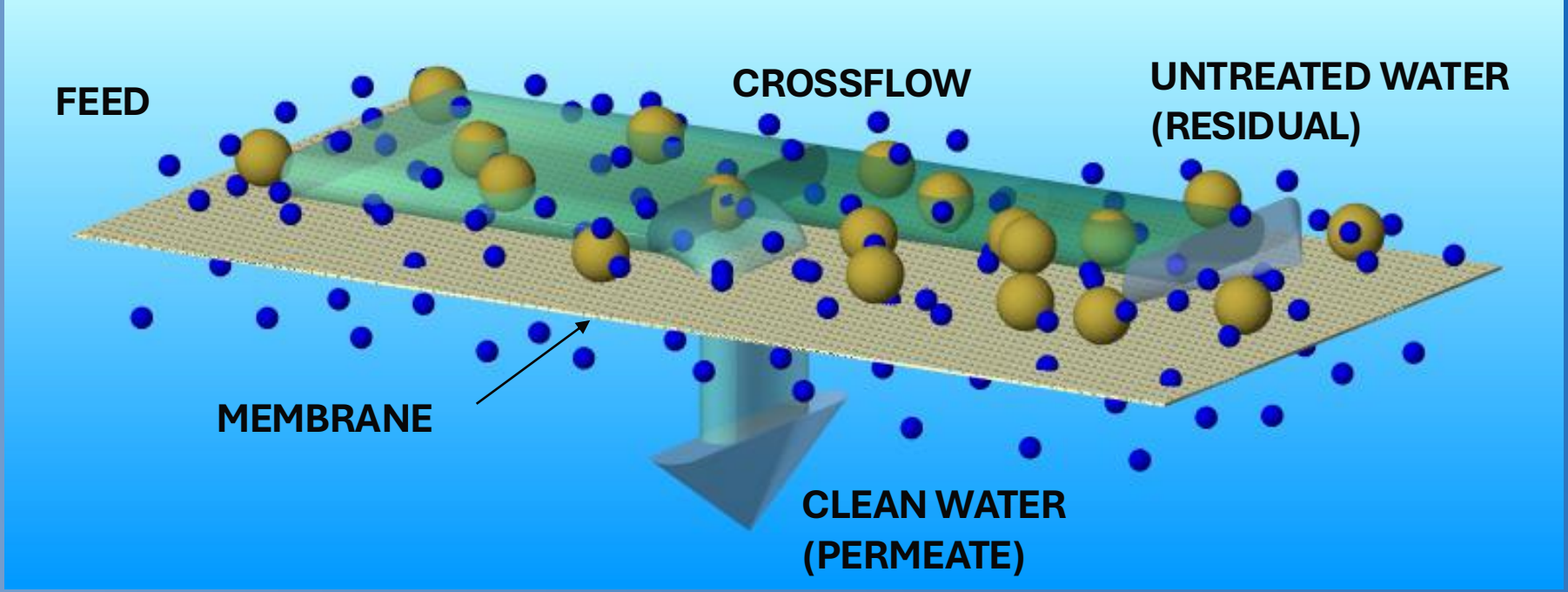
REVERSE OSMOSIS



Reverse osmosis (RO) is a *separation* technology to force clean water (permeate) through a semi-permeable membrane.

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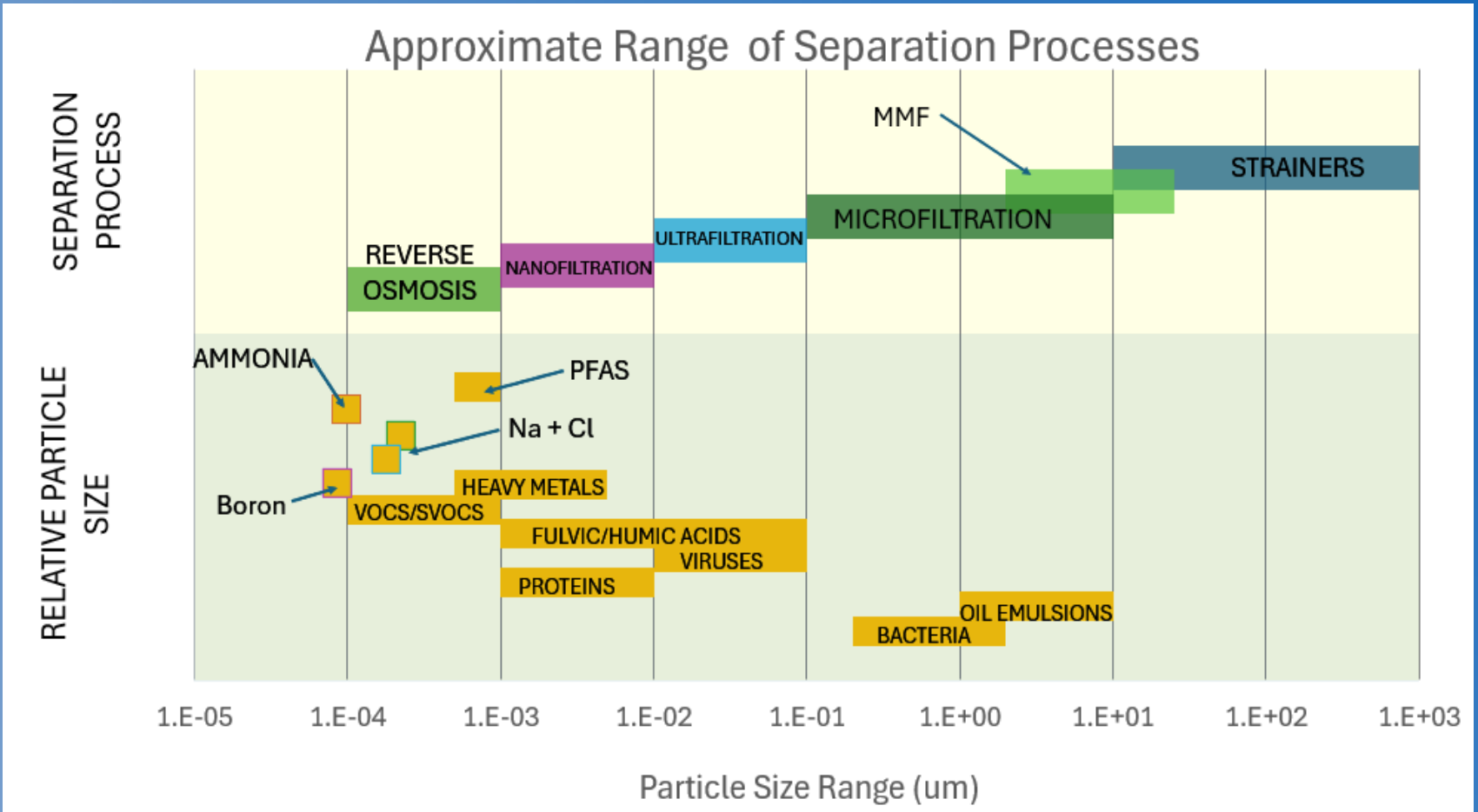
REVERSE OSMOSIS AND PFAS



Reverse osmosis will effectively remove >99% of all constituents with molecular weight greater than 100 Da, as well as ionic species.

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RO FOR LEACHATE TREATMENT - BENEFITS

- Broad-based removal
  - >99.9% total removal (PFAS)*
  - ND values typical (Method 1633 & 537.1)
  - **Also effective for non-PFAS constituents**
- Proven process > 30 years
- “Simpler” to operate (vs. biological)
  - No biomass to maintain
  - Mechanical system with limited chemistry
  - Larger pool of operators (compared to biological)
- Rapid startup/deployment

*Assumes 2-pass system, generally employed for leachate

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RO FOR LEACHATE TREATMENT - CHALLENGES

- Broad-based removal
  - >99.9% total removal (PFAS)*
  - ND values typical (Method 1633 & 537.1)
  - **Also effective for non-PFAS constituents**
- Proven process > 30 years
- "Simpler" to operate (vs. biological)
  - No biomass to maintain
  - Mechanical system with limited chemistry
  - Larger pool of operators (compared to biological)
- Rapid startup/deployment

- Organic loading (fouling)
- Inorganic loading (scaling)
- Discharge requirements
  - NH3/BOD/TDS (typ.)
  - 2 passes generally required
- Need for high recovery/ minimal residuals
- Residuals management

*Assumes 2-pass system, generally employed for leachate

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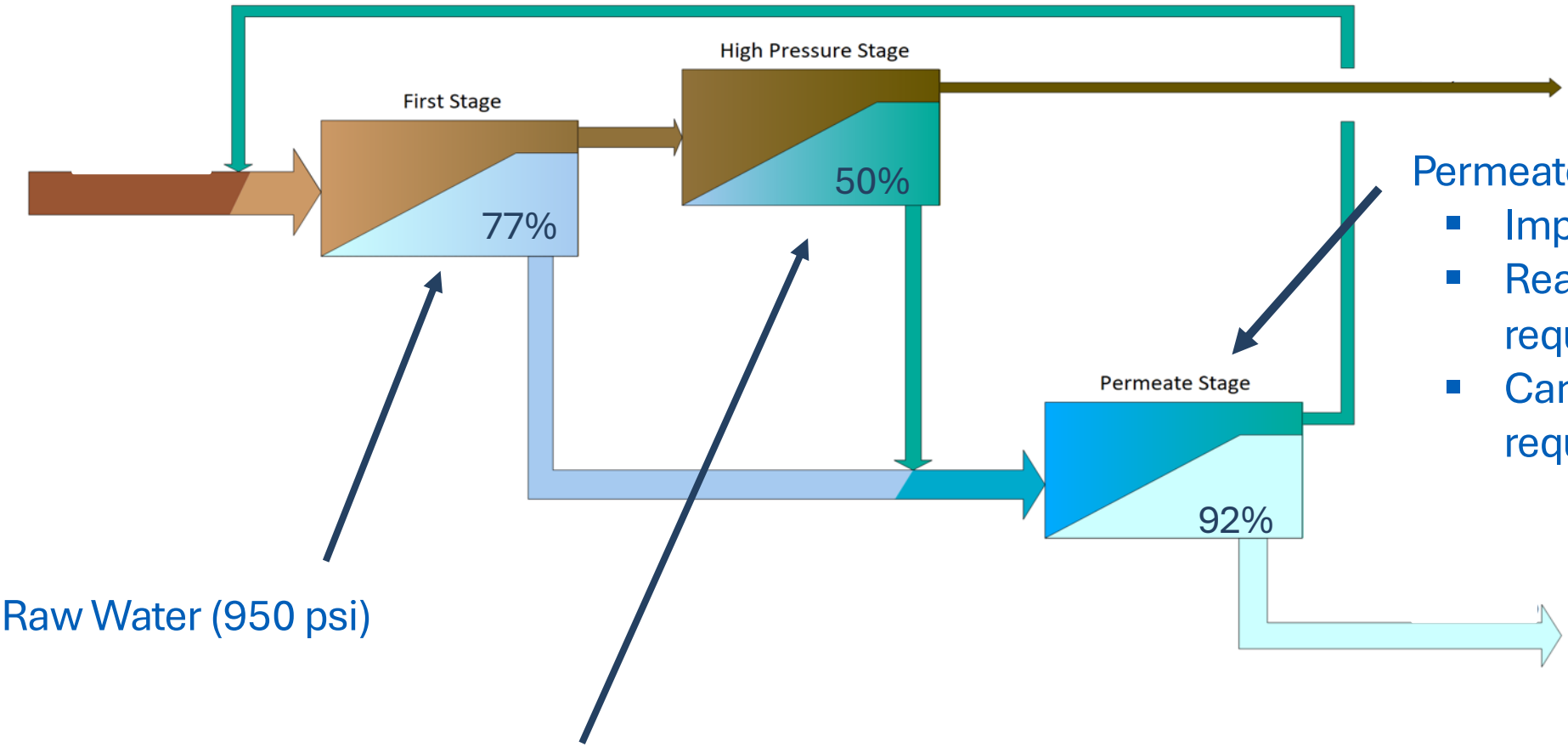
RO SYSTEM – MULTIPLE STAGES



Permeate Stage

- Improved effluent quality
- Readily meets sewer requirements
- Can meet NPDES requirements

Raw Water (950 psi)

High Pressure Stage (1740 psi)

~ 87.5% Recovery System

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VERTICALLY STAGED ELEMENTS

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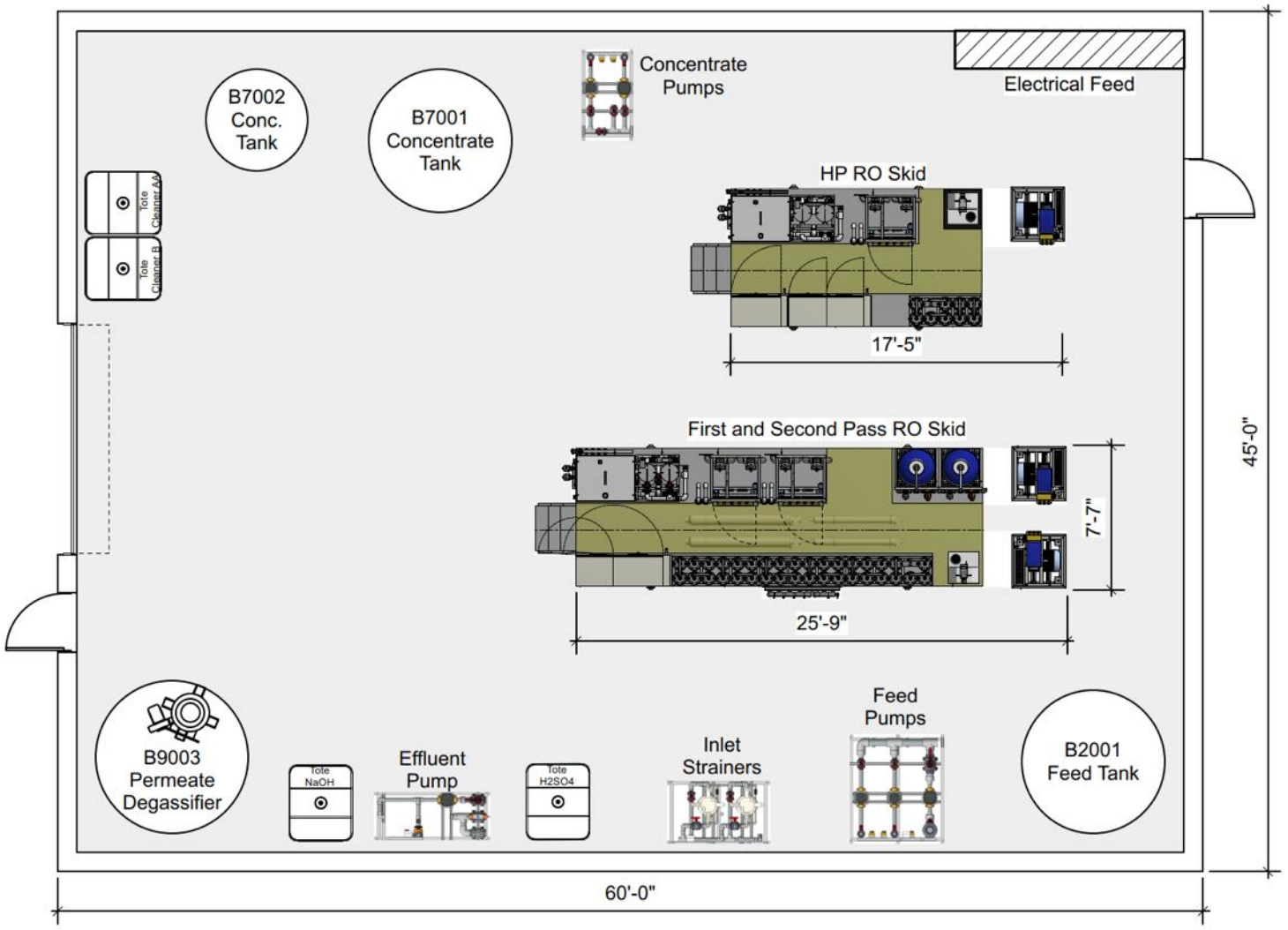
EXAMPLE BUILDING LAYOUT – 50,000 GPD



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TYPICAL LEACHATE TREATMENT RESULTS

Parameter	Units	Leachate	Single Pass Effluent	Final Pass Effluent	Rejection
TDS	mg/L	23,800	308.3	16.5	99.9%
TSS	mg/L	57	0.8	0.0	99.9%
BOD	mg/L	392	39.1	3.4	99.1%
COD	mg/L	9,070	163.3	2.9	99.7%
TOC	mg/L	7,330	187.0	4.7	99.9%
Ammonia-Nitrogen	mg/L	1,800	60.0	5.0	99.7%
Iron	µg/L	4,200	3.1	0.002	99.9%

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PFAS RESULTS

Overview:

- **Rochem systems historically operated for leachate management of *conventional* parameters (NH3, BOD, TDS, etc.)**
- **Two-pass systems often required for leachate**
  - For PFAS → Typically ND levels, or > 99.9% removal
- **All projects include other parameters/performance requirements**

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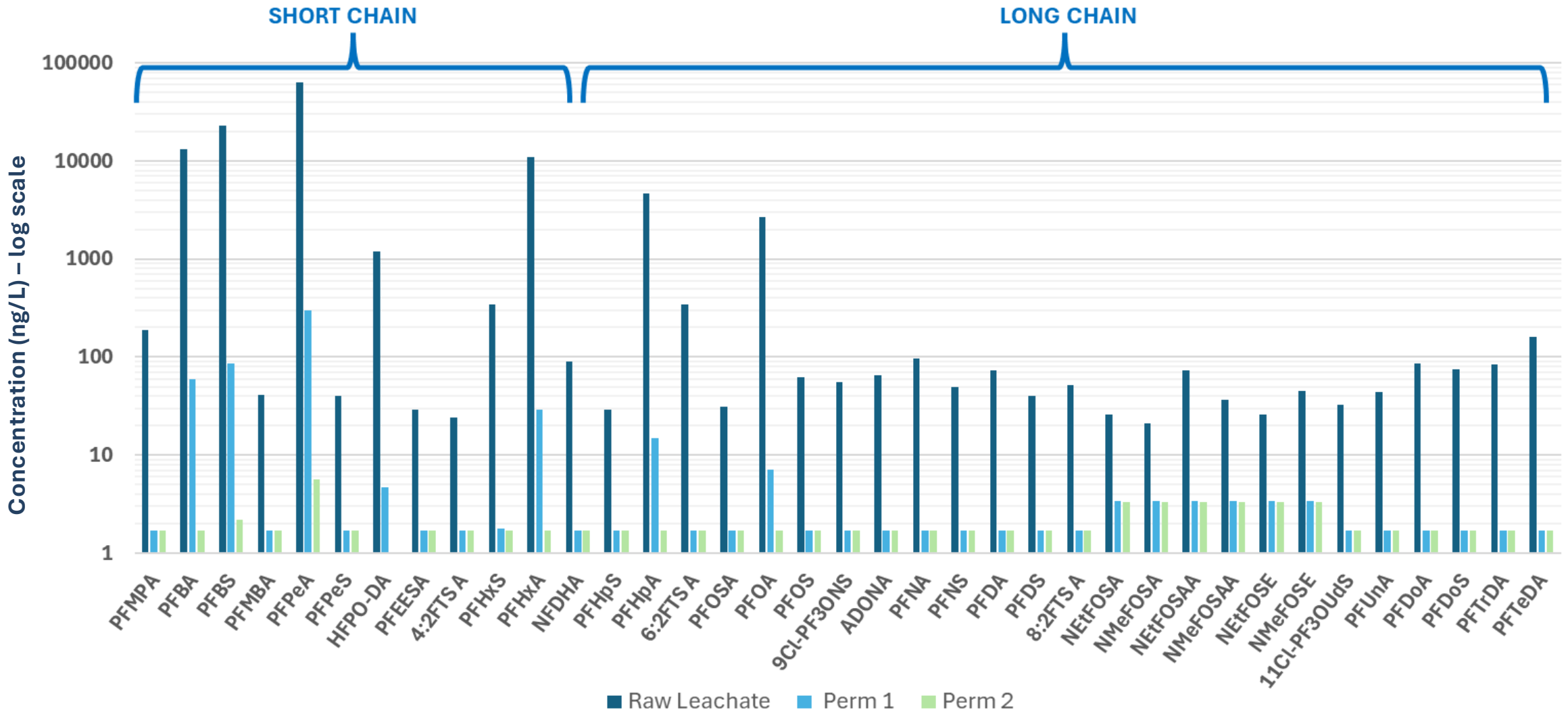
PFAS RESULTS – BENCH TESTING



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ORCHARD HILL SANITARY LANDFILL, MICHIGAN

- **RO system operational since 2014**
  - Installed to reduce leachate hauling costs
  - 80,000 gpd capacity
- **NPDES Permit (MI0058853)**
- **PFOA & PFOS added to permit in 2021**
  - PFOA: 3 detections in 52 months
  - PFOS: 1 detection in 52 months
  - All others ND values (< 2 ng/L)*

** Source: EPA ECHOES → https://echo.epa.gov/effluent-charts#MI0058853 NPDES Individual Permit No. MI0058853*

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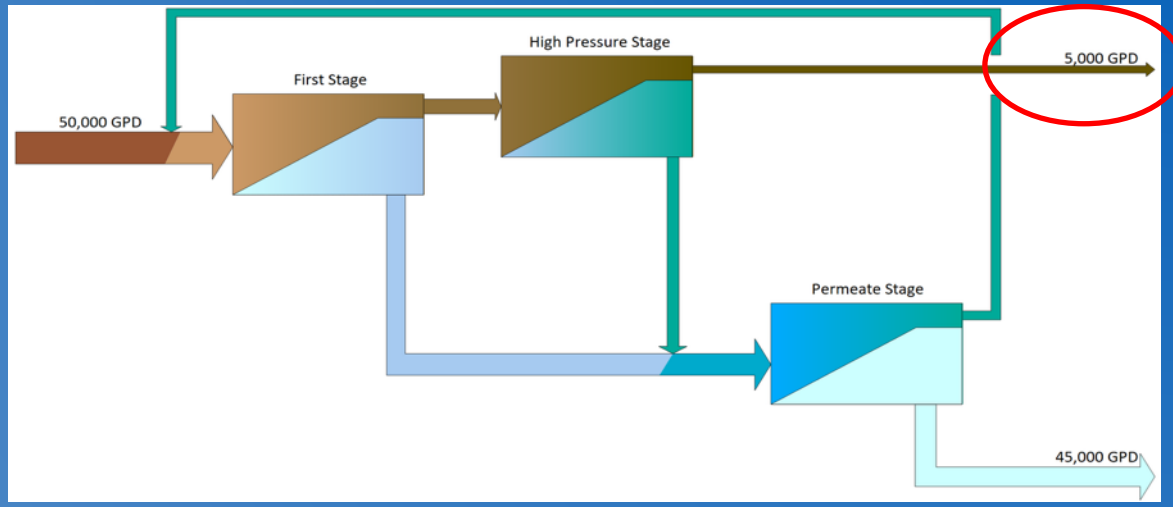
RESIDUALS MANAGEMENT CONSIDERATIONS

RO residuals: 100% of mass/10-20% of volume

- **Off-site disposal**
  - Commercial treatment
  - Deep well injection
- **Evaporation**
  - Energy availability
  - Air permitting
- **Reapplication/recirculation**
- **Stabilization**

Using landfills as PFAS repository



PFAS Specific Technologies

- **Foam fractionation**
- **Destructive technologies**
  - Commercial availability

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IN CONCLUSION

Reverse osmosis is an effective technology for the sequestration of PFAS and other contaminants within landfills.

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Thank You!!!

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