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## Nutrient Recovery Solutions

1.25.2024

# Agenda

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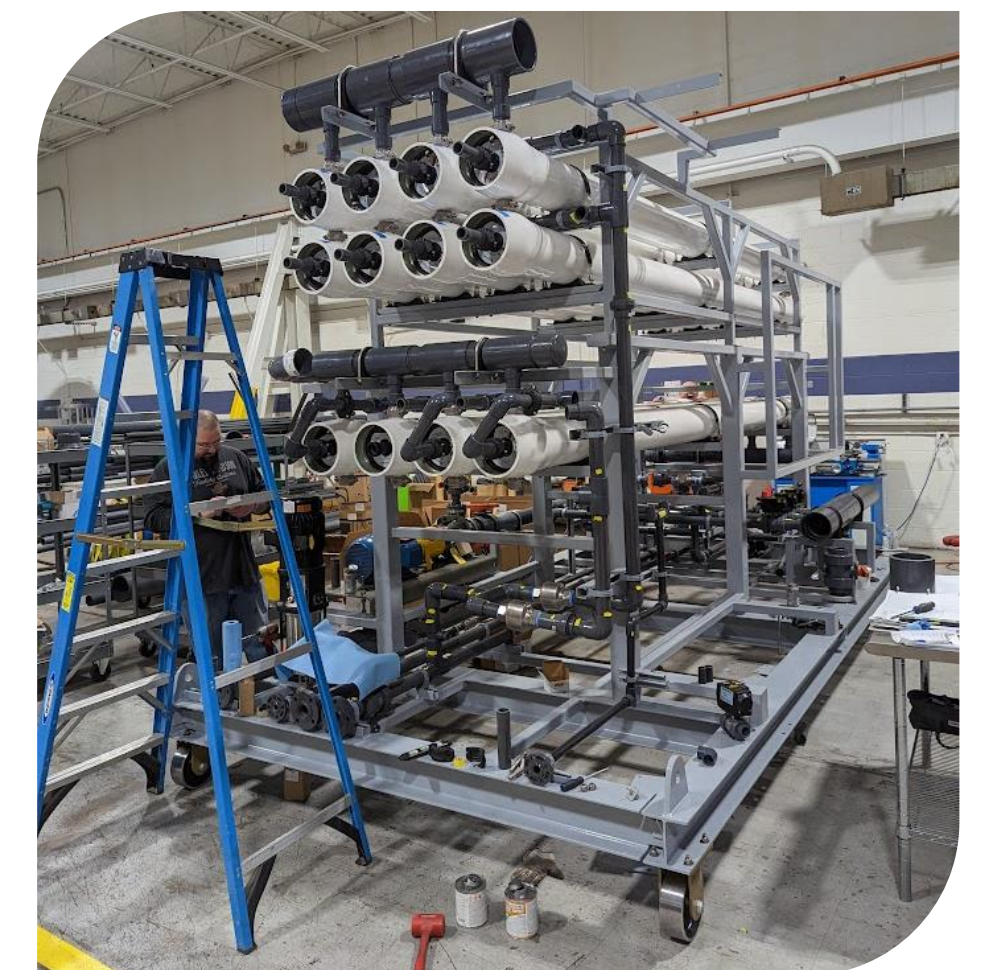
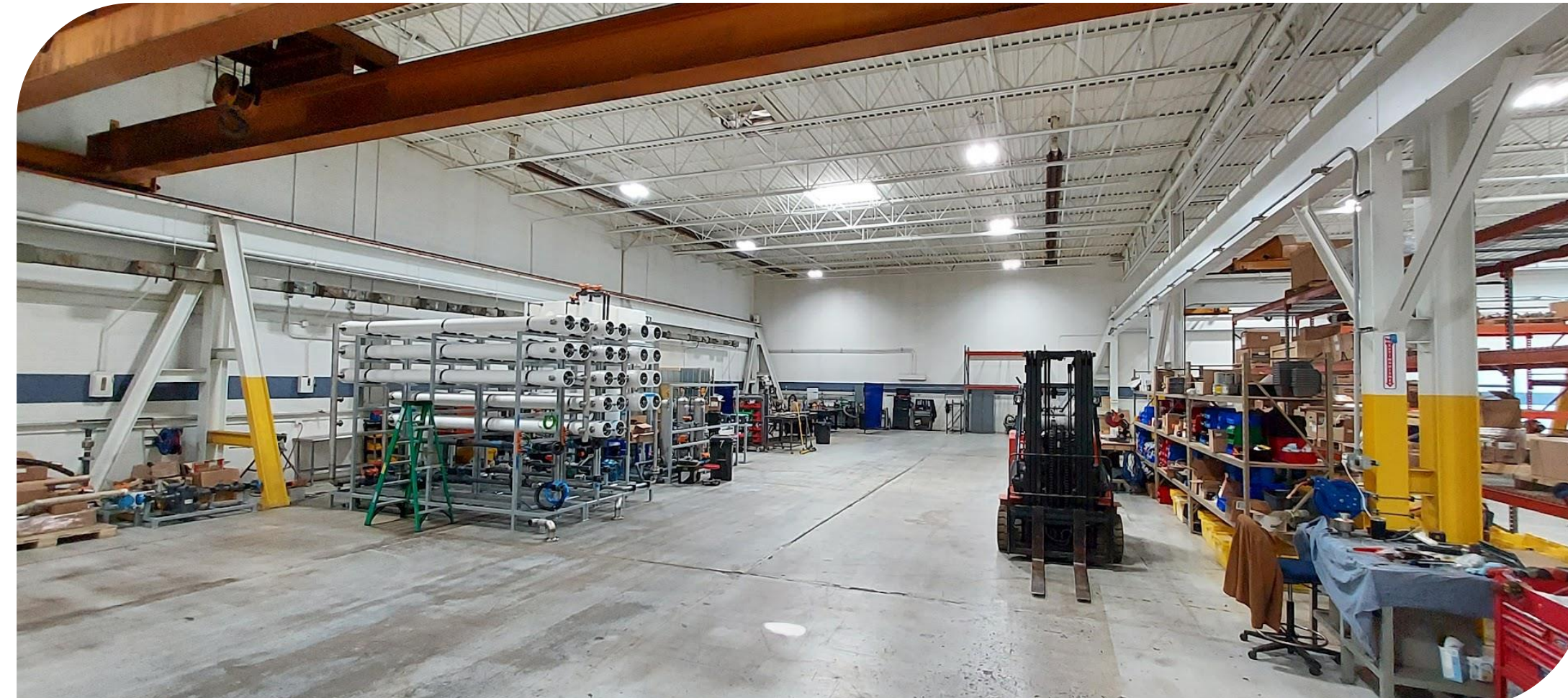
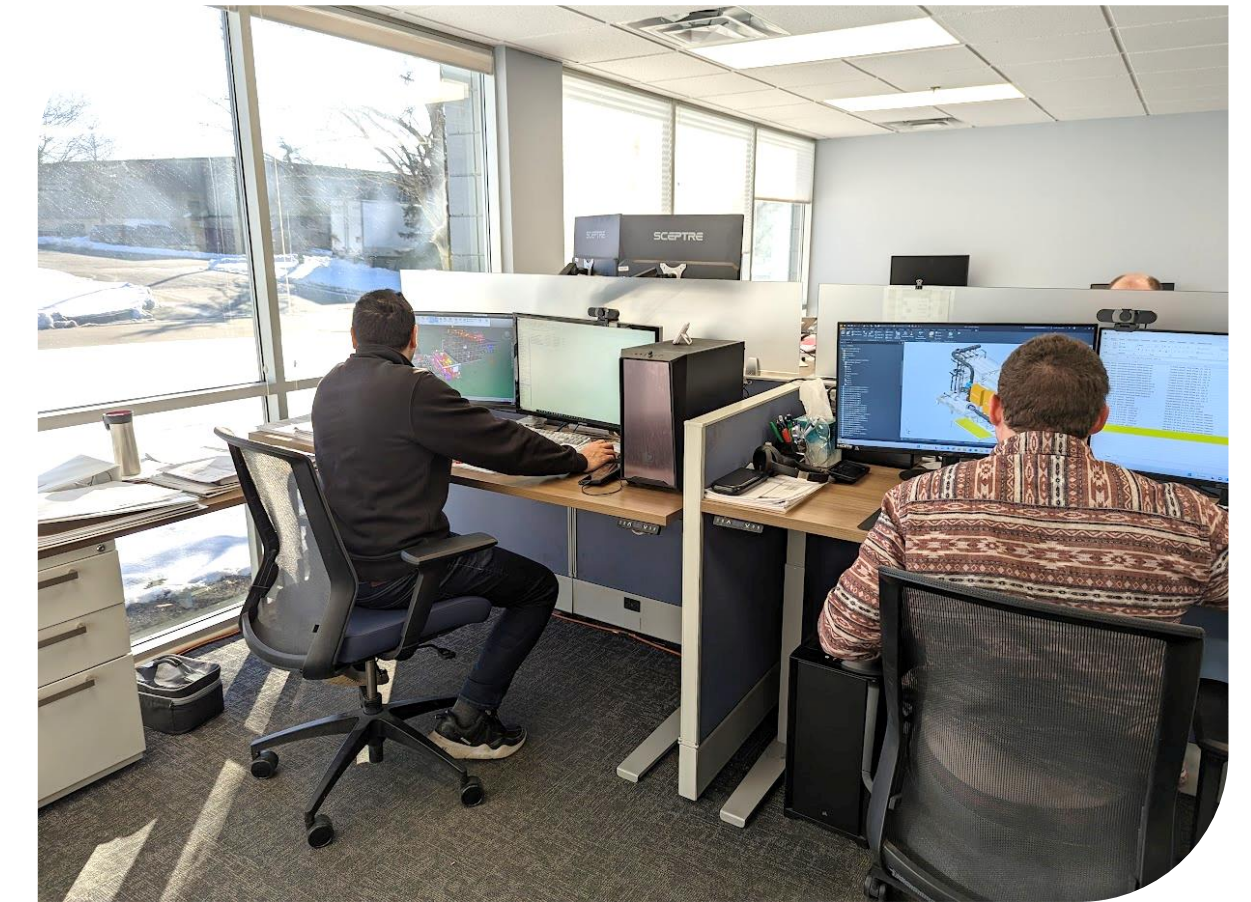
- Background on Digested Organics
- Why digestate management matters
- Two case studies
- Terraflow fertilizers

**Our vision is a world where all liquid wastes are upcycled to clean water and value-added products.**

**We specialize in the engineering and manufacturing of filtration systems with dedicated project management to deliver holistic solutions to our customers.**

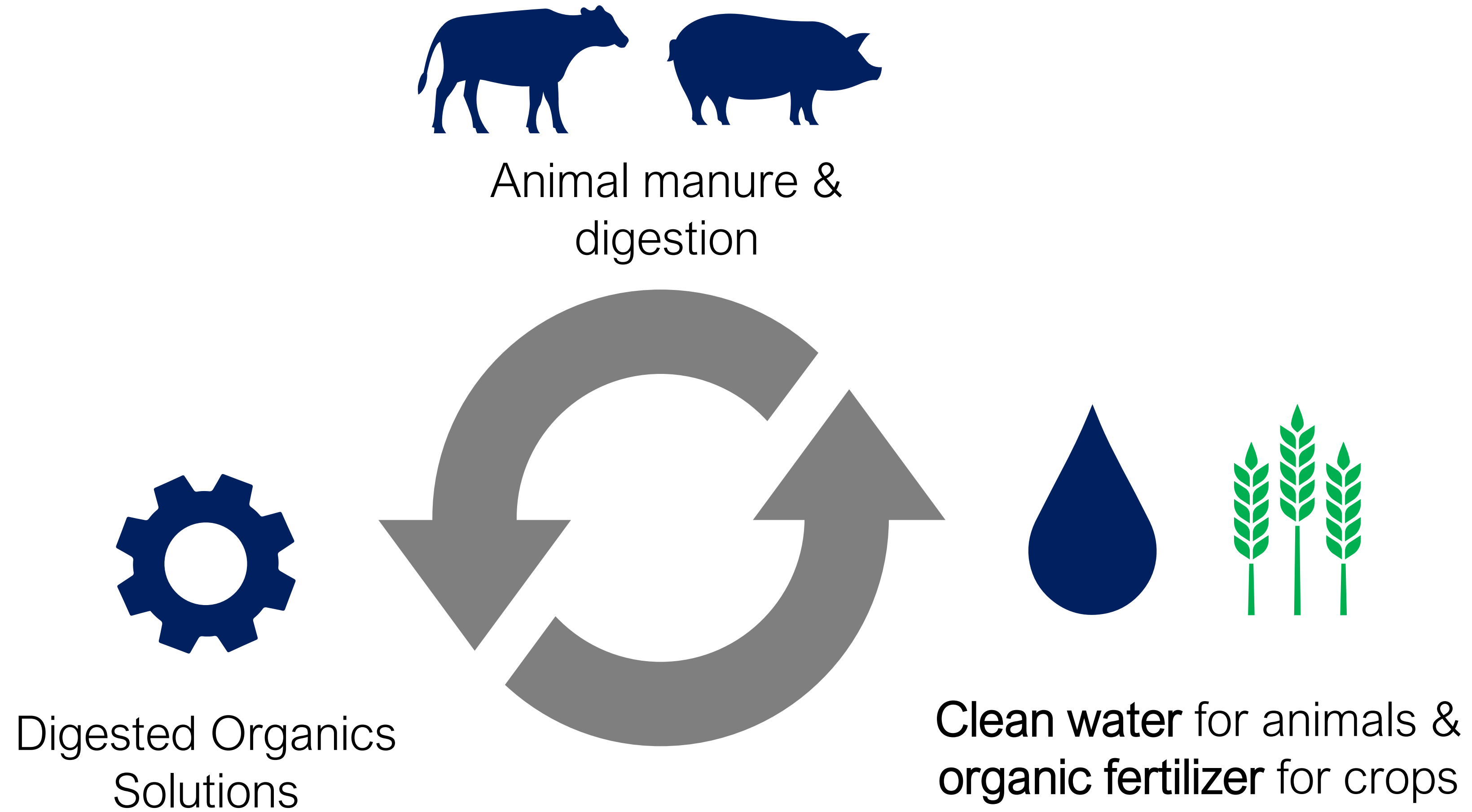
# Michigan-based engineering and manufacturing

- Founded in 2013; now about 50 employees
- Merged with Mott in February 2023 (400+ employees)
- All engineering and manufacturing done in-house
- ~20,000 sq. ft. manufacturing space in Plymouth, MI
- Complete turn-key project management resources



# Digested Organics has developed unique platforms that convert digestate into resources and increase profitability

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# Digestate treatment provides substantial benefits



Financial	Environmental	Social
<ul style="list-style-type: none"> <li>• Reduces hauling &amp; spreading costs</li> <li>• Volatile solids removal from digestate improves CI score</li> <li>• Fertilizer sales provide new revenue stream</li> <li>• Volume reduction is a service farms may pay for</li> <li>• Water and nutrient trading credits</li> </ul>	<ul style="list-style-type: none"> <li>• Reduces ammonia and CH4 emissions from lagoon storage</li> <li>• Reduces excess nutrient runoff associated with dilute digestate application</li> <li>• Enables more targeted delivery of nutrients, increasing crop uptake and yields</li> </ul>	<ul style="list-style-type: none"> <li>• Reduces the number of manure trucks on the road</li> <li>• Reduces odors from lagoon storage and spreading</li> <li>• Improves community experience of large projects, especially hub-and-spoke models</li> </ul>

# Key Challenges by Feedstock Type

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## Dairy

- N & P spreading limits
- Dilute material costly to haul
- Winter storage of P-concentrate

## Swine

- Lagoon digesters only productive in warm months; how to preserve VS?
- Today's nitrification & denitrification systems are expensive

## Poultry

- Dry feedstock requires dilution; need to keep water in a loop
- High ammonia content

## Food Waste

- Lots of nutrients centralized to one facility, often need to export back out
- Dilution required



# Unique and exclusive filtration solutions offer a competitive advantage

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## Primary Solids Removal

- Screw Press (SP)
- Solids Removal & Dewatering Unit™ (SRDU)
- Multi-Disc Press (MD)

## Self Cleaning Screening Technology

- Spiral Brush Filter (SBF)
- Woven Mesh Filter – Vacuum (WMF-V)
- Woven Mesh Filter – Ultrasound (WMF-U)

## Cartridge Filtration

- Pleated mesh filter
- Standard meltblown and string wound

## Micro & Ultrafiltration

- Tubular stainless steel with TiO<sub>2</sub> (MF & UF)
- PVDF multi-channel (UF)

## Tight Ultrafiltration

- Superfiltration (SF)

## Reverse Osmosis

- Sub-Induction Time Reverse Osmosis™ (SIT-RO)
- Polishing RO (pRO)

## Evaporation

- Multi-effect thermal evaporators

## Final Water Polishing

- Biofiltration/nitrification/aeration (BF)
- Electrochemical water treatment (EWT)

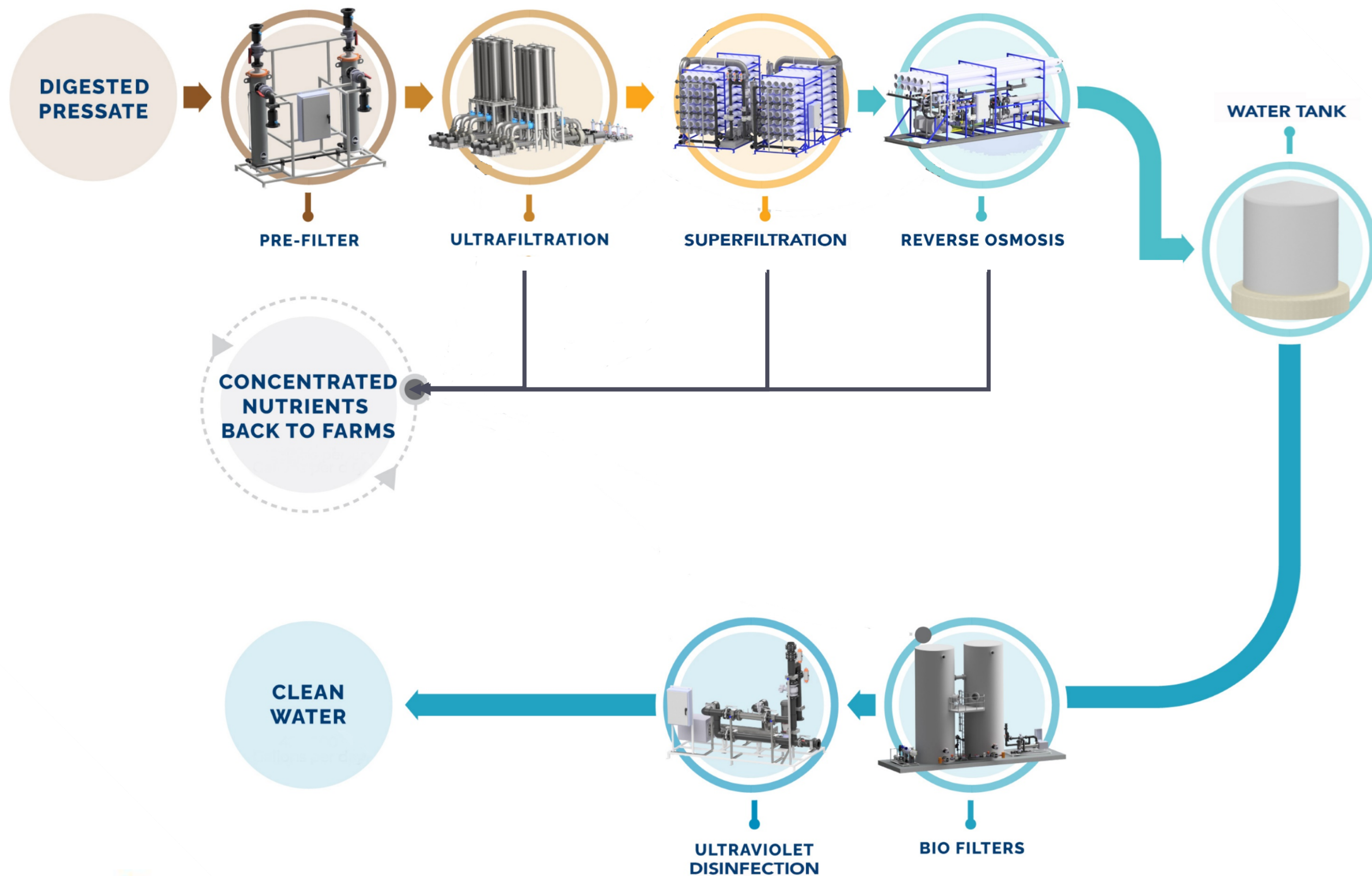
## Biological Treatment

- Membrane Bioreactor (MBR)
- Moving Bed Bioreactor (MBBR)

Our combined platform in many instances is called the  
**Nutrient Concentration & Water Reclamation™ (NCWR) System**

All Liquid Platform

# Case Study #1 – BC Organics in Greenleaf, Wisconsin



## Project Overview

- 720,000 GPD pressate to NCWR
- 50% recovery as clean water back to farms or river discharged

## Technologies Deployed

- UF, SF, SIT-RO, Polishing RO, Biofiltration, UV

## Benefits

- Volume reduction, lower trucking and land application costs
- Everything is pumpable

# Case Study #1 – BC Organics in Greenleaf, Wisconsin



Screw Presses



Ultrafiltration

# Case Study #1 – BC Organics in Greenleaf, Wisconsin



Superfiltration



SIT-RO

# Case Study #1 – BC Organics in Greenleaf, Wisconsin



Polishing RO



Biofiltration

# Case Study #1 – BC Organics in Greenleaf, Wisconsin



- System regularly producing water and discharging to the East River or to local farm
- Concentrates collected together and sent back to farms (pipeline and trucked)



# Case Study #1 – Key Learnings & Next Steps

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## Key Learnings

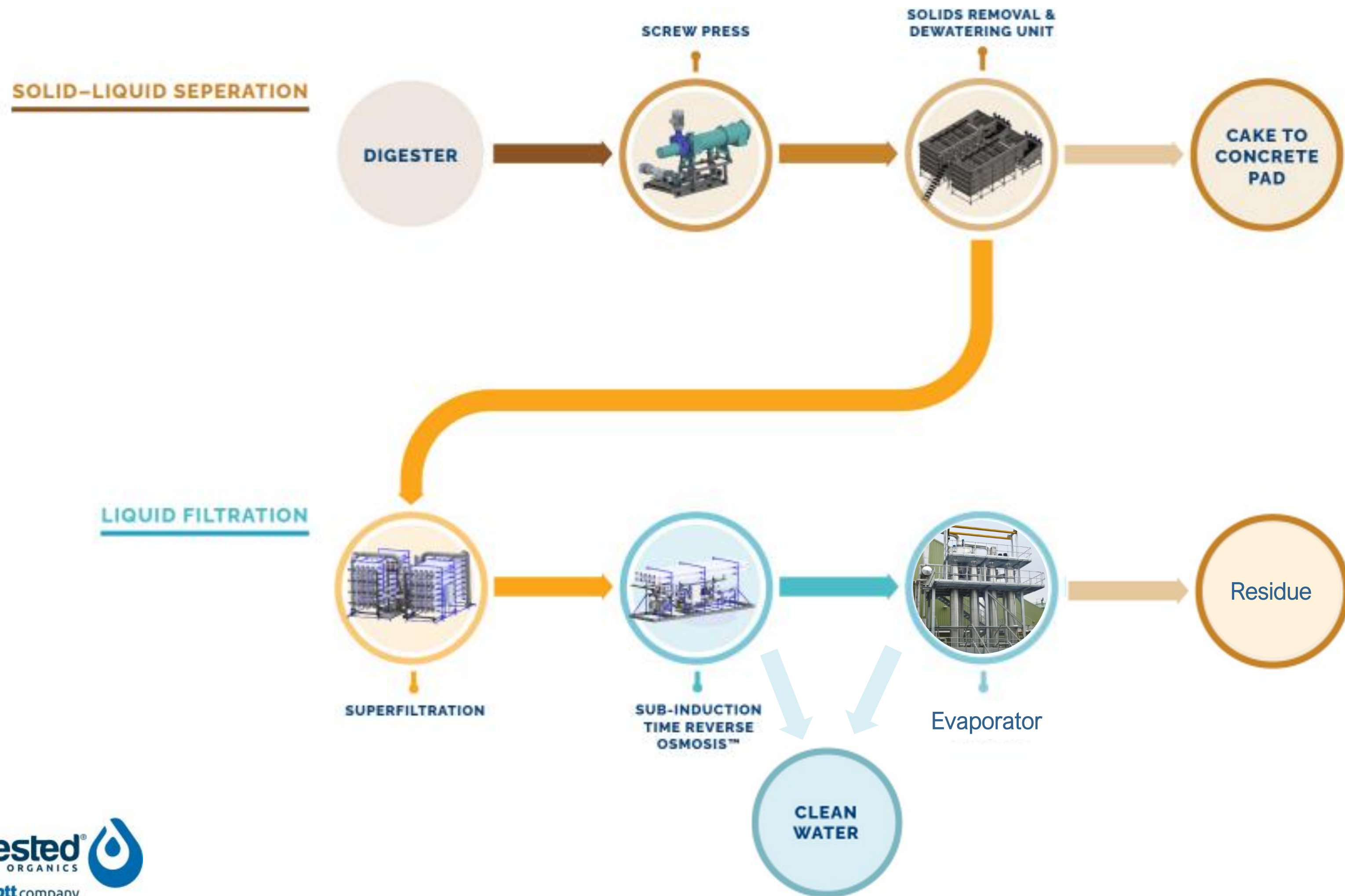
- Balancing multiple unit operations and upstream upsets require bigger tankage for continuous operations
- Temperature management for discharge (more chilling required)
- Commissioning time for biofiltration and impact of human mistakes
- Staffing for 24/7 operations

## Next Steps

- Continue optimization
- Bolt-on additional processes to generate liquid organic fertilizer for sale

Solid P Platform

# Case Study #2 – Bettencourt Dairy in Jerome, Idaho



## Project Overview

- 300,000 GPD pressate to NCWR
- 210 tons/day wet cake
- 15,000 GPD evaporator residue
- 270,000 GPD water
- 88% water recovery

## Technologies Deployed

- SRDU, SF, SIT-RO, Evaporation

## Benefits

- Volume reduction
- Salt removal
- Compostable high-P product



# Solids Removal & Dewatering Unit™ (SRDU)

Unique polymer and compressed air injection technology to create superior floating flocs of solids

- Removes small suspended solids and some colloids
- Similar to a DAF but uses less polymer, has a smaller footprint, lower power consumption, enhanced efficacy, and drier sludge production (which means lower overall costs)
- Unique high molecular weight polymer developed 15 years ago for use specifically in digested dairy manure (*exclusively available from Digested Organics*); other polymers available for various wastewaters
- Stainless steel Multi-Disc Press creates wet cake product

## Typical Applications:

- Dairy manure raw – concentration ahead of digestion
- Dairy manure (raw or digested) – phosphorus and organic N capture in wet cake
- Other high TSS wastewaters



# Solids Removal & Dewatering Unit™ (SRDU)



Separation of solids  
and liquids in dairy  
digestate



Wet cake  
(~20% TS)

# Primary Solids Removal – Solids Removal & Dewatering Unit™ (SRDU)

Parameter	Units	CONCENTRATION			POUNDS PER DAY			Percent of Pressate Nutrients in Wet Cake
		Pressate	SRDU Effluent	Wet Cake	Pressate	SRDU Effluent	Wet Cake	
Total solids	%	4.0	1.6	20.8	33,264	11,642	21,622	65%
Total volatile solids	%	2.3	0.6	13.6	18,827	4,704	14,124	75%
Total suspended solids	%	2.30	0.16	17.28	19,127	1,164	17,963	94%
Total Kjeldahl nitrogen	ppm	2,229	911	11,455	1,854	663	1,191	64%
Phosphorus	ppm	400	75	2,675	333	55	278	84%
Potassium	ppm	2,500	2,200	4,600	2,079	1,601	478	23%

Model: 100,000 GPD pressate; 87,500 GPD of effluent

# Fertilizers – Why are they attractive?

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- Digestate contains nitrogen, typically ~60-70% of total N is in the ammonia-N form
- Ammonia is lost during lagoon storage (wasted)
- Concentrating the nitrogen to make sellable fertilizers brings projects a new revenue source
- Organic farmers struggle to find cost-effective nitrogen with high plant availability
- Many sources of organic nitrogen are imported and have regulatory limitations (e.g., Chilean nitrate)





# Terraflow Fertilizers

Commercially available fertilizers produced from digestate



**8-0-0**



**16-0-0**



**6-0-5**

NPK →

## Aqueous Ammonia Solutions

- Looks and handles like water
- No salts, just ammonia in water
- Must be incorporated into soil
- pH 12-13 (volatile)

## Concentrated Digestate

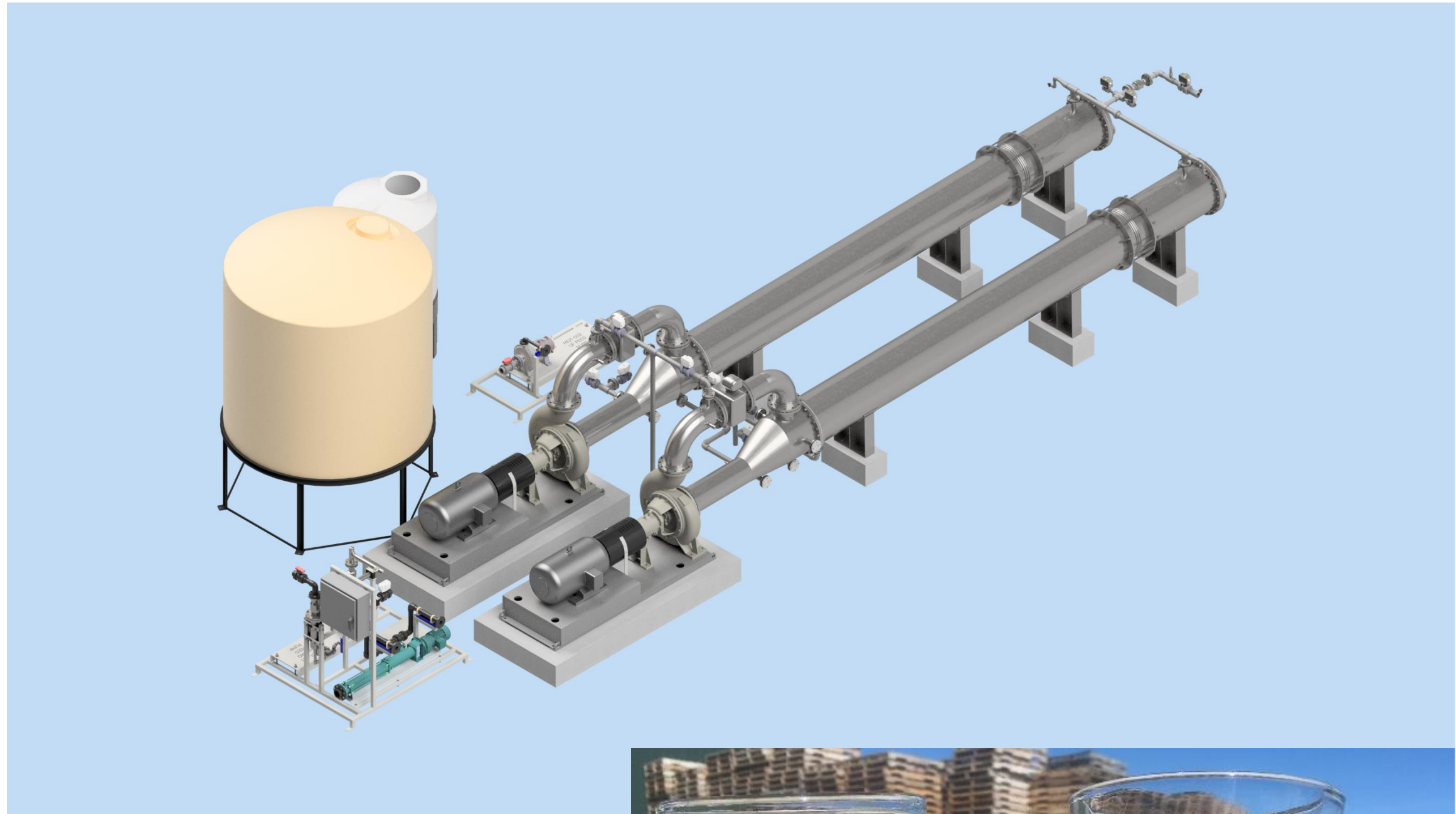
- 100% plant available N
- Dark liquid with ~50% TS
- Won't clog drip systems or nozzles
- pH 5-6 (stabilized)

# Digestate filtration



Pressate – SF Permeate – SF Concentrate – RO concentrate – RO Permeate

# Case Study #3 – BioTown Ag in Reynolds, Indiana



*UF Skid*

*Raw manure and  
UF permeate*



## Project Overview

- 3 large farms 30+ miles away from centralized digester
- Use stainless UF to concentrate volatile solids to haul less gallons

## Technologies Deployed

- Stainless UF

## Benefits to Farmer/Developer

- Reduced hauling costs
- Fewer trucks on the road

Similar concentration can also be achieved with our SRDU

# Thank You



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*Part of the Digested Organics team outside its corporate headquarters in Plymouth, MI*

Check out our YouTube Channel:

<https://www.youtube.com/channel/UCxFHNFyds2sUgOnf4rqwuJw>