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worm powered wastewater solutions

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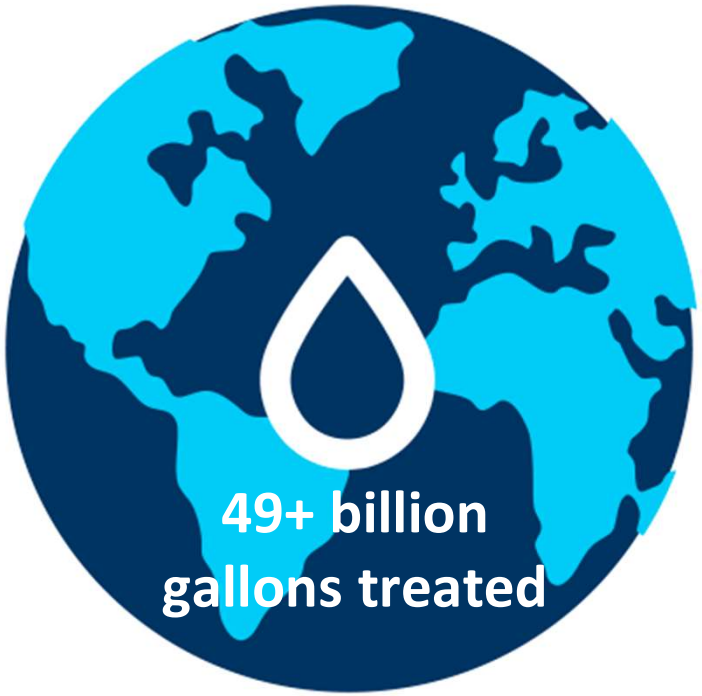
Who We Are

- BioFiltro is a wastewater treatment provider
- Our patented Biodynamic Aerobic (BIDA®) System uses vermifiltration (worm power!) to treat wastewater
- Our systems regenerate water, reduce green house gas emissions, and revive soils.

Timeline

- 1990 – Technology developed in Chile
- 2010 – BioFiltro started operations in Chile
- 2015 – Moved HQ to Davis, CA



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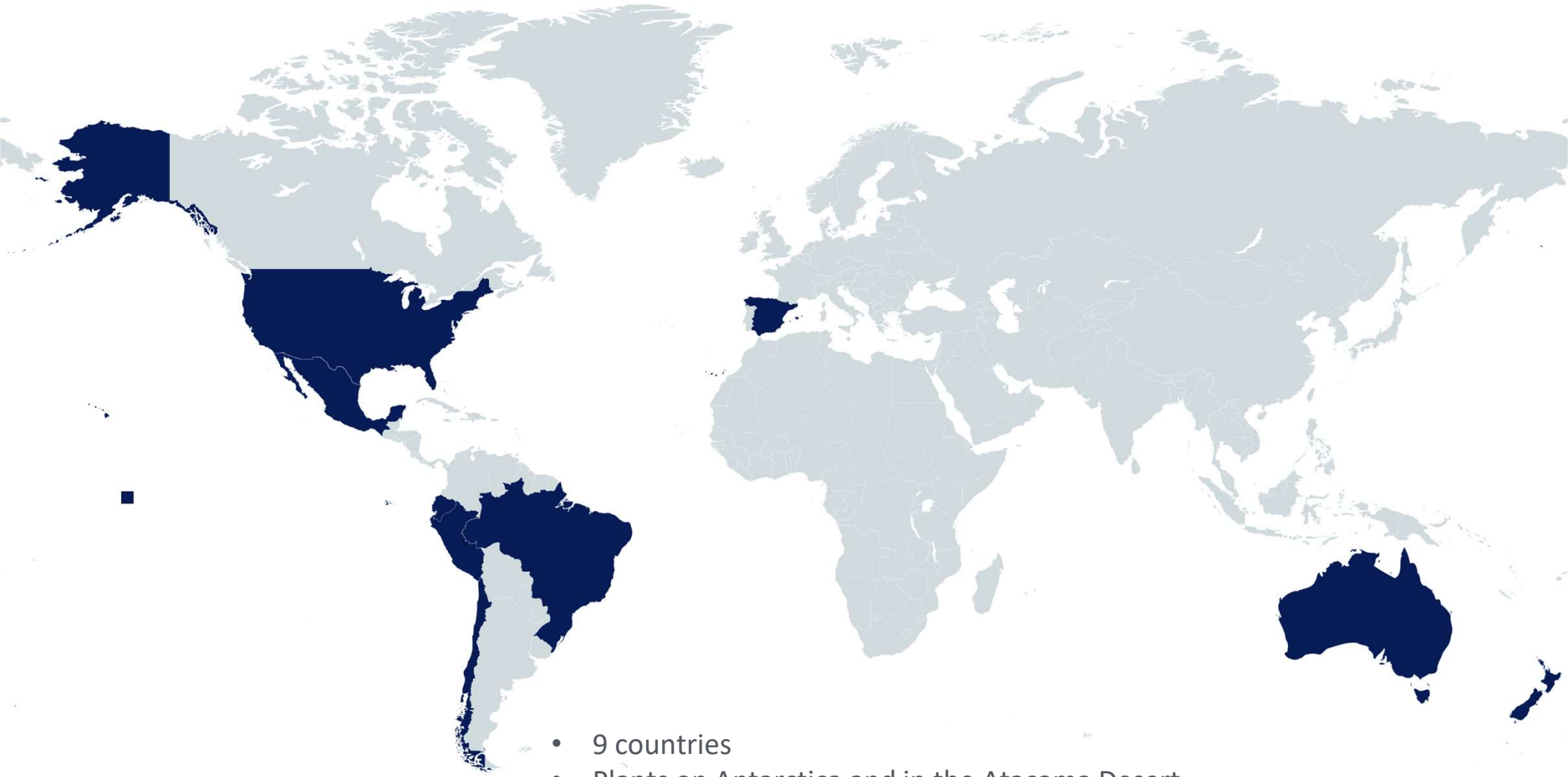
Global Experience



- 9 countries
- Plants on Antarctica and in the Atacama Desert
- Offices in the United States and Chile
- More than 200 projects worldwide.
- ~35 plants in US (CA, OR, WA, and TX)
- Applications include rural sanitary, wineries, food processors, and dairies

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What is the BIDA® System?

Biodynamic Aerobic or BIDA®

- Wood media & worms
- Aerobic secondary wastewater treatment using vermifiltration
- Percolating biofilter – physical & biological treatment
- Telemetry system:
  - Fully automated process
  - monitors water characteristics,
  - adjusts pH (if necessary),
  - and triggers intermittent irrigation batch process

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Container and Custom Solutions

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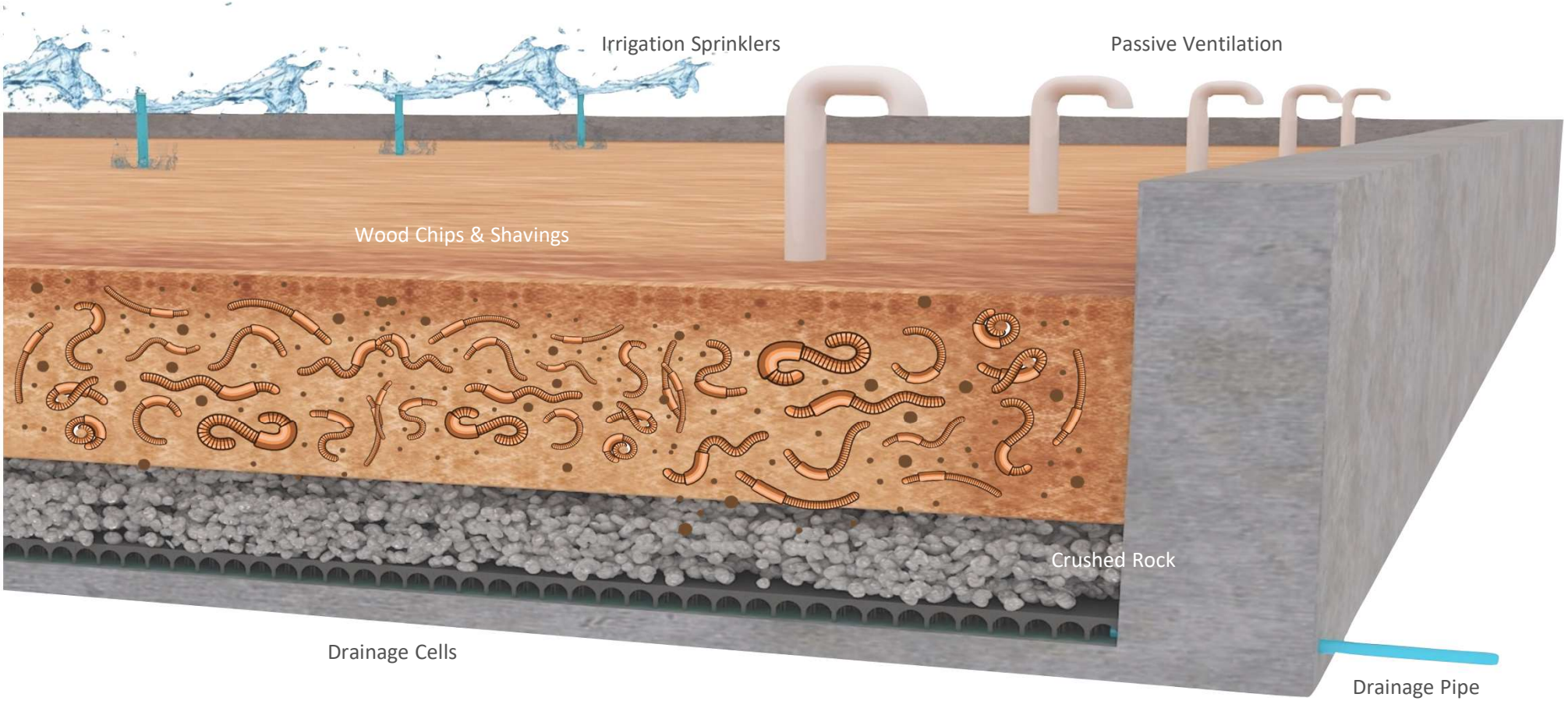
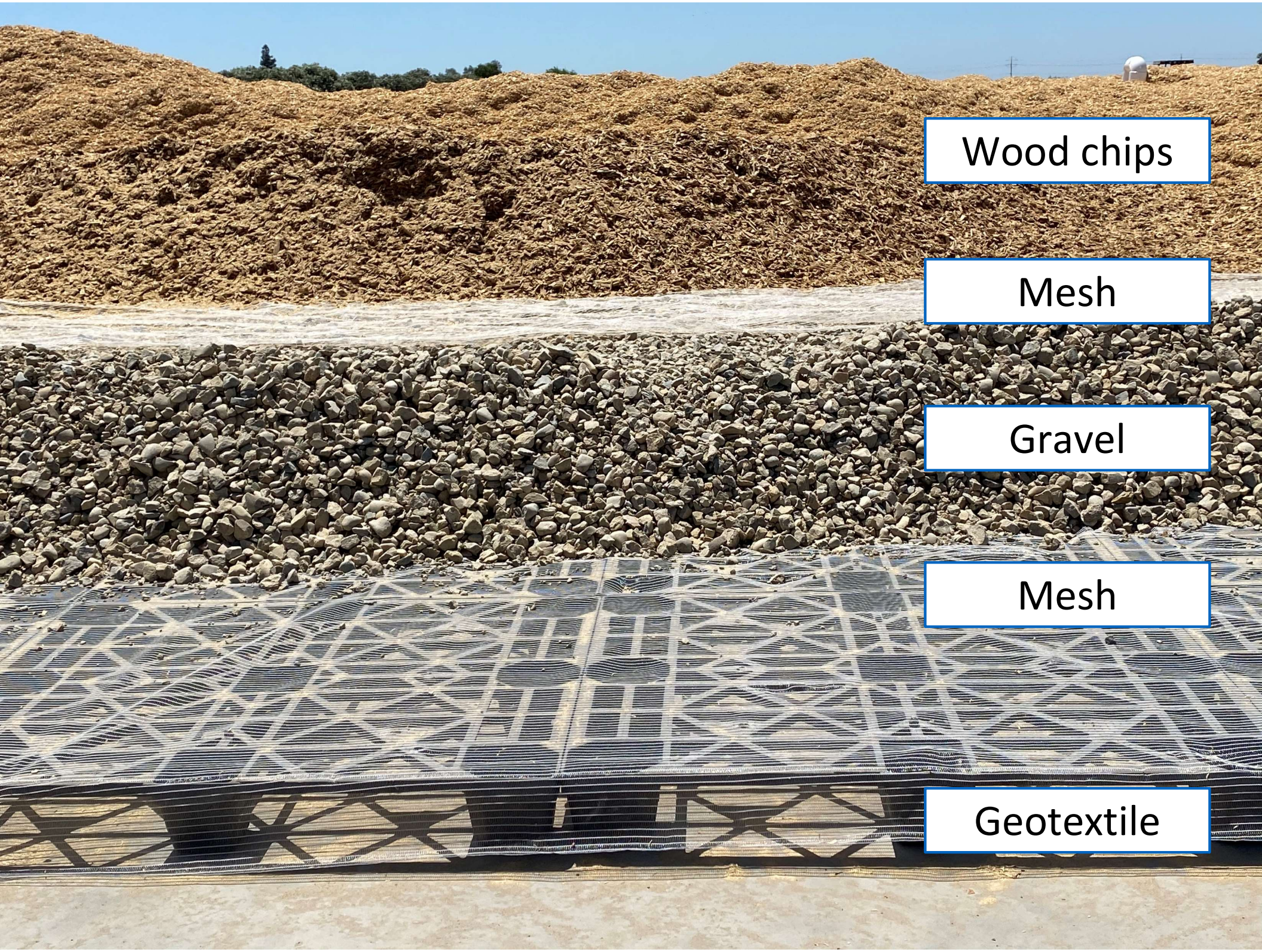
How It Works



- Wastewater is applied evenly across the surface via an irrigation system
- There is a layer of wood chips, where the worms and majority of the microbes live
- The rock layer is where a lot of microbes live that help remove nitrogen from the water
- Water drains along the sloped bottom and out through exit pipes
- It takes the water about 4 hours to travel through the system
- Over time the worms generate worm castings on the surface


Wood chips
Mesh
Gravel
Mesh
Geotextile

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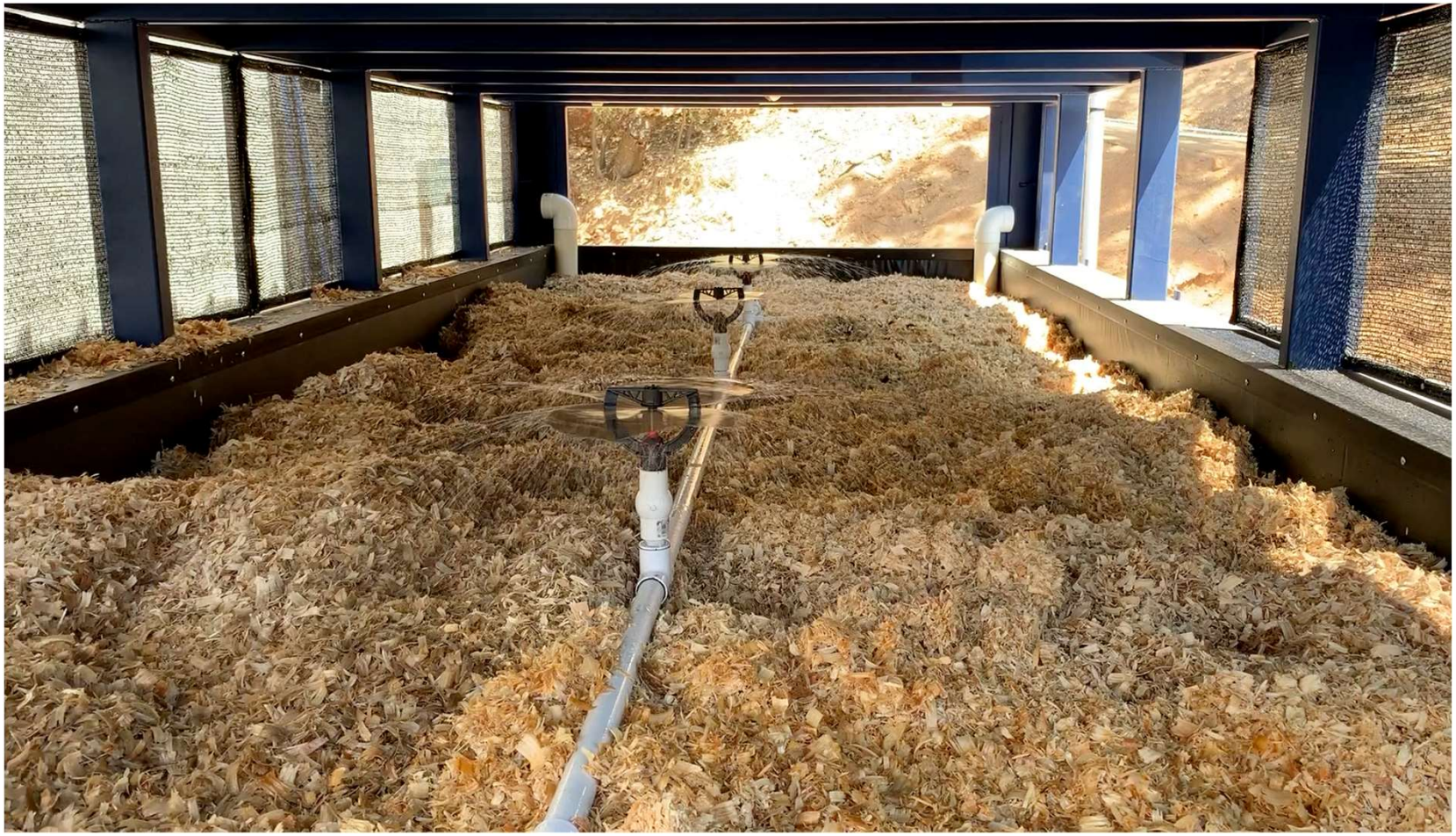
Hydraulic Loading Assumptions

The size of the system depends on daily volume and pounds of contaminants that need to be removed. Assuming a targeted 90%+ removal rate, you can estimate the following:

Sanitary Waste	Food Processors & Wineries	Liquid Manure/Dairies
~11 Gallons/ft2/day	~3.75 Gallons/ft2/day	~2.5 Gallons/ft2/day



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But what do worms have to do with it?

Worms – Eisenia andrei , also known as “Red Wiggler”

- Breakdown larger solids—think of them as filter cleaners!
- Aerate as they burrow
- Mixing and drainage
- Neutralize pH
- Average lifespan of 5 years
- Hibernate
- Simultaneously hermaphroditic
- Up to 2 cocoons per week
- Up to 12 hatchlings per cocoon
- Microbe rich castings
- Stabilize local environment

Microbiology

- Fixed-film process
- Biofilm responsible for removal of BOD, N, P

Symbiotic relationship forms biofilm, a dynamic external digestive layer, across the system medias for bioremediation of waste.

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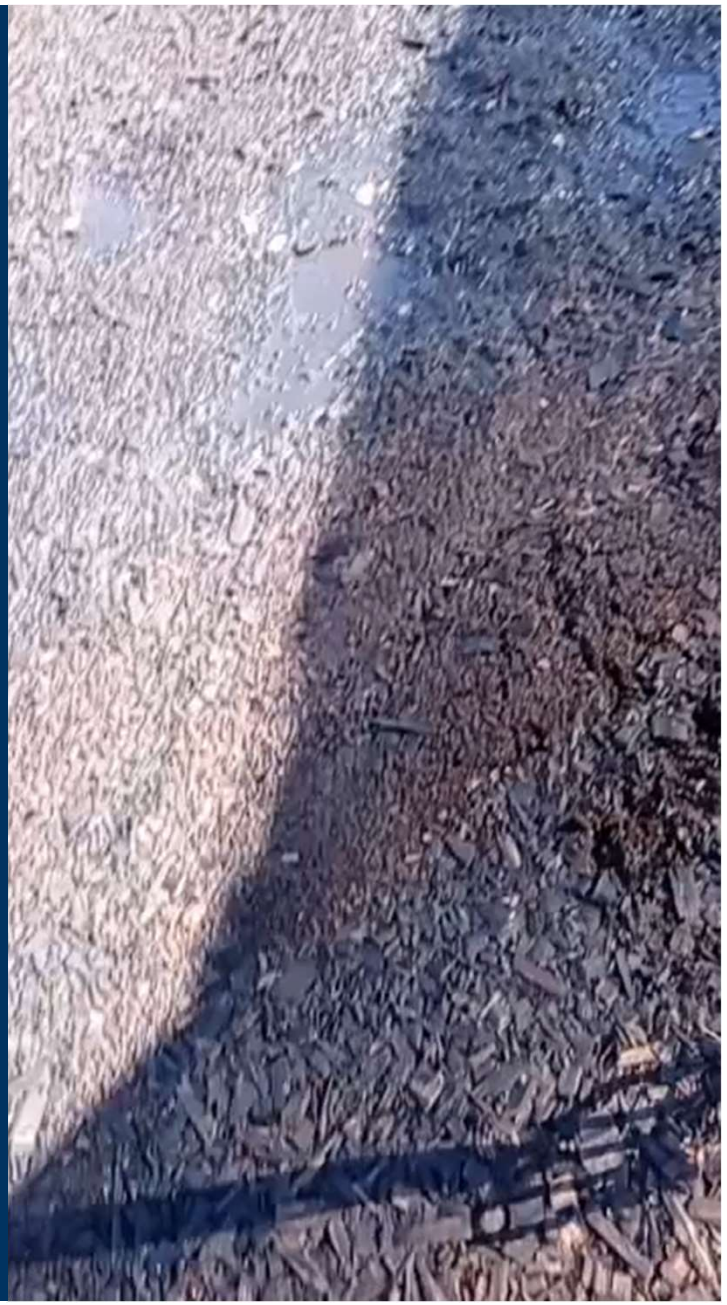
In healthy fertile soil, there's about 400 worms per cubic yard.

In our system, you can expect to find up to 12,000!



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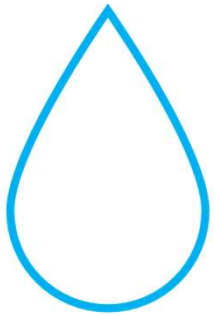

Our Impact on Water

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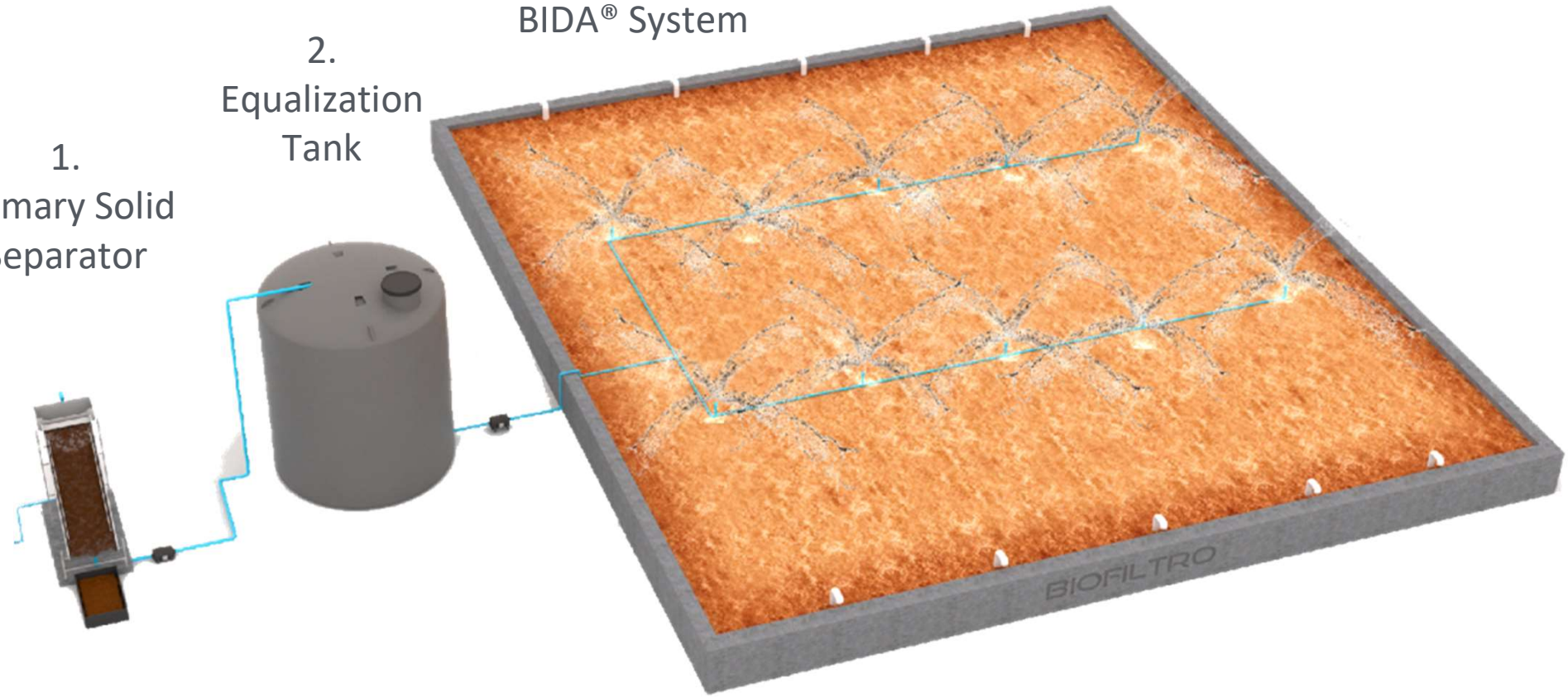
System Design

1. Primary Solid Separator

2. Equalization Tank

3. BIDA® System



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Average Removal

BOD_5	90 – 99%
Total Suspended Solids	90 – 99%
Total Nitrogen	70 – 95%
Fats, Oil and Grease	80 – 95%
Total Phosphorus	75 – 85%
Total Dissolved Solids	10 – 40%
Total Volatile Solids	75 – 95%

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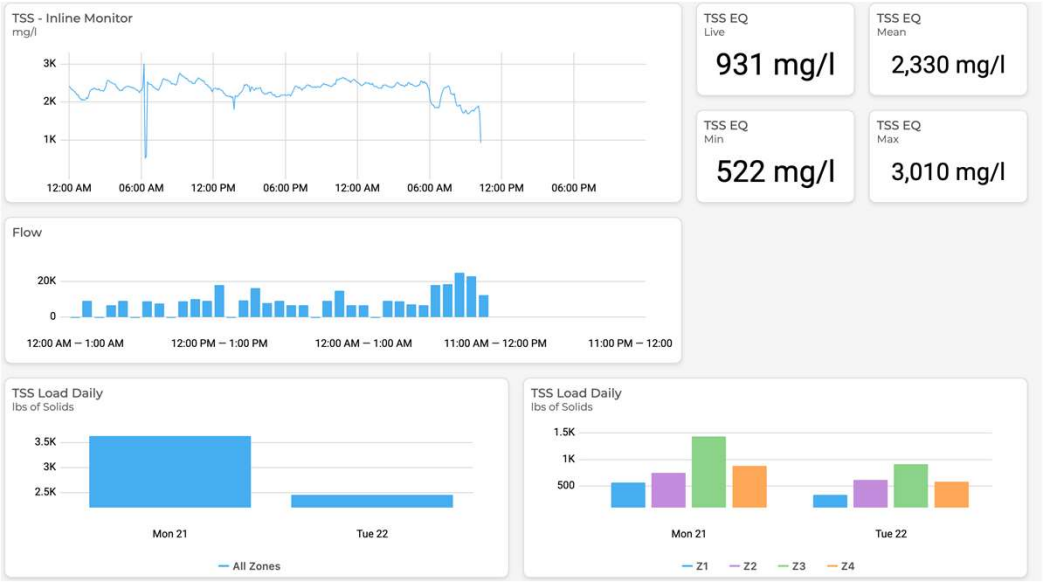
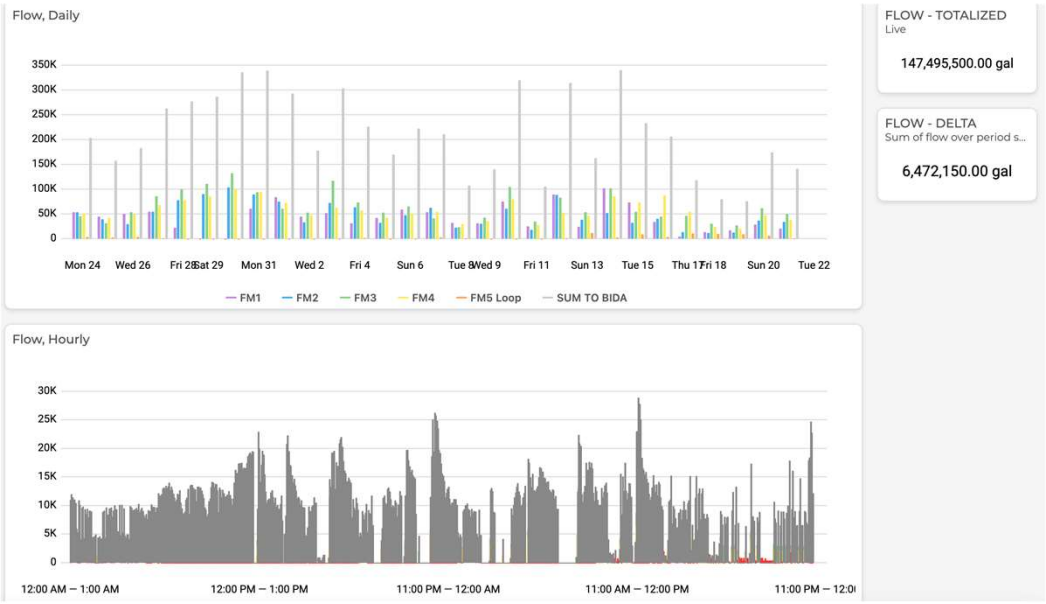
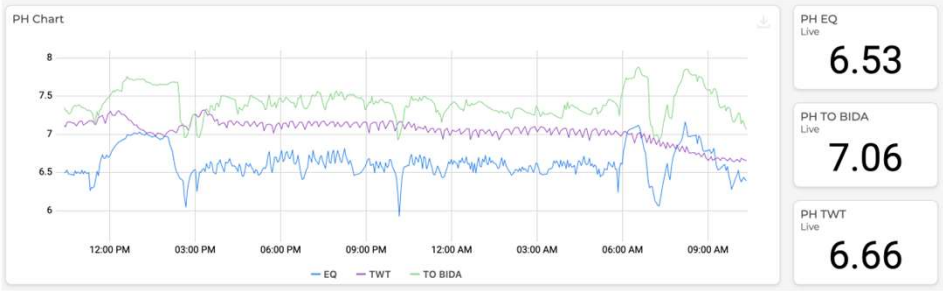
Intelligence of Worms (IoW)







- Automated-Telemetry system monitors water characteristics and triggers intermittent irrigation batch process
- See and log data in real time
- Flow, pH, pressure, temperature, tank levels, pump status
- Instruction manuals
- Emergency contacts

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System Reports

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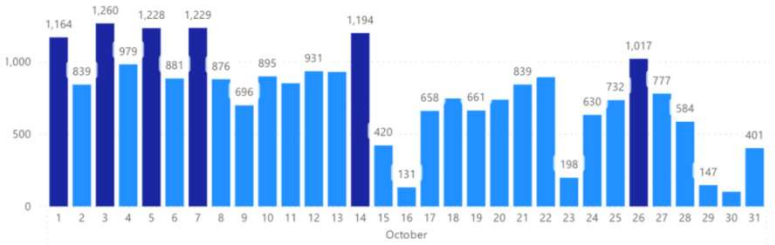
Monthly Report
October 2022
Plant #131

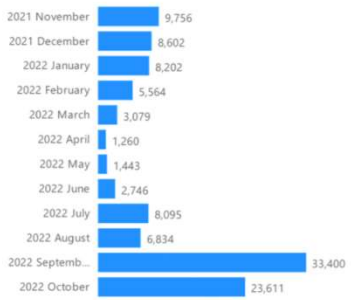
System Size	Flow Design	Start Up Date	BIDA® System Purpose
Two modules 20 feet in diameter	1,000 Gallons per Day	August 29, 2016	Deliver effluent with Biological Oxygen Demand below 160 mg/L and Total Suspended Solids below 80 mg/L

Daily Flow GPD



Note: Daily flows exceeding the maximum design flow are shown in a different color.

Monthly Gallons



	Month		Year		Lifetime	
Treated Water	23,611 Total Gallons	762 Average GPD	94,233 Total Gallons	578 Average GPD	823,422 Total Gallons	559 Average GPD
	1,260 Peak GPD	31 Days Irrigated	163 Days Irrigated	2,659 Peak GPD	1474 Days Irrigated	5,684 Peak GPD

Last Water Analysis (mg/l)

10/24/2022

Attribute	in	out
BOD	2,700	5
TSS	120	13

Attribute	Removal
BOD	100%
TSS	89%

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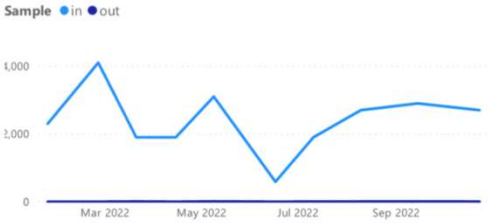
Monthly Report
October 2022
Plant #131

Water Analysis Data (mg/l)

Attribute	BOD		TSS	
Year	in	out	in	out
2022	**2,40**	**4**	**895**	**7**
October	2,700	5	120	13
September	2,900	7	650	2
August	2,700	6	230	4
July	1,900	4	490	0
June	590	0	640	2
May	3,100	10	4,400	14
April	1,900	0	490	8
March	1,900	7	160	3
February	4,100	0	770	3
January	2,300	0	1,000	16
Average	**2,40**	**4**	**895**	**7**

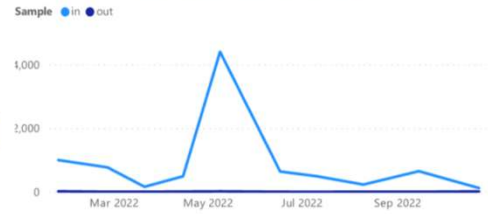
Biological Oxygen Demand (mg/l)



Removal

Year	BOD	TSS
2022	**100%**	**99%**
October	100%	89%
September	100%	100%
August	100%	98%
July	100%	100%
June	100%	100%
May	100%	100%
April	100%	98%
March	100%	98%
February	100%	100%
January	100%	98%
Average	**100%**	**99%**

Total Suspended Solids (mg/l)



Lifetime Water Analysis Overview

BOD (mg/l)

Sample	Average	Peak
in	2,041	7,700
out	26	340

TSS (mg/l)

Sample	Average	Peak
in	2,091	37,000
out	20	350

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Boutique Winery

Abbott Claim Winery, OR (2020)
Water is Reused for Irrigation
Peak Flow 1,200 GPD

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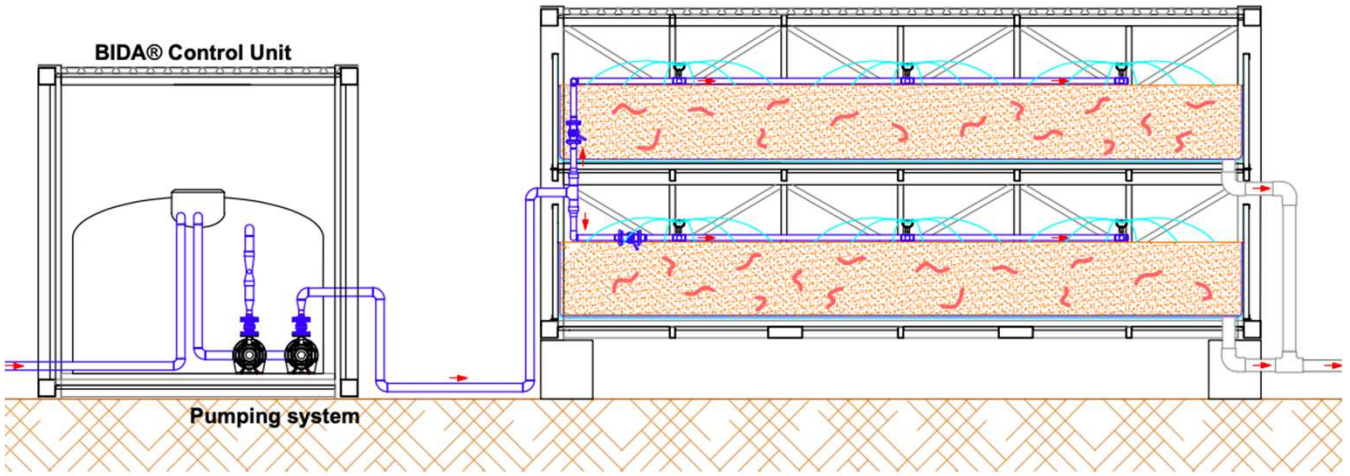
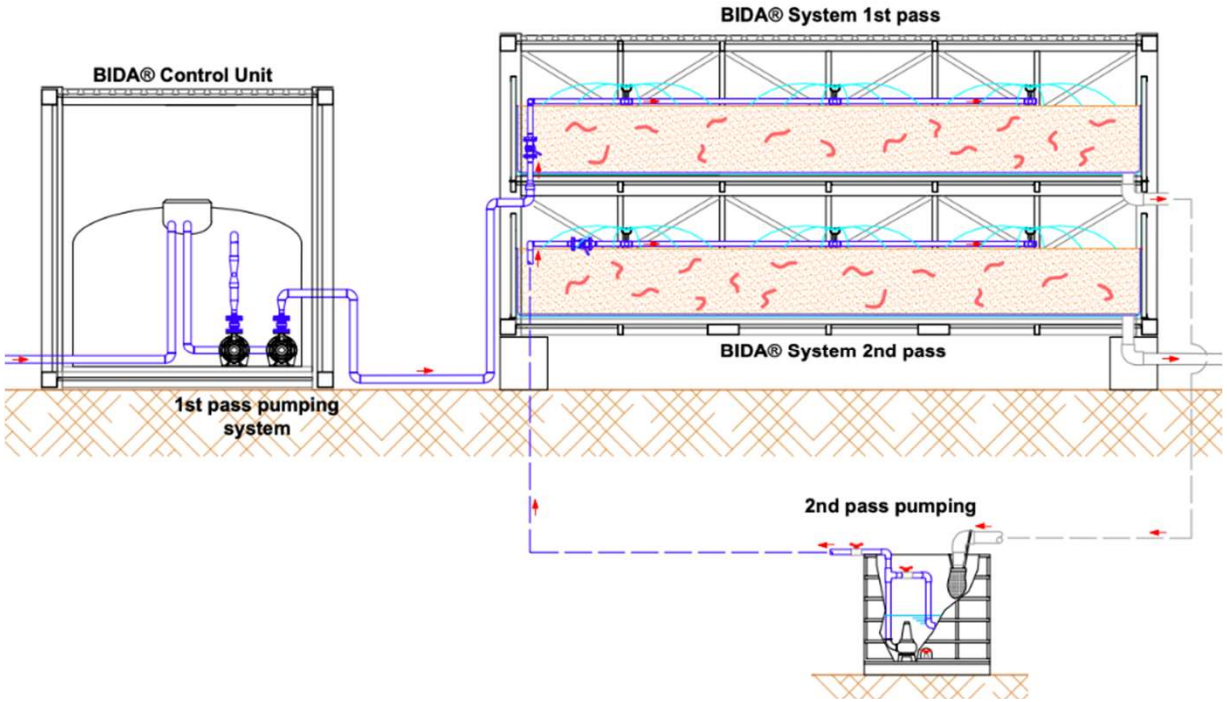
M2 Treatment Options

Single pass/parallel operation (80%+ Target BOD5 Removal):



Double pass/series operation (95%+ Target BOD5 Removal):



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Control Unit

	Standard Equipment
A	Equalization Tank
B	Pumps
C	Venturi Injector
D	pH & temperature probes
E	PLC
F	Camera (optional)
G	Overhead Light & Ventilation Fan
I	Flow Meter
J	Solid Separator (optional)
K	pH Adjustment System (optional)

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Winery

Aonair Wines - Saint Helena, CA (2016)
Water is Reused for Irrigation
Peak Flow 1500 GPD
BIDA Area 509 sq. ft.

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Winery

Peltier Vineyards - Acampo, CA (2016)
Water is Reused for Irrigation
Peak Flow 10, 000 GPD
BIDA Area 3,000 sq. ft.
Single pass—discharging to existing pond for final polishing

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Winery

Frey Vineyards – Redwood Valley, CA (2018)

Water is Reused for Irrigation

Peak Flow 10,000 GPD

BIDA Area 6,000 sq. ft.

Double pass for 95%+ removal of BOD & TSS

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Winery

Fetzer Vineyards, Hopland, CA (2016)
Water is Reused for Irrigation
Peak Flow 100,000 GPD
BIDA Area 21,000 sq. ft.
Single pass operation
~2M Cases

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Winery & Distillery

O'Neill Vintners & Distillers - Parlier, CA (2020)
Water is Reused for Irrigation
Peak Flow 1,000,000 GPD
BIDA Area 216,000 ft^2

"BioFiltro BIDA System recycles 80MM gallons of water each year for vineyard irrigation and generates 1,225 dry tons of worm castings to boost the soil health of 500 acres of farmland."

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Sanitary Sewer

Customs & Border Protection (2019)
Water is Discharged to Evaporation Pond
Peak Flow 5,000 GPD
BIDA Area 1,120 ft²

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Sanitary

I-5 Property Services, Firebaugh, CA (2016)
Sanitary System for Highway Interchange (Hotel, Restaurants, Gas Stations)
Peak Flow 80,000 GPD
BIDA Area 7,200 ft²

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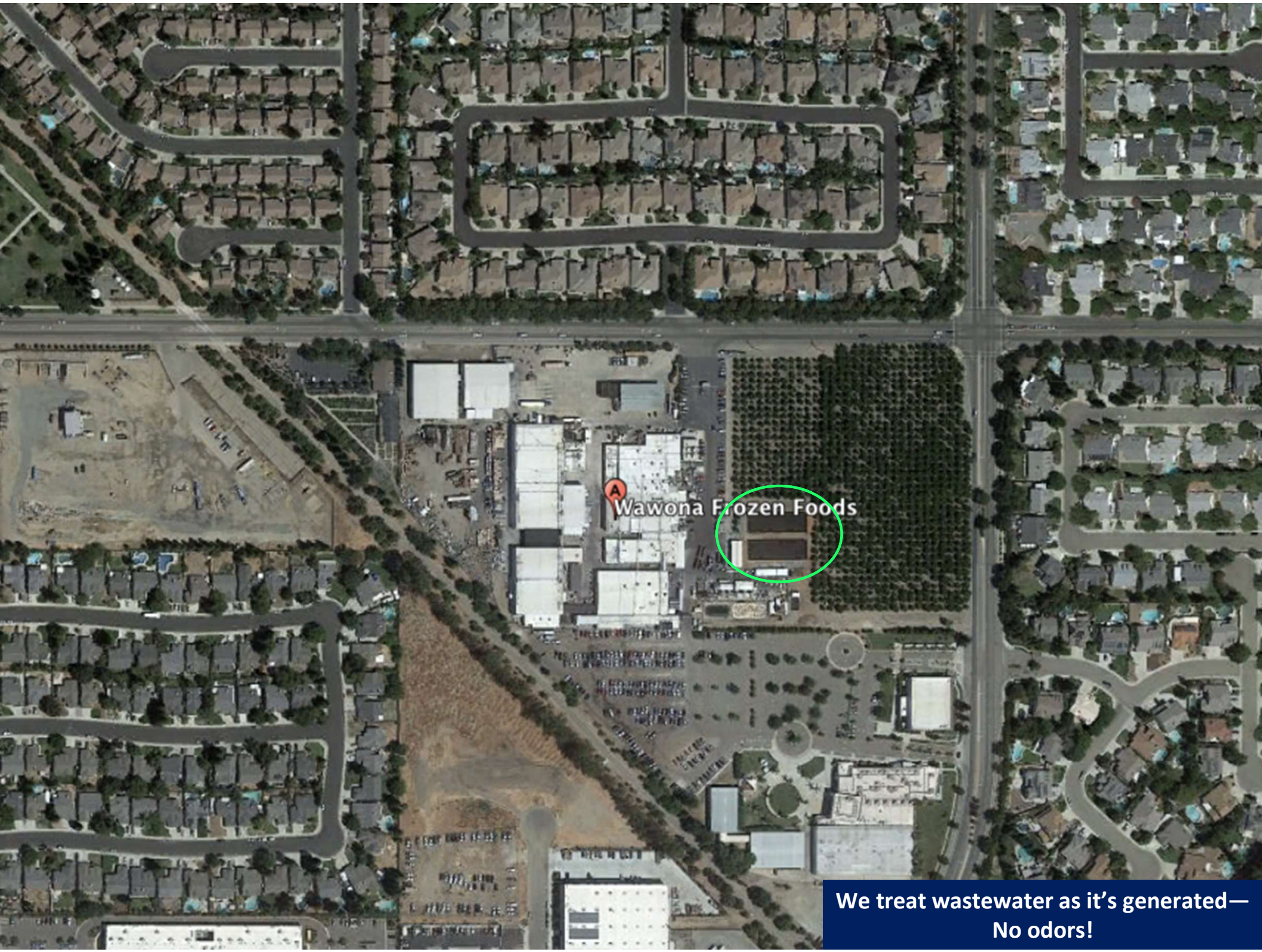
Food Processor

Wawona Frozen Foods, Clovis, CA (2015)
Water is Discharged to City Treatment Plant
Peak Flow 50,000 GPD
BIDA Area 14,000 ft^2


A
Wawona Frozen Foods
We treat wastewater as it's generated—
No odors!

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Our Impact on Air

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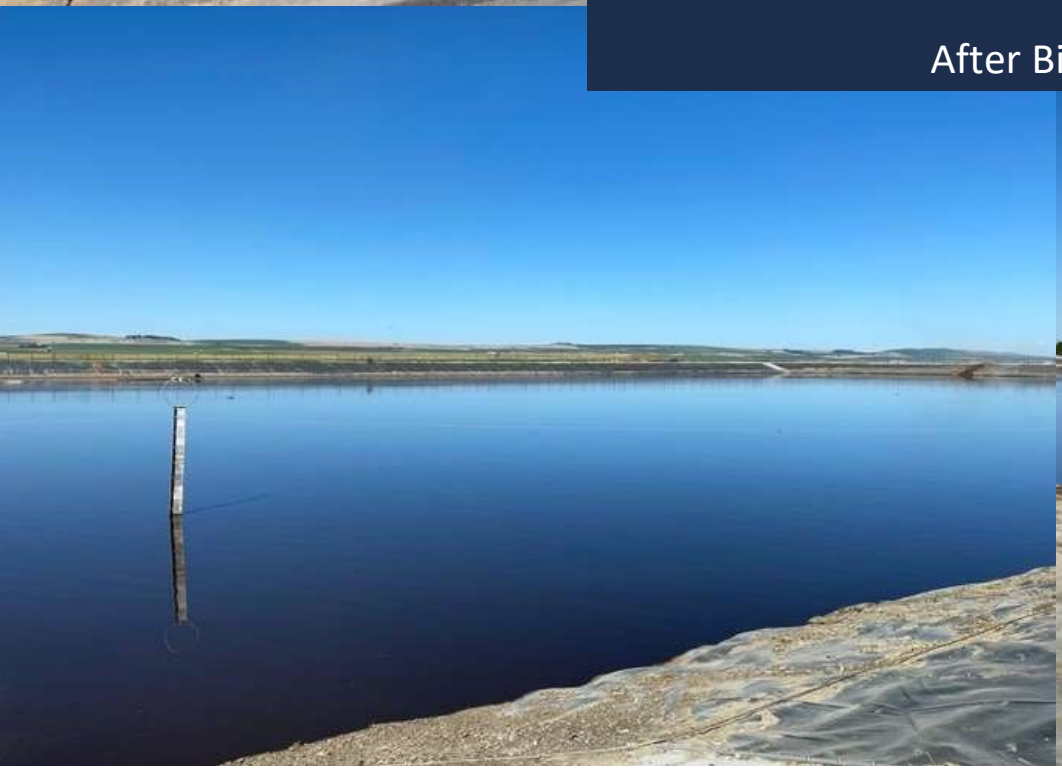
Dairy

Royal Dairy, Royal City, WA (2017)
Water is Reused for Flush and Irrigation
Peak Flow 750,000 GPD
BIDA Area 320,000 sq. ft.

Before BioFiltro

After BioFiltro



Total Suspended Solids	Total Nitrogen	Total Phosphorus	**Total Volatile Suspended Solids**
97%	91%	92%	**89%**

Reducing the amount of TVSS by 89% before water arrives to the lagoon means that 89% less methane has the potential to form

Royal Dairy's carbon credits are verified, audited every 3 years, and sold to the buyer of Royal's milk, to offset their carbon footprint by supporting carbon projects within their milkshed.

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Vermifiltering the Air

Methane
97-100% Reduction

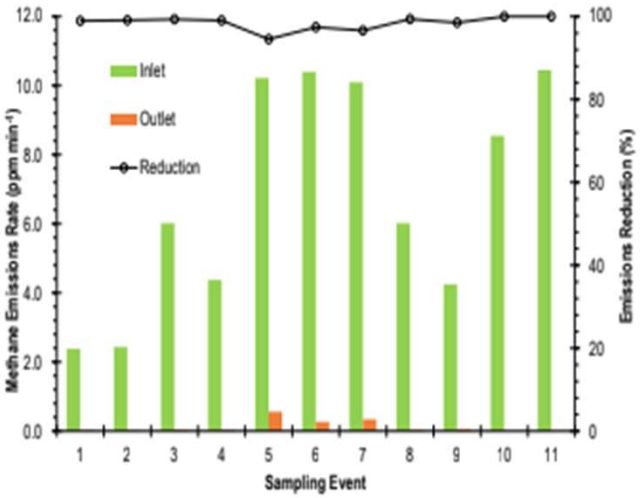

Figure 12. Emission Rates of Methane at the inlet and outlet of the Vermifilter system and methane emission reduction.

Carbon Dioxide
60-85% Reduction

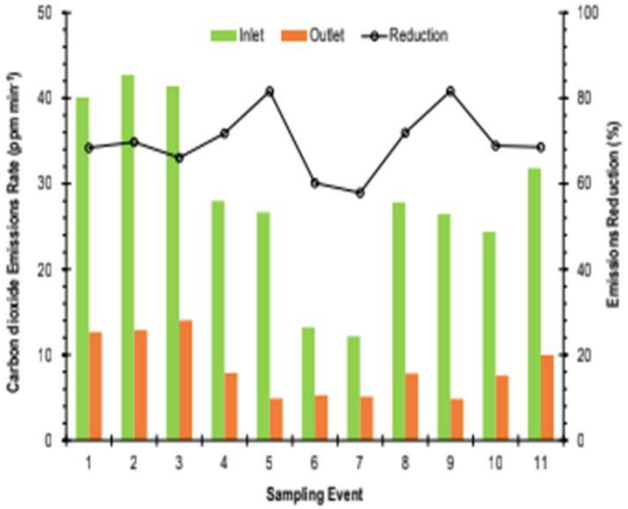

Figure 14. Emission Rates of carbon dioxide at the inlet and outlet of the vermifilter system and methane emission reduction.

Ammonia
84-110% Reduction

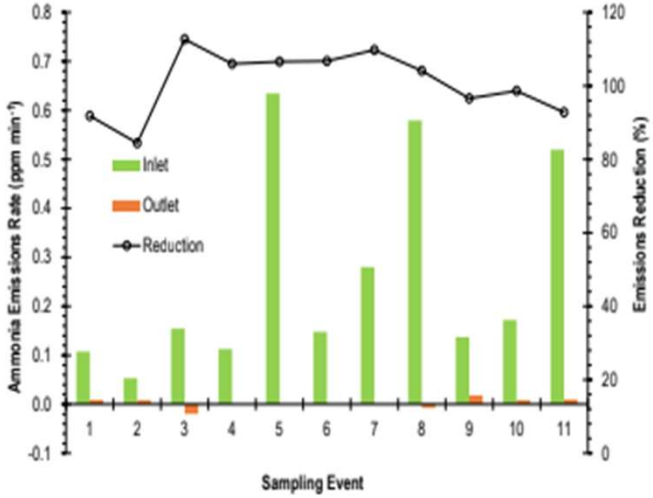

Figure 18. Emission Rates of ammonia at the inlet and outlet of the Vermifilter system as well as on emission reduction.

Carbon Credits Per Holstein
8.2 tCO2/yr GHG Credit/Year

Carbon Credits Per Jersey
5.6 tCO2/yr GHG Credit/Year

An emissions study conducted by Washington State University investigated the reduction in greenhouse gas emissions by comparing the inlet (untreated water) and outlet (treated water) of a BIDA® System at a dairy in Sunnyside, WA

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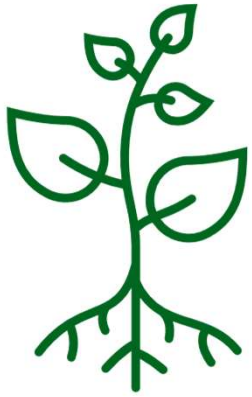

Our Impact on Soil

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What is Vermicompost?

- Co-benefit of our system
- The result of worm digestion and aerobic decomposition
- Rich in microbes
- A soil amendment that improves nutrient cycling, water retention, soil health, and reduces GHG emissions.
- BioFiltro generates tens of thousands of cubic yards of vermicompost annually, which is then sold to growers, nurseries, and farmers
- We’re regenerating healthy soil!

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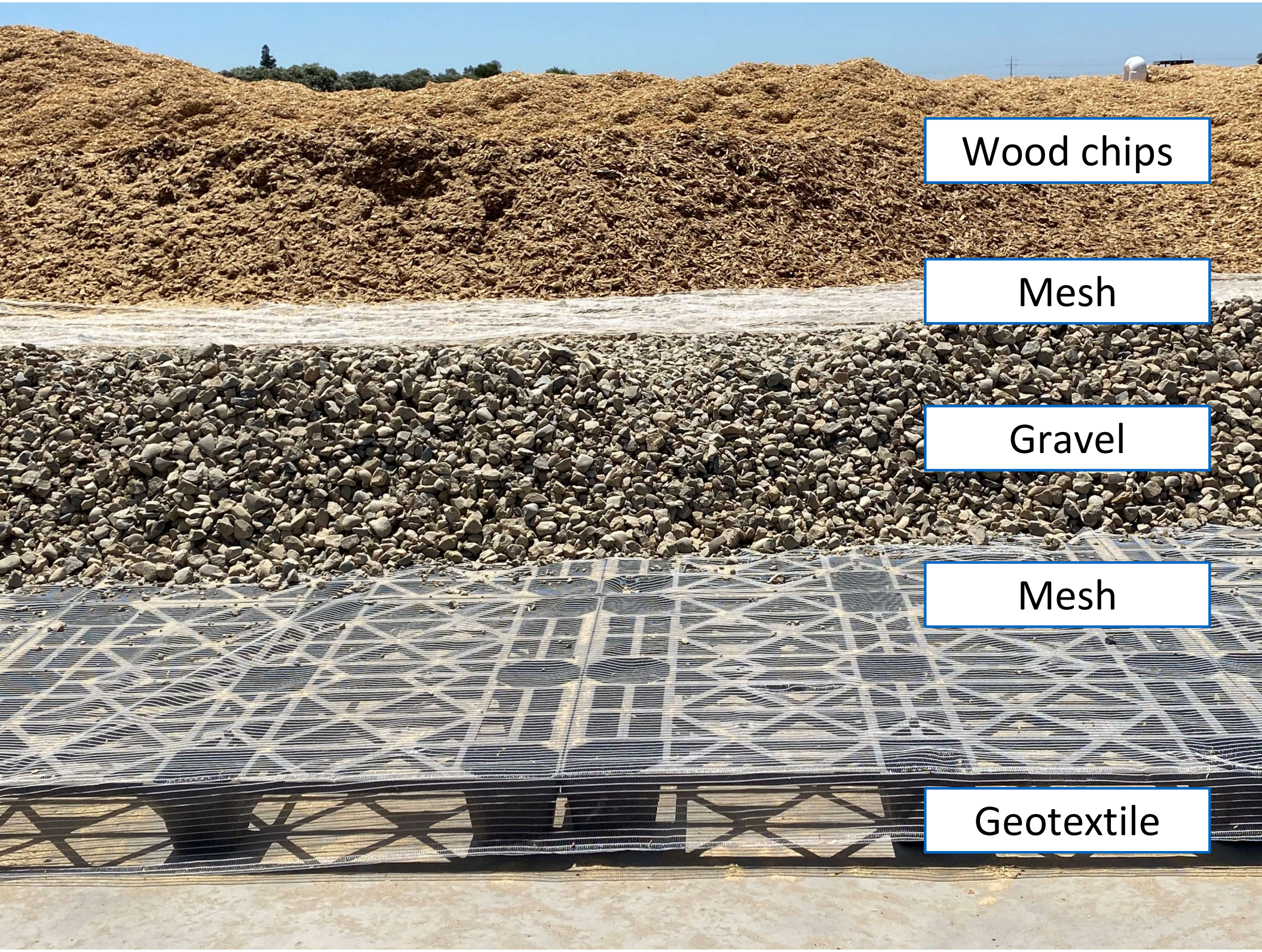
Maintenance

Casting Removal Frequency
Seasonal facility: 18-36 months
Year-round facility: 24 months
Dairy: 18 Months
Zonal for no operational downtime


Wood chips
Mesh
Gravel
Mesh
Geotextile

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Maintenance

Tilling once a month and as needed to prevent solids from accumulating and sealing off the media.

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Maintenance

In addition to castings harvest, which includes replenishing wood chips/shavings, other maintenance items are:

- Clean solid separator
- Order/refill pH chemical
- Clean out any upstream tanks/pumps

No need for specialized & expensive operators

- Initial O&M term where we maintain the system and train the client

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Winery General Order

Who?

- Wineries that discharge 10,000-15M gallons per year of process wastewater to land

Tier	Facility Process Water Design Flow (gal/year)
Exempt	<10,000
Tier 1	10,000-30,000
Tier 2	30,001-300,000
Tier 3	300,001-1,000,000
Tier 4	1,000,001-15,000,000

$$ 50% annual fee reduction for dischargers with sustainable certifications!

Identify Enrollment Needs:

- Which PW system do you have? Pond, SDS, Other?
- Determine tier
- Current WW discharge quality?

Enrollment:

- Submit Technical Report and NOI to Regional WQCB
- New wineries 180 days before operations
- Existing wineries by 1/20/2024

Approval & Construction

- Expect 3-6 months for Board review and NOA issuance

Monitoring & Reporting Program

- Conduct MRP and (bi)annual report(s) per NOA

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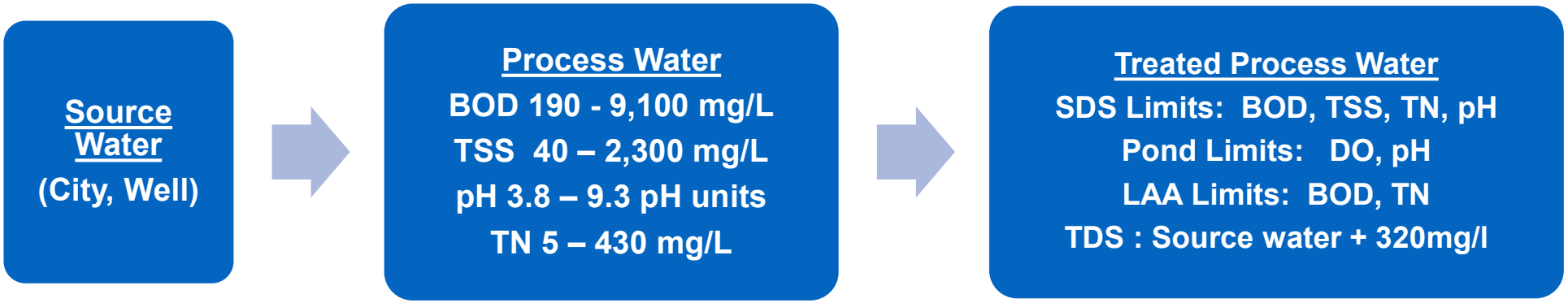
Winery General Order



Tiers 2, 3, & 4:

LAA Requirements

- Annual total process water discharge flow from the winery must be measured and reported annually
- Loading to a LAA must not exceed 100lb/ac/day of BOD over the course of an irrigation cycle.
- Nitrogen application rate must not exceed crop agronomic rate in the LAA.

SDS Requirements

- Total Nitrogen (**TN**) less than 10 mg/L (average of 3 most recent samples)
- Biochemical Oxygen Demand (**BOD**) and Total Suspended Solids (**TSS**) less than 300 mg/L and 330 mg/L respectively (average of 3 samples)

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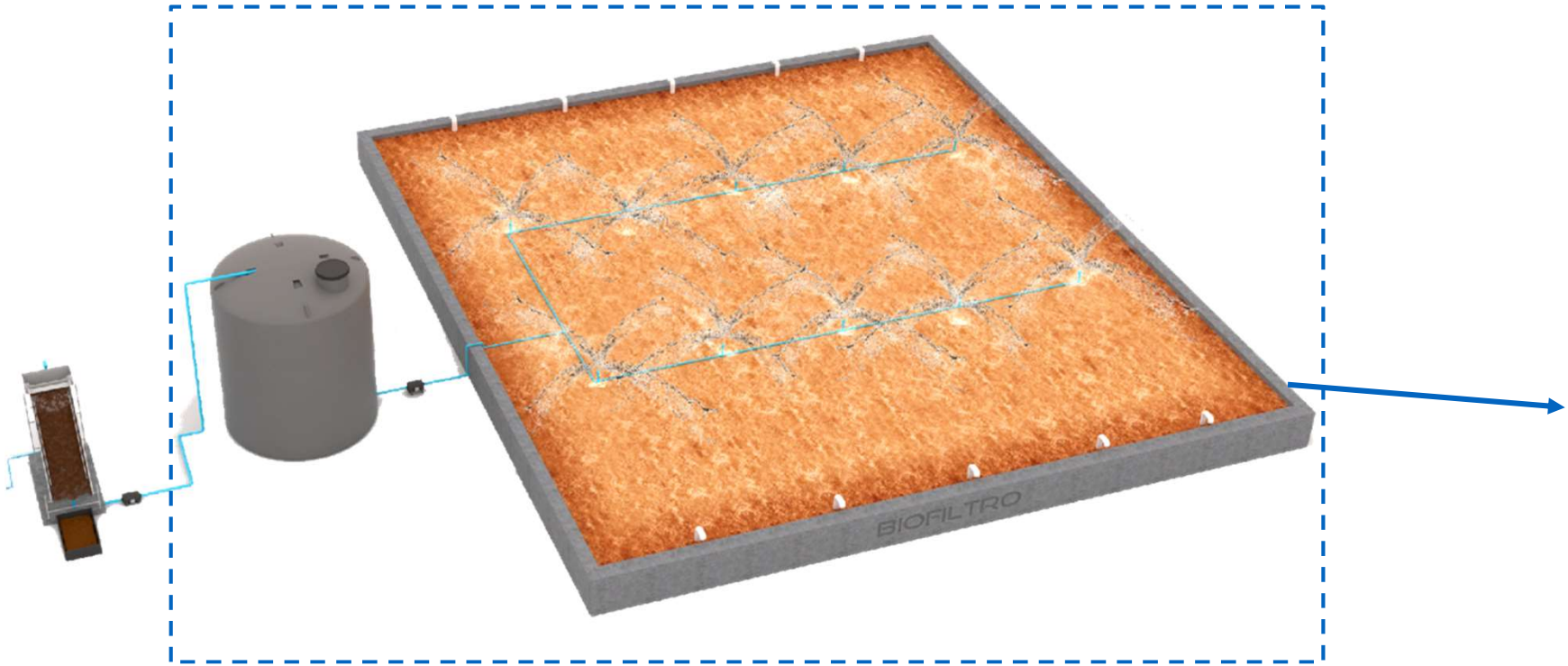
Next Steps

For cost estimate and sizing:

- Space available for WW treatment
- WW flows
- WW water quality
- Discharge requirements and point of discharge
- Existing wastewater infrastructure & process flow

BioFiltro's Scope of Work:



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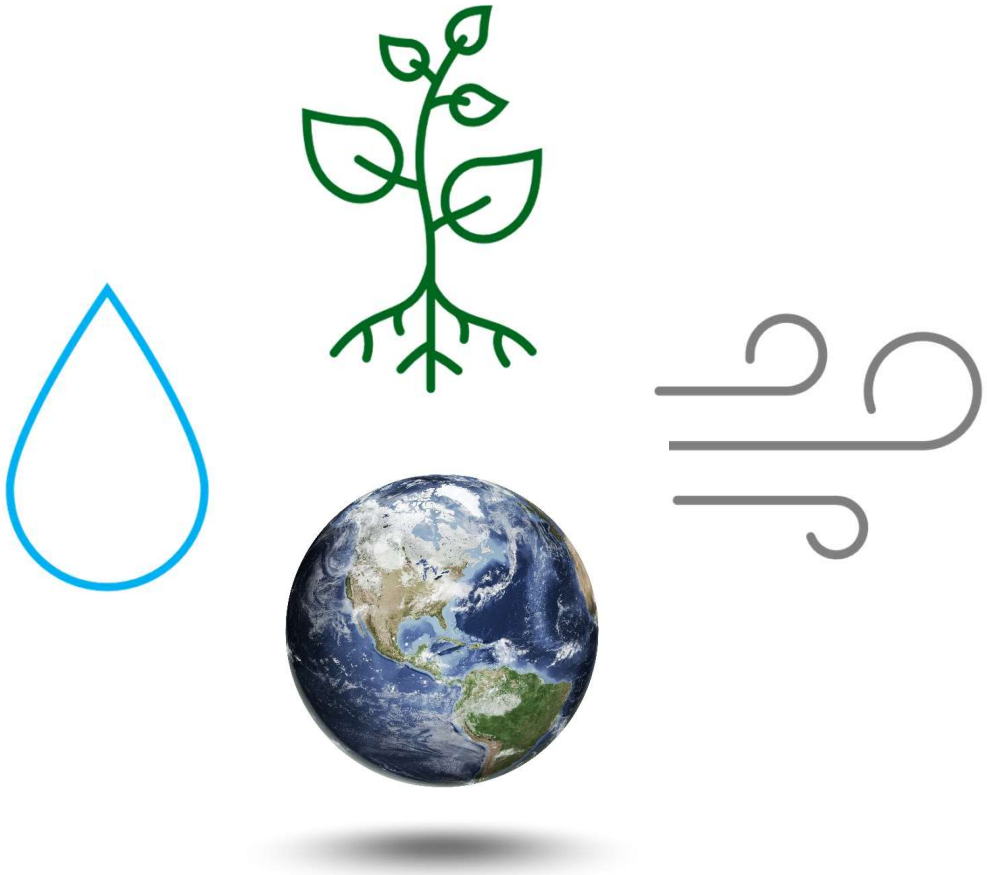

Our Overall Impact

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Thank You!

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