

Application of the Vetiver System for Landfill Leachate Disposal in the United States



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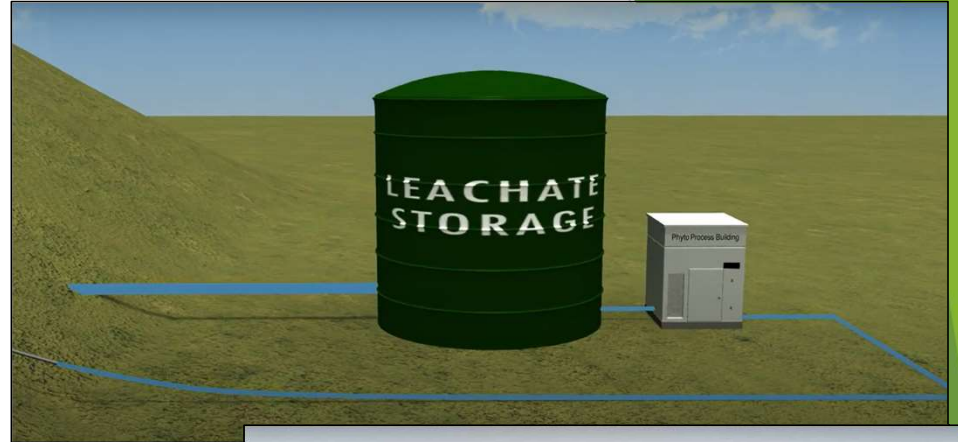
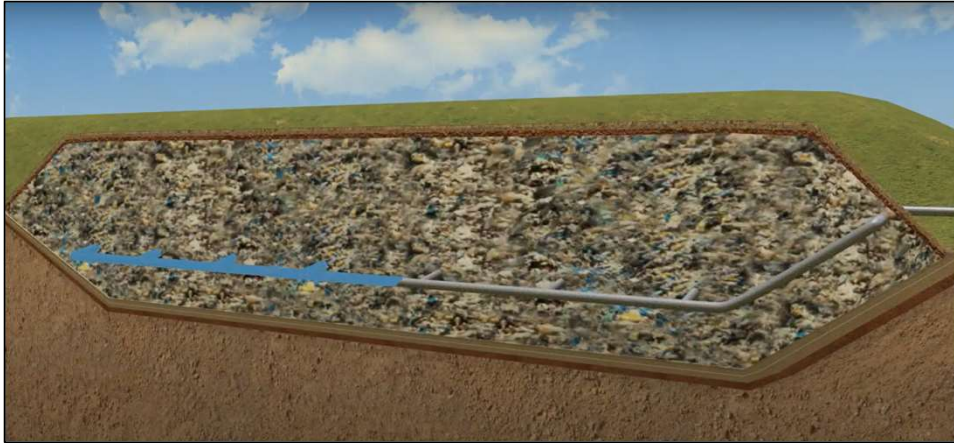


Vetiver Network International
R.H. Princess Maha Chakri Sirindhorn of Thailand

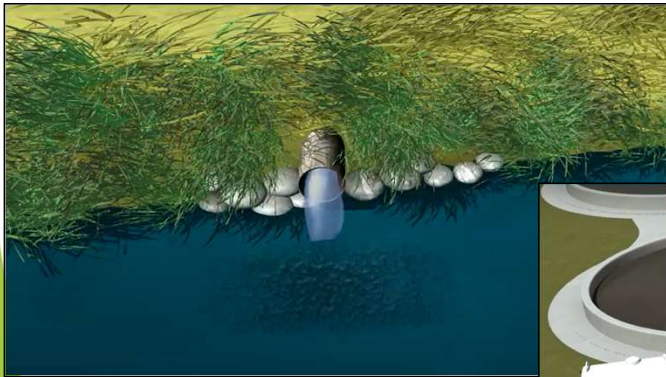
Introduction

- There are approximately 2,000 active landfills and 20,000 closed landfills and dumps in the United States.
- One of the biggest challenges with landfills is LEACHATE, which is the rainwater that percolates through a landfill and becomes contaminated.
- Leachate is one of the highest non-labor operating expenses for landfills.



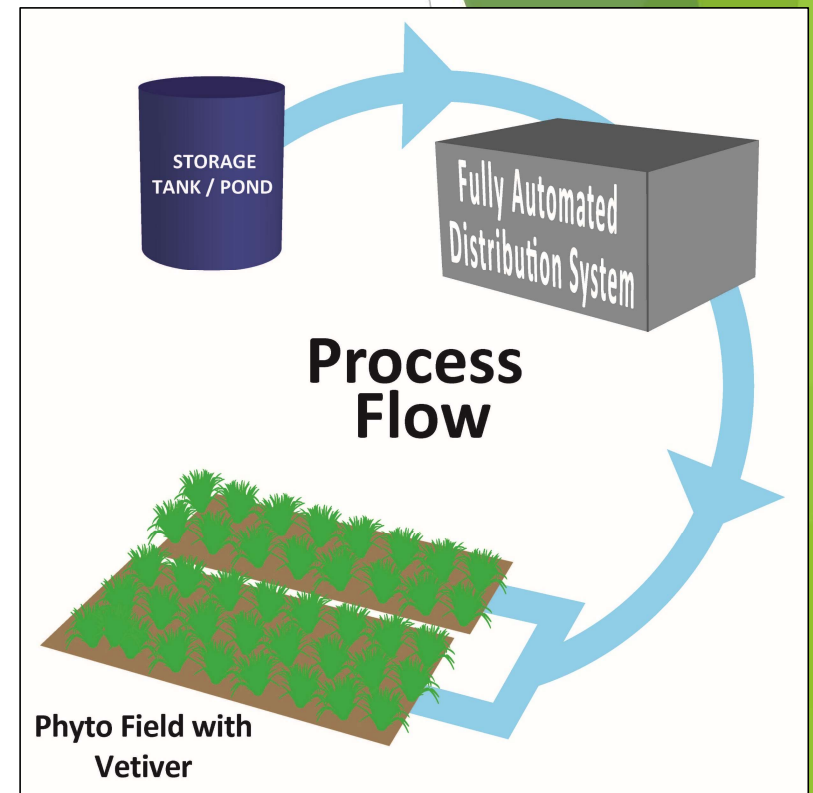


Traditional Leachate Transportation & Disposal

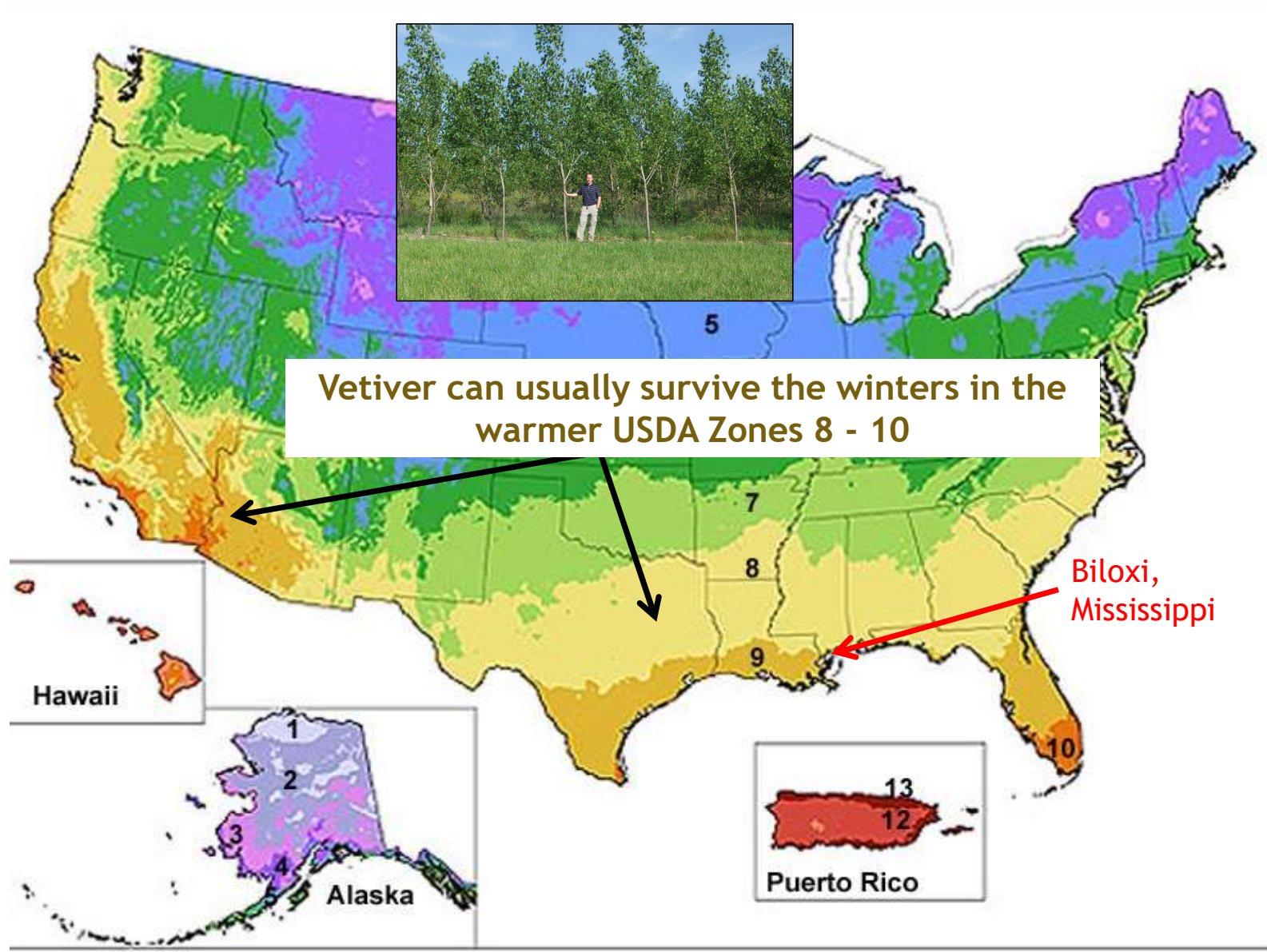


First Vetiver System Application at a United States Landfill

- In 2009, the 2nd largest waste company in the USA wanted a cost-effective and environmentally friendly leachate solution for one of its old landfills in Biloxi, Mississippi.
- The engineering team, led by Brad Granley, proposed a nature-based system that would pump the leachate to a field of vetiver where the leachate would be applied through slow drip irrigation.



Brad and his team already had success with similar projects using hybrid poplar trees on landfills, but vetiver was selected due to location, vetiver's high demand for water and nutrients, and its tolerance to harsh conditions and contaminants.



Vetiver can usually survive the winters in the warmer USDA Zones 8 - 10

Biloxi, Mississippi

First Vetiver System Application at a United States Landfill

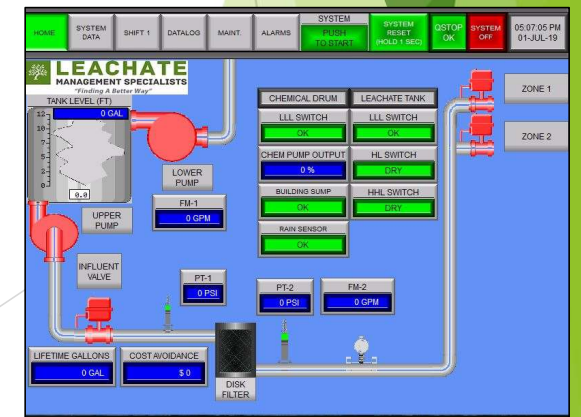
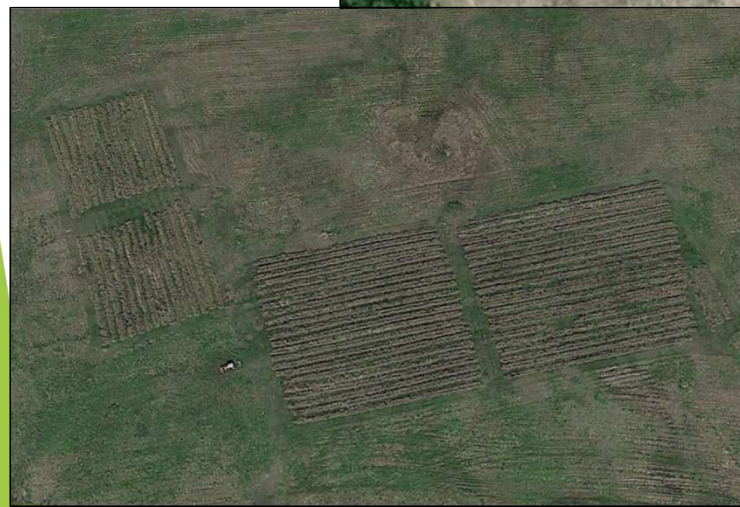
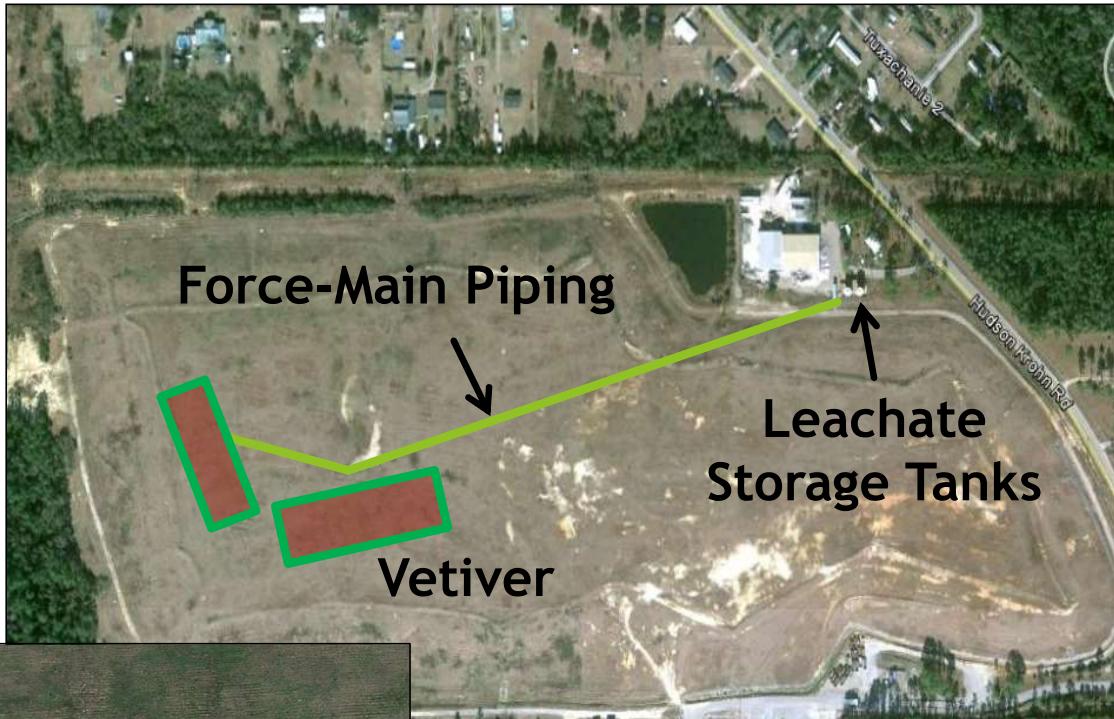
In 2011, the vetiver system was installed at the Gulf Pines Landfill in Biloxi with approximately 75,000 vetiver plants on 1.2 hectares (3 acres) and 4,570 meters (15,000 feet) of subsurface drip irrigation tubing.



Planted slip



3.5 month old plant



First Vetiver System Application at a United States Landfill

In 2012, the vetiver system won a National Engineering Excellence "Grand Award" for First Place in its category at the American Academy of Environmental Engineers Conference.



First Vetiver System Application at a United States Landfill

- Total volume consumed to date: 36 million liters (>9.5 million gallons)
- Total cost avoidance to date: >\$1.2 million
- Tanker trips avoided: 1,900
- CO₂ not emitted by the trucks: 952 metric tons (1,050 US tons)
- CO₂ sequestered by the vetiver*: 246 metric tons (272 US tons)



* Assuming 1.5 kgC/m² and ~5 plants per m².



Phyto-Utilization™ System Using Vetiver

Phyto-Utilization™: a plant-based, sustainable system that CONSUMES liquid (leachate) on-site through the evapotranspiration process.

LEACHATE AS A RESOURCE

LIQUID = MOISTURE

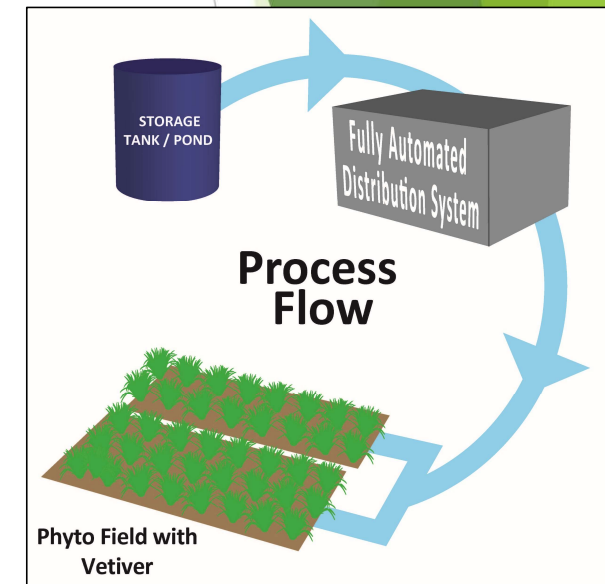
CONTAMINANTS = NUTRIENTS

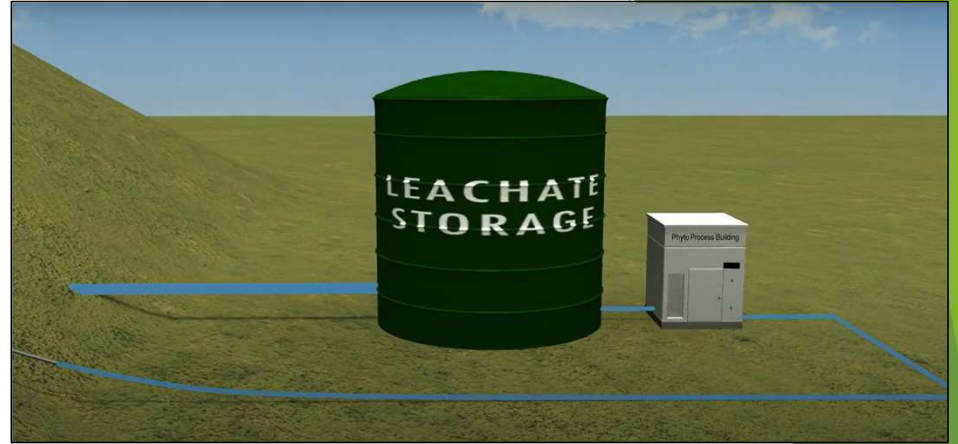
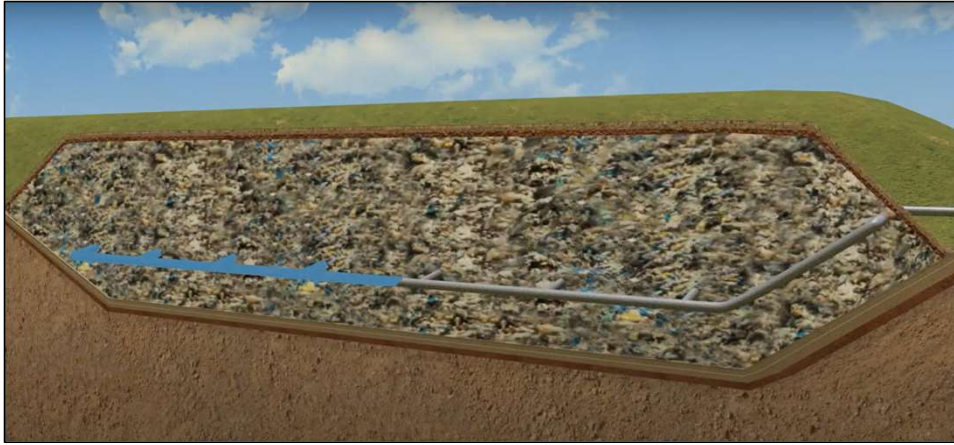
Macro-Nutrients

- Nitrogen (ammonia)
- Phosphorous
- Potassium
- Magnesium
- Sulfur
- Calcium
- Others

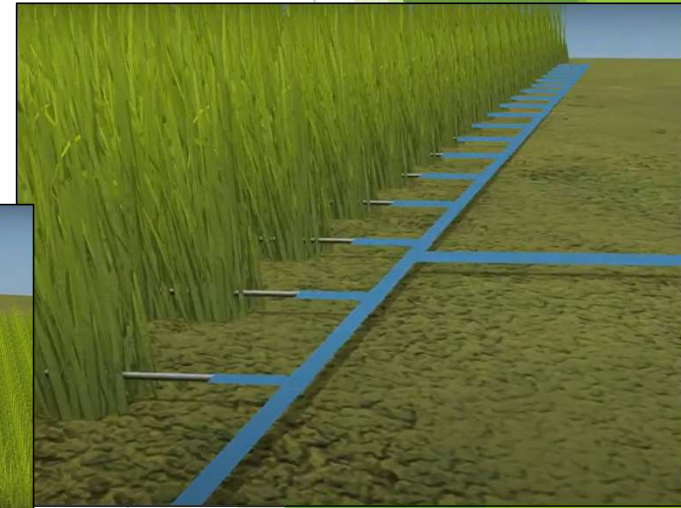
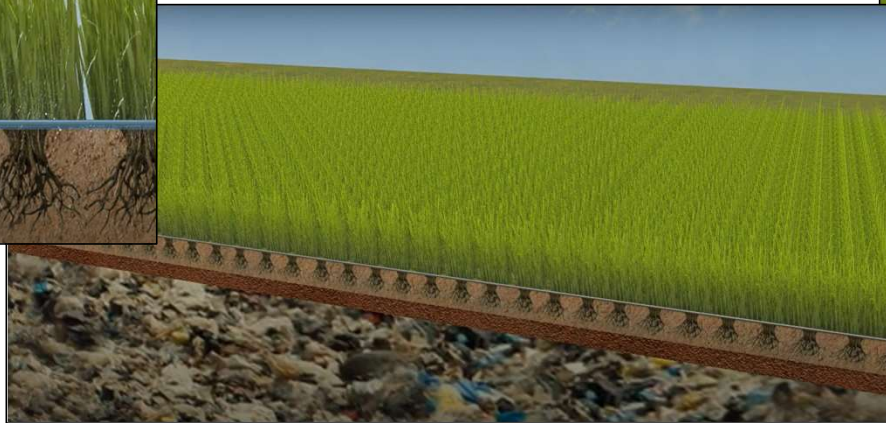
Micro-Nutrients

- Iron
- Boron
- Manganese
- Zinc
- Copper
- Others





Vetiver-Based Phyto Leachate Solution



Water Balance in a Phyto System

Percolation = Rain + Irrigation - Evaporation - Transpiration - Run-off

Net Evaporation (ET) determined through Modeling (EDVI)

Traditional Grass-Only Cap < ET of a Phyto Cap

Additional capacity = leachate irrigation



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Installation of a Phyto-Utilization™ Using the Vetiver System

Step 1: Dirt work to prepare phyto field

Step 2: Installation of irrigation drip tubing and supply piping

Step 3: Delivery and testing of control system

Step 4: Vetiver Planting

Step 5: Establishment using freshwater

Step 6: Start-up with leachate and monitor plant growth

Installation of a Phyto-Utilization™ Using the Vetiver System

Step 1: Dirt work to prepare field



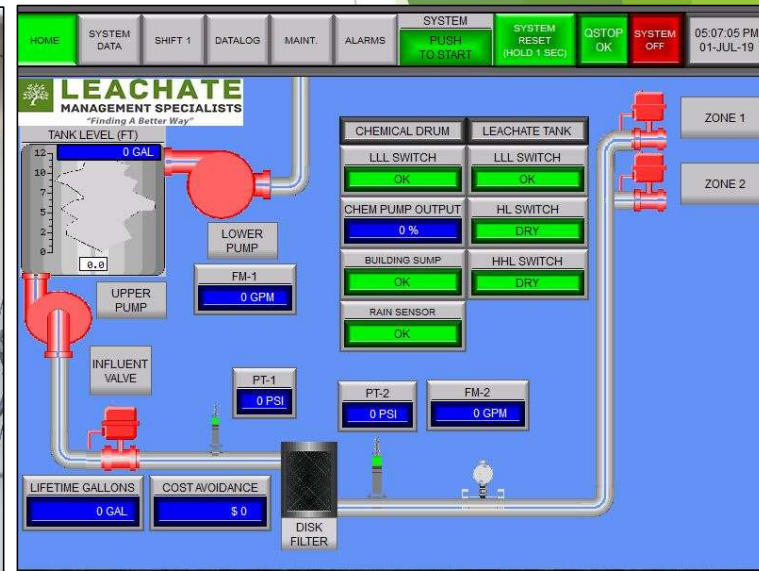
Installation of a Phyto-Utilization™ Using the Vetiver System

Step 2: Installation of irrigation tubing and supply piping



Installation of a Phyto-Utilization™ Using the Vetiver System

Step 3: Delivery and testing of control system



- Automated system monitoring flow, pressure, rain, tank level, etc.
- If sensors detect a malfunction (i.e. high/low pressure), system stops.
- Automated backflush disc filter.
- Distribution system: Multiple irrigation zones that cycle throughout the day.
- Connected to the internet, so personnel can access systems remotely.

Installation of a Phyto-Utilization™ Using the Vetiver System

Step 4: Vetiver Planting



Installation of a Phyto-Utilization™ Using the Vetiver System

Step 5: Establish using freshwater



Installation of a Phyto-Utilization™ Using the Vetiver System

Step 6: Start up with leachate and monitor plant growth



Operation and Maintenance

- Because a Phyto system using vetiver is both biological and mechanical, specialized expertise is required to maintain successful operation.
- Remote access to control systems to monitor and operate. Daily system emails.
- Site visits:
 - Inspect equipment, system operation, field conditions, plant health
 - Flush piping, including thorough acid injection to remove biological and mineralogical build-up
 - Clean disc filter
 - Collect leachate, soil, and foliar samples for laboratory analyses
 - Fertilizer, herbicides, and mowing as needed



Project Examples: Woodland Hills Landfill Sulphur, Louisiana

- Installed in 2014
- 20,000 vetiver plants across 0.5 hectares (1.2 acres)
- Total volume consumed to date: > 20 million liters (>5.3 million gallons)
- Total cost avoidance to date: >\$960,000
- Tanker trips avoided: 1,070
- CO2 not emitted: 445 metric tons (490 US tons)
- CO2 sequestered by the vetiver: 48 metric tons (53 US tons)





Project Examples: Rock Prairie Road Landfill College Station, Texas

- Installed in 2019
- 20,000 vetiver plants across 0.4 hectares (1 acre)
- Total volume consumed to date: 3.3 million liters (870,000 gallons)
- CO2 sequestered by the vetiver: 18 metric tons (20 US tons)





Project Examples: Fort Bend Regional Landfill Needville, Texas

- 2017-2022
- 70,000 vetiver plants across 1.6 hectares (4 acres)
- Total volume consumed: 9.5 million liters (2.5 million gallons)
- Total cost avoidance: >\$620,000
- Tanker trips avoided: 500
- CO2 not emitted: 82 metric tons (90 US tons)
- CO2 sequestered by the vetiver: 83 metric tons (92 US tons)





Project Examples: León Landfill, León, Guanajuato, Mexico

- 2012-2019
- PASA (largest solid waste company in Mexico)
- 200,000 vetiver plants across 4 hectares (~10 acres)



Landfill Leachate Seep Control Using Vetiver System



Promotion of the Vetiver System

- The Vetiver System is an important tool to both protect water resources and in the fight against climate change.
- LMS is helping raise awareness of the Vetiver System through its successful leachate projects, as well as:
 - A company website: www.leachate.us
 - Videos about Phyto-Utilization™ using vetiver: www.leachate.us/resources
 - Social media accounts and articles in waste magazines
 - Posts and research shared on the TVNI website and facebook page
 - Presentations at conferences
 - Networking with colleagues and providing webinars
- As the saying goes, pollution is just a resource out of place, and nature-based systems like the Vetiver System for contaminated liquid help realign that mindset in a GREEN and sustainable way.



Thank you!!



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