# VETIVER SYSTEM APPLICATION IN THE USA AND MEXICO


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**PHYTOREMEDIATION IN THE USA**

Although vetiver grass was introduced to the USA more than 150 years ago for essential oil production and more recently for erosion control in California and the states bordering the Gulf of Mexico ( from Texas to Florida), its application has been limited to small scale projects.

Leggette, Brashears & Graham Inc., (LBG) is the oldest groundwater consulting firm in the US and is a consistent leader in innovation as shown by a rich history of not only developing industry-changing ideas, but applying them with success in the field to solve real problems for clients. One of LBG specialities is phytoremediation to treat/dispose landfill leachate. LBG has successfully used hybrid Poplar trees in several projects for US waste disposal industry. Hybrid poplar is suitable for cold climate of the northern states of the US.

In search for an equally environmentally friendly and cost effective plant for phytoremediation in the warmer southern states around the Gulf of Mexico, LBG identified vetiver as a potentially suitable plant for this application. In cooperation with Paul Truong, (TVNI Technical Director), Brad Granley, (Senior Associate of LBG) developed a phytoremediation approach to treat leachate from an old landfill near Biloxi, Mississippi operated by Republics Services.

The Biloxi project started early in 2011, was highly successful and the **American Academy of Environmental Engineers** subsequently awarded LBG the ***2012 National Grand Prize for Excellence in Environmental Engineering - Small Projects Category.***

The followings are some exerpts from the Academy citation for the Award:

*Leggette, Brashears & Graham, Inc. has successfully implemented a first-of-its kind project in the western hemisphere that is likely to change sustainability practices in the $50 billion US solid waste industry. Through the innovative application of sustainable phytoremediation technology, landfill leachate can actually be utilized on-site as a resource in lieu of disposal as a waste. The approach provides an excellent option to address one of the most persistent and expensive long-term problems associated with landfills. LBG was retained by Republic Services. (the second largest solid waste company in the US) to implement this cutting-edge technology at one of their Gulf Coast Area landfills (GCAL), located near Biloxi, Mississippi. The role of LBG in this innovative environmental project was to develop and implement the entire phytoremediation concept from start to finish.*

*LBG evaluated numerous traditional and non-traditional options and*

*recommended that phytoremediation should be implemented as a 'new way' to handle leachate. This cost-cutting approach allows leachate to be handled on site. By definition, phytoremediation is a plant-based system used to remove pollutants from groundwater, surface water, soil, or air. Specifically, LBG recommended phytoremediation using a unique grass called vetiver. Vetiver has been in the US for decades, but has never been used to address leachate problems, making the project a first-of-its kind for the US solid waste industry. Vetiver is ideally suited for leachate utilization due to its tremendous water and nutrient demand, fast growth, and extraordinary tolerance to extreme environmental conditions (contaminants, pH, soil, moisture, insects, and disease). Vetiver is also a USDA non-invasive plant. Coincidentally, leachate's main components are water and contaminants (micro and macro-nutrients to the plants), exactly what vetiver needs.*

*The use of phytoremediation at landfills represents an integrated approach having a profound environmental impact.*

- ***Groundwater** is protected through minimization of surface water infiltration and better control of leachate within the landfill, which can otherwise result in contamination of aquifers, especially at old facilities like GCAL, which has no bottom liner.*
- ***Surface water**, Vetiver reduces infiltration which helps prevent leachate seeps (leachate that flows out the side of a landfill and to surface water), and can dry up existing seeps. Vetiver also removes sediment and nutrients from surface water runoff.*
- ***Subsurface "biological treatment reactor"** develops in the rhizosphere (root zone) which effectively breaks down and mineralizes a wide range of compounds.*
- ***Great reduction of adverse impacts to air quality.** Using phytoremediation at GCAL instead of hauling 3.5 million gallons of leachate per year to a distant, out of state disposal facility, results in the following:*
  - *1 year: 232,000 miles not driven; 38,000 gallons of diesel not burned (6 mpg); 380,000 kg CO2 emissions (10 kg CO2/gal diesel burned)*
  - *30 years: 7 million miles not driven; 1.14 million gallons diesel not burned; 11,400,000 kg CO2 (25 million pounds CO2)*
- ***Carbon sequestration**. Fast growing vetiver will sequester 113,000 kg CO2/year through carbon fixation.*

***Achievement***

*The Biloxi project has exceeded Republic's expectations. The system has performed as designed and 100% of leachate generated has been utilized on site, well ahead of anticipated results. Republic is also thrilled with the cost savings.*

- *Phytoremediation system low-cost O&M has cut annual costs by 60%, saving millions over a standard 30-year post-closure care period. Per Republic, "the approach is a game changer for leachate management."*
- *The work has also attracted the serious interest of other multi- billion dollar US solid waste companies.*

- *Internationally, the first three vetiver system installations in Latin America are underway for PASA, the largest solid waste company in Mexico.*

***Original and Innovative***

- *The GCAL phytoremediation effort represents* ***the first-ever use of vetiver for landfill leachate utilization in North America****. The standard for leachate disposal (load, haul and dump) was essentially an accepted, 'necessary evil' and the concept of utilizing leachate as a resource is changing the industry.*
- ***The use of an amazing plant like vetiver has greatly expanded the scope of phytoremediation****. Further, by incorporating a specialized, sub-surface drip-irrigation system to distribute leachate year-round, the process is further advanced.*

***Complexity***

- *After overcoming justifiable scepticism by regulatory authorities, the success at Biloxi still required overcoming technical limitations, logistical obstacles, budget restraints, and difficult site conditions all within a compressed timeline.*
- *From a technical standpoint, the approach blended numerous disciplines including engineering, hydrology, microbiology, plant physiology/morphology, soil science, agronomy, chemistry, hydrology, and computer science (PLC programming and evapotranspiration modelling).*
- *Further, the actual phytoremediation approach includes a number of sub-processes: phytostabilization, rhizofiltration, rhizodegradation, phytodegradation, phytovolatilization, and biodegradation.*
- *In addition, the coordination of 15 subcontractors and specialty suppliers from nine states was completed seamlessly. The end result was a highly innovative, successful project completed on time and under budget.*

***Contribution to Social or Economic Advancement***

*The new, vetiver-based phytoremediation approach offers numerous direct and ancillary benefits to the end-user and community at large:*

- *Leachate treatment costs reduced > 60%, millions of dollars saved*
- *Initial capital investment offset in only 2 years*
- *Direct reduction in GHG emissions, additional carbon fixation*
- *Millions fewer miles driven,*
- *Carbon footprint reductions (diesel emissions eliminated, and carbon fixation)*
- *Habitat for wildlife*
- *New technology for landfill Owners and engineers to consider*
- *Advancement of regulatory acceptance*
- *Protection of groundwater, surface water, and air*
- *Reduced loading to WWTPs*
- *Sustainable, GREEN approach*

**Waste Expo – Las Vegas, NV, May 2012**

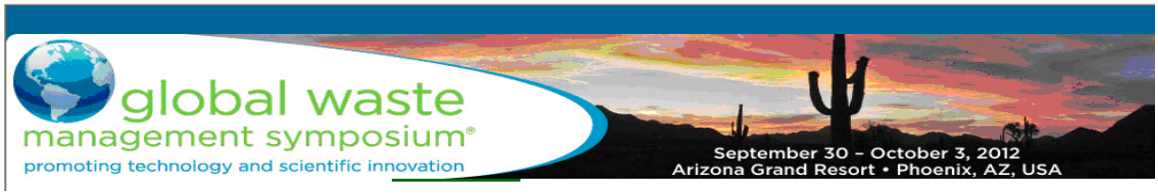
At the Waste Expo conference in Las Vegas (largest solid waste tradeshow in the US), Brad Granley provided a platform presentation entitled, <*PHYTOREMEDIATION APPLICATIONS FOR THE SOLID WASTE INDUSTRY USING HYBRID POPLAR AND VETIVER GRASS – Slope Stabilization and Erosion / Sediment Control, Leachate Seep Control, and On-Site Leachate Utilization*>. **The presentation was given during a technical educational portion of the conference and attended by landfill owners and regulators.**

**GLOBAL WASTE MANAGEMENT SYMPOSIUM – Phoenix, Arizona, October 2012**

At the Global Waste Management Symposium in Phoenix, Paul Truong and Brad Granley presented a paper entitled: <*A Changing Industry: On-site Phytoremediation of Landfill Leachate Using Trees and Grasses – Case Studies*> in which the details of the Biloxi and Mexican projects were outlined. In addition, a poster entitled < *Leachate Treatment with Phytoremediation: Case Studies> provided case study information for* landfill leachate treatment projects in Australia, China, Mexico, Singapore and USA.

**FUTURE PROJECTS**

As a result of the successful Biloxi project, the Academy of Environmental Engineering Award and the presentations at the national conferences, LBG has since begun planning and working on additional vetiver phytoremediation projects in Mississippi, Alabama and Texas for other multiplewaste management companies.




*Tweeds Shire Landfill, Australia*

*Guangzhou Landfill, China*

*Poza Rica Landfill, Mexico*

*Lorong Halus Constructed Wetlands, Singapore*

*Biloxi Landfill, Mississippi, USA*

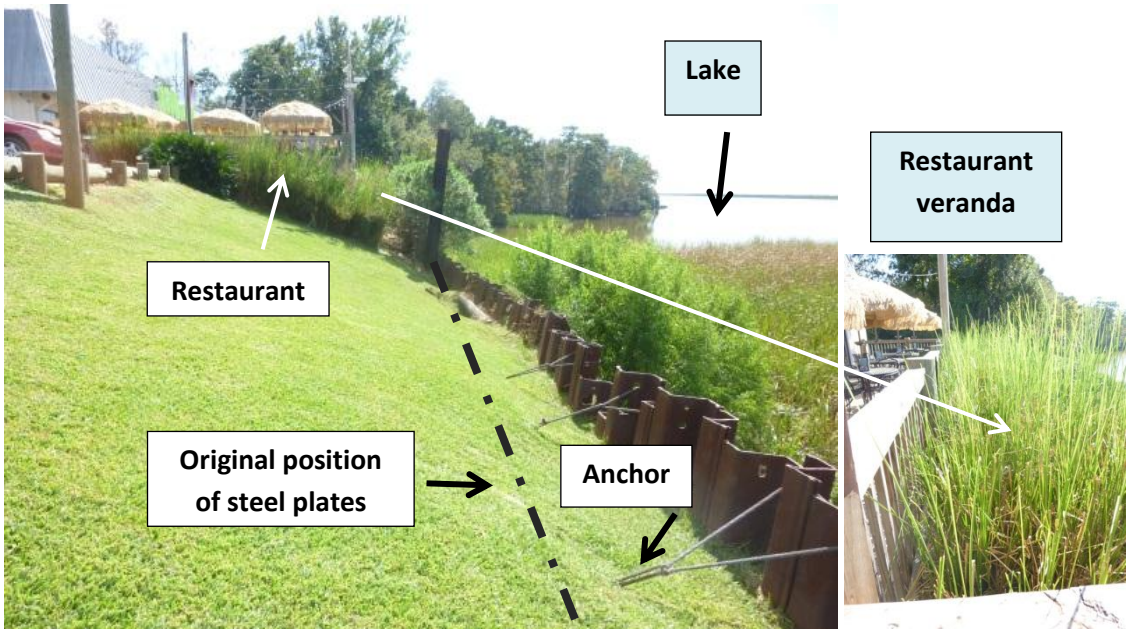
*Two months after planting* *One year after planting*

**PHYTOREMEDIATION IN MEXICO**

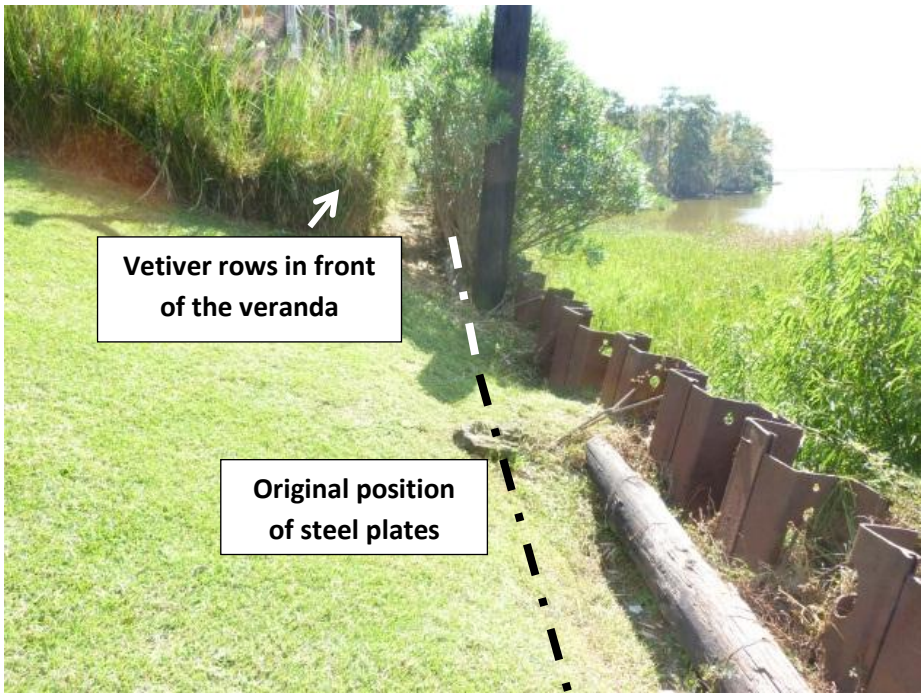
Concurrent to the Biloxi project, LBG was commissioned by PASA, the biggest solid waste company in Mexico, to implement vetiver phytoremediation projects in Leon, Poza Rica and Villahermosa. Three additional projects are expected to completed in 2013

**LAND SLIP CONTROL IN THE USA**

While travelling in the Mississippi Delta, Paul Truong came across an extraordinary sight at Daphne, a small coastal town in Alabama, where vetiver out performed interlocking steel plates in preventing landslip.




This restaurant is perched on the edge of a salt water wetland. Due to erosion, a cliff of at least 10m high was formed between the edge of the restaurant and the wetland. To stop further erosion and possible landslide, the owner installed a wall of solid interlocking steel plates about 12m high. As an extra measure, two thick rows of vetiver were planted right next the restaurant veranda. Surprisingly, after about 2 years, the section of the steel wall in front of the restaurant that is protected by vetiver rows remained upright. However, the section of the wall on the car park which was not protected by the vetiver rows the land slid down 2-3m, bending the steel plates at least $10^0$. Instead of planting a few rows of vetiver on the affected area, the owner installed anchors to hold up the steel wall to preserve the scenic ocean view.



Similarly, on the other side of the restaurant, instead of planting a few rows of vetiver on the affected area, the owner installed anchors to hold up the steel wall to preserve the scenic ocean view.