Clean To Green, Inc., a Florida corporation, is an environmentally responsible business enterprise organized to draw from leading edge technologies and scientific sentiment to develop and promote an environmentally sensitive approach to waterway and other environment restoration efforts. An approach that combines leading edge technology in a manner that meets the practical demands required to restore waterways with the environmental acumen that integrates habitat restoration, water quality enhancement and reintegration of byproducts from the restoration into materials for everyday consumption by agriculture and industry. As a component of the restoration efforts, Clean To Green, Inc. offers rapid dredge-sediment dewatering technology to remove water from fine-grained sediment in real time, while separating solids and contaminants from the water that instantly separates and classifies solids into recoverable piles of debris, shells, sand and fines that include clays, silts and organics for easy reuse or disposal, while simultaneously returning clear water to the waterway.

The collaborative approach of Clean To Green, Inc. to environmental restoration ensures the integration of innovative technologies with cost saving measures through the streamlining of project administration, access to numerous resources to facilitate any restoration effort and utilization of innovative approaches to the disposal and recycling of sediment. Clean To Green, Inc. provides an integrated approach to waterway restoration and treatment of water discharge from municipal and industrial facilities through rapid dewatering and disposal technologies and methodologies that provide sustainable solutions in an environmentally responsible manner.

Lake Apopka

The understand what drives the collaborative effort of governmental and private sectors to identify, study and demonstrate new and innovative methods that may eventually lead to the restoration of Lake Apopka, one must first understand the Lake's history.

Brief History

Prior to 1947, Lake Apopka was renowned as a premier largemouth bass (*Micropterus salmoides floridanus*) fishing lake. The lake supported 13 fish camps and had a fishery valued at $1,000,000 per year (over $12 million in 2011 dollars). Lake Apopka, at that time was covered extensively (over 80%) with dense (boats moved in defined trails) growths of aquatic

macrophytes (e.g., Water Hyacinths, Spatterdock, Illinois pondweed, and Eel-grass). By 1950, Lake Apopka had changed from a macrophyte-dominated lake to a phytoplankton-dominated lake. The cause or causes of the switch to a long-term algal state (an alternative stable state) have been the fodder for many scientific debates (e.g., water level stabilization, conversion of wetlands to farmlands, nutrient enrichment, destruction of macrophyte beds by a 1947 hurricane), but the extensive macrophyte community and the largemouth bass fishery became functionally nonexistent at Lake Apopka by 1960s (Johnson and Crumpton 1998; Florida Fish and Wildlife Commission).

In the late 1960s, the State of Florida adopted a strategy for the restoration of Lake Apopka that relied heavily on the reduction of nutrient (primarily phosphorus) inputs. The scientific basis for the nutrient reduction strategy was the numerous studies of lake eutrophication that had established a growing scientific consensus that control of nutrients could restore lakes to their environmental condition prior to the major human impacts. Eutrophication control strategies at Lake Apopka were and still are based on the assumption that a reduction in nutrient inputs will lead to a reduction in in-lake nutrient concentrations. The reduction in in-lake nutrient concentrations will then lead to a reduction in phytoplankton biomass (as measured by chlorophyll) and an increase in water clarity (as measured by a Secchi disc). These two changes should then lead to improved environmental conditions that allow aquatic plant communities and fisheries to recover.

Restoration efforts at Lake Apopka began in the 1960s with point source removals and by the 1980s nutrient loading from sewage and citrus processing plants was virtually eliminated. In the 1980s, national eutrophication control efforts began to focus on non-point sources of nutrients. Agricultural runoff was often ranked as the number one source of nutrients to U.S. waters. With this change of focus, the discharges from farms located along the north shore of Lake Apopka became the primary political focus of Florida's restoration efforts. The Florida Legislature with the passage of the Surface Water Improvement Management (SWIM) Act directed the St. Johns River Water Management District (SJRWMD) to reduce nutrient loading, especially phosphorus, from the farms. Ultimately, the Florida Legislature authorized the expenditure of over $100,000,000 to buy out the majority of farmlands with discharges to the lake.

Despite the complete elimination of farm discharges, Lake Apopka remains a nutrient-rich lake (phosphorus concentrations above the SJRWMD's target goal of 55 µg/L; Battoe et al. 1999 and Hoge et al. 2003; SJRWMD) and the aquatic macrophyte and sport fish fisheries communities have not recovered to target levels (50% bottom coverage of aquatic macrophytes and 15 largemouth bass per acre of littoral zone) established in the 1970s (United States Environmental Protection Agency 1978; USEPA – EPA 904/9-78-027). The lack of a recovery of Lake Apopka to pre-1947 conditions through nutrient control alone, however, was not unexpected as the USEPA (1978) identified the presence of unconsolidated bottom sediments over most of the lake bottom as a key factor retarding restoration.

USEPA (1978) recognized that any improvements in water quality resulting from nutrient reduction programs would be, at least periodically, compromised by wind and motorboat induced resuspension of bottom sediments. USEPA (1978) proposed two important alternatives to restore Lake Apopka that involved enhanced water level fluctuations, large-scale drawdown of the lake

and limited dredging. These alternatives were never implemented because of a number of constraints such as lack of treatment of nutrient-rich water moving downstream, cost of dredging, freeze protection for citrus, and water supply for irrigation of the north shore farms. However, nearly all of the constraints identified in the 1970s have been eliminated and implementation of USEPA recommendations could now restore the macrophyte and sport fish communities at Lake Apopka.

Current Restoration Efforts

Beginning in 2010, Dr. Canfield of the University of Florida was able to generate enough interest and support at the governmental level to secure funding through the State of Florida for a demonstration project to study new and innovative restoration methods and technologies in Lake Apopka. As a result of his lifelong selfless efforts and commitment to restore Lake Apopka, Dr. Canfield drew the attention and support of former House of Representative Trudi Williams and Senator Alan Hays, who secured funding for the demonstration project. Pursuant to a prime contract that originated through the State of Florida's Fish & Wildlife Conservation Commission ("FWC"), the University of Florida ("UF") recently conducted a demonstration project to evaluate rapid dewatering technology and beneficial reuse methods for bottom sediment in non-vegetated areas of Lake Apopka. UF monitored and studied all aspects of the demonstration project (i.e. dredging, rapid dewatering and disposal). Pursuant to a subcontract, Clean To Green, Inc. was contracted by UF to provide the labor, supervision, materials and equipment needed to complete the project, which included, but not limited to dredging, dewatering and disposal of dredge materials.

The demonstration project was staged from Magnolia Park in Apopka. Orange County granted a license to permit the project to be staged from the park, which license extends through the end of June as the project winds down and the site restored. Orange County contributed no monies to the project, as the demonstration project was fully funded through grants from the State of Florida. In order to demonstrate new technologies and methodologies in waterway restoration, the demonstration project was centered around the dredging of the boat ramp and area along the dock in the park to enhance the launching and docking of boats. Prior to the project, the boat ramp was unusable to most recreational watercraft due to the deterioration of lake conditions, and even proved to be a challenge for research boats launching and docking from the facility.

The demonstration project is part of a larger effort spearheaded by the University of Florida working in concert with the State of Florida's Fish & Wildlife Conservation Commission ("FWC") , Florida Department of Environmental Protection and various other state agencies to expand the study of various approaches currently being considered to restore water quality in nutrient rich freshwater lakes in the State of Florida for environmental and/or aquatic habitat purposes, which entail the removal of organic detrital material. Lake Apopka has been identified as a freshwater lake in the State of Florida with organic detrital material that has degraded water quality and inhibits restoring aquatic habitat requiring the implementation of dredging program and establishment of a comprehensive aquatic plant management program.

The demonstration came to a successful conclusion a couple of weeks ago and all that remains is the removal of equipment and restoring the site to its original condition, which restoration is scheduled to be completed by the end of June. Although challenging at times, the concerted efforts and perseverance of many allowed the project to overcome technology, political, funding and other obstacles to realize numerous successes, which include, but not limited to, the following:

1. The project resulted in the dredging of 11,000 cubic yards of sediment from the lake bottom and clearing the boat ramp area of the park to permit the launching and docking of boats in Lake Apopka.
2. Lake bottom sediment found to be a fibrous peat material that could be treated and dewatered with patented technology in a manner to encourage the beneficial reuse of the same.
3. Patented screening technology removed sediment down to 200 micron, thus lowering the cost of treating the water to remove fine sediments before discharging back to the lake.
4. Pumps utilized previously in concrete pumping applications proved to be an effective means to transport sediment.
5. Shore conveyor integrated into the dewatering process used to transport sediment to create dry and stackable piles for beneficial reuse. The modified conveyor system using weights to apply pressure on the sediment while moving across the conveyor to further encourage dewatering, avoids stacking of material for further drying and results in depositing material directly into vehicles for transport from the site to ensure a small processing footprint.
6. Water with fines treated with iron resulting in phosphorus being separated and adhering to the fine sediments ("fines") creating a flocculent of small flocs or floccules (nitrogen ext.), then small flocs further treated resulting in large heavy flocs to encourage the removal of fines from the water.
7. The small footprint for the dewatering system integrated a limited number of settling tanks, thus avoiding the need for open detention ponds, in which the heavy flocs would settle to the bottom of the tanks, then clear water would be decanted off the top of the tanks and discharged into the lake, which water met all governmental criteria and standards for discharge directly into the lake. The remaining fine sediments were then pumped into a patented vertical hanging dewatering tower decreasing the total volume by approximately 66%, while further dewatering the fine sediments, resulting in the water being able to be discharged back into the lake while meeting all governmental criteria and standards for discharge directly into the lake.
8. The dewatering tower makes it possible to transport the fine sediments in dry truckable form within a 24 hour period for beneficial reuse opportunities.
9. The small footprint for treatment and dewatering enables sediments to be dredged, dewatered and trucked from the site in real time without use of traditional methods utilizing detention ponds, geotubes and stacking of material to dry and separate requiring a much larger footprint with less effective results as to time and cost.
10. Integration of the Clean To Green, Inc. waterfall to aerate the water in the dewatering process addressed concerns with potentially harmful levels of ammonia in the water and sediment.

11. The demonstration project utilized different dredge equipment to determine the best equipment to extract the sediment from the lake bottom and work in harmony with the dewatering equipment. Studies revealed that dredging equipment using higher pumping rates while maintain high solid to water ratios results in less water to be treated, thus realizing an economic benefit in the dewatering and treatment process.
12. The small footprint proved to be more desirable than traditional dredging methods known as "pump and dump", as pumping onto open ground is an eyesore, dangerous to surrounding wildlife and birds, requires too large an operational footprint, and resulting material being deposited in a manner on the ground that requires too long to dry and results in a material that cracks and opens, thus questioning the suitability of the sediment for capping or sealing contaminated areas and use in agricultural applications.
13. With test of unconsolidated material, Clean To Green, Inc. was able to show that the suspended fines in the lake migrate to low areas, thus supporting earlier studies that the strategic dredging of the lake creating large holes can be used to attract and contain migrating suspended fines in the lake from which the fines can be removed with sump pumps and treated before discharging the water back into the lake.
14. Studies confirm that weather conditions and winds cause suspended fines to be transported and circulate in the lake, which movement can likely be restricted and contained through armoring or barrier techniques using geotubes or other similar geotextiles that restrict, channel and limit the movement enabling the implementation of systems to contain and remove the fine sediments from the lake.
15. Millions of gallons of water were treated through the small footprint during the demonstration project meeting applicable discharge standards by successfully removing approximately 99% of the phosphorous from the water, which cost to remove such phosphorus from surface waters would have cost hundreds of thousands of dollars under current technologies currently being implemented for the removal of phosphorous from surface waters.
16. Different types of grasses were successfully grown and rooted in geotextile bags supporting the use of geotextiles to create wave breaks or barriers to limit the migration of fine sediments throughout the lake, while being used and positioned in a manner that encourages and supports plant and fish habitat.

The next demonstration project, scheduled to follow later this summer, is currently in the design phase. The research/demonstration project will study and evaluate the use of geotextile fabric bags ("GFB"), commonly known as "geotubes", with the rapid dewatering program utilized in the most recent project. The study will specifically determine if GFBs can be filled with dewatered organic sediments produced during rapid dewatering operations rather than sand, the traditional fill material. If it is successfully demonstrated that the GFBs can be filled with dewatered sediments, this study will evaluate whether the GFBs can protect dredged areas from re-sedimentation. The study will also determine if the organic-sediment filled bags can be successfully anchored in a large, dynamic lake such as Lake Apopka and establish technical guidelines that can be included in future bid solicitations.

The next project originally contemplated continuing to use Magnolia Park as the staging area in order to protect and enhance the improvements made to the park in the most recent project by

expanding the recently dredged area at the boat ramp and dock area to include a boat basin to encourage boat access and armoring the dredged areas with GFBs to retard the movement of flocculent sediments into the dredged area. Unfortunately, Orange County has declined to participate further in the project. The staging area for the next demonstration project will be located in another suitable area of Lake Apopka.

The recently completed project has raised the level of confidence for dredging, dewatering and treating sediments, even fines, from the lake bottom, awareness of the fragile eco-system and health of Florida's lakes and the implementation of programs over the last several decades that have made no measurable impact on restoring the lake, and shape plans for the success of the next project and lake restoration projects throughout Florida. The success of the recently completed project is creating considerable momentum for the next project. Many have worked tirelessly in the face of considerable opposition and attacks to identify and implement a viable means for restoring Lake Apopka, and the efforts are seeing tangible and positive results to encourage continued efforts. It would be unwarranted and unjustified to consider the current project anything but a success and providing the necessary momentum and impetus to pursue the next project. The resolve of Dr. Canfield, Senator Hays and like others in the public and private sectors to identify and implement solutions to restoring Lake Apopka are making a positive and hopefully lasting impact on our lakes and ecosystem.

Robert A. Hendrick
President