LittLine®

Littoral Zone Treatment Technology (Patent Pending)
(BEST AVAILABLE TECHNOLOGIES (BAT) TO MEET THE
2011 NPDES PESTICIDES GENERAL PERMIT (NPDES PGP) REQUIREMENTS)

Research & Development Information and Specifications

The LittLine® is a proprietary Patent Pending **Green NextGen Technology** that was developed in 2008 to support agencies, as well as private sector aquatic pesticide applicators reduce aquatic pesticide use, while increasing efficacy. In addition, the LittLine® technology supports compliance with Best Management Practices (BMP's), through the availability of Best Available Technologies (BAT's), as required under current Nation Pollution Discharge Elimination System Permits (NPDES) in the Western US (9th Circuit Region), and most likely will be required after April 2011 throughout the United States.

The LittLine® was developed to meet the requirement of the Idaho Department of Agriculture to treat approximately 2,000 acres of Eurasian Watermilfoil with liquid aquatic herbicides during the summer of 2008, and was based on the concepts discussed in the winter 2007 *Aquatics* Magazine article, "How to Build Weighted Trailing Hoses"[i]. As outlined in the article, the main goal of the trailing hose concept is to place the aquatic pesticides in the lower portion of the water column to increase control efficacy. This philosophy explains why granular versions of several products have been developed to facilitate placement of herbicide directly in target weed beds. Per the article, conventional trailing hose systems "... must go slowly to keep the hoses on the bottom…, must avoid tight corners or the long hoses will collect lots of weeds, and the operator is required to pull on the hoses every couple of minutes to shake loose any clinging weeds". The LittLine® system was developed to overcome the problems associated with conventional trailing hose systems, and was designed to operate at higher speeds (+-5 mph compared to 1-2 mph), make tight corners and turns without collecting weeds, and meet the

tangle and weed free system requirements, all of which resulted in increased operational efficiencies while reducing aquatic pesticide and application costs.

The LittLine® has undergone extensive testing on various demonstration and research projects with the US Army Corps of Engineers Environmental Research and Development Center (2008 through 2010), the Phelps Lake District in Northern Wisconsin under a Wisconsin Department of Natural Resources Grant (2010), the City of Orlando, Florida (2010), and the US Army Corps of Engineers, Mobile District (2010). The LittLine® has been used to control Hydrilla in Florida and Georgia (+-25% aquatic herbicide reduction, Lake Underhill FL), and Eurasian Watermilfoil in California, Idaho, Montana and Wisconsin (up to 50% aquatic herbicide reduction, Lake Pend Oreille). As outlined below, research efforts have focused on aquatic pesticide applications in lake and run of the river systems.

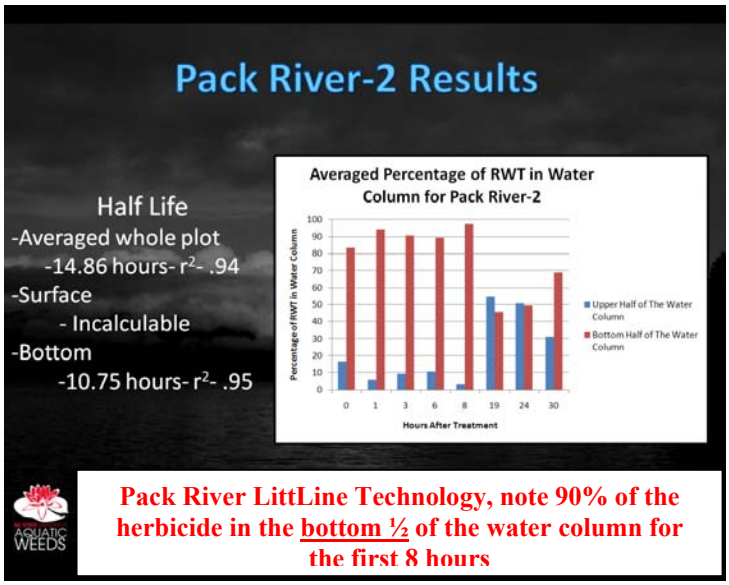
Operational Field Data 2008

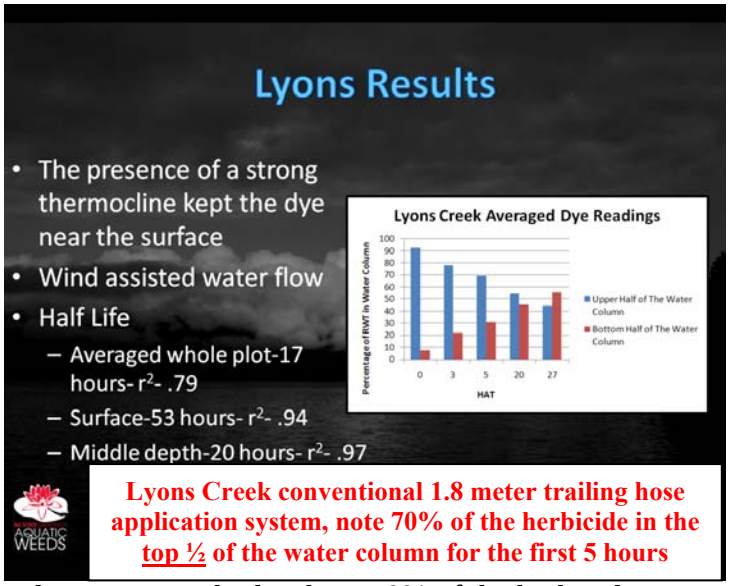
"Lake Pend Oreille Water Exchange Evaluations" (2008-Idaho): US Army Corps of Engineers Environmental Research and Development Center/Aquatic Ecosystem Restoration and Foundation Special Project CY/UP/AB-08-1. In collaboration with the Aquatic Ecosystem Restoration Foundation (AERF) and CLI, Water Exchange Evaluations using Rhodamine RWT dye were carried out by the US Army Corps of Engineers, Environmental Research and Development Center (ERDC), on the Pend Oreille Project during the summer of 2008, and observations showed that the LittLine® was able to make herbicide applications at desired depths throughout the water column. Through a Pre and Post Treatment Point Intercept survey by Mississippi State University (MSU) scientists in 2008, in Pack River treatment sites of Lake Pend Oreille, control was rated at 92% with little to no impact to native plant community as outlined in the report, **"Aquatic Plant Community and Eurasian watermilfoil (*Myriophyllum spicatum* L.) Management Assessment in Lake Pend Oreille, Idaho for 2008"[ii] .** In the Pack River area, liquid triclopyr treatments were performed using the LittLine® system where only the bottom half (1/2) of the water column was treated, using 50% less aquatic herbicides than would have been required through conventional liquid surface applications (2,028 gallons vs. 4,120 gallons). In the cited report, control was rated at 92% (Pack River EWM presence pre treatment at 39 points, EWM presence post treatment at 3 points). Based on this level of efficacy, the LittLine® demonstrated the ability to reduce aquatic herbicide use by up to 50%, while increasing Eurasian watermilfoil control efficacy up to 92%. The use of liquid triclopyr in the Pack River sites (312 acres) resulted in a herbicide cost saving of $111,517.73 when compared to the use of granular triclopyr treating the same bottom half (1/2) of the water column at 1.75-2.00 ppm (2,028 gallons of liquid triclopyr used @ $43.50 per gallon, compared to 61,457.00 pounds of granular triclopyr @ $3.25 per pound).

Go Green, Reduce Aquatic Pesticide Use with LittLine® Technology

A video describing a portion of the project, the process and the LittLine® technology in action can be viewed at http://www.littline.com/littlinevideos.html.

Available in the report titled, **"The Evaluation of Two Herbicide Application Methods (Justin J Nawrocki[1], Kurt D. Getsinger[2], Robert J. Richardson[1.] [1]North Carolina State University, Raleigh, North Carolina [2]U.S. Army Engineer Research and Development Center, Vicksburg, Mississippi)"[iii]**, the data charts on the right outline the major differences between the LittLine® technology, and conventional trailing hose application methods. As the data clearly illustrates, LittLine® is capable of placing aquatic herbicides in aquatic plant beds in the lower portion of the water column, resulting in a higher concentration and exposure time (CET) relationship in the lower portion of the water column, which provides increased efficacy with a reduction in the amount of herbicides used when compared to conventional trailing hose application systems.





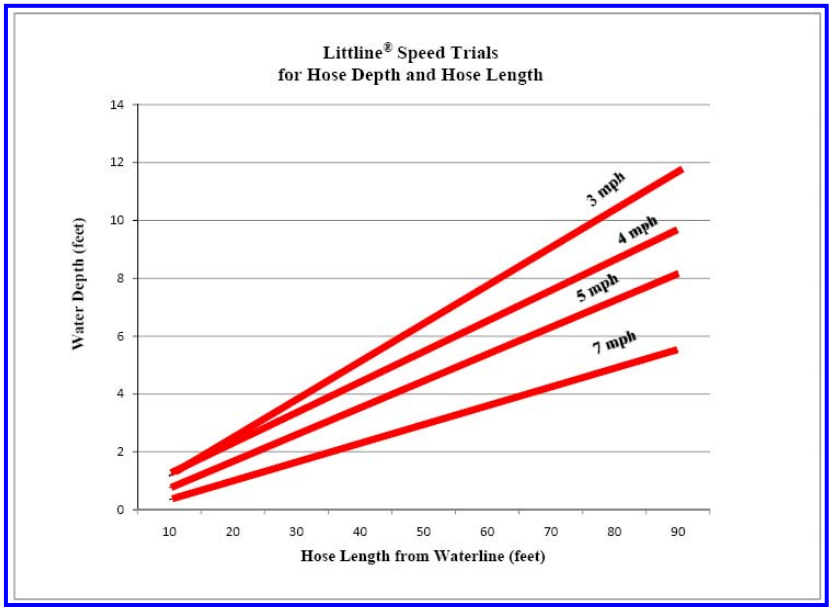
The LittLine® was able to placed 90% of the herbicides in the lower half (1/2) of the water column, where it remained for the first eight (8) hours compared to conventional Trailing Hose methods where 70% of the herbicides were placed in the upper half (1/2) of the water column for the first five (5) hours.

The presentation can in the document library at http://www.littline.com/researchdevelopment.html.

Operational Field Data 2009

Eurasian Watermilfoil/Curlyleaf Pondweed Research Project on Noxon Rapids Reservoir, Montana, Demonstrations and Evaluations (2009): In collaboration with the Aquatic Ecosystem Restoration Foundation (AERF), the Sanders County Extension, and the Montana Department of Agriculture (under partial funding from the Montana Weed Trust), Clean Lakes, Inc. participated as a Research Cooperator with the U. S. Army Engineers Research and Development Center (ERDC) and Mississippi State University, Geosystems Research Institute on the **2009 Eurasian Watermilfoil/Curlyleaf Pondweed Research Project**[iv]. The LittLine® was used for Rhodamine (RWT) dye applications for water exchange evaluations, as well as for aquatic herbicide treatments.

Speed Depth Chart (Performance) Data*



*Trials performed in Lake Coeur d'Alene, September 8, 2009, independent third party Hose depth data collected by Jim Flodin, Divers West, and Coeur d'Alene Idaho.

Operational Field Data 2010

Selective Control of Eurasian Watermilfoil and Curlyleaf Pondweed on Noxon Rapids Reservoir, Montana: Demonstrations and Evaluations, Phase 2 (2010): The U. S. Army Corps of Engineer Research and Development Center (ERDC), Chemical Control and Physiological Processes Team (Dr. Kurt Getsinger) led the Research Cooperators in conducting water exchange evaluations and aquatic herbicide trials using the LittLine® for controlling mixed stands of Eurasian watermilfoil (EWM) and curlyleaf pondweed (CLP) in selected locations in Noxon Rapid Reservoirs, Montana. Pre and Post Treatment Aquatic Vegetation surveys were performed by Dr. John Madsen's research team from Mississippi State University, Geosystems Research Institute (MSU-GRI).

On August 24, 2010 USCOE personnel from across the US visited Noxon Reservoir and were briefed on ERDC's EWM Research & Development efforts (3-year project), and on a separate Corps of Engineers American Recovery and Reinvest Act (ARRA) funded project, both of which were demonstrating and evaluating the selective use of herbicides to control the invasive aquatic vegetation Eurasian watermilfoil and curlyleaf pondweed through the use of the LittLine® technology. Following the briefing, the group boarded pontoon boats and toured the treatment sites.

Hydrilla Control Evaluation, Lake Underhill, City of Orlando Florida (March 2010): Clean Lakes, Inc., working in conjunction with the City of Orlando, Public Works, Lakes/Surface Water Management Division, performed an aquatic herbicide application to 18.26 acres of Lake Underhill, City of Orlando Florida on March 17, 2010. The treatment was performed to evaluate the potential benefits of utilizing the LittLine® Littoral Zone Treatment Technology for the control of the aquatic invasive plant Hydrilla. Utilizing the LittLine® Technology, the bottom five (5) acre foot of the 18.26 acre site was treated at the rate of 1.34 ppm in the entire water column, which required 110 gallons of Aquathol K, an approximate 23 percent reduction (110 gallons compared to 144 gallons) in the amount of herbicide used compared to the standard treatment rate. Six weeks post treatment, Hydrilla had dropped out of the water column, and the native species Vallisneria was flowering. Under standard operating procedures, City of Orlando staff treated approximately 20 acres of Hydrilla in the northern portion of Lake Underhill at the rate of 1.75 parts per million (ppm), and post treatment observations (John Evertsen, City of Orlando personal communication) revealed that both treatments provided similar results and efficacy for the control of Hydrilla in Lake Underhill. Through the use of the LittLine technology for this application, the aquatic herbicide costs were reduced by $125.68 per acre.

Long Lake of Phelps Lake District, Wisconsin, Eurasian Watermilfoil Control Program (May 2010): On May 24th and 25th, 2010, the LittLine® was utilized for the application of liquid 2,4-D to 142 acres on Long Lake for the control of Eurasian Watermilfoil (EWM). Due to the use of the LittLine® application system for the first time in Wisconsin, and the use of liquid 2,4-D in place of the previously used granular formulation, Long Lake was one of a number of lakes selected for herbicide residual monitoring. Water sampling was conducted by both the Engineer Research and Development Center (ERDC), a division of the Army Corps of Engineers, and by a Long Lake volunteer from sites located both within and outside of herbicide application areas. The goal of the herbicide treatment was to maximize target species (EWM) mortality while minimizing impacts to valuable native aquatic plant species. Monitoring herbicide treatments and defining their success incorporates both quantitative and qualitative methods. As the name suggests, quantitative monitoring involves comparing

number data (or quantities) such as plant frequency of occurrence before and after the control strategy is implemented. Qualitative monitoring is completed by comparing slightly more subjective data such as EWM colony density ratings before and after the treatments. Quantitative evaluation methodologies followed Wisconsin Department of Natural Resources (WDNR) protocols in which point-intercept data was collected within treatment areas both the summer before and the summer immediately following the treatments taking place. On Long Lake, a quantitative evaluation was made through the collection of data at 287 point-intercept sub-sample locations all located within the areas where herbicides were directly applied. On a lake-wide level, 80% of the treatment areas on Long Lake were reduced by at least one density rating, exceeding the WDNR qualitative success criteria (75% reduction) for the 2010 treatment. In 2009, there were approximately 53 acres of EWM that were classified as highly dominant, and in 2010 this was reduced to approximately 21 acres following treatment. EWM surfacing matting was not observed anywhere within the lake in 2010, although it must be noted that water levels increased by approximately 1 foot over the course of the summer (Dan Anderson personal comm.). While reductions in EWM density were observed in the majority of the treatment areas, it was most apparent in the southern, shallow portion of the lake. Prior to treatment, this area had large colonies of highly dominant EWM surrounded by scattered EWM. Many of the highly dominant colonies were reduced in density while no EWM was observed in the highly scattered areas. During the summer of 2009, 52% of the 287 point-intercept sampling locations contained EWM compared to 20% following the 2010 treatment, demonstrating a statistically valid 60% reduction in EWM occurrence within the 2010 treatment areas and meeting the lake-wide quantitative success criteria (50% reduction in occurrence)[v]. Through the use of liquid 2,4-D and the Littline®, aquatic herbicide costs for the project were reduced by $52,133.00, or $367.13 per acre (liquid costs compared to granular formulation costs).

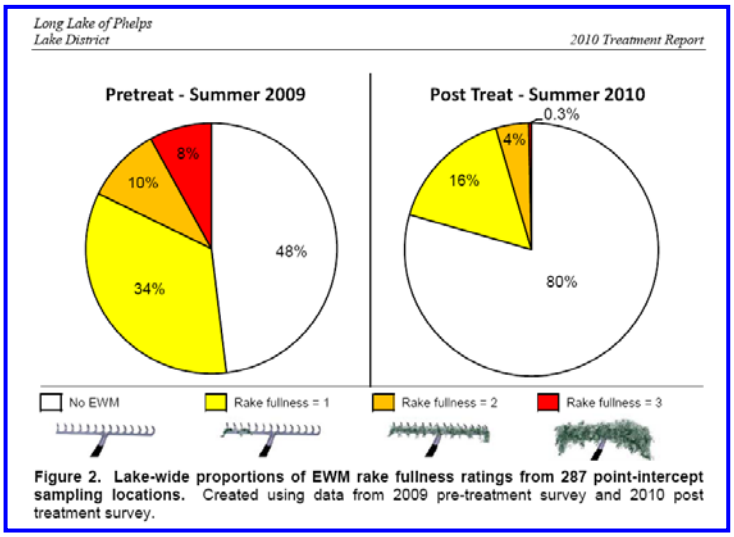


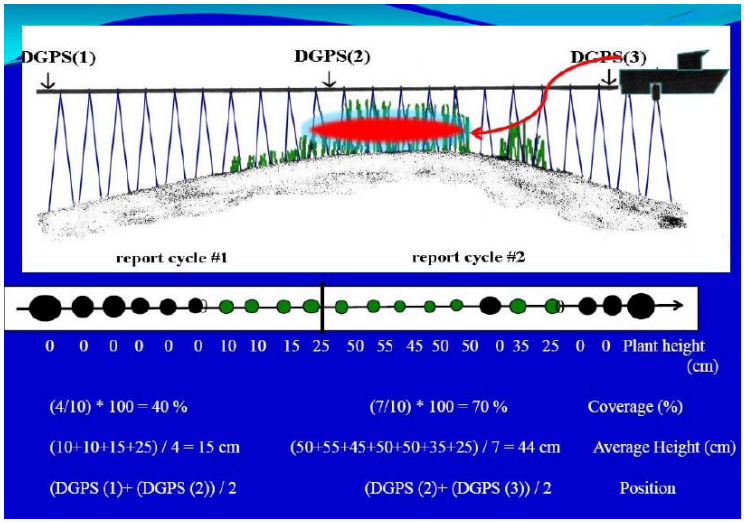
Figure 2. Lake-wide proportions of EWM rake fullness ratings from 287 point-intercept sampling locations. Created using data from 2009 pre-treatment survey and 2010 post treatment survey.

<u>Hydrilla Control Evaluation, Lake Seminole, Georgia (December 2010):</u> Working in conjunction with the US Army Corps of Engineers, Mobile District, the LittLine® performed an aquatic herbicide application to a 9.5 acre site located in the Sealy Point area of Lake Seminole on December 9, 2010. The treatment was performed to evaluate the potential benefits of utilizing the LittLine® technology for the control of the aquatic invasive plant Hydrilla in an area where control efficacy has been difficult to achieve due to water exchange characteristics.

The LittLine® system performed well and there were no instances of the lines getting tangled and or caught on stumps or underwater branches. Post treatment observations made on February 8, 2011 by CLI and Corps staff (Brent Mortimer) revealed that Hydrilla had dropped from the water column and had decomposed in portions of the plot, while portions of the plot had not achieved total knockdown. A spring 2011 survey will reveal further data on control efficacy for comparison to current treatment protocols.

On Going Current Research Projects:

Cooperative Research and Development Agreement for the "Research and Testing of a System for Precision Littoral Zone Application of Aquatic Herbicides": On October 28, 2009, the US Army Engineer Research and Development Center, Environmental Laboratory (ERDC-EL), and Clean Lakes, Inc. entered into a Cooperative Research and Development Agreement for the "Research and Testing of a System for Precision Littoral Zone Application of Aquatic Herbicides". The Scope of the Cooperative Research and Development Program is to provide for the joint conduct of research and development investigations related to coupling the LittLine® ® System (Littoral Zone Treatment Technology) with ERDC-EL Hydroacoustic Submersed Plant Mapping capabilities (SAVEWS™ and related developments). It is envisioned that these two technologies will be used together to achieve precision application of herbicides to submerged, nuisance aquatic vegetation.



LittLine® Equipment Specifications/Components

- LittLine® Vessels:
  - 22 to 26 foot Alumaweld Vessel with Mercury Outboard engines and enclosed cabin for all weather operations
  - Furuno or equivalent GPS Navigation System

- LittLine® Pesticide Application System:
  - Application System Controls:
    - Legacy 6000 Task Controller, operating a Controlled Area Network (CAN bus system), connected by a high-speed cable or bus, allows a vast amount of information to be shared across the system. This self-managing system constantly monitors its own operational status, and reports any inconsistencies to the operator before they become a problem.

The system is coupled with a Control Module (DCM) that can be tasked with all types of product applications, from single-product applications to variable-rate applications. Connected to the GPS receiver, the Legacy 6000 maintains a record of where it has applied product within any particular site. Based on this information, the Legacy 6000 can automatically switch off boom sections when they enter a previously applied area. The Legacy 6000 with pre-loaded application data files controls the rate of pesticides applied and adjusts pesticide flow rates based on any change in speed to maintain a consistent application rate.

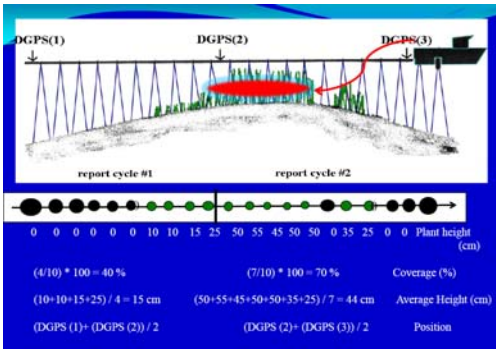
    - GPS: Sub-meter DGPS, compatible with differentially-corrected, GPS (DGPS) receivers outputting a NMEA 0183 GGA sentence at 2 Hz or greater.

    - Lightbar Guidance System: The Lightbar guidance system can display application swaths from parallel, contour or curved AB modes. The system automatically gives guidance information to the closest swath and counts down the distance to the next swath as the vessel turns at row ends. A bright text display reports the application information of choice automatically. It also warns the operator when the vessel enters an area of the treatment plot that has already been applied. Data monitor includes: Current position error from active swath, Current swath number, Vehicle speed, Area that's been applied, Course relative to 360° position.

    - Data and Mapping: Complete Real-Time Field Mapping allows the operator to view their position on the lake in real-time, and records the application as it takes place. The system maps the treatment area boundaries and allows instant area measurements. All application records show the specific application rate of each product at each location. Every application is recorded so the customer knows what was applied and where it went.

- Control Modules:
  - Power Speed Module: This module informs the control system of the vessels speed, so the controller can adjust the pesticide application rate based on speed variations.
  - Switch Sense Module: This module monitors the on-off status of each LittLine® section switch (4 line sections).
  - Product Control Module: This module controls the product delivery system and controls and adjusts the application rate based on the vessels speed and the number LittLine® hose sections that are turned on.
- Software: Fieldware™ software provides a complete set of tools to map the treatment plots, guide the vessel, control a variable rate application, and move data into a Geographic Information System (GIS).

- LittLine® Submerged Aquatic Vegetation Mapping System:
  - BioSonics DT-X Digital Echosounder System used in combination with BioSonics EcoSAV data processing software specifically designed for submerged aquatic vegetation (SAV) assessment. As transects are driven over during pesticide applications, the echosounder system automatically records bottom depth and plant canopy height and density. The data collected is time-stamped, geo-referenced and digitally stored. This system allows for the data to be collected during treatment, so real time plant data is available to support post treatment efficacy evaluations.



- Application System:
  - Dual pesticide pumping and Product Control Modules that allows for two aquatic pesticides to be applied at different application rates at the same time.
  - Two (2) 100 gallons pesticide holding tanks, 200 gallon total capacity.
  - Two (2) independent pump and rate control systems, one for each pesticide tank.

- Through hull water intake for water supply and pesticide application system cleaning.
- Four (4) pesticide discharge hose, 100 foot in length each, mounted on hose reels on each side of the vessel, allows for dual pesticide product applications with each pesticide being applied simultaneously at the same location on each side of vessel.
- Hose depth operator adjustable to reach target depth determined by boat speed and length of hose deployed.

Liquids vs. Granular: The LittLine® system allows aquatic liquid pesticides to be placed in the bottom of the water column, that supports increased concentration and exposure times for increased control efficacy. This eliminates the need for granular products, which were developed as a carrying agent to get the active ingredients in aquatic pesticides to the submerged target species. Granular products are more expensive than liquids, have inconsistent release rates, and can release too slowly and not reach the targeted treatment rate. Granular products can also accumulate in bottom sediments.

LittLine® Benefits: Research and Development efforts as outlined above have shown that the LittLine® system can reduce aquatic pesticide usage while increasing control efficacy when compared to conventional treatment methods. The LittLine® permits aquatic pesticide applications to the most effective zone for species treatment, reduces overall treatment costs, meets or exceeds state and federal reporting requirements, and provides easily accessed, highly accurate application data for retrieval and reporting.

LittLine® Benefits

Aquatic Pesticide Application System Attribute	LittLine®	Conventional Application Vessel
Must go slowly to keep the hoses on the bottom (<2 mph @ 30 foot swath = 7.3 acre per hour)	NO	YES
Operator is required to pull on the hoses every couple of minutes to shake loose any clinging weeds	NO	YES
Go Green, Reduce Aquatic Pesticide Use with LittLine® Technology	YES	NO
Can apply at 8 foot depth traveling at 5 mph (@ 30 foot swath = 18 acres per hour)	YES	NO
Ability to place aquatic pesticides to any depth of water column	YES	NO
Tangle free system	YES	NO
Ability to apply two different pesticide formulations through separate systems at the same time	YES	NO
Can make sharp turns without tangling weeds	YES	NO
Precision rate controlled system insures a precision application rate	YES	NO
Ability to reduce aquatic pesticide usage while increasing control efficacy (Third party verification through R & D Trials in 2008-2010)	YES	NO
The ability to precisely apply pesticides in sensitive areas	YES	NO
Reduces noise during treatments, compared to airboat or helicopter methods, that can adversely affect endangered species (Snail Kites)	YES	NO
Provides a lower public concern profile	YES	NO
Reduces off target impacts through precision application of the herbicides	YES	NO
Can operate in a wide variety of weather conditions (enclosed cabin)	YES	NO
The ability to precisely document, report and map pesticide applications	YES	NO
Reduces overall aquatic pesticide application costs	YES	NO
Speed/Hose Length Data Available	YES	NO
US Patent Pending	YES	NO
Ongoing Research and Development Program in cooperation with Federal, State and Academic Agencies and Institutions	YES	NO

[i] How to Build Weighted Trailing Hoses by Bill Haller(1), Lyn Gettys (1), Margaret Glenn(1) and Greg Reynolds(2) (1) University of Florida/IFAS Center for Aquatic and Invasive Plants – Gainesville, FL (2) Syngenta Professional Products – Greensboro, NC Aquatics, Winter 2007 / Vol. 20, No. 4 http://www.littline.com/researchdevelopment.html.

[ii] Aquatic Plant Community and Eurasian watermilfoil (*Myriophyllum spicatum* L.) Management Assessment in Lake Pend Oreille, Idaho for 2008: A Report to the Idaho State Department of Agriculture, John D. Madsen and Ryan M. Wersal, Mississippi State University, Geosystems Research Institute Report 5032 (http://www.littline.com/researchdevelopment.html)

[iii] , "The Evaluation of Two Herbicide Application Methods (Justin J Nawrocki[1], Kurt D. Getsinger[2], Robert J. Richardson[1.] [1]North Carolina State University, Raleigh, North Carolina [2]U.S. Army Engineer Research and Development Center, Vicksburg, Mississippi)". http://www.littline.com/researchdevelopment.html

[iv] Environmental Assessment – Eurasian Watermilfoil / Curlyleaf Pondweed Research Project (Tetra Tech) (http://www.littline.com/researchdevelopment.html)

[v] Onterra LLC-Long Lake of Phelps Lake District 2010 Treatment Report http://www.llpld.org/Downloads/LongLake2010EWMTreatment.pdf