C-139 Basin Best Management Practices
Demonstration Grant 2008 - 2011

Technical Scope of Work (SOW)

Project Name: C & B Farms Chemical Precipitation Treatment
Grantee: Charles Obern
Location: C&B Farms, Inc. – Basin 26-325-01

1. Project scope

The purpose of this project is to demonstrate in the field a practical method to remove the dissolved phosphorus fraction from vegetable farm discharges through chemical precipitation. Technical literature indicates that above ground impoundments (AGI), which are generally employed to address water quality and quantity issues from agricultural operations, are most effective in removing the particulate phosphorus fraction. Water quality monitoring in the C-139 basin indicates that the dissolved phosphorus fraction is largely prevalent in discharges (SFER, 2007).

Chemical flocculation/precipitation is used to remove the dissolved and particulate forms of phosphorus by the addition of a coagulant. The metal salts most commonly used are associated with calcium, aluminum and iron. There is limited information on the use of chemical precipitation in agricultural operations in South Florida. In order to identify the most appropriate reactive compounds, the form (liquid or solid), the rates and effectiveness of the treatment, the project has been divided in two phases: a laboratory phase and a field implementation phase. The field project location is shown is Figure 1.

2. Project Description

2.1 Laboratory phase

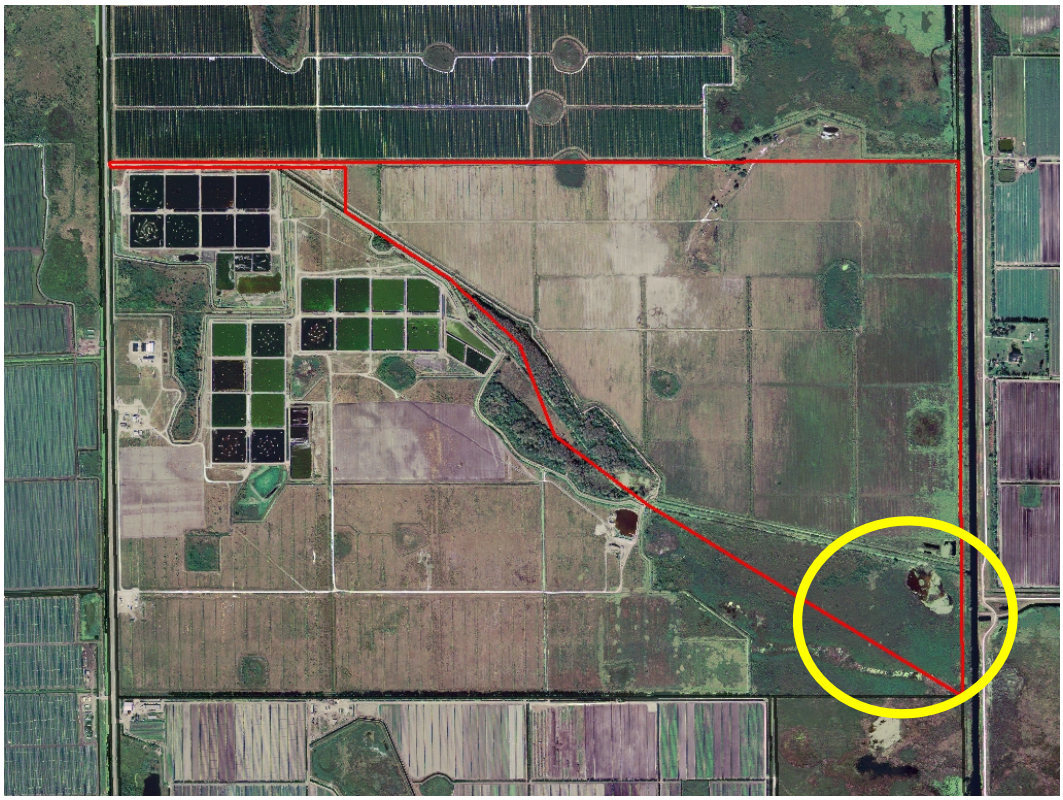
Surface water samples will be collected during representative discharge events in December, 2008 and January, 2009. These samples will be analyzed in situ for temperature, pH, and dissolved oxygen (DO) and for alkalinity, total phosphorus (TP), and total dissolved phosphorus (TDP) in the laboratory. Once the inflow water quality conditions are established, batch experiments (jar tests) will be set to test different reactive compounds such as calcium (lime), aluminum (alum), and iron (ferrous chloride or sulfate) to determine their phosphorus flocculation efficiencies. Basically, in a batch experiment the reactive compound will interact with different concentrations of phosphorus in a "batch" allowing a complete mixing and chemical equilibrium. Supernatant water samples will be collected to represent the outflow from a flocculation system and will be analyzed again for pH, alkalinity, TP, and TDP to represent the outflow; the difference between the inflow and the outflow phosphorus concentration will provide the removal rates for each compound. The reactive compound(s) and the rates that show the best results will then be demonstrated in the field implementation phase.

Stop/Go point: the grantee shall not proceed with the Field Implementation phase, until written approval by the District of the design plan.

2.2 Field Implementation phase

The field implementation phase will be located at the south end of C & B Farms, Inc. – Little Cypress farm as indicated in figure 1.

Figure 1. Location of the project

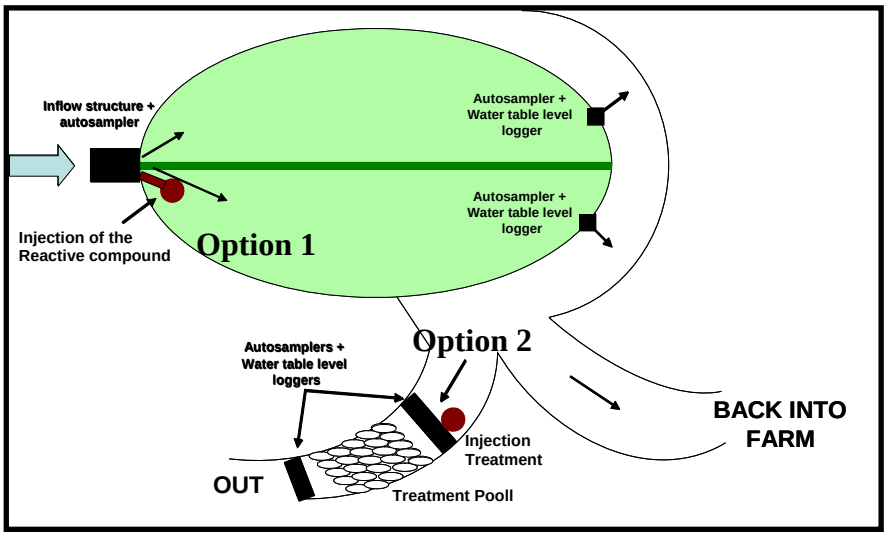


Note however, that although the location has been selected, the specific design of the experiment, which includes the reactive compound, application methods, layout design, and rates, is not defined. This will be determined upon completion of the laboratory phase, data analysis and consultation on regulatory requirements affecting the design and future implementation. It is apparent that there are two options for applying or injecting the reactive compounds. Upon completion of the laboratory phase, it will be determined whether either or both are recommended for optimum performance (see figure 2):

Option 1. Prior to an AGI (e.g., at the inflow pump) and,
Option 2. In a treatment pool after the AGI, providing adequate residence time and flow control.

The grantee shall be responsible for regulatory-appropriate disposal of any waste byproducts of this short-term demonstration project.

Figure 2. Field Implementation Design



3. Monitoring Plan

Water quantity and quality data will be monitored by the grantee during the period of June, 2009 through May, 2010. Autosamplers along with water table level loggers will be installed at the inflow and outflow points of each cell (1A and 1B) so data can be compared and effectiveness of the treatment can be determined. During periods of discharge, water quality composite samples will be collected by a flow proportional automatic sampler and preserved. The composite sample will be: a) removed from the sample collection site and delivered to the laboratory no later than 7 days from the time the individual first sample was drawn, and b) analyzed for total phosphorus (TP) no later than 28 days form the time the first individual sample was drawn. Additionally, grab samples will be collected every time samples are removed from the autosamplers and analyzed for TP and TDP. Monitoring of additional constituents of concern is not anticipated, however, it may prove necessary based on the results of the laboratory analysis and the selection of the flocculant. The funding provided under this scope does not include any additional parameters. This will need to be determined and funded separately prior to field implementation.

3.1 Data Quality Indicators (DQIs)

The quantitative DQIs used to express the quality objectives for this project are precision, accuracy, completeness, and detection limit. Criteria for laboratory precision, accuracy, and detection limits are as follows:

Table 1. Analyte and Associated Laboratory Criteria

Analyte	Analytical Method	Precision (% RPD[1])		Accuracy (% R[2])		MDL (mg/L)
		High	Low	High	Low	
TP	SM4500-PF	0-10	0-25	90-110	75-125	0.002
TDP	SM4500P-F	0-10	0-25	90-110	75-125	0.002

[1] RPD = Relative Percent Difference; High limit for values > 20 times the MDL; Low limit for values < 20 times the MDL.
[2] %R = Percent Recovery; High limit for values > 20 times the MDL; Low limit for values < 20 times the MDL.

Completeness of the data set is expected to be within 95 and 100 percent. That is, the percent of data lost due to equipment or sampling failure is expected to be less than 5 percent. Once the number of samples to be collected is determined, the number of samples that will comprise a complete data set can be determined.

3.2 Sample Collection Methods

Sample collection will be performed in the manner most appropriate for existing field conditions at the time and following procedures outlined in the FDEP SOP 001/01 FS1000 – FS2100 (Can be found at **http://www.dep.state.fl.us/labs/qa/sops.htm**). Procedures used may involve direct sampling by immersion of sample bottles, collection of a representative sample in an appropriate container such as a cleaned bucket which is then used to fill the sample bottles. The following table summarizes the sample container size and materials, preservation requirements and holding times.

Table 2. Sample Collection Requirements

Analyte	Preservative	Container Size (ml)/Material	Holding Time
TP	Sulfuric Acid to pH<2	125; Plastic	28 days
TDP	Sulfuric Acid to pH<2 Field Filter	125; Plastic	28 days

3.3 Equipment

The equipment to be used for sample collection includes:

- Plastic bucket
- 125 and 60 ml plastic bottles
- 60-ml disposable syringes
- Disposable 0.45 micron filters
- Disposable gloves

3.4. Sampling Protocols for Grab Samples

Protocols have been established when grab samples are taken at the monitoring location with clear water. Grab sample procedures can be seen in Appendix A.

3.5 Laboratory Analysis

Samples should be analyzed in a lab certified under NELAP by the Florida Department of Health (FDH). A current listing of certified labs is kept at **http://www.dep.state.fl.us/labs/cgi-bin/aams/index.asp**.

4. Evaluation Method

For Option A, the effectiveness of the chemical precipitation treatment will be estimated by comparing the quality and quantity of the water discharged from cell 1A (control) with the one discharged from Cell 1B (modified to allow P-sorption), under various inflow concentration levels and conditions. For Option B, the effectiveness will be based on the before and after the treatment pool. Evaluation of effectiveness may need to consider whether use of chemical precipitation shall be only during specific discharge events (e.g., discharges with higher P levels or with certain speciation conditions) and not during others, as to make it more economically feasible. The assumption is that chemical precipitation is used as a last resort for phosphorus reduction after AGI and reuse/recycle back into the farm when TP levels in the discharge warrant.

5. Deliverables & Schedule

The grantee is responsible for completion of the following tasks. Reimbursement will be per deliverable with justification (reports, photo documentation, invoices, as applicable) upon District verification that requirements were met. The grantee shall not complete any work until a contract is executed with the HSWCD.

Task	Deliverable	Deliverable Description	Due Date[1]	Payment Amount
Task 1	Laboratory Phase			
1.1	Laboratory Design Report	- Report will contain details of the experimental design for the laboratory phase of the project, which is to determine the P flocculation rates for various Ca, Fe, and Al compounds	02/01/09	$5,000.00

Task	Deliverable	Deliverable Description	Due Date[1]	Payment Amount
1.2	Findings Report of Laboratory Work[2]	- Report will contain details of the collection and water quality results for the representative surface water samples and the results of the batch P-flocculation (jar tests).	05/01/09	$10,000.00
1.3	Chemical Selection Report	Report will provide details of the chemical(s) selection process and design parameters for the field demonstration system including the following: - Selected flocculant(s) with injection rates including economic, availability, and efficiency considerations. - Any regulatory issues or additional constituents that should be monitored and cost.	06/01/09	$7,500.00
Task 2	Field Phase			
2.1	Design Report of the Treatment Equipment and Area	Report will provide details of the site location with sketch indicating treatment configuration (e.g. injection at the pump or via filters or detention pool). Additional information on the following will also be provided:, - Indication of why the specific location was selected (e.g., before of after discharge from reservoir, etc.) - Include description of how BMP performance will be measured. - Include cost of equipment to be used.	06/15/09	$2,000.00
2.2	Implementation Report	Report will provide details of the final constructed treatment system.	08/01/09	$35,000.00

Task	Deliverable	Deliverable Description	Due Date[1]	Payment Amount
2.3	Monitoring Design and Implementation Report	Report will provide details of the monitoring system that will install to provide the verification data for the effectiveness of the treatment system.	08/01/09	$40,000.00
2.4	August - September/09 Datat[3]	Data Report – August - September/09	10/30/09	$1,000.00
2.5	October - November/09 Data[3]	Data Report – October - November/09	12/30/09	$1,000.00
2.6	December/09 – January/10 Data[3]	Data Report – December/09 – January/10	02/28/10	$1,000.00
202.7	February - March/10 Data[3]	Data Report – February - March/10	04/30/10	$1,000.00
2.8	April - May/10Data[3]	Data Report – April - May/10	06/30/10	$1,000.00
2.9	June - July/10 Data[3]	Data Report – June - July/10	08/30/10	$1,000.00
2.10	Final Report[2]	Report describing project implementation and analysis of BMP (chemical treatment system) measured effectiveness based on water quality and quantity data, an estimate of cost and cost feasibility (infrastructure and operation), as well as discussion of any factors potentially affecting BMP performance and assumptions that could not be evaluated in the analysis and that should be considered on a case-by-case scenario for implementation in other sites..	09/30/10	$5,000.00
TOTAL Not to Exceed Amount				**$110,500.00**

Notes:
[1] These are tentative dates, which may need to be revised based on weather conditions or logistics related to the agricultural operations. The grantee shall notify Hendry County Soils and Water District if substantial deviation from these dates will occur.
[2] Includes all raw data
[3]Collection of the samples will start as soon as the autosamplers and loggers are installed. Data Report (2.4 – 2.9) will be on the minimum frequency indicated above and will not include analysis of the data (only raw data). It will only be for reimbursement of analytical and data collection cost.

References

SFWMD, 2007. 2007 South Florida Environmental Report. South Florida Water Management District, West Palm Beach, FL. Online at **https://my.sfwmd.gov/portal/page?_pageid=2714,14424186&_dad=portal&_schema=PORTAL**