ASSESSING THE POTENTIAL FOR NUTRIENT UTILIZATION AND LOSS ON THE C&H FARM

The project described here is designed as an environmental assessment and water quality monitoring of the C&H farm. This plan of work covers equipment purchase, installation, and initial monitoring of nutrient fate and transport in the C&H farm. It will focus on a minimum of two representative, high-use fields that have been permitted to receive manure. Water quality assessment of Big Creek above and below the farm will provide preliminary baseline information. To address the long-term sustainability of the C&H Farm, the project includes development of a pilot plan for manure treatment. This option is regarded as a possible solution to nutrient imbalance concerns and has the potential to provide the farm with cost-beneficial alternative for the use and export of treated manures.

This information will be a short-term assessment and it must be noted that funds allocated below will not cover long-term monitoring, sample analysis, and assessment of land use impacts on area waters. Additional funds would be needed for sample collection and labor to continue monitoring for a minimum of five years. This time frame is recognized by NRCS, EPA, and general scientific community to be the minimum required to accurately assess any impacts and overcome annual weather fluctuations.

The plan of work meets the level of funding currently available. Other important methods of investigation, such as the use of dye-tracer tests, could provide valuable information on possible rapid by-pass flow pathways common in karst dominated areas. With additional funding, this would be conducted at sites identified from year 1 studies. Finally, a broad pool of expertise from the partner organizations will be brought together for both for work plan development and review.

<u>Field Monitoring - Land Application Sites</u>

Assess the risk of nutrient loss from a minimum of two fields that will be used to land apply manure (see Maps 1 and 2). On each field install;

1. Conduct a detailed topographic survey of the application fields to better understand surface water flow patterns and the most appropriate locations for surface runoff collection and lysimeter devices.
2. Bermed surface runoff area (>2 acres) to collect and monitor surface runoff, with weather station.
3. Three sets of four nested lysimeters to measure infiltration of applied nutrients in rainfall – leachate.
4. Collect samples after each rainfall event from the surface runoff areas and lysimeters, filter on site, store on ice and ship to the AWRC Laboratory for nitrogen, phosphorus, pH, and sediment sample analysis for one year only.
5. Install piezometers across monitored fields to automatically and continuously determine if subsurface water is moving to or away from the adjacent river. The piezometers will measure subsoil water table water height only along predefined land gradients; nutrient concentrations will be determined in the lysimeters.

<u>Assess the Risk of Nutrient Loss from Lagoon and Holding Ponds to Groundwater and Surface Water</u>

1. Install two deep observation wells adjacent to the holding ponds and upslope of the holding ponds to determine any potential seepage of nutrients, nitrogen and phosphorus.
2. Install flow monitoring and autosampler on the road culvert below holding ponds and another flow monitoring and autosampler upstream of the holding ponds for nitrogen and phosphorus analysis.

Chemical Assessment of Water Quality above and below Farm

Assess impact of the farm operation on nutrient concentrations in Big Creek at upstream and downstream of farm. This will involve installation of a calibrated stream gauge for flow determination and collection of Creek water samples and a flow measurement on a monthly basis.

Liquid Manure Nutrient Manipulation via Solids Separation: A Farm Case Study to Evaluate Alternatives and Associated Plant Nutrient Management, Nutrient Export, and Economic Considerations

Work with the owners of the C&H Farm to explore potential long-term, economically viable, options to modify current manure management practices in the general areas of:

1) Separating manure liquids and solids along with their differential management;
2) Retaining sufficient nitrogen to meet crop needs;
3) Exporting excess phosphorus off the farm;
4) Mitigating off site odor; and
5) Not exceeding the current economic, labor, and management resources of the farm.

The project will identify management options to meet the above objectives. It is anticipated that the options will include but not be limited to:

- Mechanical separation manure solids from liquids with or without chemicals as a precursor for off-farm transport of separated solids; and
- Selective application of higher phosphorus content solids and lower phosphorus content liquids to different fields that minimizes any loss of nutrient loss.

For the management options identified, their initial and long-term costs will be estimated and an assessment of their implementation impacts made. Available literature and other information resources will be utilized in this process. However, there will be a need for laboratory and onsite tests/trials. This is especially true when evaluating manure solid-liquid separation and/or chemical use.

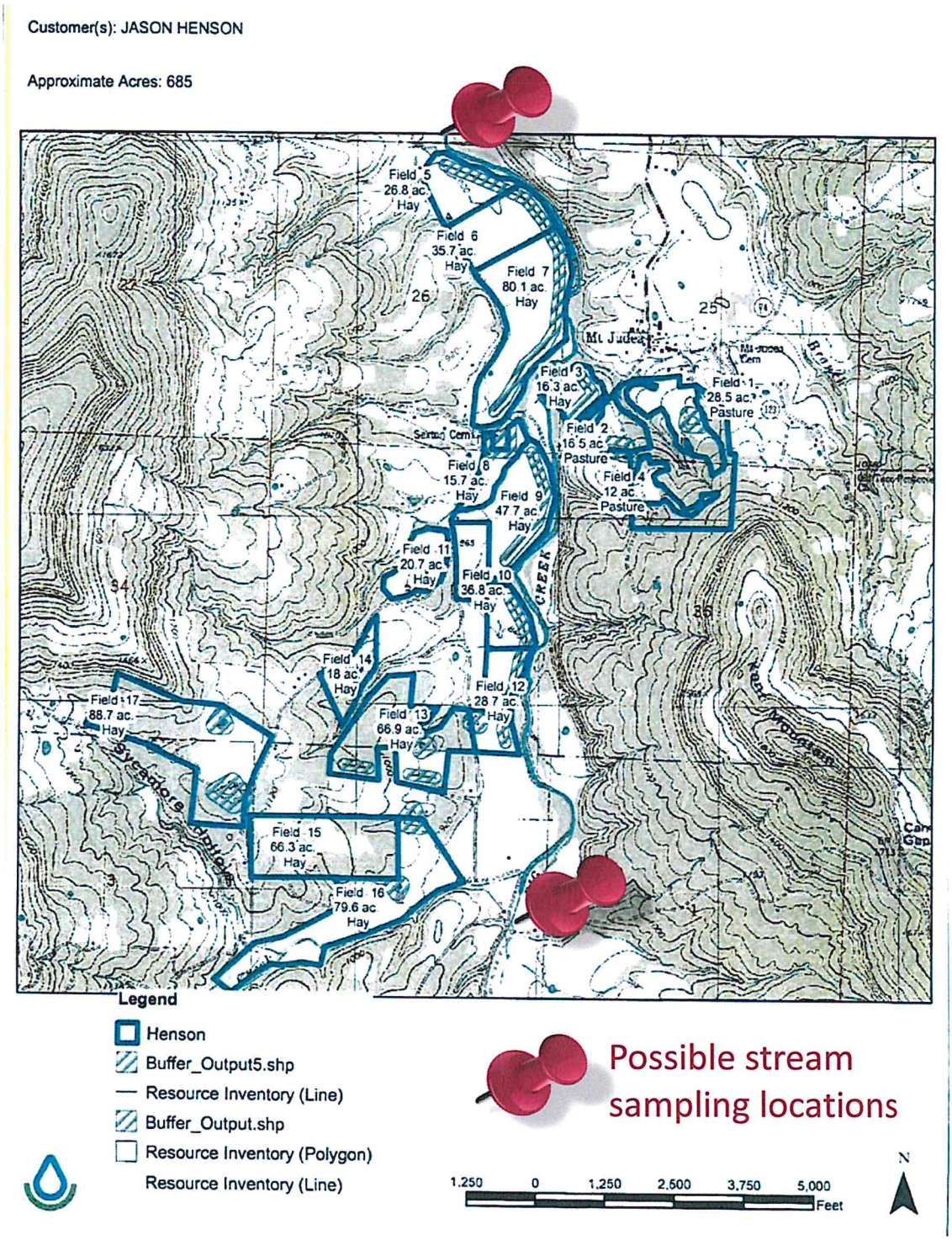
An outcome of this phase of the project will be to document and report the management options evaluated and the details of their evaluation. The report will provide C&H farm input for their decision on appropriate options to implement and associated funding and maintenance requirements, so that this project would be followed by full implementation of the desired options. In addition, the project report will provide a basis for general educational materials on the practical, scientific, and economic pros and cons of manure slurry treatment and solid-liquid separation for other farms in the region.

Budget

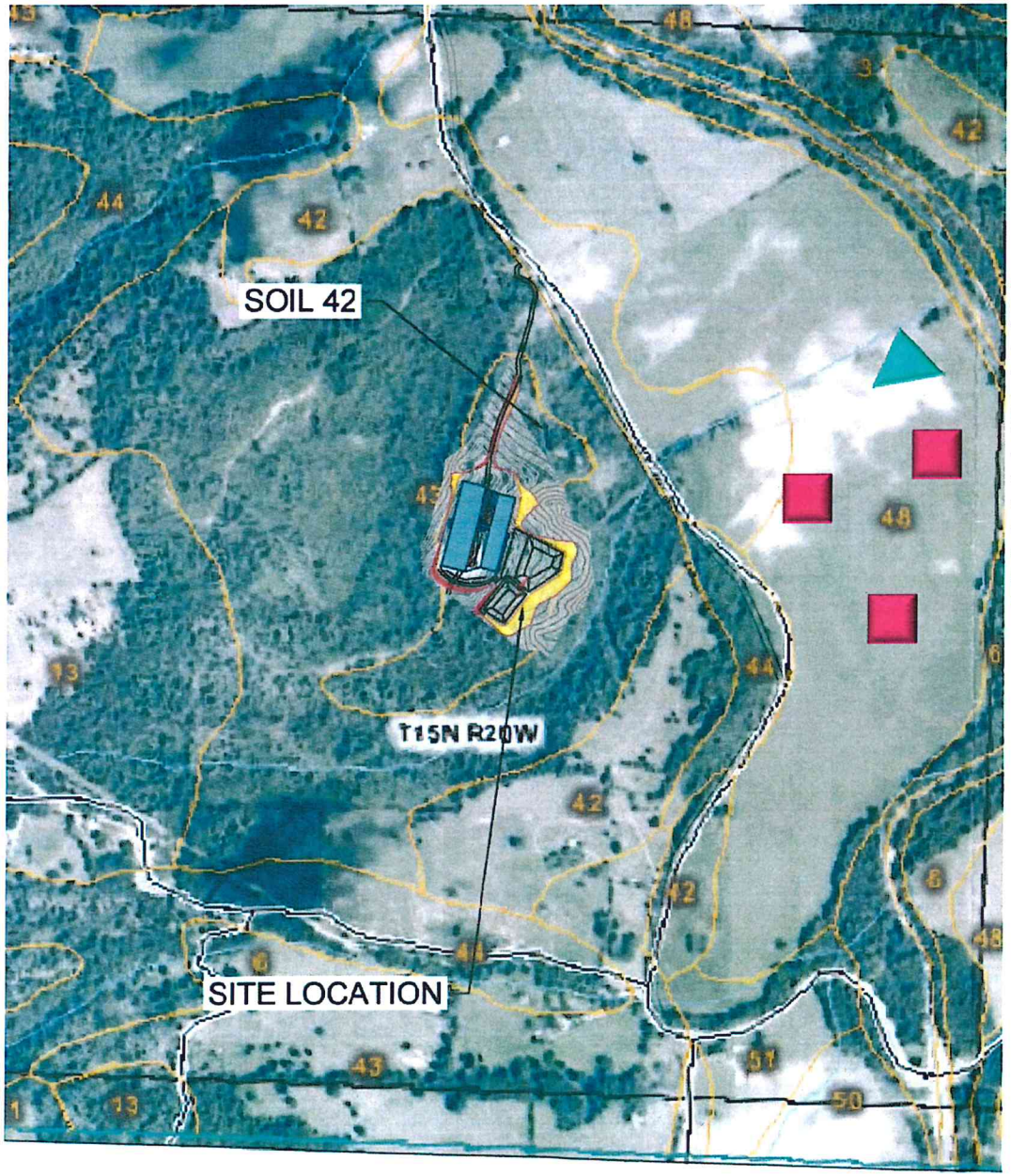
Item	**Unit cost**	**Total cost**
Field monitoring		
Detailed topographic survey of application fields	10,000	10,000
Surface runoff plot (installation & flume) @ 2 total	4,000	8,000
Weather station @ 3 total	750	2,250
Lysimeter @ 12 per field / 36 total	250	9,000

Piezometers @ 16 per field / 48 total	75	3,600
Velocity flow meter for culvert and upstream	5,000	10,000
ISCO sampler @ 2 total	6,000	12,000
Sample analysis @ ~10 samples per site for 39 sites	100	39,000
Data loggers @ 15 total	150	2,250
Deep observation well @ 2	5,000	10,000
Subtotal		$106,100
In-stream chemical monitoring		
Sontek Flow Meter @ 2 stream sites	5,000	10,000
Stream gauge, install @ 2 sites	5,000	10,000
Sample analysis @ 12 samples per site for 2 sites	100	2,400
Subtotal		$22,400
Manure treatment		
Chemical treatment: Benchtop test to determine to chemical types and rates. Equipment and sample analysis. 144 samples @ $50 per sample.	10,000	10,000
Physical treatment: Manure separation lab field tests. 30 samples $50 @ per sample	2,500	2,500
Miscellaneous supplies for chemical and physical treatment tests		10,000
Field Technician –$30/hour for 320 hours (2 months)		14,400
Travel for technician and extension researcher		5,000
Subtotal		$41,900
Personnel		
Travel to site from Little Rock and Fayetteville for site inspection and maintenance	10,000	10,000
Charges for shipping samples to AWRC for analysis	8,000	8,000
Contractual labor – earthwork for install	20,000	20,000
Field technician – hourly basis @$30/hour half time (1040 hours)	31,200	31,200
Student aides to help with sample processing & cleaning @ $10 / hour (2@ 15 hours/week/50 weeks each year)	7,500	15,000
Subtotal		84,200
Project total		**$254,600**

Map 1. Land application fields and possible stream sampling locations.



Map 2. Possible location of surface and subsurface sampling sites



LEGEND

3 Arkana-Moko complex, 20 to 40 percent slopes
6 Ceda-Kenn complex, frequently flooded
11 Enders gravelly loam, 3 to 8 percent slopes
13 Enders stony loam, 3 to 20 percent slopes
26 Moko-Rock outcrop complex, 15 to 50 percent slopes
35 Nella-Enders stony loams, 8 to 20 percent slopes
42 Noark very cherty silt loam, 3 to 8 percent slopes
43 Noark very cherty silt loam, 8 to 20 percent slopes
44 Noark very cherty silt loam, 20 to 40 percent slopes
48 Razort loam, occasionally flooded
50 Spadra loam, occasionally flooded
51 Spadra loam, 2 to 5 percent slopes
54 Water

Nested lysimeters

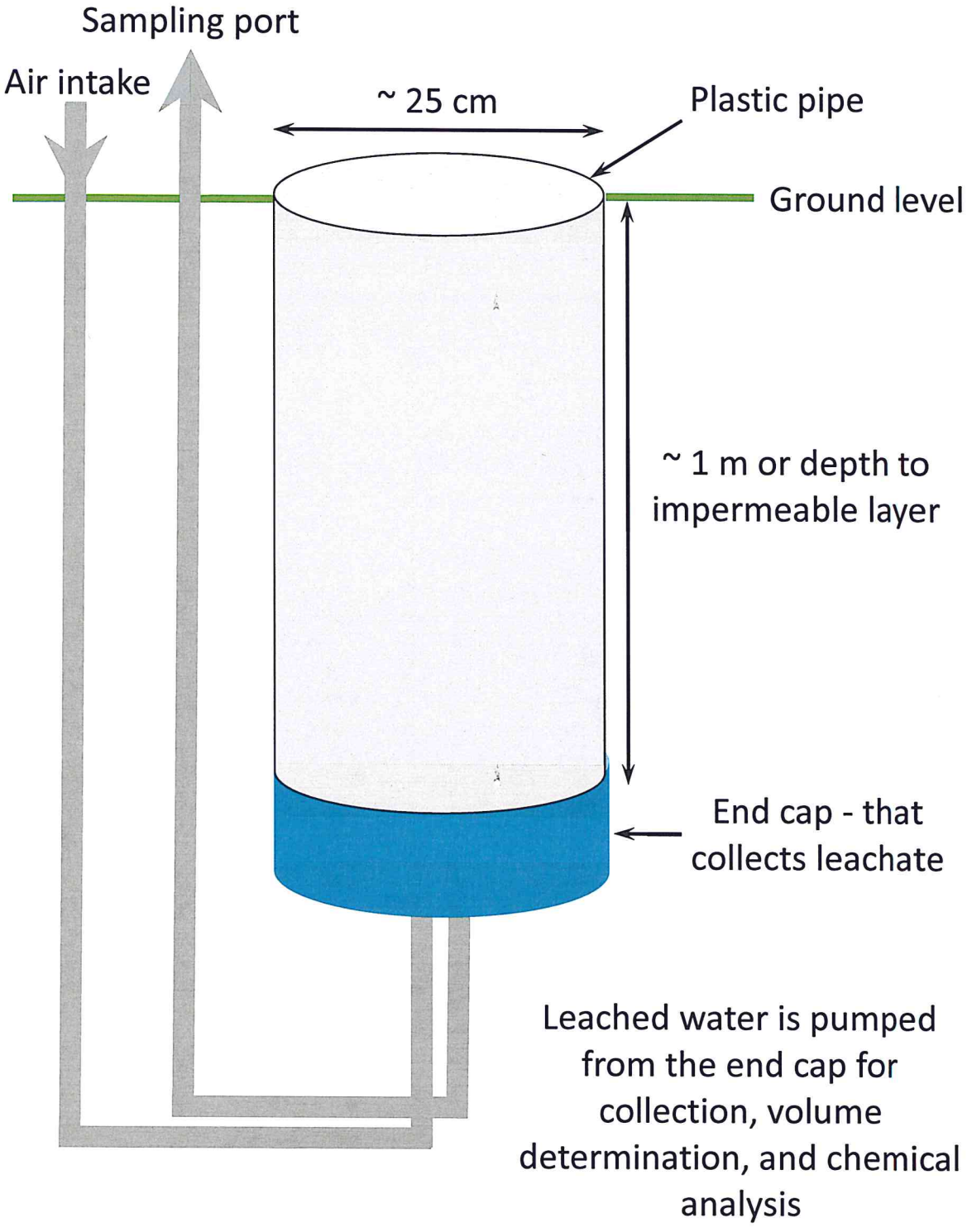
Surface runoff flume

Lysimeters

Zero-tension lysimeters will be installed to characterize percolate moving through the undisturbed soil profile. A plan of the lysimeter is given below. The lysimeter casing is made of heavy gauge plastic and a sharpened metal cap will be attached to the leading end of the pipe during soil insertion. The lysimeters will pushed / pounded into the ground with the bucket of a backhoe and then dug out, and capped to create a 20-cm deep collection chamber. Suction tubing is attached to the base of the cap to remove leachate from the bottom chamber. A second tubing is attached as an air inlet to provide zero tension in the capped chamber, so that leached water can freely collect in the chamber.

The lysimeter is the replaced in the soil and pack around them to leave the top of the lysimeter flush with the land surface. This will minimize any damage to the lysimeter during normal field operations. Another option is to have the lysimeter casing stand a couple of cm above the land surface to ensure all water falling on the lysimeter has the chance to percolate and to minimize any runoff and run on of water.

The lysimeter design is developed to minimize disturbance of soil within the lysimeter and to be able to quantify water movement through the soil profile as accurately as possible.



Plan of field lysimeter.