Energy Efficient Manure Dewatering Technology Evaluation

Final Report 07-11
August 2007

New York State
Energy Research and
Development Authority

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ENERGY EFFICIENT MANURE DEWATERING TECHNOLOGY EVALUATION

FINAL REPORT

Prepared for the

NEW YORK STATE ENERGY RESEARCH AND DEVELOPMENT AUTHORITY

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NOTICE

DISCLAIMER

Innovative Environmental Products (IeP) (formerly Jannanco, LLC) has prepared this report based upon the extensive on-farm project at Noblehurst Farms in Lynwood, New York. This program could not have been completed without the overwhelming willingness on the part of the management and staff of Noblehurst Farms to assist in its success. However, the data provided in this report is based upon the performance of the IeP process and equipment performance. The calculations regarding system capacities, on-farm operations, capital costs and cost recovery are based upon legitimate but theoretical equipment configurations that were developed from the evaluation of the data. The calculations and results are in no way intended to represent any aspects of the business or farm operations of the Noblehurst Farms.

ABSTRACT

Innovative Environmental Products, Inc. (IeP) (formerly Jannanco, LLC), with funding assistance from NYSERDA and technical assistance from Cornell University Departments of Agricultural Engineering and Agronomy, completed a demonstration project on a new manure dewatering process called the Nutrient Trap Process[1]. This process uses "active filtration™" technology for the mechanical separation of dairy manure and produces a clarified filtrate low in phosphate and nitrogen.

The key benefits gleaned from the demonstration were nutrient control, reduced fossil fuel combustion associated with land applying liquid manure, and odor reduction. Specifically, the following average results were observed upon analyses of clarified manure (NTP Filtrate) produced from all waste streams tested: Phosphate reduction – 97%; Organic Nitrogen reduction – 90%; Fecal Matter reduction – 99%; and Total Manure Solids reduction – 80%, with removal of essentially all suspended solids. The process produces a clarified filtrate, approximately 65% to 70% of the original manure mass, that is suitable for heavy loading land application and irrigation. The remaining nutrients are retained on the separated solids, approximately 30% to 35% of the original manure mass, providing a high nutrient, spreadable solid that is suitable for, among other applications, slinger spreader broadcasting. The phosphates are embedded within the solids as an insoluble metal phosphate salt.

This technology has a primary benefit in watershed areas where there are nutrient constraints that limit land application of filtrate. The project successfully demonstrated that the Nutrient Trap Process, when combined with proper agricultural land management practices, can achieve key nutrient overload control within sensitive farmed watersheds.

Keywords: Filtration, nutrient recovery, phosphate elimination, manure clarification, manure dewatering, manure separation, water recovery, odor reduction, manure lagoon.

[1] The Nutrient Trap Process is patent pending.

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- The New York State Energy Research and Development Authority
- The management, staff, and operating personnel of Noblehurst Farms in Lynwood, New York
- The faculty, staff, and student body of the Agricultural Engineering and Agronomy Departments of Cornell University
- The Drew Industrial Chemical Division of Ashland Chemical Co.
- Bridgestone Associates, Inc. for significant contributions to the demonstration project and the report
- Michael Fawdry, P.E. for his contributions to the project
- Dr. David Palmer, President, Cow Power for his contributions to the project
- Dairy One for support with laboratory testing

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SUMMARY

On Feb 12, 2003 the United States Environmental Protection Agency (USEPA) issued final rules that revised and clarified its regulatory requirements under the Clean Water Act (CWA) relating to "concentrated animal feeding operations" (CAFOs) CAFOs that meet certain applicability criteria were required to develop Comprehensive Nutrient Management Plans (termed CNMPs). Of the 238,000 Animal Feeding Operations (AFOs) in the country, 15,500 are CAFOs, and will be required to comply with the new regulations. The remaining AFOs will be required to comply with certain other environmental requirements. Effectively, the CNMPs may substantially restrict the manner in which CAFOs land apply liquid manure, the existing management technique of choice in most cases. States are taking action to assure enforcement of the new regulations. For example, Pennsylvania has levied large fines ($60,000-$100,000) against several offending farms. As such, it appears that these new regulations may exert substantial, additional compliance and monetary pressures on New York State farmers[2].

New York State is the third largest milk producer in the nation, with more than 7,200 dairy farms and 678,000 cows. The typical large New York dairy farm is required to manage 80 to 100 tons of liquid manure daily. There are over 1,100 CAFOs in New York State where nutrient overload poses potential farm management problems. Additionally, there are increased restrictions, scheduled to come into effect on July 1, 2007 that will severely limit the ability of some farmers to spread manure on their available or proximate land[3].

For the last several decades, research has indicated that phosphates, bacteria, and to some extent organic nitrogen, are damaging valuable ecosystems. For example, in 1999 the New York State Department of Health investigated what is believed to be the largest outbreak of waterborne *E. coli* O157:H7 illness in United States history. The outbreak occurred at a fair in Washington County, New York (New York State Department of Health, March, 2000). A total of 781 persons were identified with suspected infections of *E. coli* O157:H7 and/or *Campylobacter jejuni*. Of these, 127 persons were culture confirmed with *E. coli* O157:H7, 71 individuals were hospitalized, 14 persons exhibited hemolytic uremic syndrome (HUS), and two people died. A household telephone survey indicated that the number of people infected by either pathogen after visiting the Washington County Fair might be as high as 2,800. Another example occurred in 2005, when a manure lagoon in Upstate New York failed; millions of gallons of manure flowed into the Black River killing hundreds of thousands of fish.

[2] In the preamble to the 2003 rule, USEPA estimates that the annual compliance costs for large diary CAFOs will be approximately $88,415 per year, in 2001 dollars.
[3] Revised National Pollutant Discharge Elimination System Permit Regulation and Effluent Limitation Guidelines for Concentrated Animal Feeding Operations in Response to Waterkeeper Decision; Proposed Rule [(40 CFR Parts 122 and 412 - Federal Register June 30, 2006 (Volume 71, Number126)]

Additionally, throughout New York State, large quantities of fuel are consumed daily to pump millions of gallons of manure to areas where management or storage can occur. Countless trucks are filled with liquid manure and driven to land that can support the phosphates and organic nitrogen. Millions of gallons of manure are being handled daily because there are only rudimentary separating processes available to today's farms.

As such, the goals of this project were twofold:

1) To demonstrate the ability of the Nutrient Trap Process (NTP) technology to reliably and cost-effectively separate dairy manure and produce a high clarity filtrate for storage, irrigation, spreading, and use; and
2) To evaluate the effectiveness of the technology as an energy-efficient on-farm waste management strategy for controlling key nutrient overload.

The specific objectives of the project included the following:

1. Verify the technology's ability to achieve a superior quality filtrate.
2. Determine the quality of the dewatered manure and determine its suitability for use as bedding and for composting.
3. Confirm the technology's ability to dewater manure with the estimated 30% energy savings compared to conventional technologies.
4. Determine the technology's ability to achieve filtrate suitable for spray application or small nozzle injection equipment, and assess the degree to which land spreading energy and costs may be reduced.
5. Determine the suitability of the filtrate from pre- and post-digester manure for use on sensitive crops determine additional treatment requirements, if any, for this application, and determine an estimated cost benefit from the offset of purchased commercial fertilizer.
6. Determine additional treatment requirements, if any, for use of the filtrate from post digester filtrate for reuse within the barn.
7. Assess the degree to which fresh water use costs may be reduced.
8. Develop a mass and nutrient balance model for a typical dairy operation based upon the results of the demonstration project.
9. Prepare an economic model and a return on investment analysis for a typical dairy operation based on the results of this project.

Innovative Environmental Products (IeP) demonstrated the use of the NTP "active filtration™" filtration technology to dewater dairy manure at Noblehurst Farms in Lynwood, New York. Demonstrations using the "DryBox" were run on multiple waste streams including filtrate from the screw press separator of digested manure, digested manure directly from the outlet of the digester, and raw manure taken directly from the barn. The DryBox can be readily engineered to site specific applications, and because of its modularity and compact footprint, can be easily retrofitted into nearly any existing farm setting. The DryBox is completely portable and requires only a small volume of medium-pressure compressed air. The estimated operating costs of a NTP system for a typical dairy operation are in the range of $0.005 to $0.0125 (2006 dollars) per gallon of manure treated. The capital costs of a NTP system are in the range of $100-150 per cow, depending on site-specific constraints. This compares to over $200 per cow for conventional technologies (2006 dollars) (taken from Wright-Pierce report to the State of Connecticut on Manure Management[4]).

The key benefits gleaned from the demonstration were nutrient control, reduced fossil fuel combustion associated with land applying liquid manure, and odor reduction. Specifically, the following average results were observed upon analyses of clarified manure (NTP Filtrate) produced from all three waste streams: Phosphate reduction – 97%; Organic Nitrogen reduction – 90%; Fecal Matter reduction – 99%; and Total Manure Solids reduction – 80%, with removal of essentially all suspended solids. The process produces a clarified filtrate, approximately 65% to 70% of the original manure mass, that is suitable for heavy loading land application and irrigation. The remaining nutrients are retained on the separated solids, approximately 30% to 35% of the original manure mass, providing a high nutrient, spreadable solid that is suitable for, among other applications, slinger spreader broadcasting. The phosphates are embedded within the solids as an insoluble metal phosphate salt.

Additional benefits, depending on site-specific conditions, may include:

1. Electrical horsepower (HP) energy savings of up to 75% per ton of manure dewatered compared to conventional separation technologies
2. Use of clarified filtrate as a source of irrigation water, or as gray water for barn and manure trench flushing
3. Use of clarified filtrate in higher-level reuse applications following ozone purification
4. A significant reduction in the area required for spreading treated manure
5. Elimination of manure lagoons
6. A reduced mass of manure solids, which would be beneficial to community digester or composting projects due to the reduced transportation requirements
7. Revenue generated through nutrient trading programs
8. Cost savings associated with eliminating the need for downstream nutrient control treatment
9. Cost savings compared to conventional separation and spreading of liquid manure
10. Cost savings associated with eliminating the amortization and maintenance costs associated with the conventional manure spreading equipment

Note: On farms where sand bedding or flush systems for manure handling are used, cost savings are anticipated to be higher than those observed at the host farm. This is due to the fact that these systems use much higher

[4] Feasibility Study for Alternative Technologies and Utilization for managing Dairy and Poultry Manure. Submitted to the Connecticut Department of Environmental Protection – Draft Report October 2005

volumes of fresh water, which ultimately requires treatment and/or spreading. Additionally, in some sensitive watershed areas the spreading of this dilute manure water is becoming limited.

To summarize, the demonstration project confirmed the Nutrient Trap Process' ability to consistently and cost-effectively dewater and clarify large volumes of dairy manure, isolating virtually all of the environmentally dangerous or destructive elements from the liquid manure while retaining much of the value as fertilizer on the separated solids. The project successfully demonstrated that the Nutrient Trap Process, which, when combined with proper agricultural land management practices, can achieve key nutrient overload control within sensitive farmed watersheds.

Section 1
TECHNOLOGY DESCRIPTION

The NTP system combines chemical treatment with mechanical separation. The proprietary chemical treatment regimen uses a catalyst manufactured from recycled materials and an environmentally friendly flocculating chemical. The chemicals are blended with the manure in a particular sequence and under specific hydraulic conditions to achieve an optimum chemical reaction. The chemical reaction causes the fine particles to separate from the liquid in the manure. When the slurry of solids and liquid enter the mechanical separation equipment they are exposed to mild forces produced by the active filtration™[5] equipment that promote uniform and complete separation of the chemically treated solids and any other larger solids, such as bedding solids, from any free liquid.

The configuration of the NTP system is site-specific. However the chemical treatment regimen and the mechanical separation components are similar in all cases. A series of process schematics are provided in Appendix B for various farm applications. The equipment requirements for these farms have been estimated based upon the performance of the equipment during this and subsequent demonstrations. It is estimated that approximately 20 cubic yards of active filtration™ DryBox capacity are required for each 500 cows. This estimate is subjective and is directly impacted by the nature of bedding material used by a given farm and any additional pre- and post-processing of the manure solids that may be incorporated into the farm's practices.

Active Filtration™ Technology

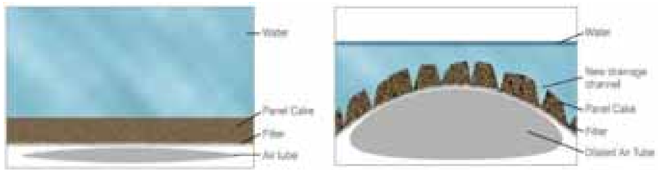
"Active filtration" is a patented filtration technology developed in Italy by Idee e Prodotti. IeP is the U.S. distributor for this technology. The active filtration™ technology uses a patented membrane separation technology[6] that has extensive historical success in municipal and industrial wastewater sludge dewatering applications throughout Europe.

"Active Filtration™" is a dynamic filtering system that continuously alternates between static filtration and active filtration. A basic schematic of the process is shown in Figure 1. Inflatable air tubes (bladders), ranging from 4 to 18 inches in diameter, which are positioned under a filtration membrane, cause the "active" motion. They dilate beneath the waste material, constantly causing a number of cracks in the forming layers of dewatering manure. This, in turn, opens up fan-shaped channels in the manure cake, creating additional passageway for the drainage of the filtrate. This unique feature allows a much better extraction of the filtrate. "Active Filtration™" increases the effectiveness of dewatering, producing a dryer dewatered manure, compared to other processes, in reduced filtration time.

[5] The "active filtration™" technology is marketed throughout Europe by Idee e Prodotti of Milan, It. under the trade name of "Squeeze Box". IeP is the US distributor for this technology.
[6] US Patent # 5614092

Figure 1

Active Filtration ™ Principal of Operation



The active filtration™ process is available in two configurations, the DryBox and the SqueezeTower Press, which is sold as the Squeeze Box in Europe. Both of these technologies were tested during this demonstration program. The DryBox, the focus of this report, offered far superior treatment of the bulk quantities of the manure typical to a dairy farm. The SqueezeTower Press demonstrated excellent performance for polish filtration of the filtrate from the DryBox. A description of both the DryBox and SqueezeTower Press Technologies is provided below.

DryBox

The basic DryBox consists of mobile rolloff containers that work like a "super" strainer. Filtration is accomplished via "Active Filtration". A large filtration cloth is installed over the large bladders in the floor of the DryBox. The bladders are set on top of an under drain system created by grating covering the entire bottom and sides of the rolloff container. The entire filtration process takes place inside the container.

Manure is loaded from the top. It may be batch fed with bucket loading equipment or fed continuously with a low pressure feed pump. The manure is contained and initially filtered by gravity through the filter cloth. The liquid is drained out of the box through a pipe coupling. Then the "Active Filtration" system is engaged. For the DryBox this consists of two stages: dilation (ON) and stand-by (OFF).

Dilation occurs when the air bladders are dilated by 15 to 30 psig compressed air. This dilation of the bladders warps the panel of manure cake just formed on the filter cloth thus causing cracks to the manure mass. The free liquid in the manure finds additional and preferential drainage channels within these cracks.

Stand-by occurs when the bladders are vented and the manure panel recedes in order to undergo subsequent dilation and warping to create new drainage channels.

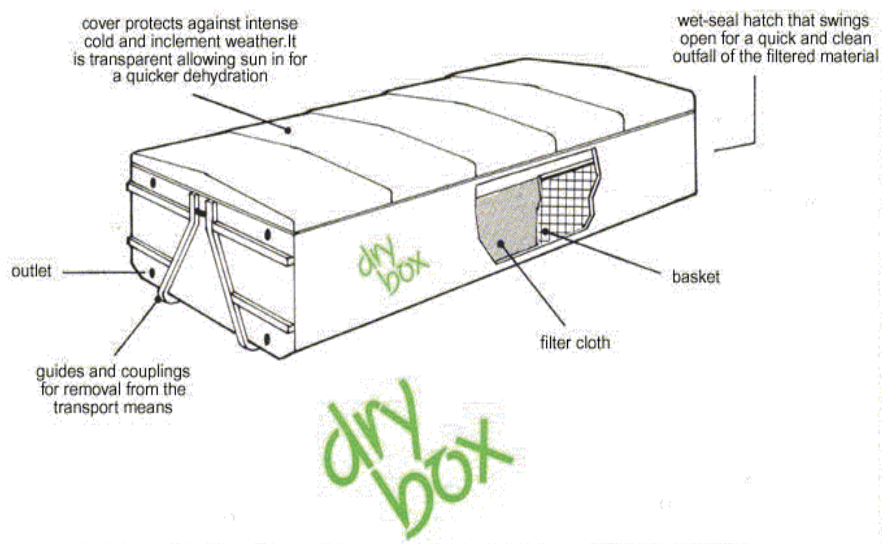
An electric control panel runs the filtering stages and it provides the opportunity to customize the cycle to obtain ideal manure dryness. The cycle is customized by variations in the dilation, standby time setting, and the operating pressure.

Once a manure cake has adequately dewatered in the DryBox, it may be staged temporarily to decant off any remaining free liquid from the container. The DryBox is then hauled with a rolloff transfer truck to the disposal site. The dewatered manure is dumped from the truck. The filtration cloth may be reused, depending upon the nature of the manure, or disposed of at the disposal site. The filter cloth is manufactured of non-woven polypropylene similar to "GEOTUBE" membrane fabrics and is not detrimental to landfill operations. Filtration performance is not dependant on ancillary process systems.

For manure management applications the DryBox technology is available in three containers. The basic DryBox unit is a 20 cubic yard rolloff container, as shown in Figure 2. Alternate, and possibly more convenient containers for farm use, include aluminum body dump trailers and side dump hoppers such as silage dump hoppers.

Figure 2

DryBox Dewatering System Schematic



Handling and installation costs are negligible. In fact, system handling is limited to filter cloth replacement. Installation does not entail any infrastructure; the operation of the DryBox can be carried out on any reasonable level area that is convenient to the user. It is ideal to have the DryBox housed in an enclosure with modest heat to prevent freezing of the manure, similar to other separation systems. However, DryBox performance has proven satisfactory in unheated shed applications.

Mini DryBox

The Mini DryBox 200 is a small scale version of the DryBox. It is used for very small municipal sludge treatment applications, specialty chemical sludge applications and for demonstration programs. The principal of operation is identical to the DryBox with the exception of the method of discharging of the dewatered solids.

The solids are collected within a fabric liner in a removable basket. This basket is removed by a fork truck and the fabric, along with the dewatered solids, is discharged out to the basket's clam shell style bottom.

Figure 3

Mini DryBox 200 Equipment Configuration

SqueezeTower Press

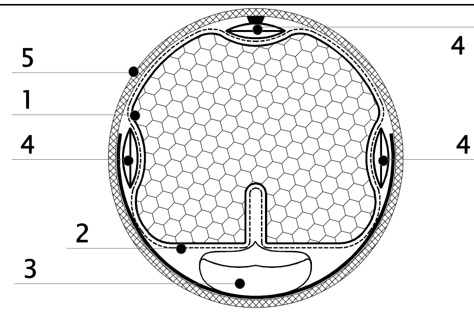
The SqueezeTower Press has potential use as a polish filter for NTP Filtrate from the DryBox, which may be further clarified with the balance of the organic nitrogen removed in addition to the remaining suspended solids. The basic building block of the SqueezeTower Press is the active filtration™ filter press. This operation has three stages, filling, pressurization and detachment/discharge. The system operates in fully automated, semi continuous/batch mode. The filter press construction consists of a large tubular filter membrane "hose" suspended within a longitudinal arrangement of bladders installed within a metal cylinder.

During filling, the bladders are partially inflated. The dilute fiber and water manure slurry is pumped into the filter hose with gravity and pressure separation of the liquid from the slurry occurring through the membrane. The flow rate gradually declines as fiber and filler accumulate on the internal face of the filter membrane. From the Noblehurst Farm demonstration project, the optimum flow degradation pattern has been determined for each water source to establish the desired filling cycles.

The filtered water passes through the membrane and descends down within the cylinder in the annular space between the membrane and the cylinder wall created by the bladders. The filtrate collects in a pan at the base of each filter and then drains off through a drain pipe.

Figure 4

General SqueezeTower Press Internal Arrangement

1 2 3 4 5	**TUBULAR FILTER** **MEMBRANE** **DRAINAGE NET** **PRESSURIZATION** **BLADDER** **DETACHMENT BLADDER** **CASING**	

Once the filling cycle is completed, the six bladders inflate in a programmed sequence to further compress the fiber manure and force out additional liquid. Following this pressing stage a bottom discharge port is opened and additional bladder inflation and deflation are initiated to break up the compacted fiber manure cake created during the pressurization stage. This detaches any filter manure cake from the face of the membrane. This cake and the thickened slurry are discharged from the bottom of the filter press. Then the discharge door closes and the filter resets and restarts the filling cycle.

The filtration membrane media is a highly durable, woven, calendared, polypropylene fabric. This media is manufactured to provide high clarity filtrate independent of supplemental filter filtration aids (other than common flocculants). The calendared surface promotes the detachment of materials during discharge. The filtration performance is not dependant upon ancillary process systems such as sweetener addition. The primary potential failure mode in this technology is blinding of the membrane and an associated reduction of flow. This failure, although uncommon, is easily corrected with clear water flushing sequences. This is unlike conventional systems in which the failure mode is typically solids breakthrough or carryover and the resultant poor clarity.

Section 2

DEMONSTRATION METHODOLOGY, RESULTS AND COMPARISON TO CONVENTIONAL TECHNOLOGIES

Demonstration Methodology

Three sources of manure were tested during the demonstration; raw unseparated manure taken directly from the barn, digested unseparated manure taken directly from the digester, and digested and separated manure filtrate from a screw press. All feed stock materials were generated by the host farm. Demonstrations of the Nutrient Trap Process performed subsequent to this project have shown that similar performance is observed with roller press separated manure filtrate and with flush barn manure streams. Limited testing was also performed on filtrate from the DryBox that was "polish" treated through the SqueezeTower press.

Approximately 24 DryBox batches and six (6) SqueezeTower Press batches were run in total. A schematic of the demonstration process system is provided in Appendix B. Dewatering was performed as follows:

1. Manure from the desired source was delivered into a 500 gallon storage tank. The intent was to provide sufficient manure to complete a set of at least three (3) replicates. The tank contained a 1.75 Hp gear driven mixer with an 8" propeller blade. The speed of the mixer was adjusted with a rheostat control to achieve visible movement of the manure in the tank. (The speed of the mixer was not specifically recorded as this is not considered a significant process parameter. However, the required mixer speed would be higher to maintain mixing on unseparated raw manure than filtrate manure from a screw press due to the lower solids concentration and viscosity.)
2. The supply manure was drawn from the storage tank with either an air diaphragm or a peristaltic pump. There was no apparent impact on the process based on the pump selection, however the flow control on the peristaltic pump was provided by a variable frequency drive that provided far superior flow rate control. The operating flow rate for the process was in the range of 5 gpm.
3. At the discharge of the pump on the storage tank the metal chloride was injected directly into the delivery line. Direct injection of the metal chloride was determined to be the most effective and stable method of addition with the best results for mixing. The flow rate of the metal chloride was controlled by a mechanical diaphragm feed pump. The flow of the metal chloride was matched at its maximum anticipated flow rate of 1% metal chloride to manure slurry. (Please note that this flow rate is very site-specific and unique to the process conditions and the selection of the polymer used for this demonstration. This value has been shown in commercial practice to be very site-specific, based upon parameters such as manure pH, manure collection method, bedding material, etc.)
4. Following the injection of the metal chloride the slurry was collected in a small collection tank. Slurry was pumped into the collection tank in approximately 90 gallon batches.
5. The partially treated manure was drawn from the small collection tank with a peristaltic pump. The operating flow rate for the process was in the range of 5 gpm.

6. At the discharge of the pump on the small collection tank the diluted polymer was injected directly into the delivery line. Direct injection of the polymer was determined to be the most effective and stable method of addition with the best results for mixing. The flow rate of the diluted polymer was controlled by a rubber impeller gear pump with diverting valves for feed of the polymer to the process and return of the excess to the polymer supply tank. The flow of the polymer was matched at its maximum anticipated flow rate of 350 parts per million (ppm) polymer (bone dry basis) to manure slurry. (Please note that this flow rate is very site-specific and unique to the process conditions and the selection of the polymer used for this demonstration. This value has been shown in commercial practice to be very site-specific based upon parameters such as manure collection method, bedding material, etc.)
7. Following the injection of the polymer the slurry was collected in a larger flocculation tank, until there were approximately 250 to 300 gallons in the tank. The flocculation tank contained a fractional horsepower, low speed, large bladed mixer. The speed of the mixer was adjusted with a rheostat control to achieve visible movement of the slurry in the tank. The minimum adjustable speed of the mixer, approximately 30 RPM, was sufficient to maintain the movement of the slurry.
8. The flocculated manure was drawn from the flocculation tank with a peristaltic pump.
9. The flocculated manure slurry was delivered directly into the DryBox. For this process the Mini-DryBox 200 was used. For each replicate approximately 80 to 90 gallons of slurry was delivered into the DryBox. The pneumatic bladder cycles within the DryBox were set at 12 minutes on and 12 minutes off. In all cases there was no free water emanating from the DryBox drain following 20 hour of operation. Each batch was allowed to dewater overnight, then the solids were removed and sampled.
10. The filtrate was collected in a 250 gallon storage tank. A portion of the filtrate from this was recycled back to into the process as dilution water for the polymer; the balance was discharged.
11. The dewatered manure solids were removed from the Mini DryBox with a fork truck and stacked for storage.
12. For a small number of batches the manure slurry was pumped from the flocculation tank to the SqueezeTower Press for several cycles. The clarified filtrate from the DryBox in the filtrate collection tank was re-treated with metal chloride and with polymer similar to the manure slurry. This slurry was fed to the SqueezeTower Press. The purpose of these cycles was to determine the capability of the SqueezeTower Press as a polishing filter for the DryBox. In these cases the dewatered solids discharged directly from the SqueezeTower Press into a container and the filtrate was collected in the filtrate collection tank.

Demonstration Results

A summary of the demonstration results are described herein. All laboratory testing was performed by Dairy One and Cornell University.

NTP Filtrate

Phosphate reduction exceeded 98% and organic nitrogen reduction exceeded 90%. When treated in the SqueezeTower Press, organic nitrogen removal exceeded 97% and essentially all particulate matter was removed. If a farm requires that less phosphate be removed from the filtrate, the extent of phosphate removal may be adjusted by methods discussed at the end of Section 3. Potassium and ammonia nitrogen, both of which are valuable and necessary components of fertilizer, were retained by the NTP filtrate.

The filtrate had a minimal odor compare to liquid manure produced in conventional treatment processes.

Essentially all particulate matter was removed from the NTP Filtrate. As such, it may be used as irrigation water or fertilizer, and spread with a typical irrigation or spray mechanism. Conventional manure slurry systems require that the slurry be transferred and spread over land with mobile equipment.

Typically, *E. coli* concentrations in raw manure range from 33,000 to 80,000 MPN/gram. The *E. coli* concentrations in the NTP Filtrate were consistently in the range of 20 to 80 MPN/gm. The low level of bacteria in the NTP filtrate may allow for spreading of the manure on sensitive crops such as hay without concern for bio-security.

Due to the low levels of particulate matter and bacteria the NTP Filtrate may be cost effectively treated with ozone. Preliminary evaluations by commercial ozone treatment equipment manufacturers have suggested that a 150 watt ozone generator would be required for the treatment of up to 20,000 gallons per day of the NTP Filtrate, which would render filtrate free of all bacteria and/or any remaining malodorous character. This should allow for use of the filtrate on hay crops for irrigation and/or fertilizer at a savings to the farmer.

The low level of bacteria coupled with the reduced odor would also allow for the reuse of the NTP filtrate as gray water within a barn. Historically, recirculation of poor quality water in flush style barns has resulted in the accumulation of salts and nutrients. However, with the Nutrient Trap Process, the phosphate and organic nitrogen nutrients are extracted from the flush water with each trip out of the barn, which prevents the accumulation of these salts. Additionally, the recirculation of poor quality flush water has shown to accumulate slime on the barn floors and alleyways in warm weather, which is mitigated by increasing the volume of fresh water introduced into the flush water systems and through the use of lime. The use of NTP filtrate for barn flushing or as dilution water for flush water systems is expected to reduce the fresh water and lime requirements to some extent. However, the extent of the reduction will be site-specific.

Dewatered Manure

The dewatered solids were stiff and mud-like, containing approximately 14 – 20% solids. The dewatered solids were higher in organic nitrogen nutrients than conventional dewatered manure, thereby retaining much of their value as a fertilizer. The dewatered solids were spreadable with a slinger style spreader. However, the dewatered solids did not appear suitable for use as a bedding material due to the elevated moisture content, compared to conventional treatment process. The solids were evaluated by a major composting equipment and supply company, as well as several farmers involved with commercial composting, who agreed that, with the addition of appropriate amendments, they would produce an acceptable composted material.

In subsequent testing of the NTP Process, dewatered solids samples were tested by Pennfield Corporation, and were found to retain insoluble phosphate. It will be necessary for the regulatory agencies to recognize the benefit of the phosphate being rendered insoluble and therefore no longer available for contamination of the watersheds. Modifications to the regulations for testing and for land application associated with this technology would be required. Following such regulatory relief the farmers may be allowed to spread the solid manure to the limitation of other criteria nutrients in their manure stream. Typically this is a far more lenient limitation than for phosphate dependant upon site specific soil conditions and crop nutrient uptake.

System Energy Consumption

System energy consumption averaged 3 to 7 cubic feet per minute of compressed air at 30 pounds per square inch gauge (psig), which is approximately equivalent to 1.5 HP. Subsequent demonstrations have shown similar flow rate to manure processing rates of up to 8000 pounds per day (bone dry basis), which equates to a power consumption rate of approximately 0.005 HP per pound of manure. The existing dewatering equipment at the host farm required a 15 HP motor for operation of the screw press. The capacity of the screw press was in the range of 1500 pounds per hour (bone dry basis), which equates to a power consumption rate of approximately 0.010 HP per pound of manure. However, the screw press captures only 40% to 55% of the solids, so the adjusted rate is actually closer to 0.020 HP per pound. (Note: solids produced by the screw press do achieve a higher level of dryness than those produced by the Nutrient Trap Process). The pumping and mixing apparatus power requirements were not included for this evaluation since they would be similar for both the Nutrient Trap Process and conventional treatment processes.

Spray application of the NTP filtrate and subsequent spreading of the NTP dewatered solids would provide for a reduction in diesel fuel consumption in the range of 150 gallons per week for a typical 500 head dairy. Additionally, for a typical farm of this size approximately 5,000 gallons per day of NTP filtrate could be recycled to the barn or used as irrigation water, which would reduce annual diesel fuel consumption by an additional 5000 gallons. Combined, these equate to potential savings of nearly 15,000 gallons of diesel fuel per year.

Economics

The estimated cost for manure spreading is in the range of $0.009 to $0.015 per gallon for farms with suitable proximate lands for spreading, adjusted for 2006 fuel costs. This estimate is based upon a sampling of the fees charged for contracted disposal of liquid manure in Pennsylvania, Wisconsin and Connecticut, as well as interviews with dairymen from those states and New York State. Based on the interviews, if a farm must move the manure farther than four miles, the cost increases. The current operating cost for a typical farm using the Nutrient Trap Process will be in the range of $0.008 per gallon[7]. For a farm handling 10,000 gallons per day this represents a potential savings in the range of $25,000 per year based upon current fuel costs. This is not a significant cost savings; however, the auspices of the new regulations for nutrient management may render all or portions of some farm land unsuitable for spreading of any manure or require drastically reduced spreading. This will force the farmer to pursue more distant lands for treatment of manure. The NTP dewatered solids may be more economically transported to more suitable lands and to locations for alternative processing such as composting. The values of this benefit cannot be quantified as the alternative to some farmers in sensitive watersheds without this option could be to cease operations. A sample analysis of these savings is provided in Appendix C.

Other

Mass and nutrient balances for a model farm are described in Section 3 with additional information provided in Appendix C. The number of acres required for the spreading of liquid manure can be drastically reduced when the NTP process is used. In a realistic model, there was a 700% reduction in the land area required for spreading of the liquid manure.

[7] The cost of the Nutrient Trap Process is primarily chemical costs. This cost is based upon a proprietary chemical formulation that is currently part of a U.S. Patent filing and is not available for publication at this time.

Consistent performance of nutrients and solids removal was observed during the demonstration. A summary of process repeatability is presented in Table 2-1.

Table 2-1
Summary of Process Repeatability (for all manure streams)

	Nutrient Concentration in Manure and resultant NTP Filtrate Values listed are in Pounds Per 1,000 Gallons		
Nutrient	Average	Minimum	Maximum
	Phosphate		
Source Manure	5.1	3.6	6.0
NTP Filtrate	0.2	0.0	0.3
Dewatered Manure	9.7	6.5	13
Percent Reduction	98%	92%	100%
	Organic Nitrogen		
Source Manure	15.3	14.4	18.2
NTP Filtrate	1.6	0.2	3.1
Dewatered Manure	36	28	44
Percent Reduction	90%	83%	100%
	Total Nitrogen		
Source Manure	39.4	37.3	41.5
NTP Filtrate	21.4	17.9	25.8
Dewatered Manure	56.2	45.3	66.2
Percent Reduction	45%	34%	57%
	Potash Equivalent		
Source Manure	23.5	20.5	28
NTP Filtrate	18.9	15.3	22.4
Dewatered Manure	20	14.2	27.7
Percent Reduction	18.2%	11%	32.9%
	Total Solids *		
Source Manure	8.%	4.3%	13.8%
NTP Filtrate	1.57%	0.61%	2.77%
Dewatered Manure	15.9%	10%	20.6%
Percent Reduction	79%	68%	85%

* Suspended solids were essentially eliminated and not visible in the filtrate.
Note 1: This table is based upon all of the data from the demonstration program. Therefore the source manure nutrient concentrations do not necessarily coincide with specific samples of the NTP Filtrate or the Dewatered Manure nutrient concentrations.
Note 2: Raw data is provided in Appendix D.

Comparison to Conventional Technologies

The Nutrient Trap Process is more cost effective than conventional technologies, and provides phosphate removal rates available only in much more expensive, energy-intensive, or labor intensive technologies such as chemically enhanced dissolved air floatation, vacuum drum filters, or filter presses. Tables 2-2 and 2-3 depict the comparative economics and utility of the Nutrient Trap Process to Conventional Technologies. The Nutrient Trap Process may be operated independently but is most cost effective when used downstream of a conventional coarse separation system (i.e., screw press or roller press). The NTP dewatered solids may be slightly higher in moisture content than the solids produced available from a roller press, but it is still suitable for broadcast spreading with a slinger spreader. In addition, the phosphate in the NTP dewatered solids is chemically bound in an insoluble metal phosphate salt.

The economic analysis shown in Table 2-2 depicts the cost of the Nutrient Trap Process alone and in conjunction with a conventional separation process. The operating cost is decreased when used in conjunction with a mechanical separation process, due to the lower chemical requirements.

Conventional mechanical separation technologies used in conjunction with a chemical regimen similar to the Nutrient Trap Process would not be expected to yield comparable levels of solids removal and filtrate clarity due to the fact that they subject the manure slurry to high pressures and/or excessive shear. These conditions would break down the chemical bonds that enhance the separation and resultant clarity of the NTP filtrate. In addition, conventional technologies operate on the premise of mechanical separation through screens with openings that allow for most or all of the fines from the manure to pass on to the filtrate.

In all cases the liquid manure spreading cost associated with each technology is not included in the analysis. As discussed above this cost is lower with the Nutrient Trap Process than with the manure from conventional separation processes. The costs associated with any of the regional facilities considered below would be reduced when combined with multiple onfarm Nutrient Trap Processes. The liquid mass that makes up over 65% of the total mass of the manure would remain on the farm and be reused and or spread as clarified liquid. Only the dewatered solids would require transportation to and handling and treatment at the regional facility. If necessary for operation of a digester, the solids could be rewetted into a slurry at the central site. Following digestion and mechanical separation, the water could subsequently be removed using the Nutrient Trap Process and recirculated to rewet the new incoming manure.

Table 2-2

Summary of Economic Analyses

Scenario	Capital Cost			Operating Costs/Income			Total cost per Cow per year[8]	
	Total	Annualized 6% Interest	Annualized 2% Interest	O & M	Income	Net Cost	6%	2%
Farms								
Nutrient Trap Process Alone	$150,000	$15,465	$11,667	$20,445	$0	$20,445	$282	$263
Nutrient Trap Process After L/S Separation[9]	$137,000	$14,125	$10,656	$20,445	$0	$20,445	$173	$156
Liquid/Solids Separation Alone	$387,000	$39,900	$30,100	$60,100	$0	$60,100	$500	$451
Combined Nutrient Trap + L/S Separation[10]	$484,000	$49,900	$37,644	$80,545	$0	$80,545	$652	$591
Liquid/Solids Separation With Conventional Chemical Precipitation	$487,000	$50,100	$37,900	$103,500	$0	$103,500	$768	$707
Composting After L/S Separation	$570,000	$58,700	$44,300	$123,200	$65,430	$57,770	$582	$510
Regional Facility								
Composting with Liquid/Solids Separation at Farms[11]	$2,580,000	$266,000	$201,000	$686,000	$562,000	$124,000	$156	$130
Composting with Regional Digester	$9,830,000	$1,012,000	$765,000	$1,758,000	$1,062,000	$696,000	$683	$584
Composting with Regional Digester and Chemical Precipitation	$10,450,000	$1,076,000	$813,000	$2,176,100	$1,317,000	$859,000	$774	$669

[8] Total cost per cow equal to the annualized capital cost plus the net operating cost. Design bases for single farm and regional facility are 200 and 2,500 cows, respectively.
[9] Nutrient Trap Process After L/S Separation is intended to indicate the addition of the Nutrient Trap Process downstream of an existing conventional mechanical liquid solid separation system.
[10] Combined Nutrient Trap + L/S Separation is intended to indicate the complete installation of conventional mechanical liquid solid separation in conjunction with the Nutrient Trap Process.
[11] Capital and operating cost do not include the cost of liquid/solids separation equipment at the farms.

Table 2-3
Summary of Comparison of Technologies

Dairy Manure – Individual Farm Options					
	Review Parameter	**Liquid/Solid Separation**	**Composting Whole Manure**	**Liquid/Solid Separation and Chemical Precipitation**	**Nutrient Trap Process following Liquid Solid Separation**
1.	Technical Feasibility	High, Similar Facilities Exist	High, Similar Facilities Exist	Moderate. Note many Full-size Facilities	Moderate to High
2.	Economic Feasibility	$500 per cow per year Cap. Cost = $387,300	$643 per cow per year Cap. Cost - $663,000	$768 per cow per year Cap. Cost = $486,600	$282 per cow per year Cap. Cost = $150,000
3.	Nutrients moved to a new market or to a solids phase	19% of N 50% of P (31% of N is lost)	24% of N 100% of P (76% of N is lost)	29% of N 92% of P (46% of N is lost)	90% of Organic Nitrogen 99.9+% of P
4.	Water Pollution Impacts	Neutral	Positive	Positive	Positive
5.	Air Emission Impacts	Neutral	Neutral	Neutral	Positive
6.	Renewable Energy Production	None	None	None	None
7.	CT Class I Renewable Portfolio Standard	Does Not Meet	Does Not Meet	Does Not Meet	Does Not Meet
8.	Greenhouse Gases	No Change	No Change	No Change	Positive
9.	Criteria Air Pollutants	No Change	No Change	No Change	Positive
10.	Funding Mechanisms	EQUIP Funding	EQUIP Funding	EQUIP Funding	EQUIP Funding
11.	Contribution to Climate Change Action Plan	N/A	N/A	N/A	N/A

Note 1: The data provided in 2-4 and 2-5 tables that does not relate to the Nutrient Trap Process has been obtained from the Wright Pierce draft report to the State of Connecticut regarding manure management options (Feasibility Study for Alternative Technologies and Utilization for managing Dairy and poultry Manure. Submitted to the Connecticut Department of Environmental Protection – Draft Report October 2005)

Section 3

DEVELOPMENT OF PROCESS DESIGN FOR A MODEL FARM

General Process Concepts

A process design for a typical 800 head dairy farm practicing scrape manure removal is provided within this section. Of course, each individual farm will have site-specific variations including logistics, bedding material, existing sub systems and colloquial farm practices. For this example, the farm uses sawdust bedding, and a Houle roller press for primary manure liquid solid separation. The design would be similar for a farm using a screw press or separator tumbling drums. Additionally, hybrid systems could be developed for farms using both sand and sawdust bedding, or combinations of the two. Farms using paper mill sludge would see performance similar to sawdust bedding applications. Typical process schematics are provided in Appendix B.

A typical 800 head dairy farm with scrape manure handling will produce approximately 5,000,000 gallons per year of manure filtrate from a Houle separator at a solids concentration of approximately 4%. For this example, the Nutrient Trap Process would be designed to treat 20,000 gallons per day, which would provide for up to two days per week for non-operation or for catching up on processing volume in the event of problems with the upstream systems. The process operating capacity would be in the range of 30 to 60 gallons per minute (GPM), which would provide for approximately 5.5 hours per day of normal operation.

The Houle separator system would continue to be fed from a manure pump in a large, raw manure storage tank adjacent to the barn. The separated coarse materials would continue to drop into a separated manure storage shed. However, the system would be modified as follows:

- The filtrate from the Houle separator would drain into a new 10,000 gallon concrete equalization pit, which is required to dampen out the normally and typically occurring variations in the nature of the filtrate from the Houle separator. The equalization pit would be constantly agitated.
- The Houle filtrate would be drawn from the equalization pit by one of two matched trash pumps. Two pumps are provided in order to provide for an installed on line spare in the event that one of the pumps experiences a failure.
- The discharge from the trash pumps would be directed to a concrete treatment tank. Along the pipeline from the equalization pit to the treatment tank there would be ports for injection of the treatment chemicals. An in-line monitoring system would be installed to provide management of all of the chemical feed rates through a metering pump.
- The chemically treated manure would pass through the treatment tank and discharge into a delivery system. The manure would drain by gravity to the DryBox Separator.

- The NTP filtrate would drain from the DryBox to the NTP filtrate pit. From this pit a pump would transfer the NTP filtrate to an existing manure storage tank that would become the NTP filtrate storage tank.
- The manure solids would be discharged directly into a solids manure spreader where material with would be added to achieve the desired consistency for spreading and/or composting. Alternately the solids could be stockpiled for land spreading without supplemental materials if appropriate.

Two DryBox containers are proposed of this model. With a single DryBox the drainage period would be approximately 16 to 18 hours for a given “batch”. From prior experience, 24 hours are required to achieve a suitable dewater solid. Therefore the second DryBox has been added to the design.

The operating and maintenance costs for the model consist of chemical purchases, maintenance costs , and minimal electric power costs. The model would require a connected electrical load in the range of 15 to 20 HP, which would include the manure transfer pumps currently used by conventional mechanical separation systems. Based upon the expected cycle times and associated power requirements, an annual cost of $7,500 would be required for electric power for this farm.

The annual cost for chemicals for this model is based upon the demonstration project rates extrapolated to an annual consumption rate. The costs are based upon the specific coagulant and flocculants used for the demonstration work. The annual chemical cost is estimated at $0.007 per gallon of manure input into the system. These costs would be lower for manure systems using pre-separation equipment, as the primary operating costs are for chemicals; liquids with higher concentrations of manure solids typically require more chemicals to treat.

With respect to maintenance costs historical results indicate that the bladders and membranes have a two-to-three-year life. A complete bladder and membrane set for an average-sized dairy farm (i.e., 95 head) would be in the range of $4,000. Other miscellaneous maintenance would also be required (e.g., pumps, valves, instrumentation). For purposes of this report an assumed annual maintenance cost of 2.5% of the capital equipment cost has been used. This cost would be in the range of $3,750.

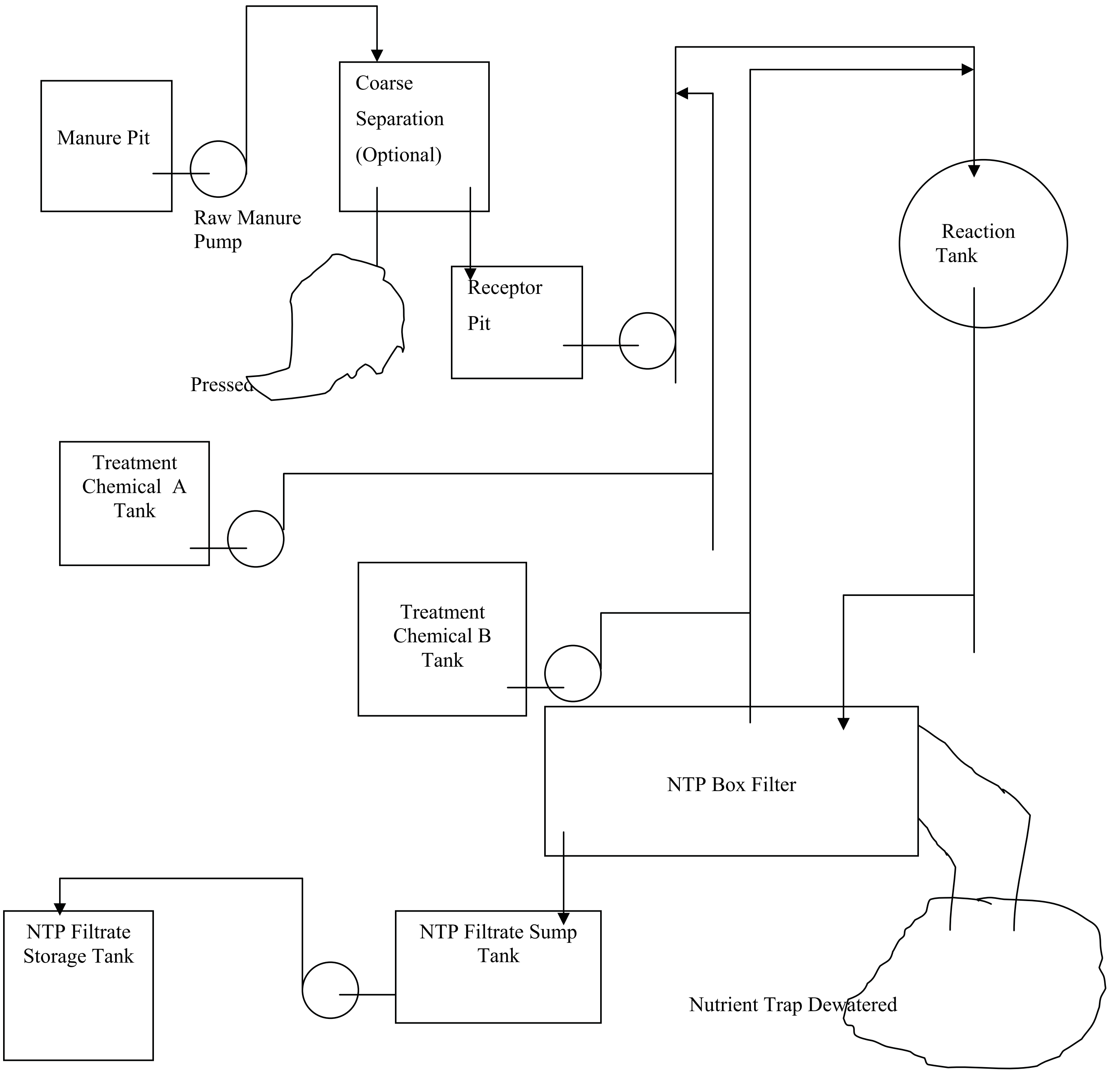
The filtration media proposed for this model would be semi permanent and require replacement on a two-to-four- week cycle. The replacement cost is in the range of $500 per month. The replacement task require two laborers for approximately two hours.

The Nutrient Trap Process is fully automated. However, daily observation of the system discharge would be required to ensure proper operation.

For dairy operations where removal of all of the phosphates and organic nitrogen are not mandated, the process could be modified to treat the percentage portion of the manure stream required to meet the nutrient management requirements. The balance of the flow could bypass the process and be re-blended with the NTP filtrate. This configuration would be most practicable for farms practicing flush operations or farms using pre-separation equipment such as a screw press or roller press from which a thinner filtrate is produced. This would allow for easier flow control of the manure slurry to the process and would also separate out a significant portion of the solid manure, and its associated nutrients, prior to the process so that the nutrients are still available for spreading if so desired. The system cannot, however, be modified by reducing the amount of chemical treatment added to the entire stream. This would inhibit adequate coagulation and flocculation, which will lead to blinding and plugging of the filtration fabric.

Figure 5

Model Nutrient Trap Process Configuration for a Typical Farm



Section 4
BENEFITS

Economic Benefits

The greatest overall benefits of using the Nutrient Trap Process will be experienced by the typical dairy farm that is facing limits on the amount of manure that can be spread on proximate lands. Preliminary estimates indicate that for a typical 500 head dairy farm with an existing conventional coarse separation system the simple return on investment (ROI) for the capital cost of the system would be in the range of 15%. This is solely based on the estimated savings in liquid manure spreading costs. The savings do not include potential additional benefits such as reduced operations and maintenance costs or the value of the recovered nutrient laced cake for beneficial reuse as a soil nutrient additive. These would be site-specific but may add significantly to the overall ROI.

Additionally, potential savings of up to $55 per acre are associated with the ammonia nitrogen and potash fertilizer level. On a farm where the NTP filtrate could be spread over 250 acres, an additional $13,750 could be saved, which increases the simple ROI to 27%. Conventional practices may limit the application of liquid manure in a concentrated manner due to bacterial or phosphate levels. However, this is not the case in filtrate produced by the Nutrient Trap Process. Again, these savings are site specific and based upon soil nutrient loadings and crop nutrient uptake rates.

The economics could also be improved through the sale of the conventional manure handling equipment. Conservative estimates base upon interviews indicate that the potential recoverable cost from the sale of portions of the conventional manure handling equipment may offset 50% to 90% of the cost of a NTP system. Additionally, with the promulgation of the CAFO regulations, Congress has set aside considerable funding for equipment purchases to assist farmers in meeting the regulations.

One of the more significant economic benefits that could come from using the Nutrient Trap Process is the potential sale of the nutrient credits. Recent legislation has been passed in the state of Pennsylvania that allows farmers, whom are able to reduce and/or sequester and remove nutrients from the Chesapeake Bay watershed, to sell the offset of these nutrients to farms, industries or municipalities that are economically or physically unable to meet their nutrient release limitations. This program is in its infancy, however, nitrogen credits are currently being traded for up to $10 per pound and phosphate credits for up to $5 per pound. For a model farm in southern Pennsylvania the value of these credits would be in the range of $150,000 per month. A sample calculation deriving the potential revenue stream from the trading of nutrient credits is provided in Appendix C. The economic benefits from nutrient credits are contingent on a number of factors including:

1. The farmer must have the means and methods to remove the dewatered solids from the watershed. The ability of the NTP system to concentrate the nutrients into the solid mass makes this more feasible. It is anticipated that entrepreneurial companies will develop methods to collect solids for processing at central composting or digestion facilities, a business development strategy that is currently being developed in Pennsylvania.
2. The trading of nutrient credits would typically be conducted through a broker. The broker and any of his agents would retain a portion of the value of the credits for their fee.
3. The value of the credits will vary; as more farms are able to market the credits the value may fall.
4. Other states will also consider the implementation of nutrient trading.

Emission Reduction

As a result of decreased diesel consumption, truck and tractor emissions will also be reduced. Based upon the U.S. DOT's Federal Highway Administration Estimation of Future Truck and Tractor Emissions, for the average truck traveling five miles the estimated reduction in emissions per 100 truckloads would be as follows:

Table 4-1

Potential Individual Farm Emission Reductions per 100 Truckloads

	Pounds/Year	
Pollutant	**Current**	**2010**
VOC	0.75	0.48
CO	4.5	2.14
NOx	25.3	9.8
PM-10	0.48	0.2

If the NTP technology were used on only 10% of the dairy farms in New York State there would be an associated reduction of 70,000 tons of manure requiring transportation to remote fields. At an average of 22 tons per truckload this would represent 3200 truckloads per year.

Based upon these volumes the estimate of reduced emissions across New York State would be as follows:

Table 4-2
Potential State Wide Emission reductions

	Pounds/Year	
Pollutant	**2002**	**2010**
VOC	24	15.36
CO	144	68.48
Nox	809.6	313.6
PM-10	15.36	6.4

Water Quality Benefits

With its unique, near complete phosphate and solids capture rate, the Nutrient Trap Process provides the only known cost effective commercial means to control non-point source farm generated nutrient runoff. Moreover, with its 90% organic nitrogen capture rate it is currently the best known commercially-viable solution to the overall nutrient overload problem within sensitive New York State watersheds. In fact, all New York State watersheds could benefit from non-point runoff control of phosphates and organic nitrogen, and these benefits are not limited to New York State. Additionally, in light of recent events on the Black River, the elimination of manure lagoon storage would also be a significant benefit.

APPENDICES

Appendix A

DEMONSTRATION PROJECT METHODOLOGY AND ANALYSIS OF DATA

TEST MATRIX AND PROTOCOL
Table A-1

Testing Matrix

Protocol #	FILTRATION PROTOCOL Three Replicates per Protocol	Separation Equipment			% Solids Manure Feed	% Solids in Nutrient Trap Solids	% Solids in NTP Filtrate	Processing Rate	Johnes	K (Potassium)	P (Phosphate)	OP (Ortho Phosphate)	ON (Organic Nitrogen)	VN (Volatile Nitrogen)	E. coli
		DBX SF	DBX LLF	SQZBX											
1	Digested Manure - Filtrate from Screw Press	X	X		X			X		X	X	X	X	X	X
	NTP Filtrate from Nutrient Trap Process						X	X		X	X	X	X	X	X
	Dewatered Manure from DryBox					X				X	X	X	X	X	X
2	Digested Manure - Direct from Digester (Not Screw Press)	X	X		X			X		X	X	X	X	X	X
	NTP Filtrate from Nutrient Trap Process						X	X		X	X	X	X	X	X
	Dewatered Manure from DryBox					X				X	X	X	X	X	X
3	Raw Manure – Not Screw Pressed *	X	X		X			X	X	X	X	X	X	X	X
	NTP Filtrate from Nutrient Trap Process						X	X		X	X	X	X	X	X
	Dewatered Manure from DryBox					X				X	X	X	X	X	X
4	Raw Manure – Not Screw Pressed (Aged) **	X	X		X			X	X	X	X	X	X	X	X
	NTP Filtrate from Nutrient Trap Process						X	X		X	X	X	X	X	X
	Dewatered Manure from DryBox					X				X	X	X	X	X	X
5	DryBox NTP Filtrate			X	X					X	X	X	X	X	X
	NTP Filtrate from Nutrient Trap Process									X	X	X	X	X	X
	Dewatered Manure from Tower					X				X	X	X	X	X	X

Separation Equipment Key – DBX SF - DryBox with Standard Filter Cloth DBX LLF - DryBox with Reusable Filter Cloth
SQZBX - Tower Filter (Squeeze Box)

See Notes on Following Page

Note 1: The laboratory testing was conducted by Dairy One (Standard Manure Nutrient Analysis), and by Cornell University (spot sampling and testing of Johes and of e. coli (MPN method))

Note 2: The compressed air consumption to the DryBox for the initial week of operation was observed. This was observed to be completely repeatable and was no longer checked.

Note 3: The motor horse power on the existing screw press separator at the host farm was noted as 15 Hp. The operator indicated that the motor generally runs at full load.

Note 4: Screw Pressed Raw Manure was not evaluated. The host farm does not have the mechanical means to deliver raw manure to the inlet of the screw press. Subsequent commercial scale demonstration programs with flush manure systems and Houle roller press separation systems have supported that the performance on mechanically separated raw manure and flush barn manure will be in accordance with the results of this demonstration.

* Note 5: Due to problems with sampling only two replicate samples were available for protocol #3. The results were nearly identical to each other, however and significantly similar to protocol 4.

** Note 6: Protocol 4 used raw non separated manure. This manure was treated with the reagents and left to age for two to eight days in the flocculation tank with constant mixing. The purpose of this Protocol was to determine the impact of the process on long term, low speed, mixing of the flocculated manure prior to separation.

Table A-2
Summary of Demonstration Project Data Analysis

	COMPONENTS (Average Values in %)														
	NITROGEN (N)		AMMONIA NITROGEN		ORGANIC NITROGEN		PHOSPHORUS (P)		PHOSPHATE EQUIVALENT (P205)		POTASSIUM (K)		POTASH EQUIVALENT (K20)		TOTAL SOLIDS
	%AS REC'D	LBS/TON	%AS REC'D	LBS/TON	%AS REC'D	LBS/TON	%AS REC'D	LBS/TON	%AS REC'D	LBS/TON	%AS REC'D	LBS/TON	%AS REC'D	LBS/TON	%AS REC'D
MANURE	0.48%	9.6	0.30%	5.9	0.19%	2.7	0.06%	1.2	0.14%	2.9	0.24 %	4.8	0.29 %	5.7	4.2% - 13.8 %
NTP FILTRATE	0.26%	5.2	0.24%	4.9	0.02%	0.4	0.00%	0.0	0.00%	0.1	0.19 %	3.9	0.23 %	4.7	1.7%
DEWATERED MANURE	0.67%	13.4	0.24%	4.7	0.44%	8.7	0.11%	2.3	0.26%	5.2	0.20 %	3.9	0.24 %	4.8	17.7 %
AVERAGE % REDUCTION IN NTP FILTRATE	45%		16%		90%		99%		97%		18%		18.5%		80%
MINIMUM % REDUCTION IN NTP FILTRATE	34%		3.4%		83%		92%		96%		8.3%		8.6%		68%
MAXIMUM % REDUCTION IN NTP FILTRATE	56%		38%		100%		100%		100%		31%		31%		85%

See Notes on Following Page

Note 1: This table shows the average values of the nutrients and solids based upon all of the data from the demonstration program. Therefore the source manure nutrient concentrations do not necessarily coincide with specific samples of the NTP Filtrate or the Dewatered Manure nutrient concentrations. It is provided for general information to depict the overall performance of the Nutrient Trap Process.

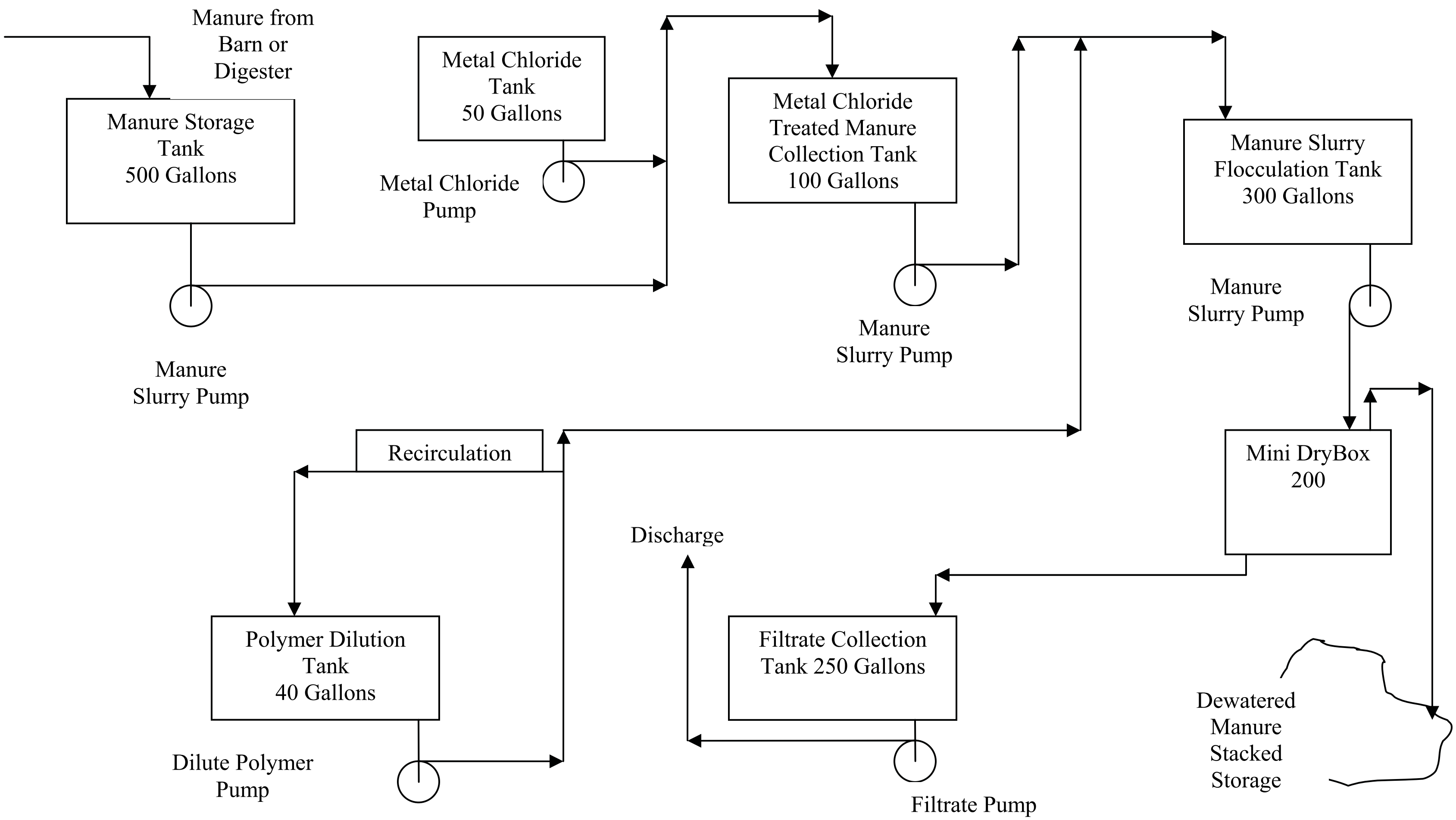
Note 2: Table includes results from all manure streams tested (Raw unseparated, Digested unseparated and Digested separated with a screw press) Raw Data is provided in Appendix D

Note 3: The Percent Solids in the NTP Filtrate Consist Primarily of dissolved solids. Suspended solids are minimal, generally not visible.

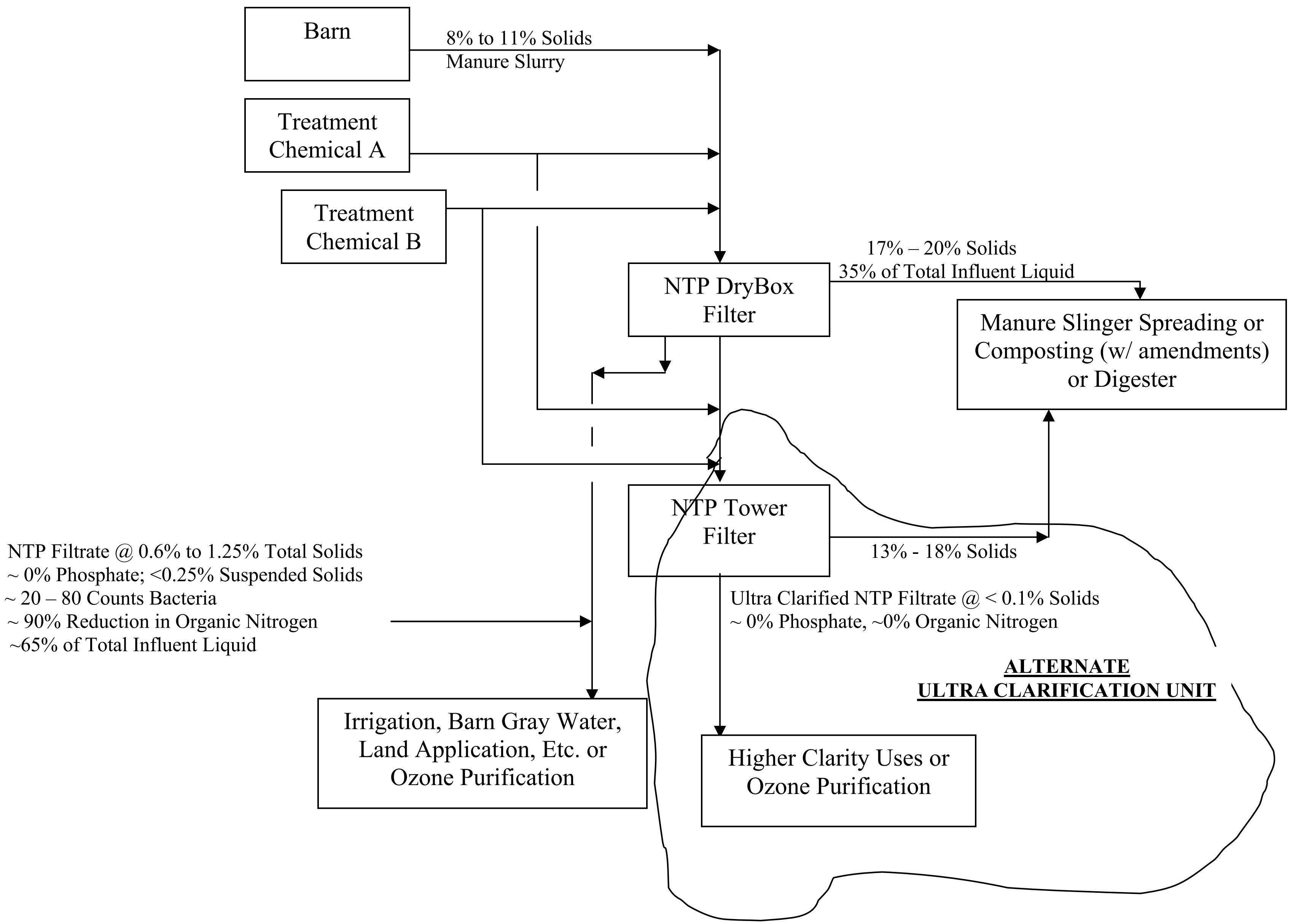
Appendix B

PROCESS SCHEMATICS

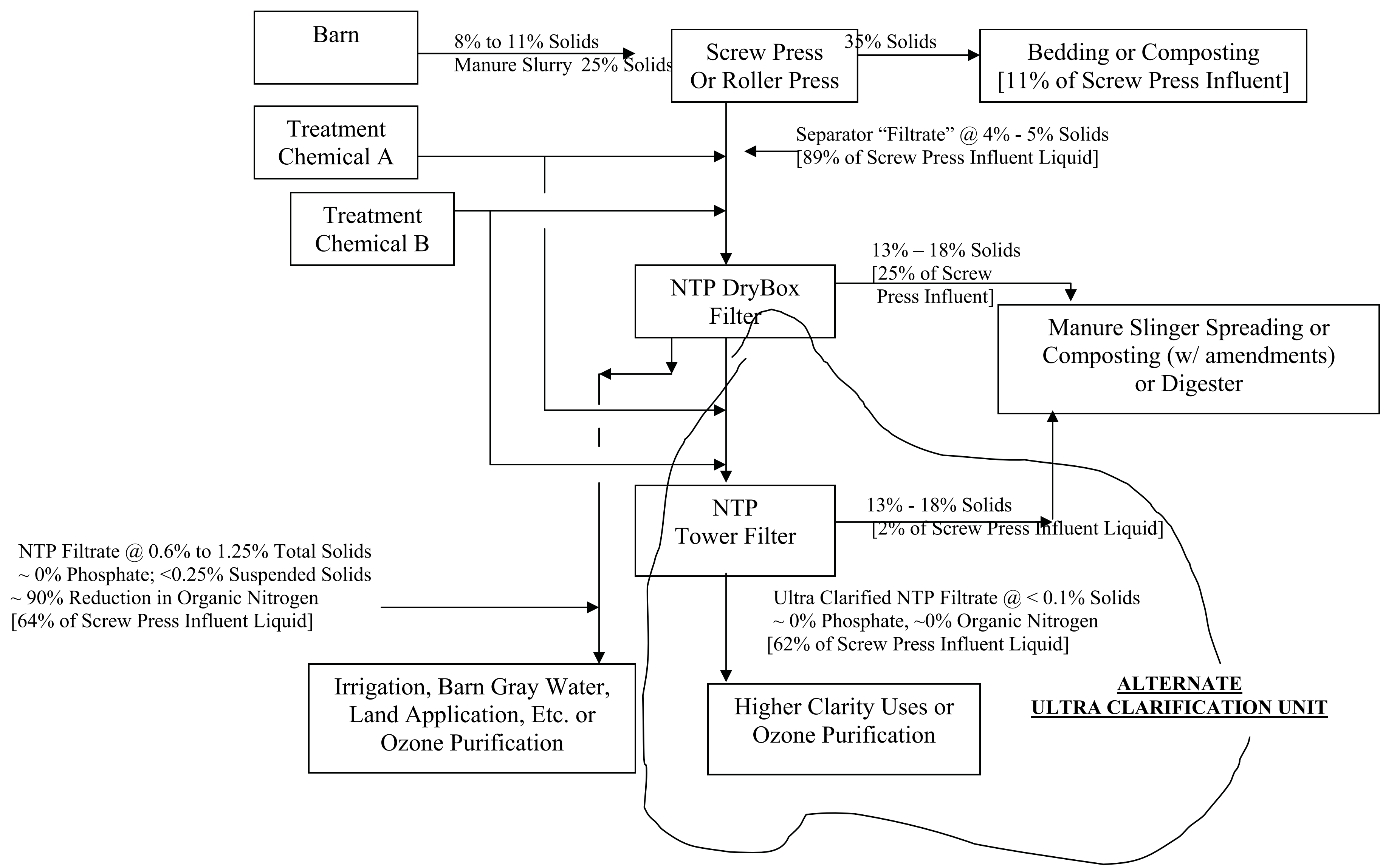
Figure B-1
DEMONSTRATION PROCESS SCHEMATIC
NUTRIENT TRAP PROCESS



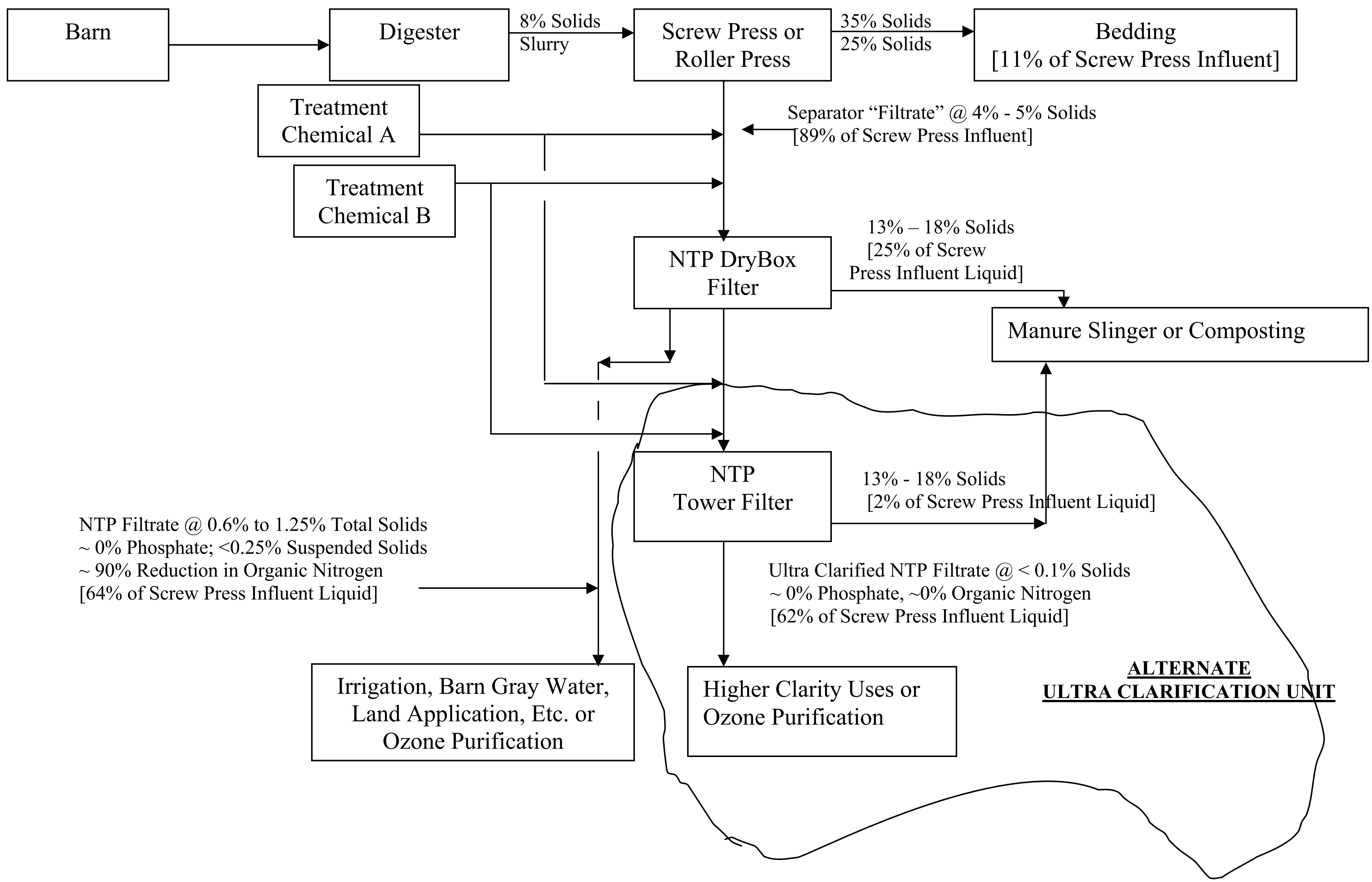
“NUTRIENT TRAP PROCESS (NTP)” SEPARATION TECHNOLOGY FOR MANURE MANAGEMENT
“TYPICAL” SAWDUST BEDDING APPLICATION W/O PRE-SEPARATION OF COARSE SOLIDS



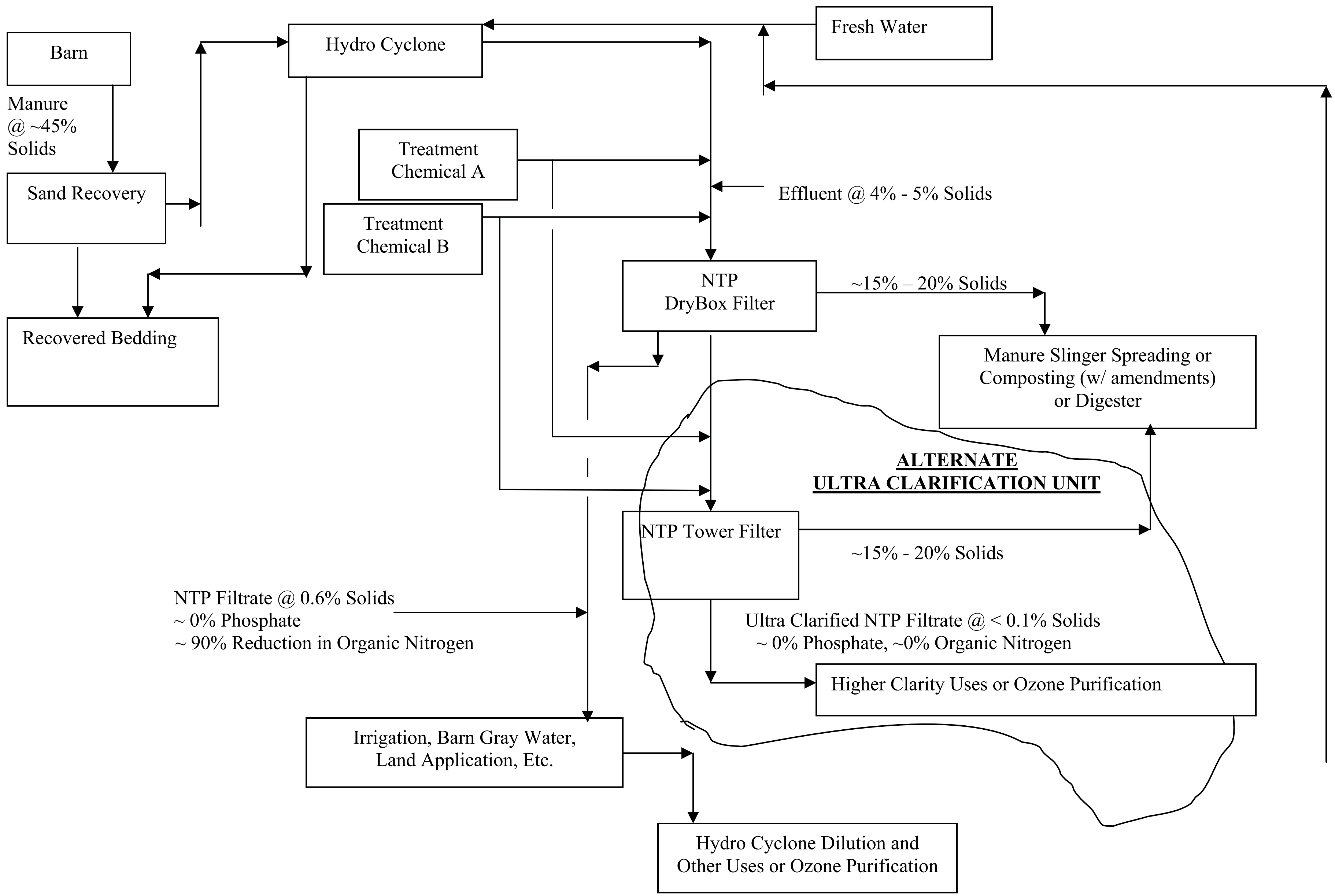
"NUTRIENT TRAP PROCESS (NTP)" SEPARATION TECHNOLOGY FOR MANURE MANAGEMENT
"TYPICAL" SAWDUST BEDDING APPLICATION W/ PRE-SEPARATION OF COARSE SOLIDS



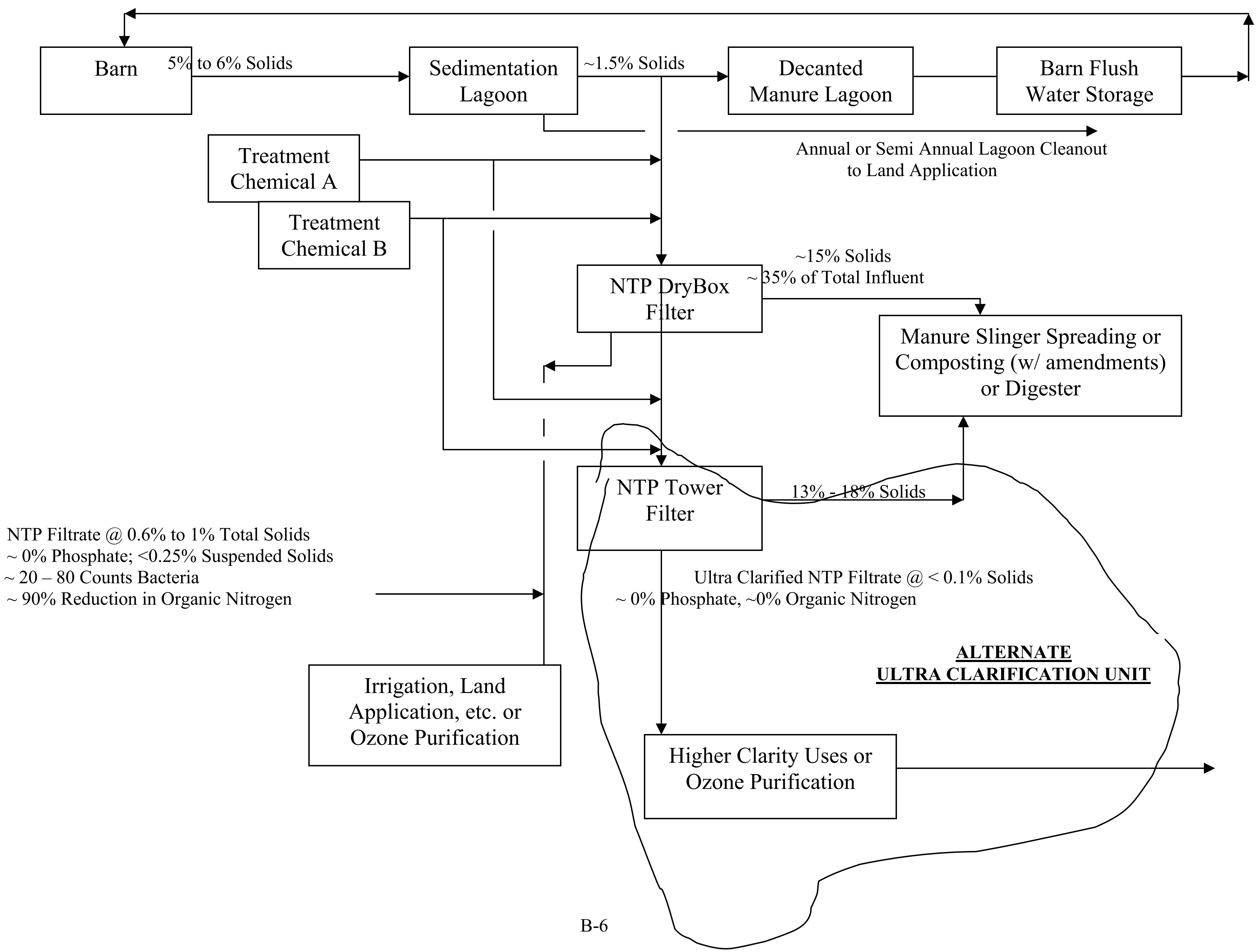
“NUTRIENT TRAP PROCESS (NTP)” SEPARATION TECHNOLOGY FOR MANURE MANAGEMENT
“TYPICAL” SAWDUST BEDDING APPLICATION
W/ DIGESTER PLUS PRE-SEPARATION OF COARSE SOLIDS



“NUTRIENT TRAP PROCESS (NTP)” SEPARATION TECHNOLOGY FOR MANURE MANAGEMENT
“TYPICAL” SAND BEDDING APPLICATION



“NUTRIENT TRAP PROCESS (NTP)” SEPARATION TECHNOLOGY FOR MANURE MANAGEMENT
“TYPICAL” FLUSH BARN WITH SAWDUST BEDDING APPLICATION



Appendix C

CALCULATIONS AND SPREAD SHEETS

MASS AND NUTRIENT BALANCE AND SPREADING PLAN FOR A SAMPLE FARM

The following tables depict the projected results of treatment of manure from an actual proposed farm expansion in upstate New York. These tables show the results of treating the manure based upon the current practice (Screw Press dewatering alone) and the proposed process (Screw Press Followed by the Nutrient Trap Process (NTP)).

The first table (Table C-1.1) depicts the change in the number of acres required for spreading of the manure based upon the current practice compared to the proposed. The daily volume of manure has been estimated at 80,000 GPD, which is approximately equivalent to 29,000,000 gallons per year.

The succeeding tables depict the anticipated results of treating the manure from the sample farm in the areas of solids and nutrient removal performance. The results of the succeeding tables were used to develop Table C-1.1. The tables demonstrate a 700% reduction in the land area required for spreading of the NTP treated manure. In practicality the realistic limitation may actually be based upon the hydraulic absorption capacity of the land and no longer the nutrient loading.

Table C-1.1

Liquid Manure Application Plan

Nutrient		Phosphate	Total Nitrogen	Potassium
Filtrate from Screw Press Alone				
Nutrient Limitation	#/Acre	0.25	19	4.6
Nutrient Concentration	#/1,000 Gallon	3.59	37.38	11.07
Allowable Spreading Rate	Gallons per Acre	70	508	415
Acres Required for 29,000,000 Gallons per Year		**1148**	157	193
Limiting Nutrient for Land Application ----------		**Phosphate**		
Filtrate from Nutrient Trap Process (NTP) following Screw Press Pre-separation				
Nutrient Limitation	#/Acre	0.2	19	4.6
Nutrient Concentration	#/1,000 Gallon	0.13	25.02	9.26
Allowable Spreading Rate	Gallons per Acre	1599	759	497
Acres Required for 29,000,000 Gallons per Year		50	105	**161**
Limiting Nutrient for Land Application --				**Potassium**
Reduction in Required Acres for Spreading of Liquid manure		**987**		
Percent Reduction in Spreading Acres Required		**713%**		

Table C-1.2

Manure Stream From Farm X
(Actual Data for proposed Farm Expansion in Upstate NY)

Approximate Gallons Per Day -		80,000
Approximate Total Head on Premises -		2700
NUTRIENTS	lbs/day	#/1,000 Gal
Organic Nitrogen - (Org N)	1461	18
Ammonia - (NH3N)	256	3
Total Nitrogen - (Total N)	1717	21
Phosphate - (P)	305	4
Potassium - (K)	941	12
Phosphate Equivalent - (P2O5)	693	9
Potassium Equivalent - (K20)	1130	14

Proposed Management Process

The manure will be dewatered in the Screw Press to a solids concentration of approximately 30% to 35%.
The filtrate from the Screw Press will be treated in the Nutrient Trap Process and Dewatered in the DryBox.
Assumptions:

- Screw Press Solids for Bedding @ 30% (assumed worst case, actual performance varies from 30% to 39% solids)
- Screw Press Filtrate @ 5% (based upon results from host mill)
- NTP Solids to Spreading @ 14% to 16% Solids
- NTP Filtrate @ ≤1.25% solids with < 0.2% Suspended Solids

Table C-1.3

Manure Solids Removal Results			% Solids in Stream	#/Day Solid in Stream	TTL #/Day in Stream	TTL GPD in Stream	TTL CuYD/Day of Stream	
	Flow to Screw Press	% of Total Solids in Stream						
	Screw Press Inlet	100%	6.5%	46,079	708,900	85,000		
	Screw Press Bedding	43%	37%	19,814	53,551	6,421	44	
	Screw Press Filtrate	57%	5.0%	26,265	655,349	78,579		
	Flow to NTP	% of Total Solids in Stream						
	NTP Inlet	100%	5.0%	26,265	655,349	78,579		
	NTP Filtrate	19%	1.00%	4,977	497,658	59,671		
	NTP Cake	81%	14%	21,288	157,692	18,908	90	

Table C-1.4

Phosphate Removal Results			% P in Stream	#/Day P in Stream	TTL #/Day in Stream	TTL GPD in Stream	# P /1,000 Gal	# P /Ton
	Flow to Screw Press	% of Total P in Stream						
	Screw Press Inlet	100%	0.04%	305	708,900	85,000		
	Screw Press Bedding	43%	0.04%	131	53,551	6,421		**4.90**
	Screw Press Filtrate	57%	0.04%	282	655,349	78,579	**3.59**	
	Flow to NTP	% of Total P in Stream						
	NTP Inlet	100%	0.04%	282	666,323	78,579		
	NTP Filtrate	2.5%	0.0015%	7	462,725	55,483	**0.13**	**0.03**
	NTP Cake	98%	0.14%	275	203,599	24,412		**2.70**

Table C-1.5

Potassium Removal Results			% P in Stream	#/Day P in Stream	TTL #/Day in Stream	TTL GPD in Stream	#/1,000 Gal "K"	#/Ton "K"
	Flow to Screw Press	% of Total K in Stream						
	Screw Press Inlet	100%	0.13%	941	708,900	85,000		
	Screw Press Bedding	43%	0.13%	71	53,551	6,421		**2.66**
	Screw Press Filtrate	57%	0.13%	870	655,349	78,579	**11.07**	
	Flow to NTP	% of Total K in Stream						
	NTP Inlet	100%	0.13%	870	666,323	78,579		
	NTP Filtrate	43%	0.11%	514	462,725	55,483	**9.26**	**2.22**
	NTP Cake	57%	0.11%	357	203,599	24,412		**3.50**

Table C-1.6

Organic Nitrogen Removal Results			% TKN in Stream	#/Day TKN in Stream	TTL #/Day in Stream	TTL GPD in Stream	# TKN /1,000 Gal	# TKN /Ton
	Flow to Screw Press	% of Total OrgN in Stream						
	Screw Press Inlet	100%	0.21%	1,461	708,900	85,000		
	Screw Press Bedding	43%	0.21%	110	53,551	6,421		**4.12**
	Screw Press Filtrate	57%	0.21%	1,350	655,349	78,579	**17.18**	
	Flow to NTP	% of Total OrgN in Stream						
	NTP Inlet	100%	0.21%	1,350	666,323	78,579		
	NTP Filtrate	7%	0.02%	93	462,725	55,483	**1.67**	**0.40**
	NTP Cake	93%	0.62%	1,258	203,599	24,412		**12.36**

Table C-1.7

Ammonia Removal Results			% NH3N in Stream	#/Day NH3N in Stream	TTL #/Day in Stream	TTL GPD in Stream	# NH3N /1,000 Gal	# NH3N /Ton
	Flow to Screw Press	% of Total NH3N in Stream						
	Screw Press Inlet	100%	0.24%	1,717	708,900	85,000		
	Screw Press Bedding	43%	0.24%	130	53,551	6,421		**4.84**
	Screw Press Filtrate	57%	0.24%	1,587	655,349	78,579	**20.20**	
	Flow to NTP	% of Total NH3N in Stream						
	NTP Inlet	100%	0.24%	1,587	666,323	78,579		
	NTP Filtrate	71%	0.24%	1,121	462,725	55,483	**20.20**	**4.84**
	NTP Cake	29%	0.24%	493	203,599	24,412		**4.84**

Table C-1.8

Total Nitrogen Removal Results			% NH3N in Stream	#/Day NH3N in Stream	TTL #/Day in Stream	TTL GPD in Stream	# NH3N /1,000 Gal	# NH3N /Ton
	Flow to Screw Press	% of Total NH3N in Stream						
	Screw Press Inlet	100%	0.45%	3,178	708,900	85,000		
	Screw Press Bedding	43%	0.45%	240	53,551	6,421		**8.97**
	Screw Press Filtrate	57%	0.45%	2,938	655,349	78,579	**37.38**	
	Flow to NTP	% of Total NH3N in Stream						
	NTP Inlet	100%	0.45%	2,938	666,323	78,579		
	NTP Filtrate	47%	0.30%	1,388	462,725	55,483	**25.02**	**6.00**
	NTP Cake	53%	0.76%	1,549	203,599	24,412		**15.22**

Table C-2

Potential Diesel Fuel Consumption and Cost Reductions with Nutrient Trap Process

Weekly Reduction in Gallons of Diesel Fuel	852
Reduction in Gallons of Diesel Fuel per Gallon of Manure	0.005
Reduction in Cost of Diesel Fuel per Gallon of Manure	$ 0.0134
Annual Reduction in Gallons of Diesel Fuel	44,290
Annual Reduction in Cost of Diesel Fuel	$ 121,797

Basis of Evaluation (Western New York Dairy Farm)

Tractor Diesel Fuel Consumption Rate***	0.87	lb. per Hp per Hour
2004 Agricultural Fuel Cost ***	$2.50	$ per gallon

***per US DOE Reports

Head Cows Milked Daily	1200	
Head of Heifers	400	
Approx. Percent of manure spread as liquid	67%	
Volume of Manure Spread as Liquid	25,000	Gallons

Current Practice

Manure Slurry - Pumped ~700 feet through a 6" Main to Storage Lagoon

Horse Power of Transfer Pump	100	Hp
Hrs per year	200	

44.6	Gallons per week for Transfer
0.25	Gallons fuel per 1,000 gallon manure for Pumping
2320	Gallons per year for pumping

Nurse Tankers for Transfer of Liquid Manure from Lagoon to Distant Field for Spreading

Horse Power for Nurse Tankers	200	Hp
Hrs per week	10	15

116	Gallons per week for Nurse Tankers @ 40% of Engine Hp
0.66	Gallons fuel per 1,000 gallon manure for Nurse Tankers
6032	Gallons per Year for Nurse Tankers

Tankers for Manure Spreading

Horsepower of Tractor Pulling Tanker	200	Hp
Average Loads Per Day	3.5	
Gallons of Manure Per Load	7500	Gallons

26.5	Gallons fuel per Load of Manure @ 50% of Tractor Hp
650	Gallons per week for Spreading
3.54	Gallons fuel per 1,000 gallon manure for Spreading
33779	Gallons per year for Spreading

Spreading Tanker Loading @ Lagoon

Loading Pump Horsepower	100	Hp
Hours Per Year @ Lagoon	300	400

4.6	Gallons per hour for Loading Manure @ 40% of Pump Engine Hp
62	Gallons per week for Loading
0.36	Gallons fuel per 1,000 gallon manure for Loading
1624	Gallons per year for Loading Tankers

Heifers & Dry Cow Manure

Horsepower of Tractor Pulling Slinger Spreader	200	Hp
Loads per Week	4	

9.3	Gallons Per Hr for Slinger Spreader @ 40% of Tractor Hp
28	Gallons per Load for Slinger Spreader
111	Gallons Per Week for Slinger Spreader
5791	Gallons per year for Slinger Spreader

Summary

Current Practice

4.81	Gallons of Fuel per 1,000 gallon of liquid manure for handling and spreading
$0.013	$ for Fuel per gallon of liquid manure handling and spreading
873	Gallons per week for Hauling and Spreading Liquid Manure
111	Gallons Per Week for Slinger Spreader
984	Gallons per week for Hauling and Spreading Liquid and Heffer Manure
51,170	Gallons per year for Hauling and Spreading Liquid and Heffer Manure

Nutrient Trap Practice

Spreading NTP Filtrate as Irrigation Water and Spreading NTP Dewatered Solids w/ Slinger Spreader

45	Gallons of Fuel per week required to pump NTP Filtrate for Irrigation
2,320	Gallons of Fuel per year required to pump NTP Filtrate for Irrigation
3	Slinger Spreader Trips per week to Spread NTP Dewatered Solids
88	Gallons of Fuel per week for Spreading NTP Dewatered Solids
4,560	Gallons of Fuel per year for Spreading NTP Dewatered Solids
132	Total Gallons of Fuel per week for Spreading NTP Filtrate and NTP Dewatered Solids
0.76	Gallons of Fuel per 1,000 gallon of NTP Filtrate and NTP Dewatered Solids Spreading
$0.002	$ for Fuel per gallon of NTP Filtrate and NTP Dewatered Solids handling and spreading
6,880	Total Gallons of Fuel per year for NTP Filtrate and NTP Dewatered Solids

44,290	Annual Reduction in Gallons of Diesel Fuel
$121,797	Annual Reduction in Cost of Diesel Fuel

Table C-3

Potential Revenue Stream Associated with Nutrient Credit Trading

Number of Head on Farm	1,000
Gallons of Liquid Manure Spread per Year	15,000,000
Current Phosphate Level	2.2
NTP Percent Reduction of Phosphate	98%
Proposed NTP Phosphate Level	0.044
Annual Reduction in Phosphate	32340
Current Trading Value of Phosphate Nutrient Credits $/ Pound	$5
Potential Annual Revenue from Phosphate Credits	$161,700
Current Total Nitrogen Level	12.5
NTP Percent Reduction of Nitrogen	90%
Proposed NTP Total Nitrogen Level	1.25
Annual Reduction in Nitrogen	168750
Current Trading Value of Nitrogen Nutrient Credits - $/ Pound	$10
Potential Annual Revenue from Nitrogen Credits	$1,687,500
Total Potential Nutrient Credit Value	$1,849,200

Note 1: Actual Data from sample farm in Southern Pennsylvania within Chesapeake Bay Watershed `

Appendix D

RAW DATA TABLES and DATA ANALYSIS GRAPHS

TABLE D-1
RAW DATA - NUTRIENT TRAP PROCESS DEMONSTRATION PROJECT

		COMPONENTS																								
		NITROGEN (N)			AMMONIA NITROGEN			ORGANIC NITROGEN			PHOSPHORUS (P)			PHOSPHATE EQUIVALENT (P205)			POTASSIUM (K)			POTASH EQUIVALENT (K20)			TOTAL SOLIDS	DENSITY		
SAMPLE DATE	DESCRIPTION	AS REC'D	LBS/TON	LBS/1000 GAL	AS REC'D	LBS/TON	LBS/1000 GAL	AS REC'D	LBS/TON	LBS/1000 GAL	AS REC'D	LBS/TON	LBS/1000 GAL	AS REC'D	LBS/TON	LBS/1000 GAL	AS REC'D	LBS/TON	LBS/1000 GAL	AS REC'D	LBS/TON	LBS/1000 GAL	AS REC'D	kg/l	#/cu.ft.	LBS/1000 GAL
	Digested Screw Press Filtrate																									
Run 1																										
02/22/2006	Digested Screw Press Filtrate in Storage Tk 2/22/05	0.47%	9.4	37.6	0.29%	5.8	23.2	0.18%	3.6	14.4	0.05%	1.00	4.0	0.12%	2.40	9.6	0.29%	5.80	23.2	0.35%	7.00	28.0	4.00%	0.96	59.82	7.99
02/22/2006	NTP Filtrate 2/22/05	0.25%	5.0	20.6	0.23%	4.6	19.0	0.02%	0.4	1.7	0.00%	0.00	0.0	0.00%	0.00	0.0	0.22%	4.40	18.2	0.26%	5.20	21.5	0.61%	0.99	61.69	8.25
02/22/2006	NTP Dewatered Manure 2/22/05	0.79%	15.8	66.2	0.27%	5.4	22.6	0.52%	10.4	43.6	0.13%	2.60	10.9	0.29%	5.80	24.3	0.27%	5.40	22.6	0.33%	6.60	27.7	12.38%	1.00	62.31	8.38
Run 2																										
03/18/2005	Digested Screw Press Filtrate in Storage Tk #18 FT	0.47%	9.4	38.4	0.29%	5.9	24.0	0.18%	3.5	14.4	0.06%	1.1	4.6	0.13%	2.6	10.5	0.23%	4.6	18.6	0.28%	5.5	22.5	4.25%	0.98	61.06	8.17
03/18/2005	NTP Filtrate #18 F	0.25%	5.0	20.0	0.23%	4.6	18.2	0.02%	0.5	1.8	0.00%	0.0	0.2	0.00%	0.1	0.4	0.18%	3.5	13.9	0.21%	4.2	16.8	0.82%	0.95	59.19	7.92
03/19/2005	NTP Dewatered Manure #18-19 C	0.75%	15.1	61.1	0.23%	4.7	19.0	0.52%	10.4	42.1	0.14%	2.7	11.0	0.31%	6.2	25.2	0.19%	3.8	15.3	0.23%	4.5	18.4	10.04%	0.97	60.44	8.12
03/19/2005	NTP Filtrate #19 F	0.25%	5.1	20.6	0.24%	4.8	19.4	0.01%	0.3	1.2	0.00%	0.0	0.1	0.00%	0.1	0.2	0.18%	3.5	14.4	0.21%	4.3	17.4	0.86%	0.97	60.44	8.13
03/20/2005	NTP Dewatered Manure #19-20 C	0.71%	14.2	58.5	0.27%	5.3	22.0	0.44%	8.8	36.5	0.16%	3.2	13.0	0.36%	7.2	29.8	0.22%	4.3	17.7	0.26%	5.2	21.4	12.70%	0.99	61.69	8.25
03/20/2005	NTP Filtrate #20 F	0.23%	4.7	18.6	0.22%	4.5	17.9	0.01%	0.2	0.8	0.00%	0.0	0.1	0.00%	0.0	0.2	0.17%	3.3	13.2	0.20%	4.0	15.9	1.07%	0.95	59.19	7.96
03/21/2005	NTP Dewatered Manure #20-21 C	0.71%	14.2	56.1	0.26%	5.1	20.3	0.45%	9.0	35.8	0.14%	2.8	11.3	0.33%	6.5	25.9	0.21%	4.2	16.5	0.25%	5.0	19.8	10.39%	0.95	59.19	7.92
03/22/2005	NTP Filtrate #21-22 F	0.26%	5.2	21.5	0.25%	5.0	20.4	0.01%	0.3	1.1	0.00%	0.0	0.1	0.00%	0.0	0.2	0.18%	3.7	15.2	0.22%	4.4	18.3	1.18%	0.99	61.69	8.23
03/22/2005	NTP Dewatered Manure #21-22 C	0.76%	15.2	61.7	0.28%	5.5	22.4	0.48%	9.7	39.3	0.13%	2.7	10.9	0.31%	6.1	24.9	0.22%	4.4	17.7	0.26%	5.3	21.3	11.46%	0.97	60.44	8.1
03/23/2005	NTP Filtrate #22-23 F	0.28%	5.6	23.2	0.25%	5.0	20.6	0.03%	0.6	2.5	0.00%	0.0	0.1	0.00%	0.1	0.3	0.19%	3.7	15.3	0.22%	4.5	18.4	1.26%	0.99	61.69	8.25
03/24/2005	NTP Dewatered Manure #23-24 C	0.74%	14.8	57.9	0.25%	5.0	19.8	0.49%	9.8	38.2	0.14%	2.7	10.6	0.31%	6.2	24.3	0.21%	4.2	16.6	0.26%	5.1	20.0	12.31%	0.94	58.57	7.83
03/24/2005	NTP Filtrate #24 TF	0.24%	4.8	19.8	0.24%	4.7	19.3	0.01%	0.1	0.5	0.00%	0.0	0.0	0.00%	0.0	0.0	0.18%	3.6	14.5	0.21%	4.3	17.5	1.07%	0.98	61.06	8.17
03/24/2005	Floc Tk #24 TWR FD	0.34%	6.8	27.8	0.24%	4.8	19.6	0.10%	2.0	8.3	0.01%	0.1	0.5	0.01%	0.3	1.1	0.18%	3.6	14.9	0.22%	4.4	17.9	2.93%	0.98	61.06	81.7
03/24/2006	NTP Dewatered Manure #24 TOWER SOLID	0.34%	6.8	27.7	0.24%	4.8	19.6	0.10%	2.0	8.2	0.01%	0.20	0.8	0.03%	0.60	2.4	0.20%	4.00	16.3	0.24%	4.80	19.6	4.72%	0.98	61.06	8.15
03/29/2005	NTP Filtrate #29 F	0.24%	4.8	19.8	0.25%	5.0	20.4	-0.01%	-0.2	-0.6	0.00%	0.0	0.1	0.00%	0.0	0.2	0.18%	3.6	14.6	0.22%	4.3	17.6	1.09%	0.98	61.06	8.17
03/30/2005	NTP Dewatered Manure #29-30 C	0.78%	15.6	59.1	0.27%	5.4	20.7	0.51%	10.1	38.4	0.13%	2.6	9.9	0.30%	6.0	22.7	0.21%	4.1	15.6	0.25%	5.0	18.8	14.74%	0.91	56.70	7.58
03/29/2005	NTP Filtrate #31 F	0.31%	6.2	25.2	0.29%	5.7	23.2	0.02%	0.5	1.9	0.00%	0.0	0.1	0.00%	0.1	0.3	0.20%	4.0	16.2	0.24%	4.8	19.5	1.37%	0.97	60.44	8.12
03/30/2005	NTP Dewatered Manure #29-30 C	0.74%	14.7	56.4	0.28%	5.5	21.0	0.46%	9.2	35.4	0.12%	2.4	9.3	0.28%	5.6	21.2	0.21%	4.1	15.8	0.25%	5.0	19.1	15.81%	0.92	57.33	7.65
	Unpressed Digested Manure																									
Run 3																										
03/30/2005	Unpressed Digested Manure in Stg Tk #3/30 NSRD FT	0.50%	10.0	41.3	0.32%	6.3	26.1	0.18%	3.7	15.1	0.07%	1.4	5.9	0.16%	3.2	13.4	0.22%	4.5	18.4	0.27%	5.4	22.2	8.63%	0.99	61.69	8.28
03/30/2005	NTP Filtrate #30 F	0.29%	5.7	22.7	0.26%	5.2	20.6	0.03%	0.5	2.1	0.00%	0.0	0.1	0.00%	0.1	0.2	0.18%	3.7	14.6	0.22%	4.4	17.6	1.27%	0.95	59.19	7.96
03/31/2005	NTP Dewatered Manure #30-31 C	0.70%	14.1	57.2	0.26%	5.3	21.5	0.44%	8.8	35.7	0.11%	2.3	9.3	0.26%	5.3	21.4	0.21%	4.1	16.8	0.25%	5.0	21.2	14.98%	0.97	60.44	8.13
03/31/2005	NTP Filtrate # SMT 3/31	0.31%	6.3	25.4	0.29%	5.8	23.4	0.02%	0.5	2.0	0.00%	0.0	0.2	0.00%	0.1	0.4	0.20%	4.0	16.2	0.24%	4.8	19.6	1.53%	0.97	60.44	8.09
04/01/2005	NTP Dewatered Manure #30-1 C	0.72%	14.3	59.3	0.28%	5.7	23.6	0.43%	8.6	35.7	0.11%	2.2	9.3	0.26%	5.1	21.3	0.21%	4.1	17.2	0.25%	5.0	20.7	15.15%	0.99	61.69	8.3
Run 4																										
04/02/2005	Unpressed Digested Manure in Stg Tk # FT 4/2	0.50%	9.9	41.5	0.32%	6.3	26.3	0.18%	3.6	15.2	0.07%	1.4	6.0	0.17%	3.3	13.8	0.23%	4.5	18.9	0.27%	5.5	22.8	7.84%	1.00	62.31	8.35
04/22/2005	NTP Filtrate # F 4/2	0.31%	6.3	25.6	0.29%	5.8	23.6	0.03%	0.5	2.1	0.00%	0.0	0.2	0.00%	0.1	0.4	0.20%	4.0	16.3	0.24%	4.8	19.7	1.34%	0.98	61.06	8.15
04/04/2005	NTP Dewatered Manure #2-3 C	0.69%	13.8	55.4	0.29%	5.9	23.5	0.40%	8.0	31.9	0.13%	2.5	10.2	0.29%	5.8	23.4	0.22%	4.4	17.7	0.27%	5.3	21.4	16.64%	0.96	59.82	8
04/03/2005	Floc Tank for Tower Feed #4/3 FEED TANK	0.28%	5.6	23.1	0.26%	5.1	20.9	0.03%	0.5	2.2	0.00%	0.0	0.1	0.00%	0.1	0.2	0.18%	3.6	14.8	0.22%	4.4	17.8	1.73%	0.98	61.06	8.18
04/03/2005	NTP Filtrate #4/3 TOWER FL	0.25%	5.1	20.3	0.25%	5.0	20.0	0.00%	0.1	0.3	0.00%	0.0	0.0	0.00%	0.0	0.1	0.18%	3.6	14.3	0.21%	4.3	17.2	1.48%	0.96	59.82	7.99
04/03/2005	NTP Dewatered Manure #4/3 TOWER MIX	0.63%	12.6	51.3	0.29%	5.7	23.3	0.34%	6.9	28.0	0.02%	0.5	1.9	0.05%	1.0	4.3	0.21%	4.3	17.4	0.26%	5.1	20.9	8.64%	0.97	60.44	8.13
04/03/2005	NTP Dewatered Manure #4/3 TOWER THI	0.70%	14.1	56.7	0.28%	5.7	22.8	0.42%	8.4	33.8	0.03%	0.6	2.4	0.07%	1.4	5.6	0.22%	4.4	17.8	0.27%	5.3	21.5	10.22%	0.97	60.44	8.05
04/08/2005	NTP Filtrate #4/8 F	0.22%	4.4	17.9	0.20%	3.9	15.9	0.02%	0.5	2.0	0.00%	0.0	0.1	0.00%	0.1	0.3	0.16%	3.1	12.7	0.19%	3.8	15.3	1.25%	0.97	60.44	8.23
04/09/2005	NTP Dewatered Manure 8-9 C	0.58%	11.7	49.9	0.16%	3.1	13.4	0.43%	8.5	36.5	0.11%	2.2	9.5	0.26%	5.1	21.8	0.14%	2.8	11.8	0.17%	3.3	14.2	17.23%	1.03	64.18	8.56

TABLE D-1
RAW DATA - NUTRIENT TRAP PROCESS DEMONSTRATION PROJECT

		COMPONENTS																								
		NITROGEN (N)			AMMONIA NITROGEN			ORGANIC NITROGEN			PHOSPHORUS (P)			PHOSPHATE EQUIVALENT (P205)			POTASSIUM (K)			POTASH EQUIVALENT (K20)			TOTAL SOLIDS	DENSITY		
SAMPLE DATE	DESCRIPTION	AS REC'D	LBS/TON	LBS/1000 GAL	AS REC'D	LBS/TON	LBS/1000 GAL	AS REC'D	LBS/TON	LBS/1000 GAL	AS REC'D	LBS/TON	LBS/1000 GAL	AS REC'D	LBS/TON	LBS/1000 GAL	AS REC'D	LBS/TON	LBS/1000 GAL	AS REC'D	LBS/TON	LBS/1000 GAL	AS REC'D	kg/l	#/cu.ft.	LBS/1000 GAL
	Unpressed Raw Manure																									
Run 5																										
04/08/2005	Unpressed Raw Manure in Stg Tk #4/8 RTW	0.48%	9.6	40.4	0.27%	5.3	22.2	0.22%	4.3	18.2	0.06%	1.2	4.8	0.13%	2.6	11.1	0.22%	4.3	18.1	0.26%	5.2	21.8	9.38%	1.00	62.31	8.38
04/09/2005	TREATED MANURE #4/9 FLOCK TK	0.34%	6.8	27.6	0.22%	4.3	17.6	0.12%	2.5	10.0	0.04%	0.7	3.0	0.08%	1.7	6.8	0.18%	3.5	14.2	0.21%	4.2	17.2	7.03%	0.97	60.44	8.09
04/09/2005	NTP Filtrate #4/9F	0.25%	5.0	20.4	0.23%	4.6	18.8	0.02%	0.4	1.6	0.00%	0.1	0.2	0.01%	0.1	0.5	0.18%	3.7	15.0	0.22%	4.4	18.0	1.46%	0.98	61.06	8.17
04/09/2005	NTP Dewatered Manure #4/9 C TP @ 6H	0.57%	11.4	45.3	0.22%	4.4	17.5	0.35%	7.0	27.8	0.08%	1.6	6.5	0.19%	3.8	15.0	0.18%	3.6	14.3	0.22%	4.3	17.2	13.82%	0.95	59.19	7.96
04/10/2005	NTP Dewatered Manure #4/9-10 C @ 18H	0.66%	13.2	56.5	0.22%	4.3	18.4	0.45%	8.9	38.1	0.12%	2.5	10.6	0.28%	5.7	24.2	0.19%	3.7	15.9	0.22%	4.5	19.1	19.59%	1.02	63.56	8.52
04/10/2005	NTP Filtrate #4/10 F	0.24%	4.8	19.7	0.22%	4.5	18.3	0.02%	0.4	1.4	0.00%	0.0	0.2	0.01%	0.1	0.4	0.18%	3.5	14.5	0.21%	4.2	17.5	1.47%	0.98	61.06	8.22
04/11/2005	NTP Dewatered Manure #4/10-11 C	0.64%	12.7	54.0	0.21%	4.2	17.9	0.42%	8.5	36.1	0.11%	2.1	9.1	0.25%	4.9	20.8	0.19%	3.9	16.6	0.23%	4.7	20.0	18.59%	1.02	63.56	8.51
04/11/2005	NTP Dewatered Manure 4/11 C	0.67%	13.5	56.4	0.20%	4.0	16.8	0.47%	9.4	39.6	0.11%	2.3	9.5	0.26%	5.2	21.8	0.19%	3.7	15.6	0.22%	4.5	18.8	20.30%	1.00	62.31	8.38
Run 6																										
04/12/2005	Unpressed Raw Manure in Stg Tk 4/12	0.46%	9.2	37.3	0.28%	5.6	22.7	0.18%	3.6	14.6	0.07%	1.3	5.4	0.15%	3.1	12.4	0.24%	4.8	19.6	0.29%	5.8	23.6	13.83%	0.97	60.44	8.09
04/18/2005	UNTREATED MANURE SLURRY VR1 Tower Feed	0.18%	3.5	14.3	0.16%	3.1	12.6	0.02%	0.4	1.7	0.03%	0.7	2.7	0.08%	1.6	6.3	0.23%	4.5	18.2	0.27%	5.4	22.0	1.12%	0.97	60.44	8.07
04/18/2005	NTP Filtrate VF1 Tower Filtrate	0.15%	3.1	12.5	0.14%	2.9	11.6	0.01%	0.2	0.9	0.00%	0.0	0.0	0.00%	0.0	0.1	0.22%	4.3	17.4	0.26%	5.2	21.0	0.81%	0.97	60.44	8.09
Manure Slurry Treated into Flocculation Tank																										
04/14/2005	MANURE SLURRY In Floc Tank 4/14 FL	0.45%	9.1	36.0	0.26%	5.1	20.2	0.20%	4.0	15.8	0.05%	0.9	3.6	0.10%	2.1	8.3	0.22%	4.4	17.3	0.26%	5.3	20.9	7.98%	0.95	59.19	7.92
04/14/2005	NTP Filtrate #4/14 F	0.29%	5.9	23.8	0.26%	5.1	20.7	0.04%	0.8	3.1	0.00%	0.1	0.3	0.01%	0.1	0.6	0.23%	4.6	18.6	0.28%	5.5	22.4	2.20%	0.97	60.44	8.09
04/26/2005	NTP Filtrate #4/14 F	0.28%	5.7	22.9	0.25%	5.1	20.6	0.03%	0.6	2.3	0.00%	0.1	0.3	0.01%	0.1	0.6	0.21%	4.3	17.4	0.26%	5.2	20.9	2.43%	0.97	60.44	8.1
04/15/2005	NTP Dewatered Manure #4-14-15C	0.62%	12.5	53.2	0.22%	4.5	19.2	0.40%	8.0	34.0	0.10%	2.1	8.8	0.24%	4.7	20.2	0.21%	4.1	17.7	0.25%	5.0	21.3	19.18%	1.02	63.56	8.52
04/26/2005	NTP Filtrate #4/15 F	0.26%	5.1	21.1	0.24%	4.8	19.8	0.02%	0.3	1.3	0.00%	0.0	0.2	0.01%	0.1	0.4	0.20%	4.1	16.7	0.24%	4.9	20.1	2.47%	0.98	61.06	8.22
04/16/2005	NTP Dewatered Manure #4-15/16C	0.60%	12.0	50.2	0.22%	4.4	18.6	0.38%	7.6	31.6	0.10%	1.9	8.1	0.22%	4.4	18.5	0.20%	4.0	16.8	0.24%	4.8	20.2	18.29%	1.00	62.31	8.35
04/26/2005	NTP Filtrate #4/16 F	0.24%	4.7	19.3	0.24%	4.8	19.5	0.00%	0.0	-0.2	0.00%	0.0	0.2	0.01%	0.1	0.4	0.21%	4.2	17.2	0.25%	5.0	20.7	2.45%	0.98	61.06	8.2
04/26/2005	NTP Dewatered Manure #4/16-18 C	0.69%	13.8	59.0	0.21%	4.3	18.3	0.48%	9.5	40.7	0.11%	2.1	9.0	0.24%	4.8	20.7	0.20%	4.0	16.9	0.24%	4.8	20.4	20.27%	1.03	64.18	8.56
04/26/2005	NTP Filtrate #4/18 F	0.23%	4.7	18.7	0.23%	4.7	18.6	0.00%	0.0	0.2	0.00%	0.1	0.2	0.01%	0.1	0.5	0.20%	4.0	15.9	0.24%	4.8	19.1	2.42%	0.98	61.06	7.97
04/26/2005	NTP Dewatered Manure #4/18-19 C	0.66%	13.3	55.8	0.20%	4.1	17.1	0.46%	9.2	38.7	0.11%	2.1	9.0	0.25%	4.9	20.6	0.19%	3.8	16.0	0.23%	4.6	19.3	20.58%	1.01	62.93	8.43
04/26/2005	NTP Filtrate #4/19 F	0.27%	5.4	21.4	0.25%	5.0	19.9	0.02%	0.4	1.6	0.00%	0.1	0.2	0.01%	0.1	0.5	0.22%	4.4	17.5	0.26%	5.3	21.0	2.77%	0.98	61.06	7.99
04/26/2005	NTP Dewatered Manure #4/20 C	0.62%	12.3	51.6	0.22%	4.3	18.1	0.40%	8.0	33.5	0.10%	2.0	8.2	0.22%	4.5	18.7	0.19%	3.9	16.3	0.23%	4.7	19.6	18.52%	1.00	62.31	8.38
04/26/2005	NTP Filtrate #4/20 F	0.25%	5.0	20.7	0.23%	4.5	18.6	0.03%	0.5	2.1	0.00%	0.1	0.2	0.01%	0.1	0.5	0.20%	4.0	16.3	0.24%	4.8	19.6	2.60%	0.98	61.06	8.18
04/26/2005	NTP Filtrate #4/21 F	0.24%	4.8	19.6	0.23%	4.5	18.4	0.01%	0.3	1.2	0.00%	0.0	0.0	0.00%	0.0	0.1	0.19%	3.9	15.7	0.23%	4.7	18.9	2.53%	0.97	60.44	8.1
04/21/2005	NTP Dewatered Manure for Tower #4/21 FD TK	0.26%	5.2	21.1	0.24%	4.8	19.2	0.02%	0.5	1.9	0.00%	0.0	0.2	0.01%	0.1	0.4	0.20%	4.0	16.2	0.24%	4.8	19.5	2.31%	0.97	60.44	8.07
04/25/2005	NTP Dewatered Manure From Tower #4/23C	0.57%	11.3	45.7	0.24%	4.7	19.0	0.33%	6.6	26.7	0.03%	0.6	2.5	0.07%	1.4	5.7	0.20%	4.1	16.3	0.24%	4.9	19.7	9.83%	0.97	60.44	8.05
Nutrate Fed to Tower (Copied From Above)																										
03/24/2005	Floc Tk #24 TWR FD	0.34%	6.8	27.8	0.24%	4.8	19.6	0.10%	2.0	8.3	0.01%	0.1	0.5	0.01%	0.3	1.1	0.18%	3.6	14.9	0.22%	4.4	17.9	2.93%	0.98	61.06	81.7
03/24/2005	NTP Filtrate #24 TF	0.24%	4.8	19.8	0.24%	4.7	19.3	0.01%	0.1	0.5	0.00%	0.0	0.0	0.00%	0.0	0.0	0.18%	3.6	14.5	0.21%	4.3	17.5	1.07%	0.98	61.06	8.17
03/24/2006	NTP Dewatered Manure #24 TOWER SOLID	0.34%	6.8	27.7	0.24%	4.8	19.6	0.10%	2.0	8.2	0.01%	0.20	0.8	0.03%	0.60	2.4	0.20%	4.00	16.3	0.24%	4.80	19.6	4.72%	0.98	61.06	8.15
04/03/2005	Floc Tank for Tower Feed #4/3 FEED TANK	0.28%	5.6	23.1	0.26%	5.1	20.9	0.03%	0.5	2.2	0.00%	0.0	0.1	0.00%	0.1	0.2	0.18%	3.6	14.8	0.22%	4.4	17.8	1.73%	0.98	61.06	8.18
04/03/2005	NTP Filtrate #4/3 TOWER FL	0.25%	5.1	20.3	0.25%	5.0	20.0	0.00%	0.1	0.3	0.00%	0.0	0.0	0.00%	0.0	0.1	0.18%	3.6	14.3	0.21%	4.3	17.2	1.48%	0.96	59.82	7.99
04/03/2005	NTP Dewatered Manure #4/3 TOWER MIX	0.63%	12.6	51.3	0.29%	5.7	23.3	0.34%	6.9	28.0	0.02%	0.5	1.9	0.05%	1.0	4.3	0.21%	4.3	17.4	0.26%	5.1	20.9	8.64%	0.97	60.44	8.13
04/03/2005	NTP Dewatered Manure #4/3 TOWER THI	0.70%	14.1	56.7	0.28%	5.7	22.8	0.42%	8.4	33.8	0.03%	0.6	2.4	0.07%	1.4	5.6	0.22%	4.4	17.8	0.27%	5.3	21.5	10.22%	0.97	60.44	8.05
04/21/2005	NTP Dewatered Manure for Tower #4/21 FD TK	0.26%	5.2	21.1	0.24%	4.8	19.2	0.02%	0.5	1.9	0.00%	0.0	0.2	0.01%	0.1	0.4	0.20%	4.0	16.2	0.24%	4.8	19.5	2.31%	0.97	60.44	8.07
04/25/2005	NTP Dewatered Manure From Tower #4/23C	0.57%	11.3	45.7	0.24%	4.7	19.0	0.33%	6.6	26.7	0.03%	0.6	2.5	0.07%	1.4	5.7	0.20%	4.1	16.3	0.24%	4.9	19.7	9.83%	0.97	60.44	8.05

TABLE D-2
DRYBOX PERFORMANCE DATA - NUTRIENT TRAP PROCESS DEMONSTRATION PROJECT

		COMPONENTS																							
		NITROGEN (N)			AMMONIA NITROGEN			ORGANIC NITROGEN			PHOSPHORUS (P)			PHOSPHATE EQUIVALENT (P205)			POTASSIUM (K)			POTASH EQUIVALENT (K20)			TOTAL SOLIDS	DENSITY		
SAMPLE DATE	DESCRIPTION	AS REC'D	LBS/TON	LBS/1000 GAL	AS REC'D	LBS/TON	LBS/1000 GAL	AS REC'D	LBS/TON	LBS/1000 GAL	AS REC'D	LBS/TON	LBS/1000 GAL	AS REC'D	LBS/TON	LBS/1000 GAL	AS REC'D	LBS/TON	LBS/1000 GAL	AS REC'D	LBS/TON	LBS/1000 GAL	AS REC'D	kg/l	#/cu.ft.	LBS/1000 GAL
	Digested Screw Press Filtrate																									
Run 1																										
02/22/2006	Digested Screw Press Filtrate in Storage Tk 2/22/05	0.47%	9.4	37.6	0.29%	5.8	23.2	0.18%	3.6	14.4	0.05%	1.00	4.0	0.12%	2.40	9.6	0.29%	5.80	23.2	0.35%	7.00	28.0	4.0%	0.96	60	8.0
02/22/2006	NTP Filtrate 2/22/05	0.25%	5.0	20.6	0.23%	4.6	19.0	0.02%	0.4	1.7	0.00%	0.00	0.0	0.00%	0.00	0.0	0.22%	4.40	18.2	0.26%	5.20	21.5	0.6%	0.99	62	8.3
02/22/2006	NTP Dewatered Manure 2/22/05	0.79%	15.8	66.2	0.27%	5.4	22.6	0.52%	10.4	43.6	0.13%	2.60	10.9	0.29%	5.80	24.3	0.27%	5.40	22.6	0.33%	6.60	27.7	12.4%	1.00	62	8.4
	Percent Reduction of Nutrient in Liquid	46.8%	46.8%	45.1%	20.7%	20.7%	18.1%	88.9%	88.9%	88.5%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	24.1%	24.1%	21.7%	25.7%	25.7%	23.3%	84.8%			
Run 2																										
03/18/2005	Digested Screw Press Filtrate in Storage Tk #18 FT	0.47%	9.4	38.4	0.29%	5.9	24.0	0.18%	3.5	14.4	0.06%	1.1	4.6	0.13%	2.6	10.5	0.23%	4.6	18.6	0.28%	5.5	22.5	4.3%	0.98	61	8.2
03/18/2005	NTP Filtrate #18 F	0.25%	5.0	20.0	0.23%	4.6	18.2	0.02%	0.5	1.8	0.00%	0.0	0.2	0.00%	0.1	0.4	0.18%	3.5	13.9	0.21%	4.2	16.8	0.8%	0.95	59	7.9
03/19/2005	NTP Dewatered Manure #18-19 C	0.75%	15.1	61.1	0.23%	4.7	19.0	0.52%	10.4	42.1	0.14%	2.7	11.0	0.31%	6.2	25.2	0.19%	3.8	15.3	0.23%	4.5	18.4	10.0%	0.97	60	8.1
	Percent Reduction of Nutrient in Liquid	46.8%	46.8%	47.9%	20.7%	22.0%	24.2%	88.9%	85.7%	87.5%	100.0%	100.0%	95.7%	100.0%	96.2%	96.2%	21.7%	23.9%	25.3%	25.0%	23.6%	25.3%	80.7%			
03/19/2005	NTP Filtrate #19 F	0.25%	5.1	20.6	0.24%	4.8	19.4	0.01%	0.3	1.2	0.00%	0.0	0.1	0.00%	0.1	0.2	0.18%	3.5	14.4	0.21%	4.3	17.4	0.9%	0.97	60	8.1
03/20/2005	NTP Dewatered Manure #19-20 C	0.71%	14.2	58.5	0.27%	5.3	22.0	0.44%	8.8	36.5	0.16%	3.2	13.0	0.36%	7.2	29.8	0.22%	4.3	17.7	0.26%	5.2	21.4	12.7%	0.99	62	8.3
	Percent Reduction of Nutrient in Liquid	46.8%	45.7%	46.4%	17.2%	18.6%	19.2%	94.4%	91.4%	91.7%	100.0%	100.0%	97.8%	100.0%	96.2%	98.1%	21.7%	23.9%	22.6%	25.0%	21.8%	22.7%	79.8%			
03/20/2005	NTP Filtrate #20 F	0.23%	4.7	18.6	0.22%	4.5	17.9	0.01%	0.2	0.8	0.00%	0.0	0.1	0.00%	0.0	0.2	0.17%	3.3	13.2	0.20%	4.0	15.9	1.1%	0.95	59	8.0
03/21/2005	NTP Dewatered Manure #20-21 C	0.71%	14.2	56.1	0.26%	5.1	20.3	0.45%	9.0	35.8	0.14%	2.8	11.3	0.33%	6.5	25.9	0.21%	4.2	16.5	0.25%	5.0	19.8	10.4%	0.95	59	7.9
	Percent Reduction of Nutrient in Liquid	51.1%	50.0%	51.6%	24.1%	23.7%	25.4%	94.4%	94.3%	94.4%	100.0%	100.0%	97.8%	100.0%	100.0%	98.1%	26.1%	28.3%	29.0%	28.6%	27.3%	29.3%	74.8%			
03/22/2005	NTP Filtrate #21-22 F	0.26%	5.2	21.5	0.25%	5.0	20.4	0.01%	0.3	1.1	0.00%	0.0	0.1	0.00%	0.0	0.2	0.18%	3.7	15.2	0.22%	4.4	18.3	1.2%	0.99	62	8.2
03/22/2005	NTP Dewatered Manure #21-22 C	0.76%	15.2	61.7	0.28%	5.5	22.4	0.48%	9.7	39.3	0.13%	2.7	10.9	0.31%	6.1	24.9	0.22%	4.4	17.7	0.26%	5.3	21.3	11.5%	0.97	60	8.1
	Percent Reduction of Nutrient in Liquid	44.7%	44.7%	44.0%	13.8%	15.3%	15.0%	94.4%	91.4%	92.4%	100.0%	100.0%	97.8%	100.0%	100.0%	98.1%	21.7%	19.6%	18.3%	21.4%	20.0%	18.7%	72.2%			
03/23/2005	NTP Filtrate #22-23 F	0.28%	5.6	23.2	0.25%	5.0	20.6	0.03%	0.6	2.5	0.00%	0.0	0.1	0.00%	0.1	0.3	0.19%	3.7	15.3	0.22%	4.5	18.4	1.3%	0.99	62	8.3
03/24/2005	NTP Dewatered Manure #23-24 C	0.74%	14.8	57.9	0.25%	5.0	19.8	0.49%	9.8	38.2	0.14%	2.7	10.6	0.31%	6.2	24.3	0.21%	4.2	16.6	0.26%	5.1	20.0	12.3%	0.94	59	7.8
	Percent Reduction of Nutrient in Liquid	40.4%	40.4%	39.6%	13.8%	15.3%	14.2%	83.3%	82.9%	82.6%	100.0%	100.0%	97.8%	100.0%	96.2%	97.1%	17.4%	19.6%	17.7%	21.4%	18.2%	18.2%	70.4%			
03/29/2005	NTP Filtrate #29 F	0.24%	4.8	19.8	0.25%	5.0	20.4	0.01%	0.2	0.6	0.00%	0.0	0.1	0.00%	0.0	0.2	0.18%	3.6	14.6	0.22%	4.3	17.6	1.1%	0.98	61	8.2
03/30/2005	NTP Dewatered Manure #29-30 C	0.78%	15.6	59.1	0.27%	5.4	20.7	0.51%	10.1	38.4	0.13%	2.6	9.9	0.30%	6.0	22.7	0.21%	4.1	15.6	0.25%	5.0	18.8	14.7%	0.91	57	7.6
	Percent Reduction of Nutrient in Liquid	48.9%	48.9%	48.4%	13.8%	15.3%	15.0%	94.4%	94.3%	95.8%	100.0%	100.0%	97.8%	100.0%	100.0%	98.1%	21.7%	21.7%	21.5%	21.4%	21.8%	21.8%	74.4%			
03/29/2005	NTP Filtrate #31 F	0.31%	6.2	25.2	0.29%	5.7	23.2	0.02%	0.5	1.9	0.00%	0.0	0.1	0.00%	0.1	0.3	0.20%	4.0	16.2	0.24%	4.8	19.5	1.4%	0.97	60	8.1
03/30/2005	NTP Dewatered Manure #29-30 C	0.74%	14.7	56.4	0.28%	5.5	21.0	0.46%	9.2	35.4	0.12%	2.4	9.3	0.28%	5.6	21.2	0.21%	4.1	15.8	0.25%	5.0	19.1	15.8%	0.92	57	7.7
	Percent Reduction of Nutrient in Liquid	34.0%	34.0%	34.4%	0.0%	3.4%	3.3%	88.9%	85.7%	86.8%	100.0%	100.0%	97.8%	100.0%	96.2%	97.1%	13.0%	13.0%	12.9%	14.3%	12.7%	13.3%	67.8%			
	Filtrate Averae	0.26%	5.2	21.2	0.25%	4.9	19.9	0.02%	0.4	1.4	0.00%	0.0	0.1	0.00%	0.1	0.2	0.19%	3.7	15.1	0.22%	4.5	18.2	1.0%	0.97	61	8.1
	Dewatered Manure Average	0.75%	15.0	59.6	0.26%	5.2	21.0	0.48%	9.7	38.7	0.14%	2.7	10.9	0.31%	6.2	24.8	0.22%	4.3	17.2	0.26%	5.2	20.8	12.5%	0.96	60	8.0
	Filtrate Min	0.23%	4.7	18.6	0.22%	4.5	17.9	0.01%	0.2	0.6	0.00%	0.0	0.0	0.00%	0.0	0.0	0.17%	3.3	13.2	0.20%	4.0	15.9	0.6%	0.95	59	7.9
	Dewatered Manure Min	0.71%	14.2	56.1	0.23%	4.7	19.0	0.44%	8.8	35.4	0.12%	2.4	9.3	0.28%	5.6	21.2	0.19%	3.8	15.3	0.23%	4.5	18.4	10.0%	0.91	57	7.6
	Filtrate Max	0.31%	6.2	25.2	0.29%	5.7	23.2	0.03%	0.6	2.5	0.00%	0.0	0.2	0.00%	0.1	0.4	0.22%	4.4	18.2	0.26%	5.2	21.5	1.4%	0.99	62	8.3
	Dewatered Manure Max	0.79%	15.8	66.2	0.28%	5.5	22.6	0.52%	10.4	43.6	0.16%	3.2	13.0	0.36%	7.2	29.8	0.27%	5.4	22.6	0.33%	6.6	27.7	15.8%	1.00	62	8.4

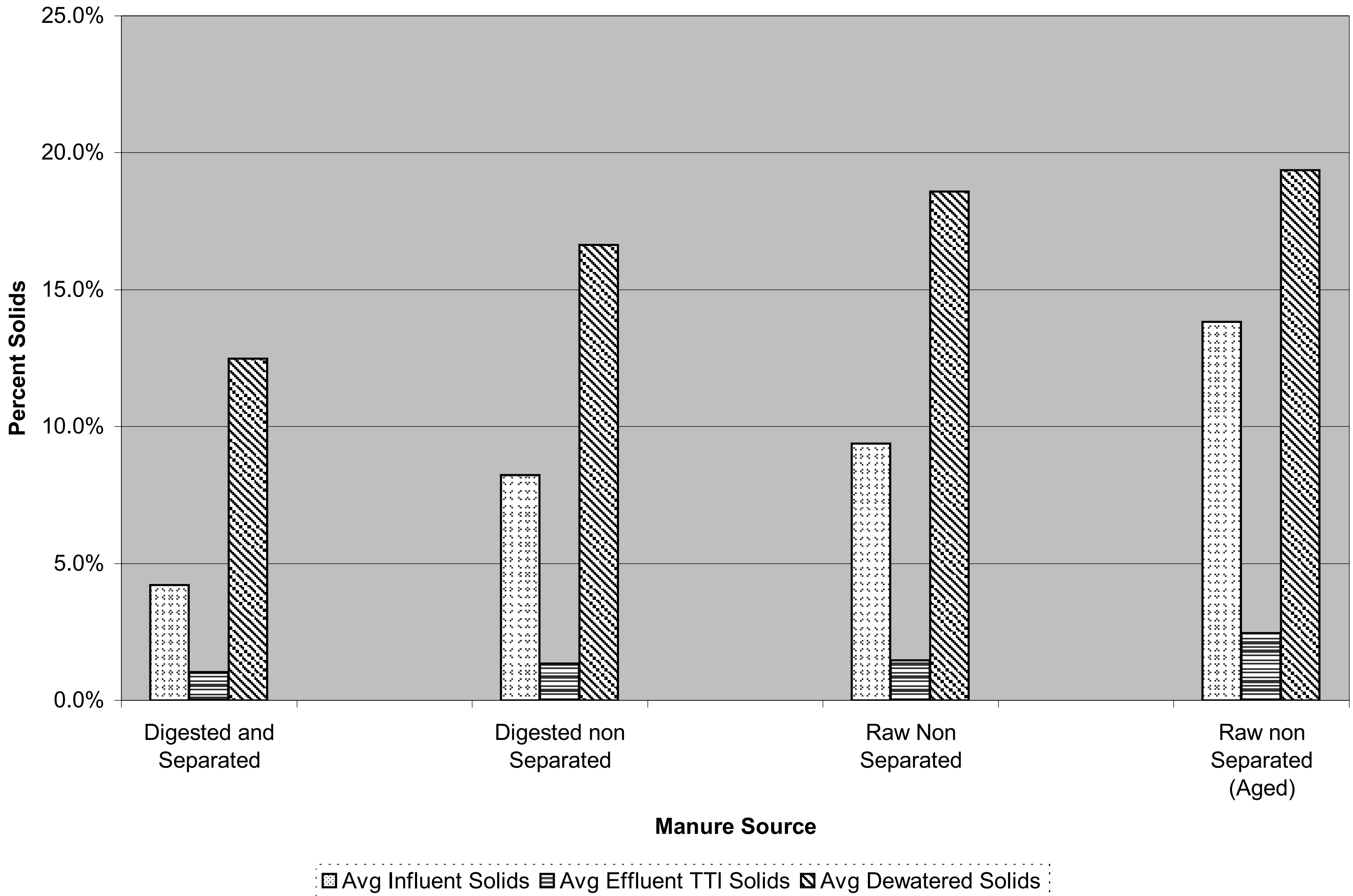
TABLE D-2
DRYBOX PERFORMANCE DATA - NUTRIENT TRAP PROCESS DEMONSTRATION PROJECT

		COMPONENTS																								
		NITROGEN (N)			AMMONIA NITROGEN			ORGANIC NITROGEN			PHOSPHORUS (P)			PHOSPHATE EQUIVALENT (P205)			POTASSIUM (K)			POTASH EQUIVALENT (K20)			TOTAL SOLIDS	DENSITY		
SAMPLE DATE	DESCRIPTION	AS REC'D	LBS/TON	LBS/1000 GAL	AS REC'D	LBS/TON	LBS/1000 GAL	AS REC'D	LBS/TON	LBS/1000 GAL	AS REC'D	LBS/TON	LBS/1000 GAL	AS REC'D	LBS/TON	LBS/1000 GAL	AS REC'D	LBS/TON	LBS/1000 GAL	AS REC'D	LBS/TON	LBS/1000 GAL	AS REC'D	kg/l	#/cu.ft.	LBS/1000 GAL
	Unpressed Digested Manure																									
Run 3																										
03/30/2005	Unpressed Digested Manure in Stg Tk #3/30 NSRD FT	0.50%	10.0	41.3	0.32%	6.3	26.1	0.18%	3.7	15.1	0.07%	1.4	5.9	0.16%	3.2	13.4	0.22%	4.5	18.4	0.27%	5.4	22.2	8.6%	0.99	62	8.3
03/30/2005	NTP Filtrate #30 F	0.29%	5.7	22.7	0.26%	5.2	20.6	0.03%	0.5	2.1	0.00%	0.0	0.1	0.00%	0.1	0.2	0.18%	3.7	14.6	0.22%	4.4	17.6	1.3%	0.95	59	8.0
03/31/2005	NTP Dewatered Manure #30-31 C	0.70%	14.1	57.2	0.26%	5.3	21.5	0.44%	8.8	35.7	0.11%	2.3	9.3	0.26%	5.3	21.4	0.21%	4.1	16.8	0.25%	5.0	21.2	15.0%	0.97	60	8.1
	Percent Reduction of Nutrient in Liquid	42.0%	43.0%	45.0%	18.8%	17.5%	21.1%	83.3%	86.5%	86.1%	100.0%	100.0%	98.3%	100.0%	96.9%	98.5%	18.2%	17.8%	20.7%	18.5%	18.5%	20.7%	85.3%			
03/31/2005	NTP Filtrate # SMT 3/31	0.31%	6.3	25.4	0.29%	5.8	23.4	0.02%	0.5	2.0	0.00%	0.0	0.2	0.00%	0.1	0.4	0.20%	4.0	16.2	0.24%	4.8	19.6	1.5%	0.97	60	8.1
04/01/2005	NTP Dewatered Manure #30-1 C	0.72%	14.3	59.3	0.28%	5.7	23.6	0.43%	8.6	35.7	0.11%	2.2	9.3	0.26%	5.1	21.3	0.21%	4.1	17.2	0.25%	5.0	20.7	15.2%	0.99	62	8.3
	Percent Reduction of Nutrient in Liquid	38.0%	37.0%	38.5%	9.4%	7.9%	10.3%	88.9%	86.5%	86.8%	100.0%	100.0%	96.6%	100.0%	96.9%	97.0%	9.1%	11.1%	12.0%	11.1%	11.1%	11.7%	82.3%			
Run 4																										
04/02/2005	Unpressed Digested Manure in Stg Tk # FT 4/2	0.50%	9.9	41.5	0.32%	6.3	26.3	0.18%	3.6	15.2	0.07%	1.4	6.0	0.17%	3.3	13.8	0.23%	4.5	18.9	0.27%	5.5	22.8	7.8%	1.00	62	8.4
04/22/2005	NTP Filtrate # F 4/2	0.31%	6.3	25.6	0.29%	5.8	23.6	0.03%	0.5	2.1	0.00%	0.0	0.2	0.00%	0.1	0.4	0.20%	4.0	16.3	0.24%	4.8	19.7	1.3%	0.98	61	8.2
04/04/2005	NTP Dewatered Manure #2-3 C	0.69%	13.8	55.4	0.29%	5.9	23.5	0.40%	8.0	31.9	0.13%	2.5	10.2	0.29%	5.8	23.4	0.22%	4.4	17.7	0.27%	5.3	21.4	16.6%	0.96	60	8.0
	Percent Reduction of Nutrient in Liquid	38.0%	36.4%	38.3%	9.4%	7.9%	10.3%	83.3%	86.1%	86.2%	100.0%	100.0%	96.7%	100.0%	97.0%	97.1%	13.0%	11.1%	13.8%	11.1%	12.7%	13.6%	82.9%			
04/08/2005	NTP Filtrate #4/8 F	0.22%	4.4	17.9	0.20%	3.9	15.9	0.02%	0.5	2.0	0.00%	0.0	0.1	0.00%	0.1	0.3	0.16%	3.1	12.7	0.19%	3.8	15.3	1.3%	0.97	60	8.2
04/09/2005	NTP Dewatered Manure 8-9 C	0.58%	11.7	49.9	0.16%	3.1	13.4	0.43%	8.5	36.5	0.11%	2.2	9.5	0.26%	5.1	21.8	0.14%	2.8	11.8	0.17%	3.3	14.2	17.2%	1.03	64	8.6
	Percent Reduction of Nutrient in Liquid	56.0%	55.6%	56.9%	37.5%	38.1%	39.5%	88.9%	86.1%	86.8%	100.0%	100.0%	98.3%	100.0%	97.0%	97.8%	30.4%	31.1%	32.8%	29.6%	30.9%	32.9%	84.1%			
	Filtrate Averae	0.28%	5.7	22.9	0.26%	5.2	20.9	0.03%	0.5	2.1	0.00%	0.0	0.2	0.00%	0.1	0.3	0.19%	3.7	15.0	0.22%	4.5	18.1	1.3%	0.97	60	8.1
	Dewatered Manure Average	0.67%	13.5	55.5	0.25%	5.0	20.5	0.43%	8.5	35.0	0.12%	2.3	9.6	0.27%	5.3	22.0	0.20%	3.9	15.9	0.24%	4.7	19.4	16.0%	0.99	62	8.2
	Filtrate Min	0.22%	4.4	17.9	0.20%	3.9	15.9	0.02%	0.5	2.0	0.00%	0.0	0.1	0.00%	0.1	0.2	0.16%	3.1	12.7	0.19%	3.8	15.3	1.3%	0.95	59	8.0
	Dewatered Manure Min	0.58%	11.7	49.9	0.16%	3.1	13.4	0.40%	8.0	31.9	0.11%	2.2	9.3	0.26%	5.1	21.3	0.14%	2.8	11.8	0.17%	3.3	14.2	15.0%	0.96	60	8.0
	Filtrate Max	0.31%	6.3	25.6	0.29%	5.8	23.6	0.03%	0.5	2.1	0.00%	0.0	0.2	0.00%	0.1	0.4	0.20%	4.0	16.3	0.24%	4.8	19.7	1.5%	0.98	61	8.2
	Dewatered Manure Max	0.72%	14.3	59.3	0.29%	5.9	23.6	0.44%	8.8	36.5	0.13%	2.5	10.2	0.29%	5.8	23.4	0.22%	4.4	17.7	0.27%	5.3	21.4	17.2%	1.03	64	8.6
	Unpressed Raw Manure																									
Run 5																										
04/08/2005	Unpressed Raw Manure in Stg Tk #4/8 RTW	0.48%	9.6	40.4	0.27%	5.3	22.2	0.22%	4.3	18.2	0.06%	1.2	4.8	0.13%	2.6	11.1	0.22%	4.3	18.1	0.26%	5.2	21.8	9.4%	1.00	62	8.4
04/09/2005	TREATED MANURE #4/9 FLOCK TK	0.34%	6.8	27.6	0.22%	4.3	17.6	0.12%	2.5	10.0	0.04%	0.7	3.0	0.08%	1.7	6.8	0.18%	3.5	14.2	0.21%	4.2	17.2	7.0%	0.97	60	8.1
04/09/2005	NTP Filtrate #4/9F	0.25%	5.0	20.4	0.23%	4.6	18.8	0.02%	0.4	1.6	0.00%	0.1	0.2	0.01%	0.1	0.5	0.18%	3.7	15.0	0.22%	4.4	18.0	1.5%	0.98	61	8.2
04/09/2005	NTP Dewatered Manure #4/9 C TP @ 6Hours	0.57%	11.4	45.3	0.22%	4.4	17.5	0.35%	7.0	27.8	0.08%	1.6	6.5	0.19%	3.8	15.0	0.18%	3.6	14.3	0.22%	4.3	17.2	13.8%	0.95	59	8.0
04/10/2005	NTP Dewatered Manure #4/9-10 C @ 18Hours	0.66%	13.2	56.5	0.22%	4.3	18.4	0.45%	8.9	38.1	0.12%	2.5	10.6	0.28%	5.7	24.2	0.19%	3.7	15.9	0.22%	4.5	19.1	19.6%	1.02	64	8.5
	Percent Reduction of Nutrient in Liquid	47.9%	47.9%	49.5%	14.8%	13.2%	15.3%	90.9%	90.7%	91.2%	100.0%	91.7%	95.8%	92.3%	96.2%	95.5%	18.2%	14.0%	17.1%	15.4%	15.4%	17.4%	84.4%			
04/10/2005	NTP Filtrate #4/10 F	0.24%	4.8	19.7	0.22%	4.5	18.3	0.02%	0.4	1.4	0.00%	0.0	0.2	0.01%	0.1	0.4	0.18%	3.5	14.5	0.21%	4.2	17.5	1.5%	0.98	61	8.2
04/11/2005	NTP Dewatered Manure #4/10-11 C	0.64%	12.7	54.0	0.21%	4.2	17.9	0.42%	8.5	36.1	0.11%	2.1	9.1	0.25%	4.9	20.8	0.19%	3.9	16.6	0.23%	4.7	20.0	18.6%	1.02	64	8.5
04/11/2005	NTP Dewatered Manure 4/11 C	0.67%	13.5	56.4	0.20%	4.0	16.8	0.47%	9.4	39.6	0.11%	2.3	9.5	0.26%	5.2	21.8	0.19%	3.7	15.6	0.22%	4.5	18.8	20.3%	1.00	62	8.4
	Percent Reduction of Nutrient in Liquid	50.0%	50.0%	51.2%	18.5%	15.1%	17.6%	90.9%	90.7%	92.3%	100.0%	100.0%	95.8%	92.3%	96.2%	96.4%	18.2%	18.6%	19.9%	19.2%	19.2%	19.7%	84.3%			
	Filtrate Averae	0.25%	4.9	20.1	0.23%	4.6	18.6	0.02%	0.4	1.5	0.00%	0.1	0.2	0.01%	0.1	0.5	0.18%	3.6	14.8	0.22%	4.3	17.8	1.5%	0.98	61	8.2
	Dewatered Manure Average	0.64%	12.7	53.1	0.21%	4.2	17.7	0.42%	8.5	35.4	0.11%	2.1	8.9	0.25%	4.9	20.5	0.19%	3.7	15.6	0.22%	4.5	18.8	18.1%	1.00	62	8.3
	Filtrate Min	0.24%	4.8	19.7	0.22%	4.5	18.3	0.02%	0.4	1.4	0.00%	0.0	0.2	0.01%	0.1	0.4	0.18%	3.5	14.5	0.21%	4.2	17.5	1.5%	0.98	61	8.2
	Dewatered Manure Min	0.57%	11.4	45.3	0.20%	4.0	16.8	0.35%	7.0	27.8	0.08%	1.6	6.5	0.19%	3.8	15.0	0.18%	3.6	14.3	0.22%	4.3	17.2	13.8%	0.95	59	8.0
	Filtrate Max	0.25%	5.0	20.4	0.23%	4.6	18.8	0.02%	0.4	1.6	0.00%	0.1	0.2	0.01%	0.1	0.5	0.18%	3.7	15.0	0.22%	4.4	18.0	1.5%	0.98	61	8.2
	Dewatered Manure Max	0.67%	13.5	56.5	0.22%	4.4	18.4	0.47%	9.4	39.6	0.12%	2.5	10.6	0.28%	5.7	24.2	0.19%	3.9	16.6	0.23%	4.7	20.0	20.3%	1.02	64	8.5

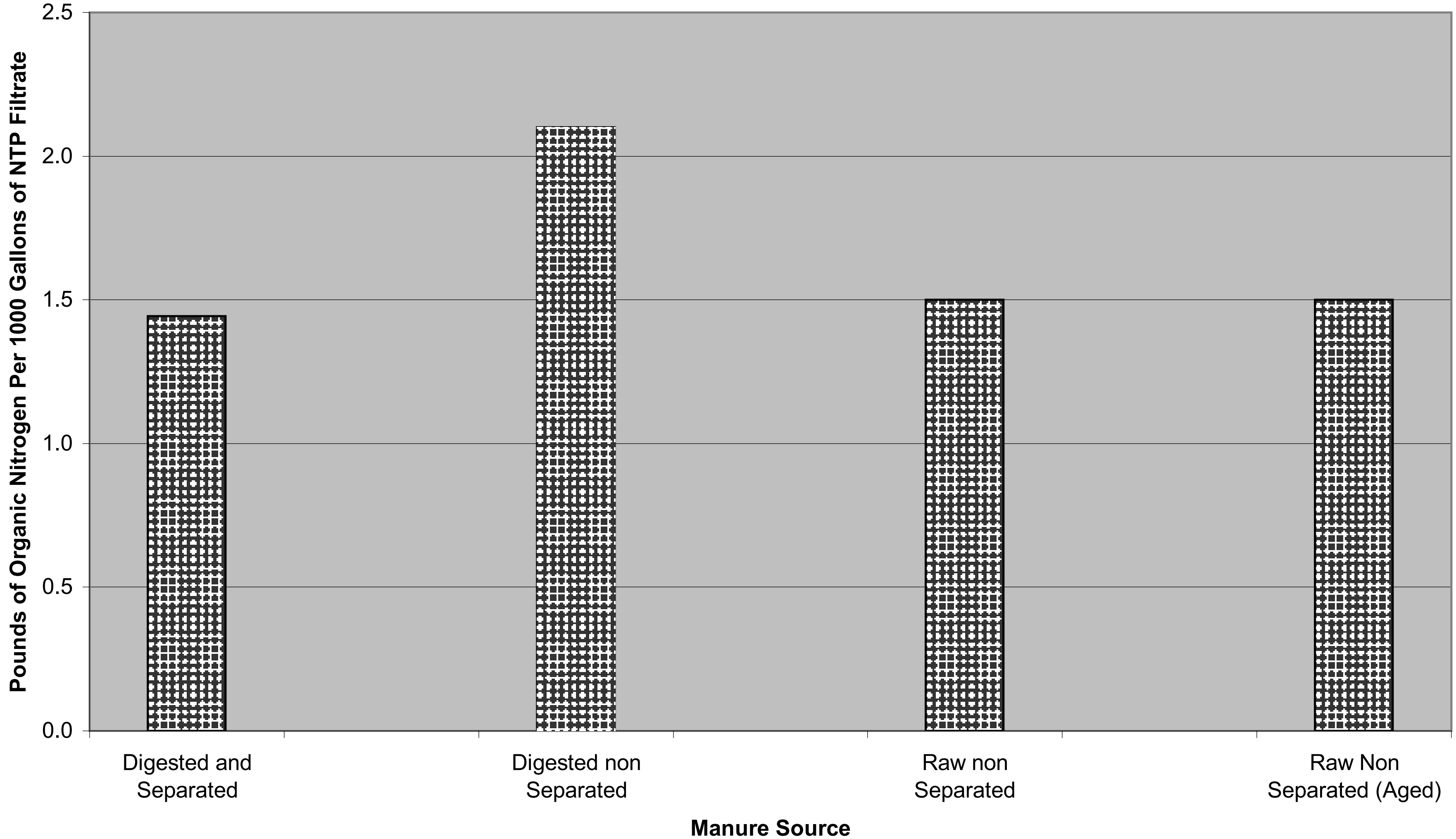
TABLE D-2
DRYBOX PERFORMANCE DATA - NUTRIENT TRAP PROCESS DEMONSTRATION PROJECT

		COMPONENTS																								
		NITROGEN (N)			AMMONIA NITROGEN			ORGANIC NITROGEN			PHOSPHORUS (P)			PHOSPHATE EQUIVALENT (P205)			POTASSIUM (K)			POTASH EQUIVALENT (K20)			TOTAL SOLIDS	DENSITY		
SAMPLE DATE	DESCRIPTION	AS REC'D	LBS/TON	LBS/1000 GAL	AS REC'D	LBS/TON	LBS/1000 GAL	AS REC'D	LBS/TON	LBS/1000 GAL	AS REC'D	LBS/TON	LBS/1000 GAL	AS REC'D	LBS/TON	LBS/1000 GAL	AS REC'D	LBS/TON	LBS/1000 GAL	AS REC'D	LBS/TON	LBS/1000 GAL	AS REC'D	kg/l	#/cu.ft.	LBS/1000 GAL
Run 6																										
04/12/2005	Unpressed Raw Manure in Stg Tk 4/12	0.46%	9.2	37.3	0.28%	5.6	22.7	0.18%	3.6	14.6	0.07%	1.3	5.4	0.15%	3.1	12.4	0.24%	4.8	19.6	0.29%	5.8	23.6	13.8%	0.97	60	8.09
Manure Slurry Treated into Flocculation Tank																										
04/14/2005	MANURE SLURRY In Floc Tank 4/14 FL	0.45%	9.1	36.0	0.26%	5.1	20.2	0.20%	4.0	15.8	0.05%	0.9	3.6	0.10%	2.1	8.3	0.22%	4.4	17.3	0.26%	5.3	20.9	8.0%	0.95	59	7.92
04/14/2005	NTP Filtrate #4/14 F	0.29%	5.9	23.8	0.26%	5.1	20.7	0.04%	0.8	3.1	0.00%	0.1	0.3	0.01%	0.1	0.6	0.23%	4.6	18.6	0.28%	5.5	22.4	2.2%	0.97	60	8.09
04/26/2005	NTP Filtrate #4/14 F	0.28%	5.7	22.9	0.25%	5.1	20.6	0.03%	0.6	2.3	0.00%	0.1	0.3	0.01%	0.1	0.6	0.21%	4.3	17.2	0.26%	5.2	20.9	2.4%	0.97	60	8.1
04/15/2005	NTP Dewatered Manure #4-14-15C	0.62%	12.5	53.2	0.22%	4.5	19.2	0.40%	8.0	34.0	0.10%	2.1	8.8	0.24%	4.7	20.2	0.21%	4.1	17.7	0.25%	5.0	21.3	19.2%	1.02	64	8.52
	Percent Reduction of Nutrient in Liquid	37.8%	37.4%	36.4%	3.8%	0.0%	-2.0%	85.0%	85.0%	85.4%	100.0%	88.9%	91.7%	90.0%	95.2%	92.8%	4.5%	2.3%	0.6%	0.0%	1.9%	0.0%	69.5%			
04/26/2005	NTP Filtrate #4/15 F	0.26%	5.1	21.1	0.24%	4.8	19.8	0.02%	0.3	1.3	0.00%	0.0	0.2	0.01%	0.1	0.4	0.20%	4.1	16.7	0.24%	4.9	20.1	2.5%	0.98	61	8.22
04/16/2005	NTP Dewatered Manure #4-15/16C	0.60%	12.0	50.2	0.22%	4.4	18.6	0.38%	7.6	31.6	0.10%	1.9	8.1	0.22%	4.4	18.5	0.20%	4.0	16.8	0.24%	4.8	20.2	18.3%	1.00	62	8.35
	Percent Reduction of Nutrient in Liquid	43.5%	44.6%	43.4%	14.3%	14.3%	12.8%	88.9%	91.7%	91.1%	100.0%	100.0%	96.3%	93.3%	96.8%	96.8%	16.7%	14.6%	14.8%	17.2%	15.5%	14.8%	82.1%			
04/26/2005	NTP Filtrate #4/16 F	0.24%	4.7	19.3	0.24%	4.8	19.5	0.00%	0.0	0.2	0.00%	0.0	0.2	0.01%	0.1	0.4	0.21%	4.2	17.2	0.25%	5.0	20.7	2.5%	0.98	61	8.2
04/26/2005	NTP Dewatered Manure #4/16-18 C	0.69%	13.8	59.0	0.21%	4.3	18.3	0.48%	9.5	40.7	0.11%	2.1	9.0	0.24%	4.8	20.7	0.20%	4.0	16.9	0.24%	4.8	20.4	20.3%	1.03	64	8.56
	Percent Reduction of Nutrient in Liquid	47.8%	48.9%	48.3%	14.3%	14.3%	14.1%	100.0%	100.0%	98.6%	100.0%	100.0%	96.3%	93.3%	96.8%	96.8%	12.5%	12.5%	12.2%	13.8%	13.8%	12.3%	82.3%			
04/26/2005	NTP Filtrate #4/18 F	0.23%	4.7	18.7	0.23%	4.7	18.6	0.00%	0.0	0.2	0.00%	0.1	0.2	0.01%	0.1	0.5	0.20%	4.0	15.9	0.24%	4.8	19.1	2.4%	0.98	61	7.97
04/26/2005	NTP Dewatered Manure #4/18-19 C	0.66%	13.3	55.8	0.20%	4.1	17.1	0.46%	9.2	38.7	0.11%	2.1	9.0	0.25%	4.9	20.6	0.19%	3.8	16.0	0.23%	4.6	19.3	20.6%	1.01	63	8.43
	Percent Reduction of Nutrient in Liquid	50.0%	48.9%	49.9%	17.9%	16.1%	18.1%	100.0%	100.0%	98.6%	100.0%	92.3%	96.3%	93.3%	96.8%	96.0%	16.7%	16.7%	18.9%	17.2%	17.2%	19.1%	82.5%			
04/26/2005	NTP Filtrate #4/19 F	0.27%	5.4	21.4	0.25%	5.0	19.9	0.02%	0.4	1.6	0.00%	0.1	0.2	0.01%	0.1	0.5	0.22%	4.4	17.5	0.26%	5.3	21.0	2.8%	0.98	61	7.99
04/26/2005	NTP Dewatered Manure #4/20 C	0.62%	12.3	51.6	0.22%	4.3	18.1	0.40%	8.0	33.5	0.10%	2.0	8.2	0.22%	4.5	18.7	0.19%	3.9	16.3	0.23%	4.7	19.6	18.5%	1.00	62	8.38
	Percent Reduction of Nutrient in Liquid	41.3%	41.3%	42.6%	10.7%	10.7%	12.3%	88.9%	88.9%	89.0%	100.0%	92.3%	96.3%	93.3%	96.8%	96.0%	8.3%	8.3%	10.7%	10.3%	8.6%	11.0%	80.0%			
	Filtrate Averae	0.26%	5.3	21.2	0.25%	4.9	19.9	0.02%	0.4	1.5	0.00%	0.1	0.2	0.01%	0.1	0.5	0.21%	4.3	17.2	0.26%	5.1	20.7	2.5%	0.98	61	8.1
	Dewatered Manure Average																									
	Filtrate Min																									
	Dewatered Manure Min																									
	Filtrate Max																									
	Dewatered Manure Max																									
	OVERALL																									
	Filtrate Averae	0.26%	5.3	21.4	0.25%	4.9	19.9	0.02%	0.4	1.6	0.00%	0.0	0.2	0.00%	0.1	0.4	0.19%	3.9	15.7	0.23%	4.6	18.9	1.57%	0.97	61	8.1
	Filtrate Min																									
	Filtrate Max																									
	Dewatered Manure Average																									
	Dewatered Manure Min																									
	Dewatered Manure Max																									
	Influent Manure Average	0.48%	9.6	39.4	0.30%	5.9	24.1	0.19%	3.7	15.3	0.06%	1.2	5.1	0.14%	2.9	11.8	0.24%	4.8	19.5	0.29%	5.7	23.5	8.0%			

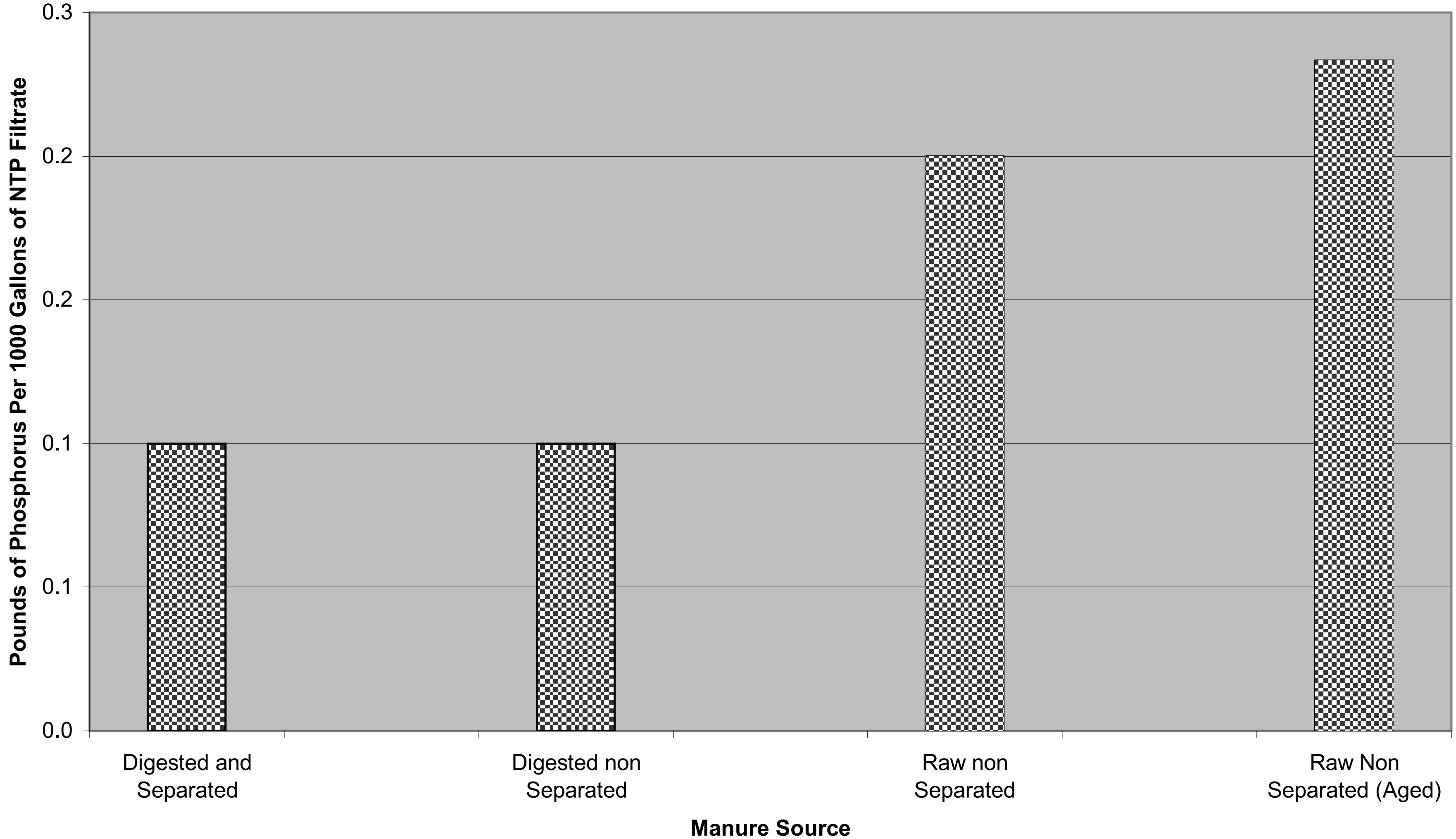
Graph D-1
NTP Filtrate and Dewatered Manure Solids Based on Manure Source



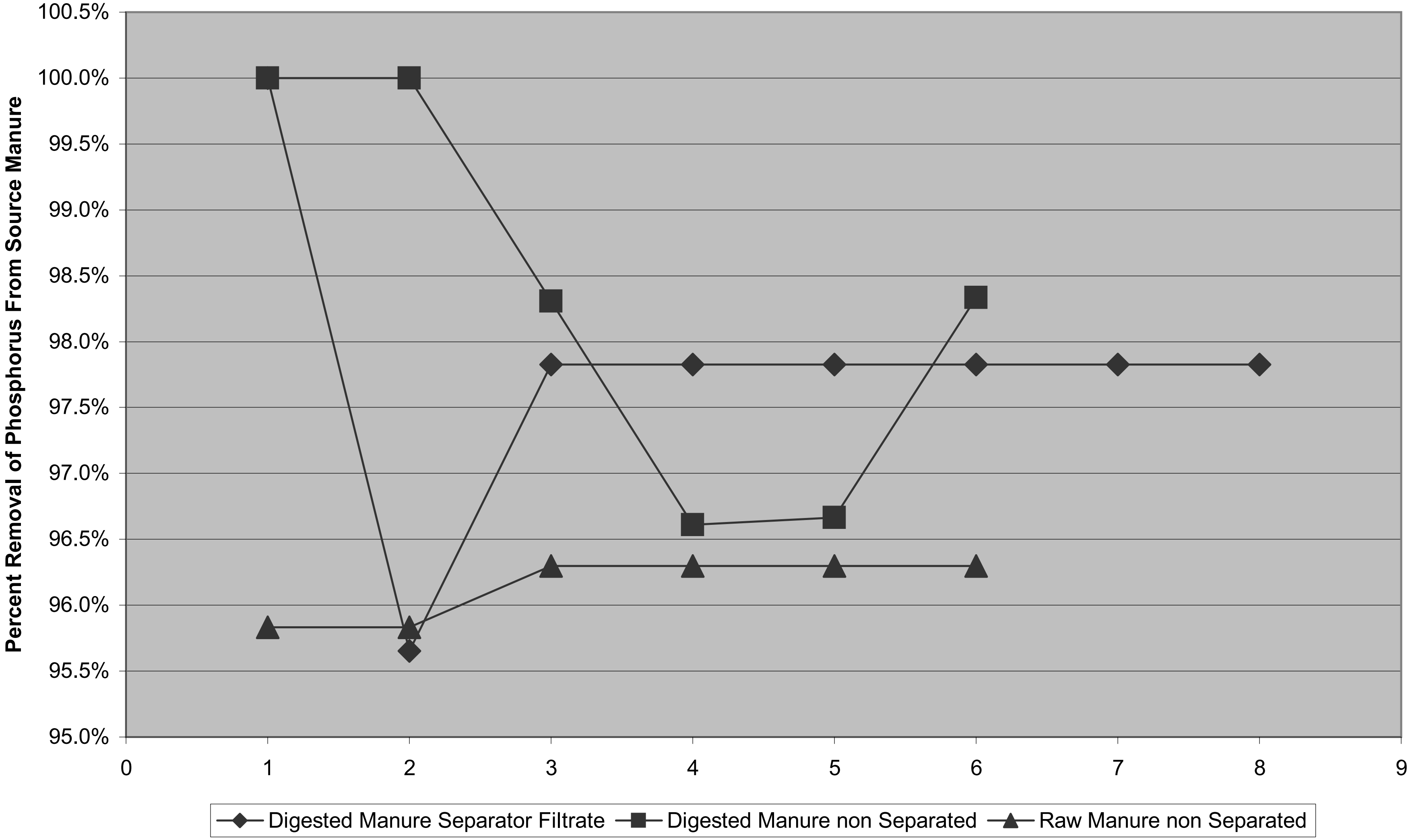
Graph D-3
NTP Filtrate - Average Organic Nitrogen Content Based on Manure Source



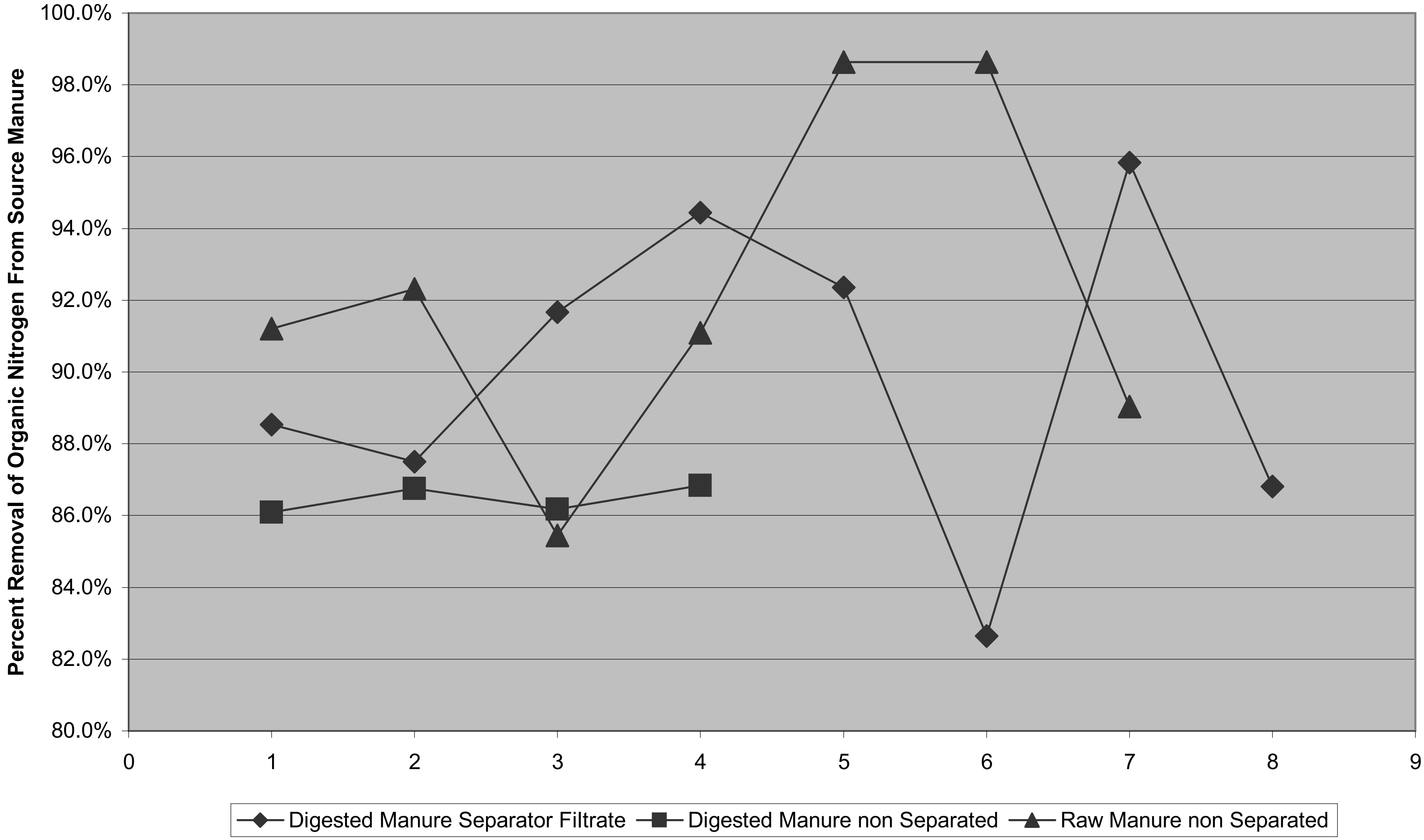
Graph D-2
NTP Filtrate - Average Phosphorus Content Based on Manure Source



Graph D-4
Percent Removal of Phosphorus Based on Manure Source



Graph D-5
Percent Removal of Organic Nitrogen Based on Manure Source



Appendix E

SAMPLE PHOTOGRAPHS OF A COMMERCIAL NUTRIENT TRAP PROCESS IN OPERATION

Figure E-1

Commercial Scale Nutrient Trap Process
DryBox separator system installed within common farm scale aluminum dump trailer. Filtrate pumped to slurry spreader.

Figure E-2

Clarified Filtrate discharging directly from Nutrient trap Process

Figure E-3

Manure Slurry Being Dewatered within DryBox Separator of Nutrient Trap Process

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Energy Efficient Manure Dewatering Technology Evaluation

Final Report 07-11

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