

# **BENEFICIAL CO-UTILIZATION - LENOIR, NORTH CAROLINA**

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## **ABSTRACT**

The City of Lenoir, North Carolina has developed a successful biosolids program through beneficial co-utilization of biosolids and other indigenous by-products. Beneficial co-utilization involves the blending by-products from a variety of sources to yield a product of substantiated value. The City of Lenoir initially blended wood ash, lime, and Class “A” - Exceptional Quality biosolids to produce Lenoir’s Blends. As time and success progressed the introduction of sawdust and other wood by-products readily available in the area were used as a substitute for the wood ash. These blends are all natural organic products that offer a balance of nitrogen, calcium, phosphorus, potassium, as well as essential micro- and macro-nutrients.

The Blends were produced with various wood ashes and sawdust principally derived from the internationally known local furniture industries (e.g. Broyhill, Bernhardt, Thomasville, and others). The wood ash was available to the City of Lenoir at no cost and greatly reduces the quantity of materials that were destined for the Caldwell County land-fill. At the same time, both the wood ash and sawdust add valuable micro- and macro-nutrients to the City’s Class “A” - Exceptional Quality biosolids product.

Lenoir’s Blends are used primarily on City property for the benefit of the citizens of Lenoir. In addition, interested parties come to the plant to receive product in their own vehicles. Larger volume users can make prior arrangements to be loaded in bulk.

## **KEY WORDS**

biosolids, wood ash, sawdust, Class “A”, pasteurization, marketing, organic fertilizer, blends

## INTRODUCTION

The Lower Creek Wastewater Treatment Facility was originally constructed in 1969 to provide the City of Lenoir with a modern wastewater treatment facility. At that time, the design of the 6.0 MGD system was based on an extended aeration biological process with static aerators, clarification, and a chlorinating facility for disinfecting effluent which is discharged into the Lower Creek basin. The Class “B” sludge which was initially generated was aerobically digested and dried in sand beds. These Class “B” biosolids were land applied in either a liquid or solid “cake” form with the majority of the product being applied as a liquid.

In the early 1990’s land was beginning to disappear from the City of Lenoir’s permitted Class “B” land application program. Consequently, the City became interested in pursuing a Class “A” sludge treatment process to generate a “beneficial reuse product,” reduce the paperwork, and potential liability associated with the Class “B” program. In 1996, the City of Lenoir installed RDP’s EnVessel Pasteurization™ process in concert with a new 2.0 meter belt filter press to manage the solids at the Lower Creek facility. It is worth noting here that the Lower Creek Wastewater facility also receives wastewater sludge from the City of Lenoir’s Gunpowder Wastewater facility, wastewater sludge from the nearby Town of Blowing Rock, and alum sludge from the City of Lenoir’s Lake Rhodhiss Water Treatment facility. At the time of the contract, the City of Lenoir also installed a dechlorination system in an attempt to prepare for a tightening of the chlorine regulatory limits. In addition, the city constructed a combined laboratory space as a part of this project. The total cost of the project was 2.0 million dollars. The dewatering and biosolids processing facilities comprised approximately 1.6 million dollars of the 2.0 million dollar total. Paralleling these physical improvements the City of Lenoir expanded their existing biosolids storage pad with reclaimed asphalt and purchased a spreader truck. The truck is used to land apply biosolids on demonstration projects as well as fertilizing properties for the City’s benefit.

Table 1. Construction cost summary.

Laboratory building & equipment	\$ 400,000
Dewatering building & equipment	325,000
Dewatering equipment (belt press)	350,000
Pasteurization building & equipment	888,000
Misc.	37,000
sub total	\$2,000,000

## DECISION TO PRODUCE A CLASS “A” - EXCEPTIONAL QUALITY PRODUCT

The decision to produce a Class “A” product was based on both “hard” and “soft” factors. Some of the key factors in this decision making process were a direct result of challenges which existed with the Class “B” operation. Many of these challenges were based on the public’s perception and not necessary upon real facts. For example, there was a public perception that the biosolids product was similar in nature to septic tank sludge. This perception was created as a result of the physical similarities between the Class “B” biosolids and septage. These perceptions included, for the most part, the similar appearance and consistency of the two products. In addition, both products, the Class “B” biosolids and septage were being hauled by tanker trucks which looked similar. Frequently, when the tanker trucks were seen being driven through city, there would be generated a number of questions directed to the office of City Manager and the Director of Public Works and Engineering inquiring as to the similarity of the two operations and the practice of land application.

Another major factor, as it is with most municipalities, was compliance with the “503 Regulations” which quickly became a big issue for the City of Lenoir. At the beginning of the project the State of North Carolina had not been delegated the responsibility of enforcing the “503 Regulations” at the Federal level. As a result, the City of Lenoir was unclear as to which direction they would be facing as a result of “unknown” compliance from the State and Federal regulations, and the regulators charged with the enforcement of those regulations. It was imperative that reasonable and accurate documentation, record keeping, and analysis be kept. The process finally chosen has to assure the City that it would have accurate documentation which showed that substantially every particle in the operational train met both the time and temperature requirements of the 503 regulation. It is worth noting here, that the plant does their own pH and fecal testing and that metals concentrations are determined periodically through certified independent testing laboratories. It has been several years since the initiation of this project, and the State has not, to date, been delegated from the Federal level. Consequently, the issue of compliance is even more important today than it was at the beginning of the project, noting that the regulations are still self imposing at this time.

Cost was also a significant consideration. Prior to the implementation of the improvements Lenoir was utilizing, via contract, a national firm to perform the hauling and broadcasting of the liquid Class “B” biosolids product. There was, therefore, a defined cost associated with the execution of this contract. Also included were so called “soft costs,” for example, permit fees. These permit fees were relatively high because of the limited amount of available permitted land. Land in the Lenoir area, suitable for Class “B” application, is limited due, in large part, to the topography of the entire region. Lenoir is located in the foothills of the Blue Ridge Mountains, and much of the land is too steep to be permitted. Additionally, there are a number of small farms in the area and these farms have fields that are frequently too small to be considered for permitting.

Of greatest concern for the City of Lenoir was the issue of potential short and long term liability. It was quite clear that the City of Lenoir would be significantly less exposed to potential liability if the City produced a Class “A” - “Exceptional Quality” product.

## EVALUATION OF ALTERNATIVES

A number of alternatives for “Class ‘A’ Sludge Stabilization” were evaluated. The initial list was quickly and efficiently narrowed down to two choices: a.) dryers and b.) lime stabilization. There were a number of lime stabilization processes which were evaluated. These included “Lime Only” Pasteurization, “N-VIRO” and “RDP’s EnVessel Pasteurization™” process. The City of Lenoir narrowed these process’ to the RDP EnVessel Pasteurization™ Process versus an Envirex dryer proposal. The evaluation criteria was based on the combination of capital and operating cost. In final analysis the RDP EnVessel™ process was selected based upon overall cost effectiveness.

## CURRENT OPERATIONS

The Lower Creek Wastewater Treatment Facility, which became operational in May of 1996, now houses an RDP EnVessel™ Pasteurization process adjacent to the city's dewatering operation. The dewatering operation utilizes a 2.0 meter Enviroquip belt filter press constructed from stainless steel. It is worth noting that liquid SBR (sequential batch reactor) concentrated sludge is trucked to the Lower Creek facility from the City of Lenoir's Gunpowder Wastewater (2.0 MGD) plant. In addition, the Lower Creek facility receives, from the City of Lenoir's Water Treatment (12 MGD) plant approximately 50,000 gallons/week of concentrated alum sludge. The City of Lenoir also receives wastewater sludge from an adjacent municipality, the Town of Blowing Rock. All of these sludges are combined and dewatered at the Lower Creek Wastewater Treatment Facility. These sludges are initially blended and then thickened to >3% in a DAF thickener. These blends are subsequently dewatered on the 2.0 meter belt filter press which produces consistent "cake" solids which are easily produced to a 22% to 25% dry solids.

Initially it was decided to utilize only the wood ash blend with some experimentation given toward the use of wood dust, fine chips, and sawdust - all by-products of the furniture and particle board industries. Further experimentation was also performed with the use of yard wastes. Although the results with wood ash were tremendous, the availability of wood ash was not as reliable or as plentiful as the other by-products (e.g. wood dust, fine chips, and sawdust). Because of the greater reliability for sawdust product, its more plentiful supply, and of greatest significance, its "look" in the final biosolids product, sawdust is now the preferred by-product material for use in Lenoir's Blend. Of importance too is the sheer tonnage reduction of sawdust which was previously entering the solid waste stream at the county landfill.

Landowners in the community have responded extremely well to the Class "A" biosolids program especially now that sawdust is an integral part of the blend. The material is typically applied at a rate of 3 tons of wet product per acre, or higher. Currently, the City of Lenoir is applying the product at no cost to the requesting landowners. Of most significance is that the biosolids are used on City parks, recreational fields, greenway areas, and at the airport.

## BENEFICIAL CO-UTILIZATION

As is the case in other North Carolina cities, the biosolids issue is not the only issue which the City of Lenoir is facing. Prior to and during the time of initial start-up of the Lower Creek facility, many other issues have confronted the City of Lenoir particularly with issue of overall waste recycling and reduction. The Caldwell County landfill was, and is currently, under a state mandate to not only close its existing operational landfill, but to reduce the total solid waste stream by at least 25%. On April 1, 1998, the state of North Carolina would no longer allow any solid waste to enter the county landfill. This has put great strain on the various industries and municipalities

within Caldwell County. The county is looking to these industries to greatly reduce, or eliminate, their waste streams, which was going into the landfill. Two of the major industries in Lenoir include furniture manufacturing and particleboard. As both of these industries utilize great amounts of wood in their manufacturing processes, they also generate a considerable amount of by-products. These by-products contain essential nutrients and the City of Lenoir has been fortunate in pursuing a program of beneficially reusing these nutrient rich by-products from both the furniture and particle board industries. The agronomic value of these by-products is summarized in the following chart.

Table 2. Agronomic analysis of constituents of Lenoir's Blends.

	Quick Lime	Wood Ash	Saw Dust
Solids		87.25 %	55.90 %
Nitrogen		0.35 %	2.90 %
Calcium Carb Eqv.	98.5%	65.24 %	2.43 %
Phosphorous		0.83 %	0.04 %
Potassium		4.46 %	0.10 %
Magnesium		2.70 %	0.04 %
Sulfur		0.70 %	0.05 %
Organic Carbon		8.98 %	57.13 %

The City of Lenoir also has a yard waste recycling program and the alum sludge from the water plant which they are recycling. All of the above are combined with a Class "A" - Exceptional Quality biosolids product to produce a blend that has a relatively high agronomic value. The constitution of the blend can be changed to suit various agronomic requirements. The following chart summarizes some of the more typical blends.

Table 3. Agronomic analysis of the City's blends. Lenoir's Blends.

Lenoir's' Blends	Saw Dust Blend	Wood Ash Blend
Solids	48.25 %	47.25 %
Nitrogen	1.22 %	0.05 %
Calcium Carb Eqv.	75.67 %	87.25 %
Phosphorous	0.54 %	0.89 %
Potassium	0.19 %	2.05 %
Magnesium	0.48 %	1.35 %
Sulfur	0.26 %	0.025 %
Organic Carbon	6.01 %	5.15 %

## BUILDING PARTNERSHIPS

The City of Lenoir realized early on that in order to have a successful program they would need the support of other key groups in the area. The City of Lenoir was fortunate to enlist the support of nationally recognized Professor A. R. Rubin, Ph.D. of North Carolina State University's agricultural-extension office. Dr. Rubin performed an in-depth analysis of the product and published valuable information which could be forwarded to state and local agricultural organizations. One particular organization, the local Cattleman's Association, was instrumental in developing much of the initial demand for the product. Other farmers soon became interested in the product after they saw, first-hand, what it could do for them. A key component of Lenoir's program was, and continues to be, a building of partnerships. A key component was the purchase of the City's own biosolids vehicle. With this vehicle, the City was able to demonstrate the quality of the biosolids products they were producing.

It is worth noting that there are a number of other biosolids products which are being produced and made available within the region. The City of Lenoir felt as though they had to make a higher quality product to ensure effective and positive market acceptance and use. Other products which are available in the region include N-VIRO soil from the City's of Asheville and Statesville. In addition, there are two dryers in the area, one in Boone and the other in Forest City. Finally, there are other lime products which are produced in Old Fort and Tuckaseegee, NC.

## PUBLIC ACCEPTANCE AND AWARENESS

The City of Lenoir has always been concerned about public awareness and the acceptance of biosolids. In the past, there have been numerous odor complaints associated with the operation of the wastewater treatment facility. In one case, a resident came to the plant to "take pictures of [the] odors." This is an extreme example of just what the City of Lenoir was facing. The City of Lenoir certainly did not want to incur any additional complaints as a result of any decision to place into operation a lime stabilization facility. Clearly, the potential for unwanted ammonia odors exists in a lime stabilization operation/process. The selection of the RDP EnVessel Pasteurization™ process was a key factor in the process selected because of its relatively low lime dosing which resulted in a minimal amount of ammonia production. Since the facility has been in operation there have not been any "legitimate" complaints directly related to the RDP En Vessel Pasteurization™ process.

The area surrounding the Lenoir region is keenly aware of the use and practice of land application of biosolids. In fact, land application is generally accepted throughout the entire state of North Carolina. The acceptance of the product by the community is, however, a function of the methods that are used in the land application practices, the models that are produced during these operations, and the physical appearance of the product. The program that has been instituted by the City of Lenoir effectively deals with these three potential objections to land application of biosolids. As the result of having a good program, land application of biosolids continues to be well accepted in the community. Without a good program it is questionable whether even a Class "A" biosolids program would be accepted by any community.

The level of acceptance of biosolids in the City of Lenoir can also be seen in where the City chooses to apply the product. The City regularly applies the biosolids product to baseball fields, soccer fields, and other community areas. There have not been any complaints by the citizens in the first two years of operation. In fact, due to a scheduling conflict, product was applied on a thought to be unused soccer field, in reality the field was used one day later for a major statewide competition. No complaints were heard from either the players or spectators.

## DESCRIPTION OF OPERATIONS

One of the most striking things about the City of Lenoir's operation at the Lower Creek plant is its relative simplicity, ease of operation, "product flow," and cleanliness. This simplicity translates into a direct savings in both capital and operating costs. The facility was designed by the City of Lenoir's consulting engineers McGill Associates of Asheville, North Carolina. The capital cost for the facility is approximately 1.5 million dollars which includes all of the buildings, equipment, and construction and installation which was required for both the dewatering operation and the sludge lime stabilization operation. The major components of equipment which were included in this facility are a 2.0 meter belt filter press, polymer feed system, lime stabilization system, and odor control.

## DEVELOPING A FERTILIZER GRADE PRODUCT

Low operating cost is great, but if you can't move the product then a low operating cost is of little, or no, benefit. Therefore, product quality is of prime importance, especially for the City of Lenoir. The quality is judged in terms of odor, consistency of the product, and agronomic value. The agronomic value is balanced to provide both micro- and macro-nutrients in an aesthetically pleasing organic blend. Incorporating a proper mix improves soil structure, root development, tissue structure, and increased yield of the crops grown. The City of Lenoir is currently utilizing test plots to compare the City's Class "A" biosolids product with those from the other facilities mentioned above. The objective is to produce a consistent quality product to effectively market the product.

The number one objective of the marketing program is to "make it go away". This was, and is, being accomplished by identifying potential customers and conducting demonstration programs for them. Once again, the biggest customer for the product is the City of Lenoir itself. Lenoir spreads the biosolids products on their own baseball fields, soccer fields, cemetery grounds, airport, and makes the product available for its citizens. As a result of these activities there is little or no need for any "formal" promotional or marketing materials - all of the demand has come through word of mouth.

Other blends are currently being investigated by combining the by-products with topsoil, or topsoil and bark. The City of Lenoir makes other blends which consist of biosolids, composted wood chips, and "green" waste from curbside residential pickup. Materials are also made available to the City from landscape contractors who are trimming and chipping trees, shrubbery, as a part of their business.

## CONCLUSIONS AND RECOMMENDATIONS

The City of Lenoir has clearly demonstrated that it is possible to operate a successful Class "A" biosolids processing and marketing program, all at a lower cost than a liquid Class "B" operation. There seems to be an unlimited potential for beneficial co-utilization in North Carolina and, moreover, the entire United States. There are both direct and indirect benefits from this operation. Beneficial co-utilization will lower biosolids processing costs and it will reduce the high costs associated with landfilling. The indirect benefits are equally and quite possibly of greater significance. A program of beneficial co-utilization is good for the environment and it provides good public relations for the City. Residents can see the benefits throughout the community, and even on their own property. The City of Lenoir is producing an all natural organic product which will enhance the soils in the region.

Beneficial co-utilization makes good "cents." The City of Lenoir would like to extend an open invitation to any professional to come see "first-hand" our facilities and discuss beneficial co-utilization in your own communities.

## ACKNOWLEDGMENTS

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