**BENEFICIAL USES
OF PAPER MILL RESIDUALS FOR
NEW YORK STATE'S RECYCLED-PAPER MILLS**

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A NYSERDA Report in Brief

Report: Beneficial Uses of Paper Mill Residuals for New York State's Recycled-Paper Mills, Report 95-15

Project Manager: Judy Jarnefeld

Contractor: BES Technologies, Watertown, NY

Background: New York State paper mills are facing increasing problems with sludge disposal. In particular, costs for landfill disposal are rising. At a recent NYSERDA workshop, one recommendation was to help plants assess their sludge and identify potential technologies that could lead to beneficial use. In this project, NYSERDA and the New York State Department of Economic Development decided to work together to help New York State paper mills find more cost-effective sludge-disposal alternatives.

Objectives: The objectives were to:

- identify viable beneficial uses of paper sludge from mills using post-consumer fiber;
- identify the sludge generation and management practices of paper mills participating in the survey;
- identify the major obstacles to beneficial reuse of post-consumer fiber sludge in New York State; and,
- develop a set of recommendations for fostering beneficial uses of paper sludge in New York State's paper industry.

R&D Results: This project introduced new technologies to New York State's paper industry that produce useful, value-added products from paper mill sludge. It evaluated the industry's management and treatment of sludge, identified current efforts to use sludge, and suggested options for the industry in general and for individual mills in particular. It also examined regulations and economics that affect mills and suggested actions to improve industry's ability to convert sludge into value-added products.

The report recommends that NYS paper mills continue measures to reduce fiber and filler clay losses, promote the transfer of usable fiber and clay to mills able to use them, upgrade sludge-dewatering capabilities, and take a more regional approach to solid waste disposal problems. State agencies are urged to support these efforts, encourage the development and commercialization of new beneficial-use technologies, and reduce regulatory barriers whenever possible.

Copies Available: A limited number of copies of the full report are available from the New York State Energy Research and Development Authority, 2 Empire State Plaza, Suite 1901, Albany, New York 12223-1253; (518) 465-6251, ext. 241.

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NEW YORK STATE'S RECYCLED-PAPER MILLS**

Final Report

Prepared for

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ABSTRACT

This report evaluates the New York paper mill industry in terms of the productive management and treatment of solid wastes. It identifies current efforts by recycling mills to beneficially use paper mill residuals (often called sludge) and suggests additional options that should be considered by the industry in general and individual mills in particular. It also examines the regulations and economics affecting the mills and suggests actions that could improve the industry's ability to convert wastes to value-added products.

The report recommends that the mills should continue measures to reduce fiber and filler clay losses, promote the transfer of usable fiber and clay to mills able to use them, upgrade sludge dewatering capabilities, and take a more regional approach to solid waste disposal problems. State agencies are urged to support these efforts, encourage the development and commercialization of new beneficial use technologies, and reduce regulatory barriers whenever possible.

Key Words: (Paper mill, Paper mill residual, Sludge, Recycle, Waste reduction, Beneficial uses, Barriers, Regulations)

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SUMMARY

New York's paper industry is being challenged by competition from newer recycled mills in other parts of the country, higher costs for waste treatment and disposal, and increased demand for recycling. To meet these challenges, a project was sponsored by the New York State Energy Research & Development Authority and the Department of Economic Development's Office of Recycling and Market Development to identify and recommend technologies that may help the mills meet demand while controlling costs.

Each of the 49 paper mills in the state were contacted as part of this research report. Twenty four of thirty mills that use post-consumer/secondary fiber provided detailed information on the products they manufacture; how they manage the losses of paper mill residuals (fiber and clay) from their operation; the physical and/or chemical characteristics of the residuals; beneficial use opportunities that they may have investigated; and any technical, regulatory, and economic barriers that limit beneficial reuse of residuals.

Many of these mills are old and have limited staff and capital resources. Few large or smaller recycled, post-consumer fiber mills can afford further upward pressure on their costs of wastewater treatment and solid waste disposal.

There are a wide variety of beneficial use technologies that are proven to be commercially viable for converting paper mill residuals to value-added products. Unfortunately, the variation in quantity and quality of waste produced from the hundreds of paper products manufactured does not lead to a single, universal technology that applies to all mills in the state. There are, however, a number of strategies that the industry and state leaders should focus on that can: 1) assist the paper industry in meeting the demand for recycled content products; and 2) reduce the costs for managing paper mill solid wastes.

One strategy is to look at technologies such as in-mill fiber and filler clay collection and/or separation equipment to avoid losses to the drains. In addition, New York's paper industry could take advantage of the elimination of regulatory barriers to transfer residuals from one mill to another for use as a raw material for new paper products. The current demand for usable secondary fibers such as newsprint, mixed office waste, and cardboard fiber has opened up residual reuse opportunities for many of the state's mills.

Replacing or upgrading the equipment used by paper mills to remove water from their waste treatment plant residuals will open up a broad array of beneficial use technologies. Enhanced dewatering capabilities for paper mill residuals reduces long-term storage problems, allows for more cost effective year-round transportation to other recycling mills or beneficial use firms, and reduces energy costs for facilities that require other processing steps. The commercially viable product lines that would benefit the most from improved dewatering technologies include absorbents, animal bedding, filler clay reuse, cement binders and aggregate, energy recovery, and gasification. Value-added products not as dependent on moisture levels include compost, engineered soil substitutes, molded/construction products and chemicals.

The Department of Environmental Conservation (DEC) and the paper companies have been working together during the past year to begin evaluating the potential benefits of reusing paper mill residuals in three demonstration areas that have proven successful in other parts of the country. These research, development, and demonstration (RD&D) projects involve: 1) high moisture residuals in the reclamation of an iron tailings mine; 2) a high-ash, medium-high moisture residual in place of the clay barrier layer for a landfill closure project; and 3) low- moisture residuals (after drying) for animal bedding material and subsequent spreading on agricultural farms. Each of these projects could lead to these paper making residuals being declared as beneficially reused products and no longer as wastes. The mine land reclamation and landfill closure projects may benefit only two or three paper companies in the state because of the unique characteristics of their waste or the particular point of use of the product. The animal bedding project has broad application to a variety of paper mill residuals and has a large number of potential users given the state's large agricultural sector.

A regional or co-ordinated approach between neighboring mills is recommended to address some of the solid waste problems and develop successful commercial operations. For a number of emerging technologies that have lower capital demands (such as producing cement binders from existing kilns and recovering filler clays for landfill caps), residuals from several larger paper mills is needed to supply a cost-effective plant. State support for constructing regional drying facilities would also serve as a springboard for the successful development of these large plants and provide flexibility in directing the paper mill residuals to the products with the greatest market potential.

The research and development of product specifications for compost and engineered/synthetic soils is recommended for small producers of a variety of paper mill residuals. The nature of the paper mill residuals and the proper balance of nutrients to break down the residuals and produce a value-added soil amendment product must be evaluated for each paper mill. Many of the smaller mills do not have the test data available to determine whether a successful commercial operation can be established.

New York has more paper mills than any other state in the country. Figures indicate that the value of pulp and paper products shipped from New York total more than \$ 4.8 billion. The mills employ nearly 10,000 workers. Given the size and importance of the paper industry to New York's economy, continued focus by state agencies, commercial firms, and the paper industry is recommended to capitalize on beneficial use opportunities and to reduce or eliminate the financial and regulatory barriers that have been identified in this report. The momentum generated during the past year should lead to further exchanges of ideas that should improve the state's economy and environment.

In addition, an annual update on progress toward the goal of developing beneficial use projects is recommended. The update should identify any outstanding barriers that continue to impede the paper companies and beneficial use technology firms and determine if they can be resolved.

Section 1 INTRODUCTION

This report provides an overview of the pulp and paper industry's waste treatment and management practices in New York State; identifies promising technologies for beneficially reusing paper mill solid wastes generated by New York's recycling mills; and identifies key technical, regulatory, and economic barriers/limitations to beneficially reusing residuals.

This research report is the first of four major components of a statewide project to:

- Maximize the recovery and reuse of some or all components of paper mill residuals generated by mills using post-consumer fiber sources in New York State
- Minimize mill reliance on solid waste disposal capacity for mill residuals and
- Improve the cost effectiveness of mill residual management practices.

Research for this report was conducted by interviews, a literature search, and a survey of the pulp and paper mills in New York. The other project components involve: 1) disseminating these research findings (completed in March 1995); 2) evaluating the technical and economic feasibility of using various reuse technologies by the state agencies; and 3) selecting of at least two projects by state agencies to implement technologies and/or market applications of the beneficial use technologies (by October 1995).

The report is not intended to research methods to reduce the generation of mill residuals by making process modifications or by reusing any of the components of residuals within the process (e.g., fiber recovery for reuse onsite or as a fuel supplement). Although industrial waste minimization through such process modifications is an important objective, it is beyond the scope of this report.

The report does, however, occasionally reference in-plant recycling practices used by New York mills or current technologies in which paper mill residuals are used as a fuel supplement. Also, the report includes discussions of beneficial uses of paper mill residuals that are transferred from one mill to another for use as a replacement fiber source (fiber reuse program). The recovery and reuse offsite of paper mill residuals is definitely a beneficial use technology. Opportunities to enhance fiber reuse efforts are to be encouraged and have been identified in this report for some of the mills.

For the purposes of this report, the byproducts of the paper mill and waste treatment plants are referred to as paper mill residuals. Over the years, the nomenclature for these residuals has been variously referred to in the literature and the waste disposal industry as 'sludge', 'paper mill wastes', or 'biosolids'. These terms are used occasionally in the report, particularly when cited by others in the field, but all are meant to describe a mixture of fibers, filler clays, and/or biological organisms that are produced as a result of the manufacture of paper and processing through a wastewater treatment plant.

Section 2 examines the results of a survey of 54 New York State mills and discusses alternatives for managing the solid wastes. Section 3 looks at the current commercially available alternative uses for paper mill residual technologies, some emerging technologies identified as part of this research effort, and their general applicability to New York State paper mills. At the end of Section 3, descriptions of individual mills have been included to provide specific information and recommendations on beneficial use technologies that should be considered based on the nature of their wastes. Section 4 presents a few of the barriers to implementing reuse technologies for paper mill residuals and Section 5 contains recommendations for the most promising technologies for research, development, and commercialization efforts. Section 6 provides a listing of the references that were cited in the previous sections. Other references that are noted in the Appendices are listed at the end of each respective appendix.

The principal audiences for this report are paper mill management personnel, commercial firms and developers, and state agencies. Since the audience may vary widely in technical knowledge and expertise, a glossary is provided in Section 7. For readers who are not familiar with the pulping, paper, and paperboard manufacturing process, a short review is provided in Appendix A. Also, a thorough discussion of typical waste treatment practices used by the pulp and paper industry are included in Appendix B. Appendix C contains a detailed discussion of specific applications of beneficial use technologies.

A copy of the mill survey form and more detailed information about the survey process are presented in Appendix D. Appendix E contains summary tables of some of the important information obtained from the survey effort. Finally, Appendix F contains information from a meeting held in March 1995 to review the survey results, discusses some of the regulatory obstacles, and brings together some of the beneficial use companies serving the pulp and paper industry.

BACKGROUND

Since the mid-1800s, the US paper industry has depended upon renewable resources (forest) to produce the myriad paper products used by its customers. The versatility of uses for paper and its low cost have resulted in a high throw-away rate for paper products. A significant percentage of the solid wastes thrown out by the consumer (up to 44 percent) contain renewable fiber that can be "reharvested" in the city and suburbs.

Federal and state regulations for solid waste disposal and more recycling have become significant environmental protection issues. In response to the recycling pressures, the paper industry announced in February 1990, a major public commitment to recover and use more recycled fiber. A national goal was set to reach a level of 40 percent paper recovery for recycling (including export of paper for reuse) by the end of 1995. (This is compared to a recovery and recycle rate in 1988 of 30 percent of all paper and paperboard produced in the US).

According to the American Forest and Paper Association (AFPA), at the end of 1994 (1 year ahead of schedule), recycling programs by businesses and local governments had recovered and recycled more than 40.4 percent of all the paper produced in the US. A new goal of 50 percent was established to be reached in the year 2000.

By January 1994, there were 145 new projects for expanding the use of recovered paper announced or operating throughout the country, including many new plants. Recycling capacity was added to the more than 500 paper mills that were already engaged in paper production in the US. Since the use of recycled fiber produces an increase in the quantity of paper mill residuals produced by the mill, there was a shift in the nature of the solid waste problem. According to research conducted by the National Council of the Paper Industry for Air and Stream Improvement (1), the industry generated 13.5 million tons of solid waste in 1989. Of that total, 4.1 million tons per year are solids from the wastewater treatment plant operation.

Within the paper industry, primary and secondary residual solids (also referred to in the literature as sludge or biosolids) from mill waste treatment plants have long been of concern regarding their proper disposal. More recent contributors to limiting opportunities for disposal are: more stringent environmental regulations that put landfill space at a premium, and increases in the number of recycled fiber mills (2).

Regulatory pressure comes from requirements to reduce biochemical oxygen demand (BOD) and total suspended solid (TSS) loadings of wastewater discharges into waterways. Additionally, the proposed so-called "cluster" rule published in the December 17, 1993 Federal Register by the US Environmental Protection Agency (EPA), is anticipated to produce even more pressure on limited landfill space (2). The proposed "cluster" rule controls effluent discharges and air emissions. By decreasing the allowable pollutant levels that can be discharged, the efficiency of the waste treatment plant will have to increase, or other process changes made, to maintain compliance. A more efficient treatment plant will generate more primary and secondary residual wastes by the mills. A mill's residuals must be disposed of properly or it will have to find beneficial uses for even more solid wastes. It should be noted that bleach mills that implement process changes and decrease chlorine application levels will produce residuals with lower or non-detectable dioxin levels, creating a higher quality solid waste more suitable for land applications.

The proposed "cluster" rule does not set limits on paper mill residuals. Page 66090 of the Federal Register references activities affecting the pulp and paper industry (40 CFR Parts 63 and 430, December 17, 1993, Effluent Limitation Guidelines, Pretreatment Standards, and New Source Performance Standards: Pulp, Paper, and Paperboard Category; National Emission Standards for Hazardous Air Pollutants for Source Category: Pulp and Paper Production; Proposed Rule). Process changes and use of best management practices will reduce the loads going to the treatment system, and thus may minimize increases and potentially decrease residual volumes.

Stringent environmental rules also have placed landfill space at a premium. Specifically in New York State, the closure rate for landfills increased significantly after the Department of Environmental Conservation (DEC) Part 360 Solid Waste Management regulations were revamped in December 1988. Disposal costs for the general public, commercial firms, and the industrial sector dependent upon public landfills spiralled upward as more closed because they could not meet the environmental regulations. The number of landfills in New York has dropped from 518 in 1982 to about 40, in 1995, according to figures from the DEC. As a result, tipping fees that had been generally less than \$30 per ton in the 1980s jumped to anywhere from \$65 to \$130 per ton in the 1990s.

Finally, the growth of recycled mills during the early 1990s to meet the commitment of AFPA's recycling goals have indirectly had a bearing on the generation rate of solid wastes. Some mills began using purchased recycled fiber in their finished paper grades, while other companies built deinking plants or other types of secondary fiber mills. A typical post-consumer recycled fiber mill produces 881 pounds of solid waste (residuals, dirt, tape, wire, and other types of contaminants) per ton of finished product for a nearly 45 percent waste generation rate (1). On the other hand, a typical bleached kraft virgin mill that makes paper directly from logs or wood chips produces only 381 pounds of waste of all types per 2000 pounds (1 ton) of finished paper, less than a 20 percent waste generation rate.

In New York, most of the growth in recycled mills has come from an increase in the use of post-consumer fiber at existing mills rather than the startup of new facilities. The introduction of post-consumer fiber to the blend of pulp furnishes has caused an increase in the amount of organic matter (BOD) and small fiber fines (TSS) that is discharged to the sewer and, therefore, the effluent loading to the treatment plant. The mills have had to respond to this increased loading by effective capture and/or removal to remain in compliance with permit limits.

Competition from the newer recycled machines in other parts of the country, higher costs for wastewater treatment and disposal, and increased recycling have presented some significant challenges to New York State's important paper industry. The value of pulp and paper products shipped from New York totals more than \$ 4.8 billion. The variety of mills in New York State employ nearly 10,000 workers (4).

Few companies in this state, whether large virgin fiber users or smaller recycled, post-consumer fiber mills can afford further upward pressure on their costs for wastewater treatment and solid waste disposal. The higher waste generation rates for the production of recycled paper put them at a competitive disadvantage with other mills in the US (2).

The overall objective of this research project will be met if New York can assist the paper industry in: 1) meeting the demand for recycled content products; and 2) reducing costs for managing solid wastes by identifying/eliminating barriers to the development or expansion of beneficial use technologies that can make value-added products from paper mill residuals.

Section 2

REVIEW OF NEW YORK AND REGIONAL PAPER INDUSTRY

The paper industry has been active in the recovery of its solid wastes for decades (3). This is reflected in discussions in Section 3 and Appendices B and C on RD&D projects and the implementation of beneficial use technologies. The United States has nearly 700 operating mills that have all, at one time or another, looked at alternative uses for their pulp and/or paper mill residuals.

A recent report (4) quotes US Census Bureau statistics that there are 180 pulp and paper mill facilities in the northeast. The nine northeastern states include New York, Pennsylvania, New Jersey, Massachusetts, Connecticut, Rhode Island, Vermont, New Hampshire, and Maine. There are 157 paper and board mills in this region (113 paper mills and 44 paperboard mills) that produce 9.6 million tons per year of paper and board. New York is home to the most paper mills of any state in the region and the country with 49 currently in operation.

The most frequently produced grades in the region are the coated groundwood and uncoated freesheet printing and writing paper products. A wide variety of other products are produced because many of the mills in the northeast are small speciality grade operations. However, very few of the region's paper mills are integrated with their own pulp mill. The northeast is the lowest regional producer of pulp in the United States. Only 25 of the nation's 201 pulp mills are located in the northeast. They produce 4 million tons annually out of the 60.7 million tons produced nationwide (6.6 percent of the total) (4).

Given that the region does not have many integrated pulp and paper mills, much of its pulp is purchased from competitor mills on the open market or transferred at market prices from company or affiliated mills. Recovered paper comprises almost one half of the total fiber consumed in the northeastern region. The need to purchase market pulp and waste paper has created a strong economic incentive to internally recover and reuse as much fiber as possible and keep it out of the landfills. Ultimately, some wastes do end up in the wastewater treatment plant and must be managed in an economical and environmentally sound manner.

Mills in New York, as with the other states in the northeast, are faced with a number of challenges. First they must face federal and state pressures to increase their use of post-consumer fiber in their processes. The use of this fiber may introduce quality control problems, which require rejection to the sewers of more fiber/clay or production of off-quality paper; the problems also raises disposal costs. To makeup for the lost fiber more is purchased, which adds to the rising costs for furnish. As a result, the paper industry has been compelled to explore alternatives to landfilling that beneficially reuse the waste.

SURVEY OF NEW YORK RECYCLED MILLS

Many examples of beneficial use projects cited in this report and the appendixes have been

researched and developed in the northeastern states. One of the primary goals of this report was to survey post-consumer recycling mills in New York and identify the beneficial use technologies that have been and are being used. Some of the small mills have been driven to implement beneficial use activities by the economic pressures of more expensive fiber furnish and more expensive disposal costs. Others have not had the resources to develop the technologies and may benefit from the findings of this report, enabling them to reduce their waste management costs.

Survey Methodology

The primary focus of the survey effort was the mills in the state that use post-consumer fiber in the process of making various paper grades. In Fall 1994, available information indicated there were 49 mills in the state. Of that total, between 23 - 30 mills were believed to use post-consumer or recycled fiber. The balance were considered as potential resources for information on their waste management practices; their waste characteristics; types of technical, regulatory and economic barriers or limitations to beneficially reusing residuals; and costs for disposal.

Thirty recycled/post-consumer mills were identified and asked to complete the survey. Twenty four mills participated for an 80-percent return rate. Of the non-recycled fiber-using mills in the state (19), only one mill completed the survey. Given the lack of participation by the non-recycled mills and the fact that the primary focus of the survey was the secondary fiber mills, only data for the recycled/post-consumer mills has been included in this report. General reference may be made to comments or beneficial use technologies used by the non-recycled mills in the state, but none of their statistics have been included for these facilities.

Types of Mills Responding

The 24 recycled mills in New York that responded to the survey are very typical of the mills in the northeast region. Five of the respondents are integrated facilities in that they manufacture both pulp and paper for use. Four of integrated pulp mills process logs (two by mechanical pulping) or chips (using ammonium bi-sulfite or high-yield sulfite). The other integrated mill takes in waste fiber and deinks it for their paper mill operation. The remaining 19 facilities are non-integrated mills that depend upon purchased virgin pulp and/or secondary (recovered) fiber for their paper production.

A variety of virgin purchased fiber sources are used by 17 of the 24 respondents. The fiber sources include both bleached and unbleached varieties from the kraft, groundwood, and sulfite pulping processes. All 24 mills use some secondary (recycled) fiber as part of their required furnish. These secondary furnish sources include mixed office waste (MOW), old magazine (OMG), old corrugated containers (OCC), high grade deinked fiber (HDI), pulp substitutes (P Subs), double lined kraft (DLK), and cotton. Some other less commonly used secondary fiber sources that are very specialized include eucalyptus, fiber glass, kevlar, and polyester.

Production Rates and Grades

The New York mills resemble those throughout the rest of the northeast region: older, smaller mills that produce a wide variety of speciality grades. The production rates for the integrated pulp and paper mills that responded to the survey covered the broadest range of tonnages but generally are the larger mill operations. These integrated mills produce fine paper, book, magazine, and catalogue grades of paper.

Table 2-1 groups the various mills in general categories of grades of paper they produce with the saleable production figures. (Saleable production refers to the finished paper by a mill after cutting/trimming the roll to size and removing any off-quality, off-specification paper. It represents paper that is ready for sale and is expressed in tons of production per day).

Table 2-1. Production Rates of Respondents by Grades.

GENERAL GRADE CATEGORY	SALEABLE PRODUCTION (TPD)
Integrated Mill: Fine Paper, Book, Magazine, and Catalogue	174 - 665
Non-Integrated Fine Paper & Book	100 - 303
Tissue, Toweling, and Napkin	42 - 155
Linerboard & Corrugating Medium	260 - 354
Molded Packaging/Board	30 - 85
Wallboard Paper	122 - 175
Various Speciality Products	60 - 195

The non-integrated fine and book paper mill category are often smaller producers of saleable paper than the integrated mills. Linerboard and corrugating medium mills are large consumers of old cardboard boxes and other secondary fiber sources and have relatively large saleable production rates. The remaining grade categories are from survey respondents that are all under 200 tons per day of saleable production. The smallest mill responding to the survey is in the molded packaging and board category and turns out 30 tons of paper per day. It is not unusual to find mills that make dozens or more grades covering a broad spectrum of secondary fiber, kraft, and/or groundwood pulp furnishes. Many types reported by the mills are listed in the Table 2-2.

Table 2-2. Fifteen Types or Grades of Products Produced by Survey Respondents.

Fine Printing & Writing	Corrugating Medium	Paper For Wallboard
Gasket & Floor Backing	Paper/Linerboard	Molded Packaging
Matboard, Cover Stock Boxboard, & Specialities	Tissue, Toweling, & Napkin Paper	Latex Reinforced Paper & Board
Wet Creped Grades (Tape, Coffee Filters)	Food Service, Packaging, & Placemat	Photo paper, Greeting Cards
(Un) Coated Book, Catalogue, & Directory	Publication Papers	Book & Brochures

With the wide variety of grades listed in Table 2-2, one would expect to find a high degree of variability in the furnishes. This is the case for the survey respondents. Some of the above grades contain only a small proportion of secondary (recycled) fiber while other grades contain as much as 100 percent secondary furnish. Seven of the respondents reported that they have a high degree of variability in their fiber furnishes (some have little or no recycled fiber while others are 75 percent or more secondary). Eleven of the respondents reported that they have a low degree of variability in their fiber furnishes with either: 1) consistent runs of secondary furnish and not many other fiber blends; or 2) consistent runs of kraft, groundwood, and/or sulfite pulps, and the occasional grade with some recycled fiber in the finished paper product. The remaining mills run various grades and have what they consider only a medium degree of variability.

Quantities of Solid Wastes Produced

A 1989 NCASI (1) study cited a survey of the paper industry showing that 4.1 million dry tons of wastewater treatment plant solids are produced each year. One might expect that the amount of residuals (sludge) generated by the large number of mills in New York State would represent a significant proportion of the paper industry total. While not all the mills in the state responded to this survey, the 24 recycled mills include all but a few of the largest producers of treatment plant residuals. Based on additional data from non-survey respondents available to the researchers, as well as the 24 mills respondents, the total quantity of paper mill residuals produced in New York is estimated to be 0.144 million dry tons per year. This estimate represents 3.5 percent of the US paper industry total of 4.1 million dry tons per year of treatment plant residuals.

Table 2-3 lists the New York State mills that responded to the survey and the quantities of paper mill residuals that they dispose of. The data include the quantity generated in both wet tpd and in bone dry tpd. The table also provides the percent of solids content for their residuals after processing and the average or range for the percent of inorganic solids/ash.

TABLE 2-3. New York Mill Survey Respondents - Paper Mill Residuals Data.

PAPER MILL NAME	CITY	WASTE QUANTITY (Wet TPD)	QUANTITY (Dry TPD)	PERCENT SOLIDS	PERCENT ASH
Armstrong World Ind.	Fulton	16	8	47+/-23	61 +/-11
Brownville Specialty Paper	Brownville	50	1	2	NA
Buffalo Paperboard Corp.	Lockport	5.6	2.2	40	N/A
Cascades-Niagara Falls	Niagara Falls	30	7.5	25	NA
Champion International	Deferiet	171	60	35	35
Columbia Corporation	Chatham	0	0	N/A	N/A
Columbia Corporation	Wallomsac	0	0	N/A	N/A
Encore Paper Co., Inc.	S. Glens Falls	330	100	30	45 +/-5
Finch Pruyn & Co.	Glens Falls	238	76	32	25
International Paper	Corinth	107	40	37+/-3	40
International Paper	Oswego	3	0.9	30	9
James River Corp.	Carthage	38	18	47+/-3	17 +/-2
James River Corp.	Gouverneur	5	1.8	35	<1
Lyons Falls P&P	Lyons Falls	16.7	5	30	12
Mohawk Paper	Cohoes	0	0	N/A	N/A
Mohawk Paper Mills	Waterford	8	3.5	42	20
Norfolk Paper Co.	Norfolk	50	15	30	11 +/-3
Packaging Corp. of America	Plattsburgh	N/A	N/A	N/A	N/A
Potsdam Paper	Potsdam	2.4	1.2	50	9
Schoeller Tech.	Pulaski	14.3	5	35	15
Solvay Paperboard Corp.	Solvay	60	27	45+/-5	2
Specialty Paperboard	Beaver Falls	9.7	2.9	30	25
Stora Papyrus	Newton Falls	38.5	7.7	25	65 +/-3
U.S. Gypsum Co.	Oakfield	1.5	0.9	60	5

Table 2-4 presents the data for the quantity of residuals produced in each general grade category and the pounds of waste per ton of saleable paper. The mills that generate the highest waste solids loss (expressed in dry tons of residuals per day) are integrated pulp/deinking and paper making facilities. The one New York State respondent with a deinking facility produces various grades such as tissue, napkin, and paper toweling and generates about 100 dry tpd of residuals. The integrated mills generate as much as 76 tpd of residuals, with the low end of the range totaling 5 dry tpd. One linerboard and corrugating medium mill produces 41 dry tpd of waste mill residuals. The other mills in the general grade categories produce a low of zero tons of residuals because they take their wastes to other mills for reuse as a raw material fiber (non-integrated fine paper and book category) or up to 15 tpd in the molded packaging and board category.

Researchers (5) have reported data regarding the amount of residual wastes in dry pounds that is produced for various recycled operations grades relative to the tons of paper and paperboard production. For secondary fiber mills that deink, NCASI has noted that the amount of waste produced by recycling facilities depends to a great extent upon the grade and sorting standards of the paper to be produced. For example, deinked newsprint mills with their low ash feedstock generally produce less residuals than deinked fine paper mills and tissue mills.

The mean paper mill residual (primary and secondary) production rates expressed in dry pounds of residuals per ton of production for a newsprint deinking mill is about 350 pounds per ton with a range of about 200 to 475 lb/ton. The fine paper and tissue mill facilities average 600 and 810 lb/ton, respectively. The range for a fine paper mill is about 290 to 1075 lb/ton and for a tissue mill it was 310 - 1250 pounds of combined residuals per ton of deinked mill production. Only one respondent was a deinking facility that produces various grades such as tissue, napkin, and paper toweling. This operation had the highest residual generation figure of any of the respondents at 1333 pounds of combined residuals per ton of production.

Findings (1) from a 1989 survey of paper mill's solid waste management and disposal practices have been reported for various production categories (bleached, sulfite, groundwood, paperboard, non-integrated, etc, categories). The mean values for the residuals (combined) generation rates on a dry pound per ton of final product basis ranged from a low of less than 70 pounds to nearly 600 pounds of residuals per ton of production. The 24 mills responding to the survey fall in the general range of the 1989 survey results, although many of the New York mills tend to produce residuals in the lower end of the grade categories. This is likely driven by the significant disposal costs that the mills face in the state.

Waste Management Methods Used

Responses from the 24 New York mills are consistent with research findings previously cited (1) that reported landfilling as the most frequently used waste management method used in the US paper industry. That finding holds true in New York, where 13 of the 24 mills dispose of their wastes in landfills. A departure from the national statistics is evident in the second most frequently used disposal method: incineration. In New York, none of the mill respondents

Table 2-4. Mill Solids for Disposal & Waste Generation by General Grade Category.

GENERAL GRADE CATEGORY	SOLIDS RANGE (Dry TPD)	POUNDS OF WASTE PER TON OF FINISHED PAPER
Integrated Mill: Fine Paper, Book, Magazine, & Catalogue	5 - 76	57 - 229
Non-Integrated: Fine Paper & Book	0 - 7.7	0 - 51
Tissue, Toweling, & Napkin	1.8 - 100	82 - 1333
Linerboard & Corrugating Medium	0.9 - 41	42 - 260
Molded Packaging/Board	1.2 - 15	40 - 353
Wallboard Paper	0.9 - 2.2	25 - 110
Various Speciality Products	1 - 5	33 - 84

directly used incineration to dispose of their residuals. (Some mills send their wastes to a municipal treatment plant or incinerator facility that may burn their residuals.)

The second most frequently used waste management method (four mill respondents) is actually a beneficial use of paper mill residuals; i.e., using it for daily cover at a municipal landfill. These mills benefit by a lower tipping fee (usually 10-15 percent lower) at the municipal facility than the tipping fee if it was simply buried. The next two most common methods used are also beneficial uses of paper mill residuals. Three mill respondents are reusing their treatment plant wastes or recycling it into their products. Two mills provide a portion of their residuals for composting operations. The final two mill respondents either reuse their waste back in their process or send it to a waste treatment plant.

Waste Management Treatment Cost

Many of the mills in the general grade categories appear to be below the average pound of dry paper residuals per ton of paper production rates reported for the industry. This is likely driven by the significant disposal costs that the mills face in New York. Table 2-5 summarizes the data from the 24 mills and includes all types of waste management technologies that are currently used. (Since some mills use two or three waste management methods, more than 24 mill respondents are listed in the table). Also listed is the range of costs reported by each mill for the various waste management methods. These costs have all been equalized to a dollars per dry ton of solids basis, regardless of the method used for dewatering.

Typically, mills that do not operate their own waste management facilities contract for pickup, transportation, and disposal or beneficial reuse and are charged a cost or tipping fee

(\$/ton of waste rate). That rate is based on the actual or as-is weight of the residuals so that it includes the dry weight of the fiber and clay solids in the residuals and the weight of the water present. Take for example a mill that is paying a tipping fee of \$60 per wet ton of residuals with a solids content of 30 percent. A significant portion of that tipping fee (70 percent) covers transport/disposal of water and not the actual solid waste material. Thus, the true cost of waste disposal on a bone dry basis is \$200 per dry ton. (\$60 per wet ton divided by the 30 percent solids of the residuals equals \$200 per dry ton).

Table 2-5. Waste Management Method and Cost Per Bone Dry Ton.

WASTE HANDLING TECHNOLOGY	MILL RESPONDENTS	COST * PER BONE DRY TON OF WASTE
Mill Landfill (Old)	4	\$40-60
Mill Landfill (New)	2	\$23 - 110
Public /Commercial Landfill	9	\$83 - 450 (Mean- \$239)
Landfill (Daily Cover)	4	\$40 - 154
Fiber Reuse	4	\$0** - 9
Compost Facility	3	\$69 - 263
Engineered Soils	2	\$15 - 67
Energy Recovery	1 (trial)	\$128

* Costs Include Transportation Unless Otherwise Noted

** Transportation Costs Not Included

For a mill that has installed up-to-date dewatering equipment and can achieve a 46 percent solids content, the same \$60 per wet ton charge would mean a \$133 per dry ton cost. It follows that the cost or tipping fee on a wet residuals basis (as-is or as-delivered) will always be lower than the cost on a dry (sometimes called bone dry or oven dry) basis.

The cost range data in Table 2-5 include the transportation costs for the waste management method unless otherwise noted. The mills engaged in fiber reuse programs did not have transportation figures available because they generally provide the waste fiber at no charge to the using mill, which picks up the cost of transportation.

Table 2-5 data support the point made earlier about high New York disposal costs driving mills to be in the low end of residuals generation per ton of paper production. The highest waste management costs (\$450 per dry ton of residuals produced) are for the public and

commercial landfills that some of the mill respondents are dependent upon. The spread in the range is also the highest in the public/commercial landfill category.

It should be noted that the design requirements for new municipal landfills in the state are the strictest/most expensive in the country. New York State mandates a double composite liner system (clay - geomembrane liner on the bottom, followed by a leak detection layer, followed by another clay-geomembrane liner system) for municipal wastes. Thus, the average tipping fee of \$239 per bone dry ton of waste reflects both the amount of water that is in the mill's waste and the capital/operating costs that the municipalities must recoup to pay off the cost of the facility.

The four mills that may be using older, onsite landfills that have not yet reached capacity, that are not impacting the environment, and/or have not had to incorporate the latest design requirements are incurring costs that are well below those mills that have to send their wastes to a municipal landfill. The waste management costs for the two mills that have newer single-composite liner facilities (built after the DEC Solid Waste Management regulations of December 31, 1988, went into effect) cover a wide waste management cost range. The spread is primarily because the lower cost mill has an onsite landfill while the other mill respondent has an offsite facility that has contracted outside help for pickup, transportation, and operation of the landfill facility. Both mills dewater to about the same solids content (mid 30 percent range), so that has no cost impact except for increasing the offsite mill's transportation costs and for bringing that moisture (leachate) back to the mill for treatment.

Mills that are currently using or have supplied their wastes to a composting operation can pay anywhere from \$69 to \$263 per dry ton of solid waste used. Proximity of the mill to the facility and the type of composting operation (windrow vs in-vessel type) can affect the cost of this beneficial reuse method.

The most effective means of reducing the cost impact of solid waste disposal is to recover and reuse the primary residuals that are high in fiber content. This is a very common practice in the United States. In fact, more than one half of the recycled paperboard mills in this country reuse their primary residuals in the production processes (6). The continual recycle and reuse of a mill's residuals back in its paperboard eventually leads to an ever increasing ash content in the finished product. While a moderate amount of primary waste and ash can improve the properties of the paperboard product, the continued reincorporation of the residuals may also effect the recyclability of the paper board product in the future (6). In these cases, it is appropriate to provide the fiber to other mills for use, particularly when the mill needs fiber.

It is apparent from the data in Table 2-5 that the lowest cost waste management option for a number of New York mills is to engage in a fiber reuse program. The old adage that "One person's waste is another person's resource" holds true for the mills in this beneficial reuse activity. Unfortunately, barriers currently exist that limit the development of this fiber reuse market. Obstacles include the suitability /quality and form of the waste from one mill being used as a fiber furnish in another mill's operation.

Fiber in a reuse agreement between two or more mills must be in an acceptable condition in terms of packaging, loading, transport, unloading, storage, and reblending with water for reuse. The moisture level of the baled/bundled material must be low enough (typically less than 60 percent) so as not to promote bacterial activity and the production of odors during transportation and use. The amount and type of waste contaminants is also important to the mill using the waste fiber and has to be of a size, density, and composition so that the mill's own fiber/clay/contaminant separation equipment can handle it. Materials such as bits of tape, plastic, styrofoam, waxes, and glues can cause significant operational problems if the user mill does not have the right type of screens, cleaners, savealls, etc, to separate out these contaminants.

Even if the issue of quality can be fully resolved, a regulatory issue exists for mills wanting to explore fiber reuse opportunities. New York State law has previously declared paper mill residuals as a waste at the point of generation; consequently, it must be transported in trucks registered with the DEC that have obtained a special Part 364 waste hauler's permit. New trucking firms wanting to securing a Part 364 Permit have encountered months of delay in obtaining such a permit and the mills incurred higher transportation rates to get the fiber resource to the mill interested in evaluating it for reuse feasibility. The DEC has now revisited this barrier and adopted a policy to encourage the beneficial use of waste fiber. (See Section 4 for more on this issue.)

BENEFICIAL USE INITIATIVES IN NEW YORK STATE

New York currently has a petition process that was incorporated into law with the December 1988 Solid Waste Management Regulations. New York State Rule 6 NYCRR Part 360, Section 360-1.15, exempts from the definition of solid waste, materials that have been granted by the DEC a beneficial use determination (BUD) based on acceptance of a written petition by the generator or user. The petition must provide the following:

1. Description of the solid waste material and its proposed use
2. Chemical and physical characteristics of the solid waste and of each type of proposed product
3. Demonstration that there is a known or reasonably profitable market for the intended use of the solid waste under the review and of all proposed products
4. Demonstration that the management of the solid waste under review will not adversely affect human health and safety, the environment, and natural resources.

A complete copy of the text and requirements of the BUD petition process can be found in Appendix D, which contains the paper industry survey.

New York law had also required that any material that must be transported offsite to be processed (pelletized, dried, burned, blended, etc) be hauled in a Part 364 permitted truck. If the waste material was processed onsite, no Part 364 permit was required. The DEC's

change in policy will be a significant help in reducing the costs for any commercial hauler for transporting residuals to be reused as products.

Since the BUD process was established in 1988, industries of all types have petitioned the DEC for opportunities to have their material declared of beneficial use and not a waste. A number of paper mills in New York have taken the time and expense of petitioning the DEC for projects and technologies that will reduce the amount of material going into expensive private or public landfills. In general, it can take as much as a year or a year and a half to prepare the necessary information on waste and product characteristics, market potential, and environmental and health risk information. Once this information has been collected and the BUD petition submitted, the regulatory review process can require from 5 weeks to 11 months or longer for acceptance or rejection.

Many paper mills and/or commercial companies have been involved in finding beneficial uses of mill wastes. As of July 1995, 15 BUD petitions involving paper mill wastes have been sought with 14 approved and three recently completing the RD&D permit process. (A successful RD&D project may lead to a successful BUD petition or fulfilling requirements for other permits). The purpose of the RD&D permit program is to provide a means for proving an innovative and experimental solid waste management technology or process. (The specific regulatory rules for RD&D permits are included in Appendix D, Page D - 29).

Table 2-6 lists the BUD applications (issued or pending) for paper mill wastes that have been registered by the DEC. Also included are the applicants, the type of waste, final use of the beneficial use product, and the issuance dates. The BUDs that have been issued cover the conversion of paper mill residuals to the following final uses: soil substitutes (seven); non-food fiber reuse efforts (two); absorbents products (two); construction uses such as building materials (one); cement products (one); and fuel products (one). There are three approved RD&D permits: one for the drying and evaluation as an animal bedding product at New York State farms, one for a mined land reclamation project, and one to explore the use of residuals in landfill clay capping projects.

Six of the seven beneficial uses activities listed as soil substitute products involve landfill uses such as daily cover (applied to a 6-inch depth at the end of each operating day at a public or commercial landfill), intermediate cover (12-inch depth after a 30-day dormant period at a landfill), and grading material and/or topsoil at landfills. Prior to October 9, 1993, any uses of paper mill wastes for daily cover required applying for a BUD. The regulations were revised to amend the landfill operating requirements (Part 360 - 2.17 (c)) to allow the use of materials like paper mill wastes as daily cover. The purpose of the revision was to cut down on the DEC's need to administer BUDs for this type of use. Parties (paper mill representatives and landfill operators, for example) interested in having paper mill residuals evaluated or used as a daily cover should send a letter of request to the DEC.

One BUD involves using paper mill residuals as a soil-less growing medium, a top dress-hydro mulch, a soil conditioner, and a composted bark/residuals mixture. This falls into the area of land application of paper mill residuals. When this BUD was issued in 1990, the DEC

imposed a number of analytical requirements on the paper mill and commercial firm for this application. The BUD required monthly testing of the residuals for heavy metals, nutrient content, chloride, sulfate, fluoride, total solids, total volatile solids, and pH and annual testing of dioxin and furans. For any current land application activity, the DEC requires that the conditions in Part 360-4 be met. Specifically, Part 360-4.2(d) requires that land applied materials must benefit the soil or crop.

Two mills in Table 2-6 provide their wastes (primary only and combined) to the secondary fiber market, where it can be used to manufacture non-food grade paper products. Although the transportation of wastes for fiber reuse is no longer subject to all provisions of the Part 364 waste hauling permit process, the DEC does require that the transfer, processing, and storage of the secondary materials meet all provisions of Part 360 rules.

Two BUDs cover wastes from as many as four New York paper mills for the production of absorbent products. One manufacturer, Cellutech, Inc., has been drying paper residuals onsite and offsite to produce absorbent products such as loose particulate, granulated and pelletized forms in bags, pails, drums, socks, and pillows. Champion International (Deferiet) supplies a combined (primary and secondary) paper mill residuals and James River (Carthage) provides a primary treatment plant residuals to Cellutech for absorbent production. The other absorbent manufacturer, Energy Management Services, LP (Solvay, NY), is using combined residuals from a deinking mill and a linerboard mill. EMS also has a BUD for drying and making a product as a substitute solid fuel. Finally, EMS has obtained an RD&D permit for evaluating open stall animal bedding. The same two mills are potential suppliers for the fuel and animal bedding product lines.

A BUD for the IP mill in Corinth covers the use of a combined paper mill residuals using one of two processes for pre-cast building and construction products. The first involves blending mill wastes and Portland cement, mixing, and then molding it at a block and panel facility. The second relies on the inherent mix of fiber and clay in the mill's waste and uses pressure only to form the residuals into thin, strong corrugated panels for use in exterior wall construction. The other construction product BUD involved the use of mill residuals from an out-of-state paper mill as a substitute feedstock for red shale in the manufacture of cement.

IMPACT OF WASTE CHARACTERISTICS ON BENEFICIAL USE TECHNOLOGIES

Throughout this report and appendixes, the physical and chemical characteristics of the paper mill residuals have been referenced with respect to their impact on implementing various beneficial use technologies. As part of the survey effort, all mills were asked to provide general information on the physical properties of their waste solids, compositional analyses, and chemical composition data, including TCLP metals, pesticides/herbicides, organics, PCBs, dioxin and furans.

No mill that completed the survey requested that the information be considered a trade secret or proprietary. Where specific/detailed information from the survey was referenced to a mill,

Table 2-6. Existing Beneficial Use Determinations (BUD) Applications For New York Paper Mill (PM) Wastes.

BUD #	APPLICANT'S NAME	VILLAGE/TOWN/CITY	WASTE TYPE	FINAL USE	DESCRIPTION OF BENEFICIAL USE	DEC	DATE
014-5-46	International Paper	Corinth (T)	P M Waste	Soil Substitute	Soil conditioner, composted bark/residuals, top dress-hydro mulch, and soil-less growing medium	Region 5	10/3/90
151-5-16	International Paper	Ticonderoga (T)	P M Primary Waste	Non-Food Paper	Non-food box (card) board, file folders, etc.	Region 5	2/7/92
170-5-16	International Paper	Ticonderoga (T)	P M Primary Waste	Soil Substitute	Daily cover, blended intermediate, grading & topsoil	Region 5	9/22/92
167-5-46	International Paper	Corinth (T)	PM Wastes	Soil Substitute	Daily cover, blended intermediate, grading & topsoil	Region 5	4/15/92
202-5-46	International Paper	Corinth (T)	PM Wastes	Building Matl.	Manufacture of pre-cast building & construction matls	Region 5	9/13/93
317-5-57	Hollingsworth & Vose	Greenwich (T)	PM Wastes	Soil Substitute	Intermediate cover & grading material	Region 5	6/10/94
017-5-57	Encore Paper Company	South Glens Falls (V)	PM Wastes	Soil Substitute	Daily, vegetative & intermediate cover, grading matl.	Region 5	4/16/91
044-5-46	Mohawk Paper Mills	Cohoes (T)	PM Wastes	Non-Food Paper	Non-food box (card) board, file folders, etc	Region 4	5/14/91
134-5-57	Stevens & Thompson	Colonie (T)	PM Wastes	Soil Substitute	Use of PM fiber as daily and intermediate cover	Region 4	3/22/94
196-0-33	Cellutech, LTD	Deferiet (V)	PM Wastes	Absorbents	Use of wastes from two mills as absorbents	Region 6	5/13/92
305-6-23	Development Authority of The North Country	Rodman (T)	PM Wastes	Soil Substitute	Use of paper mill wastes from six regional paper mills for daily cover at public landfill	Region 6	5/2/94
NA	E M S, LP	Solvay (V)	PM Wastes	Fuel Products	Production of dried PM wastes for solid fuel boilers	Region 7	10/29/94
NA	E M S, LP	Solvay (V)	PM Wastes	Absorbents	Dried PM wastes for absorbent products	Region 7	Pending
Approved	E M S, LP	Solvay (V)	PM Wastes	Bedding	RD&D project with PM wastes for animal bedding	Region 7	3/95
084-4-20	Independent Cement	Catskill (T)	PM Wastes	Cement Product	Use as a substitute for red shale for cement mfg.	Region 4	8/16/91
Approved	Stora Papyrus	Newton Falls (V)	PM Wastes	Mine Land Reclamation	RD&D project for lagoon wastes for iron ore tailings mine	Region 6	3/95
Approved	Encore Paper Co.	S. Glens Falls	PM Wastes	Clay Cap(As Is)	RD&D project for landfill clay cap closure	Region 5	3/95

a copy was provided to the mill for review and permission was obtained to release it. Of the 24 mills that completed the survey, four provided most of the data. Some of the smaller mills have tested for the basic TCLP metals but not for Btu content, ultimate analysis, etc. Because of the lack of comprehensive physical and chemical data from the mills, no such data was included in this report.

For the physical parameters of the paper mill wastes, some of the important ones that have been cited in the literature and this report are bulk density, appearance, color, odor, and particle size. Few of the New York mills provided information on the physical properties of bulk density and particle size. Color, odor, and texture are important properties for products that are to be dried and used for consumer or commercial products. Consumers look for products with consistent appearances and odor of products before use and after rewetting for animal feeds, absorbent products, cat litters, mulch, and soil-less products containing paper mill residuals.

Nearly all of the respondents provided data on the composition of their paper mill residuals, including the source of residual (primary and/or secondary), solids or moisture content, and ash/clay type or content. (See the data compiled and summarized in Table 2-3.) Few of the mills had analytical data such as Btu or heat content of the paper mill wastes, ash fusion temperature, ultimate analysis (carbon, hydrogen, sulfur, etc), carbon to nitrogen ratio, or pH. Some of the mills that have already explored beneficial use technologies like energy recovery, land application, and composting have collected this type composition data. A list of waste characteristics, properties, and/or chemical tests to conduct for each of the significant beneficial use technologies is presented in Table 2-7.

The moisture/solids content of a residuals produced by the dewatering process at a paper mill is a critical parameter to measure because it affects the operations, economics, and marketability of every beneficial use technology. Residual moisture content can vary considerably from one paper mill to another. The variability can be affected by the type of pulp and paper manufactured and its waste discharges; whether the residuals consist of only primary solids or secondary solids, or are a combination of both; and the type of dewatering devices employed. (See Appendix B for a more detailed discussion of dewatering.) The moisture/solids content is important because it determines the volume and weight of waste to be handled by the beneficial use technology. The more amenable the residuals are to dewatering, then the smaller the volume of wastes to be handled, the lower its weight if it must be transported offsite and the lower the operating/conversion costs for the beneficial use.

Any beneficial use technologies that involve the direct or indirect placement of paper mill residuals on land should be evaluated for its nutrient content to determine if there is enough to meet the needs of the plants or crops that are being grown. The pH of the paper mill residuals or commercial by-product made from it is important to test for land application activities as well as in uses for clay/cement products.

The rate of breakdown (decomposition) by microbes (bacteria) of paper mill residuals in soil amendment activities is also a key characteristic that should be evaluated. The rate of decomposition of paper mill residuals can determine whether the material will produce objectionable odors during the storage, production, or use of the beneficial use product.

The organic and inorganic content of the potential beneficial use residuals are also an important parameter (highlighted in Table 2-7) that is frequently cited in the main text or discussed in the Appendices of this report. The organic fraction can be cellulose fiber from the pulp and paper mill operation or can be biosolids produced during the secondary waste treatment plant process. The quantity of the cellulose fiber impacts on the water holding/soil amendment properties of the direct and indirect land applied products made from paper mill residuals. If the residuals are a combination of primary and secondary source, the material may be a good source of both carbon and nitrogen for land application and composting purposes. Of course, the quantity of cellulose fibers is also important in providing absorbency for oil spill cleanup products and animal bedding/cat litter products. The presence of sufficient quantities of cellulose (organic matter) affects the performance and marketability of residuals used in the other higher value added products such as compost, building products, chemical products, fuel pellets, and gasification applications.

The remaining key properties of residuals or finished product tests that are recommended for various beneficial use technologies are listed in the table. Paper mill residuals used in landfill clay caps (as-is, without any further processing) or when the clay recovered after thermal oxidation and used as capping material must generally meet certain material specifications such as compaction, permeability/porosity, plasticity index, and particle/grain size. If the paper mill material fibers or clays are to be converted into clay cap material, cement and binders/products, aggregate, bleached clay for reuse, or chemical products, or recovered for its energy value, then the heat or BTU content of the residuals should be a very important parameter to evaluate. Other important tests like absorption and bulk density are of particular significance when residuals are used for absorbent products.

Table 2-7. Key Characteristics, Properties, & Tests * Needed for Certain Beneficial Use Technologies.

BENEFICIAL USES	KEY CHARACTERISTICS, PROPERTIES AND TESTS NEEDED FOR CERTAIN PAPER MILL RESIDUAL PRODUCTS											
	MOISTURE OR SOLIDS	NUTRIENT	pH	MICROBIAL DECOMPOSITION	(IN)ORGANIC CONTENT	COMPACTION	ABSORPTION	BULK DENSITY	PERMEABILITY OR POROSITY	PLASTICITY INDEX	PARTICLE & GRAIN SIZE	HEAT CONTENT
Landspreading	X	X	X	X	X				X			
Mine Land Reclamation	X	X	X	X	X				X			
Landfill Daily Cover	X			X				X	X			
Engineered Soils	X	X	X	X	X				X			
Hydroseeding	X	X	X	X	X							
Clay Capping (As Is)	X		X	X	X	X			X	X	X	
Composting / Mulch	X	X	X	X	X			X	X			
Animal Bedding & Agricultural Products	X		X	X	X	X	X	X				
Absorbents	X				X	X	X	X				
Clay Recovery for Caps	X		X		X	X			X	X	X	X
Cement & Binders	X		X		X				X	X	X	X
Light weight Aggregate	X				X				X		X	X
Molded Fibers & Construction Uses	X			X	X	X		X	X			
Clay Recovery, Bleaching & Reuse	X		X		X						X	X
Chemical Products	X				X							X
Energy Recovery & Gasification	X				X							X

* All Residuals and/or Finished Products Must Pass Toxicity Characteristic Leaching Procedure (TCLP) Test

WASTE CHARACTERISTICS MATRIX

The successful application of beneficial uses technologies with paper mill residuals is very dependent upon the properties of the waste and the technology to be employed. The research literature provides some minimum and maximum criteria for certain parameters/waste characteristics. Some commercial firms have also established desired target ranges for those characteristics. Presenting these minimums, maximums, and targets may help paper mills looking for new applications of beneficial use technologies and may serve as a useful tool for state agencies supporting the development of such technologies.

Table 2-8 is a matrix listing the minimum range of the solids content for a paper mill residual feedstock for the various beneficial use technologies. Where information was available, target solids content for the finished product is also listed for many of the technologies. The minimum and target solids ranges listed in the matrix are those typically cited in the literature or referred to in conversations with commercial technology firms. For some of the technologies, maximum or not-to-exceed solids values are provided in the table.

In general, the significant costs to dry the fiber and clay solids produced by a mill precludes a mill or commercial operation from intentionally over drying a material. Also, the finished product properties may be negatively affected if the fiber and clay solids are over dried. For example, paper mill residuals to be used for animal bedding can be too dry and cause handling/dusting issues. Maintaining a medium-high solids rather than a high solids (low moisture) concentration can avoid those handling issues and save on the cost of drying.

No specific formula or model can be developed for every beneficial use technology that will apply to all types of waste from various types of pulping, paper making, and waste treatment plant processes. Thus, the information in matrix tables 2-8 and 2-9 and for various physical, compositional, and chemical parameters, and the processing technologies are to serve as a general guide. Each mill has its own set of conditions and variables that can determine the economics of a given beneficial use technology, and use should be determined on a case-by-case basis by the paper mill, commercial beneficial use company, or engineering consulting firm working in the beneficial use technology field. (A review of the barriers in the development of beneficial use technologies is more thoroughly discussed in Section 4.)

The organic and inorganic content of the beneficial use material is also an important parameter. The organic fraction can be cellulose fiber from the pulp and paper mill operation or solids produced during the secondary waste treatment plant process. The quantity and type of the inorganic portion of the residuals are particularly important to clay capping activities (wet fiber/clay blends or clay recovered from a rotary kiln), cementious building and construction products, and dry clay that is being recovered and bleached for reuse in the paper mill operation for filler purposes. Table 2-8 is a matrix listing of the various beneficial use technologies with the minimum, maximum, and target ash content of the paper mill residuals noted.

**Table 2-8. Minimum, Maximum, and/or Final (Targeted) Solids Content
(Percent Solids) for Beneficial Use Technologies.**

Beneficial Uses	LOW 0.5-24%	MEDIUM LOW 25 - 39%	MEDIUM 40 - 59%	MEDIUM- HIGH 60 - 75%	HIGH 76 -100%
Land Spreading	Minimum *	Target**			
Mine Land Reclamation	Minimum	Target	Maximum ***		
Landfill Daily Cover		Minimum	Target		
Hydroseeding	Minimum		Maximum		
Clay Cap (As Is)		Minimum	Target	Maximum	
Engineered Soil		Minimum	Target		
Compost/Mulch		Minimum		Target	
Animal Bedding & Agr. Products		Minimum		Target	Maximum ***
Absorbents		Minimum			Target
Clay Recovery for Capping			Minimum		Target
Cements & Binders			Minimum		Target
Light Weight Aggregate			Minimum		Target
Molded Fiber & Construction		Minimum			Target
Clay Recovery, Bleaching, & Reuse			Minimum		Target
Chemical Products		Minimum			
Fuel & Gasification			Minimum		Target

* Minimum means minimum desired percentage range for a beneficial use application

** Target is the desired percentage range for the given beneficial use.

*** Maximum means desired percentage for a given beneficial use application

Table 2-9. Minimum, Maximum, and/or Final (Targeted) Ash Content (Percent Solids).

Beneficial Uses	VERY LOW (0-9%)	MEDIUM LOW (10-19%)	MEDIUM (20-29%)	MEDIUM HIGH (30-39%)	HIGH (40+%)
Land Spreading	Minimum*	Target**		Maximum***	
Mine Land Reclamation	Minimum	Target			
Landfill Daily Cover					
Hydroseeding					
Clay Cap (As Is)			Minimum		Target
Engineered Soil					
Compost/Mulch					
Animal Bedding & Agr.. Products	Minimum				Maximum
Absorbent	Minimum				Maximum
Clay Recovery for Capping			Minimum		Target
Cements & Binders			Minimum		Target
Light Weight Aggregate			Minimum		Target
Molded Fiber, Construction	Minimum		Target		Maximum
Clay Recovery, Bleaching, & Reuse			Minimum		Maximum
Chemical Products					
Fuel & Gasification	Minimum			Maximum	

* Minimum means minimum desired percentage range for a beneficial use application.

** Target is the desired percentage range for the given beneficial use application.

*** Maximum percentage for a given beneficial use application

SURVEY COMMENTS ON BENEFICIAL USE TECHNOLOGIES

As part of the research undertaken during this study, paper companies using recycled pulp fibers and commercial beneficial use technologies were asked to provide specific comments about regulatory, economic, and technical barriers/issues (if they had any past experiences with beneficial use activities for their residual wastes.) Other barriers for which information was solicited in the survey included: management philosophical barriers, local issues, legal barriers, and other barriers. The survey of the paper mills asked questions about their beneficial use activities such as "Have you used beneficial use technologies for some/all of your mill biosolids (sludge)? If so, please indicate which method(s) are used, describe other beneficial uses currently in place or tried but were not utilized? What were the barriers that prevented you from following through on any of the beneficial methods?"

For a number of paper mills, new company personnel have become involved in recent years in solid waste/beneficial use technologies and they did not recall specific issues that had affected their facility. In other cases, environmental staff from paper mills that have actively pursued beneficial use technologies have encountered various obstacles.

SUMMARY OF COMMENTS ON BARRIERS TO IMPLEMENTATION

Regulatory Issues

Complex Regulations. In general, mill personnel reported that the environmental regulations are complex and difficult to understand. When they are considering alternative uses of their residuals, they cannot devote their full time and effort to interpreting the regulations to see whether they apply. Questions are continually raised as to whether future changes in the regulations will affect decisions about beneficial use technologies that they may make today. The questions include: What is the impact of the EPA's "cluster rule"? Will changes in the New York State Part 360 Solid Waste Management Rules increase or decrease the cost of a particular technology?

Regulatory Policies. Past regulatory policies have prevented fiber generated by one New York State mill from being taken and used as a raw material fiber source at another mill without securing a BUD for the fiber and a special Part 364 waste hauling permit for the fiber. This policy discouraged mills from exploring reuse opportunities and did not reduce the quantity of waste they disposed of in landfills. Also, there are limits on commercial hauling of fibrous paper residuals which could be reused. Only haulers licensed under Part 364 can handle such materials and this increased the costs of transportation significantly. (See Section 4 for the status on this issue.)

Prior to October 9, 1993 revisions to Part 360 BUDs, the DEC required that the liquid (leachate) that passed through products made from paper mill residuals/soil blends meet groundwater quality standards. Under the old regulations, chemical concentrations in the

soil substitute could be below the groundwater concentrations on nearly 240 different parameters; but if it had a high iron content, the beneficial use project could be held up and questioned. (See Section 4 for a more detailed discussion of this policy issue.)

The mills reported that they need help from regulators to interpret the law/policies and they need assistance from legal, commercial, and consulting firms to implement the regulations. The acceptance by the DEC of research and field studies/case histories of beneficial use technologies could encourage new projects and avoid forcing mills to reinvent the wheel.

Economic Issues

Lack of Capital. Many of New York mills are small and do not have excess capital. In some cases, the capital required to support the development of pilot operations and new technology far exceeds the current disposal costs. Substantial sums are needed to hire the outside expertise and to purchase the processing equipment required for implementing most of the high technology options such as energy recovery, gasification, lightweight aggregate, and chemical recovery. For mills that generate an insufficient quantity of residuals, the issue of finding a cost-effective technology for that mill becomes an economic barrier. (A potential solution for these situations is to provide a regional facility that can use a high volume of wastes economically to service a number of mills. The amount of water in the residuals that must be transported to the regional facility can then become a point of concern. See the following technical barrier discussion.)

Technical Issues

Limited Technical Resources. The size of the New York mills generally means that a small environmental or technical staff is available to lead them through the research, development, and demonstration of potential beneficial use applications. Mill personnel are often performing multiple functions such as both technical and environmental duties, and so they cannot also manage the responsibilities of evaluating new beneficial use technologies. Also, the time and expertise required to take a beneficial use technology from the early lab stage to a full-fledged commercially successful venture can be a major problem. Every process step has to be matched up with reliable, safe equipment that can turn out a uniform product.

Waste Characteristics. The properties of the residuals are a very important technical issue for mills with limited dewatering equipment. The low solids (high moisture) content of many paper mill residuals can result in significant tipping fee charges for any of the technologies that require high target solids contents for beneficial use. In Table 2-7, the technologies that are particularly constrained by their high dryness requirements include: absorbents, clay recovery for landfill caps or bleaching for reuse in a mill, cement and molded construction products, lightweight aggregate, energy recovery, and gasification. Even some of the low technology applications that do not require high solids contents can

be negatively affected by poor dewatering equipment at a paper mill. Stockpiling paper mill solids that are too wet can generate odorous compounds that limit the successful land application of paper mill residuals. Mills that can upgrade their dewatering equipment or can use available sources of energy at their plant site or in conjunction with nearby facilities that have excess waste heat should consider doing so.

The ability to collect representative data on the paper mill's waste stream can sometimes be difficult, particularly if the mill is producing a wide range of paper grades with varying amounts of recycled fiber (some with no recycled and others that are nearly 100 percent recycle.) Mills that implement some internal measure to recover and reuse fiber losses are concerned that these efforts will later affect the performance of their treatment plant or hurt the beneficial use technology they are using. For example, if the mill installs equipment to recover fiber in the mill and keep it out of the mill process drains, the primary clarifiers may not perform properly. The beneficial use technology that depends upon a high fiber content (absorbent products, building materials, etc) will then be negatively affected by the in-mill fiber recovery effort.

Other Comments on Key Barriers/ Issues

Mill Management / Philosophical Barriers. Some companies in the paper industry are very conservative when it comes to new and innovative technologies. They do not want to be the first to try a process that could save them money compared with offsite landfilling (fear of failure). Other large companies are concerned about beneficial use technologies that produce a product for the consumer (composting, building products). They are worried that it will open themselves up to a lawsuit if the product does not perform exactly as advertised.

Some mills are looking for a single solution to their waste management practices. In general though, there is no single best use of some of the waste fiber/clay originating from a dynamic, paper making process. Some waste streams may work as soil substitutes, some for energy recovery, and still others for various building products or combinations of these and other technologies. Each end use has different specifications or structural testing standards that a value added product must meet.

A final management concern for paper mills seeking alternative uses for paper mill residuals is finding one that is not labor intensive. In addition, many mills do not want to get involved in large scale marketing efforts for the products being produced.

Local /Legal Issues. Some companies are concerned that the local government may change personnel and stop a beneficial use technology once it has been implemented. Odor complaints from one or two neighbors can shut an operation down if the local government is not a supporter of the project. Other companies are concerned about being potentially liable for the cleanup of a contaminated site where products containing paper mill solids have once been applied. Long-term liability issues are a concern of the corporate legal staff looking at any waste disposal or beneficial waste management option.

Section 3

TECHNOLOGY ASSESSMENT FOR NEW YORK STATE

SUMMARY OF BENEFICIAL USE TECHNOLOGIES

This section will look at the current commercially available alternative uses for mill residuals that have been used, some of the emerging technologies that have been identified as part of this research effort, and the general applicability of these technologies to New York paper mills. It will not attempt to summarize all of the alternatives documented in all publications; however, those technologies that have been routinely used in other states or countries that may have particular applicability to New York will be cited. A more detailed discussion of specific technologies can be found in Appendix C.

Many basic as well as technically advanced and environmentally sound options are used by the paper mills and commercial technology firms for short-term and long-term residual management. At one time landfilling was a basic alternative, but without a system of clay liners and leachate pipes it was not an environmentally acceptable option. Today, landfills are technically advanced and environmentally sound but politically difficult to implement.

Research has lead to the development of many technologies and processes for the beneficial uses of paper mill residuals. Some of the technologies that are now commonplace may at one time have been general concepts or nonconventional methods, and have since emerged as viable means of waste management. The shift away from landfilling and basic incineration toward efforts to find alternative beneficial uses has been due in part to the cost of disposal and the national push toward recycling and reducing the waste of resources.

Clearly, efforts to reduce the amount of waste by reclaiming the fiber and clay within the mill before discharging it into drains should be a mill's first priority. Many companies provide specialized equipment to separate and recover these fiber and clays. A listing of these type of companies, as well as those involved in dewatering, drying, processing, and beneficial use technologies can also be found in Appendix C. The list includes the company names, addresses, phone numbers, and primary contacts.

Table 3-1 summarizes various beneficial use technologies, products, processing, and preparation requirements that are discussed in detail in Appendix C of this report.

VIABILITY OF BENEFICIAL USE TECHNOLOGIES

The following pages assess the current state of beneficial use technologies in New York. Readers that need more detail should review the summaries in Appendix C. A summary assessment is presented in Table 3-2. The assessment is made in the context of the status of the technology (both nationally and internationally), the technology's status in New York, and the future needs for the technology in New York. This section also contains descriptions of 24 New York mills and recommendations for implementing beneficial use technologies.

Table 3-1. Beneficial Use Technologies, Products, and Processing Preparation Requirements When Using Paper Mill Residuals.

I. Little Or No External Processing of the Paper Mill Residuals:

- In-mill fiber/clay recovery & waste reduction activities
- Fiber recovery & reuse with another secondary fiber mill
- Direct land application processes and/or products:
 - Landspreading
 - Landfill daily cover

II. Some External Mechanical/Wet Processing of the Mill Residual Required:

- Land application processes and/or products
 - Mine land reclamation
 - Hydroseeding
 - Clay capping substitute (used as-is)
 - Engineered soils (used as barrier protection layer & topsoil at a landfill)

III. Biological/Thermal Drying or Oxidation/Chemical/Mechanical Processing Required:

- Indirect land application processes and/or products:
 - Composting
 - Animal bedding
 - Absorbents
 - Mulch & soil-less media
 - Clay Capping (after thermal oxidation)
 - Cement products
 - Pesticide carrier
 - Lightweight aggregate
 - Molded products/construction materials
- No land contact or application:
 - Clay recovery, bleaching, & reuse in the paper mill
 - Chemical products (ethanol, levulinic acid)
 - Energy recovery & gasification

The meaning of each assessment category for the technology follows. The assessment is based on the literature search conducted as part of this research effort and from discussions with professors at colleges and universities, and professionals in the beneficial use technology field. It should be noted that the assessment is a snapshot of the beneficial use technology field and will thus change with time. In some cases, the technologies are emerging from the research and development stage and moving into the pilot and pre-commercial stage. As such, the technology developers would not release any information to researchers until patents, financing, and potential customers had been secured. The assessment categories for the technologies are:

- RD/LBS (Research & Development): The technology is under active research and development in the laboratory/bench stage in the private, public, or commercial sector.
- RD&D (Research, Development & Demonstration): The technology is advancing from the RD/LBS stage to field demonstration stage.
- PPCS (Pilot and Pre-Commercial Scale): Technology has been field-demonstrated and are now ready for the pilot scale/pre-commercial stage to prove its economic viability.
- CV (Commercially Viable): The technology has been through the previous development stages, has a sufficient market potential, and is ready for commercial application.
- NCV (Not Commercially Viable): The technology has been through the previous development stages, but the technology does not currently have a sufficient market or can not effectively use mill residuals due to operational or regulatory issues.
- CE (Commercially Established): The technology has been through the previous development stages and one or a number of commercial firms are fully established.

Table 3-2 does, in some cases, list more than one assessment status for the beneficial use technology. This is due to on-going efforts in the institutional and commercial arenas to develop the beneficial uses of paper mill residuals. In the Future Needs column a number of assessments are listed to depict a progression of actions that are needed to bring the technology to an established commercial (CE) stage.

State agency and paper mill efforts should focus on technologies that have been demonstrated it in other parts of the country or world and need an impetus to be developed in New York State. Many of the RD&D technologies noted in the table are already being actively promoted/supported by the Energy Authority or the Department of Economic Development.

COMMERCIALLY ESTABLISHED TECHNOLOGIES FOR NEW YORK MILLS

The following technologies are considered commercially established within the state, nation, or elsewhere in the world. The technologies represent good opportunities for mills in New York State with a conservative management philosophy (not wanting to accept any risk by being the first with a technology). Other technologies that are not yet commercially available but which can be or are being evaluated further by New York mills are also presented in this section.

Table 3-2. Assessment of Status and Viability of Beneficial Use Technologies for New York State Paper Mills.

Beneficial Use Technology	Status of Technology Nationally /Internationally	Status of Technology in New York	Future Needs of the Technology in New York
Fiber Reuse	CE	CE	More RD&D > CE
Land Spreading	CE	NCV	More RD&D
Landfill Daily Cover	CE	CE	CE
Mine Land Reclamation	CE	RD&D	CV > CE
Hydroseeding	PPCS, CE	RD&D	More RD&D, CE
Clay Cap Substitute (As Is)	CE	RD&D	CV > CE
Engineered Soil	CE	CE	CE
Compost/Mulch	CE	RD&D	RD&D > CE
Animal Bedding	CE	RD&D	CV > CE
Agricultural Products	PPCS, CE	RD&D	Feed Product - NCV
Absorbents	CE	CE	CV > CE
Clay Recovery for Capping	CE	RD	CV > CE
Cements/ Binders Products	RD & D, CE	CE	CE
Lightweight Aggregate	RD/ LBS, PPCS	RD&D	CV > CE
Molded Fiber & Construction Uses	CE, CV	RD&D, CE	CV > CE
Clay Recovery, Bleaching, & ReUse	RD/ LBS	RD&D	RD&D > CV
Chemical Products	PPCS, CE	RD&D	RD&D > CV
Fuel Pellets & Energy Products	CE	RD&D	C > CE
Gasification	PPCS, CE	PPCS , RD/LBS	CV > CE

KEY: RD/LBS = Research & Development/Lab-Bench Scale
RD&D = Research, Development & Demonstration

CV= Commercially Viable
CE = Commercially Established

NCV = Not Commercially Viable
PPCS = Pilot, Pre-Commercial Scale

Brief comments are provided where appropriate for certain technologies or mills. While they may be available, not all technologies are necessarily viable for the mills. As a result, individual mill write-ups are included at the end of this section for each survey respondent. The write-ups provides background information, some preferred options for the mill based on its waste material, highlights of mill specific issues, and mill/commercial company contacts.

Little or No External Processing Required

Inplant Waste Reduction. With regard to the first category of Table 3-1 (little or no external processing of the waste treatment plant residuals required), all New York State mills should review opportunities to reduce the quantity of waste they produce and to evaluate the various technologies to separate reusable fiber from the filler clay that they discharge to their process drains. Reclaiming these materials can cost tens to hundreds of thousands of dollars, but their recovery at a very early stage in the papermaking process will reduce the presence of contaminants that could affect paper quality.

There are a number of companies that specialize in in-mill fiber/clay separation equipment. A few of the companies that specialize in fiber separation are listed in Appendix C tables. The equipment for fiber separation is commercially available to reduce the quantity of waste within New York State mills. In many cases, limited manpower/staff at the mill precludes the testing of small-scale or portable test units and the cost of the equipment can be an obstacle to their installation.

Fiber Reuse. Recovery of paper mill residuals (fiber/filler) and reuse as a raw material furnish at a secondary mill is a major opportunity for New York mills. As noted in Section 2, one half of New York's paper mills need additional fiber of various types because of a widespread shortage of fiber. The lack of fiber is driving up the price of furnishes for the secondary fiber mills and has generated a strong interest in the reuse of residuals.

Barriers exist that limit the development of this fiber reuse market, including the suitability, quality, and form of the fiber waste from one mill that would be used as a fiber furnish in another mill operation. Material to be offered for fiber reuse between two or more mills must be in a condition that the mills can accept for packaging, loading, transport, unloading, storage, and reblending with water for reuse. The moisture level of the baled/bundled material must be low enough (typically less than 60 percent) so as not to promote bacterial activity and odors during transportation and use.

The amount and type of waste contaminants is also important to the mill using the waste fiber. The contaminants must be of a size, density, and composition that the mill's own fiber/clay/contaminant separation equipment can handle. Materials such as bits of tape, plastic, styrofoam, waxes, and glues can cause significant operational problems if the mill does not have the right type of screens, cleaners, savealls, etc, to separate out these contaminants.

Fiber reuse is an established beneficial use technology in the state for some but not all mills. A number of New York's secondary fiber mills have a lot of experience in using low-quality fiber sources for their furnish. Some of these same mills have been using waste fiber, perhaps from their company's other facilities or nearby mills with residual having compatible characteristics. If the mills have the packaging, loading, and transport facilities for secondary fiber reuse/transfers, they are in a good position to benefit quickly from reduction in technical or regulatory barriers to this activity. Further research, development, and demonstration of fiber reuse issues is recommended for mills with fiber needs.

Landfill Daily Cover. Paper mill residuals are currently being used as a substitute daily cover soil material at landfills by over 25 percent of the New York mill survey respondents. There are no particular obstacles to any mill from beneficially using its paper residuals in landfill daily cover projects. This 'low tech' option is commercially viable and is easy for a mill to secure approvals for from the DEC and the landfill operator.

Any mill that is interested in pursuing this option should maintain as high a solids content as possible (particularly if the residuals are a combination of primary and secondary) because of the likelihood that odors can be produced in the residuals and be offensive to the landfill operators or their neighbors.

Some Processing Required

Engineered Soils. The future use of synthetic soils for private and public landfill closure projects in the state is expected to be limited given the sharp decline in the number of landfills that remain open. For New York mills that will need to close their own landfill, they can likely benefit from commercial development of engineered soil projects. One potential application for the synthetic soil is as the 2-foot barrier protection layer (frost protection layer) or as the 6-inch topsoil layer in landfills.

A program was set up in 1992 using waste solids from a groundwood pulp and paper mill owned by International Paper Mill in Corinth, New York. Extensive testing has been conducted and approvals obtained from state regulators (DEC) for this use through the Beneficial Use Determination (BUD) process. Other New York mills with their own landfills that could benefit from further development in this area include Champion International (Deferiet), Finch Pruyn (Glens Falls), Schoeller Technical Papers (Pulaski), and US Gypsum (Oakfield).

Significant Processing Required

Composting. All types of organic paper mill residuals are being composted and sold extensively to farmers, landscape contractors, nurseries, greenhouses, etc. The practice of producing compost from paper mill residuals grew considerably in the late 1970s and

early 1980s in the United States. Composting has similar limitations to landspreading because: 1) the seasonal market for composts use in New York; 2) the potential liability associated with marketing and distributing compost products following the discovery of minute quantities of chlorinated dioxins and furans in some residuals from paper mills bleaching with chlorine; and 3) some unsuitable characteristics of the paper mill residuals used in composting (particularly from those mills with high ash residuals).

Residuals from a mechanical (groundwood) pulp and paper making operation are particularly good for composting given the non-chlorine bleaching process and the coarser fiber characteristics that facilitate aeration. If it is a combined paper mill residual (with both primary and secondary solids), it may also be a good candidate; e.g., Champion International Corp. (Deferiet, NY). Paper mill residuals from other mills need to be researched and developed on a case-by-case basis to see whether it would be suitable for biological breakdown if used as an admixture in composting operations.

Paper mill residuals by themselves are not typically high in nitrogen and are not considered for use as fertilizers. To compost successfully, the carbon-to-nitrogen ratio is targeted at approximately 30:1. If a high C:N ratio exists in the paper mill residuals, it must be combined with ingredients having a high nitrogen content.

Absorbent Products. The production of absorbent products from paper mill residuals is commercially available to New York mills depending upon the composition of the residuals being used (fiber and ash content levels). High clay residuals can absorb amounts of oil equal to or perhaps twice its own weight. Low clay/high fiber adsorbents can absorb as much as five times their own weight in certain oils.

There are two commercial producers of absorbents already in operation in New York out of a total of three operations nationwide. All three are currently attempting to expand the markets for their products. The development of another new producer in the state could flood the spill cleanup market with too many producers and hurt the economic viability of the existing absorbent operations.

Cements & Binder Products. The inorganics (clays and fillers) in the paper residuals help produce an effective binder that can be incorporated into cement products. This cement can be combined with aggregate and turned into inert concrete block, brick, or tile. Systech (Xenia, Ohio) and Independent Cement Corporation (Catskills, NY) added paper mill residuals along with red shale processing in New York in the early 1990's for cement manufacture. The high temperatures (over 2000° Fahrenheit) and long dwell times (6 to 8 seconds) in the cement kilns ensure virtually total destruction of organic constituents and, therefore, should reduce regulatory concerns and barriers.

Mills that produce a large quantity of residuals with a high ash content could likely supply a rotary kiln cement plant and produce a marketable product. A regional cement plant

sized to handle 500 wet tons of residuals would be commercially successful if the solids content was at least 45 percent. Potential candidate mills would be International Paper (Corinth), Finch Pruyn (Glens Falls), and Encore (South Glens Falls).

RD&D TECHNOLOGIES REQUIRING SOME PROCESSING

Mined Land Reclamation

Mined land reclamation projects and those involving the mixing of paper residuals, soil, and nutrients have been pursued by US paper companies as well as those in the state; they require a higher degree of mechanical processing for preparation or placement of the beneficial use product than farm land application. Left unreclaimed and exposed to rainfall, old mines often produce a runoff that is high in heavy metal contaminants and very acidic with pHs as low as 2.5. Mine land is generally highly erodible and offsite transport of sediments to nearby streams is a significant problem.

There are a variety of ways that the paper mill residuals can be spread on mine land. One method to apply residuals to get a uniform soil blend that will not travel off the mined land is to rototill or disk the paper residuals into the top 6 inches of spoil material. Because of the general lack of nutrients in paper mill residuals, nitrogen, phosphorus, and potassium may have to be applied before seeding with native plant species.

The production of synthetic or engineered soils from paper mill residuals represents a second, more controlled method of land application than the mined land reclamation example given above. A synthetic or engineered soil process involves blending residuals with varying proportions of sand, conditioner (bark fines, wood ash, or liming agents) and fertilizer to achieve the appropriate agronomic ratios. Ingredients are fed from multiple hoppers, and conveyed to a mixing point where the synthetic soil is produced. This blending process provides for a uniform mixture that can then meet a variety of end uses.

The number of New York mills that can benefit from mine reclamation projects is very limited. Yet, there are certain mine sites in the state that may be able to benefit. Stora Papyrus (Newton Falls) is using a third method of mined land application to blend its paper mill residuals at an iron ore tailings wastepile. Stora Papyrus has obtained a RD&D permit from the DEC to conduct mined land reclamation with tree plantings and paper mill residuals placed in narrow trenches. The unique characteristics of the mine site with its very deep sandy soils and limited existing vegetation allowed the DEC to approve the project. NYCRR Part 360 Subpart 4: Land Application and Associated Storage Facilities concerns about potential groundwater impacts from placing high moisture content paper mill residuals on soil and liability concerns by the paper mill companies will slow down the commercial development of this technology.

Hydroseeding

There is a potential market in the hydroseeding field for the use of certain fibrous paper mill residuals that can be substituted for newspaper fiber. The seasonal use of hydroseeding products does limit its widespread application to producers of paper mill residuals. (Hydroseeding is generally limited to April/May or August/September when grasses have the best opportunity to retain moisture.) Currently, various companies purchase bags of dried, shredded paper and wood fiber products for landscaping. The cellulose fibers are added to a nutrient rich slurry of water and grass seed and then sprayed onto flat and side slopes areas that are being replanted/revegetated. Mills with only primary residuals are best suited for use in hydroseeding since secondary residuals can raise odor concerns during storage of the wet paper mill residuals. If combined (primary and secondary) paper residuals are first dried, this added cost would limit the marketability of paper mill residuals for use in hydroseeding.

Clay Capping Substitute (As Is)

Another beneficial use of paper mill residuals is for producing the landfill clay barrier layer itself. Residuals that have a high ash/filler content and dewatered on a belt or screw press can be used directly without further processing. The presence of fine filler clay in the residuals of certain paper mills has led to the research and development of uses to replace the clay used for landfill capping projects. While private and public landfill closure projects in New State are expected to be limited in the long term given the number of landfills that remain open, some high ash residuals can be successfully used for landfill caps. Encore Paper (South Glens Falls) will be evaluating over the next two or three years the use of its residuals for a nearby public landfill. The mills with their own landfills (IP in Corinth, Champion International, Finch Pruyn, Schoeller Technical Papers, and US Gypsum) should also consider a RD&D project for landfill caps.

RD&D TECHNOLOGIES REQUIRING SIGNIFICANT PROCESSING

Animal Bedding/Litter

The manufacture of dried paper mill residuals for use as animal bedding and animal litter is commercially available to New York state mills. Energy Management Services, L.P. (EMS, LP) in Solvay is undertaking an RD&D project with DEC approval to produce animal bedding. Testing of animal bedding and litter products is recommended for any company interested in using its residuals. Odor can be created when combined residuals are used for litter, while use of only primary mill residuals does not create odor problems. The initial capital investment for manufacturing an animal bedding product can be substantial because of the need to dry the dewatered residuals from the mill.

Molded Fiber and Construction/Building Products

Paper mill residuals have for years been dewatered, shaped, and dried for use as egg cartons,

plant pots, and other products. These have typically not involved any additional binder or glue to provide strength to the product. The market for these materials is fully developed and significant growth in these applications is not likely to occur.

An area of recent interest/study has been in the use of paper mill residuals with a binder for making various building products. Adding dewatered fiber directly to cement products has proven to increase their physical properties. The use of cellulosic fibers results in higher strength properties as compared to results from ordinary cement-sand concrete results. The final product also retains some properties similar to that of wood, in that it can be nailed, screwed, and fastened without special materials, and it can also be cut with a typical handsaw. These results are from short-term experiments conducted by researchers; and evaluations must be performed to determine long-term durability and dimensional stability of fiber-reinforced masonry products.

The International Paper mill (Corinth) and two other New York firms have researched the use of paper mill residuals for the manufacture of pre-cast building products. The products included ceiling, wall, and door panels; sub flooring; door jams and casings; baseboards; cabinets; roof shingles; siding; structural beams; bricks; insulation; etc. Two different processes were proposed to pre-cast the products. Some of the products were tested and found to be safe and viable for building purposes. The company received a case-specific BUD from the DEC to produce these products from paper mill residuals. New York State regulators have expressed concerns about the concept of an "all sludge" house. The Health Department may have an interest in indoor air quality issues. As a result, future opportunities may encounter barriers to development of this beneficial use.

Chemical Products

The use of residuals as a feedstock for chemicals has been researched for decades and is now being looked at as both technically and economically feasible. While full-scale plants have been considered, many of the processes for converting paper mill residuals are at the pilot plant/demonstration stage. Some of the processes included fermentation, chemical conversion, and/or enzymatic hydrolysis for the production of calcium magnesium acetate (CMA), levulinic acid, and ethanol, to name a few.

A small-scale plant (1 ton per day) is planned to convert low-grade cellulosic wastes into levulinic acid (Biofine process). The process should aid mills producing 50 to 100 dry tons of residuals per day given the inherent increase in the production of wastes as more mills use more deinked and recycled waste.

Using paper mill residuals for ethanol production has also been considered as an alternative carbohydrate source to using the typical corn products. Lab studies have used both acid (sulfuric or hydrochloric) hydrolysis or enzymatic hydrolysis to break down the

cellulose into sugars that are then fermented into alcohol. The weaknesses of the acid process are: 1) high temperatures are needed to break down the cellulose to simple sugars; 2) one must avoid producing breakdown products that inhibit fermentation; and, 3) the cost of corrosion-resistant equipment. In the enzymatic process, the cost of the enzyme is high and the residence time required for complete cellulose hydrolysis is long (2-4 days). The production of chemicals from paper mill residuals is expected to be commercially viable in the future and is a technology that should be evaluated further.

Fuel Pellets & Energy Products

The organic content of paper mill residuals can represent a significant value for mills. Residuals are generally poor fuels in the "as received" condition due to a poor dewatering operation. If the paper mill waste is adequately dewatered and has sufficient organic matter (fiber) for self combustion in the boiler, incineration can become a net producer of energy. The minimum solids content at which a low ash residuals can be burned is 32 percent, but a more typical minimum solids level is between 40 and 45 percent. (7). Additional dewatering/drying at the paper mill is therefore generally recommended. Some specialized circumstances are possible for obtaining the energy value of a paper mill residuals by mixing in a dry, combustible material like coal dust/fines prior to burning. This would serve as an added benefit to mills or electrical utilities burning coal that have coal fines to manage.

Typically, energy recovery of paper mill residuals in a boiler does not reclaim the resource value of the ash waste that remains. In contrast, the feeding of paper mill residuals into rotary kilns uses the heat content of the organic fiber from the primary residuals and also incorporates the inorganic clay that is present into a cementitious product for beneficial use.

Pyrolysis & Gasification

Pyrolysis (gasification) is the process of using heat in an oxygen-deficient atmosphere to physically and chemically decompose organic material. Pyrolysis has proven to be technically feasible to convert wood to charcoal, coal to coke, municipal solid waste and paper mill residuals to gas or oil. When applied to paper mill wastes, pyrolysis has produced fuel gas with low Btu value (150 to 200 Btu per standard cubic foot) or oil that can be used as supplemental fuel in an existing boiler. Research continues in the area of gasification, and commercial companies are preparing to demonstrate its viability for more paper mill waste products throughout the world.

In New York State, alternative solid waste fuels fed to an energy recovery incinerator or solid waste pyrolysis unit can be used as long as they have a minimum heating value of 4,000 Btu per pound (as received). Many of the New York paper mill residuals would have to be dewatered or dried to a medium high solids content (probably to as much as 70 - 75 percent solids) to be used as a fuel pellets. Under certain circumstances, facilities

using solid waste as fuels (e.g., dried paper mill residuals) may be required to register with the DEC in accordance with 6 NYCRR Part 360-3.1(c). However, this is a fairly simple procedure and is valid for the life of the facility. The boiler using the pellet fuel would not be subject to Part 360 permitting as a solid waste incinerator.

NEW POTENTIALLY COMMERCIAL TECHNOLOGIES IN NEW YORK STATE REQUIRING SIGNIFICANT PROCESSING

Some new technologies that have been developed in other parts of the country should be considered for practical application on a regional basis in New York. The technologies have been briefly researched in the state but further development of the technology is needed to demonstrate its potential commercial application.

Clay Recovery for Landfill Capping

Technology Development Corporation (TDC- Fairfield, OH) has developed and holds patents for a process to convert paper mill wastes with ash into clays for recovery and reuse. A new thermal oxidation unit (rotary kiln) has started up in Middletown, Ohio, and is able to handle from 500 - 750 wet tons per day of paper solids fed at a 45 - 50 percent cake solids and at least 20 percent ash. The company is interested in completing research with paper mill residuals and building or licencing a regional plant in New York State that could handle up to 750 wet tons of paper residuals each day (at a 50 percent solids - 50 percent moisture content). The throughput would be reduced if the paper waste was at a higher moisture level.

The patented equipment has excess heat available to pretreat the incoming solids. The construction of a plant to process up to 750 tpd of high ash wet paper residuals can not be firmly established without detailed information from the paper mills. Projected capital costs are estimated at \$ 2.5 - 3.5 million.

Lightweight Aggregate (LWA) from Paper Mill Residuals

Trade sources estimate that between 3.6 million and 5.5 million cubic yards of aggregate are used each year in the US. LWA can be produced from paper mill residuals, and replaces sand and gravel as a filler in the production of concrete blocks, architectural panels, decorative stone, and other construction activities. The use of paper mill residuals allows for reductions in the final density of the aggregate while maintaining acceptable strength properties. Greengrove Corporation (Brooklyn, MN and Appleton, WI) has developed the Aggrecel process to produce LWA from paper industry residuals and ash.

Mill residuals and ash are mixed together where they produce balls or pellets which are fed directly to the rotary kiln process. The capital cost of an Aggrecel plant that can process 300 wet tons per day residuals (if at 40 percent solids and 35 percent ash) and that

would be located adjacent to a mill to produce process steam for mill use is estimated as between \$ 13 to 15 million. Greengrove indicates that the tipping fee for their process is expected to be competitive with or better than the rate charged for landfills without the liability and closure issues associated with landfills.

Clay Recovery, Bleaching and Reuse

Technology Development Corporation (TDC) is applying for a patent for a process to use the clay residue from the rotary kiln described above under Clay Recovery for Landfill Capping, bleach it with a non-chlorine solution and provide the brighter clay to a paper mill as a filler in various paper grades. Further research & development work is required for this reusable clay to quantify the brightness improvement possible for different paper mill wastes using the rotary kiln (thermal oxidation) process. TDC requires technical data from the New York mills that generate large quantities of residuals. Bleachability studies of the resulting clay filler would establish whether there is a potential for reuse by the residuals producing mills or any other user of fillers in their paper making process.

TECHNOLOGIES NOT COMMERCIALY VIABLE IN NEW YORK MILLS

Landspreading

Paper mill residuals have been sprayed on agricultural fields and forest lands in a slurry form or after some level of dewatering. Because of the potential for objectionable odors from paper mill slurry residuals on the surface, equipment was developed to inject it into the ground. Land application of paper mill residuals are generally limited to spreading during the spring before the crop is planted and/or in the fall after the crop has been harvested. The fiber or organic matter in paper mill residuals has value as a soil amendment that improves several physical soil characteristics.

Most of the land application pilot or field evaluations methods discussed in Appendix C have involved equipment to spread the slurry (spray irrigation) and semi-solid paper mill residuals on the surface or inject it below the surface. Then other necessary materials like urea or granular fertilizers (nitrogen source) are applied on the surface and plowed into the field. The decomposition of the organics in the mixture and uptake of the macro and micronutrients into the croplands may be irregular with this staggered in-place blending process.

Commercial development of land application technologies using certain types of paper mill residuals has been proven, but it is not considered a commercially viable technology at this time without more RD&D and regulatory support. The information in the following sections and the Appendices indicate that widespread use of land application projects in New York is constrained in particular by: 1) the high degree of variability in the characteristics of the waste residuals from mills using post consumer waste; 2) the limited

time period during which paper mill residuals can be land applied; and 3) the uncertainty in the regulatory requirements.

The variability of the grades produced by the mills in New York is discussed in Section 2 and is particularly high given the speciality nature of the mills in the state. This variability in grade combined with the irregularity in the breakdown/decomposition in the soil of land applied paper residuals will not provide the necessary uniformity and quality control for crop growth. The seasonal nature of land application limits the opportunities to handle the daily output from the mills and is not likely to be an acceptable alternative with mill managers.

Landspreading in New York State is regulated by NYCRR Part 360 Subpart 4: Land Application and Associated Storage Facilities. These rules are currently being re-evaluated and revised to comply with federal landspreading requirements. Until the Part 360 regulations were revised on October 9, 1993, the Albany central office or 9 regional offices of the DEC have required that paper mill residuals or soil substitute products for land application be tested by the toxicity characteristic leaching procedure (TCLP) procedure. Discussions between BES Technologies, the project sponsors and the DEC indicate that opportunities for land spreading of paper mill residuals may be increased if product specifications are developed. There is a potential opportunity for the development of product specifications using land applied paper residuals in some modified form (like engineered soil products which are less odorous since they are not rapidly decomposing) that would be acceptable to the regulators. (See Section 4 for the status of this regulatory issue.)

Agricultural /Feed Products

Paper mill residuals have been incorporated into animal feedstocks directly or after a fermentation process. Studies have been conducted on the direct incorporation of residuals in goat and beef cattle feed mixtures. Results have shown that its digestibility was directly related to the carbohydrate content and inversely related to the ash and lignin content. Another method involves using the protein present in secondary residuals as an additive in animal feed. Fermentation of the fibrous primary mill residuals has also been evaluated. Companies, as well as, regulators have reservations about the use of industrial wastes that may be consumed by animals. Liability and product acceptance issues for these type of beneficial uses of paper mill residuals will limit the development of markets in New York.

SUMMARY TECHNOLOGIES THAT SHOULD BE DEVELOPED IN NEW YORK STATE

Clearly, efforts to reduce the amount of waste by reclaiming the fiber and clay within the mill before discharging it into the drains should be a priority. The next priority for mills

in the state is to research opportunities to transfer their paper mill residuals to others in need of post-consumer fiber as an ingredient in their paper products.

At least seven categories of beneficial use projects with paper mill residuals are currently underway in paper mills, institutions, or commercial firms and have been or are being supported by state activities:

- Mined land reclamation
- Clay cap substitutes
- Absorbents
- Engineered soils
- Animal bedding
- Chemical products
- Fuel pellets

Some potentially commercially viable beneficial use technologies that should be advanced with paper company and state support is (but are not limited to):

- Clay recovery for landfill capping
- Light weight aggregate
- Clay recovery, bleaching, and reuse

SURVEY OF MILLS AND OPTIONS FOR BENEFICIAL USE TECHNOLOGIES

The remainder of this section contains (in alphabetical order) write-ups that were provided to each mill that participated in this state-sponsored survey. The information should provide a ready reference for mills, commercial companies, and others exploring new opportunities for beneficially reusing paper mill residuals.

ARMSTRONG WORLD INDUSTRIES, INC.

Fulton, NY

As of: March 15, 1995

Beneficial Use

Project: Background

Armstrong World Industries, Inc. produces about 195 tpd of gasket material and backing for flooring. The mill is located in the community of Fulton, NY, on the southwestern edge of Oswego County. Armstrong purchases some cellulose-based (wood) fiber, which includes bleached kraft and unbleached sulfite pulp, old newsprint, and some waste fiber from its primary treatment. Other materials used to make the company's unique products include fiber glass, polyester, and/or kevlar. After processing through flotation tanks (with top and bottom skimmer), the solids reaching the primary clarifiers are removed and sent to a belt press. The amount processed on the belt filter varies widely in composition and totals about 8 bone dry tpd of solids. The solids/water content of this waste also varies widely (from 25 percent solids/75 percent water to as high as 80 percent solids and 20 percent water). This produces a range of wet weights for the solids from the belt press of from 10 to 32 tpd. The ash content of the solids is also variable with a range of from 50 to about 75 percent.

The mills wastes are currently transported 2-3 miles to the Oswego County Solid Waste Management facility for disposal at their state-of-the-art landfill. Current disposal costs are estimated at over \$80 per dry ton (equivalent) of solid waste. The mill has an option of not paying anything for disposal in the Oswego County mass burn incinerator that provides steam to the plant. Their highly variable and high moisture waste stream is currently limiting their ability to use this particular option. Armstrong World Industries, Inc. has investigated composting its wastes with Oswego County but has not conducted any other studies into beneficial use options.

Preferred Options:

- Armstrong could benefit from an evaluation of improved dewatering equipment for the paper solids from its waste treatment plant clarifier. The mill may be able to replace the belt press with a screw press unit that could potentially yield a higher cake solids content.
- Another option would be to process the belt press solids through an after/secondary screw press to yield a higher solids. If either of the above options is successful, the solids may be high enough to provide to the county mass burn unit at no cost to Armstrong (other than transportation).

ARMSTRONG WORLD INDUSTRIES, INC.

Fulton, NY

As of: March 15, 1995

- Transport material to the EMS drying facility in Solvay, NY, for evaluation and possible use as a beneficial fuel, blended in as animal bedding, or return to the Oswego County mass burn plant.

Mill Specific Issues:

In general, mill management has concerns about land application projects. They worry that future environmental regulations will result in potential liabilities for cleanup of newly defined "contaminated" areas where wastes have been placed during land spreading. The mill is receptive to any beneficial use technologies that do not have impediments to their implementation.

Contacts:

Mr. Frank Page-Environmental Coordinator
Tel: (315) 598-4271 Fax: (315) 598 -4990
Armstrong World Industries, Inc.
RR # 2, Box 184
Fulton, NY 13069

**For Mechanical
Dewatering Option:**

Mr. Steve Dumont - President
Tel: (603) 926 - 4830 Fax: (603) 926-8269
Zane Blanchard & Co., Inc.
Box 789
Hampton Beach, NH 03842

**For Mechanical
Dewatering Option:**

Mr. John Trinward
Tel: (207) 877-0459 Fax: (207) 877- 0460
Castine Energy Services
117 Silver Street
Waterville, ME

Drying Option:

Mr. Bob Bishop - General Manager
Tel: (315) 487-4346 Fax: (315) 487-4981
EMS, LP
1700 Milton Avenue
Solvay, NY 13209

BROWNVILLE SPECIALITY PAPER PRODUCTS, INC.

Brownville, NY

As of: March 15, 1995

Beneficial Use

Project: Background

The Brownville Speciality Paper Products mill produces about 60 tpd of speciality matboard, cover stock, boxboard, and various speciality products containing virgin and post-consumer recycled fiber. The mill is located in the village of Brownville, NY, in the central part of Jefferson County. All the fiber is purchased and consists of old corrugated containers (OCC) and cuttings, newsprint, and purchased kraft and groundwood. Mill wastes are currently processed via treatment units that included dissolved air flotation saveall/screening equipment and a combination primary clarification & secondary aeration unit (called a Sanitaire Mark IV unit).

Excess wastes from the operation that can not be reused in the mill's pulper must be placed in a tanker truck (2 percent solids) and taken to the local waste treatment plant. (Estimated at 50 wet tpd or 1 bone dry tpd.) The cost for their current disposal method is \$600/dry ton of waste or \$4.50 per ton of finished paper produced.

Preferred Options:

- Brownville Speciality Paper Mill can evaluate improved dewatering equipment for the paper solids from its waste treatment plant (now 2 percent). The mill would then be able to store and/or reuse more of its fiber. After processing through dewatering equipment mill grade changes may preclude reuse of that fiber and require alternate management methods.
- If onsite dewatering can not be provided, a regional dewatering and processing plant may be able to serve many of the mill's wastes and produce a clean fiber. Then the dewatered material could serve as a substitute feed stock at secondary fiber or linerboard facility.
- Dewatered wastes (to 35 - 45 percent solids) from the mill or a regional processing facility can open up other beneficial use technologies if a clean fiber transfer product could not be produced. These technologies include composting, animal bedding, conversion of wastes to chemical feedstocks, gasification, etc.
- The mill is a potential user of fiber from a waste transfer program provided the source is clean (mill or regional processing facility). This could provide a low-cost fiber source back to the mill.

BROWNVILLE SPECIALITY PAPER PRODUCTS, INC.

Brownville, NY

As of: March 15, 1995

Mill Specific Issues: The mill does not have sufficient capital to provide for improved mechanical dewatering equipment and/or the manpower for R&D trials. Modular dewatering equipment can be evaluated and if the results are positive, the mill can lease the unit(s) to reduce its impact on capital. The mill also has limited manpower to conduct various trials of the dewatering equipment.

If the mill is able to install the dewatering equipment (or transport it to a central facility for processing), the mill could then substantially reduce its fiber and disposal cost.

Contacts: Mr. Gene Rood
Tel: (315) 782-4500 Fax: (315) 782-3964
Brownville Speciality Paper Products
Bridge Street
Brownville, NY 13615

Fiber Transfer Option: Mr. Labe Haverstock - Environmental Manager
Tel : (315) 493 -6178 Fax: (315) 493-3015
James River Paper Company
695 West End Avenue
Carthage, NY 13619

Fiber Transfer Option: Mr. Steve Van Doren
Tel: (315) 484- 9050 Fax: (315) 484 -9434
Solvay Paperboard Corporation
1800 Milton Avenue
Solvay, NY 13209-0310

Fiber Transfer Option: Mr. Jerry Landwehr
Tel: (518) 392 - 4000 Fax: (518) 392- 4030
Columbia Corporation
PO Box 330
Chatham, NY 12037

**Dewatering System
Option-Belt and Screw
Press:** Mr. Steve Dumont - President
Tel: (603) 926 - 4830 Fax: (603) 926-8269
Zane Blanchard and Co., Inc.
Box 789
Hampton Beach, NH 03842

BROWNVILLE SPECIALITY PAPER PRODUCTS, INC.

Brownville, NY

As of: March 15, 1995

**Dewatering System
Option-Screw Press:**

Mr. John G. Trinward
Tel: (207) 877-0459 Fax: (207) 887 -0460
Castine Energy Services
117 Silver Street
Waterville, ME 04901

**Dewatering System-
Rotary Vacuum
Option:**

Mr. Conrad Tuefel, Jr.- Environmental Consultant
Tel: (315) 474-3157 Fax: (315) 472-7915
Upstate Environmental Services (UES), Inc.
215 Tully Street
Syracuse, NY 13204

**Dewatering System-
Screw Press
Option:**

Mr. Rick Hollmeyer
Tel: (513) 855-6555 Fax: (855) 855-6554
PO Box 189, 548 N. Cherry
DUPPS Corporation
Germantown, OH 45327

BUFFALO PAPERBOARD CORPORATION

Lockport, NY

As of: March 15, 1995

Beneficial Use Project: Background

Buffalo Paperboard Corporation manufactures the face and backpaper (175 tpd) used in the production of gypsum wallboard. The mill uses a wide variety of post consumer sources and includes old corrugated containers, old newsprint, high grade deinking, double lined kraft, and mixed paper and old newsprint. The mill is located in the central part of Niagara County in the town of Lockport. The fibrous solids from the mills are processed through a hydraulic ram press. The press handles about 2.2 (bone dry) tons or 5.6 wet tpd of waste which is landfilled. The normal solids content of the material is 40 percent (60 percent moisture) and it has an unknown ash content. The mill sends its solids in a closed lugger to a commercial landfill in the area. Landfilling costs are currently \$194 per bone dry ton of wastes. Buffalo Paperboard has considering composting with the Blue Heron facility in Skaneateles, N.Y and inquired into potential fuels.

Preferred Options:

- The mill has expressed an interest in alternatives such as producing compost. The Buffalo Paperboard mill can explore opportunities with other paper mills in the area. Possible partners to conduct R & D trials would be Cascades-Niagara Falls & the US Gypsum mill in a regional effort to develop beneficial use products.
- Another option is for the mill to negotiate with the compost facility in Leroy (southeastern corner of Genesee County) to provide its solids to them.
- A potential opportunity for the mill involves blending its fiber with sandy soils and nutrient rich materials for production of a substitute soil. Discussions with BFI (Houston) would be required to determine the economics and feasibility of the project.

Mill Specific Issues:

The mill's main issue regarding implementation of beneficial use projects is the economics of alternatives to commercial landfill. A joint initiative between the three regional paper mills would minimize the economic impact to the participants. The participating mills need to conduct R & D work to evaluate the various recipes of the onsite composting operations.

The participants can obtain a DEC waiver from the Part 364 Waste Hauling Permit requirements to evaluate small samples (less than 500 pounds) for its composting performance. A single truckload may also be exempted by the DEC from requiring a BUD/Part 364 Waste Hauling Permit for R&D purposes.

BUFFALO PAPERBOARD CORPORATION

Lockport, NY

As of: March 15, 1995

Contacts:

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Tel: (716) 434 -2045 Fax: (716) 434 - 1801
Buffalo Paperboard
470 Ohio Street
Lockport, NY 14094

**Compost Option:
(Regional)**

Mr. Ray O'Keefe - Special Projects Manager
Tel: (716) 285-3681 Fax: (716) 285 -3767
Cascades , Inc.
4001 Packard Road
Niagara Falls, NY 14303

**Compost Option:
(Regional Mill Effort)**

Mr. Mike Willoughby - Paper/Power Manager
Tel: (716) 948-5221 Fax: (716) 948 - 5018
US Gypsum Co.
2844 Judge Road
Oakfield, NY 14125

**Compost Option:
(Regional - Leroy
Facility)**

Mr. Peter Mezzit - Sales Representative
Tel: (800) 662 -2440 Fax: (603) 929 -3164
All - Gro Corp. (Sub. of Wheelabrator Clean Water Systems, Inc.)
Liberty Lane
Hampton, NH 03842

Engineered Soil Option:

Mr. Joe Laubenstein
Tel: (713) 870 -7470 Fax: (713) 584-8572
BFI (Browning - Ferris Industries)
PO Box 3151
Houston , TX 77253

CASCADES NIAGARA FALLS, INC.

Niagara Falls, NY

As of: March 15, 1995

**Beneficial Use
Project: Background**

Cascades-Niagara Falls, Inc. produces about 354 tpd of kraft corrugating medium from old corrugated containers and mixed paper and old newsprint. The mill is located in an industrial section of the city of Niagara Falls in Niagara Falls County. The primary solids and secondary solids from the sequencing batch reactors (SBR) are processed either through a belt or screw press. The press handles 7.5 (bone dry) tpd or 30 wet tpd of residuals waste, which is available for beneficial reuse. The normal solids content of the material is 25 percent and it has an undetermined ash content. The mill provides paper mill residuals to the local landfill and/or as a carbon source for a composting facility in Leroy, NY. Landfilling and composting costs are both currently about \$170 per bone dry ton of waste or about \$3.50/ton of production.

Preferred Options:

- The preferred option for this blend of fiber and residuals is to use it as a blend in composting operations or as a soil substitute product. Mill alternatives include developing/producing compost and/or working with other mills in the region (Buffalo Paperboard and US Gypsum).
- Conduct R&D trials on mechanical dewatering equipment to reduce transportation costs for any offsite soil substitute products.

Mill Specific Issues:

The local Cascades-Niagara Falls mill is committing to beneficially use its residuals for land application - artificial/blended soils projects. The mill reports no major issues that would restrict development of this beneficial use technology (full corporate support is required). The mill has worked with the City of Niagara Falls to use their leaves/grass clippings and would conduct R&D work to evaluate onsite composting operations. The mill can also obtain a DEC waiver from the Part 364 Waste Hauling Permit requirements to evaluate the soil substitute option.

Contacts:

Mr. Ray O'Keefe - Special Projects Manager
Tel: (716) 285-3681 Fax: (716) 285 -3767
Cascades , Inc.
4001 Packard Road
Niagara Falls, NY 14303

CASCADES NIAGARA FALLS, INC.

Niagara Falls, NY

As of: March 15, 1995

**Compost Option:
(Regional Mills)**

Mr. Dave Shouk - Accountant
Tel: (716) 434 -2045 Fax: (716) 434 - 1801
Buffalo Paperboard
470 Ohio Street
Lockport, NY 14094

**Compost Option:
(Regional Mills)**

Mr. Mike Willoughby - Paper/Power Manager
Tel: (716) 948-5221 Fax: (716) 948 - 5018
US Gypsum Co.
2844 Judge Road
Oakfield, NY 14125

Compost Option:

Mr. Peter Mezzit - Sales Representative
Tel: (800) 662 -2440 Fax: (603) 929 -3164
All - Gro Corp. (Sub. of Wheelabrator Clean Water Systems, Inc.)
Liberty Lane
Hampton, NH 03842

Soil Substitute Option:

Mr. Joe Laubenstein
Tel: (713) 870 -7470 Fax: (713) 584-8572
BFI (Browning - Ferris Industries)
PO Box 3151
Houston , TX 77253

**Dewatering System
Option-Belt & Screw
Press:**

Mr. Steve Dumont - President
Tel: (603) 926 - 4830 Fax: (603) 926-8269
Zane Blanchard & Co., Inc.
Box 789
Hampton Beach, NH 03842

**Dewatering System
Option- Screw Press:**

Mr. John G. Trinward
Tel: (207) 877-0459 Fax: (207) 887 -0460
Castine Energy Services
117 Silver Street
Waterville, ME 04901

CHAMPION INTERNATIONAL CORPORATION

Deferiet, New York

As of : March 15, 1995

Beneficial Use

Project: Background

Champion International Corporation (Champion) produces groundwood pulp and about 540 tpd of a wide variety of kraft, groundwood, and recycled fiber paper grades. The mill is located in Deferiet, in the north central part of Jefferson County. The primary and secondary treatment plant produces a total of approximately 171 wet tpd or 60 bone dry tpd of treatment plant solids (called filter cake). The normal solids content of the waste is 35 percent (65 percent water) with an ash content of the solids of 35 percent. The majority of Champion's waste is currently sent to the company's own state-of-the-art landfill operation, but a portion of its filter cake waste is provided to another company. Cellutech has a beneficial use determination (BUD) petition for conversion of Champion wastes into various absorbent products (oil spill clean-up and cat litters). The cost of landfilling is about \$110 per dry ton of waste or \$12 per ton of saleable production. The cost of absorbent production is not available from Champion.

Preferred Options:

- Expansion of the Cellutech operation to allow use of more of Champion's filter cake remains the best option currently available for reducing dependence on its own landfill. Improved drying could be evaluated in a modular infrared drying unit (Envirotech). Coordination with a potential drying trial at the James River facility is suggested.
- Conduct R & D trials of after-press dewatering equipment (Zane Blanchard) for potential purchase. Installation of such a unit could increase fiber solids to 50 -55 percent and benefit the Cellutech drying operation. Added dewatering equipment could also expand opportunities to investigate/implement other offsite benefits.
- Conduct evaluation/trials for conversion of filter cake wastes into an engineered/artificial soil product. BFI (Houston) can supply expertise in this field and can produce a soil product from Deferiet's filter cake at an estimated \$71.50 per dry ton of waste.
- Develop opportunities to incorporate Deferiet filter cake into cement products or light weight aggregate. The properties of the Champion filter cake are excellent for these uses.

Mill Specific Issues:

Mill management indicates that the time and resources required to

CHAMPION INTERNATIONAL CORPORATION

Deferiet, New York

As of : March 15, 1995

develop alternative disposal methods is a major barrier. One economic issue of concern is that the cost of other beneficial technologies can exceed current disposal methods. The mill has invested heavily in landfilling. (Initially, implement the above recommendations would increase the costs of waste management, but provide greater flexibility in reducing their long term landfill costs.)

Champion reports that it does not have any technological issues in implementing alternative uses. Yet, the high ash content of the filter cake with the presence of coal fly ash can limit its performance in the Cellutech absorbent products. Removal of some of the fly ash from the waste stream could benefit the Cellutech option, but negatively affect the use for cement products that need fly ash.

The mill also reports that compliance with the Part 360 Solid Waste Management regulations drives up the costs of implementation of beneficial use technologies. No specific cases were provided.

Contacts:

Mr. Bryon Perry - Senior Environmental Engineer
Tel: (315) 493 -3540 Fax: (315) 493 - 7150
Champion International Corporation
400 Anderson Avenue
Deferiet, NY 13628

Absorbent Product Option:

Mr. Henry LaLone - Plant Manager
Tel: (315) 786 - 7782 Fax: (315) 786-7783
Cellutech, Ltd.
Starbuck Avenue
Watertown, NY 13601

After Press Equipment Option:

Mr. Steve Dumont - President
Tel: (603) 926 - 4830 Fax: (603) 926-8269
Zane Blanchard & Co., Inc.
Box 789
Hampton Beach, NH 03842

Cement Products Option:

Mr. John Beasley
Tel: (513) 372-8077 Fax: (513) 372-8099
Systec Environmental Corporation
245 North Valley Road
Xenia, OH 45385-9354

CHAMPION INTERNATIONAL CORPORATION

Deferiet, New York

As of : March 15, 1995

**Lightweight
Aggregate Option:**

Mr. George Meade - Environmental Engineer
Tel: (612) 566-5733 Fax: (612) 566-5517
Greengrove Corporation
7301 Zane Avenue North - Suite 103
Brooklyn Park, MN 55443

Drying Trial Option:

Mr. Michael Gustavson - President & Director
Tel: (604) 685-8496 Fax: (604) 683-2256
Environtech Systems Corporation
1820-99 West Hastings Street
Vancouver, B.C.
Canada, V6C 2W2

COLUMBIA CORPORATION

Chatham and N. Hoosick, NY **As of: March 15, 1995**

Beneficial Use

Project: Background

The Columbia Corporation mills each produce about 80 tpd (24 hours/day, 6 days/week) of paperboard products containing post-consumer recycled fiber. One recycled mill is located in the village of Chatham, in Columbia County. The company also has a paperboard mill located in North Hoosick - Walloomsac Division (Rensselaer County), which also uses recycled fiber. All fiber is purchased and consists of old corrugated containers (OCC), old newsprint, mixed office and magazine pulp substitutes, waste fiber from other mills and a small amount of bleached kraft and groundwood fiber sources. Primary wastes are processed on disc filters and are completely reused back on their paper machine. No fibrous residuals are produced at either facility that requires disposal. The mills are interested in conducting fiber reuse trials with other mills having acceptable fibrous wastes. Elimination of requirements to have the waste fiber transported in Part 364 permitted trucks would assist fiber reuse efforts by the mill.

Preferred Options:

- The mill is a potential user of fiber from a waste reuse/transfer program provided the source is producing a clean, fibrous product for their facility. This would provide a low cost fiber source for the mill and also benefit the supplier in avoided disposal cost.

Mill Specific Issues:

Mill management has no specific issues preventing them from pursuing beneficial uses of paper mill wastes. The most significant issue for the mill is evaluating whether the fiber is in a usable form at delivery and at the stock/fiber preparation point and the quality of the fiber source. Trials (about 2-weeks duration) is recommended to determine whether the fiber from the other mills is an attractive option for the mill.

The regulatory requirements associated with fiber transfer efforts are minimal. The mill should be able to obtain a waiver from the BUD/Part 364 Waste Hauling permit program requirements for evaluation/research into the fiber reuse program. A one truckload exemption can generally be obtained from the DEC for transport of fiber to another paper mill. Efforts are underway by the DEC to issue a policy that would eliminate the need to use trucks requiring a Part 364 hauling permit for paper mill residuals being evaluated and/or used by another mill in a fiber reuse program.

COLUMBIA CORPORATION

Chatham and N. Hoosick, NY **As of: March 15, 1995**

Contacts:

Mr. Jerry Landwehr - Technical Director
Tel: (518) 392 - 4000 Fax: (518) 392- 4030
Columbia Corporation
PO Box 330
Chatham, NY 12037

**Fiber Reuse
Option:**

Mr. George Milner -Assistant VP- Environmental Affairs
Tel: (518) 237- 1740 ext 205 Fax: (518) 237 - 7374
Mohawk Paper Mills
PO Box 497
Cohoes, NY 120473

**Fiber Reuse
Option:**

Mr. Tim Stocker
Tel: (315) 343-1581 Fax: (315) - 343-8831
International Paper Company
RR # 9, Box 2A
Oswego, NY 13126

ENCORE PAPER COMPANY

South Glens Falls, NY

As of: March 15, 1995

Beneficial Use Project: Background

Encore Paper Company produces about 150 tpd of tissue, toweling and napkin paper. The mill is located in South Glens Falls in the northeastern tip of Saratoga County. A wide variety of waste fiber sources are used, and include groundwood trimmings, coated book, manifold ledger, mixed office waste, window envelopes, milk cartons, etc. The mill has two onsite deinking plants with the smaller plant capable of producing 60 tpd and the larger plant able to process 220 tpd of incoming fiber. The primary and secondary treatment plant produces approximately 330 wet tpd or 100 bone dry tpd of treatment plant solids (called fiber/clay). The normal solids content of the waste is 30 percent (70 percent water) with an ash content of the solids between 40-50 percent. Encore has beneficial use determination (BUD) petitions to use its wastes for topsoil, daily and intermediate cover, and grading material within the Town of Moreau landfill. Current disposal cost for daily cover at the town landfill is about \$40 per dry ton of waste or nearly \$27 per ton of finished production.

Preferred Options:

- Expansion of their BUD to allow use of Encore's fiber/clay is a preferred option. RD&D efforts on its fiber/clay may produce an engineered soil for use in the barrier protection layer of landfill caps, landfill covers, and soil substitution activities.
- In a related clay capping technology, an Ohio firm (Technology Development Corporation) wants to build a regional plant in New York State that can dry and thermally oxidize (burn) from 500 - 750 wet tpd of sludge from a group paper mills. The plant would recover clay for beneficial reuse in landfill caps. The patented process has excess heat available to preheat incoming wet sludges like that of Encore and may be able to bleach and reclaim the high ash for reuse in a paper mill.
- Conduct R&D trials on mechanical dewatering equipment to reduce transportation costs for soil substitute products or to reduce energy costs for drying and the production of clay cap or cementitious products.

Mill Specific Issues:

Mill management has reported it has limited financial resources/capital to support the development of pilot/trial operations. Another economic barrier is that projected costs of the above disposal options exceed the current disposal cost of \$40 per dry ton.

ENCORE PAPER COMPANY**South Glens Falls, NY****As of: March 15, 1995**

Encore reports that many options presented to the company have not been developed beyond a lab bench scale and they do not have the resources available to do so internally. The high ash content of the Encore wastesludge limits its use in compost to only a 15 percent proportion versus a potential 33 percent level for a low ash /high fiber sludge. (A low ash sludge has more open area and is easier to compost than materials like Encore's.)

The DEC has revised their Part 360 Solid Waste rules (October 9, 1993) and the BUD requirements to allow the use of approved solid wastes in landfill liner or final cover systems component projects when part of an approved closure plan. (In the past, the DEC restricted the use of any soil amendment products containing paper sludge if the blend is used outside the containment boundaries of a landfill.) In April 1995, Encore was granted an RD&D permit by the DEC to evaluate the potential use of its paper mill residuals for barrier soils and soil substitute products.

Contacts:

Ms. Barbara Hemken - Technical Manager
Tel: (518) 793 -5684 ext 627 Fax: (518) 793 -2650
Encore Paper Company
1 River Street
South Glens Falls, NY 12803

For Options:

Mr. Mark Millspar (Consultants for Encore Paper)
Tel: (518) 782 - 0882 Fax: (518) 782-0973
Spectra Environmental Group, Inc.
19 American Blvd.
Latham, NY 12110

**For Clay Capping &
Cementitious Products
Option**

Mr. Wendell Judd - President
Tel: (513) 829 - 4450 Fax: (513) 829 - 4480
Technology Development Corporation
1567 Congress Hill Lane
Fairfield, OH 45014

**For Mechanical
Dewatering Option**

Mr. Steve Dumont - President
Tel: (603) 926 - 4830 Fax: (603) 926-8269
Zane Blanchard & Co., Inc.
Box 789
Hampton Beach, NH 03842

ENCORE PAPER COMPANY

South Glens Falls, NY

As of: March 15, 1995

**For Mechanical
Dewatering Option:**

Mr. John Trinward
Tel: (207) 877-0459 Fax: (207) 877- 0460
Castine Energy Services
117 Silver Street
Waterville, ME 04901-5923

Beneficial Use
Project: Background

Finch, Pruyn & Co., Inc. manufactures about 665 tpd of fine paper, uncoated free sheet grades (bond, xerographic, offset) and incorporates post-consumer recycled fiber into its product line. The mill is located in Glens Falls in the southeastern edge of Warren County. The mill is one of less than a half dozen integrated facilities (produces both pulp and paper) in New York State. The pulp is produced by the ammonium based bisulfite process (resulting in a higher nitrogen content waste than the kraft or groundwood process). Other pulp sources used include purchased hardwood and softwood kraft and high grade deinking post-consumer fiber. The mill burns much of its bark and landfills the ash with the other waste treatment plant solids. The primary and secondary treatment plant produces approximately 238 wet tpd or 76 bone dry tpd of solids. The normal solids content of the waste is 32 percent (68 percent water) off from its two belt dewatering presses and have an ash content of 25 percent. The mill has a 40-acre, unlined offsite landfill and is seeking DEC permits for a new off-site landfill. Landfilling costs are currently about \$40 per bone dry ton of waste produced or \$4.50 per ton of finished paper produced. This cost would increase substantially with the construction of a new double composite landfill.

Preferred Options:

- Finch Pruyn should evaluate improved dewatering equipment for the paper mill residuals from its waste treatment plant (now 32 percent). The mill has the option of replacing the two belt presses with a screw press that would potentially yield up to a 40 percent solids. Another option would be to take the solids and process it through an after/secondary screw press to yield 45-48 percent solids.
- Wilmot Farms of Washington County needs bark/wood waste to improve its chicken manure composting operation. The mill should discuss opportunities to also provide paper residuals at a reduced tipping fee from that charged by Wilmot (at an estimated cost of \$141 per dry ton waste).
- An Ohio firm (Technology Development Corporation) has offered to build a regional plant in New York State that can dry and thermally oxidize from 500 - 750 tpd of sludge from Finch Pruyn & Co. and nearby paper mills. (Estimated capital cost of \$2.5-3.0 million). The system would produce clay and cementitious products for beneficial reuse in the state. The patented process has excess heat available to preheat the incoming wet sludge and the reclaimed ash can be used as clay capping material or potentially bleached and reused in the mill (estimated cost of about \$92 per dry ton of waste.)

FINCH, PRUYN & CO., INC

Glens Falls, NY

As of : March 15, 1995

- Investigate and develop opportunities to incorporate dried paper mill residuals into cement products or light weight aggregate. The waste characteristics of the material may be suitable for these uses.

Mill Specific Issues:

An economic issue noted by mill management is that the projected costs (tipping fees in \$/ton) of many disposal options far exceed the current disposal cost of \$13 per wet ton or \$40 per dry ton. The mill is moving ahead with new landfill development plans, but this will substantially increase their disposal costs. A regional (multi-mill) effort to address the paper mills long-term waste management options would provide the most cost effective solution for the mills.

Finch, Pruyn & Co. management reports that their solid wastes have poor BTU value (1758 Btu per pound vs minimum required of 4000 Btu per pound) which limits the recovery of its heat content. Also, in responding to the survey, they expressed concern that the poor BTU value could cause reduced strength in cement and concrete products. They plan on exploring further the use of their residuals for cementitious products.

Improved mechanical dewatering equipment also needs to be tested (R&D) at the mill. Successful trials leading to a higher solids content mill waste would reduce the transportation/operating costs for landfilling. It would also open up opportunities for thermal treatment and recovery of their ash for landfill clay cover products, cementitious products, or even bleaching of the ash for reuse at a papermill.

Contacts:

Mr. Phil Arthur - Environmental Control Manager
Tel: (518) 793 -2541 ext 312 Fax: (518) 793-7364
Finch, Pruyn & Company
1 Glen Street
Glens Falls, NY 12801

**Dewatering System
Option-Belt & Screw:**

Mr. Steve Dumont - President
Tel: (603) 926 - 4830 Fax: (603) 926-8269
Zane Blanchard & Co., Inc.
Box 789
Hampton Beach, NH 03842

**Dewatering System
Option- Screw Press:**

Mr. John G. Trinward
Tel: (207) 877-0459 Fax: (207) 887 -0460
Castine Energy Services
117 Silver Street
Waterville, ME 04901

FINCH, PRUYN & CO., INC
Glens Falls, NY

As of : March 15, 1995

**Bark/Paper Solids
Exchange Option:**

Mr. Bob Wilmot - President
Tel: (518) 677 - 8543
Wilmot Farms
Box 89
Buskirk, NY 12028

**Clay Cap Products, Filler
Clay Recovery & Cement
Products Option:**

Mr. Wendell Judd - President
Tel: (513) 829 - 4450 Fax: (513) 829 - 4480
Technology Development Corporation
1567 Congress Hill Lane
Fairfield, OH 45014

**Light Weight Aggregate
Option:**

Mr. George Meade - Environmental Engineer
Tel: (612) 566-5733 Fax: (612) 566-5517
Greengrove Corporation
7301 Zane Avenue North - Suite 103
Brooklyn Park, MN 55443

INTERNATIONAL PAPER COMPANY

Corinth, NY

As of: March 15, 1995

Beneficial Use Project: Background

International Paper Company produces about 565 tpd of freesheet, groundwood, and/or recycled coated printing paper grades. The mill is located in the town of Corinth on the northwestern edge of Saratoga County. The mill is an integrated facility producing both groundwood pulp & finished paper. IP-Corinth purchases the remainder of its fiber as bleached kraft (softwood and hardwood) and hi-grade deinking (recycled) fiber. The solids from the primary clarifiers and trickling filters are processed through a screw press and total about 107 wet tpd or 40 bone dry tpd of residuals. The normal solids content of the waste is 35-40 percent (60-65 percent water) with an ash content of the solids about 40 percent. IP-Corinth has a beneficial use determination (BUD) petition to allow use of its residuals for topsoil, daily, intermediate cover and grading material, building products and general use as feedstock in corrugated board mills (fiber transfer). Current costs for onsite landfilling is about \$25 per dry ton of residuals produced, fiber reuse costs about \$10 per dry ton, and engineered soils cost approximately \$15 per dry ton.

Preferred Options:

- Modification of their BUD to allow utilization of IP-Corinth's paper wastes for other soil substitute (engineered soil) projects is an attractive option. Joint RD&D efforts on their residuals with Encore or Finch Pruyn may reduce the cost to produce a viable engineered soil for use in the barrier protection layer of landfill caps, landfill covers, other soil substitution activities and building products. Since October 9, 1993, the DEC has eliminated the need for case-specific BUDs to utilize paper mill residuals as daily cover material or final cover system components.
- In a related clay capping technology, an Ohio firm - TDC (Technology Development Corporation) wants to build a regional plant in New York State that can dry and thermally oxidize (burn) from 500 - 750 wet tpd of sludge from a group paper mills. The plant would recover clay for beneficial reuse in landfill caps or cementitious products. (The ash has a high carbonate content - 80 percent which would result in a good cement binder.) The patented process has excess heat available to preheat incoming sludges and to reclaim the high ash in IP's wastes. TDC is applying for a patent to use the clay residue from the above process, bleach it with a non-chlorine solution and provide the brighter clay to a paper mill as a filler in

INTERNATIONAL PAPER COMPANY

Corinth, NY

As of: March 15, 1995

various paper grades. Further R&D work is required for this reusable clay to quantify the brightness improvement possible for different paper mill wastes such as IP's, Encore's, and Finch Pruyn.

Mill Specific Issues:

Mill management has reported it has limited time/monies to research and develop its own beneficial use technologies. Long-term impacts and liabilities are of concern with various beneficial use technologies. IP-Corinth has already applied for and obtained BUD permits in the past with varying degrees of success in overcoming regulatory issues. The DEC has previously been restrictive in granting BUDs for of any soil amendment products containing paper residuals used outside the containment boundaries of a landfill.

The DEC has revised their Part 360 Solid Waste rules (October 9, 1993) and the BUD requirements to allow the use of approved paper mill residuals in landfill liner or final cover systems component projects when part of an approved closure plan. The company can request an RD&D permit for other soil substitute (engineered soil) projects for mixtures used outside the landfill.

Contacts:

Mr. Stuart E. Field, Manager -Manufacturing (Technical Services)
Tel: (518) 654-3445 Fax: (518) 654-3487
International Paper - Hudson River Mill
15 Pine Street
Corinth, NY 12822

Contacts (Regional Efforts):

Ms. Barbara Hemken - Technical Manager
Tel: (518) 793 -5684 ext 627 Fax: (518) 793 -2650
Encore Paper Company
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South Glens Falls, NY 12803

Contacts (Regional Efforts):

Mr. Phil Arthur - Environmental Control Manager
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Finch, Pruyn & Company
1 Glen Street
Glens Falls, NY 12801

INTERNATIONAL PAPER COMPANY

Corinth, NY

As of: March 15, 1995

Soil Substitute Option: Mr. Joe Laubenstein
Tel: (713) 870 -7470 Fax:(713) 584-8572
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PO Box 3151
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**For Clay Capping,
Cementious Products &
Bleached Clay Options:** Mr. Wendell Judd - President
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Technology Development Corporation
1567 Congress Hill Lane
Fairfield, OH 45014

INTERNATIONAL PAPER COMPANY

Oswego, NY

As of: March 15, 1995

Beneficial Use

Project: Background

International Paper Company produces about 260 tpd of recycled linerboard and medium. The mill is located in the city of Oswego on the western edge of Oswego County near Lake Ontario. The mill had produced fine white papers from virgin kraft pulp until October, 1994. Since that time it has converted production over to making 100 percent recycled linerboard. IP-Oswego purchases its fiber in the form of double lined kraft (DLK) clippings and old newsprint (ONP). After screening and/or cleaning process steps, the mill sends its effluent to the Oswego municipal waste water treatment plant. The solids from the mill's own centricleaners are potential candidates for beneficial reuse and total about 3 wet tpd or 0.9 bone dry tpd of solids. The normal solids content of their paper mill residuals is 30 percent (70 percent water) with an ash content of the solids at about 9 percent. Current disposal costs are about \$190 per bone dry ton or about \$0.70 per ton of finished production. IP-Oswego has investigated beneficial uses for this material as a composting study (30 tons), as an admixture for yard wastes (150 tons), and as feedstock in a paperboard mill (3 tons).

Preferred Options:

- Continue trials/evaluations of this fiber as a blend in composting operations. A Watertown bark mulch business (Pala Wood Services) is considering a compost operation using paper mill sludges. The mill could discuss opportunities with Pala Wood and provide a truck load quantity for R&D purposes to the facility (if it proceeds with its compost plans).
- Consider uses as a soil substitute product. Discussions with BFI or AllGro would be required to determine the economics and feasibility for use as a soil blending project for area landfills (Oswego County or Schoeller Technical).
- Transport material to the EMS facility in Solvay, NY, for evaluation and utilization as absorbent products or as animal bedding material. (The low ash and high fiber value has potential benefit as an absorbent product.)
- Conduct R&D testing of equipment to separate fiber from contaminants and to offer it as a fiber source (fiber transfer/reuse) for recycled mills in the region. A number of secondary mills in are in need of good quality fiber if it is free of many contaminants and can be delivered in a form that is acceptable to their mill.

Mill Specific Issues: Mill management has not reported any specific barriers to implementation of beneficial use technologies. Since October 9, 1993, the DEC has eliminated the need for case-specific BUDs to utilize paper mill residuals as daily cover material or final cover system components (See section 360-1.15(b)(10). IP-Oswego should be able to obtain information from the IP - Corinth mill on the best methods for using paper mill residuals as a cover, grading, or intermediate cover material.

Contacts: Mr. Tim Stocker - Environmental Manager
Tel: (315) 343-3445 Fax: (315) 343-8831
International Paper - Oswego Mill
RR # 9, Box 2A
Oswego, NY 13126

Regional Compost R & D Efforts: Mr. Bob Geary - Senior Environmental Engineer
Tel: (315) 298 - 5133 Fax: (315) 298 - 4337
Schoeller Technical Papers, Inc.
PO Box 250
Pulaski, NY 13126

Regional Compost R & D Efforts: Mr. Pat Patterson - President
Tel: (315) 788 -3713 Fax: (315) 788-5215
Pala Wood Services Co.
22566 Patterson Road
Watertown, NY 13601

Regional Compost R & D Efforts: Mr. Peter Mezzit
Tel: (800) 662 - 2240 Fax: (603) 929-3164
AllGro Corp. (Sub. of Wheelabrator Clean Water Systems, Inc.)
Liberty Lane
Hampton, NH 03842

Soil Substitute Option: Mr. Joe Laubenstein
Tel: (713) 870 -7470 Fax: (713) 584-8572
BFI (Browning - Ferris Industries)
PO Box 3151
Houston, TX 77253

Drying, Absorbent & Animal Bedding Option: Mr. Bob Bishop - General Manager
Tel: (315) 487-4346 Fax: (315) 487-4981
EMS, LP
1700 Milton Avenue
Solvay, NY 13209

JAMES RIVER CORPORATION
Natural Dam-Gouverneur, New York As of: March 15, 1995

Beneficial Use
Project: Background

James River Corporation produces about 42 tpd of paper products such as napkin, carrier, and filters. The mill is located in Gouverneur near the southern section of St. Lawrence County. The mill purchases virgin hardwood and softwood kraft and deinked post-consumer wet lap pulp (10 percent of total furnish). The primary clarifier solids are processed through an screw press. The press produces approximately 5.2 wet tpd or 1.8 bone dry tpd. The normal solids content of the waste is 35 percent (65 percent water) with an ash content of the solids of less than 1percent. The James River mill is listed as a supplier of its wastes under a beneficial use determination (BUD) permit to use its sludge as a daily cover at the Regional landfill at a cost of \$250/ dry ton of waste or over \$10 per ton of production.

Preferred Options

- A viable option for this fiber is to offer it as a fiber source (fiber reuse) for nearby recycled mills. A number of secondary mills in Jefferson County are in need of good quality fiber if it is free of many contaminants and can be delivered in a form that is acceptable to the mill.
- Transport material to the EMS facility in Solvay, NY, for evaluation and utilization as absorbent products, as an animal bedding material or as a fuel product by EMS. (The low ash and high fuel value has benefit as an energy source.)
- If the contamination is low, the mill's wastes may serve as a good carbon source/blending material in a composting operation or soil substitute program. A Watertown bark mulch business (Pala Wood Services) is considering a compost operation using paper mill sludges. The mill could discuss opportunities with Pala Wood and provide a truck load quantity for R&D purposes to the facility (if it proceeds with its compost plans).

Mill Specific Issues

Mill management has noted that use of its material as a fiber replacement in other mills requires a convenient method of handling. Assistance is needed in evaluating various types of fiber packaging equipment to facilitate shipping.

The mill reports that the DEC had not been receptive or encouraging to interest that the mill has had in landspreading. Landspreading in New York is regulated by the Part 360 Subpart 4 Land Application rules. These rules are currently being re-evaluated, but currently require that land applied materials benefit the soil or crop.

JAMES RIVER CORPORATION

Natural Dam-Gouverneur, New York As of: March 15, 1995

The Gouverneur mill will likely monitor developments in the land application regulations as they undergo revision by the DEC.

Contacts:

Mr. Ryan Schermahorn - Technical Director
Tel: (315) 287-7180 Fax: (315) 287 - 1111
James River Corporation - Natural Dam
Route 58
Gouverneur, NY 13642

Fiber Reuse Option:

Mr. Gene Rood - Mill Manager
Tel: (315) 782-4500 Fax: (315) 782-3964
Brownville Speciality Paper Products
Bridge Street
Brownville, NY 13615

**Potential Compost
Option:**

Mr. Pat Patterson
Tel: (315) 788 -3713 Fax : (315) 788 - 5215
Pala Wood Services Co.
22566 Patterson Road
Watertown, NY 13601

JAMES RIVER PAPER COMPANY

Carthage, New York

As of: March 15, 1995

Beneficial Use

Project: Background

James River Paper Company produces about 155 tpd of unbleached and semi-bleached paper toweling of various colors and sizes. The mill is located in Carthage, near the eastern edge of Jefferson County. The mill operates around the clock and purchases only recycled fiber (mixed office, old corrugated containers, double lined clippings etc.) with 40 - 50 percent of it containing post-consumer fiber content. The mill handles its primary clarifier solids by processing it through a screw press. The mill produces approximately 38 wet tpd or 18 bone dry tpd. The normal solids content of the waste is 45-50 percent (50-55 percent water) with an ash content of the solids between 15-20 percent. James River is listed on a regional landfill beneficial use determination (BUD) petition as a supplier of its wastes as a daily cover at the facility at a cost of about \$120 dry ton of waste or \$13.50 per ton of finished production. The mill also is listed on another BUD as a supplier of material to Cellutech, Ltd. for absorbent products. The mill has taken material to the EMS, LP facility for drying and testing.

Preferred Options:

- It is likely that a portion of James River's wastes will continue to be used by Cellutech for beneficial use as an oil spill cleanup product. Their waste fiber has excellent absorption qualities given that it is all primary solids and has a relatively low ash. Use in the Cellutech product requires further drying and could be evaluated in a modular infrared drying unit (Envirotech) at the James River facility or with a steam-heated drying unit.
- Transport material to the EMS facility in Solvay, NY, for evaluation and utilization as Cellutech feedstock, as an animal bedding material, or as a fuel product by EMS. (The low ash and high fuel value has benefit as an energy source.)
- James River has an interest in developing long-term beneficial use alternatives. The Envirotech Radiant Plate Infrared Dryer unit that was referenced above for Cellutech may be a significant, energy efficient means of beneficially using the mills sludge. Purchase (\$600,000+/-) of a single, full-scale Envirotech unit capable of drying 20 tpd of sludge may be warranted. It can not be determined without research work on Envirotech's 1/10 scale proto-type unit. A second drying alternative would involve the installation of a rotary steam drier unit that potentially could be supplied by EMS. Steam is

JAMES RIVER PAPER COMPANY

Carthage, New York

As of: March 15, 1995

available from a nearby co-generation facility to potentially offset some of the heat required for drying.

Mill Specific Issues

A third option would be to use an onsite gas fired, triple-pass dryer available on the market. (See potential vendors at end).

Mill management has not reported any specific economic barriers. New beneficial use technologies would require local and corporate approval for any financial resources/capital necessary for the support of the equipment.

To operate a prototype dryer (infrared, steam, or other units) a temporary certificate to operate a process, exhaust and/or ventilation Systems (6 NYCRR Part 212) permit may be needed from the regional DEC office.

Contacts:

Mr. Labe Haverstock - Environmental Manager
Tel : (315) 493 -6178 Fax: (315) 493-3015
James River Paper Company
695 West End Avenue
Carthage, NY 13619

Absorbent Option:

Mr. Henry LaLone - Plant Manager
Tel: (315) 786 - 7782 Fax: (315) 786-7783
Cellutech, LTD.
Starbuck Avenue
Watertown, NY 13601

**Drying Option:
(Offsite Drying)**

Mr. Bob Bishop - General Manager
Tel: (315) 487-4346 Fax: (315) 487 - 4981
EMS, LP
1700 Milton Avenue
Solvay, NY 13209

Onsite Drying Trial:

Mr. Michael Gustavson - President & Director
Tel: (604) 685-8496 Fax: (604) 683-2256
Envirotech Systems Corporation
1820-99 West Hastings Street
Vancouver, B.C.
Canada, V6C 2W2

LYONS FALL PULP & PAPER, INC.

Lyons Falls, NY

As of: March 15, 1995

Beneficial Use Project: Background

Lyons Fall Pulp & Paper, Inc. manufactures about 174 tpd of book publishing paper and incorporates post-consumer recycled fiber into some of its grades line. The mill is located in Lyons Falls in the south central part of Lewis County. The mill is an integrated facility that produces a high-yield bleached hardwood sulfite pulp and finished paper. Other pulp sources used by the mill include purchased softwood and hardwood kraft and high-grade recycled fiber. The mill burns its bark and the wood ash is used by area farmers for soil enrichment purposes. The pulp mill wastes are screened and sent to the primary (5 acres) aerated stabilization basin for treatment. The paper mill effluent is processed through a primary flotation clarifier and sent to the secondary aerated stabilization basin (10 acres) with activated sludge recirculation. The primary solids are processed on a twin belt press, which handles approximately 50 wet (or 15 bone dry) tpd of solids. The normal solids content of the waste is 30 percent (70 percent water) off from its belt press. These fibrous solids are transported to various mills in the region (Carthage and Brownville, NY) as a fiber feed to recycled fiber mills. The belt press ash content is about 12 percent. When waste are dredged from the secondary basin, a series of dewatering units have been used-belt press and screw press. For successful operation, primary fiber has had to be blended with secondary (60/40 ratio) in order to process the material. The resultant material (approximately 17 wet tons @ 30 percent solids or 5 bone dry tons per day equivalent) has gone to a regional landfill for cover at a cost of over \$400 per dry ton of waste or over \$12 per ton of finished production.

Preferred Options:

- Lyons Fall Pulp & Paper, Inc. will likely continue to send as much of its primary fiber from the belt press to other mills in a fiber exchange program. Given the general shortage of recycled fiber, this material is a valuable resource for the mill and those that can utilize it.
- The mill may also benefit from leasing/installing equipment to recover additional fiber lost each day from the pulp/paper mill operation for internal reuse or for their fiber exchange program. This option would reduce the mill's need in the future to dredge the lagoons and would help maintain compliance with permit conditions.

LYONS FALL PULP & PAPER, INC.

Lyons Falls, NY

As of: March 15, 1995

- Future dredging options for its secondary solids from the lagoon involve improved dewatering on a rotary vacuum press unit. The biosolids could potentially be blended with the mill's ash and provided to farmers for spreading. Research would have to be conducted to determine whether the blended product has the appropriate nutrient and mechanical properties for use by the agricultural community or for a commercial soil blending process. (AllGro or BFI).
- Another option could be to take the blend of ash and secondary basin solids and process it with paper solids from other paper mills into compost. A Watertown bark mulch business (Pala Wood Services) is considering a compost operation using paper mill sludges. The mill could discuss opportunities with Pala Wood and provide a truck load quantity for R & D purposes to the facility (if it proceeds with its compost plans).

Mill Specific Issues:

Lyons Fall Pulp & Paper, Inc. management reports that their secondary wastes are difficult to dewater without blending in fibrous material. Improved mechanical dewatering equipment needs to be tested (R&D) at the mill. Successful trials leading to a higher solids content mill waste would reduce the transportation/operating costs for other beneficial uses such as composting or soil substitutes. It would also open up opportunities for expanded markets for their recovered ash for soil enrichment purposes. Regulatory issues involving composting versus land spreading would have to be addressed.

Contacts:

Mr. Noel Schneider - Environmental Engineer
Tel: (315) 348 -2269 Fax: (315) 348-8629
Lyons Fall Pulp & Paper, Inc
PO Box 338
Lyons Falls, NY 13368

Fiber Separation Option:

Ms. Kathy Russell - Technical Sales Representative
Tel: (800) 240-5366 Fax: (716) 458-7476
AFTEK, Inc.(Applied Filtration Technology, Inc.)
740 Driving Park
Rochester, NY 14613

LYONS FALL PULP & PAPER, INC.

Lyons Falls, NY

As of: March 15, 1995

**Fiber Separation
Option:**

Mr. Steve Dumont - President
Tel: (603) 926 - 4830 Fax: (603) 926-8269
Zane Blanchard & Co., Inc.
Box 789
Hampton Beach, NH 03842

**Dewatering System
Option-Rotary
Vacuum Press:**

Mr. Conrad Tuefel, Jr. - Environmental Consultant
Tel: (315) 474-3157 Fax: (315) 472-7915
Upstate Environmental Services (UES), Inc.
215 Tully Street
Syracuse, NY 13204

Compost Option:

Mr. Peter Mezzit - Sales Representative
Tel: (800) 662 -2440 Fax: (603) 929 -3164
All - Gro Corp. (Sub. of Wheelabrator Clean Water Systems, Inc.)
Liberty Lane
Hampton, NH 03842

**Engineered Soil
Option:**

Mr. Joe Laubinstein - Sale Representative
Tel: (713) 870 -7470 Fax: (713) 584-8572
BFI (Browning - Ferris Industries)
PO Box 3151
Houston , TX 77253

**Compost Option:
(Regional Project)**

Mr. Pat Patterson - President
Tel: (315) 788 -3713 Fax: (315) 788-5215
Pala Wood Services Co.
22566 Patterson Road
Watertown, NY 13601

MOHAWK PAPER MILLS, INC

Cohoes & Waterford, NY

As of: March 15, 1995

Beneficial Use

Project: Background

Mohawk Paper Mills each produce about 100 tpd of fine printing and writing papers containing pre- and post consumer recycled fiber. One mill is located on O'Connor Drive in Waterford, NY, in the Saratoga County, and the other is in Cohoes in Albany County. No virgin pulp is produced by the facilities and all fiber is purchased bleached hardwood and softwood kraft (50 percent), high grade deinked fiber (20 percent), and post-consumer pulp (30 percent). Primary wastes (Waterford Mill only) are processed via screening and dissolved air flotation saveall and total only 8.3 wet tpd (@ 42 percent) or 3.5 bone dry tpd. The solids content of the waste is 42 percent (58 percent water) with an ash content of 20 percent. The Mohawk Mill - Waterford currently provides its wastes for composting at a cost of about \$70/dry ton of waste produced or about \$2.50 per ton of finished production.

Preferred Options:

- Mohawk Paper Mills produces a clean, fibrous product for potential use as a substitute feed stock at a secondary fiber facility. The mill is currently investigating opportunities to engage in a fiber reuse program at no cost to the mill. Transport to other mills that have lower quality requirements is clearly an attractive option that the mill should continue to pursue.
- Although beyond the scope of this project, further in-plant recovery and reuse of fiber from the mill may be feasible if it can meet their quality specifications. Fiber-clay separation equipment is available for this purpose.

Mill Specific Issues:

Mohawk Paper Mills management has reported it has limited financial resources/capital and cannot support the development of new technologies. They are hesitant to implement new technologies that have not been proven elsewhere. A trial (R&D) can be investigated to evaluate the potential benefits of the various suppliers of fiber/clay separation equipment. This equipment has been used extensively in the pulp and paper industry.

The mill should be granted a waiver from the Part 364 Waste Hauling permit program requirements to pursue the waste reuse/transfer projects. The compost program is an approved activity and would not pose any regulatory issues.

MOHAWK PAPER MILLS, INC

Cohoes & Waterford, NY

As of: March 15, 1995

Contacts:

Mr. George Milner - Assistant VP- Environmental Affairs
Tel: (518) 237- 1740 ext 205 Fax: (518) 237 - 7374
Mohawk Paper Mills
PO Box 497
Cohoes, NY 120473

**Fiber Reuse
Options:**

Mr. Jerry Landwehr - Technical Director
Tel: (518) 392 - 4000 Fax: (518) 392- 4030
Columbia Corporation
PO Box 330
Chatham, NY 12037

**Fiber Reuse
Options:**

Mr. Steve Van Doren
Tel: (315) 484- 9050 Fax: (315) 484 -9434
Solvay Paperboard Corporation
1800 Milton Avenue
Solvay, NY 13209-0310

**Fiber/Clay Separation
Option:**

Ms. Kathy Russell - Technical Sales Representative
Tel: (800) 240-5366 Fax: (716) 458-7476
AFTEK, Inc.(Applied Filtration Technology, Inc.)
740 Driving Park
Rochester, NY 14613

**Fiber/Clay Separation
Option:**

Mr. Steve Dumont - President
Tel: (603) 926 - 4830 Fax: (603) 926 - 8269
Zane Blanchard & Co., Inc.
Box 789
Hampton Beach, NH 03842

Composting Options:

Mr. Bob Wilmot - President
Tel: (518) 677 - 8543
Wilmot Farms
Box 89
Buskirk, NY 12028

NORFOLK PAPER COMPANY

Norfolk, NY

As of: March 15, 1995

Beneficial Use Project: Background

Norfolk Paper Company produces about 85 tpd of recycled kraft packaging grades from old corrugated containers and double lined kraft (DLK) trimmings. The mill is located in the southern part of St. Lawrence County in the village of Norfolk. The solids from the floatation saveall are processed through an old screw press. This press handles 15 (bone dry) tpd of fibrous waste, which is reused back in the mill. This screw press is to be replaced by a new unit in 2 -3 months. The mill also produces about 10 wet tons (three times per week) of fibrous solids, plastic, and grit wastes. The normal solids content of the waste is 30 percent and it has an ash content of about 12 percent. The mill provides this waste fiber, plastic, & grit to the Regional DANC (Development Authority of the North Country) landfill where it can be used as a landfill cover material. Landfilling costs are currently \$135/wet ton or \$450 per bone dry ton.

Preferred Options:

- The preferred option for any relatively clean fiber is to offer it as a fiber source for secondary fiber mills. A number of mills in nearby Jefferson County are users of good quality fiber provided it is relatively high in solids and can be delivered in a form that is acceptable to the fiber user.
- Conduct R & D testing of equipment to separate fiber from other wastes, reduce the waste generated internally by the paper mill operation, and transport the waste to the nearest user of waste secondary fiber.
- If onsite contaminant removal can not be provided, a regional dewatering and processing plant may be able to serve many mills wastes and produce a clean fiber. Then the dewatered material could serve as a substitute feed stock at another secondary fiber or linerboard facility.
- If the plastic contamination is sufficiently low, the mill's wastes may serve as a good carbon source/blending material in a composting operation or soil substitute program. A Watertown bark mulch business (Pala Wood

Services) is considering a compost operation using paper mill solids. The mill could discuss opportunities with Pala Wood and provide a truckload quantity for R&D purposes to the facility (if it proceeds with its compost plans).

Mill Specific Issues:

Norfolk Paper Company does not report any specific issues that would restrict development of appropriate beneficial use technologies. The mill would need to conduct R&D work to evaluate equipment to separate useable fiber from other mill contaminants (plastic). The mill can also obtain a DEC waiver from the Part 364 Waste Hauling permit requirements to evaluate the composting option, or the animal bedding and fuel program option.

Contacts:

Mr. Don Spiradakis - Technical Supervisor
Tel: (315) 384-4225 Fax: (315) 384 -4148
Norfolk Paper Company
100 Remington Avenue
Norfolk, NY 13667

Compost Option:

Mr. Pat Patterson - President
Tel: (315) 788 - 3713 Fax: (315) 788-5215
Pala Wood Services Co.
22566 Patterson Road
Watertown, NY 13601

PACKAGING CORPORATION OF AMERICA

Plattsburgh, NY

As of: March 15, 1995

Beneficial Use Project: Background

Packaging Corporation of America (PCA) produces about 30 tpd of molded paper fiber products from purchased hardwood and softwood sulfite pulp, mixed paper, old newsprint, and other pulp substitutes. The mill is located in the city of Plattsburgh in Clinton County. The solids from the mill are processed through shaker or sidehill screens and cyclone cleaners. All effluent is sent to the publicly-owned treatment works (POTW) so no paper mill residuals wastes have to be processed by the mill.

Preferred Option:

- The mill has adequate onsite processing and offsite wastewater treatment capacity. The POTW treatment is currently the best option for their mill waste solids.

Mill Specific Issues:

The mill reports no solid waste management issues that are of concern to the facility. No further action is warranted.

Contacts:

Mr. Tony Searing - Plant Manager
Tel: (518) 561-4880 Fax: (518) 561 - 6968
Packaging Corporation of America (PCA)
74 Weed Street Extension
Plattsburgh, NY 12901

POTSDAM PAPER MILLS

Potsdam, NY

As of: March 15, 1995

Beneficial Use Project: Background

Potsdam Paper Mills produces about 60 tpd of wet creped grades (masking tape base, coffee filter) and packaging and food service and placemat products. The mill incorporates purchased hardwood and softwood kraft and recycled pulp substitutes into its products. The mill is located in Potsdam in northern St. Lawrence County. The solids from the primary treatment plant is processed through a screw press and yields 2.4 wet tpd or 1.2 bone dry tpd of residuals. The normal solids content of the waste is 50 percent and it has an ash content of 9 percent (occasionally the ash content increases to over 20 percent). The mill provides its waste fiber to the Regional DANC landfill (Development Authority of the North Country) as a landfill cover material. Landfilling cover costs are currently over \$100 per bone dry ton of waste or about \$2.00 per ton of finished paper produced.

Preferred Options:

- The preferred option for this clean, high-solids fiber is to offer it as a fiber source for other users of secondary fiber. A number of mills in nearby Jefferson County are users of good quality fiber provided it is high in solids and can be delivered in a form that is acceptable to the fiber user.
- The mill's wastes could also serve as a good carbon source/blending material in a composting operation or soil substitute program. A Watertown bark mulch business (Pala Wood Services) is considering a compost operation using paper mill sludges. The mill should discuss opportunities with Pala Wood and provide a truckload quantity for R&D purposes to the facility (if it proceeds with its compost plans).

Mill Specific Issues:

Potsdam Paper Mill does not report any specific issues that would restrict development of appropriate beneficial use technologies. The mill could obtain a beneficial use determination (BUD) or obtain a waiver from the Waste Hauling permit (Part 364) requirements to pursue the fiber reuse program with a couple secondary fiber mills in the region.

Also, a one truckload exemption can be obtained from the DEC for transport of the mills material to the potential Watertown composting facility.

POTSDAM PAPER MILLS

Potsdam, NY

As of: March 15, 1995

Contacts:

Mr. Joel Behm - Technical Manager
Tel: (315) 265-4000 Fax: (315) 265 -4004
Potsdam Paper Mills
547A Sissonville Road
Potsdam, NY 13676

Fiber Reuse Option:

Mr. Gene Rood
Tel: (315) 782-4500 Fax: (315) 782-3964
Brownville Speciality Paper Products
Bridge Street
Brownville, NY 13615

Fiber Reuse Option:

Mr. Steve Van Doren
Tel: (315) 484 9051 Fax: (315) 484 -9434
Solvay Paperboard Corporation
1800 Milton Avenue
Solvay, NY 13209-0310

Fiber Reuse Option:

Mr. Jerry Landwehr
Tel: (518) 392 - 4000 Fax: (518) 392 - 4030
Columbia Corporation
PO Box 330
Chatham, NY 12037

**Paper Residuals
Compost Option:**

Mr. Pat Patterson
Tel: (315) 788 -3713 Fax:(315) 788 - 5215
Pala Wood Services Co.
22566 Patterson Road
Watertown, NY 13601

SCHOELLER TECHNICAL PAPERS, INC.

Pulaski, NY

As of: March 15, 1995

Beneficial Use Project: Background

Schoeller Technical Papers, Inc. is a non-integrated paper mill that produces about 120 tpd of photographic, greeting card, and specialty papers. The mill is located in the community of Pulaski in the north central section of Oswego County. Technical Papers, Inc. purchases virgin bleached hardwood and softwood kraft as well as high grade deinked (recycled) fiber. The paper mill's effluent (including sanitary wastes), is processed through their trickling filter and continues on to the polishing lagoons (2) before release to the Salmon River. The solids from the trickling filters are dewatered on a twin belt press and totals about 14.3 wet tons or 5 bone dry tons per day of solids. The solids content of this waste is normally about 35 percent (65 percent water) with an ash content of the solids at about 15 percent. The mill has its own onsite unlined landfill that will reach capacity by 1998. Schoeller has investigated beneficial uses as a composting additive and as a daily cover material.

Preferred Options:

- Conduct research into the potential for the beneficial uses as a soil substitute product. Discussions with existing firms (like BFI or AllGro) are warranted to determine the feasibility for use as soil blending project for Schoeller's own landfill or for those in the area (Oswego County).
- Continue trials/evaluations of this fiber as a blend in composting operations. A Watertown bark mulch business (Pala Wood Services) is considering a compost operation using paper mill sludges. The mill could discuss opportunities with Pala Wood and provide a truck load quantity for R&D purposes to the facility (if it proceeds with its compost plans).
- Transport material to the EMS facility in Solvay, NY, for evaluation and utilization as absorbent products, animal bedding material, or fuel pellet. (The low ash, high fiber, and high Btu value has excellent potential as a fuel source.)

Mill Specific Issues:

Mill management has expressed a preference for a low technology approach when implementing any specific beneficial use technologies. The DEC revised their Part 360 Solid Waste rules (October 9, 1993) and the BUD requirements to allow the use of approved paper mill residuals in landfill liner or final cover systems component projects when part of an approved closure plan. Schoeller would realize a significant cost savings if they used their

SCHOELLER TECHNICAL PAPERS, INC.

Pulaski, NY

As of: March 15, 1995

paper mill residuals in their landfill when it is closed in 1998.

The mill has expressed an interest into other beneficial use technologies (e. g., conversion of mill wastes to chemicals) as a supplier of raw material.

Contacts:

Mr. Bob Geary - Senior Environmental Engineer
Tel: (315) 298 - 5133 Fax: (315) 298 - 4337
Schoeller Technical Papers, Inc.
PO Box 250
Pulaski, NY 13126

**Regional Compost
R & D Efforts:**

Mr. Peter Mezzit
Tel: (800) 662 - 2240 Fax: (603) 929 - 3164
AllGro Corp. (Sub. of Wheelabrator Clean Water Systems, Inc.)
Liberty Lane
Hampton, NH 03842

**Regional Compost
R & D Efforts:**

Mr. Pat Patterson- President
Tel: (315) 788 -3713 Fax: (315) 788-5215
Pala Wood Services Co.
22566 Patterson Road
Watertown, NY 13601

Soil Substitute Option:

Mr. Joe Laubenstein
Tel: (713) 870 -7470 Fax: (713) 584-8572
BFI (Browning - Ferris Industries)
PO Box 3151
Houston , TX 77253

**Drying, Absorbent &
Animal Bedding
Option:**

Mr. Bob Bishop - General Manager
Tel: (315) 487-4346 Fax: (315) 487-4981
EMS, LP
1700 Milton Avenue
Solvay, NY 13209

SOLVAY PAPERBOARD CORPORATION

Solvay, NY

As of: March 15, 1995

Beneficial Use

Project: Background

The Solvay Paperboard Mill produces about 315 tpd of linerboard and medium (C Quality) containing post-consumer recycled fiber. The mill is located in the village of Solvay in Onondaga County. All fiber is purchased and consists of old corrugated containers (OCC). Primary wastes are processed via clarification, dissolved air flotation saveall, followed by a screw press. The press processes 60 wet tpd or 27 bone dry tpd of material. The fibrous wastes solids content of the waste is 45 +/- 5 percent (55 percent water) with an ash content of about 2 percent. The mill has provided its wastes for landfill cover at a cost of over \$150 per ton disposed or \$20 per ton of finished product. It is also evaluating the use of its waste product as an animal bedding material.

Preferred Options:

- Solvay Paperboard produces a clean, fibrous product for potential use as a substitute feed stock at a secondary fiber facility. The mill has opportunities to engage in a fiber reuse program potentially at a low cost to the mill. R&D evaluations at other mills that have lower quality requirements is a attractive option that the mill can pursue.
- Given the mills proximity to the EMS facility, Solvay's material should continue to be transported and evaluated as an animal bedding material or as a fuel product by EMS, LP. (The low ash and high heat value is a benefit as an energy source.) Other technologies can be set up at the EMS facility (conversion of wastes to chemical feedstocks or gasification) and could serve as a good site for R&D testing of the Solvay material.

Mill Specific Issues:

Mill management has reported that they do not have the manpower for R&D trials. Given that Solvay is new (startup August 1994) the mill also indicates that they have limited contacts with other mills or commercial beneficial use firms.

The mill can pursue a beneficial use determination (BUD) or obtain a waiver from the Part 364 Waste Hauling permit program requirements to research the fiber reuse program. A one-truckload exemption can generally be obtained from the DEC for transport of the mill's material to another paper mill in need of quality fiber. Efforts are underway to eliminate the need to use trucks requiring a Part 364 hauling permit for paper mill wastes being evaluated and/or used by another mill in a waste reuse program.

SOLVAY PAPERBOARD CORPORATION

Solvay, NY

As of: March 15, 1995

Contacts:

Mr. Steve Van Doren
Tel: (315) 484- 9050 Fax: (315) 484 -9434
Solvay Paperboard Corporation
1800 Milton Avenue
Solvay, NY 13209-0310

Fiber Reuse Option:

Mr. Gene Rood
Tel: (315) 782-4500 Fax: (315) 782-3964
Brownville Speciality Paper Products
Bridge Street
Brownville, NY 13615

Fiber Reuse Option:

Mr. Jerry Landwehr
Tel: (518) 392 - 4000 Fax: (518) 392- 4030
Columbia Corporation
PO Box 330
Chatham, NY 12037

Fiber Reuse Option:

Mr. Labe Haverstock - Environmental Manager
Tel : (315) 493 -6178 Fax: (315) 493-3015
James River Paper Company
695 West End Avenue
Carthage, NY 13619

Drying, Absorbent & Animal Bedding Option:

Mr. Bob Bishop - General Manager
Tel: (315) 487-4346 Fax: (315) 487-4981
EMS, LP
1700 Milton Avenue
Solvay, NY 13209

SPECIALITY PAPERBOARD, INC

Beaver Falls, NY

As of: March 15, 1995

Beneficial Use Project: Background

Speciality Paperboard, Inc. manufactures about 69 tpd of latex reinforced products and speciality paperboard grades. The mill uses a wide variety of furnishes and can include purchased bleached kraft, hi-alpha, eucalyptus, recycled mixed paper, old newsprint, old corrugated containers, pulp substitutes and other post-consumers fibers (cotton, wool, etc.) The mill is located in the village of Beaver Falls in the north central part of Lewis County. Primary wastes are processed via dissolved air flotation (DAF) with solids removal and secondary treatment through aerated stabilization basin. The solids removed from the DAF system are processed through a retrofitted screw press unit and total 8.9 wet tpd or 2.9 bone dry tpd. The solids content of the waste is 30 - 35 percent (65 -70 percent water) with an ash content of 25 percent. Speciality Paperboard currently provides its wastes to the regional Development Authority of the North Country (DANC) landfill for daily cover in the Town of Rodman. The cost for this use of the public landfill is about \$150 per dry ton of waste produced or nearly \$7 per ton of finished paper.

Preferred Options:

- Speciality Paperboard produces a highly variable waste product. R&D work is required to evaluate the potential use of the material as a substitute feed stock at a secondary fiber facility. Transport to other mills that have lower quality requirements is a potential option that the mill could pursue.
- Although beyond the scope of this project, further in-plant recovery and reuse of fiber from the mill may be feasible if it can meet their quality specifications. Fiber-clay separation equipment is available for this purpose.
- Obtain DEC approval for transport of their wastes to the EMS facility in Solvay, NY, for evaluation and possible use as an animal bedding material at an estimated cost of about \$110 per dry ton of waste produced.
- Speciality Paperboard could evaluate improved dewatering equipment for the solids from its DAF/old screw press system to increase the waste solids (now 32 percent) to 40 - 42 percent solids to reduce transportation costs for any off-site option.

Mill Specific Issues:

Speciality Paperboard management has limited financial resources to support the development of new technologies. They are also

SPECIALITY PAPERBOARD, INC

Beaver Falls, NY

As of: March 15, 1995

concerned about the regulatory requirements to implement new technologies. A trial (R&D) is suggested to demonstrate the potential benefits of the various suppliers of fiber/clay separation equipment. This equipment has been used extensively in the pulp and paper industry.

The mill may want to obtain a beneficial use determination (BUD) or obtain a waiver from the Part 364 Waste Hauling permit program requirements to pursue the fiber reuse program. A one-truckload exemption can be obtained from the DEC for transport of the mill's material to the EMS facility. A broader exemption for fiber exchange efforts is under review by the DEC that could benefit mills like Speciality Paperboard.

Contacts:

Mr. George McBride -Technical / Sales Manager
Tel: (315) 346 - 7221 Fax: (315) 346 - 1063
Speciality Paperboard, Inc.
Main Street
Beaver Falls, NY 12803

Fiber Reuse Option:

Mr. Labe Haverstock - Environmental Manager
Tel : (315) 493 -6178 Fax: (315) 493-3015
James River Paper Company
695 West End Avenue
Carthage, NY 13619

Fiber/Clay Separation Option:

Ms. Kathy Russell - Technical Sales Representative
Tel: (800) 240-5366 Fax: (716) 458-7476
AFTEK, Inc.(Applied Filtration Technology, Inc.)
740 Driving Park
Rochester, NY

Fiber/Clay Separation & Dewatering (Screw Press) Option:

Mr. Steve Dumont - President
Tel: (603) 926 - 4830 Fax: (603) 926 - 8269
Zane Blanchard & Co., Inc.
Box 789
Hampton Beach, NH 03842

Animal Bedding Option:

Mr. Bob Bishop - General Manager
Tel: (315) 487-4346 Fax: (315) 487-4981
EMS, LP
1700 Milton Avenue
Solvay, NY 13209

SPECIALITY PAPERBOARD, INC

Beaver Falls, NY

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**Dewatering Equipment
(Screw Press) Option:**

Mr. John G. Trinward
Tel: (207) 877-0459 Fax: (207) 877-0460
Castine Energy Services
117 Silver Street
Waterville, ME 04901

STORA - NEWTON FALLS MILL

Newton Falls, NY

As of: March 15, 1995

Beneficial Use Project: Background

The Newton Falls mill in the northwest corner of the Adirondack Park in southern St. Lawrence County produces about 350 tpd of coated and uncoated book, label, and recycled containing alkaline paper, and about 8 dry tpd of treatment plant solids for disposal. (The average ash content is about 65 percent.) Past landfill (mill owned) disposal costs have been about \$40 per bone dry ton of waste. This landfill has been closed, but the mill has the necessary permits for the construction of a new landfill facility. Due to the significant costs for landfill construction (over \$1 million), various alternatives are being pursued including in-plant waste reductions & using dredged lagoon wastes to reforest a nearby 375-acre mine spoils area. The wastes are produced daily but the waste lagoons that are part of the treatment process are typically dredged only once every 3 - 4 years. The mill prepared a RD&D permit request to the DEC for the reforestation project, which was approved on April 1, 1995. The Adirondack Park Agency (APA) also approved the reforestation project.

Preferred Options:

- Given the variable solids content of the dredged solids from Stora Papyrus, many beneficial use technologies are not appropriate for use at this mill (see bullet below). The proposed reforestation project is suited to the variable nature of the mill's solids with appropriate nutrient supplements and should be actively pursued by Applied Residuals Management (West Chester, PA), ESF, and other consultants hired by the mill.
- Stora Papyrus can benefit from leasing/installing equipment to recover the fiber generated each day within the paper mill operation for internal reuse or for a fiber exchange program. This option would reduce the mill's need in the future to dredge the lagoon as often. Stora Papyrus can complete trials to characterize the fiber quality and then negotiate acceptable agreements to transport it to users of waste secondary fiber.

Mill Specific Issues:

Mill management has reported it has limited capital and can not fund large scale commercial projects (e. g. lightweight aggregate, oil absorbents, chemical production). The intermittent nature of the lagoon dredging (once every 3-4 years) would require large-scale commercial equipment to sit idle for long periods of time with no opportunity to provide a return on the investment. The mill has also stated that the remote location of the mill limits

STORA - NEWTON FALLS MILL

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opportunities to market many value-added products. In-plant recovery and reuse of fiber by the Stora mill itself would require a high degree of expensive cleaning equipment and capital improvements (\$1-2 million) to meet its quality specifications. But fiber recovery and transport to other mills that have lower quality requirements would reduce this issue.

The solids content of the biosolids dredged from the lagoon can be very low (10 percent) and quite variable (range from 10 - 30 percent). Very few technologies (except compostin or reforestation) are capable of handling the wide range of lagoon solids content and yielding an acceptable product. As mentioned previously, the waste material from the lagoons are generated only when it is dredged, so a reliable, daily source is not available for a continuous commercial process.

The DEC has previously rejected beneficial use determination (BUD) requests for other NY paper companies sludge (Hollingsworth & Vose, International Paper-Corinth) for use in reclamation of sand and gravel pits. The reasons for rejection include concern over the effect of the sludge/soil mixture on groundwater in the highly porous soils in excavated mines. (The mine that Stora Papyrus would reforest does not have shallow soils or a high groundwater level.)

Stora has applied to the DEC for a RD&D permit to conduct a one-year trial on an 8-acre plot at a nearby mine for a reforestation initiative. TCLP testing of Stora samples have met groundwater standards except for a few parameters. The DEC issued the permit on April 1, 1995.

Contacts:

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Stora Papyrus (Appleton Papers)
PO Box 253
Newton Falls, NY 13666

For Reforestation Option:

John O'Neal - Principal
Tel: (610) 486 - 0365
Applied Residuals Management
1245 West Chester Pike, Suite 313
West Chester, PA 19382

STORA - NEWTON FALLS MILL

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**Fiber/Clay Separation
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**Fiber/Clay Separation
Option:**

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AFTEK, Inc. (Applied Filtration Technology, Inc.)
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Fiber Reuse Option:

Mr. Labe Haverstock - Environmental Manager
Tel : (315) 493 -6178 Fax: (315) 493-3015
James River Paper Company
695 West End Avenue
Carthage, NY 13619

Fiber Reuse Option:

Mr. Gene Rood - Mill Manager
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Brownville Speciality Paper Products
Bridge Street
Brownville, NY 13615

**Beneficial Use
Project: Background**

US Gypsum Co. produces about 122 tpd of post-consumer wallboard and linerboard from old corrugated containers and mixed paper and old newsprint. The mill is located in the north central part of Genesee County in Oakfield. Paper mill residuals from the primary clarifiers and three-stage biological system (with trickling filter and aerated stabilization basin) are processed through a screw press. The press handles less than 1.0 bone dry tpd or 1.5 wet tpd of solids waste which is landfilled. The normal solids content of the material is 25 percent and it has an undetermined ash content. The mill sends its solids to its own onsite 20- acre unlined landfill. Landfilling costs are currently \$55 per bone dry ton (including closure), which is less than \$0.50 per ton of finished paper production. It is considering land spreading, composting, and/or mulching as potential beneficial use activities for its predominately biosolids wastes. US Gypsum's biosolids from the dredging of the aerated basin every 2 years (6 - 8 percent solids) are expected to be rich in nutrients and suitable for land application or compost projects.

Preferred Options:

- The mill has adequate onsite landfill capacity (until the year 2040) and is the current option of choice for their waste solids.
- While the mill has expressed an interest in alternatives such as producing compost, the US Gypsum mill can explore opportunities with other paper mills in the area. Possible partners would be to conduct R&D trials with the Cascades-Niagara Falls and the Buffalo Paperboard mill in a regional effort to develop beneficially use products.
- Another option is for the mill to negotiate with the compost facility in Leroy (southeastern corner of Genesee County) to provide its residuals to them.
- A potential opportunity for the mill involves blending its fiber with sandy soils and nutrient rich materials for production of a substitute soil. Discussions with BFI would be required to determine the economics and feasibility of the project.

Mill Specific Issues:

The mill indicates that there are issues such as quantities of contaminants (wood, metal, styrofoam, and plastics) that would impact the development of beneficial use technologies (like composting). The cost of capital equipment (for processing, sorting, and separation of contaminants) and labor costs have affected the mill's interest in

US GYPSUM CO.

Oakfield, NY

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composting. Other issues cited by the mill are permitting, odor control, and storage impacts.

A joint initiative between the three regional paper mills would require R&D work to evaluate the various receipe/blends of the onsite composting operations. The mill can obtain a DEC waiver from the Part 364 Waste Hauling permit requirements to evaluate small samples (less than 500 pounds) for its composting performance. A single truckload may also be exempted by the DEC from requiring a BUD/Part 364 Waste Hauling permit for R&D purposes. Efforts are underway by the DEC to increase the flexibility in the current requirement to have all beneficially reused material to be transported in trucks with Part 364 Permits.

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**Compost Option:
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Mr. Ray O'Keefe - Special Projects Manager
Tel: (716) 285-3681 Fax: (716) 285 -3767
Cascades , Inc.
4001 Packard Road
Niagara Falls, NY 14303

**Compost Option:
(Regional)**

Mr. Dave Sholk
Tel: (716) 434 2045 Fax: (716) 434 -1801
Buffalo Paperboard Corp.
470 Ohio Street
Lockport, NY 14094

**Compost Option:
(Leroy Facility)**

Mr. Peter Mezzit
Tel: (800) 662 -2440 Fax: (603) 929-3164
All - Gro Corp. (Sub. of Wheelabrator Clean Water Systems, Inc.)
Liberty Lane
Hampton, NH 03842

Soil Substitution Option:

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Tel: (713) 870 - 7470 Fax: (713) 584 - 8572
BFI (Browning - Ferris Industries)
PO Box 3151
Houston , TX 77253

Section 4

REGULATORY, ECONOMIC, AND TECHNICAL BARRIERS AFFECTING IMPLEMENTATION OF BENEFICIAL USE TECHNOLOGIES

The decades of research and use of paper mill residuals in a wide variety of beneficial materials and marketable products has not always received much notice outside the paper industry itself. This lack of broad attention to the beneficial uses of paper mill residuals has led to a tendency to establish barriers against the use of such an "industrial waste" in applications typically associated with "natural materials" like agricultural wastes, clay soils, sawdust, and other wood wastes.

It is hoped that the detailed case histories of successful uses of paper mill residuals presented in this report will be recognized by the paper companies themselves, environmental regulators, commercial beneficial use firms, and the general public. A desired outcome would be a reduction or elimination of some of the key barriers, whether regulatory, economic, technical and/or legal, and the expansion of opportunities for beneficially reusing paper mill residuals generated, by New York mills using post-consumer (recycled) fiber.

Concern about regulatory barriers was the issue most frequently cited by the mills, commercial companies, and consulting firms as potentially limiting development of beneficial use technologies. Of the total comments cited, one - third of them related to regulatory issues. New York's environmental regulations have shaped and at times inhibited the use of paper mill byproducts. Focusing attention on some of the specific issues and barriers that confront the paper industry as they pursue beneficial use initiatives will result in the development of strategies to overcome the barriers.

The New York State DEC has recognized this need and has stated a commitment "to working with businesses and the public to develop the most sensible and cost effective regulations for reducing pollution." The DEC report titled "Improving Our Environment, Improving Our Economy - Regulatory Reform at the Department of Environmental Conservation" published in July, 1994 (6), notes that:

DEC's regulatory program has evolved over time to incorporate state and federal laws enacted to protect the environment our water is cleaner, our air is healthier and past damage is being remediated. At the same time, environmental regulation, while improving the quality of life for New Yorkers as a whole, must be done in a way that is sensitive to potential economic impacts, as individuals, businesses and other regulated entities comply with a complex matrix of laws and regulations. The New York State DEC is also committed to achieve maximum environmental protection as directed by law in an efficient and effective manner.

One of the tasks conducted during the period of this project was to begin to identify for the DEC some of the regulatory obstacles that confronted companies engaged in beneficial reuse technologies. Some of these regulatory obstacles were identified and reviewed with the DEC in late 1994 and early 1995. The DEC agreed that some of the barriers to the reuse of paper mill residuals at other mill facilities should be eliminated because waste reduction and reuse were important goals that the DEC wanted to encourage. Another perceived barrier for paper companies and the commercial beneficial use companies applied to the use of paper mill waste as substitute soils in components of the landfill cap. Confusion existed in the regulated community as to whether such projects were recognized and could be approved by the DEC.

Highlighted below are two specific regulatory issues that the DEC has addressed and/or clarified for New York's paper mills. This cooperative effort between the DEC and the paper mills has helped to reduced barriers to the development of alternative beneficial use technologies. Following that is a discussion of some existing barriers to the beneficial use of paper mill waste treatment plant residuals.

In addition, in 1995, the DEC approved three RD&D projects for the beneficial use of paper mill residuals referenced in this report. The three projects are: 1) mined land reclamation with tree plantings and land-applied residuals in trenches at an iron ore tailings wastepile; 2) evaluations into the use of high-ash paper mill residuals as a landfill barrier layer; and 3) the evaluation of dried paper mill residuals from a number of recycled mills for use as a substitute cattle animal bedding material.

DEC ELIMINATION OF BARRIERS TO FIBER REUSE PROGRAMS:

Issue: In the past 7 years, fiber generated by one New York State mill could not be used as a raw material fiber source at another mill without securing either a beneficial use determination (BUD) for the fiber or a special Part 364 Waste Hauling permit for the fiber. The time and expense associated with obtaining a BUD under the Part 360 Solid Waste Management Regulations can discourage a mill from exploring reuse opportunities which reduces the quantity of waste disposed of in a landfill facility. Also, limiting the transportation of reusable fibrous paper residuals to haulers licensed under Part 364 significantly increases the costs of transportation. Currently, the Part 364 rules contain a variety of exemptions (Part 364.1(e)(2)(vi)) for secondary materials being transported including rubber, paper, cardboard, wood chips, glass, etc., but not for fibrous residuals.

Status of the Barrier: As a result of the cooperative efforts of BES Technologies, the project sponsors, and the DEC, a policy is being prepared by the DEC that would exempt from Part 364 Waste Hauling permit regulations paper mill residuals that is transported and beneficially reused as a raw material fiber source at another paper mill facility. Such programs would also not require the completion of a detailed BUD. This policy change will provide the mills with the same flexibility they have with other raw materials in that the pulp fiber can be transported by a common carrier. As a result, paper mill residuals will become

a more cost effective substitute for virgin or deinked/recycled raw material. In addition, the DEC may exempt any paper mill that has a BUD from having to use a truck with a Part 364 permit to transport their residuals to any beneficial use processing facility.

REDUCTION OF BARRIERS TO THE USE OF RESIDUALS FOR LANDFILL COVER COMPONENTS

Issue: Prior to October 9, 1993, when the Part 360 regulations were revised, paper mill and commercial beneficial use companies interested in using paper mill residuals had to petition the DEC for a beneficial use determination for landfill capping purposes.

Status of the Barrier: After October 9, 1993, the DEC revised their Part 360 Solid Waste Management Regulations and the BUD requirements (6 NYCRR 360 - 1.15 (b)(10)) to allow the use of approved solid wastes in "landfill liner or final cover system components" projects as part of an approved closure plan. Many mills and commercial firms surveyed as part of this research report were not aware of this change in the regulations. As mentioned earlier regarding approved RD&D projects, paper mill residuals have now been considered for a number of state evaluations as a substitute barrier soil (clay) layer. Other potential applications for paper mill residuals include contour grading in the landfill and use in the barrier protection layer (the 2-foot layer of soil that protects the clay below it from freeze-thaw cycles).

CONTINUED BARRIERS TO THE IMPLEMENTATION OF BENEFICIAL USE TECHNOLOGIES

As noted above, progress has been made in reducing a number of the barriers that paper mills and commercial beneficial use companies have faced in New York. Some additional issues and concerns identified as part of this project are discussed in the following pages.

Testing Requirements And Criteria For Land Application Projects

Issue: Paper mill and commercial beneficial use companies remain concerned that projects they propose or implement that involve placing paper mill byproducts upon land (whether directly or indirectly after no biological processing and/or use) have to meet overly strict regulatory standards. Any use involving the land application of paper mill residuals are subject to the Subpart 4 provisions of DEC's Part 360 regulations. The BUD process is not relevant under such circumstances.

In the past, the DEC has required that the paper mill residuals or soil substitute products for land application be tested for an array of chemicals using the toxicity characteristic leaching procedure (TCLP). The liquid extract from the material is analyzed for the chemicals of concern and the concentrations had to be below the level for groundwater. If there was a "pollutant at a concentration of concern," which meant any chemical concentration that

exceeded the groundwater standard, the DEC could deny permission to apply the paper mill material. Iron concentrations often were too high to pass this test.

New York was the only state in the nation that compared the TCLP extract for proposed projects or actual samples from beneficial use projects that had been constructed to groundwater standards. Such a comparison applied regardless of the type of beneficial use technology, the land application rates, or the location/placement of the finished beneficial use product. Many natural materials or commercial products used/brought into the state could fail this strict criteria; i.e., some naturally occurring regional groundwater could fail the standard for iron, natural quarry materials, inorganic fertilizers, and other materials could have concentrations in excess of groundwater standards. By subjecting products manufactured in New York State containing paper mill residuals to additional scrutiny compared to products brought into the state, the DEC could be unduly burdening the New York companies without any actual benefit to the environment.

The beneficial use projects that impacted by the DEC groundwater standard comparison at the central office or regional level have included mine or gravel pit land reclamation projects, other types of engineered soil substitute projects, uses of blended residuals on farm land, the land spreading of used animal bedding made from paper mill residuals, hydroseeding and mulch projects, and the use of residuals as a substitute clay cap.

It should be noted that paper mill residuals that have first been composted have not been subject to the TCLP extract comparison but to a shorter list of chemicals that are much less restrictive than groundwater concentrations standards. This is because composted paper mill residuals are stabilized and the mobility of the chemicals is less than with land-applied material. But many successful projects have been demonstrated throughout the country where paper mill residuals are an admixture to soil and other materials. In New York State, paper mill residuals that are land-applied rather than composted are viewed as an environmental concern and significant regulatory testing can be encountered.

Potential Alternatives/Solutions:

- Establish a set of product specifications that a non-composted, paper mill residual/soil/nutrient admixture must meet in order to be applied to the land in New York State that is clearer and less restrictive than the criteria in Part 360-4.2 of the Solid Waste Regulations. Simplify the permit application and operational criteria found in sections 360-4.6 and 4.7 when applied to admixtures using non-hazardous paper mill residuals.
- For paper mill projects, test the paper mill waste materials after processing into a product and/or its use, but prior to land application. Compare the test results of the new beneficial material to the commercial product it is displacing/replacing to ensure it not creating greater harm or threat to human health or the environment. If the concentrations of the chemical parameter in the paper residuals are not statistically different than the commercial product, the application for the paper mill material should be approved. If

the paper mill residual cannot meet the chemical criteria, the DEC could evaluate whether the parameter of concern causes a significant health risk using a realistic exposure route for the actual use of the finished product (modeling).

BENEFICIAL USES ARE CONSIDERED ON A CASE-BY-CASE BASIS

Issue: The case-by-case BUD process is potentially expensive and does not lend itself to broader application by other mills interested in the beneficial use activity. The DEC can require every paper mill to qualify a beneficial product at each individual point of production. Other paper mills with similar materials each have to go through the complete BUD process to obtain an approval for the same product. This need to obtain a case-by-case BUD, however, presents a significant barrier to entering a market. If the DEC were to have in place flexible guidelines for review and agreement to generic or pre-determined BUDs for certain land application uses, the cost of developing markets could be reduced. The DEC currently provides for a predetermined BUD for the use of compost and other distribution and marketing (D&M) products that are produced for reuse in a manner similar to composting. The department has not identified specific standards for D&M products.

Potential Solution:

- Well-established mills or companies in the state with a good record of environmental compliance should be able to complete a simple registration process to obtain approval for a beneficial use that has been proven by existing research/data from other mills, beneficial reuse companies, or organizations, or for which a BUD has been granted. If a particular technology using paper mill residuals is developed and found effective in other parts of the country or world, the DEC should review such information for its acceptability and applicability to the circumstances in New York. The DEC should not require companies to repeat research or generate data already available if that information has relevance to the beneficial use under review for New York.

UNIQUE/NEW BENEFICIAL USE PROJECTS CAN BE DIFFICULT TO PERMIT AND IMPLEMENT

Issue: Projects that are innovative and do not fit a particular solid waste management activity can generate a long list of questions and requirements by the DEC and encounter delays in implementation. For example, projects using a drying process on paper mill residuals may be subject to incinerator requirements under Part 360-3; a commercial facility producing cement/clay products from paper mill residuals for landfill caps may have to also meet Part 360 - 11 or 360-12 Storage, Part 360 - 3 incinerator requirements, as well as Part 220 Portland Cement Plant and Part 231 New Source Review requirements. DEC regulators are under significant pressure in these situations to over-regulate because of concerns that a problem may occur or that their decision would be challenged in court.

Potential Solutions:

- Project applicants and DEC regulators should have early and regular meetings at the planning stage to identify the requirements of new, innovative technologies. Instead of a standard regulatory/enforcement approach being use, a customer/partnership approach tapping into the DEC's broad expertise in the regulations and their technical expertise could facilitate the development of these new technologies.

Section 5 RECOMMENDATIONS

The paper industry is very diverse in the means and methods it uses to obtain its fiber and to produce the variety of grades of paper. Materials such as fiber and filler clay that cannot be retained in the sheet of paper eventually gets discharged to the mill's drains and waste processing equipment. Here again there is a broad range of treatment systems producing paper mill wastes with diverse characteristics. Institutions, commercial firms, and industry personnel have sought technologies that can convert these wastes into value-added by-products for beneficial use.

Efforts by state agencies and the paper industry itself should focus on the following visions, strategies, approaches, and/or technologies for the beneficial use of paper mill wastes:

- Consistent with the state DEC's solid waste management hierarchy of solid waste management actions (waste source reduction should be conducted before reuse, incineration, or finally landfilling), New York paper mills should continue to implement internal measures to reduce fiber and filler clay losses.
- New York State agencies should reduce any existing barriers to the successful transfer of usable fiber and clay from one mill to another. Fiber transfer can produce significant cost savings to both the generating and consuming mill in need of raw material.
- Opportunities to improve/upgrade the paper mill residuals dewatering capabilities at the mill's waste treatment plant operation should be promoted by those associated with the industry even if the material is not slated to be beneficially reused. All mills are not located in close proximity to plant locations that can dispose of wastes or facilities that can beneficially reuse the paper mill residues. Transportation of large quantities of moisture from the treatment/dewatering plant solids is not very efficient for the mills or the commercial firms.
- Technologies that can cost-effectively dry a waste material from a paper mill should be supported with additional RD&D effort as these technologies can open up a broad spectrum of successful beneficial use opportunities. Beneficial use technologies that have the potential for using large quantities of a variety of paper mill residuals include animal bedding, fuel pellets, cement products, and clay recovery for landfill caps.
- For a number of the higher capital cost technologies, such as lightweight aggregate, cement production, and recovery of clays for landfill caps, residuals from multiple mills are needed to support a full-scale facility. This is because a small plant can be as expensive to build and operate as a large-scale facility (economies-of-scale). As a result, a regional approach is recommended to combine the small-to-medium waste quantities from New York paper mills that have solid waste disposal problems.

- State support for the construction of regional drying facilities would serve as a springboard for the successful development of a number of beneficial use technologies that require dry waste for processing or use. These plants would provide flexibility in directing the paper mill residuals to the products with the greatest market potential.
- Less complex beneficial use technologies (such as animal bedding, synthetic soil, or barrier clay production) or lower capital cost facilities (clays from a rotary kiln for landfill clay cap purposes) should be developed further and demonstrated in New York. They have a higher probability of being accepted by the paper mills, which tend to resist complex, high-cost technologies. Also, the simpler technologies are more likely to require lower operating costs and result in reduced tipping fee charges to the mills involved in the technology.
- Research and development should be conducted on compost product specifications to benefit small producers of a variety of paper mill residuals. Composting paper mill residuals on a large scale is more complex and expensive than generally believed and requires further understanding of the correct ratios of carbon and nitrogen needed from all materials before widespread composting can become commercially viable.
- State agencies, commercial beneficial use firms, and the paper industry should continue their emphasis on opportunities and outstanding barriers identified in this report. The momentum generated during the past few years will lead to further exchanges of ideas and opportunities to improve the economy and environment. An annual update of progress and a report on the issues that remain would help focus the attention of the agencies, paper companies, and the beneficial use technology firms.

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Section 7 GLOSSARY

PULP AND PAPER MILL TERMS

Broke: Partly or completely manufactured paper that does not leave the paper machines as saleable paper or paperboard; also, paper damaged in finishing operations such as rewinding rolls, cutting, and trimming.

Flotation Device/Clarifier or Thickener: A primary device used to increase the solids content of a process/wastewater stream. There are two types of flotation savealls: those that operate under reduced pressure and those that operate under atmospheric pressure. The air forms very fine bubbles that become attached to suspended fibers and clay particles, carrying them to the surface. The mechanical scraper skims the floating floc from the clear liquid.

Groundwood Pulp/Process: Process of producing pulp by reducing logs or chips into their fiber components by the use of mechanical energy and/or chemicals and heat via grinding stones or refiners.

Integrated Mill: A mill that produces some or all of its pulp and may use some or all of that pulp (in combination with purchased virgin or recycled pulp/fiber) to produce paper or paperboard products.

Kraft Pulp/Process: Pulping process used to produce fibrous, cellulose material by chemically reducing wood chips in a pressurized vessel (digester). Also referred to as the sulfate process.

Non-integrated Mill: A mill that produces none of its own pulp onsite, but it produces paper (board) from purchased virgin or recycled pulp fiber.

Pre-Consumer Fiber: Examples include solid bleached sulfate (SBS) from offsite converting operations, but do not include onsite mill broke.

Recycled Fiber (Same as Secondary / Recovered Fiber): Fiber furnish consisting of recovered fibrous paper or paperboard known also in the regulatory community as post-consumer material. Common types include:

Mixed paper: mixed office waste (MOW) and old magazines (OMG)

Old newsprint (ONP): is old newspapers

Old corrugated containers (OCC): old cardboard boxes

High grade deinking (HDI): fiber would typically be deinked or reclaimed computer and laser papers

Pulp substitutes (PSubs): baled/rolled trimmings from perfect bound books or softwood bleached sulfate (SBS) sources

Saleable Production: Refers to the finished paper produced by a mill after cutting /trimming the roll to size and removing any off-quality, off-specification paper. It represents paper that is ready for sale and is expressed in tons of production per day.

Saveall: Savealls are the primary dewatering devices used to remove reusable fibers and fillers from the process water; typically used on each paper machine. Many different types are used in the industry, including drum filters, flotation devices, and disc filters.

Sulfite Pulp/Process: An acid pulp manufacturing process in which wood chips are reduced to individual, fibrous components by cooking in a pressurized vessel using chemical solutions such as calcium, sodium, magnesium, or ammonium salts of sulfurous acid.

Virgin Pulp: Pulp produced directly from cellulose fiber and not from any recycled fiber.

SOLID WASTE AND TREATMENT PLANT TERMS

By-products - Materials resulting from a beneficial use process that may be sold or given away for incorporation into products. Examples are contaminated broke converted into refuse-derived fuel. It does not include composted waste, even if it is used as a feedstock for further processing.

Company Landfill - A landfill owned by a company and available for the storage of waste material.

Compost(ing) - A process by which biodegradation of the material is deliberately encouraged. Compost wastes do not include byproduct or unprocessed wastes, even if it is eventually distributed or used as a feedstock for further processing. A composting facility is a solid waste management facility used to provide aerobic, thermophilic decomposition of solid organic constituents of solid waste to produce a stable, humus-like material.

Hazardous Waste - A waste failing the TCLP criteria and that must be taken to a permitted hazardous waste treatment or disposal facility. If the material is processed into a fuel, see "by-products."

Incineration - Incineration in any form, whether it be in company-owned facilities or not.

Land Application or Land Spreading - Spreading paper mill waste onto land or incorporating it into the soil for any purpose (other than landfilling), including agriculture, forest production, and land reclamation.

Lagoon or Surface Impoundment - The disposal of a waste by pumping it into a basin.

Normally, the supernatant from lagoons is returned to the waste treatment plant.

Municipal Landfill - A landfill that also serves community solid waste management needs by receiving municipal or commercial solid waste. The landfill may be either privately or publicly owned. It does not include disposal in a company-owned landfill that also receive municipal waste.

Private or Other Landfill - This means placement of materials in a landfill owned by someone other than a company that receives no municipal solid waste but which may receive wastes from other industries.

SELECTED REGULATORY DEFINITIONS, BENEFICIAL USE PRODUCTS, OR TECHNOLOGIES

Artificial or Substitute Soil: Paper mill residuals mixed with sand, clay, and/or other soils to produce a replacement (top)soil.

Animal Bedding: Dried mill solids used as bedding for livestock, chickens, etc.

Animal Feed: Paper mill solids and other additives used as a feed supplement for animals.

Building Materials: Paper mill residuals mixed with gypsum and particleboard materials to make drywall and/or panels.

Cementitious Products: Wet solids added to Portland cement and aggregate to produce products for sale.

Chemical Products: Paper mill solids that are processed/converted to chemicals such as ethanol, levulinic acid, etc.

Cat Litter: Absorbents made from paper mill solids used as cat litter products.

Daily Cover: A compacted layer of at least 6 inches of cover material that is placed on all exposed solid waste at the end of each working day of operation at a landfill.

Disposal facility: A solid waste management facility or part of one in or on which solid waste is intentionally placed, including any land or water, and at which solid waste will remain after closure.

Export Fiber or Fiber Reuse: Paper mill solids that are shipped to another mill facility (in or out of the US) for reuse/reclaiming and that serves as a raw material for paper production.

Final cover: An engineered layer of materials approved by the DEC that is placed on any surface of a landfill where no additional solid waste will be deposited within 1 year. It serves to restrict infiltration, support vegetation, control landfill gas, and promote surface drainage.

Hydroseeding: Paper mill solids used as substitutes for newspaper/sawdust for grass seeding/landscaping purposes.

Incinerator: An enclosed device using controlled flame combustion to thermally break down solid waste, including refuse-derived fuel, to an ash residue that contains little or no combustible materials.

Intermediate cover: A compacted layer with at least 12 inches of cover material, unless otherwise approved by the DEC, placed where no additional solid waste has been deposited or will be deposited within a period of 30 days.

Landfill Cover: Paper mill solids used as a daily or intermediate cover at a landfill (not the company's own landfill)

Molded Products: Fibrous paper mill solids pressed into various product shapes (egg cartons, flower pots, etc.) for sale

Monofill: A landfill or landfill cell into which only one type of waste, as recognized by the DEC, is placed.

Mulch: Biosolids blended with bark, sawdust and/or other wood debris and used for landscaping.

Oil Absorbents: Solids that are dried and converted to absorbents for recovery/cleanup of oil spills.

Paper Mill Residuals(Sludge): Any solid, semi-solid or liquid waste generated from a paper mill wastewater treatment plant, but does not include the treated effluent from the plant.

Publicly Owned Treatment Works (POTW): Any device or system (including recycling and reclamation) used in the treatment of municipal sewage or industrial wastes of a liquid nature that is owned by a state or municipality (as defined in Section 502(4) of the Federal Water Pollution Control Act, as amended; see Section 360-1.3 of the NYCRR Part 360 regulations). This definition includes sewers, pipes, or other conveyances only if they convey wastewater to a publicly owned treatment works providing treatment.

Recyclable: Solids that exhibit the potential to be used repeatedly.

Recycle: To use recyclables in manufacturing a product.

Refuse-Derived Fuel: Treated solid waste that is used as a fuel. Off-products of pyrolysis are not considered refuse-derived fuel.

Refuse-Derived Fuel Processing Facility: The combination of structures, machinery or devices utilized to reduce or alter the volume of mixed solid waste before delivery to a solid waste incinerator or pyrolysis facility.

Rotary Kiln Feed: Biosolids added to the input to a cement kiln to recover energy and reuse filler clays.

Routine Parameters: The standard chemical species or other samples listed in the Routine Parameters Table of the Water Quality Analysis Tables in paragraph 360-2.11(d)(6) of NYSDEC Part 360 Regulations.

Site: The geographically contiguous property of a solid waste management facility; includes the land area of that facility and its access roads, appurtenances, and land buffer areas.

Stabilized residuals: Residuals that has been digested or otherwise treated to reduce putrescibility and odor, reduce pathogenic organisms and, except for lime stabilization, reduce the volatile solids content.

Toxic Characteristic Leaching Procedure (TCLP): A lab test method that evaluates the mobility of both organic and inorganic chemicals present in liquid, solid, and mixtures of waste. It is intended to identify those wastes that pose an environmental hazard due to their potential to leach significant concentrations of specific toxic constituents. If the concentrations exceed a particular level, the solid waste is considered hazardous. The procedure is generally used to predict the leaching potential of a given waste under a worst-case scenario.

Transporter: A person engaged in the offsite transportation of any solid waste by air, rail, highway, or water.

Treatment: Any method, technique, or process designed to change the physical, chemical, or biological character or composition of any solid waste to recover energy or materials from it, to render it safer to transport, store, or dispose of, or to make it amenable for reuse, recovery, storage, or reduction in volume.

Appendix A

PULPING AND PAPER/BOARD MANUFACTURING PROCESSES

A short review of the pulping and paper/board manufacturing process is warranted in order to discuss waste treatment, solids management, and dewatering in its proper context. Some pulp and paper mill wastes are easier to dewater than others because of the way they are produced, the form they are in, the nature of the fiber feedstocks, and the amount of the additives in the paper making process. The American Forest and Paper Association (AFPA) reported that the US pulp and paper industry produced, in 1992, almost 91 million tons of pulp by the following processes: a) chemical pulping (60.3 percent); b) mechanical pulping (7.2 percent); c) secondary fiber pulping (28.0 percent); and d) semi-chemical pulping (4.5 percent) (A1).

Examples of chemical pulping are the kraft, soda and sulfite processes. The wood pulp (usually in chip form) is produced by using concentrated cooking chemical solutions under controlled temperature and pressure to yield the individual cellulose fibers necessary for making the various grades of paper. The cooking operation can be performed in a batch or continuous process. Kraft pulping generates some unique types of solid wastes, such as slaker grits, unburned lime rejects from a kiln, and green liquor dregs.

Mechanical pulping is conducted by mechanical energy to separate the wood fibers, with some or no use of chemicals and moderate or no use of heat. Mechanical pulping processes include stone groundwood, refiner mechanical, thermo-mechanical, chemi-mechanical, and chemi-thermo-mechanical (A1). The pulp yields are high (less solid wastes produced compared to the kraft process), but the fiber strength is low (like newsprint paper). If stronger paper is needed, mechanical pulp is supplemented with kraft fiber. Groundwood pulps are more difficult to dewater than the individual, longer softwood, and hardwood fibers from the kraft (chemical) processes. This is partially caused by the short fibers/fragments, high lignin (chemical glue), and poor settling characteristics of some mechanical pulps produced by the stone groundwood process.

Secondary fiber processing includes all pulping/processing operations performed to repulp secondary fiber and remove contaminants. Common contaminants include ink, adhesive and coatings, polystyrene foam, plastic chips, plastic tape and pressure sensitive glues, waxes, and synthetic fibers. The types of secondary fiber processing operations performed depend upon the grade of waste paper or paperboard processed and the desired finished product. For example, envelope trimmings or waste fiber from another mill may require simple repulping and minimal contaminant removal. This high-grade secondary fiber is used in place of virgin market pulp to manufacture a variety of products. Recycled post-consumer newspaper, on the other hand, may require extensive contaminant removal, including deinking, prior to reuse in manufacturing various grades of fiber containing recycled, secondary fiber (A1).

NCASI notes that if mills that deink are compared with those that directly repulp paper and paperboard, the solid waste management practices for the repulping facility are straightforward. One-half or more of the recycled paperboard mills reuse primary residuals directly in the production process (A2). The deinking process uses surfactants, including detergents and dispersants, to remove the ink particles from the surface of the fiber in washers and/or flotation. The pulping and deinking process produces residuals that are relatively high in inorganic (ash) loadings. The ash content of a primary deinked residuals can be highly variable and range from 25 to 70 percent. Residuals from mills that deink newsprint have a low ash content, whereas those from fine paper or tissue mills are in the higher range (A3). Generally, the higher the ash content, the harder it is to dewater. Some dewatering processes can be improved by higher ash levels, so generalities must give way to actual evaluations of dewatering performance with pilot- scale units.

Appendix A

REFERENCES

- A1. U. S. Environmental Protection Agency. Engineering & Analysis Division, "Development document for proposed effluent limitations guidelines and standards for the pulp, paper and paperboard point source category". Office of Water, Report # 821-R-93-019. Washington, D.C., October, 1993.
- A2. National Council of the Paper Industry for Air and Stream Improvement. "Characterization of wastes and emissions from mills using recycled fiber". Technical Bulletin 613, NCASI. New York, September 1992.
- A3. National Council of the Paper Industry for Air and Stream Improvement. "Progress in reducing water use and wastewater loads in the U.S. paper industry". Technical Bulletin 603, NCASI. New York, February 1991.

Appendix B

WASTE TREATMENT PRACTICES IN THE PAPER INDUSTRY

With the development of intense environmental awareness in the United States in the early 1970s, most members of the pulp and paper industry installed new primary wastewater treatment facilities to protect the quality of the rivers and streams where they were located. In 1977, the federal government required the industry to comply with even stricter standards for wastewater. Most mills had to have some form of secondary (biological treatment) or to join forces with a municipality to make use of their treatment system (publicly owned treatment works - POTW). These environmental laws led to a need to find locations for the disposal of primary and/or secondary residuals produced from those facilities.

NCASI reported in 1983 (B1) that the 180 mills responding to a survey generated 2,870 tons per day (bone dry basis) of primary treatment plant residuals, 190 tons per day of secondary (biological) residuals, and 1,800 tons per day of combined (primary and secondary) residuals per day.

PRIMARY SOLIDS TREATMENT METHODS

The alternative methods used in primary solids recovery and/or to concentrate (thicken) the residuals more and decrease the moisture content include: 1) screening the materials; 2) flotation thickeners, savealls, or clarifiers; 3) settling ponds or lagoons; and 4) gravity thickeners or clarifiers. The screening method for solids recovery/removal is generally designed for in-mill fiber/clay separation and reuse of the material in the paper or board making operation. Screening systems can be subject to blinding and plugging with fines unless proper safeguards are used in their design and installation (B2).

Inside a number of mills, dissolved air flotation thickeners or clarifiers are used to collect the light fiber and clay particles in the mills drains and wastewater streams. Air that is under pressure is mixed with the liquid entering the bottom of a tank or clarifier. Small bubbles become attached to the suspended solids and float the particles to the surface. The floating solids are then skimmed off for reuse or disposal. Flotation equipment can typically fit in very small areas but can be high in cost and maintenance and are severely affected by changes in flow and solids loading (B2).

Where space is not at a premium, settling ponds or lagoons are used for solids recovery or thickening. These large (tens to hundreds of acres in size) and quiescent systems allow the solids to settle and the liquid to overflow the opposite end for subsequent biological treatment. The settled fiber and clay in the system must be periodically dredged every few years to allow room for more solids handling.

Many US paper mills have a mechanically cleaned clarifier consisting of a large (up to 150-foot) circular concrete tank with a bottom scrapper to collect the mill solids. The

settled residuals are raked to the center of the tank and pumped out for further dewatering. The detention time in this clarification process can range from 0.1 to 0.5 days. Mills with no subsequent biological treatment reported in the EPA's survey of the industry in 1990 (B3) that they had larger clarifiers with slightly longer detention times than mills with biological treatment.

SECONDARY SOLIDS TREATMENT METHODS

Some mills must provide for their own secondary treatment rather than send it to a POTW. Secondary (biological) treatment is required to consume the organic compounds that are found in mill wastewater that could otherwise deplete the oxygen and be toxic to aquatic life in the waterways. Some of the various biological treatment systems used in the pulp and paper industry include: 1) trickling filter system; 2) rotating biological surface (RBS) system; 3) aerated stabilization basins; and/or 4) activated sludge system. Another treatment process involving anaerobic digestion (B4)(B5) of paper mill residuals will also be discussed briefly.

The trickling filter device and the RBS system depend upon the buildup of a biological film on a plastic media or rotating screen to remove the organic materials in the wastewater. The aerated stabilization basins or lagoons consist of floating or submerged devices (aerators) that add oxygen and create a dispersed-growth of biological organisms in the wastewater that provides necessary treatment. The effluent typically stays in the lagoon or basin for 5-10 days before it reaches the river. High removal rates for organic material are achieved but some secondary biological solids are produced; these must be disposed of through some dewatering device. As with the settling lagoon (primary treatment), large acreage can be involved (tens to hundreds of acres).

Where space is limited and high treatment effectiveness is still required, the activated sludge process is used. The effluent for a primary clarification device is typically aerated in a tank or small lagoon, with the solids later separated in a secondary clarifier. Some of the biological solids are recycled back through to the aerated tank and the remainder removed from the clarifier and sent to a dewatering device for processing.

The ability to dewater the paper mill residuals produced from these treatment processes previously can vary considerably in their characteristics. The variability can be affected by the type of pulp and paper manufactured and its waste discharges, and whether the residuals consist of just primary solids, secondary solids only, or are a combination of both primary and secondary.

METHODS OF DEWATERING PAPER MILL RESIDUALS

The overall issue of dewaterability is important because it determines the volume of waste to be handled by other waste treatment plant operations. The more amenable the residuals are to dewatering, the smaller the volume of waste to be handled and the lower the

operating and disposal costs for the facility. Primary residuals with a high fiber content and low ash level is the easiest material to dewater.

According to a survey conducted for the EPA (3), the solids content of primary sludges ranges from 1 to 6 percent. Biological sludges (regardless of what type of secondary treatment process) are lower and vary from 0.3 to 2.2 percent solids content. While BES Technologies has had experience with secondary sludges in the 3-4 percent range, the main point is that biological sludge is more difficult to dewater. These secondary biosolids often have to be blended with primary sludge (if they cannot be used individually in some beneficial use application) to improve opportunities for cost-effective dewatering.

Waste treatment plant residuals are preconditioned by adding long-chained chemical polymers or other compounds to coagulate and flocculate the primary and secondary solids. Following this preconditioning stage is the major dewatering operation. The types of dewatering equipment used in the pulp and paper industry include: 1) vacuum coil filters; 2) plate-and-frame presses; 3) belt filter presses; 4) screw presses; or 5) combinations of these dewatering devices.

The vacuum (coil) filters were prevalent in the 1970s for facilities that needed a higher solids content (20 to 25 percent) than they could achieve with floatation thickeners (typically up to only 10 percent). The vacuum filter consists of a horizontal cylinder with steel ends and the circumference covered with fabric or steel coils close together. The lower third of the horizontal cylinder is submerged in the slurry solids being dewatered and air (vacuum) is drawn from the inside of the cylinder. As the cylinder rotates, the fibrous solids coats the outside of the fabric or coil surface and a full vacuum develops. Water is continuously removed from the inside of the cylinder and the thick solids mat is scraped from the coil surface onto a conveyor for disposal or processing on a second unit.

Some small mills without a vacuum filter may take their solids from the DAF units and process it through a mechanical plate-and-frame type press to reduce the water content for disposal or subsequent uses. The plate-and-frame filter press was developed in Europe and Japan and operates on the principle of pressure filtration. Several vertical plates are mounted on a frame in a horizontal plane. When horizontal pressure is applied, the plates lock together forming a group. A filter fabric/screen is located on the face of each plate forming a continuous filter envelope within each plate. Residuals are fed through a horizontal pipeline and enter each plate or filter envelope. As the slurried sludge is pressurized, water is forced out through the filter cloth and collected in the filtrate pipe with the residuals collecting on the filter screen. After a period of time, the pressure is released, the plates are separated, and the paper mill residuals drop into a hopper for disposal.

During the 1980s, many mills installed the popular twin belt filter press where preconditioned paper mill residuals are applied to the lower section of a porous traveling fabric. Water drains by gravity from the residuals and then the solids are sandwiched

between a top traveling fabric. Low-pressure compaction squeezes out additional water through both the top and bottom fabrics. The residuals then travel into a high pressure zone. This zone typically has a series of opposing rolls with top and bottom fabrics and the residual cake in between. The press cake is then scraped off and transferred away.

The residual solids can be anywhere from 25-40 percent bone dry solids content, depending upon the fiber to clay/ash content and the ratio of primary to secondary residuals. The twin belt press is continuous and is able to handle a higher amount of solids than a coil filter with less operator attention. The fabrics are subject to wear, tear, and blinding and may have to be changed every 2-3 to three months.

Screw presses have been replacing the belt presses in the later 1980s and the 1990s as the preferred method of dewatering primary or blended residuals containing high percentages of biological solids. The screw press is a positive displacement mechanical dewatering device. It consists of a spiral flight on the exterior of a rotating shaft surrounded by a cylindrical screened section. As low consistency residuals are fed into the inlet hopper, it goes through the initial stage of the screw press with minimal pressure being applied. The residuals continue to travel down the exterior of the spiral screw and water is gradually pressed through the perforated screened cylinder on the outside. The screw flighting diameter remains constant throughout the entire shaft length (up to 45 feet long), but the screw shaft itself is tapered. That widening taper from the feed end forces the residuals to become more and more compact and dryer as the plug is being formed. Depending upon the desired dryness, steam heat can be applied from inside the screw shaft improving dryness an additional 5 percent solids to as much as 50 percent bone dry solids.

Results of studies by NCASI (B6) indicate that a variety of residuals can be dewatered, ranging from primary solids to combined primary and secondary wastes containing as much as 60 percent biological solids. Press throughput ranged from only 3 bone dry tons for small screw presses to 60 dry tons per day for the larger units. The cake consistency from the screw presses average about 42 percent solids. In general, the screw presses require less maintenance than other types of dewatering processes.

METHODS USED BY THE PAPER INDUSTRY TO DISPOSE OF ITS RESIDUALS

Numerous methods are used by the pulp and paper industry to dispose of dewatered residuals, including: 1) landfilling; 2) surface impoundment; and 3) incineration. Landfilling is the primary method of residuals disposal used by the industry. During 1988-89, NCASI (B7) surveyed its member mills and obtained an update on a prior survey (1979) of paper industry residual management practices. The responses to the survey represented about two-thirds of the industry's total production of paper, paperboard, and market pulp. In 1989, the amounts of residuals being landfilled or lagooned accounted for 77 percent of the total, compared to 89 percent in 1979. Reliance on incineration for disposal had doubled to over 23 percent of the total.

Landfills

The EPA survey (B3) of 305 mills conducted in 1990 found that more than 67 percent of all mills disposed of their residuals in company-owned, municipal or commercial landfills.

Surface impoundments were used by about 19 percent of the mills and incineration by 14 percent of the facilities. For both the NCASI and EPA surveys, some mills reported other disposal methods that they used. These mills were not included in the statistics of this report because the methods listed as disposal (i.e., land application, saleable byproducts, recycle to the process, and composting) are considered beneficial uses of paper mill residuals. In fact, in NCASI's 1989 report entitled "Progress in Reducing Water Use And Wastewater Loads in the U.S. Paper Industry" (B8), the information referenced the disposition of wastewater treatment plant sludges for the paper industry rather than disposal. The report indicated "the industry is relying less on landfill or lagoon disposal and more on burning for energy, applying to land for soil conditioning, and other recycle/reuse/byproduct opportunities that represent beneficial uses of wastewater treatment sludges." The various beneficial uses of paper mill residuals are discussed in the main section of this report.

While landfilling is widely used in the US by the paper industry, new landfill construction projects are rare. It is becoming more difficult to overcome public opposition in order to design, build, and operate landfills in any state. Disposal requirements of pulp and paper mill wastes in New York are among the most strict in the country. In 1964, there were about 1600 landfills/dumpsites in New York that were taking municipal and industrial wastes. By 1988, there were 288 landfills in the state accepting solid wastes. Of these, there were only 51 that had permits to continue operation, 9 were under orders to upgrade, 137 were under legal consent order for closure, and 91 were awaiting regulatory enforcement actions (9). The number of landfills projected to be in use in 1995 was down to only 40!

In New York, landfills are regulated by the DEC, through Part 360 - Subpart 2 of the Solid Waste Management Facilities regulations. These regulations define the requirements for private, public, and commercial landfill facilities in the state. Section 360-2.14 applies to Industrial/commercial waste monofills and solid waste incinerator ash residue monofills.

Briefly, paragraph 360-2.14(a)(2) notes that paper mill residual monofills must have as a minimum:

- (a) A single composite liner system consisting of a minimum of 60-mil HDPE (high density polyethylene) geomembrane placed directly above a 2-foot layer of low permeability clay. A 2-foot thick leachate collection and removal system must be located over the liner.

- (b) At the time of landfill closure, a single composite cover (consisting of 18 inches of low permeability clay) and a 60-mil HDPE top cover followed by 2 feet of barrier protection soil (for freeze-thaw protection of the clay cover), and finally a topsoil layer of 6 inches. A gas venting layer between the paper mill waste in the landfill and the composite clay cap may not be needed.
- (c) Paper mill residuals placed in the landfill must be dewatered to at least 20 percent solids with no free liquid. Daily cover (6 inches) on all exposed surfaces of paper mill wastes may not be required at the end of each operating day if a waiver is granted by the DEC. If a section of landfill is not to be used for 30 days, an intermediate cover of soil (12 inches) must be placed over the wastes. (Paper mills may petition the DEC to have its wastes beneficially reused as intermediate cover on a public or commercial landfill. (See Section 2 on the beneficial use determination (BUD) process.)
- (d) Extensive water quality monitoring requirements apply for paper mill monofills during the operation, closure, and post-closure period (minimum 30-year period after closure).

Surface Impoundment or Lagoon

The placement of paper mill wastes in a surface impoundment or lagoon rather than a landfill typically refers to the disposal of a pumpable fibrous waste into a basin. Then, the liquid (supernatant) that has separated from the heavier fiber in the lagoon water is subsequently directed to other stages of waste treatment, evaporates, or may seep into the subsoil (in the years prior to environmental regulations). The fibrous solid wastes that remain in the lagoon are dredged/removed every few years from the surface impoundment and may then be placed in a landfill or beneficially reused. The potential groundwater contamination and other environmental liabilities from operating a waste lagoon account for the decline in the use of these types of systems. For those facilities that are planning to use these types of impoundments, engineering, design, and construction requirements are almost as stringent as landfills and require clay and/or geomembrane liner systems to prevent groundwater contamination.

Incineration and Energy Recovery

Incineration has been used by many paper mills for solid waste disposal with varying degrees of success. Where this technology has not been properly applied, the mill may see a net loss in the power or steam output from the incinerator or power boiler. In these circumstances, the one benefit to the mill may be in the volume reduction that occurs as the organic material in the feed residuals are burned, leaving only an ash residue. A volume reduction of 50 to 80 percent is not uncommon for many paper mill residuals. The remaining ash must either be disposed of in a landfill or a beneficial use found for the material.

The organic content of the paper mill residuals can represent a significant value for the location. Paper mill residuals are generally poor fuels in the as-received condition because of a poor dewatering operation. Much of the water introduced into the boiler furnace has to be heated and evaporated from the solid waste before combustion of the organic matter can begin. Thus, any increase in moisture content of the fuel will reduce the overall furnace temperature, reduce the heat transfer rate in the boiler, and ultimately decrease boiler efficiency (B10).

Examples of successful incineration and energy recovery follow:

- Mjoberg, et al (B11) have reported that the two main operations in Norwegian paper mill residual incineration are: 1) incineration with bark in bark boilers; and, 2) separate sludge incineration. There is a trend toward replacing bark boilers that now have inclined, traveling grates with fluidized bed bark and sludge boilers. (Tampella Power of Tampere, Finland, supplies a fluidized bed boiler that can use a wide range of fuels such as bark wood wastes, paper mill residuals, peat, municipal refuse derived fuel, bagasse and coal. One such unit is handling up to 100,000 tons per year of combined and deinking residuals at about 63 percent moisture from United Paper Mills in Kaipola, Finland (B12)). For separate residuals incineration, particularly where the solids are low or variable, fluidized or bubbling bed systems are preferred. The fluidized bed boiler can be run with 100 percent paper mill residuals, although the use of some support fuel (e.g., oil or coal) is more common.
- Inland Empire Paper Company (Spokane, Washington) started up an Energy Products, Inc. (EPI of Coeur d'Arline, Idaho) atmospheric fluid bed combustor in June 1992. Inland is a 225 tpd newsprint mill with a deinking plant. The combustor can burn about 69 wet tons per day (30 bone dry tons) of combined primary-secondary (one third of total) and deinking residuals (two thirds), while producing up to 600 gallons per minute of hot water. Emission control begins in the fluid bed with dolomite addition for acid gas capture and is completed in the pulse jet baghouse at the end of the process. It produces about 4 dry tons per day of fly ash. (Another EPI fluid bed combustor (B13) is in operation at Bear Island Paper Company in Ashland, Virginia. It is handling about 32 dry tons per day of paper mill residuals at a feed content of 65 percent solids).

Regardless of the type of incineration system, if the paper mill waste is adequately dewatered and has sufficient organic matter (fiber) for self-combustion in the boiler, incineration can become a net producer of energy. For mill residuals with 20 percent ash, the dry solids content for autogenic (self) combustion is about 45 percent. For deinking residuals (B14) with 50 percent ash, the corresponding dry solids content is about 70 percent. The minimum solids content (B15) at which a low ash residual can be burned is 32 percent, but a more typical minimum solids level is between 40 and 45 percent.

- In a study done at Westvaco's North Charleston mill, thermal efficiencies using residuals as 50 percent of the total fuel content did not affect the overall boiler efficiency. The thermal efficiency of the boiler using bark and fuel oil as fuel sources was shown to be 62 percent, and remained at this level when up to 50 percent bark and 50 percent dewatered residuals was used to fuel the boiler. As the weight percent of residuals in the fuel increased above 50 percent, thermal efficiencies declined due to the high moisture content of the fuel being fed to the boiler (B15).
- NCASI has reported on the use of paper mill residuals which is dried and formed into pellets or briquettes for fuel recovery (B16). The dewatered residuals are taken from a 35 percent solids content to a finished pellet that has been dried to nearly 85 percent solids. Drying increases the compressive strength of the briquettes and enables them to be stored in large piles. They become hydrophobic, enabling them to withstand short exposures to rain when stored in outdoor piles before final use. A pellet or briquette with an ash content of 10 percent has a heating value of 6325 Btu's per pound. (For comparison, the theoretical fuel value of cellulose is about 8800 Btu per pound. Bark at 50 percent solids has a heating value of 4500 Btu/lb. Bituminous coal at a solids content of 93 percent and 10 percent ash level will have an as fired heating value of 11,500 - 12,500 Btu's per pound).
- Wausau Papers (Brokaw, Wisconsin) has a contract with Bio-Technology Inc. to dry and pelletize the combined solids from their 490 ton per day integrated paper mill. Wausau produces 110 tons per day of residuals at 70 percent moisture. The drying and pelletizing process reduces the moisture content of the residuals to 20 percent and the volume of residuals by nearly 40 percent. The pellets (3/8 inch in diameter and about 1 inch long) have been assessed as a possible fuel. Lab analysis has indicated that the pellets have a heat content of 5200 Btu's per pound. Elemental analysis shows no contaminants in the fuel pellet that would prevent it from use as a fuel. Proportions of coal to pellets of up to 85:15 burned acceptably, with 90:10 being the optimal ratio during their trials (B17).

Incineration of paper mill residuals in a boiler typically does not recover the resource value of the ash waste materials that remains. In contrast, the feeding of paper mill residuals into rotary kilns uses the heat content of the organic fiber from the primary residuals and also incorporates the inorganic clay that is present into cementitious product for beneficial use. (See Section 2 thermal oxidation of paper mill residuals).

Pyrolysis and Gasification. Pyrolysis is the process of using heat in an oxygen-deficient atmosphere to physically and chemically decompose organic material. Pyrolysis has been effectively used to convert wood to charcoal, coal to coke, municipal solid waste and paper mill residuals to gas or oil. (The first gasifier/boiler system was installed in the United States in 1986 for power generation and was fueled by dried wood waste.) When applied to paper mill wastes, pyrolysis has produced fuel gas with low Btu value (150 to 200 Btu

per standard cubic foot) or oil, which can be used as supplemental fuel in an existing boiler. Research continues in the area of pyrolysis and commercial companies are preparing to demonstrate its viability for paper mill wastes products throughout the world.

In New York, alternative solid waste fuels fed to an energy recovery incinerator or solid waste pyrolysis unit can be used as long as they have a minimum heating value of 4,000 Btu per pound (as-received). A simple registration of the boiler facility may be required rather than a more complex solid waste incinerator permit. The waste must be nonhazardous, nonputrescible, recognizable, unadulterated, and uncontaminated to proceed with this simple registration process. Fuel pellets made from paper mill residuals would likely meet all of the criteria. The producer of the pellets would need to obtain a BUD petition to make the pellets from the residuals. This would likely satisfy the criteria relating to 'recognizable' wastes. The facility combusting the pelletized material would need to be registered in accordance with Part 360-1.15(d)(2)(iii) and be in compliance with subdivision 360-3.1(c) of the regulations.

Wet-Air Oxidation. In the early 1980's, Mertz and Jayne (B18) reported on a process called wet-air oxidation (WAO) that is an offshoot of sludge incineration. This process allows recovery of heat energy and the reuse of oxidized mineral byproducts as a base paper filler. As its name implies, WAO is an oxidation reaction carried out on paper mill sludge slurry under high temperature and pressure. Air is introduced into the slurry under high pressure and the resulting exothermic reaction of oxygen with the organic material in the sludge further increases the slurry temperature. Overall sludge volume is reduced, yielding an inert ash composed of clay, titanium dioxide, and calcium carbonate, which is reused in the mill as ordinary paper fillers, thus offsetting the mill's raw material costs. The resulting clay has had problems with low brightness, primarily due to iron residues within the clay. The iron may come from sources such as corrosion of process pipes and/or the use of high iron alum in papermaking .

IN-PLANT RECOVERY OF MATERIALS

As was noted earlier, the purpose of this report is not to report detailed research on methods used to process paper mill wastes into a fuel supplement or for in-plant recovery of fiber or clay. Instead the purpose is to provide an overview of the pulp and paper industry's waste treatment and management practices in New York State; identify promising technologies for beneficially reusing paper mill solid wastes generated by New York's recycling mills and; to identify key technical, regulatory and economic barriers/limitations to beneficially reusing residuals. The reader is encouraged to review the NCASI report (B16) and references cited at the end of the report and the Appendices for other opportunities to incorporate paper mill sludge as an alternative fuel source to No. 2 fuel oil and natural gas. In-plant recovery of fiber and clay materials has been extensively discussed/reviewed by NCASI and can be researched further in references (B19), (B20), (B21) and (B22).

Appendix B

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Appendix C

STATE, NATIONAL, AND/OR INTERNATIONAL TECHNOLOGIES

The remainder of this report will examine alternative uses for paper mill residuals that have been used in the state, nationally, or internationally, and barriers to their implementation. Some technologies are widely used in many countries while others may not be in common practice at all. Incineration/energy recovery has found wide use in Europe and, in particular, the Scandinavian countries. In Europe, some examples of land application of paper mill residuals are described in the literature, but it is much less common there and in Scandinavia.

In addition to the information contained in these Appendixes, other resources can be referenced regarding the beneficial uses of paper mill residuals. An excellent summary of beneficial uses has been compiled by NCASI in technical bulletin (C1). Technologies that represent alternatives to landfilling, lagooning, and burning/incineration are reviewed in the bulletin. While the report is not comprehensive, it contains 37 pages of information on more than 30 paper mill residual management alternatives. Discussions of lime mud, green liquor dregs, wood ash, and bark are also included in NCASI's report. Over 100 hundred references are cited in the bulletin for the various residual management technologies. The document is a comprehensive resource for anyone interested in exploring over 50 years of research effort by NCASI, paper companies, commercial firms, and universities in various methods of waste management. Some of the alternative methods that may at one time have been general concepts or nonconventional methods, have since emerged as viable means of waste management.

This report will therefore not attempt to summarize all of the alternatives documented in the NCASI bulletin. The technologies that have been routinely used in other states or countries that may have particular applicability to New York State will be discussed. Also, the beneficial uses will be presented in the context of whether the beneficial use product is processed by some biological, thermal, mechanical, and/or chemical method, and if the product comes in contact with the ground. The use of paper mill wastes that are land applied (either directly to the land or indirectly after blending with other materials, nutrients, binders, etc.) will be highlighted. Each beneficial use that may be acceptable in other states or other countries will have to meet New York State's land application criteria. A discussion of various barriers (regulatory, economic, regulatory, etc) to implement of beneficial use activities can be found in Section 4.

The reason for making distinctions between the processing methods used for making beneficial use products from paper mill wastes and whether the material comes in contact with the land relates to how New York State regulates paper mill wastes. Prior to revisions to the Part 360 regulations in October 9, 1995, the DEC required any waste (including paper mill waste) that comes in contact with land to be tested for its toxicity (via the toxicity characteristic leaching procedure - TCLP test) and the chemical results are compared to groundwater/drinking water standards.

If the chemical concentration exceeds the groundwater standard, the beneficial use activity may be restricted or the opportunity to use the material revoked altogether. Comparison of TCLP results to groundwater standards are not required for materials that have been composted or materials that are not wastes and exempt under the beneficial use determination (BUD) petition process. Uncontaminated newspaper or newsprint when used as animal bedding is considered a beneficial use and exempt from being classification as a solid waste. Virtually any use of paper mill residuals that can come in contact with the environment is considered land application and must be permitted in the Subpart 360 - 4 Land Application regulations. For example, dried paper residuals used for animal bedding is not an exempt solid waste material. However, placement of the used material is currently considered land application and subject to TCLP characterization and comparison to groundwater standards.

Alternative uses of mill residuals that will be discussed in the following pages include:

- Direct (surface or subsurface) land application. Beneficial use of slurried paper mill residuals with no conditioning or processing of the slurry on farm and forest lands (spray irrigation) or the subsurface injection of wet residuals on cropland (soil conditioning).
- Direct and indirect land application (surface or subsurface) of wet blended/processed paper mill residuals. Direct land application (surface or subsurface) of mechanically blended and/or wet blended paper mill residuals includes mine land reclamation projects, and the use of wet blended residuals in hydroseeding applications. Some indirect land applications include the use of paper mill residuals in place of clay for the capping of landfills, and the production of engineered/substitute soils for use as an intermediate cover, grading material, barrier protection layer soil, or topsoil in or around a landfill and the use of dewatered residuals in landfill daily cover.
- Indirect land application after biological, thermal, chemical, and/or mechanical processing. Materials made from paper mill wastes and land-applied as a benign or relatively inert material include composting (chemical, biological, and mechanical processing); animal bedding (thermal drying and mechanical processing); grass seed mulch (thermal drying, chemical & mechanical processing); adsorbents (thermal drying, mechanical, and/or chemical processing); clay capping (thermal oxidation and mechanical processing); concrete building products (thermal oxidation and mechanical processing); lightweight aggregate (mechanical and thermal oxidation process); building/molded products (drying, mechanical, and/or chemical processing); and a pesticide carrier for crops (drying, mechanical, and/or chemical processing).
- No land contact or land application after biological, thermal, chemical, and/or mechanical processing. Technologies that can be used where the product will not come in contact with the land include clay recovery/bleaching (thermal, mechanical, and chemical processing); chemical by-products (mechanical, thermal, and chemical processing) and energy recovery/gasification (drying, oxidation, or mechanical).

DIRECT APPLICATION OF MILL RESIDUALS ONTO OR INTO THE LAND

Many companies and universities in the world have researched and practiced the land application of paper mill residuals for decades. In 1984, NCASI identified 75 mills in the United States with investigations of, operational land application, or related programs. In some cases, paper mill residuals have been sprayed on agricultural fields and forest lands in a slurry form. Because of the potential for objectionable odors being emitted from paper mill residuals on the surface, equipment was developed to inject the sludge slurry into the ground. Land application of paper mill residuals are generally limited to spreading during the spring before the crop is planted and/or in the fall after the crop has been harvested. The fiber or organic matter component has value as a soil amendment that improves several physical soil characteristics (C2).

Key physical characteristics of the soils include cationic exchange capacity (CEC), organic matter, and available soil moisture. Cationic exchange capacity is a measure of a soil's ability to hold nutrients in the upper soil horizons. Sandy soils usually have very low CEC. The organic matter in the soil is a measure of soil fertility. Organic matter helps raise the cationic exchange capacity of the soil by supplying adsorption sites for cations. On sandy soils, organic matter aids in the retention of water by closing pore spaces and adsorbing water. Organic matter also helps to reduce soil erosion by aiding in aggregate formation. Available soil moisture (ASM) is that moisture in the soil for which the plant can successfully compete. It is determined by subtracting the percent of soil moisture at which a plant will wilt from the moisture the soil is capable of holding under the force of gravity.

Mill residuals alone are not typically considered fertilizers but function more as soil amendments or conditioners. For a soil amendment product, the carbon to nitrogen ratio is typically targeted for about 30:1. If a higher C:N ratio exists, soil nitrogen becomes immobilized or tied up where the residuals are applied to the soil. The amount of nitrogen immobilized is proportional to the quantity of residuals applied. If the residuals are mostly primary solids, the appropriate carbon to nitrogen ratio may not be available. (One primary sludge had a C:N ratio of 213, whereas the nitrogenous secondary sludge had a C:N ratio of approximately 7.5) (C2). The calcium to magnesium ratio for a soil amendment product should be above 6:1. Many combined paper mill residuals fail to meet this ratio, but the addition of lime to the residuals can fulfill the calcium to magnesium ratio requirements (C3). Studies have not indicated a concern for toxic substances or heavy metals, as may be the case with some municipal residuals or other industrial residuals (C4).

Information was also compiled papers in 1985 reviewing case studies of the use of paper mill residuals or wood ash in farm and forest land projects (C2). The paper companies included Boise Cascade Corp (St. Helen, Oregon), Crown Zellerbach (Wauna, Oregon), Boise Cascade (Tacoma, Washington area), Consolidated Paper (Adams County, Wisconsin), Nekoosa Papers, Inc. (Port Edwards, Wisconsin), Great Northern Paper Company (now Bowater, Millinockett, Maine), Georgia Pacific (now Lyons Falls P&P, Lyons Falls, NY), and Hammermill Paper Company (Westfield, Massachusetts). Primary,

secondary, or combined residuals were used in experimental plots and field trials on agricultural and silvaculture projects. In more recent years, other paper companies have used land application (direct and/or indirect) for their wastes. Mills include Pope and Talbot, (Eau Claire, Wisconsin), Leaf River Paper Company (Perry County, Mississippi), and SD Warren, (Westbrook, Maine). Some findings (C2) are given below.

Primary Treatment Plant Residual Used for Land Application

- Addition of paper mill residuals to poor quality, sandy soils should improve such soils by adding nutrients and modifying the soils physical properties. Paper mill residual with an 83 percent moisture content, 29.1 percent ash, 0.28 percent ammonia, 0.64 percent TKN and 1.3 mg/l of soluble nitrate up to an application rate of about 36 dry tons per acre was found to have a positive impact on cation exchange capacity.
- Paper mill residual addition will likely raise the available soil moisture in sandy soils by reducing the permeability of the soil by filling of pore spaces. Cellulose is hydrophilic (water loving) and will restrict water movement through absorption and desorption mechanisms.
- Use of paper mill solids (primary) alone has no impact on tree growth. Addition of fertilizers to paper mill residual/herbicide combinations (to eliminate competition for nutrients) resulted in dramatic increase in growth.
- Application of primary residuals to cottonwood trees increased height growth 41 percent over the fertilized control plots.

Secondary Residuals Used for Land Application

- If the paper mill solids are from a secondary waste treatment plant (100 percent biological), too high a nitrogen content may predominate. Soil pH has been known to drop markedly due to the production of nitric acid by mineralization of the organic nitrogen in secondary solids. When primary solids were combined with secondary, soils were not acidified in comparison to the controls.
- Organic matter levels can increase slightly with secondary solids applications.

Combined (Primary & Secondary) Residuals/or Ashes for Land Application

- Pulp and paper mill residual characteristics vary widely with individual processes and determining beneficial or potentially limiting constituents (e.g., lime, nutrients, and organic material) is the first fundamental step toward determining correct management.
- Mixed residual solids applications on cottonwood plants have resulted in 68 percent increases in height over the fertilized control plots.

- Seven different combined residuals from 10 different mill types were tested in the 1980s and were found to have a 26:1 carbon to nitrogen ratio.
- Pope and Talbot Inc. (Eau Claire, Wisconsin) has been landspreading their deinking mill residuals since 1987. About 25 percent of the recycled fiber furnish ends up as fiber and clay wastes that must be land applied. The mill has covered over 5000 acres of agricultural land during that period and use about 800 acres per year. Residual application rates are limited to under 22.5 dry tons per acre on croplands such as field corn, soybean and hay. The deinking plant residuals are not used in fields used to grow crops that will be directly consumed by people as a precaution. Since the mill bleaches with hypochlorite and hydrosulfites, dioxin levels are extremely low. Heavy metal content are lower than in regular soil. Beneficial uses of some paper mill residuals may be limited by their chemical make-up to an application (C5)(C6)(C7).
- Land-applied combined residual from Leaf River Paper Company (Perry County, Mississippi) has produced as much as a 30 percent increase in the yield of farmer's wheat, corn, and soybean crop. The residuals were supplied to test plots at rates of up to 36 bone dry tons per acre after the addition of 45 pounds of urea per acre (to prevent nitrogen immobilization). There was no difference in yields from the 18-, 27- or 36 dry tons per acre residual application rates. The mill requires 1200 acres per year of land to beneficial reuse its paper mill residuals (C8).
- SD Warren Co. (Westbrook, Maine), which operates a 650-ton per day integrated kraft mill began land spreading its paper mill residual (40 dry tons per day) and biomass boiler ash (50 dry tons of wood and coal ash per day) on area farms starting in Fall 1983. Experiments conducted at the mill and extensive chemical analyses indicated that these materials could be a valuable resource. Other uses investigated or implemented in 1984 included golf course expansion, municipal parks, gravel pit reclamation, improvement of athletic fields, and landfill covering/capping (C9).
- Wood ash is a valuable liming agent and soil amendment that enhances agricultural productivity. Ash has been used as a substitute for agricultural lime and it also provides supplemental macro- and microelements (iron, manganese, molybdenum, copper, zinc, cobalt) needed for plant growth (C10).
- Paper mill residuals and waste ash can be effectively mixed with bark fines and used as an alternative competitor to peat humus landscaping products (C11). Paper mill wood-derived ash contains phosphorus, potassium, calcium, magnesium, and trace minerals derived from burning of hog fuel. When this wood ash is blended with paper mill residuals, essential crop nutrients and a more fertile soil results (C2).

Direct Mine Land Reclamation Projects

Some mills have evaluated the effectiveness of using their paper mill residuals in strip mine reclamation projects. Left unreclaimed and exposed to rainfall, these old mines often

produce a runoff that is high in heavy metal contaminants and very acidic, with a pH 2.5 or lower. Because of the lack of vegetation, the land is highly erodible and offsite transport or sedimentation of nearby streams is a significant problem. One can directly apply paper mill residuals with a bulldozer blade (by pushing and back dragging) or by box type spreaders and then rototilling or disking into the top 6 inches of spoil material. Nitrogen, phosphorus, and potassium may have to be applied before seeding with native plant species to have a benefit on these mine spoils areas. A few cases that have been reported in the literature are:

- Mead Corporation (Chillicothe, Ohio) and the Ohio Agricultural Research and Development Center (Wooster, Ohio) has conducted lab and field evaluations using combined solids for reclaiming an acidic shale spoils area. The integrated bleached kraft pulp-and-paper mill uses primary clarifiers and aerated stabilization basins with mechanical clarification of the secondary solids. The residuals consists of cellulose fiber, clay, and lime. Nearly 240 dry tons of paper mill residuals are produced each day (1989 data) from the waste treatment plant process. After 7 years of greenhouse and field testing, 100 percent utilization of the residuals were targeted for some of the 370,000 acres of abandoned, strip-mined land in Ohio. The effect of paper mill solids incorporation with bulldozers gave a wide range in grass and legume root penetration (3 -10 inches), while box spreading and disking yielded a more consistent 7- 10 inches. A residual application rate of 555 dry tons per acre of strip mined land was the most effective. At this loading rate, the site remained stable and the vegetation continued to grow for many years after reclamation. The issue of dioxin in 1986 initially resulted in concerns about the 33-91 parts per trillion toxic equivalent (TEQ) concentration found in Mead's solids. Guidelines were set up on the beneficial use of Mead's residual material (called BYPRO^R) applied to strip mines. In 1994, all of Mead's combined treatment plant residuals were applied to Ohio's strip mines in the region (C12)(C13).
- Superior Recycled Fiber Industries (Duluth, Minnesota) and the Eveleth Mines Plant (Forbes, Minnesota) have evaluated (C14) the use of deinked residuals in the restoration of vegetation on coarse tailings in northeastern Minnesota. Taconite is rock that contains iron for the production of ore. After taconite is mined from large open pits, the ore is crushed, finely ground, concentrated, and processed into pellets. Each ton of iron ore pellets makes 2 tons of tailings. Taconite tailings are mostly fine and coarse sands (silicate). The fine sands are easy to revegetate using a standard seed mix, commercial fertilizer, and mulch. However, the coarse tailings have consistently failed in establishing and maintaining a ground cover for three consecutive years because of poor physical, chemical, and biological properties. The fiber and clays present in Superior's deinked residuals could benefit plant growth at these coarse tailings mines (estimated at 25,000 acres). The deinked residuals are at approximately 33 percent solids (67 percent moisture) with a pH of 8.2 and a C:N ratio of 123:1. The high C:N ratio dictates the addition of enough nitrogen to satisfy plant growth. Total carbonate content was 8 percent and calcium at nearly 7 percent. The results of tests from 1992 through 1993 have indicated that for application rates

of 10 to 20 dry tons per acre and supplemental fertilizer rates (160 pounds of nitrogen per acre and 359 pounds of phosphorus as P_2O_5), the paper mill residuals covered area had significantly higher vegetative plant cover rates than tailings with just fertilizer.

- Willamette Industries (Johnsonburg, Pennsylvania) operates an integrated kraft pulp and paper mill with an elemental chlorine-free bleaching process. In 1994, the mill received a beneficial use general permit (the first in the state) to land-apply dewatered primary and secondary solids to strip mine acreage. The residual solids are from two 2-meter belt presses and can be blended with fly ash and wood rejects for land application. The mined land reclamation project is limited to application from May through October each year. About 60 acres have been used thus far and there are enough acres to be reclaimed for 5 additional years. The general permit allows the stockpiling of the combined residual solids at the mine site itself, which facilitates the continuous operation of the treatment plant and dewatering process (C15).

Direct Land Hydroseeding and Landfill Daily Cover

There is a potential market for the use of paper mill residuals containing cellulose that can be substituted for newspaper fiber used in the hydroseeding field. Currently, various companies purchase bags of dried, shredded paper and wood fiber products for landscaping purposes. The cellulose fibers are added to a nutrient rich slurry of water and grass seed and then sprayed onto flat and side slopes areas that are being replanted/revegetated. Some paper companies have explored the cost/benefits and performance of using dried pulp and paper mill residuals in this hydroseeding application. The seasonal use of hydroseeding products does limit its widespread application to large producers of paper mill residuals. Hydroseeding is generally limited to April/May or August/September when grasses have the best opportunity to hold their moisture for root development.

- A company called New Waste Concepts (Perrysburg, Ohio) offers a sprayable daily cover material for use in landfill operations (C16)(C17). It currently uses over 1 million pounds of shredded paper fiber a year. This company produces a product called ConCover that is a technologically advanced blend of polymers and recycled fiber that forms a slurry when mixed with water. When sprayed over most surfaces, ConCover forms a uniform encapsulating layer between the waste and the environment, providing reliable daily coverage in a variety of climatic conditions. The reported benefits from the ConCover technology include the control of blowing litter, odors, volatile organic compound emissions, vectors and rodents, ash and dust, and fire. The various ingredients including the cellulose fiber make the cover material biodegradable and non-flammable. A sprayable cover uses up virtually no landfill space and reduces operating costs when compared to have to use soil for daily cover.

- The concept has been tested at a regional and private landfill in New York with primary and combined paper mill residuals as a substitute for shredded newspaper. Results indicated that primary residuals are more comparable in performance to newspaper and is not as likely to produce odors as a combined paper mill residuals.

INDIRECT INCORPORATION OF PAPER MILL RESIDUALS INTO LAND

Engineered Soils Used in Land Application Projects

Most of the direct land application pilot or field evaluations methods discussed above involved equipment for surface spreading the slurry (spray irrigation) and semi-solid paper mill residuals or subsurface injection. Then other necessary materials like urea or granular fertilizers (nitrogen source) might be surfaced applied and plowed into the field. The decomposition of the organics in the mixture and uptake of the macro and micronutrients into the croplands may be irregular with this staggered in-place blending process.

The production of synthetic or engineered soils from paper mill residuals represents a more controlled method of land application than the examples given above. A synthetic or engineered soil process involves the blending of residuals with varying proportions of sand, gravel, and fertilizer to achieve the appropriate agronomic proportions. Ingredients are fed from multiple hoppers, conveyed to a mixing point and the synthetic soil produced. This blending process provides a more homogenous mixture that can then meet a particular end use. The type of residual wastes being used would dictate which agronomic testing would be conducted.

As noted above, primary residuals may have sufficient organic and clay material but lack some of the appropriate nutrients. Conversely, a secondary solids may have the needed nutrients but lack the organic or inorganic characteristics. The production of synthetic soils using only primary or secondary solids can then be manufactured and carefully controlled by blending in the necessary amendment material (bark fines, wood ash, liming agents, etc) to the product being produced. A combined residual feedstock can still benefit from the control that is afforded when producing an engineered soil product. The agronomic testing parameters will determine what adjustments are needed to yield a useable product.

- One potential application for the synthetic soil is for use in landfill closure projects as the 2-foot barrier protection layer (frost protection layer) or the 6-inch topsoil layer. Resource Conservation Services, now part of Browning-Ferris Industries (BFI)/Organics has reported (C18) on the use of paper mill waste (called short paper fiber) in the production of synthetic soils. A program was set up in 1992 using waste solids from a groundwood pulp and paper mill owned by International Paper Mill, located in Corinth, New York. Extensive testing has been conducted and approvals obtained from state regulators (DEC) for this use through the beneficial use determination (BUD) process.

- Overall, BFI/Organics markets 15 different disposal/beneficial use applications to the pulp and paper industry. The programs range from composting, to mine reclamation projects, to direct applications on agricultural fields.

In - Direct Application of Paper Mill Residuals for Landfill Clay Capping Material

Another beneficial use of paper mill wastes is for the production of the landfill clay barrier layer itself. This application is considered indirect in that the material is used inside the confines of a secure landfill facility and not spread directly on the ground as a soil amendment product or used outside the clay barrier of a landfill. The presence of fine filler clay in paper mill residuals of certain paper mills has led to the research and development of uses in place of the clay used for landfill capping projects.

The use of paper mill residuals for clay capping purposes has been extensively studied by NCASI since the mid 1980's (C19). A lab study yielded the conclusion that pulp and paper mill residuals have definite potential as a substitute to clay for use as hydraulic barrier material in landfill covers. Thirteen fresh residuals from various wastewater treatment plants were tested during the lab phase. Also tested were eight fly ashes from mill boilers incinerating wood wastes, coal, or a combination of the two. The mean hydraulic conductivities (a measure of the impermeability of the material to water penetration) of the residuals was 1.8×10^{-6} cm/second and for the fly ash it was 2.8×10^{-6} cm/sec. (This hydraulic conductivity level is close to the regulatory requirement of 1.0×10^{-6} cm/sec.)

- SD Warren Co. (Westbrook, Maine) has investigated uses for its primary solids from its waste treatment plant solids (40 dry tons per day) as a landfill capping material. The residuals have the high clay content required to reduce water infiltration into landfill wastes. It can also be a substitute for clay borrow (C9).
- NCASI (C19) has been field testing the effectiveness of paper mill residuals, fly ash, or combinations of the two as a hydraulic barrier (clay capping) material for landfill closure projects since November 1987. The study involved four pilot landfill cells that were constructed at a Midwestern location. Cell 1 contained combined primary and secondary waste treatment residuals. Cell 2 and 4 each contained a local clay soil as a barrier material. Cell 3 contained only primary waste treatment plant residuals. Each hydraulic barrier was compacted material 2-feet thick. The natural clay layers were placed in and compacted in 6-inch layers at a time. The residual barrier layers were placed and compacted in 12-inch layers. On top of the hydraulic layer was placed a mix of 1.5 feet of sand and silt that served as the barrier protection (freeze thaw) layer. Finally, a 6-inch topsoil layer was placed over each cell. During the first 2 years of operation, the barrier layers using paper mill residual consolidated (settled) approximately 30 percent. The primary cell initially generated more seepage than the clay cells, but after the initial two years became equal to or lower than the clay layer. The combined sludge cell produced less seepage (was less permeable to water) than even the two natural clay cells. After 2 years, both paper sludge layers had conductivities from $2 - 7 \times 10^{-7}$ cm/ second. After 4 years, results continue to show that the paper mill sludges are equal to or better than the native clay soil cells.

- Erving Paper Company (Erving, Massachusetts) is a 120-ton per day deinked pulp and recycled paper mill that depends 100 percent upon recovered fiber for its furnish. In the process of making its tissue paper products, approximately one-third of the furnish ends up as paper mill residuals. The ash content of its solids is about 50 percent clay. With the approval of the Massachusetts Department of Environmental Protection, Erving constructed test cells and conducted a field evaluation of the residuals as a clay capping material. The field evaluation involved a 3-foot layer of residuals used as a clay barrier layer over a 5-acre landfill for the municipality of Hubbardston. The cap was completed in 1992 and monitoring has since indicated that the cover is providing the required impermeabilities. As expected, some consolidation of the cap has occurred but no breaks in the cap have been noted. The Erving mill was granted a beneficial use determination for the use as the final capping material. Plans are to use the material in about 24-inch thicknesses on other landfills in the state (C16)(C21).

Indirect Land Application - Composting (Aerobic and Anaerobic)

Composting is the process through which microorganisms break down organic materials and produce a stabilized, humus material that is then used as a soil substitute. The typical composting process involves air (aerobic), but a less known anaerobic process will also be mentioned. For the more common composting process, municipal and paper mill residuals are placed in windrows, aerated static piles, or into a confined reactor or vessel. In the early days static windrows and aerated, static piles (windrows with air distribution pipes) were evaluated. The windrow method requires little capital cost but needs personnel to tend the piles and a large land area to accommodate the windrows. Windrows also present the most opportunity for odor generation since localized deficiencies in air occur and odorous compounds are produced. Aerated static pile composting is similar to the windrow method in that the mixture is placed in piles. Physical turning, however, is not needed because oxygen enters the mixture through perforated plastic piping or permanent piping located under the piles. The static pile method offers better odor control and needs less labor and time for composting. A large land area to accommodate the piles is still necessary. Aerated static piles are being used successfully for some paper mill residuals. The reactor method/system consists of one or more mechanically-aerated enclosed vessels. Typically, two stages are used-one for high-rate composting and the other for curing the compost. Reactor systems offer greater control of odors and the process, requires less labor, time and land area for composting, but they have high capital costs.

All types of organic solids are being composted and sold extensively to farmers, landscape contractors, nurseries, greenhouses, etc. The practice of producing compost from paper mill residuals grew rapidly in the late 1970s and early 1980s in the United States. That growth changed significantly in the late 1980s. This was due in part to the seasonal market for the composts usage, particularly in the northern sections of the US. As with land application, composting of mill residuals can be limited to widespread use during the spring when farmers are planting, and the demand increases for compost products used by landscape contractor, nurseries, and greenhouses. Some markets also exist in the fall after

the crops have been harvested and preparations made for the subsequent plantings. Paper mills need a large, local user since it is continuously producing paper mill residuals.

Another reason for the decline was the potential liability associated with marketing and distribution of compost products. The discovery of minute quantities of chlorinated dioxins and furans in some residuals from paper mills bleaching with chlorine raised regulatory concerns about land applying/composting of solids. Some vestiges of concern remain in the 1990s in spite of the significant reduction (over 90 percent) in dioxin and furan levels from these mills.

Composting paper mill residuals (particular those mills not bleaching with chlorine), as with direct spreading or indirect blending of paper mill solids, has the benefit of improving soil properties (cation exchange capacity) and plant growth by increasing soil aeration, water holding capacity, and water infiltration, and by lowering bulk density and surface crusting. Composting reduces the tendency of nitrogen immobilization when compared with direct land spreading or indirect blending of solids. Solids from a groundwood pulp operation is particularly good for composting given the non-chlorine bleaching process and the coarser fiber characteristics that helps aeration. (C3).

- P.H. Glattfelter (Spring Grove, Pennsylvania) has been composting their bleached kraft mill primary-secondary solids since the late 1970s. Early efforts began with bin composters followed by field trials to further define the composting parameters. Both static piles and aerated static piles (windrows with air distribution pipes) methods were evaluated with aerated windrows being used very successfully. A 65:35 blend of combined solids (22-30 percent solids and 40 percent ash) and bark fines are generally composted for three weeks and cured for a few additional weeks. Pile temperatures of up to 170 degrees Fahrenheit destroy any pathogens that may be present. The final compost product has a pH of between 6.8 - 7.2 and can be used as a farm soil conditioner to loosen up clay soils and as a substitute for peat moss in horticultural applications (C22).
- Browning-Ferris Industries (BFI)/Organics operates a co-composting facility in Hawk Ridge, Maine, that takes biosolids from 18 communities and combines them with paper mill residuals/fiber, wood ash, spent wood shavings, and sawdust. In 1993, the Hawk Ridge plant was converted from a windrow type composting facility to an in-vessel operation. This allows better control and monitoring of the oxygen and moisture content of the blend and can be done in a smaller area. The production facility charges a tipping fee of only \$16 per wet ton for paper mill residuals (C23).
- Testing was conducted in the early 1990's at the University of Idaho (Moscow, Idaho) on a combined solids from a mechanical pulp and newsprint paper mill. An aerated, static composting pile trial showed that the non-hazardous raw sludge could be easily composted without a bulking agent or urea amendment. Composting rate (6-week period) was unaffected by residual moisture over the range studied (34-55 percent

moisture). Cationic exchange capacity and total humus content were strongly correlated with composting time and plant biomass (C22).

- Daishowa Forest Products Limited (Quebec City, Quebec, Canada) has been working with Laval University's Horticulture Department to use a composted, deinked residual in a field with a 25-foot layer of natural clay. A nearby ditch and basin system is used to contain and collect runoff for study. The solids are mixed with liquid pig manure until the mixture reaches about 70 percent moisture (30 percent solids) and the carbon to nitrogen ratio is reduced to about 60:1. A composting windrow that is about 100 meters long and 12 to 15 feet high is used and researchers turn the windrow once per month (less frequently in the winter). The windrow reaches 160 degrees Fahrenheit at the center within 24 hours of turning. The composted solids can be used as a substitute for rich soil. The finished product is used for potato growing areas (C5).
- Nippon Paper Industries (Oji And Marunouchi, Tokyo, Japan) and a landscape company (Jomo Landscape, Yoshioka, Gunma, Japan) have used a combination of processing technologies to produce an artificial soil (C24). Paper mill residuals are typically incinerated in a rotary kiln to generate a kiln ash. About 20 percent of the country's paper mill kiln ash is used as a slagging material in iron manufacture, a raw material for cement products, spreading on roads for melting snow, or soil amendment uses. The balance of the ash is landfilled. Nippon Paper's kiln ash (at 35 percent moisture) is sent to an artificial soil production plant and mixed with dewatered solids (85 percent moisture) discharged from an activated sludge plant. After mixing, the material is allowed to stand for 5 days with occasional turning to supply air. The mixture is then treated in a compost reactor for 8 hours. The compost gets to 140 degrees Fahrenheit with a moisture content of 50 percent, and the material is removed for final composting action. The artificial soils final moisture is about 35 percent and is bagged for use as a planting soil in mountainous regions of the country, golf courses and parks.
- Monadnock Paper Mills Inc. (Bennington, New Hampshire) is a small, non-integrated mill producing 125 tons of fine and lightweight speciality papers each day. Testing in the 1990s showed that the residuals from the facility has a high nutritive value, was an excellent carbon source, and contains below detectable levels of heavy metals, volatile and semi-volatile organics, and PCBs. Dioxin and furans are detectable but below regulatory levels of concern. The material is composted into a rich topsoil or soil amendment that has been used successfully (C25).
- Crane & Company (Dalton, Massachusetts) is working with composting experts to investigate the feasibility of composting the dewatered solids from their mill. The solids consists primarily of cotton fiber used in making currency paper and permanent documents. The mill currently dewateres the solids and has it incinerated in a small combustor unit. Various studies of the rate of decomposition and the appropriate types of bulking agents needed for effective composting have been evaluated.

Anaerobic digestion produces mainly methane, a substitute natural gas. (The decomposition of waste in a landfill, is in essence, anaerobic digestion). Anaerobic digestion does not require as dry a sludge as regular composting. Typically, the best moisture content for anaerobic digestion is 70 percent moisture (30 percent solids). Some detoxification of the chemical constituents in paper mill residuals can occur when anaerobic digestion is used. Anaerobic digestion of wastewaters to reduce the production of paper mill residuals are more common than anaerobic digestion of paper mill residuals. Over 30 anaerobic systems were in place in the U. S. pulp and paper industry to treat wastewater. In New York, the Energy Authority has sponsored various anaerobic pretreatment techniques for municipal wastewater treatment plant sludges. (Dynatech Scientific Inc. and City College of NY). The organic fraction of some residuals has been reduced by one half by using anaerobic digestion. The biogas produced is a medium Btu gas (about 600 Btu/cubic foot) that can be recovered and burned onsite.

- Experiments (C26) have been conducted at Cornell University (Ithaca, New York) to evaluate the potential for pulp and paper mill residual reductions using anaerobic digestion. Solids samples were supplied from a bleached Kraft mill and from a recycled paper mill in 1993. The Kraft solids were combined biological solids and fiber from an aerated lagoon effluent, while the recycled mill sample was dewatered primary clarifier solids. The result indicated that over 60 percent of the recycled mill residuals were converted to methane gas. The Kraft mill sample showed only an 18 percent conversion/digestion level.

IN-DIRECT APPLICATIONS FOR PAPER MILL RESIDUALS

The fiber and clay content of some primary or combined treatment plant residuals has led to the investigation and/or the development of a wide variety of uses. Higher value-added products that may involve the use of paper mill residuals include such items as egg cartoons, floor tile, pre-cast building construction materials, absorbent products, animal bedding, etc. A few common denominators for these products are that they require some type of processing and/or drying to yield the value-added product. In some cases the finished product may come into indirect contact with the land (i.e., plant pots, absorbent products, animal bedding/litter, lightweight tile or block). In other cases, the product/material may not come into direct contact with the ground but be confined to a building (roofing/shingles, roofing felt, ceiling and wall panels, baseboards, siding, beams, insulation). The DEC is expected to require more testing requirements for those products that come into indirect contact with soil than with those that do not come into ground contact at all.

Absorbent Products

Research into the absorbent properties of dried paper mill waste for the manufacture of oil and chemical cleanup adsorbents products has been reported as early as 1973. Depending upon the composition of the paper mill residual being utilized (fiber and ash

content) varying absorption ratios can be achieved for picking up various oils per unit of weight of absorbent. High clay solids or 100 percent clay product can absorb amounts of oil equal to or perhaps twice the weight of the absorbent product. Low clay/high fiber adsorbents can absorb as much as five times their weight in certain oils.

The high organic content absorbents can also be incinerated in approved boilers to recover the energy from the absorbed hydrocarbon product and dry fiber. Some of the plastic oil absorbent products (like polypropylene blankets/pads) that compete with an absorbent made from paper mill residuals cannot be readily burned. The placement on the ground of absorbents made from dried paper mill residuals represents an insignificant impact on the environment. These type of absorbents are recognized by regulators as not posing any great risk when land applied. Exposure to absorbents during cleanup are considered short-term and leaching of any contaminants from adsorbents are not likely and not as critical as the spilled chemical.

- In recent years interest has increased in using paper mill residuals to a point where a number of Canadian and US companies are producing oil spill cleanup products for customers. A US Patent (# 4,497,688) was issued on February 5, 1985, covering the use of clean pulp and paper mill residuals for oil absorbent purposes. Since then, a company named Cellutech, Inc. (Framingham, Massachusetts) has begun manufacturing a product called LIQUICK^R from primary or combined solids from two New York paper mills. The product is supplied in loose particulate, granulated, and pelletized form in bags, pails, drums, socks and pillows. Each product form is available as a universal absorbent capable of absorbing most liquids (including water) or as a water repelling (hydrophobic) absorbent.
- Absorption Corporation (Bellingham, Washington) is using primary clarifier solids for the production of oil absorbents. The cellulose absorbent can be used as a general purpose product that picks up chemicals, oil-based liquids, and water, and another product that absorbs oil-based product and repels water. Their product is reported to have 2 or 3 times more absorbency by volume than polypropylene and 14 times more absorbency (by volume) than clay. The material can be incinerated and produces less than 1 percent ash. The material is available in booms, socks, pillows, and bags in loose particulate (C27).

Animal Bedding/Litter and Agricultural Products

The manufacture of dried paper mill residuals for use as animal bedding and animal litter is closely allied with the general category of adsorbents. In fact, Cellutech Inc. holds a US Patent (# 4,723,509) issued on February 9, 1988, covering the use of dewatered, paper mill residuals as a cat litter material. Absorption Corporation also produces kitty litter, bedding for pets, and lab and larger animals.

- NCASI has noted that one paper company (C1) has tested a kitty litter product claimed to be more absorbent and lighter than conventional clay-based litters. Odor problems were created when combined paper mill solids used for kitty litter were wetted, while use of only primary solids did not create odor problems. The company decided not to move into full scale production or distribution facilities because of the initial capital investment for the manufactured product.
- Energy Management Services, L.P. (EMS, LP) currently operates a paper mill waste drying facility at its location in Solvay, New York. EMS has received a RD&D permit from the DEC to produce dried animal bedding for cattle and/or poultry. The dryer is a rotary steam tube drum unit and can process about 250 tons per day (basis of 40 percent feed solids) of paper mill solids. Final product moisture contents of as low as 5 percent have been achieved from a feed moisture content of 65-70 percent using the dryer system. The solids content for animal bedding products is generally targeted for about 80 percent. The facility currently has a permit to operate and a BUD petition issued by the DEC for the production of an alternative fuel from these wastes. Dried material has also been provided to a landfill in the region for use in their facility. An additional BUD has been obtained for potential use of dried mill residuals as an oil adsorbent product.

According to NCASI, (C1) paper mill residuals have been incorporated directly into animal feedstocks or after a fermentation process. Research in the 1970s and 1980s looked at ways to take advantage of the high carbohydrate content (cellulose) and other nutrients found in primary and combined solids. Studies have been conducted on the direct incorporation of residuals in goat and beef cattle feed mixture. Results have shown that its digestibility was directly related to the carbohydrate content and inversely related to the ash and lignin content.

Another method involves using the protein present in secondary solids as an additive in animal feed. Fermentation of the fibrous primary solids has also been evaluated. Liability and product acceptance issues for these uses of paper mill residuals have limited the markets for some of these beneficial use processes.

- Envirotech Systems Corporation (Vancouver, B.C., Canada) has completed approximately 5 years of technology development of a modular, mobile, and/or fixed radiant plate dryer (RPD) process for municipal or paper industry waste residuals producing high value-added, recycled end products. The company reports that the RPDs unique design will dewater solids at a fraction of the cost of comparable processes and produces a recycled, sterile, and inert dried sludge, which can be turned into products ranging from fertilizer, to fireplace logs, fuel pellets, and cattle feed. The processing costs for the RPD system are under \$100 per dry ton. A single RPD module feed at about 35 percent solids can produce about 25 tons of product at a 90 percent solids content (10 percent moisture). The radiant plate dryer (RPD) process consists of two, self-contained mobile trailers and is an auger-driven solids

metering system to feed a screw conveyor that transports the waste solids to a drying chamber. The drying chamber operates at a temperature of 1300 to 2000 degrees Fahrenheit. The design of the chamber allows the material to make three passes beneath a radiant plate that can evaporate 3.85 tons of water in 1 hour (C28)(C29).

Another unique application was developed in 1983 by Edward Lowe Industries and has operated since 1990 as Granulation Technology (GranTech in Green Bay, Wisconsin). NCASI has reported (C30) on the company's production of a new patented granular carrier made from recycled paper waste for use with pesticides. The current granular products contain clays, vermiculite, diatomaceous earth, and corn cob products. But these carriers have come under increasing scrutiny because of environmental and worker exposure concerns. The concerns include whether any of these materials contain asbestos or silica dust, their bulk density, and dust levels.

- Fort Howard Paper Company (Fort Howard, Wisconsin) supplies its deinked press cake at about 40 per cent solids (60 percent moisture) to GranTech. The cellulosic-based paper waste is dried completely and a proprietary four-step granulation process turns the raw material into granules of optimum density. The granules are processed and sorted into product grades (called Biodac^R) to meet a variety of agrichemical, lawn and garden, and industrial needs.

In-Direct Use of Paper Mill Residuals for Molded and Building Products

Waste paper mill fiber has for years been dewatered, shaped, and dried for use as egg cartons, plant pots, and other products that may come in contact with the ground. These have typically not involved any additional binder or glue to strengthen the product. The market for these materials is already fully developed and significant growth is not likely to occur.

An area of recent interest has been in the use of paper mill residuals with a binder for making various building products. Adding dewatered fiber directly to cement products has proven to increase the products overall strength and durability, as well as reducing shrinkage cracking. Experiments conducted by Thomas, et al. (C31) resulted in fiber reinforced cement products that are potentially useful in building, blocks, wallboard and panels, shingles, fire retardants, or filler material for fireproof doors. One significant problem was fiber flocks, which caused decreases in compression strength with increasing fiber volume above 11 percent. To eliminate fiber flocks, Portland cement mix was added directly to the raw sludge, prior to dewatering. This method reduced the tendency of pulp fibers to agglomerate into flocks, thus ensuring adequate dispersal of the fibers throughout the cement mixture. This method increased tensile and compressive strengths and yielded the best overall results.

The use of cellulosic fibers results in higher strength properties compared to results from ordinary cement-sand concrete results. This may be attributed to the fibrillated nature of

the fibers, which increase the development of mechanical bonding with the cement, as is seen in paper. Compressive and tensile strengths were greatly increased and fiber reinforced cement composites showed an extremely high capacity to deform prior to failure. The final product also retains some properties similar to that of wood, in that it can be nailed, screwed, and fastened without special materials, and it can also be cut with a typical handsaw. This is indicative of the basic properties of cellulosic fibers. Results presented here were from short-term experiments only; evaluations must be done to determine long-term durability and dimensional stability of fiber-reinforced masonry products (C31).

- The International Paper mill (Corinth, New York) and two other New York firms have a BUD the use of paper mill residuals in the manufacture of pre-cast building products. The products included ceiling, wall, and door panels, sub-flooring, door jams and casings, baseboards, cabinets, roof shingles, siding, structural beams, bricks, insulation, etc. Two different processes were proposed to pre-cast the products. The first involved blending paper mill wastes and Portland cement, mixing and then molding it at a block and panel manufacturing facility. The second relied solely on the inherent mix of fiber and clay in the mill residual waste and used pressure only to form the blend into thin, strong corrugated panels for use in exterior wall construction. BUD approval was given by the DEC. Although some of the products were tested and found to be safe and viable for building purposes, the regulators had concerns about the concept of an all sludge house and raised the issue that the State Health Department may have an interest in indoor air quality.

Products from Thermal Oxidation of Paper Mill Residuals

An indirect method by which paper mill waste can come into indirect contact with the ground is after the organic fibers have been burned off. The clay/ash is recovered for use as a substitute for clays in landfill caps or directly as a cement substitute or supplement. Paper mill wastes have been incorporated into building products by using it as a feedstock to a cement kiln. Paper mill residuals from mills deinking old magazines or producing coated grades of paper can contain substantial quantities of calcium carbonate, clay, silica and/or smaller amounts of iron, aluminum, and magnesium (C1). These chemicals are basic components of the materials needed to produce cement and can also serve as a substitute clay capping layer in landfill closure projects.

- Technology Development Corporation (TDC, Fairfield, Ohio) has developed and holds patents for a process to convert paper mill wastes with ash into clays for recovery and reuse (US Patent # 5,054,406 - Water Retardant Covering Material for Solid Waste Landfills and US Patent # 5,018,459 - Method and Apparatus for Recycling Paper Pulp Sludge.) The technology was designed in the 1980s and has culminated in the startup in Middletown, Ohio, of a new thermal oxidation unit (rotary kiln) able to handle from 500-750 wet tons per day of paper solids fed at a 45-50 percent cake solids and at least 20 percent ash. A new recovery company was

licensed by TDC, which is now serving three paper companies. The facility is maintaining compliance with the air quality and solid waste requirements of the Ohio EPA. TDC is prepared to demonstrate the technology and build a plant in New York that could handle up to 750 wet tons of paper solids each day (at a 50 percent solids - 50 percent moisture content). The throughput would be reduced if the paper waste was at a higher moisture level. The patented equipment has excess heat available to pretreat the incoming solids. TDC wants to provide a regional facility to serve two to three paper companies participating in the project. The construction of a plant to process up to 750 tpd of high ash wet paper solids cannot be firmly established without detailed information about the specific location of the plant. Projected capital costs (per TDC staff) are approximately \$ 2.5-3.0 million.

- Systec Environmental Corporation (Xenia, Ohio) can convert wastes (including paper mill residuals) into fuel for powering cement kilns and recovery of inorganics through the technology of co-processing (33). The solids waste replaces non-renewable fossil fuels normally burned in the cement kilns; e.g., as coal or natural gas. The inorganics in the paper mill residuals help produce the binder and are incorporated into the cement product. This cement can be combined with aggregate, turned into inert concrete block, brick, tile, etc. Systech introduced cement kiln coprocessing in 1979. Systech's commitment to this field was strengthened when it was acquired in 1986 by Lafarge Corporation, a Fortune 300 company. Lafarge is one of the largest manufacturers of cement and construction materials in North America. The high temperatures (more than 3000 degrees Fahrenheit) and long residence/dwell times (6 to 8 seconds) in the cement kilns ensures virtually total destruction of organic constituents.

Light weight Aggregate from Paper Mill Residuals

There are 19 companies reportedly producing lightweight aggregate (LWA) in 26 plants throughout the United States, predominantly in eastern and southern regions. Trade sources estimate that between 3.6 million and 5.5 million cubic yards of aggregate are used each year. LWA can be produced from solids, and replaces sand and gravel, as a filler in the production of concrete blocks, architectural panels, decorative stone, and other construction activities. The use of paper mill residual allows for reductions in the final density of the aggregate while maintaining acceptable strength properties (C34). The LWA is favored by the construction industry for three reasons: 1) LWA is more efficient to handle and transport than sand and gravel, which can weigh as much as 3500 pounds per cubic yard vs 1500 pounds per cubic yard; 2) builders can use lighter steel support, thus reducing cost; and 3) LWA has great insulating value compared to sand and gravel (C35).

- Greengrove Corporation (Brooklyn, Minnesota and Appleton, Wisconsin) has developed the Aggrecel process to produce LWA from paper industry residuals and ash. Paper mill solids and ash are mixed together in a pug mill and fed to a fan-like device that concurrently dries and mixes the solids and ash constituents. The

product is next fed into a disk pelletizer that produce balls or pellets which are fed directly to the rotary kiln process. In the kiln, the green pellets are further dried and the cellulose fibers and other materials are burned. Hot gases and moisture can be reclaimed through the production of steam in a waste-heat recovery boiler. The kiln's secondary combustion chamber allows the heat hardened solid that is formed to be withdrawn as usable, lightweight aggregate product (C35). The capital cost of an Aggrecol plant which can process 300 wet tons per day of solids (if at 40 percent solids and 35 percent ash) would be located adjacent to a mill, and would produce process steam for mill use is estimated at between \$13-15 million. Greengrove indicates that the tipping fee for their process is expected to be competitive with or better than the rate charged for landfills without the liability and closure issues associated with landfills.

NON-LAND-APPLIED USES: PRODUCTION OF CHEMICALS

A field of research and development that does not involve the direct or indirect application of paper mill residuals onto the land is conversion of wastes into chemicals for a variety of beneficial uses. The use of paper mill solids as a feedstock for chemicals has been researched for decades and is now being looked at as both technically and economically feasible in the United States. While full-scale plants have been attempted, many of the processes for converting paper mill residuals are at the pilot plant/demonstration stage. Some of the processes that have been used include fermentation, chemical conversion, and/or enzymatic hydrolysis for producing calcium magnesium acetate (CMA), levulinic acid, and ethanol, to name a few.

- Pulp and paper mill residuals were investigated in the 1980s as a feedstock for the potential manufacture of a road de-icing agent called calcium magnesium acetate. CMA is as effective as road salt (sodium chloride) for de-icing roads but does not have the corrosive properties to bridges, other highway structures, automobiles, utilities, and water supplies. The pellet substance is manufactured by fermenting sludge with unique microbes to produce acetic acid. The acetic acid is then chemically reacted with dolomitic lime to produce CMA. The effort was researched by Dynatech Scientific Inc. and also supported by the Energy Authority and commercial companies. Production costs for CMA from organic wastes are about \$700 per ton compared to \$25-50 per ton for road salt. (An Energy Authority study (C36) determined that the real cost of salt, taking into account the costs of damage it causes, is closer to \$1450 per ton). Research efforts also include to dairy wastes (cheese whey) as another potential feedstock for CMA production.
- Biofine Inc. (Wellesley, Massachusetts) and the Energy Authority have been working on a thermochemical process to convert low-grade cellulosic wastes into levulinic acid. Levulinic acid is a versatile intermediate chemical with many commercially viable derivatives. Potential feedstocks that can be used for the process in the paper industry are mill residuals, wood wastes, or wastepaper. These wastes are acidified

and heated by the injection of high pressure steam in the first stage causing the cellulose to be hydrolyzed to levulinic precursors. In a second stage, the pressure is lowered to for completion of acid hydrolysis to a solution of levulinic acid (C37).

Paper mill residuals are an ideal feedstock due to its cellulose/hemicellulose content, finely divided form, fairly uniform composition, and high solids content. A small scale feedstock testing unit has been in operation at Dartmouth University with a 1 ton per day production unit planned in the future. The Biofine process should aid mills producing from 50 to 100 dry tons of solids production per day given the inherent increase in the production of wastes as more mills utilize more deinked and recycled waste in the paper grades they produce.

- Using paper mill residuals for ethanol production has also been considered as an alternative carbohydrate source to using typical corn products. Lab studies have used both acid (sulfuric or hydrochloric) hydrolysis or enzymatic hydrolysis to break down the cellulose into sugars like glucose that are fermented into alcohol (C38). Cellulose is hydrolyzed to glucose in one of three ways. Hydrolysis with dilute acids at elevated temperatures is possible, but at reduced glucose yields. Hydrolysis with concentrated acids at moderate temperatures increases glucose yields, but acid recovery is highly expensive. A weakness of the acid process is that high temperatures are needed to break down the cellulose to simple sugars, but one must avoid producing breakdown products that inhibit fermentation. In addition, corrosion resistant equipment is expensive. In the enzymatic process, the cost of the enzyme is high (C39) and the residence time required for complete cellulose hydrolysis is long (2-4 days).

SUMMARY OF TECHNOLOGIES, PRODUCTS, AND PROCESSING REQUIREMENTS

Research throughout the decades has lead to the development of many technologies and processes for the beneficial uses of paper mill residuals. The shift away from landfilling and basic incineration toward efforts to find alternative beneficial uses has been in part due to the cost of disposal and the national push toward recycling and reducing the waste of resources. Clearly, efforts to reduce the amount of waste by reclaiming the fiber and clay within the mill before discharging it into the drains should be a mill's first priority.

Many companies provide specialized equipment to separate and recover these fiber and clays. A listing of these companies, as well as those involved in dewatering, drying, processing, and beneficial use technologies can be found in Table C-1. The list includes the company names, addresses, phone numbers, and primary contacts for those interested in obtaining details on the beneficial use technology.

TABLE C-1. Addresses of Beneficial Use Technology Companies.

Application/Technology	Company Name	Street	City	State	Zip Code	Phone Number	Fax Number	Primary Contact
Agricultural Products	GranTech-Granular Technologies	607 Liberty Lane	Green Bay	WI	54304	414-435-5200	414-435-5229	Steve Anderson
Cement/Aggregate Products	Greengrove Corporation	7301 Zane Ave North	Brooklyn Park	MN	55443	800-362-7314	612-566-5517	George Mcade
Cement/Aggregate Products	Minergy Corp (Sub Wise Energy)	231 W Michigan St	Millwaukee	WI	53201	414-221-4700	414-221-3853	Tim Nechval
Cementitious Products	Advanced Concrete Technologies	235 West Road-Unit 11B	Portsmouth	NH	3801	603-431-5661	603-431-5547	Max Hocne
Cementitious Products	Enviro Block Industries	246 E Eau Claire Blvd	Indian Hrb Beach	FL	32937	407-779-0829	407-773-3783	Dr Gary Zeller
Cementitious Products	System Environmental Corp	245 North Valley Road	Xenia	OH	45385-9354	513-372-8077	513-372-8099	John Beasley
Cementitious Products	TDCC(Technology Development Co)	1567 Congress Hill Lane	Fairfield	OH	45014	513-829-4450	513-829-4480	Wendell Judd
Chemical Products	Biofine Incorporated	70 Walnut Street	Wellesley	MA	2181	617-239-8111	617-239-8005	Steve Fitzpatrick
Compost	AllGro (Sub. Wheelabrator Co)	Liberty Lane	Hampton	NH	3842	800-662-2440	NA	Peter Mezzi
Compost	Earth Blends	9293 Bontia Bridge Road	Jordan	NY	13080	800-666-8406	315-689-1359	C.Wesley Gregory
Compost	International Process System	655 Winding Brook Dr	Glastonbury	CT	6033	203-657-3447	203-657-8203	Lewis Naylor
Compost	SSI (Sludge Systems, Intl)	1125 Starr Avenue	Eau Claire	WI	54703	715-835-3151	716-835-6625	NA
Compost	The Scotts Company	1411 Scotts Lawn Rd	Marysville	OH	43041	800-221-6220	513-644-7153	Mike Trueman
Compost	Wilmet Farms	Box 89	Buskirk	NY	12028	518-677-8543	NA	Bob Wilmet
Dewatering Equipment	Andritz-Ruhler	1010 Commercial Blvd S	Arlington	TX	76017	817-465-5611	910-890-5109	Steve Fowler
Dewatering Equipment	Castine Energy Services	117 Silver Street	Waterville	ME	4901	207-877-0459	207-887-0460	John Trivard
Dewatering Equipment	EnviroTech Systems Corporation	1820-999 W Hastings St	Vancouver, B.C	CAN	V6C 2W2	604-685-8496	604-683-2256	Mike Gustavson
Dewatering Equipment	Hydropress	59 Dwight Street	Halfield	MA	1038	413-247-9656	NA	Drew O'Hara
Dewatering Equipment	IMS-Innovative Material System	15630 S. Keeler	Olath	KA	66062	800-800-4010	913-829-2989	NA
Dewatering Equipment	Mobile Dredging & Pumping Co	3100 Bethel Road	Chester	PA	19013	215-497-9500	215-497-9708	Jerry Vetter
Dewatering Equipment	UES (Upstate Environ Services)	215 Tully Street	Syracuse	NY	13204	315-474-3157	315-472-7915	Conrad Teufel
Dewatering & Separation	ZSB (Zane S Blanchard & Co)	Box 789	Hampton Beach	NI	03842	603-926-4830	603-926-8269	Stephen Dumont
Dewatering-Drying Equip	Baker-Rullman, Mfg., Inc	4 East Main PO Box 67	Watertown	WI	53094	414-261-0703	414-261-0425	Dick Lawson

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Application/Technology	Company Name	Street	City	State	Zip Code	Phone Number	Fax Number	Primary Contact
Dewatering-Drying Equip	DUPPS Corporation	548 North Cherry	Germanstown	OH	45327	513-855-6555	513-855-6554	Rick Hollmeyer
Dewatering-Drying Equip	Stord, Inc (An Aket Company)	309 Regional Rd South	Greensboro	NC	27409	919-668-7727	919-668-0537	John DeBollis
Dewatering-Separation	AFT/EC (Applied Filtration Tech)	740 Driving Park	Rochester	NY	14613	800-240-5366	716-458-7476	Kathy Russell
Drying Equipment	Aeroglide Corporation	PO Box 29505	Raleigh	NC	27626	919-851-2000	919-851-6029	Les Horton
Drying Equipment	Consertherm Systems, Inc	PO Box 1146	South Windsor	CT	6074	216-323-5734	216-323-5734	Dave Hocche
Drying Equipment	M-B-C Company	PO Box 330	Neodesha	KS	66757	316-325-2673	316-325-2678	Richard Chaney
Drying Equipment	Ottawa Valley Grain Products	138 Argyle St. North	Renfrew, Ontario	CAN	K7V 4A6	613-432-3614	613-462-6148	Allian Lindsay
Drying Equipment	Rader Companies (Sub.-Beloit)	PO Box 181048	Memphis	TN	38181	901-365-8855	901-795-4077	Ted Gentile
Drying Equipment	Wal-Dor Industries Ltd.	202 Bleams Road East	New Hamburg, Ont	CAN	NOB 2G0	519-662-2820	519-662-2820	Waldm Eckstein
Drying-Absorbent/Animal Bedding	Energy Management Services, LP	1700 Milton Avenue	Solvay	NY	13209	315-487-4346	315-487-4981	Bob Bishop
Energy Recovery	EPI (Energy Products of Idaho)	4006 Industrial Avenue	Coeur d'Alene	ID	83814	208-765-1611	208-765-0503	Brian Meckel
Energy Recovery	Ichikawa EE Co., Ltd	NA	Ichikawa City,	JAPAN	NA	NA	NA	NA
Energy Recovery	InnovEnergy Ltd -Autium Energy	PO Box 81	Marblehead	MA	01945	617-631-6341	617-631-6341	NA
Energy Recovery	Kubota Corporation of Japan	NA	NA	JAPAN	NA	NA	NA	NA
Energy Recovery	Tampella Power Inc.	Lapointe 1	Tampere,	FIN	SF-33101	358-931-241-3111	358-931-241-2666	NA
Engineered Soil	Browning-Ferris Industries	PO Box 3151	Houston	TX	77253	713-870-7470	713-584-8592	Joe Laubenstein
Gasification	Thermogenics, Inc	3620 Wyoming Blvd. NE	Albuquerque	NM	87111	505-298-4381	505-296-4860	Stephen Brand
Land Applic - Compost - Dewatering	Enviro-Gro Technologies	1540 Calton Center Dr	Baltimore	MD	21227	301-536-9000	NA	NA
Land Applic/ Dewatering	Bio-Normic Services, Inc	516 Roundree Road	Charlotte	NC	28217	800-782-6798	NA	NA
Landfill Cover-Hydrosceding	New Waste Concepts	7401 Freemont Pike	Perrysburg	OH	43552	800-359-2783-103	419-837-2692	Jim Offer
Molded Products	Fiber Mold & Petruzzo Products	PO Box 1415	So Glens Falls	NY	12803	518-623-2184	NA	Ralph Petruzzo
Molded/Building Products	All Paper Recycling, Inc.	101 West Pine Street	St Peter	MN	56082	507-931-9615	507-931-9734	Stanley J. Sheika

TABLE C-1. Addresses of Beneficial Use Technology Companies.

Application/Technology	Company Name	Street	City	State	Zip Code	Phone Number	Fax Number	Primary Contact
Oil Absorbents	Absorption Corp	PO Box 5667	Bellingham	WA	98227	206-734-7415	206-671-1588	Doug Ellis
Oil Absorbents	Cellutech, LTD	400 Anderson Avenue	Deferiet	NY	13628	315-493-3540-227	315-493-3540-455	Henry LaLone
Pelletizing Equipment	CPM (California Pellet Mill)	1114 East Wabash Ave	Crawfordsville	IN	42933	317-362-2600	317-362-7551	Paul Tucker
Pelletizing Equipment	Lundell Manufacturing Co , Inc	PO Box 171	Cherokee	IO	51012	712-225-5181	712-225-5185	Steve Paulsen
Pelletizing Equipment	Warren-Bacrg	39950 Rd 108	Dinuba	CA	93618	209-591-6790	209-591-5728	NA

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Appendix D

SURVEY OF NEW YORK STATE RECYCLED MILLS

One of the primary goals of this project was to survey post-consumer recycling mills in New York and identify the beneficial use technologies that have been implemented because of the economic pressures of more expensive fiber furnish and more expensive disposal. The survey was conducted by using the questionnaire included in this Appendix.

SURVEY METHODOLOGY

This survey focused on pulp and paper mills in the state that use post-consumer fiber in the process of making various paper grades. During Fall 1994, available information indicated there were 53 mills in the state. Of that, 23 to 30 mills were believed to be users of post-consumer or recycled fiber. The balance of the mills were believed to be potential resources for information on their waste management practices; waste characteristics; types of technical, regulatory, and economic barriers or limitations to beneficially reusing paper mill residuals; and costs for disposal.

When BES Technologies made initial contact with all 53 mills, it learned that three mills were recently shutdown and one mill was no longer producing paper products. This left 49 potential survey respondents that would receive one of two comprehensive surveys. Each of the surveys were similar, with the major difference being the section describing the fiber sources and uses. A sample copy of the detailed survey that was sent to the recycled/post-consumer mills is included in this appendix. The survey was drafted in October 1994, and reviewed with potential mill respondents, NCASI personnel from the Central Lakes States Region, staff from the Department of Economic Development and the Energy Authority, and the BES Technologies project team.

Typically, less than 20 percent of mailed surveys are completed and returned. To increase the response rate after the surveys were mailed, extensive followups via phone and/or fax were conducted with the mill representatives. Another technique used to increase the level of participation was to provide each mill with the entire survey on 3½-inch computer disk. Because of the variety of word processing programs available, some of the mills were initially asked which type and format they used. For those that responded, the appropriate software format was provided. All the others received their survey in the more common word processing formats.

As a result, of the 30 recycled/post-consumer mills expected to complete the survey, 24 mills did participate, for an 80 percent return rate. Over 20 percent completed the surveys on the computer disk while the remainder completed their survey by hand or typewriter. Of the 20 non-recycled fiber mills in the state, only one mill completed the survey. Given the lack of participation by the non-recycled mills and the fact that the primary focus of the survey was the secondary fiber mills, only the data for the recycled/post-consumer mills have been

included in this report. General reference may be made to comments or beneficial use technologies used by this or other non-recycled mills in the state, but no statistics have been included for these facilities.

**NEW YORK STATE PAPER INDUSTRY
POST-CONSUMER FIBER MILL
SURVEY
BENEFICIAL USES OF PAPER MILL BIOSOLIDS (SLUDGE)**

Information on mill processes, biosolids/sludge generation, disposal and waste management practices by New York State recycling mills is requested for use in a Department of Economic Development and New York State Energy Research and Development Authority project initiative. The purpose of the survey is to assist state paper mills that are facing increasing difficulty with waste disposal. This joint solicitation was awarded to BES Technologies (Watertown, NY), who along with the College of Environmental Science and Forestry (ESF), Young, Stockli & Rowe Law Firm and commercial operations will identify and assess appropriate beneficial use technologies for participating mills.

Questions regarding the survey questions should be directed to: Mr. Keith A. Bowden
@ Telephone Number: (315) 788 - 3621

The survey can be completed in one of two ways:

PREFERRED: On Computer Disk you Received, or

STANDARD: Hard Copy (Typed or Print) 3 ½ " DS DD in Word Perfect 5.x (Windows or DOS) or Microsoft Word-Version x.x

Return in Pre-paid, Self Addressed Envelope Provided MAIL TO: Mr. Keith A. Bowden

All mills have been assigned a unique identification number to ensure that Individual mill data can be maintained confidential, if requested. Any information already public knowledge can't be kept confidential by the BES Technologies Project team.

Feel free to make any clarifications to the survey questions as you go through it. If you need to provide more detailed answers to clarify points, please type the question, respond and append it to the survey before returning.

Important Note : Central Lake States NCASI is conducting a national survey to update an important confidential solid waste survey they conducted in 1989. Many questions NCASI would be asking are the same as this New York State Beneficial Use Survey. For mills that want to save time and not have to answer the same questions in NCASI's survey early next year, BES Technologies will provide its results to them if you approve. Please check either:

Yes, You can provide NCASI with this survey. No, We will complete the NCASI Survey

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SURVEY
BENEFICIAL USES OF PAPER MILL BIOSOLIDS (SLUDGE)
FOR BES Technologies

1. General Information on Your Mill:

Mill name Mill address: City/State: Zip Code:

Mill Identification Code Number: _____

Mill Contact: Title: Tel no: Fax no:

Secondary Contact: Title: Tel. No:

Is the location a 24 hour a day 7 day per week operation: Yes or No

If No, Describe: _____ Hours per day _____ Days Per Week

What is your 1993 & 1994 (Y- T-D) Production (Finished) _____tpd (1993) _____tpd(1994)

2. Description of your Mill's Recycle Operation: (See Glossary/Definitions at the end of the Survey)

Raw Material (Pulp Fiber) Input Sources: (Include percent For All That Apply)

Produce Own Virgin Pulp: (Integrated Mill) Yes or No X if Need More Fiber Sources?

Type: Describe _____percent Total

Type: Describe _____percent Total

Type: Describe _____percent Total

Purchase Virgin Pulp: Yes or No X if Need More Fiber Sources?

Type: Describe _____percent Total

Type: Describe _____percent Total

Type: Describe _____percent Total

Recycled Fiber Purchased/Produced/Used: Yes or No X if Need More Fiber Sources?

Mixed Paper (MOW & OMG) _____percent Total

Old Newsprint (ONP) _____percent Total

Old Corrugated Containers _____percent Total

High Grade Deinking (HDI) _____percent Total

Pulp Substitutes (PSUBS) _____percent Total

Other Fiber Types: Describe: _____percent Total

Total (Should Equal 100 percent) 100 percent

Describe any unique aspects of your recycle operation that may affect the properties of your Waste Treatment Plant Biosolids/Sludge:

How variable is the recycled pulp recipe for the various grades run? High (Some Grades have little or no recycle while others are 75 percent + recycle content) Medium (Grades range from 50-- 80 percent Recycle Content) Low (Consistently over 75 percent Recycle Content)

Describe the furnish preparation procedures for your recycle operation:

(Include a simple flow diagram of the Pulping, Deinking, screening, cleaning and/or bleaching.)

3. Finished Products Manufactured @ this Location:

Describe Product(s) produced:

Do some recycled grades produce higher losses of clays, fillers, fiber, contaminants: Y or N

If yes, Please describe:

How much do sewer losses (BOD and TSS) increase from these grades?:

(Express as a Percentage or as Pounds of BOD or TSS Per Ton of Finished Production)

4. Other Waste Types/Sources:

Describe the major contributors to the Influent Loading to the treatment plant that will become part of the waste treatment plant Biosolids:

A. Pulp Mill Sources: Kraft: Y or N Deinked: Y or N Recycled: Y or N

Pulper Rejects: Y or No Screens & Cleaners Y or N

Other Major Pulp Mill Sources (i.e. Debarking, wood washing) Describe:

B. Bleach Plant Sources: Describe:

C. Coating Kitchen/Department: Describe:

D. Boiler/Power Plant Sources: Bottom Ash Y or N Fly Ash Y or N

What is the source of Ash? Coal Wood Waste? Waste Tires? Other? Combination? If a combination, what are the ratio's?

E. Causticizing Area? Y or N

F. Other Major contributors (Water Treatment plant / Alum Sludges, etc.) Describe:

Can any of these waste streams be separated before processing or disposal or do they have to be combined for proper treatment plant operation? Describe:

5. Waste Treatment Plant Operation (WTP):

Does WTP treat any sanitary wastes under normal operations? Y or N

Could it handle any sanitary wastes under some upset condition? Y or N

If Yes was answered above, Please Explain Below:

Is the Treatment Plant Company Owned and Operated? Y or N

If No, Do you Discharge Some/All to a Public Works (POTW) Y or N

What is the Ratio of Company Owned to POTW Biosolids Discharges. _____to _____

What Type of Treatment Plant Operation (or Combination) Do You Operate?

 i.e. Activated Sludge, Trickling Filter, Aerated Stabilization Basins, etc.

Does the company-owned WTP system include primary clarification? Y or N

Please Check the Type: Settling Pond/Lagoon Primary Clarifiers

Thickeners:

Other (Describe):

What is the age of the Primary Treatment Plant equipment: Years

How would you characterize the condition of your plant: Fair Good Excellent?

How Much Primary Biosolids is Generated Per Day _____Bone Dry Tons Per Day

What is the Per Cent Solids of this Primary Biosolids? _____percent Solids (Bone Dry)

Does the Wastewater Treatment include Secondary Treatment? Y or N

Please Check/Describe the Type: Activated Sludge Aerated Stabilization Basin
Trickling Filter Other (Describe)

What is the age of the Primary Treatment Plant: _____ Years

How would you characterize the condition of your plant: Fair Good Excellent

Are WTP Biosolids generated intermittently due to the dredging of treatment basins, sludge
lagoons? Y or N If Yes, Please Describe:

How Much Secondary Biosolids is Generated Per Day Bone Dry Tons Per Day

What is the Per Cent Solids of this Secondary Biosolids: percent Solids (Bone Dry)

If the Primary and Secondary Treatment Plant Solids are combined and the generation rate cannot be
determined separately, what is the total Biosolids production? _____ BD Tons/Day

What is the % Solids of this combined solids fed to the dewatering plant or POTW? ____percent Solids (BD)

6. Sludge Dewatering Plant Data:

What Type of Dewatering Process, if any do you have? (Check ALL that are applicable)

Coil Filters Centrifuge Belt Press
Screw Press Drying Bed Oven Other

How much Biosolids (Bone Dry Tons Per Day) is generated at the Dewatering Plant for each type?:

Coil Filters Tpd Centrifuge Tpd Belt Press Tpd
Screw Press Tpd Drying Bed Tpd Oven Tpd Other Tpd

How much Biosolids (Cubic Yards Per Day) is generated at the Dewatering Plant for each type?:

Coil Filters CYD Centrifuge CYD Belt Press CYD
Screw Press CYD Drying Bed CYD Oven CYD Other CYD

Do you have a specific/preferred name for your Dewatered Biosolids/sludge? (Examples: Filter Cake,
Short Paper Fiber, Fiber Clay, Etc.) If so, Please provide the name Here.

7. Current Waste Disposal Methods:

Is your primary Biosolids disposal method dependent upon landfilling? Y or N

Do you currently use a company owned landfill? On-Site or Off-Site

If it is Off-site, What is the one way distance (In Miles) to the facility? Miles

Describe the Features of the landfill.

Does it have a single or a composite liner system? Y or N

Does it have a leachate collection system? Y or N

When was it first placed in operation? Year.

When will the currently constructed landfill reach capacity? Year

Can you expand the current Landfill to provide additional air space?

Does it meet the Part 360 landfill Regulations in NY State? Y or N

If No, are you under a consent order to provide approved biosolids/sludge disposal capacity:

Describe:

Do you use a public landfill for your mill Biosolids? Y or N A private landfill?

If you use an off -site landfill, How are the Biosolids waste transported to the off-site facility?

Company owned Truck transportation? Y or N

Contracted Services? Y or N

Do you utilize an alternate means of Biosolids disposal, such as:

Incineration (no energy recovery) Y or N

Energy Recovery? Y or N

Other Disposal methods? Describe:

8. Beneficial Uses of Mill Generated Biosolids:

Do you currently utilize some type of beneficial use of your Biosolids wastes? Y or N

Has your company explored alternate Beneficial Use technologies? Y or N

If so, please indicate which method(s) are used and/or have been considered/attempted?

	Are currently used?	Have been considered/attempted?
Land Spreading:	Y or N	Y or N
Composting:	Y or N	Y or N
Mulch:	Y or N	Y or N
Artificial Soil:	Y or N	Y or N
Animal Feed:	Y or N	Y or N
Animal Bedding:	Y or N	Y or N
In Cement Block:	Y or N	Y or N
Building Materials:	Y or N	Y or N
Cement Kiln Feed:	Y or N	Y or N
For Chemicals:	Y or N	Y or N
Oil Absorbents:	Y or N	Y or N
Cat Litter:	Y or N	Y or N
Hydroseeding:	Y or N	Y or N
Products-Egg Box	Y or N	Y or N
Export Fiber:	Y or N	Y or N
Landfill Cover:	Y or N (Not on own))	Y or N (Not on own)
Other Uses:	Y or N	Y or N

Describe other Beneficial Uses current in place or tried but were not utilized? (Please provide any written documentation, copies of BUD petitions, consultant reports etc. that you can on your beneficial use activities for your location)

Would you consider any of the above technologies for Beneficial Use of Biosolids at your mill if there were no barriers to their implementation? If Yes, Which one(s) would you consider?

If no, which ones would you not consider?

Why not?

What were the barriers that prevented your company from following through on the alternate Methods?

Technological Barriers?	Describe:
Economical Barriers?	Describe:
Economic Barriers?	Describe:
Management Philosophical Barriers:	Describe:
Local Issues?	Describe:
Legal Barriers?	Describe:
Regulatory Barriers?	Describe:
Other Barriers?	Describe:

9. Biosolids Characteristics/Properties:

This Section requires specific information on the physical and chemical make-up of your Biosolids. The information you provide will only be included in the final report under the mill's unique code number

assigned under Section 1.0. This data will NOT be directly referenced to your mill without your knowledge.

Please check here if this is acceptable: Yes, this is acceptable.

No, We would prefer other provisions to keep this data confidential. The other provisions are as follows:

Describe:

What are some of the Physical Properties of your final Biosolids:

Color: Describe:

Odor: (As is, from final Dewatering process) Describe:

Is there a different Odor after the Biosolids has sat at room temperature for 3-5 days?

Describe:

Describe any odor from Biosolids samples during/after dried in an oven (104-150 degrees C):

Describe the texture of the Wet, as is Biosolids:

Describe the texture of the dried Biosolids:

Other Physical Properties of the Biosolids:

Bulk density (as is Moisture level): Pounds/Cubic Foot (Loose Compaction)

Bulk density (as is Moisture level): Pounds/Cubic Foot (Tight Compaction)

Bulk density (Oven Dried): Pounds/Cubic Foot (Loose Compaction)

Bulk density (Oven Dried): Pounds/Cubic Foot (Tight Compaction)

Compositional Analyses of the Biosolids: (Please Provide a Copy of any/all Analyses)

Percent solids (Bone Dry): Percent Moisture:

Percent Ash (non-Volatile): Percent Volatiles:

Ash fusion Temperature, If Known:

Please provide a copy of an ash Analysis: Attached? Yes or No

Have you had an ultimate Analysis done on your Biosolids? Yes or No

(An ultimate analysis is done for data on the carbon, hydrogen, sulfur, Btu content, etc.)

Provide a copy of an Ultimate Analysis: Attached? Yes or No

What is the Heat Content of your Biosolids: _____Btu's Per Pound (As Is)

_____Btu's Per Pound (Bone Dry)

What is the nutrient content of your Biosolids: Nitrogen Phosphorus Potassium

What is the Carbon to Nitrogen ratio of your Biosolids? to (C:N)

Please provide a copy of a Nutrient Analysis: Attached. Yes or No

Particle Size Distribution Results: Attached? Y or N

Calcium Carbonate Present? Y or N

Chemical Composition of your mill's Biosolids: (From last dewatering step): If you have more than one analysis for the Biosolids, please include the mean/average, the range (low-High) and the number of Data Points the average represents, i.e. a 3 would mean the average of 3 analyses.

TCLP (Heavy) Metal Extracts from Biosolids:

Chemical Constituent (Units)	Average	Range (Lo-Hi)	Data Points
Aluminum(mg/l)			
Antimony(mg/l)			
Arsenic(mg/l)			

Barium(mg/l)
Beryllium(mg/l)
Cadmium(mg/l)
Calcium(mg/l)
Hex.Chromium(mg/l)
Copper (mg/l)
Iron (mg/l)
Lead(mg/l)
Manganese(mg/l)
Mercury(mg/l)
Nickel(mg/l)
Selenium (mg/l)
Silver(mg/l)
Sodium(mg/l)
Thallium(mg/l)
Zinc(mg/l)

TCLP Pesticides/Herbicides Extracts from Biosolids

Chlordane (mg/l)
Endrin (mg/l)
Heptachlor (mg/l)
Hept. Epoxide(mg/l)
Lindane (mg/l)
Methoxychlor (mg/l)
Toxaphene (mg/l)
2,4 - D (mg/l)
2,4,5-TP (mg/l)

Summary Tables (Mean, Range, Data Points) & Copies of the Analytical Data as Well:

TCLP Volatile Organics - TCLP Extracts from Sludge:

Benzene (ug/l)
Xylene (ug/l)

Toluene (ug/l)

Etc.

TCLP Semi-Volatile Organics Extracts from Biosolids:

EPA METHOD 624 - TCLP Extract from Biosolids:

EPA METHOD 8270 - Acid/Base/Neutrals - TCLP Extract :

EPA METHOD 8080 - PCB in Solids-Biosolids:

Dioxin and Furan Range Data on Biosolids:

10. Cost Information for Mill Biosolids:

Disposal Method Costs Data: (Include For all that Apply)

Landfills: Company Owned: \$ /Bone Dry Ton

Does Above Figure Include Transportation? Y or N

If No, Please provide a Detailed Breakdown of Costs.

Public/Municipal landfill: \$ /Bone Dry Ton

Does Above Figure Include Transportation? Y or N

If No, Please provide a Detailed Breakdown of Costs.

Private landfill: \$ /Bone Dry Ton

Does Above Figure Include Transportation? Y or N

If No, Please provide a Detailed Breakdown of Costs.

Other alternate means of Biosolids disposal:

Incineration (no energy recovery) \$ /Bone Dry Ton

Does Above Figure Include Transportation? Y or N

If No, Please provide a Detailed Breakdown of Costs.

Energy Recovery? \$ /Bone Dry Ton

Does Above Figure Include Transportation? Y or N

If No, Please provide a Detailed Breakdown of Costs.

Other Disposal Methods: Describe: \$ /Bone Dry Ton

Does Above Figure Include Transportation? Y or N

If No, Please provide a Detailed Breakdown of Costs.

Beneficial Use Method Costs Data: (Include Costs to Utilize the Beneficial Reuse Method - If you Are Actually Making a Profit from the Method, Note it as Income - \$ xx/Bone Dry Ton for all that Apply)

Land Spreading: \$ /Bone Dry Ton

Does Above Figure Include Transportation? Y or N

If No, Please provide a Detailed Breakdown of Costs.

Composting: \$ /Bone Dry Ton

Does Above Figure Include Transportation? Y or N

If No, Please provide a Detailed Breakdown of Costs.

Mulch: \$ /Bone Dry Ton

Does Above Figure Include Transportation? Y or N

If No, Please provide a Detailed Breakdown of Costs.

Artificial Soil: \$ /Bone Dry Ton

Does Above Figure Include Transportation? Y or N

If No, Please provide a Detailed Breakdown of Costs.

Animal Feed: \$ /Bone Dry Ton

Does Above Figure Include Transportation? Y or N

If No, Please provide a Detailed Breakdown of Costs.

Animal Bedding: \$ /Bone Dry Ton

Does Above Figure Include Transportation? Y or N

If No, Please provide a Detailed Breakdown of Costs.

In Cement Block: \$ /Bone Dry Ton

Does Above Figure Include Transportation? Y or N

If No, Please provide a Detailed Breakdown of Costs.

Building Materials: \$ /Bone Dry Ton
Does Above Figure Include Transportation? Y or N
If No, Please provide a Detailed Breakdown of Costs.

Cement Kiln Feed: \$ /Bone Dry Ton
Does Above Figure Include Transportation? Y or N
If No, Please provide a Detailed Breakdown of Costs.

For Chemicals: \$ /Bone Dry Ton
Does Above Figure Include Transportation? Y or N
If No, Please provide a Detailed Breakdown of Costs.

Oil Absorbents: \$ /Bone Dry Ton
Does Above Figure Include Transportation? Y or N
If No, Please provide a Detailed Breakdown of Costs.

Cat Litter: \$ /Bone Dry Ton
Does Above Figure Include Transportation? Y or N
If No, Please provide a Detailed Breakdown of Costs.

Hydroseeding: \$ /Bone Dry Ton
Does Above Figure Include Transportation? Y or N
If No, Please provide a Detailed Breakdown of Costs.

Products-Egg Box \$ /Bone Dry Ton
Does Above Figure Include Transportation? Y or N
If No, Please provide a Detailed Breakdown of Costs.

Export Fiber: \$ /Bone Dry Ton
Does Above Figure Include Transportation? Y or N
If No, Please provide a Detailed Breakdown of Costs.

Landfill Cover: \$ /Bone Dry Ton

(Not own Landfill) Does Above Figure Include Transportation? Y or N

If No, Please provide a Detailed Breakdown of Costs.

Other Uses: \$ /Bone Dry Ton

Does Above Figure Include Transportation? Y or N

If No, Please provide a Detailed Breakdown of Costs.

11. Other Related Factors that Can Effect Economics/Viability of Implementing Beneficial Use

Methods:

Company Philosophy/Policy:

Does your company have any specific policies that would prevent you from pursuing a particular Beneficial Use technology? i.e. will not landsread, must be low (or high) technology, will not be first to use new technology, etc. Describe:

- Has your mill incorporated Total Quality Management, Empowerment, ISO 9000 etc. practices and/or procedures at your mill location? Describe:

Land Availability:

- Does Your Company Own Large Amounts (Over 500 acres) of Acreage? Y or N
Is it Open/Agricultural Type Land? Y or N Forested? Y or N
If Yes, how Close to the Mill (Miles) is it? Miles

Are there Other Large Non-Company Owned Lands Nearby? Y or N

Is it Open/Agricultural Type Land? Y or N Forested? Y or N

If Yes, how Close to the Mill (Miles) is it? Miles

Transportation Services:

- Is Your Mill Near to Railroad Service? Y or N
Is it Company Owned? Y or N
- Is Your Mill Near (within 5 miles) of an Interstate Highway System? Y or N
- Near a State Road with high load/ carrying capacity? Y or N
- Near Water Transportation? Y or N

Are there any major bridges that have weight/load restrictions on them? Y or N

Community Issues:

- Is your Mill in a city/village limits that may be sensitive to high truck traffic or noise?

Y or N If Yes, please Describe:

- How is your Mill viewed in terms of compliance with Environmental Regulations by the following groups:

Your Employees: Poor Fair Good Very Good Excellent Don't Know

Local Government: Poor Fair Good Very Good Excellent Don't Know

County Government: Poor Fair Good Very Good Excellent Don't Know

State Government: Poor Fair Good Very Good Excellent Don't Know

Regional DEC: Poor Fair Good Very Good Excellent Don't Know

State DEC: Poor Fair Good Very Good Excellent Don't Know

- Do you know your local officials: (Respond to only those that apply)

Town/Village Board: Poor Fair Good Very Good Excellent Don't Know

Planning Board: Poor Fair Good Very Good Excellent Don't Know

Zoning Board: Poor Fair Good Very Good Excellent Don't Know

Mayor/City Council: Poor Fair Good Very Good Excellent Don't Know

State Senator: Poor Fair Good Very Good Excellent Don't Know

Representative: Poor Fair Good Very Good Excellent Don't Know

Industrial Dev. Agcy: Poor Fair Good Very Good Excellent Don't Know

Survey Glossary, Definitions, Abbreviations and / or Examples: (Source: NCASI or other
Pulp and Paper Publications)

Raw Material (Pulp Fiber) Definitions:

Biosolids: Primarily an organic material produced from the primary and/or secondary treatment of wastewater to make a product that can be beneficially recycled into the environment.

Integrated Mill: A mill which produces some or all of its pulp and may use none, some or all of that pulp in combination with purchased virgin or recycled fiber.

Non-integrated Mill: A mill that produces none of its own pulp on-site, but it produces paper(board) from purchased virgin or recycled pulp fiber.

Virgin Pulp: Pulp produced directly from wood/cellulose fiber and not from any recycled fiber source.

Recycled Fiber (Same as Secondary / Recovered Fiber): Fiber furnish consisting of recovered fibrous paper or paperboard known also in the regulatory community as "post-consumer" material.

Pre-Consumer Fiber: Examples would include Solid Bleached Sulfate (SBS) from off-site converting operations, but not including on-site mill broke.

Common Types of Recycled/Secondary Fiber:

Mixed Paper: consists of Mixed Office Waste (MOW) and Old Magazines (OMG)

Old Newsprint: (ONP) is old newspapers.

Old Corrugated Containers: (OCC) represents old cardboard boxes.

High Grade Deinking: (HDI) fiber is used computer and laser papers that's been reclaimed. Pulp Substitutes (PSUBS): Pulp Substitutes would be baled/rolled trimmings from perfect bound books, SBS (Softwood Bleached Sulfate) sources, etc.

A. Company Landfill - Refers to placement of materials in a landfill which your company owns.

B. Municipal Landfill - This means disposal in a landfill which also serves community solid waste management needs by receiving municipal or commercial solid waste. The landfill may be either privately or publicly owned. It does not include disposal in company-owned landfill which also receive municipal waste. See (A) above.

C. Private or Other Landfill - This means placement of materials in a landfill owned by someone other than your company which receives no municipal solid waste but which may receive wastes from other industries.

- D. Land Application - This means application to the land for any purpose (other than landfilling) including agriculture, silviculture, and land reclamation. (See also Regulatory Definition # 93)
- E. Incineration - This means incineration in any form whether it be in company-owned facilities or not. If the material is processed into a fuel, see (H) below.
- F. Recycle/Reuse in Process - This does not include incineration of the material in a process-related furnace or boiler. See (E) above.
- G. Distribute Unprocessed - This could be, for example, selling or giving away dewatered lime mud to local farmers for soil conditioning. Do not include composted waste even if it is distributed after composting. See (I) below.
- H. By-products - This is selling or giving away materials for incorporation into products, usually after some processing. Examples are contaminated broke converted into refuse derived fuel. Do not include composted waste even if it is used as a feedstock for further processing.
- I. Compost(ing) - This means a deliberate process by which biodegradation of the material is encouraged. Do not include composted waste in (G) or (H) above even if it is eventually distributed or used as a feedstock for further processing.
- J. Hazardous Waste - This means a waste meeting the TCLP criteria and that must be taken to a permitted hazardous waste treatment or disposal facility.
- K. Lagoon - This means the disposal of a 'pump-able' waste in a basin. Normally, the supernatant from lagoons is returned to the waste treatment plant.

Land Spreading: (See Land Application (D) Above)

Composting: (See I above)

Mulch: Biosolids blended with bark, sawdust and/or other wood debris and used for landscaping

Artificial Soil: Biosolids mixed with sand, clay and/or other soils to produce a replacement (top)soil

Animal Feed: Paper Mill Biosolids and other additives for use as a feed supplement for any animal.

Animal Bedding: Dried Biosolids used as bedding for livestock, chickens etc.

Cement Block: Wet Biosolids added to Portland cement, etc. to produce a light weight aggregate/block

Building Materials: Biosolids mixed with gypsum, particleboard materials to make drywall and/or panels.

Cement Kiln Feed: Biosolids added to the input to a cement kiln to recover energy and reuse filler clays.

Chemicals: Biosolids that are processed/converted to chemicals such as ethanol, levulinic acid,

Oil Absorbents: Biosolids that are dried and converted to absorbents for clean-up of oil spills

Cat Litter: Absorbents made from Biosolids used as cat litter products.

Hydroseeding: Biosolids used as substitutes for newspaper/sawdust for grass seeding/landscaping purposes.

Products: Biosolids pressed into various product shapes (egg cartons, flower pots, etc.) for sale

Export Fiber: The Biosolids are shipped to another paper mill facility (in or out of the US) for reuse/reclaim.

Landfill Cover: Biosolids used as a daily or intermediate cover at a landfill (Not own Landfi

REGULATORY DEFINITIONS THAT APPLY TO MILLS IMPLEMENTING BENEFICIAL USE TECHNOLOGIES

Part 360 Section 1.2:

The definitions that follow have been excerpted from 6 NYCRR Part 360 Subpart 360-1, Section 360-1.2 of the General Provisions of the New York State Solid Waste Management Regulations promulgated October 9, 1993. They represent some of the definitions that a New York State mill would have to apply to any beneficial use, reuse and/or recycle activity that they need to pursue. Use these definitions as applicable while completing this DED and NYSERDA sponsored survey. You may find that the way the definitions are themselves written are a regulatory/legal barrier in implementing a particular technology. If so, please note on a separate page/attachment which definition is of concern and how it could be improved to remove a barrier. (If you are using/completing this survey by computer, feel free to "Cut and Paste" the critical sections and mark them up with suggested language changes).

The following terms have the following specific meanings when used in this Survey: (From Part 360 Rules)

(a) Solid waste and related terms.

(1) Solid waste means, except as described in paragraph (4) of this subdivision, any garbage, refuse, sludge from a wastewater treatment plant, water supply treatment plant, or air pollution control facility and other discarded materials including solid, liquid, semi-solid, or contained gaseous material, resulting from industrial, commercial, mining and agricultural operations, and from community activities, but does not include solid or dissolved materials in domestic sewage, or solid or dissolved materials in irrigation return flows or industrial discharges that are point sources subject to permit under 33 USC 1342, as amended (86 Stat. 880), or source, special nuclear or by-product material as defined by the Atomic Energy Act of 1954, as amended (68 Stat. 923) except as may be provided by existing agreements between the State of New York and the government of the United States (see section 360-1.3 of this Part).

(2) A material is discarded if it is abandoned by being:

(i) disposed of;

(ii) burned or incinerated, including being burned as a fuel for the purpose of recovering usable energy; or

(iii) accumulated, stored or physically, chemically or biologically treated (other than burned or incinerated) instead of or before being disposed of.

(3) A material is disposed of if it is discharged, deposited, injected, dumped, spilled, leaked or placed into or on any land or water so that such material or any constituent thereof may enter the environment or be emitted into the air or discharged into groundwater or surface water.

(4) The following are not solid waste for the purposes of this Part:

(i) domestic sewage;

(ii) any mixture of domestic sewage and other wastes that pass through a sewer system to a publicly owned treatment works for treatment, except for any material that is introduced into such system in order to avoid the provisions of this Part;

(iii) industrial wastewater discharges that are actual point source discharges subject to

permits under ECL article 17. Industrial wastewaters, while they are being collected, stored or treated before discharge, and sludges that are generated by industrial wastewater treatment are solid wastes and are regulated by this Part;

(iv) irrigation return flows;

(v) radioactive materials which are source, special nuclear or byproduct material as defined by the Atomic Energy Act of 1954, as amended (see section 360-1.3 of this Part);

(vi) materials subject to in situ mining techniques which are not removed from the ground as part of the extraction process;

(vii) discarded materials that the department has determined are being beneficially used pursuant to section 360-1.15 of this Part; and

(viii) materials including source separated recyclables that have been traditionally incorporated as a secondary material in the manufacturing process. In this context, manufacturing processes may include, but not be limited to, the production of: inorganic chemicals; iron, steel and iron and steel products; leather and leather products; nonferrous metals and nonferrous metal products; organic chemicals; plastic products and plastic resins; pulp and paper products; rubber and miscellaneous plastic products; textiles and textile products; household and business products; and, transportation equipment.

REGULATORY DEFINITIONS FROM SECTION 360-1.2 OF THE GENERAL PROVISIONS(SOLID WASTE)

(17) Baseline parameters means the list of standard chemical species or other samples listed in the Baseline Parameters Table of the Water Quality Analysis Tables in paragraph 360-2.11(d)(6) of this Part.

(20) Bottom ash means the ash residue remaining after combustion of solid waste or solid waste in combination with fossil fuel in a solid waste incinerator that is discharged through and from the grates, combustor or stoker.

(34) Composting facility means a solid waste management facility used to provide aerobic, thermophilic decomposition of solid organic constituents of solid waste to produce a stable, humus-like material.

(48) Daily cover means a compacted layer of at least six inches of cover material, unless otherwise approved by the department, that is placed on all exposed solid waste at the end of each working day of operation at a landfill.

(52) Disposal facility means a solid waste management facility or part of one in or on which solid waste is intentionally placed, including any land or water, and at which solid waste will remain after closure.

(53) Domestic sewage means water-carried human and animal wastes from residences, buildings, industrial establishments or other places, together with such groundwater infiltration and surface waste as may be present.

(63) Farm means the raising or harvesting of any agricultural or horticultural commodity through the cultivation of the soil, aquacultural product or the raising, shearing, feeding, caring for, training mgmt of livestock, bees, poultry, furbearing animals, fish, domestic animals or wildlife.

(66) Final cover system means an engineered layer of materials approved by the department that is placed on any surface of a landfill where no additional solid waste will be deposited within one year and serves to restrict infiltration, support vegetation, control landfill gas and promote surface drainage.

(68) Fly ash means the ash residue from the combustion of solid waste or solid waste in combination with fossil fuel that is entrained in the gas stream of the solid waste incinerator and removed by the air pollution control equipment.

(69) Food chain crops means tobacco, crops grown for human consumption and crops grown for feed for animals whose products are consumed by humans.

(72) Free liquids means liquids which readily separate from the solid portion of a solid waste under ambient temperature and pressure.

(73) Garbage means putrescible solid waste including animal and vegetable waste resulting from the handling, storage, sale, preparation, cooking or serving of foods. Garbage originates primarily in home kitchens, stores, markets, restaurants and other places where food is stored, prepared or served.

(87) Incinerator means an enclosed device using controlled flame combustion to thermally break down solid waste, including refuse-derived fuel, to an ash residue that contains little or no combustible materials.

(88) Industrial waste means solid waste generated by manufacturing or industrial processes. Such processes may include, but are not limited to the following: electric power generation; fertilizer/agricultural chemicals; inorganic chemicals; iron and steel manufacturing; leather and leather products; nonferrous metals manufacturing/foundries; organic chemicals; plastics and resins manufacturing; pulp and paper industry; rubber and miscellaneous plastic products; stone, glass, clay and concrete products; textile manufacturing; transportation equipment; and water treatment. The forms of such wastes are exemplified by but not limited to: liquids such as acids, alkalis, caustics, leachate, petroleum (and its derivatives), and processes or treatment wastewaters; sludges which are semi-solid substances resulting from process or treatment operations or residues from storage or use of liquids; solidified chemicals, paints or pigments; and dredge spoil, foundry sand, and the end or by-products of incineration or other forms of combustion. This term does not include oil or gas drilling, production, and treatment wastes (such as brines, oil, and frac fluids); overburden, spoil, or tailings resulting from mining; or solution mining brine and insoluble component wastes.

(91) Intermediate cover means a compacted layer of at least 12 inches of cover material, unless otherwise approved by the department, placed where no additional solid waste has been deposited or will be deposited within a period of 30 days.

(92) Intermediate processor means any person who receives separated recyclables only from registered recyclables handling and recovery facilities within New York State or facilities otherwise acceptable to the department if located outside of New York State, and then markets same to other intermediate processors, brokers or manufacturers.

(93) Land application facility means a site where solid waste is applied to the soil surface or injected into the upper layer of the soil to improve soil quality or provide plant nutrients. Solid waste suitable for this purpose includes, but is not limited to, certain food processing waste, sewage treatment plant sludge and septage.

(95) Landfill means land or a disposal facility or part of one where solid waste or its residue after treatment is intentionally placed and which is not a land application facility, surface impoundment, injection well or waste pile.

(103) Mixed solid waste means combinations of putrescible & nonputrescible waste materials.

(104) Monofill means a landfill or landfill cell into which only one type of waste, as recognized by the department, is placed.

(105) Municipality means a county, village, town, city, any designated agency thereof, a solid waste management district, a public benefit corporation having power granted otherwise than under

ECL article 51, to construct, operate and maintain a solid waste management facility, including a public corporation created pursuant to agreement or compact with another state; or any combination thereof.

(106) Municipal solid waste means combined household, commercial and institutional waste materials generated in a given area.

(107) Offsite means any property which is not onsite.

(109) Onsite means the same or geographically contiguous property under the control or ownership of the same person. It may be divided by public or private rights-of-way, provided the entrance and exit between the properties is at a crossroads intersection, and access is gained by crossing, as opposed to going along, the right-of-way. Noncontiguous properties owned by the same person, but connected by a right-of-way which that person controls and to which the public does not have access, are also considered on-site property.

(120) Processing facility means a combination of structures, machinery or devices, other than collection and transfer vehicles, utilized to reduce or alter the volume or the chemical or physical characteristics of solid waste through processes such as, but not limited to, separating, crushing, screening, baling or shredding before its delivery to any solid waste management facility.

(122) Publicly owned treatment works (POTW) means any device or system used in the treatment (including recycling and reclamation) of municipal sewage or industrial wastes of a liquid nature that is owned by a state or municipality (as defined in section 502(4) of the Federal Water Pollution Control Act, as amended; see section 360-1.3 of the Part 360 regulations). This definition includes sewers, pipes or other conveyances only if they convey wastewater to a publicly owned treatment works.

(129) Recycle means to use recyclables in manufacturing a product.

(130) Recyclable means solid waste that exhibits the potential to be used repeatedly.

(131) Recyclables handling and recovery facility means a solid waste processing facility, other than collection and transfer vehicles, at which nonputrescible recyclables are separated from the solid waste stream or at which previously separated nonputrescible recyclables are processed.

(132) Refuse means anything putrescible or nonputrescible that is discarded or rejected as useless or worthless.

(133) Refuse-derived fuel means treated solid waste that is used as a fuel. Off-products of pyrolysis are not considered refuse-derived fuel.

(134) Refuse-derived fuel processing facility means the combination of structures, machinery or devices utilized to reduce or alter the volume of mixed solid waste before delivery to a solid waste incinerator or pyrolysis facility.

(139) Residuals means sludge, sewage sludge, septage, air pollution control facility waste or any other such waste having similar characteristics or effects and solid waste remaining after the processing of solid waste by composting methods that was not suitable for use.

(140) Residue means all solid waste remaining after treatment and includes, but is not limited to ash residue and other solid waste that is not recovered or combusted.

(141) Resource recovery facility means a combination of structures, machinery or devices utilized to separate, process, modify, convert, treat or prepare collected solid waste so that component materials or substances or recoverable resources may be recovered or used as a raw material or energy source.

(142) Routine parameters means the standard chemical species or other samples listed in the Routine Parameters Table of the Water Quality Analysis Tables in paragraph 360-2.11(d)(6) of the Part 360 regulations.

(146) Salvaging means the incidental removal of solid waste for reuse under the control of the facility owner or operator.

(151) Septage means the contents of a septic tank, cesspool or other individual sewage treatment facility that receives domestic sewage wastes.

(153) Sewage sludge means the accumulated semi-solids or solids resulting from treatment of wastewaters from publicly or privately owned or operated sewage treatment plants. Sewage sludge does not include grit or screenings or ash generated during the incineration of sewage sludge.

(154) Site means the geographically contiguous property of a solid waste management facility and includes the land area of that facility and its access roads, appurtenances and land buffer areas.

(155) Sludge means any solid, semi-solid or liquid waste generated from a wastewater treatment plant, water supply treatment plant or air pollution control facility but does not include the treated effluent from a wastewater treatment plant.

(162) Stabilized sludge means sludge that has been digested or otherwise treated to reduce putrescibility and odor, reduce pathogenic organisms and, except for lime stabilization, reduce the volatile solids content.

(163) Start-up means that period of time (not to exceed 180 days) starting with the initial receipt of solid waste, refuse-derived fuel, or regulated medical waste at the facility, in which a solid waste incinerator, refuse-derived fuel processing facility, pyrolysis unit or regulated medical waste treatment and destruction facility is breaking in and adjusting equipment before long term operation. This period provides for equipment adjustment and owner acceptance testing.

(164) Storage means the containment of any solid waste in a manner which does not constitute disposal under section 360-1.2(a)(3) of the Part 360 regulations; provided, however, that any accumulation of solid waste for a period in excess of 18 months shall be deemed to constitute disposal.

(172) Transfer station means a solid waste management facility other than a recyclables handling and recovery facility, used oil facility, or a construction and demolition debris processing facility, where solid waste is received for the purpose of subsequent transfer to another solid waste management facility for further processing, treating, transfer or disposal. Transfer of solid waste from vehicle to vehicle for the purpose of consolidating loads, as part of the initial collection process, is not considered a transfer station provided the transfer activity occurs along the collection route where the point of transfer changes from day to day. Transfer of leakproof, closed modular containers of solid waste from vehicle to vehicle, including truck to train, for the purpose of consolidating loads for shipment to an authorized disposal or treatment facility, is not considered a transfer station provided: the contents of each container remain in their closed container during the transfer between vehicles; storage remains incidental to transport at the location where the containers are consolidated; containers are acceptable to the department and maintained in a safe, nuisance-free (e.g., dust, odor, noise, etc.) manner; and, the transfer location is under the ownership or control of the transporter.

(173) Transporter means a person engaged in the off-site transportation of solid waste by air, rail, highway or water.

(174) Treatment means, except in the case of regulated medical waste, any method, technique or process designed to change the physical, chemical or biological character or composition of any solid waste to recover energy or materials from it, to render it safer to transport, store or dispose of or to make it amenable for reuse, recovery, storage or reduction in volume. Treatment of regulated medical waste is defined in section 360-17.2 of the Part 360 regulations.

(175) Unadulterated wood means wood that is not painted or treated with chemicals such as glues, preservatives or adhesives. Any painted wood or chemically treated wood (e.g., pressure treated wood, treated railroad ties) or wood containing glues or adhesives (e.g., plywood, particle board) is considered adulterated wood.

SECTION 1.13 : RESEARCH, DEVELOPMENT AND DEMONSTRATION PROJECTS:

The Research & Development section that follows has been excerpted from Part 360 Subpart 360-1, of the General Provisions of the Solid Waste Management Regulations. Some mills may have encountered problems obtaining approvals for R & D demonstration projects for demonstrating/implementing a particular technology. If so, please note on a separate page/attachment which definition is of concern and how it could be improved to remove a barrier. (If you are using/completing this survey by computer, feel free to "Cut and Paste" the critical sections and mark them up with suggested language changes).

Section 360-1.13 Research, development and demonstration permits.

(a) Permit: The department may issue a research, development and demonstration permit for any solid waste management facility proposing to utilize an innovative and experimental solid waste management technology or process, including a beneficial use demonstration project. The application for such permit must clearly demonstrate adequate protection of public health and the environment and be consistent with federal and State laws and regulations and this Part. A permit issued under this section must not be for an activity of a continuing nature. The department may, at its discretion, waive or modify some or all of the application requirements for permits issued under this section.

(b) Permit application. An application for a permit issued under this section must:

- (1) describe the proposed activity in detail;
- (2) describe how the applicant intends to provide for the receipt and treatment or disposal by the proposed facility of only those types and quantities of solid waste necessary to determine the efficiency and performance capabilities of the technology or process and the effects of such technology or process on human health and the environment; and how the applicant intends to protect human health and the environment in the conduct of the project; and

- (3) state that the applicant will provide, on a timely basis, the department with any information obtained as a result of the activity undertaken under the permit. The information must be submitted in accordance with schedules identified in the permit.

(c) Permit restrictions. The permit must:

- (1) provide for the construction of facilities as necessary, and for the operation of the facility for not longer than one year (unless renewed as provided in subdivision (d) of this section);

- (2) provide for the receipt and treatment or disposal by the facility of only those types and quantities of solid waste that the department determines necessary to determine, the efficiency and performance capabilities of the technology or process and the effects of such technology or process on human health and the environment;

- (3) include such requirements as the department determines necessary to protect human health and the environment (including, but not limited to requirements regarding monitoring, operation, financial assurance and closure, and such requirements as the department deems necessary regarding testing and providing of information to the commissioner about the operation of the facility); and

- (4) provide that the commissioner, without affording the permittee a prior opportunity for a hearing, may order an immediate termination of all operations at the facility at any time the commissioner determines that termination is necessary to protect human health and the environment, provided that the permittee is provided an opportunity for a hearing on the termination issue no later than 10 days after the issuance of the order and a decision is rendered no more than 20 days after the close of the hearing record. Nothing in this Part shall preclude or affect the commissioner's authority to issue summary abatement orders under section 71-0301 of the ECL or to take emergency actions

summarily suspending a permit under section 401.3 of the State Administrative Procedure Act.

(d) Renewal. Permits issued under this section may be renewed not more than three times, unless the permittee demonstrates to the satisfaction of the department that a longer time period is required to adequately assess the long-term environmental effects of the technology or process being studied under authority of the permit. Each renewal period will not exceed one year and will be conditioned upon compliance with this section.

SECTION 1.15: BENEFICIAL USE DETERMINATION PROCESS

Many New York State Paper Mills have attempted to or have actually obtained Beneficial Use Determinations (BUDS) from the NYSDEC for the paper mill by-products. Perhaps, certain sections of the BUD regulations have been particularly burdensome or have prevent your company from successfully implementing a technology. Please attach a separate page identifying parts of the Beneficial use regulations that have impacted your operation. The entire BUD section is excerpted below for your review. (If you are using/completing this survey by computer, feel free to "Cut and Paste" the critical sections and mark them up with suggested language changes).

Section 360-1.15 Beneficial use.

(a) Applicability.

(1) This section applies to materials that, before being beneficially used (as determined by the department), were solid waste. This section does not apply to solid wastes subject to regulation under Subpart 360-4 of this Part, except in the manner identified in subdivision 360-1.15(b) of this Part.

(2) Beneficial use determinations granted by the department before the effective date of this section shall remain in effect, subject to all conditions contained therein, unless specifically addressed by subsequent department action.

(b) Solid waste cessation. The following items are no longer considered solid waste for the purposes of this Part when used as described in this subdivision:

(1) materials identified in subparagraphs 371.1(e)(1)(vi)-(viii) of this Title that cease to be solid waste under the conditions identified in those subparagraphs;

(2) compost and other distribution and marketing (D&M) products that satisfy the applicable requirements under Subpart 360-5 of this Part;

(3) unadulterated wood, wood chips, or bark from land clearing, logging operations, utility line clearing and maintenance operations, pulp and paper production, and wood products manufacturing, when these materials are placed in commerce for service as mulch, landscaping, animal bedding, erosion control, wood fuel production, and bulking agent at a compost facility operated in compliance with Subpart 360-5 of this Part;

(4) uncontaminated newspaper or newsprint when used as animal bedding;

(5) uncontaminated glass when used as a substitute for conventional aggregate in asphalt or subgrade applications;

(6) tire chips when used as an aggregate for road base materials or asphalt pavements in accordance with New York State Department of Transportation standard specifications, or whole tires or tire chips when used for energy recovery;

(7) uncontaminated soil which has been excavated as part of a construction project, and which is being used as a fill material, in place of soil native to the site of disposition;

(8) nonhazardous, contaminated soil which has been excavated as part of a construction project, other than a department-approved or undertaken inactive hazardous waste disposal site remediation program, and which is used as backfill for the same excavation or excavations containing similar contaminants at the same site. Excess materials on these projects are subject to the requirements of this Part. (Note: use of in-place and stockpiled soil from a site being converted to a realty subdivision, as defined by the Public Health Law (10 NYCRR 72), must be approved by the local health department.);

(9) nonhazardous petroleum contaminated soil which has been decontaminated to the

satisfaction of the department and is being used in a manner acceptable to the department;

(10) solid wastes which are approved in advance, in writing, by the department for use as daily cover material or other landfill liner or final cover system components pursuant to the provisions of subdivision 360-2.13(w) of this Part when these materials are received at the landfill;

(11) recognizable, uncontaminated concrete and concrete products, asphalt pavement, brick, glass, soil and rock placed in commerce for service as a substitute for conventional aggregate;

(12) nonhazardous petroleum contaminated soil when incorporated into asphalt pavement products by a producer authorized by the department;

(13) unadulterated wood combustion bottom ash, fly ash, or combined ash when used as a soil amendment or fertilizer, provided the application rate of the wood ash is limited to the nutrient need of the crop grown on the land on which the wood ash will be applied and does not exceed 16 dry tons per acre per year;

(14) coal combustion bottom ash placed in commerce to serve as a component in the manufacture of roofing shingles or asphalt products; or as a traction agent on roadways, parking lots and other driving surfaces;

(15) coal combustion fly ash or gas scrubbing by-products placed in commerce to serve as an ingredient to produce light weight block, light weight aggregate, low strength backfill material, manufactured gypsum or manufactured calcium chloride; and

(16) coal combustion fly ash or coal combustion bottom ash placed in commerce to serve as a cement or aggregate substitute in concrete or concrete products; as raw feed in the manufacture of cement; or placed in commerce to serve as structural fill within building foundations when placed above the seasonal high groundwater table.

(c) Special reporting requirements. No later than 60 days after the first day of January following each year of operation, the generator of coal combustion ash must submit a report to the department that identifies the respective quantities of coal combustion bottom ash, fly ash, and gas scrubbing by-products it generated during the calendar year to which it pertains and, with respect to coal combustion bottom ash, how much was sent to a manufacturer of roofing shingles or asphalt products, how much was used as a traction agent on roadways, parking lots, and other driving surfaces, how much was sent to a manufacturer of cement, concrete or concrete products, and how much was used as structural fill; and, with respect to coal combustion fly ash and to gas scrubbing by-products, how much was used to produce light weight block, light weight aggregate, low strength backfill material (flowable fill), manufactured gypsum or manufactured calcium chloride.

(d) Case-specific beneficial use determinations.

(1) The generator or proposed user of a solid waste may petition the department, in writing, for a determination that the solid waste under review in the petition may be beneficially used in a manufacturing process to make a product or as an effective substitute for a commercial product. Unless otherwise directed by the department, the department may not consider any such petition unless it provides the following:

(i) a description of the solid waste under review and its proposed use;

(ii) chemical and physical characteristics of the solid waste under review and of each type of proposed product;

(iii) a demonstration that there is a known or reasonably probable market for the intended use of the solid waste under review and of all proposed products by providing one or more of the following:

(a) a contract to purchase the proposed product or to have the solid waste under review used in the manner proposed;

- (b) a description of how the proposed product will be used;
- (c) a demonstration that the proposed product complies with industry standards and specifications for that product; or
- (d) other documentation that a market for the proposed product or use exists; and
- (iv) a demonstration that the management of the solid waste under review will not adversely affect human health and safety, the environment, and natural resources by providing:
 - (a) a solid waste control plan that describes the following:
 - (1) the source of the solid waste under review, including contractual arrangements with the supplier;
 - (2) procedures for periodic testing of the solid waste under review and the proposed product to ensure that the proposed product's composition has not changed significantly;
 - (3) the disposition of any solid waste which may result from the manufacture of the product into which the solid waste under review is intended to be incorporated;
 - (4) a description of the type of storage (e.g., tank or pile) and the maximum anticipated inventory of the solid waste under review (not to exceed 90 days) before being used;
 - (5) procedures for run-on and run-off control of the storage areas for the solid waste under review; and
 - (6) a program and implementation schedule of best management practices designed to minimize uncontrolled dispersion of the solid waste under review before and during all aspects of its storage as inventory and/or during beneficial use; and
 - (b) a contingency plan that contains the information and is prepared in accordance with subdivision 360-1.9(h) of this Part.
- (2) The department will determine in writing, on a case-by-case basis, whether the proposal constitutes a beneficial use based on a showing that all of the following criteria have been met:
 - (i) the essential nature of the proposed use of the material constitutes a reuse rather than disposal;
 - (ii) the proposal is consistent with the solid waste management policy contained in section 27-0106 of the ECL;
 - (iii) the material under review must be intended to function or serve as an effective substitute for an analogous raw material or fuel. When used as a fuel, the material must meet the requirements of paragraph 360-3.1(c)(4) of this Part and the facility combusting the material must comply with the registration requirements in subdivision 360-3.1(c) of this Part, if appropriate;
 - (iv) for a material which is proposed for incorporation into a manufacturing process, the material must not be required to be decontaminated or otherwise specially handled or processed before such incorporation, in order to minimize loss of material or to provide adequate protection, as needed, of public health, safety or welfare, the environment or natural resources;
 - (v) whether a market is existing or is reasonably certain to be developed for the proposed

use of the material under review or the product into which the solid waste under review is proposed to be incorporated; and

(vi) other criteria as the department shall determine in its discretion to be appropriate.

(3) The department will either approve the petition, disapprove it, or allow the proposed use of the solid waste under review subject to such conditions as the department may impose. When granting a beneficial use determination, the department shall determine, on a case-by-case basis, the precise point at which the solid waste under review ceases to be solid waste. Unless otherwise determined for the particular solid waste under review, that point occurs when it is used in a manufacturing process to make a product or used as an effective substitute for a commercial product or used as a fuel for energy recovery. As part of its petition, the petitioner may request that such point occur elsewhere. In such a request, the petitioner must include a demonstration that there is little potential for improper disposal of the material or little potential for the handling, transportation, or storage of the solid waste under review to have an adverse impact upon the public health, safety or welfare, the environment or natural resources.

(4) The department may revoke any determination made under this subdivision if it finds that one or more of the matters serving as the basis for the department's determination was incorrect or is no longer valid or the department finds that there has been a violation of any condition that the department attached to such determination.

Appendix E
SURVEY DATA ON TREATMENT PLANTS

WASTE TREATMENT PROCESSES EMPLOYED

The variety of mills in the state and the wide range of their products are reflected in the types of treatment processes employed. Many of the small, speciality mills do not have secondary waste treatment plant operations, providing only primary screening or dissolved air flotation of their mill fiber and clays. The large integrated or non-integrated paper and paperboard mills provide both primary and secondary treatment of their mill waste stream.

Primary Treatment Processes

The breakdown of mill respondents that have some form of basic primary treatment of their plant wastes is shown in Table E-1.

Table E-1. Primary Treatment Processes Used by Survey Respondents

TYPE OF PRIMARY WASTE TREATMENT PROCESS USED	NUMBER OF RESPONDENTS USING PROCESS
Cleaners/Shakers/Screens	2
Dissolved Air Flotation Units	9
Primary Clarification Tanks	5
Primary Settling Lagoons	5
Combination Primary and Secondary Units (Package Treatment Plant)	3

Of the 24 survey respondents, 9 mills (38 percent) have dissolved air flotation devices as their primary waste treatment plant process. These mills may subsequently recover and/or dewater some or all of their fiber and clay materials for internal reuse or for transfer to another mill so it can be used as their fiber furnish. Others in this category may have their own secondary waste treatment plant operation or send the clarified wastewater to a public treatment plant (publicly owned treatment works or POTW).

The primary clarification tanks and settling lagoons are also frequently used primary treatment processes. Five New York mills report that they used either of these methods. Three mills have a modular or package waste treatment plant that combines both primary and secondary treatment in the same vessel or tank. Since these are single units with combined functions (primary settling with biological treatment), they are separately categorized.

Secondary Treatment Processes

Over half of the mills (14) have their own secondary wastewater treatment plant operation. Nine of the mills send their wastewater to a POTW and, as a result, do not have any secondary biosolids to manage (see Table E-2). These nine mills discharging to POTWs are indirectly paying for secondary biosolids disposal or beneficial reuse of the material through the fees charged to them by the municipality. These fees are often based on the amount of biochemical oxygen demand (BOD) in the effluent, the total suspended solids, and/or the volume of waste that is sent to the POTW. Depending upon the performance of the POTW and the frequency of revisions to the sewer charges, the paper mill may have an incentive to improve or upgrade its primary treatment to reduce its impact on the POTW and/or the cost burden on the mill.

Table E- 2. Secondary Treatment Processes Used by Respondents.

TYPE OF SECONDARY WASTE TREATMENT PROCESS UTILIZED	NUMBER OF RESPONDENTS USING PROCESS
Trickling Filter	1
Aerated Stabilization Basin	2
Activated Sludge Treatment	3
Combination of Above	7
Publicly Owned Treatment Works	9
Other	2

Municipal treatment plants that have excess capacity or can handle the discharge from the mills are less likely to be asking the mills for improved pretreatment or charging increased sewer rates. Mills with a high degree of variability in their furnish and final grades are more likely to be pressured to upgrade or have their sewer rates increased.

The next category of secondary waste treatment processes is a combination of an aerated stabilization basin with activated sludge recycle, or vice versa. Some of the mill respondents have just one or the other secondary treatment process. One facility still uses a trickling filter process for effluent treatment.

SURVEY RESULTS ON DEWATERING METHODS

The survey data presented in Table E-3 clearly shows that New York mills have attempted to keep pace with improvements in dewatering technology. In Appendix B, it was noted that the early methods of dewatering primary and combination sludges used plate and

frame/hydraulic presses and vacuum coil filter. Then, in the 1980s the twin belt presses emerged as popular dewater devices because of their ability to produce drier paper mill cake solids. Pressure for even drier paper mill residuals and lower operational and maintenance costs led to the use of the screw press as the preferred dewatering device. Many of the New York mills that produce a higher volume of residuals have evolved through the progression so that more mills (9) have screw presses than belt presses (8).

The average bone dry solids for the nine mills with screw presses is 41 percent (range of 30-50 percent). For the mills with belt presses, the average bone dry solids was 35 percent (range of 25-47 percent). The range or variation in performance for a particular type of dewatering device relates to the amount of primary solids (fiber, ash/clay) and how much secondary solids is blended. Some mills have not been able to afford the capital investment required for a new screw press or belt press and have depended on smaller, lower throughput, and less expensive dewatering devices.

Table E-3. Dewatering Methods Used and Resultant Solids.

TYPE OF DEWATERING DEVICE OR PROCESS USED	NUMBER OF MILLS	AVERAGE PERCENT DRY SOLIDS
Hydraulic/ Ram Press	2	32
Coil Filters (Backup)	1	NA
Twin Belt Press	8	35
Screw Press	9	41
Shaker & Sidehill Screen	1	NA
Dissolved Air Flotation	3	NA

The tables that follow provide additional data from the survey on the dewatering plant quantities, cost, primary waste management/disposal method, and alternative method.

Table E-4. New York Paper Industry Survey - Dewatering Plant and Waste Management Data.

Mill Name	City	Waste Quantity Produced (wet Tpd)	Disposal Cost (\$/wet ton)	Primary Disposal Method	Alternate Method #1
Armstrong World Ind.	Fulton	16	42	landfill	composting
Mohawk Paper	Cohoes	0	0	recycle to P.M.	NA
Schoeller Tech.	Pulaski	14.3	21	landfill	composting
Cascades-Niagara Falls	Niagara Falls	30	42	50 percent composting	50 percent landfill
U.S. Gypsum Co.	Oakfield	1.5	33	landfill	NA
Norfolk Paper Co.	Norfolk	50	135	landfill	NA
Lyons Falls P&P	Lyons Falls	16.7	127	landfill	energy recovery
Columbia Corporation	Wallomsac	0	0	recycle to P.M.	needs fiber
Buffalo Paperboard Corp.	Lockport	5.6	78	landfill	composting
James River Corp.	Gouverneur	5	88	landfill	NA
Finch Pruyn & Co.	Glens Falls	238	13	landfill	NA
Stora Papyrus	Newton Falls	38.5	10	landfill	NA
International Paper	Corinth	107	9	landfill	fiber exchange
Specialty Paperboard	Beaver Falls	9.7	108	landfill-cover	NA
Potsdam Paper	Potsdam	2.4	53	landfill-cover	NA
Champion International	Deferiet	171	39	landfill	NA
Packaging Corp. of America	Plattsburgh	N/A	N/A	recycle	NA
Columbia Corporation	Chatham	0	0	recycle to P.M.	need fiber
Encore Paper Co., Inc.	S. Glens Falls	330	12	landfill-cover	engineered soil
International Paper	Oswego	3	63	landfill	NA
James River Corp.	Carthage	38	56	animal bedding	landfill-cover
Mohawk Paper Mills	Waterford	8	25	composting	fiber exchange
Solvay Paperboard Corp.	Solvay	60	27	landfill	R & D for animal bedding
Brownville Specialty Paper	Brownville	50	12	reuse or POTW	NA

Appendix F

REVIEW AND DISSEMINATION OF THE SURVEY RESULTS

MARCH 2, 1995 INFORMATIONAL WORKSHOP MEETING

An important component of the project on beneficial uses of treatment plant solids for the New York State recycled mills was to present the findings and preliminary recommendations from the research. A workshop was set up and held on March 2, 1995 at the State Fairgrounds - Empire Room in Solvay, New York. Attendees included the BES Technologies project team, State and local government officials involved with solid waste management (New York State Department of Economic Development - Office of Recycling and Market Development, New York State Energy Research and Development Authority, New York State Department of Environmental Conservation), paper industry officials from the state, and a host of beneficial use technology companies that have had specific involvement with pulp and paper industry wastes.

Following opening remarks and introductions by local and Department of Economic Development officials, Keith Bowden of BES Technologies reported to the mills on the results of the survey, the waste management practices of the New York State mills, some of the beneficial use technologies that have been and can be utilized, and some of the issues/obstacles that all companies face in New York State. In addition, key information collected from the survey and analysis of the research presented in the preceding sections and appendices was used to prepare individual summaries for each specific paper mill or joint company operation. The specific mill write-ups were drafted and provided to all the mills attending the informational workshop. Those mills that did not send mill representatives were sent or faxed copies of the mill write-ups. All were asked to review the information for content and accuracy and to inform BES Technologies by March 9, 1995, whether or not the individual mill write-ups could be released to the public. No mills requested that this information be kept confidential and have as a result been included in this report.

Mr. Jeff Schmitt, a member of the Department of Environmental Conservation then provided an overview of the Beneficial Use Determination (BUD) petition process, various beneficial uses of paper mill residuals that have been advanced in the state and some recent case studies/initiatives that have been approved since this research effort had begun in the fall of 1994. A copy of the DEC overheads are at the end of this appendix.

The Energy Authority presented information on its plans to provide up to \$500,000 to fund projects that would beneficially use paper mill residuals. The program is designed to introduce new technologies into the New York paper industry produce useful, value-added products. Projects eligible for funding would include but not be limited to demonstration and/or implementation of innovative beneficial use technologies with mill residuals to:

- Produce energy products such as fuels and chemicals; or,
- Increase energy efficiency of sludge management practices and produce value-added products.

Proposals were due on June 9, 1995 and awards were expected to be offered by the Energy Authority for 2 to 4 projects. All proposals must be cost shared at or above 50 percent and must be demonstrated in New York.

Tables F-1 and F-2 list the mills and commercial companies that are involved in the beneficial uses of paper mill residuals and that were invited to the March 2, 1995 informational meeting.

TABLE F-1. New York State Paper Mills Invited to March 2 1995 Informational Meeting.

MILL NAME	STREET	CITY	STATE	ZIP CODE	CONTACT PERSON
Armstrong World Ind. Inc	RR #2 Box 184	Fulton	NY	13069	Frank Page
Brownville Specialty Paper	Bridge Street	Brownville	NY	13615	Gene Rood
Buffalo Paperboard Corp.	470 Ohio Street	Lockport	NY	14094	Dave Sholk
Cascades Niagara Falls	4001 Packard rd	Niagara Falls	NY	14303-2297	Ray O'keefe
Champion International	400 Anderson Ave	Deferiet	NY	13628	Bryon Perry
Columbia Corp.	PO Box 330	Chatham	NY	12037	Jerry Landwehr
Encore Paper Co. Inc.	1 River Street	S. Glens Falls	NY	12803	Barbara Hemken
Finch, Pruyn & Co.	1 Glen Street	Glens Falls	NY	12801	Phil Arthur
International Paper Corp.	15 Pine Street	Corinth	NY	12822	Stuart Field
International Paper Corp.	Mitchell St Box 238	Oswego	NY	13126	Tim Stocker
James River Corporation	695 End Ave.	Carthage	NY	13619	Labe Haverstock
James River Corporation	Natural Dam Box 98	Gouverneur	NY	13642	Ryan Shermerhorn
Lyons Falls Pulp & Paper	Elcon Inc Po Box 338	Lyons Falls	NY	13368	Noel Schneider
Mohawk Paper Mills Inc.	Po Box 497	Cohoes	NY	12047	George Milner
Packaging Corp of America	74 Weed Street	Plattsburgh	NY	12901	Anthony Searing
Schoeller Technical Paper	PO Box 250	Pulaski	NY	13142	Bob Geary
Solvay Paperboard Corp.	1800 Milton Avenue	Solvay	NY	13209-0310	Steve Van Doren
Speciality Paperboard Inc.	Lewis Mill	Beaver Falls	NY	13305	George McBride
Stora Papyrus-Newton Falls	PO Box 253	Newton Falls	NY	13666	Bill Hunter
US Gypsum Co.	PO Box 139	Oakfield	NY	14125	Mike Willoughby
Hollingsworth & Vose	Co. Route 113 -Easton	Greenwich	NY	12834	Tom Nash

TABLE F-2. Commercial Firms Invited to March 2 1995 Informational Meeting.

COMPANY NAME	STREET	CITY	STATE	ZIP CODE	PRIMARY CONTACT
Absorption Corp.	PO Box 5667	Bellingham	WA	98227-5667	Doug Ellis
Cellutech, LTD	400 Anderson Avenue	Deferiet	NY	13628	Henry LaLone
Energy Management Services,LP	1700 Milton Avenue	Solvay	NY	13209	Bob Bishop
Browning-Ferris Industries	PO Box 3151	Houston	TX	77253	Joe Laubenstein
M-E-C Company	PO Box 330	Neodesha	KS	66757	Mike Maley & Mike Gaines
EnviroTech Systems Corporation	1820-999 W Hastings St	Vancouver	BC	V6C 2W2	Mike Gustavson
Greengrove Corporation	7301 Zane Ave.North	Brooklyn Park	MN	55443	Bill & George Meade
Advanced Concrete Technologies	235 West Road-Unit 11B	Portsmouth	NH	3801	Max Hoene
Castine Energy Services	117 Silver Street	Waterville	ME	4901	John & Kevin Trinward
ZSB (Zane S. Blanchard & Co.)	Box 789	Hampton Beach	NH	3842	Stephen Dumont
Thermogenics, Inc.	3620 Wyoming Blvd. NE	Albuquerque	NM	87111	Stephen Brand
UES (Upstate Environ.Services)	215 Tully Street	Syracuse	NY	13204	Dave Roffey & Conrad Teufel
Biofine Incorporated	70 Walnut Street	Wellesley	MA	2181	Steve Fitzpatrick
TDC(Technology Development Co)	1567 Congress Hill Lane	Fairfield	OH	45014	W endell Judd
AFTEC(Applied Filtration Tech)	740 Driving Park	Rochester	NY	14613	Kathy Russell
AllGro	Liberty Lane	Hampton	NH	3842	Matt Cole & Peter Mezzit
Cornell University - Biotechnology	130 Biotechnology Bldg.	Ithaca	NY	14853-2703	Dick Holsten
Wilmot Farms	Box 89	Buskirk	NY	12028	Bob Wilmot
Kenetech Energy Mgmt.	380 Franklin Road	Denville	NJ	7834	Bill Taylor

360-1.15(d)(2) CASE-SPECIFIC BUD APPROVAL

- Must be reuse, not disposal
- Must be consistent with section 27-0106 of ECL:
 1. waste reduction
 2. recycling/reuse
 3. waste-to-energy
 4. landfilling
- Material must substitute for a raw material or fuel
- Material must not require decontamination or processing
- Must be a market for the product

**THE BUD APPROVAL WILL SPECIFY
WHEN THE BUD ATTACHES**

360-1.2(a)(4)(vii)

**Discarded materials which are
used under an approved
beneficial use determination (BUD)
are not solid waste
for the purposes of Part 360.**

360-1.15(d) CASE-SPECIFIC BUD's

APPLICATION MUST INCLUDE:

- Description of material and proposed use
- Chemical and physical characteristics of material and product
- Demonstration that the proposal will not adversely affect human health & safety, the environment and natural resources

- solid waste control plan
- contingency plan

ECL ARTICLE 70

UNIFORM PROCEDURES ACT (UPA)

- 6 NYCRR PART 621

FOR REVIEW OF PERMIT APPLICATIONS:

- 1. PROVIDES PROCEDURES**
- 2. IMPOSES DEADLINES**
- 3. APPLIES ONLY WHEN ACTIVITY
IS SUBJECT TO REVIEW JURISDICTION
OF ONE OR MORE DEC
REGULATORY PROGRAMS**

- A BUD PETITION IS NOT A PERMIT APPLICATION

**A BUD PETITION, LIKE A DECLARATORY
RULING, SEEKS RECOGNITION OR
CONFIRMATION THAT THE DEPARTMENT'S
SOLID WASTE REGULATIONS
DO NOT APPLY TO A SET OF FACTS
PRESENTED IN A PETITION**

Beneficial Use of Papermill Sludge As Alternate Daily Cover (ADC)

PRIOR TO OCTOBER 9, 1993

- The Department had approved the use of papermill sludge as ADC.
- This approval required a mill to petition for a case-specific Beneficial Use Determination.

AFTER OCTOBER 9, 1993

- § 6 NYCRR 360-1.2(b)(48) defined daily cover as "a compacted layer of ...cover material...placed on exposed solid waste."
- § 6 NYCRR 360-1.2(b)(46) defined cover material as "soil or other suitable material."
- § 6 NYCRR 360-2.17(c) allows the use of alternative daily cover materials that control:
 1. Vectors
 2. Fires
 3. Odors
 4. Blowing Litter
 5. Scavenging

Beneficial Use of Papermill Sludge In Landfill Closure

PRIOR TO OCTOBER 9, 1993

- Case-specific BUDs were required for use of papermill sludge as a component in a landfill's cover.

AFTER OCTOBER 9, 1993

- § 6 NYCRR 360-1.15(b)(10) allows the use of approved solid waste in "landfill liner or final cover system components."
- Solid waste must fulfill the equivalent design requirements of § 6 NYCRR 360-2.13(w) for approval.
- Approval for use of a solid waste will be granted in conjunction with approval of the landfill's closure plan.
- Potential Applications:
 1. Contour Grading
 2. Barrier Layer
 3. Barrier Protection Layer

Beneficial Use of Papermill Sludge

Land Application

- Use as Vegetative Cover in landfill closure.
Use as Soil Amendment/Conditioner.
(Engineered Soils)
- These uses must be permitted pursuant to § 6 NYCRR 360-4 or a Consent Order (Vegetative cover only).
- The following criteria will be considered when reviewing a permit application: (see 360-4.2)
 1. Potential impact on human/animal health.
 2. Potential impact on soil biota.
 3. Potential impact on permanent vegetation.
 4. Potential benefit of material.
If no benefit cannot be land applied.
(360-4.2(d))
 5. The suitability of the site.
- Permit application and operational criteria found in Sections 360-4.6 and 4.7.

Land Application of Sludge Contaminant Concentration Limits

Contaminant	Current Limit	Proposed Limit
Mercury	10	10
Cadmium	25	25
Nickel	200	290
Copper	1000	1500
Lead	1000	300
Chromium	1000	1200
Zinc	2500	2500
Total PCBs	10	N/A
Arsenic	N/A	41
Molybendum	N/A	54
Selenium	N/A	28

Beneficial Use of Papermill Sludge Composting

- § 6 NYCRR 360-1.15(b)(2) provides a predetermined BUD for the use of compost and other Distribution and Marketing (D&M) products.
- D&M products are materials produced for reuse in a manner similar to composting.
 1. Heat Drying/Pelletization
 2. Chemical Stabilization, etc.
- In order to qualify for the predetermined BUD the compost or D&M products must satisfy the requirements of § 6 NYCRR 360-5.
- Possible uses for compost and D&M products produced from papermill sludge depend on concentrations of contaminants. [§ 6 NYCRR 360-5.3(p)(1)(i) & (p)(2)(i)]
- Refer to § 6 NYCRR 360-5.3(p) for conditions of allowable usages.

Beneficial Use of Papermill Sludge

Animal Bedding

- Use dried papermill sludge as substitute for newspaper or sawdust as animal bedding.
- Used bedding and manure would be applied to land as fertilizer.
- § 6 NYCRR 360-1.15(b)(4) contains a predetermined beneficial use for uncontaminated newspaper or newsprint when used as animal bedding.
- Papermill Sludge used as animal bedding is currently the subject of an R,D&D project.
- The results of this study could allow the future addition of papermill sludge to the predetermined newspaper BUD.

Beneficial Use of Papermill Sludge

Case-Specific BUDs

- Manufacture of papermill sludge construction materials.
- Cast papermill sludge with Portland cement to produce blocks with compressive strengths similar to concrete blocks.
- Press papermill sludge into corrugated wall board for use on walls and floors.
- Replace red shale with papermill sludge in the production of cement.

The papermill sludge had mineral constituents in more favorable ratios than original raw material.

- Others must follow case-specific requirements of § 6 NYCRR 360-1.15(d)(2).

Beneficial Use of Papermill Sludge

Case-Specific BUDs

- Use recycled primary sludge in the production of non-food grade paper products.
 1. Muti-ply paper board
 2. Box board
 3. Game Board.
 4. File folders
 5. Cardboard, etc.

- Use dried papermill sludge to manufacture a fuel product.

Fuel must meet the 4000 Btu/lb heating value required by § 6 NYCRR 360-3.1 (c)(4).

- Use dried papermill sludge to manufacture absorbent products.

Beneficial Use of Papermill Sludge

Case Studies

- Research projects' findings could lead to Beneficial Use Determinations or permits.
- R,D&D project at Corinth Landfill
Use papermill sludge as Daily, Intermediate cover, grading material, and barrier layer.
- R,D&D project at Moreau Landfill
Use papermill sludge for landfill closure.
- R,D&D project for use as animal bedding.
Use dried papermill sludge for animal bedding.
- R,D&D project by Stora Papyrus.
Use papermill sludge to reclaim iron ore mine tailings.

Transport of Papermill Sludge

§ 6 NYCRR Part 364 Waste Transporter Permits

- Papermill Sludge is listed under Industrial Sludge Code N133.
- § 6 NYCRR 364 defines industrial-commercial wastes as Regulated Waste.
- Regulated waste must be transported by a permitted Part 364 Waste Hauler.
- ISSUES:
- Fiber Exchange
Traditionally recycled materials are not considered solid waste.
§ 6 NYCRR 360-1.2(a)(viii)
- Beneficial Uses
- Disposal