earthbound environmental

A Study into Economic Opportunities Utilizing Waste Materials in Thompson, Wabowden & Norway House

FINAL REPORT

Prepared for:

Thompson Recycling Centre

Submitted:

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Integrated waste management

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Executive Summary

earthbound environmental Inc. has been contracted by the Thompson Recycling Centre (TRC) to identify opportunities that may exist for creating jobs through the value-added processing of materials that are currently being discarded in Thompson, Wabowden, and Norway House. The Thompson Employment Centre and North Central Development Corporation have provided financial support for the study.

Based on the results of the research presented in this report, each of the five opportunities analysed has potential and could be successful if pursued further. Each project would create additional employment in the Thompson, Wabowden, and or Norway House area and, with the possible exception of hydro pole milling, reduce the amount of waste currently being disposed of in local landfills:

1. **Fish Waste Composting**

   Producing a saleable product using fish waste and sawdust appears to be technically feasible. There is some question as to whether sufficient demand for the finished product exists to make the operation viable. Working with an established operation in completing a comprehensive feasibility study and/or bringing in joint venture partners is likely the best way proceed with this opportunity.

2. **Improved Collection of Scrap Metal and Other Recyclable Materials at Local Waste Disposal Grounds**

   This project appears to hold considerable potential as an economically viable opportunity to create jobs using discarded materials. Not only would sustainable jobs be created, but less waste would be disposed of in local landfills, the management of existing landfills would improve, and significant revenue could be generated.

3. **Hydro Pole Milling**

   If a used sawmill is available and the necessary expertise can be accessed, or a local sawyer is available, operating a hydro pole sawmill operation on a part-time basis may be a feasible business opportunity for the TRC.

4. **Pallet Collection/Sales**

   Because many more pallets are shipped to Thompson than are required by local businesses to ship material south, it is recommended that TRC focus on collecting pallets for resale in the Winnipeg market. Good quality pallets could be sold to satisfy whatever local demand exists without investing in expensive processing equipment.

5. **Kindling/Firewood Packaging and Sales**

   If an efficient production system can be developed, revenue of $1.75 per unit be generated, and transportation costs keep to a minimum, it would appear that a kindling/firewood operation could be profitable selling into the Southern Manitoba market.

Establishing a fish waste composting operation and setting up a system for improving the capture rates of recyclable material disposed of landfills are larger scale projects that would require a greater level of planning and co-ordination prior to implementation. Partnerships would need to be formed between funding agencies, regulatory bodies, raw material suppliers, and project management to make these larger projects work.

The hydro pole milling, pallet recovery, and kindling/firewood opportunities could be implemented with a much lower level of partnership development. As smaller ventures, TRC (or another entity) could implement one or all of these projects with much less effort than the two larger projects would require.

Additional research will still be required for each specific opportunity with full feasibility studies required for the fish waste composting operation and the project to capture more recyclable materials currently disposed of in local landfills.

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Introduction

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This final report focuses on the five most viable opportunities that were presented in the preliminary report that was submitted to TRC in April, 2000. These opportunities are:

1. Fish Waste Composting
2. Improved Collection of Scrap Metal and Other Recyclable Materials at Local Waste Disposal Grounds
3. Hydro Pole Milling
4. Pallet Collection/Sales
5. Kindling Packaging and Sales

An analysis of the economic viability of each of these opportunities was conducted with the results presented in the following sections of this report. It should be noted that the information presented is not intended to represent a complete and comprehensive feasibility analysis or business plan. Additional research and planning will be required for each opportunity selected for possible implementation, particularly those opportunities involving large financial commitments.

To obtain a copy of the preliminary report please contact the Thompson Recycling Centre.

1. Fish Waste Composting Operation

1.1. Product Description

A mixed fertiliser made from fish processing waste and sawdust/woodchips. The product could be bagged and sold in garden supply stores and/or sold in bulk to northern landscaping companies that are currently importing soil from southern Manitoba.

1.2. Market Information

1.2.1. Gardening Industry

The main market for this type of fertiliser product is home gardeners. Overall sales in this industry have expanded significantly during the past decade. A 22% increase has been recorded between 1993 and 1997 in Canada in the sale of greenhouse and nursery products from $244 million to $300 million.[1] A similar trend has occurred in the United States with employment in the retail nurseries and garden stores sector increasing from 91,000 in 1990 to 112,000 in 2000.[2]

In Manitoba, approximately $13 million was spent on fertilisers, soil, and soil conditioners in 1996.[3] This translates into a per capita expenditure of approximately $12.

Shigawake Organics Ltd, a company that produces a fish-based fertiliser product in Quebec, has stated that their sales are currently doubling every year (although it took a number of years from the time they began production to the time they were in a position to begin marketing the product).

1.3. Technical Considerations

Compost made from fish/seafood waste, also known as offal, has been scientifically proven to provide an excellent soil additive and growing medium.[4] A Quebec company, Shigawake Organics Limited, has been producing a fish compost product since 1980 that has no chemical additives and is sold as an organic fertiliser.

1.3.1. Passive Aeration in Windrows

The recommended process for producing compost from fish waste is described in a video titled "Composting Seafood Wastes: A hands-on Guide to Getting Started", produced by the National Fisheries Institute in the US (a copy of this video has been provided to TRC). It recommends the use of a static pile that is not turned during the composting process, a procedure that minimises odour problems. Steps to create a static pile include:

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[1] Statistics Canada, "Canadian Statistics – Direct Sales by Product Type".

[2] U.S Bureau of Labour Statistics Data

[3] WD Profile Report, 1996 Census.

[4] Dr. S. P. Mathur. "Economic Viability of Commercial Composting of Fisheries Waste by Passive Aeration", The Composting Council of Canada Symposium, September, 1994.

1. Creating a base for the compost pile made from wood chips or peat moss to keep the composting material off of the ground. This prevents moisture-related problems and provides for air circulation.
2. Placing the fish material to be composted along the centre of the base.
3. Covering the composting fish with a bio-filter made from a carbon source such as peat moss or a wood by-product such as sawdust and/or wood shavings. The bio-filter prevents excessive moisture accumulations and eliminates odour.

Depending on the type of fish waste being composted, the composting process can be finished within 6 to 12 weeks. The finished compost must then be cured before it can be bagged, a process which takes approximately 6 months. Using sawdust as the carbon source may delay the completion of the process.[5]

A complete copy of a technical paper entitled "Economic Viability of Commercial Composting of Fisheries Waste by Passive Aeration" is provided in Appendix A.

1.3.2. In-Vessel Composting

Composting fish waste using an in-vessel composter could also be considered although this type of system is generally much more expensive to set-up and operate than a windrow system. One advantage of an in-vessel system, however, is that it could be mobile and taken around to the several potential sites where the fish waste is generated instead of having to deliver the waste to a central facility.

Quotes on the cost of a mobile in-vessel composter have not yet been received from the local company that supplies this type of technology.

1.4. *Raw Material Supply*

Two main raw materials will be required to produce the finished compost; fish processing wastes and a fibre mixture of sawdust and wood chips.

1.4.1. Fish Processing Waste

It is estimated that approximately 420 tonnes of fish processing waste would currently be available on an annual basis from the fish processing operations at Norway House and Wabowden. An additional 180 tonnes of fish offal is discarded on the lake each year prior to the cleaned fish being delivered to the processing plants. This material may also be available for composting although a financial incentive would need to be provided to the fishers.

[5] Personal communication, Joey Hayes, Shigawake Organics Ltd., July, 2000.

Table 1 - Fish Processing Waste Sources and Estimated Annual Volumes

Period	Source	Estimated Available Quantity	Total Weight for Period
Norway House			
June 1-July 15	Processing Waste	Approx. 150 tonne	Approx. 150 tonne
Sept 1 – Oct 15	Processing Waste	Approx. 150 tonne	Approx. 150 tonne
		Norway House Total	Approx. 300 tonnes
Wabowden			
May	Mullet Run	25 – 45 G. drums/day	112 tonnes
June	Processing Waste	125 lbs. per day	1.25 tonnes
July	Processing Waste	125 lbs. per day	1.25 tonnes
August	Processing Waste	125 lbs. per day	1.25 tonnes
September	Processing Waste	125 lbs. per day	1.25 tonnes
October	Processing Waste	125 lbs. per day	1.25 tonnes
		Wabowden Total	120 tonnes
		Combined Annual Total	**420 tonnes**

There are other communities in the area with fish processing plants that could potentially be available including South Indian Lake, Leaf Rapids, Split Lake, and Nelson House. Based on estimates of annual levels of processing at each of these facilities provided by Mr. Leon Benson of the Freshwater Fish Marketing Board, another 200 tonnes of fish processing waste could potentially be available to the composting operation.

Collection infrastructure would need to be established for collecting the material at centralised points and transporting the fish offal from designated processing plants to the composting site.

1.4.2. Sawdust/Woodchips

The owner of NorWest Manufacturing in Thompson estimates that there is between 100-300 tonnes of sawdust at his plant although the exact amount has never been tracked. This plant also generates wood off-cuts that could be chipped into wood shavings.

Sufficient supplies of a carbon source, likely sawdust and wood shavings, would need to be secured. At a ratio of one to one (recommended in the demonstration video), up to 400 tonnes of wood fibre would be required. Rob Meilke, past member of the North Central Development Corporation suggested that additional wood fibre may be available from logs that are discarded in areas of timber harvesting.

1.5. *Staffing*

Joey Hayes from Shigawake Organics stated that staff would be required to maintain the compost piles, transporting materials to the site, processing, and bagging the finished product. Additional employment would also be generated during the set-up phase of the project as the land is cleared and the site is prepared.

1.6. *Marketing*

Garden supply wholesalers recommended that a marketing campaign would be required to drive demand for a fish-based fertiliser in the local market. According to the information provided by one of the largest local wholesalers, current levels of demand may not be sufficient to sustain an operation.[6] However other, more distant, markets could also be accessed.

1.7. *Regulatory Issues*

According to Charles Conyette of Manitoba Conservation, the province currently has no regulations governing large-scale fish composting operations. They would, however, require that a proposal be submitted to the department for review to determine what class of development a fish waste composting operation would fall into.

In addition to the Province of Manitoba, it should be anticipated that permits would need to be received from local municipal, and possibly regional governments. The Federal Government also has established guidelines for composting operations. A copy of these guidelines has been included in Appendix B.

1.8. *Barriers/Risks*

Potential barriers for successfully establishing a fish waste composting operation include:

1. Lack of sufficient market for the finished product
2. Lack of sufficient volume of material to make the enterprise viable
3. Difficulty in siting a suitable location
4. Difficulty in obtaining required permits
5. Seagulls and other birds may be a nuisance problem at the composting site although once the piles are properly covered this problem should be eliminated. Also, according to the video produced by the National Fisheries Institute, fish waste composting does not attract larger animals if properly covered.
6. A financial incentive would need to be in place for the fishing boats to bring in offal generated while cleaning fish on the lake (e.g. 1 or 2 cents per pound).
7. The economic viability of transporting the required amount of fibrous material (e.g. sawdust or wood shavings) will need to be confirmed.
8. Long period between project beginning and the first product sales.

[6] Personal Communication, Marion Yarema – Cary's Ltd., July, 2000.

These issues should be addressed during the preparation of a full feasibility study should this opportunity be pursued further.

1.9. Distribution

Garden supply wholesalers in Winnipeg that were contacted had limited enthusiasm for a fish-based fertiliser product although many only had experience with the liquid variety. Main concerns are:

- Sales in fish fertilisers represent only a small percentage of overall fertiliser sales
- The market appears to be declining with older people more inclined to use fish fertiliser
- This type of product is much more popular in BC and Toronto where interest in organic products is higher
- The cost of fish fertilisers tend to be higher than chemical alternatives and price is the main factor for most customers in Manitoba, Saskatchewan, and Northwest Ontario.
- The market for fertiliser is very competitive with little mark-up for distributors. They therefore have little incentive to put significant energy into promoting this product.
- One major distributor felt that it would be very important for a significant advertising campaign to be developed for the new product to drive demand. They would be more likely to carry the product if retailers and customers were requesting it.

Out of nine local garden supply retailers contacted, only one carries a dry fish-based compost product. The manager of this operation explained that they like to carry a line of organic fertilisers but that demand is weak and they sell only a small quantity every year.[7]

A fish waste compost is, however, being sold at the Canadian Tire store in Thompson with apparent success. A local market has therefore already been established for this type of product and could be built upon. The final product could also be sold in bulk to local landscape companies.

1.10. Joint Venture Partnership

There are two major fish waste composting operations in Canada; Genesis Organics in Newfoundland and Shigawake Organics in Quebec. Both have expressed an interest in providing consulting services to help get the project off the ground and/or the possibility of a joint venture. Contact information for these companies are:

Genesis Organic Inc.

Glen Janes
Genesis Organic
9 Main St., Suite 304
Corner Brook, Newfoundland
Phone # (709) 634-4769
Website : http://www.genesis.ca

[7] Personal communication, Manager – LaCoste Garden Centre, July, 2000.

Shigawake Organics Ltd.

Joey Hayes
Shigawake Organics Ltd.
252 Route 132, Shigawake, PG G0C 3E0
ph: 418-752-2549 email: first@sympatico.ca
Website: http://www3.sympatico.ca/first

There will likely be a steep learning curve in producing a consistent product that meets the desired quality standard. Having experienced operators involved in the project can help the project avoid or overcome many of these problems in less time and at lower cost. The contacts identified at each of the companies listed have indicated that they would potentially be available for a site visit to assess the viability of the project

1.11. Set-Up Costs & Operating Costs

The amount of money required to cover start-up costs would depend on how large an operation would be established at the beginning. Developing the project on a relatively small scale at the start would help reduce initial capital outlays and provide an opportunity to build the operation incrementally. According to Glen Janes of Genesis Organic, a number of relatively small fish waste composting operations currently exist in Maine which demonstrates that smaller operations may be viable.

Operating costs would include:

- Administration
- Labour
- Marketing
- Equipment maintenance
- Taxes
- Communications
- Transporting finished

1.12. Revenue Projections

Assuming that 400 tonnes of fish waste is available for composting when the plant is fully operational, and a one-to-one ratio is used to mix in the carbon source, approximately 800 tonnes (800,000 kilograms) of finished product could be available on an annual basis.

Table 2 shows the wholesale prices of comparable products as provided by a local wholesaler

Table 2 – Wholesale Costs of Fertiliser Products

Product	Landed Wholesale Cost	Per Unit Cost ($/kg)
7 lb. Bag Dry Fish-Based Fertiliser	$7.73	$2.43/kg
10 kg Bag Vegetable Grower	$6.34	$0.63/kg

On a per unit basis it is clear that the synthetic Vegetable Grower product is significantly less expensive than the fish-based fertiliser. If it assumed that the fertiliser product needs to be sold at a competitive price, say $.60 per kg, total revenue from the sale of 800,000 kgs of product would result in gross revenues of $480,000.

A Minneapolis-based garden centre that was contacted indicated that their wholesale cost for a 50 lb bag (23 kg) of composted chicken manure, a competing product, is approximately $7.00 U.S. ($10.00 CDN). This results in a per unit cost of $.43/kg (CDN). If the product were to be priced to compete with the chicken manure, revenues would fall to $344,000 (CDN).

1.13. Conclusions

Producing a saleable product using fish waste and sawdust appears to be technically feasible. There is some question as to whether sufficient demand for the finished product exists to make the operation viable. Working with an established operation such as Genesis Organic or Shigawake Organics Inc. in completing a comprehensive feasibility study and/or bringing in joint venture partners is likely the best way proceed with this opportunity.

2. Increasing Capture of Scrap Metals and Other Recyclables

2.1. *Description of Opportunity*

Given the amount of scrap metal and other recyclables currently being discarded in Northern Manitoba, and the well-established markets for many of these materials, it is proposed that a system be established for increasing the collection of scrap metal (and other recyclable materials) at local landfills.

2.2. *Background Information*

Lionel Burneaux from Indian & Northern Affairs Canada (INAC) stated that there are a number of dumps on reserve land in several communities (Nelson House, Split Lake, Cross Lake, York Landing, Norway House) that are totally unregulated because there is no money to staff them. This lack of oversight has created serious litter and material management problems at these sites. He thought it would be a very viable proposition to establish a system of collected salvageable materials for transport to Thompson.

INAC organised for Mandak Metals from Selkirk go to Red Sucker Lake and remove car bodies as a pilot project three years ago. Mr. Burneaux said it was a success but has not been repeated because the metals in other communities are not sufficiently well organised.

A report prepared for Manitoba Keewatinoui Okimakanak Inc. (MKO) in 1996 also profiled concerns that many residents of native reservations have about solid waste management in their communities.[8]

The Manitoba Product Stewardship Corporation (MPSC), a provincial arms-length corporation, provides $152 per tonne for all eligible materials collected in municipal recycling programs. These revenues could help support a program to divert residential recyclables from landfills in the region.

2.3. *Market Information*

Materials to be collected could include:

- Scrap steel (e.g. cars, appliances, etc.)
- Scrap aluminium (e.g. old lawn chairs, salvaged pieces from cars, etc.)
- Residential recyclables included in the MPSC program (Old Newsprint, Corrugated Cardboard, Boxboard, aluminium beverage containers, steel food and beverage containers, telephone books, milk cartons, PET #1 and HDPE #2 plastic beverage containers, and glass bottles.
- Reusable building materials (e.g. doors, dimensional lumber, etc.)

Markets for these most of these materials are well established. Scrap steel and aluminium have been collected and recycled in the north for many years. The MPSC provides financial support to provincial recycling programs collecting eligible residential recyclables. There are also well developed markets for most of the eligible materials in

[8] Cowie, Geoff, "Environmental Health Initiative – Final Report", MKO, April, 1996.

the MPSC basket. Reusable building materials could be resold through the Re-Store, a used building material thrift store, located in Thompson.

2.4. *Landfills in the Region*

The following Table provides a list of landfills operated in the region provided by Manitoba Conservation and INAC. An estimate of the number of people in the associated communities has been developed using data from the 1996 census conducted by Statistics Canada.

Table 3 – Landfill Locations and Estimated Population Figures

Landfill Location	Local Population
Berge Lake	N/A
Brochet	250
Cross Lake	1,529
Gillam	1,534
Grandville Lake	77
Ilford	155
Inco	-
Island Lake	2,884
Limestone (Fox Lake Band)	2,042
Leaf Rapids	1,504
Lynn Lake	1,038
Nelson House	1,760
Norway House	3,402
Oxford House	1,615
Paint Lake	N/A
Pikwitonei	77
Setting Lake	269
South Indian Lake	887
Split Lake	1,500
Thicket Portage	204
Thompson	14,385
Wabowden	204
Wass Island	N/A
York Landing	300
Total Population	35,616

Some of these communities are accessible overland only through winter roads.

2.5. *Raw Material Supply*

2.5.1. Scrap Metal

According to Tom Hofer, buyer for General Scrap (a large scrap metal processing company headquartered in Winnipeg), considerable amounts of scrap metal are likely available for collection/capture in northern communities in addition to what is currently being collected. A rough estimate for the region around Thompson is 400 tons per year of steel. No estimates are available for aluminum.

Anecdotal evidence suggests that considerable quantities of additional scrap metal are available in many northern communities. Lionel Burneaux of INAC, for example, said that he counted 400 abandoned cars in a single community a few years ago. Using an average weight of 3000 lbs for each car, this site alone would provide 600 tons of metal salvage.

General Scrap sends a car flattener up to the Thompson area once a year to compact metal scrap. They collect approximately 1000 tonnes each year from the Thompson landfill, and also visit The Pas, Flin Flon, Snow Lake and other Northern communities. According to Mr. Hofer, it would be feasible to reclaim more scrap if local landfills performed better separation of scrap metal from solid waste.

Generally speaking, there needs to be at least 100 tons per site for a pick-up to be financially feasible. This translates to 4 or 5 truckloads of between 20 and 25 tonnes each. From the Thompson area, freight costs are approximately $25/t, or $500-625 per load.

Some First Nations transport their scrap on their own trucks travelling down to Winnipeg. General Scrap has experienced some difficulties determining ownership of scrap vehicles and other metal sources when they have tried to collect the materials themselves in First Nations communities.

Under current arrangements, individual haulers do not receive payment for scrap they bring to landfill collection sites. As a result there is currently little incentive for local residents to collect scrap metal generated in the area.

2.5.2. MPSC Materials

Based on a study into provincial waste generation rates conducted for the Manitoba Product Stewardship Corporation by ***earthbound environmental Inc.*** in 1998, 74 kg/cap/yr overall provincial average generation rate for MPSC eligible materials. Applying this per capita generation rate to the total population figure in Table 3, potential recovery of MPSC eligible materials is estimated at 2,635 tonnes per year.

2.5.3. Reusable Building Materials

Good quality, reusable building materials deposited at landfill sites could also be collected for resale at the Re-Store operated by TRC in Thompson. These materials would be shipped to TRC along with other recycled products diverted from area landfills.

2.6. *Staffing*

Staffing landfill sites in the region is an important component of the project. On-site staff are required to ensure that material delivered to the site is properly separated and organised for delivery to Thompson.

Staff would also be required to transport material from the remote landfills to a central site, likely in Thompson. This crew would make regular runs to each site to pick up available material. Depending on the number of landfills included in the system, and the distances involved, two full-time collection crews may be required.

2.7. *Equipment Requirements*

Equipment required would include:

1. A large flat bed truck with attached crane
2. Removable storage containers at each landfill site (full containers could be exchanged for empty ones)
3. Additional processing capacity at the Thompson Recycling Centre

2.8. *Other Materials*

Other materials could also be considered for inclusion in the system as they prove viable or as programs are established to help fund their diversion. Examples would include used oil, household hazardous waste, and compostable materials.

2.9. *Barriers/Risks*

- Developing a system that minimises the potential for confusion over the ownership of scrap metals collected in remote communities would need to be developed.
- Ensuring that high value recyclables collected at landfills are not stolen prior to being picked-up for delivery to Thompson. The area used to store materials in Thompson would also need to be secure.

2.10. *Set-Up Costs & Operating Costs*

2.10.1. Set-up costs

In addition to the equipment requirements discussed above, the organisational capacity of TRC would need to be expanded to accommodate a program of this magnitude.

2.10.2. Operating Costs

Operating expenses would include:

- Collecting and transporting materials to Thompson
- Processing residential recyclables
- Program management
- Staffing

2.11. Revenue Projections

2.11.1. Scrap Metal

Prices of the metals collected are determined as follows:

Steel - Prices are based on semi-trailer loads of steel. One ton of car bodies, appliances, barrels etc. is currently worth $80. One ton of structural steel (e.g. I-beams) is worth $100.

Aluminum - Prices vary based on the quality of the aluminum. If it is mixed with other metal, the price is $0.20/lb, or $400/ton. If it is 'sheet aluminum', for instance aluminum pots and pans, the price is approx. $0.50/lb, or $1,000/ton.

As the proportion of the 400 tons of scrap metal made up of aluminum is not available at this time, no projected revenue from the sale of aluminum is provided in this analysis. The projected revenue figure from the sale of scrap metal is therefore a very conservative number and could be considerably higher should aluminum prove to be a sizeable portion of the scrap metal category.

As $25/ton is charged to transport scrap steel to southern Manitoba, net revenues is $55 per ton. Using an estimate of 400 tons of steel per year, total net revenue would equal $22,000.

2.11.2. MPSC Materials

The MPSC provides a per tonne pay-out of $152/tonne to municipalities based on the weight of eligible materials collected. Total available revenue from collecting 2,635 tonnes of material therefore totals $400,000. Applying a more realistic capture rate of 50% to this material[9], would result in annual revenues of approximaelty $200,000. Thompson Recycling Centre is already collecting approximaelty $36,000 per year in MPSC revenue (based on 1999 figures) leaving an estimated $164,000 per year still available.

Additional revenue would also be available from the sale of the recyclable materials. The MPSC funding formula assumes an average per tonne revenue of $60 per tonne.[10] The sale of this material would therefore generate an estimated $79,000 per year. In years when recycled commodity prices are higher, as is currently the case, revenues would also increase. Again, Thompson sold about $24,000 worth of recycled material in 1999 which would leave about $55,000 per year still available.

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[9] Achieving a 50% capture rate would require a very well organised and well promoted recycling program in the region.

[10] Recent prices for recyclables materials have brought the average per tonne revenue number significantly higher.

Table 4 – Projected Available Revenue From MPSC Eligible Materials

	Total Revenue	TRC Revenue in 1999	Total Still Available
MPSC Revenue	$200,000	$36,000	$164,000
Revenue From Material Sales	$79,000	$24,000	$55,000
TOTALS	$279,000	$60,000	$219,000

A transportation subsidy for northern regions is also provided by the MPSC which essentially covers the cost of shipping these materials to markets in the south.

2.11.3. Reusable Building Materials

It is very difficult to project the value of building materials and other potentially reusable products discarded at landfill sites. Anecdotal evidence suggests, however, that some potentially valuable materials will be diverted. For the purposes of this analysis a conservative estimate of $2,500 per year in revenue from this category of material will be used.

2.12. Financial Summary

Table 4 shows total projected net revenue from the sale of diverted materials.

Table 5 – Total Projected Revenue From Landfill Diversion System

	Total Still Available
Scrap Steel	$22,000
Residential Recyclables	$219,000
Used Building Materials	$2,500
TOTALS	$243,500

2.13. Conclusions

This project appears to hold considerable potential as an economically viable opportunity to create jobs using discarded materials. Not only would sustainable jobs be created, but less waste would be disposed of in local landfills, the management of existing landfills would improve, and significant revenue could be generated.

3. Pallet Recovery

3.1. Project Description

The Thompson Recycling Centre could collect pallets that have been discarded in the local area and either resells them to local companies or ship them to a used pallet supply operation in Winnipeg.

3.2. Market Information

There is a steady demand for used pallets in Winnipeg. Prices for used pallets depend upon the quality and the type of pallet. In general, the better the quality of the pallet (the fewer the broken parts), the higher the price the seller will receive.

The following are the main companies that accept used pallets in Winnipeg:

Hobart Pallets *Unit 4-895 Dugald Rd., Winnipeg ph. 233-0593 contact: Colin Morris*

- Prices range from $1.75 to $3.00 depending on the condition of the pallet.
- They prefer pallets sized 40" by 48" (90% of all pallets sold are this dimension).
- Demand for pallets remains constant throughout the year. (Most of the pallets they sell are used in the food industry)
- They will accept pallets in any condition as they are a pallet repair company that re-furbishes broken/damaged pallets for re-sale.

Palex *1B-2595 McGillivray Blvd. Winnipeg ph. 889-4431 contact: Steve*

The amount Palex pays for a pallet depends on their condition and the type of pallet. They pay for anything that is fixable. There are three main kinds of pallets:

1. CMAC – This is the standard pallet. (40" x 48"). Average value is $1.50 -$1.60 per pallet however that is negotiable dependent upon their condition.

2. CPC – These pallets are orange in colour and much heavier than the CMAC pallets. They are usually constructed of birch or oak and have a greater re-sale value than the CMAC pallets. The CPC pallets have three general prices: $3, $5 and $7 per pallet (dependent again on condition).

3. White board – Various sized pallets that are painted white. The white board pallets generally sell for the same price as the CMAC pallets.

Palex defines "fixable" based on the number of boards on the pallet that need to be fixed. The CMAC pallets are seen as fixable if there are no more than 7 pieces that need to be replaced on the pallet. The CPC pallets are seen as fixable if there are no more than 5 pieces that need to be replaced on the pallet.

Pallets that are encrusted with chemical residue or animal waste cannot be accepted as the re-used pallets are destined for the food industry.

According to Palex, if the pallets are of a consistently good quality then a re-selling operation should be viable. Quality not quantity is what counts in the business. Palex would have no trouble accepting all the pallets collected by the Thompson recycling

Centre. According to the source at Palex they could accept 500 pallets a day as there is a consistently strong demand for pallets.

St. Boniface Pallet *200 Panet Rd. Winnipeg. Ph. 233-0383* *contact: Steve*

- Will accept any pallets as long as they are essentially intact.
- Price depends on size and quality. For the CMAC standard pallet (40" x48") they will pay between $1.25 and $2.00 dependent on the quality. Odd sized pallets with small market demand may fetch 50 cents. Prices for CPC pallets range from $3 -$5 dollars dependent on quality.
- Constant demand for pallets throughout the year.

3.3. *Raw Material Supply*

TRC currently collects approximately 2000 pallets per year. Many of these pallets are dropped off by local businesses as TRC does not regularly offer a collection service. Currently these pallets are used by TRC to ship out recyclable materials, given away for firewood, or provided free of charge to local businesses. Of the total number collected, it is estimated that 600 are disposed of at the landfill every year.

The total number of pallets discarded in Thompson every year is unknown at this time. TRC believes, however, that a substantial increase in the number currently being collected would be possible if an effective system to divert pallets from the landfill was established. Key components of a system for diverting pallets from the landfill would include a free collection service for pallets, establishing a pallet recovery centre at the local landfill, and extensive promotion of the program.

3.4. *Staffing*

One part-time employee should be sufficient to manage the work associated with operating a pallet recovery operation.

3.5. *Transportation*

According to Palex, the viability of re-selling pallets from Thompson in Winnipeg depends upon securing a good freight rate. Palex pays approximately $450 in freight rates for bringing a truck load of pallets from Alberta to its operations in Winnipeg. A 48' trailer can haul approx. 430-600 pallets.

TRC currently pays approximately $400 per load to ship material to Winnipeg.

3.6. *Barriers/Risks*

Barriers and/or risks include:

- The ability to maintain a secure location for the pallets to reduce the number of pallets that are removed without payment.
- A manageable system would need to be established for organizing and storing the pallets at TRC without taking up too much space.

- The collection of discarded pallets in the community would need to be enhanced.
- TRC would need to stop giving away the pallets and start selling them which may alienate a few local business owners, at least in the short-term.

3.7. *Set-Up Costs & Operating Costs*

Set-up costs should be relatively limited if no pallet refurbishing is conducted by TRC. All that would be needed would be some signage and perhaps a fenced compound. Using space at the Thompson landfill to store the pallets would be ideal as a fenced compound would then not be needed. TRC's existing truck could also be used for pallet collection thereby eliminating the need to purchase a vehicle.

If TRC was to begin rebuilding pallets, set-up costs would increase substantially.

3.8. *Revenue Projections*

Given the many variables involved in determining the value of a pallet, it is difficult to precisely estimate the amount of revenue that would be received from an average load of pallets. Assuming, however, that the average value of the pallets shipped south from Thompson was $2.00 and an average load size of 500 pallets, gross revenues per load would amount to $1000. With transportation costs of $400, net revenue would equal $600 per load.

Total annual revenue would thus depend on the number of loads TRC could ship in a year.

The price of a used pallet sold in Winnipeg starts at $5.00 and goes up from there. If TRC began selling good quality used pallets to users in Thompson, additional revenue could be generated.

3.9. *Conclusions*

Because many more pallets are shipped to Thompson than are required by local businesses to ship material south, it is recommended that TRC focus on collecting pallets for resale in the Winnipeg market. Good quality pallets could be sold to satisfy whatever local demand exists without investing in expensive processing equipment.

Purchasing pallet refurbishing equipment and establishing a processing operation could be considered at a later date depending on the results of the initial project. This would not only expand the number of good quality pallets available in the local market but would also increase the prices that TRC would receive for the pallets in Winnipeg.

4. Hydro Pole Sawing Operation

4.1. *Product Description*

Saleable lumber from used hydro poles.

4.2. *Market Information*

The market for various grades of dimensional lumber is strong and well established. The increasing demand for used hydro poles from Manitoba Hydro supports the fact that a good market exists for this type of lumber.

4.3. *Technical Considerations*

Once the poles are secured they require little preparation besides the removal of any metal pieces or nails that may be embedded in the wood.

4.4. *Raw Material Supply*

There is an established re-sale market in the province for used hydro poles. Manitoba Hydro currently charges $1.00 per foot for its used hydro poles (there has been a price increase since the preliminary report was prepared due to an increase in demand for the poles). The poles themselves are either cedar or pine with each type representing approximately 50% of the total. The pine poles are generally 35-40` in length and the cedar poles are usually around 50` in length. In Winnipeg, used hydro poles are purchased by a variety of sawmill operators to be cut up into usable lumber. Sawmill operators who purchase the hydro poles prefer to buy the cedar poles.

The total number of poles collected by Manitoba Hydro from around the province in 1999 was 624 poles. Exact figures for the Thompson region are unknown as no records are kept. According to the central storage facility in Winnipeg, most of the poles they receive are sold to saw mills or to farmers for use in hay sheds. Of the 624 poles they received by central stores last year, only 100 have not yet been sold.[11]

4.5. *Regulatory Issues*

Manitoba Hydro requires that the poles not be used in water and they cannot be burned.

4.6. *Barriers/Risks*

- According to sources at Manitoba Hydro, the company is moving away from storing used hydro poles and instead encouraging local sub-contractors to remove the poles from their original sites once the hydro lines are taken down. The Manitoba Hydro storage facility has seen a decrease in the number of poles that they have been storing as local contractors throughout the province directly remove the poles from their original sites. This change means that TRC would likely have to begin contracting with Manitoba Hydro to remove the poles from their original sites or

[11] Personal conversation with Jerry Convery, Stores Manager, Manitoba Hydro

enter into purchasing arrangements with local contractors performing this service to guarantee supply.

- The cut lumber would need to be stored in a secure area to prevent theft.

4.7. *Distribution*

TRC could either sell the lumber for retail prices through the Re-Store or wholesale it to established building material stores. Depending on the quantity of lumber produced, distribution may not be required beyond the Thompson area.

4.8. *Set-Up Costs & Operating Costs*

The main issues involved in a hydro pole sawing operation primarily concern the economic viability of purchasing a sawmill in order to cut up the used hydro poles and the potential re-sale price of the lumber produced from the poles. The cost of purchasing a portable sawmill varies widely. A new Enercraft portable sawmill (a manual not hydraulic model) capable of sawing a log 16 feet in length and 24" in diameter costs approximately $7,500.00. Enercraft also produces a number of other models that are fully hydraulic and capable of sawing larger logs. Prices for these machines run as high as $39,500.00 (see Appendix C for a price list of various types of sawmills).

There is also a market for used portable sawmills in which case the price of a particular sawmill may be substantially cheaper than the prices quoted here. The particular type of machine required and the costs associated with a portable sawmill would need to be investigated in depth to determine the feasibility of the entire operation.

Another option to alleviate the financial burden of purchasing a sawmill would be to contract out the actual sawing of the wood. A local sawyer could be commissioned to cut the wood to the required dimensions after TRC had purchased and prepared the poles.

4.9. *Revenue Projections*

The prices that could be charged for the lumber produced from the poles would also need to be carefully investigated. A 40 foot pine hydro pole with a diameter of 15" contains approximately 750 board feet of lumber. In Winnipeg rough pine lumber sells at between 32 cents and 60 cents a board foot for an 8' 2x4. Using a median figure of 46 cents per board foot, at present, that particular hydro pole could fetch approximately $345.00 if cut into usable lumber and sold through the Re-Store. The 40 poles currently available to TRC (assuming they are all pine) would therefore generate an estimated $13,800 in gross revenue.

Cedar is considerably more valuable than pine at approximately $.90 per foot for an 8' 2x4. 750 board feet of cedar would therefore generate $675.

Selling this material wholesale would cut the revenue figure approximately in half.

4.10. *Conclusions*

If a used sawmill is available and the necessary expertise can be accessed, or a local sawyer is available, operating a hydro pole sawmill operation on a part-time basis may be a feasible business opportunity for the TRC.

5. Packaged Kindling and Firewood Sales

5.1. *Product Description*

Bundled packages of kindling and firewood (small pieces of wood off-cuts) for sale through retail outlets such as gas stations and building product stores. This product would be environmentally superior to competing products made from cut timber as only discarded lumber would be used.

5.2. *Market Information*

Packaged firewood can be found in many different retail outlets including large building supply outlets, gas stations, and convenience stores. The breadth of the distribution for this product would indicate that significant demand currently exists.

5.3. *Raw Material Supply*

The main supply of wood off-cuts would be the NorWest Manufacturing plant located in Thompson. They produce an estimated 10 to 20 tonnes of various sizes and shapes of trimmings from their manufacturing operation every year. These pieces are often long and thin and can be made from spruce, pine, or poplar.

A small portion of this material is currently used by local residents as firewood with the rest being burned on-site.

If the market for firewood exceeds the supply available from the NorWest plant, considerable amounts of good quality wood is available from areas around Thompson that have recently been logged.

5.4. *Staffing*

Staffing levels would depend on the volume of sales although at least one full-time labour position and one part-time managerial position would presumably be required. The labourer would need to be responsible for all day-to-day operations including cutting wood lengths to size and packaging the firewood.

5.5. *Marketing*

Little promotion in addition to establishing relationships with potential distributors would be required. The packaging for the products, however, should strive to market the environmental and community development aspects of the product.

5.6. *Barriers/Risks*

The security of supply for the raw material from NorWest Manufacturing should be confirmed prior to investing significant time or energy into this project.

5.7. *Distribution*

Supplying a local chain of gas stations and/or convenience stores with firewood would help provide the sales volume required to make this project viable. This would require contacting various purchasing agents for outlets such as Domo Gas, Canadian Tire, Petro-Canada, etc.. The Manager of Gas Bar Operations at Red River Co-op expressed an interest in the product and encouraged TRC to contact the individual store owners to discuss possible sales contracts. A list of Red River Co-op gas bar owners is provided in Appendix D.

In order to establish these relationships purchasing agents will need to see the type of product that they will be purchasing. This will require that TRC prepare several prototype bundles to be shipped to potential clients.

5.8. *Set-Up Costs & Operating Costs*

5.8.1. Set-up costs

The equipment required to establish this type of operation would include:

- a jig to cut the wood into consistent lengths
- a saw to cut through a number of pieces at one time
- bagging equipment (or speciality bags that could be closed without mechanical assistance)

Depending on the final requirements, some of this equipment could either be made in-house (e.g. the jig) or purchased used (e.g. bagging equipment). While precise estimates on the costs of getting this operation going are not available at this time due to the many variables involved, the low-tech nature of the operation would suggest that costs would be minimal.

5.8.2. Operating Costs

Operating costs would include:

- labels
- bags
- labour
- transportation
- pallets

5.9. *Transportation Costs*

Assuming that:

1. an .8 cu. ft package is used to bundle the firewood,[12]
2. twenty eight 48 x 40 pallets fit into a 48' trailer,
3. and each pallet is piled 4 feet high,

then each pallet would hold 104 bundles. A full truckload would total of 2,912 firewood bundles could shipped in one load. At $400 per load, this works out to a shipping cost of about 14 cents per bundle.

[12] This is the size of bundle sold at 7 Eleven.

5.10. Productivity

As labour costs would be by far the most expensive part of the operating costs, productivity levels would have an important impact on the viability of this project. Assuming that proper equipment is available to the employee, and the raw material does not have to handled often or transported any distance, it should be realistic to assume that a minimum of 10 bundles per hour could be produced. In a seven hour work day, this would result in 70 bundles could be made in one day. Producing enough bundles to fill a trailer would therefore take 40 days or approximately 8 work weeks.

If the employee was paid $8.00 per hour for 7 hours per day and 5 days per week, the total labour cost to fill a trailer would be about $2,300. If it was possible to make 20 bundles per hour, labour costs to fill a trailer would be half of this amount.

5.11. Revenue Projections

7 Eleven sells an .8 cu. ft. bundle of firewood for $4.99[13]. It could be assumed that the wholesale price of that product was in the range of $1.75. If TRC was able to sell a full trailer load of firewood bundles (approximately 3000 bundles) for $1.75 in southern Manitoba, gross revenues would be $5,250.

5.12. Conclusions

If TRC can;

1. develop a production system that can produce 10 bundles per hour,
2. can wholesale the bundles for at least $1.75 per unit, and
3. can keep transportation costs to $400 per load

it would appear that a gross profit of about $2,500 per load could be realised. Overhead expenses such as managerial costs and amortised capital and set-up expenses would still need to be deducted. On this basis it would seem that the project warrants further investigation.

[13] This product has been imported from Richmond, B.C.

6. Conclusions

Based on the results of the research presented in this report, each of the five opportunities analysed has potential and could be successful if pursued further. Each project would create additional employment in the Thompson, Wabowden, and or Norway House area and, with the possible exception of hydro pole milling, reduce the amount of waste currently being disposed of in local landfills.

Establishing a fish waste composting operation and setting up a system for improving the capture rates of recyclable material disposed of landfills are larger scale projects that would require a greater level of planning and co-ordination prior to implementation. Partnerships would need to be formed between funding agencies, regulatory bodies, raw material suppliers, and project management to make these larger projects work.

The hydro pole milling, pallet recovery, and kindling/firewood opportunities could be implemented with a much lower level of partnership development. As smaller ventures, TRC (or another entity) could implement one or all of these projects with much less effort than the two larger projects would require.

Additional research will still be required for each specific opportunity with full feasibility studies required for the fish waste composting operation and the project to capture more recyclable materials currently disposed of in local landfills.

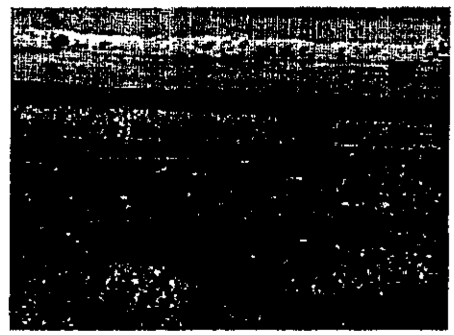
APPENDIX A

Commercial Composting of Fish Waste Technical Paper

Compost Symposium

ECONOMIC VIABILITY OF COMMERCIAL COMPOSTING OF FISHERIES WASTE BY PASSIVE AERATION

Extracts from



Dr. S. P. Mathur

The Compost Council of Canada Symposium

Montreal, Qc. Canada

September 1994,

ECONOMIC VIABILITY OF COMMERCIAL COMPOSTING OF FISHERIES WASTE BY PASSIVE AERATION

by

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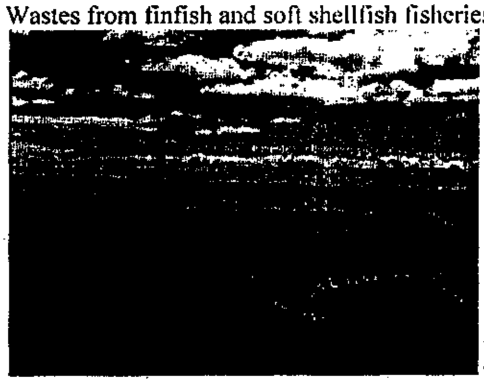
Abstract

Wastes from finfish and soft shellfish fisheries and aquiculture are exceptionally rich in a variety of plant nutrients and devoid of problematic metals, pathogens and inert contaminants. Although highly valuable as fertilisers, their proper agricultural utilisation by soil interment faces operational and climatic hurdles; and is challenged by the sporadic nature of availability of the waste. *Shigawake Organics Inc.* therefore attempted composting to optimise utilisation of the waste on their farm in the Gaspé area of Quebec. Environment Canada's DRECT Program and Agriculture Canada assisted Shigawake Organics to ascertain technical feasibility of composting fish wastes by a passive (natural) aeration technique and develop a model of economic viability in view of all considerations relevant



to a farm-based commercial operation. The model will be presented for profitable composting of fish waste with peat.

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1. Introduction

This report represents a coming together of many interests. The decline in cod fishery is directing the industry's attention towards aquiculture and other marine biomass resources. At the same time it is being increasingly realized that to abuse a resource is to lose a resource. Portions of a biomass resource when improperly disposed generally cause pollution that perturbs habitats, and contributes to climate change affecting whole ecosystems, including the local work force. Alternate or additional employment and wealth, however, can be generated for the local human population by closing nature's loops locally through technologies that are economically and environmentally sustainable.

It is therefore not surprising that commercial composting of fish wastes by a technique that requires low capital and operational costs was supported by Environment Canada's DRECT program to encourage waste reduction; by the Environmental Partners program to improve the local ambience, by Proctor and Gamble Inc's Compost Fund to encourage ecosystem integration, by the provincial governments, and the National Research Council of Canada's IRAP programs to bring more science to industry; by ACOA (Atlantic Canada Opportunities Agency) and others to create employment; and by Agriculture Canada to enhance the environmental sustainability of farming. But, all these interests came together only because Ms. Lois Saunders, an interested citizen and government worker from Colinet, Newfoundland, wrote to the Federal Ministry of Environment asking "what are we supposed to do with the fish offal you don't want us to spread on open pastures anymore". "Do you know if we can compost it with the local bog". To go from there to where we are today we will deal below with the fish offal, bog, wood wastes and passive aeration composting, to arrive at how to profit from helping the planet.

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2. The Compost Feedstocks

These were fish wastes and peat or wood wastes, namely sawdust and shavings or tree bark.

2.1 Fish Wastes

Commercial fishing and aquiculture generate large proportions of waste called offal (that was made to fall off the boat), 'morts', racks, gurry, scrap, chum etc. The waste may be 80% or higher when landed catches are found to be unfit as food, when there are massive kills in aquiculture, or when only roe (eggs) is harvested from herring or other fishes. About 30% of the population during aquiculture turns up as 'morts', while there is usually a by catch of non commercial sizes and species and some squashed fish in dragnets. Filleting of fish, such as of the groundfish family culls 40 to 60% of the total processed (see Mathur, 1991 and Martin and Patel, 1991). About 30% of the fish sliced into steaks, or canned, is scrapped. The discarded exoskeletons and other parts of processed shellfish such as lobster, crab and shrimp comprise 30 to 80% of the landed weight. According to Green and Mattock (1979), processing of fin fish, crab and shrimp can generate 30 to 60%, 75-85% and 40-80% solid waste, respectively.

It was estimated (Mathur, 1991) that processing of groundfish alone in Canada generates about 140,000 to 200,000 metric tonnes of waste that is disposed. A corresponding estimate for seafood processing waste in the U.S. is 2 million metric tonnes per year.

Environmental concerns and regulations in North America have made it costly (CAD 20 to 70 per ton) to dispose fish wastes by dumping on open seas (>20 km from shore), or by appropriate land filling. Low technology land burial and open surface dumping, of such wastes is likely to be prohibited and regulations enforced in more and more jurisdictions, due to the nuisances of malodours and scavengers, and the eventual contamination of surface and groundwater by such disposal.

Fish wastes include whole waste fish, offal that contains viscera, and racks that remain after filleting. The racks include skin, heads, fins, tails and backbones. Finfish wastes are thus rich in proteins and bones, and contain some lipids (fats and oils). Herring waste from roe harvesting, about 95% of the total landing, is particularly oily. Dogfish gurry, being from a (sand) shark is boneless but contains cartilaginous skeletal parts, the tough sharkskin, tail, fins and viscera, usually in a thick suspension. Shellfish scraps contain about 33% protein and 33% chitin (poly-N-acetyl glucosamine) (Martin and Patel, 1991). Chitin and crustaceans of a Ca and P compounds constitute the shellfish exoskeletons. The crustacean waste also contains unextracted meat and organs. The finfish and soft shellfish wastes carry up to 8% N, 7% P and 15% Ca and all the elements essential to life. (It should be noted that the hard molluscan shells e.g. of clams, are of no organic value as they are mostly Ca carbonate).

Martin and Patel (1991) have discussed and referred to other reviews of various means of utilizing fish wastes. The wastes can be cooked and dried to produce fish meal. Small proportions of fish meal can be included in animal feeds. Larger proportions can taint animal products like, milk, eggs or meat with fishy smells. Various types of fish sauces are made by fermenting different whole small fishes or specific fish organs. Fish tissues are degraded into soluble proteins, peptides and amino acids mainly due to endogenous fish enzymes (biological catalysts), and flavour is contributed by certain naturally-occurring or introduced bacteria or fungi. Salt is added to control the degradation. Specific sauces are popular in small geographical areas. Fish silage production involves (i) chopping or mincing, (ii) blending with the acid, e.g. formic or H_2SO_4 + HCl, and (iii) digestion and storage. Attempts have been made to reduce transportation costs of the liquid silage and fish hydrolysates, by drying the products through vacuum desiccation, spray drying, or drum drying. Fish silage, hydrolysates and meal have difficulty in competing in the animal feed market with widely available plant protein sources, e.g. soybeans, oilseed cakes and cottonseed, partly because the capital-cost of producing the easily transported fish meal is rather high. Also, as size of the population that is solely dependant on fisheries declined so that the tolerance of communities for the odours associated with production of certain fish by-products, e.g. fishmeal.

All technologies designed for specific marine wastes are challenged for commercial viability by the variable volume and sporadic nature of availability of the feedstock. And, most require specialized skills in the labour force employed.

2.2 Problems in Direct Use of Fish Wastes

Direct use of the fish wastes for land manuring; or land spreading, is generally discouraged by the uniquely obnoxious odour of putrefying fish. Such use even in areas where it is permitted is therefore restricted mainly to immediate ploughing in of the waste before or at the time of planting. This can not be done is summer when crops are standing although that's when most of the fish waste is generated. Ploughing is also difficult when the soils are excessively wet, or frozen.

The fish proteins, lipids, and chitin are easily broken down by (nonliving) exoenzymes and autolytic enzymes in dead cells, even under conditions in which the decomposer organisms themselves are not active. The intestines and muscle tissues of fishes are particularly rich in enzymes that degrade various components of flesh, e.g. proteins, scales and skin. Fish wastes have been studied as sources of such degradative enzymes (Martin and Patel, 1991). Enzymes are essential to all life but life is not essential for all enzyme activities. Enzymes can act even under conditions suboptimal for microbial activities e.g. at -20°C (Mathur, 1982). Even under cool conditions therefore volatile ammonia is released rapidly from these wastes by the exoenzymes while the organisms that assimilate it or convert the ammonia to nitrate are not active. The nitrate-producing organisms may also be suppressed by high ammonia concentrations. At the same time, fish lipids being mostly of the unsaturated type oxidize rapidly in air to produce foul rancid odours. Aerobic (in presence of air) and anaerobic decomposition of fish wastes in soil or ordinary hot composts is therefore so rapid (and malodorous) that much of the ammonia is lost by volatilisation. More so, because the calcium present in the waste makes them alkaline and thus promotes ammonia loss. This decreases the fertiliser value of the waste. The loss and odour dissipation may be even greater when the compost is force-aerated or turned as fresh air carries more ammonia, and the heat promotes volatilisation. Usually, corrective measures have to be taken with variable effectiveness.

When the wastes are buried or land filled decomposition of the fish wastes occurs under the anaerobic conditions that generate particularly malodorous reduced S and N compounds like cadaverine and putrescence that have evocative names, and hydrogen sulphide (the rotten egg gas). Anaerobic composting of fish wastes therefore poses problems of smell, transport, application and aesthetic utilisation without adverse environmental impacts. The impacts may be mainly due to most of the nitrogen in the product being in forms that can be easily volatilized or washed away, not in the form of the stable humus that is formed by aerobic composting.

2.3 Challenges in Composting of Fish Wastes

As fish wastes have narrow C/N ratio, and are or become alkaline, they need to be mixed with acidic or acidogenic material(s) with a wide C/N ratio. Because fish wastes, particularly from finfish, tend to be wet and dense they need to be mixed with a water-absorbing loose material. However, in most circumstances even the inclusion in fish waste composts of mildly acidic materials of low permanent buffering capacity (e.g. river mud, citrus and banana wastes) may not prevent loss of most of the ammonia nor provide a naturally well-aerated mix. Materials of wide C/N ratio like fresh wood by-products have their own oxygen demand particularly when they are mixed with fish waste that generates ammonia as the ammonia neutralises and promotes autooxidation of the phenols released from wood wastes. The phenols normally, otherwise, slow down decomposition by inhibiting the micro-organisms involved in the process. When a mixture of fish wastes and wood by-products therefore is actively aerated by forcing air, and/or by turning of the composts, the loss of ammonia is exacerbated. At the same time active oxidation of the mixture generates more heat that may cause further odour generation due to chemical 'charring' of the waste that is similar to singing of hair. Further aeration to cool the mass promotes ammonia loss, and the need for biofilters and/or scrubbers of high capacity. Conversely, if the aeration is withheld, decomposition of the fish waste would continue under the anaerobic (oxygen-deficient) conditions that generate the highly malodorous amines and sulphamines and H_2S.

2.4 Use of Peat or Wood By-products for Fish Waste Composting

In 1983, a team of researchers in Canada realized that fish wastes should be composted aerobically by being mixed (bulked) with and enveloped in a material that (a) has a wide C/N ratio, (b) is acidic and hydrophilic enough to trap ammonia in solution; (c) has high capacities for adsorbing and complexing ammonium and calcium ions; (d) is fluffy enough to be well aerated so that malodours of anaerobic decomposition are not created but the process oxidatively generates the acidic sulphate and nitrate ions that help dissolve the basic phosphates in bones and soft crustacean shells; (e) deodorizes any malodours generated even transiently; (f) provides heat insulation; and (g) though biodegradable will not decompose fast enough to generate high heat (>45°C) by itself so that its own oxygen demand is not great, and the compost can mature in a short Canadian summer without having to be turned or actively aerated.

It was concluded that horticultural sphagnum (blonde) peat and light brown peat that is used neither for fuel nor horticulture meet the above requirements fully. Some wood byproducts also meet many of the same requirements except that they do decompose during composting. Wood has lower acidity and buffering capacity than peat but a higher bulk density so that a cm^3 of wood waste weighing 0.3 g with a buffering capacity of 25 meq/100 g is as effective in trapping ammonia as a cm^3 of peat weighing 0.06 g with a buffering capacity of 125 meq/100 g. Both have low fertilizer value by themselves although peat tends to be richer in N. While peat has high market acceptability as a soil conditioner wood byproducts are more widely available, and are often being disposed in an environmentally inimical manner. For example, open dumps and stockpiles of wood wastes may contaminate water with leachates and emit the highly potent greenhouse gas methane.

The peat used for composting does not have to be the milled air-dry product available in bags. It should be moist, loose and be fine screened only after the composting. Some of the coarse material can be put back at the base of compost piles. In effect, the peat itself does not decompose significantly during the composting. It becomes valorized due to the nutrients from the fish waste. Shigawake Organics is indeed using rough unscreened peat that has been drained of excess water by simple stockpiling with more than satisfactory results.

One possibly negative consideration was that peat harvesting may affect some wetland ecosystems. However, it is now proven that harvested peatlands (cut over peat) can be restored to new wetland ecosystems which sequester carbon rather than contribute methane to the atmosphere, as virgin peatlands do. Methane is 28 times more forcing than carbon dioxide as a greenhouse gas. At the same time, peat applied to mineral soils helps to restore soil organic matter and does not contribute much CO_2 to the atmosphere. In fact, more than 80% of the peat applied to land remains there even after 10 years so that peat is 5 to 8 times more effective in rebuilding soil humus than uncomposted manure, crop residues and green manuring. Wood byproducts also build more soil humus than animal and crop wastes (Janssen 1984).

On the economic side, a market exists for high-priced, limed and fertilized peat for use in greenhouses, house plants, and home gardens. By composting with fish waste the peat becomes limed and fertilized completely so that it can be a substitute for the enriched peat neutralized and supplemented otherwise at considerable cost. High quality composts can also be generated from some wood byproducts, particularly if they have been partly decomposed such as while in old stockpiles or dumps.

2.5 <u>Sawdust and Shavings</u>

Sawdust and shavings, like other wood wastes, are low in N and P and therefore are composted best in combination with other counter-balancing materials, or with N and P fertilizers. Wood wastes contain hemicelluloses and celluloses that degrade easily, and the recalcitrant lignins that contribute heavily to humus formation. During decomposition phenolic compounds and polymers release bioinhibitory phenols, terpenes and tannins periodically so that the process of wood waste composting is staggered rather than continuous (Mathur, 1991). This problem is mitigated when wood-based composts contain sufficient ammonia-generating compounds, e.g. proteins, chitin, urine and urea. Ammonia raises the pH value of the compost. The slightly alkaline pH in the presence of air causes neutralization and autooxidation of phenols to produce semiquinone free radicals and hydro quinones which polymerize, by themselves, or through enzymatic catalysis, into insoluble humus-like polymers, thus removing the bioinhibitory compounds from an active role (Mathur, 1991).

Mixtures of sawdust and shavings, or bark chips alone are more suitable for composting than pure sawdust alone. And, in general, partly decomposed old wood waste may be better than the freshly generated. Sawdust deters air movement and creates greater oxygen demand as it is denser and tends to degrade faster and to a greater extent than peat, bark or shaving. Finer materials are more accessible to microbial and chemical action. Presence of the lighter and larger shavings of wood with the sawdust makes it suitable for composting with fish waste. This has been confirmed by trials at Shigawake Organics. Sawdust and shavings are being also tested at Belchertown (New England Small Farms Institute), Massachusetts, for composting with rabbit manure or aquiculture morts by the passive aeration technology, with encouraging initial results.

2.6 Tree barks

Like other wood wastes, tree barks are also poor in N and P, and contain carbohydrates, lignins and resins. But unlike other wood wastes barks may contain up to 22% of their weight in tannins, which are water-soluble polyphenols based on gallic acid. Tannins, as per their role of protecting trees from pathogens, inhibit cellulose decomposition, and are toxic to many organisms (Bollen and Lu, 1969). On the other hand, tannins readily form water-insoluble, humus-like stable complexes with proteins, as in the tanning of leather.

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3. The Technology of Passive Aeration Composting

The purpose of countermarching peat, sawdust, or bark with fish waste to conserve ammonia, and eliminate malodour generation and dissipation, would have been partly defeated if the compost had been force-aerated or turned.

The ammonia generated within the hot compost mass combines with the carbonate ions of the carbon dioxide produced there to form ammonium carbonate. This salt is stable under moist conditions only if the carbon dioxide concentration is high as within a compost, but not under normal atmospheric conditions. Consequently ammonia loss occurs when air is passed through a compost it is exposed to the atmosphere during turning. The escaping ammonia would contribute to pollution and acidification unless it is recaptured for the compost through the use of costly biofilters and/or scrubbers.

Forcing air and/or turning of composts aerates, warms and retains the whole mass at a high temperature for a long period. High temperatures, however, inhibit the oxidation of volatile ammonia and malodorous sulphides to nonvolatile nitrate and sulphate, particularly the former. Organisms that oxidize ammonia to nitrate can not tolerate high temperatures and very high concentrations of ammonia. Nor can they compete with organisms that use oxygen for oxidizing the more abundant carbon present. Turned composts or force-aerated static pile composts without a colder envelope therefore tend to lose ammonia that causes odour problems and decreases the fertilizer value of the product. The loss of the nitrogen also prolongs composting because then more of the carbon has to be oxidized before a stable C/N ratio is reached as, ideally, eventually only ten units of carbon will be retained in humus for every unit of nitrogen in the product. And yet, the compost has to have enough oxygen. To solve these dilemma, a team of scientists in Canada devised the Passively Aerated Windrow System (PAWS).

PAWS has two essential features, passive aeration and envelopment; these are explained below.

The air in the middle of a compost pile or windrow is warmed up by the heat generated by oxidation of the waste by the decomposer organisms. Warm air naturally rises upwards and outwards of the composting mass. As nature abhors vacuum, the warm air is replaced by cooler air mostly from or through other parts of the compost, setting up a mostly internal circulation until the air is almost uniformly warm and oxygen-deficient thus creating anaerobic pockets that generate malodours. That is why composts usually have to be force-aerated or turned. Another reason is that peripheral parts of the compost mix also have to be subjected to the high heat in the interior in order to kill weed seeds and disease-causing organisms all over. In the PAWS, both needs for turning are eliminated. First, by placing open-ended air intake pipes at the base, with holes only on the top side so that the heat generated in the compost mass itself energizes the movement of fresh oxygen-rich air into the mix. The rate of air-intake in effect is controlled by the heat generation or the rate of activity and oxygen demand of the decomposer organisms. Thus the overheating caused by chemical oxidation due to excessive aeration, which generates hair-singing and charring-type smells, is avoided. Overheating can also cause a collapse of activity as some microorganisms are killed by >70°C heat. Consequently, up to 90% of the air forced for active aeration systems is for cooling rather than warming the compost.

The second need for turning is avoided in PAWS by enveloping the decomposing mass in already sanitary (hygienic, weed seed and pathogen-free) peat or mature compost. Thus, PAWS, in a sense, is an in-vessel technology. The 'vessel walls', that is the peat or mature compost, do not decompose much, and are cooler than the interior so that they trap hot vapours by condensation and chemical adsorption in an environment where more oxygen is available for their oxidation to innocuous and beneficial compounds. In effect, the envelope acts as a scrubber and a biofilter in intimate contact with the compost, and as a screen against insects and vermins. Being in appropriate temperature (mesophilic) range the envelope supports oxidation of ammonia to nitrate, thus replenishing the ammonia-neutralizing capacity of the envelope throughout the process.

The PAWS technology has been proven to be effective in all aspects for composting wastes from seafood processing, pulp and paper mills, all types of farm animals, and kitchens. This was done by researchers from Agriculture Canada, National Health and Welfare Canada, Correctional Services Canada, Environment Canada, Universities in New Brunswick, Newfoundland, Maine and Minnesota, and others (Mathur, 1992).

The PAWS technology is employable for both short and long windrows. For the smallest short scale, the compost heaps are 1.5 meter (5½ ft) high, trapezoidal in cross-section, with base and top planes of 3 m x 2 m, and 2 m x 0.3 m, respectively. A basal 10 to 15 cm (4" to 6") layer of peat or any mature compost is laid in a fluffy state on the ground. Two 3 m long standard PVC or ABS soil pipes, 10 cm in diameter with perforations 1.2 cm in diameter are placed lengthwise on the basal layer about 0.6 m from the margins. The two parallel rows of perforations at 5 cm intervals are about 10 cm apart on the two sides of the apex. Such pipes are routinely used for discharging and spreading effluents from septic tanks in North America, and for collecting leachates from landfills. Mixtures of layers of materials to be composted are placed on the pipes to a height of about 1.3 meter, and then the mass is covered with peat or any mature compost as an envelope.

On the medium scale, passively aerated windrow with one series of pipes placed cross the base can be of any length, 1.5 m high and 3.1 m wide.
Even larger passively aerated piles have been found to be effective for composting farm manures containing straw or wood shavings as litter. Two pipes were joined to provide aeration ducts of 6.1 m length to build windrows of 6 m width and 3 m height. A further modification recently achieved obviates the need for the aeration pipes by using a open plenum below the composting mass that is placed directly on a perforated platform. This has so far been tested successfully for farm manures only.

The length of the medium and large scale passively aerated windrows has no technical limit.

The mature compost or peat used in PAWS is generally about 20% to 40% of the compost mix by volume, nearly a quarter of which is used in the base. The 40% value is for conditions where some peat is mixed in with the waste such as when composting whole fish or their viscera. Wood wastes and mature compost can be used instead of peat in some situations.

Temperatures in the interior of the windrows rise within 2 or 3 days, attaining the thermophilic range of 45 to 65°C within 10 days even at ambient temperatures of 4 to 10°C. The oxygen concentration decreases during the warming up phase to less than 5%, but as the mixture heats up to 45°C or so fresh air starts to be pulled through the pipes. Thereafter, the oxygen concentration generally stays between 13 and 18% during the thermophilic phase which may last for as long as 8 weeks, depending upon the bioxidizability of the material. When the composting mass cools down to 30°C or ambient conditions, the compost can be reheaped for curing and the pipes reused for another windrow.

A current Environmental Partners project of Environment Canada with the Bonaventure English Harbour Development Association at Trinity, Nfld., is attempting to use PAWS channels with removable roofs. Here the windrows are enclosed on the sides, and of rectangular shape 50 ft long, 8 ft wide and 8 ft high. Thus the compost is better protected from wind and rain.

More details on the system and the research behind it are available in the references given at the end of this report.

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4. The Site and Permits at Shigawake Organics

The site has the following features:
(i) good drainage;

(ii) away from streams and water bodies (> 1 km);

(iii) away from habitation (> 1 km);

(iv) sufficient space for operation and manoeuvring of equipment;

(v) wind protection from a ridge on one and treed areas on two sides;

(vi) easy accessibility.

One undesirable feature of the site is that it is within 1 km of a local dump site where various wastes, including fish offal, are disposed by shallow burial, and also within 1 km of farms where fish waste is dumped openly (to be disposed by natural scavengers). The area therefore has a well-primed population of scavengers, e.g. seagulls and crows. This problem is being addressed by seeking elimination of the wasteful practices.

The authorizations required to use the site were met by obtaining permits from the local municipal and regional governments, and of Quebec ministries of both agriculture and environment. The site was fully documented, surveyed and tested. An inventory of waterways, and water supplies (e.g. wells within 5 km of the site), habitation, plant and animal life in the area was made. Surface soil and core samples were taken and standpipe stations (piezometers) established to monitor groundwater quality. If and when the groundwater is found to be affected, the site will be made impermeable.

Important steps taken to forestall pollution included never placing the fish waste directly on land, but always on a base of the bulking agent or mature compost.

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5. Production of Composts

Various combinations and configurations have been tested at Shigawake Organics but the main production is by the passively aerated windrow system of Agriculture Canada.

The composts have been monitored for several parameters including temperature, pH, Eh (redox potential), H_2S, NH_3 and $\%O_2$. Details of the methodology and observations have been given in Hayes (1993).

Table 1 presents data on the peats and wood byproduct used at Shigawake Organics. The low N and wide C/N ratio of the sawdust and shavings is noteworthy.

TABLE 1. KNOWN PROPERTIES OF COMPOST RAW MATERIALS USED BY SHIGAWAKE ORGANICS, (ON DRY MATTER BASIS, EXCEPT FOR MOISTURE AND PH).

Properties	Lameque Peat	Sawdust + Shavings	Herring Waste	Crab Scrap	Shigawake Peat
pH	3.00	7.1	6.7	-	4.4
% Moisture	50.00	22.20	73.00	35.00	75.00
% Dry Matter	50.00	77.80	27.00	65.00	25.00
% Mineral Matter	4.00	8.43	11.00	43.7	1.28
% Organic Matter	96.00	91.57	89.00	56.3	98.72
% Carbon	43.70	45.05	44.22	27.70	54.84
% Nitrogen, total	0.80	0.15	13.40	8.20	1.03
% Ammonium-N	0.07	0.00	-	-	-
% P_2O_5, "Phosphate"	0.09	0.02	13.99	6.66	0.05
% K_2O, Potash	0.06	0.14	0.45	0.39	<0.01
% MgO, Magnesia	0.16	0.36	0.44	1.48	0.05
% CaO "Lime"	0.14	1.65	14.27	20.87	0.14
C/N Ratio	53.30	300.33	3.30	5.34	53.24

Table 2 presents data on some of the composts prepared at Shigawake Organics. As expected the peat-based composts tended to be richer in nitrogen than the wood-based composts. One of the composts (#1 in Table 2) indeed was richer in N than almost all others summarized in Table 3.

TABLE 2. PROPERTIES OF SOME COMPOSTS PREPARED BY SHIGAWAKE ORGANICS LTD., BY PAWS IN 1991 (EXCEPT PH AND % MOISTURE, ALL ON DRY MATTER BASIS)

Properties	Compost and Components					
	1	2	3	4	5	6
	Peat + Herring Upper Level	Peat + Herring Lower Level	Sawdust + Herring + Mature Compost	Sawdust + Herring + Peat Cover	Peat + Crab	Various Wastes
pH	7.83	7.51	7.02	7.30	7.52	6.95
% Moisture	67.10	77.20	63.00	66.90	57.30	68.00
% Dry matter	32.90	22.80	37.00	33.10	42.70	32.00
% Mineral matter	44.70	31.58	50.80	37.46	75.2	50.00
% Organic matter	55.30	68.42	49.2	62.54	24.8	50.00
% Carbon	30.72	38.01	27.33	41.69	13.78	27.70
% Nitrogen, total	5.08	3.52	1.08	1.80	1.41	1.76
% Ammonium-N	2.83	1.10	0.21	0.03	0.00	0.32
% P_2O_5, "Phosphate"	3.53	3.18	2.04	4.81	5.52	3.98
% K_2O, Potash	0.63	0.89	0.42	0.45	0.22	0.31
% MgO, Magnesia	1.88	2.23	2.76	4.81	5.05	3.66
% CaO, "Lime"	3.02	3.39	5.60	7.84	17.60	11.88
C/N ratio	6.05	10.80	25.30	11.56	9.77	15.94

TABLE 3. PROPERTIES OF VARIOUS PEAT OR SAWDUST COMPOSTS (ON DRY MATTER BASIS, EXCEPT PH AND MOISTURE).

Properties	Composted with Peat Moss by PAWS				Composted with sawdust by turning
	Whole Small Fish (Herring) Me., U.S.A.	Crab Scrap (Chum) N.B., Canada	Various Seafood Wastes in Me., U.S.A. (Range)	Various Seafood Wastes in N.B.,Canada (Range)	Fish Waste in Me., U.S.A. (200 days)
pH	7.15	7.75	59.97 to 7.49	7.72 to 7.99	69.20
% Moisture	60.70	60.00	29.00 to 69.80	59.10 to 64.80	69.20
% Dry Matter	29.30	40.00	30.20 to 71.00	35.20 to 40.90	30.80
% Mineral Matter	7.60	36.60	8.50 to 20.50	33.50 to 36.60	31.30
% Organic Matter	92.40	63.40	79.50 to 91.50	63.40 to 66.50	68.70
% Carbon	46.2	31.70	39.75 to 45.75	31.70 to 33.25	35.7
% Nitrogen, total	4.47	2.61	3.38 to 5.12	2.70 to 3.52	1.35
% Ammonium-N	?	?	?	?	0.01
% P_2O_5, "Phosphate"	?	4.00	?	2.01 to 4.51	1.58
% K_2O, Potash	0.44	0.30	0.30 to 0.55	0.29 to 0.41	0.32
% MgO, Magnesia	?	0.99	?	0.25 to 0.99	?
% CaO, "Lime"	?	4.93	?	1.06 to 3.44	1.12
C/N Ratio	10.33	12.14	7.76 to 13.53	9.45 to 11.74	29.9

Shigawake Organics has found it beneficial to utilize professional help in designing the packages, and in formulating, and getting approval for, the text printed on the bags.

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APPENDIX B

Federal Composting Guidelines

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Environmental Assessment Considerations

Composting Facilities

The following environmental assessment considerations for composting facilities are related to Environment Canada's specialist knowledge and expertise (consult the FACT SHEET - Environmental Assessment and Environment Canada's Mandate).

1. Identify location of proposed project (latitude and longitude) and provide map of area (drawn to scale) showing project components, drainage and nearby water bodies.

2. Identify possible constraints to the siting, design and construction of the proposed project. A priority should be placed on impact avoidance.

   - potential impacts on National Wildlife Areas, Migratory Bird Sanctuaries, endangered species, migratory birds, wetlands and hydrological conditions
   - potential impacts on groundwater and surface waters including shellfish growing waters
   - presence of contaminated areas and acid generating rock
   - type and permeability of surficial materials
   - potential impacts of meteorological conditions and flooding on the project

3. Describe the design of the proposed project.

   - type of technology to be employed (e.g. windrow system or in-vessel system)
     - for windrows: covered or uncovered
     - for in-vessel systems: non-agitated or agitated system
     - aerobic or anaerobic (anaerobic digester)
     - control and treatment of exhaust air (e.g. biofilters)
   - type, thickness, and placement of impermeable liners if needed
   - provisions for runoff/leachate collection with attention to meteorological conditions
   - recirculation/treatment system including provisions for routing and discharge of effluents

4. Identify and describe the design of related infrastructure (e.g. access roads, buildings) and show their locations on a map.

5. Describe construction, operation, maintenance and decommissioning activities together with

environmental protection measures. A priority should be placed on impact avoidance and pollution prevention opportunities.

- clearing, grubbing and excavation of land (e.g. for construction of access roads, tipping areas, composting and curing pads, liners, leachate collection system, treatment ponds, and buildings) including provisions for minimizing and controlling erosion, dusting and the introduction of suspended solids into receiving waters
- transportation, use and storage of hazardous materials (e.g. petroleum products) including provisions for preventing and responding to accidental releases
- measures for preventing exposure/attraction of migratory birds (e.g., gulls) and endangered species to feedstock and compost
- provisions for monitoring water quality including sampling schedule, parameters (e.g. BOD, TSS, pH, nitrates, nitrites) and locations (e.g. effluent, groundwater, receiving waters)
- proposed composting procedures with particular attention to:
  - source, volume and composition of feedstock, and provision for separation of feedstock from other waste materials (e.g. at source or on-site)
  - size and composition of bulking agents
  - parameters to be measured during composting process (e.g. carbon:nitrogen ratio, temperature, oxygen, moisture content) and proposed quality control measures
  - turning mechanism and interval used
  - length of composting and curing processes
  - parameters to be measured in analysis of final compost product (e.g. foreign matter, maturity, organic matter content, organic contaminants, pathogens, trace elements)
  - end product uses

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6. Describe waste management practices.

- provisions for disposal of hazardous and non-hazardous wastes (e.g. non-compostable material) with attention to pollution prevention opportunities (reduce, reuse and recycle). Particular consideration should be given to methods for dealing with accumulated solids and sludges in treatment systems and anaerobic digesters

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7. Prepare an environmental management plan.

An environmental management plan which outlines how potential impacts associated with a composting project will be minimized or eliminated should be prepared (consult the FACT SHEET - Environmental Assessment and Environmental Management Plans)

For more details on environmental assessment considerations for composting facilities, contact the Environmental Assessment Section (Atlantic Region) of Environment Canada at barry.jeffrey@ec.gc.ca.

Fact Sheets | Environmental Assessment Home Page

APPENDIX C

Sawmill Price List

Enercraft
SILVA-SAW LTD.

2365 Cassell Drive
General Delivery
Hillsdale, Ontario L0L 1V0
Phone: (705) 835-3222
1-800-387-5553
Fax: (705) 835-3780
Email: sales@enercraft.com

Canadian Price List

Effective May 1, 2000

MODEL 18M

This manually operated sawmill cuts logs up to 24" diameter and 16' long. It has 18" bandwheels and is a stationary mill. (Axle package $895.00 extra) Electric Start $395.00

With 11HP Honda	$ 6,895.00
With 13HP Honda	$ 7,250.00

MODEL 24M

This manually operated sawmill cuts logs up to 24" diameter and 20'6" long. It has 18" bandwheels.

With 13HP Honda	$ 12,600.00
With 20HP Honda	$ 14,400.00

MODEL 30M

This manually operated sawmill cuts logs up to 30" diameter and 20'6" long. It has 18" bandwheels. (24" bandwheel option $1,400.00)

With 20HP Honda	$ 15,250.00
With 24HP Honda	$ 16,100.00

MODEL 30H

This model cuts logs up to 30" diameter and 20'6" long. It has 24" bandwheels. It has hydraulic carriage feed and return with flow controls for variable speed and is operated from a remote control box which is hand held.

With 24HP Honda	$ 21,775.00
With 25HP Kubota Diesel	$ 26,800.00
With 37.5HP Kubota Diesel	$ 28,500.00
With 20HP 3 Phase Electric	$ 25,520.00

MODEL 30HTL

This mill cuts logs up to 30" diameter and 20'6" long. It has 24" bandwheels. This mill is fully hydraulic for all functions.

With 24HP Honda	$ 29,900.00
With 37.5HP Kubota Diesel	$ 36,545.00
With 20HP 3 Phase Electric	$ 33,950.00

MODEL 36HTL

This mill cuts logs up to 36" diameter and 20'6" long. It has 24" bandwheels. This mill is fully hydraulic for all functions.

With 37.5HP Kubota Diesel	$ 39,500.00
With 42HP Kubota Turbo Diesel	$ 41,100.00
With 20HP 3 Phase Electric	$ 36,480.00
With 30HP 3 Phase Electric	$ 37,780.00

MODEL 40HTL

This mill cuts logs up to 42" diameter and 20'6" long. It comes with either a 1-1/2" or 2" blade. This mill is fully hydraulic for all functions.

With 37.5HP Kubota Diesel	$ 46,700.00
With 42HP Kubota Turbo Diesel	$ 48,300.00
With 20HP 3 Phase Electric	$ 43,200.00
With 30HP 3 Phase Electric	$ 44,500.00

SILVA SAW PORTABLE BOARD EDGER

The board edger cuts up to 2-1/4" thick and finished boards from 3" to 16" wide. The opening is 24" wide. It has two blades on it.

With 13HP Honda	$ 7,795.00
With 20HP Honda	$ 9,085.00

EQUIPMENT OPTIONS AND ACCESSORIES

Model 24 and 30 Bed Extension	$ 275.00/ft
Model 40 Bed Extension	$ 325.00/ft
Extension Leg Support *(all models)*	$ 340.00
Board Drag Back *(all hydraulic models)*	$ 495.00
Log Debarker/Mud Saw	$ 1,795.00
Hydraulic Guide Arm	$ 1,216.00
Electric Feed for 24 and 30 Manuals	$ 2,500.00
Spare Tire	$ 126.00
Bevel/Lap Siding Attachment	$ 324.00
Set of Log Ramps	$ 168.00
12 Volt Winch and Bracket	$ 795.00
Set of Stainless-Steel Bunk Covers	$ 225.60
Shingle Attachment	$ 319.00
Cant Hook 2'6"	$ 89.95
Cant Hook 3'6"	$ 94.95
Spare 10 Litre Fuel Tank	$ 49.90
Spare 20 Litre Blade Lube Tank	$ 35.75
Resaw Attachment	$ 2,995.00
12 Volt Semi-Auto Blade Sharpener/Stand	$ 1,495.00
12 Volt Fully Automatic Blade Sharpener/Stand	$ 2,230.00
Gauged Tooth Setter	$ 635.00
Tooth Setter Stand	$ 92.00
Log Wizard Debarking Tool *(fits on chainsaw)*	$ 275.00
Model 18 and 24 Blades 3/4" or 1" pitch *(10 per box)*	$ 357.50
Model 30M Blades 3/4" or 1" *(10 per box)*	$ 387.50
Model 30H Blades *(18" bandwheels - 10 per box)*	$ 387.50
Model 30H, 30HTL Blades *(24" bandwheels - 10 per box)*	$ 437.00
Model 30HTL Blades 2" wide *(10 per box)*	$ 570.00
Model 30HTL Blades 1-1/2" wide *(10 per box)*	$ 489.50
Model 36HTL Blades 1-1/2" *(10 per box)*	$ 520.00
Model 40HTL Blades 2" Bimetal *(each)*	$ 120.00
Model 40HTL Blades 1-1/2" *(10 per box)*	$ 565.00
Extra Grinding Wheel	$ 23.00
Spare Edger Blades *(each)*	$ 79.95
Dino Tooth Setter	$ 845.00

APPENDIX D

Red River Co-op Gas Bar Operators

Location	Operator	Phone Number
1084 Ellice	Rhonda	772-7308
1070 Henderson	Tom	334-0043
3455 Pembina	Wayne	261-3014
1101 Logan	Brad	774-3948
1600 Regent	Dave	668-8498
747 Pembina	Darlene	474-2364
1925 Portage	Dan	888-8234
1008 A Keewatin	-	632-5190
3623 Roblin	Harry	896-4408
790 St Annes	Dave	257-7326
3755 Portage	Ron	837-7451
1681 Grant	Mike	487-0881
1947 Henderson	Don	338-9950
Gimli	Jeannette	642-4430
Ste. Agathe	Yvonne	882-2506
Niverville	Pete or Rose	388-4435
Stonewall	Gord or Louise	467-5846
Teulon	Larry	886-2038