ABSTRACT
The Perham Resource Recovery Facility (PRRF) in Perham, Minnesota receives and processes Municipal Solid Waste (MSW) from Otter Tail, Todd, Wadena and Stearns Counties. Combustion of the MSW provides the generation of steam for sale to two local industries. Under the terms of these steam sales agreements, the PRRF supplies the base load and peak steam required by these industries from a MSW boiler and/or a natural gas-fired auxiliary boiler.

The City of Fergus Falls, Minnesota until recently operated the Fergus Falls Waste-to-Energy (WTE) plant. This facility received municipal solid waste (MSW) from Otter Tail and Grant County. The facility combusts the MSW and produces steam for use in the State Hospital. However, the State of Minnesota has decided to shut down the hospital and will no longer need the steam. As a result, on February 28, 2006, the Fergus Falls plant stopped burning MSW.

This study was initiated to provide a contingency plan for disposal of the waste currently processed in Fergus Falls. Options to be considered are other processing facilities in the area and potential landfill sites. One potential source of disposal is the PRRF located in Perham on the western side of Otter Tail County.

Three of the options considered included expansion of the PRRF. These options included salvaging of portions of the Fergus Falls WTE plant and providing pre-combustion processing of the waste to recover recyclables in order to maximize the Perham plant capacity. This paper describes the options and the conclusions of the investigations.
auxiliary boilers to mean the peak steam load demand of those industries.

The source of the waste for both facilities is residential, commercial and light industrial municipal solid waste. This study considered the following options for expansion of the PRRF:

1. Adding an additional boiler train. This could be accomplished using some of the existing grate capacity, adding some new boiler equipment and relocating the Air Pollution Control (APC) from Fergus Falls. This modification is estimated to expand the capacity from 105 to 200 Tons per Day (TPD).

2. Add a Material Recovery Facility (MRF) to the front end of the facility to remove some recyclables and undesirables from the processing stream. This would result in a plant that would have the ability to process additional waste and enhance the fuel quality. While all of the material would be processed through the MRF, anything that was not recovered as a recyclable or combusted would be taken to a landfill.

3. Add an additional boiler train and a MRF. This option could yield a plant capacity of as much as 270 TPD.

The economic feasibility of the options above considered the possibility of receiving Minnesota Pollution Control Agency (MPCA) grant funding. The economics include estimating the revenue associated with energy sales to the existing steam customers. Potential new steam customers were identified and also considered in this study.

**APPROACH**

The approach in the following analysis was to develop a conceptual plant arrangement for each option. Preliminary opinions of probable construction cost were prepared based on the available information and an assumed general arrangement. Vendor equipment budget quotes were received and included for major components.

A preliminary bond sizing program was applied to the capital cost to establish the financing costs of implementing the project. This was based on procuring revenue backed bonds at an interest rate of 5.25%. The 2006 PRRF operating budget was used as a basis in estimating the adjusted O&M costs for the facility after completion of each option. All of this information was rolled up into a 20-year financial projection that adjusted the tipping fee to maintain cash flows to meet minimum reserve requirements. The financial models evaluated the net income results, with and without the MPCA grant funding.

**FACILITY EXPANSION OPTIONS**

Expansion at the PRRF will allow additional waste to be processed at the facility. These alternatives are preferable to landfilling under the MPCA's established hierarchy of disposal options.

Otter Tail County is planning to construct a transfer station that will collect the waste that was delivered to the Fergus Falls plant. For purposes of this report, it was assumed that the waste would be hauled from the transfer station to the PRRF in trailers. The waste would generally be hauled Monday through Friday at an average daily rate of 75 tons.

**Option 1** - The PRRF currently consists of two redundant waste combustion units, one boiler and one air pollution control system. In this option, the two combustion units will be separated and a second boiler and air pollution control system will be added to the facility, creating two independent combustion systems at the facility. This project would approximately double the capacity of the PRRF to allow it to accept and process the additional waste stream from Fergus Falls as well as allow for future growth. The energy from the waste will generate steam, which will offset steam currently generated with fossil fuels and sold to the industrial customers. Any additional steam could be used for added steam sales or for electrical generation sold to the local utility.

The general equipment arrangement was based on the disassembly and relocation of the recently installed APC equipment at the Fergus Falls Plant. The building housing the Fergus Falls APC equipment would also be relocated. The existing PRRF capacity is currently limited by the waste heat boiler size. The combustion grates that were installed as part of the recent retrofit have processing capacity of greater than 100 TPD each and would be reused in the proposed project. The only major new equipment required would be a new waste heat boiler with superheater and
economizer. A considerable amount of new auxiliary equipment would be required to support the new combustion train.

Option 2 - The delivered waste would be processed through an up-front MRF to recover recyclables and divert undesirable material from entering the combustion process. This option would increase the receiving capacity of the plant and increase the amount of available waste processed annually from 35,000 tons to 55,000 tons.

The front-end MRF will presort incoming material to remove certain recyclable components and fines prior to combustion of the remaining material. The energy from the waste will be used to generate steam for sale, as is currently done. The recyclables collected will increase recycling rates and will be sold to help defray the cost of the system.

The general equipment arrangement was established to allow the tipping floor space adjacent to processing equipment suitable for recovery of the materials recyclables from the mixed waste. A new building will be required to house the MRF processing equipment. The system will be designed to recover ferrous (magnetic) metal, aluminum and old corrugated cardboard (OCC) as the primary products. Fines, including much of the glass and grit in the MSW, will be separated and removed from the fuel supply. The remaining material will be the fuel supply and will be conveyed to the existing refuse pit. Although the fine material contains little combustible material, it contains higher ash and abrasive material. Removal of the fines is expected to reduce boiler slag and equipment wear. Removing the aluminum and ferrous material from the fuel supply can also provide operating benefits for the combustion units. Additional staff will be required to operate the MRF.

With this arrangement it is expected that approximately 5-6% of the incoming stream could become recyclables in the form of OCC, ferrous and aluminum, based on the experience at similar facilities. The analysis that follows anticipates that all of the available waste, 55,000 tons, would be processed through the MRF 3,160 tons would be removed and sold as recyclable material, 35,000 tons would be processed through the combustion train and the remainder would be loaded and transported to the landfill.

Option 3 - This option is a combination of the first two options. It includes both an up-front MRF and a new boiler train. This alternative would offer the highest throughput capacity; however no additional waste processing beyond the currently available 55,000 tons considered in this report. This alternative offers additional steam sales revenues available from the additional combustion train and recycling revenues associated with recovery of OCC, aluminum and ferrous. This option could process as much as 280 TPD.

ECONOMIC ANALYSIS

Capital Costs - The capital cost for each option is summarized in the following table.

<table>
<thead>
<tr>
<th>TABLE 1- ESTIMATED CAPITAL COST ($000)</th>
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<tbody>
<tr>
<td>Equipment</td>
</tr>
<tr>
<td>Installation</td>
</tr>
<tr>
<td>APC Relocation</td>
</tr>
<tr>
<td>Buildings</td>
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<tr>
<td>Permits, Design &amp; Admin.</td>
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<tr>
<td>Contingency</td>
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<tr>
<td>Total</td>
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</tbody>
</table>

Based on estimated preliminary capital costs, option 2 is the lowest, followed by option 1. The combined system, Option 2, naturally has the highest cost. In addition, the Perham facility has an outstanding debt service, which ends in 2022 and was not restructured in this analysis.

Revenue Potential - The principal sources of revenue considered in this study are from tipping fees, steam sales and recovered materials sales. All of the first-year tipping fee revenues for each option were adjusted to maintain minimum cash reserves to maintain each system until the outstanding debt service expires. Initial year tip fees were escalated uniformly at 3 percent per year in all cases. The same waste delivery amount of 55,000 tons was assumed for all options. PRRF net energy sales revenues are improved by Options 1 and 3 since a larger portion of the steam sales are generated from MSW combustion rather than...
fossil fuel. Taking into account the natural gas cost, the net energy sales provides revenues of about $1,600,000 for Options 1 and 3 and about $1,000,000 for Option 2. Option 2 and Option 3 provide approximately $500,000 of revenue from the sale of recyclables. Steam revenues are tied to natural gas pricing and recyclable material revenues are dependent on material market prices which have proven to be volatile over recent history.

*O&M Costs* - O&M costs were estimated for each of the three options. These costs are reflected in the financial projections and included additional personnel that would be required to operate the expanded facilities. It also assumed that maintenance costs would increase to repair and replace the additional equipment.

*Financial Projections* - The overall financial performance of each option was evaluated based on 20-year financial projections. The projections assume that 2009 would be the first full year of expected operation. Option 1 required the lowest tip fee to provide sufficient cash flow to maintain adequate reserves and provided the best 20-year net present value (using a three percent discount rate) in terms of net revenues to the System. The model takes into account revenues, expenses and financing costs of each option. The table below is a summary of the important financial information from the financial models.

**TABLE 2 - 2009 SUMMARY ($000)**

<table>
<thead>
<tr>
<th></th>
<th>Option 1</th>
<th>Option 2</th>
<th>Option 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tip Fee ($/ton)</td>
<td>$53</td>
<td>$56</td>
<td>$60</td>
</tr>
<tr>
<td>Tip Revenues</td>
<td>$2,921</td>
<td>$3,086</td>
<td>$3,306</td>
</tr>
<tr>
<td>Energy Revenue</td>
<td>$2,212</td>
<td>$2,206</td>
<td>$1,970</td>
</tr>
<tr>
<td>Recy. Revenue</td>
<td>$0</td>
<td>$465</td>
<td>$465</td>
</tr>
<tr>
<td>Oper. Expenses</td>
<td>($4,258)</td>
<td>($5,070)</td>
<td>($4,290)</td>
</tr>
<tr>
<td>Non-Oper. Exp.</td>
<td>($804)</td>
<td>($626)</td>
<td>($1,466)</td>
</tr>
<tr>
<td>Net Revenues</td>
<td>$71</td>
<td>$62</td>
<td>($15)</td>
</tr>
</tbody>
</table>

| Net Present Value (20 years) | $3,494 | $1,540 | $3,758 |

The principal assumptions are identified at the end of this document.

**IMPLEMENTATION**

*Schedule* - The schedule for implementation of any of the PRRF expansion options would be similar. This study assumes that construction could be complete for all options in a similar time frame. The majority of construction could take place without a facility outage. The major drivers in the project schedule are MPCA grant award and permitting requirements. The schedule is predicated on the assumption that no major activities would begin until the MPCA grant was awarded. One year is allowed for issuance of the permit and construction activities would follow after. With these assumptions, the project would be completed in early 2009.

**OTHER DISPOSAL OPTIONS**

Since the Fergus Falls WTE will not be an option for processing Otter Tail County waste, Otter Tail County explored available options for processing and/or disposal of the waste previously processed in Fergus Falls. The options that were evaluated include:

**Pope/Douglas Resource Recovery Facility** - This is a mass burn incinerator facility that is located approximately 50 miles from Fergus Falls in Alexandria, Minnesota. The facility includes a front end MRF that processes waste from both Pope and Douglas Counties. Because of the MRF the facility does have some existing available unused capacity. The existing tipping fee is comparable to that which is currently charged at Fergus Falls. Preliminary discussions indicate that the existing available unused capacity is much less than the Otter Tail County volume of waste currently processed in Fergus Falls and consequently would not likely present a viable long term option.

**City of Moorhead/City of Fargo** - The City of Moorhead, Minnesota and the City of Fargo, North Dakota have invited Otter Tail County along with the counties of Becker, Clay, Hubbard, and Wilkin in Minnesota and Cass County in North Dakota as well as the City of West Fargo, North Dakota to begin a preliminary process which is intended to evaluate regional waste management options for managing waste into the future. These options may include the construction of a waste processing facility. Otter Tail County intends to participate in the initial evaluation process.

**Publicly-Owned Landfills** - Publicly owned landfills within 100 to 120 miles of Fergus Falls...
include landfill sites in Clay County, Crow Wing County, Morrison County, Kandiyohi County and the City of Fargo, North Dakota. Otter Tail has had discussions with each of these facilities and none of them have been interested in accepting the waste that has been by-passed from the resource recovery facilities much less the volume of waste available once the Fergus Falls Resource Recovery Facility closes.

Landfills (Privately-Owned) - Privately owned landfills located within 100 to 150 miles of Fergus Falls include landfill sites in Elk River, Minnesota and in Gwinner and Wishek in North Dakota. All three facilities are owned by Waste Management, Inc. Tipping fees range from approximately $30 per ton to approximately $47 per ton. The transportation cost for Otter Tail County to get waste delivered to these facilities is approximately $25 per ton. All three facilities remain an option for the disposal of Otter Tail County’s solid waste. The Gwinner facility is currently used because of its location, design, and tipping fees.

ADDITIONAL REVENUES

The PRRF currently supplies steam to two industrial customers. Other industrial companies in the area were identified for consideration of the suitability as additional steam customers. The three companies were considered based on their energy needs and proximity to the PRRF facility.

The economic feasibility of adding steam customers involves many factors including:
- Capital cost of installing steam and condensate lines
- Capital cost of facility modifications to allow steam usage
- Energy requirements of the potential customer
- Load profiles of the potential customer
- Ability of PRRF to deliver steam generated from waste
- Financial stability and viability of the potential steam customer

Based on these factors, two food processing industries provide the potential for positive economics. However, under the current PRRF 24-hour operating schedule, the facility steam production could not meet the steam demand of these customers with the available waste. One alternative would be to process more waste during the high steam peak periods and less during the low periods. This would allow the PRRF to sell more steam generated from waste and produce more net revenue. This option would be evaluated in more detail after the plant modifications have been completed.

SUMMARY

Several options exist for disposal of the MSW that is currently being processed at the Fergus Falls WTE facility. These options include other processing facilities in the area, landfills within reasonable hauling distances and expansion of the PRRF. This study focused on the WTE options in a back-drop of landfill disposal options that ranged from $55 to $75 per ton.

The options involving the expansion of the PRRF provide a solution that is deemed more desirable under the MPCA established hierarchy of solid waste options. Three options were considered for disposal at the PRRF. Option 1 balances the expenses and revenues with a tipping fee of $53 per ton in 2009. This tipping fee is lower than the current fee of $59. The improved economics are a result of the ability to generate more steam from MSW combustion. This steam is sold to the energy customers and produced with the lower cost fuel source.

The second option, addition of an up-front MRF also appears to provide improved economics and a tipping fee of $56 per ton in 2009. Although higher than Option 1, a reduction over the current fees is achieved due to the revenue associated with selling recyclables, primarily ferrous and aluminum.

The third option has a much higher capital cost but results in the highest revenue. The additional revenue comes from both higher energy sales and from recyclable revenues. A tipping fee of $60 per ton in 2009 makes this option the least desirable of the three PRRF options, but still is expected to be lower than the escalated current tip fee in 2009. This option does allow for the greatest increases in the future waste stream; however both options 1 and 2 could be expanded in the future.
PRINCIPAL ASSUMPTIONS

1. The current waste quantities are assumed to grow at approximately 0.1% per year during the analysis period accept for the additional 20,000 tons per year from Fergus Falls.

2. Tip fees for delivered waste were assumed to escalate at an annual rate of 3% per year from 2009, the assumed first full year of operation at expanded capacity. The 2009 rate was adjusted for each option to meet minimum debt service coverage requirements during the analysis period.

3. The state grant request for $3,000,000 was assumed to be approved.

4. Debt service increases were calculated based on a revenue bond financing of the estimated project capital costs based on:
   a. A bond interest rate of 5.25%
   b. A twelve month construction period
   c. Interest earnings during construction on the escrowed funds based on an interest rate of 5.25% and a uniform monthly drawdown of the construction funds
   d. Twenty year amortization of the bonds starting in 2009
   e. A one year debt service reserve financing requirement
   f. Issuance costs equal to 3% of the bond issue

5. Steam sales were based on the historical steam sales to Bondgard's and Tuffy's and an assumed average price for natural gas of $8 per million Btu's. For the options that include the new waste-fired boiler, the natural gas usage for supplemental steam is reduced accordingly.

6. The electrical capacity revenues are assumed to remain constant through 2028.

7. Operating costs for the existing plant plus increased costs for the expanded facility operations calculated in 2006 dollars and assumed to escalate at 3% per year.

8. The new boiler addition assumptions include:
   a. Staffing increase of one person per shift for a total of 4 new personnel.

9. The MRF addition assumption include:
   a. Staffing increase of approximately 5 full-time and one part time personnel for a 2 shift material processing operation
   b. One additional roll-off truck for recovered materials transportation
   c. One additional forklift for baled material handling
   d. The existing facility loader can be used for the MRF operations
   e. Approximately 5.7% of the waste received is assumed to be recovered as recyclable materials based on the experience at Pope Douglas.
   f. Material recovery revenues are based pricing experience at the Pope Douglas facility minus a transportation cost estimate for hauling the materials to Minneapolis

10. The combined MRF and New Boiler option additional assumptions:
    a. Only the current WTE waste quantities plus the Fergus Falls waste is assumed available

b. Proportional increases of 57% in the historical chemical/consumables, contractor services, ash disposal, and reagent costs based on the plant capacity increase.

c. A 30% increase in environmental testing based on data from obtained at another facility.

d. Insurance cost increase of 50%

e. Increased the capital improvement budget of $250,000 on a 3-year interval subject to the O&M escalation assumptions discussed above

f. An assumed 30% increase in electrical on-site usage

g. An assumed 15% water and sewer usage.