MRF Economics

Recycling Systems & Markets

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Introductions

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Agenda

- Single stream recycling overview
- Recycling processing facilities
- Commodity pricing, markets, and market dynamics
- Single stream economics – processing costs, commodity revenue
- Single stream processing agreements – common elements

Single Stream Recycling

Single-stream recycling is a system in which all recyclables are placed in a single bin or cart for recycling.

These recyclables are collected by a single truck and taken to a Materials Recovery Facility (MRF) to be sorted into various commodity streams for sale to markets.

The materials are then further processed into feedstock which can be used in the manufacture of new products.

What goes in the recycling bin…

- Cardboard
- Containerboard
- Newspaper
- Magazines
- Office paper
- Junk mail
- Envelopes
- File folders
- Phone books

- Plastic #’s 1-7
- Water bottles
- Glass (clear, green, brown)
- Steel & tin cans
- Aluminum
- Aseptic packaging
  - Milk cartons
  - Juice boxes
  - Soup containers

Recycling Processing Facilities

Recycling Processing Facilities

- Trucks collect single stream recyclables and take them to a processing facility called a material recovery facility or “MRF.”

- MRF’s use various combinations of machinery and manual labor to separate the items and create the highest value, sale-able, raw materials.

- Raw materials are then sent to manufacturers to be made into new products.

Common MRF Elements

- Every MRF is different.
- Each has a tipping floor to accept unsorted materials and a warehouse to ship sorted materials.
- The layout progresses from a gross sort to a fine sort.
  - Manual sorting or human intervention is required at one or more stages of the process.
  - One or more horizontal balers is utilized to compress the materials in preparation for sale.

MRF Design

The unique layout of a MRF and the specific components included are based on:

- Volume
  - Lower volume = less technology & lower productivity (cost balancing)
- Composition
  - Components are selected to accommodate the highest percentages of materials in the stream.
- Goals
  - Budgetary, tons per hour, automation, cost per ton, etc.

MRF Layout

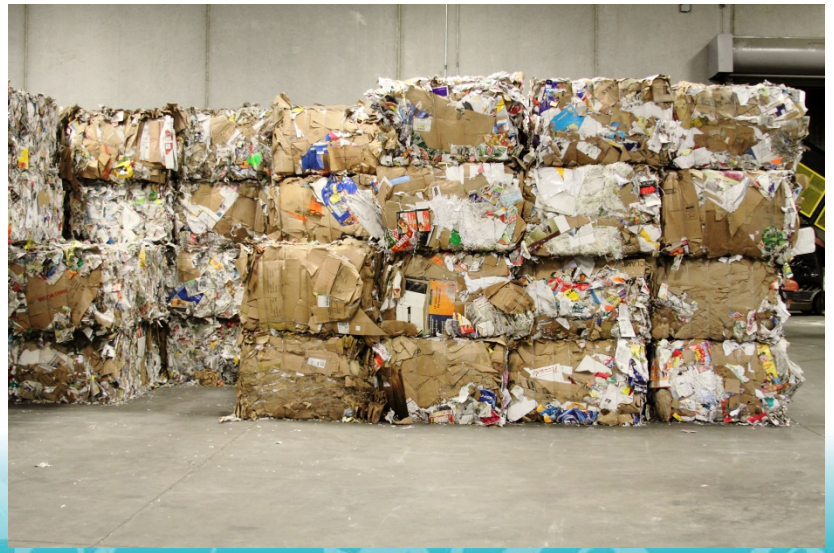
The layout progresses from a gross sort to a fine sort:

1. Pre-sort (removes large items & non-recyclables)
2. Cardboard (OCC) screen
3. Containers separated from fiber
    1. Fibers sorted by grade
        1. Mixed Paper
        2. Office Paper
        3. Paperboard
        4. Cardboard
    2. Containers sorted by type
        1. PET
        2. HDPE-Natural
        3. HDPE – Colored
        4. Mixed #3-7
        5. Steel cans
        6. Aluminum
4. Glass and residual removed at various points

Commodity Pricing, Markets & Market Dynamics

Finished Product

The end result of all sorting at the MRF is separated commodities ready for market.



Commodity Specification

- Before a sale can be made from the MRF to a buyer, each bale must meet industry and buyer specifications for that material type and grade.
- Specifications can include:
  - restrictions on contaminants (anything other than the material grade)
  - material quality
  - bale size and weight
  - trailer loading requirements
  - photo documentation
- Examples: ISRI, GP, Evermore, SP

Commodity Sales

Once recyclables have been sorted, they can be sold to:

- a broker
- another processor who might further prepare the items for remanufacturing by cleaning or grinding
- to mills or other companies that use them directly in the manufacturing process.

Recyclable materials are commodities whose value fluctuates based on market conditions. Each commodity is associated with a published price index that determines its actual sales price on a weekly or monthly basis.

What influences commodity price?

Supply & Demand

- Global
  - China's historical role in the recycling industry
  - "Operation Green Fence"
  - Post-Green Fence & the rise of Mexico & India
- US Regional
  - Mill/manufacturer location
  - Proximity to forests
  - Transportation hubs
- Local
  - Mill/manufacturer location
- 2017 National Sword Policy

Economics of virgin vs. recycled

Fiber Pricing

- Marketplace Dynamics
  - Supply-Demand
  - End user and/or mill processing capabilities
  - Distance from export hubs
  - Quality

- Pricing Indices
  - Recovered fiber is a commodity: price based on a published index.
  - Most common = Pulp and Paper Week
  - Published monthly on or around the 5th.
  - Prices by grade and geographical region
  - High and low side for each grade.
  - Purchase price and rebates are generally based on the index price.

Fiber Price Index: Pulp and Paper Week

PRICE WATCH: **Recovered Paper - Domestic** May 5, 2017

US$ per short ton for open market purchases by mills; FOB seller's dock, for delivery this month. (Further specifications below.) *Incorporating Official Board Markets*

	Northeast			Midwest (Chicago)[3]	Southeast[2]	Southwest[3]	LA-SF		Pacific NW[3]
	New England	New York	Buffalo				LA	SF	
MIXED PAPER									
Mixed (2) - OBM*	40-45 (-20)	45-50 (-20)	40-45 (-20)	55-60 (-20)	65-70 (-20)	60-65 (-25)	80-85 (+0)	70-75 (+0)	55-60 (+0)
Mixed Paper (54)	40-45 (-20)	45-50 (-20)	40-45 (-20)	55-60 (-20)	65-70 (-20)	60-65 (-25)	80-85 (+0)	70-75 (+0)	55-60 (+0)
BROWN GRADES									
Boxb cutt (4) - OBM*	105-115 (+0)	100-110 (+0)	100-110 (+0)	95-100 (+0)	100-105 (+0)	115-125 (+0)	90-100 (+0)	85-90 (+0)	75-80 (+0)
OCC (11) - OBM*	135-145 (-15)	135-145 (-15)	135-145 (-15)	130-140 (-20)	145-155 (-20)	150-160 (-15)	140-150 (+0)	130-140 (+0)	120-130 (+0)
DLK (13) - OBM*		145-155 (-15) (Northeast)		155-165 (-10)	165-175 (-10)	180-190 (+0)	145-155 (+0)	135-145 (+0)	125-135 (+0)

Non-fiber Pricing

Aluminum (UBC), Steel, PET, HDPE, Mixed Plastics, Glass, Film, etc.

- Strict quality requirements
- Not as rigidly tied to a specific index
  - Local prices can vary widely
- More sensitive to *all* market dynamics
  - Buyers & processors can be more volatile and will make expedient changes to maximize profit

Secondary Materials Market

ANNOUNCED RECOVERED MATERIALS PRICES
ATLANTA (SOUTHEAST USA) REGION
SEPTEMBER 7, 2013
Prices in US currency

Grade	Description	Historical Data	Current Price	Previous Price
Glass	Flint ($/ton del.)	View	30-35	15-20
Glass	Amber ($/ton del.)	View	20-25	5-10
Glass	Green ($/ton del.)	View	12-14	2-5
Glass	3 Mix ($/ton del.)	View	-20-0	*Varies
Metals	Aluminum Cans (Sorted, Baled, ¢/lb del.)	View	72-74	69-72
Metals	Aluminum Cans (Loose Price, ¢/lb)	View	52-53	54-55
Metals	Steel Cans (Sorted, Densified, $/ton del.)	View	110-120	120-130
Metals	Steel Cans (Sorted, Loose Price, $/ton del.)	View	80-85	75-80
Metals	White Goods (Loose, $/ton, picked up)	View	120-130	140-160
Plastics	PET (Baled, ¢/lb, picked up)	View	16-18.5	16.5-18
Plastics	Natural HDPE (Baled, ¢/lb, picked up)	View	38-38.5	34-38
Plastics	Colored HDPE (Baled, ¢/lb, picked up)	View	17-18	14-17
Plastics	Comingled (#1-7, Baled, ¢/lb, picked up)	View	3-5	5
Plastics	Comingled (#3-7, Baled, ¢/lb, picked up)	View	0-.5	0-.5
Plastics	HDPE Rigid (Baled, ¢/lb, picked up)	View	8-12	10-12
Plastics	PP Post Consumer (Baled, ¢/lb, picked up)	View	10-12	-
Plastics	Mixed Bulky Rigid (Baled, ¢/lb, picked up)	View	0-.5	-
Plastics	LLDPE-Stretch Film (Baled, ¢/lb, picked up)	View	11-13	13-14
Plastics	Polystyrene EPS (Baled, ¢/lb, picked up)	View	2-5	3-6
Paper	Mixed Residential Paper(Loose, $/ton)	View	--	--
Rubber	Tires	View	--	-100--85

London Metals Exchange (LME)

Metal Prices (U.S.$ per tonne)	Jan-15	Mar-15	May-15	Jul-15	Aug-15	Change % (Jan - Aug)
Steel	500	300	290	150	100	-80.00%
Nickel	14,375	13,680	12,650	11,175	9,670	-32.73%
Zinc	2,091	2,066	2,178	1,959	1,745	-16.55%
Aluminium	1,818	1,764	1,710	1,595	1,526	-16.06%
Brent Crude Oil*	48	56	66	53	43	-10.28%
Lead	1,845	1,830	1,932	1,707	1,678	-9.08%
Copper	5,490	6,135	6,135	5,190	5,032	-8.34%

** U.S. $ per barrel*

Source: London Metal Exchange (Price as on 25th of every month)

Single Stream Economics

MRF Revenue

- The income of a MRF is generated by the sale of the commodities that are processed at the facility.
- Each MRF has a unique average composition which drives the overall “value” of the stream.
- Income fluctuates each month based on volume produced, volume sold and the price of each commodity type.

- “Revenue-sharing” arrangements also reduce the income generated by a MRF.

Single Stream Composition Value

- Composition is determined by measuring the weight of each individual commodity and then calculating its percentage of the total materials processed over a specific period of time.
- At the end of every month – a MRF can calculate (within reason) its total composition based on the finished products sold, finished products in inventory, and residuals (typically "work in progress" materials are not counted".)
- MRF's will also often seek to understand the composition of specific recycling streams for the purpose of determining its overall value or burden to the processing operation.

Single Stream Composition				
Material	**Tons**	**Percentage of Ton**	**Material Sales Price Per Ton**	**Value Per Ton**
UBC's	9	0.69%	$ 1,640.00	$ 11.25
Steel Cans	18	1.37%	$ 120.00	$ 1.65
PET	34	2.59%	$ 300.00	$ 7.77
HDPE-N	12	0.91%	$ 520.00	$ 4.76
HDPE-C	9	0.69%	$ 410.00	$ 2.81
Plastics #3-7	6	0.46%	$ 40.00	$ 0.18
Mixed Broken Glass	100	7.62%	$ (8.00)	$ (0.61)
Mixed Paper	100	7.62%	$ 60.00	$ 4.57
ONP #8	379	28.89%	$ 65.00	$ 18.78
OCC	456	34.76%	$ 90.00	$ 31.28
Residual	189	14.41%	$ (36.00)	$ (5.19)
Totals	1312	100%	$ 3,201.00	$ 77.26

Value Fluctuation – Composition

Single Stream Composition 1				
Material	Tons	Percentage of Ton	Material Sales Price Per Ton	Value Per Ton
UBC's	9	0.69%	$ 1,640.00	$ 11.25
Steel Cans	18	1.37%	$ 120.00	$ 1.65
PET	34	2.59%	$ 300.00	$ 7.77
HDPE-N	12	0.91%	$ 520.00	$ 4.76
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OCC	456	34.76%	$ 90.00	$ 31.28
Residual	189	14.41%	$ (36.00)	$ (5.19)
Totals	1312	100%	$ 3,201.00	$ 77.26

Single Stream Composition 2				
Material	Tons	Percentage of Ton	Material Sales Price Per Ton	Value Per Ton
UBC's	14	1.06%	$ 1,640.00	$ 17.43
Steel Cans	18	1.37%	$ 120.00	$ 1.64
PET	34	2.58%	$ 300.00	$ 7.74
HDPE-N	12	0.91%	$ 520.00	$ 4.74
HDPE-C	9	0.68%	$ 410.00	$ 2.80
Plastics #3-7	6	0.46%	$ 40.00	$ 0.18
Mixed Broken Glass	100	7.59%	$ (8.00)	$ (0.61)
Mixed Paper	100	7.59%	$ 60.00	$ 4.56
ONP #8	379	28.78%	$ 65.00	$ 18.71
OCC	456	34.62%	$ 90.00	$ 31.16
Residual	189	14.35%	$ (36.00)	$ (5.17)
Totals	1317	100%	$ 3,201.00	$ 83.19

Composition changes can have a material impact on revenue generation.

In this example, a 0.37% increase in UBC increased the overall stream value up by $5.93 per ton.

Value Fluctuation – Composition

Single Stream Composition 1				
Material	**Tons**	**Percentage of Ton**	**Material Sales Price Per Ton**	**Value Per Ton**
UBC's	9	0.69%	$ 1,640.00	$ 11.25
Steel Cans	18	1.37%	$ 120.00	$ 1.65
PET	34	2.59%	$ 300.00	$ 7.77
HDPE-N	12	0.91%	$ 520.00	$ 4.76
HDPE-C	9	0.69%	$ 410.00	$ 2.81
Plastics #3-7	6	0.46%	$ 40.00	$ 0.18
Mixed Broken Glass	100	7.62%	$ (8.00)	$ (0.61)
Mixed Paper	100	7.62%	$ 60.00	$ 4.57
ONP #8	379	28.89%	$ 65.00	$ 18.78
OCC	456	34.76%	$ 90.00	$ 31.28
Residual	189	14.41%	$ (36.00)	$ (5.19)
Totals	1312	100%	$ 3,201.00	$ 77.26

Single Stream Composition 2				
Material	**Tons**	**Percentage of Ton**	**Material Sales Price Per Ton**	**Value Per Ton**
UBC's	9	0.66%	$ 1,640.00	$ 10.83
Steel Cans	18	1.32%	$ 120.00	$ 1.58
PET	34	2.49%	$ 300.00	$ 7.48
HDPE-N	12	0.88%	$ 520.00	$ 4.58
HDPE-C	9	0.66%	$ 410.00	$ 2.71
Plastics #3-7	6	0.44%	$ 40.00	$ 0.18
Mixed Broken Glass	100	7.34%	$ (8.00)	$ (0.59)
Mixed Paper	100	7.34%	$ 60.00	$ 4.40
ONP #8	379	27.81%	$ 65.00	$ 18.07
OCC	456	33.46%	$ 90.00	$ 30.11
Residual	240	17.61%	$ (36.00)	$ (6.34)
Totals	1363	100%	$ 3,201.00	$ 73.02

Composition changes can have a material impact on revenue generation.

In this example, a 3.2% increase in residual materials caused the overall value to drop by $4.24 per ton.

Value Fluctuation - Price

Single Stream Composition 1				
Material	**Tons**	**Percentage of Ton**	**Material Sales Price Per Ton**	**Value Per Ton**
UBC's	9	0.69%	$ 1,640.00	$ 11.25
Steel Cans	18	1.37%	$ 120.00	$ 1.65
PET	34	2.59%	$ 300.00	$ 7.77
HDPE-N	12	0.91%	$ 520.00	$ 4.76
HDPE-C	9	0.69%	$ 410.00	$ 2.81
Plastics #3-7	6	0.46%	$ 40.00	$ 0.18
Mixed Broken Glass	100	7.62%	$ (8.00)	$ (0.61)
Mixed Paper	100	7.62%	$ 60.00	$ 4.57
ONP #8	379	28.89%	$ 65.00	$ 18.78
OCC	456	34.76%	$ 90.00	$ 31.28
Residual	189	14.41%	$ (36.00)	$ (5.19)
Totals	1312	100%	$ 3,201.00	$ 77.26

Single Stream Composition 2				
Material	**Tons**	**Percentage of Ton**	**Material Sales Price Per Ton**	**Value Per Ton**
UBC's	9	0.69%	$ 1,640.00	$ 11.25
Steel Cans	18	1.37%	$ 120.00	$ 1.65
PET	34	2.59%	$ 300.00	$ 7.77
HDPE-N	12	0.91%	$ 520.00	$ 4.76
HDPE-C	9	0.69%	$ 410.00	$ 2.81
Plastics #3-7	6	0.46%	$ 40.00	$ 0.18
Mixed Broken Glass	100	7.62%	$ (8.00)	$ (0.61)
Mixed Paper	100	7.62%	$ 60.00	$ 4.57
ONP #8	379	28.89%	$ 65.00	$ 18.78
OCC	456	34.76%	$ 80.00	$ 27.80
Residual	189	14.41%	$ (36.00)	$ (5.19)
Totals	1312	100%	$ 3,191.00	$ 73.78

Commodity price changes can have a material impact on revenue generation.

In this example, a $10.00 drop in the OCC price caused the overall value to drop by $3.48 per ton.

Value Fluctuation - Price

Single Stream Composition 1				
Material	**Tons**	**Percentage of Ton**	**Material Sales Price Per Ton**	**Value Per Ton**
UBC's	9	0.69%	$ 1,640.00	$ 11.25
Steel Cans	18	1.37%	$ 120.00	$ 1.65
PET	34	2.59%	$ 300.00	$ 7.77
HDPE-N	12	0.91%	$ 520.00	$ 4.76
HDPE-C	9	0.69%	$ 410.00	$ 2.81
Plastics #3-7	6	0.46%	$ 40.00	$ 0.18
Mixed Broken Glass	100	7.62%	$ (8.00)	$ (0.61)
Mixed Paper	100	7.62%	$ 60.00	$ 4.57
ONP #8	379	28.89%	$ 65.00	$ 18.78
OCC	456	34.76%	$ 90.00	$ 31.28
Residual	189	14.41%	$ (36.00)	$ (5.19)
Totals	1312	100%	$ 3,201.00	$ 77.26

Single Stream Composition 2				
Material	**Tons**	**Percentage of Ton**	**Material Sales Price Per Ton**	**Value Per Ton**
UBC's	9	0.69%	$ 1,640.00	$ 11.25
Steel Cans	18	1.37%	$ 120.00	$ 1.65
PET	34	2.59%	$ 300.00	$ 7.77
HDPE-N	12	0.91%	$ 520.00	$ 4.76
HDPE-C	9	0.69%	$ 410.00	$ 2.81
Plastics #3-7	6	0.46%	$ 40.00	$ 0.18
Mixed Broken Glass	100	7.62%	$ (8.00)	$ (0.61)
Mixed Paper	100	7.62%	$ 60.00	$ 4.57
ONP #8	379	28.89%	$ 75.00	$ 21.67
OCC	456	34.76%	$ 90.00	$ 31.28
Residual	189	14.41%	$ (36.00)	$ (5.19)
Totals	1312	100%	$ 3,211.00	$ 80.15

Commodity price changes can have a material impact on revenue generation.

In this example, a $10.00 increase in the ONP #8 price caused the overall value to increase by $2.89 per ton.

MRF Operating Costs

Operating costs include:

- Labor
- Fuel
- Repair & Maintenance
- Operating supplies & consumables
- Safety supplies & training
- Utilities
- Insurance costs (accidents & injuries)

All MRF operating costs are variable and can move up or down based on:

- Changes in volume & composition
- Productivity variability
- Equipment downtime
- Repair and maintenance schedules and costs

Consistency is key to stabilizing costs: preventative maintenance, robust safety programs & standards, effective supervision, inbound quality reviews

MRF Operating Profit

	Dollars		Per Ton Calculation		
	Actual	Budget	Actual	Budget	Variance
Tons Processed	2540	2298			
Gross Revenue	$ 237,011	$ 273,001	$ 93.31	$ 118.80	$ (25.49)
Rebates	$ 26,146	$ 34,902	$ 10.29	$ 15.19	$ (4.89)
Disposal	$ 37,281	$ 22,479	$ 14.68	$ 9.78	$ 4.90
Net Revenue	**$ 173,584**	**$ 215,620**	**$ 68.34**	**$ 93.83**	**$ (25.49)**
Operating Cost	$ 178,384.20	$ 156,976.38	$ 70.23	$ 68.31	$ 1.92
SG&A Cost	$ 19,050.00	$ 15,534.48	$ 7.50	$ 6.76	$ 0.74
EBITDA	**$ (23,850)**	**$ 43,109**	**$ (9.39)**	**$ 18.76**	**$ (28.15)**

Gross revenue (Commodities Sold) – Rebates & Disposal costs= Net Revenue
Net Revenue – Operating costs & SG&A costs = EBITDA

Operating costs = labor & benefits, fuel/oil, repairs & maintenance, safety supplies
EBITDA = Earnings Before Interest Taxes & Depreciation

MRF Operating Profit

	Dollars		Per Ton Calculation		
	Actual	Budget	Actual	Budget	Variance
Tons Processed	2540	2298			
Gross Revenue	$ 237,011	$ 273,001	$ 93.31	$ 118.80	$ (25.49)
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Net Revenue	**$ 173,584**	**$ 215,620**	**$ 68.34**	**$ 93.83**	**$ (25.49)**
Operating Cost	$ 178,384.20	$ 156,976.38	$ 70.23	$ 68.31	$ 1.92
SG&A Cost	$ 19,050.00	$ 15,534.48	$ 7.50	$ 6.76	$ 0.74
EBITDA	**$ (23,850)**	**$ 43,109**	**$ (9.39)**	**$ 18.76**	**$ (28.15)**

MRF's generally operate on tight margins and can be materially impacted by upset conditions.

Changes in volume can cause cost dollars to increase or decrease. To normalize volume fluctuation; unit costing is generally used to evaluate performance.

MRF Financial Challenges

- MRF income is dynamic and influenced by a number of factors. It can change quickly and frequently.

- MRF's are generally designed to achieve a certain level of productivity (tons per hour) and process a certain number of tons per day/week/month.

Single Stream Processing Agreements

Owner and Operator

- Various arrangements can exist between owner and operator.
- Agreements must be designed to accommodate significant changes in commodity price and demand.
- The most successful ensure that the operator can remain whole when commodity prices drop – share risk and reward.
- Agreements should be considerate of commitments related to capital investments.

Operator and Supplier

- Operators need regular volume to cover costs and run at peak efficiency.
- Agreements are used to secure chunks of base volume.
- Typical agreements consider the composition of the supplier material and include provisions for initial and periodic composition studies.
- Suppliers pay a processing fee or receive a rebate based on a calculation that considers the monthly value of each commodity and the processing costs (see example)

Operator and Supplier

Commodity	Price Sources	Current Prices	Composition	Value
OCC	OBM Chicago High +$10 Mar 5	$ 75.00	8.37%	$ 6.28
ONP	OBM Chicago High +$10 Mar 5	$ 65.00	33.61%	$ 21.85
Mix	OBM Chicago High +$10 Mar 5	$ 55.00	14.16%	$ 7.79
Aluminum	SecondaryMaterialsPricing.com Chicago High Mar 1	$ 1,220.00	1.26%	$ 15.42
Tin	SecondaryMaterialsPricing.com Chicago High Mar 1	$ 25.00	1.99%	$ 0.50
HDPE Natural	SecondaryMaterialsPricing.com Chicago High Mar 1	$ 500.00	1.24%	$ 6.21
HDPE Colored	SecondaryMaterialsPricing.com Chicago High Mar 1	$ 320.00	0.99%	$ 3.16
PET	SecondaryMaterialsPricing.com Chicago High Mar 1	$ 180.00	4.06%	$ 7.30
Mixed Plastics	Market	$ 273.24	0.92%	$ 2.51
Glass - Mixed	Market	$ (17.85)	25.17%	$ (4.49)
Residue	Fixed	$ (45.73)	6.90%	$ (3.15)
Total Value			**98.67%**	**$ 63.36**
Share of Stream Value			**80%**	**$ 50.69**
Less Processing Fee				**$ (45.73)**
Rebate/(Charge) per Ton				**$ 4.96**
Tons Delivered- estimate				**5,500**
Total Rebate/Charge)				**$ 27,262**

Operator and Buyer

- Operators need to be able to move materials on a consistent basis.
- Buyers will enter into agreements with moderate pricing deals to secure volume and will agree to accept materials even when demand drops. ("Spot" buyers offer higher prices but will not buy from non-contracted sources when demand drops).
- Both parties must understand volume commitments, pricing arrangements and quality requirements.

Summary

- MRF's are complex operating entities with tangible operating costs.
- MRF income can fluctuate based on volume, quality and commodity prices.
- Commodity markets are dynamic and sensitive to various factors in the global, national, regional and local economy.
- Relationships between owners, operators, suppliers and buyers need to be well thought out and accommodate the variant nature of commodity revenue to ensure long term stability.

Thank You!