The Manitoba – Canadian Model Aqua-Farm Initiative

Interprovincial Partnership for Sustainable Freshwater Aquaculture Development

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Aquaculture Innovation Workshop
September 26-27, 2011
Campbell River, BC

Rationale

- Considerable capacity to expand freshwater aquaculture through traditional agriculture
- "Farmers" need comprehensive information
  - production technologies and practices
  - costs and benefits
  - training & skills development
- Objective:

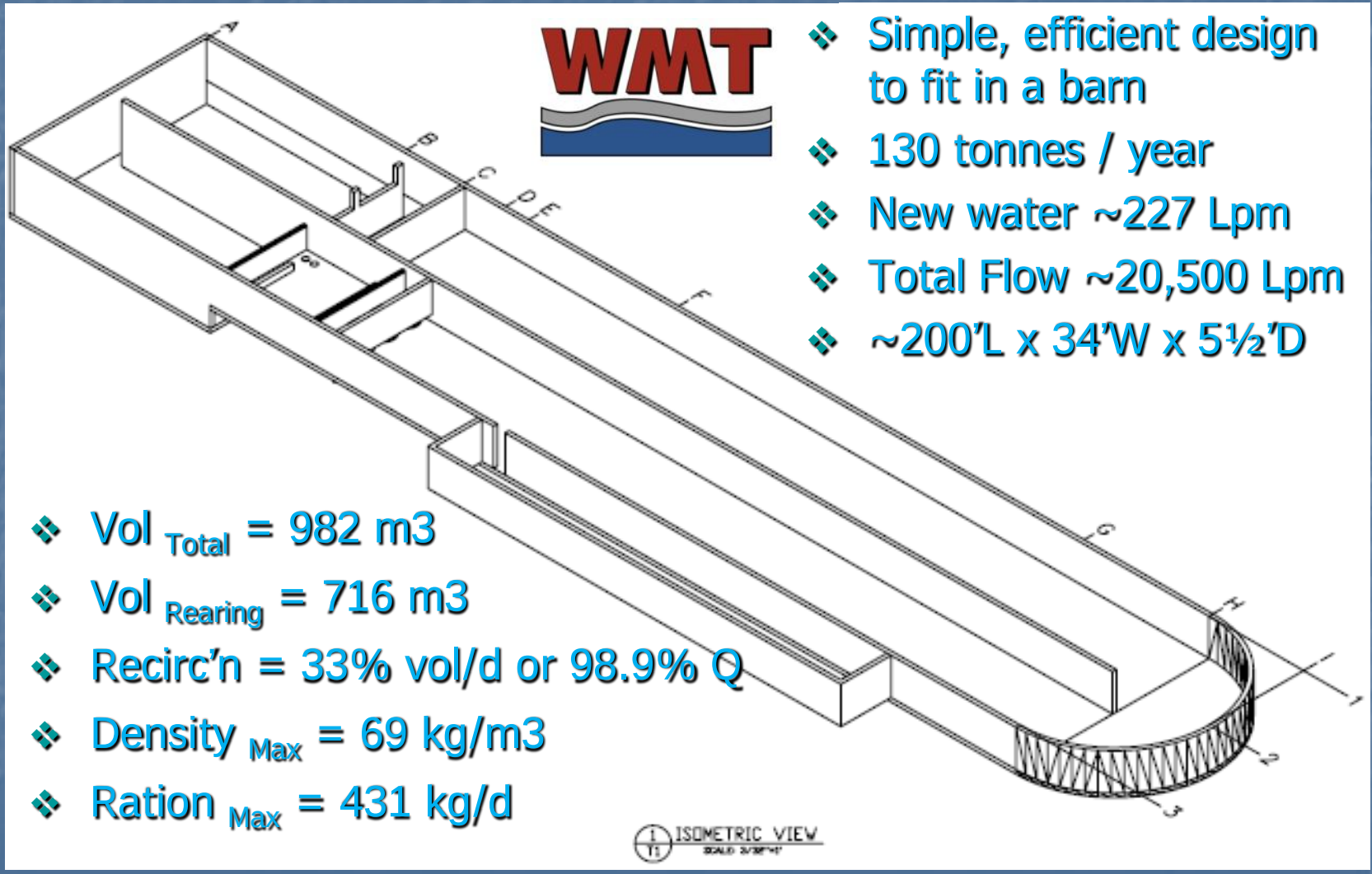
To be successful, the farmer needs more than just technology

Model Farm Planning Workshop

Scope of the Model Farm

- To optimize productivity, economic prosperity and environmental sustainability
- Species
  - Salmonids (rainbow trout)
- Product
  - Food fish / stocking / baitfish
- Scale
  - Minimal commercial size (100-200 tonnes)
  - >98% recirculation
- Industry-driven
  - Promote industry expansion

Model Farm Layout

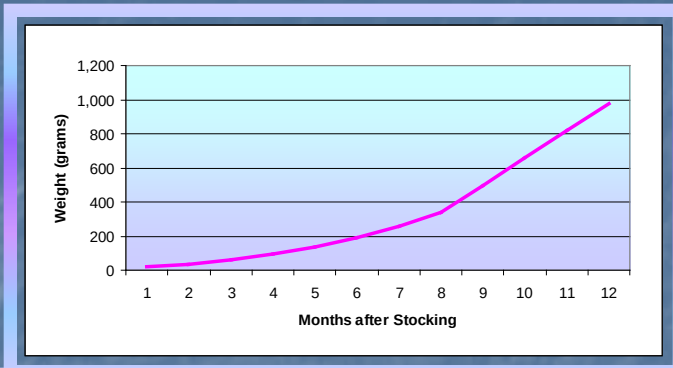


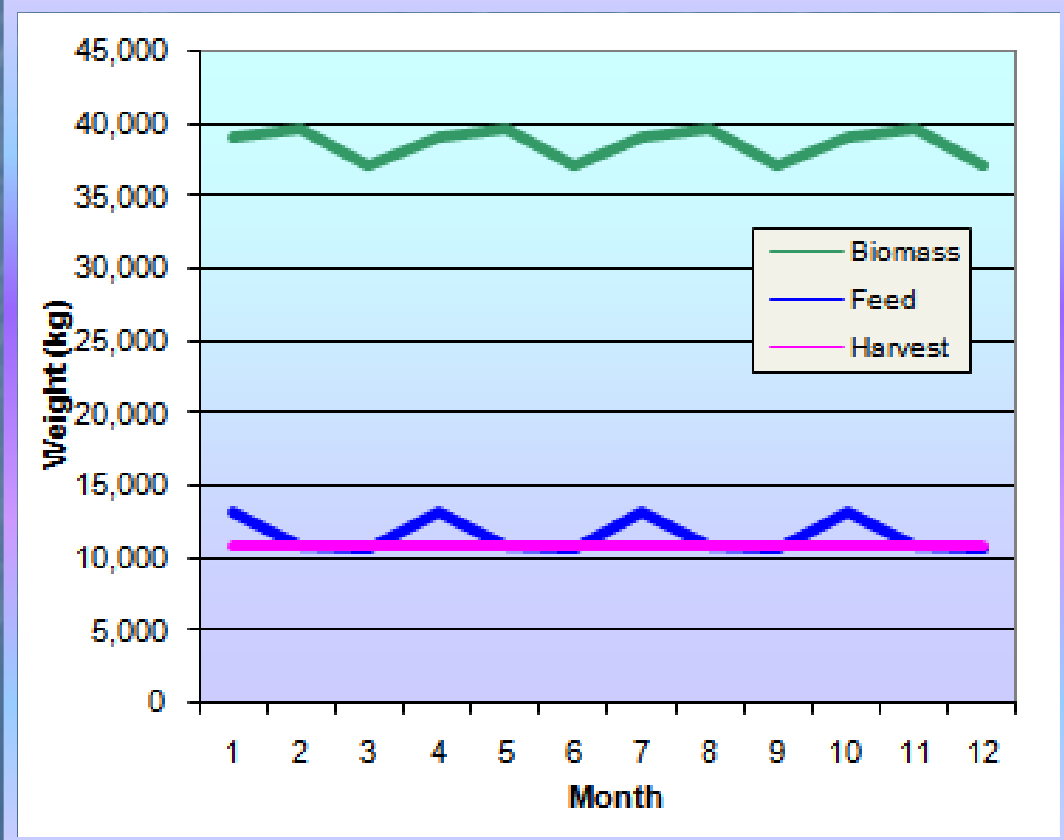
- Simple, efficient design to fit in a barn
- 130 tonnes / year
- New water ~227 Lpm
- Total Flow ~20,500 Lpm
- ~200'L x 34'W x 5½'D

- Vol $_{Total}$ = 982 m3
- Vol $_{Rearing}$ = 716 m3
- Recirc'n = 33% vol/d or 98.9% Q
- Density $_{Max}$ = 69 kg/m3
- Ration $_{Max}$ = 431 kg/d

Production Strategy

- Year-round production
  - 30,000 20g fry every 3 months
  - 12 months to ~1200g @ ~10ºC
  - Harvest ~10,800 kg per month





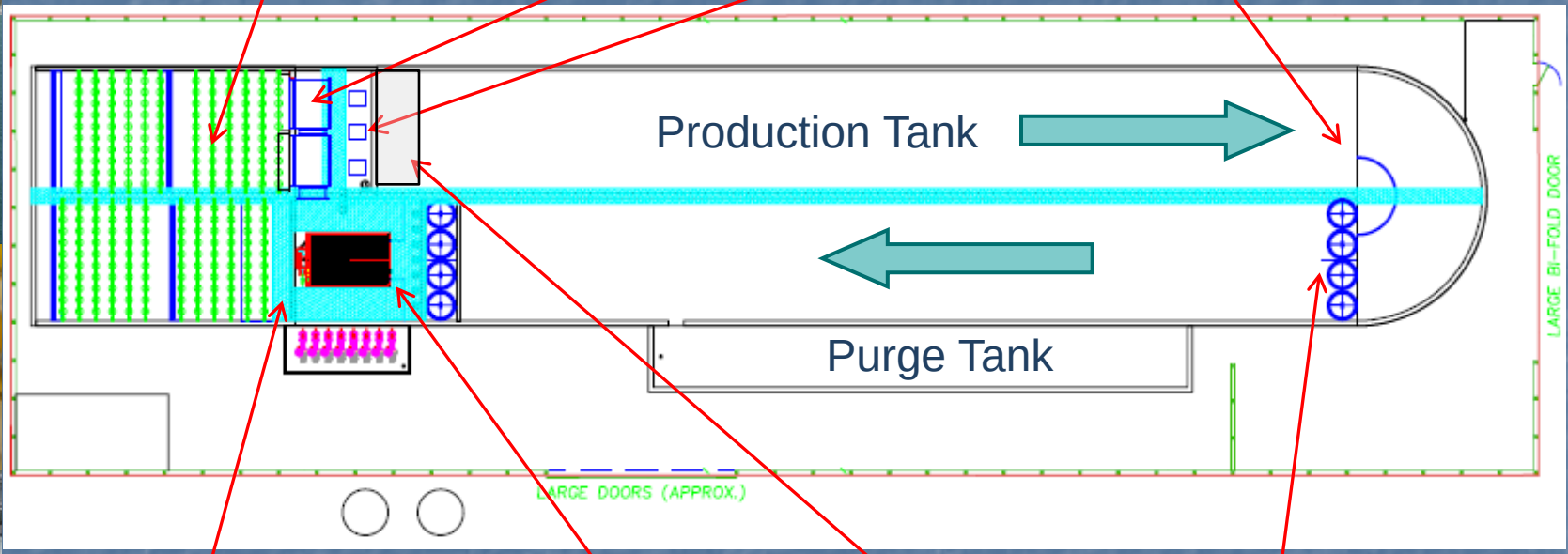
Model Farm Layout

Moving Bed Biofilter

LHOs

Pumps

Internal Curved Wall



CO2 Stripper / Pumps

Drum Filter

Fixed Media Filter

Sludge Cones

MB-CMAF Construction










MB-CMAF Construction

MB-CMAF Construction





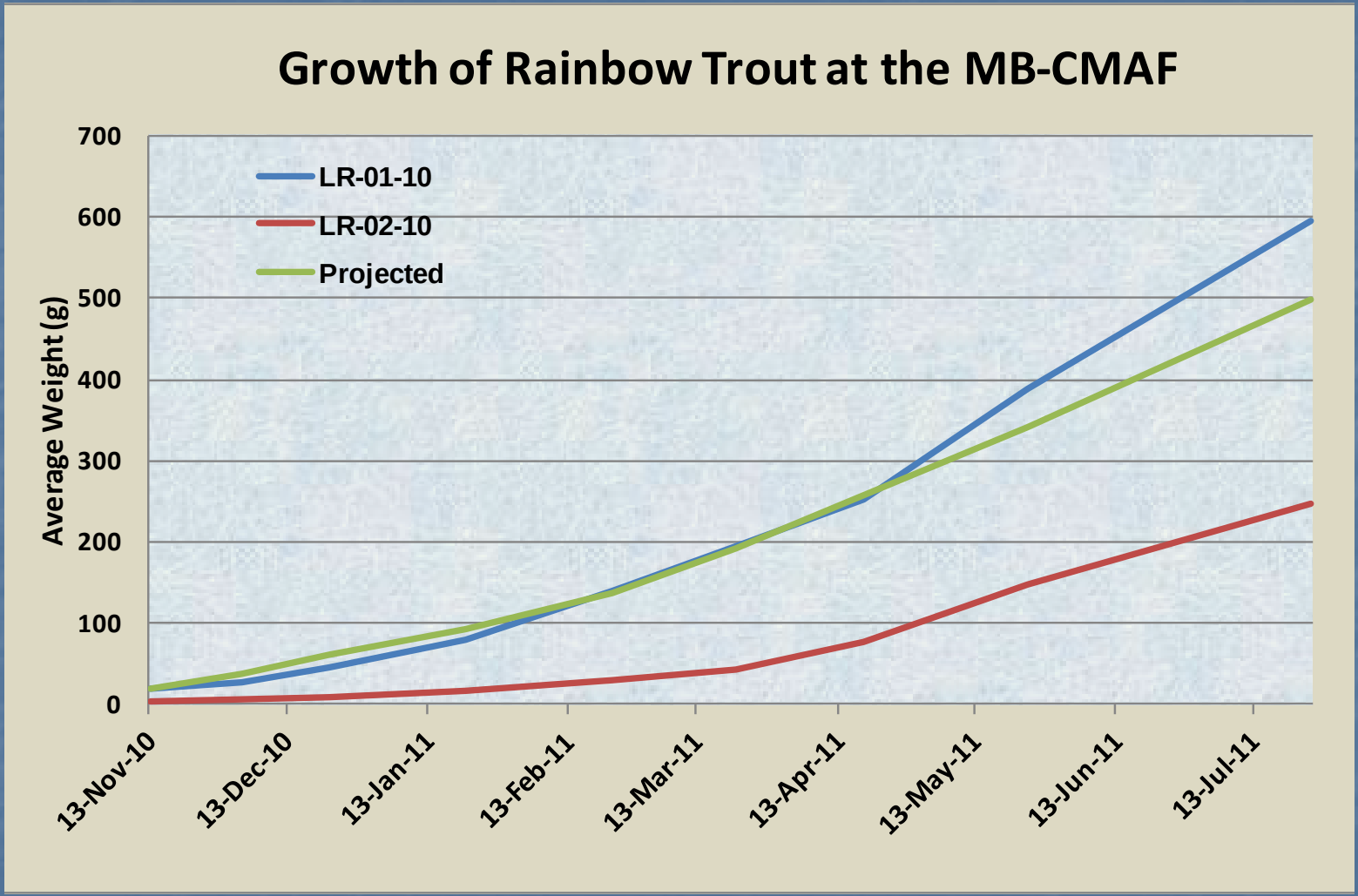




MB-CMAF Operational

First Stocking (Nov 2010)

Preliminary Performance Data



- First fish stocked in November 2010
  - 40,000 @ 20 grams
  - 40,000 @ 5 grams

Preliminary Performance Data

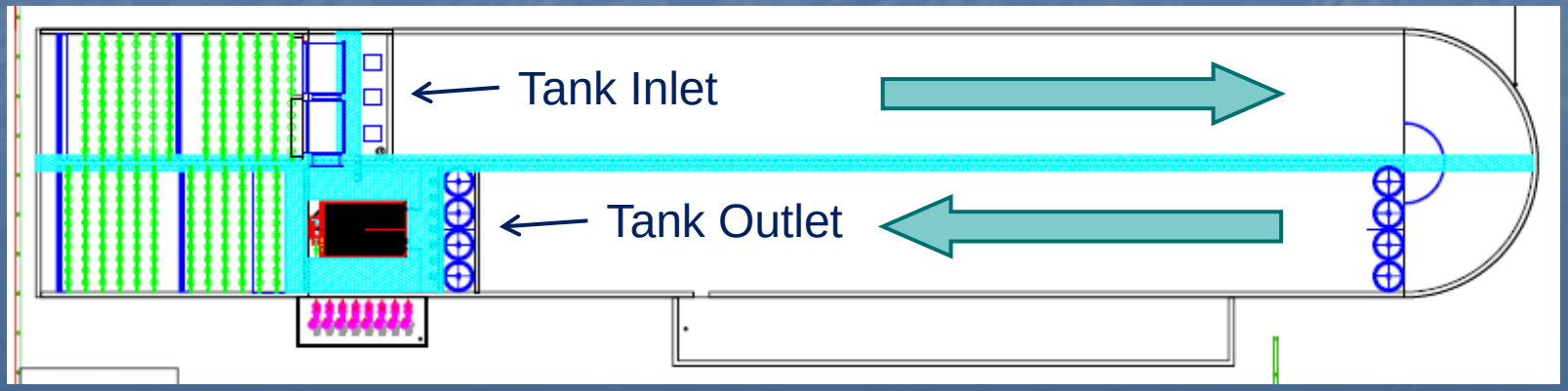
Date	Avg Wt / Fish (g)		FCR		TGC	
	LR-01-10	LR-02-10	LR-01-10	LR-02-10	LR-01-10	LR-02-10
13-Nov-10	20	4	na	na	na	na
3-Dec-10	28	6	0.80	na	2.07	na
22-Dec-10	45	8	0.70	na	3.07	na
21-Jan-11	79	16	0.90	na	2.86	na
22-Feb-11	140	30	0.82	0.49	3.12	4.31
21-Mar-11	194	44	0.96	1.48	2.44	1.73
18-Apr-11	253	78	1.08	0.91	1.68	2.32
24-May-11	388	147	1.02	0.75	2.16	2.88
25-Jul-11	594	247	2.37	1.17	1.29	1.15
Cumulative			1.20	0.96	2.02	1.92

Average Temp = 11.3^{o}C Range = 8-16°C

Water Quality

Primary Well	
Hardness	471
pH	8.1
Alkalinity	431
Chloride	6.4

Parameter	Tank Inlet	Tank Outlet
Alkalinity	336	314
TSS	2.3	2.8
TKN	2.8	3.1
TAN	0.17	0.52
NO2-N	0.13	0.16
NO3	36.6	37.1
TP	0.66	0.71
BOD	4.3	7.3
Chloride	10.1	10.4



Financial Metrics

- Capital
  - Capital Cost = $ 761,000
    - Does not include barn, well, manure lagoon (sunk costs)
    - $5.85 per kg production capacity
  - Working Capital ~$250,000
    - Feed, Fingerlings, Utilities, Supplies, etc.
- Electrical
  - Circulating Pumps, Biofilter Blowers, CO2 Pumps, Well Pumps, O2 & O3 Generator and Compressor → 72 hp (54 Kwhr)
  - 3.6 Kw / tonne production capacity

Cost of Goods Sold

		$/kg	% Sales
Harvest (kg)	130,800		
TOTAL REVENUES	**$519,048**	$3.97	100.0%
Cost of Production			
Opening Inventory	$111,299	$0.85	
Feed	$219,125	$1.68	42.2%
Fingerlings	$44,437	$0.34	8.6%
Electricity	$50,224	$0.38	9.7%
Heating	$9,653	$0.07	1.9%
Labour	$31,200	$0.24	6.0%
Maintenance & Repairs	$9,259	$0.07	1.8%
Supplies	$23,148	$0.18	4.5%
Stock Insurance	$5,793	$0.04	1.1%
	$504,139	$3.85	
Closing Inventory	$111,295	$0.85	
Cost of Sales	**$392,844**	$3.00	**75.7%**
Gross Margin	**$126,204**	$0.96	**24.3%**

Indirect Costs

Indirect Costs			
Depreciation	$43,042	$0.33	8.3%
Professional Services	$9,000	$0.07	1.7%
Insurance	$2,400	$0.02	0.5%
Interest	$21,041	$0.16	4.1%
Telecommunications	$2,400	$0.02	0.5%
Management	$0	$0.00	0.0%
Office Expense	$1,200	$0.01	0.2%
Lease	$0	$0.00	0.0%
Vehicle Expenses	$6,000	$0.05	1.2%
Total Indirect	**$85,083**	$0.65	**16.4%**
Profit/(Loss) before taxes	**$41,120**	$0.31	7.9%

EBIT = 12.0%

Ratio Analysis

RATIO	Year 1	Year 2	Year 3	Year 4	Year 5	5-Year Avg
Liquidity						
Current Ratio (times)	5.7	6.2	7.5	8.7	10.1	
Quick Ratio (times)	1.5	2.7	4.0	5.2	6.5	
Assets Management						
Inventory Turnover (days)	394	98	103	103	103	
Debt Management						
Debt Ratio	60%	64%	62%	56%	49%	
Times Interest Earned	-5.67	-1.12	0.89	1.95	2.95	
Profitability						
Gross Margin	-0.1%	19.0%	24.0%	24.3%	24.3%	18.3%
Return on Sales	-20.9%	14.9%	20.0%	20.3%	20.3%	10.9%
Cash Earnings on Sales	4.5%	7.4%	7.6%	7.6%	7.6%	6.9%
ROI (Cash in - Cash out)	7.9%	14.7%	15.0%	15.0%	15.0%	13.5%

Total CF = Labour + Net Cash Flow

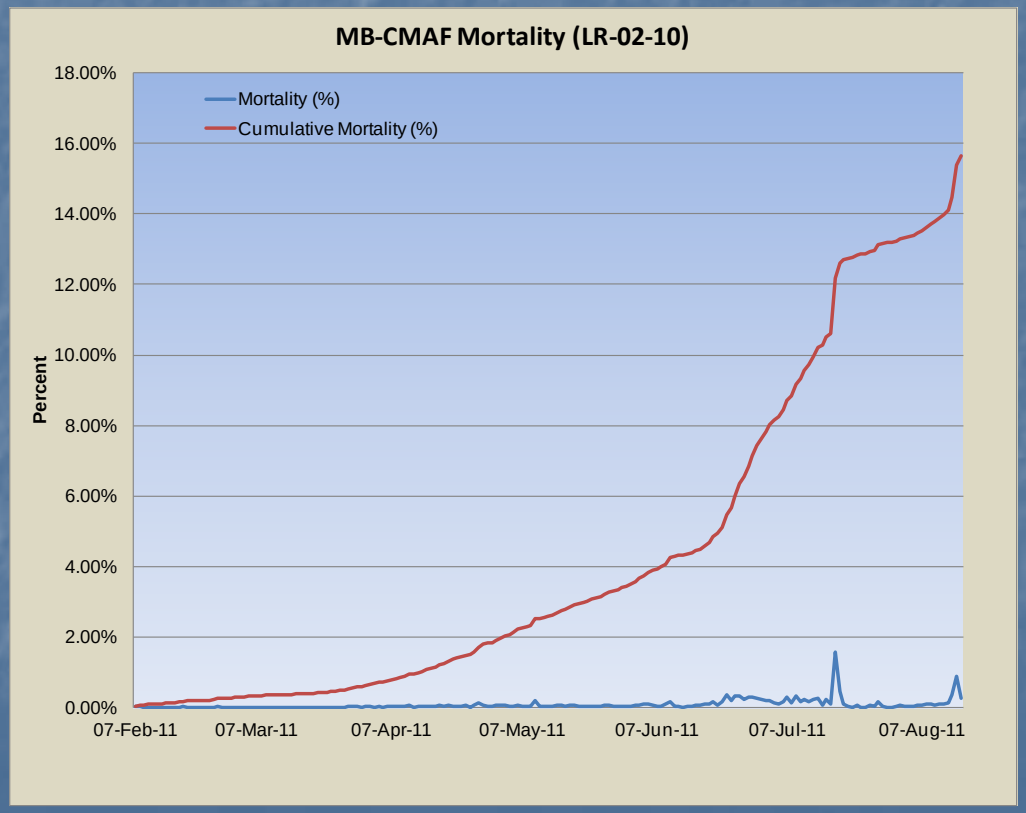
= $31,200 + 39,300

= $70,500

Lessons Learned

Disease & Mortality

- Biosecurity cannot be under-estimated
  - Aeromonas
  - Ichthyobodo (Costia)
  - Flavobacter
  - Vibrio
  - Pasturella
- Parasite-S



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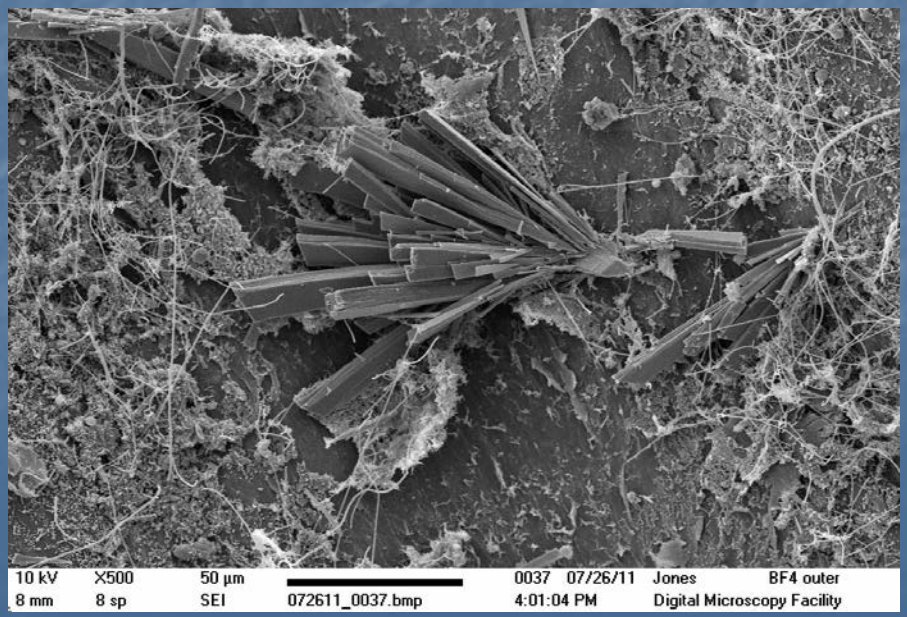
Lessons Learned

- Calcium phosphate precipitate in system
  - Sources: concrete and hard water
- Changed buoyancy of biofilter media
  - Affected hydraulics in biofilter
- Gill Lesions



Demonstration & Validation

- Intensive operational monitoring program
  - 3-year performance monitoring and management program established
  - Farm Manager hired to oversee fish culture operations and compile performance management data and information

Performance Management

- **Canadian Model Aqua-Farm**
  - OPERATIONAL SUSTAINABILITY
    - **Production**
      - Fingerlings
        - Number
        - Size
        - Timing
      - Feed / Diet
        - Formulation
        - Ration
      - Inventory
        - Number per Lot
        - Avg fish size
        - Total biomass
        - Harvest
      - Temperature
        - System
      - Energy
        - Electricity
        - Diesel
    - **Productivity**
      - Growth Rate
        - SGR
        - TGC
      - Mortality
        - Number
        - Size
      - Fish Health
        - Diagnoses
        - Treatments
      - Feed Conversion
        - Biological
        - Economic
      - Carrying Capacity
        - Water
        - Energy
        - Volume
      - Water Use
        - Total Flow
        - Exchange
    - **Economics**
      - Fingerlings
      - Feed
      - Labour
      - Supplies & Repairs
      - Power
      - Skills Training
      - Indirect Costs
      - Capital
  - ENVIRONMENTAL SUSTAINABILITY
    - **Environment**
      - Metabolic Wastes
        - Solids
        - Phosphorus
        - Nitrogen
        - BOD
        - Carbon Dioxide
      - Other Factors
        - Dissolved Oxygen
        - pH
        - Temperature
      - Chemicals
        - Therapeutics
      - Waste Managm't
        - Solids
        - Mortalities

Thank you

Financial support provided by:

- Fisheries & Oceans Canada
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