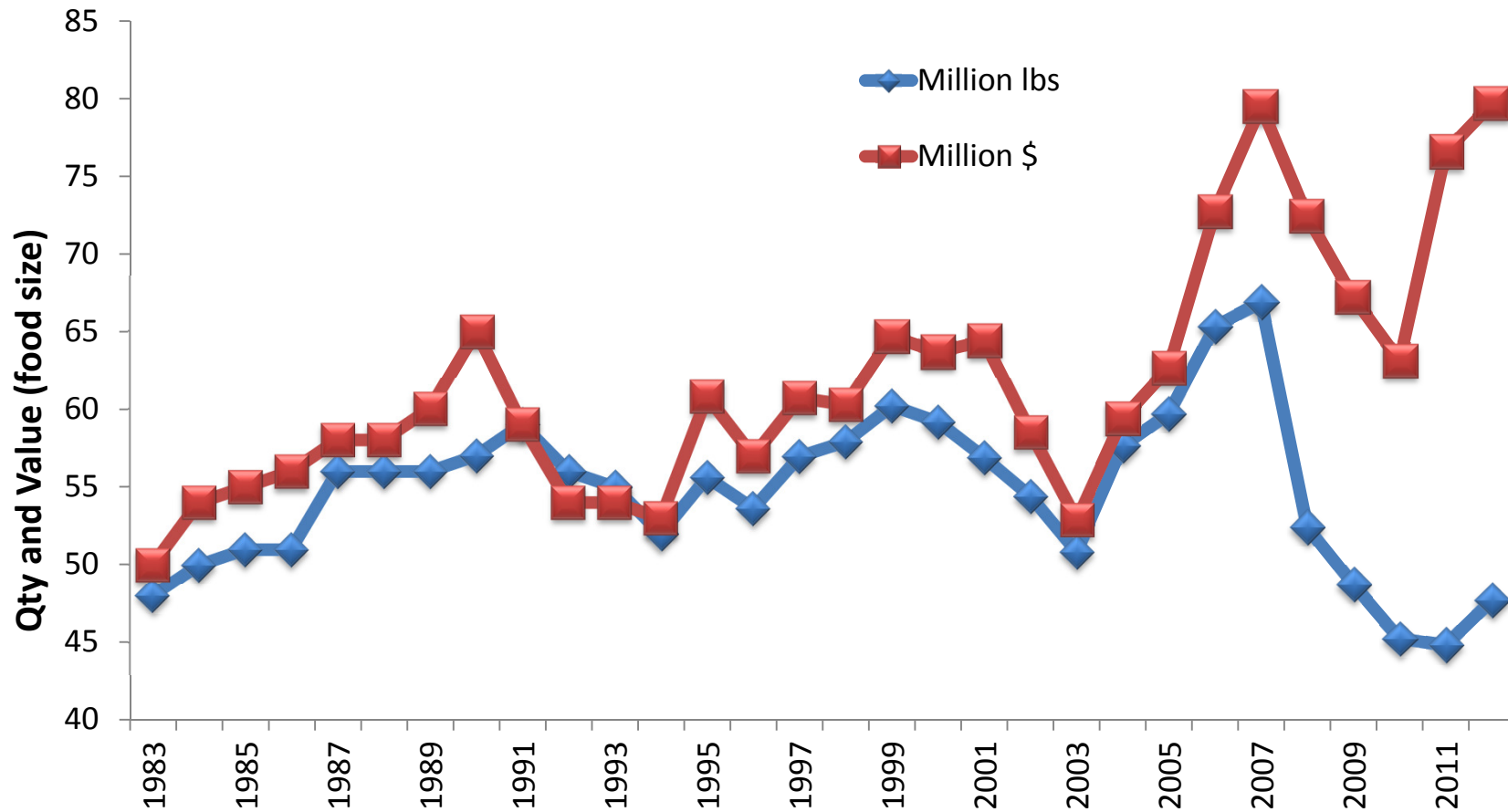


On the Brink of Trout Cage Culture

North Central Aquaculture Conference
Toledo, Ohio
February 22-23, 2014

Dr's
Chris Weeks
&
Dave Smith

US Rainbow Trout Production



Color Your Menu With Clear Springs® Ruby Red Rainbow Trout

Chefs and consumers are taking notice of rainbow trout as it continues to grow in popularity and is becoming a great addition on menus across the U.S. It's been farmed raised in the U.S. for over a century and has been named a "Best Choice" on the Monterey Bay Seafood Watch list because it's farmed in an "ecologically responsible way." 25,000 tons of rainbow trout is grown annually by U.S. farmers with Idaho producing almost 80% of that number. Clear Springs Foods, located in Buhl Idaho, is the largest producer of rainbow trout in the U.S., and through their partnership with farmers in Peru, also supplies Ruby Red rainbow trout, year-round, to foodservice operators across the country.



Chefs, take notice!

With its tender, delicate texture and mild flavor, Ruby Red rainbow trout pairs well with a variety of seasonings, garnishes



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BLOG ARCHIVE

- ▼ [2013 \(21\)](#)
 - ▶ [December \(1\)](#)
 - ▶ [November \(3\)](#)
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09:32 Puno is Peru's top trout producer

Puno, Apr. 26 (ANDINA). The Puno district is ranked as Peru's leading trout producer in registering an output of **8,500 tonnes in 2009**, informed Hipolito Mollocondo, Director for Aquaculture and Research of the Regional Directorate of Production.



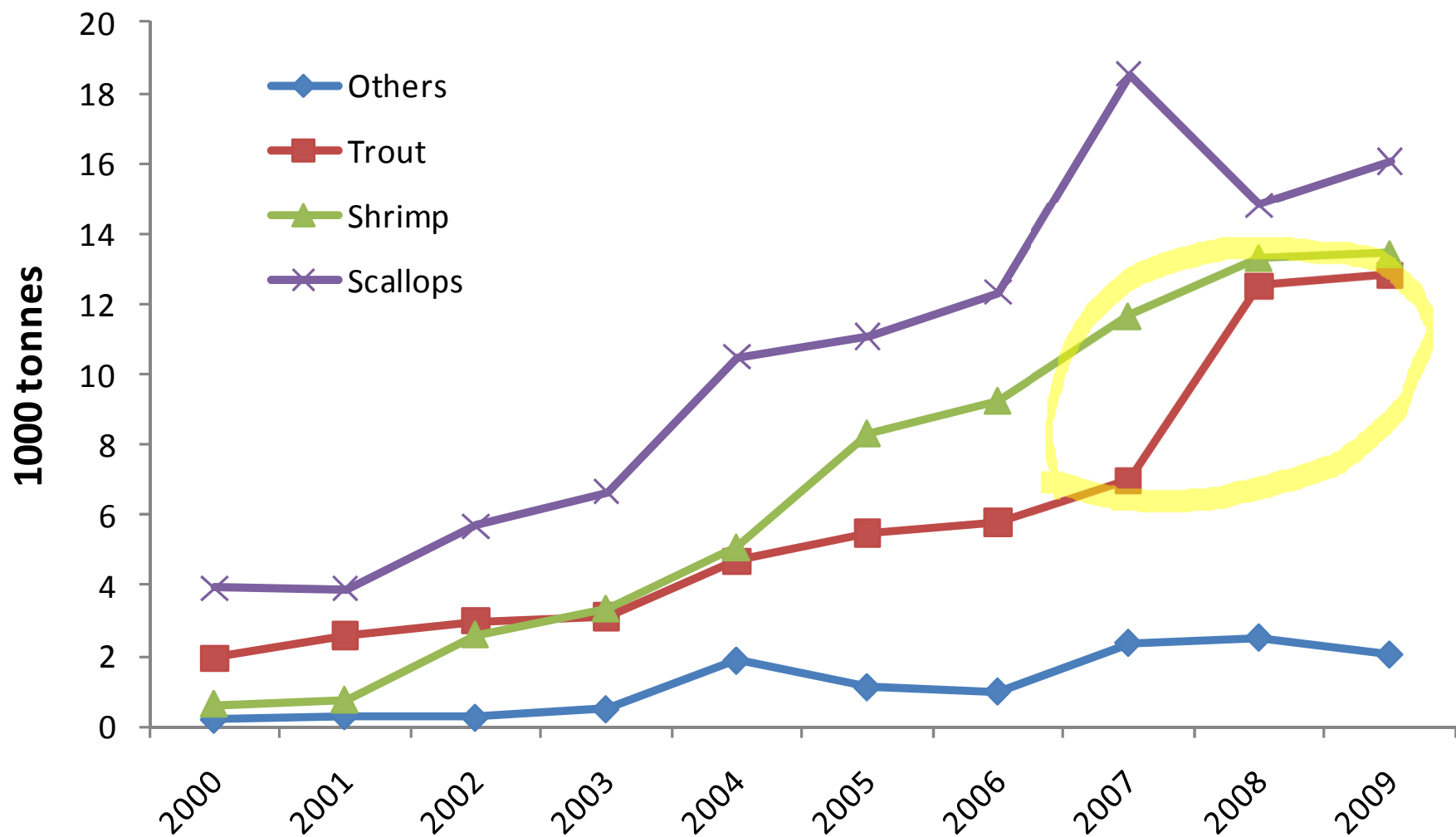
Trout farm. Photo: ANDINA

This production was obtained thanks to the work of some 900 registered aquaculture companies that possess jurisdiction in provinces like Chucuito, Lampa, Puno, Huancane and Yunguyo, the official said.

According to a **fis.com** report, the **majority** of the resource-producing companies are found **in the small-scale category (2 to 50 tonnes)**. Next are those firms that subsist on fewer than two tonnes, and only three large-scale firms, which are able to export what they produce.

Among the companies that **ship trout overseas** are Piscifactoria de Los Andes, which exported **1,000 tonnes to Canada and the United States in 2009**.

Puno trout supplies the local markets and the one in Cusco, although the fish is also commercialised in Bolivia through the municipality of Desaguadero.



Aquaculture production in Peru from 2000 to 2009 (Ministry of Production)

<http://wanderinggaia.com/2010/08/06/lake-titicaca/>



Lake Titicaca Peru



<http://pulitzercenter.org/reporting/lake-titicaca-andes-peru-bolivia-pollution-wastewater>

1st Question:

Is cage culture of rainbow trout feasible?

- pretty much anything is feasible

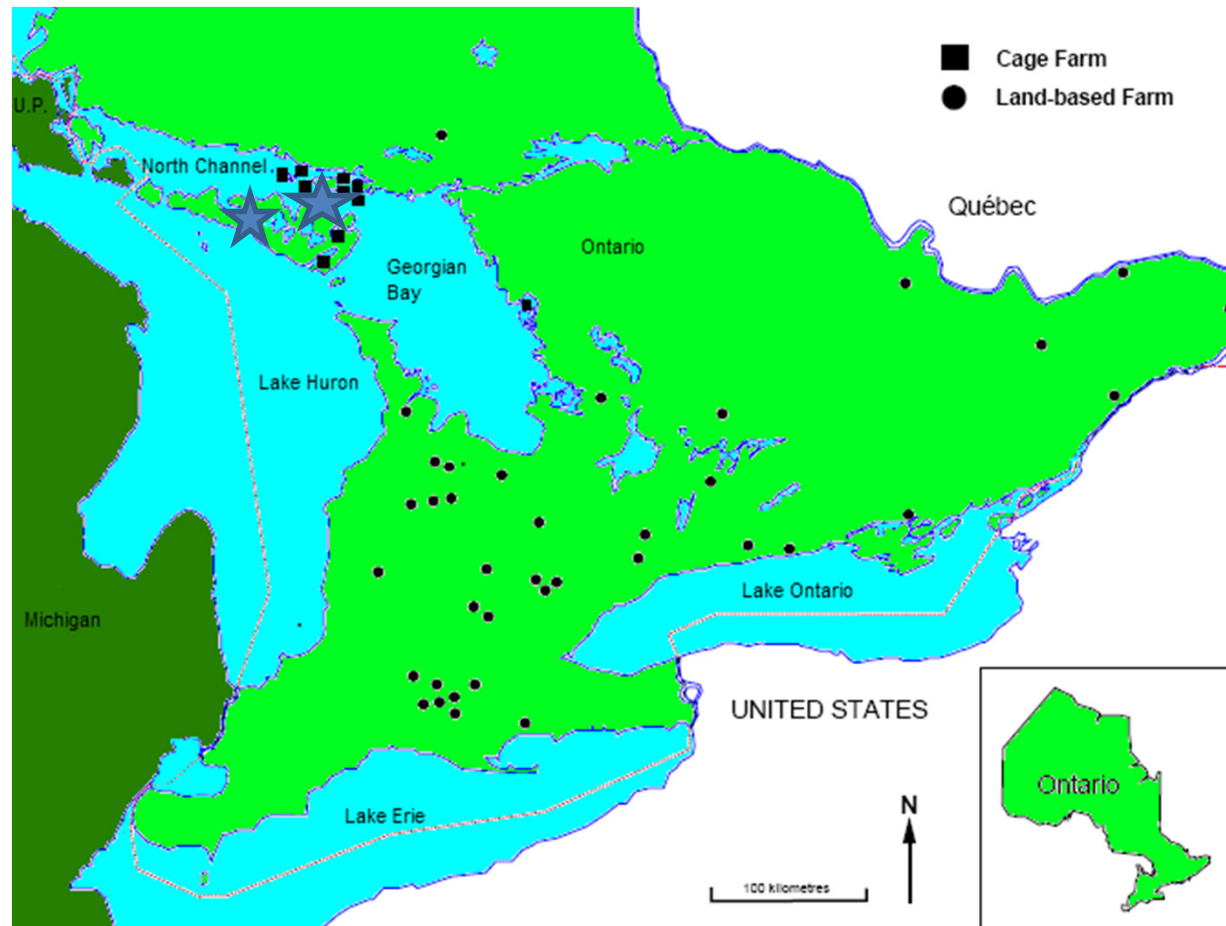
Rephrase 1st Question:

How feasible is cage culture of
rainbow trout In North Central Region US?

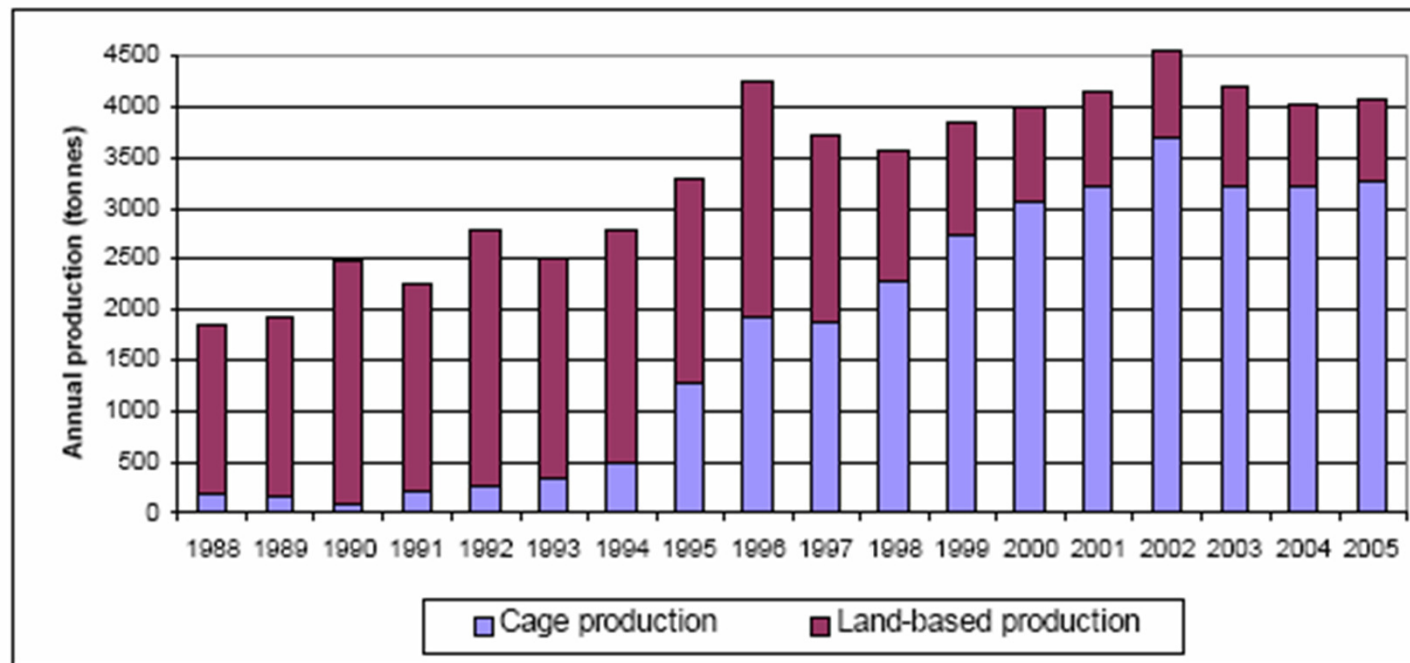
Ontario Cage-culture

- First Farm Built in 1986
- Current production: 9.1 Million lbs. annually
- 2005 Stats (Last Available):
 - 7.8 Million lbs.
 - \$12.5 Million Farm Gate Value
 - 50 Direct Jobs
 - Overall financial impact \$38.2 Million
 - 179 FTE for cage culture and related activities

Ontario Rainbow Trout Cage Culture



- 10 Facilities in Lake Huron Manitoulin Islands
- 10 million lbs per year



Meeker Aquaculture, Lake Wolsey



Meeker Aquaculture



- First Ontario Cage Culture Operation
- Started in 1986
- Produces about 900,000 lbs. annually
- Independent studies show no negative resource impacts



North Wind Fisheries

- Smallest Ontario Cage Culture Operation
- Produces about 500,000 lbs. annually
- Independent studies show no negative resource impacts





Icicle Seafoods, Inc – Atlantic Salmon
Puget Sound, Washington

Courtesy of Tollef Olson,
Aqua Farms, LLC, Maine.



Is cage culture of rainbow trout feasible?

- pretty much anything is feasible

How feasible is cage culture of rainbow trout?

- pretty darn feasible!

How do we begin to get there?

- a little math?????

Netpens and Cage Culture Systems

Netpens, sea pens, sea cages, cages

- Nets suspended in water column
 - Depths range from 9 m to 30 m
 - Volumes: 280 m³ to 30,000 m³
(Meeker's 30 x 30 x 30 m)
- Rely on tides and currents for O₂
- Stocking densities:
 - 10 – 18 kg/m³ for Atlantic salmon
 - 5 – 10 Chinook salmon
 - 10 – 13 rainbow trout

Netpens and Cage Culture Systems

The low stocking densities have resulted in Improved growth, lower mortalities, and better disease resistance.

Essentially flow-through systems – carrying capacity depends on water exchange and O₂ delivered to the fish.

Biofouling can quickly reduce the open area and restrict the flow.

Netpens and Cage Culture Systems

Example: $D = 10 \text{ kg/m}^3$

$RV = 1,000 \text{ m}^3$ (e.g. 22ft^3)

DO saturated at 10 mg/l

$DO_{\text{MIN}} = 7 \text{ mg/l}$

$\%BW = 1.5$

$OF = 250 \text{ gO}_2/\text{kgfeed}$

Maximum biomass: $MBM = RV \times D = 10,000 \text{ kg}$ ($22,000 \text{ lb}$)

Feed loading: $LdF = AO/OF = 0.012 \text{ kgfeed/lpm}$

Maximum Feed: $MFd = MBM \times \%BW/100 = 150 \text{ kg}$ (330 lb)

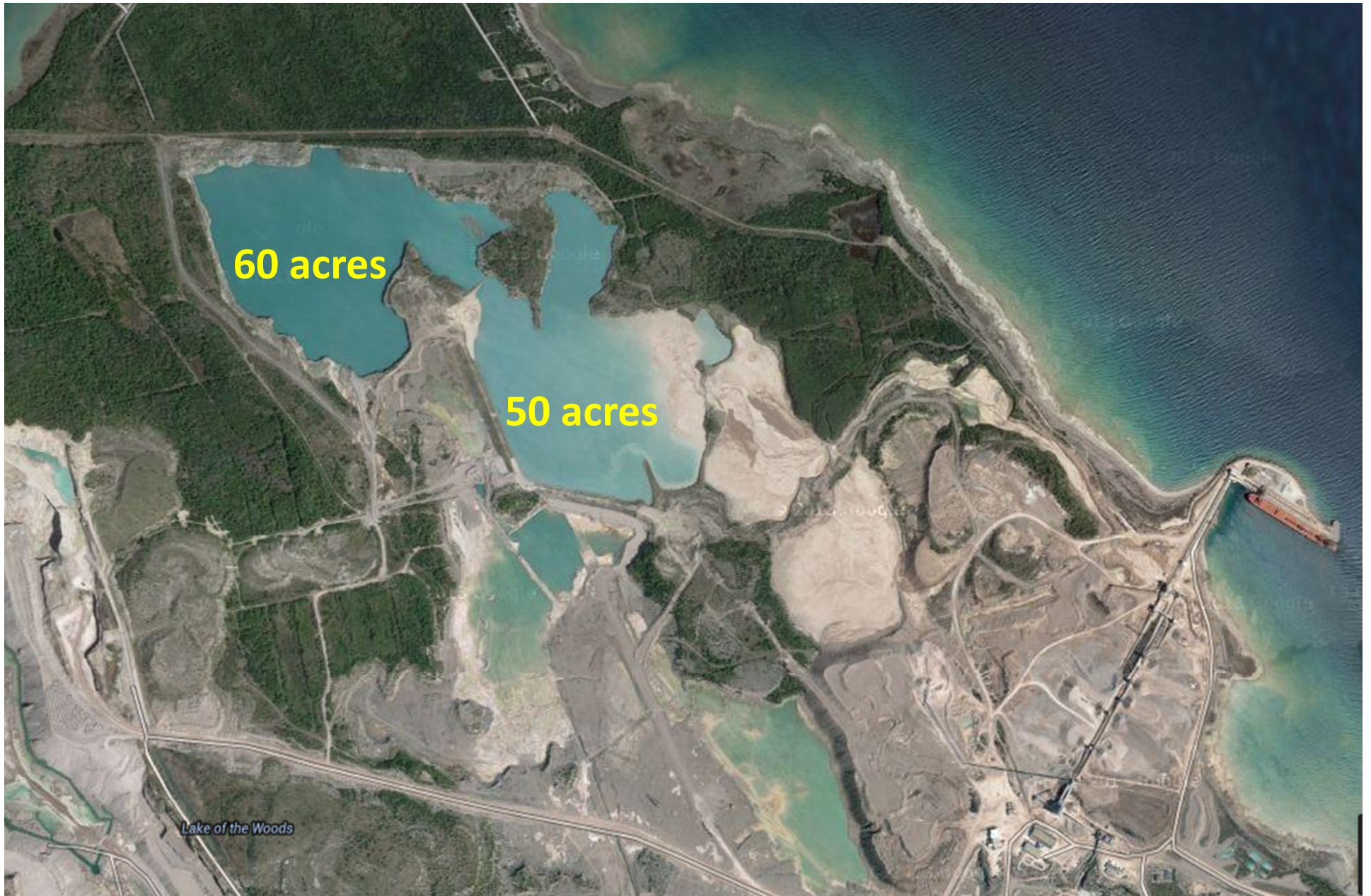
Flow required: $Q = MFd/LdF = 12,500 \text{ lpm}$ ($3,300 \text{ gpm}$)

Exchange rate: $R = (Q \times 0.06)/RV = 0.75$

Fish loading: $Ld = \frac{AO}{OF} \times \frac{100}{\%BW} = 0.8 \text{ kg/lpm}$

$\sim 1/2$ to $1/4$ D , Ld , R as RAS and flow through raceway

What about quarries?



Lafarge Presque Isle, North Eastern Michigan, LP



National City, Michigan, LP



Chisholm, MN, retired iron ore pit

Lessons learned from Minnesota Aquafarms

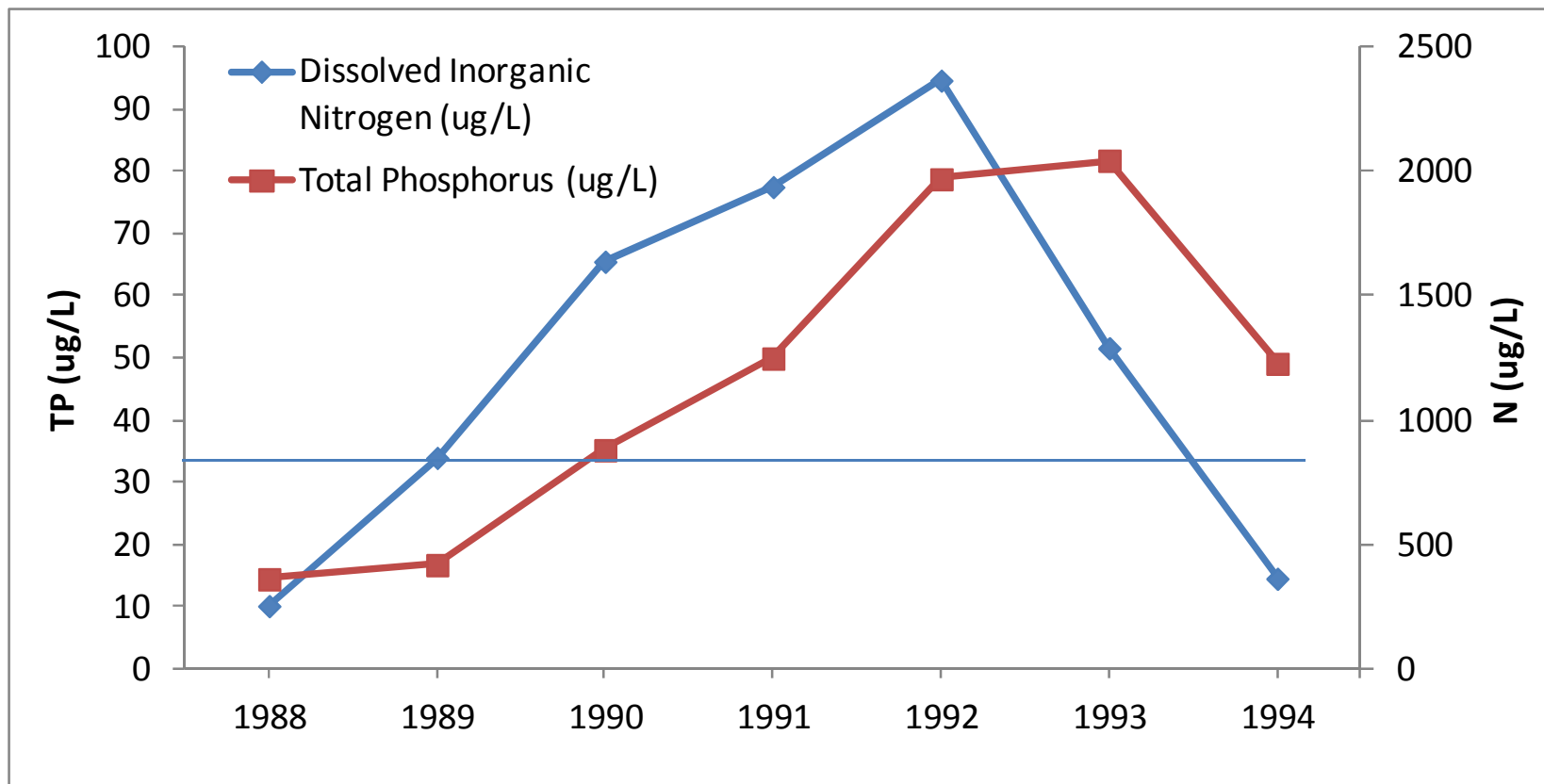
- 1988 Minnesota Aquafarms, Inc. established a large-scale net pen salmon and trout culture facility near Chisholm, Minnesota.
- The facility received a National Pollutant Discharge Elimination System (NPDES) permit.
 - authorized the production of 1.9 million kg per year of fish and phosphorus limit (33 $\mu\text{g/L}$)

Lessons learned from Minnesota Aquafarms


- At the height of production, fish were held in sixty 15 meters deep nets.
- From 1988 to 1994 a little over 1.4 million kg of fish were produced.
- Within 1 year, they exceeded NPDES phosphorus limits and forced to add a waste collection system for the facility by the Minnesota Pollution Control Agency.
- They were further forced to use Ferric Chloride to precipitate out soluble phosphorus.

Lessons learned from Minnesota Aquafarms

- 1995 Minnesota Aquafarms forced to shut down and file for bankruptcy.




Problems?

Water source a deep oligotrophic pond, low buffering capacity, with  no vegetation and little nutrient uptake potential

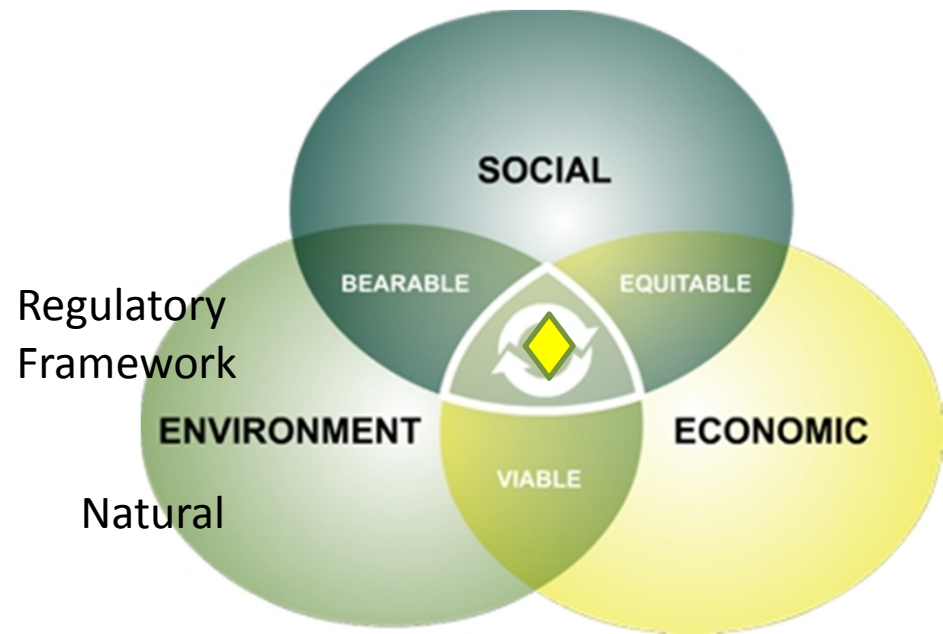
Solids accumulate on bottom contributing to high total P 

NPDES permit based on industrial waste source (limits) 

Interconnected mine shafts with ground water in populated area (drinking water) mentioned as concern 

Lessons learned from Minnesota Aquafarms

- Biggest problem?
 - Not a sustainable endeavor from start



Is cage culture of rainbow trout feasible?

- pretty much anything is feasible

How feasible is cage culture of rainbow trout?

- pretty darn feasible!

How do we begin to get there?

- A little math
- Do your homework
- Google!
- Ask questions

NEW 1st Question:

Where do I want to be 10 – 20
years from today?

Then:

Why?

What?

How?

When?

