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**Background - Washington State**

- Many questions in recent years as to the integrity of manure ponds
- Regulatory interest in requiring that all manure ponds be lined
- What extra management might be required if ponds were lined

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**Background - Washington State**

- Reflective of regional environmental emphases
- Likely an economy of scale that is represented in the case studies that will be presented
- Liners were used because they were cost effective, required due to sandy soils, or a chosen alternative
- Arid, low rainfall region in our state

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### Background - Washington State

- **Objective** - create awareness of cost and system requirements in regard to solids management
- **Disclaimer** - while I will share pictures and speak about specific equipment, it does not constitute an endorsement of any particular source of equipment

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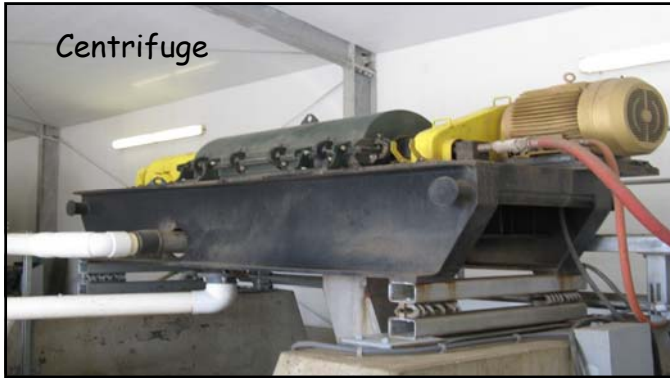
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**Case study # 1**

- 1500 milking cows
- Manure solids as bedding
- Parlor waste - Separation of solids has occurred since 1990, manure from parlor goes over liquid-solid separator, then to a concrete lined settling basin, then to lagoon

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**Case study # 1**

- Manure from Barns - is vacuumed and transported to fields or to lagoon
- ~ 2 years ago - one lagoon retrofitted
  - concrete bottom installed
  - 60 mil poly lined banks (20 ft x 70 ft(x2) x 300 ft)
- Use floating pumps to pump manure and avoid liner disturbance

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**Case study # 1**

- Cost and considerations
- Engineering, dirt work, liners, concrete,
- Total of 4 lagoons, 12 acre feet, 11 million gallon capacity
- \$500,000 (\$333/cow)

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**Case Study # 2**

- 6000 cows
- Flush system with Biolink system for sediment management, lots of sand traps, trap dimensions 14 ft wide x 500 ft long (3 of them)
- Sand traps at end of barns, 2 ft x 14 ft x 20 ft
- Processing sand with sand screw

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### Case Study # 2

- Uses DT 360 series of liquid-solid separators, 2 screen sizes, 1/8 and 1/16 inch
- Getting ready for installation of centrifuge

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### Case Study # 2

- Lagoons were engineered and clay lined prior to installing liners
- Year 2000 - 60 mil liners, 9 million gallon each (2) - 20 ft deep
- Gas emission lines installed under liner to prevent gassing up of liner
- No concrete ramps, have not entered lagoons, if building new, would put in ramps

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### Case Study # 2

- Floating pump and stinger agitator for manure movement, stinger run off of tractor PTO
- Cost - today's prices = \$87, 120 = \$15/cow

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### Case Study #3

- 5800 cows
- Manure solids as bedding, scrape feed alleys
- DT 360 liquid-solid separators, 2 screen sizes
- Use of Biolink System for sludge removal, sludge is run across smaller screen size DT 360
- Liquid after separation goes to lagoon, the settling basin, and then to big lagoon

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### Case Study # 3

- Settling ponds have concrete ramps to bottom, but not across bottom
- Maintenance on liners done in house
- Material from settling basin is pumped and injected
- Big lagoon - high volume, low pressure floating pumps, applied at field via pivots and low pressure nozzles

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### Case Study # 3

- Cost - 2002 - 35 cents per sq ft installed
  - 25 million gallons (7 acres),
  - 2 settling ponds 1.5 million gallon each, 40 mil poly,
  - 638,000 sq ft = \$223,546
- Cost 2014 - 40 cents per sq ft - 40 mil poly
  - 28 million gallons and a settling pond of 500,000 gallons
  - \$139,513 for 350,000 sq ft
- Cost = \$62/cow

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### Double Liner with Leak Detection System

- HDPE 40-MIL Installation \$ 0.55 SF Supply and
  - HDPE 60-MIL Installation \$ 0.70 SF Supply and
  - Geonet (leak detection layer) \$ 0.45 SF Supply and Installation
  - Geocomposite Clay liner \$ 0.85 SF Supply and Installation
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- Total **\$ 2.55 sf**

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### Western Washington - Lagoon Liners (high rainfall area)

Size of Dairy (cows)	Single Liner Geomembrane	Double Liner with Leak Detection (6.5 multiplier)
500	\$26,130	\$ 169,845
1000	\$52,272	\$ 339,690
2000	\$104,544	\$ 679,380

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### Summary

- There is a need for increased attention to solids management with use of lined manure ponds
- While expensive, single layer liners are an option when clay is not a viable option, or local agency requirements dictate use of a liner
- Expense for use of liners would be greater on a per cow basis in areas of high rain fall during the storage period

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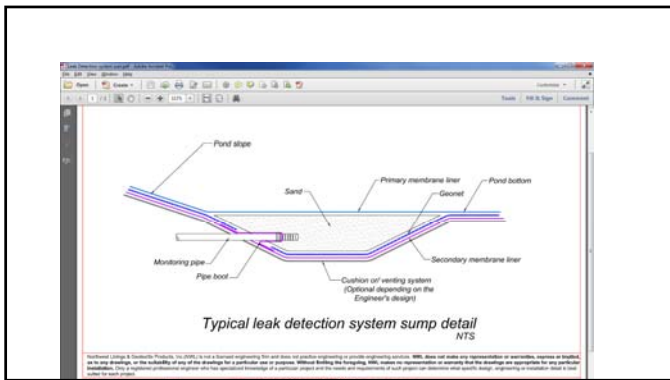
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