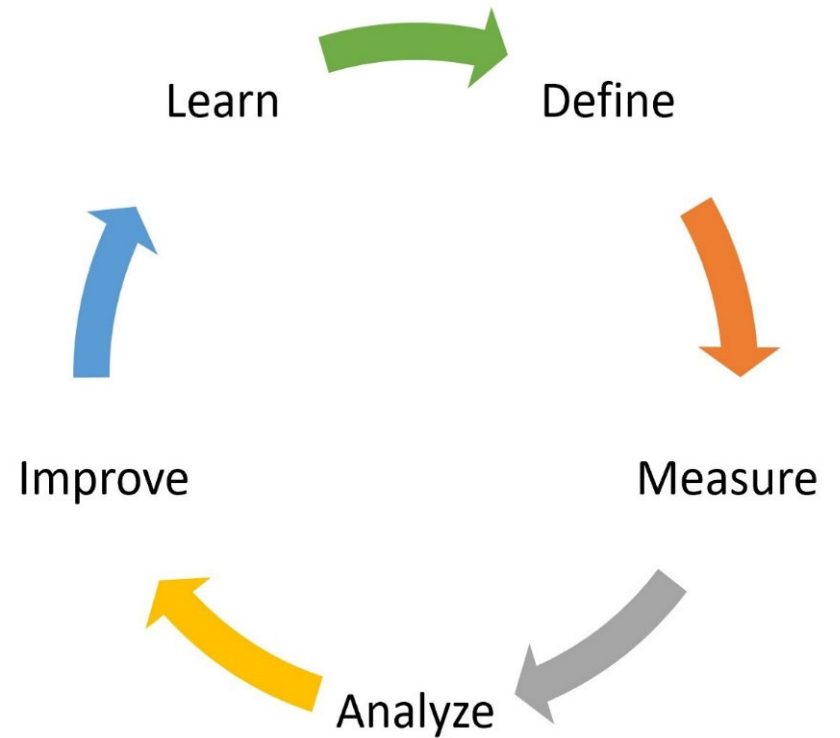
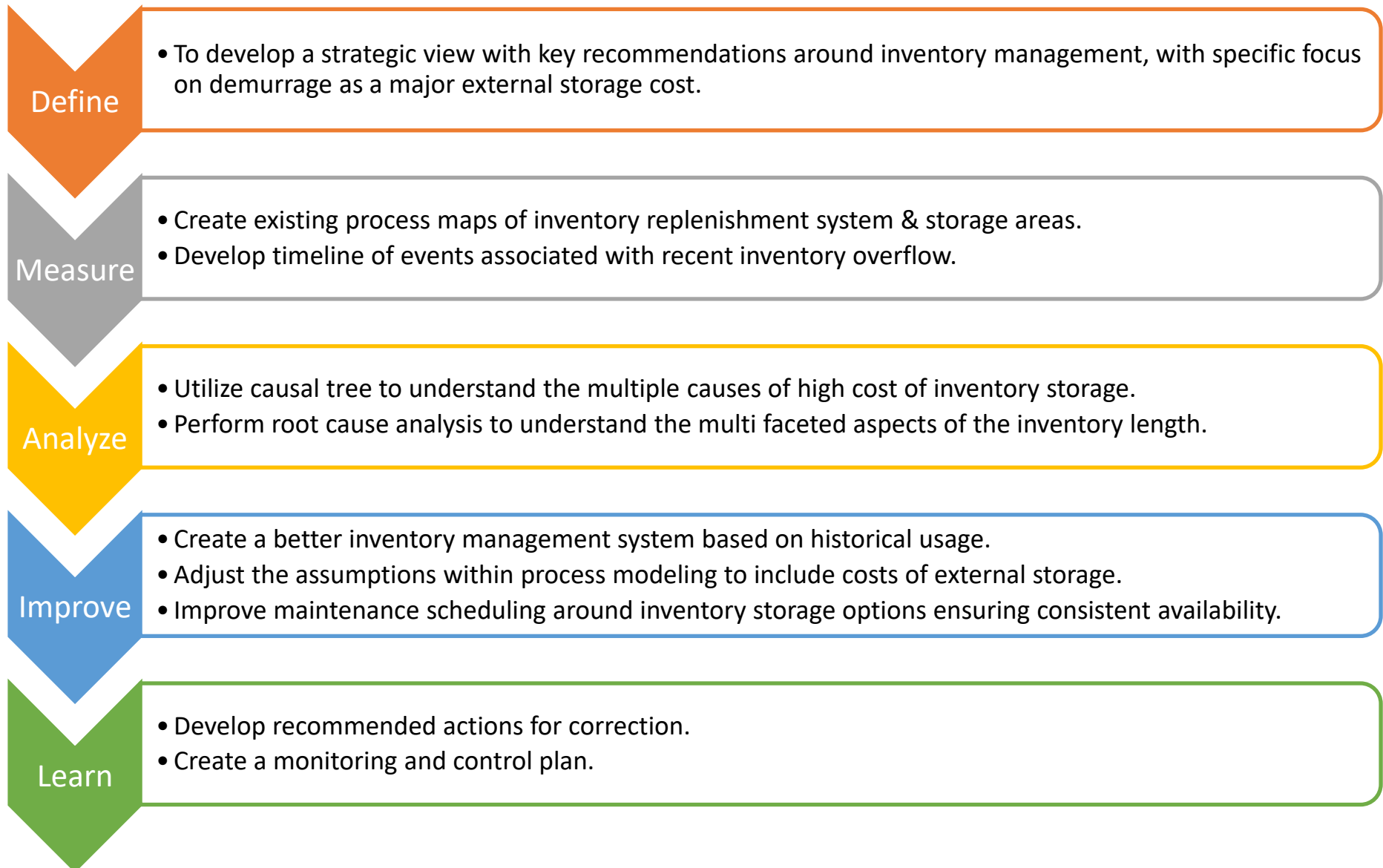


▶ PEXA

Case Study: Optimizing Inventory Management & Logistics to Reduce Costs



Process Summary



Define

Charter: Creating a Better Inventory Management System



PURPOSE

- To develop a strategic view with key recommendations around crude inventory management, with specific focus on demurrage as a major external storage cost.

IMPORTANCE

- Waterborne crude demurrage cost in 2014 is expected to be over \$30.1MM.
- Waterborne crude demurrage has increased 94% since 2013, despite reduced volume (bbls).
- Increased domestic crude rail unloading capability has dramatically changed crude inventory modeling through supply chain variability, storage limitations, and logistics constraints; necessitating a cross-functional strategic alignment around key assumptions and decision processes.

SCOPE

- All crude delivery methods and types
- Storage allocation, tankage, connectivity, and logistics constraints
- Crude planning and scheduling models along with rail variation modeling
- Commercial decisions around mitigating demurrage
- Out of Scope: products and truck demurrage, capital project implementation, rate negotiation, and non-crude feedstock

METRICS

- Demurrage (\$US and Days)
- On-time submission of key deliverables

RESOURCES

- Team Members
- Sponsor
- Team Leader
- Coach

DELIVERABLES (EXPECTATIONS)

- Historical Analysis
 - Process Map for Crude Inventory Decisions
 - Root Causes of Demurrage
 - Cost-Benefit Analysis of Crude Inventory Decisions
- Logistics Capability Analysis
 - Current System Limitations - PFD
 - Baseline Demurrage
- Recommendations
 - Immediate and Long-Term
- Control and Monitoring Plan

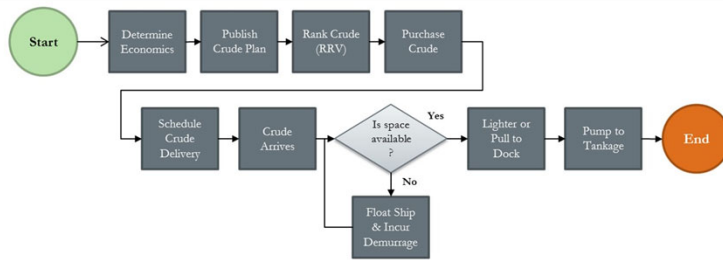
SCHEDULE

- Team Launch: February 18, 2015
- Team Close: July 16, 2015

Measure



Inventory Purchasing Process Map

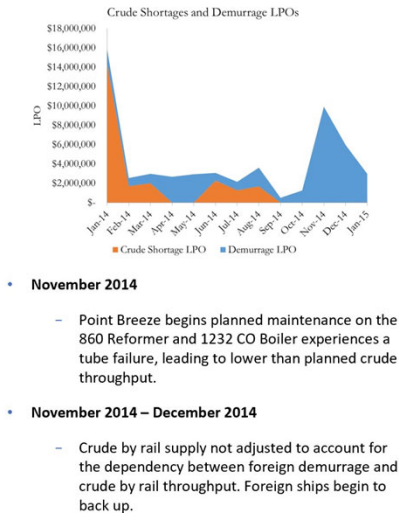


- Inventory purchasing process begins approximately 90 days prior to crude arrival.
- Foreign inventory hold longest lead times, approx. 60 days.
- Domestic inventory are purchased about 1 month in advance of their arrival.
- Inventory purchasing process heavily relies on existing inventory projections against the forward looking plan.

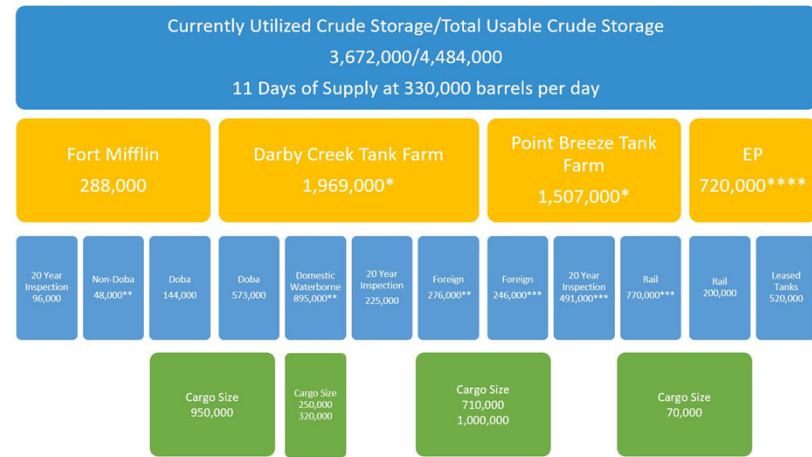


Timeline of Events

- Jan 2014 – October 2014
 - Crude by rail delays – During the first three quarters of 2014, crude by rail ran under plan by 6.5MMbbls, or 0.72MMbbls per month. Rail logistical constraints prevent ratable deliveries.
- March 2014 – May 2014
 - 868 Turnaround is extended for additional repairs. Crude rate is under plan
 - Additional purchases of foreign crude are made to offset the lack of crude by rail, increasing demurrage during April and May. The demurraged crude is quickly run off as rail delays persist.
- October 2014
 - Crude by rail volumes increase as larger volume crude train sets become prevalent.
 - Rail infrastructure improvements allow for shorter rail transit times.
 - The second crude manifold is placed in service.
 - The increase in crude by rail volume requires more tank space, as rail cars cannot logistically or economically be stored. Foreign tanks are switched to crude by rail service to compensate. A bottleneck develops in Point Breeze Tank Farm as a result.



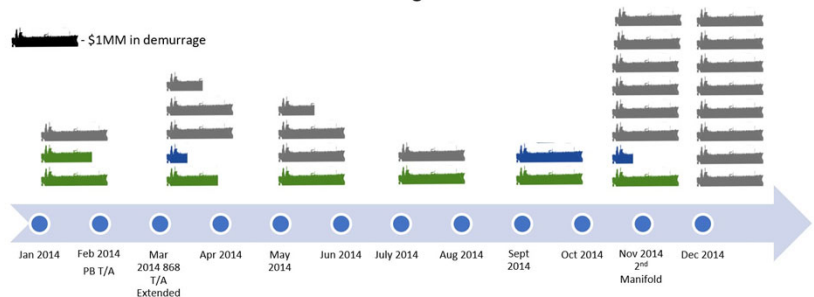
Current Crude Working Capacity (all volumes in bbls):
3,672,000 With an Additional 800,000 OOS for 20 Year Tank Inspection.



Ship Demurrage for 2014

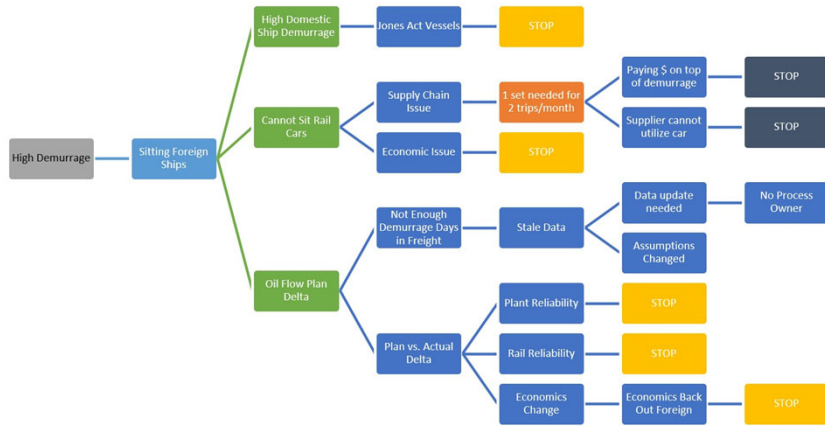
- **Foreign**
 - Foreign waterborne demurrage accounts for \$21MM and is a result of the following:
 - Poor refinery reliability and crude purchases based on projection modeling
 - Improved rail delivery and offloading
 - Increased use of foreign tanks for domestic rail and waterborne crude, and loss of tanks due to weather related damage and 20 year inspections
- **Doba**
 - Doba demurrage accounts for \$6.5MM and is a result of insufficient tankage in Darby Creek Tank Farm.
- **Domestic**
 - Domestic Waterborne accounts for \$1.5MM. Domestic waterborne demurrage duration is short, however the demurrage rates for utilizing Jones Act vessels are 6-12 times higher than foreign.

Cost of Demurrage in 2014



Analyze

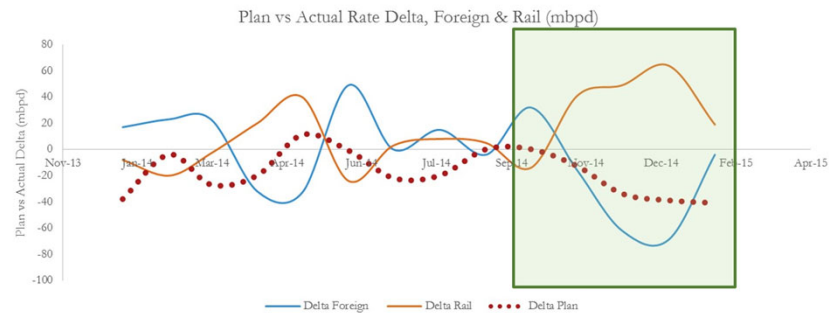
Causal Tree



Offsetting foreign ship demurrage with rail is infeasible because the rail is unable to store a comparable volume

Root Cause: Plant Reliability

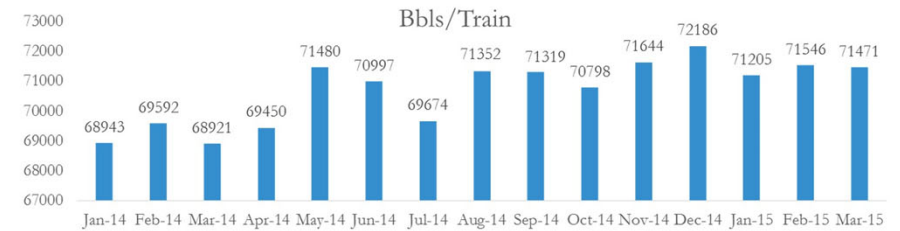
- Planned crude rates averaged 40 mbpd lower than actual crude rates between November 2014 and January 2015 due to a number of reliability outages at the plant.
- With higher than planned rail deliveries and lower crude processing rates, demurrage costs between November 2014 and January 2015 increased significantly above historical averages.



An increase in rail reliability and a decrease in plant reliability were the main drivers behind the special cause variation in waterborne demurrage.

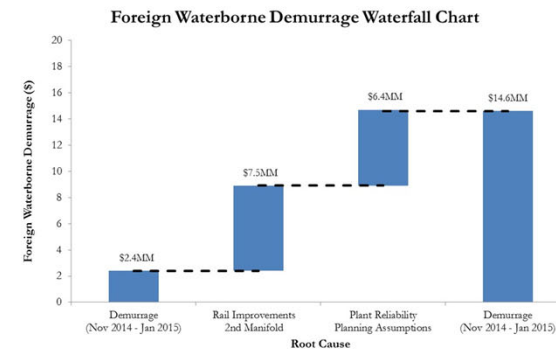
Root Cause: Crude by Rail Improvements

- Train size increased by 3.7% between January 2014 and February 2015
 - Larger capacity, purpose built train sets become more prevalent.
 - More "1232" type cars versus "111" type.
 - Shippers cycling sets only to PES.
- Transit times reduced by 18% between January 2014 and February 2015:
 - Railroad capital improvement projects completing early to mid Q4 2014.
 - Double track in Bakken Region.
 - 2nd interchange in Chicago.
 - North Yard Manifold 2 coming online.
 - Created makeup capacity.
 - Reduced surge effects.
 - Railroad employee hiring and training completed.
 - Milder winter than expected.



Financial Impact Breakdown

- Improved reliability of crude by rail deliveries from November 2014 through January 2015
 - Overruling Bakken backs out equivalent barrels of foreign crude, as rail cars cannot be demurraged.
 - This represents 3.0mmbbls of demurraged foreign crude.
- Poor refinery reliability
 - During the period of November 2014 through January 2015, the refinery ran 2.6mmbbls below plan as a result of the CO Boiler shutdown and planned maintenance at Point Breeze.

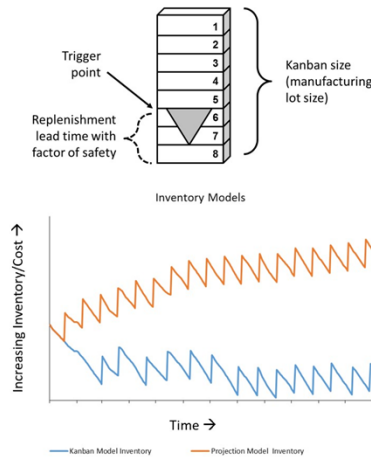


Improve

Creating a Better Inventory Management System



- Most inventory models are based on a projection model which assumes a churn rate for the existing inventory. Purchases are made to refill the inventories. The model has three limitations that effect the overall purchase accuracy:
 - The model does not account for natural variation that occurs within the system.
 - The objective function is to maximize inventory.
 - The model does not account for in-transit purchases as part of the inventory.
- A Kanban inventory model is utilized to evaluate the impact of special cause events to evaluate the overall purchase strategy.
 - Kanban inventory system refers to a scheduling system used for lean and just in time production.
- Kanban model benefits:
 - The Kanban model creates an upper limit to the amount of purchased inventory.
 - It prevents over purchasing.
 - The purchase point is based on replenishment lead time and safety stock.
 - This ensures proper inventory without investing extra money on unnecessary inventory.



Recommendations to Return 20 Year OOS Crude Tanks to Service



	Utilized Crude Storage - bbls	Kanban Model Benefit	Cycle Time Analysis Benefit
Baseline Demurrage		\$16,782,000	\$17,440,000
PB-886 (9/2014)	250,000	\$2,214,000	\$2,463,000
PB-885 (3/2015)	250,000	\$2,214,000	\$2,463,000
DC-35* (4/2015)	225,000	\$2,133,000	\$2,218,000
FM-856 (12/2014)	48,000	\$351,000	\$473,000
FM-855 (6/2015)	48,000	\$351,000	\$473,000
Baseline Contingency (15%)		\$2,517,300	\$2,616,000
New Baseline Demurrage		\$12,036,300	\$11,966,000
Savings		\$4,745,700	\$5,474,000

The team recommends accelerating the return to service time of tanks out of service for 20 year inspections.

Improve Inventory Valuation



- Current non-Doba foreign crude freight pricing assumes two days of demurrage, which was typical for pre-2014 operation without higher rates of domestic crude processing.
- Actual non-Doba foreign crude demurrage time varies depending on the rate of processing and cargo size and ranges from ten to thirty-four days.
 - Larger cargo size crudes (950 Mbbls+) incur more demurrage at the same processing rates as lower cargo size crudes (650 Mbbls+).
 - The additional demurrage time adds an incremental cost of \$35M/day (or roughly, \$0.70/bbl based on current average processing times and cargo sizes).
- Increasing the freight pricing to include the demurrage rate of ~\$0.70/bbl for non-Doba foreign crudes increases the LP-generated RRV value of all domestic crudes by that amount.
 - The values of foreign crudes with smaller cargo sizes (e.g. Hibernia and White Rose) also slightly increase relative to higher cargo size foreign crudes due to the lower demurrage times. All other foreign crude values stay roughly the same.

Ordered from Highest RRV at Current Pricing	RRV at Current Pricing	RRV at Pricing + Increased Freight	Delta (Higher Freight - Current)
Bakken	\$ 3.11	\$ 3.81	\$ 0.70
Canadian Sweet	\$ 1.67	\$ 2.37	\$ 0.70
Eagle Ford	\$ 1.40	\$ 2.15	\$ 0.75
WTI	\$ 0.85	\$ 1.64	\$ 0.79
Hibernia	\$ 0.49	\$ 0.63	\$ 0.14
White Rose	\$ 0.37	\$ 0.50	\$ 0.13
Escavos	\$ (0.19)	\$ (0.27)	\$ (0.08)
Azeri Ceyhan	\$ (0.31)	\$ (0.40)	\$ (0.09)
Saxi Blend	\$ (0.38)	\$ (0.45)	\$ (0.07)

Overall crude rankings do not change, but domestic and smaller cargo foreign crude values strengthen.

Learn



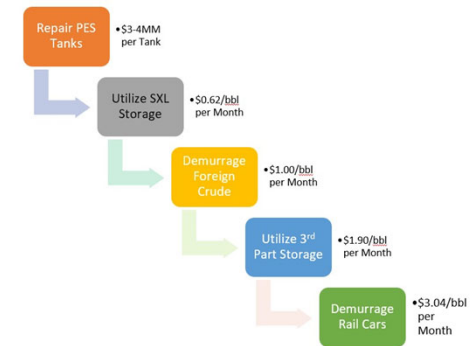
Recommendations

- Implementation of the Kanban type inventory system to current model.
 - Ensures total pipeline inventory and historical performance is considered in the crude purchasing process.
- Correct and maintain freight sheet data to current world market numbers.
 - Will ensure demurrage is properly considered against crudes during the valuation process.
- Improved management of domestic waterborne delivery timing.
 - Prevents overlapping deliveries which force disproportionate allocation of tanks for smaller cargoes.
- Align crude by rail supply with crude strategy.
 - Prevents the “backing out” effect of other crudes due to unexpected elevated rail delivery volumes.
- Increase available tank space, maximize utilization of PBTF, and protect the current in-service tanks.
 - Accelerate the return 20 year OOS tanks to service at PBTF, DCTF, & FTM.
 - Estimated benefit: \$4.8-5.5MM/Year
 - Install PBTF piping flexibility.
 - Install roofs on Bakken tanks to ensure availability during winter months.
- Creation of a continuous improvement team to investigate improvements to the 20 year OOS tank inspection process.
 - Eliminate multiple and long lead time tank outages.



Storage Options and Economics

- Repair PES Tanks/Improve tank field flexibility
 - Available Storage Volume 500Mbbbls
 - Cost to repair \$14MM for 4 tanks
- Utilize SXL Eagle Point
 - Available Storage Volume 550Mbbbls
 - \$0.62/bbl per Month
- Demurrage Foreign Crude
 - Variable Storage Volume
 - \$1.00/bbl per Month
- 3rd Party Storage – Storage and Transportation
 - Variable Storage Volume
 - \$1.90/bbl per Month (\$0.40/bbl storage + \$1.50/bbl transportation)
- 3rd Party Rail Storage
 - Limited to PES sets
 - \$3.04/bbl per Month



Monitoring and Control Plan

Monitor and Control Event	How	Distribution	Due Date
Tank OOS updates, piping & roof tank FEL	Follow up with FEL leaders	Crude Team	9/1, once/month
Evergreen Freight Data	Update freight data	NA	Once/week
Update Inventory Model	Incorporate Kanban into existing system	Crude Team	September 1/Ongoing
SXL Tank OOS repair costs	Follow up with SXL	Crude Team	9/1
Inventory Model Training	Training Session	Crude Analyst	9/1
Meetings	How	Distribution	Frequency
Review of inventory positions, coordinating all crude inventories and purchases.	Inventory forecast document.	Crude Team	Weekly
Crude Demurrage Team	Meeting		As needed

Summary

Summary

- In 2014, company paid \$30.1MM demurrage cost, an increase of \$14.6MM (94%) YOY. After a thorough analysis by our team of internal experts, it was determined that the main causes of this demurrage were:
 - Improvements in the crude by rail delivery system by BNSF, CSX, & PES, (2nd manifold).
 - Plant reliability.
 - Planning assumptions and inventory modeling strategy.
 - Tank allocation, flexibility, & availability.
- Based on the teams analysis, we expect baseline demurrage to be \$16.7MM-\$17.4MM/year*.
- The team recommends the following solutions to improve upon the baseline demurrage:
 - Implement a new inventory model to better adjust for reliability issues.
 - Correct freight data sheet used for planning assumptions.
 - Better specify delivery timing for domestic waterborne deliveries.
 - Align crude by rail supply with overall crude strategy.
 - Increase available tank space, maximize utilization of PBTF, and protect the current in-service tanks.
 - Return to service tanks OOS for 20 year inspections.
 - Install Point Breeze Tank Farm piping projects for improved flexibility & tank access.
 - Install roofs onto existing Bakken tanks.
 - Creation of a continuous improvement team to investigate improvements to the 20 year OOS tank inspection process.

Based on the [teams](#) analysis we expect baseline demurrage to be at \$15.2MM-\$17.4MM with additional opportunities for savings.

* Basis for demurrage calculation is \$27,000/day, the average demurrage rate in 2014. As market conditions change, so will the baseline cost of demurrage.

[Learn more](#)

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