Line 5 Discussion
U.P. Energy Task Force

Finlandia University, Hancock Michigan

September 20, 2019

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Agenda

1. Introduction (Peter Holran)
    - System Maps
2. System Overview (Marlon Samuel)
    - Mainline System Overview
    - System Overview: NGL
    - Line 5 Operation Overview
    - System Overview: Downstream of Superior to Sarnia
    - Pipeline Demand vs. Capacity
3. Line 5 System Design and Operations (Mike Moeller)
    - Line 5 Pipeline Design Considerations
    - Line 5 Station/Terminal Design Considerations
    - Line 5 NGL Only

Introduction

Peter Holran

Director, U.S. Government Affairs

Enbridge Pipelines

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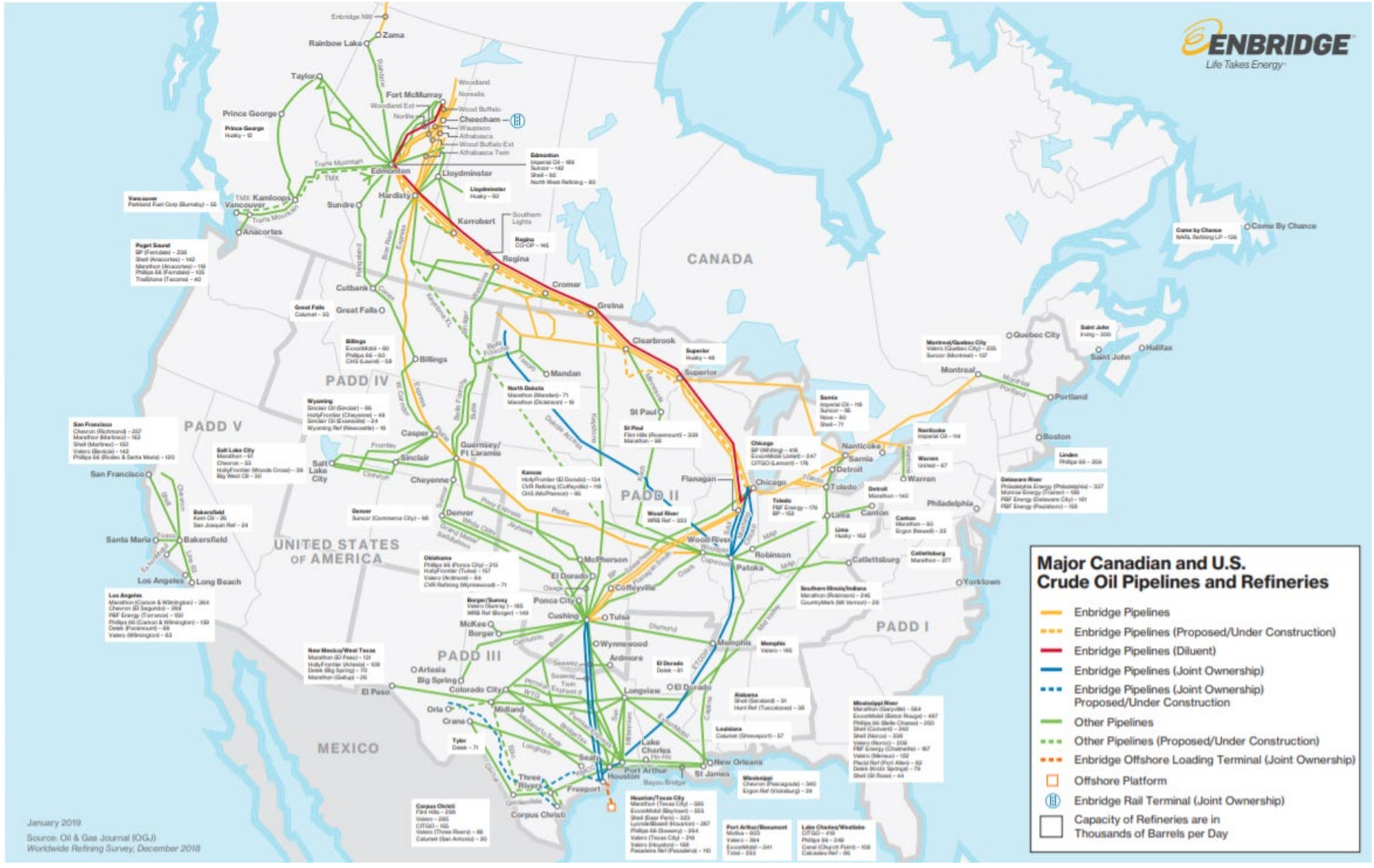
System Map

Major Canadian and U.S. Crude Oil Pipelines and Refineries



Fueling people's quality of life

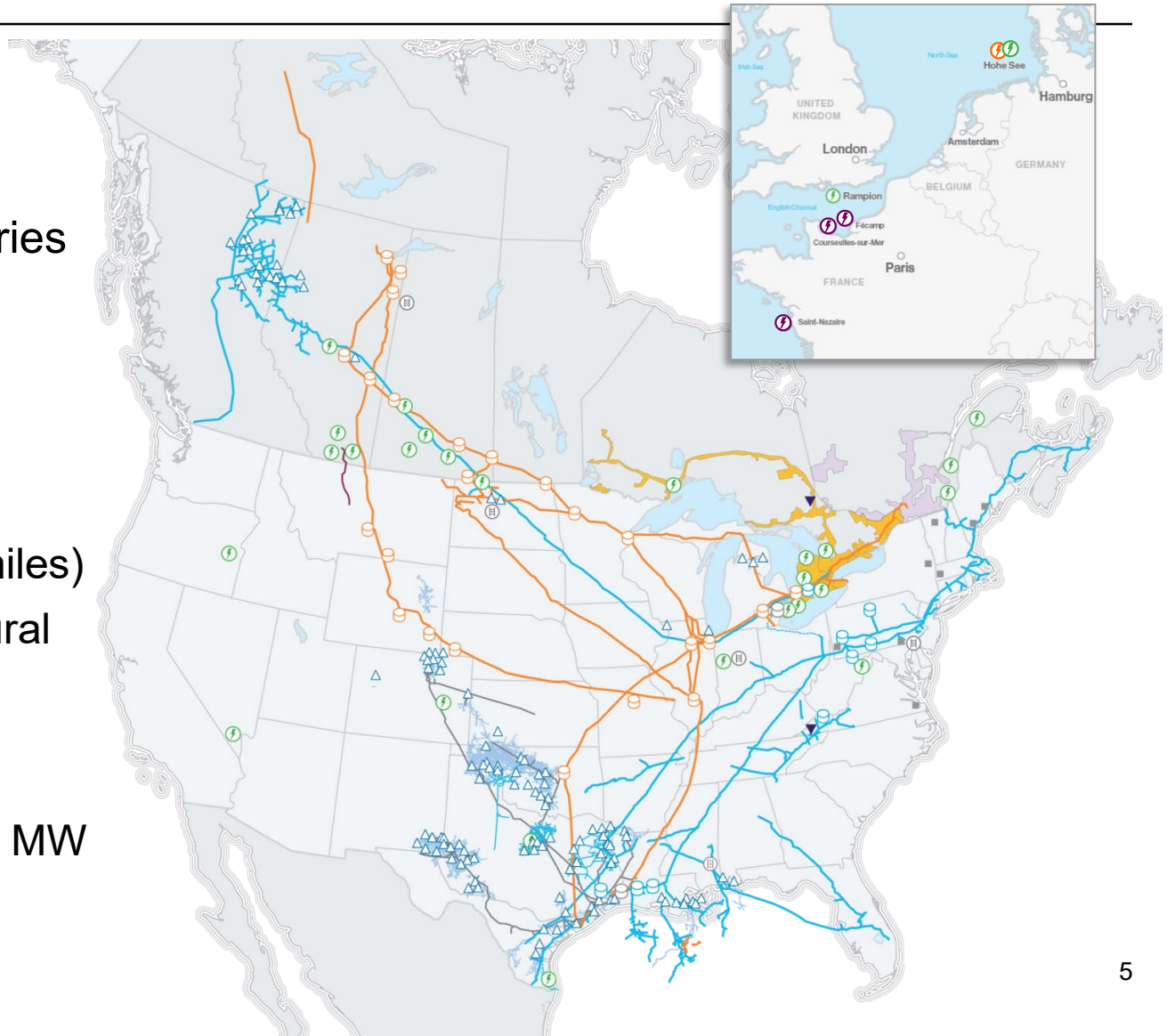
A Leading North American Energy Delivery Company

Global scale

- 12,700 employees
- Operations in 41 states, 8 provinces, 2 territories
- Headquartered in Calgary
- Hubs in Houston, Toronto, Superior/Duluth

Diversified energy assets:

- Liquids Pipelines 28% of NA crude oil (16,500 miles)
- Gas Transportation and Midstream: 20% of natural gas consumed in NA (34,500 miles)
- Gas Distribution: 3.7 million customers in 500+ communities
- Power & Transmission: Interests in nearly 1,700 MW renewable generation (net) @ 30 facilities



System Overview

Marlon Samuel
Director, Customer Service
Enbridge Pipelines

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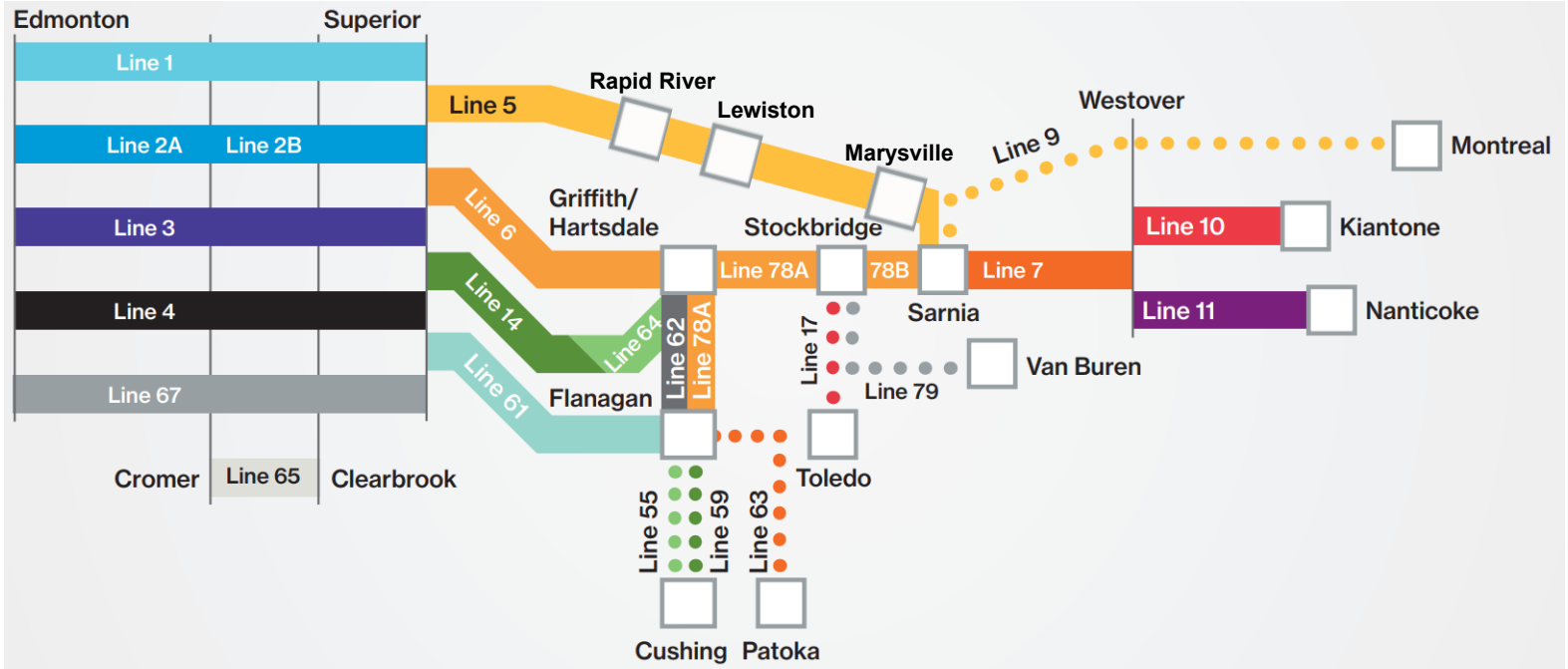
Enbridge System Overview



Line 1
37,600 m3/d (237 kbpd)
18"/20" – 1,767 km (1,098 mi)
- NGL
- Refined Products
- Light

Line 2A
70,300 m³/d (442 kbpd)
24" – 966 km (600 mi)
- Condensates
- Light

Line 2B
70,300 m³/d (442 kbpd)
24"/26" – 808 km (502 mi)
- Light

Line 3
62,000 m³/d (390 kbpd)
34" – 1,767 km (1,098 mi)
- Light

Line 4
126,500 m³/d (796 kbpd)
36"/48" – 1,770 km (1,100 mi)
- Heavy
- Medium (Ex-Clearbrook)
- Light (Ex-Clearbrook)

Line 5
85,900 m³/d (540 kbpd)
30" – 1,038 km (645 mi)
- NGL
- Light

Line 6
106,000 m³/d (667 kbpd)
34" – 748 km (465 mi)
- Light
- Medium
- Heavy

Line 7
28,600 m³/d (180 kbpd)
20" – 193 km (120 mi)
- Light
- Medium
- Heavy

Line 78A
90,600 m³/d (570 kbpd)
36" – 425 km (264 mi)
- Light
- Medium
- Heavy

Line 78B
79,500 m³/d (500 kbpd)
30"/36" – 175 km (109 mi)
- Light
- Medium
- Heavy

Line 65
29,500 m³/d (186 kbpd)
20" – 504 km (313 mi)
- Light
- Medium

Line 10
11,800 m³/d (74 kbpd)
12"/20" – 143 km (89 mi)
- Light
- Medium
- Heavy

Line 11
18,600 m³/d (117 kbpd)
16"/20" – 76 km (47 mi)
- Light
- Medium
- Heavy

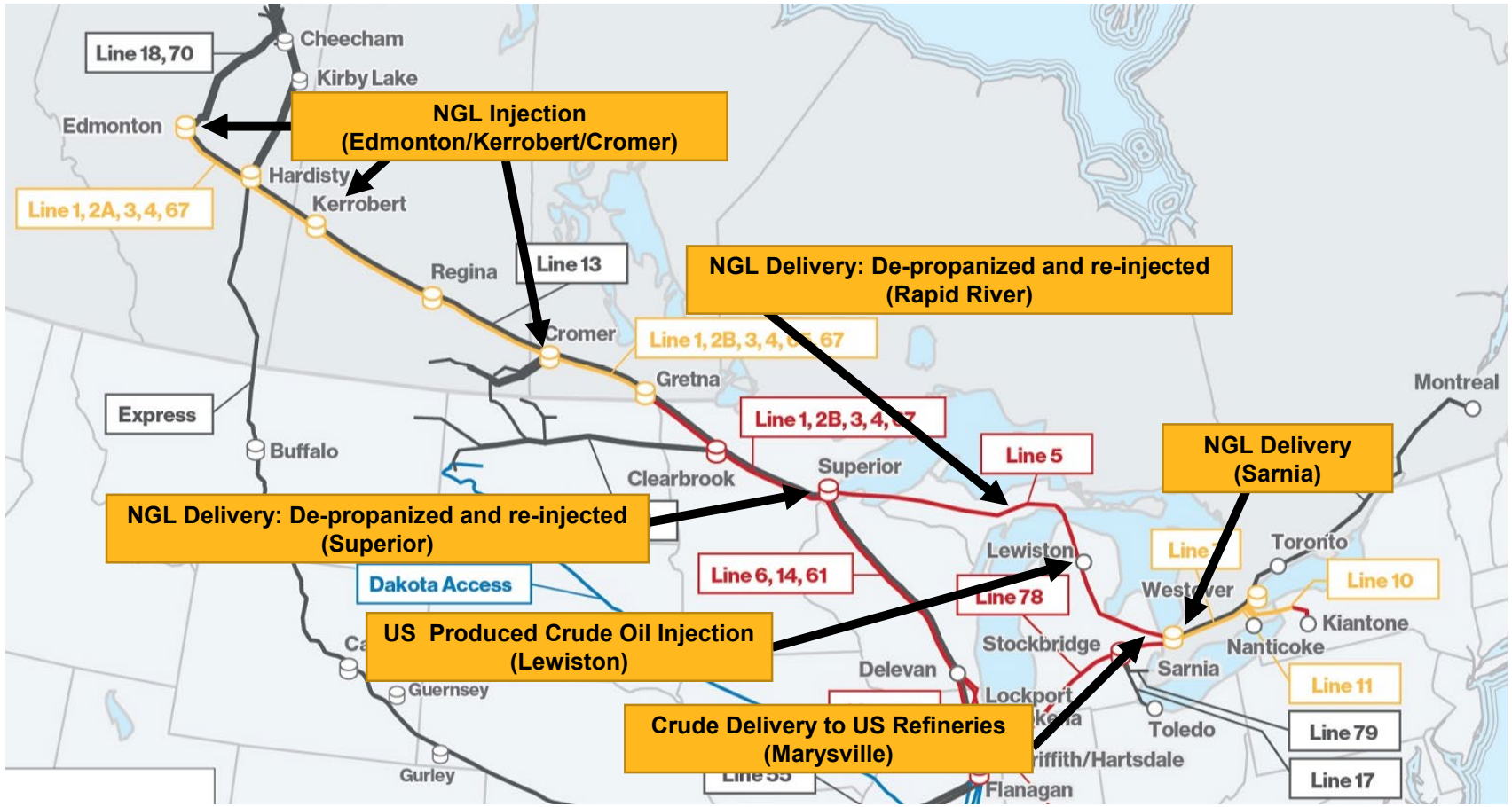
Line 62
37,400 m³/d (235 kbpd)
22" – 121 km (75 mi)
- Heavy

Line 14/64
54,600 m³/d (343 kbpd)
24" – 784 km (487 mi)
- Light
- Medium

Line 61
151,700 m³/d (954 kbpd)
42" – 744 km (462 mi)
- Light
- Medium
- Heavy

Line 67
127,200 m³/d (800 kbpd)
36" – 1,790 km (1,112 mi)
- Heavy

Enbridge System Overview - NGL



Line 1 and Line 5 designed specifically for transportation of NGL:

NGL received at:

- Edmonton
- Kerrobert
- Cromer

NGL delivered to:

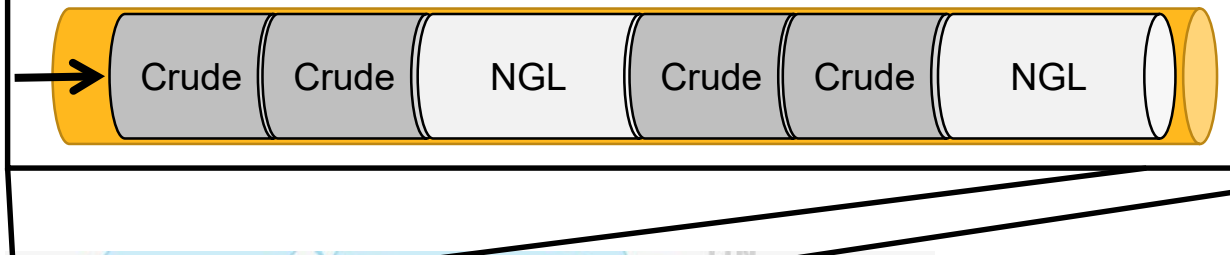
- Superior
- Rapid River
- Sarnia

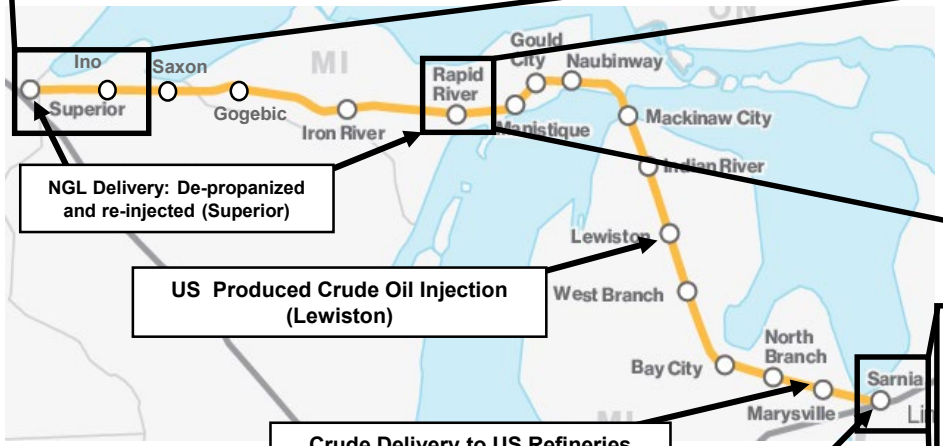
NGL: Natural Gas Liquids that contain the following:

- Propane
- Natural gasoline (pentanes)
- Butane
- Ethane

Line 5 Operation Overview

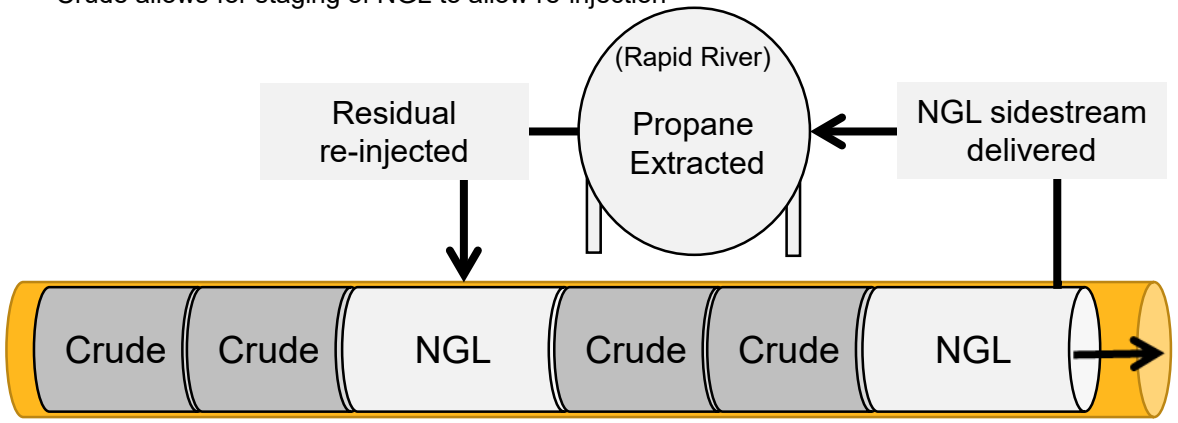
Superior: NGL/Crude injected in batches specific to quality and delivery needs



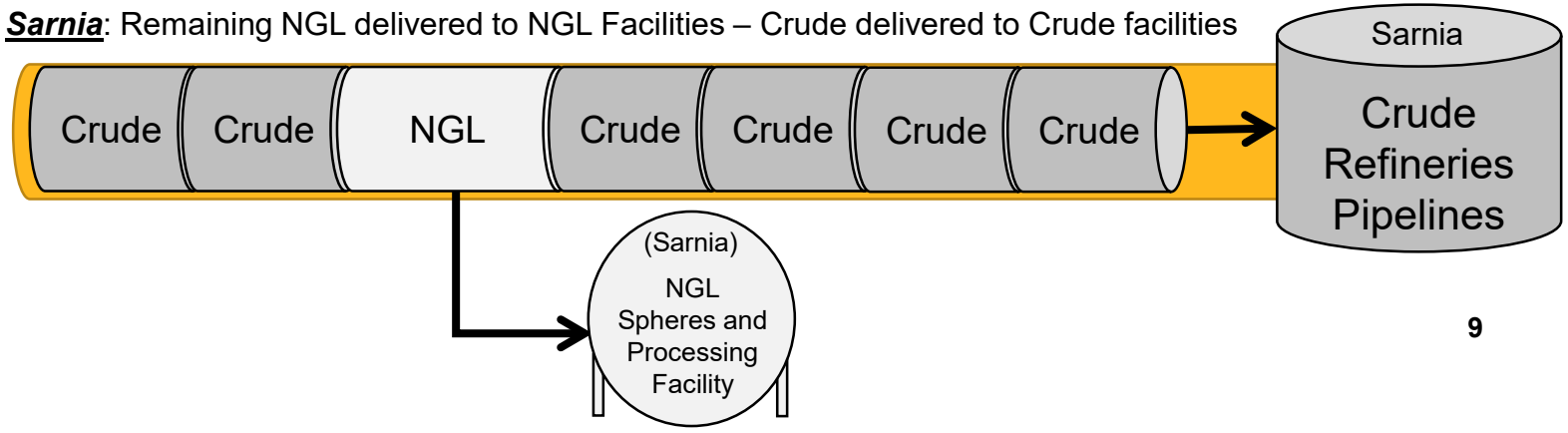


Rapid River: NGL sidestream delivered to Rapid River:

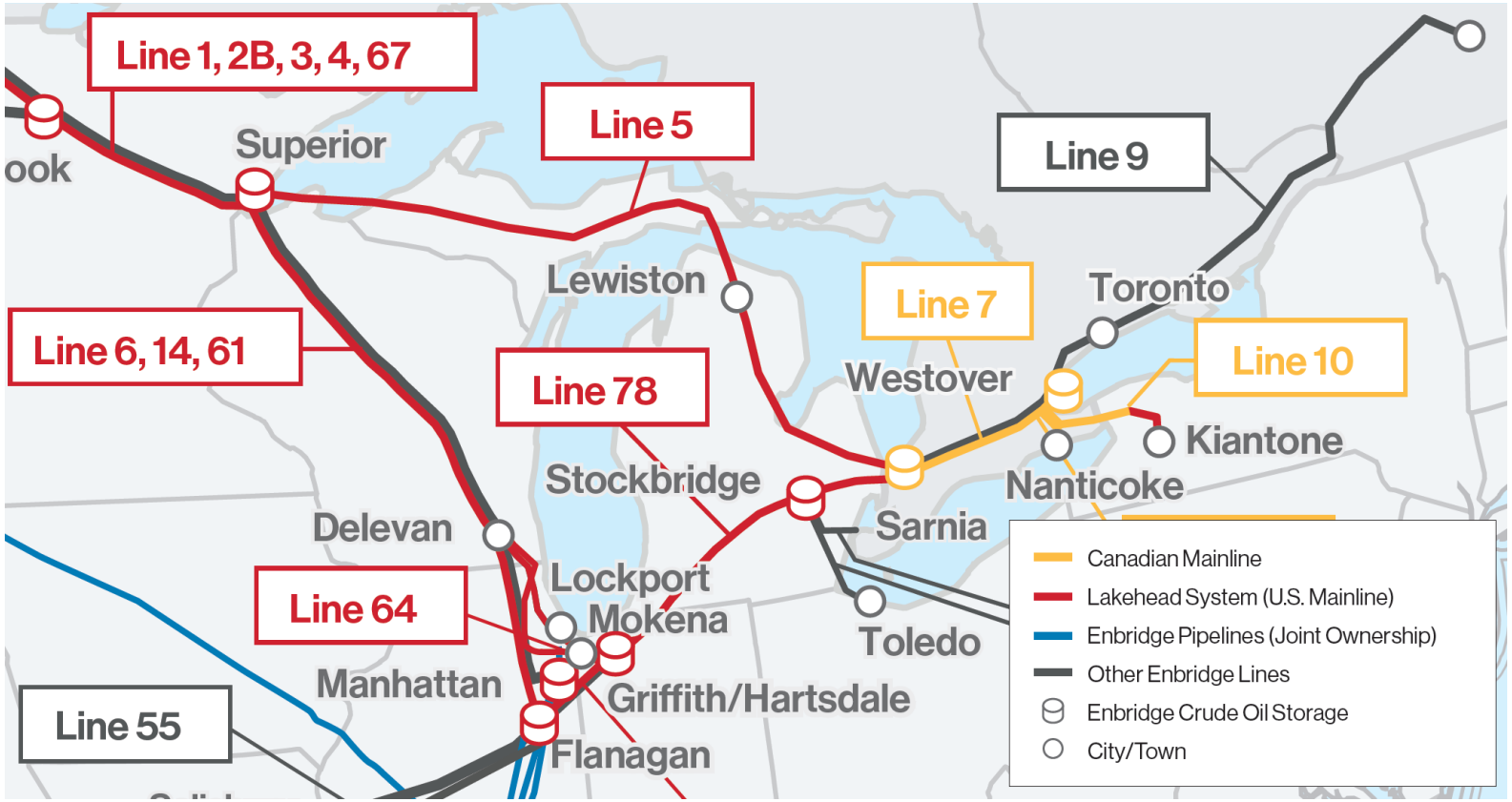
- Safely delivers product at a reduced rate of Line 5 flowrate
- Allows for timing of Propane to be stripped out and remaining product re-injected
- 70% of product delivered to Rapid River remains as propane, 30% re-injected into Line 5
- Crude allows for staging of NGL to allow re-injection



Sarnia: Remaining NGL delivered to NGL Facilities – Crude delivered to Crude facilities



Enbridge System Overview – Superior to Sarnia



Superior to Sarnia Summary:

North Route: Line 5

- Transports NGL and Light crude
- ***Specifically designed for NGL/Light crude mix***

South Routes: Lines 6/14/61/78

- Lines 6/14/61 inject from Superior, WI with full breakout locations at Griffith, IN and Flanagan, IL
- Line 78 injects at Flanagan, IL and Griffith, IL with full breakout locations at Stockbridge and Sarnia
- ***No NGL storage or transport ability on any south routes***

Pipeline Demand vs. Capacity

Demand on Enbridge pipelines (approximate)

Line	Kbpd	US gallons per day
Line 5 (including NGL)	500	21,000,000
Line 78	470	19,740,000
Total	**970**	**40,740,000**

Capacity of Enbridge pipelines

Line	Kbpd	US gallons per day
Line 5	540	22,680,000
Line 78	570	23,940,000
Line 78 (ex-Stockbridge)	500	21,084,000

- Current approximate demand on Line 5 and Line 78 totals approximately 970 Kbpd (including NGL).
- Current approximate capacity of Line 78 is respectively, 570 Kbpd and 500 Kbpd.
- The demand currently being filled via Line 5 will shift and compete for space on Line 78.
- If Line 5 were shut down, assuming current demand and line capacities, the demand for Line 78 would exceed capacity by 19,656,000 US gallons per day to refineries in Michigan, Ohio, Pennsylvania, Ontario and Quebec.
- Based on 2017 EIA data, Michigan consumption of petroleum products (excluding gas liquids and olefins) is 435.5 Kbpd, Michigan refining capacity as of January 1st 2019, is 140 Kbpd. This highlights Michigan's reliance on interstate supply of refined products to meet demand.
- Under the federally regulated rules and regulations, all shippers will be treated equally.

Line 5 System Design and Operations

Mike Moeller
Director, Great Lake Region
Enbridge Pipelines

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Line 5 Pipeline Design Considerations

Operational Requirements

- Station placement based on hydraulics
- Pumps specified to safely operate on their curve
- Software (gaskets/seals) on valves and equipment based on product served
- Full rate vs side stream deliveries; facility modifications required to facilitate

Hydraulic modeling and design of Line 5 is specific to NGL and crude mix:

- Safe operating limits of Line 5 require both products in specific quantities and line-ups
- Traps placed to allow ILI runs of various technologies

Line 5 Station/Terminal Design Considerations

Pipelines that transport NGL require terminal specific equipment:

- Facilities specific to safely contain NGL located in terminals at Superior, Rapid River and Sarnia

Stations that operate with NGL require:

- Three-sided shelters
- Tandem pump seals
- Flare pits
- Seals on equipment are sensitive to product shipped

Line 5 NGL Only - Operating Considerations

Could Line 5 operate with only NGL?

- No, Line 5 is currently designed for a mix of crude and NGL

Line 5 is a “Steady State Operation” pipeline

- It is designed, operated and maintained to minimize frequency of start/stops and flow rate changes in order to maximize reliability

Why steady state matters

- Utility power supply and infrastructure designed to match steady state operation
  - Steady State avoids excessive fatigue of pipeline steel
  - Frequent starts and stops wears motors, pumps, seals and other equipment
  - Dead headed line = Storage tank; 1.2 MMBBLS

Line 5 NGL Only – Maintenance Considerations

Line 5's operation and maintenance program was designed considering both NGL and crude properties:

The importance of a crude and NGL lineup on Line 5:

- Minimum flow requirements of pumps avoid vibration and other abnormal operating conditions
- Maintenance more difficult with start/stop operation or without crude
  - ILI tool runs would require numerous traps to be added due to battery life constraints. Tool runs ensure safety of pipeline and closely monitor pipeline for:
    - Defamations
    - Cracks
    - Corrosion
  - Very large purges for maintenance on pipe
    - Flare NGL or require storage
    - Welding/Tapping on empty pipe or when NGL in pipe is not preferred