

# Trans Alaska Pipeline System Low Flow Overview

October 2017



# TAPS Overview

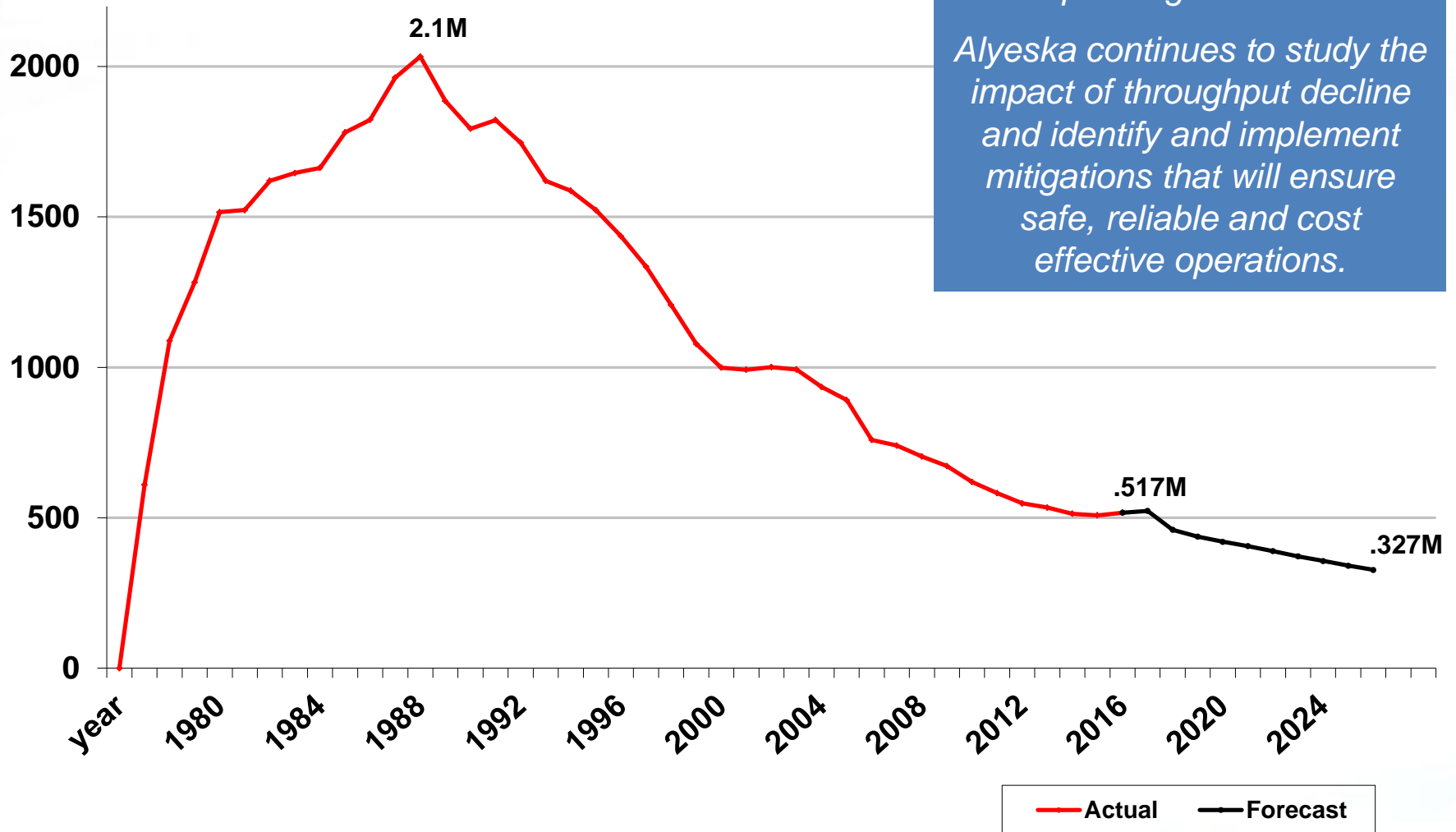
- Alyeska Pipeline Service Company was formed in 1970 to design, construct, operate and maintain the Trans Alaska Pipeline System (TAPS). TAPS began operations in 1977.
- TAPS basics
  - 48-inch diameter carbon steel
  - 800 miles long
    - 420 miles above ground
    - 380 miles below ground
  - 178 mainline valves
  - 78,000 vertical support members
  - Includes Valdez Marine Terminal and Ship Escort/Response Vessel System



# TAPS Throughput (MBD)

*Throughput has declined since peaking in 1988.*

*Alyeska continues to study the impact of throughput decline and identify and implement mitigations that will ensure safe, reliable and cost effective operations.*



Forecast figures: State of Alaska DOR, Spring 2017 Revenue Sources Book  
Actual figures are calendar year; forecast figures are State of Alaska fiscal year

# What is “Low Flow”?

*“Low Flow” refers to slower oil flow through the pipeline.*

- TAPS was designed to move warm crude oil in an Arctic environment.
- As throughput declines, so does the rate at which crude oil flows through TAPS to Valdez.
  - 4.5 day transit time in 1988
  - 18 day transit time in 2016
- Slower flow rates may allow oil and water to separate during transit.
- Oil cools during longer transit times.
- Cooling may lead to potential ice formation and wax accumulation.



# Water and Wax

## *Water and ice issues*

- The small volume of water transported through TAPS becomes increasingly problematic as throughput declines.
  - At low velocities, water separates and may create a corrosive environment.
  - Settled water, in conjunction with wax deposition on the pipe wall, increases concern about internal corrosion.
  - During cold weather shutdowns, water can accumulate, freeze and cause problems when flow resumes.
  - During extreme winter operations, without added heat, ice may form in flowing conditions.

## *Wax issues*

- The volume of crude oil solids, or wax, that forms in the oil increases at lower oil temperatures.
- Low crude oil velocity in the pipeline allows wax to settle.
- More frequent use of scraper pigs may be required to manage wax.



# Low Flow Research and Study

*A dedicated team of experts continues to evaluate low throughput challenges and mitigations.*

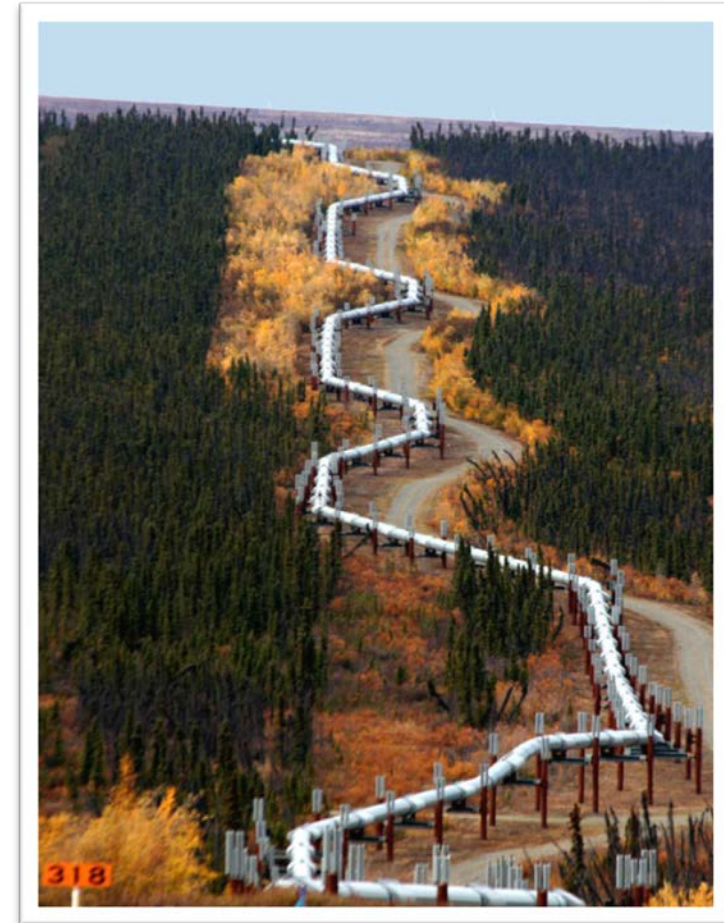
- Recent study work included testing in laboratories and flow loops in Sarnia, Ontario, and University of Tulsa, Oklahoma.
- Research and field testing, including the following, is ongoing.
  - High definition magnifying video cameras inside TAPS to collect data to determine settlement and re-entrainment velocities of wax and water
  - Wax settlement & deposition testing
  - Freeze suppressant testing
  - Pigging technology R&D



High-definition video camera at PS09

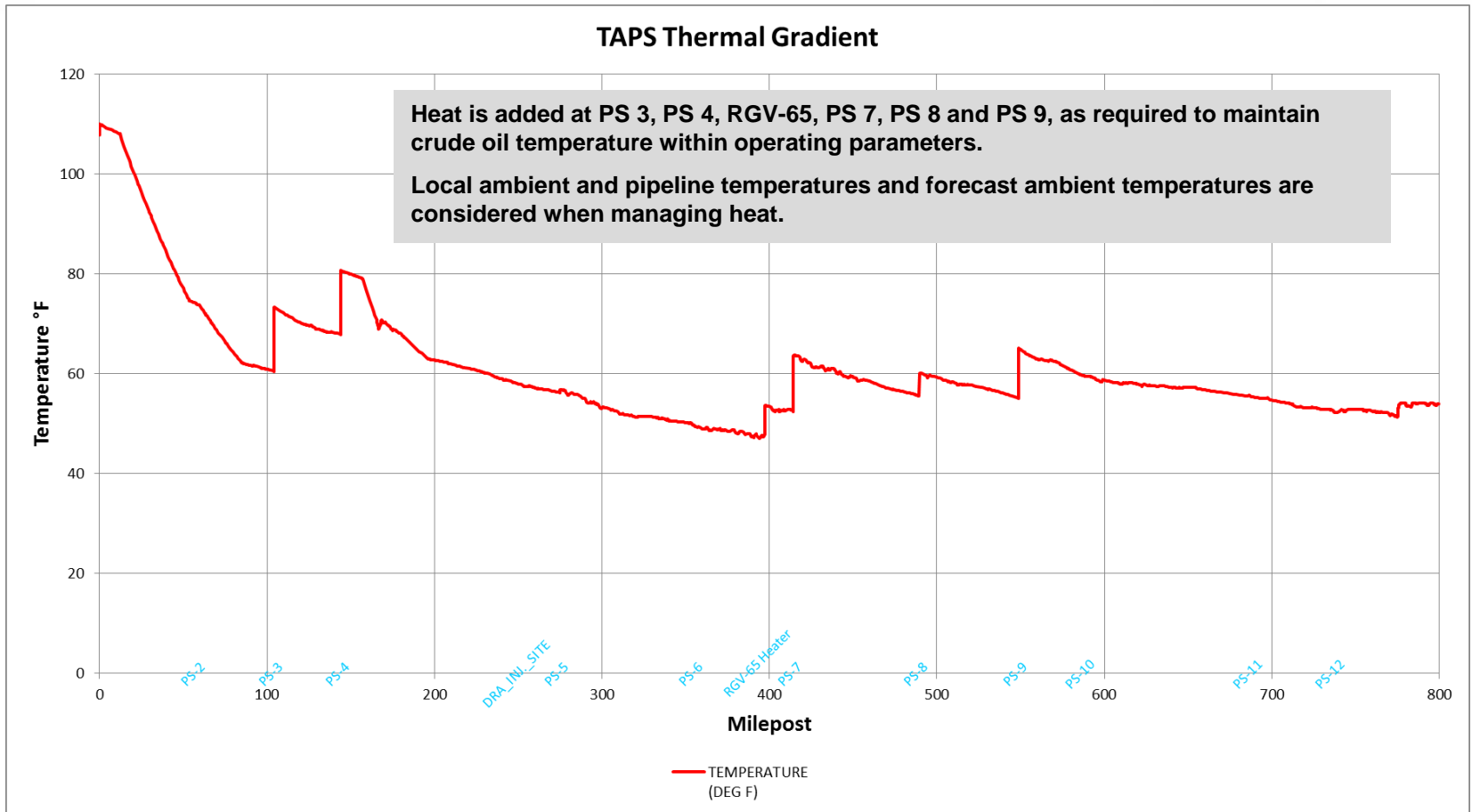
# Mitigation Strategies

- Minimize the risk of ice formation.
  - Add heat at key locations
  - Plan for contingency use of freeze point depressants
- Reduce the risk of internal corrosion.
  - Consider extending the use of corrosion inhibitors to the mainline
  - Continue pigging regime and adjust as needed
- Manage wax deposition.
  - Evaluate pigging technologies
  - Install additional pig launchers and receivers
  - Monitor wax and crude oil solids



# Temperature Monitoring

*Crude oil temperature is monitored to determine the need for mitigations, such as additional heat.*





# Additional Heat

- Cold crude oil temperatures on TAPS require added heat to keep the oil above minimum operating temperatures.
- Crude oil can be recirculated at Pump Stations 3, 4, 7 and 9 to add frictional heat.
- Supplemental skid mounted, mobile heaters are available at two locations.

*Slip Stream Heat Operation*



# Wax Management

- Alyeska regularly runs scraper pigs to manage wax and water accumulation.
- Research and monitoring inform frequency and pig configuration.
- Pig launcher / receiver facilities are located at Pump Stations 1, 4 and 9 and the Valdez Marine Terminal.



# How Low Can TAPS Operate?

- Earlier low flow research examined TAPS operational issues at flow rates above 300 MBD.
  - Based on ongoing research, it is believed that TAPS can safely operate between 300 and 350 MBD with appropriate, identified mitigations.
  - We have developed plans that will help mitigate the operational challenges that occur as throughput declines to the 300 MBD range.
  - Research continues regarding operational issues at rates lower than 300 MBD.
- A dedicated low flow team is evaluating new technologies, alternative operating modes and the feasibility of chemical additives to extend the life of TAPS to lower throughput rates.



# The Simple Solution: More Oil

- Arctic oil resources are abundant
- The simplest solution to TAPS' technical challenges is to increase throughput
- More oil in TAPS is possible with
  - Access to resources
  - Streamlined permitting
  - Reasonable regulations
  - Favorable fiscal climate

