Oil and Gas Production Forecasting

Presentation to the Senate Finance Committee February 16, 2010 Alaska Department of Revenue

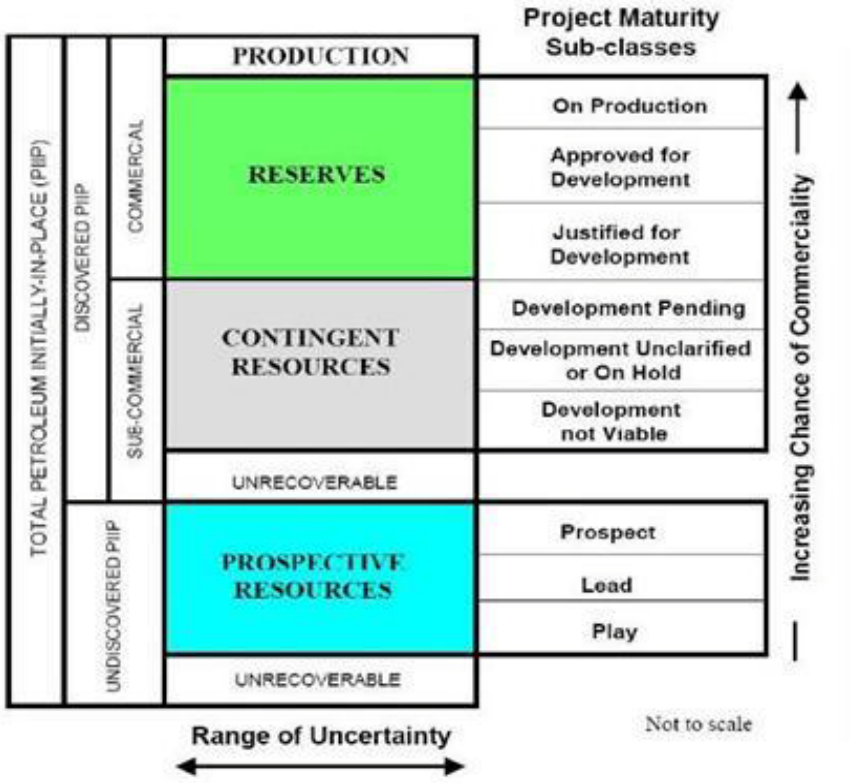
Jennifer Duval
Petroleum Economist

Frank Molli, P.E.
President, Molli Computer Services Inc.

Outline for Presentation

- **What do we forecast and why?**
- **Factors that affect forecast**
- **Review of Alaska North Slope production profiles**
- **Fall 2009 forecast methodology**
  - **Decline Curve Analysis**
  - **Demonstration**

What Do We Forecast? Reserves vs. Resources



http://www.spe.org/spe-site/spe/spe/industry/reserves/

Three Categories of Forecasted Production

1) Currently Producing- Includes base production and enhanced recovery production from investment in rate enhancing activities (perforations, stimulations, well workovers, gas and water injection support).
2) Currently under Development- New projects that are currently funded or awaiting project sanction in near future.

Three Categories of Forecasted Production

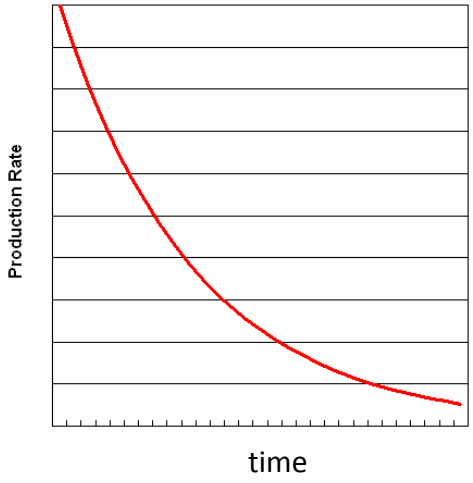
3) <u>Currently Under Evaluation</u>- Includes technically viable projects in the "pencil sharpening" stage where engineering, cost, risk and reward are being actively evaluated. Unfunded but are considered to have a high chance of being brought to fruition.

Factors That Affect Production Forecasting

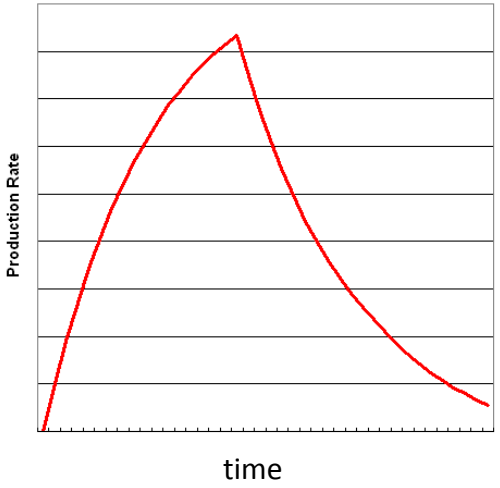
1. **GEOLOGY**
   - Rock type and formation characteristics
   - Depth, thickness, pressure
   - Oil & gas characteristics (oil gravity, viscosity, water content, etc.)
2. **DEVELOPMENT PLAN**
   - Well density and development rate
   - Well bore size and completion technique
   - Artificial lift and enhanced oil recovery
   - Facilities & surface operations
3. **COMMERCIAL**
   - Project economics
   - Oil price and market conditions
   - Government Policy: access, regulation, taxation
4. **PRODUCTION PROFILE**
   - History, stage of depletion
   - Use production profile to extrapolate trends
5. **TIMING!**

Typical Production Profile

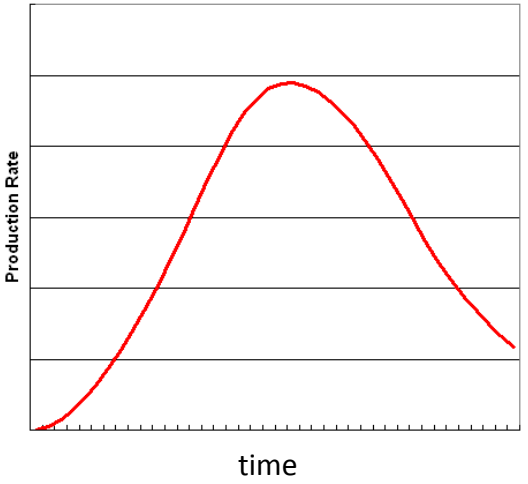
OIL WELL



OIL FIELD



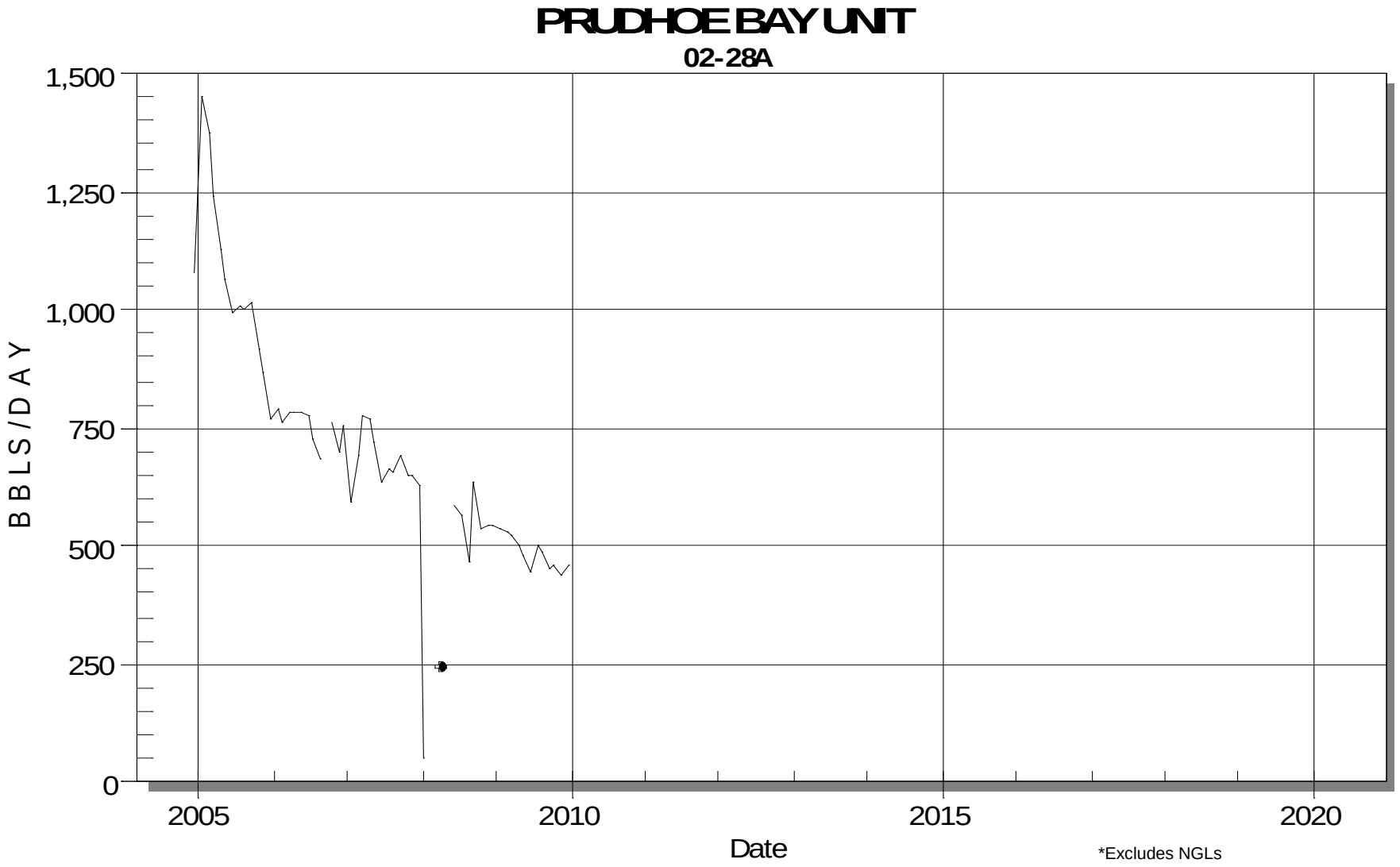
MULTIPLE FIELDS/BASIN



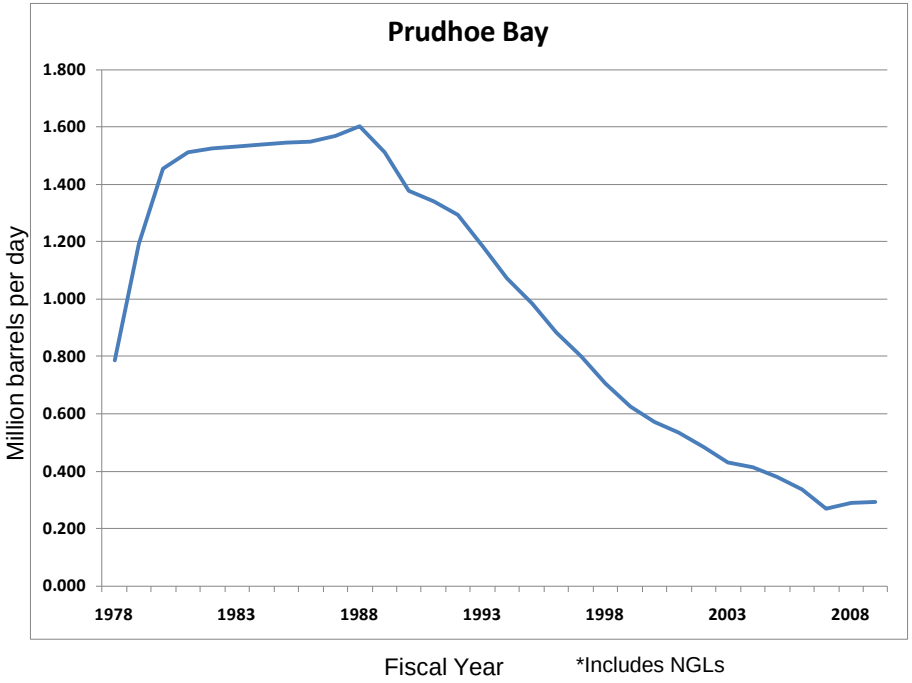
Production increases at first, reaches a peak, then declines. The decline rate typically levels off in later years.

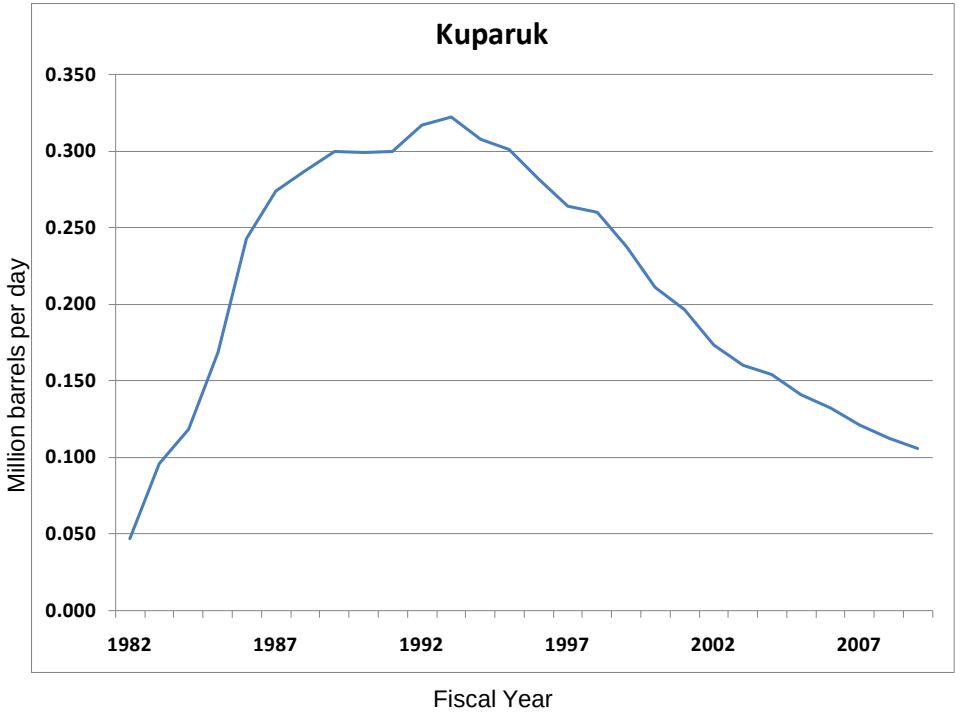
The field's geology, operator's development plan, and commercial factors, all influence the shape of the curve.

Production Profile of a Prudhoe Well

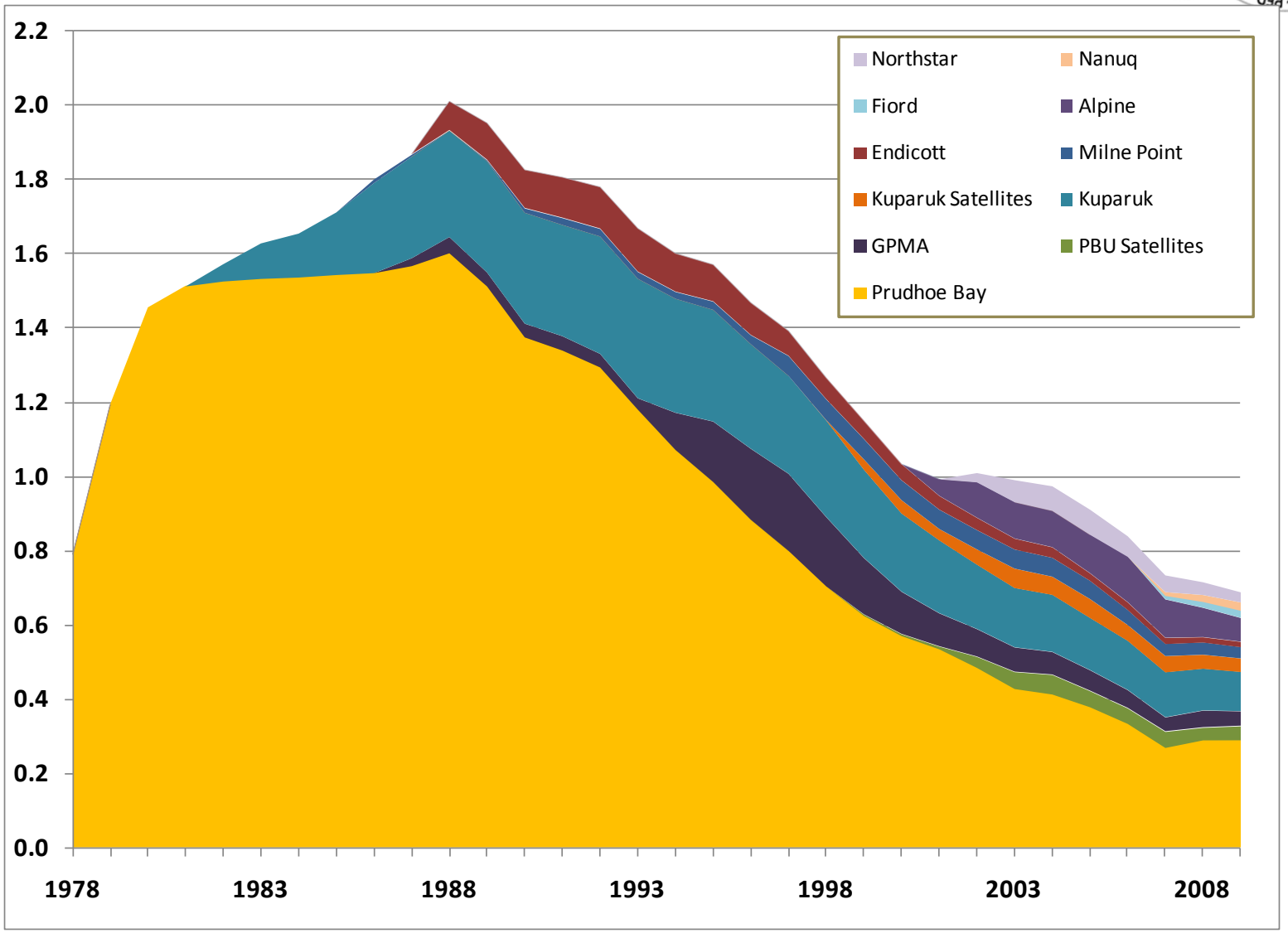


Production Profile at Field Level: Prudhoe & Kuparuk





Alaska North Slope History



*Includes NGLs

North Slope Production Decline

FY 1988: production peak → 2.01 million barrels per day (bpd).

FY 2009: production → 693,000 bpd, a 66% decline since peak.

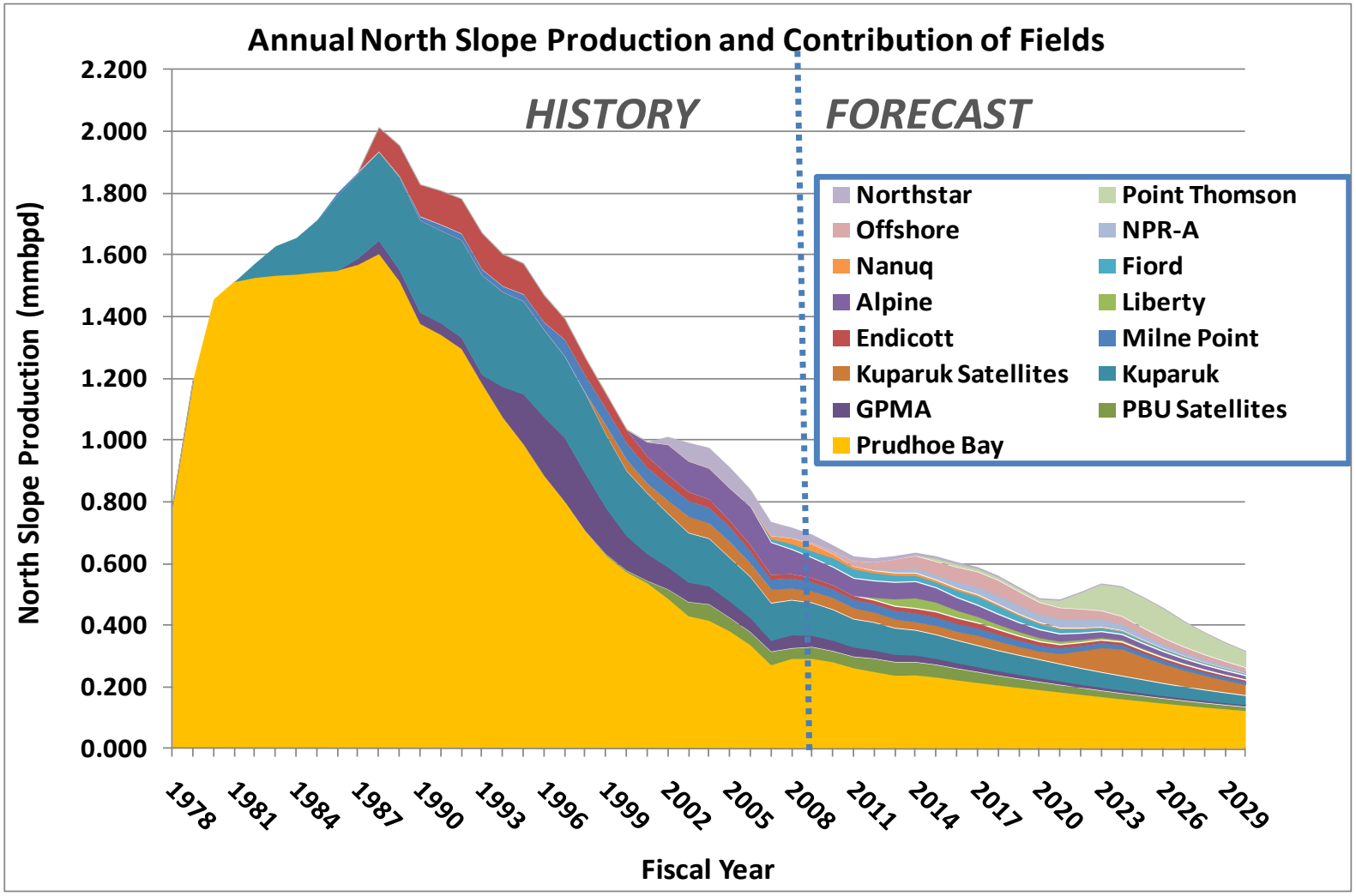
FY 1988 to date: production decline rate → 4.9% per year, on average.

Over the last 10 years, production decline rate = 4.8% per year, on average.

***Excluding 2007, 4.0% decline on average**

We expect the decline rate to flatten out to 3.6% per year, on average, through FY 2030.

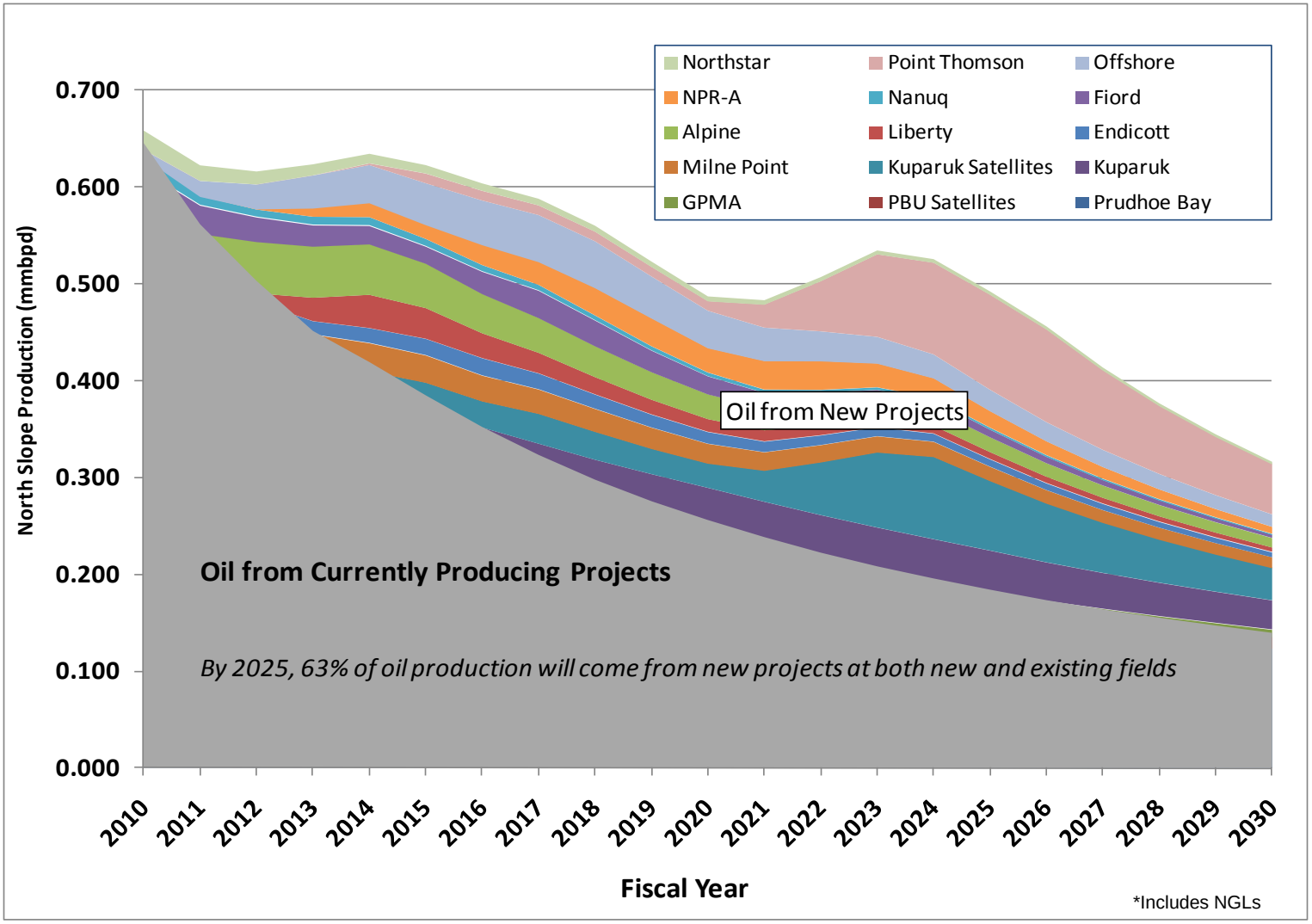
ANS Production History & Forecast



*Includes NGLs

Source: Fall 2009 Revenue Sources Book

Forecasted ANS Production FY 2010 - 2030



Source: Fall 2009 Revenue Sources Book

Timing is Important!

DOR's FY 2010 forecasted total NS production:

Spring 1989- <u>104,000 bpd</u>

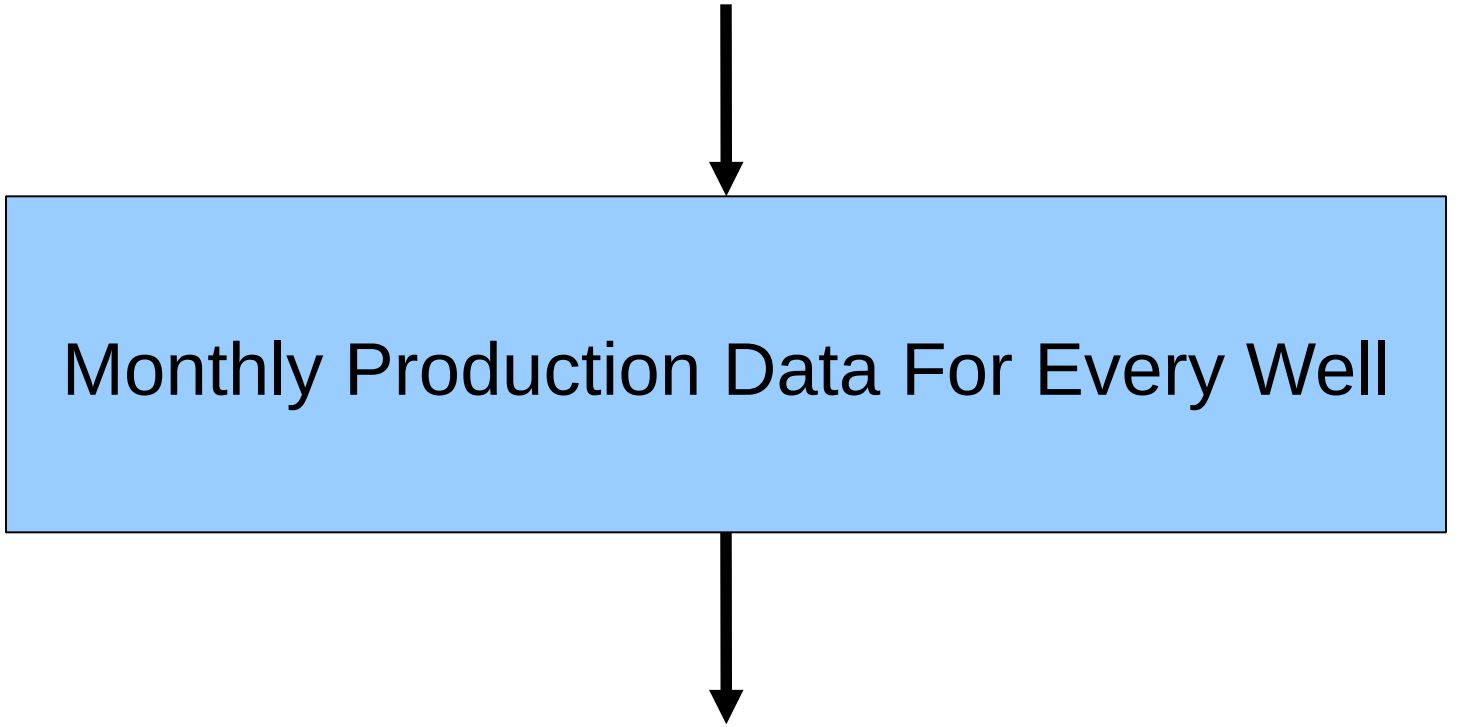
Spring 1994- <u>583,000 bpd</u>

Fall 2009- <u>659,000 bpd</u>

Plans of Development and discussions with the operators help us forecast the timing.

***However, operators are not bound to what they provide to us. Budgets can change; partners may not approve projects.**

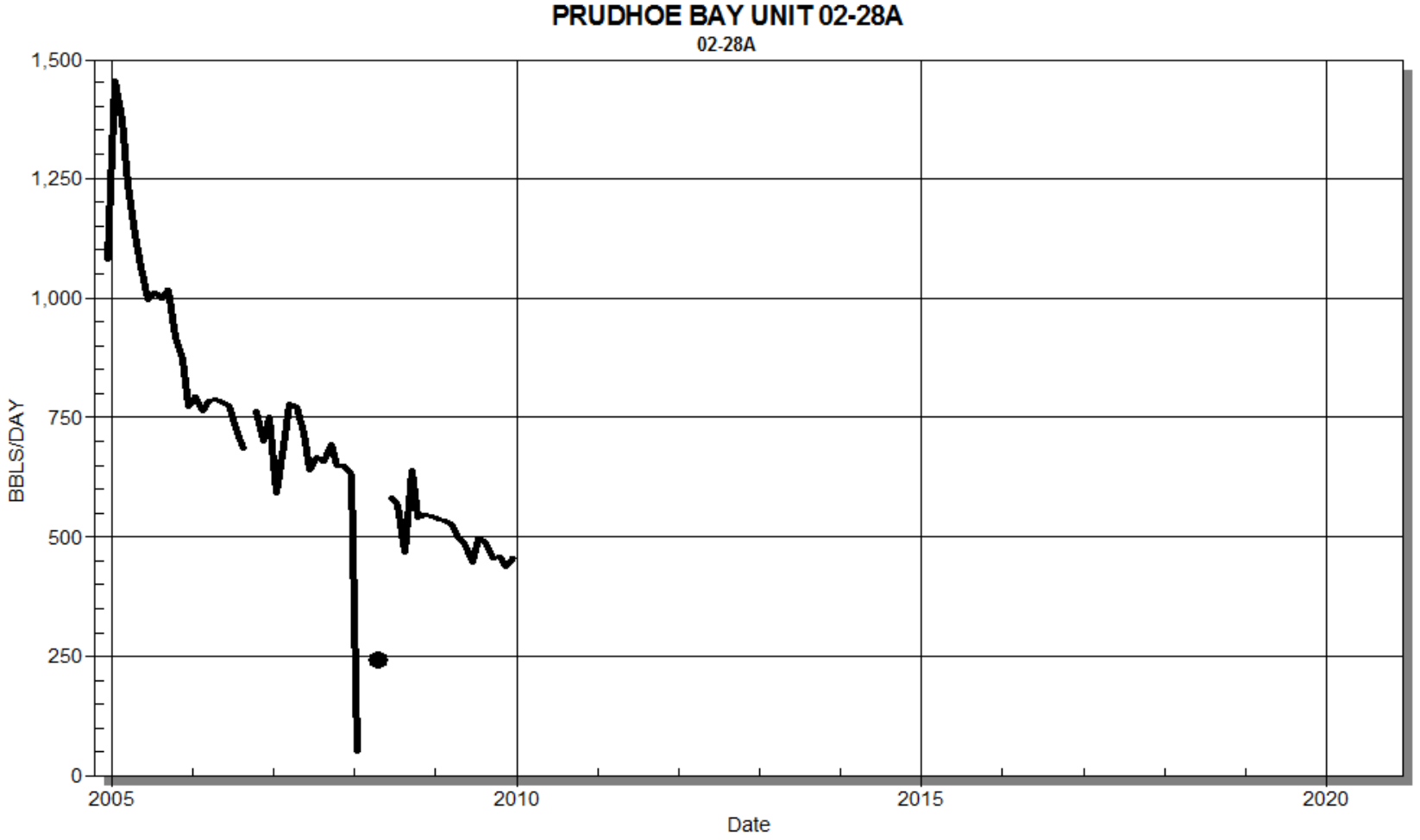
AOGCC



Decline Curve

What is a decline curve?

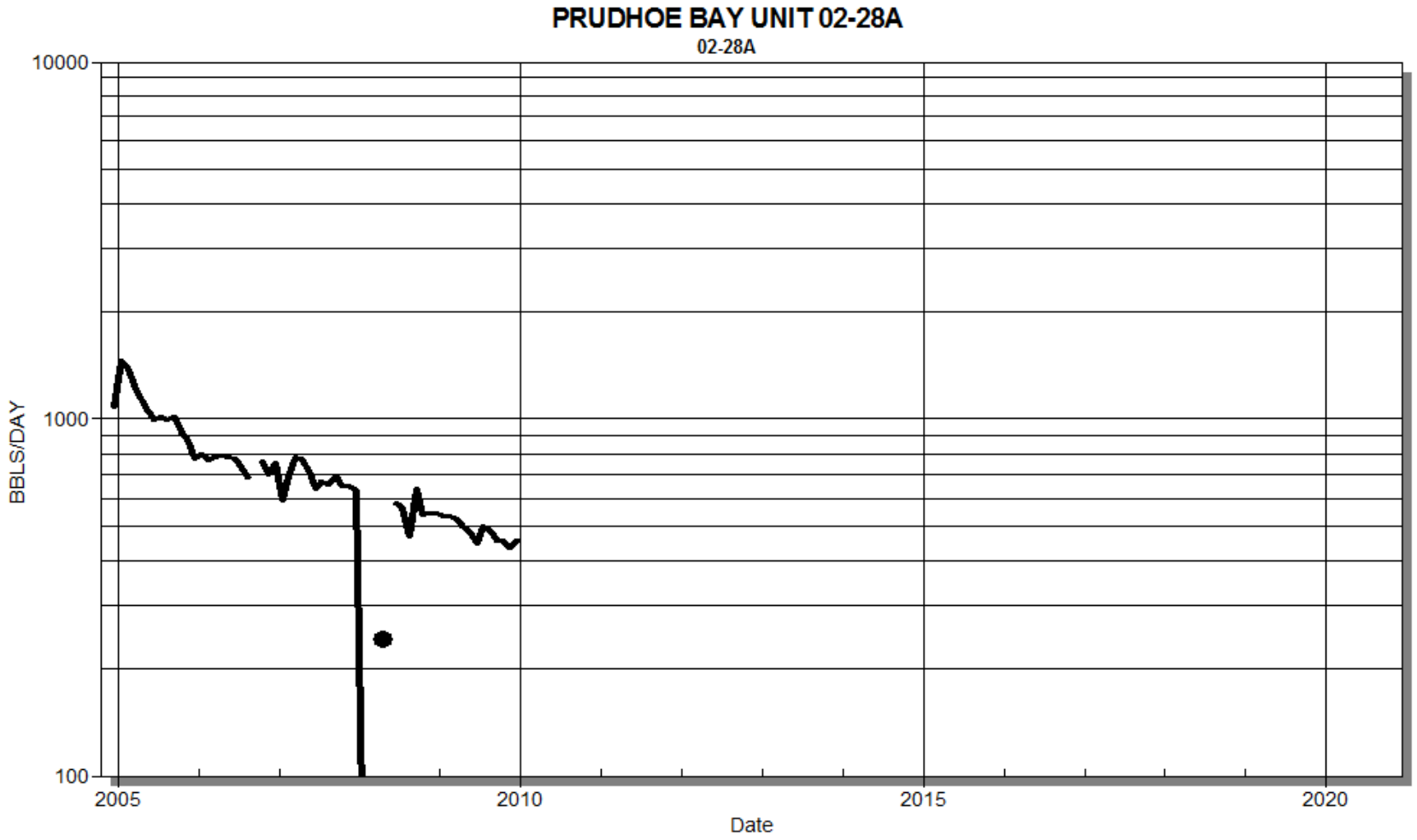
Data Plotted On A Linear Scale



Operator: BP EXPLORATION (ALASKA) INC
Field: 640150 PRUDHOE BAY
Reservoir: PRUDHOE OIL

Cum Oil [bbls]: 1,122,583
Cum Gas [mcf]: 15,544,283
Cum Water [bbls]: 18,780
*Excludes NGLs

Data Plotted on a Log Scale

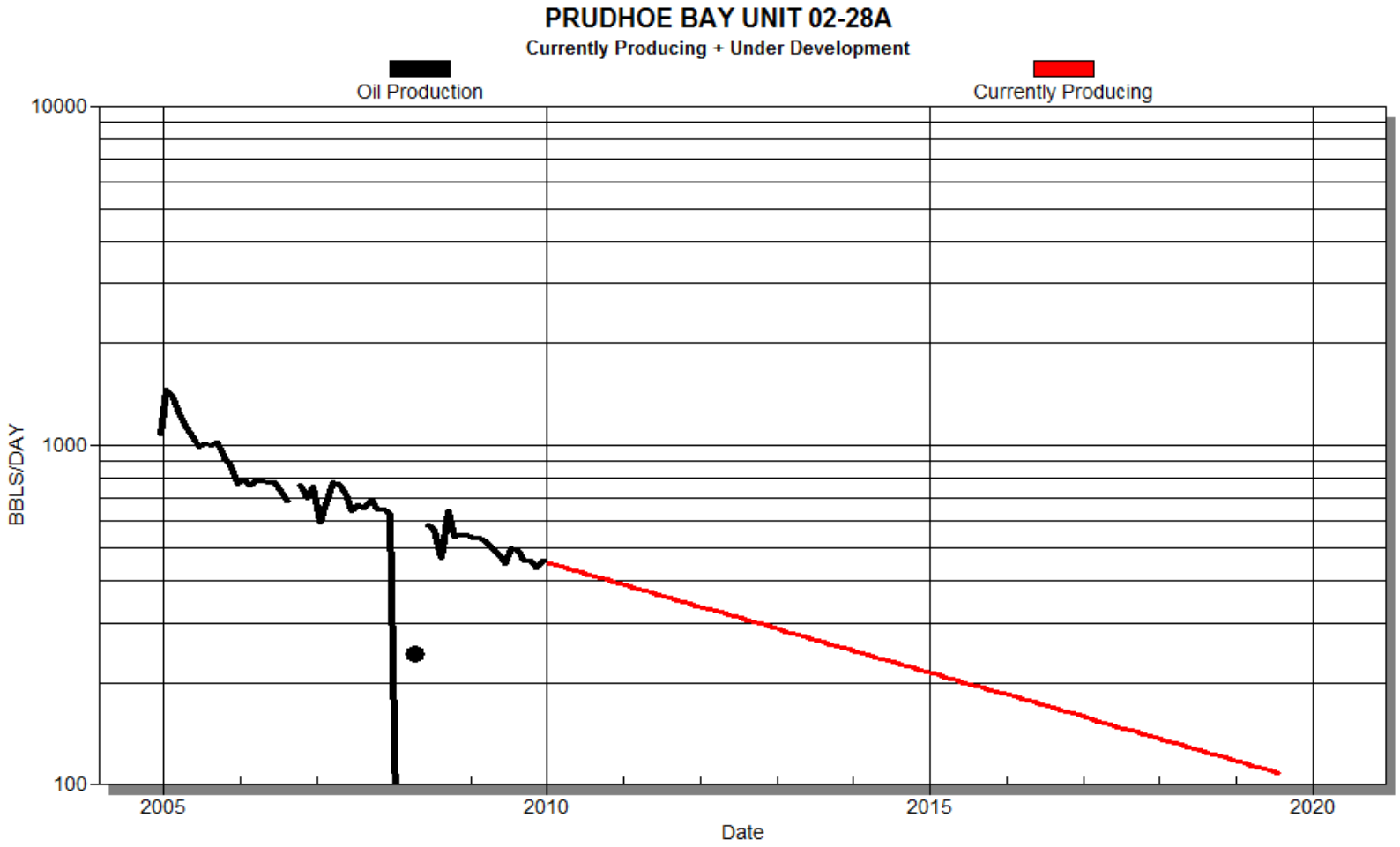


Operator: BP EXPLORATION (ALASKA) INC
Field: 640150 PRUDHOE BAY
Reservoir: PRUDHOE OIL

Cum Oil [bbls]: 1,122,583
Cum Gas [mcf]: 15,544,283
Cum Water [bbls]: 18,780

*Excludes NGLs

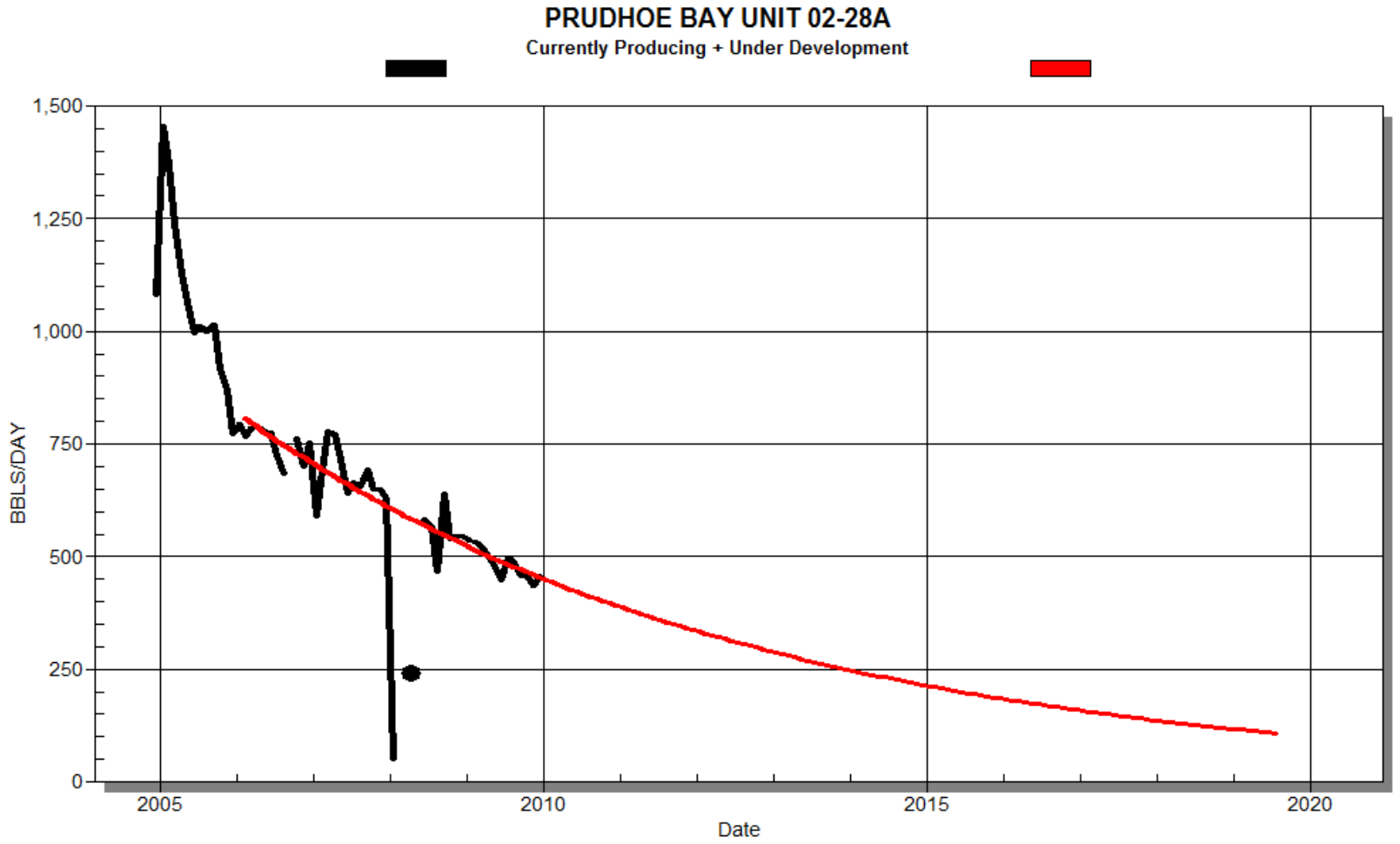
Decline Curve Extrapolates Trend



Operator: BP EXPLORATION (ALASKA) INC
Field: 640150 PRUDHOE BAY
Reservoir: PRUDHOE OIL

Cum Oil [bbls]: 1,122,583
Cum Gas [mcf]: 15,544,283
Cum Water [bbls]: 18,780
*Excludes NGLs

Trend (linear scale)

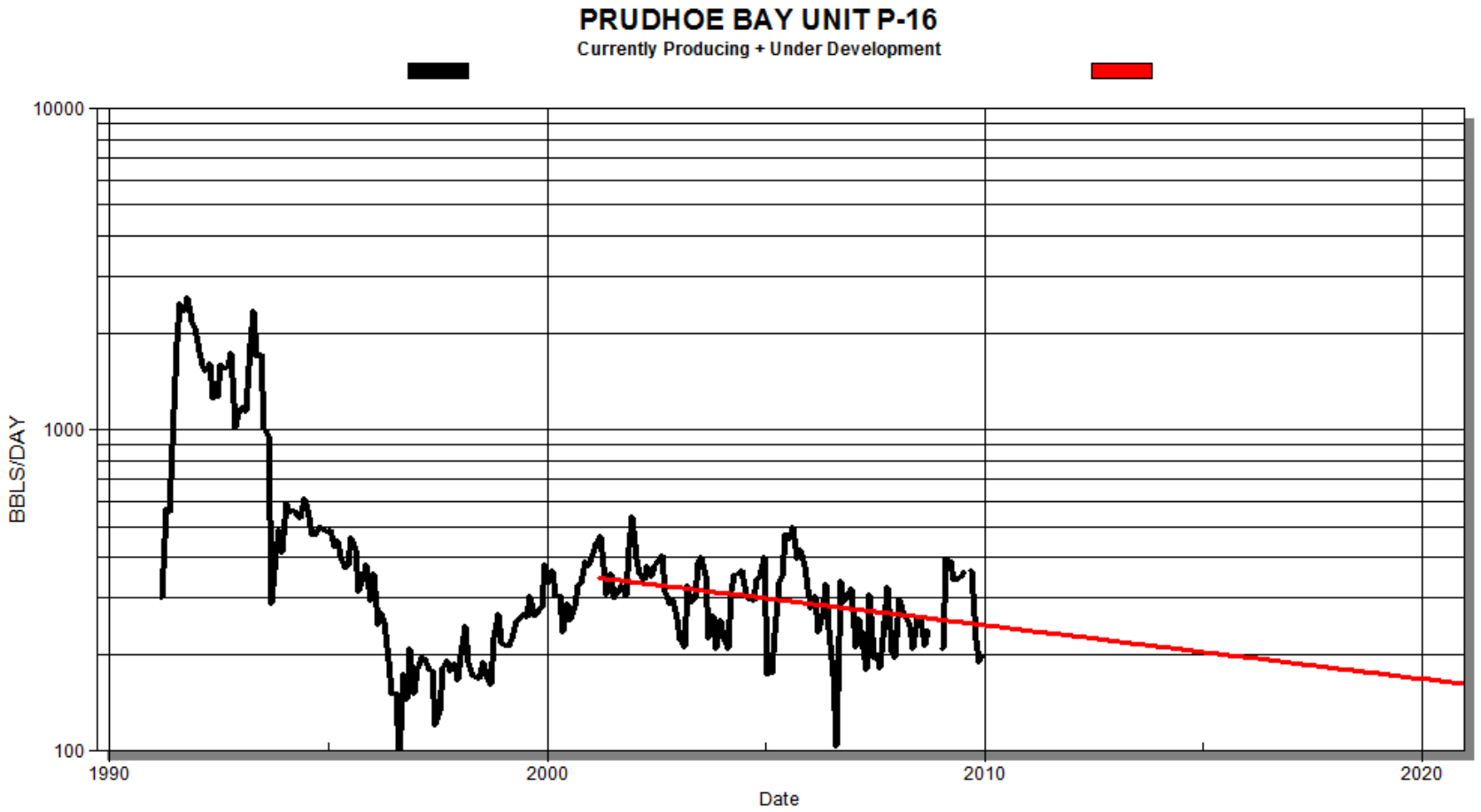


Operator: BP EXPLORATION (ALASKA) INC
Field: 640150 PRUDHOE BAY
Reservoir: PRUDHOE OIL

Cum Oil [bbls]: 1,122,583
Cum Gas [mcf]: 15,544,283
Cum Water [bbls]: 18,780

*Excludes NGLs

Another Prudhoe Bay Decline Curve

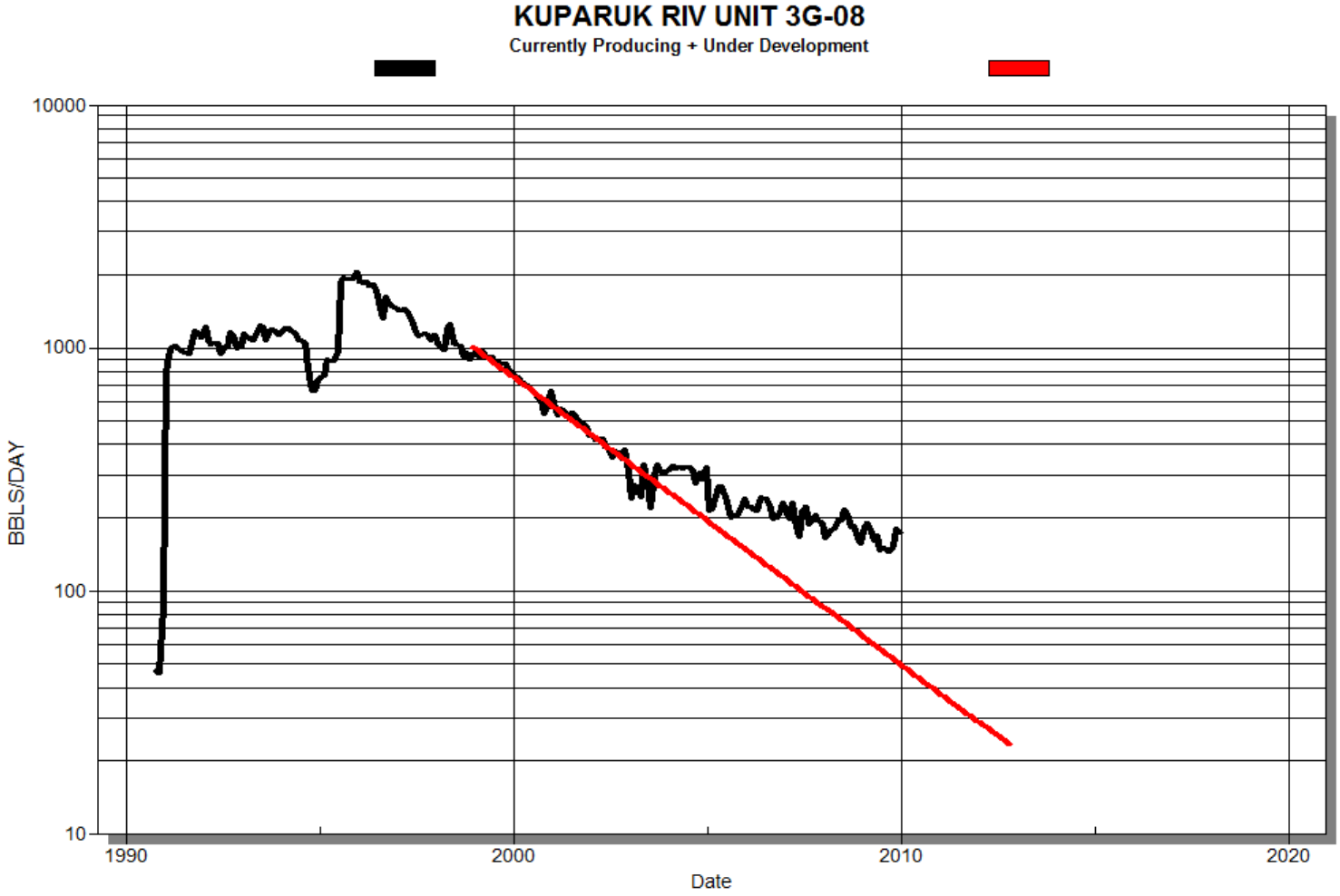


Operator: BP EXPLORATION (ALASKA) INC
Field: 640150 PRUDHOE BAY
Reservoir: PRUDHOE OIL

Cum Oil [bbls]: 2,998,630
Cum Gas [mcf]: 4,851,252
Cum Water [bbls]: 6,517,122

*Excludes NGLs

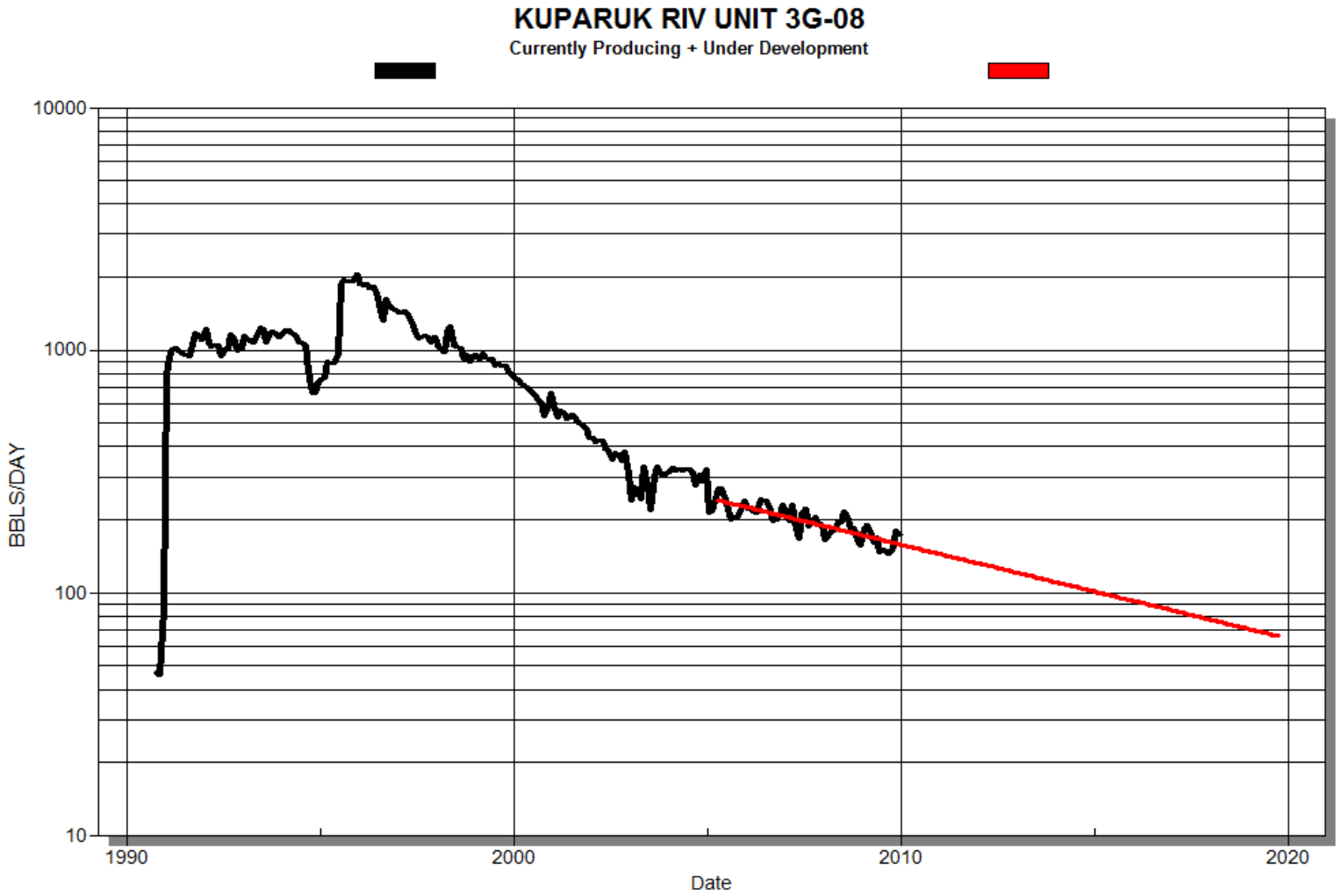
KRU Well Decline Curve At The End Of 2002…



Operator: CONOCOPHILLIPS ALASKA INC
Field: 490100 KUPARUK RIVER
Reservoir: KUPARUK RIV OIL

Cum Oil [bbls]: 4,930,933
Cum Gas [mcf]: 3,372,126
Cum Water [bbls]: 1,924,543

Kuparuk River Unit Well Decline Curve



Operator: CONOCOPHILLIPS ALASKA INC
Field: 490100 KUPARUK RIVER
Reservoir: KUPARUK RIV OIL

Cum Oil [bbls]: 4,930,933
Cum Gas [mcf]: 3,372,126
Cum Water [bbls]: 1,924,543

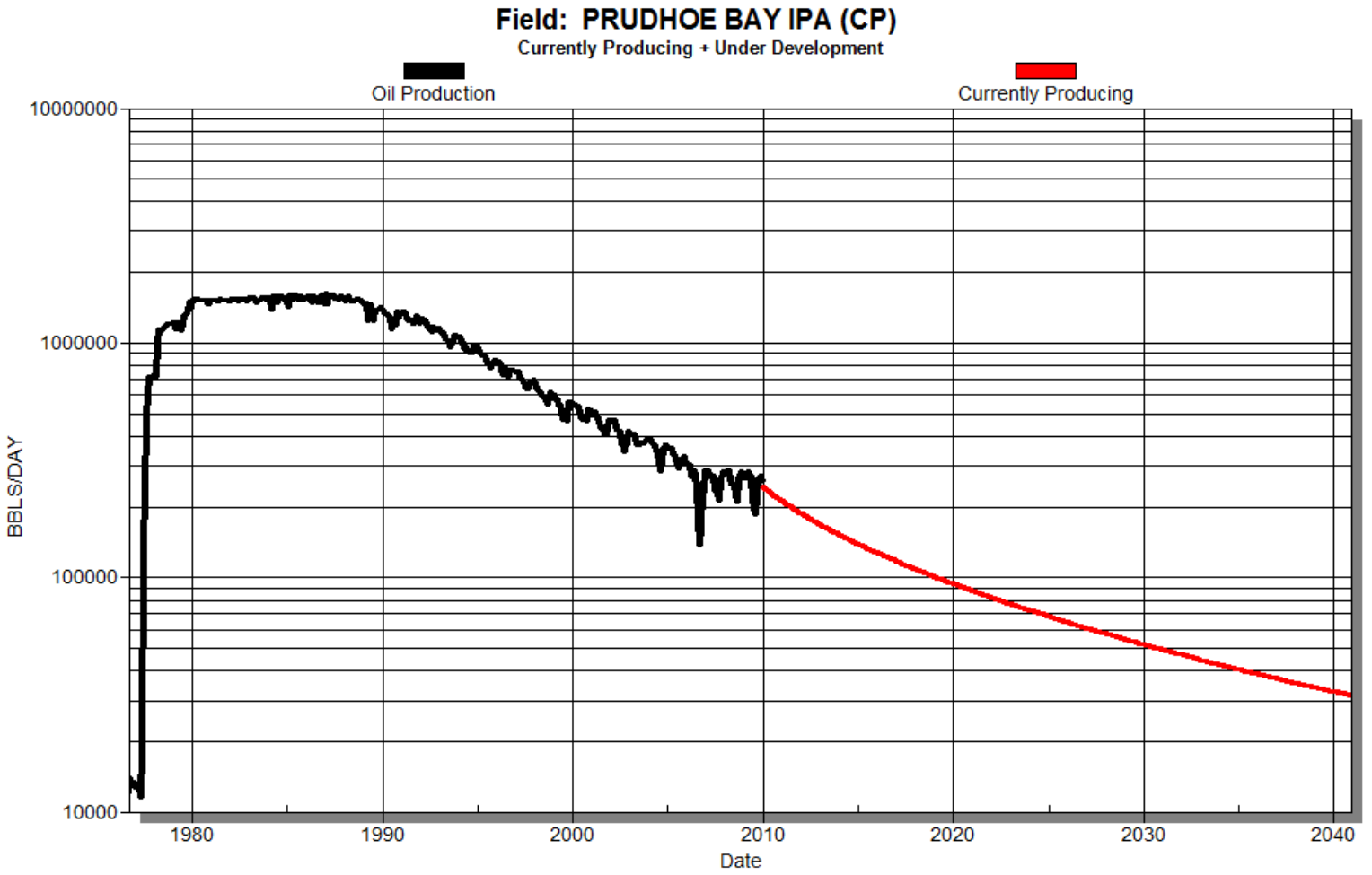
To Generate A Field Forecast:

1. Upload production history from AOGCC into database

2. Apply a decline curve to every well with recent production history data

3. Sum all of the production history and forecasts

Prudhoe Bay
Currently Producing Wells

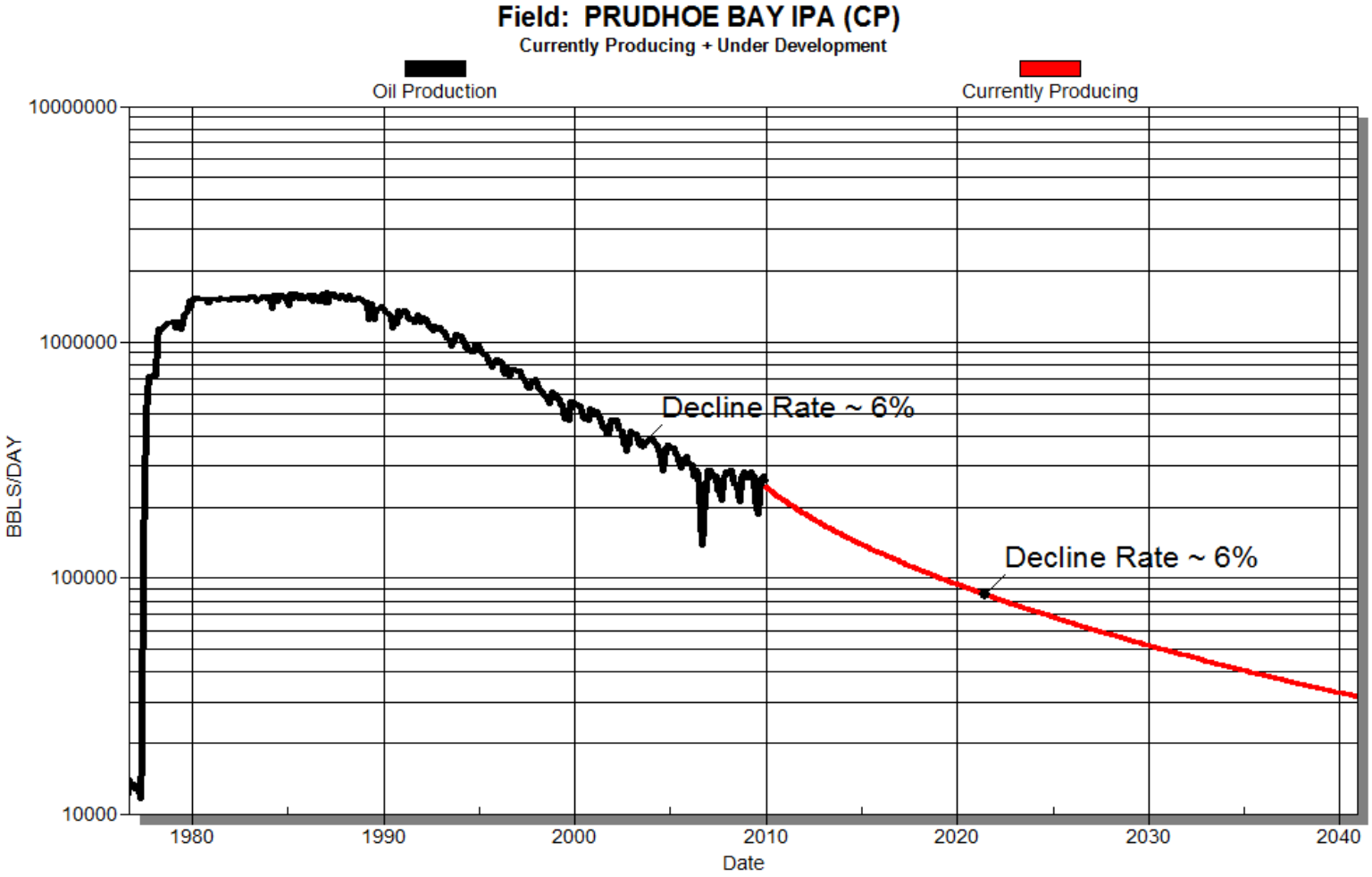


Operator: BP EXPLORATION (ALASKA) INC
Field: PRUDHOE BAY (IPA)
Reservoir: PRUDHOE OIL

Cum Oil [bbls]: 11,192,937,517
Cum Gas [mcf]: 61,452,931,005
Cum Water [bbls]: 9,021,006,529

*Excludes NGLs

Prudhoe Bay
Currently Producing Wells

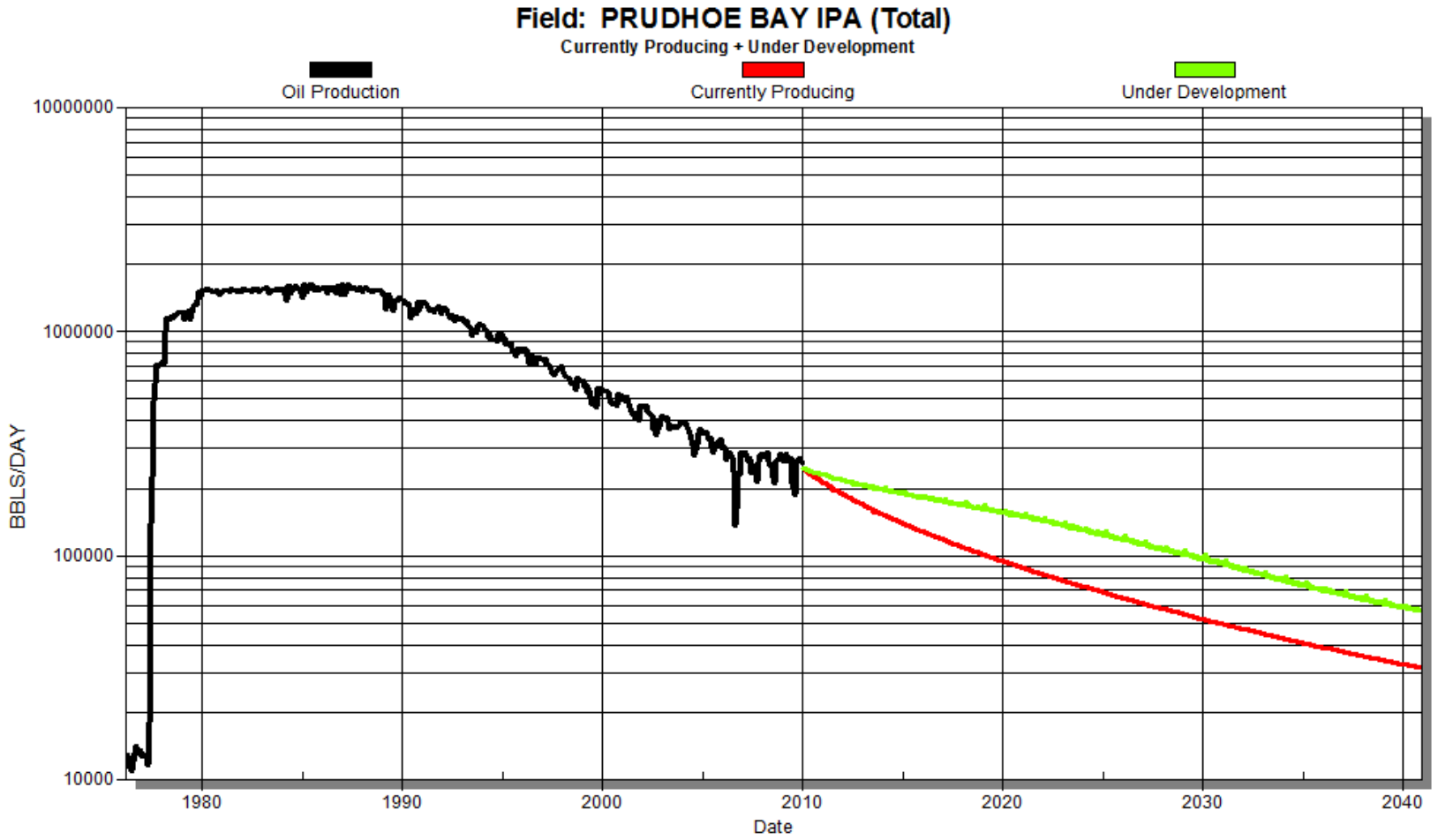


Operator: BP EXPLORATION (ALASKA) INC
Field: PRUDHOE BAY (IPA)
Reservoir: PRUDHOE OIL

Cum Oil [bbls]: 11,192,937,517
Cum Gas [mcf]: 61,452,931,005
Cum Water [bbls]: 9,021,006,529

*Excludes NGLs

Prudhoe Bay
Currently Producing + Under Dev

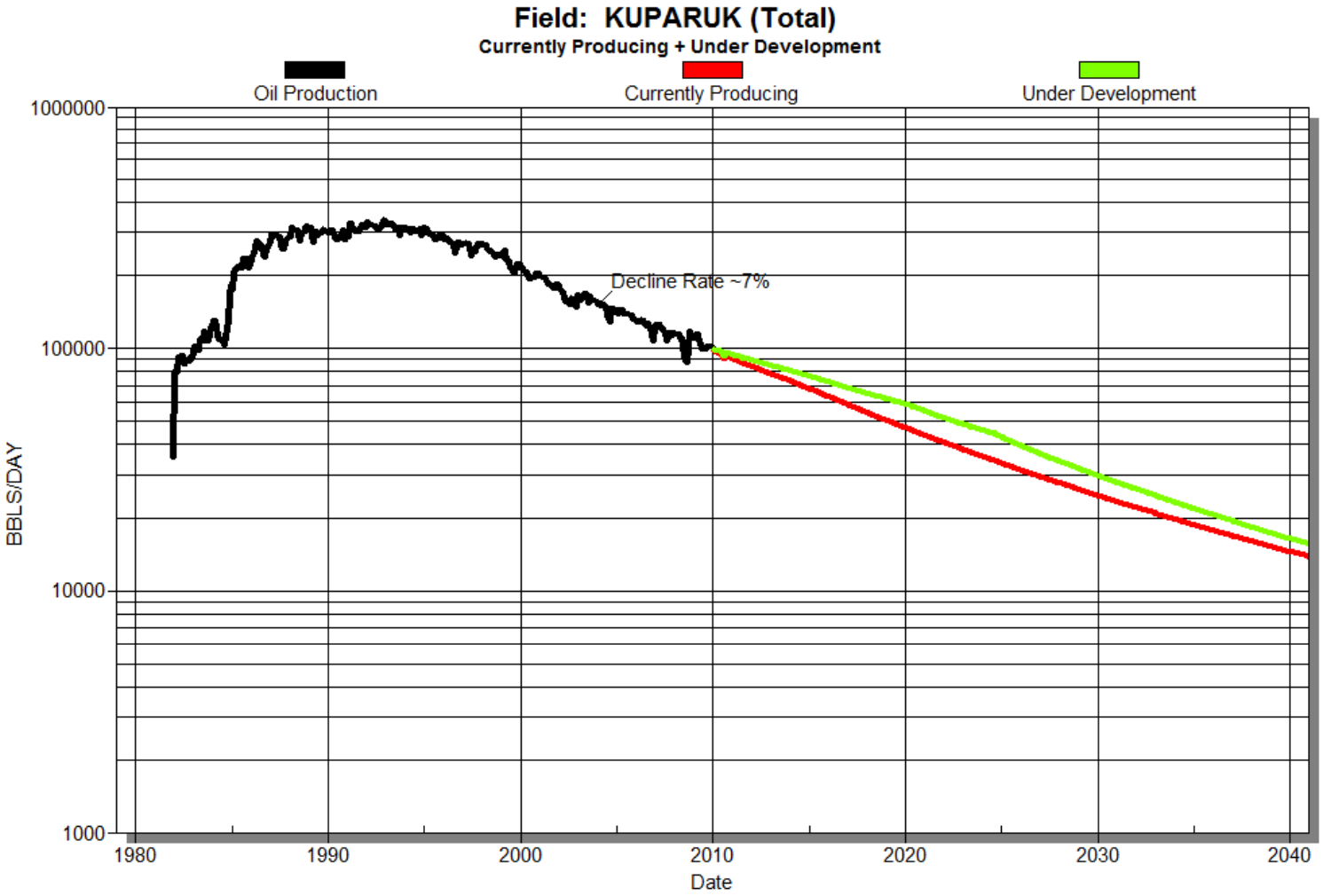


Operator: BP EXPLORATION (ALASKA) INC
Field: PRUDHOE BAY (IPA)
Reservoir: PRUDHOE OIL

Cum Oil [bbls]: 11,192,937,517
Cum Gas [mcf]: 61,452,931,005
Cum Water [bbls]: 9,021,006,529

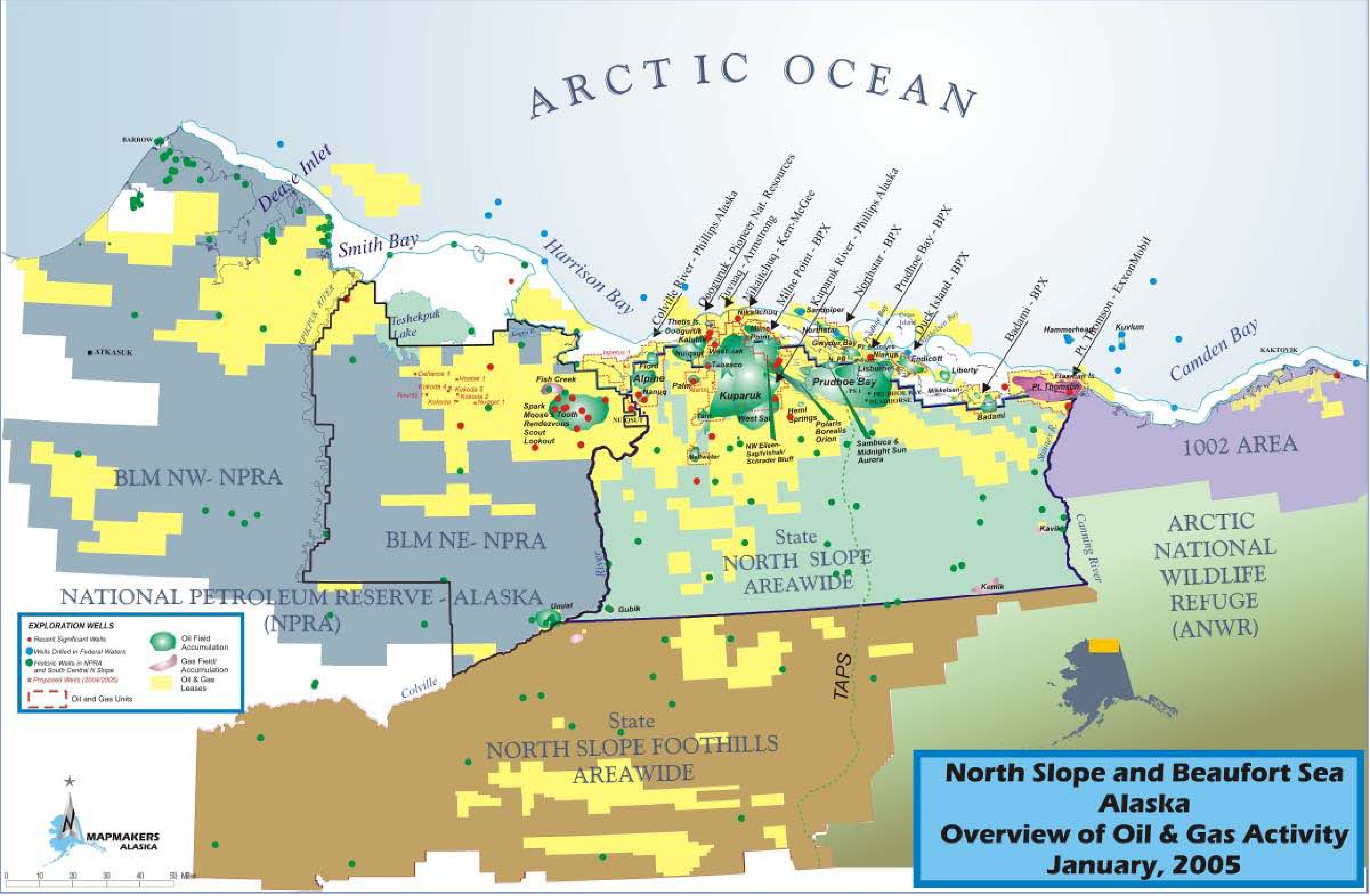
*Excludes NGLs

Kuparuk
Currently Producing + Under Dev

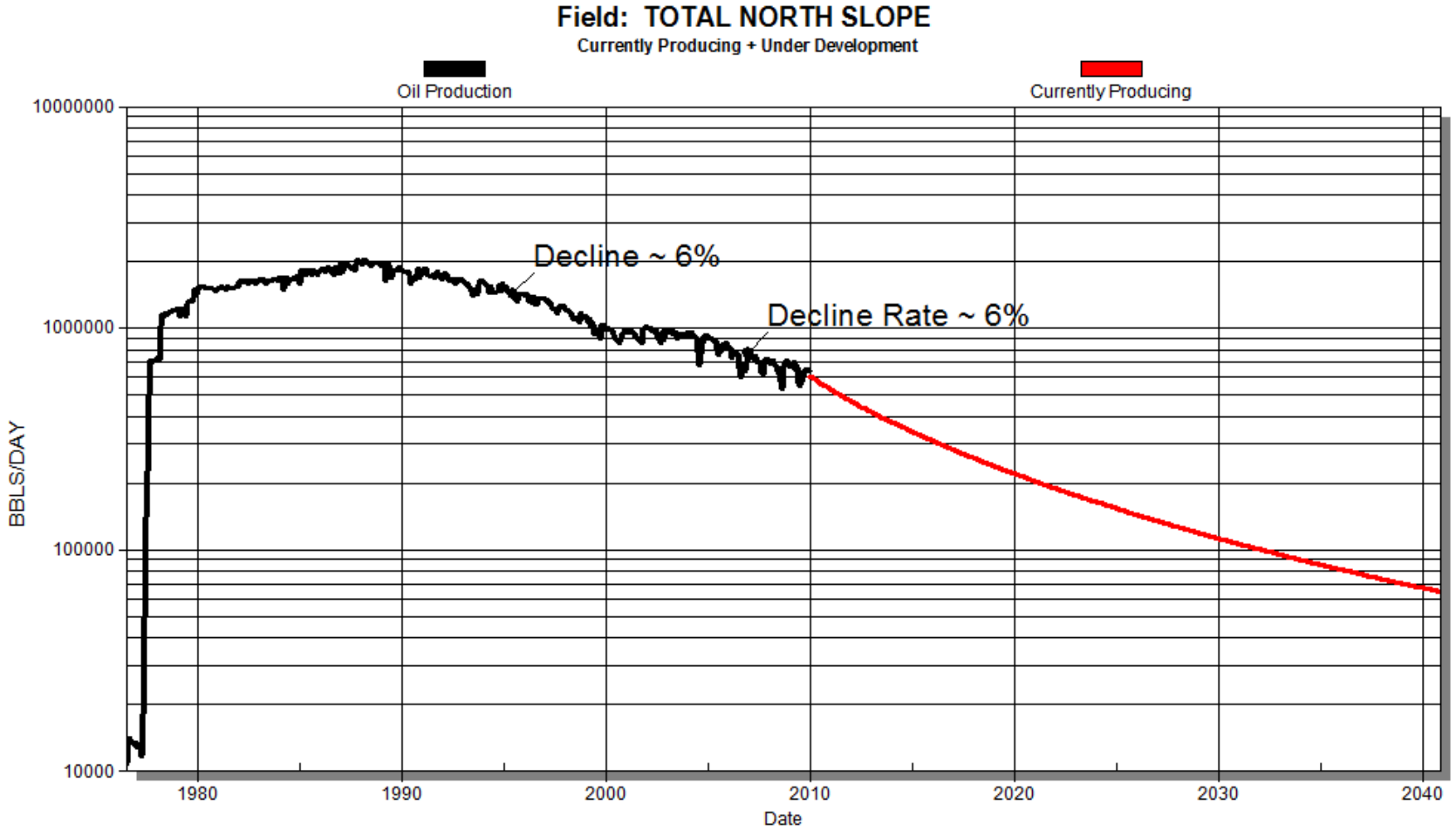


Operator: CONOCOPHILLIPS ALASKA INC
Field: KUPARUK RIVER
Reservoir: KUPARUK RIVER OIL

Cum Oil [bbls]: 2,187,540,707
Cum Gas [mcf]: 2,848,697,633
Cum Water [bbls]: 3,405,683,198


ARCTIC OCEAN
Dease Inlet
Smith Bay
Harrison Bay
Camden Bay
Teshekpuk Lake
BARROW
ATKASUK
KAKTOVIK
Colville River - Phillips Alaska
Oooguruk - Pioneer Nat. Resources
Nikaitchuq - Kerr-McGee
Milne Point - BPX
Kuparuk River - Phillips Alaska
Northstar - BPX
Prudhoe Bay - BPX
Duck Island - BPX
Badami - BPX
Pt. Thomson - ExxonMobil
Alpine
Kuparuk
Prudhoe Bay
Fish Creek
Liberty
Endicott
Hammerhead
Kuvlum
Pt. Thomson
1002 AREA
BLM NW- NPRA
BLM NE- NPRA
NATIONAL PETROLEUM RESERVE - ALASKA (NPRA)
State NORTH SLOPE AREAWIDE
ARCTIC NATIONAL WILDLIFE REFUGE (ANWR)
State NORTH SLOPE FOOTHILLS AREAWIDE
TAPS
Colville
Canning River
Umiat
Gubik
Kemik
Kavik
EXPLORATION WELLS
Recent Significant Wells
Wells Drilled in Federal Waters
Historic Wells in NPRA and South Central N Slope
Proposed Wells (2004/2005)
Oil and Gas Units
Oil Field Accumulation
Gas Field/ Accumulation
Oil & Gas Leases
MAPMAKERS ALASKA
North Slope and Beaufort Sea
Alaska
Overview of Oil & Gas Activity
January, 2005

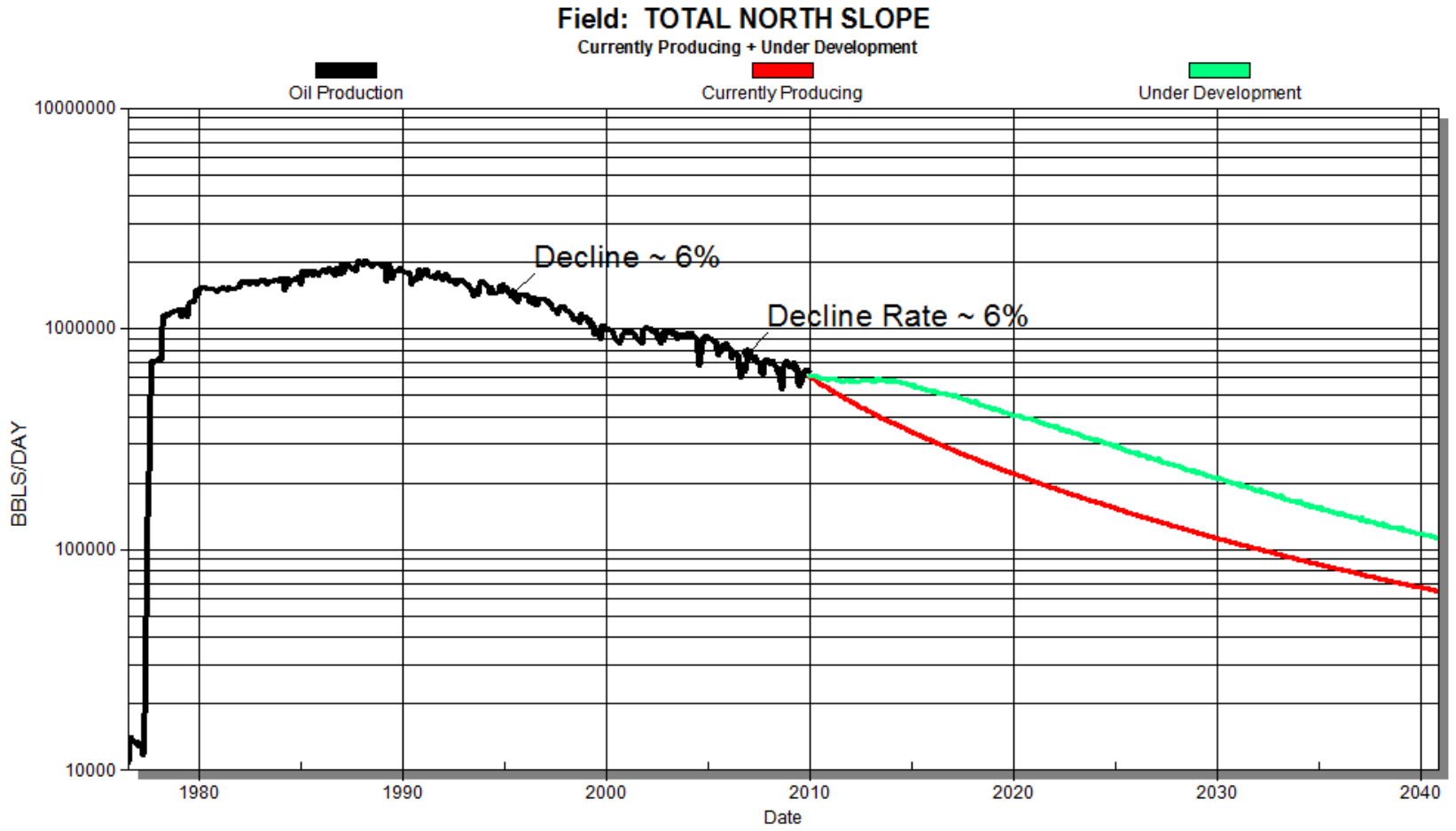
Total North Slope



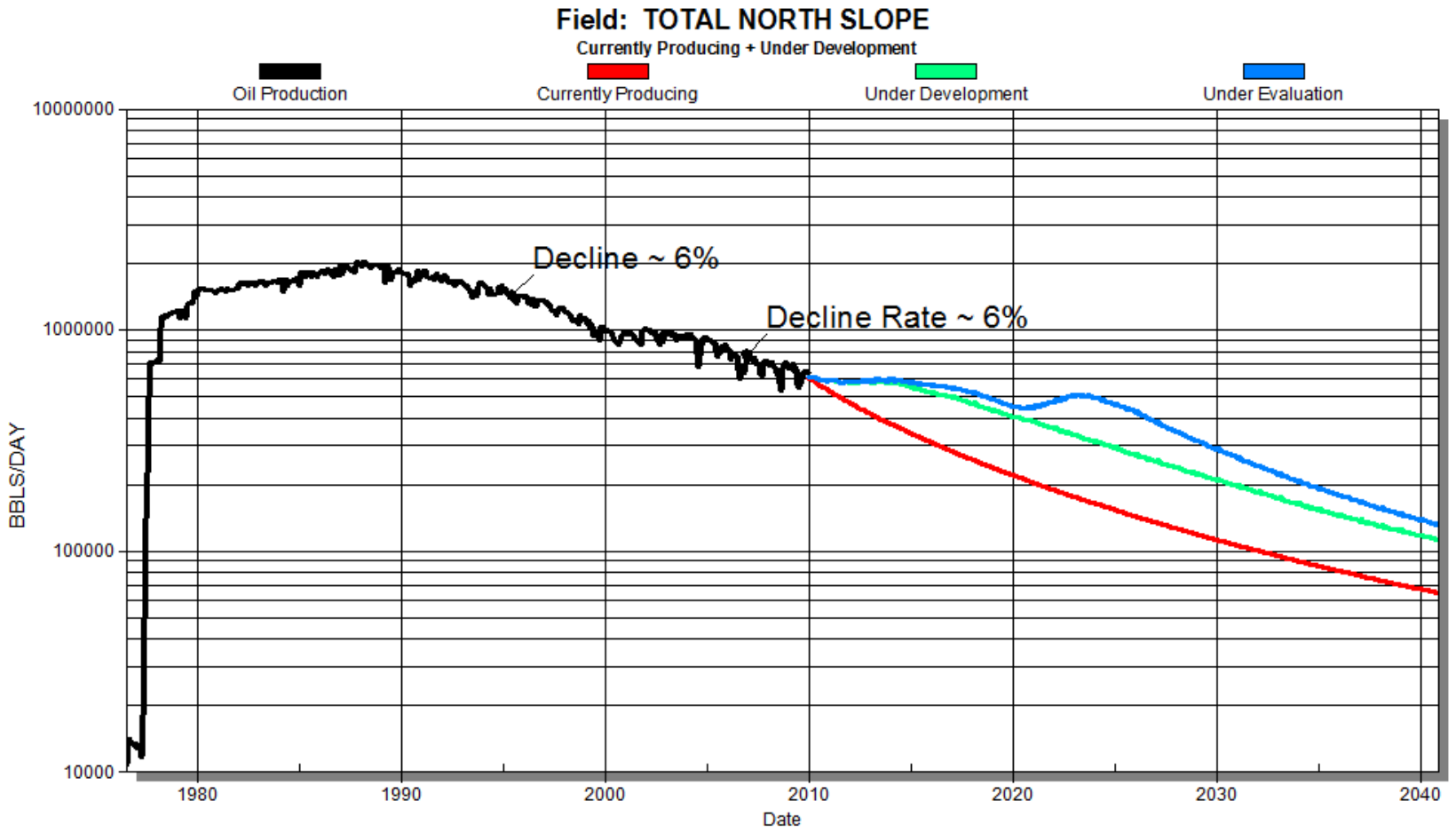
Operator:
Field:
Reservoir:

Cum Oil [bbls]: 15,603,233,666
Cum Gas [mcf]: 71,639,348,077
Cum Water [bbls]: 14,793,483,189
*Excludes NGLs

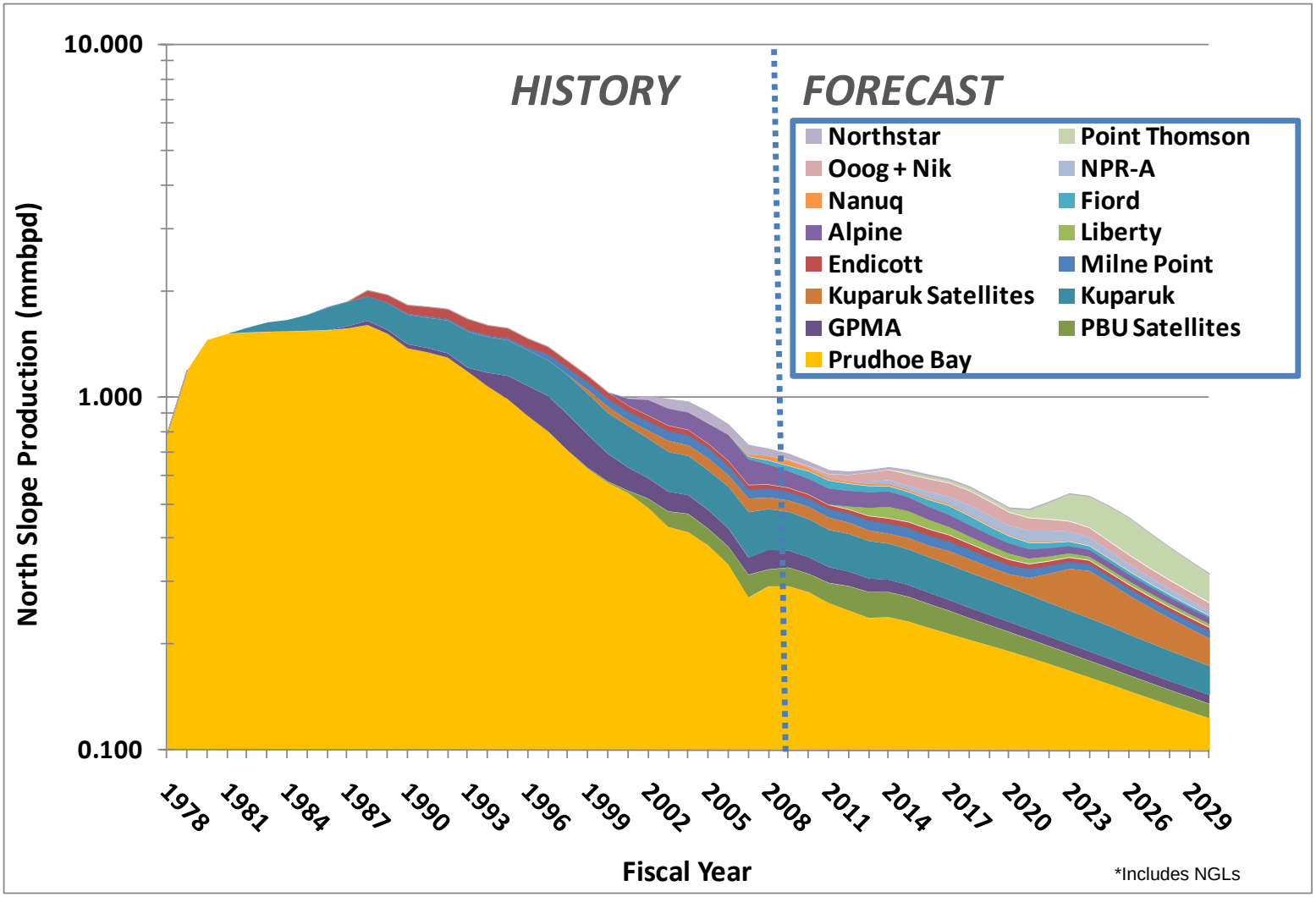
Total North Slope Currently Producing + Under Dev.



Total North Slope
CP + UD + UE



Fall 2009 Forecast: Log Scale



Conclusion

- Production forecasting requires consideration of each project's geology, development plans, commerciality, production profiles, decline curves and timing.

- Department uses extensive well and field specific data acquired from producers, AOGCC, and DNR

- Forecast is a roll up of fields that have been discovered that are currently producing, under development, and under evaluation.