

# Haynesville Shale: The Second Act



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**Cameron Horwitz, CFA**  
Managing Director  
713-366-0541  
[chorwitz@uscallc.com](mailto:chorwitz@uscallc.com)

**Omar Zakaria**  
Research Analyst  
713-366-0559  
[ozakaria@uscallc.com](mailto:ozakaria@uscallc.com)

# Haynesville Shale: The Second Act

- **Overview:** The curtain is rising on the Haynesville Shale's second act, marked by a completion-driven productivity renaissance that has leading-edge wells competing with core parts of Appalachia on a recovery per foot basis and generating robust returns at sub-\$3/Mmbtu. The upshot is a resumption of meaningful Haynesville production growth through the end of the decade, which has ramifications at both the macro and micro level. While private E&Ps currently dominate activity, big drilling CAPEX requirements likely drive a push into the public markets. As such, we've created this piece as a handbook for public investors to get re-acquainted with the Haynesville, with a big picture run-down upfront and detailed regional breakdowns thereafter. Below are our key, high-level takeaways.
- **Drilling Activity:** Haynesville rig count has come back to life, up ~230% from the '16 low to nearly 40 rigs, which is the highest level of activity since early '15. Most active Haynesville operators are BP and private Indigo Minerals with six rigs each, followed by private Vine with five rigs and privates Covey Park and GeoSouthern with four rigs a piece. Notably, private E&Ps account for ~60% of Haynesville drilling activity and comprise ~80% of rig adds since the '16 nadir.
- **Propagaddon:** In the early days of the Haynesville, the majority of wells were frac'd with 500-1,000 lbs of proppant per lateral foot. Proppant intensity began to inflect in '15 and saw a material step-change last year, with Q4'16 wells averaging north of 3,000 lbs/foot, including several tests of ~5,000 lbs/foot. To put in context, the average Haynesville well in Q4'16 pumped north of 22 million pounds of sand on an absolute basis.
- **Well Productivity:** The move to upsized fracs has driven average 3-month cumulative recovery to 220+ Mmcf/1,000' in Q4'16, which is up ~100% from the '14-'15 average and 40%+ above the prior peak in early '10. Best well performance has been in the eastern half of North Louisiana, with average '16 wells tracking a ~2.6 Bcf/1,000' EUR, while the western half of North Louisiana is close behind at ~2.2 Bcf/1,000'. Notably, several recent wells testing 3,000-5,000 lb/foot fracs are tracking at or above our 2.8 Bcf/1,000' type curve.
- **Operator Performance:** Looking at 2016 average well results, best lateral-normalized 30-day IP rates have been at Vine, CHK, CRK and Covey Park, while the same four operators also stand out as generating the best 3-month cumulative recoveries per lateral foot.

# Haynesville Shale: The Second Act, Cont'd

- **Breakevens:** From 2009 to 2014, Haynesville well performance suggested PV-10 breakeven gas price oscillated between \$3.50-\$4.00/Mcf. There was a notable decline in 2015, which was the first year play-wide breakeven dropped below \$3/Mcf. Latest results suggest a further step-change, with average 2016 Haynesville well performance implying a breakeven price of just over \$2/Mmbtu.
- **Economics:** At \$3/Mmbtu gas prices, Northern Louisiana Haynesville generates robust returns, with average '16 well performance suggesting eastern and western area BTAX IRRs of 77% and 54%, respectively. Even at \$2.50/Mmbtu, average return among eastern and western Northern Louisiana areas is ~40%. Notably, we believe recent upsized-frac well results tracking above our ~2.8 Bcf/1,000' type curve are capable of generating ~85%/~50% IRRs at \$3/\$2.50 gas prices, respectively, including incremental sand cost for higher proppant loading.
- **Acreage Valuation:** Running full development analysis and average '16 type curves, we see the eastern part of Northern Louisiana generating the highest intrinsic acreage value with BTAX PV-10 of \$35,000-\$50,000/acre depending on midstream costs (sensitized from 30-70c per Mcf). In the western half of Northern Louisiana, we see \$25,000-\$35,000/acre of fully developed leasehold value, again depending on midstream costs. Would note we think there is most room for economic improvement in the East Texas Shelby Trough area as proppant intensities here have lagged North Louisiana but rock properties are comparable.
- **Production:** Assuming 40 rigs, our model suggests Haynesville gas production should grow by 1+ Bcfpd per annum through the end of the decade, which implies output will exceed the prior play-wide peak by early '19 and exceed 10 Bcfpd in 2020. Northern Louisiana should be the biggest driver of this growth, accounting for ~75% of production adds through the end of the decade.
- **Stock Exposure:** In the public markets, greatest exposure to the Haynesville on an acreage vs. enterprise value basis is GDPP (166 acres/\$MM of EV), XCO (68 acres/\$MM of EV) and CRK (53 acres/\$MM of EV). CHK, MTDR and QEP are also exposed, but at a much smaller scale relative to respective enterprise values. In the private arena, we believe Covey Park and Indigo Minerals have the largest acreage positions with USCAe ~260,000 and ~240,000 net acres, respectively.

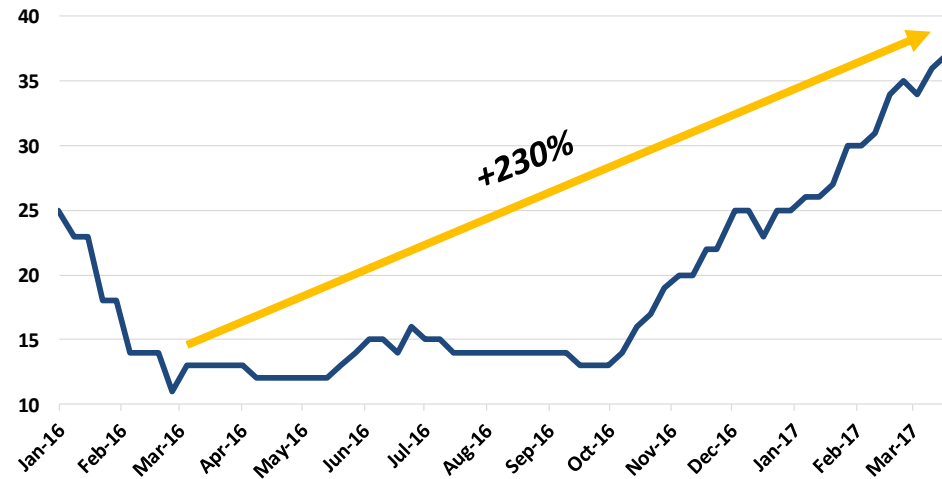
# **Haynesville Resurgence: The Big Picture**



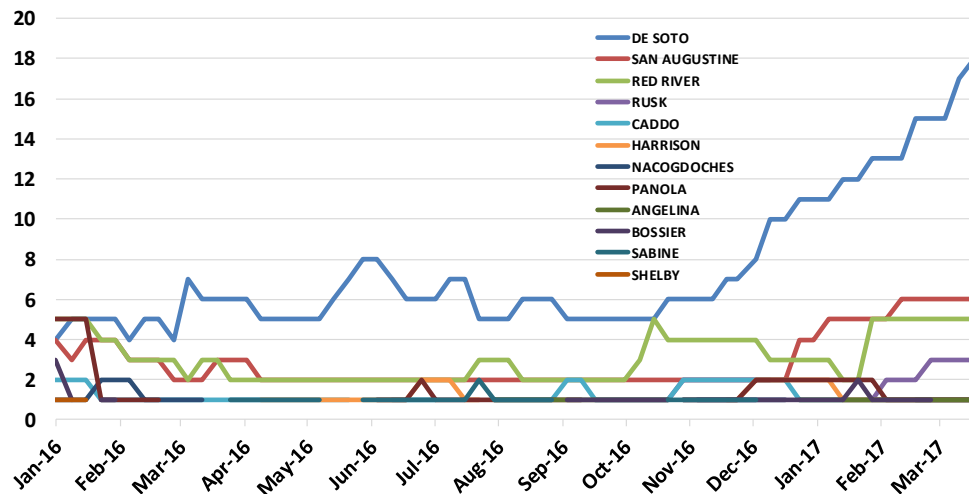
# Haynesville Rig Count Coming Back to Life

- After spending the majority of '16 below the 15-rig mark, the Haynesville rig count has come back to life in '17, with **drilling activity surging 200%+ off the recent low and breaking through 35 rigs for the first time since early '15.**
- The epicenter of the inflection in drilling activity has been **De Soto Parish, LA, which has seen its rig count increase from four at the '16 nadir to ~18 rigs presently.**
- San Augustine, TX and Red River Parish, LA have also contributed to the resurgence, with four and three rigs added from the bottom, respectively.

Haynesville Horizontal Rig Count



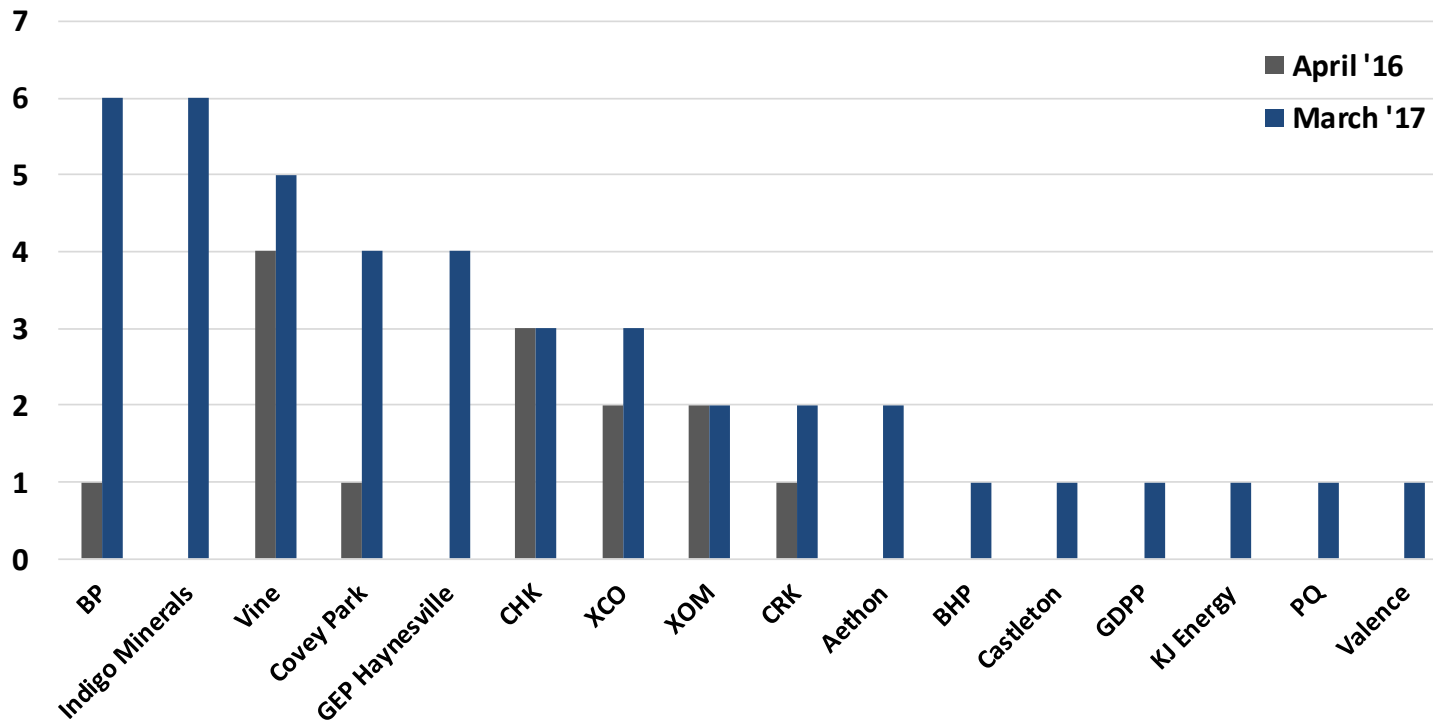
Haynesville Horizontal Rig Count By County/Parish



# Privates Largely Driving Recent Rig Ramp

- Chart shows Haynesville Shale horizontal rig count by operator currently and at the play-wide nadir in April '16.
- Most active Haynesville operators are BP and private Indigo Minerals with six rigs a piece, followed by private Vine with five rigs and privates Covey Park and GeoSouthern (GEP Haynesville) with four rigs each.
- ***We note private operators currently account for ~60% of Haynesville drilling activity and comprise ~80% of the rig adds that have occurred since the April '16 nadir.***

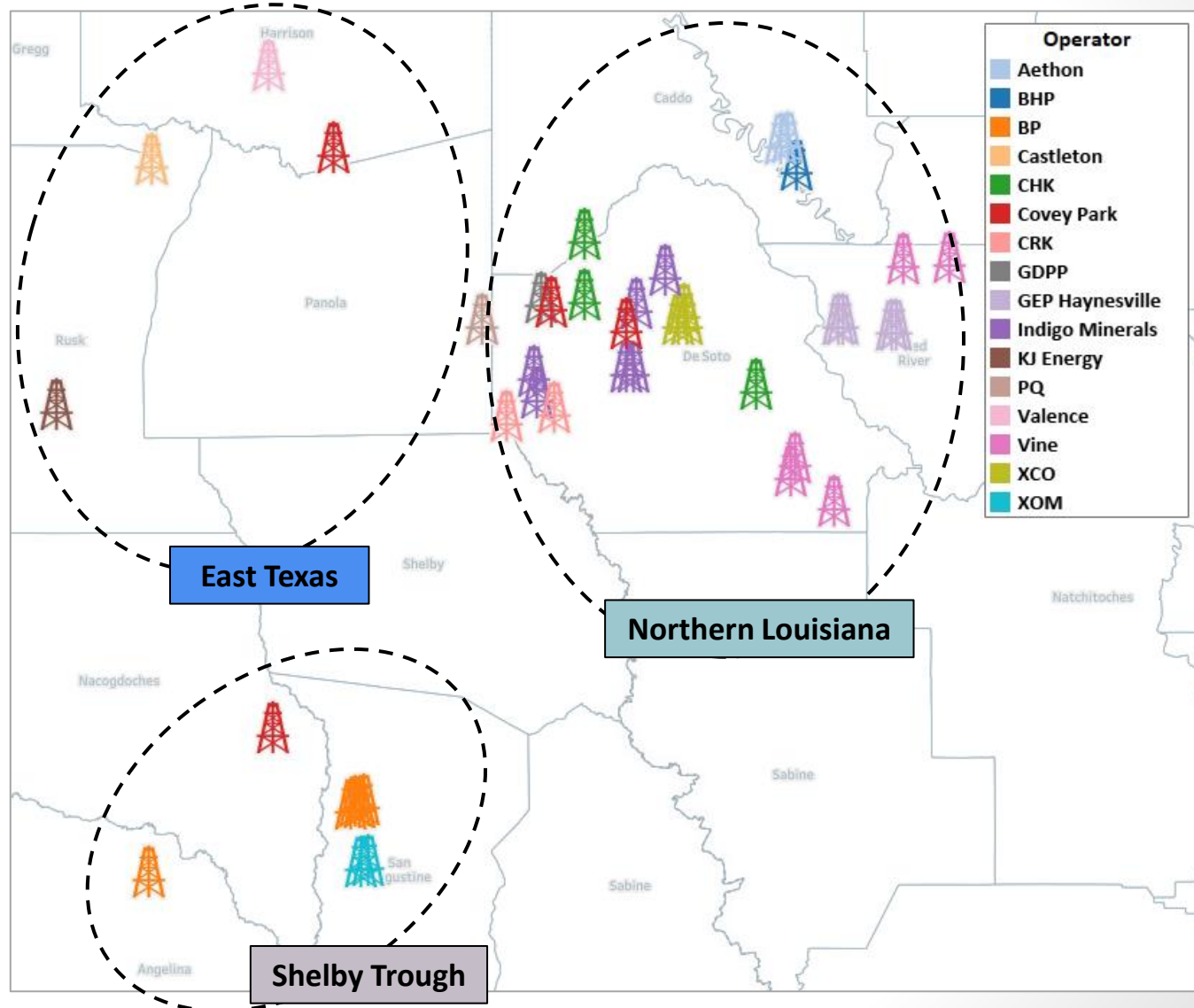
# Active Horizontal Rigs by Operator





# Activity Concentrated in Northern Louisiana

- Map shows horizontal Haynesville rigs, colored by operator.
- **North Louisiana has the highest concentration of activity, with ~26 rigs running or ~2/3rds of the play-wide rig count.**
- The Shelby Trough area has ~9 rigs running or ~25% of the total play rig count, with the bulk of this activity BP and XOM.
- East Texas has 4 rigs running, with bulk of activity being PE-backed companies.

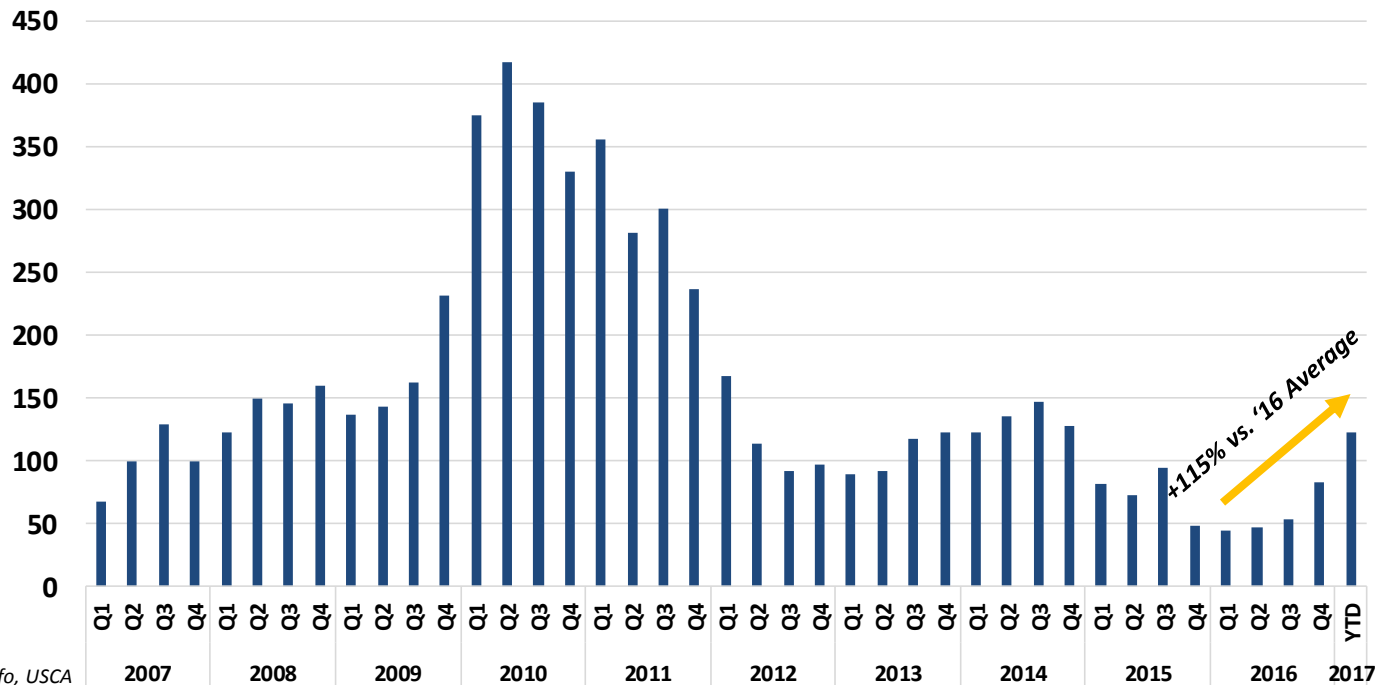




# Permits Presaging Further Activity Gains

- Chart below shows Haynesville Shale horizontal permitting activity over the past ~10 years.
- Activity peaked in Q2'10 with ~420 horizontal permits issued, but subsequently declined by nearly ~90% to the recent low of ~44 permits issued in Q1'16.
- ***While still light vs. the peak, permit activity has been on the upswing, with ~125 wells staked so far in '17 or ~115% above the quarterly average in '16. As permits usually lead drilling activity, this data could presage additional Haynesville rig adds over the next few months.***

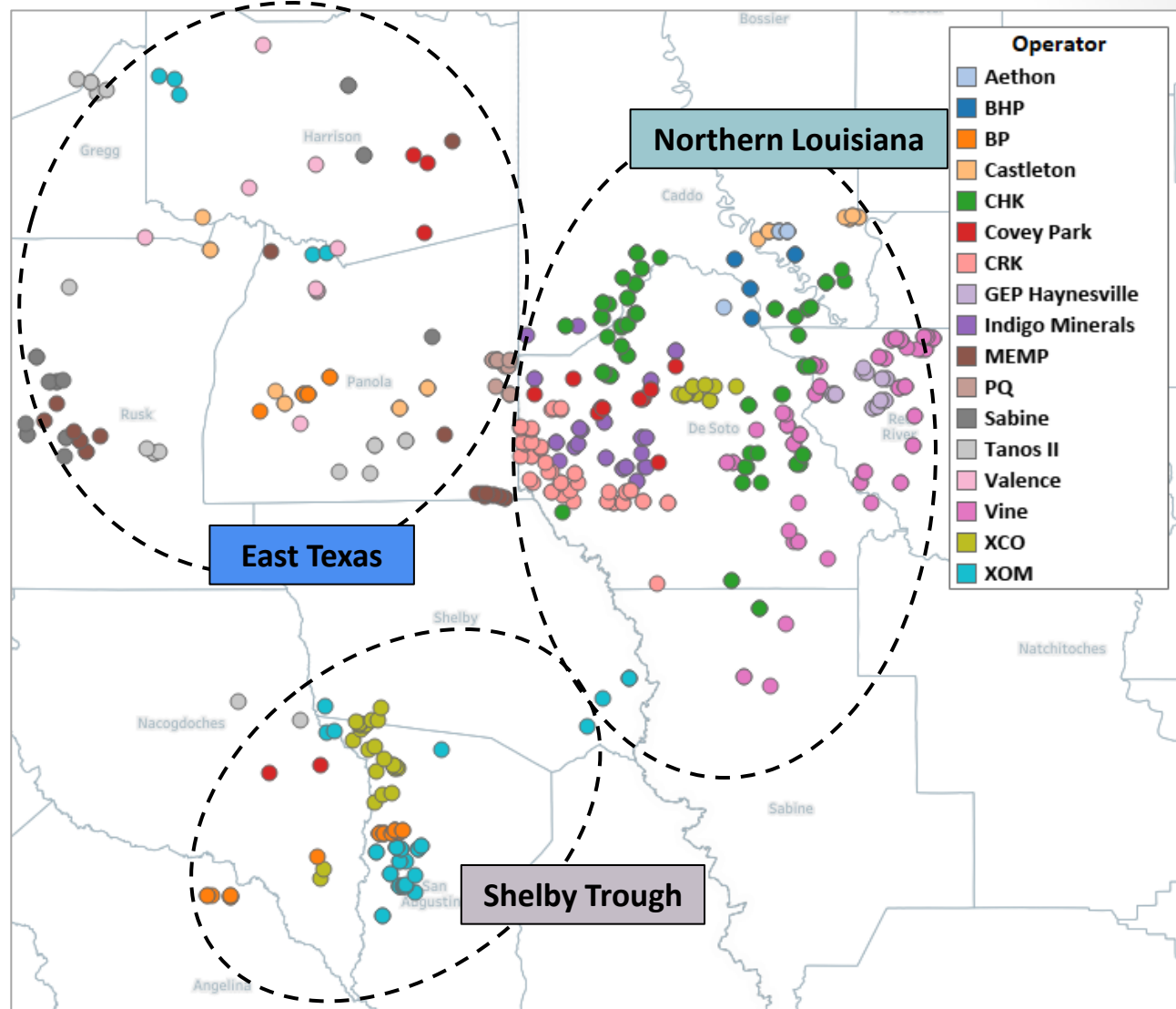
Horizontal Haynesville Permits Issued by Quarter





# Spotting Permit Activity by Operator

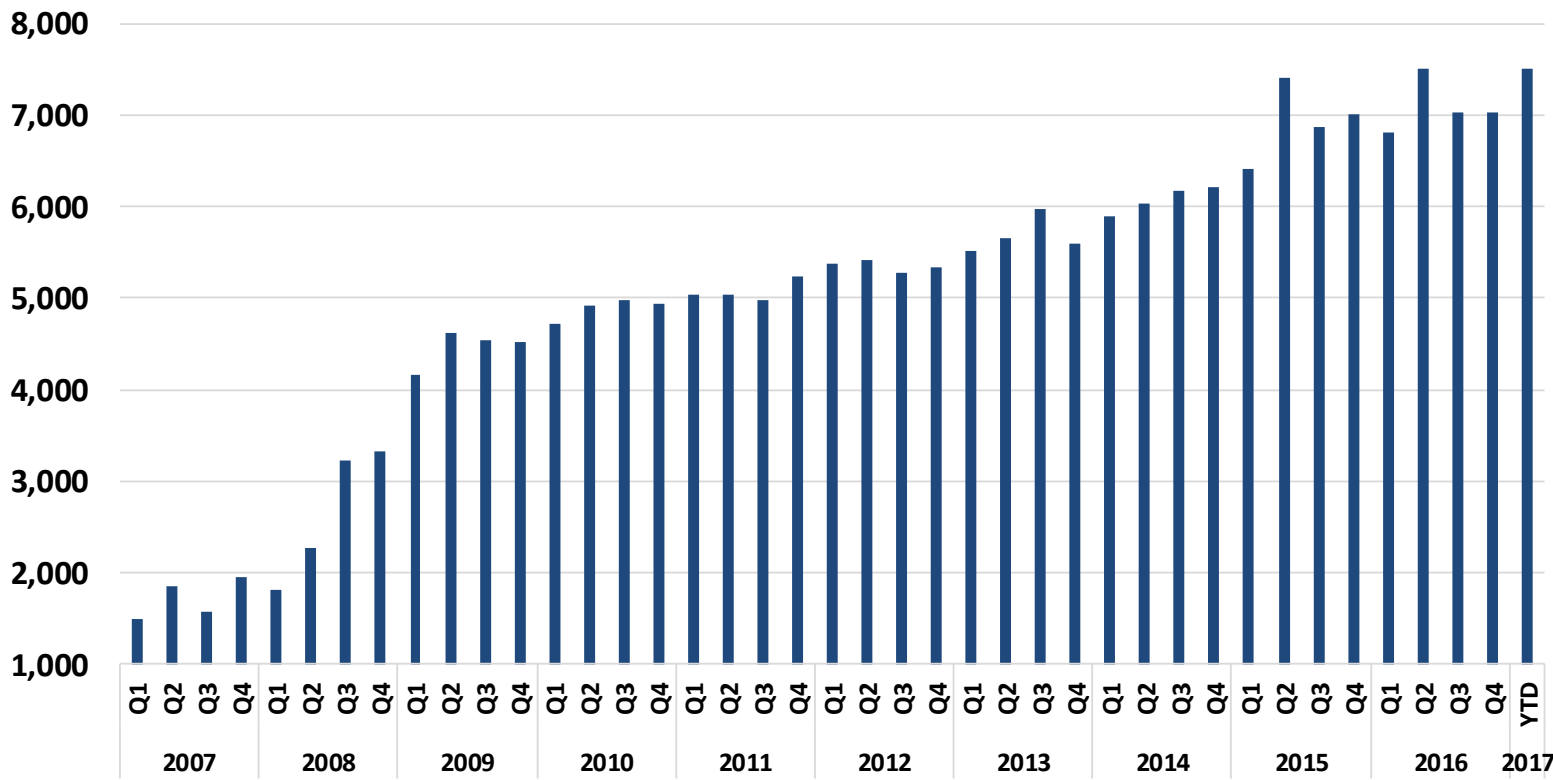
- Map shows horizontal permit activity since '15, color coded by operator.
- Looking at YTD permit activity, De Soto Parish, Red River Parish and San Augustine County have seen the most activity, with 28, 20 and 18 permits issued, respectively.
- At the operator level, most permits have been issued YTD to BP with 18, followed by private Vine with 16 permits and privates Indigo Minerals and Castleton at 10 permits each.



# Lateral Lengths Up 60% From the Old Days

- Chart below shows average permitted lateral length in the Haynesville since the play inception.
- When Haynesville activity was at its peak in 2010, the average well in the play was a single-section, ~4,500' lateral.
- Lateral lengths have embarked on a steady increase over the past 10 years, with ***average permitted lateral breaking above 7,000' over the past several quarters.***

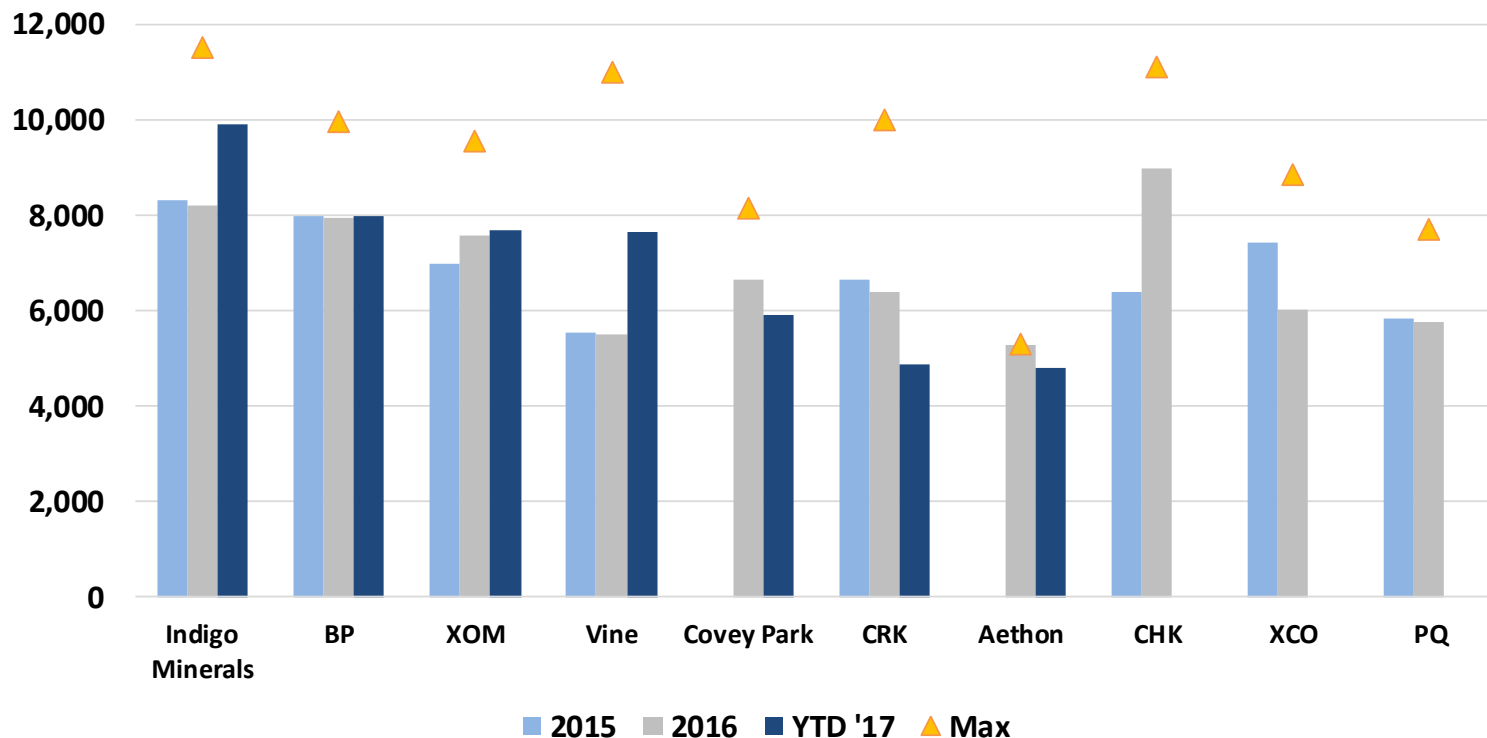
**Average Permitted Lateral Length by Quarter (Ft)**



# Permitted Lateral Lengths by Operator

- Chart below shows average Haynesville permitted lateral length by operator over the past couple of years.
- Looking at YTD '17 activity, private Indigo Minerals, BP and XOM have the longest average permitted laterals in '17 thus far, at ~9,900', ~8,000' and ~7,700', respectively.
- *We note private Indigo Minerals, CHK, private Vine and CRK all have a max permitted lateral of  $\geq 10,000'$ , highlighting benefits of contiguous acreage positions.*

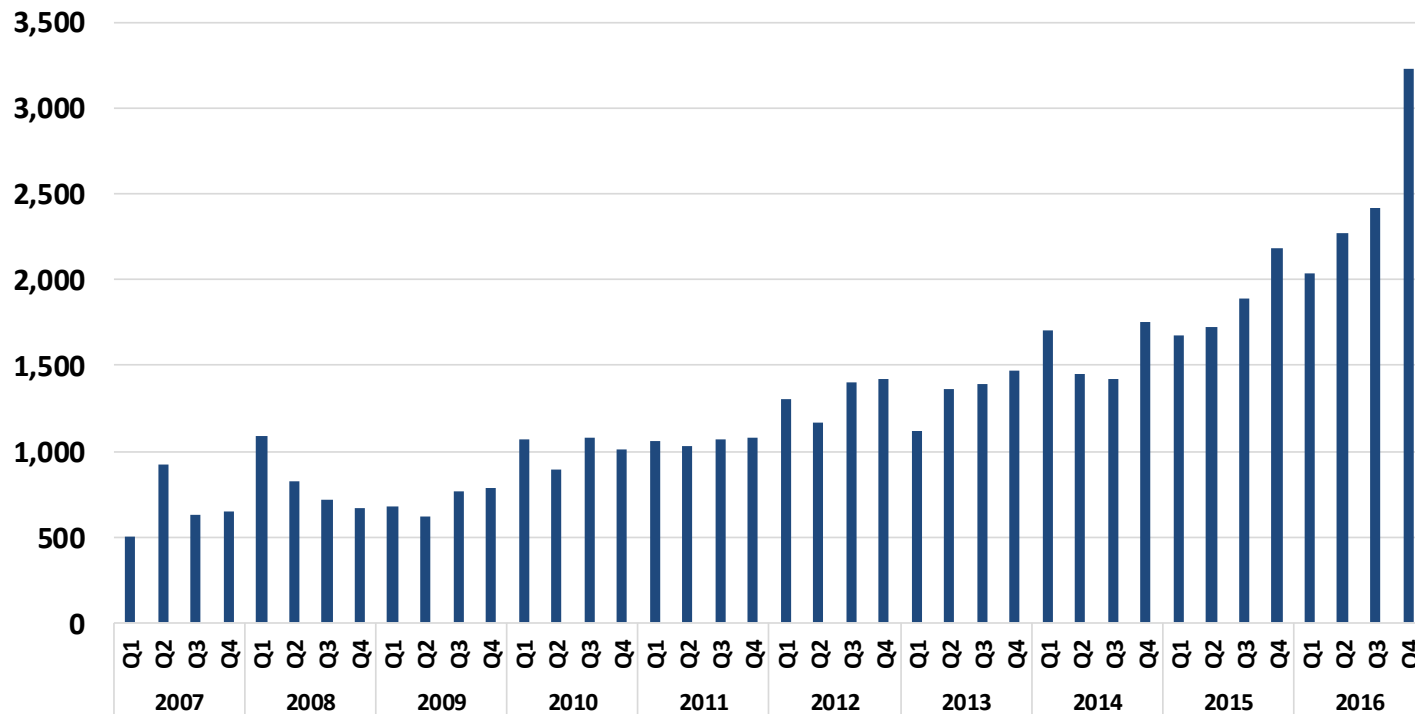
Average Permitted Lateral Length by Operator (Ft)



# Proppant Intensity Changed the Game

- Chart below shows average Haynesville proppant intensity on a pounds pumped per foot basis over the past decade.
- In the early days of the Haynesville, majority of wells were pumping between 500 and 1,000 lbs of proppant per lateral foot.
- Proppant intensity began to inflect upward materially in '15, breaking above 1,500 lbs/foot for the first time.
- ***Last year saw a further step-change in proppant intensity, with Q4'16 averaging north of 3,000 lbs/foot. To put in context, the average well in Q4'16 pumped north of 22 MM lbs of sand on an absolute basis.***

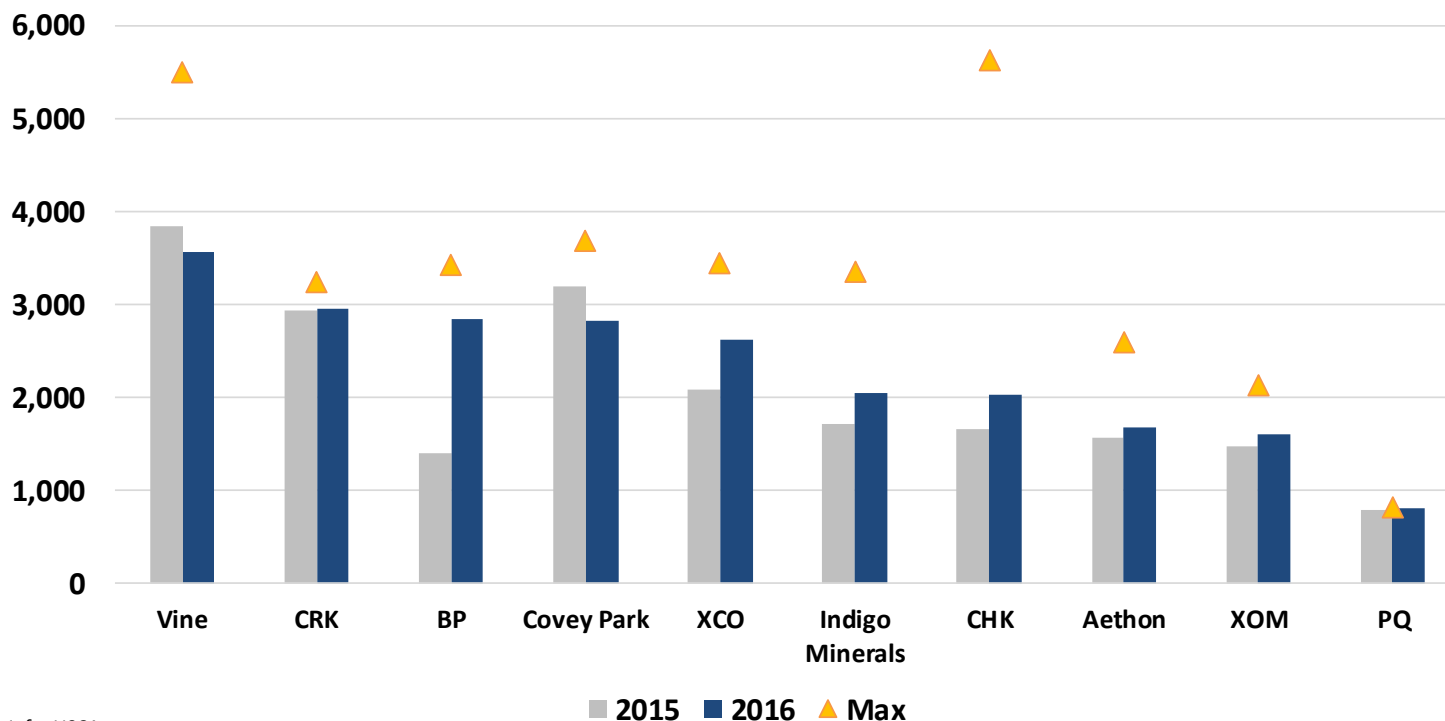
**Average Proppant Intensity by Quarter (Lbs/Ft)**



# Proppant Intensity by Operator

- Chart below shows average proppant intensity in the Haynesville by operator over the past two years.
- Looking at '16 well design, private Vine pumped the largest frac jobs, at ~3,600 lbs/foot, followed by CRK, BP and private Covey Park, all of which averaged around ~3,000 lbs/foot.
- ***Notably, Private Vine and CHK have tested 5,000+ lbs/ft proppant loadings, and we believe have seen encouraging initial results, so could see more operators testing super fracs in '17 to find break-over point on cost/recoveries.***

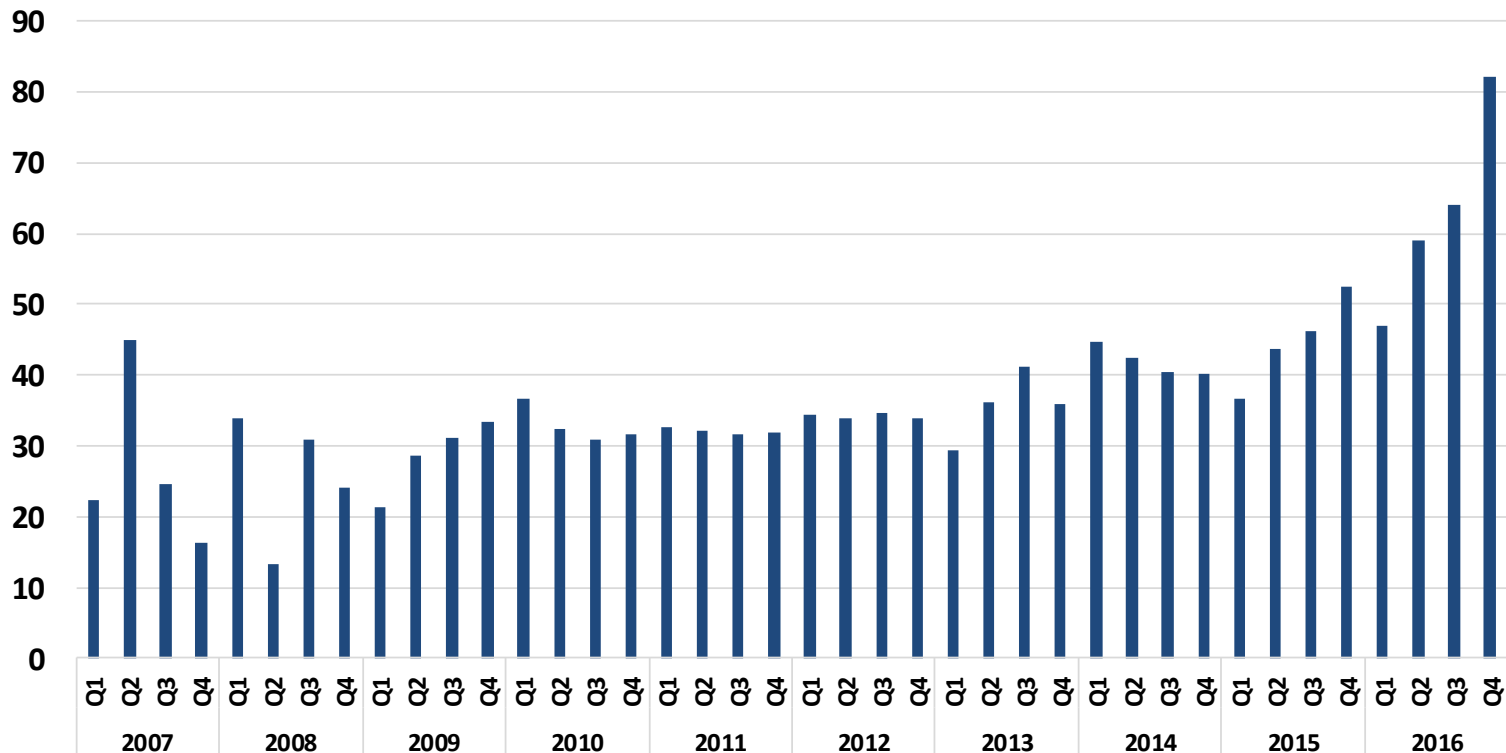
**Average Proppant Intensity by Operator (Lbs/Ft)**



# Fluid Intensity an Important Variable as Well

- Chart below shows average Haynesville fluid intensity on a barrels pumped per foot basis over the past decade.
- Like proppant intensity, fluid intensity in the Haynesville has increased dramatically over the past couple of years, moving from an average of ~45 bbls/ft in '15 to ~65 bbls/ft in '16.
- *Alongside the surge in proppant intensity in Q4'16, fluid concentration also saw a step change, increasing ~30% q/q to 80+ bbls/ft.*

**Average Fluid Intensity by Quarter (Bbls/Ft)**

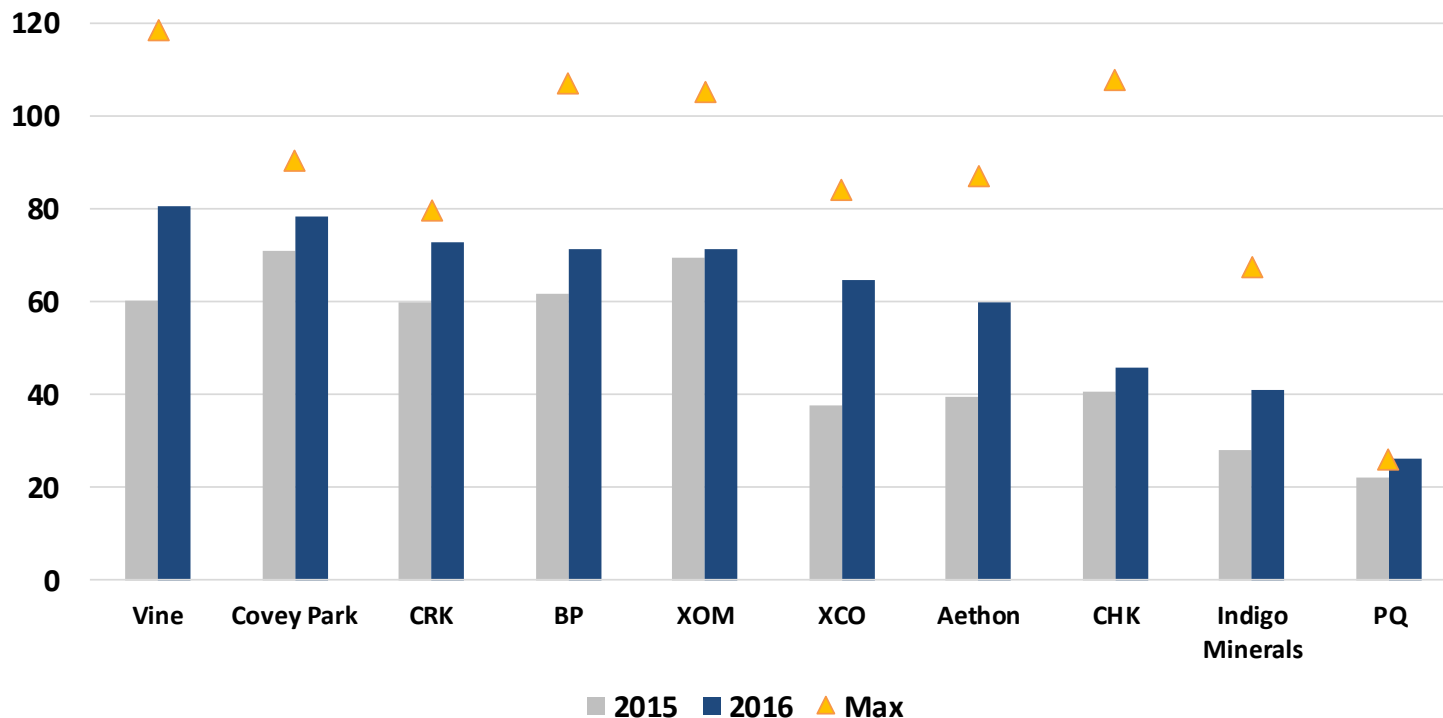




# Fluid Intensity by Operator

- Chart below shows average fluid intensity in the Haynesville by operator over the past two years.
- Looking at '16 data, privates Vine and Covey Park pumped the highest fluid intensity, both around ~80 bbls/foot, while CRK was a close third, with average of ~73 lbs/foot.
- *Interesting to note Vine, CHK, BP and XOM all look to have tested 100+ bbls/ft, with Vine and CHK correlated with 4,000-5,000 lb/foot proppant testing.*

Average Fluid Intensity by Operator (Bbls/Ft)

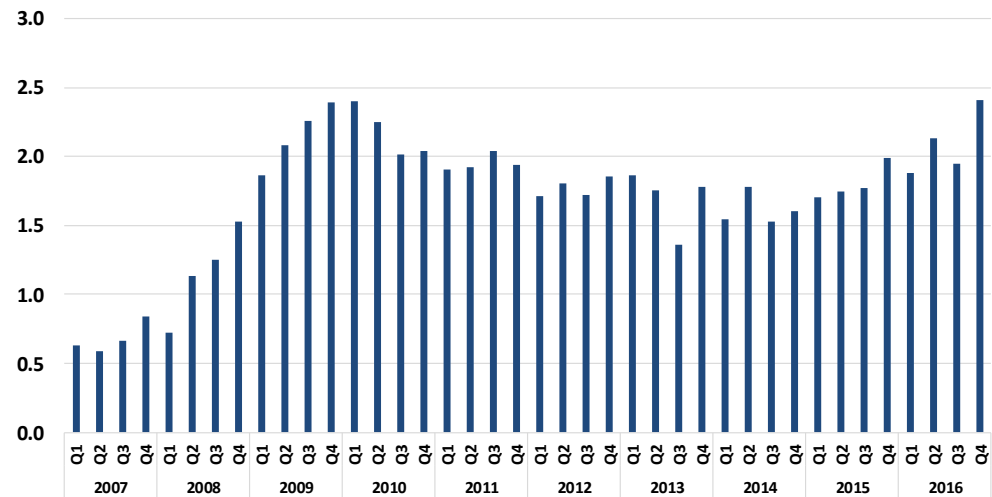




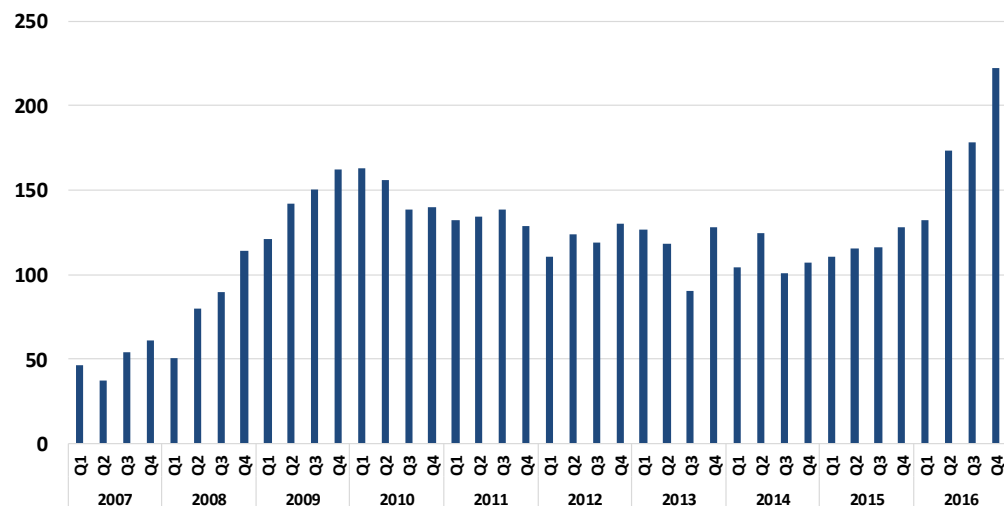
# Frac Evolution Driving Higher Recoveries

- Top chart shows average 30-day Haynesville IP per 1,000' of lateral, while bottom chart shows average 3-month cumulative recovery per 1,000'.
- Looking at 30-day IPs, Q4'16 average of ~2.4 Mmcfd/1,000' was up ~75% from the recent trough and roughly in-line with the prior peak in early '10.
- **More importantly, the average 3-month cumulative recovery in Q4'16 was 222 Mmcfd/1,000', which is an all-time high and almost 40% above the prior peak in early '10.**
- In our view, similar 30-day IPs but better 3-month cumulative recoveries highlights the combination of greater stimulated rock volume with enhanced completions and choke management to minimize pressure drawdown.

Average IP30 by Quarter (Mmcfd/1,000' Lateral)



Average 3-Mo. Cum. Production by Quarter (Mmcfd/1,000' Lateral)

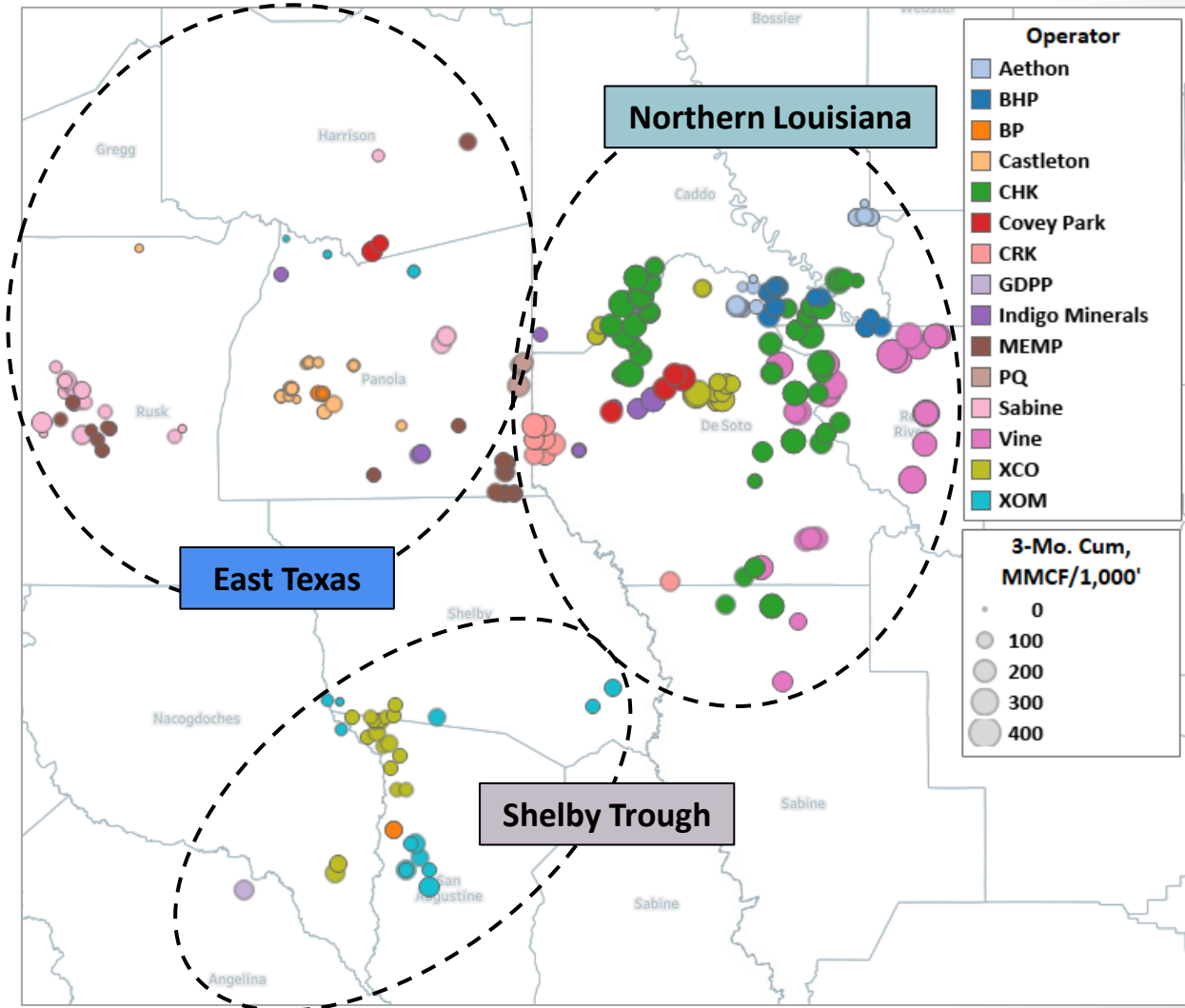






# Best Productivity in Northern Louisiana

- Map shows horizontal Haynesville wells with first production over the past two years, colored by operator and sized by lateral-normalized 3-month cumulative recovery.
- **Best lateral-normalized productivity has been in Northern Louisiana, with '16 average 3-month cumulative recovery of ~205 Mmcf/1,000'.**
- In Shelby Trough, average 3-month recovery in '16 was ~110 Mmcf/1,000', while East Texas averaged ~80 Mmcf/1,000'.

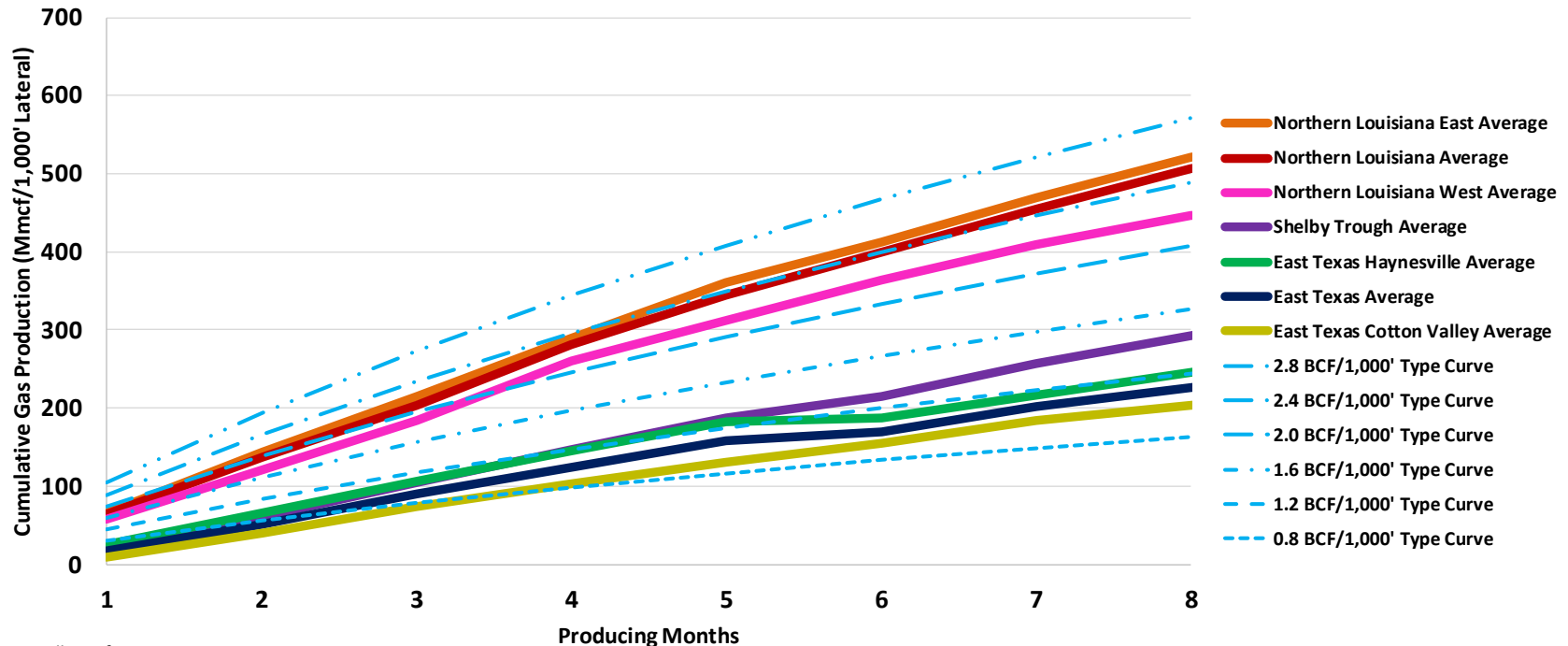




## Best Productivity in Northern Louisiana, Cont'd

- Chart below shows average 2016 lateral-normalized cumulative gas production for each Haynesville region, with Northern Louisiana broken into an eastern/western section and East Texas separated by Haynesville and Cotton Valley formations.
- **Best extended well performance has been in the eastern half of North Louisiana, with average well tracking ~2.6 Bcf/1,000' after 8 months. The western half of North Louisiana is close behind, tracking ~2.2 Bcf/1,000'.**
- To put in context, Dry Gas Utica wells in Ohio recover 2.2-2.6 Bcf/1,000', while dry gas Marcellus wells in SW Appalachia generally track 2-2.5 Bcf/1,000', suggesting **North Louisiana Haynesville is competing with core areas of Appalachia.**

Average Haynesville Well Performance

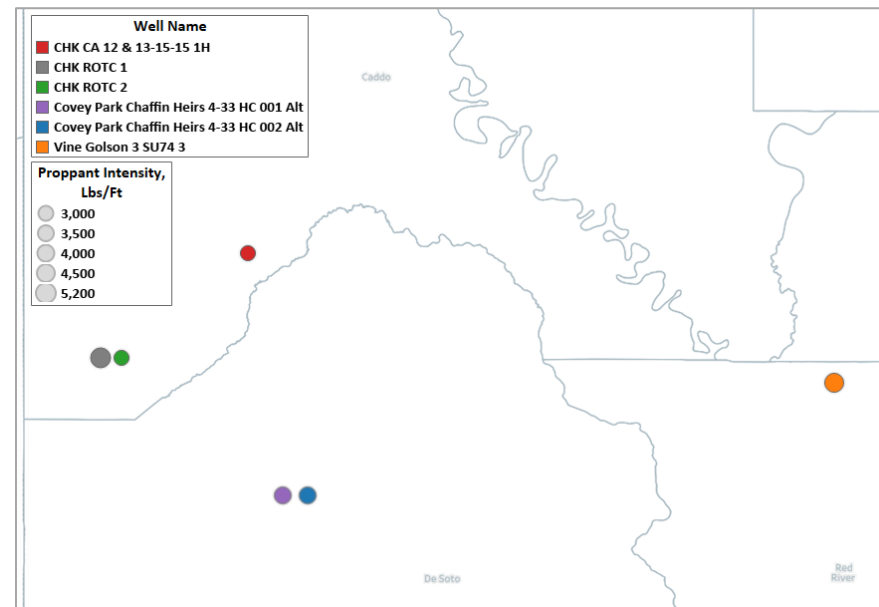
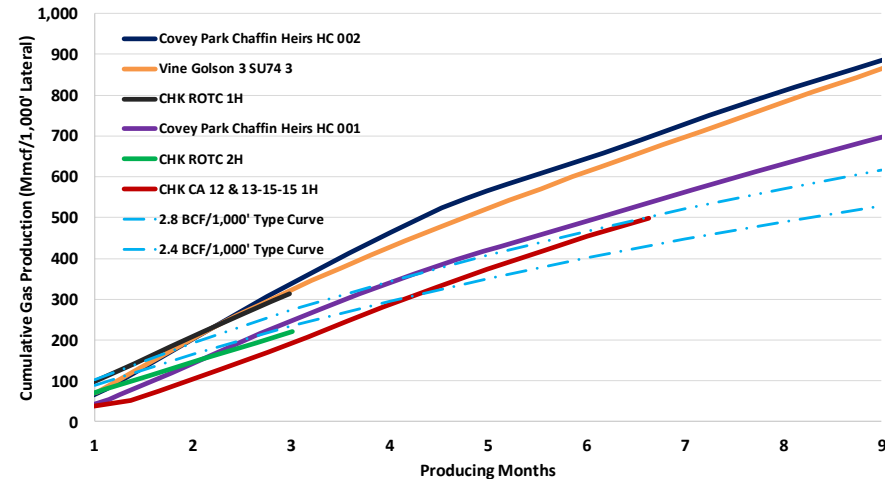




# Leading Edge Suggests More Room to Run

- Chart shows lateral-normalized cumulative production for select, leading-edge Haynesville wells that we believe tested proppant intensities of up to 5,000 lbs/ft, while map plots location of each well.
- While still early on some of these wells, ***five of the six in this sample are performing at or above our 2.8 Bcf/1,000' type curve, suggesting leading-edge proppant designs could push play-wide recoveries up even further in '17.***
- We also find the geographic disposition of these wells encouraging as there is ~35 miles of distance between the western CHK wells and the eastern Vine well.

Haynesville Well Performance from Upsized Fracs

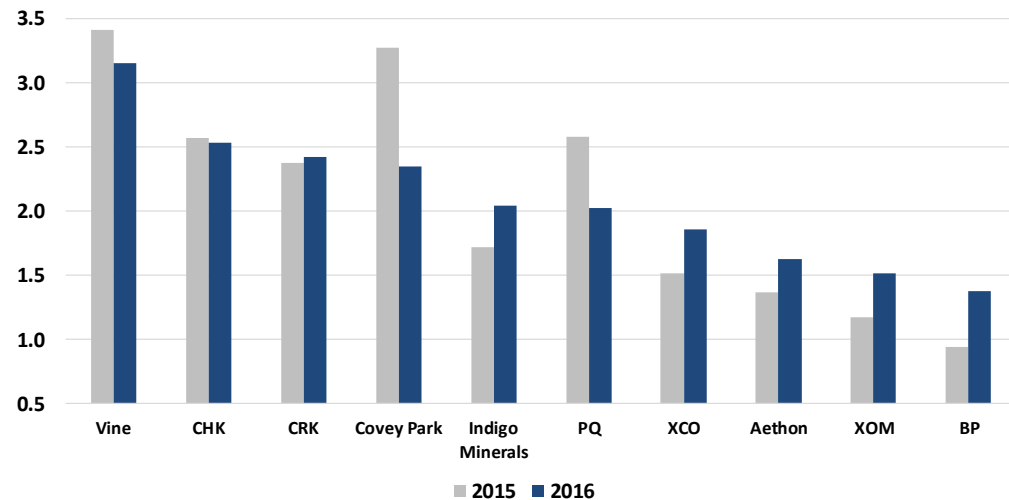




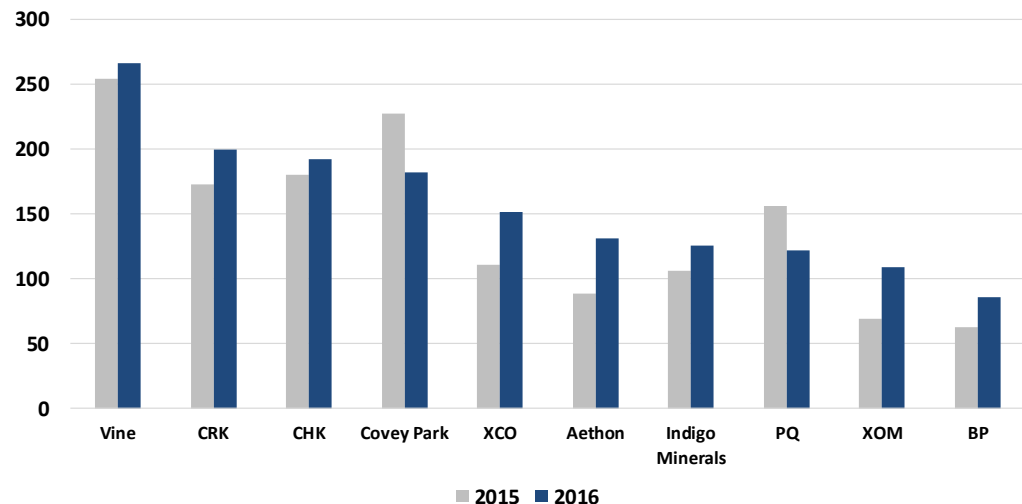
# Well Productivity by Operator

- Top chart shows average lateral-normalized 30-day IPs by operator, while bottom chart shows average 3-month cumulative recoveries.
- Looking at '16 well performance, **best lateral-normalized 30-day IP rates have been at Vine, CHK, CRK and Covey Park, while the same four operators also stand out as generating the best 3-month cumulative recoveries.**

Average IP30 by Operator (Mmcfd/1,000' Lateral)



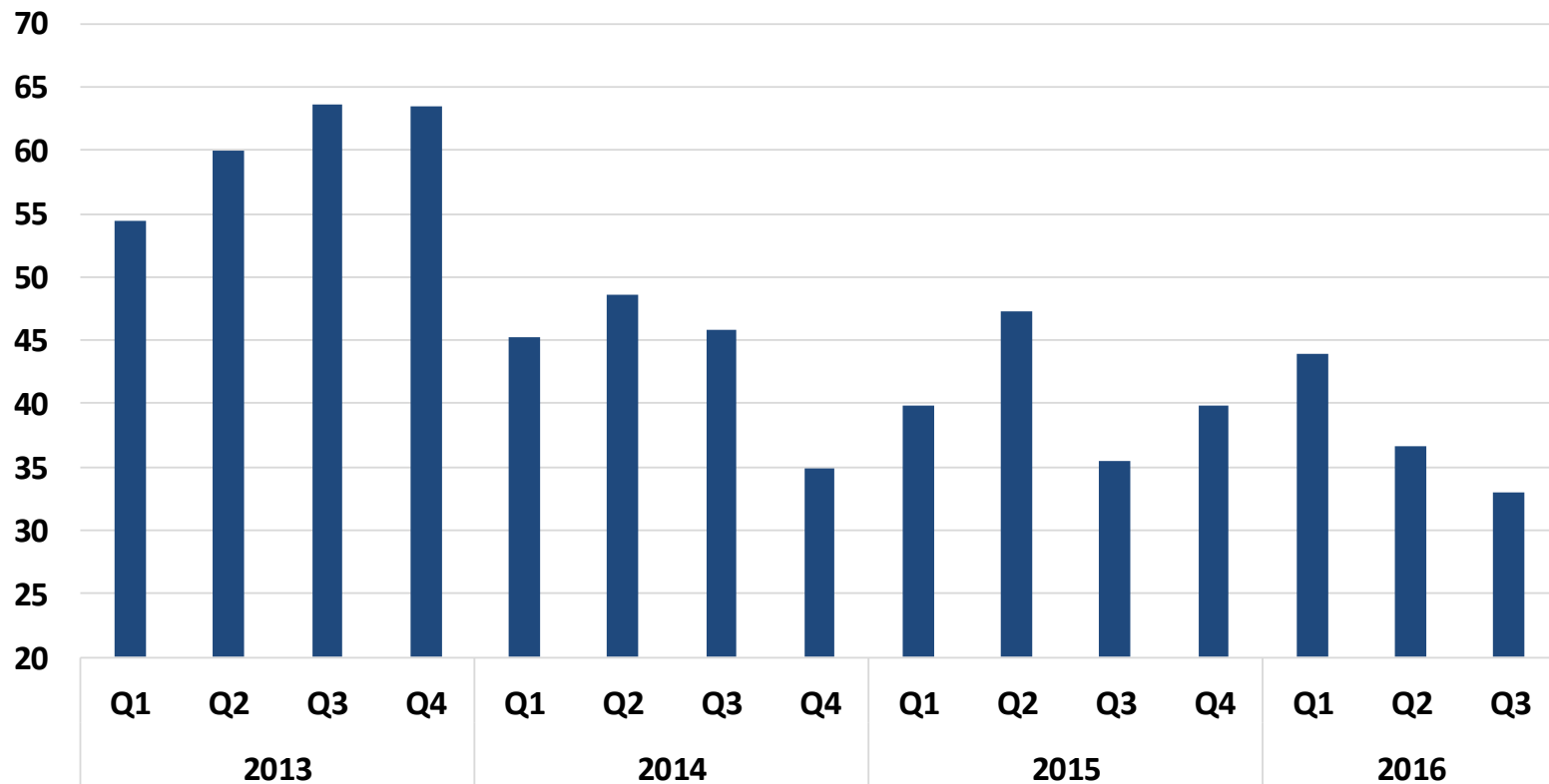
Average 3-Mo. Cum. Production by Operator (Mmcf/1,000' Lateral)



# Spud to Rig Release Down ~50%

- Chart below shows average spud to rig release times in the Haynesville over the past few years.
- *Despite a material increase in lateral length, average spud to rig release time in the play has decreased from north of 60 days in '13 to <35 days in Q3'16.*

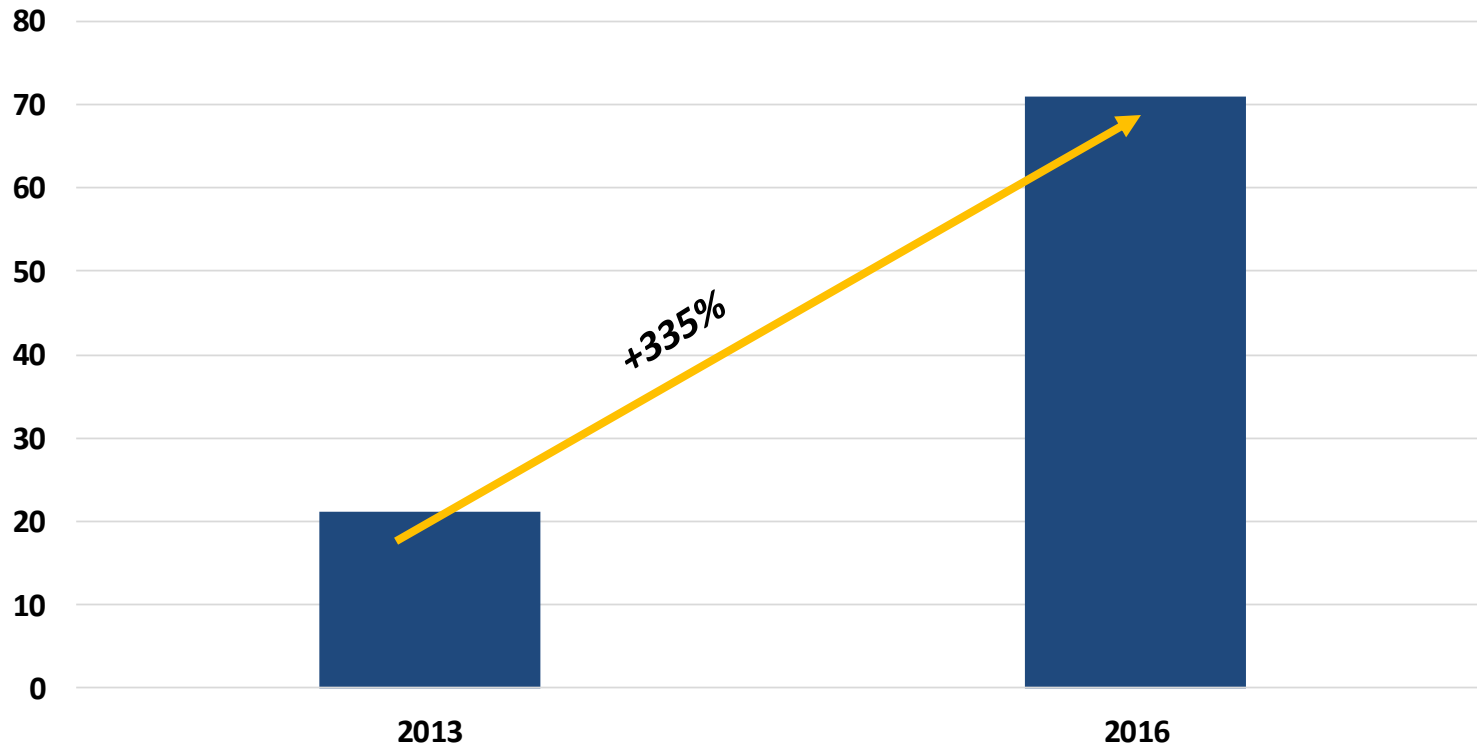
**Average Spud to Rig Release Time by Quarter (Days)**



# All Leading To More Production Per Rig...

- Using average spud to TD time, lateral length and productivity per well, below we calculate annual gas production per Haynesville rig in '13 and '16.
- ***Over the past three years, annual gas deliverability per rig has increased more than 3x to 70+ Mmcfpd, driven by the compound effect of longer laterals, drilling efficiency gains and increased well productivity from enhanced completions.***

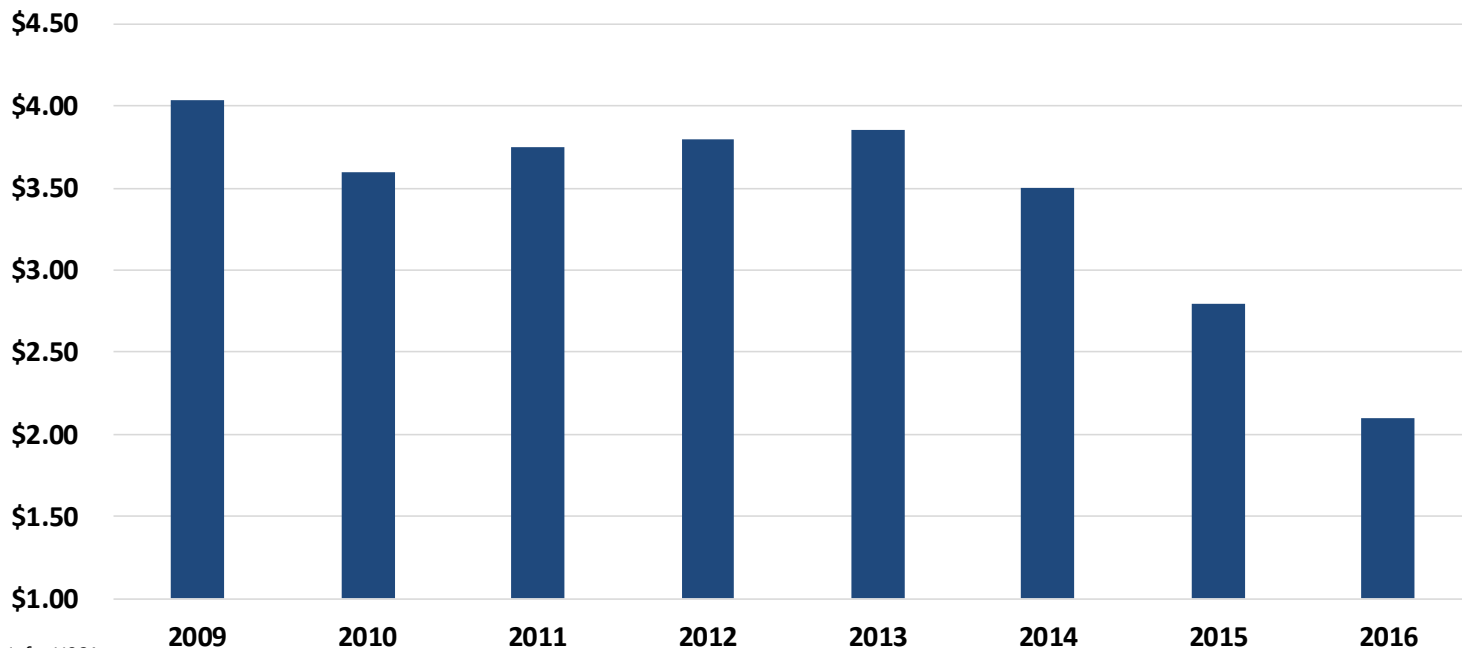
**Gross Annual Production Per Rig (Mmcfpd/Rig)**



## ...And Lower Breakeven Pricing...

- Chart below shows USCAe estimate for breakeven gas price in the Haynesville based on average well performance across the play for stated time periods.
- From 2009 to 2014, average Haynesville well performance suggests PV-10 breakeven gas price oscillated between \$3.50-\$4.00/Mcf.
- We saw a notable decline in 2015, which was the first year we believe play-wide breakeven dropped below \$3/Mcf.
- ***Latest results suggest a further step-change in breakeven prices, with average 2016 well performance implying a breakeven price of ~\$2.10/Mcf.***

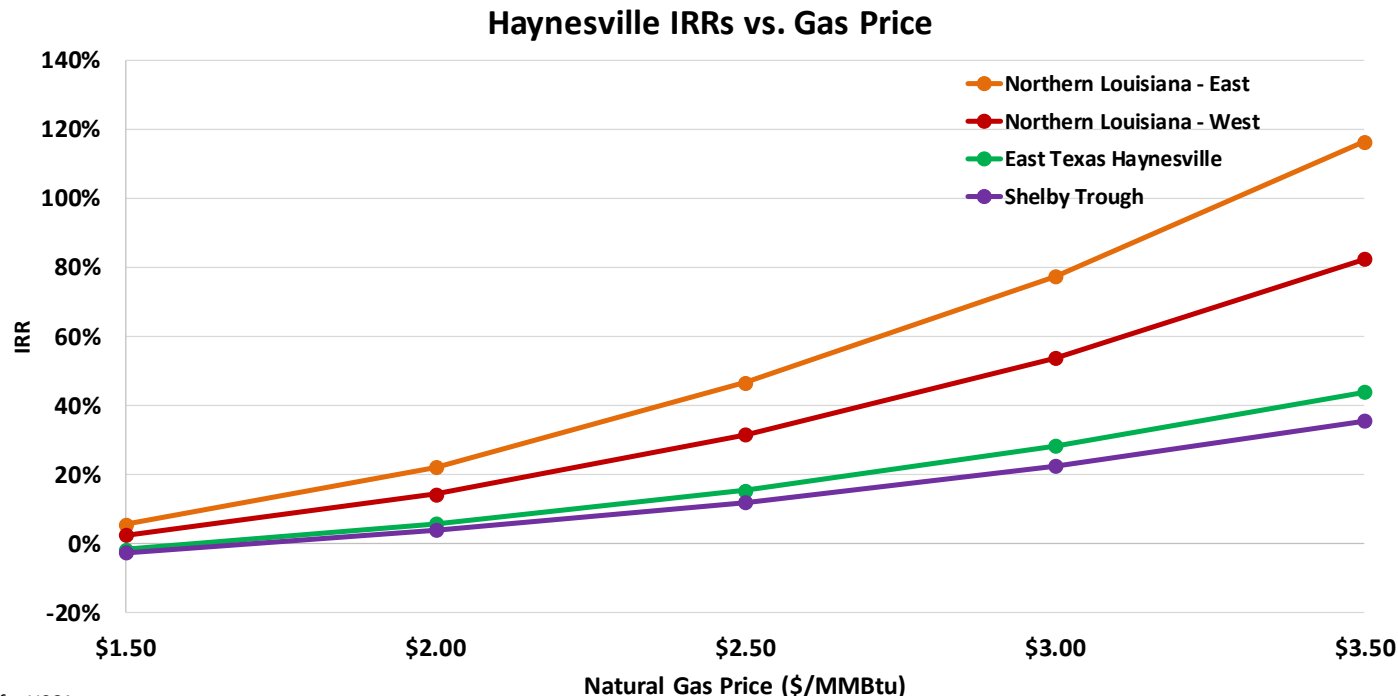
Haynesville PV-10 Breakeven Gas Price (\$/MMBtu)





## ...With Strong Returns at \$3 Gas...

- Chart shows Haynesville IRR sensitivities under various Henry Hub gas price scenarios assuming \$1,100/foot D&C cost and all-in LOE, midstream expense and basis of 75c/Mcf.
- **At \$3/Mmbtu gas prices, Northern Louisiana generates robust returns, with the eastern and western areas at 77% and 54%, respectively.**
- Notably, even at \$2.50/Mmbtu, average return among eastern and western Northern Louisiana areas is ~40%.
- We see the most room for economic improvement in the Shelby Trough area, where we believe there is still material upside to frac intensity and well recoveries.

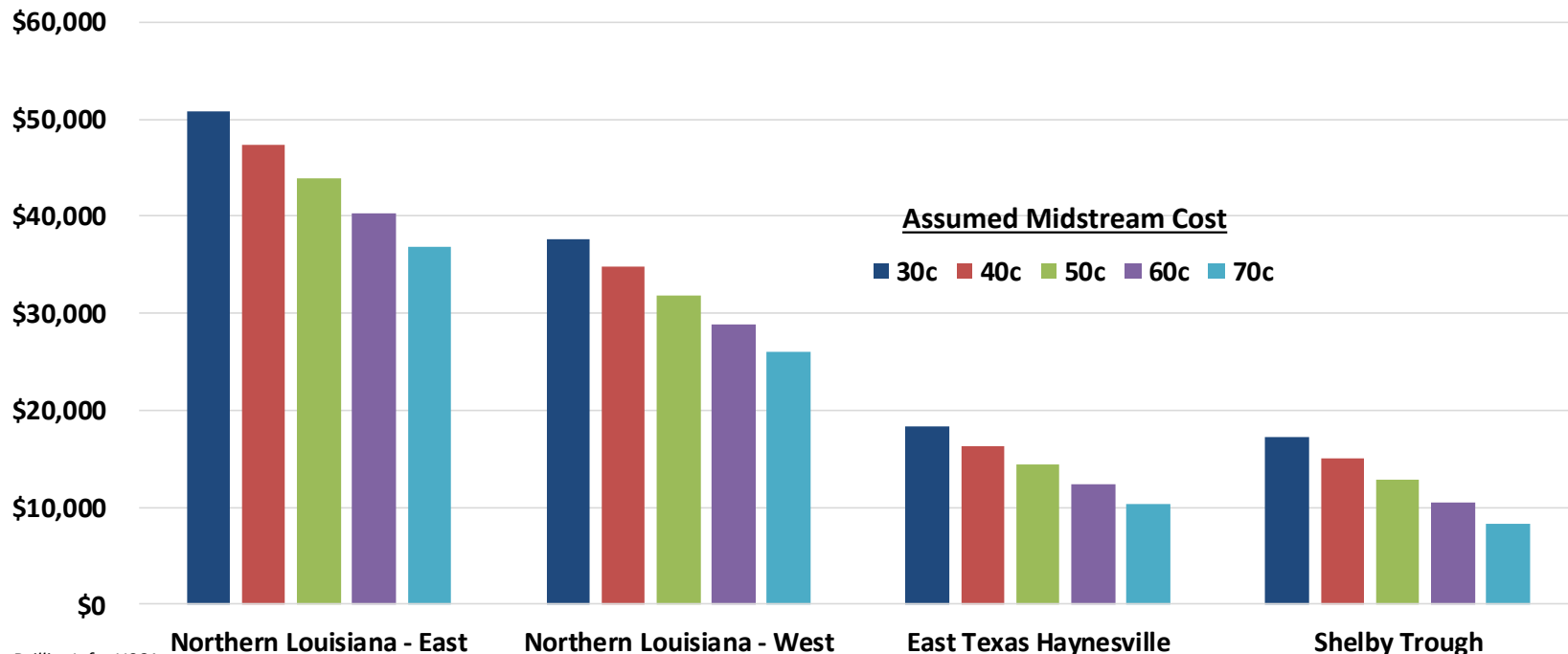




## ...Driving Higher NPV Per Acre...

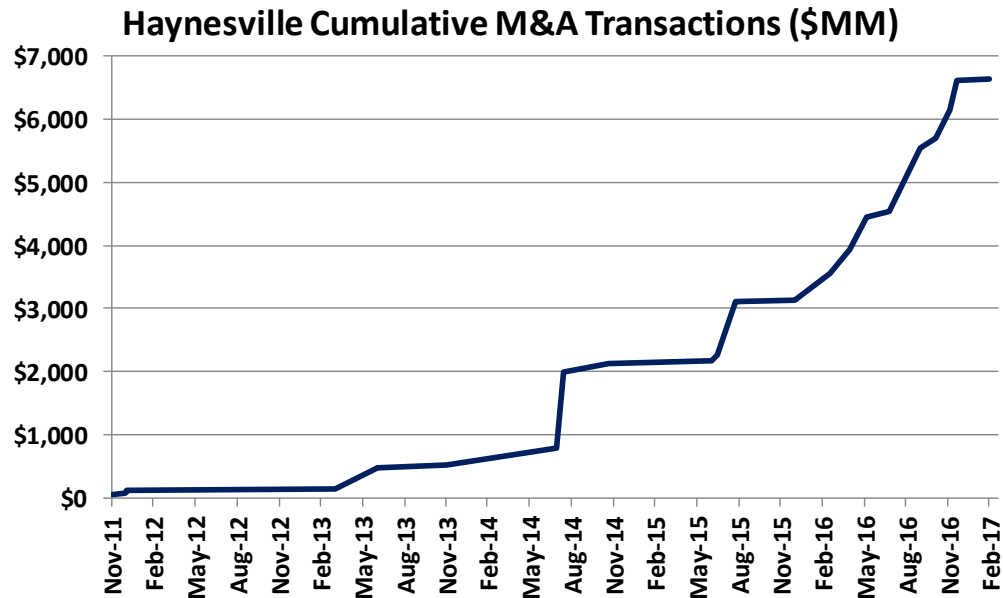
- Chart below shows implied Haynesville acreage values assuming six wells/section, various midstream costs and running strip pricing at 10% discount rate. Note midstream expenses shown are incremental to LOE/basis assumptions of 10c/15c.
- Given varying contract structures/terms, we think midstream expense is one of the more important variables to consider when assessing economics and valuation for Haynesville operators.
- *Per our math, the eastern part of North Louisiana generates the highest intrinsic acreage value, with NPV of \$35,000-\$50,000/acre depending on midstream costs, while the western part of North Louisiana is worth \$25,000-\$35,000/acre.*

Implied NPV-10 Per Haynesville Acre



## ...Fueling \$6+ Billion of M&A...

- Chart and table below show material M&A transactions in the Haynesville region over the past several years.
- The second wave of Haynesville M&A was kicked off by private Vine buying RDS' Haynesville position, followed by GeoSouthern buying ECA's acreage.
- More recently, CHK divested ~\$900 mm worth of Haynesville properties late last year to Indigo Minerals and Covey Park.
- ***In total, we count ~\$6.6 billion of Haynesville transactions over the past few years.***



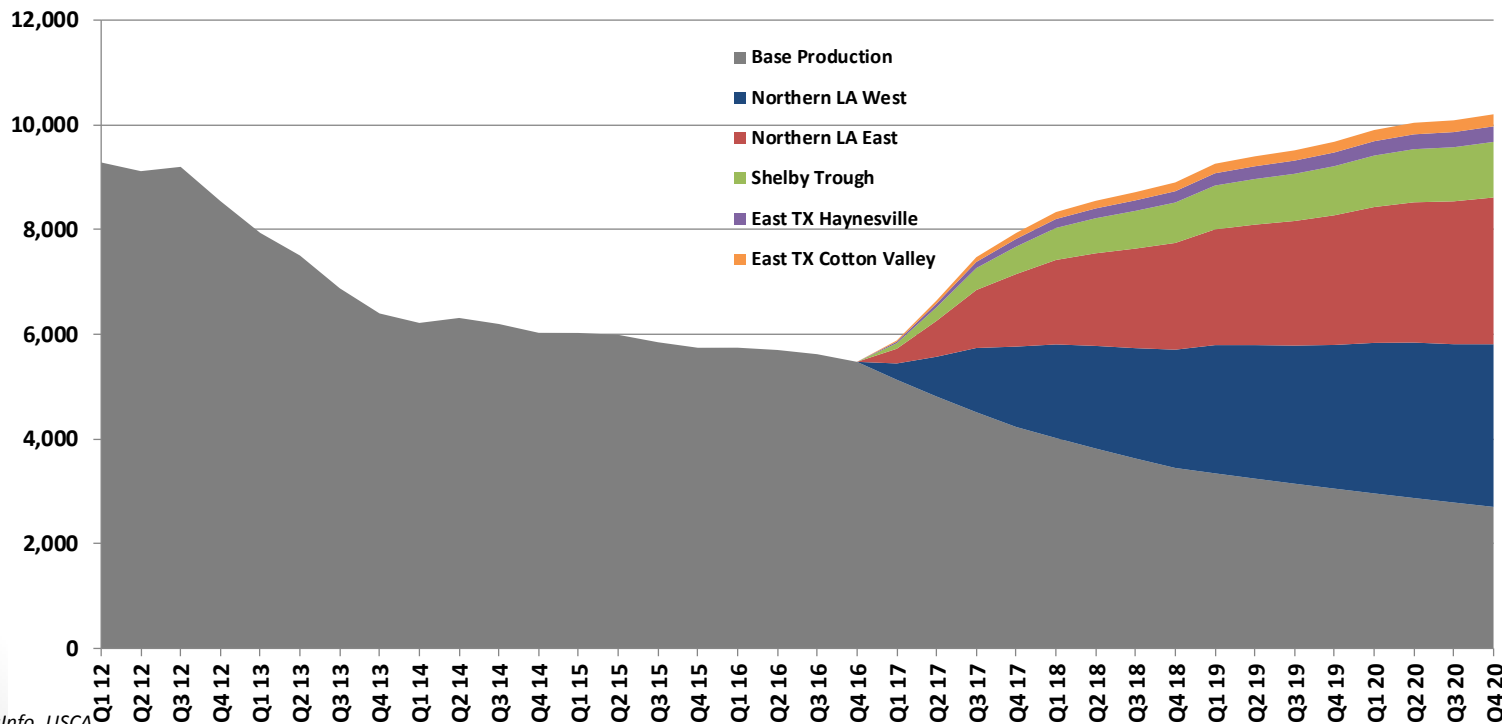
Material Haynesville M&A Transactions					
Date	Buyer	Seller	Transaction	Net Acreage	Area
8/14/2014	Vine Oil & Gas/Blackstone Group	Shell	\$1,200	107,000	Northern Louisiana
8/25/2015	GeoSouthern/GSO Capital	ECA	\$850	112,000	Northern Louisiana
3/18/2016	Covey Park	EPE	\$420	34,167	Northern Louisiana
4/28/2016	Indigo Minerals	Beusa Energy	\$375	NA	Northern Louisiana
6/6/2016	Sheridan Production	DVN	\$525	140,000	East Texas
9/30/2016	Castleton Commodities	APC	\$1,000	104,600	East Texas
12/5/2016	Indigo Minerals	CHK	\$450	78,000	Northern Louisiana
12/20/2016	Covey Park	CHK	\$465	41,500	Northern Louisiana



# ...All Culminating in Resumption of Supply Growth

- Chart below shows our forecast for gross Haynesville gas production through 2020 assuming the regional rig count averages 40 rigs over this period.
- ***Our forecast suggests Haynesville gas production should grow by 1+ Bcfpd per annum through the end of the decade, which implies output will exceed the prior play-wide peak by early '19 and exceed 10 Bcfpd in 2020.***
- Northern Louisiana should be the biggest driver of this growth, accounting for ~75% of production adds through the end of the decade.

USCA Haynesville Region Gas Production Forecast (Mmcfpd)



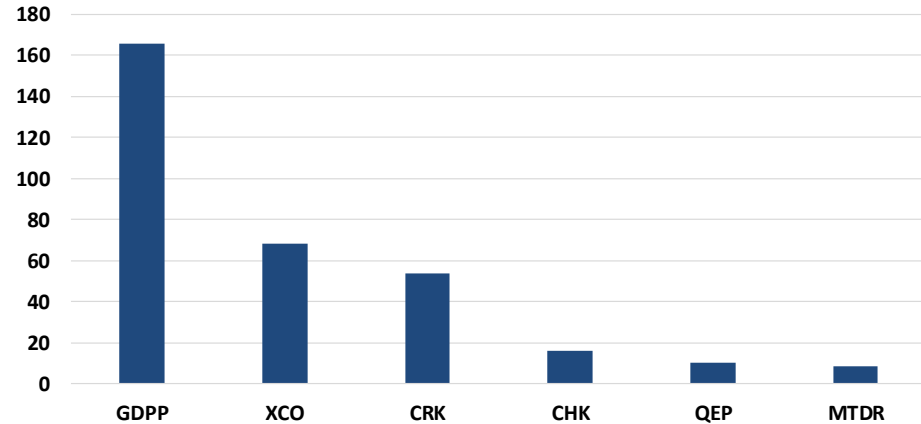
Source: DrillingInfo, USCA



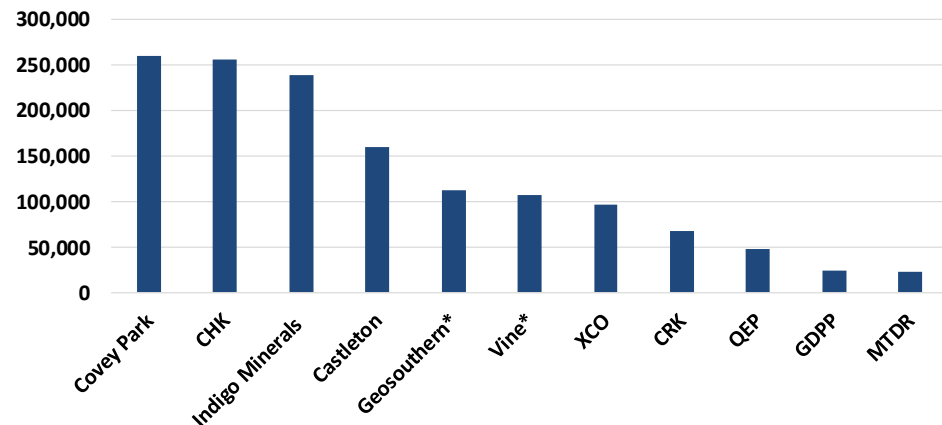
# Looking at Haynesville Leverage by Operator

- Top chart shows public E&P exposure to the Haynesville on an acre per \$MM of enterprise value basis, while bottom chart shows absolute acreage counts.
- In the public markets, greatest exposure to the Haynesville on an acreage vs. enterprise value basis is GDPP (166 acres/\$MM of EV), XCO (68 acres/\$MM of EV) and CRK (53 acres/\$MM of EV).
- CHK, MTDR and QEP are also exposed, but at a much smaller scale relative to respective enterprise values.
- In the private arena, we believe Covey Park and Indigo Minerals have the largest acreage positions with USCAe ~260,000 and ~240,000 net acres, respectively.

Public E&Ps Net Haynesville Acres per \$MM of EV



Net Haynesville Acres by Operator



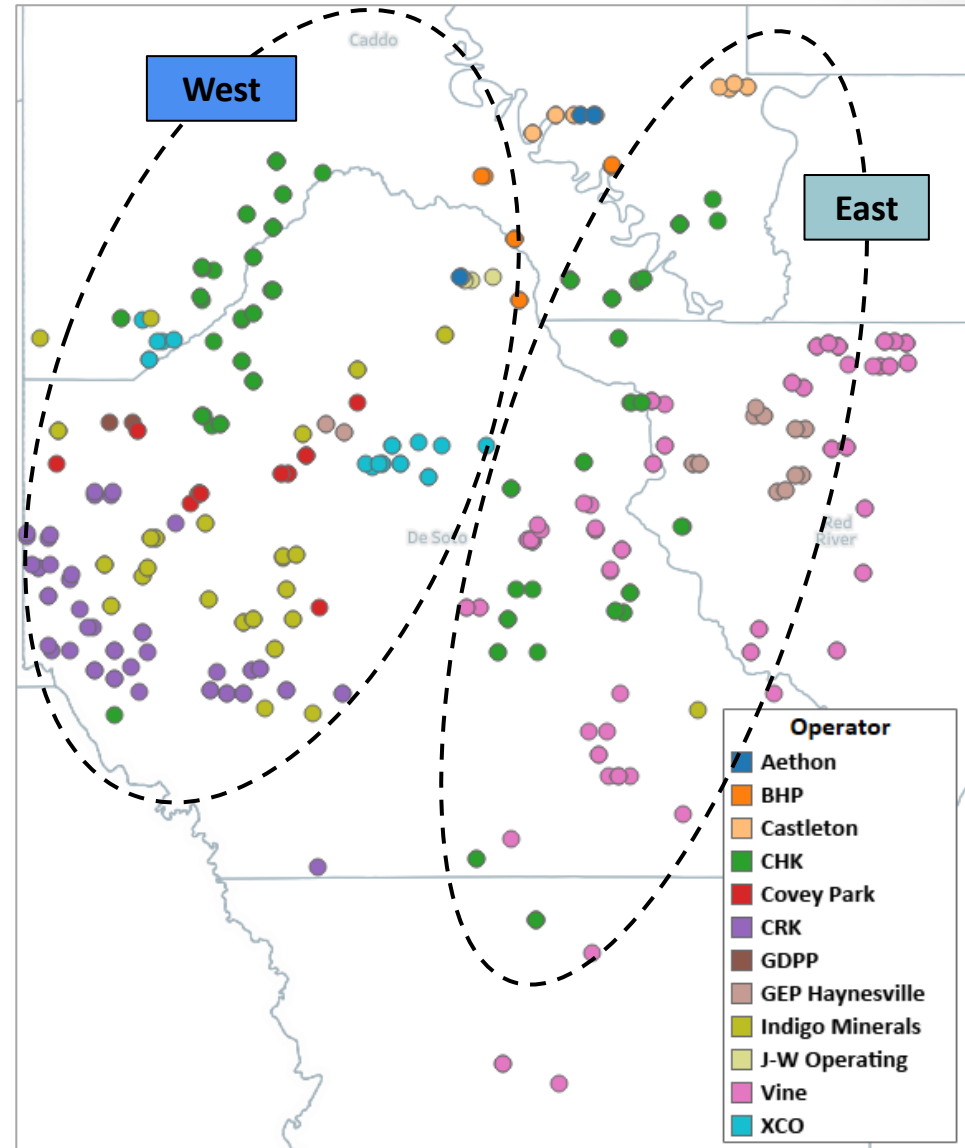
\*Acreage acquired in initial basin entry, USCA unsure if acreage positions have changed materially since

# **Regional Deep Dive: Northern Louisiana**



# Northern Louisiana – Permit Activity

- Map shows horizontal permit activity colored by operator in Northern Louisiana, which we break into east and west regions.
- **CHK, GEP Haynesville and Vine are the dominant operators in the East, while CHK, Covey Park, CRK, Indigo Minerals and XCO are the dominant operators in the Western area.**

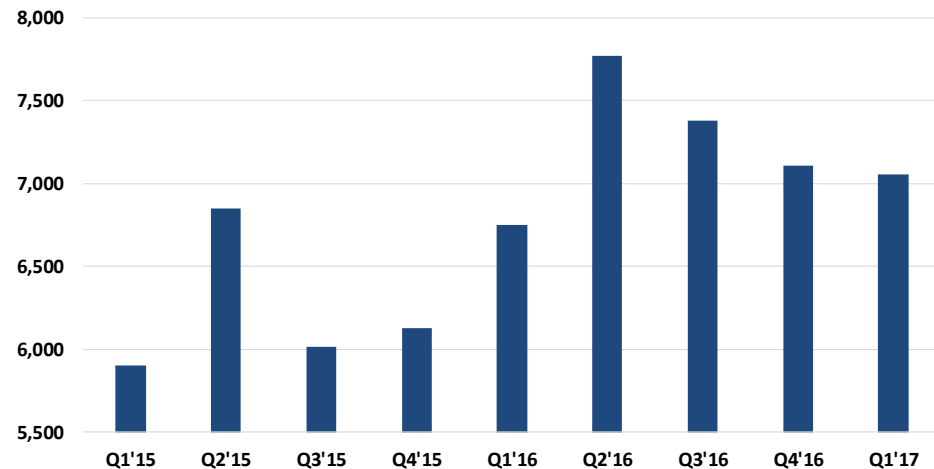




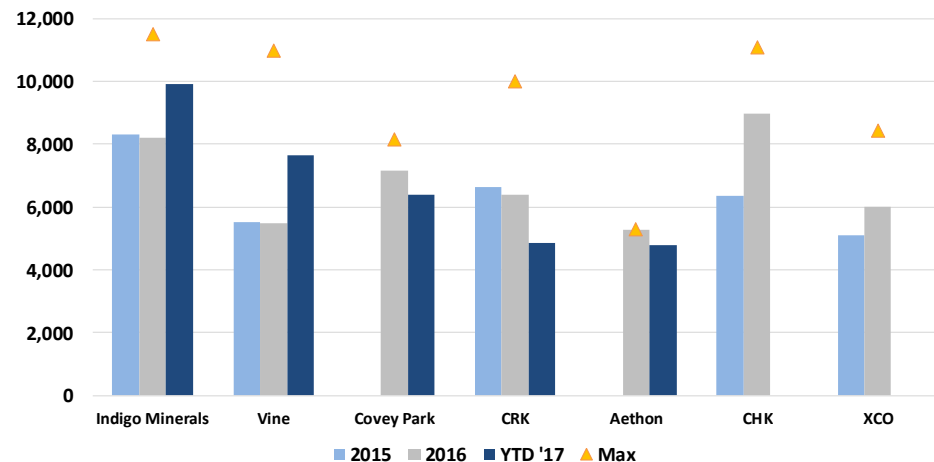
# Northern Louisiana – Permitted Lateral Lengths

- Top chart shows average permitted lateral length in North Louisiana over time, while bottom chart shows average permitted lateral length by operator.
- Northern Louisiana average permitted lateral has increased from ~5,700' in early '15 to ~7,200' average in '16, with '17 YTD data showing ~7,100' average.
- Looking at '17 YTD, private Indigo Minerals has permitted the longest average lateral at ~9,900', followed by privates Vine at ~7,700' and Covey Park at ~6,400'.

Northern Louisiana Average Permitted Lateral Length by Quarter (Ft)



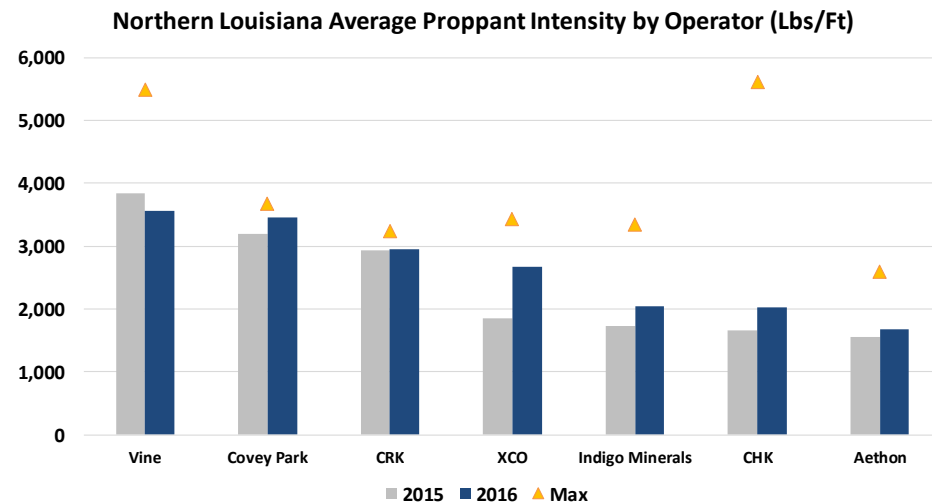
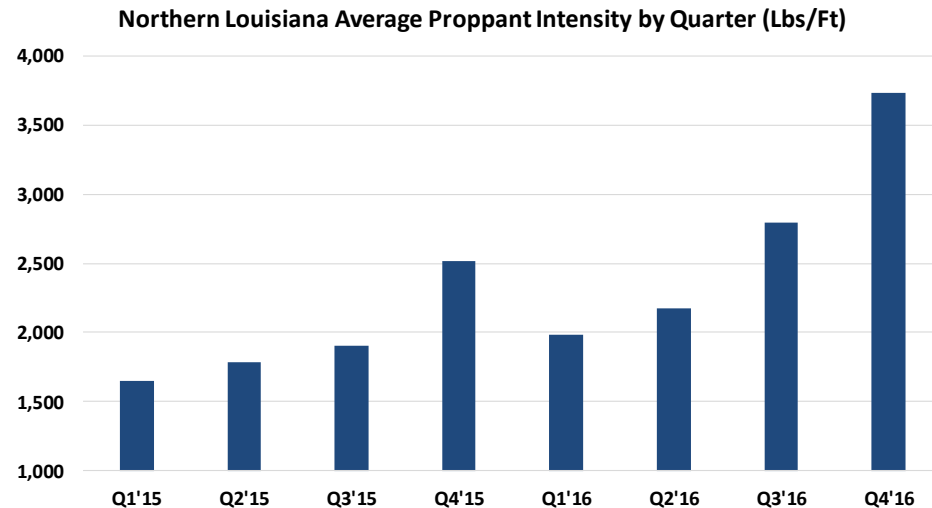
Northern Louisiana Avg. Permitted Lateral Length by Operator (Ft)





# Northern Louisiana – Proppant Intensity

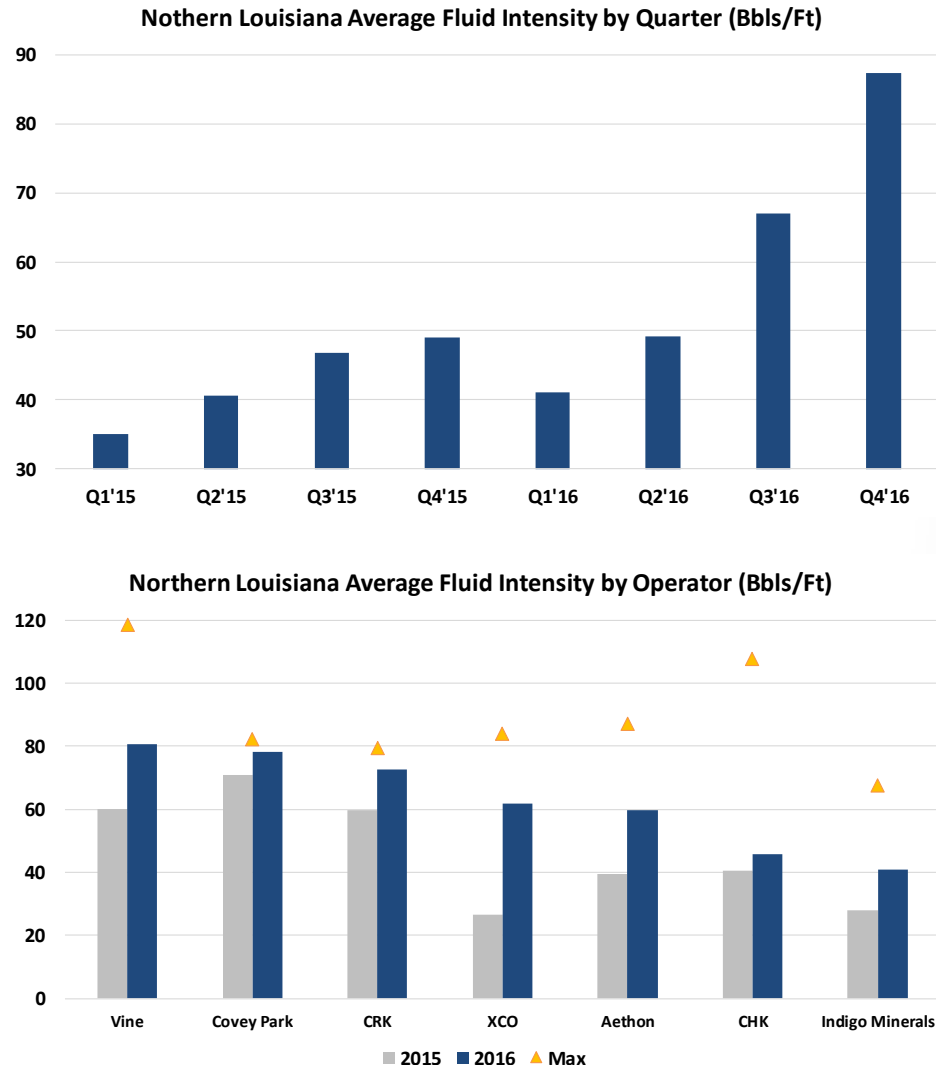
- Top chart shows average proppant intensity in Northern Louisiana over time, while bottom chart shows average proppant intensity by operator.
- Proppant intensity in Northern Louisiana has surged from ~1,700 lbs/foot in early '15 to a whopping ~3,700 lbs/foot in Q4'16.
- At the operator level, privates Vine and Covey Park have pumped the most intense fracs, both averaging near ~3,500 lbs/ft in '16.
- We note both CHK and Vine have tested ~5,000 lbs/ft proppant loadings here with encouraging initial results.





# Northern Louisiana – Fluid Intensity

- Top chart shows average fluid intensity in Northern Louisiana over time, while bottom chart shows average fluid intensity by operator.
- Similar to proppant, fluid intensities ramped appreciably throughout '16, with Q4'16 data showing ~87 bbl/ft or more than double the '15 average.
- Looking at '16 data, Vine, Covey Park, CRK and XCO ran the highest fluid intensities, all north of 60 bbls/ft.
- We note Vine and CHK have tested 100+ bbls/ft in conjunction with ramping up proppant leading toward 5,000 lbs/foot.

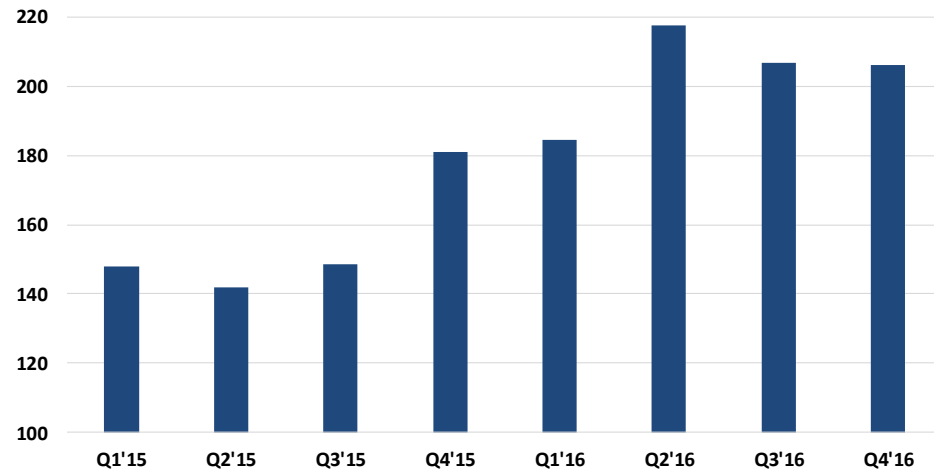




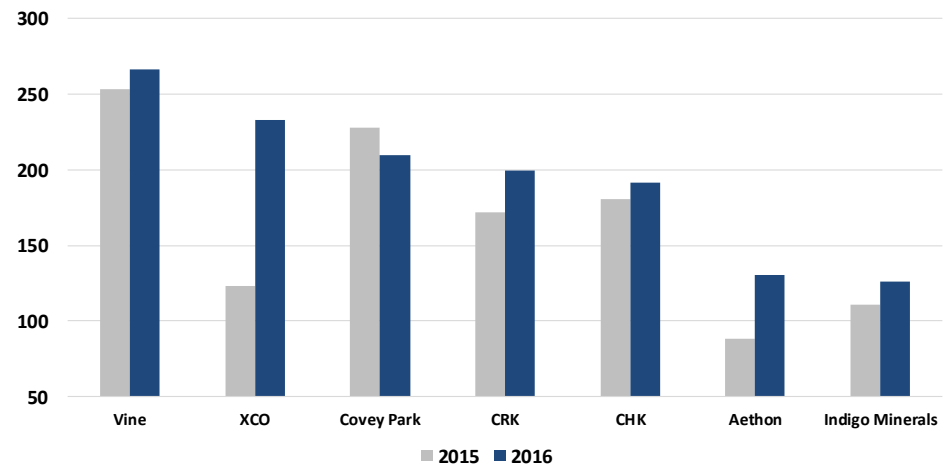
# Northern Louisiana – Well Productivity

- Top chart shows average lateral-normalized 3-month cumulative gas production in Northern Louisiana over time, while bottom chart shows similar data broken out by operator.
- Since inflecting in early '16, 3-month cumulative recoveries have been above 200 Mmcf/1,000' over the past several quarters.
- ***Looking at '16 data, Vine, XCO, Covey Park and CRK posted the best lateral-normalized 3-month cumulative performance.***

N. Louisiana Avg. 3-Mo. Cum. Prod. by Quarter (MMCF/1,000')

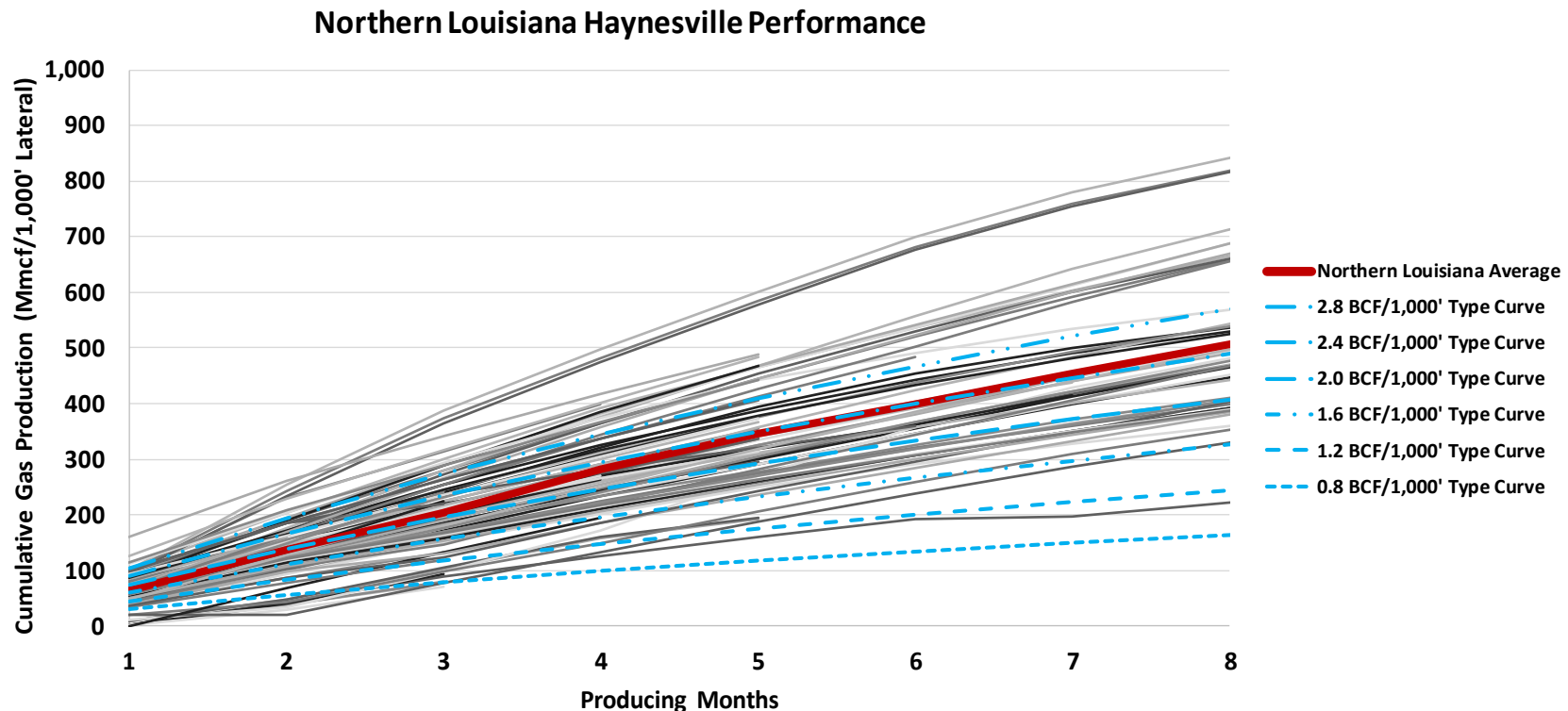


N. Louisiana Avg. 3-Mo. Cum. Prod. by Operator (MMCF/1,000')



# Northern Louisiana – Average Well Performance

- Chart below shows lateral-normalized cumulative gas production for 2016 vintage horizontal wells in the Northern Louisiana region as a whole, plotted against our internal type curves.
- ***Average 2016 well performance in Northern Louisiana is tracking our 2.4 BCF/1,000' EUR type curve after 8 months of production.***
- Notably, there are multiple wells in the data set tracking EURs at our above 2.8 Bcf/1,000', which correlates well with higher proppant intensities.

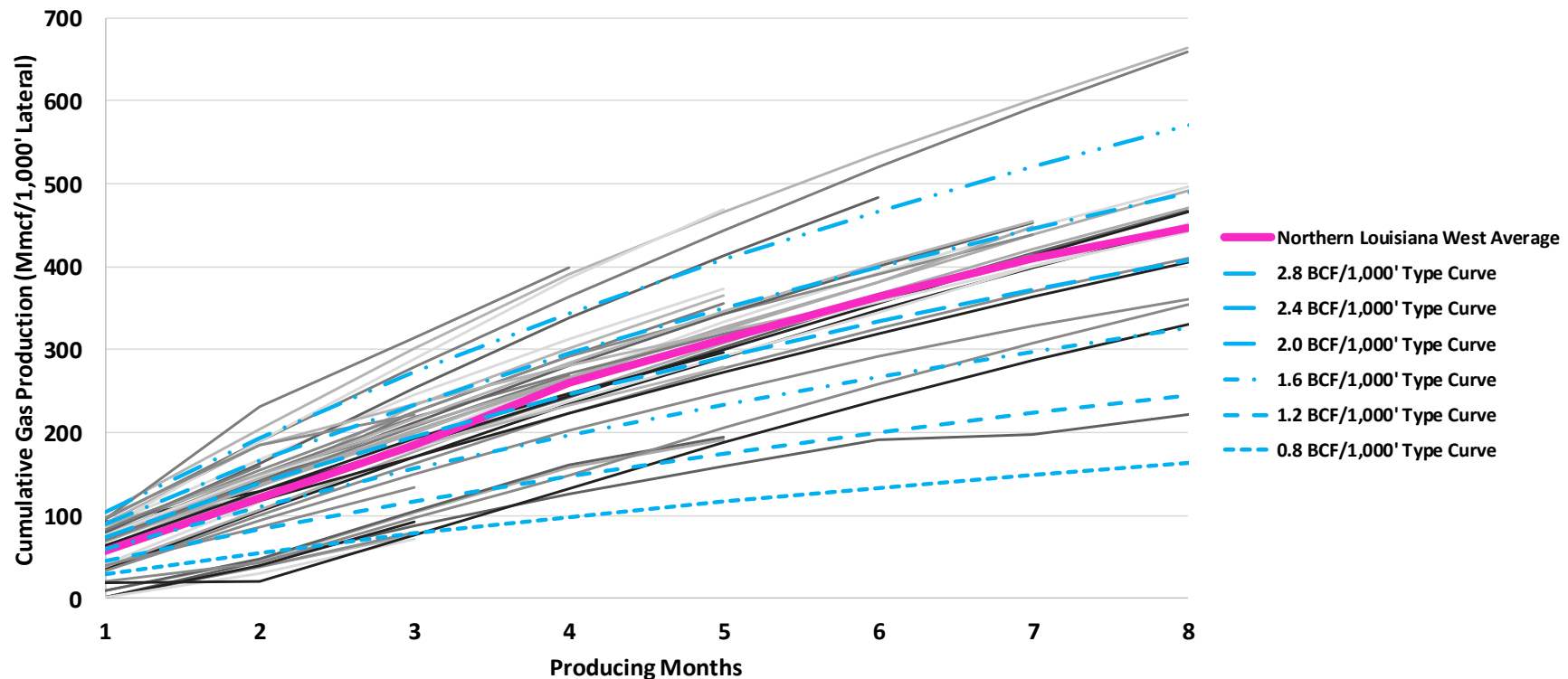




# Northern Louisiana – Western Well Performance

- Same chart as last slide, but focusing on wells in the western region of Northern Louisiana.
- *Per our analysis, the average 2016 well in the western part of North Louisiana is tracking a ~2.2 BCF/1,000' EUR type curve after 8 months of production.*

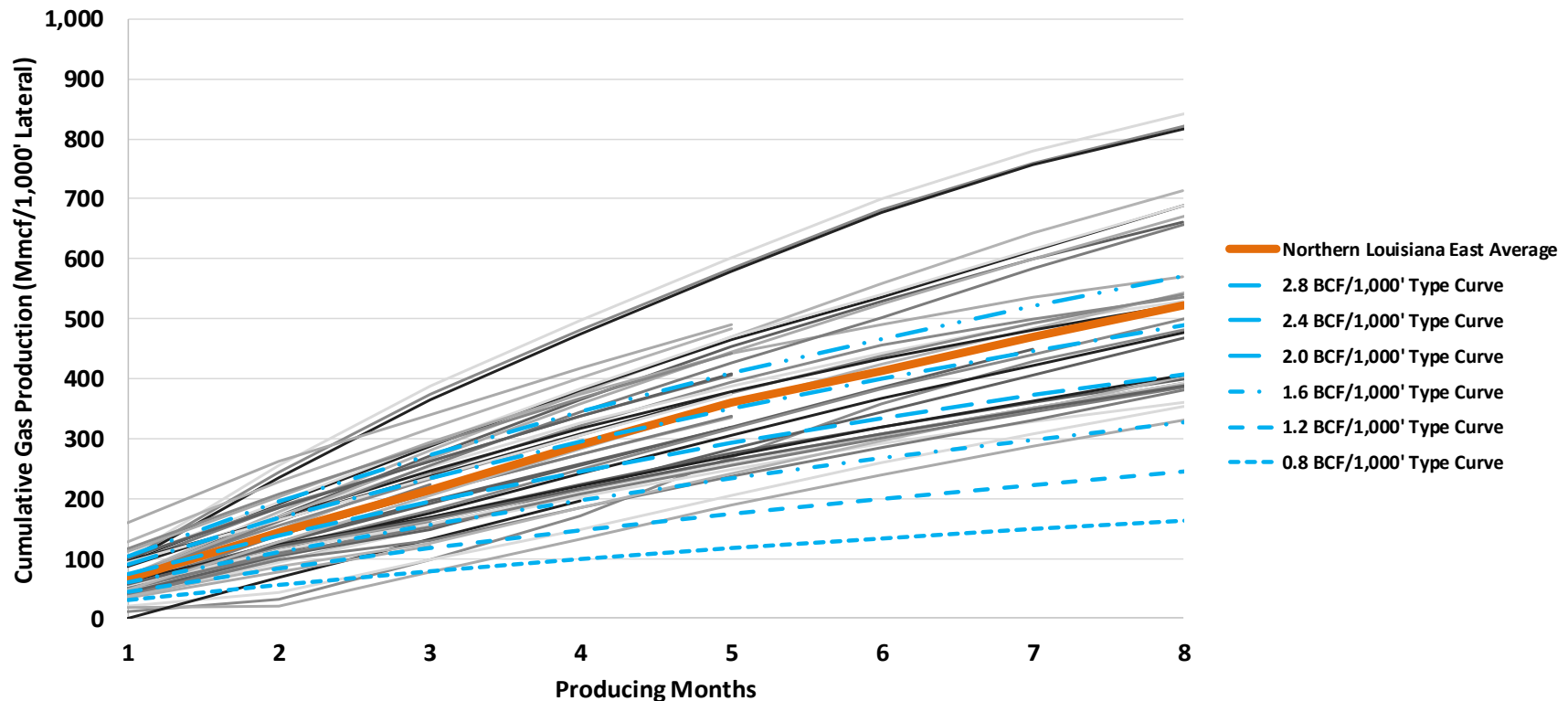
Northern Louisiana Western Haynesville Performance



# Northern Louisiana – Eastern Well Performance

- Same chart as last slide, but focusing on wells in the eastern region of Northern Louisiana.
- *Per our analysis, the average 2016 well in the eastern part of North Louisiana is tracking a ~2.6 BCF/1,000' EUR type curve after 8 months of production.*

Northern Louisiana Eastern Haynesville Performance

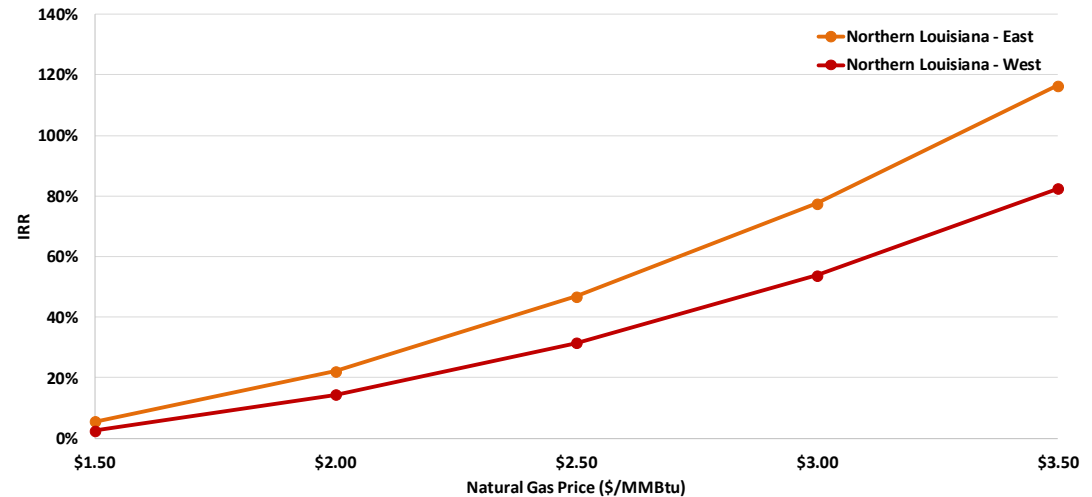




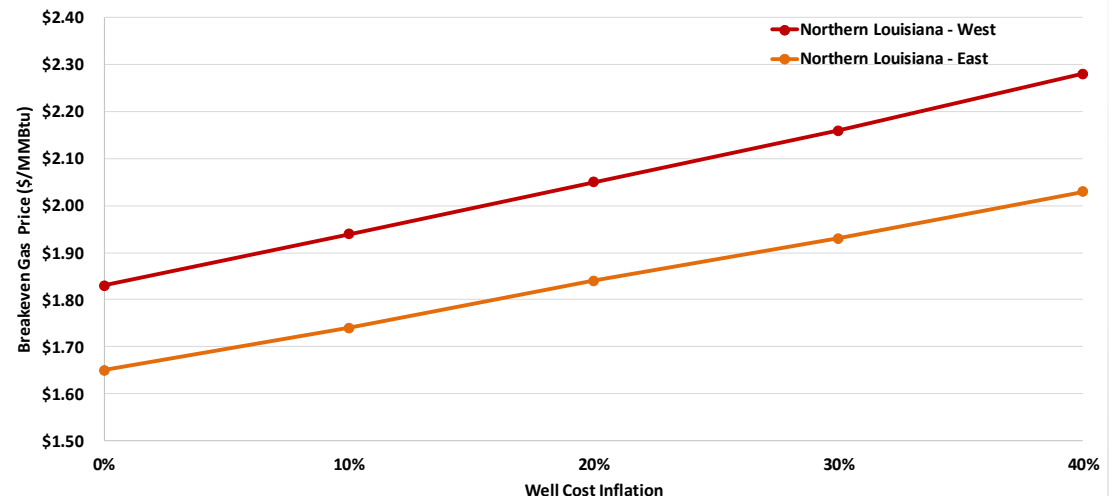
# Northern Louisiana – Breakeven Analysis

- Top chart shows Haynesville IRR sensitivity to gas prices in Northern Louisiana assuming 7,500' lateral, \$8 mm well cost and ~75c of all-in LOE/midstream/basis costs. Bottom chart runs same assumptions but compares breakeven against potential OFS inflation scenarios.
- At \$3/Mmbtu, average '16 well performance implies eastern and western area BTAX IRRs of 77% and 54%, respectively.
- **At current well costs, we see East and West Louisiana Haynesville wells breaking even at ~\$1.65/Mmbtu and ~\$1.85/Mmbtu, respectively.**
- For every ~10% of potential OFS cost inflation, breakevens increase by ~10c/Mmbtu.

Northern Louisiana IRR vs. Gas Price



Northern Louisiana Breakevens vs. Cost Inflation

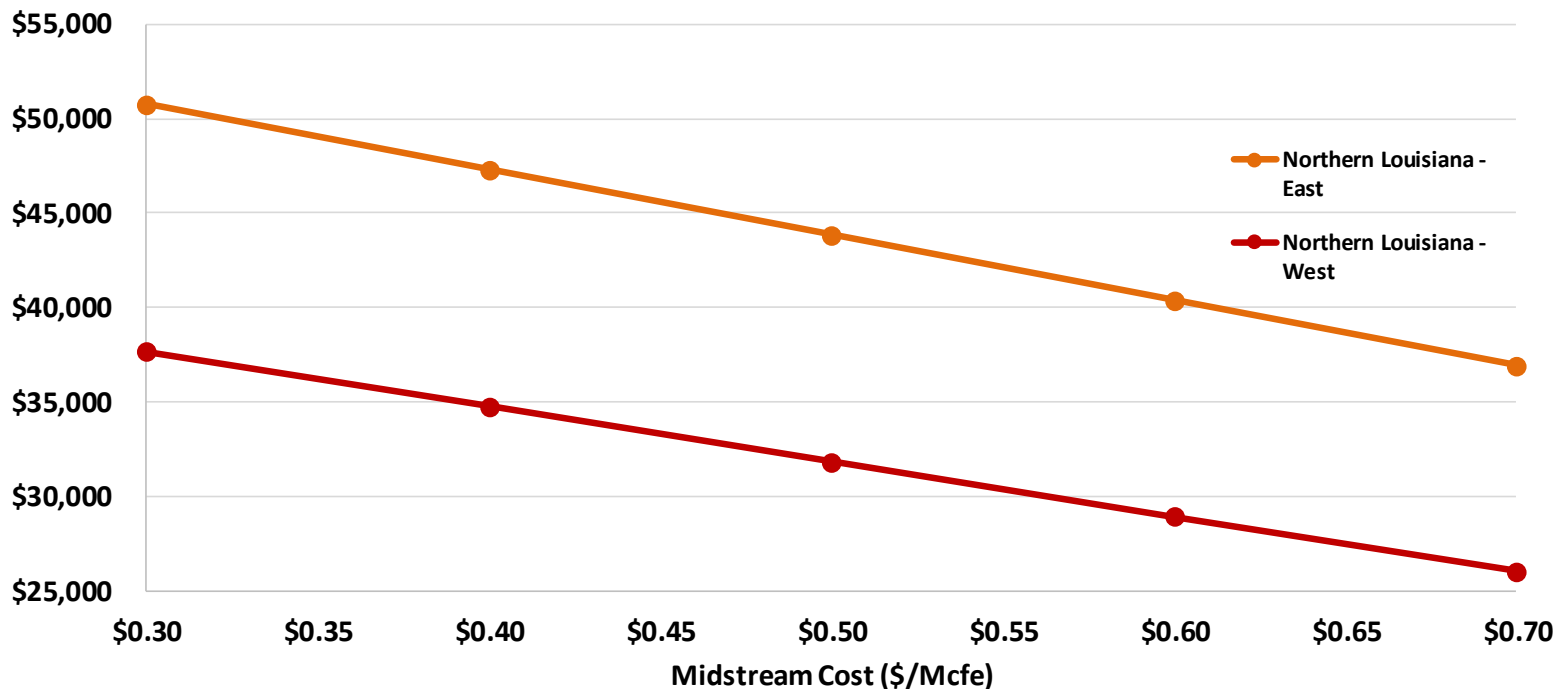




# Northern Louisiana – Implied Acreage Valuation

- Chart below shows implied fully developed acreage value in Northern Louisiana under various midstream expense structures and assuming 6 wells per section, inventory managed to 10 years, a 10% discount rate and strip gas prices.
- ***We see the eastern part of North Louisiana generating NPV of \$35,000-\$50,000/acre depending on midstream costs, while the western part of North Louisiana is worth \$25,000-\$35,000/acre.***
- Rough rule of thumb is for every 10c increase in midstream cost, NPV drops by ~\$3,000/acre.

Northern Louisiana Implied Acreage Value (\$/Acre)

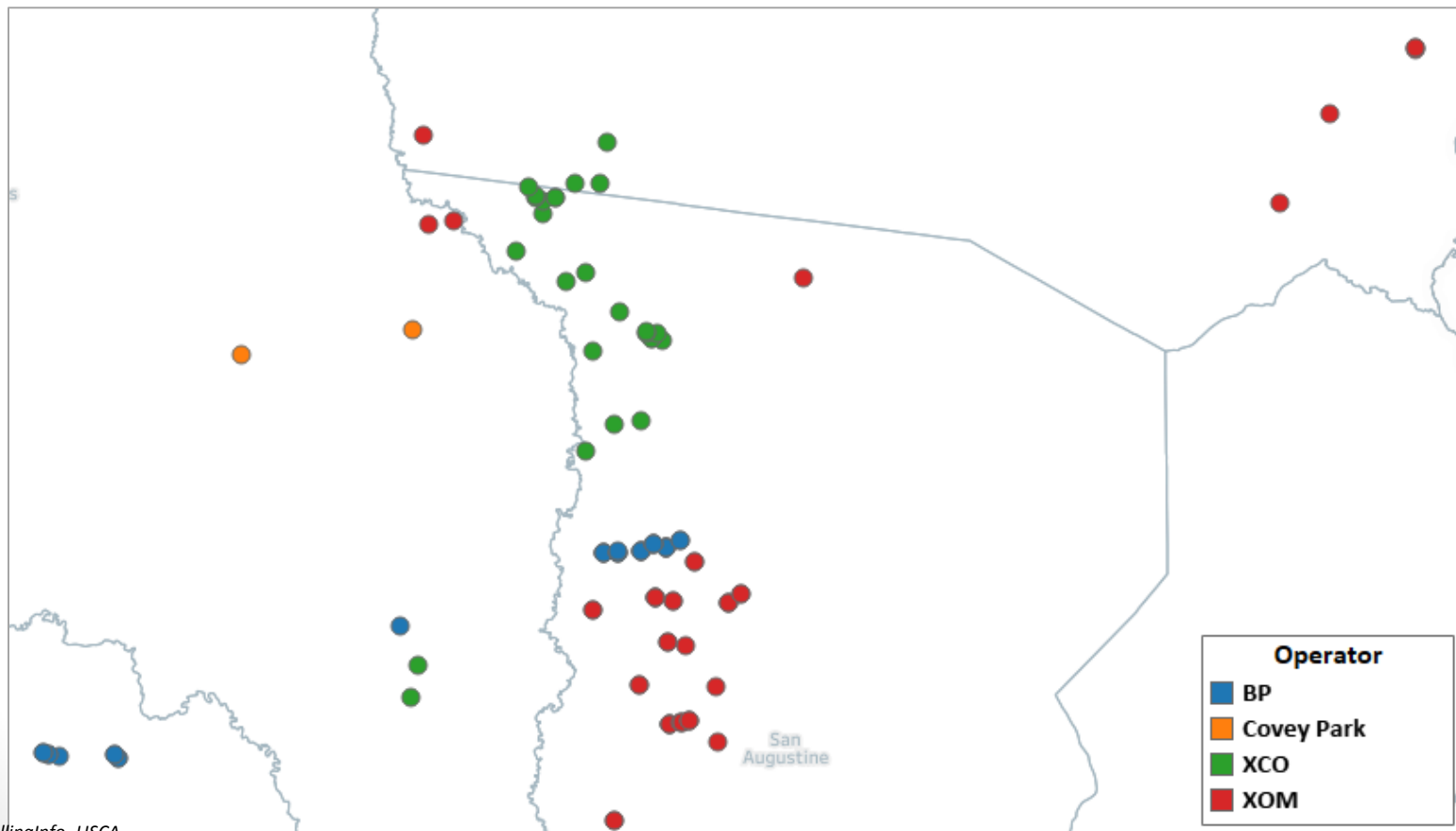


# **Regional Deep Dive: Shelby Trough**



# Shelby Trough – Permit Activity

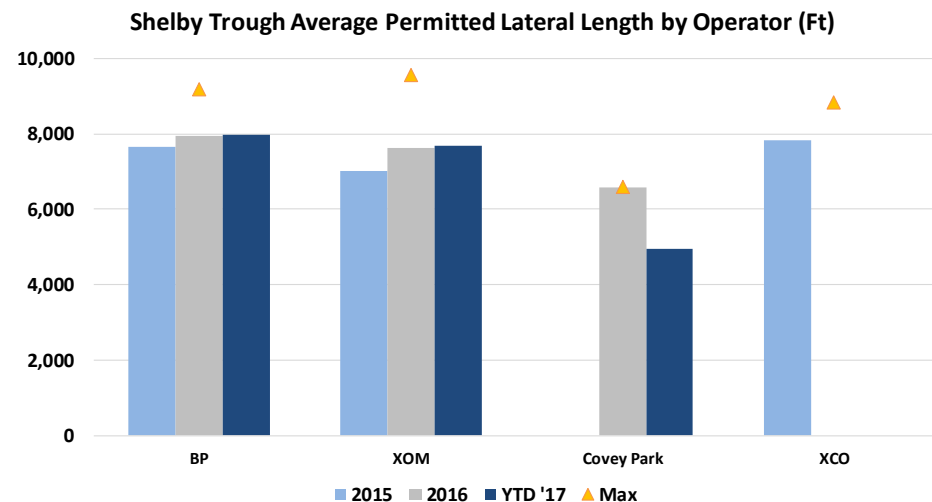
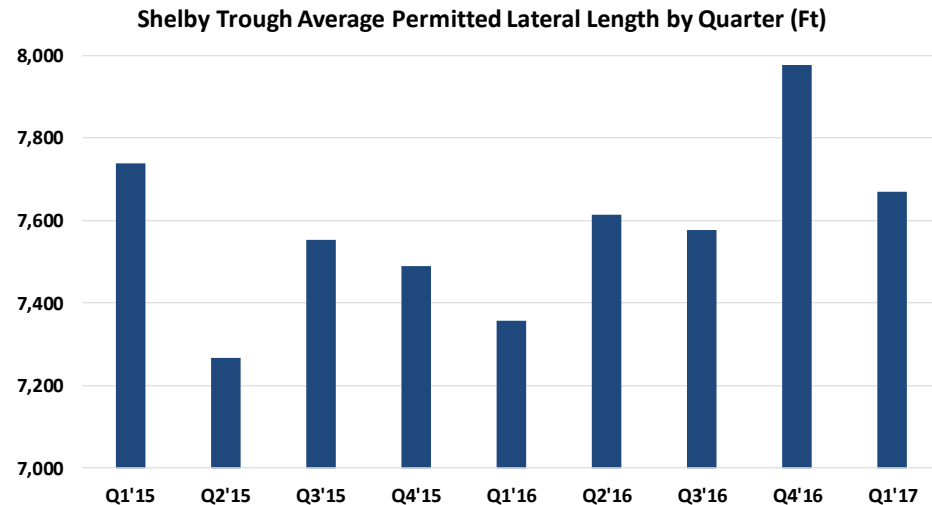
- Map shows horizontal permits issued since 2015 in East Texas Shelby Trough, color coded by operator.
- ***Permit activity in this part of the play has been dominated by the Majors, with XOM and BP staking 45 and 35 wells, respectively.***
- Other operators with positions here include GDPP, XCO and private Covey Park.





# Shelby Trough – Permitted Lateral Lengths

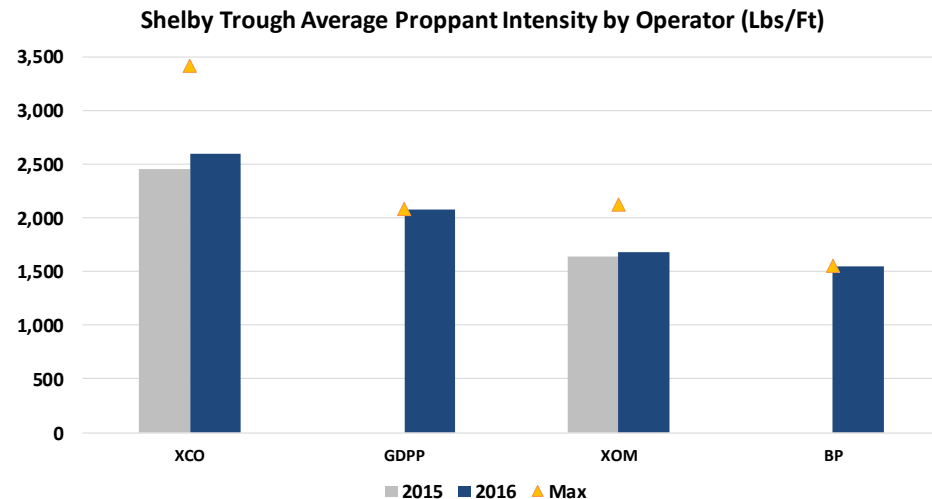
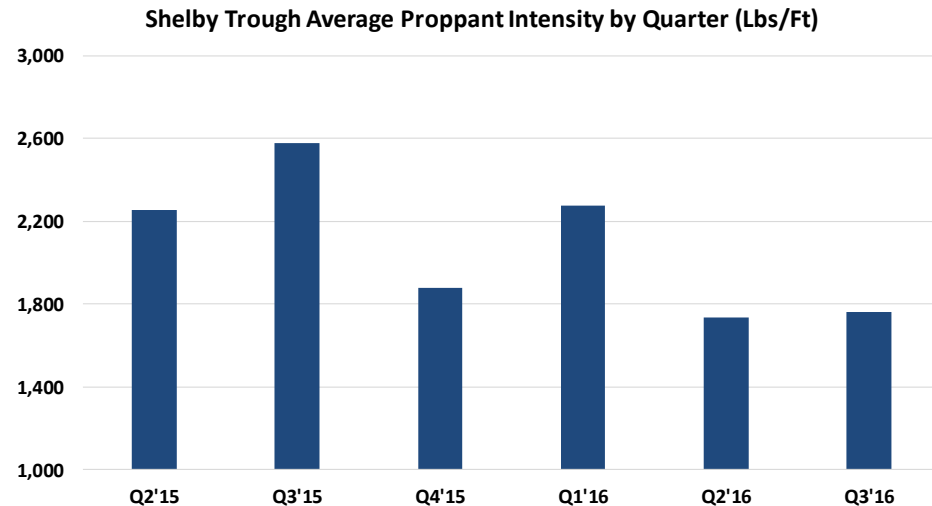
- Top chart shows average permitted lateral length in the Shelby Trough over time, while bottom chart shows average permitted lateral length by operator.
- Permitted lateral lengths have been fairly consistent around ~7,500' over the past couple of years.
- Majors BP and XOM are the source of the consistency noted above, with average permitted laterals pretty steady around ~8,000' and ~7,500', respectively.





# Shelby Trough – Proppant Intensity

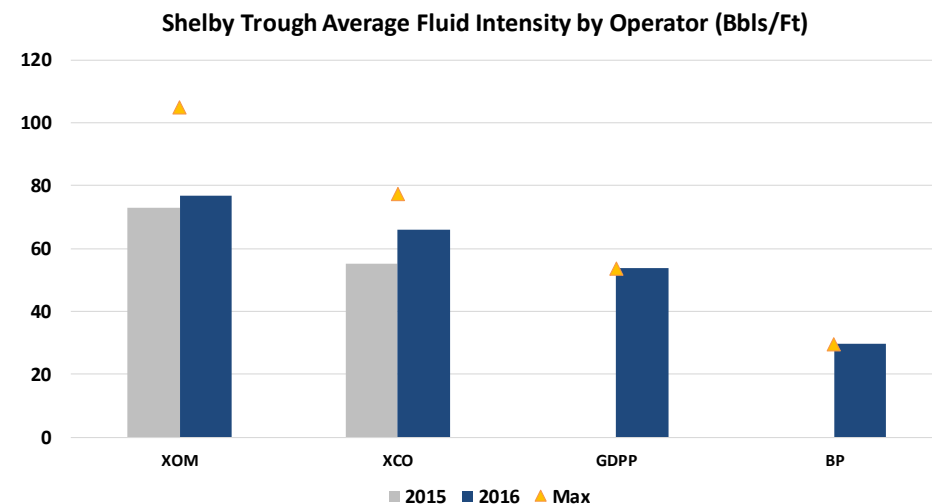
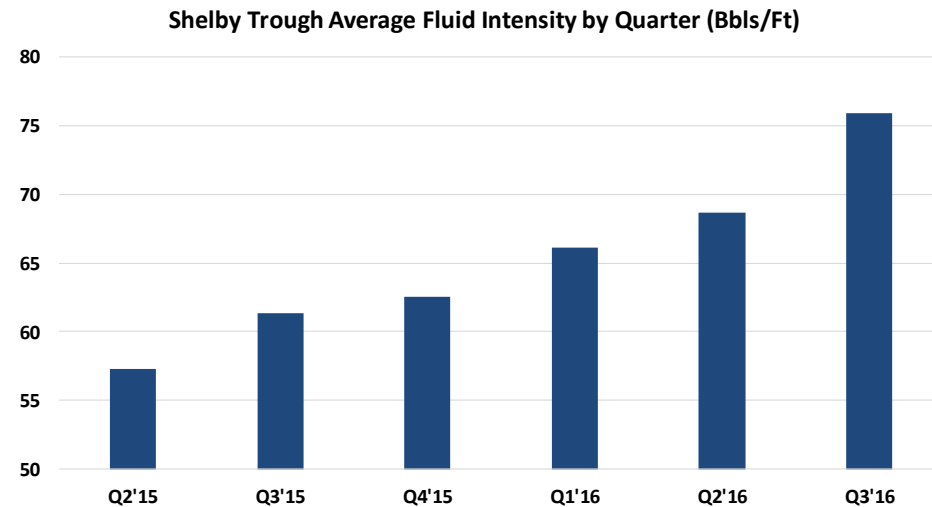
- Top chart shows average proppant intensity in the Shelby Trough over time, while bottom chart shows average proppant intensity by operator.
- Average proppant intensity has been sporadic over the past couple of years, bouncing between ~1,800 and ~2,600 lbs/ft, which we note is well below leading-edge trends in North Louisiana.
- Despite leading with longer laterals, both BP and XOM have pumped relatively light frac jobs here, both averaging just ~1,600 lbs/ft last year.





# Shelby Trough – Fluid Intensity

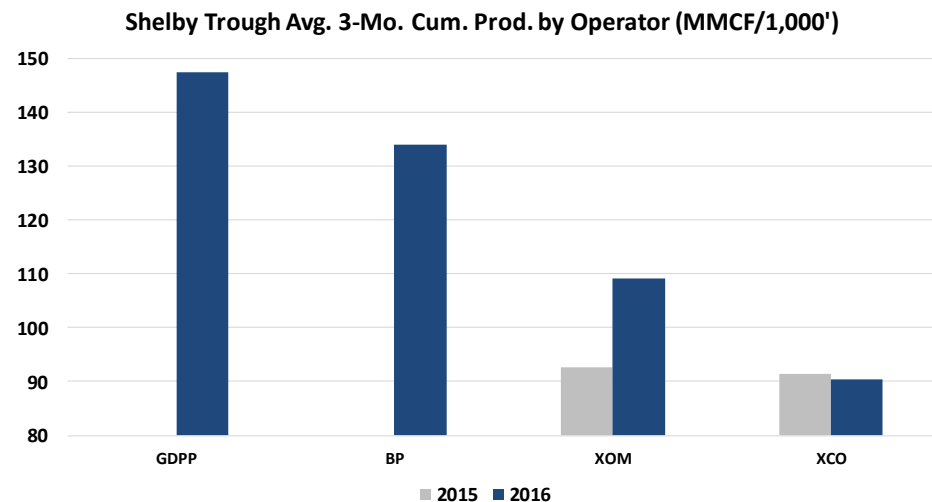
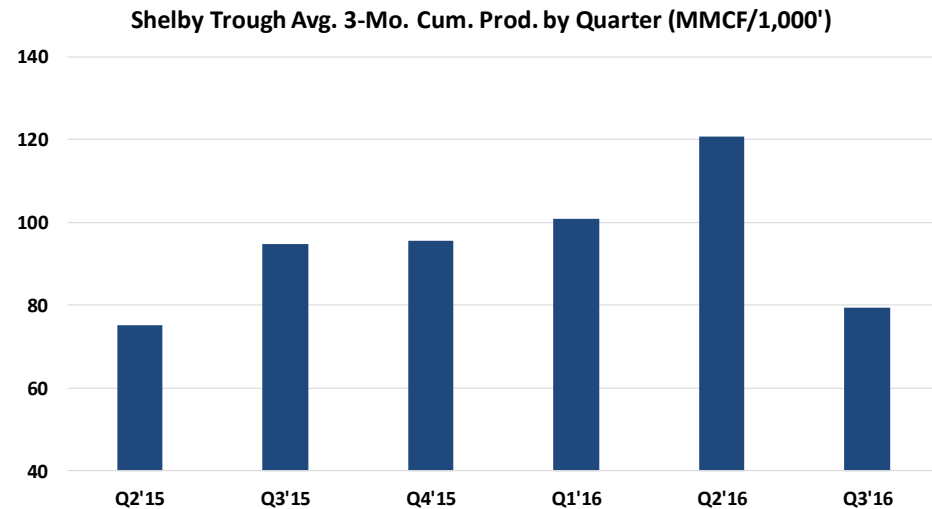
- Top chart shows average fluid intensity in the Shelby Trough over time, while bottom chart shows average fluid intensity by operator.
- Unlike proppant intensity, fluid intensity has consistently increased q/q over the past two years, with average north of 75 bbs/ft in Q3'16.
- Looking by operator, XOM has been a driver of higher fluid intensity, with a '16 average near 80 bbs/ft and a max over 100 bbs/ft.
- Interesting to note BP materially lags the group, pumping just ~30 bbs/ft in '16.





# Shelby Trough – Well Productivity

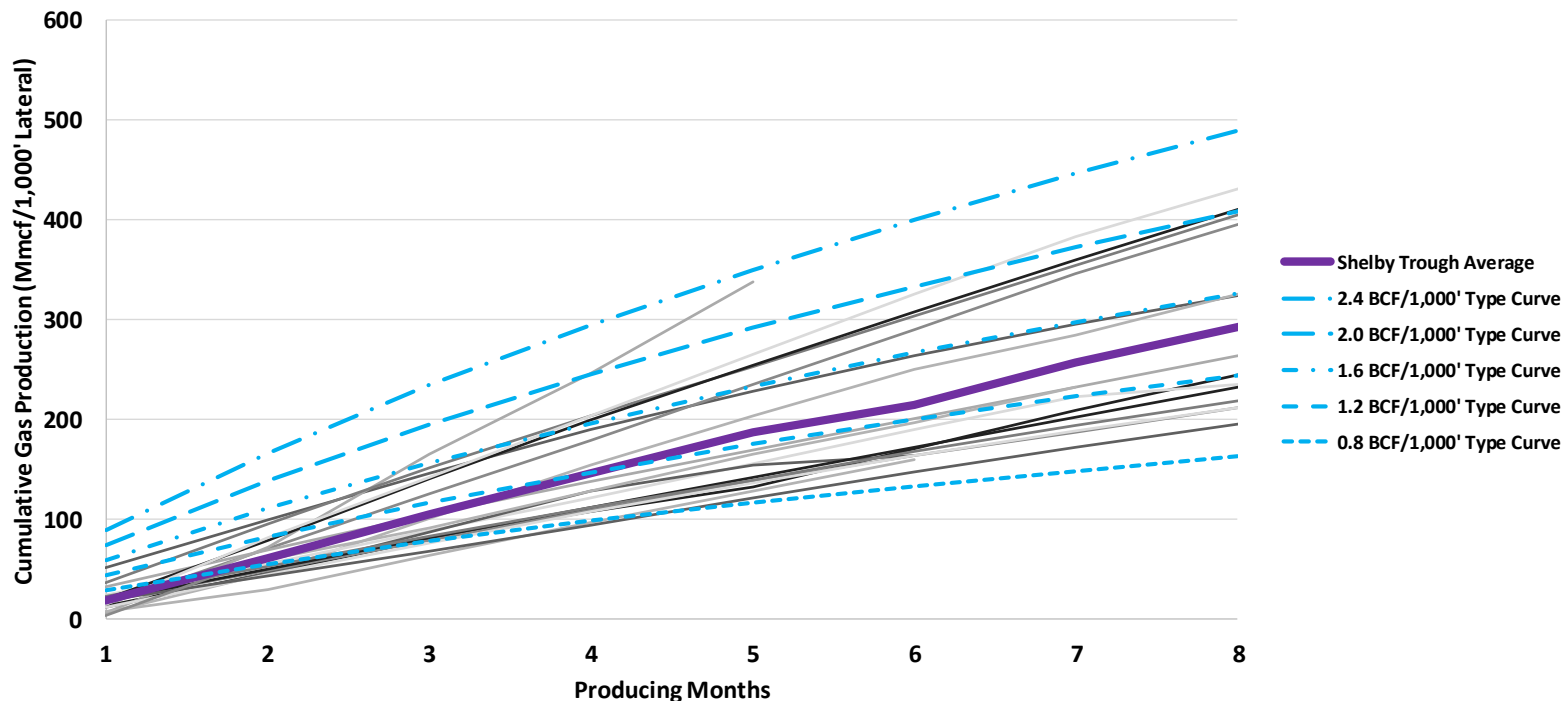
- Top chart shows average lateral-normalized 3-month cumulative gas production in the Shelby Trough over time, while bottom chart shows similar data broken out by operator.
- Looking at '16 data, the average Shelby Trough well recovered ~100 Mmcf/1,000' after 3 months, which was up 11% vs. '15.
- Looking by operator, GDPP generated solid ~147 Mmcf/1,000' from its lone Haynesville completion here in '16.
- Interesting to note despite pumping less intense fracs from proppant and fluid perspective, BP's results have been relatively respectable, with a '16 average 3-month recovery of ~135 Mmcf/1,000'.



# Shelby Trough – Average Well Performance

- Chart below shows lateral normalized cumulative gas production for 2016 vintage horizontal wells in the Shelby Trough, plotted against our internal type curves.
- **Average 2016 well performance in the Shelby Trough is tracking a ~1.4 BCF/1,000' type curve after 8 months of production.**
- We note XOM's recent BSI Fighting Camels 1H well is the best performing well in the area (top grey line on chart below) and is approaching our ~2.4 Bcf/1,000' type curve.

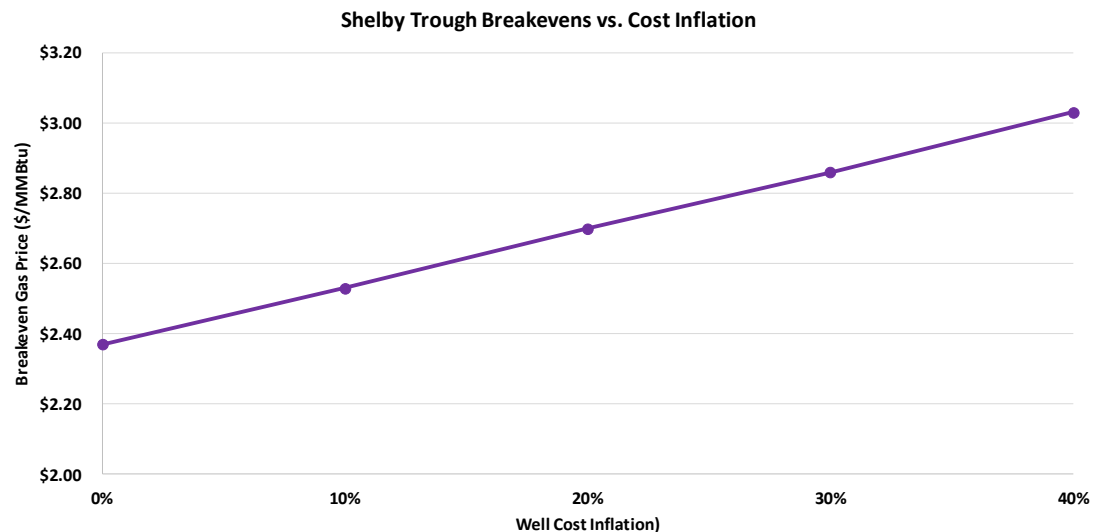
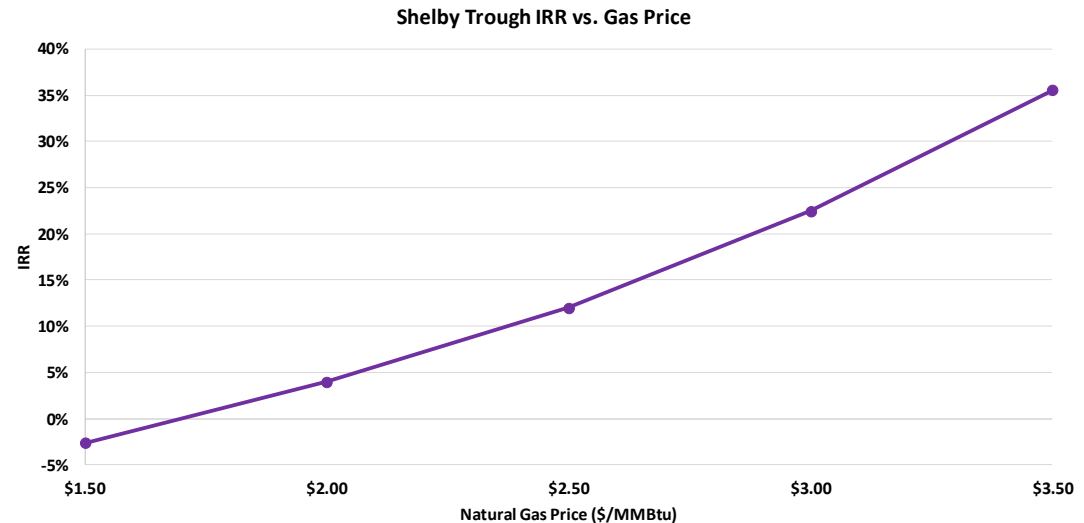
Shelby Trough Haynesville Performance





# Shelby Trough – Breakeven Analysis

- Top chart shows Shelby Trough IRR sensitivity to gas prices assuming 7,500' lateral, \$8 mm well cost and ~75c of all-in LOE/midstream/basis costs. Bottom chart runs same assumptions but compares breakeven against potential OFS inflation scenarios.
- At \$3/Mmbtu, average '16 well performance implies Shelby Trough BTAX IRRs of ~25%.
- At current well costs, we see Shelby Trough Haynesville wells breaking even at ~\$2.40/Mmbtu.
- For every ~10% of potential OFS cost inflation, breakeven increases by ~15c/Mmbtu.

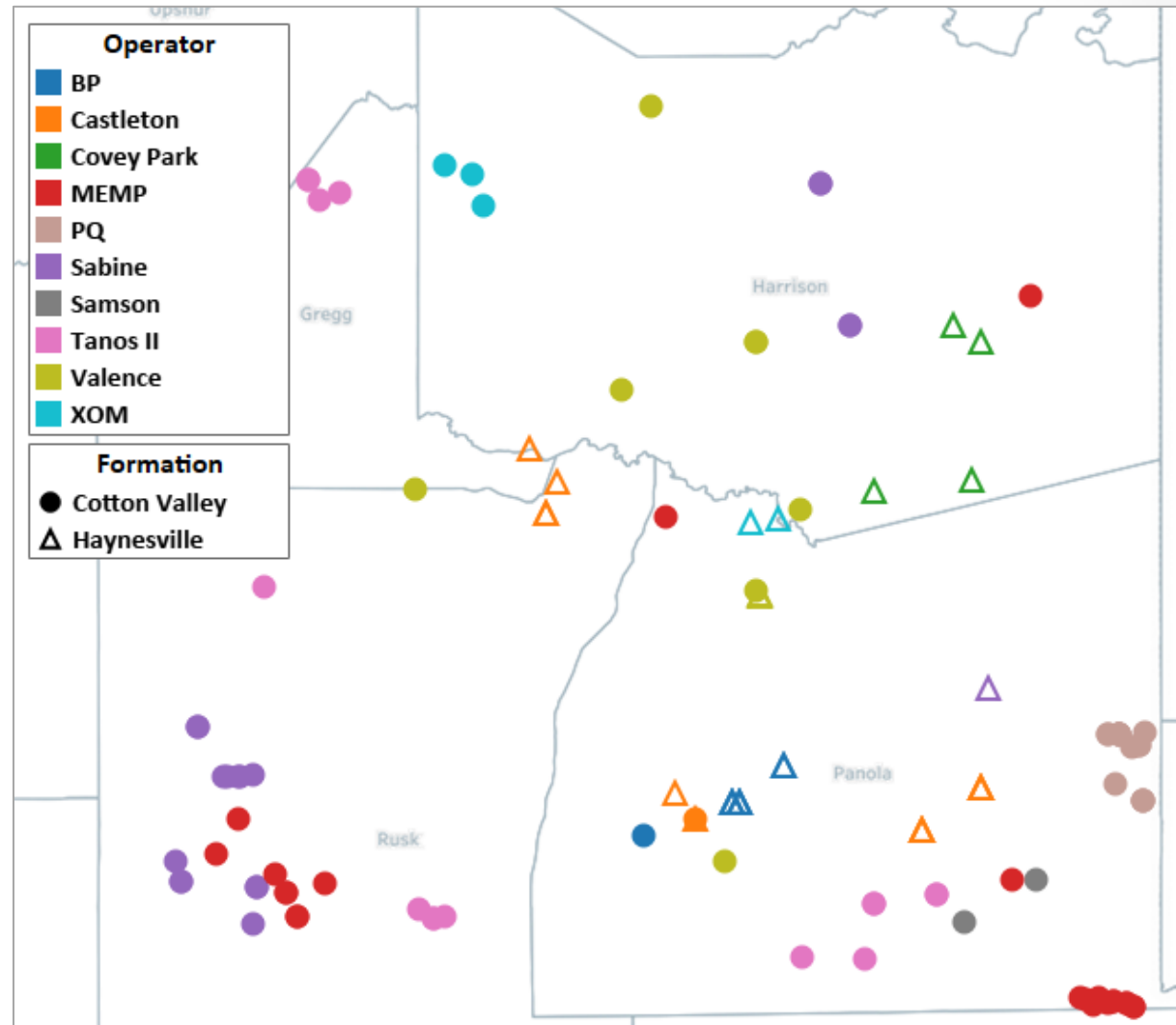


# **Regional Deep Dive: East Texas**



# East Texas – Permit Activity

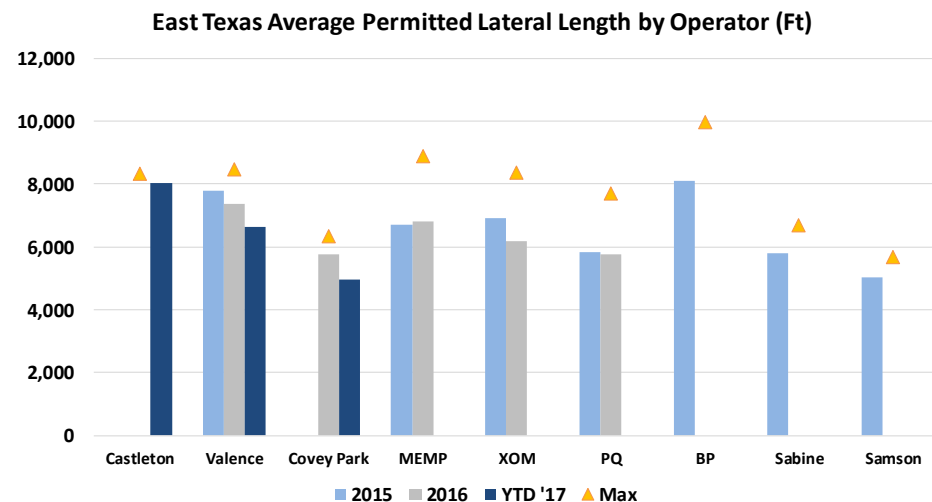
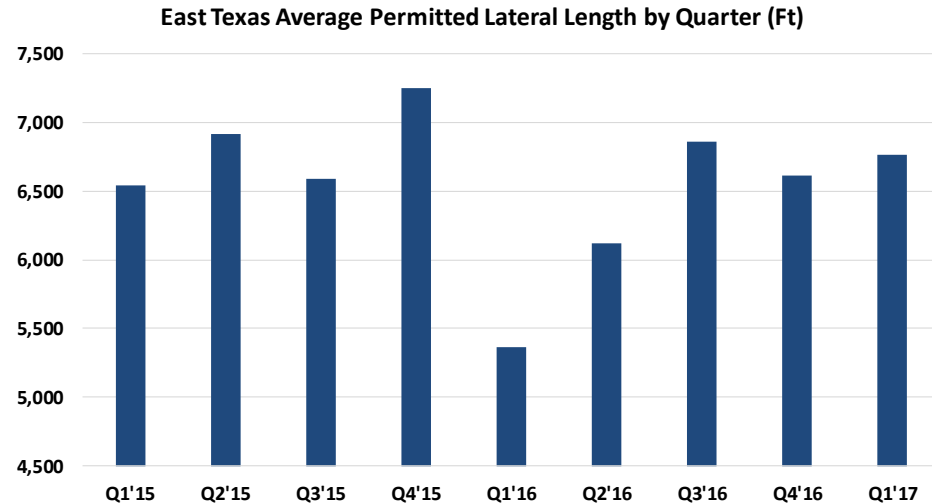
- Map shows horizontal permits issued since 2015 in East Texas, colored by operator and shaped by Haynesville/Cotton Valley formations.
- Since '15, most active permitters in this area have been MEMP, Sabine, Castleton (acquired APC's East Texas acreage), PQ, Tanos II and Valence.
- Operators have generally targeted the Haynesville in northern Panola and southern Harrison Counties, with Cotton Valley development spread around the edges of the East Texas region.





# East Texas – Permitted Lateral Lengths

- Top chart shows average permitted lateral length in East Texas over time, while bottom chart shows average permitted lateral length by operator.
- Outside of Q1'16, East Texas permitted lateral lengths have been relatively consistent in the 6,000-7,000' range.
- Looking at YTD '17, privates Castleton, Valence and Covey Park have been active permitters with average laterals of ~8,000', ~6,200' and ~5,000', respectively.

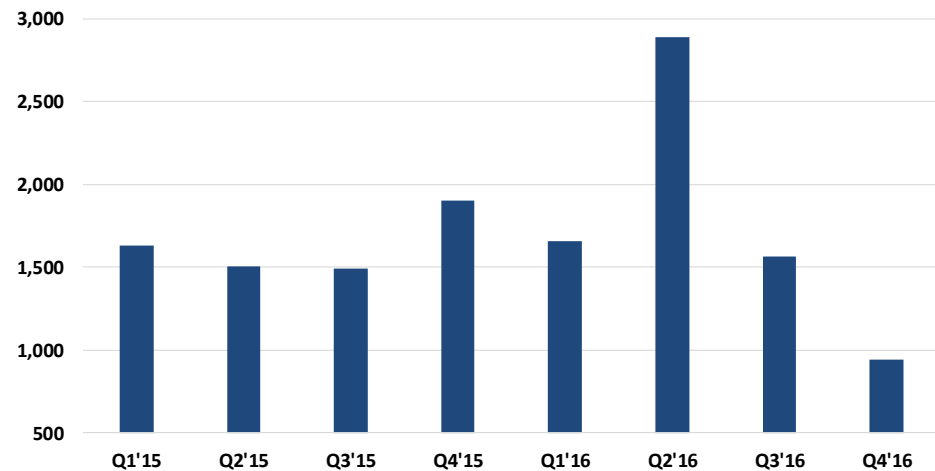




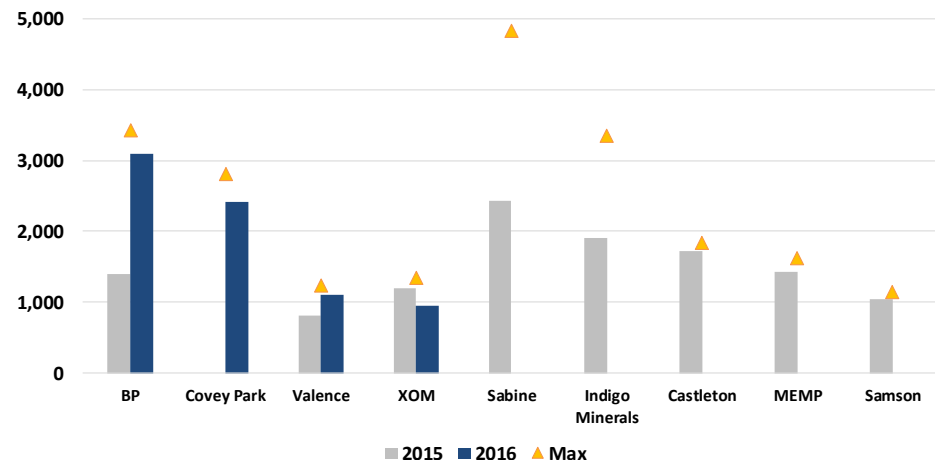
# East Texas – Proppant Intensity

- Top chart shows average proppant intensity in East Texas over time, while bottom chart shows average proppant intensity by operator.
- With the exception of Q2'16, proppant intensity has been flat to down in East Texas, bouncing between 1,000 and 1,500 lbs/ft.
- Looking at '16 data, BP and Covey Park pumped the biggest fracs at ~3,100 and ~2,500 lbs/ft, respectively. On the flip side, XOM stands out as pumping relatively light fracs with <1,000 lbs/ft on average in '16.

East Texas Average Proppant Intensity by Quarter (Lbs/Ft)



East Texas Average Proppant Intensity by Operator (Lbs/Ft)

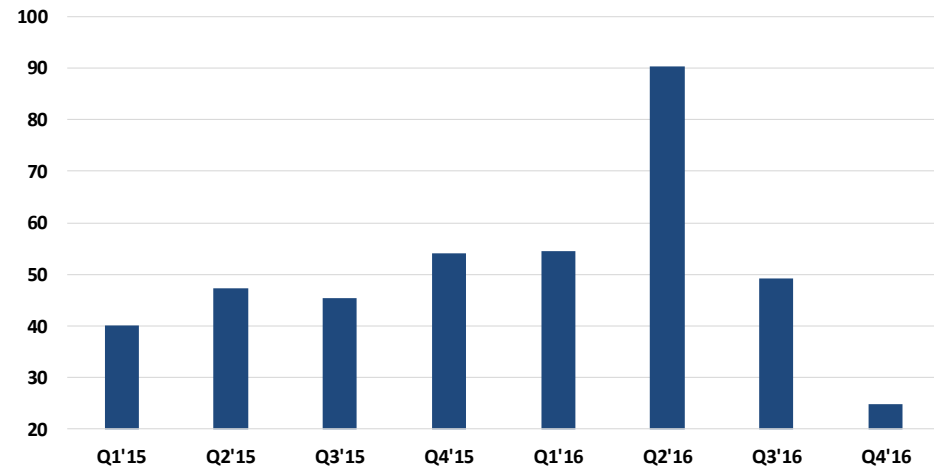




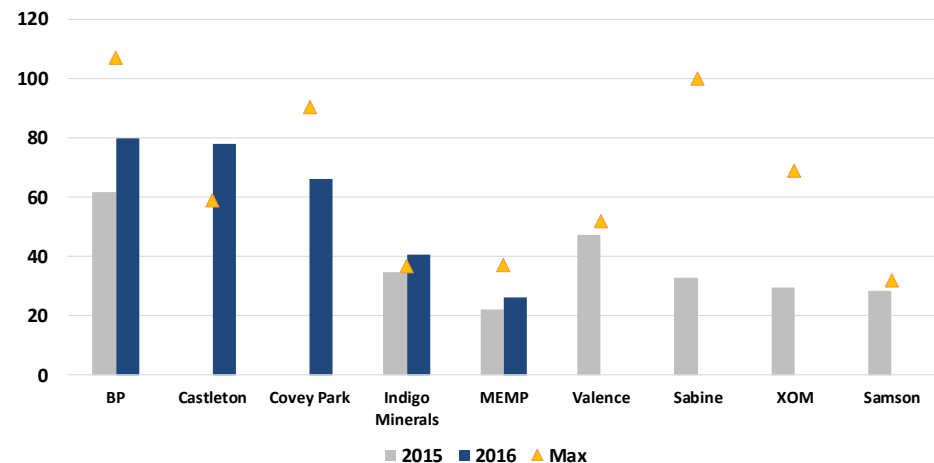
# East Texas – Fluid Intensity

- Top chart shows average fluid intensity in East Texas over time, while bottom chart shows average fluid intensity by operator.
- With the exception of a spike in Q2'16, average fluid intensity has been flat to down over the past few quarters at 25-50 bbls/ft.
- In '16, BP, Castleton, and Covey Park utilized the most fluid in their jobs, all pumping 60+ bbls/ft.

East Texas Average Fluid Intensity by Quarter (Bbls/Ft)



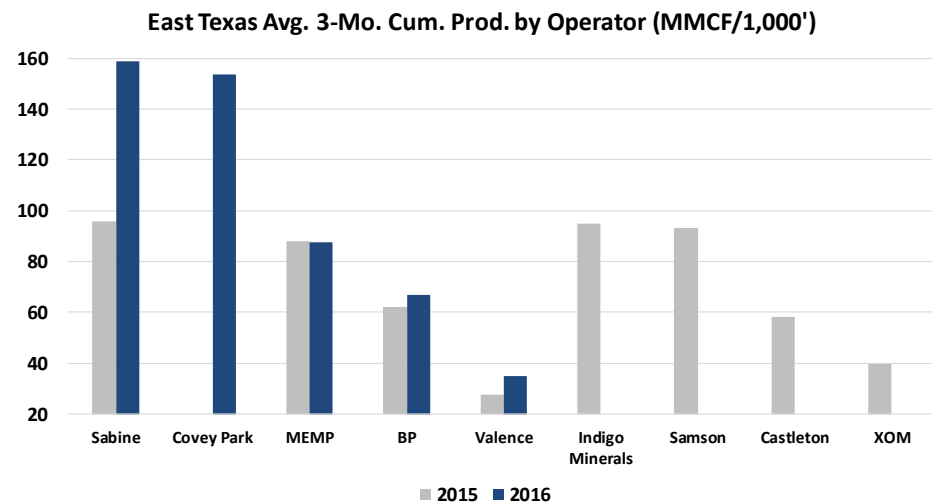
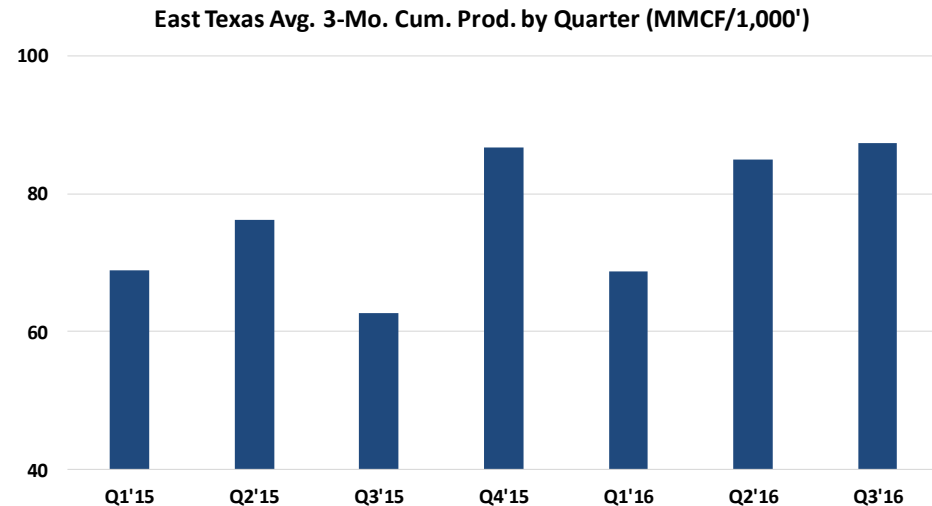
East Texas Average Fluid Intensity by Operator (Bbls/Ft)





# East Texas – Well Productivity

- Top chart shows average lateral-normalized 3-month cumulative gas production in East Texas over time, while bottom chart shows similar data broken out by operator.
- Average 2016 East Texas well has recovered ~80 Mmcf/1,000' after 3 months, which was modestly better than '15 average of ~74 Mmcf/1,000'.
- Looking at the operator level, Sabine and Covey Park have materially outperformed the regional average in '16, with ~160 and ~155 Mmcf/1,000' recoveries, respectively.

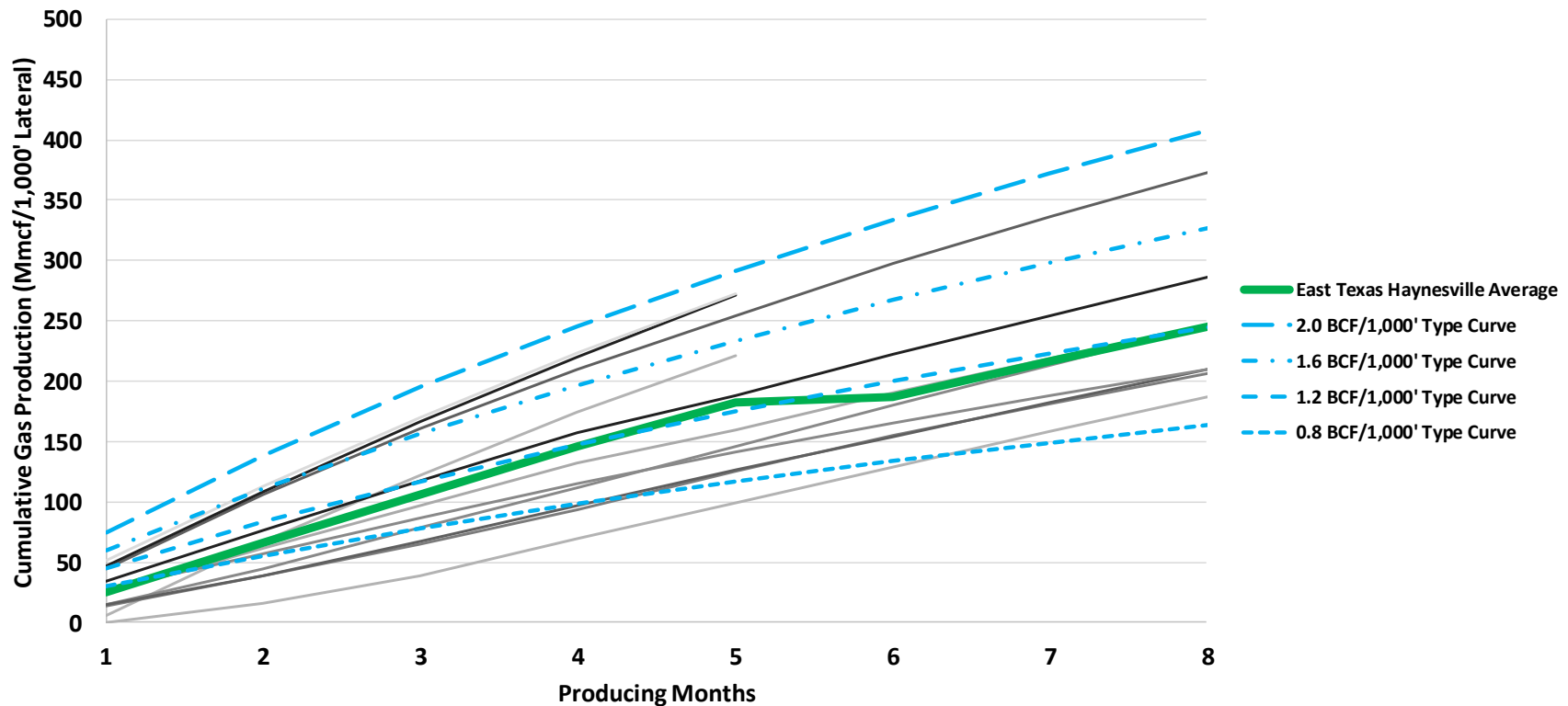




# East Texas – Haynesville Well Performance

- Chart below shows lateral-normalized cumulative gas production for 2016 vintage East Texas Haynesville wells plotted against our internal type curves.
- ***Per our analysis, average East Texas Haynesville well is tracking a ~1.2 BCF/1,000' EUR after 8 months of production.***
- We note two recent Covey Park wells in Southern Harrison County (top grey lines in chart below) are approaching our 2.0 Bcf/1,000' type curve after ~5 months.

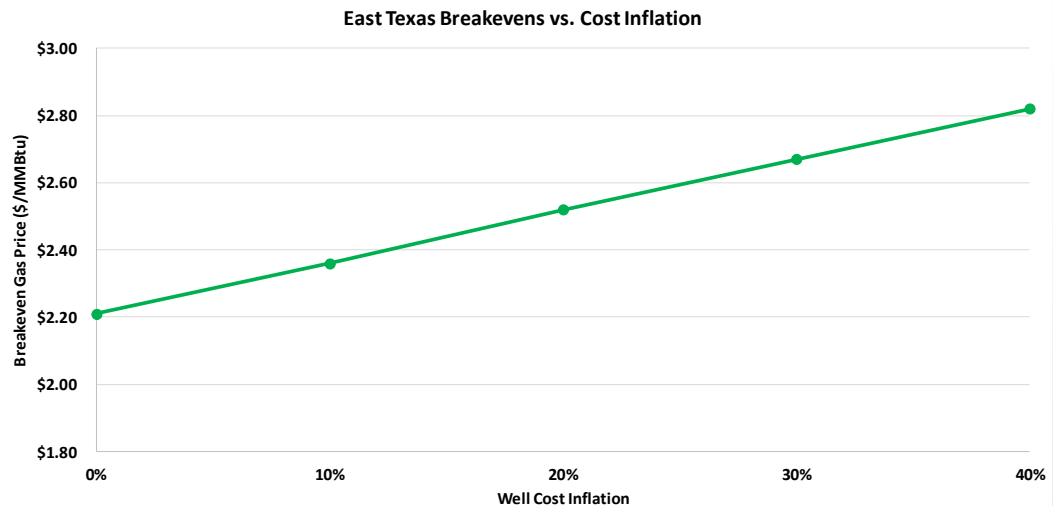
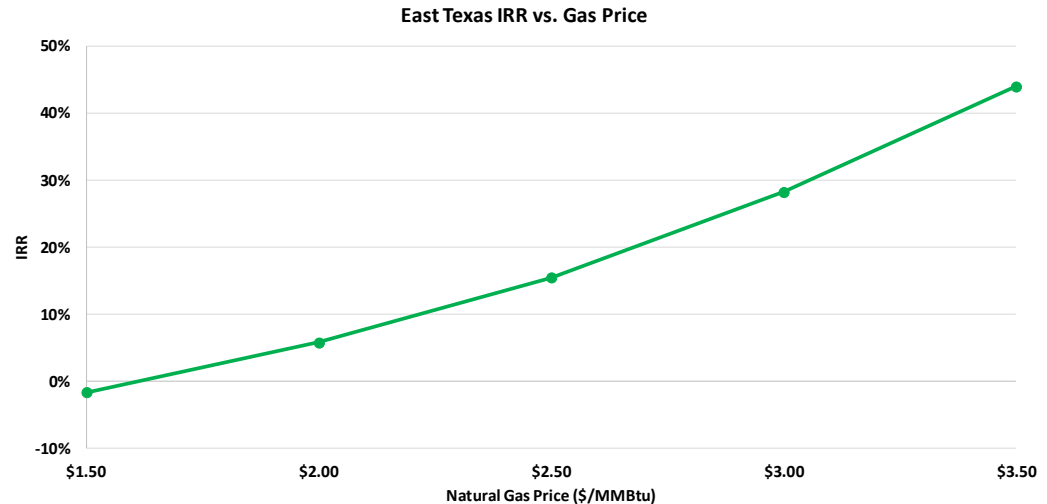
East Texas Haynesville Performance





# East Texas – Breakeven Analysis

- Top chart shows East Texas IRR sensitivity to gas prices assuming 7,500' lateral, \$6.5 mm well cost (shallower than Northern Louisiana/Shelby Trough) and ~75c of all-in LOE/midstream/basis costs. Bottom chart runs same assumptions but compares breakeven against potential OFS inflation scenarios.
- At \$3/Mmbtu, average '16 well performance implies East Texas BTAX IRRs of ~30%.
- At current well costs, we see East Texas Haynesville wells breaking even at ~\$2.20/Mmbtu.
- For every ~10% of potential OFS cost inflation, breakeven increases by ~15c/Mmbtu.



# Important Disclosures

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We, Cameron Horwitz and Omar Zakaria, do hereby certify that the recommendations and opinions expressed in this research report accurately reflect our personal views about any and all of the subject securities or issues discussed herein. Furthermore, no part of our compensation was, is, or will be, directly or indirectly, related to the specific recommendations or views expressed in this research report. We do not own any shares directly or indirectly (or any derivative thereof) of the company that is subject to this research report. Neither we nor any members of our household serves as an officer, director or advisory board member of the company that is subject to this research report.

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**BUY** - The stock has among the best combination of risk/reward and positive company specific catalysts within the sector. Stock is expected to trade higher on an absolute basis and be a top performer relative to peer stocks over the next 12 months.

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**SELL** - The stock's risk/reward is skewed to the downside with possible negative company specific catalysts or excessive valuation. The stock is expected to trade lower on an absolute basis and be among the worst performers relative to peer stocks over the next 12 months.

**Risks that may impede achievement of price target(s):**

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# Important Disclosures

## Price Target Methodology:

For E&Ps, our price targets are based on a Net Asset Value calculation that uses discounted cash flow analysis to assess the value of producing out a company's proved developed producing reserves. We then assign value to proved undeveloped, probable and possible reserves using acreage, spacing assumptions, current and projected rig counts, EURs and decline curves. Additionally, for companies with material, non-E&P assets, we apply a comparable multiple to our forward EBITDA estimate for the non-E&P segment. We then net against projected out-year debt, working capital deficit/surplus and the present value of future G&A expense to arrive at our price target.

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Recommendation	Count	Percent	Investment Banking Relationship	Count	Percent
Overweight/Buy	32	52%	Overweight/Buy	5	16%
Hold	28	46%	Hold	4	14%
Underweight/Sell	1	2%	Underweight/Sell	0	0%

## [USCA Rating and Price Target History](#)

For a hard copy of our price target/ratings history, call 888-601-8722, or write to U.S. Capital Advisors, 4444 Westheimer, Suite G500, Houston, TX, 77027.

# Important Disclosures

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## Contact Information

### Sales Team

**David King, CFA**  
Managing Partner  
[dking@uscallc.com](mailto:dking@uscallc.com)  
713-366-0530

**Gil Beer**  
Executive Director  
[gbeer@uscallc.com](mailto:gbeer@uscallc.com)  
713-366-0518

**Barry Guinn**  
Senior Managing Director  
[bguinn@uscallc.com](mailto:bguinn@uscallc.com)  
713-366-0534

**Leslie Rich**  
Director  
[lrich@uscallc.com](mailto:lrich@uscallc.com)  
713-366-0532

**Rae Lees**  
Managing Director  
[rlees@uscallc.com](mailto:rlees@uscallc.com)  
713-366-0533

**Rachel Brown**  
Director  
[rzick@uscallc.com](mailto:rzick@uscallc.com)  
713-366-0531

### Research Team

**Midstream**  
**Becca Followill**  
Senior Managing Director  
[bfollowill@uscallc.com](mailto:bfollowill@uscallc.com)  
713-366-0557

**James Carreker, CFA**  
Executive Director  
[jcarreker@uscallc.com](mailto:jcarreker@uscallc.com)  
713-366-0558

**Colin Crosby**  
Director  
[ccrosby@uscallc.com](mailto:ccrosby@uscallc.com)  
713-366-0547

**Denise Cardozo**  
Research Assistant  
[dcardozo@uscallc.com](mailto:dcardozo@uscallc.com)  
713-366-0563

**E&P**  
**Cameron Horwitz, CFA**  
Managing Director  
[chorwitz@uscallc.com](mailto:chorwitz@uscallc.com)  
713-366-0541

**Omar Zakaria**  
Research Analyst  
[ozakaria@uscallc.com](mailto:ozakaria@uscallc.com)  
713-366-0559

**Melissa LeRoy**  
Analyst  
[mleeroy@uscallc.com](mailto:mleeroy@uscallc.com)  
713-343-0648

**Refining**  
**Craig Weiland**  
Executive Director  
[cweiland@uscallc.com](mailto:cweiland@uscallc.com)  
713-343-0655

**John Coleman**  
Research Analyst  
[jcoleman@uscallc.com](mailto:jcoleman@uscallc.com)  
713-343-4969

**Utilities**  
**Dan Fidell**  
Managing Director  
[dfidell@uscallc.com](mailto:dfidell@uscallc.com)  
636-812-2270

### Trading Team

**Brad Stammen**  
Managing Director  
[bstammen@uscallc.com](mailto:bstammen@uscallc.com)  
713-366-0535

**Clint Turner**  
Managing Director  
[cturner@uscallc.com](mailto:cturner@uscallc.com)  
713-366-0536