

# Impacts to Transportation Infrastructure and Critical Needs

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# Presentation Outline

- Truck traffic volumes and truckloads
- Pavement impacts
- Traffic safety impacts
- Current initiatives
- Research and technology transfer needs

## TAMEST Shale Task Force

Well Development	Number of Trucks		
	Barnett Shale	Eagle Ford Shale	Permian Basin
Drilling pad and construction equipment	70	70	70
Drilling rig	4	4	4
Drilling fluid and materials	59	59	59
Drilling equipment: casing, drilling pipe	54	54	54
Fracking equipment: pump trucks, tanks	74	74	74
Fracking water:	533	1,021	527
Fracking water (steel tank)	373	715	369
Fracking water (aluminum tank)	160	306	158
Fracking sand:	57	147	66
Fracking sand (steel tank)	40	103	46
Fracking sand (aluminum tank)	17	44	20
Other additives and fluids	4	24	11
Flowback water removal	133	255	132
<b>Total</b>	<b>988</b>	<b>1,708</b>	<b>997</b>

## TAMEST Shale Task Force

Well Production Activity	Number of Trucks		
	Barnett Shale	Eagle Ford Shale	Permian Basin
Produced water (steel tank)	41	65	181
Produced water (aluminum tank)	14	22	62
Oil/condensate production (steel tank)	8	249	79
Oil/condensate production (aluminum tank)	3	83	27
<b>Total</b>	<b>66</b>	<b>418</b>	<b>349</b>

## TAMEST Shale Task Force

Well Re-Fracking	Number of Trucks		
	Barnett Shale	Eagle Ford Shale	Permian Basin
Fracking equipment: pump trucks, tanks	74	74	74
Fracking water:	533	1,021	527
Fracking water (steel tank)	373	715	369
Fracking water (aluminum tank)	160	306	158
Fracking sand:	57	147	66
Fracking sand (steel tank)	40	103	46
Fracking sand (aluminum tank)	17	44	20
Other additives and fluids	4	24	11
Flowback water removal	133	255	132
<b>Total</b>	<b>801</b>	<b>1,521</b>	<b>810</b>

## Barnett Shale Region (per well)

**TAMU Shale Task Force**

Item	Development	Production		Re-Fracking		Total
		Per Year	Total	Per Event	Total	
Number of trucks	988	66	1,320	801	3,205	<b>5,513</b>
ESALs (trip to well)	1,363	5	98	1,070	4,281	<b>5,742</b>
ESALs (trip from well)	474	93	1,864	423	1,694	<b>4,031</b>

## Eagle Ford Shale Region (per well):

Item	Development	Production		Re-Fracking		Total
		Per Year	Total	Per Event	Total	
Number of trucks	1,708	418	8,366	1,521	6,085	<b>16,160</b>
ESALs (trip to well)	2,261	31	625	1,968	7,871	<b>10,757</b>
ESALs (trip from well)	689	591	11,815	639	2,555	<b>15,059</b>

## Permian Basin Region (per well):

Item	Development	Production		Re-Fracking		Total
		Per Year	Total	Per Event	Total	
Number of trucks	997	349	6,975	810	3,239	<b>11,211</b>
ESALs (trip to well)	1,381	26	519	1,089	4,354	<b>6,254</b>
ESALs (trip from well)	472	492	9,850	422	1,689	<b>12,011</b>

# Critical Reality

- Most highway corridors, particularly secondary roads, were never designed to sustain heavy energy-related traffic
  - FM roads: 750,000 ESALs
  - SH roads: 2,500,000 ESALs
  - US roads: 7,000,000 ESALs

## TAMEST Shale Task Force











## TAMEST Shale Task Force





## TAMEST Shale Task Force



# Relative Pavement Impact

Total Weight (lb)	Weight Ratio	EALF Ratio	Weight Ratio	EALF Ratio	Weight Ratio	EALF Ratio
	WRT 4,000 lb		WRT 35,000 lb		WRT 80,000 lb	
4,000	1	1				
10,000	2.5	23				
35,000	8.8	583	1	1		
80,000	20	18,009	2.3	31	1	1
84,000	21	22,210	2.4	38	1.05	1.2
90,000	22	28,511	2.6	49	1.1	1.6
100,000	25	42,753	2.9	73	1.25	2.4

# Economic Impact

- \$1 billion per year
- \$2 billion per year including local roads
  - No main highways or bridges included
- Cost to industry (with no pavement repair):
  - \$1.5-3.5 billion per year
    - Equipment damage
    - Lower operating speeds

# State Funding Appropriations

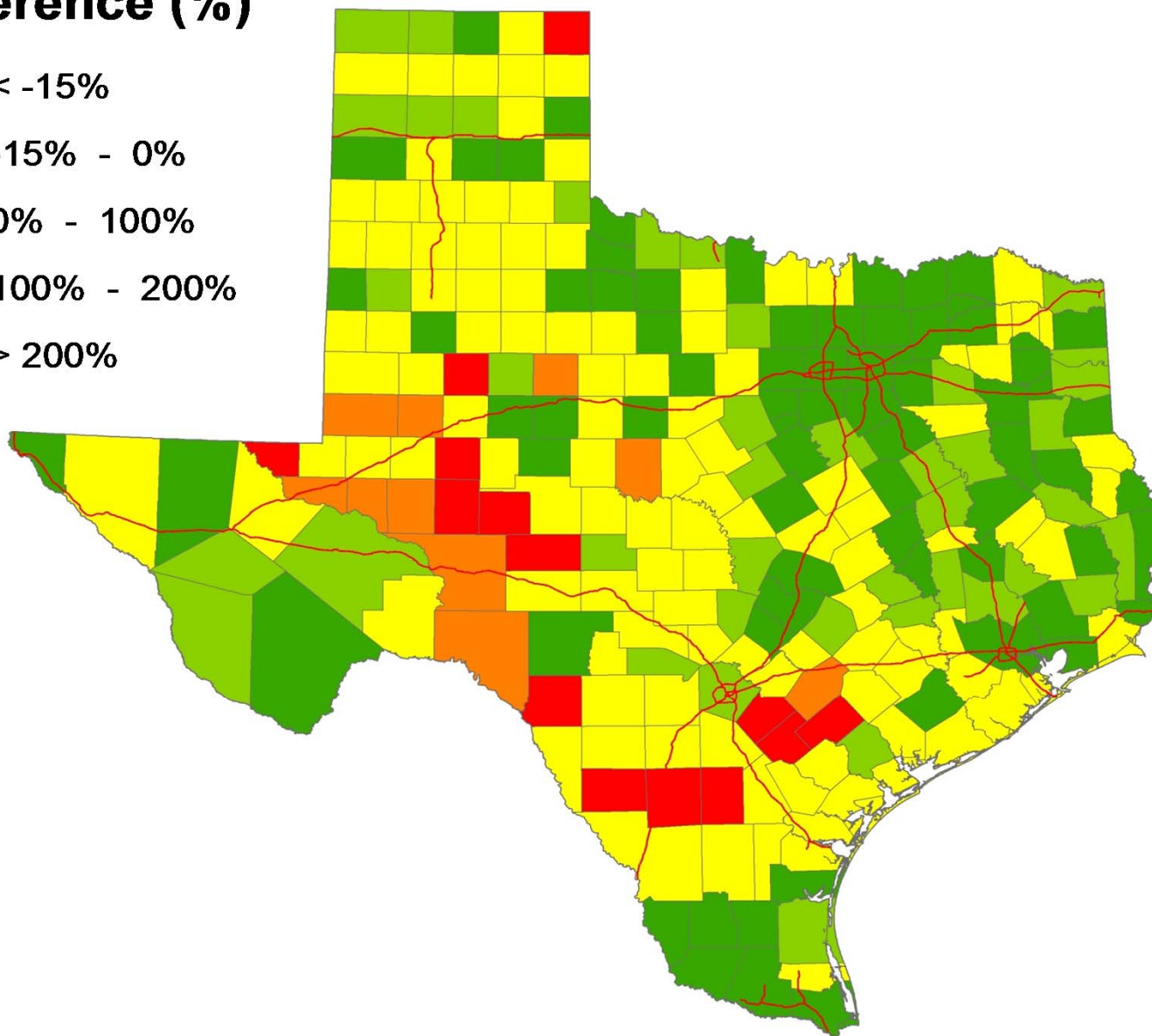
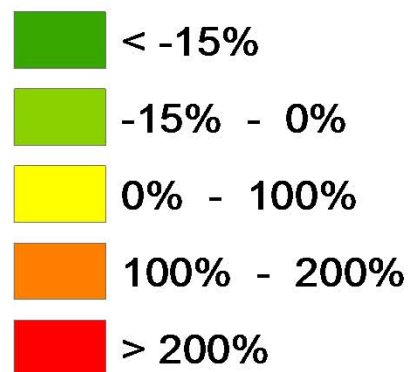
- 2012 Maintenance Funds (\$40M)
- 2013 HB 1025
  - \$225M for design-build and traditional letting
- 2014 Rural Needs (\$500M outside MPOs)
- 2014 Safety, Maintenance, and Energy Sector
  - \$200M (safety) and \$200M (maintenance and ES)
- 2015 Proposition 1 Funding (\$1.74B)
  - \$696M (connectivity), \$522M (regional corridors), \$261M (energy sector), \$261M (maintenance)

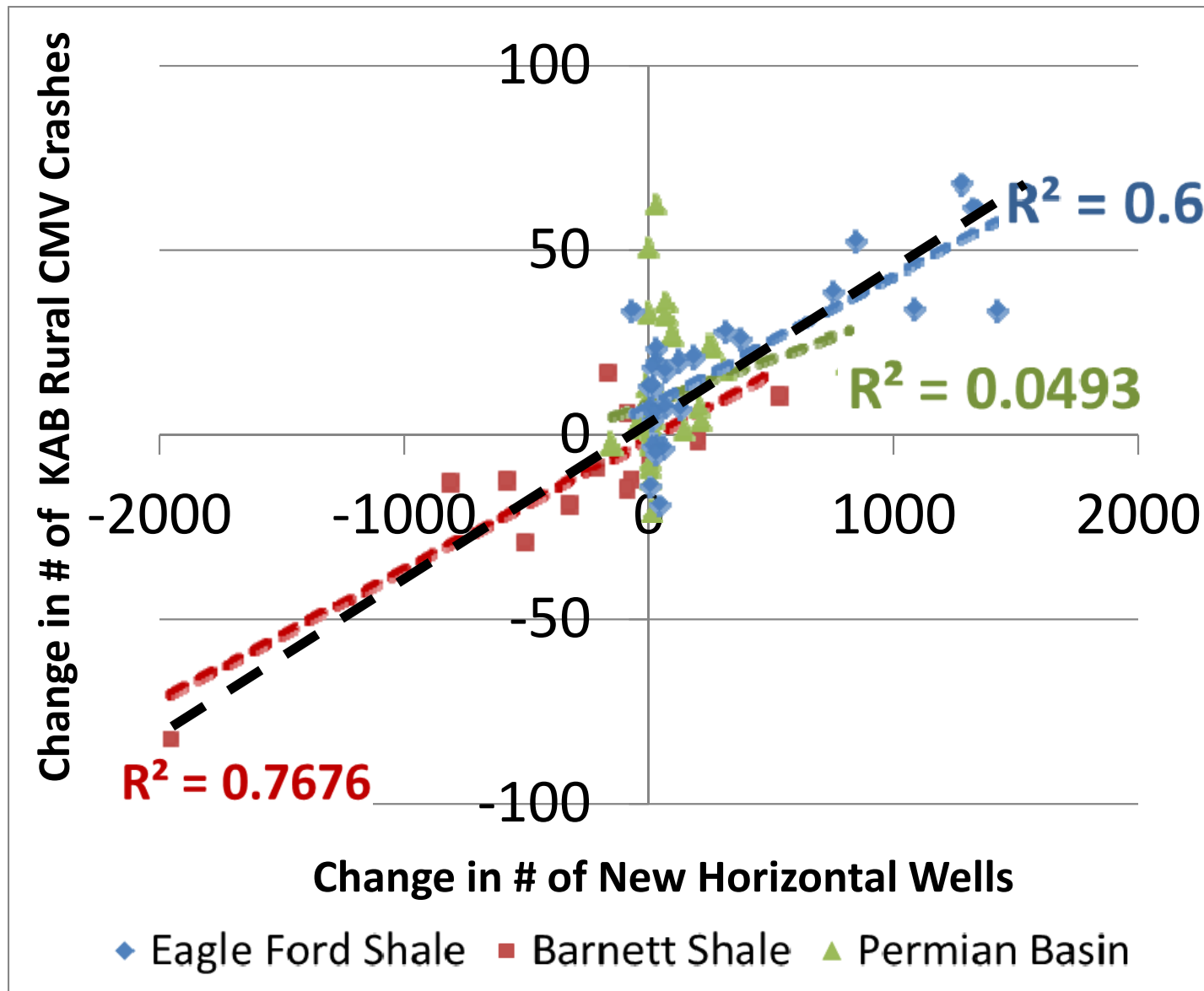
# TAMEST Shale Task Force

Region	Number of Fatal, Incapacitating, Non-Incapacitating, Possible Injury, No-Injury, Unknown Crashes											
	All			Rural			CMV			Rural & CMV		
	2006-09	2010-13	Diff.	2006-09	2010-13	Diff.	2006-09	2010-13	Diff.	2006-09	2010-13	Diff.
Barnett Shale	184,735	166,474	● -10%	24,572	18,521	● -25%	14,119	12,367	● -12%	3,130	2,061	● -34%
Eagle Ford Shale	85,964	86,744	● 1%	27,660	28,804	● 4%	6,607	8,708	● 32%	2,820	4,542	● 61%
Permian Basin	80,891	77,511	● -4%	15,689	17,426	● 11%	4,775	6,368	● 33%	2,464	3,743	● 52%
Other	1,410,907	1,306,749	● -7%	288,715	284,431	● -1%	90,081	77,755	● -14%	26,221	23,942	● -9%
<b>Grand Total</b>	<b>1,762,497</b>	<b>1,637,478</b>	<b>● -7%</b>	<b>356,636</b>	<b>349,182</b>	<b>● -2%</b>	<b>115,582</b>	<b>105,198</b>	<b>● -9%</b>	<b>34,635</b>	<b>34,288</b>	<b>● -1%</b>
Region	Number of Fatal, Incapacitating, Non-Incapacitating Crashes											
	All			Rural			CMV			Rural & CMV		
	2006-09	2010-13	Diff.	2006-09	2010-13	Diff.	2006-09	2010-13	Diff.	2006-09	2010-13	Diff.
Barnett Shale	31,739	30,728	● -3%	5,346	4,165	● -22%	2,124	1,846	● -13%	642	474	● -26%
Eagle Ford Shale	14,382	15,264	● 6%	6,889	6,948	● 1%	1,096	1,641	● 50%	662	1,173	● 77%
Permian Basin	11,520	12,019	● 4%	3,841	4,524	● 18%	883	1,333	● 51%	617	971	● 57%
Other	204,134	201,541	● -1%	57,296	54,123	● -6%	12,568	11,792	● -6%	4,998	4,751	● -5%
<b>Grand Total</b>	<b>261,775</b>	<b>259,552</b>	<b>● -1%</b>	<b>73,372</b>	<b>69,760</b>	<b>● -5%</b>	<b>16,671</b>	<b>16,612</b>	<b>● 0%</b>	<b>6,919</b>	<b>7,369</b>	<b>● 7%</b>
Region	Number of Fatal Crashes											
	All			Rural			CMV			Rural & CMV		
	2006-09	2010-13	Diff.	2006-09	2010-13	Diff.	2006-09	2010-13	Diff.	2006-09	2010-13	Diff.
Barnett Shale	1,202	1,030	● -14%	459	325	● -29%	181	135	● -25%	101	63	● -37%
Eagle Ford Shale	851	902	● 6%	629	694	● 10%	129	204	● 58%	102	179	● 76%
Permian Basin	648	789	● 22%	430	518	● 20%	94	183	● 94%	80	151	● 88%
Other	9,465	8,954	● -5%	4,673	4,293	● -8%	1,177	1,170	● -1%	663	684	● 3%
<b>Grand Total</b>	<b>12,166</b>	<b>11,675</b>	<b>● -4%</b>	<b>6,191</b>	<b>5,830</b>	<b>● -6%</b>	<b>1,582</b>	<b>1,692</b>	<b>● 7%</b>	<b>946</b>	<b>1,077</b>	<b>● 14%</b>


















## Difference (%)





# Economic and Comprehensive Costs

For rural CMV crashes (in 2014 dollars):

Region	Economic Cost (Million) - NSC				Comprehensive Cost (Million) - NSC				Comprehensive Cost (Million) - VSL			
	2006-09	2010-13	Change	Diff.	2006-09	2010-13	Change	Diff.	2006-09	2010-13	Change	Diff.
Barnett Shale	\$ 212	\$ 138	\$ (73)	 -35%	\$ 1,224	\$ 799	\$ (425)	 -35%	\$ 2,510	\$ 1,747	\$ (763)	 -30%
Eagle Ford Shale	\$ 269	\$ 408	\$ 139	 52%	\$ 1,548	\$ 2,349	\$ 801	 52%	\$ 2,931	\$ 4,927	\$ 1,996	 68%
Permian Basin	\$ 171	\$ 348	\$ 176	 103%	\$ 981	\$ 2,011	\$ 1,030	 105%	\$ 2,051	\$ 4,045	\$ 1,994	 97%
Other	\$ 1,615	\$ 1,567	\$ (47)	 -3%	\$ 9,229	\$ 8,988	\$ (241)	 -3%	\$ 19,796	\$ 19,205	\$ (591)	 -3%
<b>Grand Total</b>	<b>\$2,266</b>	<b>\$2,461</b>	<b>\$ 194</b>	 9%	<b>\$12,981</b>	<b>\$14,146</b>	<b>\$ 1,165</b>	 9%	<b>\$ 27,288</b>	<b>\$ 29,924</b>	<b>\$ 2,636</b>	 10%

# Current Initiatives

- TxDOT-TTI Joint Effort – Focus on maintenance
- TxDOT research program
- TTI Policy Research Center
- TTI's Comprehensive Transportation and Energy Sector (CTES) Initiative

## TxDOT-TTI Joint Effort Tasks

- Current practices
- Traffic
- Guidelines
- Specific project support
- Performance
- Workshops/communication
- Future impacts

# Modeling and Forecasting

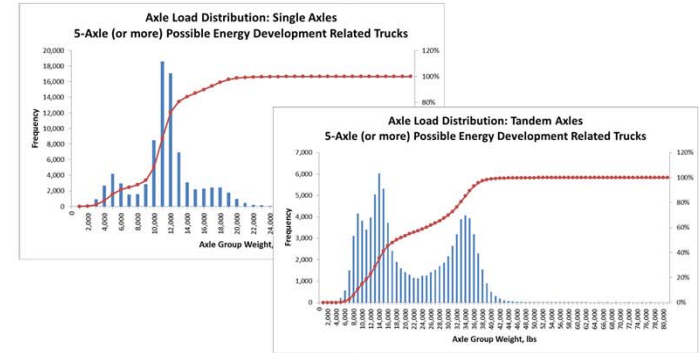
- Descriptive statistics and county maps
- Truck axle weight distributions
- Traffic loads for individual wells
- Traffic loads for segment/corridor-level analyses

# TAMEST Shale Task Force

## Trucks Needed to Develop a Well

Well Development Activity	Truck Volume (per Well)
Drilling pad and construction equipment	70
Drilling rig	4
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Fracking sand	147
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Other additives and fluids	24
Flowback water removal	255
<b>Total</b>	<b>1,708</b>

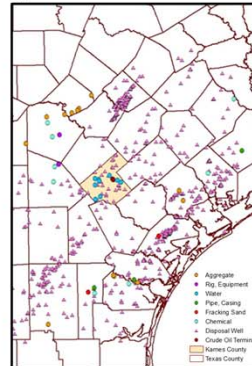
## Truck Axle Weight Distributions



## Well Locations



## Equipment and Materials



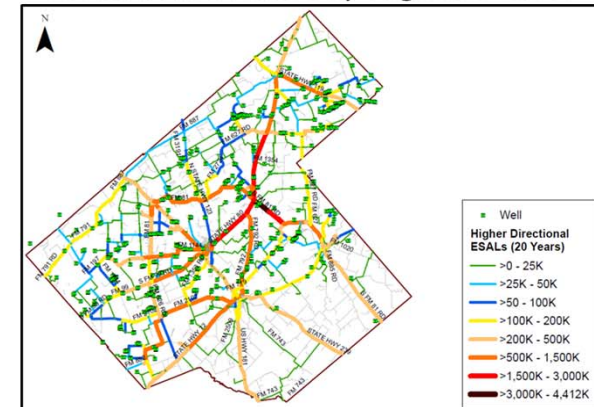
## Trucks and ESALs Needed to Develop and Operate a Well

Item	Development	Production		Re-Fracking		Total
	Per Analysis Period	Per Year	Per Analysis Period	Per Event	Per Analysis Period	Per Analysis Period
Total volume of trucks per well	1,708	418	8,366	1,521	6,085	16,160
Total ESALs per well, trip to well	2,261	31	625	1,968	7,871	10,757
Total ESALs per well, trip from well	689	591	11,815	639	2,555	15,059

## Adapted Travel Demand Modeling



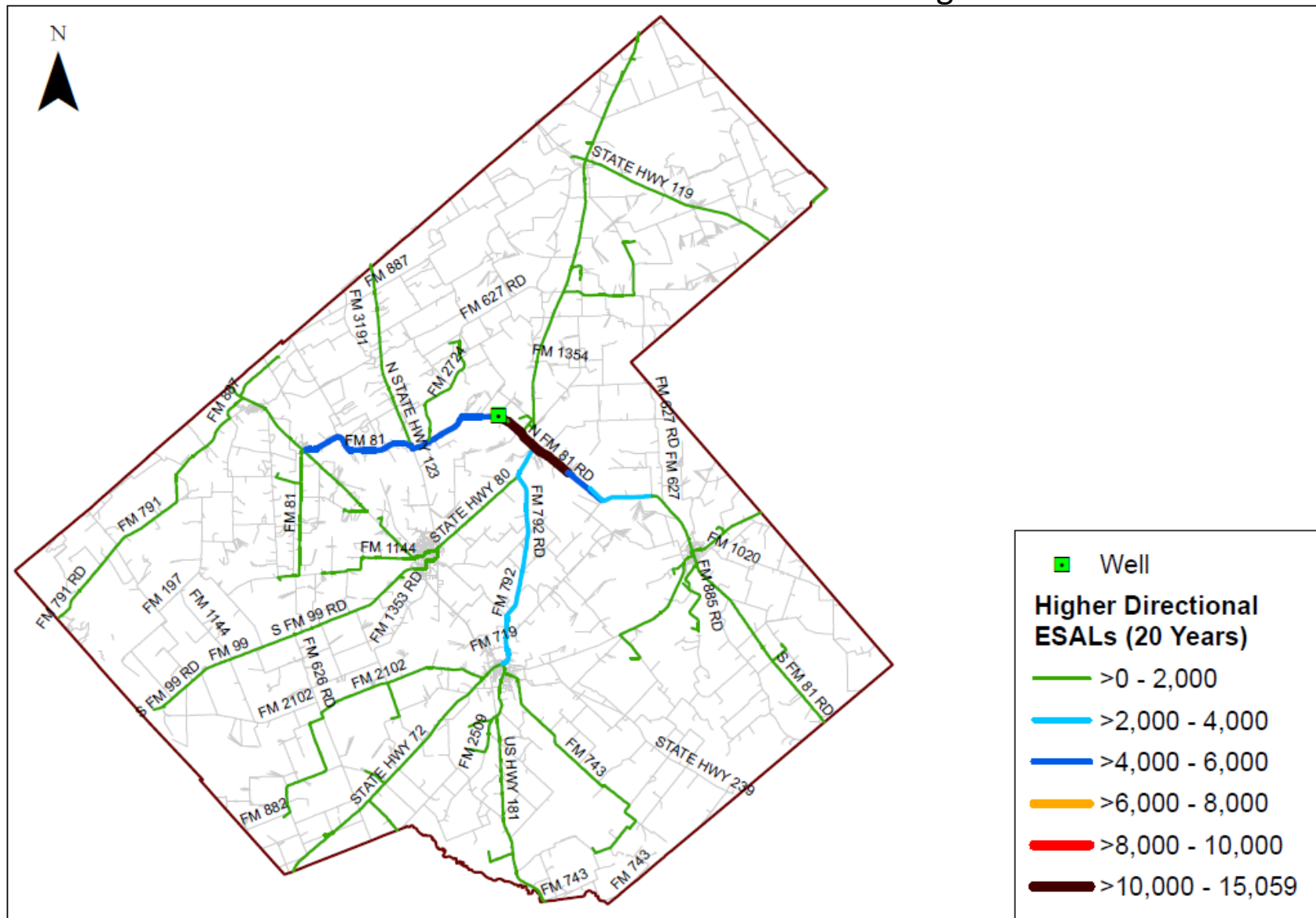
## ESALs at the Roadway Segment Level





# One Well

## Higher Directional ESALs

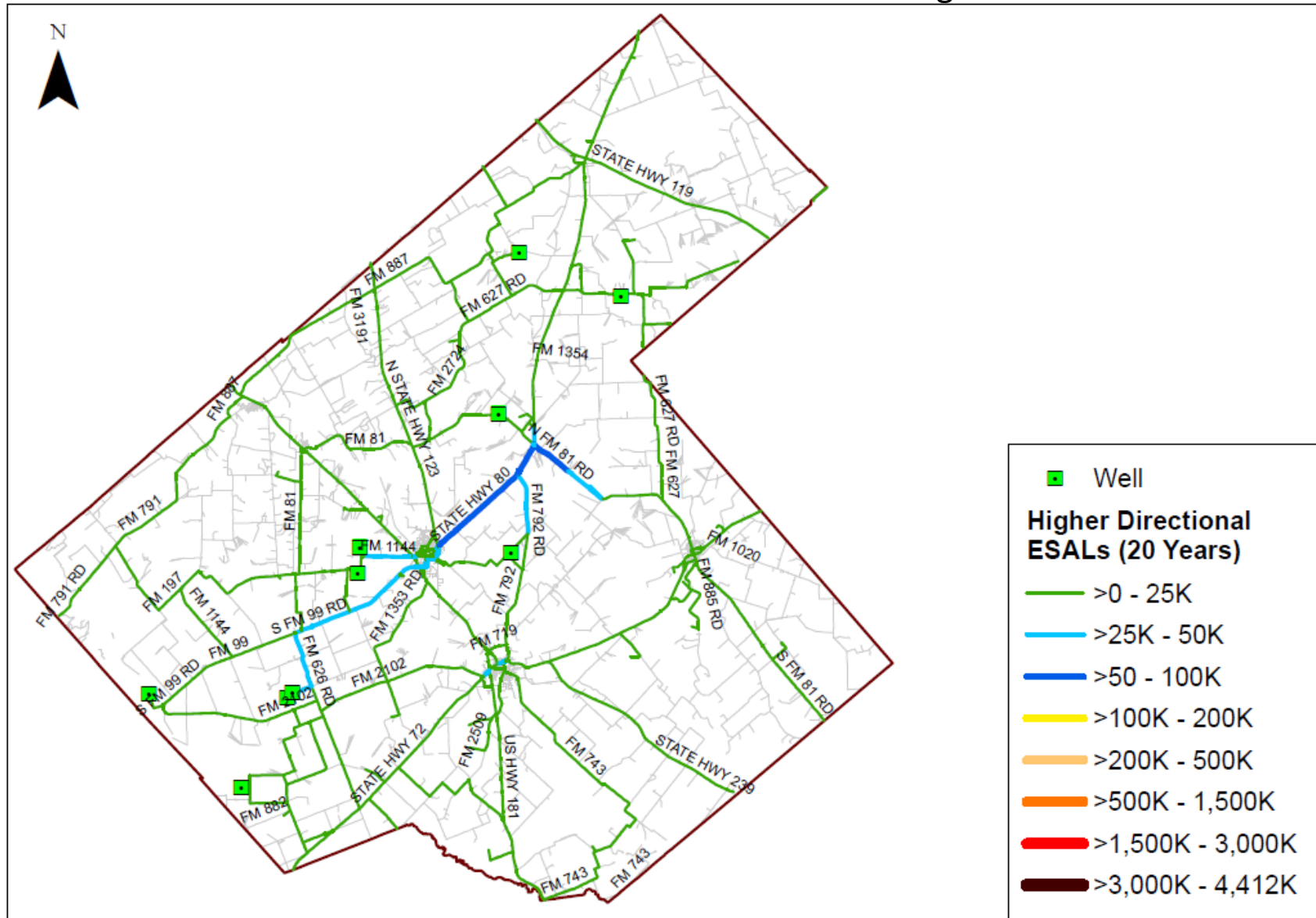




# TAMEST Shale Task Force

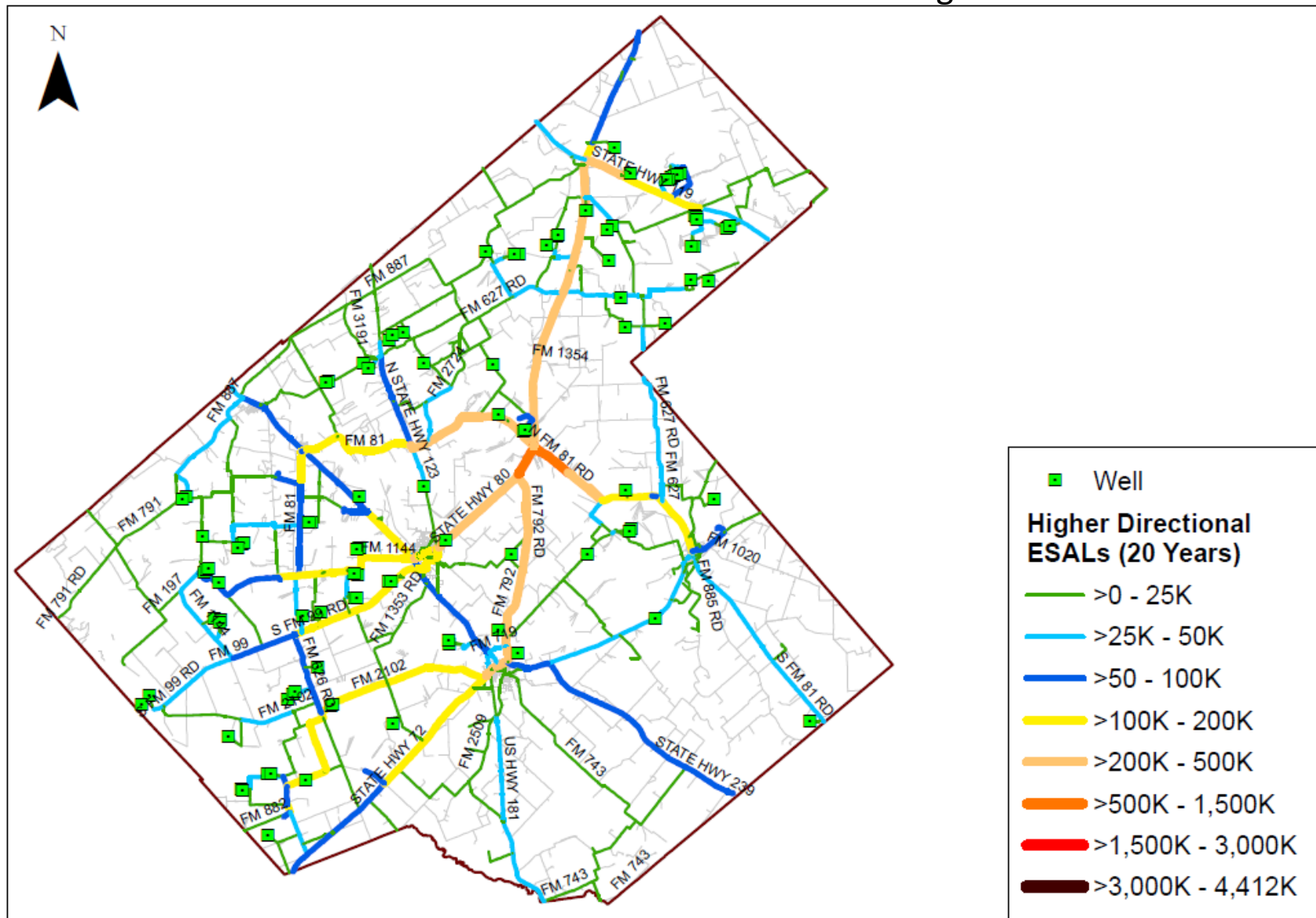
## 10 Wells

Higher Directional ESALs



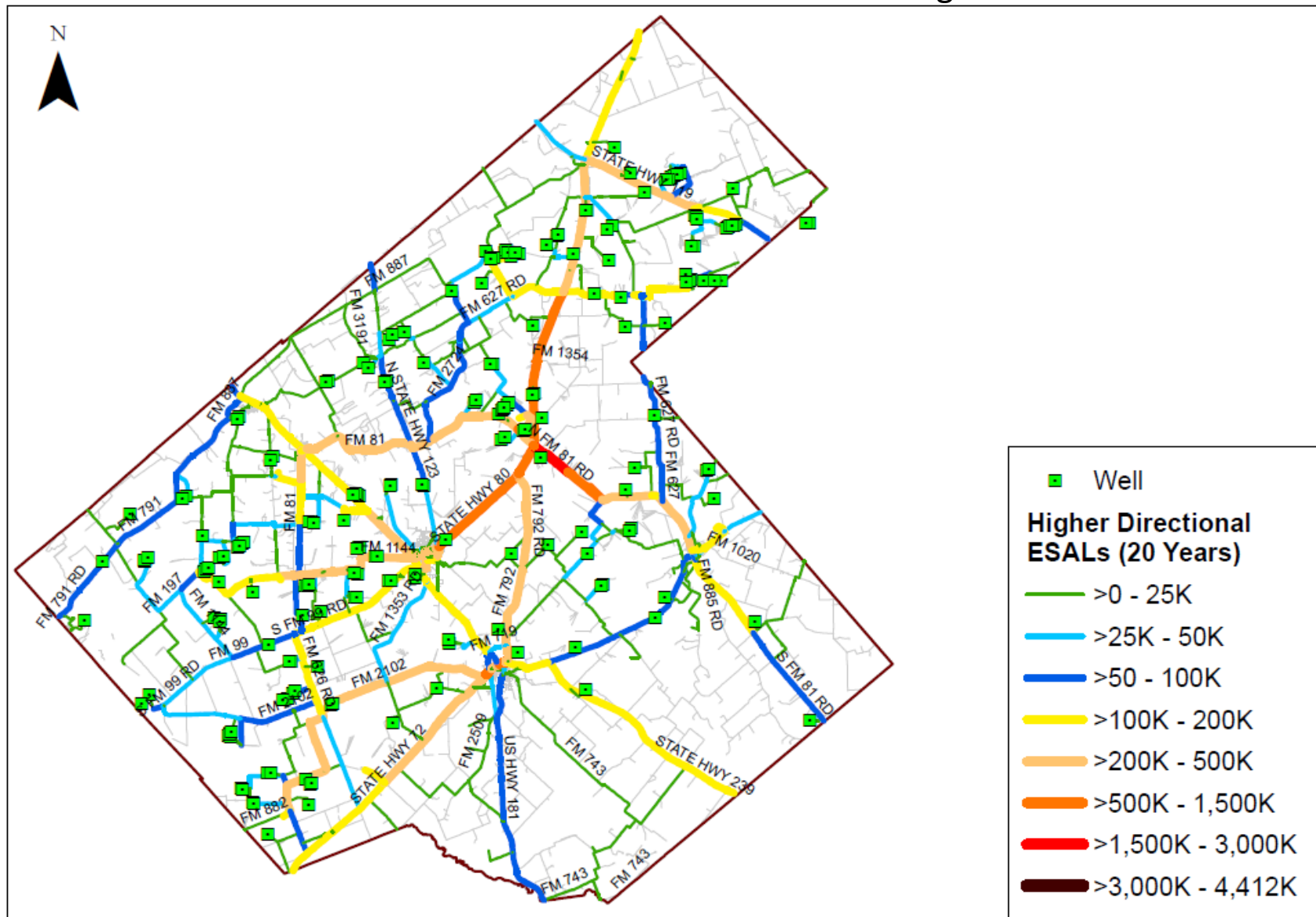
# 100 Wells

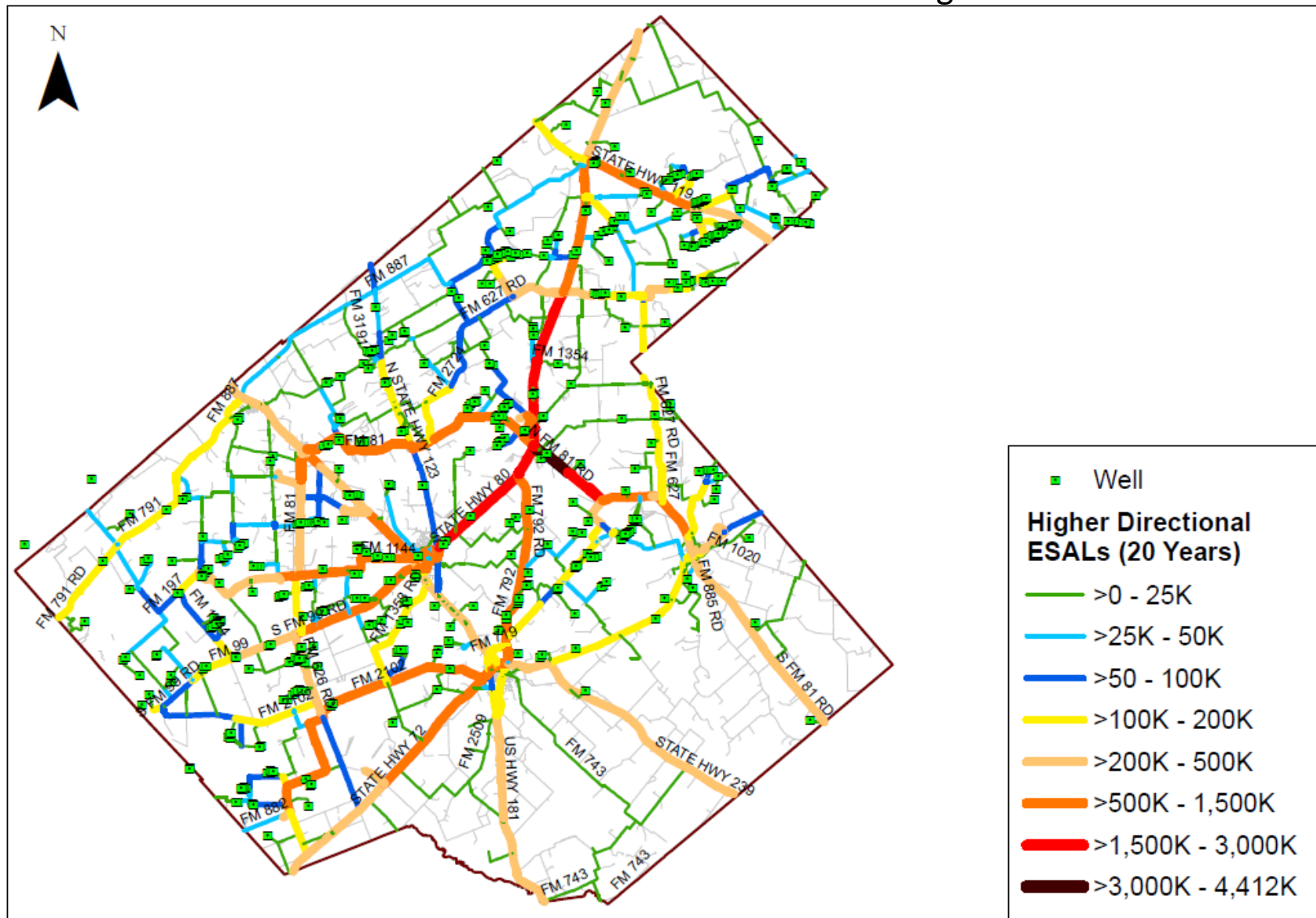
## Higher Directional ESALs



## 200 Wells

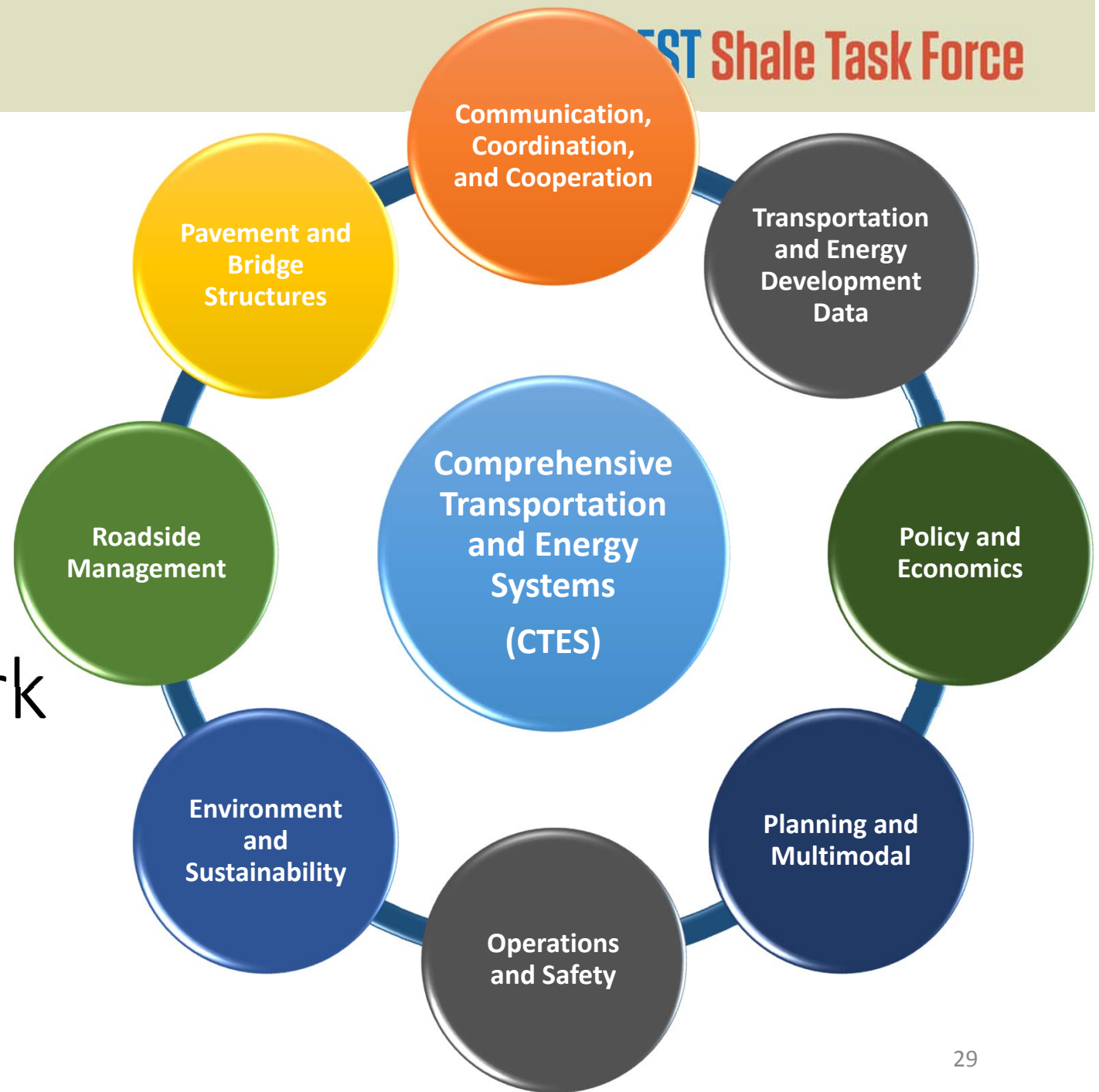
## Higher Directional ESALs







# Strategic Research Roadmap Framework



Research Idea	Duration (months)	Total Funding
Identify best practices and develop strategies to improve communication, coordination, and cooperation among public-sector and private-sector stakeholders	48	\$400,000
Identify best practices for counties and municipalities on topics related to weight limits; road damage enforcement; pavement materials, standards, and construction methods; truck routing enforcement; and staffing and funding	36	\$1,800,000
Develop and maintain a centralized database and information infrastructure to facilitate data exchange among stakeholders	24	\$500,000
Develop guidelines to improve traffic data collection practices in energy development areas, including traffic volumes, origins and destinations, supply chains, and vehicle axle weights	36	\$500,000
Analyze OS/OW permit data to extract information about truck traffic trends in energy development regions	12	\$150,000
Develop data-driven tools to forecast and quantify the location, magnitude, and impact of energy developments at different levels of spatial and temporal aggregation	24	\$400,000
Evaluate the use and effectiveness of different revenue and funding sources to address transportation infrastructure issues in energy development areas	24	\$400,000
Develop guidelines to improve transportation planning processes to account for oil and gas energy development locations and trends	24	\$400,000
Document highway/railroad integration strategies to optimize transportation system in energy development areas	24	\$300,000
Document correlations between energy developments, crashes, and transportation infrastructure conditions	24	\$400,000
Develop guidelines to improve driver safety in energy development areas	24	\$300,000
Develop technologies and guidance to improve work zone safety in areas of active energy sector developments	24	\$400,000
Provide guidelines for traffic control signage along truck routes in energy development areas	24	\$300,000
Develop strategies to reduce the use of water and promote public awareness about best water conservation strategies in energy development areas	24	\$500,000
Develop data-driven methodology to identify, prioritize, and select maintenance projects	24	\$400,000
Develop simplified process to select strategies for pavement repairs and minimum depth	18	\$250,000
Develop guidelines to mitigate impacts to bridges and other structures in energy development areas	24	\$300,000
Develop guidelines for more effective use of local resources and recycling for roadway maintenance and energy developments	36	\$900,000
Develop methodologies to partially open roads under rehabilitation or reconstruction to heavy traffic	24	\$400,000
<b>Total</b>		<b>\$9,000,000</b>

# Major Takeaways

- Current technologies for oil and gas development and production from shale formations **require extremely large volumes of heavy truckloads**
- Most existing roadways and bridges were **not designed** to carry/accommodate energy sector truckloads
- Truck traffic associated with the development and production of oil and gas from shale formations has resulted in **severe traffic crash increases**
- Funding to address the impacts to the transportation infrastructure and traffic safety in energy sector areas is **very low relative to the magnitude of the impact**

# Critical Needs

- Improved availability and quality of data related to ongoing and forecasted drilling activities
- Constructing and maintaining integrated multimodal infrastructure strategies and solutions
- Reliable and sustainable funding to proactively prepare the state's infrastructure for future drilling activities



# Thank You!

- Cesar Quiroga  
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