ENERGY-SECTOR BRIEF

Maintenance Division, Roadway Asset Management

16-08 TRAFFIC LOADS FOR DEVELOPING AND OPERATING INDIVIDUAL WELLS

PROCESS TO DETERMINE TRUCKLOADS

The general process to determine truckloads (more specifically ESALs) in connection with the development and operation of typical horizontal, hydraulically-fracked oil and gas wells in the Eagle Ford Shale, Permian Basin, and Barnett Shale regions of the state involve the following sets of activities:

- Determine the number of trucks per well phase activity, from pad construction to drilling, fracking, and operation of a typical well over a 20-year period.
- Estimate the axle weight distribution for the truck types used for each phase of well development.
- Determine a "typical" truck type and truck axle configuration for each well development, production, and re-fracking activity.
- Calculate load equivalency factors (LEFs) for loaded and unloaded axles using industry-standard AASHTO road test equations.
- Select trip load condition (loaded or empty) for each well activity in each well development phase.
- Estimate the number of ESALs for each phase.

Traditional pavement design requires the estimation of 18-kip equivalent single axle loads (ESALs). This energy sector brief describes a process to estimate the amount of truck traffic related to oil and gas energy development, and calculates the corresponding number of ESALs per well. Other energy sector briefs and an implementation report (IR-16-03) provide details associated with the underlying methodology. This report and related documents are available on the TxDOT Maintenance Division (MNT) SharePoint site at https://txdot.sharepoint.com/sites/division-MNT/SitePages/Home.aspx.

USE OF THE EXCEL TEMPLATE TO CALCULATE TRUCKLOADS

An Excel spreadsheet template enables users to calculate the following for each well:

- Total number of trucks needed by phase activity and analysis period.
- Total amount of ESALs for trips to the well by phase activity and analysis period.
- Total amount of ESALs for trips leaving the well by phase activity and analysis period.

The spreadsheet calculates these values based on inputs the user provides in various places of the spreadsheet, as shown in the red cells in Table 1 and Table 2. Default input values have been prepared for the Eagle Ford Shale, Barnett Shale, and Permian Basin regions, as described in Implementation Report IR-16-03. Once all the cells shaded in red are populated, the spreadsheet calculates the number of trucks and ESALs per well for the selected analysis period, both for trips to the well and trips leaving the well, as show in Table 3. If needed for further analysis, the Excel file also includes all the data and details used for the calculations. Note that a slightly different procedure is used to estimate the number of trucks to operate gas wells. The Excel file includes templates for both oil and gas well operations.

Table 1. Input Parameters to Determine Number of Trucks and ESALs.

Input	
Pavement Structural Number (SN) =	3.0
Pavement Terminal Serviceability Index (Pt) =	2.5
Analysis Period (Years) =	20
Number of Re-Fracking Events per Analysis Period =	4
Disposal Liquid Ratio =	0.26
Ratio of Steel to Aluminum Tank Trucks =	2.33
Flowback water ratio =	0.25

The pavement structural number and terminal serviceability index are flexible pavement design parameters that affect the calculation of load equivalency factors.

The analysis period covers the development, operation, and maintenance phases of an oil or gas well for pavement design purposes. It assumes continuous operation of the well. A well could operate past the analysis period.

The number of re-fracking events per analysis period represents the number of times a well is re-fracked during the analysis period.

The disposal liquid ratio represents the ratio of produced water to oil and condensate (by volume), which must be transported by truck to a disposal facility.

The ratio of steel to aluminum tank trucks is the ratio of the number of steel tank trucks to the number of aluminum tank trucks.

The flowback water ratio is the ratio of the volume of water recovered to the volume of water injected during fracking.

USE OF THE EXCEL TEMPLATE TO CALCULATE TRUCKLOADS (continued)

Table 2. Trucks Needed to Develop, Operate, and Maintain an Oil Well (Note: Users populate cells in red; other cells are calculated automatically).

Trucks Needed to Develop and Complete a Well	
Well Development Activity	**Truck Volume (per Well)**
Drilling pad and construction equipment	70
Drilling rig	4
Drilling fluid and materials	59
Drilling equipment: casing, drilling pipe	54
Fracking equipment: pump trucks, tanks	74
Fracking water	1,021
Fracking water (steel tank)	715
Fracking water (aluminum tank)	306
Fracking sand	147
Fracking sand (steel tank)	103
Fracking sand (aluminum tank)	44
Other additives and fluids	24
Flowback water removal	255
Total	1,708

Trucks Needed for Re-Fracking	
Well Re-Fracking Activity	**Truck Volume (per Well and Event)**
Fracking equipment: pump trucks, tanks	74
Fracking water (steel tank)	715
Fracking water (aluminum tank)	306
Fracking sand (steel tank)	103
Fracking sand (aluminum tank)	44
Other additives and fluids	24
Flowback water removal	255
Total	1,521

Trucks Needed for Oil Production	
Well Development Activity	**Truck Volume (per Well and Year)**
Produced water (steel tank)	65
Produced water (aluminum tank)	22
Oil production (steel tank)	249
Oil production (aluminum tank)	83
Total	418

Table 3. Calculation Results: Volume of Trucks and Number of ESALs per Well.

Output						
	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**

Contacts

Cesar Quiroga
Senior Research Engineer
(210) 321-1229
c-quiroga@tti.tamu.edu

Edgar Kraus
Research Engineer
(210) 321-1228
e-kraus@tti.tamu.edu

Ioannis Tsapakis
Assistant Research Scientist
(210) 321-1217
i-tsapakis@tti.tamu.edu

In partnership with
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