

# **Update on Implementation of Rule 1148.2**

**Rule 1148.2 Working Group Meeting**  
**November 12, 2014**

# Background – Rule 1148.2

- Adopted April 5, 2013
- Applies to operators of oil and gas wells and chemical suppliers
- Requires pre-project notification, emissions and chemical usage reporting for drilling, well completion, or rework activities
- SCAQMD website where the public may access notification and chemical usage information

(Adopted April 5, 2013)

## RULE 1148.2 NOTIFICATION AND REPORTING REQUIREMENTS FOR OIL AND GAS WELLS AND CHEMICAL SUPPLIERS

- (a) Purpose  
The purpose of this rule is to gather air quality-related information on oil and gas well drilling, well completion, and well reworks.
- (b) Applicability  
This rule applies to any operator of an onshore oil or gas well located in the District that is conducting oil or gas well drilling, well completion, or well reworks. In addition, this rule applies to suppliers as defined in paragraph (c)(14).
- (c) Definitions  
For the purposes of this rule, the following definitions shall apply:
- (1) ACIDIZING means a treatment of the wellbore or reservoir formation with an acid to either clean out scale, damage, or other debris in the well, or react with the soluble substances in the formation to improve permeability and enhance production of oil and gas.
  - (2) AIR TOXIC means any substance identified on a list that is compiled and maintained by the California Air Resources Board pursuant to Health and Safety Code Section 44321.
  - (3) CHEMICAL FAMILY means a group of chemicals with related physical and chemical properties.
  - (4) DRILLING means digging or boring into the earth for the purpose of developing, extracting, or producing oil, gas, or other hydrocarbons, but does not include remediation efforts to clean-up or remove contamination.
  - (5) DRILLING FLUID means fluid used to lubricate the drill string, line the walls of a well, flush cuttings to the surface, and create enough hydrostatic weight to prevent blowouts.
  - (6) FLOWBACK FLUID means the fluid that flows from an oil or gas well following a well production stimulation or treatment activity, either in preparation for a subsequent phase of well production stimulation or treatment activity, or in preparation for a cleanup and returning the well to production. The flowback period begins when material introduced into the well during the well production stimulation or treatment activity

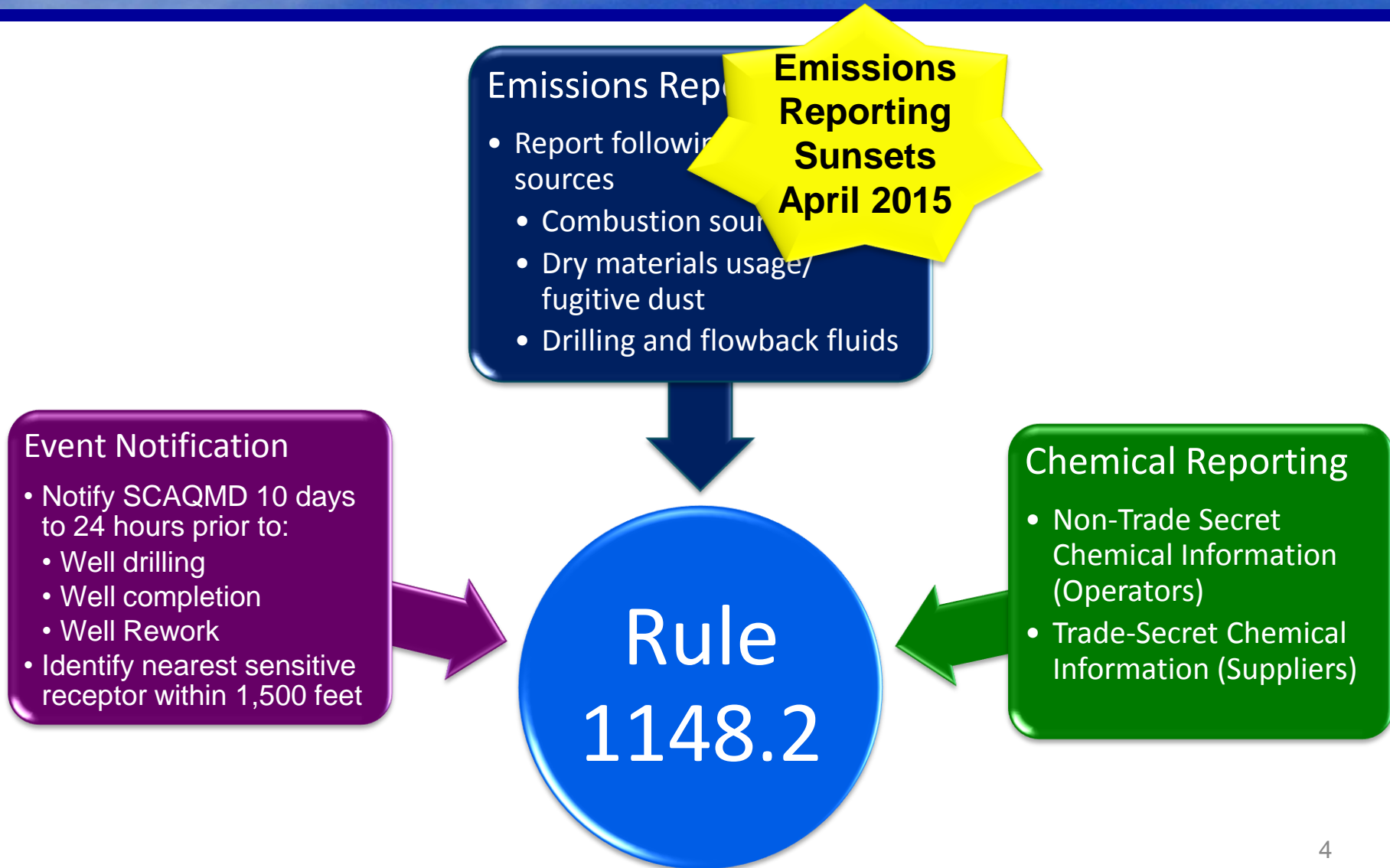
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# Board Resolution 13-31

- Convene Working Group within 6 months after the first emissions report is received to discuss equipment and chemical data, and emissions monitoring/sampling results
- Report semi-annually to Stationary Source Committee (SSC) on notifications, emissions, and chemical use reporting
- Report to the SSC within 2 years of rule adoption, findings and recommendations for the need, if any, for emission controls or regulatory efforts for well drilling, well completion, and well reworks



# Key Elements of Rule 1148.2

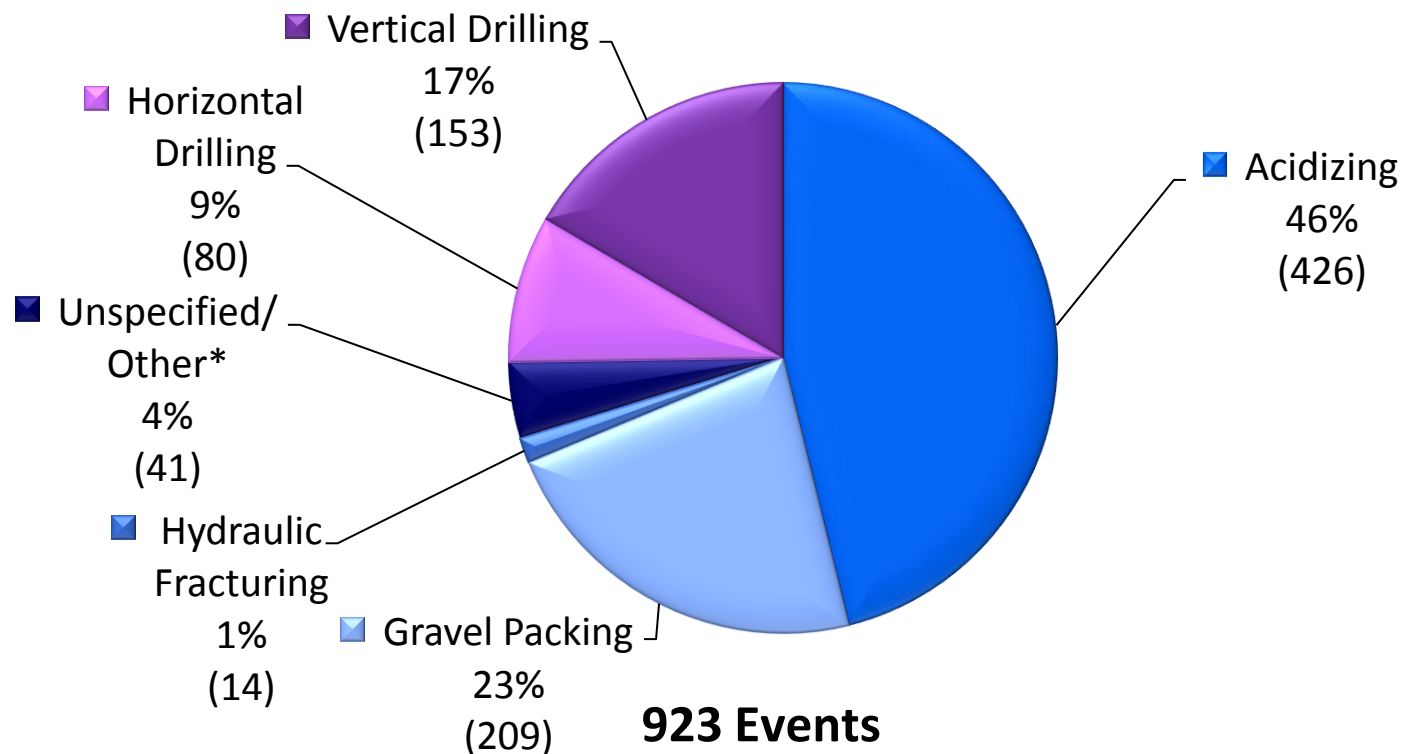


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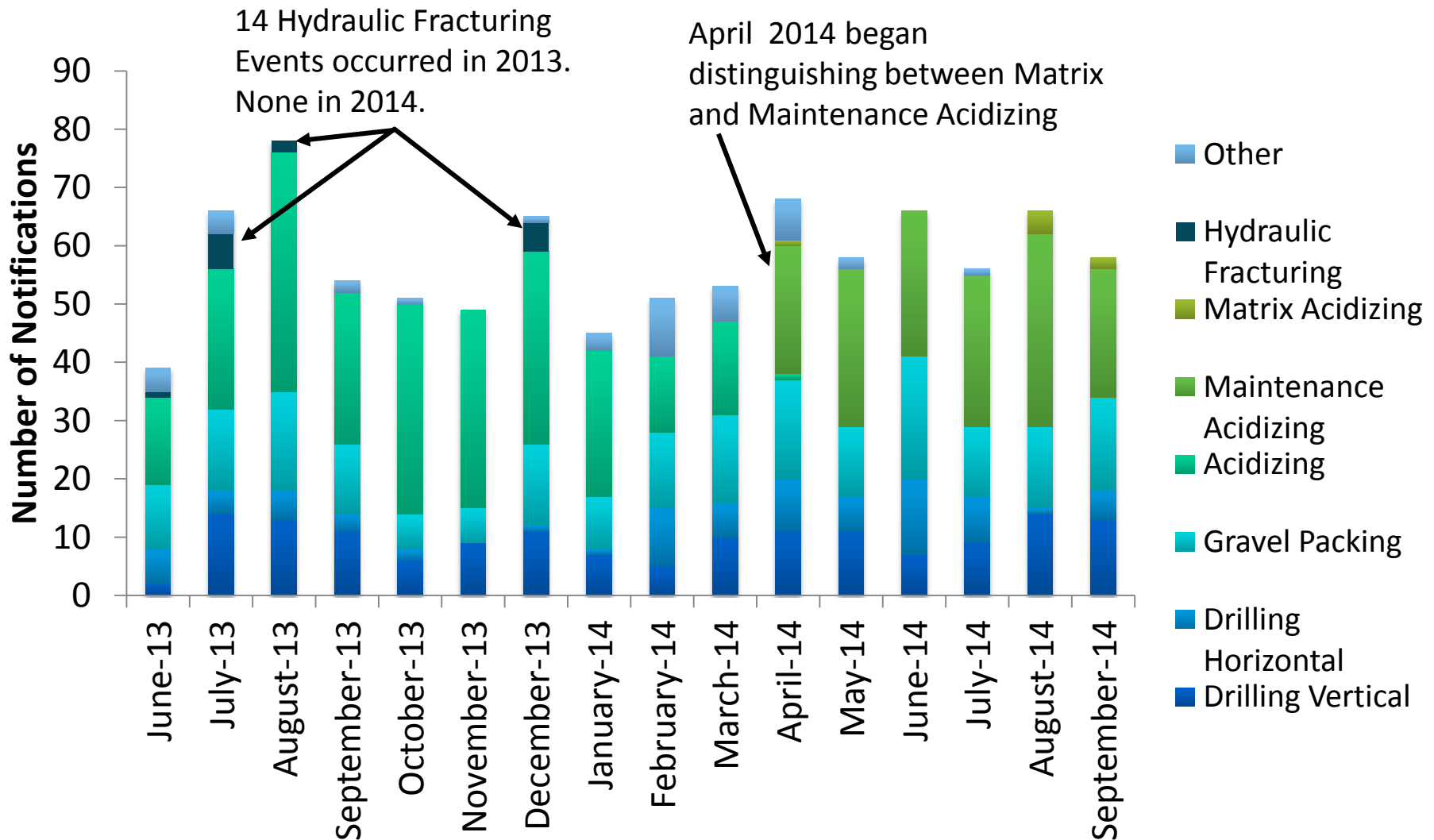
# Summary of Event Notifications

# Summary of Rule 1148.2 - Notification Data (June 2013 - Sep 2014)

- Approximately 821 Notifications representing 923 events (Some notifications have multiple events)
- >99% oil wells and <1% gas wells



# Summary of Notifications





# Acidizing Reporting Changes

- Consultation with DOGGR led to conclusion that comparison of acidizing events between DOGGR and SCAQMD data bases resulted in inconsistencies due to:
  - DOGGR only logging Matrix Acidizing
  - SCAQMD logging all types of acidizing without break down of different types of acidizing
- SCAQMD reporting portal changed in April, 2014 to require operators to report different types of acidizing such as:
  - Maintenance Acidizing
  - Matrix Acidizing
  - Acid Fracking

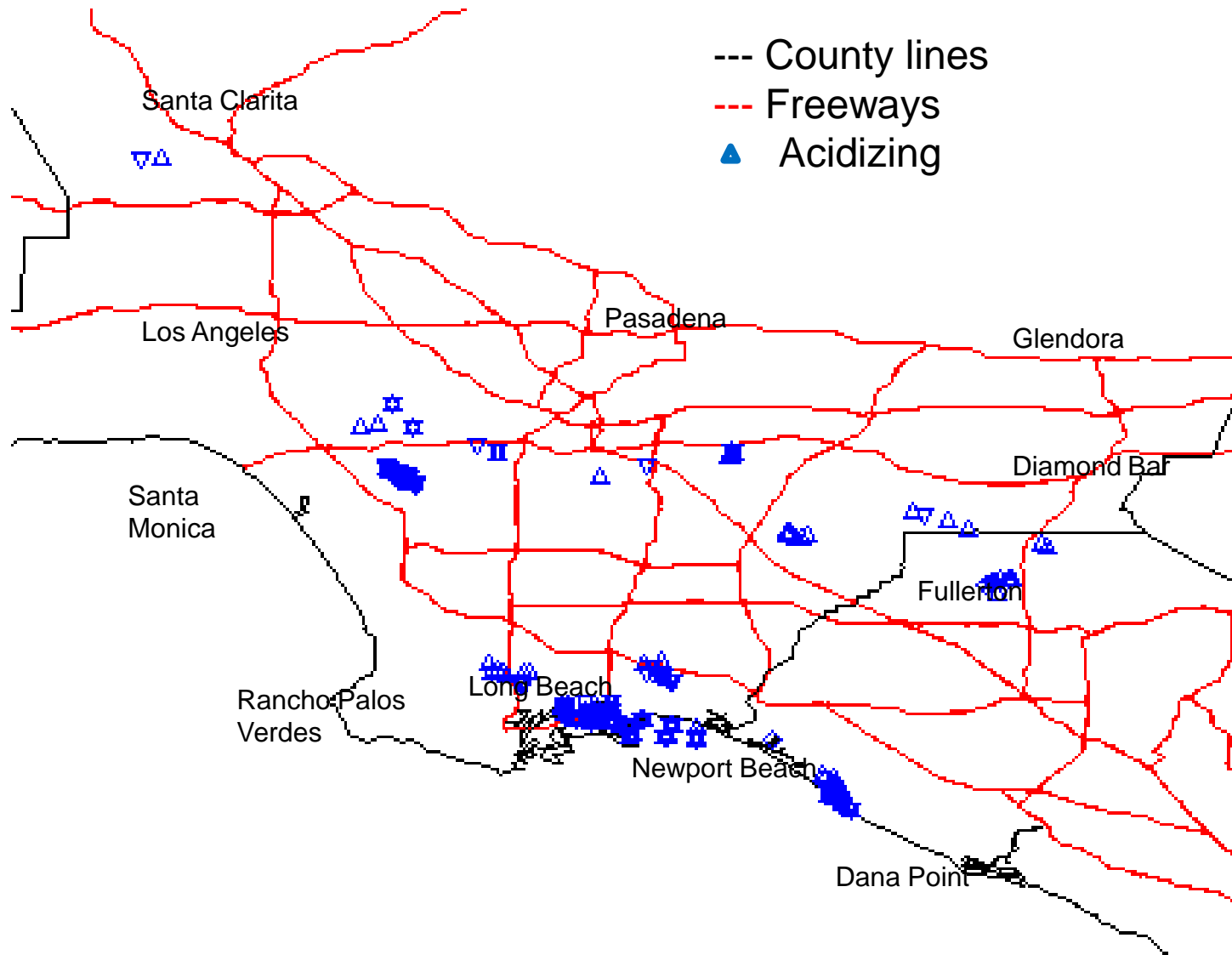


# R 1148.2 – Well Activity by Location

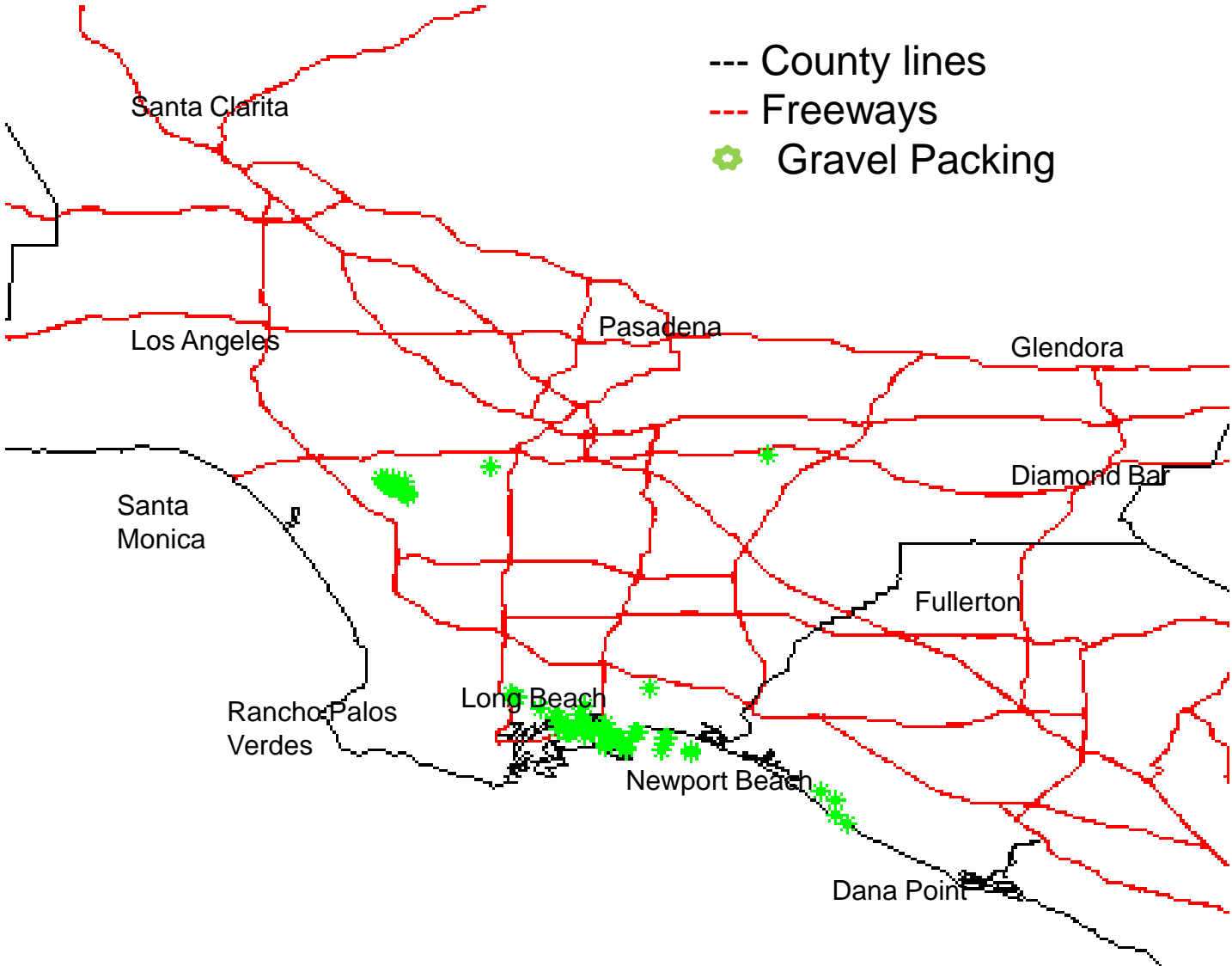
- 93% of notifications in Los Angeles County
- 7% of notifications in Orange County
- No notifications in Riverside or San Bernardino County



# Location of Acidizing Events

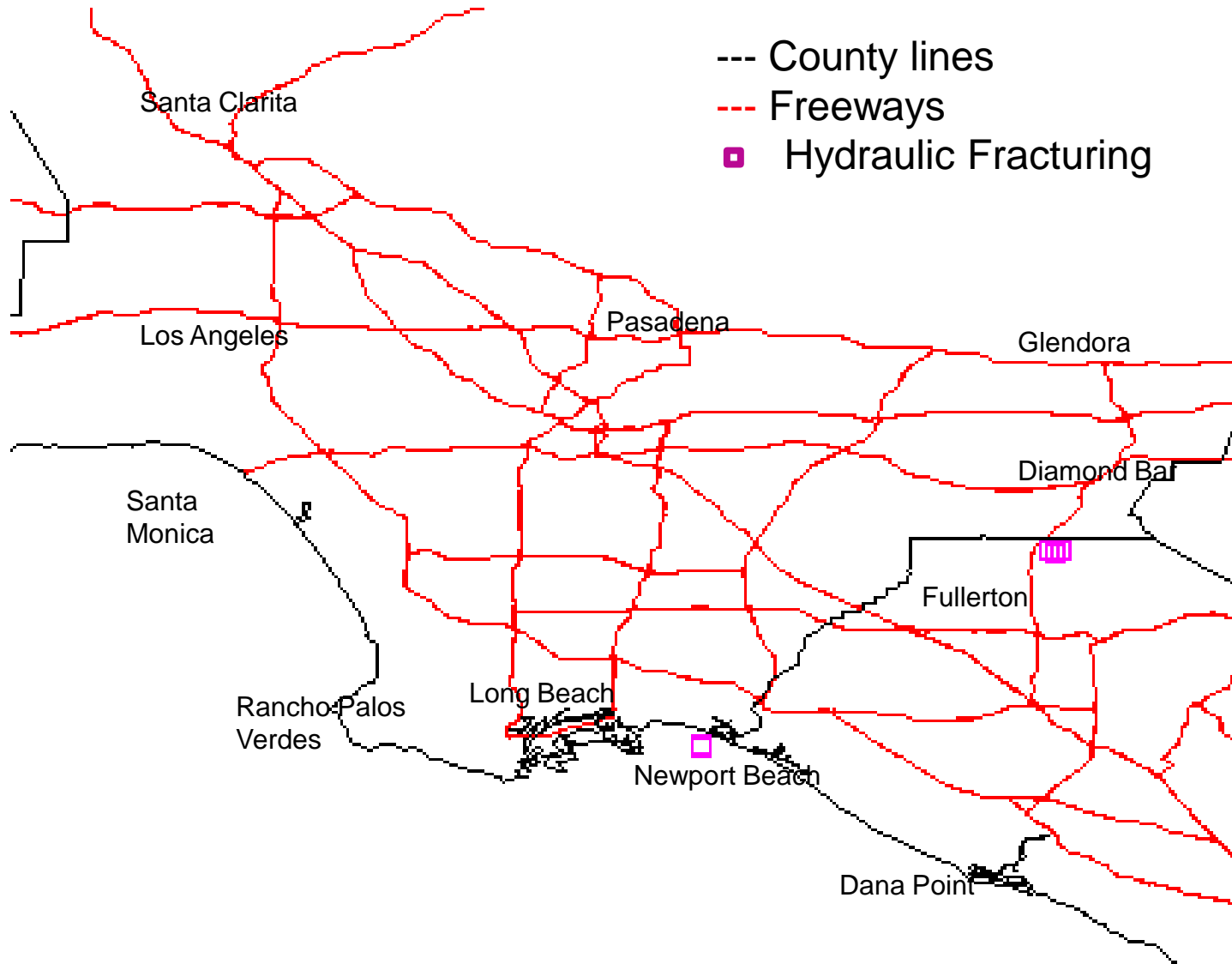


# Location of Gravel Packing Events

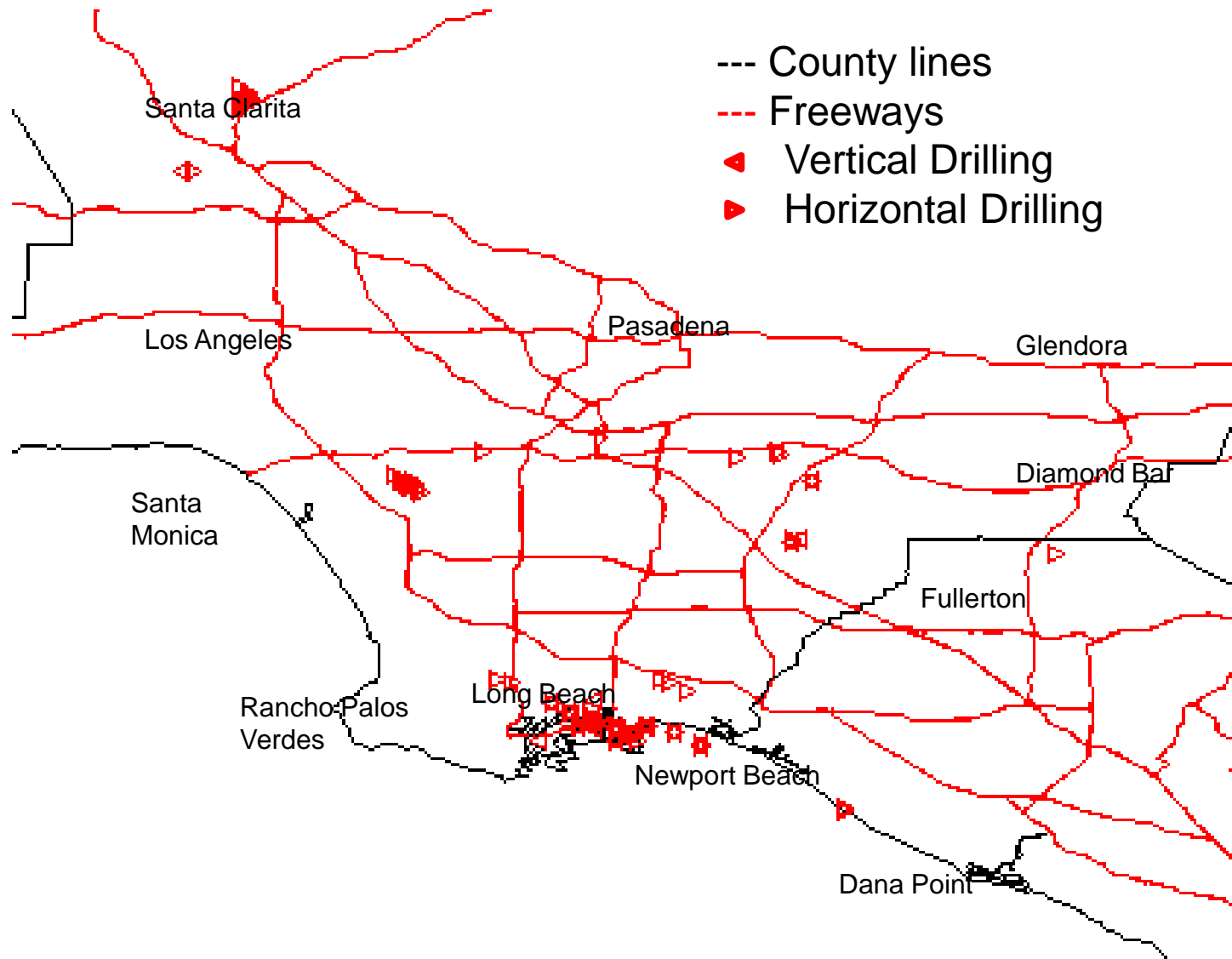




# Location of Hydraulic Fracturing Events

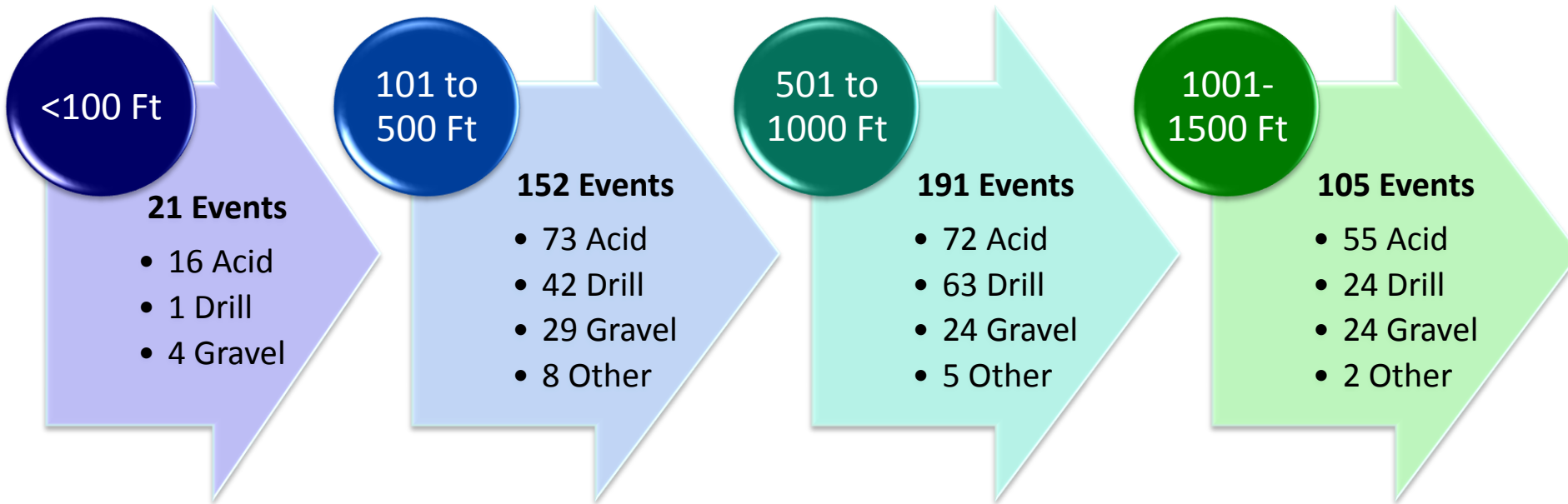


# Location of Drilling Events



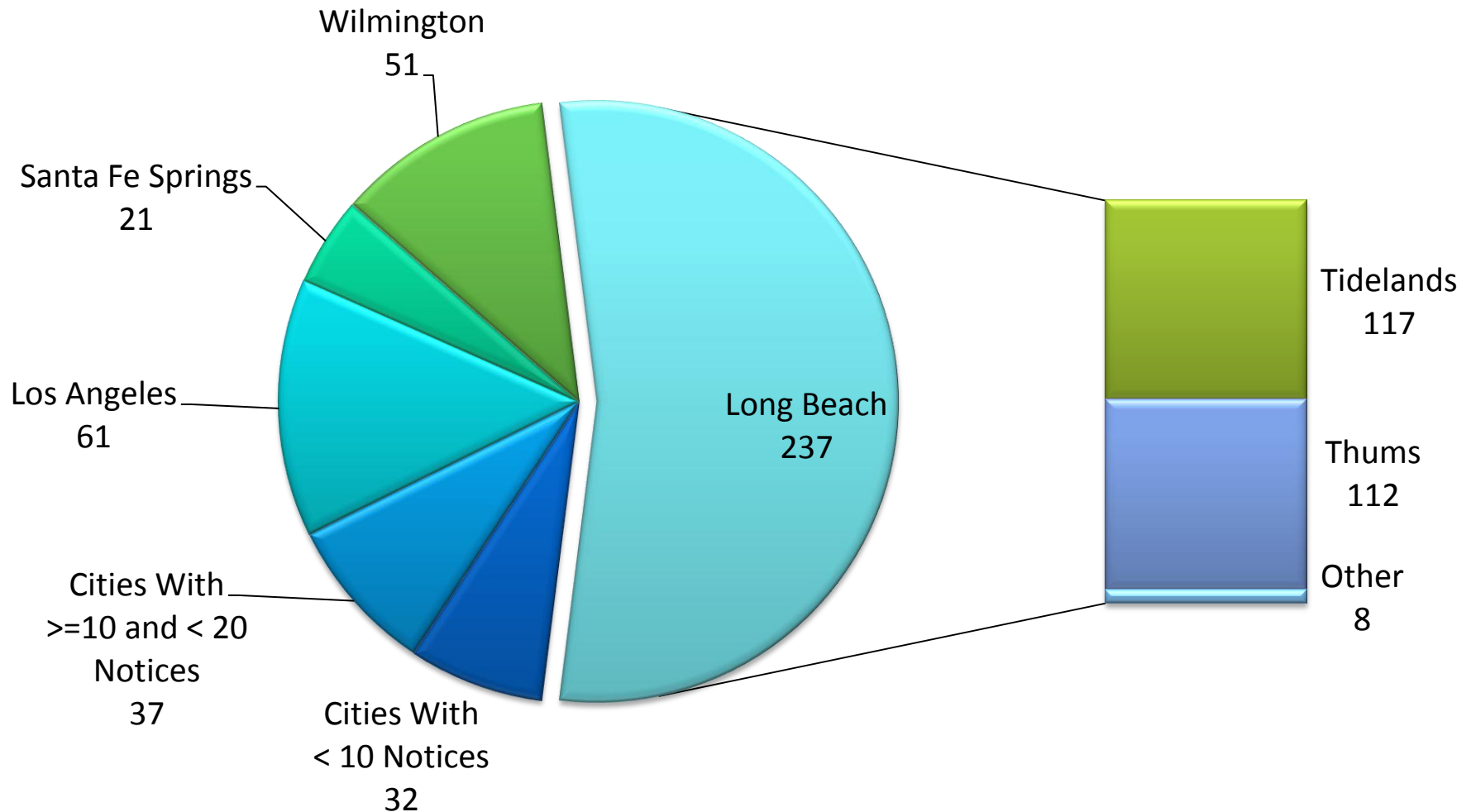
# Distance to Sensitive Receptor

- ~ 50% of events  $\leq 1,500$  feet from sensitive receptor
- All 14 hydraulic fracturing events  $> 1,500$  from sensitive receptor





# Distribution of Well Activities Near Sensitive Receptors by City



**469 Notices for Well Events  $< 1,500$  Feet from a Sensitive Receptor**

# Summary of Emissions Reporting

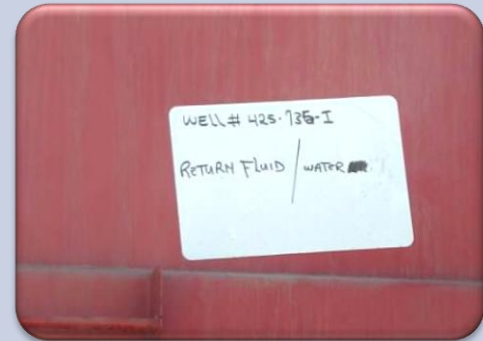
# Emissions Reporting



Calculated  
and  
analyzed  
combustion  
emissions



Analyzed  
reports for  
amount of  
dry  
materials  
used



Analyzed  
reports for  
flowback  
fluids



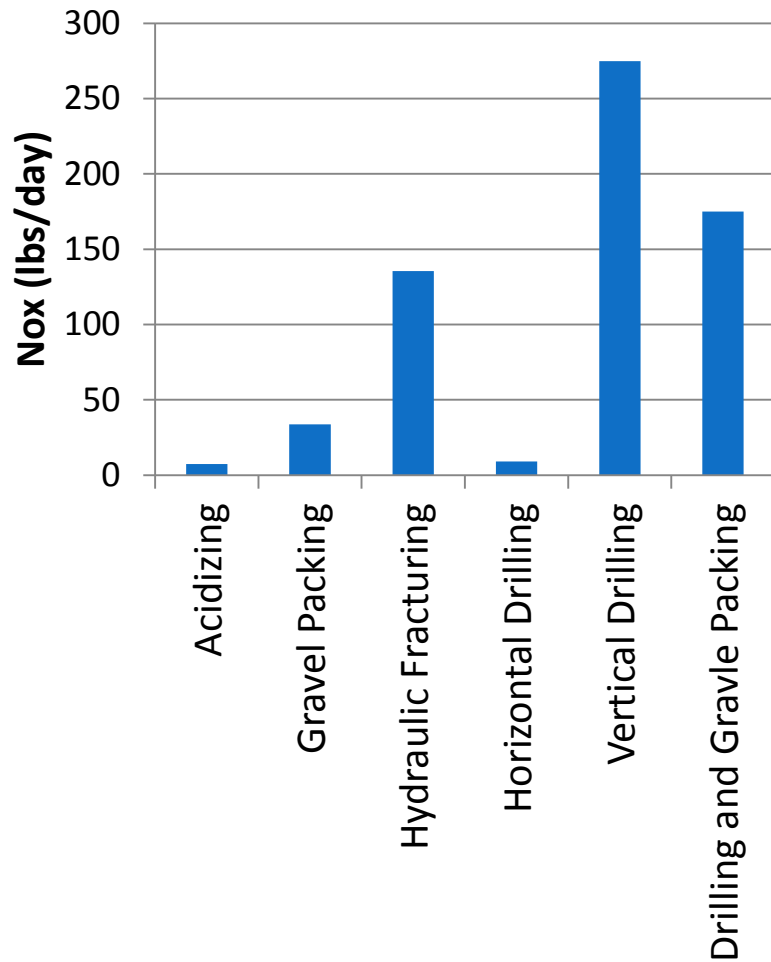
# Emissions from Combustion Equipment

- Calculated average NO<sub>x</sub> and PM emissions per event and per day
- Assumed a load factor of 0.6 (CARB recommended)
- Operators report engine horsepower, hours of operation, and engine Tier
- Used composite CARB emission factor if Tier was not reported

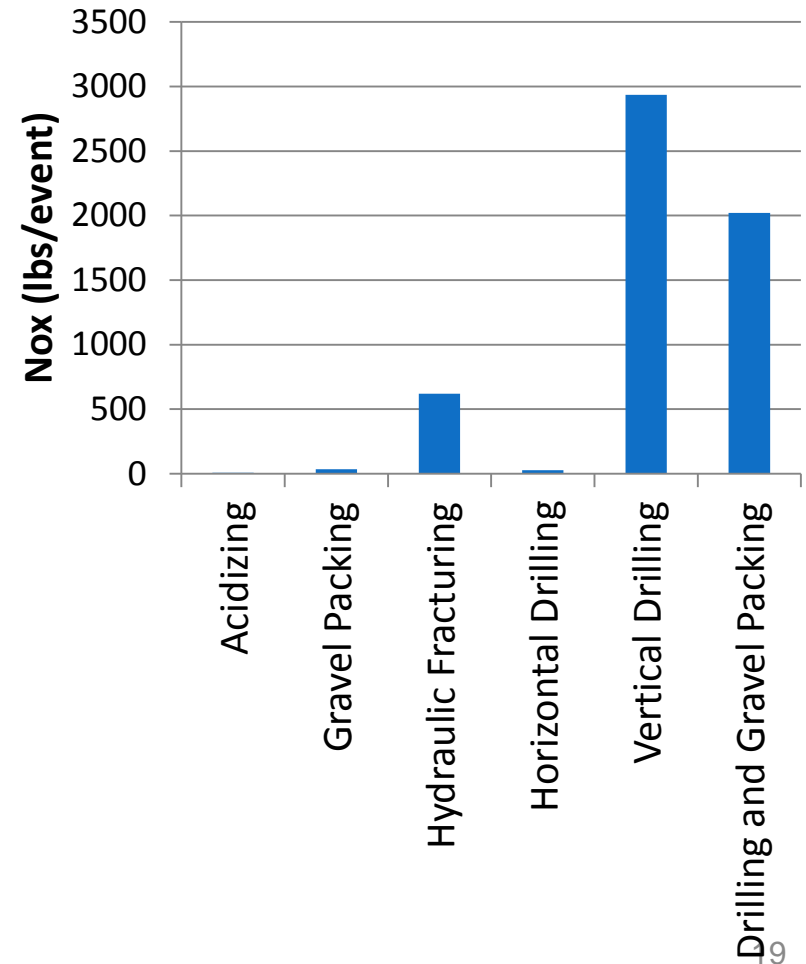


# Average NOx Emissions

## NOx Emissions Per Day

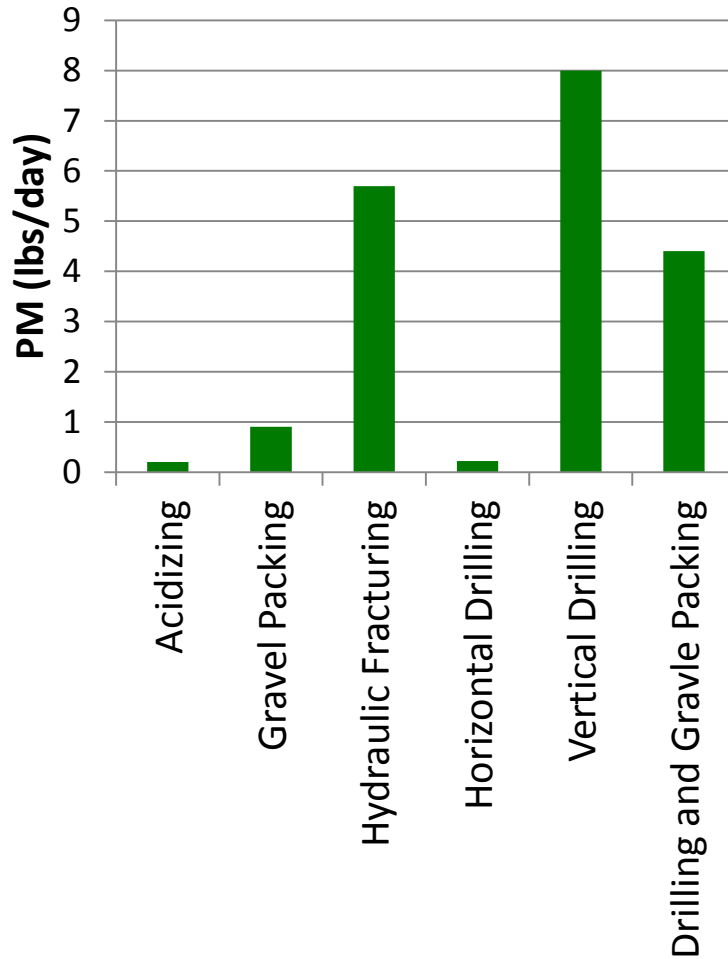


## NOx Emissions Per Event

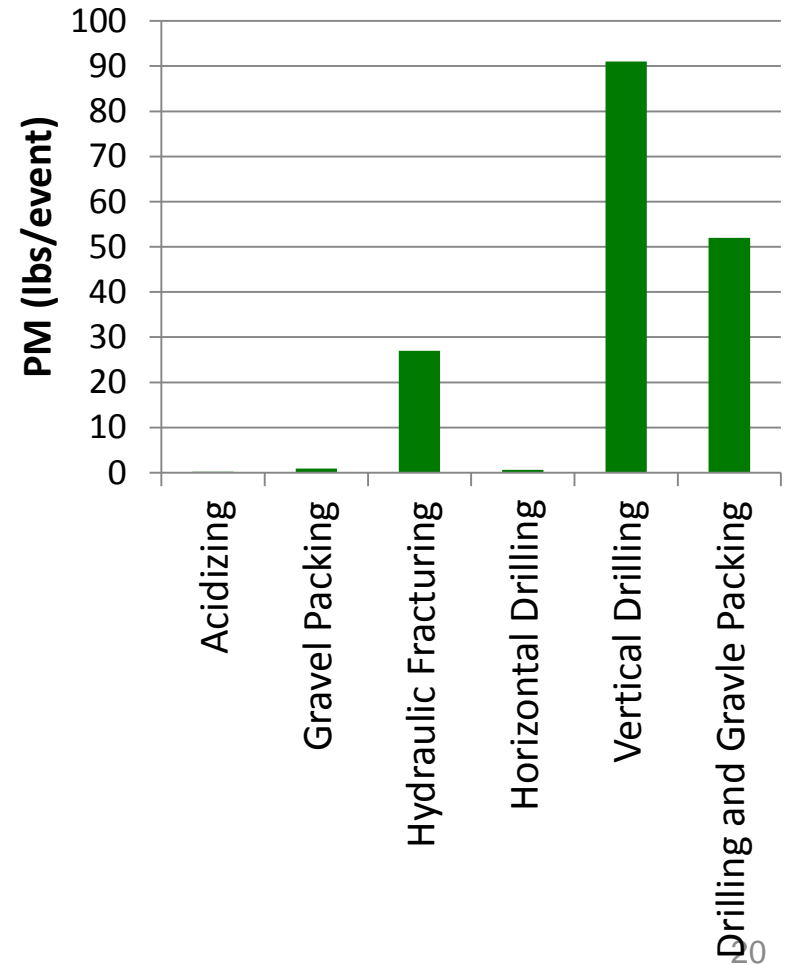


# Average PM Emissions

## PM Emissions Per Day



## PM Emissions Per Event



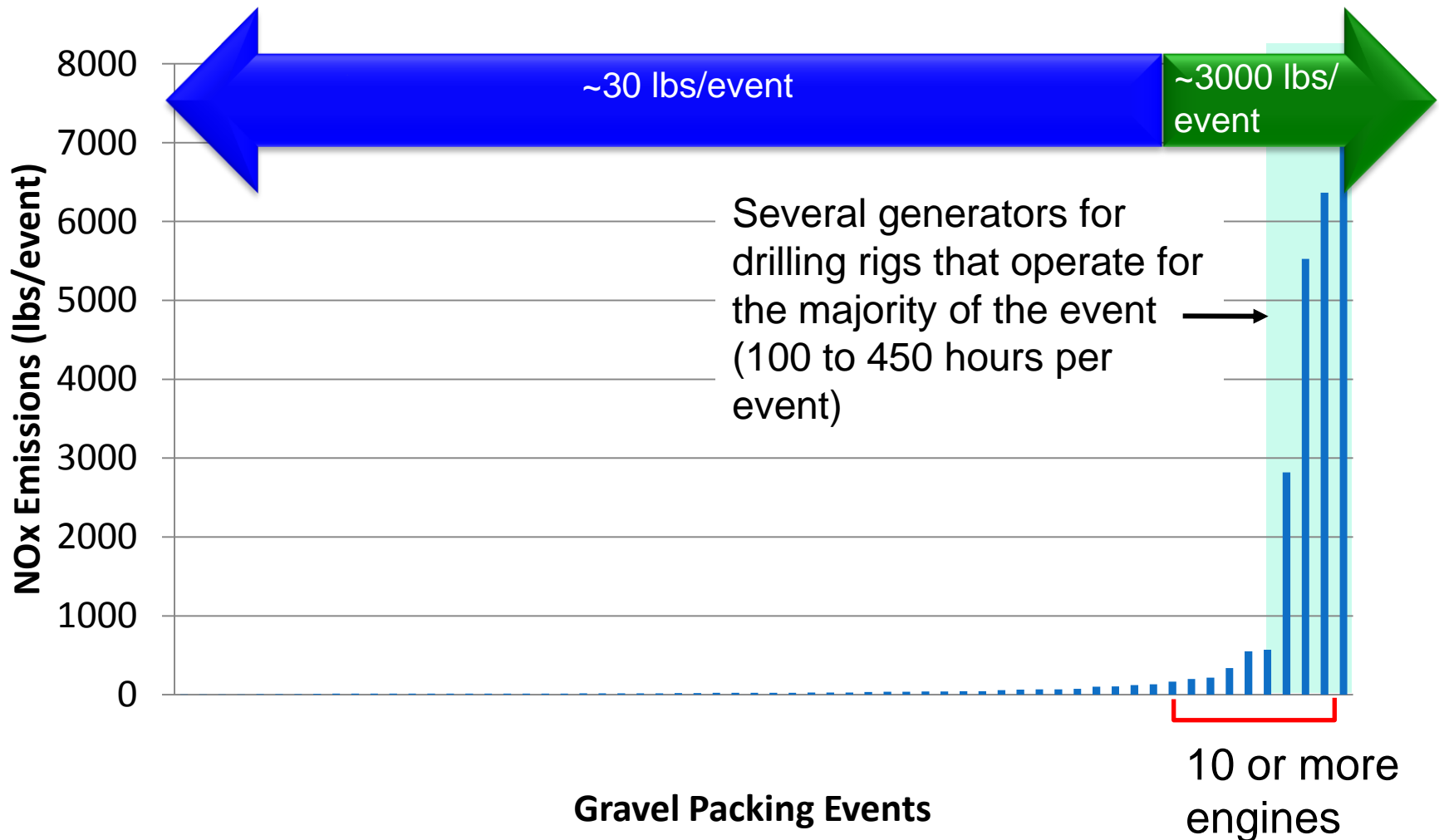
# Combustion Equipment Summary

	Average Engine Size (HP)	Average Operating Hours/Event	Average Maximum Operating Hours/Event*	Average Event Duration	Average Number of Engines
Vertical Drilling	566 HP	102 Hours	198 Hours	19 Days	11
Gravel Packing	495 HP	10 Hours	31 Hours	4 Days	6
Horizontal Drilling	451 HP	38 Hours	310 Hours	10 Days	7
Acidizing	460 HP	4 Hours	12 Hours	1 Day	2
Hydraulic Fracturing	960 HP	13 Hours	32 Hours	6 Days	8

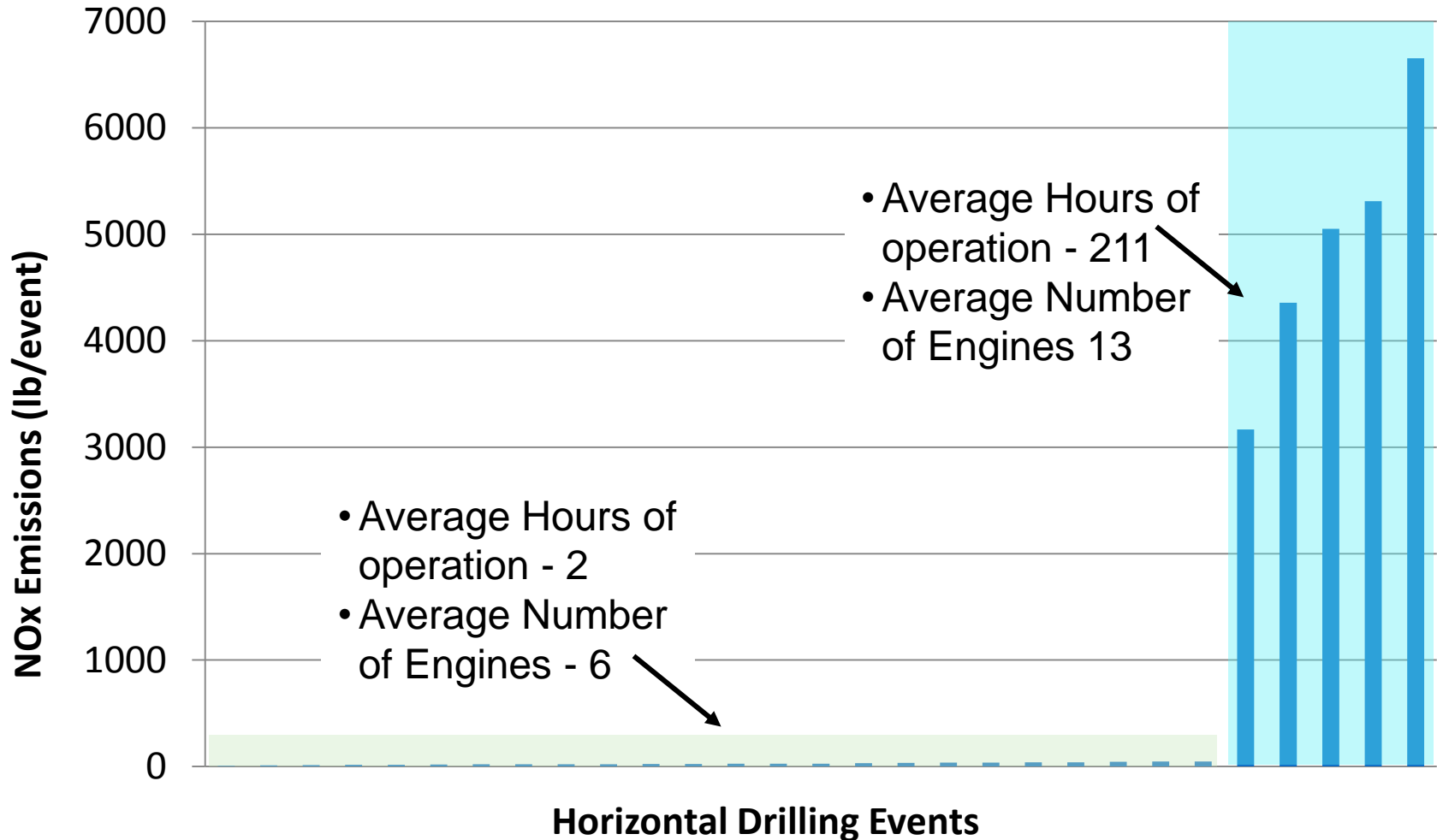
\* Individual engine maximum



# Gravel Packing Combustion Emissions



# Horizontal Drilling Combustion Emissions



# Assumptions for Estimating Cancer Risk from Single Drilling Operation

- Estimated lifetime cancer risk for single drilling event
  - Average PM emissions (90 lbs/event)
  - Maximum PM emissions (423 lbs/event)
- Assumed radius of 25 yards for engine distribution
- Long Beach meteorology conditions
- Used current and proposed revised risk assessment methodology
- Evaluated risk at varying receptor distances up to 1,500 feet

# Estimated Cancer Risk from Single Drilling Event

**Revised**

**DRAFT Cancer Risk (Current Risk Assessment Methodology) (in a million)**

	Distance to Receptor 100 Feet	Distance to Receptor 500 Feet	Distance to Receptor 1,500 Feet
Cancer Risk (90 lbs/event)	0.07	0.04	0.02
Cancer Risk (423 lbs/event)	0.26	0.14	0.08

**DRAFT Cancer Risk (Revised Risk Assessment Methodology)\* (in a million)**

	Distance to Receptor 100 Feet	Distance to Receptor 500 Feet	Distance to Receptor 1,500 Feet
Cancer Risk (90 lbs/event)	1.65	0.82	0.50
Cancer Risk (423 lbs/event)	7.12	3.83	2.33

\* Assumed for children age 0 to 2 years.



# Flowback Fluids Reporting

- Of the 626 emissions reports, only 9 events reported flowback fluid
  - 2 Vertical Drilling (larger volumes of few thousands gal)
  - 2 Well Redrill
  - 2 Maintenance Acidizing (small volume of ~28 gal reported)
  - 3 Unspecified well completions and well reworks
- No flowback fluids reported for gravel packing events
- Reports consistent with site visits

# Dry Materials Reporting

- As of September 2014 – dry materials reported on 342 events
- On average reported per event:
  - 14 types of dry materials
  - ~140,000 lb of dry material
- Examples of dry materials:
  - Alpine spotting beads
  - Bicarbonate of soda
  - Cement
  - Drilling Mud
  - Gravel Pack Sand
  - Magma Fiber
  - Potassium Chloride
  - Walnut Shells
  - Sawdust




# Emissions Reporting Findings

- Drilling operations have the highest NOx and PM emissions
- Drilling operations generally have several engines that will operate for the duration of the event
- Drilling rigs at gravel packing events can operate over a long duration (100 to 450 hours)
- Cancer risk for the largest drilling events can pose a significant health risk at close in receptors





The background of the slide is a photograph of a bright blue sky filled with large, fluffy white cumulus clouds. The clouds are scattered across the frame, with a particularly large cluster in the lower half. The overall tone is bright and clear.

# Summary of Non-Trade Secret Chemical Reporting

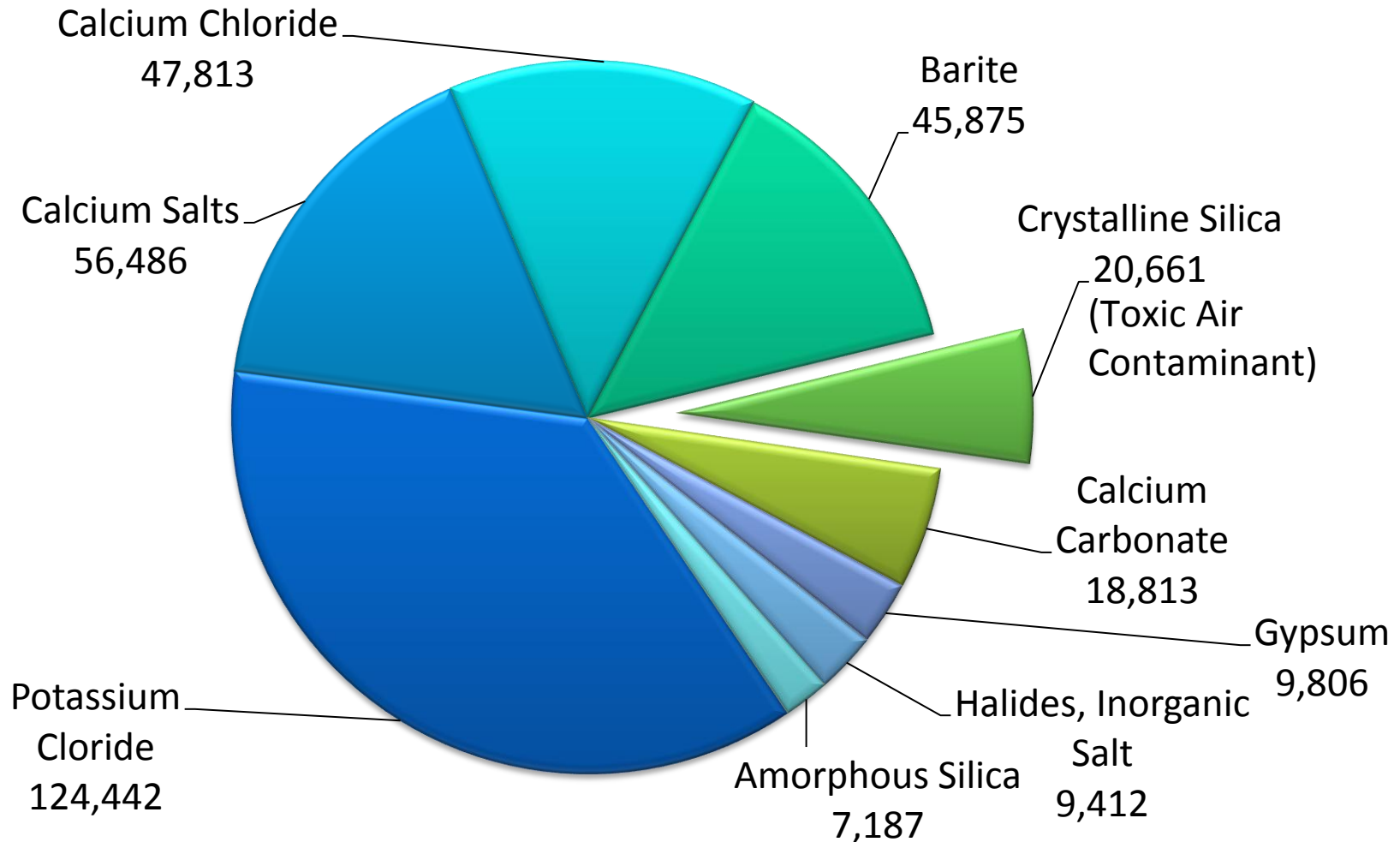


# Non-Trade Secret Air Toxic Chemicals Used in Well Activities

Chemical Ingredient	Acidizing	Drilling	Gravel Packing	Hydraulic Fracturing
Crystalline Silica		✓	✓	✓
Ethylbenzene	✓			
Ethylene Glycol	✓	✓	✓	✓
Formaldehyde	✓	✓	✓	
Glutaral		✓	✓	
Hydrochloric Acid	✓			
Hydrofluoric Acid	✓			
Methanol	✓	✓	✓	✓
Naphthalene	✓	✓	✓	
Phosphoric Acid		✓		
Sodium Hydroxide			✓	✓
Toluene	✓			
Xylene	✓			

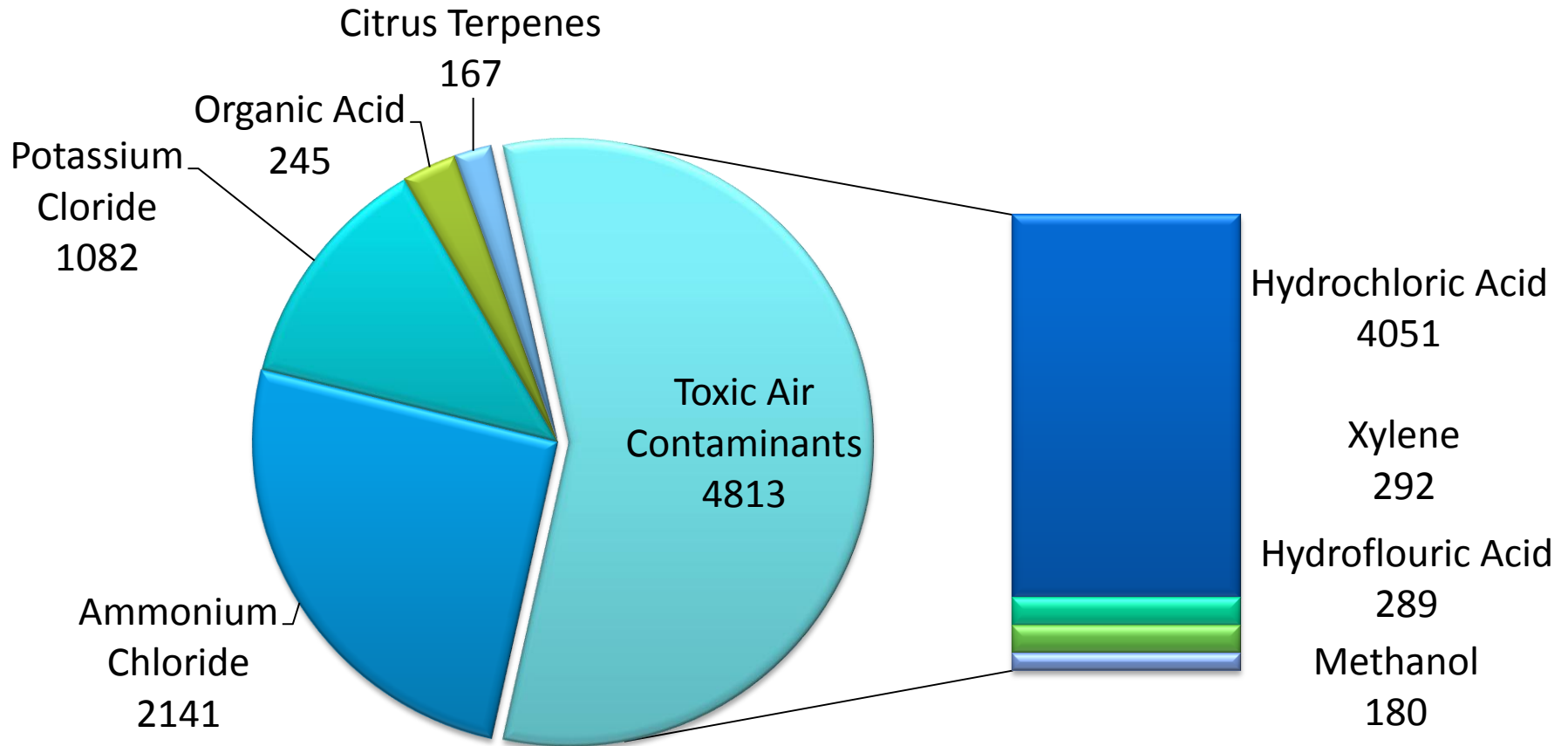
# Drilling

## (Top 9 Chemicals Used (lbs))



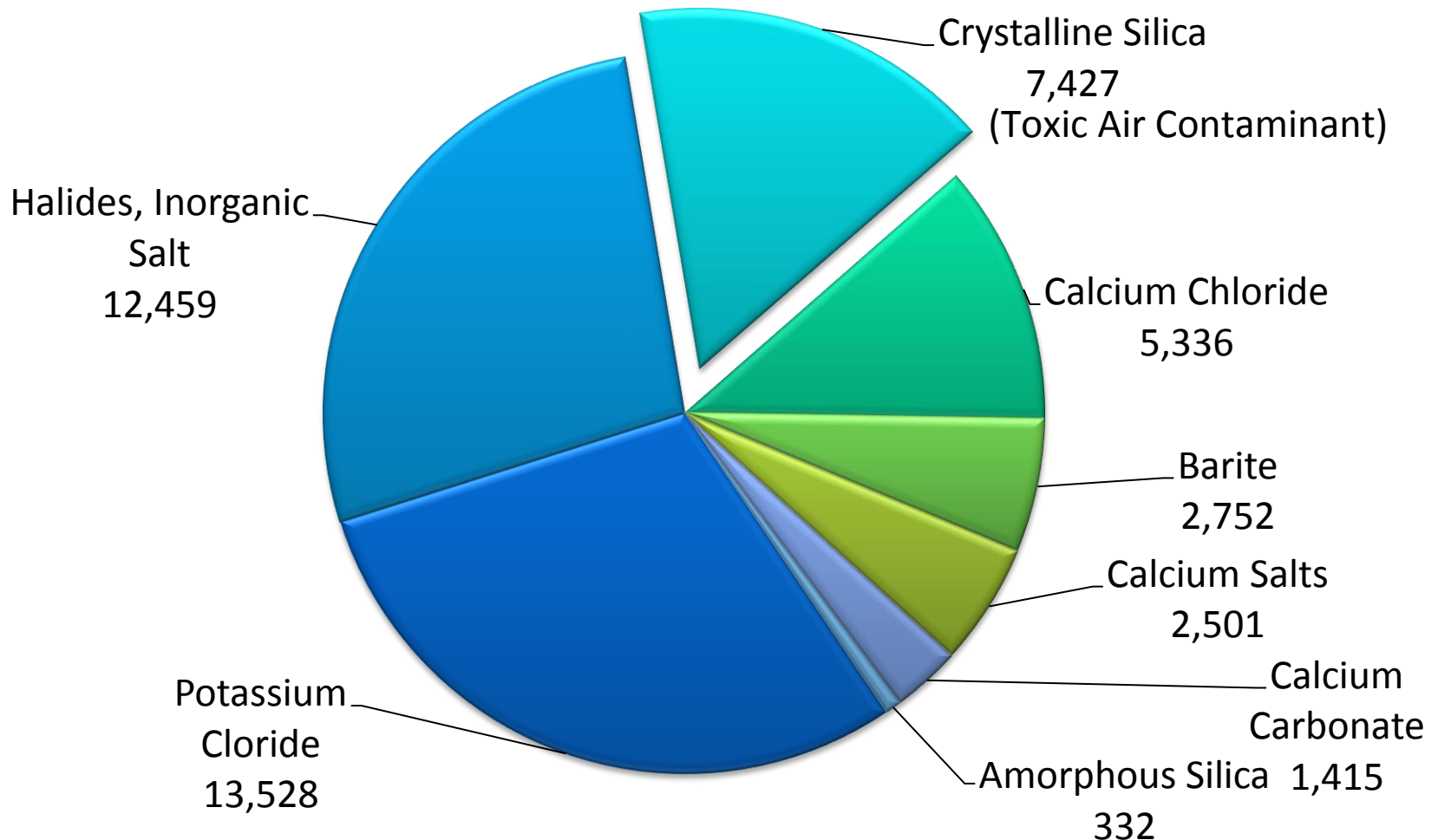
**Average Non-Trade Secret Chemical Use**  
**741,451 lbs of Water Used**

# Acidizing (Top 8 Chemicals Used (lbs))



**Average Non-Trade Secret Chemical Use  
109,389 lbs of Water Used**

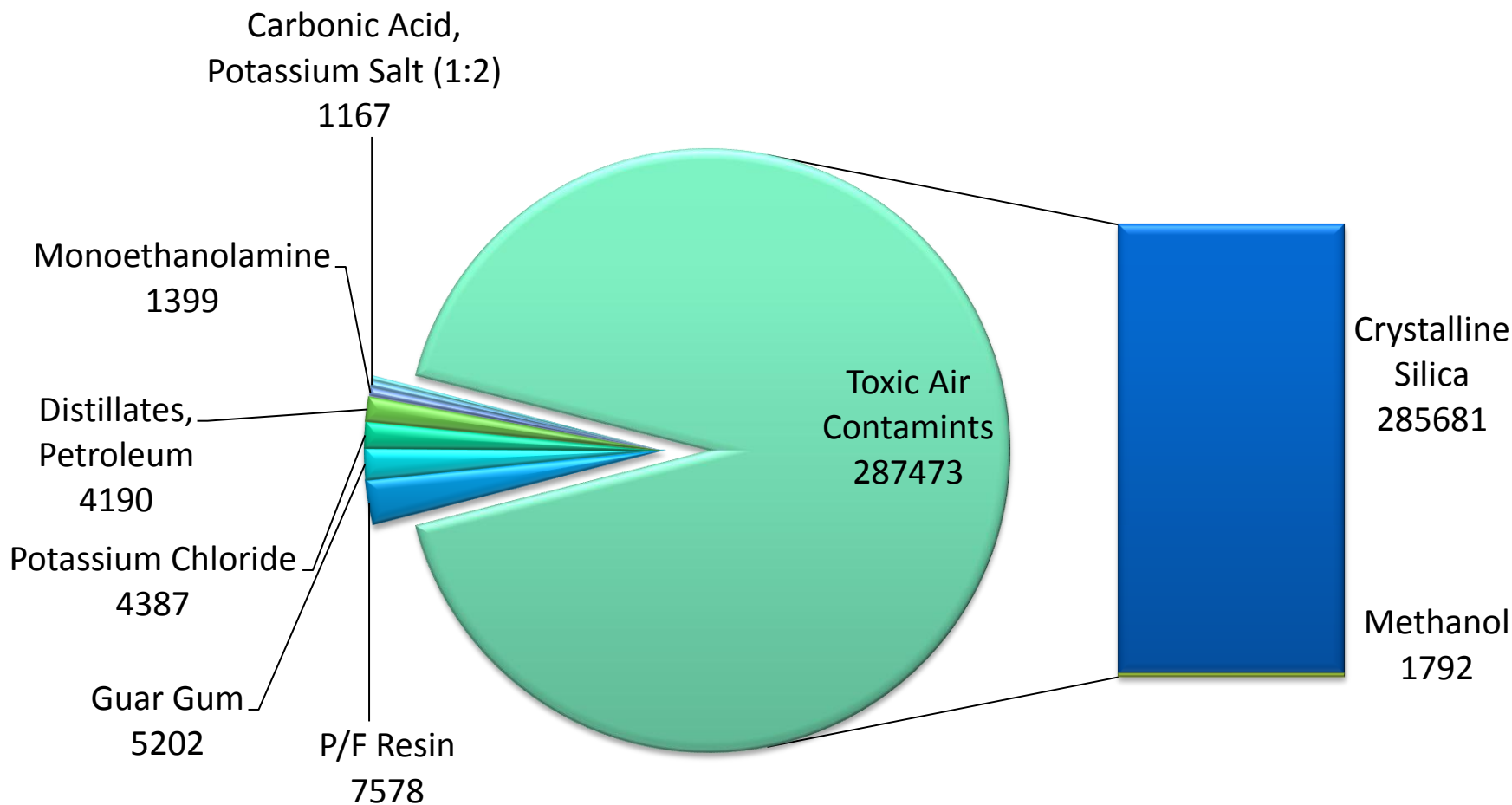
# Gravel Packing (Top 8 Chemicals Used (lbs))




**Average Non-Trade Secret Chemical Use**  
**62,582 lbs of Water Used**



# Hydraulic Fracturing (Top 11 Chemicals Used (lbs))



**Average Non-Trade Secret Chemical Use  
Reported 2,044,054 lbs of Water Used**

A photograph of a bright blue sky filled with large, white, fluffy cumulus clouds. The clouds are scattered across the frame, with a particularly large, dense cluster in the lower-left quadrant. The overall scene is bright and clear, suggesting a sunny day.

# Summary of Observations, Monitoring, and Sampling

# R1148.2 – Well Inspection Summary

- Since June 2013, SCAQMD staff conducted 104 inspections of oil/gas sites performing drilling, well completion, and well rework operations
  - 21 well drilling events
  - 14 hydraulic fracturing events
  - 44 acidizing events
  - 11 gravel packing events
  - 4 Misc. events





# R 1148.2 – Well Inspection Summary

- Observations at well inspections include:
  - Visible smoke at 13 inspections (13%)
  - Visible dust at 13 inspections (13%)
  - Noticeable odors at 10 inspections (10%)



# Sampling & Monitoring – Draft Standard Operating Procedure (SOP)

- Objective
  - Discern emissions generated from various well activities
  - Provide general guideline for SCAQMD personnel to follow when conducting monitoring/sampling
- Elements
  - Covers equipment for monitoring, sampling, and safety (PPE) to be used
  - Guidelines and procedures for gradient monitoring
  - Forms for field observation/project notes
  - Additional instruction for gravel packing and hydraulic fracturing events



# Sampling and Monitoring Equipment

- Handheld devices used to measure PM and H<sub>2</sub>S
  - Jerome Monitors (H<sub>2</sub>S)
  - DustTrak Monitors (PM)



- Summa canisters used to measure hydrocarbons



- Sample vials and jars to test flowback fluids and drilling mud



# Challenges

- Coordinating site visits is challenging due to rescheduling notifications
  - 48% of submitted notifications get rescheduled
  - 10% of submitted notifications get rescheduled multiple times

# Sampling and Monitoring (July – October 2014)

- Well Activities Sampled/Monitored
  - Re-drill (1)
  - Maintenance acidizing (1)
  - Matrix acidizing (1)
  - Gravel packing (3)
- Measurements taken:
  - Monitored H<sub>2</sub>S and PM
  - Canister samples for non-methane organic compounds (NMOC) upwind, downwind, and at return fluid catch basin and storage tanks
  - Return fluids collected in sample vials

# Monitoring and Sampling Results (July – October 2014)

Event	Event ID	Date	Handheld Results for PM and H <sub>2</sub> S	Canister Results for Organics	Other Observations
<b>Maintenance Acidizing</b>	1934	7/15/14	<ul style="list-style-type: none"> <li>No elevated levels of PM10.</li> <li>No elevated levels of H<sub>2</sub>S.</li> </ul>	No canister samples taken.	Diesel odors from engines used in well activities. Complaint reported to SCAQMD from the public.
<b>Matrix Acidizing</b>	2238	9/10/14	<ul style="list-style-type: none"> <li>No elevated levels of PM10.</li> <li>No elevated levels of H<sub>2</sub>S.</li> </ul>	No elevated levels (typical ambient air range of 100-700 ppbc) of NMOCs.	Petroleum hydrocarbon odors 75 feet from subject well.
<b>Gravel Packing</b>	2329	9/25/14	<ul style="list-style-type: none"> <li>Slightly elevated levels of PM10 due to high wind speeds and dust from loose dirt roads.</li> <li>No elevated levels of H<sub>2</sub>S.</li> </ul>	No elevated levels (typical ambient air range) of NMOCs.	Strong petroleum hydrocarbon odors at catch basin for return fluid (open to atmosphere).
<b>Gravel Packing</b>	2329	9/26/14	<ul style="list-style-type: none"> <li>No elevated levels of PM10.</li> <li>No elevated levels of H<sub>2</sub>S.</li> </ul>	Elevated levels (900-2900 ppbc) of NMOC at catch basin.	Strong petroleum hydrocarbon odors at catch basin for return fluid (open to atmosphere).
<b>Gravel Packing</b>	2354	10/2/14	<ul style="list-style-type: none"> <li>No elevated levels of PM10, except for one short-term period of elevated levels due to road dust from vehicular traffic.</li> <li>No elevated levels of H<sub>2</sub>S.</li> </ul>	Elevated levels (20 – 13,000 ppmvc) of NMOCs at open hatch of Adler tank for return fluids. Above thresholds for SCAQMD Rules 1148.1, 1166, 1173, 1176, and 1178.	Strong hydrocarbon odors from Adler tank for return fluids.
<b>Drilling</b>	2356	10/17/14	Pending	Pending	Pending



# Sampling & Monitoring Return Fluids from Catch Basin

- Interim holding area prior to storage in Adler tank
- Sampled within 2 feet of return fluid surface
- Results showed
  - Elevated levels of benzene, toluene, ethylbenzene, and xylene
  - Max NMOC concentration of 3,000 ppbc





# Sampling & Monitoring Return Fluids from Adler Tank

- Return fluid goes directly to tank from well
- Sampled 2 feet of open hatch
- Results
  - Elevated levels of benzene, toluene, ethylbenzene, and xylene
  - High NMOC concentration of 13,000 ppm
- Max thresholds in SCAQMD Rules
  - 500 ppm (R1148.1)
  - 500 ppm (R1176)
  - 500 ppm (R1178)
  - 1,000 ppm (R1166)
  - 50,000 ppm (R1173)



# Well Activity Observations – Flowback Fluids

- Gravel packing does not have flowback immediately after well treatments/stimulations due to low pressure in the formations found in the Basin
- “Return fluid” from well stimulation/treatment activities not viewed as “flowback” by operators
  - Rule 1148.2 defines this return fluid as “flowback”
  - SCAQMD staff monitoring and sampling return fluid
- Different techniques seen to capture/contain return fluids
  - Interim catch basin before storage in Adler tank with control
  - No catch basin, directly into Adler tank with no control

# Well Activity Observations – Gravel/Sand Mixing

- Operators use different techniques to mix gravel/sand in well completion fluids:
  - Fabric tote over hopper (open system)
  - Plastic tote feed into hopper (closed system)





# Controls and Housekeeping (Gravel Packing)

- Carbon canister drums connected to Adler tanks storing return fluid
- Keeping hatches closed at all times



- Plastic sheet ground cover to capture liquid leaks and spills of gravel packing fluids and dry materials

# Findings from Sampling and Monitoring and Well Observations

- No elevated levels seen for H<sub>2</sub>S or PM for acidizing or gravel packing
- Elevated NMOC concentration levels seen at holding areas of storage tanks for “return fluids” from gravel packing events
- Use of carbon canisters for Adler tanks and keeping hatches closed will reduce NMOC emissions
- Plastic tote for adding dry materials provides reduces opportunity for spillage



# Summary of Compliance Activities

# Key Requirements for Operators and Chemical Suppliers

## Operators

- Submit Emissions Reports within 60 days
- Submit Non-Trade Secret Chemical Report within 60 days
- Must provide specific non-trade secret chemical information

## Primary Chemical Suppliers

- Submit Trade-Secret Chemical Report within 60 days
- Identified by Operator
- Must provide specific chemical information

## Secondary Chemical Suppliers

- Submit Trade Secret Chemical Report within 60 days
- Identified by Primary Supplier
- Must provide specific chemical information

# Overall Compliance Approach

- Compliance Advisories
  - Issued compliance advisories if system-wide problem or
  - Issued compliance advisories if clarification regarding system-wide problem in reporting
- Notices to Comply
  - Issued Notices to Comply if operators or suppliers not submit required information and/or entire report
  - SCAQMD staff working with operators and suppliers to encourage compliance
- Notices of Violation
  - Failure to submit required forms after issuance of Notice to Comply
  - No Notices of Violation have been issued

# Compliance Advisories

- Two compliance advisories sent to operators
- February 2014 Compliance Advisory
  - Operators advised to re-submit all reports where on-road engines were used to power well rework/ stimulation equipment pursuant to R1148.2 (e)(1)(C)
  - Operators incorrectly interpreting rule requirement that on-road engines usage need not be reported
- August 2014 Compliance Advisory
  - Operators advised to report fluid of injected and/or recovered fluids required by 1148.2 (e)(1)(E)(i)
  - High number of missing or zero entries for fluid volumes



# Compliance Activities for Operators Emission Reports

For each  
Notification,  
Verified  
Emission  
Report  
Submitted  
within 60 Days



Identified  
Operators that  
Did Not Submit  
Emissions  
Source Report



14 Notices to  
Comply issued  
to Operators  
(47 Well Events)  
for Failure to  
Submit  
Emissions  
Source Report



- 19 out of 47 well events outstanding.
- Staff continuing to work with operators.



# Compliance Activities for Operators Non-Trade Secret Chemical Reports

For each  
Notification,  
Verified Non-  
Trade Secret  
Chemical  
Report  
Submitted  
within 60 Days



Identified  
Operators that  
Did Not Submit  
Chemical  
Report



14 Notices to  
Comply issued  
to Operators  
(143 Well  
Events)  
for Failure to  
Submit  
Chemical Report



- 17 out of 143 well events are outstanding.
- Staff is continuing to work with operators.

# Data Analysis Approach for Chemical Supplier Reporting

- Examine quality of data reported by trade secret chemical Suppliers
- Identified issues with reporting by Suppliers:
  - Omitting CAS numbers
  - Providing chemical family names instead of the exact names of compounds
  - Omitting identification of compounds as toxics
  - Unsatisfactory entries of chemical ingredient names such as “non-hazardous ingredient” or “proprietary blend”
- Work with Suppliers on individual basis to correct these reporting issues

# Compliance Activities for Primary Chemical Suppliers

## Revised

Primary Supplier Must Submit Trade Secret Chemical Report within 60 Days



Identified Notifications Where Primary Suppliers Were Identified, but No Trade Secret Report Received



5 primary suppliers representing 63 well events issued NCs for failure to submit Chemical Report Forms.



- Working with suppliers through conference calls and emails
- Suppliers are submitting Chemical Report Forms
- Staff is continuing to work with suppliers and evaluating submittals

# Primary Chemical Suppliers Incorrect Reporting

- Evaluation of submitted Chemical Supplier Report Forms identified two primary suppliers submitting incorrect information such as:
  - Generic (substitute) information in lieu of detailed chemical ingredients
  - Missing CAS #
  - Not properly identifying chemical as an air toxic
- Suppliers notified through emails and conference calls and AQMD staff providing assistance on completeness of reports
- Current Status:
  - Primary suppliers have re-submitted all Chemical Supplier Report Forms
  - Staff currently evaluating completeness of reports



# Compliance Activities for Secondary Chemical Suppliers

## Revised

Secondary Supplier Must Submit Trade Secret Chemical Report within 60 Days



Identified Notifications Where Secondary Suppliers Were Identified, but No Trade Secret Report Received



11 secondary suppliers representing 243 well events issued NCs for failure to submit Chemical Report Forms



- Working with suppliers through emails and phone conferences
- Suppliers are submitting missing Chemical Reports
- Smaller suppliers contracted larger chemical suppliers to submit forms
- Staff is evaluating compliance for these submittals

# Compliance Summary

- Progress in receiving reports and corrected reports
- There are still outstanding reports
- Staff will continue working with operators and suppliers to encourage compliance
- Compliance is ongoing

# Next Steps

- Briefing Stationary Source Committee  
November 21, 2014
- Continue to collect and analyze data
- Report back to the Working Group in  
six months