

# E&P SPILLS: BENCHMARKING, BEST PRACTICES, CHARACTERIZATION, COMPLIANCE, REMEDIATION, & RECLAMATION

· Presented by: Kris Andersen

November 2016

# OUTLINE

- Introduction
- Benchmarking
- Best Practices
- Characterization
- Compliance
- Response Measures
- Take-Aways

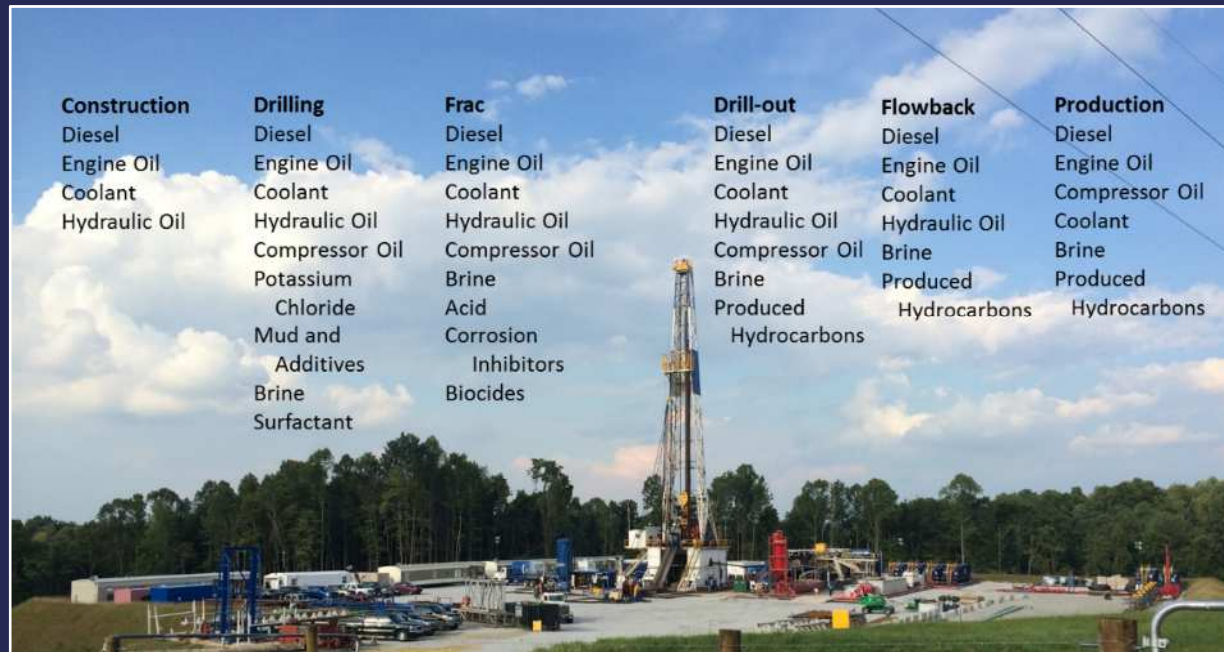
# WELLPAD SETTING

- Well pad construction often brings heavy industry to rural areas. Over the course of a few weeks, a remote pasture or hilltop can be converted to a 5 acre well pad. In less than a year, as many as six or more wells can be producing thousands of barrels of oil or condensate and millions of cubic feet of natural gas.
- Many of these areas have little in the way of existing infrastructure (water, electricity) and emergency services can be a long distance away. This can frequently make spill identification and response more challenging.



# TYPICAL OILFIELD CHEMICALS

- Development of unconventional plays requires a greater variety of chemicals, equipment and crews than conventional plays

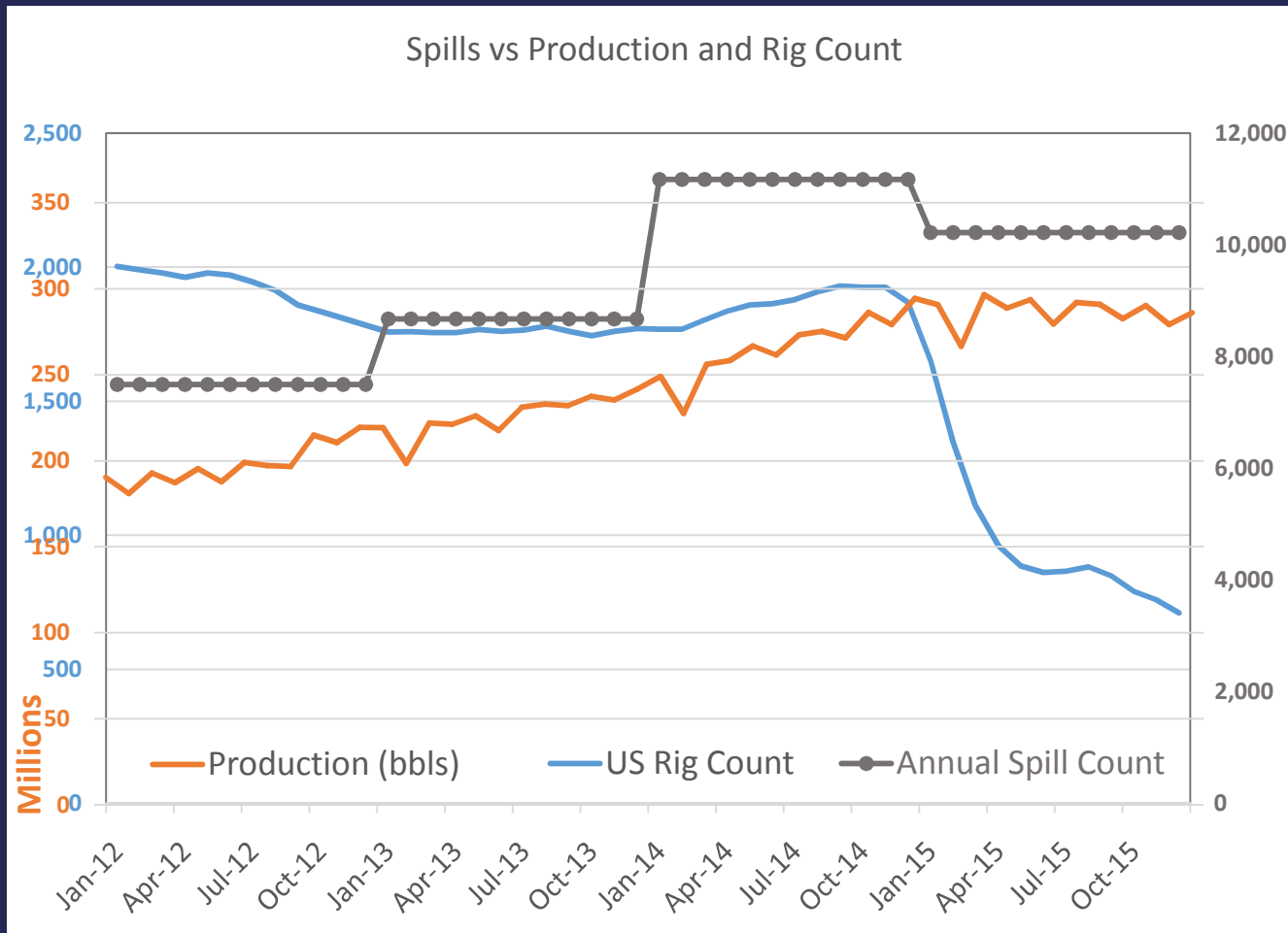


- Personnel manage chemicals on well pads in tanks, drums, cans, cylinders, sacks, buckets, piping/pipelines, etc.
- Anything can spill

# BENCHMARKING SPILLS

- Quantifying E&P-related spills is difficult, since many spills are addressed at the state level and states manage the information in various ways
- One source reports a total of 10,348 onshore spills in 2015, down roughly 8% from 2014; however the decrease is not across all states
  - Of the states in the study, 36% experienced an increase in spills ranging from 9%-100%
- 2015 US rig count low of 842, down from high of ~1,930 in 2014
- 2015 US crude production up over 7% to 9,415 thousand bbl/day

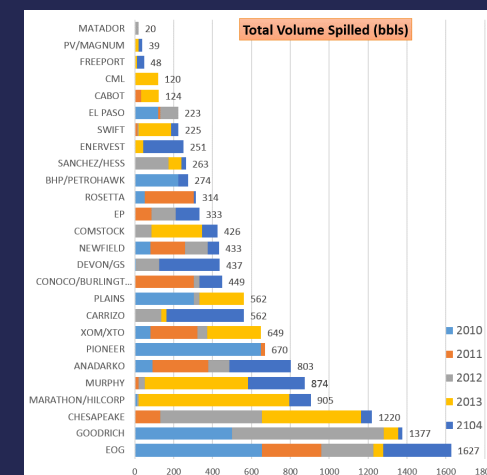
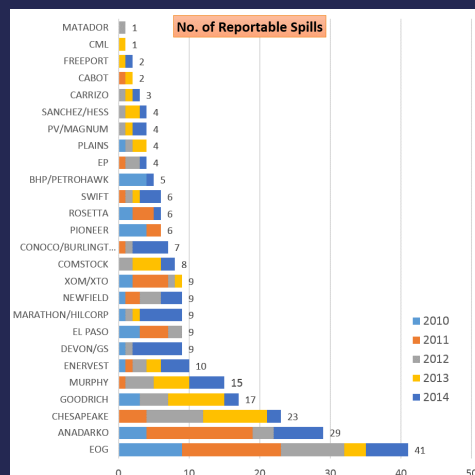
# NATIONWIDE BENCHMARKING



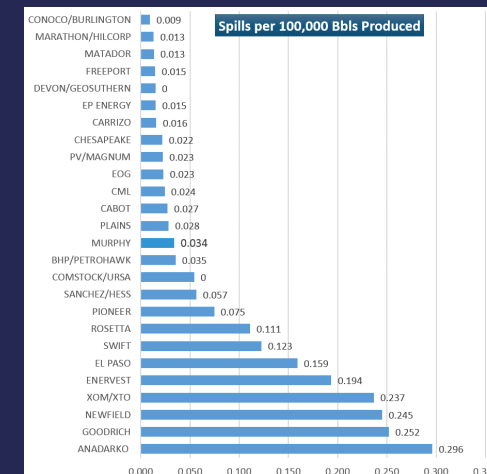
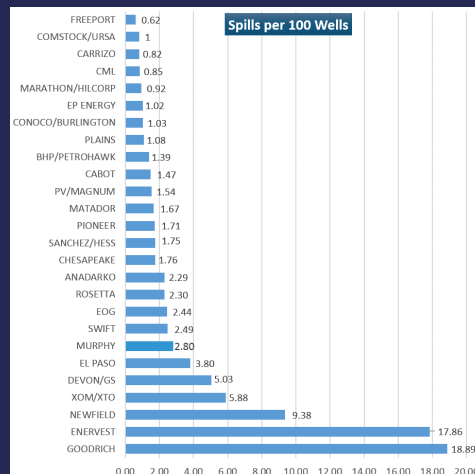
Source: Based on data from E&E Publishing 2016, American Oil & Gas Report 2016, EIA 2016

# BENCHMARKING BY PLAY

- It can be helpful to benchmark data across the operators in a single play
  - These operators often share the same E&P circumstances



- These charts present 2010-2014 spill data for the top producers in the Eagle Ford Shale



# BEST MANAGEMENT PRACTICES

- Best management practices are procedures, methods, and even technologies, with the goal of achieving an expected level of performance when conducting work. Examples of spill-related BMPS include:

Waste Management Plan	Spill Response Plan
Construction Standardization	Site Inspection and Repair
Perimeter Berm and Drain Design	Run-on/Runoff Management
Rig Containment	Recovery of Spilled Materials
Secondary Containment	Personnel Training
Chemical Storage/Handling	Limit Surplus Chemicals
Containment Fabrication	Segregation of Stored Chemicals
Chemical Compatibility	Safety Data Sheets
Protect Chemicals from the Elements	Chemical Inventory
Container Labeling	Root Cause Analysis

- **ANTICIPATING SPILLS:** Similar to the way safety concerns are identified and avoided by performing job hazard analyses, areas of vulnerability for spills may be anticipated and planned for
  - Watch for multiple, concurrent activities with overlapping hazards
  - Situational awareness



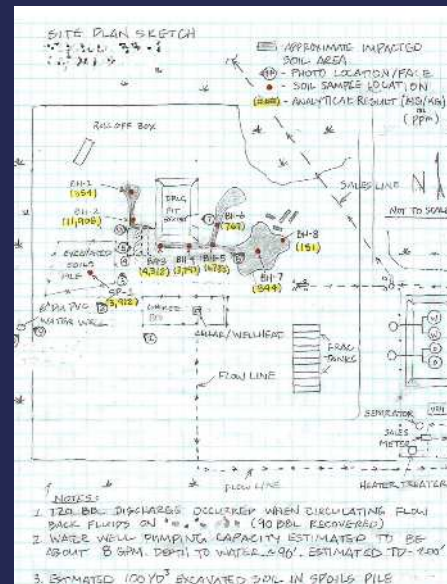
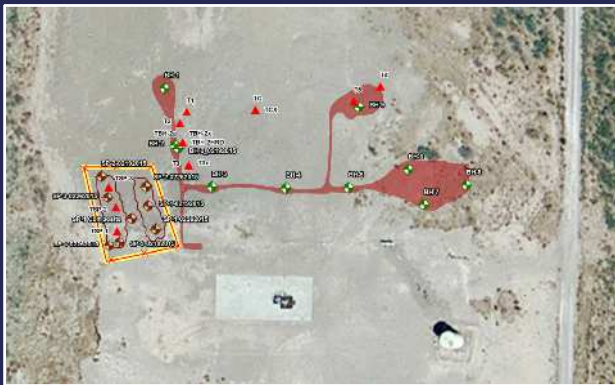
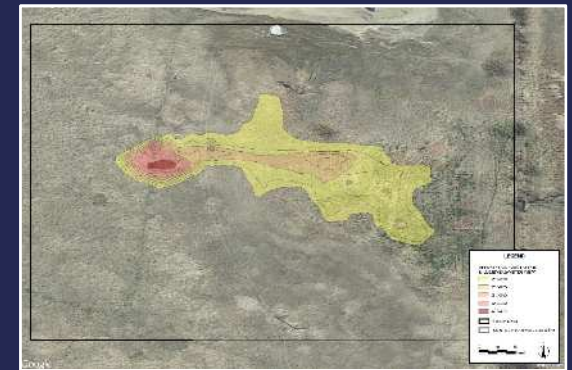
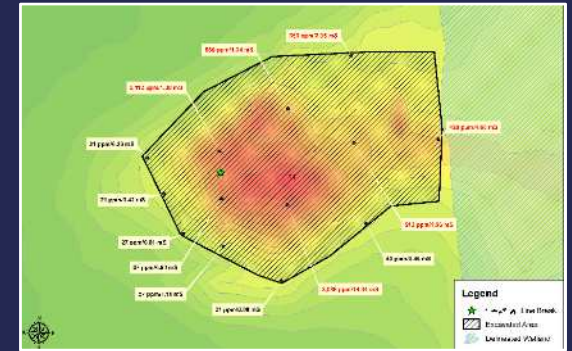
# CHARACTERIZATION

- As soon as possible, determine the nature and extent of a release
- Direct Observation – often the best early indicator of the extent of recent spills
- Field Instrumentation – crucial tools where the presence and/or hazard posed by spilled material is not evident by direct observation; however use caution against false characterization
- Field Sampling/Surveys – needed to support response actions and document conditions following remediation



# CHARACTERIZING A SPILL

- Images at right depict initial field EC measurements and chloride strip testing followed by an EM survey in response to a brine spill in ND
- The sketch and figure below record the direct observations and field TPH testing locations after a crude oil spill in Texas

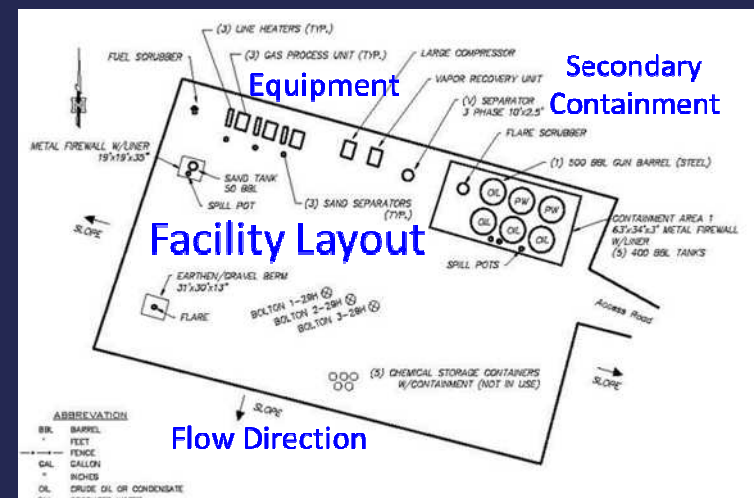


# COMPLIANCE BASICS

- Spill-related compliance can be categorized by three types of requirements:
  - Planning
  - Reporting
  - Cleanup/remediation

# PLANNING

- US EPA Spill Prevention, Control, and Countermeasure (SPCC) Plans required at many E&P locations
  - Establishes equipment, methods and procedures to prevent discharges of oil to navigable waters
  - Facilities with >1,000,000 gallons oil capacity must have a USEPA Facility Response Plan (FRP)
- Other plans may be required by states
- Some operators may have an Emergency Response Plan (ERP) designed to meet standards set by the National Incident Management Center of FEMA



# REPORTING

- Spill reports must be made to various federal and state agencies, depending on where and what was spilled
- Requirements may take time to research; must be established before work starts
- Report promptly and directly
- Don't wait until cleanup is done
- Don't let your local regulator be surprised by learning about your incident on the news

<i>EXAMPLE OHIO SPILL NOTIFICATION AND REPORTING REQUIREMENTS</i>	
TYPE AND VOLUME OF SPILL	REPORTING REQUIREMENTS FOR SPILLS
Release of any volume crude oil/produced water spill that has the potential to contaminate the surface of the land, or water on the surface or in the subsurface.	<b>ODNR</b> – Verbal notification immediately
Release of any amount of oil that causes a film or sheen on a waterway or causes discoloration of the surface of the waters or causes a sludge or emulsion to be deposited beneath the surface of the waters.	<b>NRC, Ohio SERC, LEPC, Jurisdictional FD</b> – Verbal notification immediately <b>Ohio SERC, LEPC</b> - Written follow-up emergency notice within 30 days.
Release of crude oil/produced water >1,000 gals from a single spill or >42 gals for each of 2 spills within a 12-month timeframe of crude oil that reaches a <b>navigable waterway</b> . Spill amounts represent the volume that reaches the navigable waterway; <b>not the volume of the spill which could be greater.</b>	<b>U.S. EPA and LEPC</b> – Verbal notification immediately and written report within 30 days.
Any spill or release of petroleum product (e.g., diesel fuel, gasoline, hydraulic fluid, etc.) to the environment, excluding navigable waters, of 25 gallons or more. Any spill of crude oil to the environment, excluding navigable waters, of 210 gallons (5 barrels) or more.	<b>Ohio SERC and LEPC</b> – Verbal notification immediately and written report within 30 days.
Any release of hazardous substance or extremely hazardous substance over its assigned reportable quantity (RQ).	<b>NRC, Ohio SERC, LEPC, Jurisdictional FD</b> – Verbal notification immediately <b>Ohio SERC, LEPC</b> - Written follow-up emergency notice within 30 days.

# CLEANUP/REMEDIATION

- Requirements for response measures vary based on the nature and location of the spill as well as the type of environmental damage that may have occurred
- Federal requirements are primarily focused on releases to surface water or water-related areas
- State requirements vary considerably from prescriptive steps that must be followed in response to different types of releases to broad performance requirements that must be accomplished according to plans prepared by operators and approved by the States

# RESPONSE CONSIDERATIONS

- **SAFETY:** Response measures are different from normal operations and require separate safety planning, considering the hazards posed by the spilled materials and the response actions undertaken
- **COST:** Disruptions in E&P operations are expensive (commonly more than the spill response). Once the source of a spill can be stopped and spilled materials can be removed, normal operations can often resume and the financial loss caused by the spill can be limited.
- **GROUNDWATER:** In areas where spills are proximate to groundwater, an operator may consider excavating all detectable spilled material as quickly as possible
  - This decision considers the expense of immediate, often extensive action, in comparison with the potential for widespread and potentially long term remediation
  - Groundwater remediation projects can be very expensive and take decades to complete



# RESPONSE EXAMPLE #1

- Incident type: equipment failure during Production resulting in condensate release to surface and subsurface
- Release quantity: est. over 50 bbls
- Response: immediate removal of condensate and impacted materials. Confirmation sampling indicated all condensate recovered





# RESPONSE EXAMPLE #2

- Incident type: hydraulic fluid and frac chemicals discovered beyond containment during Frac
- Release quantity: est. 10 bbls
- Response: removal of impacted pad materials. Precipitation aided in flushing spilled materials to facilitate removal by Vac-Truck. Pad drainage controlled to prevent release of materials off-pad.



# RESPONSE EXAMPLE #3

- Incident type: brine spill; vegetation kill and contaminated soils
- Release quantity: est. 10 bbls
- Response: captured pad runoff for balance of drilling; removed impacted soils and vegetation





# RESPONSE EXAMPLE #4

- Incident type: crude oil release from hole in buried pipeline
- Release quantity: est. 1,000-3,000 bbls
- Response: removed impacted materials at point of release; created weirs to control travel of oil on surface water; removed oil from surface water with vac-trucks and sorbent materials; treated residuals with bio product



# RESPONSE EXAMPLE #5

- Incident type: hydrochloric acid spill during frac
- Release quantity: est. 2,000-3,000 gallons
- Response: evacuated site and nearby neighbors; neutralized acid; demobilized frac; removed impacted materials; restored pad



# RESPONSE EXAMPLE #6

- Incident type: crude oil release from stuffing box
- Release quantity: est. 5 bbls
- Response: removed impacted materials; installed “bubble” over stuffing box and collection reservoir





# RESPONSE EXAMPLE #7

- Incident type: crude oil spill from spill pot outside containment
- Release quantity: undetermined
- Response: removed impacted materials; installed spill pots inside containment (note: example retrofit at another location in lower photo)



# TAKE-AWAYS

- Quantifying E&P-related spills nationwide is difficult due to varying requirements
  - Operators can benchmark against other operators and against their own performance
- Going over and above regulatory requirements with best management practices can help avoid spills, expedite spill response and promote worker safety
- Various tools exist to support rapid characterization of spills for both the initial spill response as well as remediation when required.
- Stop to be sure personnel can respond to releases safely
- Delineate and clean up spills as quickly as possible. Delays in cleanup can allow spills to spread and result in larger, more expensive cleanups.



# CONTACT INFORMATION



**Kris Andersen**

ALL Consulting

O: 918.382.7581

kandersen@all-llc.com

*ALL*CONSULTING

## CITATION INFORMATION:

J. Daniel Arthur, P.E. (ALL Consulting), Kris Andersen (ALL Consulting), David J. Bockelmann (ALL Consulting) “E&P Spills: Benchmarking, Best Practices, Characterization, Compliance, Remediation, & Reclamation”  
Presented at the 23rd IPEC Conference, New Orleans, Louisiana, November 8-10, 2016

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