Oil and Gas Development in Colorado

- 10s of thousands of active oil and gas wells in Colorado
- ~30 active drilling rigs currently operating in Colorado
- Current setback distance is 500’ from residences
- Expansion of O&G and population are occurring simultaneously
Governor’s Oil and Gas Task Force

O&G Task Force...“heard from many citizens who expressed concern and uncertainty about potential human health risks associated with exposure to emissions from oil and gas activities. The Task Force believes citizens deserve and need accurate, credible, peer-reviewed scientific information to help them evaluate risk” (Task Force Final Report, 2015)

- Health concerns were reported to multiple different agencies
- Limited health department resources to address health related issues
2015 Governor’s Oil and Gas Task Force

- Create a centralized health concern line
- Outfit a mobile air quality monitoring unit
- Create an oil and gas information clearinghouse
- Perform human health risk assessments
  - Initially with existing data
  - Later with CSU emissions data
Oil and Gas Health Information and Response Program

- Health concern hotline
- Information clearinghouse
- Community meetings
- Community Investigations
- Science evaluations

www.colorado.gov/oghealth
Screening Risk Assessment

**Chemical Identification**
What VOCs may be released into the air from oil and gas (OG) operations in Colorado?

**Exposure Evaluation**
What are the estimates of exposures to people living 500 feet or greater from OG operations?

**Toxicity Evaluation**
Do the VOCs have the potential to cause health effects and if so, at what concentrations?

**Risk Evaluation**
Do VOCs emitted into the air from OG operations result in exposures to Coloradans living 500 feet or greater from OG operations at levels that may be harmful to their health?
Identifying VOC Emissions

- Colorado-specific
- Data Review
  - CDPHE operator emissions inventories
  - Collett et al. (2016) characterization studies
  - Gilman et al. (2013) source apportionment study
- 56 VOCs identified
Exposure Data Criteria

• Samples collected at 500 feet and greater from O&G operations
• Representative of ground-level exposures
• Collected during any type of O&G operation
• Collected between 2008 and 2017
Exposure Data

• Identified 11 data sets
  – 3 from Piceance Basin
  – 8 from D-J Basin
• Various temporal and seasonal scales
• Represent 500-3700 feet from O&G operations
• Various phases of operations
• Data sets ranged from 36 to 28,000 individual samples
Exposure Scenarios

• Chronic exposure
  – Maximum average VOC level across 10 datasets (one data set excluded)

• Acute exposure
  – Maximum single sample across the 11 datasets
# Health Guideline Values

<table>
<thead>
<tr>
<th>Tier</th>
<th>Source</th>
<th>Health Guidance Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tier I</td>
<td>U.S. EPA’s Integrated Risk Information System (IRIS)</td>
<td>Chronic: Reference Concentration (RfC)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cancer: Inhalation Unit Risk (IUR)</td>
</tr>
<tr>
<td>Tier II</td>
<td>Center for Disease Control - Agency For Toxic Substances and Disease Registry</td>
<td>Acute &amp; Chronic: Minimal Risk Level (MRL)</td>
</tr>
<tr>
<td>Tier III</td>
<td>US EPA Peer-Reviewed Toxicity Values (PPRTV’s)</td>
<td>Chronic: PPRTV</td>
</tr>
<tr>
<td>Tier IV</td>
<td>California EPA (Cal EPA)</td>
<td>Acute and Chronic: Reference Exposure Level (REL)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cancer: Inhalation Unit Risk (IUR)</td>
</tr>
<tr>
<td>Tier V</td>
<td>Texas Commission on Environmental Quality (TCEQ)</td>
<td>Short &amp; Long-Term: Air Monitoring Comparison Value (AMCV)</td>
</tr>
<tr>
<td>Tier VI</td>
<td>surrogate approach</td>
<td>Not applicable</td>
</tr>
</tbody>
</table>
Hazard Quotients for Acute Exposure
Benzene: Acute
Hazard Quotients for Chronic Exposure
Nonane: Chronic

• Maximum average was 3.3 ppb from Helmig et al. where nearest O&G operation was 1500-2000 feet away
• Maximum average from any other data set was 0.2 ppb
  – HQ=0.05
  – HI=0.46
Benzene: Chronic
## Cancer Risk

<table>
<thead>
<tr>
<th>Substance</th>
<th>Highest Mean Concentration (µg/m³)</th>
<th>IUR (Source)</th>
<th>Excess Cancer Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benzene</td>
<td>4.6</td>
<td>2.2x10⁻⁶ - 7.8x10⁻⁶ (U.S. EPA)¹</td>
<td>1.0x10⁻⁵ - 3.6x10⁻⁵</td>
</tr>
<tr>
<td>Ethylbenzene</td>
<td>2.9</td>
<td>2.5x10⁻⁶ (CalEPA)</td>
<td>7.3x10⁻⁶</td>
</tr>
<tr>
<td>Aggregate Risk</td>
<td></td>
<td></td>
<td>4.3x10⁻⁵</td>
</tr>
</tbody>
</table>

¹ U.S. Environmental Protection Agency (EPA).
Conclusions

• All individual VOCs were below levels that may pose non-cancer health risks (both acute and chronic)

• Excess cancer risks were within the EPA “acceptable range”

• All risks driven primarily by benzene exposure

• LOTS of uncertainty in acute exposure guideline levels AND acute exposure measurements
Ongoing Activities

• Tracking reported health concerns
• Community investigations of health concerns
• More extensive health risk assessment
Colorado Air Monitoring Mobile Laboratory (CAMML)

• 1 minute resolution: Ozone, NOx, meteorology, PM2.5, PM10, Greenhouse Gases, NH3, H2S
• VOCs (by GC-MS) PAMS (55 compounds)
  • Integrated 30 min samples, once per hour
  • Possible expansion to include more compounds including diesel hydrocarbons, TO-15/17, oxygenates, terpenes
2017-18 Risk Assessment

- Emission data from CSU studies (North Front Range and Garfield County)
- Dispersion model-based exposures
- Calculate potential health risk
  - By distance
  - By operation
  - Directly attributable to oil and gas activities
- Data available June 2016
- Summer 2018 completion
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Questions?

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