Air Monitoring Data

for Pasadena

November 2021 – October 2022
### Air Pollutants

<table>
<thead>
<tr>
<th>Nitrogen Oxides (NOx)</th>
<th>Volatile Organic Compounds (VOC)</th>
<th>Ozone (O3)</th>
<th>Particulate Matter (PM2.5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oxides of nitrogen - primarily emitted by vehicles and industrial facilities.</td>
<td>Highly reactive carbon compounds – emitted by vehicles, industries, gasoline equipment, paints, chemicals, solvents etc.</td>
<td>Ground level ozone – forms due to reactions between NOx and VOCs in sunlight and heat.</td>
<td>Inhalable particles - dust, dirt, soot, and even smaller – emitted by industries, vehicles, construction sites, fires, unpaved roads</td>
</tr>
<tr>
<td>Contributes to breathing problems, smog, acid rain, ozone</td>
<td>Toxic at high concentrations, contributes to ozone</td>
<td>Contributes to breathing difficulties, respiratory issues</td>
<td>Contributes to heart &amp; lung complications, asthma</td>
</tr>
</tbody>
</table>
# Sources of Pollution

## Toxic Release Inventory (TRI)
- Industrial and federal facilities that report toxic chemical releases.
- Typically, larger facilities involved in manufacturing, metal mining/recycling, electric power generation, petrochemical, refining, and chemical manufacturing and hazardous waste treatment.

## Concrete Batch Plants (CBP)
- Facilities that combine sand, cement, and other aggregates to make concrete.
- Typically, neighborhood-level facilities, that are significant sources of particulate matter (dust), diesel truck smoke, noise and light pollution among other nuisances.

## Roads / Freeways / Trains (yards)
- Vehicular exhaust significantly emits a noxious brew of multiple types of pollution:
  - NOx, VOCs, PM2.5, GHGs and the precursors for ozone and smog

## Superfund sites
- Polluted waste locations in the United States contaminated with extremely hazardous substances. Usually abandoned.
- Uncleaned sites are continued sources of ground, air, and water pollution into the neighboring areas.
Wind Direction and Speed
Averaged over: Nov ‘21 – Oct ‘22

Sources of pollution upwind of the monitors make significant contributions to readings and measurements

Predominant winds: SOUTHEAST
In line with regional prevailing winds from the Gulf of Mexico
Air Monitor Measurements

Nov 2021 – Oct 2022

1. Nitrogen Oxides (NOx)
2. Ozone (O3)
3. Volatile Organic Compounds (VOCs)
4. Particulate Matter (PM)
Nitrogen Oxides (NOx)

Includes Nitrogen Oxide (NO) and Nitrogen Dioxide (NO2)
NOx: Day-to-Day

EPA NOx standard

<table>
<thead>
<tr>
<th></th>
<th>1 hour</th>
<th>Annual</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOx</td>
<td>100 ppb</td>
<td>53 ppb</td>
</tr>
</tbody>
</table>
NOx: Monthly Averages

<table>
<thead>
<tr>
<th>EPA NOx standard</th>
<th>Annual</th>
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<tbody>
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<td></td>
<td>53 ppb</td>
</tr>
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</table>

NOx levels for Deepwater, St. Peter’s, and Danpre over the months of November 21 to October 22, showing a peak in April 22.

Annual NOx standard is 53 ppb.
## NOx: Monthly Averages

<table>
<thead>
<tr>
<th></th>
<th>Nov</th>
<th>Dec</th>
<th>Jan</th>
<th>Feb</th>
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<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Deepwater</strong></td>
<td>12.5</td>
<td>5.6</td>
<td>12.4</td>
<td>10.6</td>
<td>10.7</td>
<td>7.9</td>
<td>7.0</td>
<td>12.2</td>
<td>11.5</td>
<td>10.5</td>
<td>19.3</td>
<td>24.0</td>
<td>12.0</td>
</tr>
<tr>
<td><strong>St Peter</strong></td>
<td>11.4</td>
<td>19.2</td>
<td>16.4</td>
<td>29.0</td>
<td>59.9</td>
<td>53.9</td>
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<td></td>
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<td></td>
<td>31.6</td>
</tr>
<tr>
<td><strong>Danpree</strong></td>
<td></td>
<td></td>
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<td>5.7</td>
<td>8.4</td>
<td>15.9</td>
<td>17.7</td>
<td>11.6</td>
<td>14.2</td>
<td>15.3</td>
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<td>12.7</td>
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<table>
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</table>
Major takeaways

- Daily values peak on average in the morning and evenings: 8 am and 6 pm
- Trending towards generally higher concentrations with time
  - Especially at St. Peters
- St. Peters monitor exposed to higher concentrations
  - Likely pollution from Ship Channel and freeway traffic
  - More heavily industrialized areas nearby
- Concerning peaks recorded at St Peters: Exceeding EPA standards
  - Highest frequency in March - June
  - Peaks at Danpree and Deepwater in Sept - Oct
Volatile Organic Compounds (VOCs)

Includes benzene, ethylene, formaldehyde, butadiene, propane, and ethane among many others
Total VOC: Monthly Averages

- Deepwater
- St. Peter’s
- Danpree
# Total VOC: Monthly Averages

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</tr>
</thead>
<tbody>
<tr>
<td>Deepwater</td>
<td>95.5</td>
<td>116.7</td>
<td>100.5</td>
<td>103.4</td>
<td>115.0</td>
<td>142.3</td>
<td>166.5</td>
<td>180.0</td>
<td>196.9</td>
<td>197.5</td>
<td>159.6</td>
<td>134.2</td>
<td>142.3</td>
</tr>
<tr>
<td>St Peter</td>
<td>112.0</td>
<td>170.7</td>
<td>133.0</td>
<td>139.6</td>
<td>157.8</td>
<td>221.1</td>
<td>220.0</td>
<td>206.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>170.1</td>
</tr>
<tr>
<td>Danpree</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>207.3</td>
<td>223.2</td>
<td>215.7</td>
<td>218.7</td>
<td>199.3</td>
<td>154.0</td>
<td>135.6</td>
<td>193.4</td>
</tr>
</tbody>
</table>
Major takeaways

• Daily values peak on average in the mornings: 5-10 am
  • Lowest in the afternoons/evenings. Picks back up at 12-4 am
  • Could be an industrial source
• Trending upward until the summer (July). Going back down since
  • Dec - May more volatile. June - Oct more stable
• St. Peters and Danpree recording highest recordings
  • Potential sources of concern may be closer
• Few peaks outside of regular cycles – likely emission events
  • Primarily at Danpree
Ground level ozone (not stratospheric) that contributes to smog formation
Ozone (O3): Day-to-Day

EPA O3 standard

8 hour
70 ppb
Ozone: Monthly Averages

<table>
<thead>
<tr>
<th>EPA O3 standard</th>
<th>8 hour</th>
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<tr>
<td></td>
<td>70 ppb</td>
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![Graph showing monthly ozone averages from November 2021 to October 2022 for Deepwater, St. Peter's, and Danpree.]
# Ozone: Monthly Averages

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<thead>
<tr>
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<td></td>
<td></td>
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Major takeaways

- Daily values peak regularly twice: Mornings and evenings
  - Likely reflecting traffic patterns
  - Zero concentrations regularly at night: 1-8 am

- Peaked in the spring - declined in the summer - going back up in Sept
  - Possibly following conflicting NOx and VOC patterns

- Deepwater exposed to highest levels
  - Peaks highest in the summer

- Peaks are highest and most prolonged in the summer
  - Lasting into the late evenings and nights
Particulate Matter 2.5 (PM2.5)

Fine inhalable particles that can penetrate deep into the lungs
Purple Air Monitors

map.purpleair.com
PM 2.5: Monthly Averages

<table>
<thead>
<tr>
<th></th>
<th>EPA PM2.5 standard</th>
<th>24 hour</th>
<th>Annual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meadowlake</td>
<td>35 ug/m³</td>
<td></td>
<td>12 ug/m³</td>
</tr>
<tr>
<td>Randolph</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Danpree</td>
<td></td>
<td></td>
<td></td>
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</table>

**Graph Description:**
- **X-axis:** Months from October to October
- **Y-axis:** PM2.5 concentration in ug/m³
- **Lines:**
  - Orange: Meadowlake
  - Gray: Randolph
  - Purple: Danpree
- **EPA Standard:**
  - Annual: 12 ug/m³
  - 24 hour: 35 ug/m³
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</table>
Major takeaways

• Daily values do not peak as regularly
  • Reflecting some unpredictable influence: Likely industrial
• Peaked in the winter - declined in the spring/summer - going back up
  • Possibly a larger regional pattern (observed in Northside as well)
• Meadowlake exposed to highest levels
  • Above EPA standard: Nov ‘21 - March ‘22 and Sept - Oct ‘22
• Peaks highest in the winter
  • Recent peaks at around similar levels across monitors
REVIEW
Methodology

• Calculated pure averages (mean) for each month and overall
  • Easy comparison with EPA standards
  • No further statistical manipulation
• Plotted progression of monthly averages on a line graph
  • To track seasonal pollution trends
• Screenshots of raw day-to-day measurements
  • To visualize short term spikes and exceedances of standards
• Observed times of highest daily pollution levels
• Tested hypotheses with real-world maps, data, information
  • Drawing informed conclusions about measurement/trend causes
Caveats / Limitations

• EPA Standards:
  • Guidelines for public health protection. Regularly updated / revised
  • Just because averages aren’t at/near limit, doesn’t mean there aren’t effects
  • Short-term spikes can still have significant effects

• Monitors:
  • Limited by wind direction, technology (pollutants measured)
  • Area of location: Results may be affected by seemingly smaller events
    • E.g.: Idling cars, household events, fireworks, outages, etc.
  • Sensitivity: A high measurement point to multiple possible sources. Cannot pinpoint 100%
  • There may be pollution levels and types that are not being caught
  • Limited number of monitors across neighborhood: Not everywhere
### Conclusions: Nov 2021 – Oct 2022

<table>
<thead>
<tr>
<th>NOX</th>
<th>VOC</th>
<th>O3</th>
<th>PM2.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highest at St. Peters</td>
<td>Highest at St. Peters (Danpree, Deepwater)</td>
<td>Highest at Deepwater (then St. Peters)</td>
<td>Highest at Meadowlake</td>
</tr>
<tr>
<td>Higher peaks at St. Peters (exceeding EPA standards)</td>
<td>Higher peaks and more activity at St. Peters and Danpree</td>
<td>Higher peaks at St. Peters and Deepwater</td>
<td>Significant peaks at all monitors (exceeding EPA standards)</td>
</tr>
<tr>
<td>Morning &amp; evening dual daily peak</td>
<td>Late night – early morning daily peak</td>
<td>Morning &amp; evening dual daily peak</td>
<td>Irregular peaks</td>
</tr>
<tr>
<td>Trending generally upwards with time</td>
<td>Trending downward since peak in summer</td>
<td>Peak in March-Apr. Trending generally downward until Sept 2022</td>
<td>Peak in Dec-Jan. Trending downward until Sept 2022</td>
</tr>
</tbody>
</table>
Next Steps

• Will continue collecting and analyzing data

• Averages may change as monitors capture more emissions
  • Greater amounts of data coming in will improve accuracy

• Will develop action plans

• Identifying new locations for additional monitors:
  • To expand network
Research Report: LyondellBasell & Chevron

• Completed by: The Center for Applied Environmental Science (CAES)

• Modeled self-reported emission estimates and compared it with values recorded at fenceline air monitors
  • Are the refineries’ self-reported emissions reliable?
  • Do these match up with pollution levels measured in the community?

• Used emission numbers and data from 2019
Major Takeaways

- Inconsistency between self-reported emissions and monitor recordings
  - Benzene: 10 - 100 times higher than reported
    - Exceeding maximum exposure guidelines / standards at many locations
  - PM: Severe underreporting in flaring emissions

- Potential limitations due to recent developments:
  - Lyondell: Decommissioning oil refinery. Transitioning to “chemical recycling”
  - PRSI: Acquired by Chevron 2019. Making changes to processes

- Opportunity to use data and recommendations from report in future permit oppositions:
  - Steps for refineries to take to reduce air pollution impacts
QUESTIONS