TULANE LAW SCHOOL

TULANE ENVIRONMENTAL LAW CLINIC

Written Statement for July 7, 2020 Subcommittee on Environment Briefing on Plastic Production, Pollution and Waste in the Time of COVID-19

Prepared and submitted by:
Kimberly Terrell, Ph.D., Staff Scientist, Tulane Environmental Law Clinic
Adjunct Faculty, Department of Renewable Natural Resources, Louisiana State University
Adjunct Faculty, Department of Biological Sciences, University of Memphis
2011 David H. Smith Conservation Research Fellow, Society for Conservation Biology

The research compiled below was conducted at the request of various clients of the Tulane Environmental Law Clinic (TELC), including:

- Concerned Citizens of St. John
- RISE St. James
- Individual members of the Mossville (Louisiana) community
- League for a Better St. James Parish
- Louisiana Environmental Action Network (LEAN)
- Louisiana Bucket Brigade

Please Note

Because our work is client-driven and (mostly) within Louisiana, much of the information below focuses on Louisiana. Further, this information was originally compiled at the request of African American community groups and thus focuses on disparities experienced by African American communities. We recognize that disparities in pollution burden are also experienced in other geographic areas and by other communities of color. For examples of nationwide studies that address pollution disparities and include other communities of color, see Kravitz-Wirtz et al. (2018); Mohai and Saha (2015); and Paolella et al. (2018).

Full citations for all studies referenced in this document are provided in the References Section (pages 13-15).

10 KEY MESSAGES

Fine particulate matter ($PM_{2.5}$) is a type of pollution produced by combustion, including from plastics manufacturing and other petrochemical processes.

1. Dozens of studies have linked long-term $PM_{2.5}$ exposure to many of the same health problems that increase risk of death from COVID-19.[1] More recent research has tied $PM_{2.5}$ exposure directly to COVID-19.[2]
2. In Louisiana, most of the Parishes with the highest per capita COVID-19 death rates are in a heavily industrialized stretch along the Mississippi River known as Cancer Alley.[3]
3. In Cancer Alley – and in Louisiana overall – African American communities are overburdened with air pollutants that can cause respiratory disease and immune suppression.[3]
4. Regardless of the cause of these disparities, the effect is that African American communities are overburdened with both air pollution and COVID-19 deaths.[3]
5. The nationwide network of $PM_{2.5}$ air monitors that EPA relies upon to ensure air quality is inadequate to protect public health because most of these monitors are located **outside** areas with the most severe $PM_{2.5}$ pollution.[4]
6. Industrial $PM_{2.5}$ emissions are increasing in Louisiana.[5] Yet LDEQ has worked to **reduce** $PM_{2.5}$ monitoring near the most heavily industrialized communities (e.g. Mossville).[6]
7. The burden of proof should be to establish that it is **safe** to live near facilities that emit harmful pollutants. For statistical reasons, it is not always possible to "prove" that pollution is causing health problems in small communities.
8. Communities are exposed to **unique mixtures of pollution**, presenting another challenge to identifying health impacts. For example, residents of St. John the Baptist Parish have been breathing dangerous levels of chloroprene – an extremely rare type of pollutant – for decades.
9. Regardless of health *outcomes*, racial disparities in health *risks* from pollution warrant corrective action.
10. Ongoing industrial expansion is exacerbating Louisiana's racial disparities in pollution burden. Department of Environmental Quality (LDEQ) permitting decisions fail to acknowledge these disparities. Instead, LDEQ has relied on **outdated information** for Environmental Justice Assessments, including for the proposed Formosa Plastics mega-plant in St. James, Louisiana.[7]

---

[1] *Reviewed in* Ciencewicki and Jaspers (2007); Wu, et al. (2020); *and* Terrell and James (*In Review*; Exhibit A).
[2] *See* Wu et al. (2020) *and* Yao et al., 2020.
[3] Terrell and James (*In Review*; Exhibit A).
[4] Comments on EPA's proposed NAAQS $PM_{2.5}$ rule submitted by TELC on behalf of LEAN (Exhibit B).
[5] Terrell and James (*In Review*; Exhibit A).
[6] Comments on LDEQ's 2020 Monitoring Plan, submitted by TELC on behalf of Mossville clients (Exhibit C).
[7] TELC's Petition for Intervention on behalf of Beverly Alexander challenging LDEQ's approval of Formosa Plastic's air permits (Exhibit D).

KEY MESSAGES (visual summary)

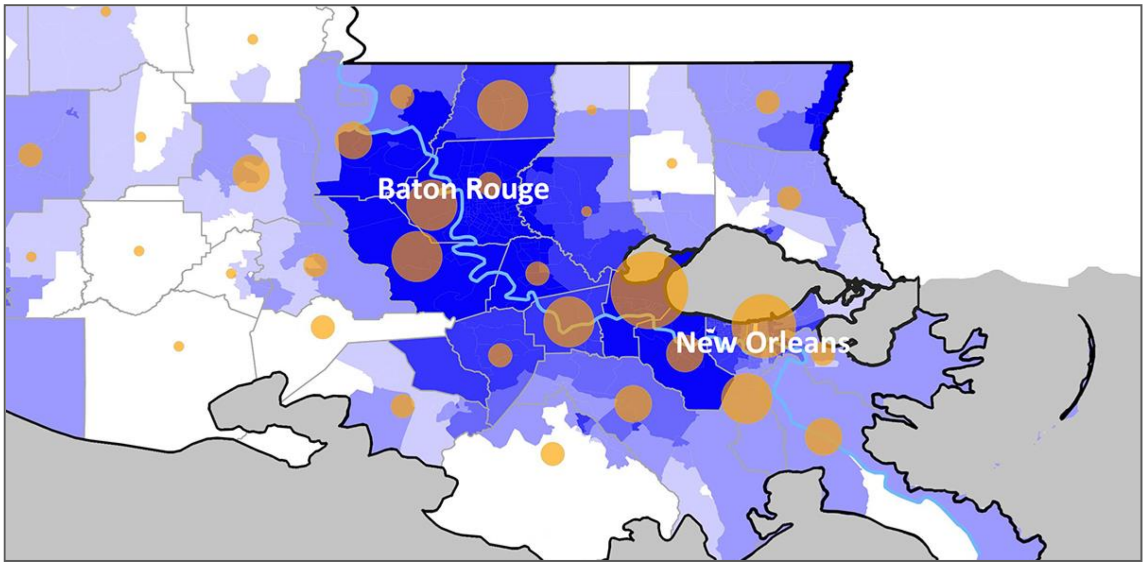

Figure 1. Respiratory Hazard from air pollution (purple shading) versus per capita COVID-19 death rates (orange circles) in Cancer Alley. See Exhibit A for more detail.

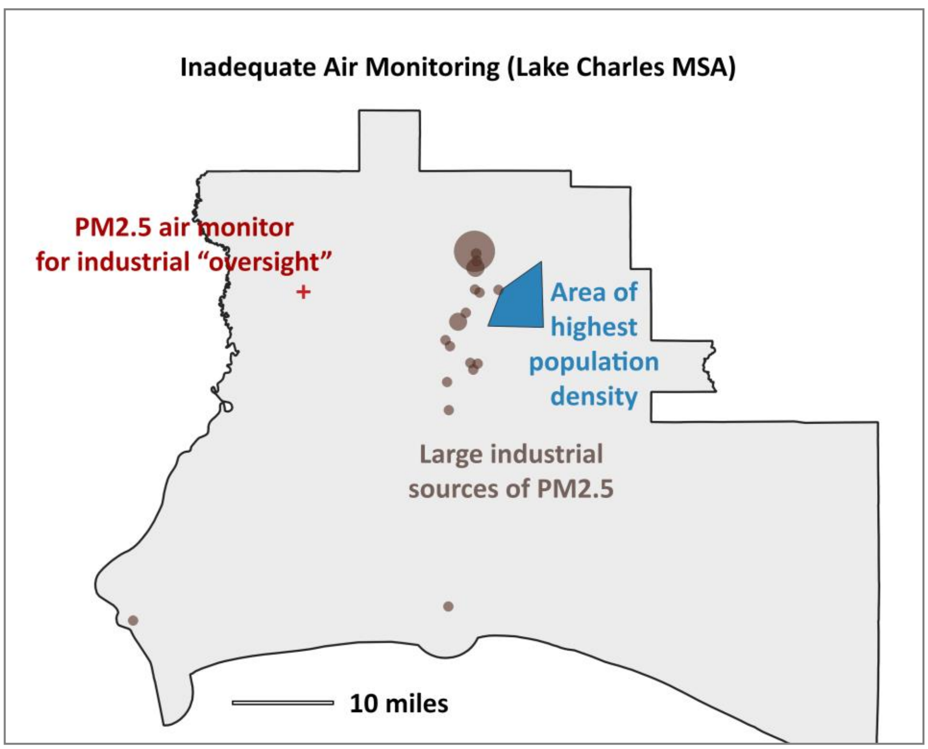

Figure 2. Example of inadequate $PM_{2.5}$ air monitoring (a nationwide problem) from the Lake Charles Metropolitan Statistical Area (MSA) in southwest Louisiana. See Exhibit C for more detail.

Air Pollution and COVID-19 (Key Messages #1-4)

A growing body of research provides compelling evidence that exposure to common air pollutants (e.g. particulate matter, nitrogen dioxide, and ozone) increases susceptibility to respiratory diseases, including from viral infections.[8] For example, exposure to particulate matter (PM) has been linked to higher rates of chronic cough, bronchitis, and chest illness among U.S. schoolchildren,[9] as well as increased hospital admissions for pneumonia in both children and adults.[10] Several studies suggest that even short-term (<7 days) increases in PM can result in higher rates of respiratory infections among children and adults.[11] Both short-term and long-term measurements of air pollution exposure (based on levels of PM and other common pollutants) were linked to higher death rates from SARS, a coronavirus, during the 2003 outbreak in China.[12] Experimental studies are beginning to elucidate the mechanisms underlying these associations, with evidence that PM suppresses the early immune response by reducing the activity of key immune cells.[13]

Given the well-established link between air pollution and respiratory disease, there is growing concern that air pollution may increase susceptibility to COVID-19. This disease, caused by a novel coronavirus (SARS-CoV-2) that attacks the lungs, is characterized by respiratory distress and pneumonia.[14] Indeed, air pollution exposure is associated with many of the co-morbidities that increase risk of severe illness or death from COVID-19, including asthma, hypertension, diabetes, and chronic obstructive pulmonary disease.[15] A recent, nationwide analysis from researchers at Harvard University found that a small increase in PM2.5 exposure (measured over the short-term or long-term) was associated with a large increase in per capita COVID-19 death rates.[16] The analysis, currently under peer review, included more than 3,000 counties and accounted for 20 confounding factors (e.g. diabetes, obesity, and days since first reported case). This evidence for a causal link between PM

---

[8] Ciencewicki and Jaspers (2007).
[9] Dockery et al. (1989).
[10] Pope (1989).
[11] Lin et al. (2005); Dominici et al. (2006); Wordley et al. (1997)
[12] Cui et al. (2003)
[13] *Reviewed in* Ciencewicki and Jaspers (2007).
[14] Wang et al. (2020); Tian et al. (2020)
[15] Ciencewicki and Jaspers (2007); Dominici et al. (2006); Di et al. (2017); Hamanka et al. (2018); Brook et al. (2004).
[16] Wu et al. (2020)

exposure and COVID-19 mortality risk is also supported by an analysis of COVID-19 death rates over time in China.[17] Smaller-scale studies in Europe have reported broad geographic patterns that are consistent with an association between air pollution and COVID-19 death rates.[18]

I recently examined the relationships among COVID-19 mortality, race, and air pollution burden in Louisiana on behalf of our clients in Cancer Alley, in partnership with the University of Memphis Department of Sociology. Our study included multiple measures of air pollution burden, specifically: long-term $PM_{2.5}$ concentrations (2000-2016) from satellite data, and estimates of respiratory and immunological health risks from toxic air pollution (calculated by the EPA's most recent [2014] National Air Toxics Assessment). We found that higher measures of pollution burden were associated with larger percentages of black residents among Louisiana census tracts.[19] This disparity remained when mobile/non-point pollution sources were excluded from the analysis. In other words, the racial disparity in pollution burden was not driven by urbanization or vehicle emissions. Across Louisiana parishes, higher COVID-19 death rates were associated with increased pollution burden and larger percentages of black residents. These associations were not driven by diabetes, obesity, smoking, age, or poverty. We found that industrial sources were a greater fraction of Louisiana's $PM_{2.5}$ in 2017 versus 1990, as vehicle contributions declined 75% while industrial emissions remained about the same overall (despite variation in the interim). Satellite data revealed that $PM_{2.5}$ levels decreased statewide from 2000 – 2015, but subsequently increased in south Louisiana, concurrent with an upward trend in industrial emissions. Collectively, our findings highlight the urgent need to reduce industrial emissions near black communities, expand air quality monitoring, and recognize exposure to harmful air pollutants as a risk factor for COVID-19.

Inadequate Air Monitoring (Key Messages # 5-6)

To my knowledge, there is no evidence that the air quality monitors operated by state environmental agencies are consistently located in pollution hotspots (i.e. areas of highest pollution concentration). These monitors are critically important because EPA relies on the corresponding

[17] Yao et al. (2020)
[18] Ogen et al. (2020); Travaglio et al. (2020)
[19] Terrell and James (*In Review*; Exhibit A).

datasets to determine compliance with National Ambient Air Quality Standards (NAAQS). Thus, monitoring in pollution hotspots is essential to ensuring NAAQS are applied uniformly and protect communities in the most polluted areas. I recently examined this issue with respect to $PM_{2.5}$ monitoring specifically, on behalf of the Louisiana Environmental Action Network. I used satellite data to compare $PM_{2.5}$ concentration at each air quality monitoring site to the highest $PM_{2.5}$ concentration that occurs in that monitor's "Service Area."[20] My analysis revealed that overall, the EPA-reporting network of $PM_{2.5}$ monitors is not protective of public health. Depending on the method used (i.e. including data from the monitors themselves, or using satellite-derived data only), 82% or 99.9% of monitoring sites were found to be non-protective, meaning that higher ambient $PM_{2.5}$ concentrations occurred elsewhere in the monitor's "Service Area." Non-protective monitoring was a broadscale phenomenon, occurring in all 48 contiguous states and the District of Columbia. On average, across all 973 Service Areas, $PM_{2.5}$ concentrations at hotspots were 1.66 $\mu g/m^3$ higher compared to monitoring sites. In other words, for monitoring to achieve health standards that are, *on average*, protective, the best available scientific data indicate that an annual $PM_{2.5}$ NAAQS standard should provide a 1.66 $\mu g/m^3$ buffer below the threshold for adverse effects. However, for hundreds of Service Areas, the hotspot/monitoring site disparity is even greater. To achieve protective monitoring for 90% of Service Areas, a buffer of at least 3.28 $\mu g/m^3$ would be required. Further, recent studies provide compelling evidence that the current annual NAAQS for $PM_{2.5}$ (12 $\mu g/m^3$) is inadequate to protect human health.

The statements in this paragraph are substantiated in recent comments that TELC submitted to LDEQ on behalf of Mossville community members (Exhibit C). In Louisiana, the DEQ has sought to systemically reduce $PM_{2.5}$ monitoring, while at the same time permitting massive increases in $PM_{2.5}$ emissions, particularly in the Lake Charles Metropolitan Statistical Area (MSA). This area includes Mossville, a community with a rich African American heritage that has been overburdened – to the point of oppression – by industrial pollution. Much of Mossville's original footprint is now occupied by major industrial facilities, including Sasol's Lake Charles Chemical Complex. In May 2014, LDEQ permitted Sasol to *increase $PM_{2.5}$ emissions by over 600 tons per year* for a major expansion of this

[20] See Exhibit B for details and methods of this analysis. I use the term "Service Area" to mean the area for which that monitor represents the closest monitor.

facility.[21] Two months later, LDEQ requested EPA approval to *deactivate two of the three $PM_{2.5}$ monitors* in that region (i.e. Lake Charles MSA), including the Westlake monitor, which is located at Sasol's fenceline. Ultimately, EPA granted approval to deactivate one of these monitors (at McNeese State University), but not the other (i.e. Westlake). The LDEQ now claims that the Westlake monitor is unreliable and its data cannot be used to determine NAAQS compliance.[22] The third $PM_{2.5}$ monitor in the region, located in Vinton, is now the only remaining "gold standard" (i.e. Federal Reference Method, FRM) monitor for $PM_{2.5}$ in the Lake Charles MSA. The EPA has stated that it "supports the continued operation of the $PM_{2.5}$ FRM at the Vinton site **due to the proximity of industrial sources** in the area."[23] (Emphasis added.) The LDEQ reaffirmed this purpose in its 2016 Monitoring Plan, stating that it would continue operating the Vinton $PM_{2.5}$ monitor "due to the proximity of industry in the area to provide **oversight of ambient air conditions in this industrial area**."[24] (Emphasis added.) But these statements ignore the fact that the Vinton $PM_{2.5}$ monitor is located nowhere near the area's major industrial sources of $PM_{2.5}$ emissions (i.e. about 24 km away). In fact, the (deactivated) monitor at McNeese State University was far closer to these industrial sources and was located in an area where the population density is nearly 20-fold higher compared to the Vinton site.

The Burden of Proof (Key Messages #7-9)

Public Health, as a discipline, is built on a core value of precaution in the face of scientific uncertainty (for example, advising pregnant women to avoid travelling in areas with Zika virus, despite scientific uncertainty about whether the virus poses a risk to their unborn child). Thus, the longstanding "Precautionary Principle" of public health shifts the burden of proof from showing the presence of risk to showing the *absence* of risk. For decades, scientists have advocated for a precautionary approach in

---

[21] The expansion included an ethane cracker, which will produce ethylene, a chemical used to manufacture plastic. The 606 tpy increase in PM2.5 included 364 tpy for the Ethane Cracker Project and 242 tpy for a Gas-to-Liquids Project that was subsequently postponed/canceled. See: LDEQ. Statement of Basis. Lake Charles Cracker Project. Page 25. EDMS # 9317309. May 23, 2014. See also: LDEQ. Statement of Basis. Gas to Liquids Project. 2 of 32. EDMS 9317335. May 23, 2014

[22] 2020 Louisiana Annual Network Assessment, LDEQ, 16 of 17. EDMS #12170694. https://edms.deq.louisiana.gov/app/doc/view.aspx?doc=12170694&ob=yes&child=yes

[23] Exhibit C, Page 10 of 25.

[24] *Id.* Page 10 of 25.

environmental science and policy-making.[25] This approach has four central components: "taking preventive action in the face of uncertainty; **shifting the burden of proof to the proponents of an activity**; exploring a wide range of alternatives to possibly harmful actions; and increasing public participation in decision making."[26] (Emphasis added.)

For multiple reasons, precaution is warranted with respect to pollution exposure:

1. Every industrialized community is exposed to a unique mixture of pollutants. For example, the proposed Formosa Plastics plant in St. James Parish (located only a few miles from our client's home) was recently permitted to emit 28 different pollutants, at quantities ranging from 0.01 to nearly 3,000 tons per year.[27] While each of these 28 pollutants is *known* to be harmful to human health, the combined effects of all 28 are *entirely unknown*. Controlled, laboratory studies have shown that simple combinations of pollutants (including those that would be produced by Formosa Plastics) can be more harmful than the sum of their individual parts.[28,29] Further, the composition of pollution mixtures can differ among neighborhoods and change daily, depending on wind patterns and industrial production rates. For these and other reasons (described below), it is virtually impossible to know the *full extent* of health hazards from industrial pollution for a given community.
2. Many of Louisiana's industrial facilities are in rural areas, near small communities.[30] Studies of small communities are unlikely to detect health effects from pollution, even when those effects are present. The reason for this problem comes from basic principles in probability and statistics. In studies of small populations, there are likely to be differences between study groups due to random chance and uncontrollable factors. By contrast, in larger populations, these differences tend to "even out in the mix." For example, if you randomly grabbed two

[25] Kribel et al. (2001); Gee and Krayer von Krauss (2005); Akins et al. (2019)
[26] Kriebel et al. (2001)
[27] LDEQ. Jan 2020. Basis for Decision. FG LA LLC. AI # 198351. Pages 4-5. Available by searching Document # 11998452 at edms.deq.louisiana.gov.
[28] *For example, see* Wang et al. (2013); Huang et al. (2012); *and* Last (1991).
[29] Note that a laboratory study to determine the interacting effects of 28 pollutants is virtually impossible, given the vast number of possible combinations (3×10^{29}) and the potential for synergistic and antagonistic interactions (or no interaction) among every unique combination of pollutants.
[30] More often than not, these are communities of color. See Perera and Lam (2013) and James et al. (2014).

handfuls of jelly beans from a jar, each handful would probably be different; maybe one handful would have twice the number of reds as the other. But if you compared two jumbo-sized containers of this same brand of jelly beans, they would likely have more similar numbers of reds. Now imagine that you're studying a real-world community, but instead of jelly bean colors you're concerned about differences in factors that affect health, including genetics, pre-natal exposures, early childhood experiences, diet, occupational exposures, residential history, healthcare access, and other factors that often cannot be accounted for. Given the large number of factors that affect peoples' health, epidemiological studies typically include thousands of people.[31] In the rural, historic communities of Cancer Alley, finding thousands of people who are all exposed to the **same** toxic mixture of pollution is virtually impossible.

3. It is difficult to accurately measure residents' exposure to pollution. Studies often use location (e.g. county or census tract) as an approximation of pollution exposure. But pollution levels can differ substantially within a county or census tract. For example, in St. John the Baptist Parish, an industrial plant that emits chloroprene – an unusual type of pollution that was recently linked to cancer – is located near the border of two different census tracts. Thus, people who represent the same census tract are living less than half a mile from this plant, as well as nearly two miles away.[32] For the census tract directly across the Mississippi River, some residents live less than a mile from this plant, while others live more than 10 miles away.[33] Concerningly, the Louisiana Department of Environmental Quality has repeatedly used reported cancer rates for census tracts and parishes to make sweeping conclusions about the safety of living near major industrial facilities.[34] Such conclusions are scientifically unsound and reflect a total lack of understanding of basic principles in statistics and scientific study design.

---

[31] Hajian-Tilaki (2011).

[32] University Network for Human Rights. "Waiting to Die. Toxic Emissions and Disease Near the Louisiana Denka/Du Pont Plant." July 2019. Page 10. https://drive.google.com/file/d/1Ie93SHF-GrgFfN61PqwXrGh1Ay4lWqMD/view

[33] U.S. Census Bureau. 2010. St. John Census Tract Reference Map. https://www2.census.gov/geo/maps/dc10map/tract/st22_la/c22095_st_john_the_baptist/DC10CT_C22095_001.pdf

[34] *For example, see* LDEQ. Jan 2020. Basis for Decision. FG LA LLC. AI # 198351. Pages 17-18. *See also the corresponding* Public Comments Response Summary. Pages 49, 54, and 65-66. Available by searching Document # 11998452 at edms.deq.louisiana.gov.

Understanding the full extent of public health impacts from industrial pollution is extremely challenging, given the complexity of these pollutant mixtures, the small size of many industrialized communities, and the reliance on imperfect estimates of pollution exposure. Yet, the pollutants in question are regulated *precisely because they are known to harm human health*. A good analogy in is cigarette smoking: it would not make sense to try to "prove" that smokers who live in a certain community are more likely to develop lung cancer compared to non-smokers; we know this risk exists from studies of much larger populations. Further, we do not consider there to be any "safe" level of cigarette smoking. In the same way, it is not rational to assume it is safe to live near facilities that emit substances which, from large-scale studies and laboratory-based research, are known to cause respiratory disease, cancer, and other health problems. Rather, the burden of proof should be shifted so that we presume it is unsafe to live near such facilities, until we have reliable evidence to indicate otherwise.

In Louisiana, high-ranking public health professionals have responded to concerns about pollution disparities by asserting that increased *risk* does not always translate to increased incidence of health problems.[35] This assertion contradicts the core principles of public health (i.e. precaution and prevention). To my knowledge, there is no other context in which state-operated public health institutions have encouraged citizens to focus on uncertainty in health *outcomes* rather than focus on reducing health *risks*. Whether risk translates to outcomes is beside the point. As an analogy, drunk driving is a crime because it presents a *risk* to the public, and drunk drivers are arrested regardless of the *outcome* of their actions (i.e. whether they hurt anyone.)

The Inevitable Time Lag (Background for Key Message #10)

Even the best indicators of pollution-related health risks cannot keep pace with the rapid expansion of industrial activity in the United States. For example, the most comprehensive and readily available estimates of health risk from pollution exposure come from the EPA's National Air Toxics

[35] "Risk doesn't necessarily translate into actual cases." Statement made by Donna Williams, DrPH, Director of the Louisiana Cancer Prevention and Control Programs and 26:37For example, see statements made in the Nov 5, 2019 public meeting with public health experts (representing the Louisiana Tumor Registry and the Louisiana Department of Health) and the Concerned Citizens of St. John. https://www.youtube.com/watch?v=zCZvHc8MeF4&feature=youtu.be

Assessment (NATA). Given the tremendous amount of work required to compile emissions data (a multi-year process) and to assess the health risks from those emissions (another multi-year process), an updated NATA is only published every ~3 years, on average. Each NATA reflects a "snapshot" of pollution levels ~4 years prior to its publication (on average). For example, the most recent NATA currently available was completed in 2018 and reflects pollution levels in 2014. Thus, even the most current NATA estimates of pollution-related health risks do not account for the ongoing, major industrial expansion that began in Louisiana in ~2016 (and is also occurring in other states). We will not begin to see the consequences of this expansion – in terms of NATA health risks – until EPA completes the next NATA, which is expected to be released in late 2021 and will reflect a snapshot of pollution levels in 2017. Likewise, NATA estimates that reflect health risks from the air we breathe today will not be available until late 2024.[36]

Inappropriate Use of Outdated Information for Industrial Permitting (Key Message #10)

Because of the complexity of NATA, a multi-year time lag is inevitable. However, this problem is severely compounded by the Louisiana Department of Environmental Quality (LDEQ)'s inappropriate use of **outdated** (i.e. not the most recent) NATA datasets in its permitting decisions. For example, in January 2020, the LDEQ approved air permits for Formosa Plastics, using data from the 2011 NATA to conduct its Environmental Justice Assessment, even though the 2014 NATA had been available for over a year.[37] Based on this outdated 2011 NATA, the agency concluded that pollution-related health risks for residents near the proposed Formosa Plastics site (located near several historic, African American communities) are no worse than the state average. However, the 2014 NATA (the most recent version) shows an entirely different picture. Residents of Welcome and St. James, two ~90% African American communities within a few miles of the proposed Formosa Plastics' site, have a **higher risk of cancer from air pollution** than 86% of Louisiana residents. Residents of Union, another African American community located just across the Mississippi River, have a higher risk of cancer from air pollution than 92% of Louisiana residents and a higher risk of respiratory disease from air pollution than 73% of

[36] Assuming the timeline of NATA publication does not change.
[37] Exhibit D.

Louisiana residents.[38] Further, even the 2014 NATA dataset would not have accounted for pollution from several new petrochemical plants in the area that are permitted to release a combined total of more than 1,400 tons per year of harmful air pollution. This proposed plant is now permitted to release over 75 tons of known carcinogens into the air each year, along with over 6,000 tons of pollutants known to cause respiratory problems and nearly 14 million tons of greenhouse gases (i.e. CO_2 equivalents).[39] Unfortunately, this is not the only recent example of LDEQ using risk estimates from an outdated NATA to justify increases in permitted emissions from industrial activity.[40]

Conclusion

This document represents a synthesis of our clients' concerns regarding their exposure to air pollution from industrial activities, including plastics production and related petrochemical processes. A precautionary approach to regulating industrial pollution is warranted for many reasons: African American communities are disproportionately impacted by pollution; novel respiratory diseases (e.g. COVID-19) can emerge unexpectedly and disproportionately affect people who have been exposed to air pollution; it is extremely difficult to accurately measure pollution exposure; air monitors are often located *outside* the areas with the highest pollution levels; communities are exposed to unique and complex mixtures of pollution, the effects of which are entirely unknown; potential links between pollution and health outcomes are much harder to identify in smaller communities; information about current pollution-related health risks cannot keep pace with industrial expansion; and, finally, state agencies may not always use the best available information to make permitting decisions. Compounding these problems, many of the communities that our clients represent face a myriad of other disparities that can impact human health, including higher poverty rates and less access to healthcare. We hope that a better understanding of our clients' concerns will help guide decision-making to safeguard human health and ensure environmental protection.

---

[38] *Id.*

[39] LDEQ. Jan 2020. Basis for Decision. FG LA LLC. AI # 198351. Pages 4-5. Available by searching Document # 11998452 at edms.deq.louisiana.gov.

[40] *For another example of the use of outdated 2011 NATA data, see* LDEQ. Jan 2020. Basis for Decision. Ergon Moda. AI # 212862. Page 18. Available by searching Document # 12042792.

REFERENCES

Akins, Ashli, Phil O'B Lyver, Hugo F. Alroe, and Henrik Moller. 2019. "The Universal Precautionary Principle: New Pillars and Pathways for Environmental, Sociocultural, and Economic Resilience." Sustainability 11 (8): 2357. https://doi.org/10.3390/su11082357

Brook, Robert D., Barry Franklin, Wayne Cascio, Yuling Hong, George Howard, Michael Lipsett, Russell Luepker, et al. 2004. "Air Pollution and Cardiovascular Disease: A Statement for Healthcare Professionals from the Expert Panel on Population and Prevention Science of the American Heart Association." Circulation 109 (21): 2655–71. https://doi.org/10.1161/01.CIR.0000128587.30041.C8

Ciencewicki, Jonathan, and Ilona Jaspers. 2007. "Air Pollution and Respiratory Viral Infection." Inhalation Toxicology 19 (14): 1135–46. https://doi.org/10.1080/08958370701665434

Cui, Yan, Zuo-Feng Zhang, John Froines, Jinkou Zhao, Hua Wang, Shun-Zhang Yu, and Roger Detels. 2003. "Air Pollution and Case Fatality of SARS in the People's Republic of China: An Ecologic Study." Environmental Health 2 (November): 15. https://doi.org/10.1186/1476-069X-2-15

Di, Qian, Yan Wang, Antonella Zanobetti, Yun Wang, Petros Koutrakis, Christine Choirat, Francesca Dominici, and Joel D. Schwartz. 2017. "Air Pollution and Mortality in the Medicare Population." The New England Journal of Medicine 376 (26): 2513–22. https://doi.org/10.1056/NEJMoa1702747

Dockery, Douglas W., Frank E. Speizer, Daniel O. Stram, James H. Ware, John D. Spengler, and Benjamin G. Ferris. 1989. "Effects of Inhalable Particles on Respiratory Health of Children." American Review of Respiratory Disease 139 (3): 587–94. https://doi.org/10.1164/ajrccm/139.3.587.

Dominici, Francesca, Roger D. Peng, Michelle L. Bell, Luu Pham, Aidan McDermott, Scott L. Zeger, and Jonathan M. Samet. 2006. "Fine Particulate Air Pollution and Hospital Admission for Cardiovascular and Respiratory Diseases." JAMA 295 (10): 1127–34. https://doi.org/10.1001/jama.295.10.1127.

Gee, D., and M. P. Krayer von Krauss. 2005. "Late Lessons from Early Warnings: Towards Precaution and Realism in Research and Policy." Water Science and Technology: A Journal of the International Association on Water Pollution Research 52 (6): 25–34. https://pubmed.ncbi.nlm.nih.gov/16304931/

Hajian-Tilaki, Karimollah. 2011. "Sample Size Estimation in Epidemiologic Studies." Caspian Journal of Internal Medicine 2 (4): 289–98. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3895825/

Huang, Yuh-Chin T., Ana G. Rappold, Donald W. Graff, Andrew J. Ghio, and Robert B. Devlin. 2012. "Synergistic Effects of Exposure to Concentrated Ambient Fine Pollution Particles and Nitrogen Dioxide in Humans." Inhalation Toxicology 24 (12): 790–97. https://doi.org/10.3109/08958378.2012.718809

James, Wesley, Chunrong Jia, and Satish Kedia. 2012. "Uneven Magnitude of Disparities in Cancer Risks from Air Toxics." International Journal of Environmental Research and Public Health 9 (12): 4365–85. https://doi.org/10.3390/ijerph9124365

Kravitz-Wirtz, Nicole, Samantha Teixeira, Anjum Hajat, Bongki Woo, Kyle Crowder, and David Takeuchi. 2018. "Early-Life Air Pollution Exposure, Neighborhood Poverty, and Childhood Asthma in the United States, 1990-2014." International Journal of Environmental Research and Public Health 15 (6): 1114. https://doi.org/10.3390/ijerph15061114

Kriebel, D, J Tickner, P Epstein, J Lemons, R Levins, E L Loechler, M Quinn, R Rudel, T Schettler, and M Stoto. 2001. "The Precautionary Principle in Environmental Science." Environmental Health Perspectives 109 (9): 871–76. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1240435/

Last, J. A. 1991. "Synergistic Effects of Air Pollutants: Ozone plus a Respirable Aerosol." Research Report (Health Effects Institute), no. 38 (January): 1–32; discussion 33-43. https://pubmed.ncbi.nlm.nih.gov/2012683/

Lin, Mei, David M. Stieb, and Yue Chen. 2005. "Coarse Particulate Matter and Hospitalization for Respiratory Infections in Children Younger Than 15 Years in Toronto: A Case-Crossover Analysis." Pediatrics 116 (2): e235–40. https://doi.org/10.1542/peds.2004-2012.

Luepker, et al. 2004. "Air Pollution and Cardiovascular Disease: A Statement for Healthcare Professionals from the Expert Panel on Population and Prevention Science of the American Heart Association." Circulation 109 (21): 2655–71. https://doi.org/10.1161/01.CIR.0000128587.30041.C8

Martuzzi, Marco, and Joël A Tickner. 2004. The Precautionary Principle: Protecting Public Health, the Environment and the Future of Our Children. https://www.euro.who.int/__data/assets/pdf_file/0003/91173/E83079.pdf

Mohai, Paul, and Robin Saha. 2015. "Which Came First, People or Pollution? Assessing the Disparate Siting and Post-Siting Demographic Change Hypotheses of Environmental Injustice." Environmental Research Letters 10 (11): 115008. https://doi.org/10.1088/1748-9326/10/11/115008.

Ogen, Yaron. 2020. "Assessing Nitrogen Dioxide (NO2) Levels as a Contributing Factor to Coronavirus (COVID-19) Fatality." Science of The Total Environment 726 (July): 138605. https://doi.org/10.1016/j.scitotenv.2020.138605.

Paolella, David A., Christopher W. Tessum, Peter J. Adams, Joshua S. Apte, Sarah Chambliss, Jason Hill, Nicholas Z. Muller, and Julian D. Marshall. 2018. "Effect of Model Spatial Resolution on Estimates of Fine Particulate Matter Exposure and Exposure Disparities in the United States." Environmental Science & Technology Letters 5 (7): 436–41. https://doi.org/10.1021/acs.estlett.8b00279

Perera, P. K. P., and N. Lam. 2013. "An Environmental Justice Assessment of the Mississippi River Industrial Corridor in Louisiana, Us Using a Gis-Based Approach." Applied Ecology and Environmental Research 11 (4): 681–97. https://doi.org/10.15666/aeer/1104_681697

Pope, C A. 1989. "Respiratory Disease Associated with Community Air Pollution and a Steel Mill, Utah Valley." American Journal of Public Health 79 (5): 623–28. https://doi.org/10.2105/AJPH.79.5.623.

Terrell, KA. And James, W. Racial and socioeconomic disparities in air pollution burden and per capita COVID-19 death rates in Cancer Alley, Louisiana, USA. *In Review at Environmental Justice*. (Exhibit B).

Tian, Sufang, Yong Xiong, Huan Liu, Li Niu, Jianchun Guo, Meiyan Liao, and Shu-Yuan Xiao. 2020. "Pathological Study of the 2019 Novel Coronavirus Disease (COVID-19) through Postmortem Core Biopsies." Modern Pathology, April, 1–8. https://doi.org/10.1038/s41379-020-0536-x.

Travaglio, Marco, Yizhou Yu, Rebeka Popovic, Nuno Santos Leal, and L. Miguel Martins. 2020. "Links between Air Pollution and COVID-19 in England." MedRxiv, April, 2020.04.16.20067405. https://doi.org/10.1101/2020.04.16.20067405

Wang, Dawei, Bo Hu, Chang Hu, Fangfang Zhu, Xing Liu, Jing Zhang, Binbin Wang, et al. 2020. "Clinical Characteristics of 138 Hospitalized Patients With 2019 Novel Coronavirus–Infected Pneumonia in Wuhan, China." JAMA 323 (11): 1061–69. https://doi.org/10.1001/jama.2020.1585.

Wang, Guanghe, Rongfang Jiang, Zhuohui Zhao, and Weimin Song. 2013. "Effects of Ozone and Fine Particulate Matter (PM2.5) on Rat System Inflammation and Cardiac Function." Toxicology Letters 217 (1): 23–33. https://doi.org/10.1016/j.toxlet.2012.11.009

Wordley, J., S. Walters, and J. G. Ayres. 1997. "Short Term Variations in Hospital Admissions and Mortality and Particulate Air Pollution." Occupational and Environmental Medicine 54 (2): 108–16. https://doi.org/10.1136/oem.54.2.108.

Wu, X, R. C. Nethery, B.M. Sabath, D. Braun, and F. Dominici. 2020. "Exposure to Air Pollution and COVID-19 Mortality in the United States. MedRxiv 2020.04.05.20054502; https://Doi.Org/10.1101/2020.04.05.20054502

Yao, Ye, Zhixi Liu, Xia Meng, Weidong Wang, Haidong Kan, and Weibing Wang. 2020. Temporal Association Between Particulate Matter Pollution and Case Fatality Rate of COVID-19 in Wuhan, China. https://doi.org/10.1101/2020.04.09.20049924