Double Jeopardy in Houston

Acute and Chronic Chemical Exposures Pose Disproportionate Risks for Marginalized Communities

Center for Science and Democracy at the Union of Concerned Scientists

t.e.j.a.s

Texas Environmental Justice Advocacy Services

Introduction

There is compelling evidence that people of color and those living in poverty are exposed to higher levels of environmental pollution than whites or people not living in poverty (Cushing et al. 2015; Bullard, Johnson, and Torres 2011; Mohai, Pellow, and Roberts 2009; Bullard 2000). The health impacts on these populations from environmental degradation are amplified by other negative socioeconomic and health factors such as the lack of access to health care, healthy foods, and public transportation, along with stress from poverty, unemployment, and crime, among other factors (Prochaska et al. 2014; O'Neill et al. 2003). This disproportionate exposure to toxic pollution, and the associated health impacts, underscores the need to address environmental justice. Environmental justice is defined by the Environmental Protection Agency (EPA) as "the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies" (EPA 2016a).

Recent reports by the Environmental Justice and Health Alliance for Chemical Policy Reform (EJHACPR 2014) and the Center for Effective Government (CEG 2016) found that, compared with national averages, a significantly greater percentage of African Americans, Latinos, and people in poverty live near industrial facilities that use large quantities of toxic chemicals and present a risk of major chemical disasters. A 2004 study found that larger, more chemical-intensive facilities tend to be located in counties with larger black populations and in counties with high levels of income inequality. It also found a greater risk of chemical accidents and spills at facilities in counties with larger African American populations (Elliott et al. 2004).

The release of toxic chemicals from industrial sources into surrounding communities is all too common. The EPA's Risk Management Plan (RMP) program encompasses the nation's most high-risk industrial facilities that produce, use, or store significant quantities of toxic and flammable chemicals. Among other requirements, these facilities must prepare plans for responding to a worst-case incident such as a major fire or explosion in which toxic chemical pollution is released into the surrounding community. The EPA estimates that approximately 150 catastrophic accidents occur each year in regulated industrial facilities. The EPA notes that these accidents "pose a risk to neighboring communities and workers

Due to a lack of comprehensive zoning laws in Houston, many fenceline communities lie directly next to chemical facilities, and hence are exposed to high levels of air pollution and risk of catastrophic accidents. Compared with the Houston urban area, neighborhoods such as Harrisburg/Manchester and Galena Park comprise a larger percentage of African Americans, Latinos, and people living at or near poverty levels.

because they result in fatalities, injuries, significant property damage, evacuations, sheltering in place, or environmental damage" (EPA 2016b). Less severe accidents happen regularly—425 chemical accidents occurred in the little more than two years between the explosion in April 2013 at the West Texas fertilizer facility and August 2015 (CPCD 2015), and many others likely went unreported.

Communities closest to these hazardous facilities are likely to experience the greatest impacts from an explosion or chemical release—and would have the least amount of time to escape these dangers (USCSB 2016; Lezon 2016; Zaveri and Dempsey 2016). Therefore, while the "vulnerability zone" that would be impacted by a worst-case accident from some of these RMP facilities extends as far as 25 miles or more, this report focuses on the demographics and health risks for people living within one mile of these facilities—the fenceline zone.

THE HOUSTON CONTEXT

In addition to the acute risk of a catastrophic chemical accident, people in fenceline communities—those in close proximity to these facilities—face the "double jeopardy" of living with daily chronic exposure to high levels of toxic pollution in their air, water, and soil. Exposure to toxic air pollution in the Houston metropolitan area has long been a concern, especially for low-income communities and communities of color along the Houston Ship Channel, home to a large concentration of oil refineries and other heavy industry. An analysis of air pollution risks in the greater Houston area conducted in 2005 to 2006 for the Mayor's Task Force on Health Effects of Air Pollution, which also focused on several east Houston communities, found that air pollution in the Harrisburg/Manchester community exceeded safe levels for seven of the 12 air pollutants deemed "definite risks," the most of any of the communities. In assessing the results of air pollution on east Houston communities, the task force concluded that "east Houston neighborhoods that face a number of vulnerabilities based on their marginal social and economic standing also carry a heavier burden of health risks from breathing pollutants in their air. They tend to be located closer to major point sources than most other neighborhoods in the greater Houston area and to be nearer to major transportation corridors. The burden of these risks taken together poses special needs in these neighborhoods" (Mayor's Task Force 2006).

Other studies of the Houston area's air pollution have found similar disproportionate impacts on people of color and the poor. A 2008 study found a disproportionate cancer risk especially for Hispanics living in poverty and with other indicators of social disadvantage (Linder, Marko, and Sexton 2008). A recent study of the Houston area examined residents' acute risks from potential chemical facility accidents as well as chronic risks from exposure to air pollution, finding that "neighborhoods with a higher percentage of Hispanic residents, lower percentage of homeowners, and higher income inequality are facing significantly greater exposure to both chronic and acute pollution risks. . . . Households isolated by language—those highly likely to face evacuation problems during an actual chemical disaster—tend to reside in areas facing significantly greater exposure to high-impact acute events"(Chakraborty et al. 2014).

The accidental release of toxic chemicals from industrial sources into surrounding communities is all too common.

425 chemical accidents occurred in the little more than two years between the explosion in April 2013 at the West Texas fertilizer facility and August 2015.

This report builds on that past work, analyzing chronic exposure and health risks from toxic air pollution as well as potential acute exposures from unplanned chemical releases from neighboring chemical facilities included in the EPA's RMP program. We compare the risks and exposures facing residents of two predominantly Hispanic and low socioeconomic east Houston communities, Harrisburg/Manchester and Galena Park, with two primarily white and wealthier west Houston communities, West Oaks/Eldridge and Bellaire (see methodology section below).

Cities, towns, and neighborhoods composed predominantly of low-income people of color—such as those of Galena Park and Harrisburg/Manchester—with high densities of commercial and industrial spaces that pose serious health and societal impacts on their residents often go unnoticed, unappreciated, and even justified as acceptable by people

© Yvette Arellano/TEJAS

The Houston neighborhoods of Harrisburg/Manchester and Galena Park, whose residents are predominantly African American, Hispanic, and low income, face far greater health risks than the members of more white and affluent communities like West Oaks/Eldridge and Bellaire, given their proximity to chemical facilities that pollute the surrounding air, water, and soil.

who have little experience with the circumstances of these communities. In his classic study of landfills and dumps in black neighborhoods in Houston, *Dumping in Dixie*, Dr. Robert Bullard asks, "Are environmental inequities a result of racism or class barriers or a combination of both? After more than two decades of modern environmentalism, the equity issues have not been resolved" (Bullard 2000). He also notes that, "poor whites and poor blacks [and brown communities] do not have the same opportunities to vote with their feet. Racial barriers to education, employment, and housing reduce mobility options available to the black [and brown] underclass and the black [and brown] middleclass."*

As a result of the multiple constraints on low-income residents, their relocation away from these polluting sources is not a realistic option without assistance. Cycles of poverty, institutionalized racism, hopelessness, fear, and complacency are the products of failed attempts to push for change. These factors call for a deeper understanding of and respect for the issues facing environmental justice communities—not only regarding the intersection of race and disproportionate impacts of pollution but including a broader look at the societal systems that allowed these situations to develop.

While Galena Park and Harrisburg/Manchester are no longer dotted by oil derricks, they now house facilities that store and produce large amounts of chemicals, oil, and other toxic products, posing disproportionate risks of catastrophic chemical spills and chronic air-pollution emissions on people of color. They are just two of many frontline environmental justice communities throughout the nation that pay the environmental and human price for rampant industrial growth.

Political Realities

Congressional and state legislative districts have a history of disenfranchising minority and low-income communities by drawing district lines to reinforce favorable voting patterns (Bush v. Vera 1994). While US House of Representatives District 29, which encompasses Galena Park, Manchester, Pasadena, and a handful of other environmental justice communities, is a majority Hispanic district established to diversify representation in Congress, it has yet to achieve this goal. Fortunately, a recent Texas voter-identification requirement was struck down in federal court, in part because it would disproportionately discourage Latino and black residents from voting (Veasey v. Perry 2014).

Further weakening the protection of east Houston communities is the lack of citywide zoning in Houston. The city officials maintain that its patchwork of ordinances and restrictions fills this gap. These include municipal management districts, ordinances, deed restrictions, historic designations, de facto locally controlled zoning, and developer-master-planned

* *Bullard added the inclusion of brown communities in personal communication with the report's authors (Bullard 2016).*

> ***Congressional and state legislative districts have a history of disenfranchising minority and low-income communities.***

communities. Such bodies have restricted motels, industrial facilities, and cell phone towers. Bodies such as the 22 municipal management districts that overlap with tax increment reinvestment zones in Houston can be effective at exerting influence over land use, and municipal management districts can use tax increment reinvestment zones to fund community improvement projects (Kiger 2015). Unfortunately, these land use efforts have not been as effective in marginalized communities as in other communities.

In recent years, Texas has frequently opposed national environmental protection efforts, having sued the EPA 23 times since the start of the Obama administration (Wray 2016a). To improve environmental conditions in their communities, local organizations such as Texas Environmental Justice Advocacy Service have communicated with the EPA, the Texas Commission on Environmental Quality, local and state officials, and industry players and have utilized the legal system to press their concerns about environmental conditions and health impacts (Selle 2013). Although working groups and strategy plans have been established to address these environmental issues, most of these bodies not only add a bureaucratic layer to communication between residents and agencies, but also create lengthy response times.

History and Community Characteristics

HARRISBURG/MANCHESTER

Harrisburg/Manchester sits beneath the 610 Ship Channel Bridge on a 5.81-square-mile plot of land and was once a booming shipping and oil town. Originally intended to be a wharf, since the 1860s Harrisburg/Manchester has been occupied by commercial industry—first, cotton and grains, followed by oil, petrochemical products, and plastics (Magnolia Park Land Company n.d.). Formerly predominately white, by the 1980s the population of Harrisburg/Manchester was predominantly Hispanic (CHPDD 2014; Kleiner 2010). While Houston, called the energy capital of the nation, experienced economic expansion fueled by the world's energy consumption and reliance on petrochemical products, Manchester and other east Houston communities bore the brunt of this growth.

Hartman Park, the only public green space in Harrisburg/Manchester, exemplifies what it means to be a fence-line community where industries such as Valero Refining and Westway Chemicals can be spotted from residents' doorsteps. These are large industrial plants. Valero Houston Refining has a throughput capacity of 160,000 barrels per day of a range of petroleum products including gasoline, kerosene, jet fuel, ultra-low sulfur, liquefied petroleum gases, propylene, no. 6 oil, and sulfur. Westway Chemical Terminals and Storage handles a wide variety of products from fertilizers to petroleum and houses 93 steel tanks ranging from 4,100 to 74,500 barrels with a total capacity of 2,059,512 barrels; additional railcar storage expansion is underway (Westway Terminal Group n.d.).

Located at the mouth of the 52-mile Houston Ship Channel, Harrisburg/Manchester is home to numerous polluting industrial facilities, including oil refineries and other heavy industry. Looming over the community to the east is the 610 Ship Channel Bridge, which casts a shadow on Harrisburg/Manchester as one of the busiest highways in the city, releasing an unbroken stream of diesel emissions. Beneath the bridge is Texas Port Recycling, a facility with the largest metals shredder in southeast Texas, specializing in ferrous and nonferrous scrap metal recycling, railcar dismantling, car crushing, torch processing, container dismantling, and other processes (Texas Port Recycling n.d.). There are more than 30 industrial emitters of wastewater, air contaminants, and hazardous waste in Harrisburg/Manchester that report to the EPA, in addition to many more facilities that handle hazardous materials but are not required to report to the agency. On the south end of this community are more than 26 lanes of Union Pacific rail tracks. Industries in neighboring communities also add to the cumulative exposures that affect this community.

Some older residents who at one point worked at nearby plants often share concerns over the workplace safety practices. If disaster struck one of these facilities, it would start a catastrophic domino effect leading to an evacuation. However, all possible exits, except for one, are crossed by rail tracks with the potential for trains blocking their use. The Bernie Guerra Bridge, named after a man who lost his life because an emergency vehicle could not reach him, provides the sole escape route and has just two lanes, one in and one out. An evacuation of Harrisburg/Manchester would require more than 3,000 people to use one road, consisting of a single lane, out of town.

Ninety-seven percent of the population in this economically depressed neighborhood is made up of people of color;

90 percent are low income and 37 percent live in poverty. Long-term daily exposures to air pollution can lead to health effects that go unaddressed due to residents' limited financial and health care resources. Residents of fenceline communities such as Harrisburg/Manchester are unable to relocate because of low home values, a product (paradoxically) of being so close to polluting industry. Residents lack access to public transportation: in March 2016 the public transportation authority stopped serving the area. They also lack sufficient access to healthy food, health care, and to political representation. This entanglement of issues, coupled with a lack resources and the disproportionate layering of intersecting social issues, epitomizes environmental justice communities like Harrisburg/Manchester.

Long-term daily exposures to air pollution can lead to health effects that go unaddressed due to residents' limited financial and health care resources.

GALENA PARK

East of Highway 610 and north of Harrisburg/Manchester is the city of Galena Park, originally named Clinton. Formed in 1835, Clinton was a ranching and farming community that benefited economically from being at the mouth of the Houston Ship Channel prior to the construction of the Turning Basin (Ramirez 2010). Due to development of the Houston Ship Channel and the oil industries it began to harbor in the early 1900s, Clinton's economy became less reliant on its agrarian trade and more on industrial development such as oil and synthetic rubber, as well as the movement of goods by water and then by rail (Sibley 2016). Clinton was renamed Galena Park in 1935 after the Galena Signal oil refinery (Siegel and Moretta 2005). Galena Park became an industry town where most of the population worked in oil production in some capacity (Leslie and Edwards 1993). At its inception, Galena Park's population was majority white, due to vast racial segregation in the city. Today, Galena Park is a low-income community of roughly 11,000 residents, of whom 81 percent are Hispanic (Census Bureau 2016).

Like Harrisburg/Manchester, Galena Park is surrounded by the oil, chemical, and supporting industries—the Valero refining stack and Eco Services' candy cane–striped sulfuric acid marker in Harrisburg/Manchester can be seen from homes in Galena Park. Today more than 50 industrial facilities are located in the community, including those owned or operated by Kinder Morgan, Shell, and United States Gypsum. Many sit within one-tenth of a mile from homes and workplaces (EPA 2015a) (see appendix).

Today, rail lines surround the city and intersect with its exits, creating a nightmare for emergency workers traveling to the site of a chemical release. Even though—unlike the city of Houston—Galena Park does have zoning restrictions, it has been on the Texas Commission on Environmental Quality's pollutant watch list for 16 years based on benzene levels that have exceeded screening levels of both the EPA and the Texas Commission on Environmental Quality (Wray 2016b). The toxic air-pollution problem is so extensive that the commission expanded the boundary of the Galena Park air pollutant watch list to include monitoring at additional benzene sources, and the Harris County Pollution Control Services Department added a monitor in 2011 (Capobianco et al. 2013).

BELLAIRE

We selected the west Houston community of West Oaks/Eldridge and the city of Bellaire as comparison communities based on their racial and economic demographics as well as their geographical locations. Both communities are substantially more affluent than the east Houston communities of Harrisburg/Manchester and Galena Park.

The city of Bellaire is a predominantly white (73 percent), upper-class community located within the inner Houston core and has an average income almost five times higher, home values eight times higher, and a poverty rate 7 and 12 times lower than those of Galena Park and Harrisburg/Manchester, respectively. Bellaire ("good air")—so named for its Gulf Coast winds—was founded in 1908 after Southwest Land Company purchased the 9,449-acre Rice Ranch and was incorporated in 1918. Bellaire has zoning for light industrial, commercial, and mixed-use residential and commercial areas. The zoning efforts do not permit open storage facilities such as wrecking, junk, or salvage yards (Bellaire, Texas, code of ordinances 2006). The city has only two allotments for light industrial activity, one of which houses the City of Bellaire Public Works.

WEST OAKS/ELDRIDGE

West Oaks/Eldridge is located in the outer Houston suburbs. Just 30 years ago, this area transitioned from rural sprawling ranches to more residential properties, with energy and business growth. Unlike Harrisburg/Manchester, West Oaks/

> ***Today, rail lines surround the city and intersect with its exits, creating a nightmare for emergency workers traveling to the site of a chemical release.***

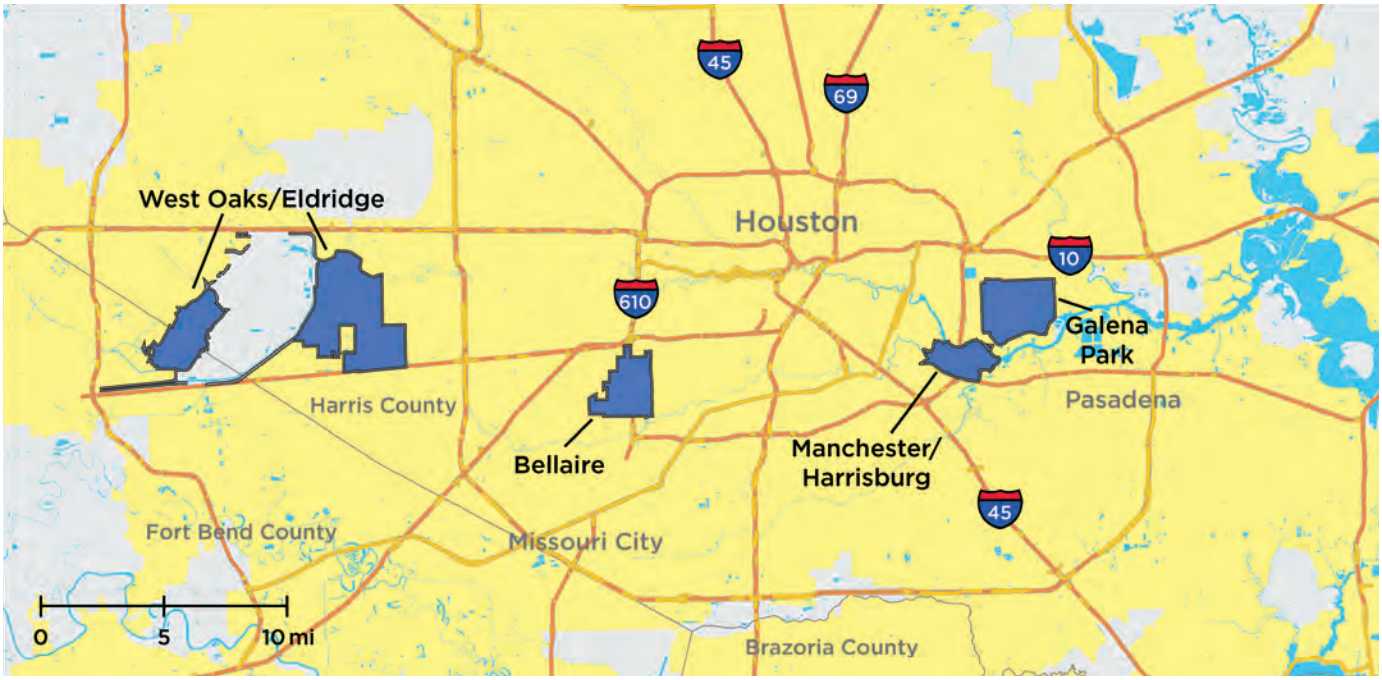
Eldridge has a vast amount of green space, including the Terry Hershey Park trail system that provides walking and bike trails, the George Bush Park west, and the Ray Miller Park with a butterfly garden. Along with several public school districts, several private schools service the area. West Oaks/Eldridge is also the headquarters of many of the corporations that own facilities in east Houston, including BP America, Citgo, ConocoPhillips, Dow Chemical, and ExxonMobil Chemical. Although the majority of the population is people of color, whites are the predominant individual race, and the poverty rate is one-half to one-third that of the east Houston communities.

Methodology

HOUSTON COMMUNITIES INCLUDED IN THE REPORT

Our analysis of chemical exposures, cancer, and respiratory health risks focused on four communities within the Houston urban area (Census Bureau n.d.a.): Harrisburg/Manchester and Galena Park in east Houston, and Bellaire and West Oaks/Eldridge in west Houston (Figure 1). West Oaks/Eldridge and Harrisburg/Manchester are both Houston "super neighborhoods," while Bellaire and Galena Park are both classified by the US census as "cities" within the Houston metropolitan area.

FIGURE 1. The Four Houston-area Communities Analyzed for Toxic Chemical Pollution and Health Risks



Toxic air pollution levels and health risks in predominately Hispanic and low-income east Houston communities of Manchester/Harrisburg and Galena Park were compared the wealthier and predominantly white west Houston communities of Bellaire and West Oaks/Eldridge.

SOURCES: HOUSTON URBAN AREA, GALENA PARK, AND BELLAIRE BOUNDARIES, CENSUS BUREAU N.D.A.; MANCHESTER AND WEST OAKS/ELDRIDGE BOUNDAIRES, HOUSTON DATA PORTAL 2013.

The four communities were chosen to allow us to assess any differences in toxic-chemical exposures and potential health risks that may exist between the two types of communities based on demographics (Table 1). The east Houston communities of Harrisburg/Manchester and Galena Park were chosen as examples of Houston frontline communities that are directly impacted by numerous polluting industrial facilities. The west Houston community of West Oaks/Eldridge and the city of Bellaire were selected as comparison communities based on their economic demographics as well as their different geographical locations within the Houston Urban Area. Both communities are substantially more affluent than the east Houston communities of Harrisburg/Manchester and Galena Park. Bellaire is a predominantly white (73 percent), upper-class community located within the inner Houston core with an average income almost five times higher, home values eight times higher, and a poverty rate seven to 12 times lower than those of the east Houston communities. In contrast to the lack of citywide zoning in Houston, Bellaire has zoning for light industrial, commercial, and mixed-use residential and commercial uses. Though West Oaks/Eldridge has a majority of people of color, whites are the predominant individual race, and the poverty rate in that community is one-half to one-third that of the east Houston communities.

With respect to the percentage of people living in poverty in all Houston communities, the Harrisburg/Manchester and Galena Park communities rank in the top 94th and 60th percentiles, respectively, while the Bellaire and West Oaks/Eldridge communities rank in the bottom 4th and 30th percentiles. The two east Houston communities are in the top 92nd and 68th percentiles for percentage of people of color, respectively, and the two west Houston communities are in the bottom 17th and 46th percentiles, respectively (Figure 2, p. 9). Both West Oaks/Eldridge and Bellaire are home to fewer high-risk chemical facilities than the five and eight facilities located within one mile of Harrisburg/Manchester and Galena Park, respectively. Only four such facilities are located within one mile of West Oaks/Eldridge, and just one lies within a mile of Bellaire (see Table 8, p. 15).

DATA COLLECTION AND MAPPING

Publicly available data from the EPA's RMP as provided by the Right-to-Know Network (CEG 2014) were used to determine which RMP facilities were located in the Houston urban area (as defined by the US census) and, more specifically, in the four communities of interest. Facilities' locations were determined based on their self-reported latitude/longitude codes.

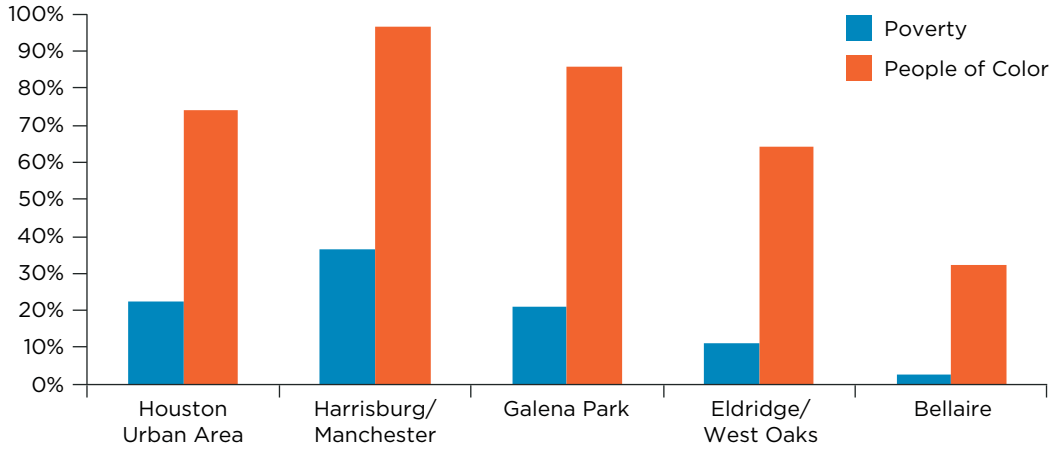
TABLE 1. Wide Demographic Differences Exist Among the Four Houston Communities, including those Populations Living within One Mile of an RMP Facility, and the Houston Urban Area

	Houston Urban Area	Galena Park	Galena Park RMP 1 Mile	Harrisburg/ Manchester	H/M RMP 1 Mile	Bellaire	Bellaire RMP 1 Mile	West Oaks/ Eldridge	West Oaks/ Eldridge RMP 1 Mile
% Population People of Color	67%	86%	86%	97%	97%	32%	34%	64%	76%
% Population in Poverty	17%	21%	21%	37%	38%	3%	4%	11%	11%
Average Home Value	$197,888	$68,118	$71,088	$80,028	$78,159	$647,544	$534,755	$243,912	$177,031
Average Household Income	$82,920	$49,732	$48,233	$45,431	$45,520	$226,333	$191,864	$91,055	$82,178

Demographic data from the US Census Bureau's American Community Survey, accessed via the Census Bureau's "data ferrett" interface (United States Census Bureau n.d.), were used to create census tract–level data tables. This database is updated annually and summarized into three- and five-year spans. The most recent five-year span, 2010 to 2014, was used for this analysis.

SOURCE: CENSUS BUREAU N.D.B.

FIGURE 2. Harrisburg/Manchester and Galena Park Have Substantially Higher Percentages of Poverty and People of Color Compared with West Oaks/Eldridge, Bellaire, and the Houston Urban Area



Using geographic boundaries and racial and poverty statistics from the Census Bureau and Houston government, the population in each of the four communities and the Houston Urban Area were compared to each other.

SOURCE: CENSUS BUREAU, N.D.B.

We obtained data from the EPA's 2011 National Air Toxics Assessment (NATA) cancer risk and respiratory hazard index, as well as specific pollutant risk data, from the NATA website (EPA 2015b), using the census-tract identification codes.

To identify the air pollution burden and chemicals with the greatest health impacts on the four Houston communities, we utilized data from the EPA's Risk Screening Environmental Indicators (RSEI) program (EPA 2016c). In addition, we used the RSEI database to identify industrial sources with the largest toxic air pollution in these communities. The RSEI data were obtained from the EPA and provided to us by Dr. Michael Ash. Dr. Ash is professor of economics and public policy and the chair of the Department of Economics at the University of Massachusetts Amherst. He is affiliated with the Political Economy Research Institute and has access to RSEI microdata. Although these data are publicly available, they are not readily available in the format we required for this analysis. Dr. Ash provided aggregated "toxic concentration" data for the census tracts in the Houston urban area.

The RSEI uses information from the EPA's Toxics Release Inventory (TRI), which tracks toxic chemical releases to the air and water as well as waste management activities for more than 400 chemicals at more than 50,000 industrial and federal facilities across the United States. The RSEI uses simplifying assumptions to fill data gaps and reduce the complexity of calculations. The RSEI toxic concentration scores are unitless numbers that integrate pollution emissions reported to the Toxics Release Inventory weighted by the toxicity of each pollutant and the amount impacting a location. It does not provide a formal risk assessment or describe a specific level of risk, but provides a numeric basis for comparing scores across communities.

Unlike the NATA data discussed previously, which are limited to information on toxic air pollution levels from 2011,

With respect to the percentage of people living in poverty in all Houston communities, the Harrisburg/Manchester and Galena Park communities rank in the top 94th and 60th percentiles.

© Yvette Arellano/TEJAS

In Harrisburg/Manchester and Galena Park, where numerous chemical facilities are located within residential neighborhoods, toxic air pollution levels are much higher than in Bellaire and West Oaks/Eldridge.

the RSEI toxic concentration values for the communities are based on more recent TRI data from 2014. However, it should be noted that while the NATA data are based on toxic air pollution emissions from a broad spectrum of sources (such as large and small industrial facilities, on-road and off-road mobile sources, secondarily formed air pollution), the RSEI data used for this analysis are limited to air pollution emissions from the industrial sources that report to the TRI program.

DEMOGRAPHIC AND TOXIC RISK CALCULATIONS

We used the areal apportionment method to determine the demographics of the neighborhoods and the one-mile zones around the RMP facilities (Mohai and Saha 2007; Mohai and Saha 2006). Thus, demographic characteristics were determined by weighting them based on the proportion of the tract that was captured in the area we studied, then aggregating those data.

NATA risk scores were calculated using the methodology explained in the NATA technical support document (EPA 2015c). We multiplied the "total cancer risk" by the tract population (calculated using the areal apportionment method described above) in the area studied, then aggregated those results and divided that total by the total population in the area. The "cancer risk" and "respiratory hazard index" were calculated for each of the pollutants, and the five chemicals with the highest cancer risk and the five chemicals with the highest respiratory hazard index in each area were identified.

The RSEI "toxic concentration" scores were calculated by multiplying the air pollution toxic concentration by the tract population (as determined using the areal apportionment method described previously) in the area studied, then aggregating those results and dividing that total by the total population in the area. The final values for toxic concentration were also analyzed by chemical and responsible facility in each of the areas studied. Those results were then sorted from highest to lowest values to determine the chemicals and facilities yielding the highest toxic concentration in each area. More information about RSEI can be found at *https://www.epa.gov/rsei/risk-screening-environmental-indicators-rsei-methodology-version-234*.

Results

TOXIC AIR POLLUTION IN HOUSTON

Using the EPA's RSEI data, we found large disparities between the east and west Houston communities in terms of overall toxicity levels from chemical exposures. Our analysis showed that toxicity levels from exposures in Harrisburg/Manchester are 12 and more than three times higher than in West Oaks/Eldridge and Bellaire, respectively, and exposures in Galena Park are 17 and almost five times higher (Table 2).

TABLE 2. Total Toxic Concentration Values in East Houston Communities Are Many Times Higher than West Houston Communities

Community	Total Toxic Concentration
Galena Park	157,653
Harrisburg/Manchester	110,712
Bellaire	32,291
West Oaks/Eldridge	9,233

RSEI data were utilized to derive total toxic concentration values from all of the reporting facility sources that release toxic chemicals into the air in the four Houston communities. By analyzing information from the Toxics Release Inventory together with risk factors, such as each chemical's toxicity, RSEI calculates a toxic concentration numeric score. These scores are then multiplied by the number of affected people in each location and divided by the location population to provide a population-adjusted toxic concentration value.

SOURCES: EPA 2016C; CENSUS BUREAU N.D.B.

POLLUTION SOURCES IMPACTING THE HOUSTON COMMUNITIES

We also analyzed which major industrial facilities contributed the greatest air pollution burden on the communities studied. The high levels of toxic air pollution from major industrial sources in the communities of Harrisburg/Manchester and Galena Park are shown in Table 3. The concentrations in the east Houston communities are 10 to 16 times greater than those in the west Houston communities.

TABLE 3. Top Five Industrial Facilities Impacting the Four Houston Communities

Community	Facility Name	Toxic Concentration	Type of Facility
Galena Park	Ameriforge Corp.	43,358	Iron and Steel Forging
	Targa Downstream LLC–Galena Park Marine Terminal	21,134	Petroleum Bulk Stations and Terminals
	Bayer Materialscience Baytown	16,414	All Other Basic Organic Chemical Manufacturing
	Valero Refining–Texas Lp Houston Refinery	15,180	Petroleum Refining
	Houston Refining LP	6,737	Petroleum Refining
	Total	**102,823**	
Harrisburg/ Manchester	The Goodyear Tire & Rubber Co.	17,191	Synthetic Rubber Manufacturing
	Valero Refining—Texas LP Houston Refinery	14,820	Petroleum Refining
	Ameriforge Corp	13,577	Iron and Steel Forging
	Bayer Materialscience Baytown	8,399	All Other Basic Organic Chemical Manufacturing
	Houston Refining LP	6,254	Petroleum Refining
	Total	**60,241**	
Bellaire	Ellwood Texas Forge	16,172	Iron and Steel Forging
	Ameriforge Corp.	2,167	Iron and Steel Forging
	Ameri-Forge Ltd. dba/Forged Vessel Connections	1,599	All Other Miscellaneous Fabricated Metal Product Manufacturing
	Dixie Chemical Co, Inc.	997	All Other Basic Organic Chemical Manufacturing
	Wyman-Gordon Forgings LP	908	Iron and Steel Pipe and Tube Manufacturing from Purchased Steel
	Total	**21,843**	
West Oaks/ Eldridge	Ellwood Texas Forge	2,413	Iron and Steel Forging
	Ameriforge Corp.	1,473	Iron and Steel Forging
	Wyman-Gordon Forgings LP	1,301	Iron and Steel Pipe and Tube Manufacturing from Purchased Steel
	Daniel Measurement & Control, Inc.	618	Automatic Environmental Control Manufacturing for Residential, Commercial, and Appliance Use
	Hoover Materials Handling Group, Inc.	565	All Other Plastics Product Manufacturing
	Total	**6,370**	

Toxic concentration scores are numbers without units calculated by aggregating the air-pollution toxic concentration for all tracts in each community studied. The toxic concentration numbers were further aggregated by responsible facility in each community. It is important to note that some of the facilities with major chemical-pollution impacts on these communities are not located within the community, but their pollution is transported over longer distances into these communities.

SOURCES: ASH 2016; EPA 2016C.

TOXIC AIR POLLUTION WITH THE GREATEST POTENTIAL FOR HEALTH IMPACTS

We further analyzed the individual chemicals contributing to the toxic concentration levels in the four Houston communities, highlighting the top five chemicals with the greatest concentrations (Table 4). While several of the chemicals with the largest toxic concentrations are consistent across the four communities, there are substantially greater exposures in the Harrisburg/Manchester and Galena Park communities for several of these toxic chemicals. For example, the toxic concentration of 1,3-butadiene, which causes cancer and a host of adverse neurological effects, was 174 times and 29 times greater in Harrisburg/Manchester than the levels in West Oaks/Eldridge and Bellaire, respectively, and levels in Galena Park were 228 times and 38 times greater. The toxic concentration of cancer-causing benzene was almost eight times greater in Harrisburg/Manchester compared with Bellaire. The toxic concentration of cobalt, which can cause respiratory health problems, was 11 and 33 times greater in Galena Park than in Bellaire and West Oaks/Eldridge, respectively.

HEALTH RISKS OF TOXIC AIR POLLUTION EXPOSURE

To compare the cancer risks and potential respiratory hazards from residents' exposure to toxic air pollution in the four Houston communities studied, we used data from the EPA's National Air Toxics Assessment. The NATA was developed primarily as a tool to inform both national and more localized efforts to collect air toxics information and characterize emissions (e.g., to prioritize pollutants or geographical areas of interest for more-refined data collection such as monitoring). The 2011 NATA data, the most recent available, include data for 140 toxic air pollutants from a broad spectrum of sources including large industrial facilities, such as refineries and power plants, and smaller sources, such as gas stations, oil and gas wells, and chrome-plating operations. Other pollution sources include cars, trucks, and off-road sources such as construction equipment and trains, as well as pollution formed by chemical reactions in the atmosphere.

The EPA calculates the amount of air pollution faced by people at the census-tract level and then uses health benchmarks to estimate cancer risks and respiratory health hazards from the combined effect of those exposures. Cancer risks are expressed as the projected number of cancers per million people based on a 70-year lifetime of exposure. The respiratory hazard index represents the ratio of pollutant levels compared with EPA benchmarks established as not likely to cause non-cancer respiratory illnesses based on a lifetime of exposure. An index value greater than 1 indicates the potential for adverse health impacts, with increasing concern as the value increases.

The cancer risk and respiratory hazard values are based on numerous modeled data and therefore should be viewed as estimates of average population risks and hazards rather than exact risk numbers for a particular person. Although NATA estimates cancer risks and non-cancer hazards for numerous toxic air pollutants, additional chemicals might exist that

TABLE 4. Chemicals with the Highest Toxic Concentration Values in Four Houston Communities

Community	Chemical	Toxic Concentration
Galena Park	Chromium and chromium compounds	47,783
	1,3-Butadiene	38,020
	Diaminotoluene (mixed isomers)	16,843
	Cobalt and cobalt compounds	11,975
	Hydrogen cyanide	11,684
Harrisburg/ Manchester	Chromium and chromium compounds	30,817
	1,3-Butadiene	29,083
	Hydrogen cyanide	9,512
	Diaminotoluene (mixed isomers)	8,541
	Benzene	6,795
West Oaks/ Eldridge	Chromium and chromium compounds	7,377
	Nickel and nickel compounds	470
	Cobalt and cobalt compounds	362
	Propyleneimine	187
	1,3-Butadiene	167
Bellaire	Chromium and chromium compounds	23,315
	Nickel and nickel compounds	1,323
	Cobalt and cobalt compounds	1,127
	1,3-Butadiene	992
	Benzene	884

Toxic concentration scores are numbers without units calculated by aggregating the air-pollution toxic concentration for all tracts in each area studied, and then multiplied by the population in each area.

SOURCES: ASH 2016; EPA 2016C.

© Yvette Arellano/TEJAS

Major toxic air pollutants, including those found in high concentrations in Harrisburg/Manchester and Galena Park, are linked to cancers and other serious illnesses affecting the eyes, heart, and respiratory system.

are not identified or for which data on these health impacts are unavailable. Therefore, these risk and hazard estimates represent only a subset of the total potential cancer and non-cancer risks associated with air toxics exposures. It is also important to note that these risk estimates do not consider ingestion or the breathing of indoor sources of air toxics as an additional exposure pathway.

Residents of Harrisburg/Manchester and Galena Park face substantially higher cancer and respiratory health risks than people in West Oaks/Eldridge and Bellaire (Table 5). This finding is not surprising given the concentration of industrial pollution sources in east Houston communities and their proximity to major highways and the Houston Ship Channel.

Residents of the Harrisburg/Manchester community have a 24 and 30 percent higher cancer risk than those of Bellaire and West Oaks/Eldridge, respectively, with people in fenceline areas of Harrisburg/Manchester facing a 20 and 29 percent greater cancer risk than those in fenceline areas of Bellaire and West Oak/Eldridge. The cancer risk for

TABLE 5. The Harrisburg/Manchester Community Faces Cancer Risks 24 to 30 Percent Greater Than Those in Bellaire and West Oak/Eldridge

	Total Cancer Risk	Cancer Risk Within One Mile of RMP	Total Respiratory Hazard Index	Respiratory Hazard Within One Mile of RMP
Texas	41.07	42.80	1.77	1.90
Houston Urban Area	44.74	47.07	2.09	2.17
Galena Park	57.28	59.05	2.56	2.56
Harrisburg/Manchester	54.44	55.14	2.56	2.55
Bellaire	44.06	45.77	2.06	2.20
West Oaks/Eldridge	42.0	42.9	1.79	1.77

Values for cancer risk and respiratory health hazard for all four communities were calculated from the EPA's 2011 National Air Toxics Assessment, using the census-tract identification codes. Cancer risk is expressed as the incidences of cancer per million people. For the respiratory hazard index, an index value greater than 1 indicates the potential for adverse health impacts, with increasing concern as the value increases.

SOURCE: EPA 2015B.

Harrisburg/Manchester is 22 percent higher than for the overall Houston urban area and is 17 percent higher for people in fenceline areas of Harrisburg/Manchester than for people in fenceline areas of the overall Houston urban area.

Residents of Galena Park face cancer risks that are 30 and 36 percent higher than those in Bellaire and West Oak/Eldridge, respectively, with those in fenceline areas facing a 29 and 38 percent higher risk than fenceline areas of Bellaire and West Oak/Eldridge. Cancer risk for Galena Park is 28 percent greater than that for the entire Houston urban area and 25 percent higher than for people in the Houston urban area living within one mile of an RMP facility.

> ***The cancer risk for Harrisburg/Manchester is 22 percent higher than for the overall Houston urban area.***

The respiratory hazard index for both Harrisburg/Manchester and Galena Park is 24 and 43 percent higher than for Bellaire and West Oaks/Eldridge respectively, indicating that residents in these communities face a comparatively higher potential for developing or worsening lung diseases such as asthma and chronic bronchitis. The respiratory hazard index for Harrisburg/Manchester and Galena Park is 22 percent greater than for the overall Houston urban area. Results for people living within one mile of RMP facilities in each of the four communities are generally similar to those for the entire community, though the respiratory hazard index for people in Bellaire living within one mile of an RMP facility is somewhat higher (7 percent) than that of the entire Bellaire community.

TOXIC AIR POLLUTANTS WITH THE GREATEST POTENTIAL HEALTH IMPACTS

Using NATA data, we analyzed which air pollutants were the greatest contributors to health risks in the four Houston communities (Table 6). Though the chemicals that contribute the greatest to cancer risks and respiratory hazards are generally similar across all four communities analyzed, the substantially higher levels of 1,3-butadiene in Harrisburg/Manchester results in a cancer risk that is 63 percent and 51 percent higher than that of West Oaks/Eldridge and Bellaire, respectively, while risks in Galena Park are 52 percent and 41 percent higher. Benzene-related cancer risks for residents of Galena Park are 46 percent and 25 percent higher in com-parison with West Oaks/Eldridge and Bellaire, respectively, and are 27 percent and nine percent higher in Harrisburg/Manchester. The cancer and non-cancer health effects from these air pollutants are summarized in Table 7. The potential for adverse respiratory impacts from acrolein, which contributed the most to respiratory hazard values for all four communities, was 21 and 43 percent greater in Harrisburg/Manchester compared with Bellaire and West Oaks/Eldridge, respectively, and 19 and 41 percent greater in Galena Park.

DISTRIBUTION OF HIGH-RISK INDUSTRIAL FACILITIES

Industrial facilities included in the EPA's RMP program are those that pose a significant danger from explosions, fires, and other incidents that could result in a release of hazardous chemicals into surrounding communities and disastrously affecting their residents. The Harrisburg/Manchester and Galena Park communities house many more of these RMP industrial facilities than do Bellaire and West Oaks/Eldridge (Table 8). This finding is not surprising given the lack of zoning in Harrisburg/Manchester and the failure to buffer residential areas from industrial facility siting in Galena Park, which does have zoning.

Particularly striking is the difference in populations living within one mile of these facilities: 90 percent of the population of Harrisburg/Manchester and almost 40 percent of those in Galena Park live within one mile of these dangerous facilities in contrast with the 9 and 14 percent of those living in Bellaire and West Oaks/Eldridge, respectively. While the focus of this analysis is on those living within one mile of the chemical facility fence lines, many of the facilities have impact zones for a worst-case accident that extend out three miles or even much farther. The disparity in the number of RMP facilities within three miles in the two sets of communities is especially pronounced, with 28 and 16 facilities in Galena Park and Harrisburg/Manchester, respectively, compared with seven and one in West Oaks/Eldridge and Bellaire, respectively.

Communities in the east Houston area include many RMP facilities that have a history of numerous accidents reported to the EPA. Harrisburg/Manchester and Galena Park have each had two accidents from facilities within one mile of their communities during the five years prior to the facilities' report to the EPA, while facilities in West Oaks/Eldridge and Bellaire have not reported any accidents. For a detailed interactive map of these accidents, as well as demographic data, please visit *www.ucsusa.org/DoubleJeopardy*. It is important to note that these numbers reflect only serious accidents that are required to be reported to the EPA and thus may significantly underestimate the actual number of accidents and chemical releases at these facilities.

SECURING CLEAN AIR AND SAFE FACILITIES FOR ALL HOUSTON RESIDENTS

The communities of Harrisburg/Manchester and Galena Park face disproportionately high levels of toxic air and chemical pollution—and the attendant health effects—from a broad range of sources when compared with the Houston urban area overall as well as two west Houston communities. The east Houston communities contain more high-risk RMP

TABLE 6. Cancer Risks and Respiratory Health Hazards in East Houston Communities from the Top Five Toxic Air Pollutants and Cancer-Causing Chemicals by Total Risk (Cancer Incidence per Million People)

	Galena Park	Harrisburg/Manchester	Bellaire	West Oaks/Eldridge
Cancer-causing Chemicals by Total Risk (Cancers/Million People)				
Formaldehyde	25.76	25.02	23.78	24.44
1,3-Butadiene	7.53	8.03	5.33	4.94
Benzene	5.94	5.18	4.75	4.07
Acetaldehyde	5.49	5.13	3.28	3.28
Carbon Tetrachloride	3.29	3.28	2.47	1.88
Respiratory Hazard Index Chemicals by Hazard Impact				
Acrolein	1.72	1.74	1.44	1.22
Acetaldehyde	0.28	0.26	0.24	0.25
Formaldehyde	0.20	0.20	0.19	0.19
Diesel PM	0.19	0.18	0.13	0.10
Chlorine	0.08	0.06	0.01	0.01

Cancer risk and respiratory health hazard values by chemical for all four communities were calculated from the EPA's 2011 National Air Toxics Assessment, using the census-tract identification code.

SOURCE: EPA 2015B.

TABLE 7. Cancer and Non-Cancer Health Effects of Major Toxic Air Pollutants

Air Pollutant	Cancer	Non-Cancer
Formaldehyde	✔	Respiratory, eyes
1,3-Butadiene	✔	Female reproductive
Benzene	✔	Immune
Acetaldehyde	✔	Respiratory, eyes
Carbon Tetrachloride	✔	Liver, kidney damage
Acrolein	No	Respiratory, eyes
Diesel Particulate Matter (PM)*	✔	Respiratory, heart
Chlorine	No	Respiratory, eyes
Hydrochloric acid/ Hydrogen chloride	No	Respiratory, eyes

Six out of the nine major air pollutants found in the communities studied can cause cancer, and all nine can cause health problems.

* The EPA does not include cancer risks from diesel PM in the NATA.

SOURCES: EPA 2016E; ATSDR 2014; CALEPA 2016.

TABLE 8. High Percentages of People in Harrisburg/ Manchester and Galena Park Live Close to RMP Facilities

Community	# of Facilities (1 Mile)	# of Facilities (3 miles)	% of Total Population Within 1 Mile of at Least One RMP Facility
Harrisburg/ Manchester	5	16	90%
Galena Park	8	28	39%
Bellaire	1	1	9%
West Oaks/ Eldridge	4	7	14%

Publicly available data from the EPA's RMP program obtained from the Right-to-Know Network (CEG 2014) were used to determine which RMP facilities were located in the four Houston communities. Facility locations were based on their self-reported latitude/longitude code.

Significant improvements in monitoring and regulating chemical exposure are needed to ensure the health and safety of east Houston residents.

> ***In recent years some east Houston monitoring stations have reported increased levels of hazardous pollutants.***

facilities in relatively close proximity to their communities and have a higher proportion of their population within vulnerable zones. In essence, they deal with the "double jeopardy" of stresses and health consequences of potential catastrophic accidents from nearby industrial facilities, as well as the daily, chronic exposure to high levels of toxic pollution. The disproportionate health and safety risks from this concentration of high-risk and heavily polluting facilities underscore the need for environmental justice for these communities.

These risks represent only one of the many factors that influence the health and well-being of the east Houston communities covered in this report. Indoor air pollution; mold and lead from inadequate housing; and lack of access to health care, healthy foods, and public transportation; along with other stresses related to poverty and crime, are just some of the compounding factors that contribute to the cumulative health impacts on residents of environmental justice communities such as those in east Houston (Prochaska et al. 2014; Hynes and Lopez 2007).

Efforts initiated by former Houston mayor Bill White in the mid-2000s to reduce the high levels of toxic air pollutants in east Houston did have some success. In recent years, however, some east Houston monitoring stations have reported increased levels of hazardous pollutants, and concentrations overall seem to be leveling off at these higher levels (Sexton and Linder 2015). A recent assessment of the efforts resulting from the earlier Mayor's Task Force on the Health Effects of Air Pollution concluded that "since White left office in 2010, air quality management in Houston has returned to the way it was before, and today there is scant evidence that his policies have had any lasting impact." This assessment also determined that toxic air-pollution levels are "still not good enough and are not improving fast enough, especially for sensitive and vulnerable populations living in close proximity to major emission sources" (Sexton and Linder 2015).

Recommendations

Significant and expedited improvements in regulatory and public policy are needed at the national, state, and municipal levels to address the health and well-being of at-risk commu-

nities in east Houston and elsewhere. The EPA is currently developing revisions to its RMP rule for chemical facilities (EPA 2016d). The program has the potential to improve the safety of chemical facilities and the ability of communities to prepare for—and respond to—accidents at these dangerous facilities (Kothari 2016).

The first four recommendations that follow aim to improve the safety of high-risk industrial facilities, expand communities' access to information about the acute hazards posed by nearby facilities, and improve communities' preparedness for responding to a toxic chemical release. They may have the additional benefit of reducing the daily load of toxic air pollution that affects these communities. The last two recommendations address both the acute risks from chemical facility accidents as well as the risks from daily chronic exposure to toxic air pollution.

Require chemical facilities to use safer chemicals and technologies. Switching to inherently safer chemicals and technologies wherever feasible is the most effective way to prevent deaths and injuries from chemical disasters. In revising its RMP rule, the EPA should require chemical facilities to assess the use of safer processes and adopt them wherever feasible.

Switching to inherently safer chemicals and technologies wherever feasible is the most effective way to prevent deaths and injuries from chemical disasters.

Ensure that facilities share information and their emergency response plans with fenceline communities. The EPA should ensure that communities have access through effective and purposeful outreach to information on hazards and emergency planning under its RMP program and that they have information on facility hazards submitted to states under the Emergency Planning and Community Right-to-Know Act. Local residents, trained health care professionals, emergency responders, and health-care providers need this information to prepare for and effectively respond to a chemical disaster, should one occur. Communities should be

Communities like Galena Park in east Houston need stronger health and environmental policies at municipal, state, and federal levels to protect residents from toxic air pollution and potential chemical release from nearby chemical facilities.

included in emergency response planning and implementation. Emergency response facilities and the measures devised under these plans should be ready for operation should a chemical release occur.

Require large chemical facilities to continuously monitor and report their fenceline-area emissions and health hazards. Unplanned, smaller releases of toxic chemicals are often a precursor to more serious incidents at chemical facilities and may themselves directly impact the health of people living in fenceline communities. People living in fenceline areas should be able to easily access information (based on validated continuous monitoring) on the toxic emissions coming from industrial facilities, along with information about the chemicals' health hazards. The EPA should expand current requirements for benzene monitoring by oil refineries in fenceline areas to include other toxic air pollutants and other major industrial sources. This information can help communities advocate for vigorous enforcement of regulatory requirements by relevant authorities; push companies to use safer chemicals; alert and educate friends, family members, and community members; and encourage the media to report on polluting facilities in their areas.

Prevent the construction of new or expanded chemical facilities near homes and schools and, conversely, the siting of new homes and schools near dangerous chemical plants. The siting of new chemical facilities or expansion of existing ones in close proximity to homes, schools, or playgrounds significantly increases the possibility that an incident will result in a disaster. Similarly, new homes, schools, and playgrounds should not be sited near dangerous chemical plants. Municipal authorities should adopt and enforce local ordinances that require an assessment of the potential health and safety risks when siting homes, schools, and other public facilities. Requiring a buffer zone between these areas and polluting sources also reduces residents' daily exposure to toxic chemical pollution.

Require publicly accessible, formal health-impact assessments and mitigation plans to gauge the cumulative impact of hazardous chemical exposures on fenceline communities. Environmental and public health agencies in Houston, in Texas, and at the federal level should assess the potential impact of unplanned chemical releases and the cumulative impacts of daily air-pollution exposures on the health of fenceline communities. A focus on cumulative impacts is a cornerstone of environmental justice. Agencies and elected officials should provide the affected communities with the tools and resources they need to fully engage in the assessment process, and the EPA should review hazard assessments of these communities. Emissions permits should be strengthened where necessary to account for the cumulative impact of air-pollution emissions on fenceline communities and provide the reductions in air pollution necessary to protect public health.

Strengthen the enforcement of existing environmental and workplace health and safety regulations. Congress should increase funding to the EPA and the states for expanding inspections and improving the enforcement of environmental and workplace health and safety laws, so that problems in chemical facilities can be identified before they lead to disasters. Better oversight and enforcement will also help agencies and the public hold companies accountable if they fail to address identified hazards and emissions of toxic pollution. Communities facing some of the greatest threats from chemical facility incidents and toxic air pollution need strong governmental policies to protect them, including strict permitting requirements and reliable inspection and enforcement of these requirements. If state and municipal governments are not providing adequate protection, it is essential that the EPA engage to defend these communities' right to a safe environment.

Ronald White *is a consultant and senior fellow in the Center for Science and Democracy at UCS.* ***Charise Johnson*** *is a research associate at the Center, and* ***Pallavi Phartiyal*** *was the senior analyst and program manager for the Center.* ***Denise Moore*** *is a global information systems analyst and consultant for UCS.* ***Yvette Arellano*** *is the research and policy fellow, and* ***Juan Parras*** *is the director and founder of the Texas Environmental Justice Advocacy Services (t.e.j.a.s).*

ACKNOWLEDGMENTS

This report was made possible by the generous support of the Wallace Research Foundation; the Chorus Foundation; the community of Manchester, Texas; Deer Creek Foundation; and UCS members.

The authors would like to thank the following external reviewers for their time and thoughtful input: Beth Rosenberg, Tufts University; Michael Ash, University of Massachusetts-Amherst; Robin Saha, University of Montana; and Victor B. Flatt, University of North Carolina-Chapel Hill. In addition, we are grateful to Michael Ash for providing us access to the Risk Screening Environmental Indicators (RSEI) database for analysis included in the report. We also thank the many UCS staff members who reviewed, edited, and otherwise helped shape the direction of this report: Juan Declet-Barreto, Joy McNally, Cynthia DeRocco, Seth Michaels, Brian Middleton, Kathleen Rest, Andrew Rosenberg, Melissa Varga, and Bryan Wadsworth. Finally, we would like to thank Karin Matchett for her masterly editing and David Gerratt for his deft layout and design.

The opinions expressed herein do not necessarily reflect those of the organizations that funded the work or the individuals who reviewed it. The Union of Concerned Scientists bears sole responsibility for the report's content.

[APPENDIX A]

Industrial Facilities in Harrisburg/Manchester and Galena Park

TABLE A-1. Industrial Facilities in Harrisburg/Manchester

Name of Facility	Location	SIC/NAICS Code	Code Description
Houston, TX #1–Westway Terminals	9325 E. Avenue S Houston, TX 77012	NAICS 424910	Farm supplies merchant wholesalers
Valero Refining	9701 Manchester Houston, TX 77012	NAICS 324110	Petroleum refineries
Echo Distribution Systems	2000 Lawndale Street Houston, TX 77017	SIC 2911	Petroleum refining
SIMS Bayour North WWTP	9500 Lawndale Street Houston, TX 77017	NAICS 221310, 921190, 221320	Water supply and irrigation systems, other general government support, sewage treatment facilities
Quality Carriers	1710 Central St. Houston, TX 77017	NAICS 48412,4841	General freight trucking, long-distance, truckload; general freight trucking
Merichem Company John T Files Technical Center	1503 Central Houston, TX 77012	NAICS 54171, 541712	Research and development in the physical sciences, engineering, and life sciences; research and development in the physical sciences, engineering, and life sciences (except biotechnology)
Solid Waste Lawndale	1502 Central Dr. Houston, TX 77012	NAICS 92119	Other general government support
South Coast Terminals WWTP	Intersection of Loop 610 and HSC Houston, TX	SIC 5171	Petroleum bulk stations and terminals
JHA Environmental Services	8930 Lawndale Street Suite E Houston, TX 77012	NAICS 92411	Administration of air and water resource and solid waste management programs
Texas Port Recycling LP	8945 Manchester St. Houston, TX 77012	NAICS 42393	Recyclable material merchant wholesalers
Solvay - Houston Plant	8615 Manchester St. Houston, TX 77012	NAICS 325180	Other basic inorganic chemical manufacturing
Lone Star Industries	402 Concrete Houston, TX 77012	NAICS 32731	Cement manufacturing
Houston Dynamic Service Inc.	8150 Lawndale Houston, TX 77012	NAICS 333319	Other commercial and service industry machinery manufacturing

TABLE A-1. Industrial Facilities in Harrisburg/Manchester (CONTINUED)

Name of Facility	Location	SIC/NAICS Code	Code Description
Ameritech Inc. (SB)	8315 Manchester Houston, TX 77012	SIC 5051-06 NAICS 423510	Steel distributors and warehouses. Metal service centers and other metal merchant (wholesale)
SIMS Bayour North WWTP	9500 Lawndale Street Houston, TX 77017	NAICS 221310, 921190, 22132	Water supply and irrigation systems, other general government support, sewage treatment facilities
Chevron USA	8001 Lawndale Houston, TX 77012	NAICS 484121	General freight trucking, long-distance, truckload
Comsource Inc.	7412 Manchester St. Houston, TX 77012	NAICS 54138	Testing laboratories
Eddy Refining Company	7401 Manchester Houston, TX 77012	SIC 2911	Petroleum refining
SWS Holdings–Pasadena	8502 Cypress St. Houston, TX 77012	NAICS 336611	Ship building and repairing
Petro-Tech Environmental	8502 Cypress St. Suite B Houston, TX 77012	NAICS 562910	Remediation services
South Coast Terminals	9317 E Ave. S Houston, TX 77012	SIC 5171	Petroleum bulk stations and terminals
Jestex	8107 E. Magnolia Houston, TX 77012	SIC 3441	Fabricated structural metal
Buffalo Marine Service	8201 E Erath St. Houston, TX 77012	SIC 4213-02 NAICS 484230	Fuel, bulk delivery Specialized freight (except used goods) trucking, long distance
CJN Offshore Solutions	7601 Harrisburg Blvd Houston, TX 77012	NAICS 332311	Prefabricated metal building and component manufacturing
Gulf Stream Marine	10000 Manchester Houston, TX 77012	NAICS 488320	Marine cargo handling
Houston Mooring Co.	10000 Manchester Suite C Houston, TX 77012	NAICS 488330	Navigational services to shippings

TABLE A-2. Industrial Facilities in Galena Park

Name of Facility	Location	SIC/NAICS Code	Code Description
Chemical Exchange Industries, Inc. (CXI)	900 Clinton Dr. Galena Park, TX 77547	SIC 2869 NAICS 424690	Industrial organic chemicals, not elsewhere classified Other chemical and allied products merchant wholesalers
Texmark Chemicals, Inc.	900 Clinton Dr. Galena Park, TX 77547	SIC 2899-05 NAICS 325110	Chemicals—manufacturers Petrochemical manufacturing,
GATX Terminals Corp	906 Clinton Dr. Galena Park, TX 77547	SIC 4226	Special warehousing and storage, not elsewhere classified
Kinder Morgan Kansas, Inc.	906 Clinton Dr. Galena Park, TX 77547	NAICS 486210	Pipeline transportation of natural gas
Equilon Enterprises LLC	780 Clinton Dr. Galena Park, TX 77547	SIC 1311 NAICS 211111	Crude petroleum and natural gas Crude petroleum and natural gas extraction
Shell Oil Company	780 Clinton Dr. Galena Park, TX 77547	SIC 2992	Lubricating oils and greases
Shell Lubricants	708 Clinton Dr. Galena Park, TX 77547	NAICS 211111	Crude petroleum and natural gas extraction
National Oilwell Varco, Inc.	210 Magnolia Dr. Galena Park, TX 77547	NAICS 213112	Support activities for oil and gas operations
Mercantile Oil & Gas Producing Corporation	2203 7th St. Galena Park, TX 77547	NAICS 211111	Crude petroleum and natural gas extraction
Enterprise Crude Oil LLC	901 Clinton Dr. Galena Park, TX 77547	SIC 5172	Petroleum and petroleum products wholesalers, except bulk stations and terminals
Texas Mill Supply & Manufacturing Company Inc.	2413 Avenue K Galena Park, TX 77547	NAICS 339999	All other miscellaneous manufacturing
Tri Resources, Inc.–Targa Resources Inc.	12801 American Petroleum Rd. Galena Park, TX 77547	NAICS 211111	Crude petroleum and natural gas extraction
Targa Downstream LLC–Galena Park Marine Terminal	12510 American Petroleum Rd. Galena Park, TX 77547	NAICS 424710	Petroleum bulk stations and terminals
Louis Dreyfus Biofuels Holdings LLC	1500 S Main St. Galena Park, TX 77547	NAICS 523130, 488210	Commodity contracts dealing, Support activities for rail transportation
Galena Park Chevron U.S.A. Inc.	12523 American Petroleun Rd. Galena Park, TX 77547	NAICS 424710	Petroleum bulk stations and terminal
Chevron Marketing Terminal	12523 American Petroleum Rd. Galena Park, TX 77547	SIC 5088-05 NAICS 423860	Ship chandlers Transportation equipment andsupplies (exceptmotor vehicle) merchant

TABLE A-2. Industrial Facilities in Galena Park (CONTINUED)

Name of Facility	Location	SIC/NAICS Code	Code Description
Kinder Morgan Liquids Terminals L.P.	405 Clinton Dr. Galena Park, TX 77547	NAICS 493110	General warehousing and storage
KM Liquids Terminals, L.P	906 Clinton Dr. Galena Park, TX 77547	NAICS 48411, 493110	General freight trucking, local; general warehousing and storage
Green Earth Fuels of Houston LLC	550 Clinton Dr. Galena Park, TX 77547	NAICS 325199	All other basic organic chemical manufacturing
Kinder Morgan Crude and Condensate LLC	407 Clinton Dr. Galena Park, TX	NAICS 32411	Petroleum refineries
Kinder Morgan Inc.	405 Clinton Dr. Galena Park, TX 77547	SIC 4925-01 NAICS 221210	Gas companies Natural gas distribution
Kinder Morgan Inc.	701 Philpot Dr. Galena Park, TX 77547	SIC 4612-01 NAICS 486110	Crude petroleum pipelines Pipeline transportation of crude oil
Kinder Morgan Inc.	906 Clinton Dr. Galena Park, TX 77547	SIC 5171-98 NAICS 424710	Petroleum bulk stations and terminals (wholesale) Petroleum bulk stations and terminals
Oil States Intl Inc.	550 Clinton Dr. Galena Park, TX 77547	NAICS 211111	Crude petroleum and natural gas extraction
Sopus Products	780 Clinton Dr. Galena Park, TX 77547	NAICS 324191	Petro lubricating oil and grease manufacturing
USG Corp. Galena Park	1201 Mayo Shell Rd. |Galena Park, TX 77547	NAICS 322121	Paper (except newsprint) mills
American Plant Food Corp Galena Park	903 Mayo Shell Rd. Galena Park, TX 77547	NAICS 325314	Fertilizer (mixing only) manufacturing
Campbell Concrete & Materials Galena Park	914 Mayo Shell Rd. Galena Park, TX 77547	NAICS 327320	Ready-mix concrete manufacturing
Century Asphalt Ltd. Galena	922 Mayo Shell Rd. Galena Park, TX 77547	NAICS 324121	Asphalt paving mixture and block manufacturing
Vopak Terminal Galena Park Inc.	1500 Clinton Dr. Galena Park, TX 77547	NAICS 42471, 493110, 493190	Petroleum bulk stations and terminals, general warehousing and storage, other warehousing and storage
Magellan Galena Park Laydown Yard	901 Clinton Dr. Galena Park, TX 77547	N/A	N/A
ESI Environmental	902 ½ Holland Ave. Galena Park, TX 77547	NAICS 48411	General freight trucking, local
Burbank Barrel & Drum	1402 Clinton Dr. Galena Park, TX 77547	NAICS 81131 SIC 5093	Commercial and industrial machinery and equipment (except automotive and electronic) repair and maintenance Scrap and waste materials
Tank Wash of America Inc.	1506 Clinton Dr. Galena Park, TX 77547	NAICS 488999	All other support activities for transportation

TABLE A-1. Industrial Facilities in Galena Park (CONTINUED)

Name of Facility	Location	SIC/NAICS Code	Code Description
Chem-coast Inc.	1609 First St. Galena Park, TX 77547	NAICS 54138	Testing laboratories
Dixie Services	1706 First St. Galena Park, TX 77547	NAICS 54138	Testing laboratories
Pick Instrument Products Co.	102 Eastway Galena Park, TX 77547	SIC 3599	Industrial and commercial machinery and equipment, not elsewhere classified
Pacific Eastern Carriers	2000 Avenue K Galena Park, TX 77547	NAICS 48411	General freight trucking, local
Rescar	2011 Clinton Dr. Galena Park, TX 77547	NAICS 488999	All other support activities for transportation
Container Care International	500 Mayo Shell Galena Park, TX 77547	N/A	N/A
Nov Rig Systems Galena Park	210 Magnolia Dr. Galena Park, TX 77547	NAICS 333132	Oil and gas field machinery and equipment manufacturing
Houston Lube Oil Blending Plant	780 Clinton Dr. Galena Park, TX 77547	NAICS 324191	Petroleum lubricating oil and grease manufacturing
Seaway Galena Park Station	901 Clinton Dr. Galena Park, TX 77547	NAICS 48611	Pipeline transportation of crude oil
Rayco Oilfield Service Inc.	2229 10th St. Galena Park, TX 77547	NAICS 213112	Support activities for oil and gas operations
Cassco Grinding & Machining	2410 Clinton Dr. Galena Park, TX 77547	NAICS 332812	Metal coating, engraving (except jewelry and silverware), and allied services to manufacturers
Cassco Grinding & Machining	300 Mayo Shell Rd. Galena Park, TX 77547	NAICS 332710	Machine shops
Speedy Transportation	202 Eastway St. Galena Park, TX 77547	NAICS 488210	Support activities for rail transportation
Texas Transloaders Inc.	701 Philpot Dr. Galena Park, TX 77547	NAICS 488510	Freight transportation arrangement
Transco Shipping Inc.	1606 Clinton Dr. #2 Galena Park, TX 77547	NAICS 488510	Freight transportation arrangement
Twin Carrier Transportation	806 Sage Dr. Galena Park, TX 77547	NAICS 488210	Support activities for rail transportation
Velasco Logistics Transportation	1902 3rd St. Galena Park, TX 77547	NAICS 488210	Support activities for rail transportation
Watco Transloading LLC	920 Mayo Shell Rd. Galena Park, TX 77547	NAICS 488210	Support activities for rail transportation

[REFERENCES]

Agency for Toxic Substances and Disease Registry (ATSDR). 2014. Agency for Toxic Substances and Disease Registry toxic substances portal. Online at *www.atsdr.cdc.gov/substances/index.asp*, accessed July 24, 2016.

Ash, M. 2016. Personal communication with the author, June 2016. Dr. Michael Ash is chair of the Department of Economics and a professor of economics and public policy at the University of Massachusetts-Amherst.

Bellaire, Texas, code of ordinances article V, section 24-510. 2006. Online at *www.municode.com/library/tx/bellaire/codes/code_of_ordinances?nodeId=PTIICOOR_CH24PLZO_ARTVZORE*, accessed August 14, 2016.

Bullard, R.D. 2016. Personal communication with Y. Arellano. August. Robert D. Bullard is is Dean of the Barbara Jordan-Mickey Leland School Of Public Affairs at Texas Southern University.

Bullard, R.D. *Dumping in dixie: Race, class and environmental quality*. Westview Press. 2000.

Bullard, R.D., G.S. Johnson, and A.O. Torres. 2011. Environmental health and racial equity in the United States. Washington, DC: American Public Health Association.

Bush v. Vera. 1996. (94-805), 517 US 952.

California Environmental Protection Agency (CalEPA). 2016. Air Resources Board. Overview: Diesel exhaust and health. Online at *www.arb.ca.gov/research/diesel/diesel-health.htm*, accessed August 24, 2016.

Capobianco, T., S.M. Hildebrand, M. Honeycutt, L. Jong-Song, D. McCant, and R.L. Grant. 2013. Impact of three interactive Texas state regulatory programs to decrease ambient air toxic levels. *Journal of the Air and Waste Management Association* 63(5):507–520.

Census Bureau. 2016. QuickFacts. Galena Park City, Texas, 2010–2015. Online at *www.census.gov/quickfacts/table/PST045215/4827996*, accessed August 24, 2016.

Census Bureau. No date (a). Geography: TIGER/Line® Shapefiles and TIGER/Line® Files. Online at *www.census.gov/geo/maps-data/data/tiger-line.html,* accessed May 19, 2016.

Census Bureau. No date (b). 2010-2014 American Community Survey five-year estimates. Generated using Data Ferrett. Online at *http://dataferrett.census.gov/LaunchDFA.html*, accessed May 19, 2016.

Center for Effective Government (CEG). 2016. *Living in the shadow of danger: Poverty, race and unequal chemical hazards*. Washington, DC.

Center for Effective Government (CEG). 2014. *Right-to-Know Network*. Washington, DC. Online at *www.rktnet.org*, accessed April 17, 2016.

Chakraborty, J., T.W. Collins, S.E. Grineski, M.C. Montgomery, and M. Hernandez. 2014. Comparing disproportionate exposure to acute and chronic pollution risks: A case study in Houston, Texas. *Risk Analysis* 34(11):2005–2020.

City of Houston Planning and Development Department (CHPDD). 2014. Super neighborhood resource assessment [for years 2000 and 2012]: Harrisburg/Manchester. No. 65. Online at *www.houstontx.gov/planning/Demographics/docs_pdfs/SN/65_Harrisburg_Manchester.pdf*, accessed August 9, 2016.

Coalition to Prevent Chemical Disasters (CPCD). 2015. Chemical incidents counter. Online at *https://preventchemicaldisasters.org/resources/158971-2/*, accessed July 21, 2016.

Cushing, L., R. Morello-Frosh, M. Wander, and M. Pastor. 2015. The haves, the have-nots, and the health of everyone: The relationship between social inequality and environmental quality. *Annual Review of Public Health* 36:193–209.

Elliott, M.R., Y. Wang, R.A. Lowe, and P.R. Kleindorfer. 2004. Environmental justice: Frequency and severity of US chemical industry accidents and the socioeconomic status of surrounding communities. *Journal of Epidemiology and Community Health* 58(1):24–30.

Environmental Justice Health Alliance for Chemical Policy Reform (EJHACPR). 2014. *Who's in danger? Race, poverty and chemical Disasters*. Brattleboro, VT.

Environmental Protection Agency (EPA). 2016a. Environmental justice. Online at *www.epa.gov/environmentaljustice*, accessed July 13, 2016.

Environmental Protection Agency (EPA). 2016b. National enforcement initiative: Reducing risks of accidental releases at industrial and chemical facilities (fiscal years 2017–19). Online at *www.epa.gov/enforcement/national-enforcement-initiative-reducing-risks-accidental-releases-industrial-and,* accessed, June 20, 2016.

Environmental Protection Agency (EPA). 2016c. Risk Screening Environmental Indicators (RSEI). Online at *www.epa.gov/rsei*, accessed July 26, 2016.

Environmental Protection Agency (EPA). 2016d. Proposed rule: Accidental release prevention requirements: Risk management programs under the Clean Air Act, section 112(r)(7). March 14. 81 FR 13638. Online at *www.epa.gov/rmp/proposed-changes-risk-management-program-rmp-rule*, accessed July 29, 2016.

Environmental Protection Agency (EPA). 2016e. Health effects notebook for hazardous air pollutants. Washington, DC. Online at *www3.epa.gov/airtoxics/hlthef/hapindex.html*, accessed August 24, 2016.

Environmental Protection Agency (EPA). 2015a. EJSCREEN. Washington, DC. Online at *https://ejscreen.epa.gov/mapper*, accessed August 24, 2016.

Environmental Protection Agency (EPA). 2015b. 2011 National air toxics assessment. Washington, DC. Online at *www.epa.gov/national-air-toxics-assessment*, accessed May 18, 2016.

Environmental Protection Agency (EPA). 2015c. *Technical support document: EPA's 2011 national-scale air toxics assessment*. Section 6.4.3, pp. 128–130. Washington, DC. Online at *www.epa.gov/sites/production/files/2015-12/documents/2011-nata-tsd.pdf*, accessed July 26, 2016.

Houston Data Portal. 2013. City of Houston super neighborhoods. Online at *http://data.ohouston.org/group/gis*, accessed May 2, 2016.

Hynes, H.P., and R. Lopez. 2007. Cumulative risk and a call for action in environmental justice communities. *Journal of Health Disparities and Practice* 1(2):29–57.

Kiger, P. 2015. The city with (almost) no limits. *Urban Land Magazine*, April 20. Online at *http://urbanland.uli.org/industry-sectors/city-almost-no-limits/*, accessed August 24, 2016.

Kleiner, D. 2010. Handbook of Texas online, Manchester, TX (Harris County). Online at *www.tshaonline.org/handbook/online/articles/hvm20*, accessed August 29, 2016.

Kothari, Y. 2016. Avoiding chemical disasters, managing risks: EPA addresses chemical safety. *The Equation* blog, March 28. Cambridge, MA: Union of Concerned Scientists. Online at *http://blog.ucsusa.org/yogin-kothari/avoiding-chemical-disasters-managing-risks-epa-addresses-chemical-safety*, accessed August 9, 2016.

Leslie, R., and S.E. Edwards. 1993. *Galena Park: The community that shaped its own history*. Houston, TX: R. Leslie.

Lezon, D. 2016. Shelter in place lifted after large fire at Lyondell Basell plant. *Houston Chronicle*, April 8. Online at *www.chron.com/neighborhood/bayarea/article/One-dead-four-injured-in-Pasadena-chemical-plant-6764032.php*, accessed August 16, 2016.

Linder S.H., D. Marko, and K. Sexton. 2008. Cumulative cancer risk from air pollution in Houston: Disparities in risk burden and social disadvantage. *Environmental Science and Technology* 42(12):4312–4322.

Magnolia Park Land Company. No date. *Extending the east end of Houston: Down the ship channel via Manchester*. Houston, TX.

Mayor's Task Force on the Health Effects of Air Pollution (Mayor's Task Force). 2006. *A closer look at air pollution in Houston: Identifying priority health risks.* Houston, TX. Online at *https://sph.uth.edu/content/uploads/2011/12/UTReportrev.pdf*, accessed August 29, 2016.

Mohai, P., D. Pellow, and J.T. Roberts. 2009. Environmental justice. *Annual Review of Environment and Resources* 34:405–430.

Mohai, P., and R. Saha. 2007. Racial inequality in the distribution of hazardous waste: A national-level reassessment. *Social Problems* 54(3):343–370.

Mohai, P., and R. Saha. 2006. Reassessing racial and socioeconomic disparities on environmental justice research. *Demography* 43(2):383–399.

O'Neill, M., M. Jerrett, I. Kawachi, J. Levy, A. Chen, N. Gouveia, P. Wilkenson, T. Fletcher, L. Cifuentes, and J. Schwartz. 2003. Health, wealth, and air pollution: Advancing theory and methods. Workshop on Air Pollution and Socioeconomic Conditions. *Environmental Heath Perspectives* 111(16):1861–1870.

Prochaska, J.D., A.B. Nolen, H. Kelley, K. Sexton, S.H. Linder, and J. Sullivan. 2014. Social determinants of health in environmental justice communities: Examining cumulative risk in terms of environmental exposures and social determinants of health. *Human and Ecological Risk Assessment* 20(4):980–994.

Ramirez, M. 2010. Handbook of Texas Online, "Galena Park, TX." Online at *https://tshaonline.org/handbook/online/articles/HFG01*, accessed August 29, 2016.

Selle, C. 2013. Environmental justice groups sue EPA for failure to enforce Clean Air Act. *DeSmogBlog*, June 14. Vancouver, BC. Online at *www.desmogblog.com/2013/06/14/environmental-justice-groups-sue-epa-failure-enforce-clean-air-act*, accessed on August 24, 2016.

Sexton, K., and S.H. Linder. 2015. Houston's novel strategy to control hazardous air pollutants: A case study in policy innovation and political stalemate. *Environmental Health Insights* 9(S1):1–12.

Sibley, M. 2016. Handbook of Texas Online, "Houston Ship Channel." Online at *https://tshaonline.org/handbook/online/articles/rhh11*, accessed August 29, 2016.

Siegel, S.E., and J.A. Moretta. 2005. *Houston: A chronicle of the Bayou city*. Sun Valley, CA: American Historical Press.

Texas Port Recycling. No date. Online at *www.texasportrecycling.com/metal-recycling-services/scrap-recycler-fast-facts/*, accessed August 29, 2016.

US Chemical Safety Board (USCSB). 2016. US Chemical Safety Board finds multiple safety deficiencies led to February 2015 explosion and serious near miss at the Exxon Mobil refinery in Torrance, California. Press release, January 13. Online at *www.csb.gov/us-chemical-safety-board-finds-multiple-safety-deficiencies-led-to-february-2015-explosion-and-serious-near-miss-at-the-exxon-mobil-refinery-in-torrance-california*, accessed August 16, 2016.

Veasey v. Perry (Abbott). 2014. 71 F. Supp. 3d 627, 633.

Westway Terminal Group. 2014. Demand spurs significant growth and an ambitious expansion. Online at *www.westwayterminal.com/announcements/demand-spurs-significant-growth-and-an-ambitious-expansion-program*, accessed August 9, 2016.

Wray, D. 2016a. Environmentalists want EPA to take over TCEQ. They know this is Texas, right? *Houston Press*, January 14. Online at *www.houstonpress.com/news/environmentalists-want-epa-to-take-over-tceq-they-know-this-is-texas-right-8068828*, accessed August 12, 2016.

Wray, D. 2016b. Air Alliance Houston report shows high benzene levels in Galena Park. *Houston Press*, July 1. Online at *www.houstonpress.com/news/air-alliance-houston-report-shows-high-benzene-levels-in-galena-park-8528879*, accessed August 12, 2016.

Zaveri, M., and M. Dempsey. 2016. Latest chemical plant explosion adds to string of accidents. *Houston Chronicle*, January 18. Online at *www.houstonchronicle.com/news/science-environment/article/Pipeline-leak-near-oil-giant-s-Baytown-plant-8383355.php*, accessed August 16, 2016.

Double Jeopardy in Houston

Acute and Chronic Chemical Exposures Pose Disproportionate Risks for Marginalized Communities

> ***Harrisburg/Manchester and Galena Park in east Houston face disproportionately high levels of toxic air pollution and risk of chemical spills compared with the two west Houston communities.***

This report examines the health risks of exposure to toxic air pollution to people living in different Houston neighborhoods that abut high-risk chemical facilities—as well as their potential exposure to unplanned chemical releases. Our analysis compares risks and exposure within two predominantly Hispanic and low income east Houston communities to those within two primarily white and wealthier west Houston communities.

We found that Harrisburg/Manchester and Galena Park in east Houston face disproportionately high levels of toxic air pollution—and risks from their attendant health effects—compared with the two west Houston communities, West Oaks/Eldridge and Bellaire, as well as to the Houston urban area. The east Houston communities also contain more high-risk facilities, and have a higher proportion of their population in close proximity to these dangerous facilities.

FIND THE FULL REPORT ONLINE: www.ucsusa.org/DoubleJeopardy
AND AT: www.tejasbarrios.org

Union of Concerned Scientists

The Union of Concerned Scientists puts rigorous, independent science to work to solve our planet's most pressing problems. Joining with citizens across the country, we combine technical analysis and effective advocacy to create innovative, practical solutions for a healthy, safe, and sustainable future.

NATIONAL HEADQUARTERS
Two Brattle Square
Cambridge, MA 02138-3780
Phone: (617) 547-5552
Fax: (617) 864-9405

t.e.j.a.s
Texas Environmental Justice Advocacy Services

Texas Environmental Justice Advocacy Services (t.e.j.a.s.) is dedicated to providing community members with the tools necessary to create sustainable, environmentally healthy communities by educating individuals on health concerns and implications arising from environmental pollution, empowering individuals with an understanding of applicable environmental laws and regulations and promoting their enforcement, and offering community building skills and resources for effective community action and greater public participation.

6731 Harrisburg Blvd.
Houston, TX 77011
(281) 513-7799