Chapter 8: Environment and Health

Introduction

Overview

In the past three chapters, NOACA staff have illustrated how the evolution of the region's transportation network shaped the economy, housing, and land use for Northeast Ohio. This chapter focuses on the relationships between the same transportation network and the region's environment (water quality, air quality, and resilience to climate change) and health. As NOACA serves the region for both transportation and environmental planning, this plan integrates transportation, air quality, and water quality in a manner consistent with the priorities of NOACA as an Areawide agency.[1]

Within this chapter are several discussions centered on the equity and environmental justice outcomes of planning related to water quality, air quality, and climate resilience. Proposed future transportation scenarios will affect the region's air and water resources both directly and indirectly. Planning for the future requires consideration of strategies to develop resilience to, and mitigation for, regional effects of climate change.

What Role Can NOACA Play?

One of the five goals specified in NOACA's vision statement is "enhance quality of life." Embedded within that goal are the attributes of the natural environment and human health. Furthermore, there are numerous objectives under this and other goals in NOACA's Regional Strategic Plan that specifically address such attributes:

- Foster collaboration on issues of transportation, air and water quality that will lead to greater regional cohesion and cooperation on other issues of regional concern
- Reduce energy use and improve air quality
- Reduce greenhouse gas emissions
- Engage in regional efforts to control stormwater, protect and improve water quality, and control development in floodplains
- Enhance the public's access to and enjoyment of the region's parks, cultural assets and recreational activities
- Preserve agricultural lands, open space and important habitat areas, woodlands, and wetlands
- Promote healthy and active living

NOACA strives to fulfill its vision through attainment of these objectives. While NOACA does not, and cannot, regulate environmental quality within and across Northeast Ohio jurisdictions, staff can certainly inform its Board and community stakeholders about the environmental impacts of local decisions. NOACA can also apprise the public about current conditions and the potential impacts of decisions on future conditions.

Environmental Justice and Equity

[1] Areawide Councils of Governments act as the lead planning agencies in 24 Ohio counties (those with large urban populations). These Areawide Agencies prepare and approve the 208 Plan in their counties. The State of Ohio prepares and maintains the 208 Plan applicable in the remaining 64 counties. The Governor then certifies the entire 208 Plan via submission to US EPA for their approval (accessed 4.17.2021 from Ohio EPA (https://www.epa.ohio.gov/dsw/mgmtplans/208index))

"Environmental Justice" embodies the concept of equity among communities. Equity can only be achieved with the involvement of all stakeholders in decision making, especially when they bear the impacts that result from policies, programs, and projects. Negative impacts of development, industry, and natural processes disproportionately harm select communities, which results in reduced quality of life across income levels and ethnicities. While this chapter focuses on environmental quality and health outcomes related to air and water resources, environmental justice reflects equity on a broader scale and is central to *eNEO2050+*. This section examines these issues and also reflects on the different perspectives of those who live inside and outside Environmental Justice Areas, per NOACA's Regional Survey (see Chapter 4).

Environmental Justice and Water Quality

As part of the engagement process, the NOACA Regional Survey (Chapter 4) asked respondents whether they agreed or disagreed with the following two statements: 1) "The water I drink is clean," and 2) "The water in Northeast Ohio's rivers and lakes is clean." Tables 8-1 through 8-4 illustrate respondents' level of agreement or disagreement with these two statements. For each set of responses, the survey consultant broke out the responses by: 1) whether respondents lived inside or outside an Environmental Justice area, and 2) the income/race group to which respondents belonged.

Table 8-1. NOACA Regional Survey Response to Statement "The Water I Drink is Clean" (Environmental Justice Areas versus Non-Environmental Justice Areas)

		The water I drink is clean	
	NOACA Region	NOACA Environmental Justice Areas	Non-EJ
BASE	2,431	1,163	1,233
Strongly Agree (5)	39.12%	32.24%	45.99%
Somewhat Agree (4)	36.36%	35.43%	37.15%
Neutral (3)	15.14%	19.17%	11.27%
Somewhat Disagree (2)	6.58%	9.54%	3.57%
Strongly Disagree (1)	2.80%	3.61%	2.03%
	100%	*100%*	*100%*
MEAN	4.02	3.83	4.21
Monthly investment in cleaner water	$13.56	$15.93	$10.88

Table 8-6. NOACA Regional Survey Response to Statement "Actions I Take as An Individual can Improve Drinking Water in Northeast Ohio" (by Income/Race Group)

		Actions I take as an individual can improve drinking water in Northeast Ohio			
	NOACA Region	Higher-income White	Lower-income White	Higher-income Nonwhite	Lower-income Nonwhite
BASE	2,431	1,217	537	220	239
Strongly Agree (5)	24.72%	25.80%	22.35%	25.45%	23.01%
Somewhat Agree (4)	33.69%	35.09%	34.45%	30.91%	29.71%
Neutral (3)	29.04%	26.95%	31.47%	27.73%	33.47%

Somewhat Disagree (2)	7.73%	8.55%	6.33%	9.09%	6.69%
Strongly Disagree (1)	4.81%	3.62%	5.40%	6.82%	7.11%
	100%	*100%*	*100%*	*100%*	*100%*
MEAN	3.66	3.71	3.62	3.59	3.55

Tables 8-5 and 8-6 show there is general agreement in Northeast Ohio that individuals feel empowered to improve the quality of drinking water through their actions. Table 8-5 shows slightly stronger agreement from respondents outside Environmental Justice Areas (61% agree) than respondents inside Environmental Justice Areas (56% agree). Table 8-6 also shows slightly stronger agreement among respondents classified as "higher-income white" (61% agree) than among respondents classified as "lower-income nonwhite" (53% agree).

Table 8-2. NOACA Regional Survey Response to Statement "The Water I Drink is Clean" (by Income/Race Group)

		The water I drink is clean			
	NOACA Region	**Higher-income White**	**Lower-income White**	**Higher-income Nonwhite**	**Lower-income Nonwhite**
BASE	**2,431**	**1,218**	**537**	**220**	**239**
Strongly Agree (5)	39.12%	45.16%	33.33%	31.82%	29.41%
Somewhat Agree (4)	36.36%	37.44%	37.24%	33.64%	32.77%
Neutral (3)	15.14%	11.49%	17.69%	21.36%	21.85%
Somewhat Disagree (2)	6.58%	4.52%	7.82%	8.64%	10.92%
Strongly Disagree (1)	2.80%	1.40%	3.91%	4.55%	5.04%
	100%	*100%*	*100%*	*100%*	*100%*
MEAN	4.02	4.20	3.88	3.80	3.71
Monthly investment in cleaner water	$13.56	$10.12	$13.03	$19.45	$22.74

Tables 8-1 and 8-2 show there is general agreement in Northeast Ohio that consumed water is clean; however, there are some differences in the strength of that agreement, as indicated by the mean response scores in the tables. Table 8-1 shows stronger agreement from respondents outside Environmental Justice Areas (83% agree) than respondents inside Environmental Justice Areas (66% agree). Table 8-2 shows strongest agreement (83%) among respondents classified as "higher-income white" and weakest agreement (62%) among respondents classified as "lower-income nonwhite."

Table 8-3. NOACA Regional Survey Response to Statement "The Water in Northeast Ohio's Rivers and Lakes is Clean" (Environmental Justice Areas versus Non-Environmental Justice Areas)

		The water in Northeast Ohio's rivers and lakes is clean	
	NOACA Region	**NOACA Environmental Justice Areas**	**Non-EJ**
BASE	**2,429**	**1,163**	**1,231**
Strongly Agree (5)	13.22%	12.55%	13.89%

Somewhat Agree (4)	34.71%	30.18%	38.83%
Neutral (3)	27.34%	28.03%	27.05%
Somewhat Disagree (2)	17.83%	20.03%	16.08%
Strongly Disagree (1)	6.92%	9.20%	4.14%
	100%	*100%*	*100%*
MEAN	3.29	3.17	3.42
Monthly investment in cleaner rivers and lakes	$13.57	$15.49	$11.30

Table 8-4. NOACA Regional Survey Response to Statement "The Water in Northeast Ohio's Rivers and Lakes is Clean" (by Income/Race Group)

		The water in Northeast Ohio's rivers and lakes is clean			
	NOACA Region	**Higher-income White**	**Lower-income White**	**Higher-income Nonwhite**	**Lower-income Nonwhite**
BASE	**2,429**	**1,217**	**537**	**220**	**239**
Strongly Agree (5)	13.22%	13.72%	10.06%	15.45%	14.64%
Somewhat Agree (4)	34.71%	40.92%	32.03%	26.36%	23.01%
Neutral (3)	27.34%	25.88%	30.35%	24.09%	27.20%
Somewhat Disagree (2)	17.83%	15.78%	20.11%	21.36%	23.43%
Strongly Disagree (1)	6.92%	3.70%	7.45%	12.73%	11.72%
	100%	*100%*	*100%*	*100%*	*100%*
MEAN	3.29	3.45	3.17	3.10	3.05
Monthly investment in cleaner water	$13.57	$10.39	$12.46	$17.77	$22.91

Tables 8-3 and 8-4 show there is less agreement in Northeast Ohio that regional surface waters are clean, compared with drinking water. Furthermore, there are differences in the strength of that agreement, as indicated by the mean response scores in the tables. Table 8-3 shows stronger agreement from respondents outside Environmental Justice Areas (53% agree) than respondents inside Environmental Justice Areas (43% agree). Table 8-4 shows strongest agreement (55%) among respondents classified as "higher-income white" and weakest agreement (38%) among respondents classified as "lower-income nonwhite." Nearly as many lower-income nonwhite respondents disagree (35%) with this statement as agree. The takeaway from these four tables is that: 1) Northeast Ohio respondents feel regional surface waters are not as clean as their drinking water; and 2) there is a substantial difference in perception toward water quality based on income and race.

Everyone lives in a watershed. Levels of protection for water resources within a watershed vary based on location and surrounding land uses. Several watersheds and subwatersheds within Northeast Ohio suffer from a legacy of pollution from industrial and urban sources. These legacies negatively impact both urban and rural Environmental Justice Areas. For urban communities, water quality concerns often focus on point source pollution at known discharge locations connected to industry and utilities. While these concerns also exist within suburban and rural communities, non-point source pollution (e.g. stormwater runoff) is of high concern.

Newly or recently developed areas with significant increases in impervious surface exacerbate the polluting effects of rainfall that carries pollutants into nearby streams, rivers, and lakes. If not

mitigated, runoff pollution may also impact the urban areas frequently downstream from suburban and rural headwaters.

The good news is that Northeast Ohio individuals believe they can positively influence their water quality through individual actions. The NOACA Regional Survey asked respondents whether their individual actions can improve both drinking water and surface water quality (see Tables 8-5 through 8-8).

Table 8-5. NOACA Regional Survey Response to Statement "Actions I Take as An Individual can Improve Drinking Water in Northeast Ohio" (Environmental Justice Areas versus Non-Environmental Justice Areas)

		Actions I take as an individual can improve drinking water in Northeast Ohio	
	NOACA Region	NOACA Environmental Justice Areas	Non-EJ
BASE	**2,431**	**1,163**	**1,233**
Strongly Agree (5)	24.72%	22.87%	26.12%
Somewhat Agree (4)	33.69%	32.93%	34.55%
Neutral (3)	29.04%	29.92%	28.47%
Somewhat Disagree (2)	7.73%	14.27%	6.97%
Strongly Disagree (1)	4.81%	8.77%	3.89%
	100%	*100%*	*100%*
MEAN	3.66	3.59	3.72

Table 8-7. NOACA Regional Survey Response to Statement "Actions I Take as An Individual can Improve Northeast Ohio's Rivers and Lakes" (Environmental Justice Areas versus Non-Environmental Justice Areas)

		Actions I take as an individual can improve Northeast Ohio's rivers and lakes	
	NOACA Region	NOACA Environmental Justice Areas	Non-EJ
BASE	**2,431**	**1,163**	**1,233**
Strongly Agree (5)	27.77%	26.05%	28.95%
Somewhat Agree (4)	36.90%	34.65%	39.01%
Neutral (3)	25.50%	27.86%	23.52%
Somewhat Disagree (2)	6.62%	7.65%	5.84%
Strongly Disagree (1)	3.21%	3.78%	2.68%
	100%	*100%*	*100%*
MEAN	3.79	3.72	3.86

Table 8-8. NOACA Regional Survey Response to Statement "Actions I Take as an Individual can Improve Northeast Ohio's Rivers and Lakes" (by Income/Race Group)

		Actions I take as an individual can improve Northeast Ohio's rivers and lakes			
	NOACA Region	Higher-income White	Lower-income White	Higher-income Nonwhite	Lower-income Nonwhite
BASE	**2,431**	**1,218**	**537**	**219**	**239**
Strongly Agree (5)	27.77%	28.65%	26.82%	31.05%	22.18%
Somewhat Agree (4)	36.90%	39.33%	36.69%	31.51%	32.22%
Neutral (3)	25.50%	22.74%	27.56%	26.48%	34.31%
Somewhat Disagree (2)	6.62%	6.98%	5.59%	6.85%	5.44%
Strongly Disagree (1)	3.21%	2.30%	3.35%	4.11%	5.86%
	100%	*100%*	*100%*	*100%*	*100%*
MEAN	3.79	3.85	3.78	3.79	3.59

Tables 8-7 and 8-8 further demonstrate there is general agreement in Northeast Ohio that individuals feel empowered to positively influence the quality of the region's rivers and lakes through their own actions as individuals. Table 8-7 shows slightly stronger agreement from respondents outside Environmental Justice Areas (68% agree) than respondents inside Environmental Justice Areas (61% agree). Table 8-8 also shows slightly stronger agreement among respondents classified as "higher-income white" (68% agree) than among respondents classified as "lower-income nonwhite" (54% agree).

Environmental Justice and Air Quality

The NOACA Regional Survey asked respondents whether they agreed or disagreed with the following statement: "The outdoor air where I live is clean." Tables 8-9 and 8-10 illustrate respondents' level of agreement or disagreement with this statement. For each set of responses, the survey consultant broke out the responses by: 1) whether respondents lived inside or outside an Environmental Justice area; and 2) the income/race group to which respondents belonged.

Table 8-9. NOACA Regional Survey Response to Statement "The Air Where I Live is Clean" (Environmental Justice Areas versus Non-Environmental Justice Areas)

		The outdoor air where I live is clean	
	NOACA Region	NOACA Environmental Justice Areas	Non-EJ
BASE	**2,432**	**1,164**	**1,233**
Strongly Agree (5)	29.19%	22.16%	35.85%
Somewhat Agree (4)	43.46%	41.24%	45.99%
Neutral (3)	17.48%	22.85%	12.25%
Somewhat Disagree (2)	7.61%	10.22%	5.11%
Strongly Disagree (1)	2.26%	3.52%	0.81%
	100%	*100%*	*100%*
MEAN	3.90	3.68	4.11
Monthly Investment in cleaner air	$12.73	$14.84	$10.32

Table 8-10. NOACA Regional Survey Response to Statement "The Air Where I Live is Clean" (by Income/Race Group)

		The outdoor air where I live is clean			
	NOACA Region	Higher-income White	Lower-income White	Higher-income Nonwhite	Lower-income Nonwhite
BASE	**2,432**	**1,218**	**537**	**220**	**239**
Strongly Agree (5)	29.19%	32.68%	27.00%	22.73%	21.76%
Somewhat Agree (4)	43.46%	47.87%	39.85%	39.09%	36.82%
Neutral (3)	17.48%	13.22%	20.86%	22.27%	25.52%
Somewhat Disagree (2)	7.61%	5.25%	9.68%	11.82%	10.88%
Strongly Disagree (1)	2.26%	0.99%	2.61%	4.09%	5.02%
	100%	*100%*	*100%*	*100%*	*100%*
MEAN	3.90	4.06	3.79	3.65	3.59
Monthly Investment in cleaner air	$12.73	$9.29	$11.99	$19.78	$21.55

Tables 8-9 and 8-10 show there is general agreement in Northeast Ohio that outdoor air is clean; however, there are some differences in the strength of that agreement, as indicated by the mean response scores in the tables. Table 8-9 shows stronger agreement from respondents outside Environmental Justice Areas (72% agree) than respondents inside Environmental Justice Areas (63% agree). Table 8-10 shows strongest agreement among respondents classified as "higher-income white" (81%) and weakest agreement among respondents classified as "lower-income nonwhite" (59%).

Air pollution is a global burden, one that the World Health Organization (WHO) has called the greatest environmental health risk.[2] But that burden is not borne equally, and it plays out through existing structural inequities. There is a clear connection between land-use patterns and individual exposure to air pollution. The durability of land-use patterns prolongs the impacts of land-use decisions for decades (see Chapter 7). The Interstate Highway System (see Chapter 6) disproportionately harmed low-income and minority neighborhoods, displacing thousands of families and damaging local economic and cultural networks.[3] Consequently, displaced racial minorities are three times more likely to live in neighborhoods adjacent to the most heavily trafficked roads.[4] In some instances, highway construction literally cemented racial segregation through physical barriers such as urban freeways.[5] For decades, the built transportation network has contributed to and sometimes even exacerbated racial segregation. There have been severe impacts on pollution exposure and public health. Cities (e.g., Cleveland) with higher levels of segregation[6] suffer from higher levels of air pollution, and that pollution tends to harm minority

[2] Diarmid Campbell-Lendrum and Annette Prüss-Ustün, Department of Public Health, Environmental and Social Determinants of Health, World Health Organization; "Climate change, air pollution and noncommunicable diseases," *Bulletin of the World Health Organization* (2019). 97:160-161.
[3] D.N. Archer, "'White Men's Roads through Black Men's Homes': Advancing Racial Equity through Highway Construction," *Vanderbilt Law Review* 73, no. 5 (2020), 1259-1330.
[4] G.M. Rowangould, "A census of the US near-roadway population: Public health and environmental justice considerations," *Transportation Research Part D* 25 (2013), 59-67.
[5] K.M. Kruse, *White Flight: Atlanta and the Making of Modern Conservatism* (Princeton, NJ: Princeton University Press, 2004). D. Kerr, *Derelict Paradise: Homelessness and Urban Development in Cleveland, Ohio* (Amherst, MA: University of Massachusetts Press, 2011), 107-108.
[6] William H. Frey, "Black-white segregation edges downward since 2000, Census shows," Brookings Institution, Dec. 17, 2018; https://www.brookings.edu/blog/the-avenue/2018/12/17/black-white-

populations disproportionately.[7] Communities of color are also more likely to be near locally unwanted land uses, such as landfills and hazardous waste facilities. Decision makers often site these facilities in areas with higher concentrations of racial minorities because such areas exhibited lower land values and local residents had less power to block such decisions.[8] The result is a disproportionately negative impact from air pollution on low-income and minority communities.

These disparities in exposure to air pollution all but ensure that the health burden is borne unequally as well. Whereas non-Hispanic whites are exposed to 17% less pollution than their consumption patterns produce, minorities (especially blacks and Latinos) endure pollution levels 56% and 63% higher than their consumption, respectively.[9] The disparity is even greater for mobile emissions. Neighborhoods with the highest shares of minority residents had nitrogen dioxide (NO_2) levels 2.7 times higher than neighborhoods with the lowest shares of minority residents in 2010.[10] Though pollution levels have fallen nationally by 73% since passage of the Clean Air Act (CAA) in 1970, these disparities have not improved. The racial gap in NO_2 levels has actually grown to 2.7 from 2.5 in 2000, even as average NO_2 concentrations fell by 37%.[11] Nationally, the Census tracts with the highest levels of fine particulate matter ($PM_{2.5}$) in 1981 remained the most heavily polluted in 2016 (similarly true for the least polluted tracts).[12]

Air pollution is most acutely harmful to vulnerable groups in Northeast Ohio. Children suffer significant health impacts from pollution exposure, even during the prenatal period based on pollution exposure endured by pregnant women. Children may suffer long-term effects from this *in utero* exposure, including higher rates of chronic illnesses such as asthma. Air pollution is also an underappreciated factor behind racial disparities in birth outcomes and infant mortality rates, one of Northeast Ohio's most acute public health crises.[13] Researchers estimate that $PM_{2.5}$ pollution is responsible for 3.3% of preterm births in the U.S., which imposes $760 million in medical costs and $4.3 billion in lost productivity among these children. Pollution can affect educational outcomes through increased absenteeism, decreased concentration, and reduced academic performance. In these ways, exposure to pollution from a young age can set children up to struggle throughout their lives. A recent study found that children exposed *in utero* to pollution from toxic sites earn 28% lower wages, are 50% more likely to depend on public assistance, are 112% more likely to drop out of high school, and are 1.5 times more likely to be

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segregation-edges-downward-since-2000-census-shows/ (accessed March 16, 2021). R. Morello-Frosch & B.M. Jesdale, "Separate and Unequal: Residential Segregation and Estimated Cancer Risks Associated with Ambient Air Toxics in U.S. Metropolitan Areas," *Environmental Health Perspectives* 114, no. 3 (2006), 386-393.

[7] R. Morello-Frosch & B.M. Jesdale, "Separate and Unequal: Residential Segregation and Estimated Cancer Risks Associated with Ambient Air Toxics in U.S. Metropolitan Areas," *Environmental Health Perspectives* 114, no. 3 (2006), 386-393.

[8] P. Mohai & R. Saha, "Which came first, people or pollution? Assessing the disparate siting and post-siting demographic change hypotheses of environmental injustice," *Environmental Research Letters* 10 (2015), 11508.

[9] C.W. Tessum, et al. "Inequity in consumption of goods and services adds to racial–ethnic disparities in air pollution exposure," *PNAS* 116, no. 13 (2019), 6001-6006.

[10] L.P. Clark, D.B. Millet, and J.D. Marshall, "Changes in Transportation-Related Air Pollution Exposures by Race-Ethnicity and Socioeconomic Status: Outdoor Nitrogen Dioxide in the United States in 2000 and 2010," *Environmental Health Perspectives* 125, no. 9 (2017), 097012.

[11] Ibid.

[12] J. Colman, I. Hardman, I. Shimshack, and J. Voorheis, "Disparities in $PM_{2.5}$ air pollution in the United States," *Science* 369, no. 6503 (2020), 575-578.

[13] B. Bekkar, S. Pacheco, & R. Basu, "Association of Air Pollution and Heat Exposure with Preterm Birth, Low Birth Weight, and Stillbirth in the US: A Systematic Review," *JAMA Open Network* 3, no. 6 (2020), e208243.

disabled than their siblings who were born in different locations. The effects are particularly acute for low-income and minority (especially black and Latino) children, who are more than twice as likely to live downwind of a toxic site.

The elderly and people with existing health conditions also bear a heavy toll from air pollution, as it can exacerbate these underlying issues, reduce their quality of life, and shorten their life expectancies. Unsurprisingly, air pollution is also uniquely harmful to people of color. Black Americans are three times more likely to die from $PM_{2.5}$ exposure as the average American.[14] The economic, environmental and health costs of Northeast Ohio's air pollution is significant; improved air quality can make the region a more attractive, equitable place to live and work.

Once again, an element of good news is that Northeast Ohioans believe they can positively influence their environmental outcomes, such as improving outdoor air quality through individual actions. The NOACA Regional Survey asked respondents whether they agreed that their individual actions can improve outdoor air quality (see Tables 8-11 and 8-12).

Table 8-11. NOACA Regional Survey Response to Statement "Actions I Take as an Individual can Improve Outdoor Air in Northeast Ohio" (Environmental Justice Areas versus Non-Environmental Justice Areas)

		Actions I take as an individual can improve outdoor air in Northeast Ohio	
	NOACA Region	NOACA Environmental Justice Areas	Non-EJ
BASE	**2,431**	**1,164**	**1,232**
Strongly Agree (5)	30.07%	28.87%	31.33%
Somewhat Agree (4)	36.73%	35.74%	37.82%
Neutral (3)	24.43%	25.86%	22.97%
Somewhat Disagree (2)	6.05%	6.53%	5.60%
Strongly Disagree (1)	2.71%	3.01%	2.27%
	100%	*100%*	*100%*
MEAN	3.85	3.81	3.90

Table 8-12. NOACA Regional Survey Response to Statement "Actions I Take as an Individual can Improve Outdoor Air in Northeast Ohio" (by Income/Race Group)

		Actions I take as an individual can improve outdoor air in Northeast Ohio			
	NOACA Region	Higher-income White	Lower-income White	Higher-income Nonwhite	Lower-income Nonwhite
BASE	**2,431**	**1,218**	**537**	**220**	**239**
Strongly Agree (5)	30.07%	30.95%	30.73%	29.55%	25.94%
Somewhat Agree (4)	36.73%	38.83%	36.31%	31.82%	32.64%
Neutral (3)	24.43%	22.41%	24.39%	27.27%	30.96%

[14] M.S. Qian Di, et al., "Air Pollution and Mortality in the Medicare Population," *New England Journal of Medicine* 376, no. 26 (2017), 2513-2522.

Somewhat Disagree (2)	6.05%	5.83%	5.59%	8.64%	6.69%
Strongly Disagree (1)	2.71%	1.97%	2.98%	2.73%	3.77%
	100%	*100%*	*100%*	*100%*	*100%*
MEAN	3.85	3.91	3.86	3.77	3.70

Tables 8-11 and 8-12 show there is general agreement in Northeast Ohio that individual actions can make a positive difference on outdoor air quality' however, Table 8-11 shows slightly stronger agreement from respondents outside Environmental Justice Areas (69% agree) than respondents inside Environmental Justice Areas (65% agree). Table 8-12 shows strongest agreement among respondents classified as "higher-income white" (70%) and weakest agreement among respondents classified as "lower-income nonwhite" (59%).

Environmental Justice and Climate Resilience

The NOACA Regional Survey provided respondents several statements about climate change and, for each, asked whether they agreed or disagreed:

1. Climate change is real.
2. Human behavior contributes to climate change.
3. Northeast Ohio is prepared for climate change.
4. My efforts to help will contribute to doing something about climate change.

Table 8-13 illustrates respondents' level of agreement or disagreement with these statements across NOACA's primary geographic units. Tables 8-14 through 8-17 illustrate respondents' level of agreement or disagreement with the first two statements, with responses broken out by 1) whether respondents lived inside or outside an Environmental Justice area; and 2) the income/race group to which respondents belonged.

Table 8-13. NOACA Regional Survey Responses to Statements about Climate Change (by Geographic Unit)

	Agreement			
Climate Change *5 = Highest 1 = Lowest*	**Climate change is real**	**Human behavior contributes**	**NEO is prepared for climate change**	**My efforts will help**
Cleveland	4.25	3.93	2.90	3.70
Cuyahoga	4.16	4.13	2.76	3.80
Lorain	4.04	4.00	2.70	3.65
Lake	4.04	4.04	2.76	3.69
Medina	3.89	3.81	2.84	3.51
Geauga	3.92	4.15	2.78	3.80
NOACA Region	4.11	4.04	2.79	3.72

Table 8-13 shows general agreement among respondents that: 1) Climate change is real; and Human behavior contributes to climate change. Although there is some variation in strength of agreement among geographic units on both statements, regional scores average higher than 4.00. It is interesting to note that the City of Cleveland respondents agree most strongly with the first statement, while Geauga County respondents agree most strongly with the second statement. Medina County respondents, on the other hand, agree the least with both statements. Table 8-13 also shows general agreement among respondents that individual efforts can make a

positive difference toward action about climate change. Again, Medina County respondents agree the least.

Despite agreement about the reality of the problem, Table 8-13 also shows respondents do not agree that Northeast Ohio is prepared for climate change. This disagreement is not very strong, but the sentiment is consistent across geographic units and marks a substantial gap between problem recognition and confidence in the future. These responses help frame the problem of climate change for policy makers and elected officials in Northeast Ohio.

Table 8-14. NOACA Regional Survey Responses to Statement "Climate Change is Real" (Environmental Justice Areas versus Non-Environmental Justice Areas)

		Climate change is real	
	NOACA Region	NOACA Environmental Justice Areas	Non-EJ
BASE	**2,432**	**1,164**	**1,233**
Strongly Agree (5)	52.10%	55.58%	48.82%
Somewhat Agree (4)	20.89%	20.19%	21.49%
Neutral (3)	17.43%	16.15%	18.65%
Somewhat Disagree (2)	5.30%	5.07%	5.52%
Strongly Disagree (1)	4.28%	3.01%	5.52%
	100%	*100%*	*100%*
MEAN	4.11	4.20	4.03
Monthly Investment to reduce climate change	$14.15	$15.68	$12.34

Table 8-15. NOACA Regional Survey Responses to Statement "Climate Change is Real" (by Income/Race Group)

		Climate change is real			
	NOACA Region	Higher-income White	Lower-income White	Higher-income Nonwhite	Lower-income Nonwhite
BASE	**2,432**	**1,218**	**537**	**220**	**239**
Strongly Agree (5)	52.10%	50.25%	54.75%	59.55%	48.12%
Somewhat Agree (4)	20.89%	20.03%	22.35%	21.82%	19.67%
Neutral (3)	17.43%	18.47%	14.90%	12.27%	22.59%
Somewhat Disagree (2)	5.30%	6.16%	3.35%	6.36%	5.02%
Strongly Disagree (1)	4.28%	5.09%	4.66%	0	4.60%
	100%	*100%*	*100%*	*100%*	*100%*
MEAN	4.11	4.04	4.19	4.35	4.02
Monthly investment to reduce climate change	$14.15	$11.38	$13.39	$18.17	$20.56

Tables 8-14 and 8-15 reiterate general agreement in Northeast Ohio that climate change is real; however, there are some differences in the strength of that agreement, as indicated by the mean response scores in the tables. Table 8-14 shows stronger agreement from respondents inside

Environmental Justice Areas (76% agree) than respondents outside Environmental Justice Areas (70% agree). Interestingly, Table 8-15 shows strongest agreement among respondents classified as "higher-income nonwhite" (81%) and weakest agreement among respondents classified as "lower-income nonwhite" (58%).

Table 8-16. NOACA Regional Survey Responses to Statement "Human Behavior Contributes to Climate Change" (Environmental Justice Areas versus Non-Environmental Justice Areas)

		Human behavior contributes to climate change	
	NOACA Region	NOACA Environmental Justice Areas	Non-EJ
BASE	**2,428**	**1,161**	**1,232**
Strongly Agree (5)	47.08%	47.46%	47.16%
Somewhat Agree (4)	25.08%	24.72%	25.08%
Neutral (3)	17.42%	17.48%	17.29%
Somewhat Disagree (2)	5.64%	5.86%	5.36%
Strongly Disagree (1)	4.78%	4.48%	5.11%
	100%	*100%*	*100%*
MEAN	4.04	4.05	4.04

Table 8-17. NOACA Regional Survey Responses to Statement "Human Behavior Contributes to Climate Change" (by Income/Race Group)

		Human behavior contributes to climate change			
	NOACA Region	Higher-income White	Lower-income White	Higher-income Non-white	Lower-income Non-white
BASE	**2,428**	**1,217**	**537**	**220**	**237**
Strongly Agree (5)	47.08%	47.66%	48.79%	51.36%	37.55%
Somewhat Agree (4)	25.08%	26.46%	22.53%	22.73%	26.16%
Neutral (3)	17.42%	16.02%	18.06%	17.73%	22.78%
Somewhat Disagree (2)	5.64%	4.77%	5.96%	5.91%	8.44%
Strongly Disagree (1)	4.78%	5.09%	4.66%	2.27%	5.06%
	100%	*100%*	*100%*	*100%*	*100%*
MEAN	4.04	4.07	4.05	4.15	3.83

Tables 8-16 and 8-17 reiterate general agreement in Northeast Ohio that human behavior contributes to climate change; however, there are some differences in the strength of that agreement, as indicated by the mean response scores in the tables. While Table 8-16 shows the same level of agreement from respondents inside Environmental Justice Areas and respondents outside Environmental Justice Areas (72% agree). Interestingly, Table 8-17 illustrates some differences. Table 8-17 indicates strongest agreement among respondents classified as "higher-income white" and "higher-income nonwhite" (74%) and weakest agreement among respondents classified as "lower-income nonwhite" (64%).

Although no area is immune from the negative effects of a changing climate, these effects will impact different communities disproportionately. Just as other negative environmental impacts tend to fall more on low-income and minority neighborhoods, the same will be true for climate change. The impacts of climate change and climate-related hazards express themselves through existing socioeconomic disparities.

Two of the key facets of residential development patterns in Northeast Ohio— outward migration and racial segregation—both exacerbate the impacts of rising temperatures. While sprawling regions experienced 14.8 more extreme heat days in 2005 than in 1956 that number was only 5.6 for compact regions.[15] Segregation also exposes communities to higher levels of extreme heat. Blacks, Asians, and Latinos are, respectively, 52%, 32%, and 21% more likely to live in areas with limited tree cover and high levels of impervious surfaces.[16] The harmful effects of discriminatory zoning and land-use patterns can linger for decades; redlined neighborhoods are 2.6˚C (4.7˚C) hotter than non-redlined neighborhoods.[17] In addition to amplifying heat, lower levels of tree cover and greater impervious surface area also increase the risks of flooding during heavy precipitation events. Extreme heat takes a particularly heavy toll on black mothers, dramatically raising the incidence of pregnancy complications and preterm births.[18] Failing to tackle the climate crisis risks could widen existing inequities in Northeast Ohio.

As demonstrated earlier in Table 8-13, NOACA Regional Survey respondents disagree that Northeast Ohio is prepared for climate change. Interestingly, those communities most vulnerable to climate change impacts disagree less about the region's lack of preparation than those in better positions to withstand climate change impacts. Table 8-18 shows 22% of respondents inside Environmental Justice Areas agree Northeast Ohio is prepared for climate change, compared with only 17% outside Environmental Justice Areas (45% of both groups disagree with this statement). Table 8-19 shows 31% of lower-income nonwhite respondents agree Northeast Ohio is prepared for climate change, compared with only 16% of higher-income white respondents.

Table 8-18. NOACA Regional Survey Responses to Statement "Northeast Ohio is Prepared for Climate Change" (Environmental Justice Areas versus Non-Environmental Justice Areas)

	Northeast Ohio is prepared for climate change		
	NOACA Region	**NOACA Environmental Justice areas**	**Non-EJ**
BASE	**2,429**	**1,162**	**1,232**
Strongly Agree (5)	7.16%	8.09%	6.17%

[15] B. Stone, J.J. Hess, & H. Frumkin, "Urban form and extreme heat events: are sprawling cities more vulnerable to climate change than compact cities?" *Environmental health perspectives* 118, no. 10 (2010), 1425–1428.
[16] B.M. Jesdale, R. Morello-Frosch, & L. Cushing, "The racial/ethnic distribution of heat risk-related land cover in relation to residential segregation," *Environmental health perspectives* 121, no. 7 (2013), 811–817.
[17] J.S. Hoffman, V. Shandas, & N. Pendleton, "The Effects of Historical Housing Policies on Resident Exposure to Intra-Urban Heat: A Study of 108 US Urban Areas," *Climate* 8, no.1 (2020).
[18] J. Kim, A. Lee, & M. Rossin-Slater, "What to Expect When it Gets Hotter: The Impacts of Prenatal Exposure to Extreme Heat on Maternal Health," *NBER Working Paper No. w26384* (2019), https://ssrn.com/abstract=3472819 (accessed April 8, 2021). B. Bekkar, S. Pacheco, & R. Basu, "Association of Air Pollution and Heat Exposure with Preterm Birth, Low Birth Weight, and Stillbirth in the US: A Systematic Review," *JAMA Open Network* 3, no. 6 (2020), e208243.

Somewhat Agree (4)	12.68%	14.03%	11.28%
Neutral (3)	45.08%	42.77%	47.48%
Somewhat Disagree (2)	21.74%	21.43%	22.40%
Strongly Disagree (1)	13.34%	13.68%	12.66%
	100%	*100%*	*100%*
MEAN	2.79	2.81	2.76

Table 8-19. NOACA Regional Survey Responses to Statement "Northeast Ohio is Prepared for Climate Change" (by Income/Race Group)

		Northeast Ohio is prepared for climate change			
	NOACA Region	Higher-income White	Lower-income White	Higher-income Nonwhite	Lower-income Nonwhite
BASE	**2,429**	**1,216**	**537**	**219**	**239**
Strongly Agree (5)	7.16%	5.51%	6.70%	10.50%	11.72%
Somewhat Agree (4)	12.68%	10.86%	12.48%	17.35%	18.83%
Neutral (3)	45.08%	49.84%	43.20%	33.79%	41.42%
Somewhat Disagree (2)	21.74%	23.11%	21.79%	22.37%	15.06%
Strongly Disagree (1)	13.34%	10.69%	15.83%	15.98%	12.97%
	100%	*100%*	*100%*	*100%*	*100%*
MEAN	2.79	2.77	2.72	2.84	3.01

Fortunately, NOACA Regional Survey results show that respondents generally agree their individual efforts can make a difference. This is true both inside and outside Environmental Justice Areas (see Table 8-20); however, Table 8-21 indicates weaker agreement with this statement among lower-income nonwhites (51%) compared with other income/racial groups, where 60-65% agree. This may suggest that lower-income nonwhite groups still feel less empowered to make a difference and they have to rely on other organizations and leadership to mitigate climate change impacts.

Table 8-20. NOACA Regional Survey Responses to Statement "My Efforts to Help will Contribute to Doing Something about Climate Change" (Environmental Justice Areas versus Non-Environmental Justice Areas)

		My efforts to help will contribute to doing something about climate change	
	NOACA Region	NOACA Environmental Justice areas	Non-EJ
BASE	**2,430**	**1,163**	**1,232**
Strongly Agree (5)	29.01%	30.18%	27.92%
Somewhat Agree (4)	31.40%	29.75%	32.87%
Neutral (3)	27.61%	29.06%	26.14%
Somewhat Disagree (2)	6.79%	7.05%	6.66%
Strongly Disagree (1)	5.19%	3.96%	6.41%
	100%	*100%*	*100%*

MEAN	3.72	3.75	3.69

Table 8-21. NOACA Regional Survey Responses to Statement "My Efforts to Help will Contribute to Doing Something about Climate Change" (by Income/Race Group)

		My efforts to help will contribute to doing something about climate change			
	NOACA Region	Higher-income White	Lower-income White	Higher-income Nonwhite	Lower-income Nonwhite
BASE	**2,430**	**1,217**	**536**	**220**	**239**
Strongly Agree (5)	29.01%	27.86%	29.66%	35.45%	24.27%
Somewhat Agree (4)	31.40%	32.70%	33.77%	26.36%	26.78%
Neutral (3)	27.61%	26.54%	25.37%	27.73%	35.98%
Somewhat Disagree (2)	6.79%	7.07%	6.34%	7.27%	8.37%
Strongly Disagree (1)	5.19%	5.83%	4.85%	3.18%	4.60%
	100%	*100%*	*100%*	*100%*	*100%*
MEAN	3.72	3.70	3.77	3.84	3.58

Regional Water Quality

NOACA is the federally designated areawide water quality management planning agency (Areawide) under Section 208 of the Clean Water Act.[19] NOACA plans for the five-county Northeast Ohio Lake Erie Basin (NEOLEB) area. In 2020, the NOACA Board adopted *Clean Water 2020*, its new "208 Plan." *Clean Water 2020*, with NOACA's Water Quality Strategic Plan and the Agency's Overall Work Plan (OWP), guide NOACA's water quality planning efforts.

Water Quality Plans

Water Quality Strategic Plan

NOACA staff updated its *Water Quality Strategic Plan* (WQSP) in 2023; the updated plan builds upon the consensus-driven mission, goals, objectives, and strategies to guide the staff-supported work of the agency. NOACA's WQSP guides the work of NOACA's water quality planning staff over a five-year planning period. Staff updated the 2023 WQSP Mission Statement, Goals, and Objectives in response to new and continued water quality issues facing the region.

The WQSP goals are intended to be broad, long-range, and guide NOACA's water planning work.

- **Goal 1:** Provide planning and technical support to protect and restore Lake Erie and the region's valuable water resources
- **Goal 2:** Protect the region's water quality/quantity to support regional economic competitiveness
- **Goal 3:** Identify and inform communities & organizations about the impacts of local decisions on valuable regional water resources and infrastructure
- **Goal 4**: Advance the philosophy of "One Water" through NOACA's water planning work
- **Goal 5:** Within NOACA's internal structure, address potential water quality & quantity

[19] 33 U.S.C. § 1288.

impacts related to climate change on the region's transportation and water infrastructure

Clean Water 2020

Clean Water 2020 is NOACA's water quality and wastewater management plan under Section 208 of the Clean Water Act (CWA).[20] The plan focuses on the protection and restoration of water resources in a region where the population has slowly declined while it has spread out over a larger area. This pattern of lower density and a larger development footprint results in higher funding demands from fewer people both to construct new infrastructure and to maintain existing, aging infrastructure. *Clean Water 2020* emphasizes optimization of existing infrastructure, minimization of development impacts associated with sanitary sewer extensions, protection of regional water quality improvements, support for watershed planning, protection and restoration of critical water resources, and support for efforts to manage stormwater runoff and on-site sewage treatment systems. The following goals framed its development:

- **Goal 1:** Optimize investment in existing infrastructure to support existing and infill development and not encourage new development on greenfield sites.
- **Goal 2:** Provide a framework for locally determined development density that mitigates water quality impacts.
- **Goal 3:** Protect regional water quality gains and guide implementation measures to improve water resources that do not yet meet designated uses.
- **Goal 4:** Support programs that address stormwater and sewage treatment systems management.
- **Goal 5:** Protect and restore valuable water resource areas.
- **Goal 6:** Support watershed planning activities that address point and nonpoint source pollution.
- **Goal 7:** Educate local decision makers on regional water quality management issues.
- **Goal 8:** Create a plan that can meet future water quality needs of Northeast Ohio.
- **Goal 9:** Educate and solicit support for implementation of *Clean Water 2020*.
- **Goal 10:** Allow flexibility in the plan to adapt to changes in future water quality needs of Northeast Ohio.

The result is that *Clean Water 2020* is a dynamic resource that will guide Northeast Ohio through the next 20 years of wastewater management and water quality planning.

Water Quality Conditions

Since the Ohio Environmental Protection Agency (Ohio EPA) began to monitor water quality nearly 50 years ago, there has been considerable progress in the protection and restoration of water resources in Northeast Ohio. Regulations have dramatically curtailed polluted discharges from pipes ("point" source pollution). The Cuyahoga River and the other large rivers (Black, Rocky, Chagrin, and Grand Rivers) have realized improved water quality and aquatic life conditions. Public wastewater treatment plant (WWTP) owners continue to reinvest in their facilities to maintain and improve nutrient removal processes. Numerous watershed groups actively focus on the development and implementation of plans to protect and restore water resources. Urban communities strive to reduce impacts from runoff through enforcing the implementation of Storm Water Management Plans (SWMP). Local health districts (LHDs) manage onsite sewage treatment system programs in areas not serviced by sanitary sewers.

Even so, local water quality problems persist, such as legacy polychlorinated biphenyls (PCBs)

[20] Ibid.

and polycyclic aromatic hydrocarbons (PAHs) pollution, and new issues, e.g. harmful algal blooms (HABs) have moved to the forefront over time. Rapid exurban development, partly enabled by the region's automobile-centric transportation polices, contributes to current Northeast Ohio water quality conditions. Drinking water and wastewater infrastructure continues to expand into new areas, while the region's population slowly declines. Lake Erie's water quality had historically improved from the reduction in point source pollution, but more recently has wavered due to nonpoint source pollution from suburban, agricultural, and rural area stormwater runoff. This increased nutrient load to Lake Erie and other interior lakes leads to seasonal HABs, which produce toxins that contaminate drinking water and hinder recreational opportunities.[21]

Water Resource Concerns

The quality of water resources in Northeast Ohio is the product of the natural landscape and human activities. According to Ohio EPA, the top five causes of impairments that affect aquatic life in Northeast Ohio are "related to landscape modification issues involving agricultural and urban development" and include sedimentation, organic enrichment, hydromodification, nutrient enrichment and habitat modification.[22] Transportation policies and water and wastewater infrastructure investments influence the region's development patterns that are linked to many of the causes and sources of stream impairments. Specifically, Northeast Ohio's sprawling development patterns have resulted in increased impervious surfaces. Outmigration patterns have also required the extension of water/wastewater infrastructure to serve the migrating population, which results in a loss of customers from existing urban sewerage systems since the region has not seen an increase in total population. Additionally, changes in the number of people per household, coupled with outmigration, increases the region's development footprint and increase impervious surfaces, ultimately impacting drinking water sources that rely on groundwater recharge areas

The conversion of natural areas or agricultural lands to residential, industrial, or commercial development increases impervious surfaces (e.g., roads, parking lots, roofs, sidewalks, etc.). From 2001 to 2021, impervious surface cover has increased in multiple Northeast Ohio Watershed Assessment Units (WAUs) (Figures 8-1 and 8-2). Multiple studies have shown increasing imperviousness harms water quality. Impervious surfaces increase the amount and speed of water runoff and lead to increased erosion and unstable streams. More runoff also brings more pollutants (e.g., nutrients, metals, bacteria, etc.) to the local waterways. Runoff over hot impervious surfaces can increase the water temperature in local waterways and deplete the dissolved oxygen for aquatic life.[23] Figure 8-3 presents the attainment status of subwatersheds within Environmental Justice Areas along with the subwatershed imperviousness percentage. Waterways within subwatersheds characterized by higher impervious cover are more likely to result in nonattainment. Figure 8-3 also shows subwatersheds (and their waterways) within identified Environmental Justice Areas are also more likely to be impaired.

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[21] Alliance for the Great Lakes, "Lake Erie Algae Blooms: Polluting Our Drinking Water," https://greatlakes.org/campaigns/lake-erie-algae-blooms/ (accessed April 8, 2021)

[22] Ohio Environmental Protection Agency, "2024 Ohio Integrated Water Quality Monitoring and Assessment Report," https://epa.ohio.gov/static/Portals/35/tmdl/2024intreport/Full-2024-IR.pdf (accessed October 3, 2024).

[23] Ohio EPA, "Ohio 2020 Integrated Water Quality Monitoring and Assessment Report," May 2020, https://epa.ohio.gov/Portals/35/tmdl/2020intreport/2020_Final_IR_CompleteReport_May2020.pdf (accessed April 8, 2021

Figure 8-1. Northeast Ohio Percentage of Impervious Surface Cover (2001)

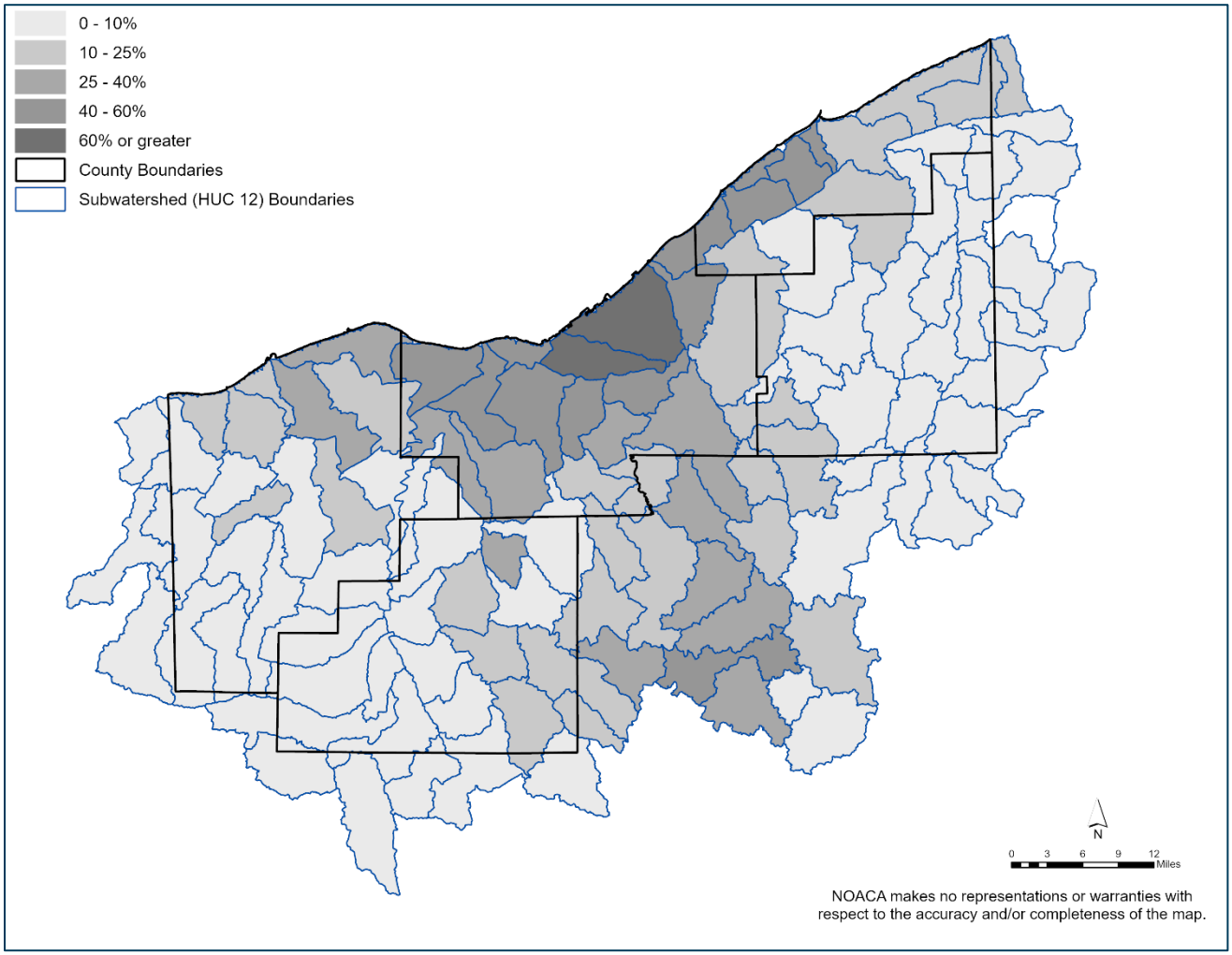


Figure 8-2. Northeast Ohio Percentage of Impervious Surface Cover (2021)

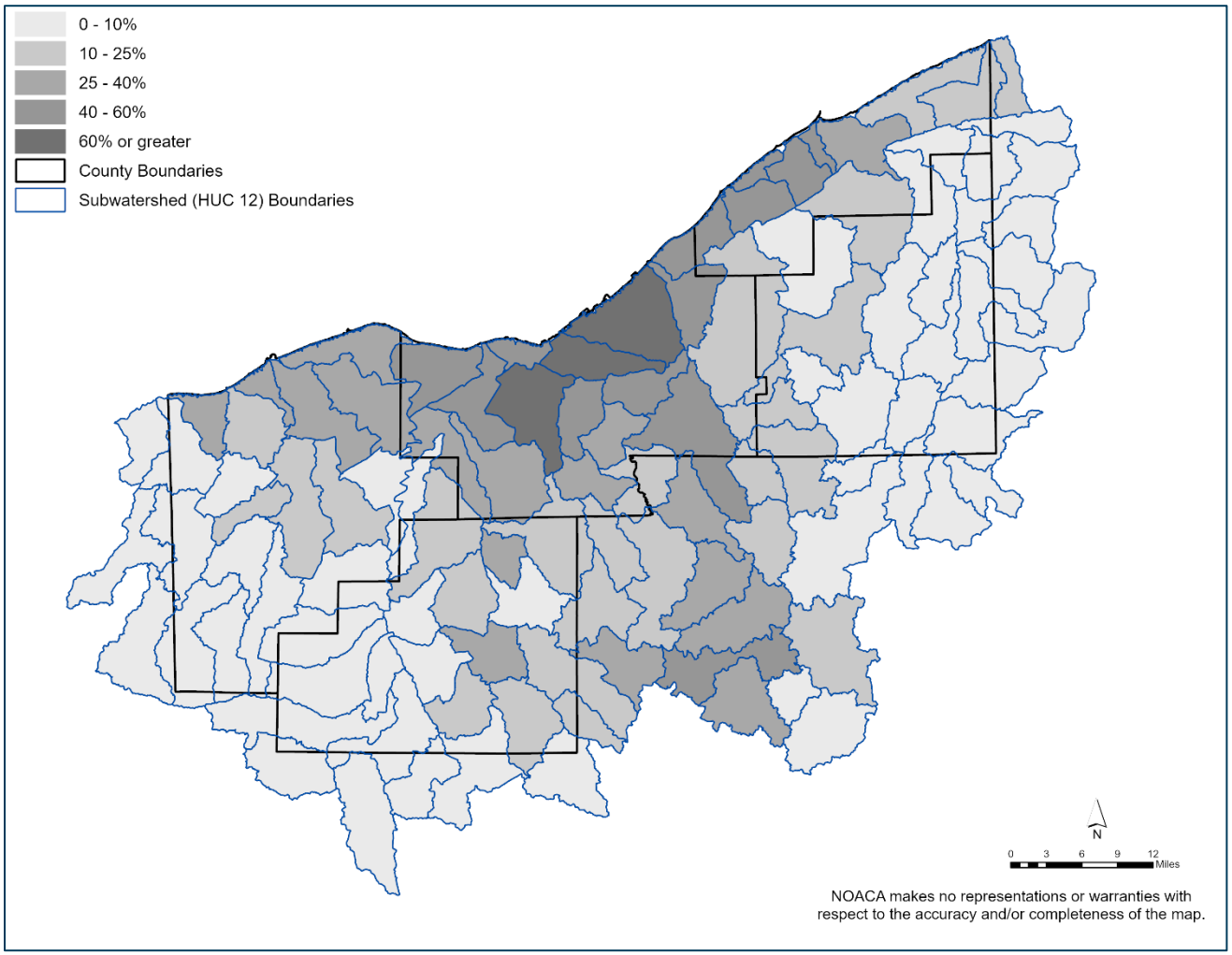
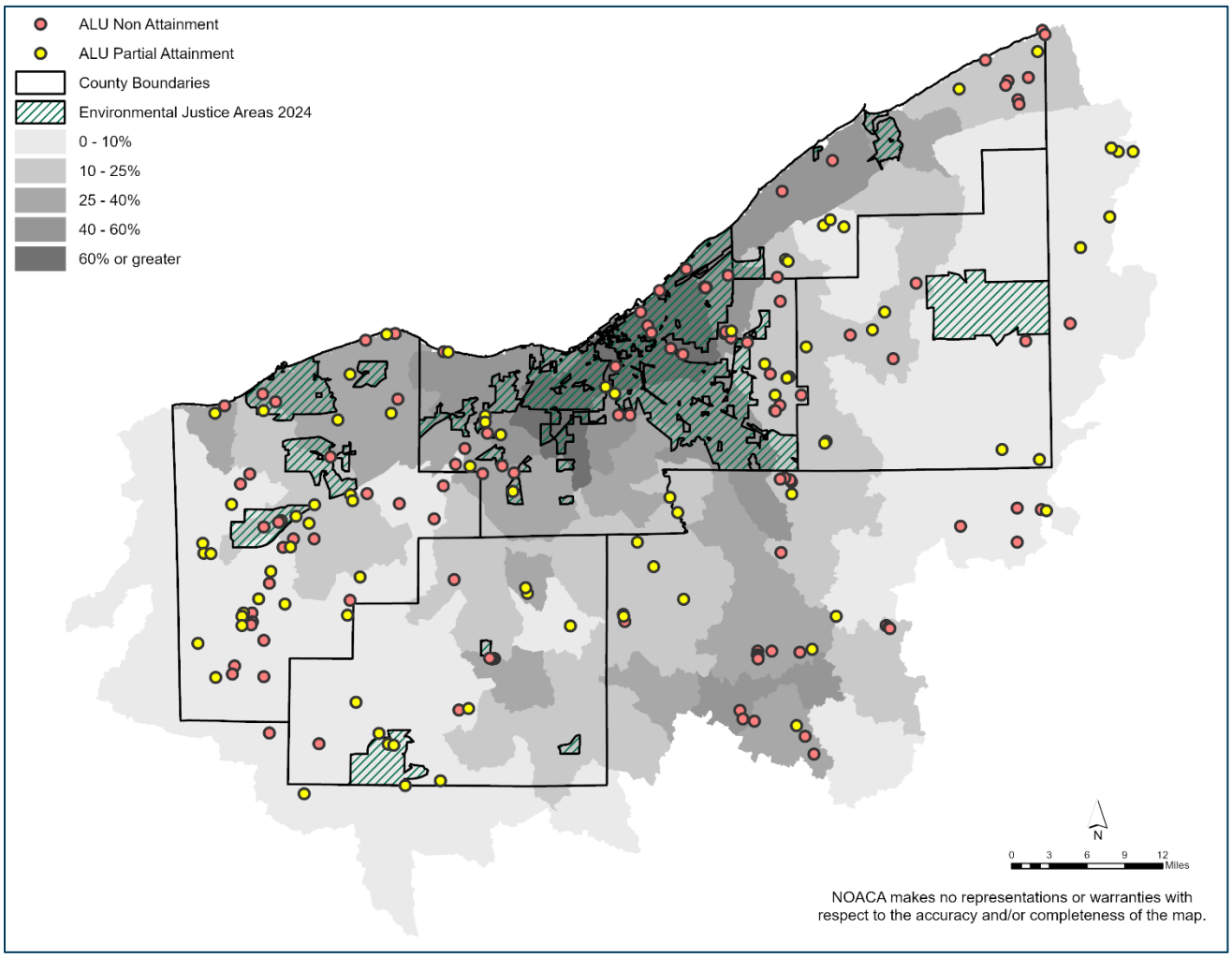


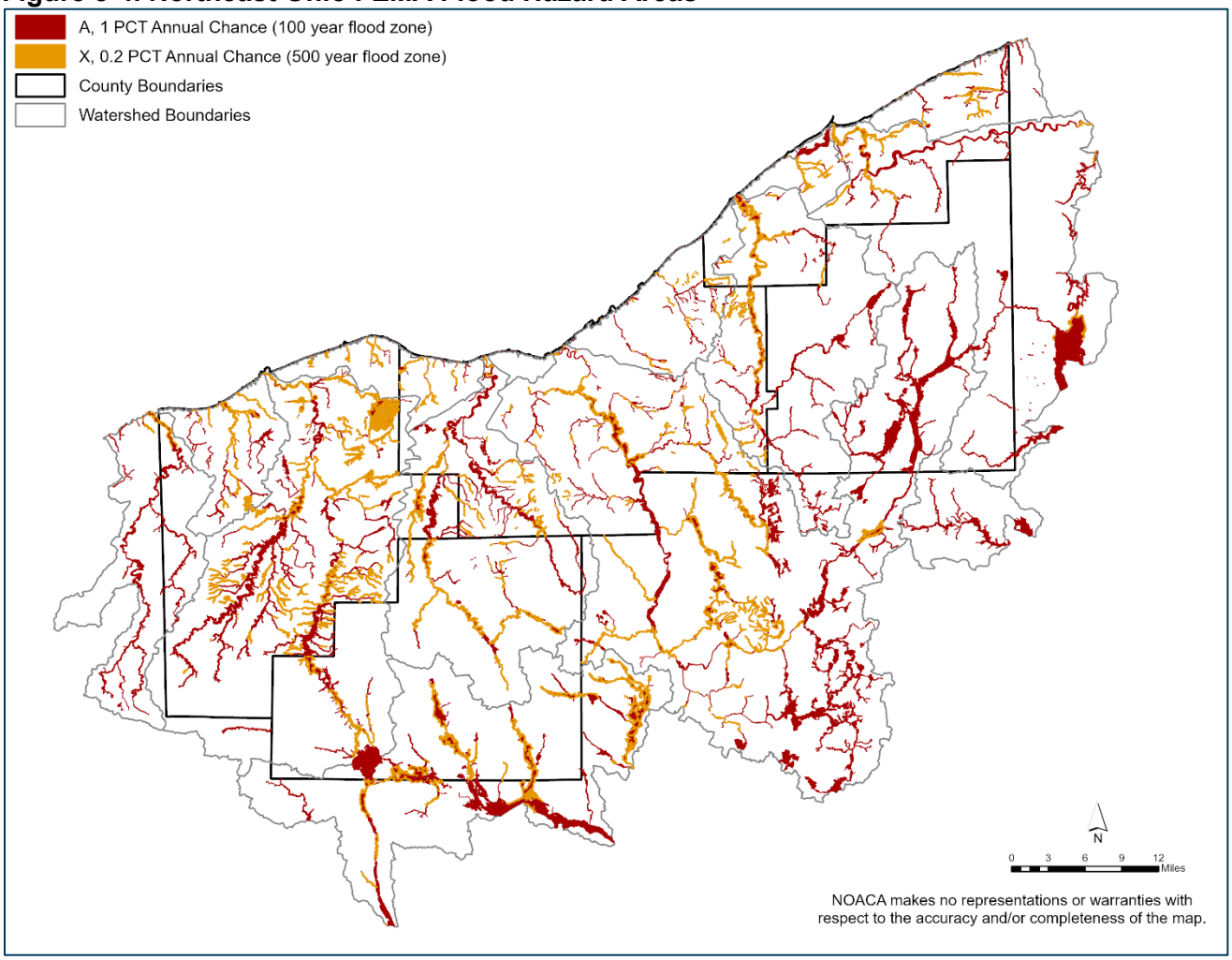
Figure 8-3. Northeast Ohio Subwatershed Percentage of Impervious Surface Coverage (2021), Aquatic Life Use Attainment Status (ALU), and Environmental Justice Areas



The continued outmigration of population and jobs has resulted in the further development of urban and suburban areas. Additionally, historical investment policies regarding transportation have prioritized automobile centric transportation infrastructure. As development continues outward, water, stormwater and wastewater infrastructure are also needed. Two of the future transportation scenarios identified by NOACA staff—1 (MAINTAIN) and 2 (CAR), which continue to support travel by car—are likely to result in continued expansion of low-density development (see Chapter 9). Low-density development also results in additional impervious surfaces, which may ultimately impact water quality. Increased imperviousness and reduction of natural open space and riparian vegetation generally increases the size and number of floods for a region. Expanded flood hazards from greater impervious surfaces may amplify the need for communities to repair, move, or redesign existing infrastructure such as roads, bridges, culverts and stormwater management structures.[24] Figure 8-4 shows the region's flood hazard areas and places most vulnerable to increased flooding from development.

[24] C.P. Konrad, "Effects of Urban Development on Floods," U.S. Geological Survey Fact Sheet 076-03, https://pubs.usgs.gov/fs/fs07603/ (accessed April 8, 2021)

Figure 8-4. Northeast Ohio FEMA Flood Hazard Areas



Wastewater Management

Infrastructure investment decisions enable development on undeveloped land as well as reinvestment in the urbanized areas. Urbanized and rural areas have different infrastructure needs. Adequate conveyance and treatment of wastewater is critical for watershed health. In Northeast Ohio, wastewater from residential, commercial and industrial establishments flow to major wastewater treatment plants (WWTPs), communal systems, or individual onsite sewage treatment systems (OSTS) of various sizes. Figure 8-5 and Table 8-22 illustrate and quantify the general areas served by sanitary sewers, areas planned to be served by sanitary sewers, areas served by OSTSs for the foreseeable future, and areas that follow community-specific wastewater planning objectives as defined by Local Prescriptions in *Clean Water 2020*.

Figure 8-5. NOACA Region Sanitary Sewer Plan Map

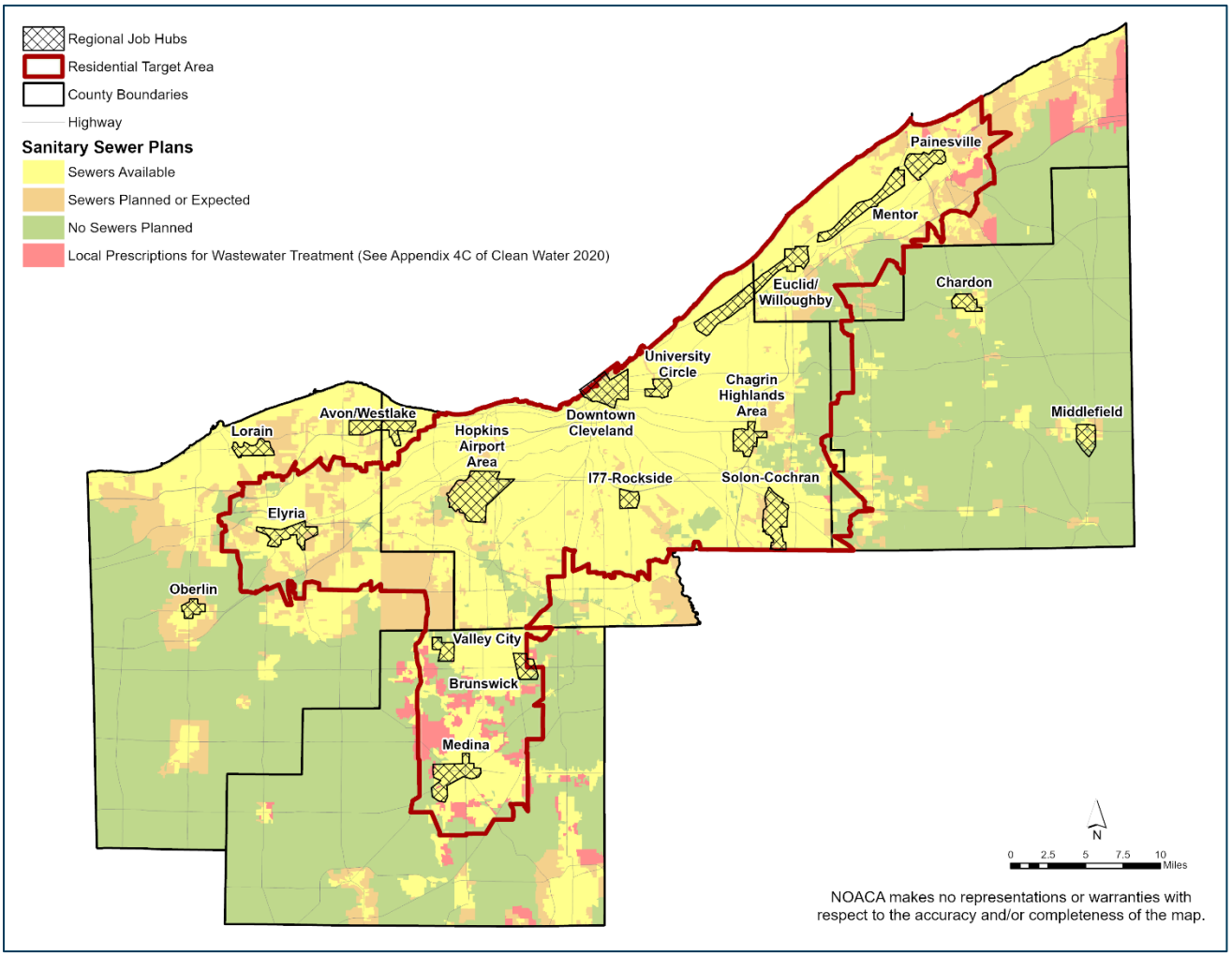


Table 8-22. NOACA Region Sanitary Sewer Plan Distribution[25]

Sewer Planning Areas and Residential Target Areas								
	NOACA Region		Residential Target Areas			Non-Residential Target Areas		
Sanitary Sewer Plans	**Total Area (mi^2)**	**% of Region**	**Total Area (mi^2)**	**% of Area**	**% of Region**	**Total Area (mi^2)**	**% of Area**	**% of Region**
Sewers Available	736.0	36.5	530.9	71.6	26.3	205.1	16.1	10.2
Sewers Planned or Expected	205.8	10.2	88.4	11.9	4.4	117.4	9.2	5.8

[25] The "Local Prescriptions" category was added since the last Long Range Plan update (eNEO2050) to align the classifications of Sanitary Sewer Plans with the Prescriptions for Wastewater Treatment in the NOACA region (as presented in *Clean Water 2020).*

No Sewers Planned	1032.1	51.2	101.5	13.7	5.0	930.6	73.0	46.1
Local Prescriptions	41.6	2.1	20.6	2.8	1.0	21.0	1.6	1.0
Total	2015.5	99.9	741.4	99.9	36.8	1274.1	100.0	63.2

The placement of wastewater infrastructure plays a critical role in enabling the disbursement of population, businesses and services. In turn, the disbursement of population, businesses and services play a critical role the placement of wastewater infrastructure. Developers interested in undeveloped land frequently approach communities, counties, water districts, and NOACA to secure sewer extensions for developments. At this point, the region faces the challenge of managing threats to water quality posed by both aging infrastructure in declining areas and new infrastructure and impervious surfaces in growing areas. The shift in population away from the urban core places a greater financial burden on remaining customers to pay for the maintenance of older sewage systems. This financial burden is even greater for customers who are connected to systems under state or federal orders to remediate combined sewer overflows (CSO) to protect local waterways from raw sewage during heavy rainfall events.

Drinking Water Resources

As square miles of open spaces are lost to development, the resulting increase in impervious surfaces impacts local and regional water quality. Impervious surfaces increase with the development of new roads, driveways, parking lots, and buildings (strip malls and additional households). Stormwater runoff flows over impervious surfaces and conveys pollution (heavy metals, oils, sediments, chemical residues, debris, etc.) into local and regional water ways that are connected to drinking water sources such as Lake Erie, inland lakes, and rivers.

The increase in impervious surfaces from the region's development patterns also impacts the region's groundwater. Additional impervious surface from development reduces the area where water can infiltrate the ground. The lack of groundwater recharge can lead to lower groundwater tables. Streams, lakes, wetlands, and other water resources replenish the groundwater table. Groundwater primarily maintains the base flow (sustained flow without direct runoff) for most streams.[26]

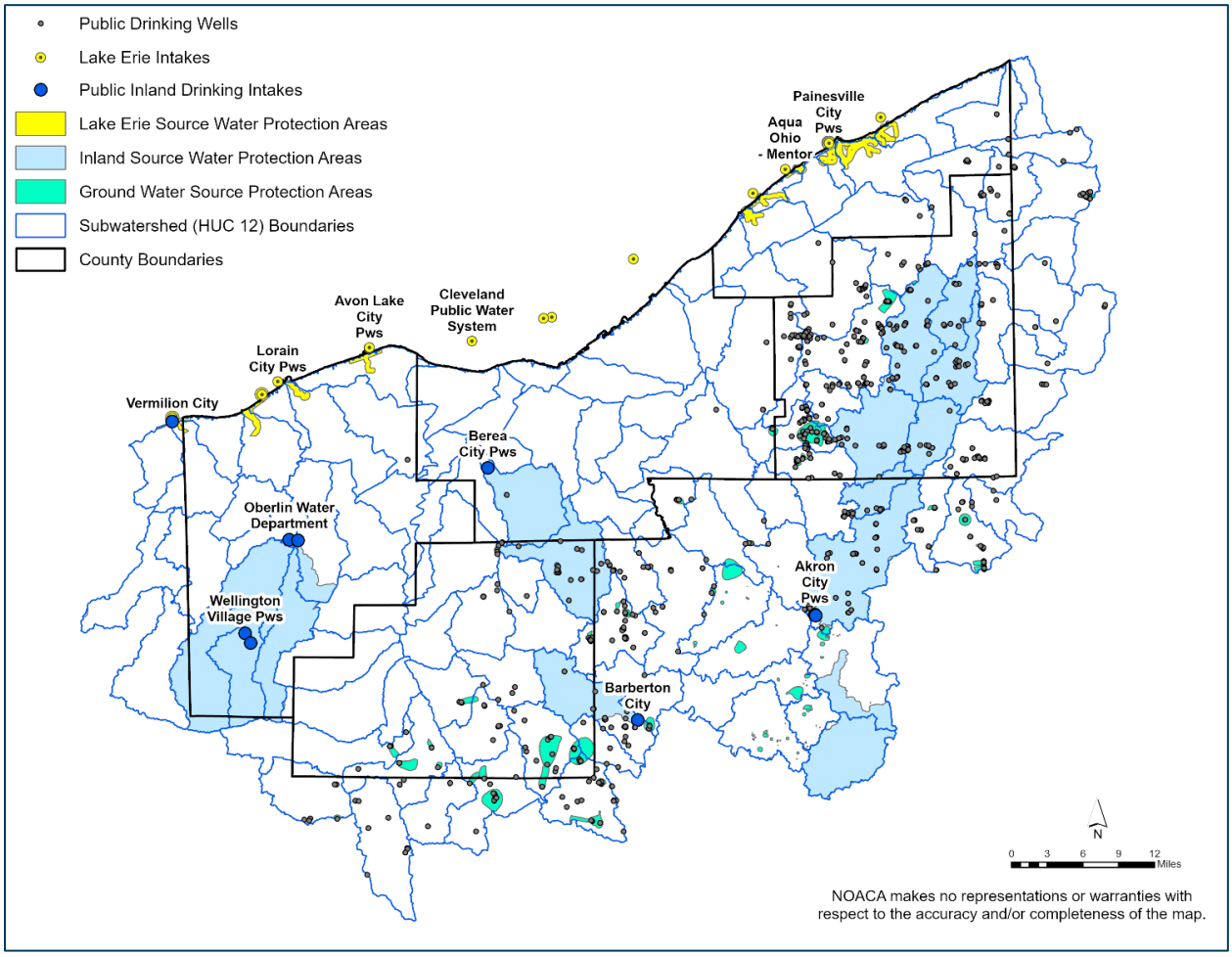
Many properties and communities rely on groundwater as their primary drinking water source (Figure 8-6). If development continues the current pattern of expansion, more of the region's population may rely on groundwater in the future. Future transportation scenarios 1 and 2 present this possibility and would likely result in higher percentages of impervious surface, which may result in increased vulnerability for groundwater contamination (see Chapter 9 for a description of the scenarios). Common groundwater pollution sources are industry, fertilizers, failing sewage treatment systems, construction sites, and oil, gas, and salt runoff from roads and other impervious surfaces. In scenarios 3 and 4, the areas targeted to attract residents and jobs are within currently developed portions of the region, which may slow the expansion of impervious surface and preserve natural open space (see Chapter 9).

Outmigration and intra-migration leave urban communities with older drinking water distribution systems that require maintenance and replacement without necessary customer base to realize such improvements. Population migration may delay infrastructure maintenance due to loss of

[26] U.S. Geological Survey (USGS), "Surface Runoff and the Water Cycle," https://www.usgs.gov/specialtopic/water-science-school/science/surface-runoff-and-water-cycle?qt-science_center_objects=0#qtscience_center_objects (last accessed January 29, 2021)

revenues. Additionally, as the drinking water distribution systems age and erode, unhealthy lead levels may occur. According to USEPA, "the most common sources of lead in drinking water are lead pipes, faucets, and fixtures" (see Figure 8-7). Often, lead service lines that connect homes to distribution lines are the most significant source of lead in water. USEPA also reports that "lead pipes are more likely to be found in older cities and homes built before 1986 and the most common problem is with brass or chrome-plated brass faucets and plumbing with lead solder."[27]

Figure 8-6. Northeast Ohio Source Water Intakes and Protection Areas



[27] USEPA, "Basic Information about Lead in Drinking Water," https://www.epa.gov/ground-water-and-drinking-water/basic-information-about-lead-drinking-water#getinto, (accessed on October 22, 2024).

Figure 8-7. Sources of Lead in Drinking Water

Regional Air Quality

National Ambient Air Quality Standards (NAAQS) and Attainment Status

In 1970, the United States Congress passed its first round of amendments to the existing federal Clean Air Act (CAA), which laid out a framework to control air pollution at the federal, state, and local levels. Because transportation accounts for a significant portion of air pollution, the 1977 Clean Air Act Amendments (CAAA) introduced the concept of transportation conformity. Under this provision, a region's transportation plans, programs, and projects cannot interfere with the region's air quality goals.[28] MPOs such as NOACA must demonstrate that their long-range transportation plans (LRTPs) and Transportation Improvement Plans (TIPs) conform to these goals through a process known as a conformity determination.[29]

Since its passage, the CAA has significantly enhanced air quality in the U.S. From 1970 to 2023, ambient concentrations of the six criteria air pollutants declined by 78% nationwide, even as the economy grew by 321% and vehicle miles traveled (VMT) nearly doubled.[30] This decline in pollutant concentrations has also reduced the associated health burden of air pollution. In 1997, US EPA concluded that, from 1970 to 1990, the CAA prevented approximately 205,000 premature deaths and generated $22.2 trillion in economic benefits.[31] US EPA also concluded that the 1990

[28] 42 C.F.R. §7506 (c)(2).
[29] FHWA, *Transportation Conformity: A Basic Guide for State and Local Officials* (Washington, DC: FHWA, 2010); https://www.fhwa.dot.gov/environment/air_quality/conformity/guide/ (accessed November 5, 2024)
[30] US EPA, "Air Quality Trends," https://www.epa.gov/air-trends/air-quality-national-summary (accessed October 21, 2024)
[31] US EPA, *The Benefits and Costs of the Clean Air Act, 1970 to 1990—Retrospective Study*

CAAA would prevent 230,000 premature deaths by 2020.[32]

Historically, Northeast Ohio has struggled with poor air quality, due in part to its reliance on heavy industry and the use of coal to produce electricity. While the smokestacks from facilities such as steel mills, oil refineries, and coal-fired power plants long dominated the landscape in the region, mobile emissions have actually been the primary source of air pollution in Northeast Ohio since at least 1990. On-road vehicles continue to generate a plurality (27.4%) of criteria pollutant emissions. Additionally, two of the pollutants most closely linked to mobile emissions— ozone (O_3) and fine particulate matter ($PM_{2.5}$)—have declined by smaller margins. As Table 8- 23 illustrates, while the region's air quality has improved dramatically over the past 50 years, this rate of improvement has slowed since 2010, which mirrors the national trend.[33]

Table 8-23. Change in Concentrations of Criteria Air Pollutants in Northeast Ohio, 1990-2023[34]

Pollutant Type	1990-2023	2000-2023	2010-2023
Carbon Monoxide (CO)	-79%	-65%	-18%
Nitrogen Dioxide (NO_2) (1-hour)	-62%	-54%	-30%
Ozone (O_3) (Eight-Hour)	-18%	-12%	-1%
PM_{10} (24-hour)	-29%	-36%	0%
$PM_{2.5}$ (annual)	n/a	-37%	-15%
Sulfur Dioxide (SO_2) (1-hour)	-92%	-87%	-78%

Source: US EPA

The CAA (40 C.F.R. § 50) requires the US EPA to set National Ambient Air Quality Standards (NAAQS) for pollutants considered harmful to public health and the environment. US EPA has created NAAQS for six criteria air pollutants. Regions that do not comply with these standards are designated as nonattainment areas. Northeast Ohio is currently a marginal nonattainment area for the 2015 ozone (O_3) NAAQS (see Table 8-24). While Northeast Ohio is currently a moderate nonattainment area for the 2015 ozone (O_3) NAAQS (see Table 8-24), the region did not meet the attainment date on August 3, 2024. As a result, US EPA bumped the region to serious nonattainment status on December 17, 2024.

On February 7, 2024, the U.S. EPA strengthened the primary annual $PM_{2.5}$ NAAQS from 12 µg/m^3 to 9 µg/m^3, while retaining the primary and secondary 24-hour $PM_{2.5}$ NAAQS. The U.S. EPA plans to issue guidance on area designations by February 2026. Using this guidance, states must develop and submit attainment plans for areas that do not meet the revised primary annual $PM_{2.5}$ NAAQS within 18 months of the EPA's final designations. These designations will likely be based on the $PM_{2.5}$ values during 2022-2024. Based on 2021-2023 $PM_{2.5}$ values, the most recent years for which there is certified data, Cuyahoga County would be the only area in Northeast Ohio in nonattainment with a value of 12.4 µg/m^3.

(Washington, D.C.: US EPA, 1997), https://www.epa.gov/sites/production/files/2015-06/documents/contsetc.pdf (accessed November 5, 2024).

[32] US EPA, *Benefits and Costs of the Clean Air Act 1990-2020, the Second Prospective Study* (Washington, D.C.: US EPA, 2011), https://www.epa.gov/clean-air-act-overview/benefits-and-costs-clean-air-act-1990-2020-second-prospective-study (accessed November 5, 2024)

[33] Z. Jian et al., "Unexpected slowdown of US pollutant emission reduction in the past decade," *Proceedings of the National Academy of Sciences* 115, 20 (2018), 5099-5014

[34] US EPA, "Air Trends," http://www.epa.gov/airtrends/index.html (accessed October 21, 2024).

In 2023, Northeast Ohio experienced several days of elevated $PM_{2.5}$ emission levels, largely due to the wildfires that took place in Canada. As the wildfires burned across the country, the smoke drifted into the Midwest and impacted air quality and public health. The wildfire smoke led to several air quality alerts across Northeast Ohio. According to the EPA's Air Quality Index (AQI), Northeast Ohio experienced 236 moderate days, six (6) unhealthy days for sensitive groups, four (4) unhealthy days and one (1) very unhealthy day in 2023; compared to 127 moderate days, one (1) unhealthy day for sensitive groups, and one (1) unhealthy day in 2022. The number of $PM_{2.5}$ exceedance days in Northeast Ohio also increased from one (1) in 2022 to nine (9) in 2023.

As fine particulate matter becomes more of a concern in Northeast Ohio, NOACA has recently analyzed the accuracy of the National Oceanic and Atmospheric Administration (NOAA) fine particulate matter forecasting model. NOACA compared NOAA's forecasting data to the daily observation data to determine the accuracy of NOAA's forecasting model. The findings of the model analysis were presented at the National Air Quality Forecasters Workshop in Washington D.C. to help NOAA improve their forecasting model. NOACA staff will continue to monitor its own forecast performance and collaborate with others to improve.

Table 8-24. Summary of Nonattainment Status for Northeast Ohio[35]

Pollutant		Averaging Time	Level	Attainment Status	Counties in Nonattainment
Carbon Monoxide (CO)		8-hour	9 ppm	Maintenance	N/A
		1-hour	35 ppm		N/A
Lead (Pb)		Rolling 3-month average	0.15 µg/m^3	Maintenance	N/A
Nitrogen Dioxide (NO_2)		1-hour	100 ppb	Unclassifiable/ Attainment	N/A
		Annual	53 ppb	Unclassifiable/ Attainment	N/A
Ozone (O_3)		8-hour	70 ppb	Marginal Nonattainment	Cuyahoga, Geauga, Lake, Lorain, Medina, Portage, Summit
Particle Pollution	$PM_{2.5}$	Annual	9 µg/m^3	Maintenance	N/A
		24-hour	35 µg/m^3	Maintenance	N/A
	PM_{10}	24-hour	150 µg/m^3	Maintenance	N/A
Sulfur Dioxide (SO_2)		1-hour	75 ppb	Maintenance	N/A

Source: US EPA

Lead Contamination

[35] US EPA, "Nonattainment Areas for Criteria Pollutants (Green Book)," https://www.epa.gov/green-book (accessed November 5, 2024)

Ambient and indoor air pollution impose substantial costs within Northeast Ohio, as described in subsequent sections. But these costs stretch beyond just health impacts. Perhaps the greatest environmental justice challenge facing the NOACA region is lead contamination, particularly among children in communities of color with aging housing stock. The use of lead-based paint was commonplace in residential settings prior to its prohibition in 1978. Due to its history as a hub for the paint and coatings industry, Northeast Ohio has a significant legacy lead pollution problem. While lead-based paint does not pose an acute health threat if it is properly sealed, that is often not the case in the older housing stock within the region's legacy cities. There is no safe level of lead in the human body, and children are most at risk. Lead can harm human health in a number of ways. Increasing from the 5th to 95th percentile of blood lead levels (BLLs) is associated with a loss of 6.9 IQ points among children; the majority of this decrement occurs at levels below 10 micrograms per deciliter (µg/dL), which health officials had previously considered safe.[36] Elevated BLLs are also linked to behavioral and mental health problems. Because lead remains in the body, its health effects can linger and exacerbate throughout the course of one's life.

The social and economic costs of lead contamination are enormous. Each child in Northeast Ohio who develops elevated BLL incurs an array of additional costs due to lost economic output and ongoing healthcare and social service demands. According to one study, elevated BLLs in the U.S. caused $165–233 billion in lost lifetime earnings, $25–35 billion in foregone tax revenue, $30–146 million in special education expenses, $11–53 billion in additional health-care costs, and $11.6 billion in additional indirect costs.[37] Conversely, the benefits of lead remediation are vast and outweigh the costs by orders of magnitude. Every $1 invested in lead paint hazard control measures generates $17-221 in total benefits.[38] The potential benefits for Northeast Ohio are apparent, as more than 10% of children in Cuyahoga County (more than 25% in the City of Cleveland) have elevated BLLs by the age of five.[39]

Because lead is more likely to be found in older housing stock and infrastructure, it is disproportionately likely to harm residents of our legacy urban areas, and they are disproportionately likely to be low-income and minority. This is why Cleveland enacted a 2019 law to reduce the number of children exposed to lead, and in 2020 followed up by committing funding to the effort.[40] This is another example of the need to address and eradicate poverty and racism to positively impact the region and improve quality of life and economic outcomes for all.

Major Sources of Air Pollution in Northeast Ohio

Broadly speaking, there are two main types of air pollutants—primary and secondary. Primary pollutants are emitted directly into the atmosphere from a given source and retain their same, basic chemical form. Two common primary pollutants are carbon monoxide (CO) and sulfur

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[36] Bruce P. Lanphear, Richard Hornung, Jane Khoury, Kimberly Yolton, Peter Baghurst, David C. Bellinger, Richard L. Canfield, Kim N. Dietrich, Robert Bornschein, Tom Greene, Stephen J. Rothenberg, Herbert L. Needleman, Lourdes Schnaas, Gail Wasserman, Joseph Graziano, and Russell Roberts, "Low-level environmental lead exposure and children's intellectual function: an international pooled analysis," *Environmental health perspectives*, 113,no. 7, (2005), 894-899.

[37] Elise Gould, "Childhood lead poisoning: conservative estimates of the social and economic benefits of lead hazard control," *Environmental health perspectives* 117, no. 7 (2009), 1162-1167.

[38] Ibid.

[39] Elizabeth Anthony, Stephen Steh, Meghan Salas Atwell, M. & Rob Fischer, *Early Childhood Lead Exposure in Cuyahoga County and the Impact on Kindergarten Readiness* (Cleveland, OH: Mandel School of Applied Social Sciences, Case Western Reserve University, 2019).

[40] Robert Higgs, "Cleveland City Council Approves $5M to Help Landlords Tackle Lead Paint Problem in Dwellings," *Cleveland.com*, Aug. 21, 2020; https://www.cleveland.com/cityhall/2020/08/cleveland-city-council-approves-5m-to-help-landlords-tackle-lead-paint-problems-in-dwellings.html (accessed April 8, 2021)

dioxide (SO_2). Secondary pollutants, in contrast, undergo a chemical change once they enter the atmosphere. Ozone (O_3) is a secondary pollutant; it is formed when nitrogen oxide (NO_x) combines with volatile organic compounds (VOCs) and oxygen in the lower atmosphere.

Table 8-25 outlines the contribution of mobile sources (highway and off-highway vehicles) to each of the criteria pollutants in Northeast Ohio. These include key primary pollutants (CO, PM_{10}, $PM_{2.5}$, and SO_2) and precursors for secondary pollutants of concern (NO_x and VOCs). As the charts indicate, transportation is a significant source of several pollutants, specifically CO, NO_x, $PM_{2.5}$, and VOCs.

Table 8-25. Share of Mobile Emissions for Criteria Pollutants in Northeast Ohio (2020)

Pollutant		Total Emissions (Tons)	Mobile Emissions (Tons)	Highway Vehicles Emissions (% Total)	Non-Highway Vehicles Emissions (% Total)
CO		324,130	222,014	34.1%	34.4%
O_3	NO_x	40,793	29,603	47.4%	25.1%
	VOCs	87,617	14,915	8.0%	9.1%
Particle Pollution	PM_{10}	41,296	2,758	4.7%	1.9%
	$PM_{2.5}$	14,199	1,458	5.0%	5.3%
SO_2		2,361	135	3.5%	2.2%

Source: US EPA, "2020 National Emissions Inventory Report," https://gispub.epa.gov/neireport/2017/ (accessed October 18, 2024).

Air Quality Trends and Analysis

Each year, NOACA produces its Air Quality Trends Report, which provides a comprehensive overview of air quality in Northeast Ohio and how the region performs on each of the NAAQS. Through this annual report, NOACA provides up-to-date information on how pollution levels change over time, which informs public education and policy making throughout the region.

NOACA plays a major role in the analysis of both the impacts of the region's transportation investments on greenhouse gas (GHG) emissions and climate resilience, and what actions the region should take to reduce emissions in order to achieve climate goals. The agency already completes an annual GHG emissions inventory for each of its five counties, and it has the capacity to provide detailed technical support to member communities. As part of its New or Modified Highway Interchange Projects Policy, NOACA staff analyze how new or modified highway interchanges influence equity measures and regional GHG emissions. This policy goes beyond existing transportation conformity requirements and informs the agency as it evaluates potential highway projects. NOACA also has the unique capacity to explore how changes to the transportation network may influence mobile emissions and public health in Northeast Ohio.

Social and Economic Costs of Air Pollution

Air pollution is connected to a host of health issues, including respiratory illnesses (e.g., asthma, bronchitis, and emphysema); pre- and neonatal health risks, including low birthweight, premature birth, and infant mortality; stroke; heart disease, including heart attacks; behavioral conditions,

such as attention deficit hyperactivity disorder (ADHD); cognitive issues, including IQ decrements and dementia; lung cancer; and premature death.[41] To quantify these impacts for Northeast Ohio, NOACA used US EPA's Co-Benefits Risk Assessment (COBRA) Health Impacts Screening and Mapping Tool.[42] Table 8-26 details the total costs and certain public health impacts of all air pollutants emitted in the NOACA region during 2023. Table 8-27 details such costs and impacts of pollutants emitted just from mobile sources.

Table 8-26. Public Health Impacts of Air Pollutant Emissions in the NOACA Region in 2023

Type of Impact	Incidence	Total Cost (2023 $)
Mortality (low estimate)	670 deaths	$9.8 billion
Mortality (high estimate)	1,300 deaths	$19 billion
Infant Mortality	4 deaths	$63 million
Nonfatal heart attacks	360 heart attacks	$30 million
Respiratory Hospital Admissions	60 admissions	$1.7 million
ER Visits for Asthma[a]	1.6 visits	$1,300
Minor Restricted Activity Days	330,000 days	$42 million
Lost Work Days	56,000 days	$18 million
Asthma Exacerbations	310,000 attacks	$39 million
Total Health Costs (low estimate)[b]	$10 billion	
Total Health Costs (high estimate)[ab]	$19 billion	

[a] U.S. EPA now calculates ER visits for asthma based on ozone concentrations rather than $PM_{2.5}$. This is why the numbers shown in this report are substantially lower than those in the CY2022 Air Quality Trends Report NOACA released last year (Source: NOACA estimates through U.S. EPA).

[b] Total costs do not include all health impacts and are therefore greater than the sum of the individual impacts included in this table (Source: NOACA estimates through U.S. EPA's COBRA model).

Northeast Ohio has directly benefited from the long-term decreases in pollutant levels. One recent analysis found that, since 1970, air quality improvements associated with the CAA have extended the average life expectancy of people within the region by 2.3 years.[43] More recent reductions in pollution concentrations have also improved public health. Due largely to regulations on tailpipe emissions, transportation-related NO_2 pollution has fallen considerably. As a result, the number of childhood asthma cases in the NOACA region fell by 42.6% from 2000 to 2010.[44]

Table 8-27. Public Health Impacts of Mobile Emissions in the NOACA Region in 2023

Type of Impact	Incidence	Total Cost (2023$)
Mortality (low estimate)	50 deaths	$730 million

[41] For further information on the public health effects of air pollution, consult the US EPA's *Integrated Science Assessments* on the criteria air pollutants at https://www.epa.gov/isa (accessed November 5, 2024).

[42] US EPA, Co-Benefits Risk Assessment (COBRA) Health Impacts Screening and Mapping Tool, https://www.epa.gov/statelocalenergy/co-benefits-risk-assessment-cobra-health-impacts-screening-and-mapping-tool (accessed November 5, 2024)

[43] Michael Greenstone, "The Connection between Cleaner Air and Longer Lives," *The New York Times*, Sept. 24, 2015; http://www.nytimes.com/2015/09/25/upshot/the-connection-between-cleaner-air-and-longer-lives.html?_r=1 (accessed November 1, 2019)

[44] Raed Alotaibi, Mathew Bechle, Julian D. Marshall, Tara Ramani, Josias Zietsman, Mark J. Nieuwenhuijsen, and Haneen Khreis, "Traffic related air pollution and the burden of childhood asthma in the contiguous United States in 2000 and 2010," *Environment International* 127 (2019), 858-867.

Mortality (high estimate)	79 deaths	$1.1 billion
Nonfatal heart attacks	17 heart attacks	$1.4 million
Respiratory Hospital Admissions	5 admissions	$110,000
ER Visits for Asthma[a]	1 visit	$280
Minor Restricted Activity Days	16,000 days	$2 million
Lost Work Days	2,600 days	$830,000
Asthma Exacerbations	31,000 attacks	$8.4 million
Total Health Costs (low estimate)[b]	$790 million	
Total Health Costs (high estimate)[ab]	$1.2 billion	

[a] U.S. EPA now calculates ER visits for asthma based on ozone concentrations rather than $PM_{2.5}$. This is why the numbers shown in this report are substantially lower than those in the CY2022 Air Quality Trends Report NOACA released last year (Source: NOACA estimates through U.S. EPA).
[b] Total costs do not include all health impacts and are therefore greater than the sum of the individual impacts included in this table (Source: NOACA estimates through U.S. EPA's COBRA model).

Air Pollution Costs by Future Transportation Scenario

NOACA staff evaluated each of the four *eNEO2050* future transportation scenarios to see how they influence mobile emissions, pollution exposure, and public health in each of the region's zip codes (see Chapter 9 for the scenarios). This provides a more fine-grained understanding of the ways that transportation investments may influence quality of life within the region. It also better informs NOACA's efforts to enhance equity and minimize ongoing environmental justice disparities. Staff used US EPA's Motor Vehicles Emissions Simulator (MOVES4.0.1) and COBRA to complete this analysis. The aggregate regional public health costs of each scenario are given in Table 8-28.

Table 8-28. Total Public Health Costs of Mobile Emissions by eNEO2050 Scenario (2050)

Type of Impact	MAINTAIN	CAR	TRANSIT	TOTAL
Mortality (low estimate)	17 deaths	17 deaths	18 deaths	18 deaths
Mortality (high estimate)	24 deaths	25 deaths	25 deaths	25 deaths
Nonfatal heart attacks	4 heart attacks	4 heart attacks	4 heart attacks	4 heart attacks
Respiratory Hospital Admissions	1 admission	1 admission	1 admission	1 admission
ER Visits for Asthma	15 visits	15 visits	15 visits	15 visits
Minor Restricted Activity Days	5,097 days	5,106 days	5,132 days	5,192 days
Lost Workdays	863 days	864 days	869 days	879 days
Asthma Exacerbations	6,639 attacks	6.649 attacks	6,682 attacks	6,752 attacks
Total Health Costs (low estimate)[a]	$190.5 million	$190.7 million	$191.7 million	$193.9 million
Total Health Costs (high estimate)[a]	$330.5 million	$330.6 million	$332.3 million	$336 million

[a] U.S. EPA now calculates ER visits for asthma based on ozone concentrations rather than $PM_{2.5}$. This is why the numbers shown in this report are substantially lower than those in the CY2022 Air Quality Trends Report NOACA released last year (Source: NOACA estimates through U.S. EPA).
[b] Total costs do not include all health impacts and are therefore greater than the sum of the individual impacts included in this table (Source: NOACA estimates through U.S. EPA's COBRA model and US EPA's MOtor Vehicles Emissions Simulator, (MOVES4.0.1)

As Table 8-28 illustrates, the differences in total public health costs among the four scenarios are small, with the maximum difference (between MAINTAIN and TOTAL) of just 2%. But, while the differences among the scenarios are small, the difference between the scenarios and the 2023 baseline (Table 8-27) is stark. Premature mortality and total public health costs may each fall by 70% from baseline. As the tiny difference in costs among the scenarios attests, anticipated changes to federal mobile emissions standards account for these improvements. Tier 3 emissions standards (79 FR 23414), which came into effect in 2017, will cut emissions of NO_x and VOCs by 80%, relative to the Tier 2 standards implemented in 2000. They would also reduce particle pollution emissions by 70% and the sulfur content of gasoline by 60%. When Tier 3 standards fully come into effect in 2025, new passenger vehicles will be up to 99% cleaner than vehicles manufactured before the 1970 CAAA.[45] As new vehicles gradually replace older models with higher rates of tailpipe emissions, air pollution from mobile sources will decline dramatically in Northeast Ohio. Nevertheless, none of the scenarios fully mitigates the health impacts of mobile emissions. Tailpipe emissions will remain for vehicles with internal combustion engines, as will non-exhaust emissions (i.e., particles from brake and tire wear) from both internal combustion engine vehicles and fully electric vehicles.[46]

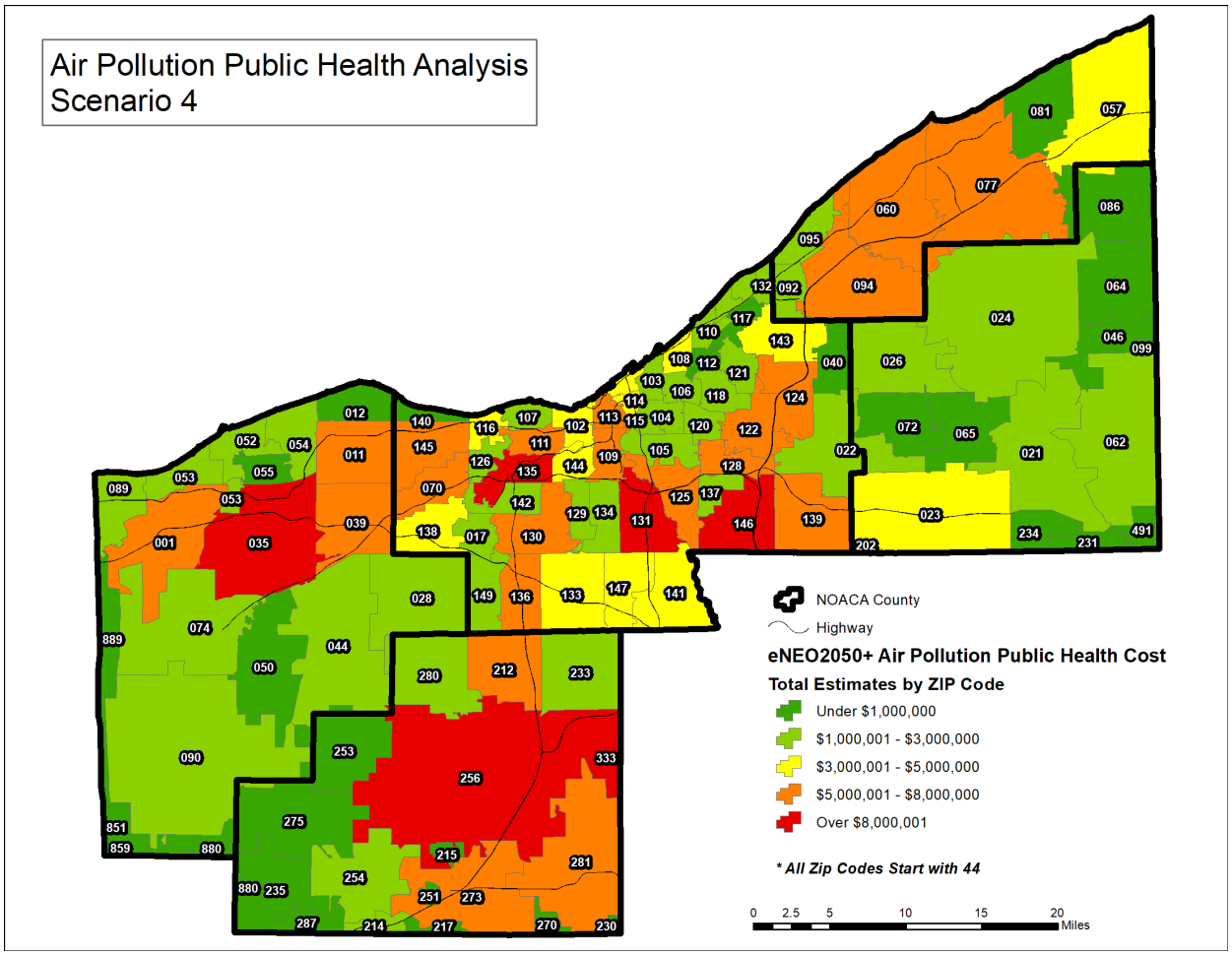
Figure 8-8 illustrates the distribution of mobile emissions health costs by zip code under the TOTAL scenario; this distribution remains almost perfectly constant across the four scenarios. NOACA staff derived the map from VMT data by zip code. Staff then converted those VMTs to mobile emissions, with data derived from MOVES4.0.1.[47] Next, staff entered those emissions data into the COBRA model to develop total health costs for each zip code in the region. The map below shows a fairly broad distribution of impacts across Northeast Ohio.

[45] US EPA, "History of Reducing Air Pollution from Transportation in the United States," https://www.epa.gov/transportation-air-pollution-and-climate-change/accomplishments-and-success-air-pollution-transportation (accessed November 5, 2024)

[46] Currently, non-exhaust emissions of $PM_{2.5}$ account for 57.8% of mobile particle pollution in the NOACA region. While exhaust emissions of $PM_{2.5}$ should fall by nearly 60% through 2050, non-exhaust emissions will remain the same or potentially even increase, as heavier electric vehicles and light-duty trucks make up a larger share of the vehicle fleet. While technological improvements, such as enhancements in regenerative braking, can help temper some of the issue, VMT reduction remains the only guaranteed way to cut further particle pollution from the region's vehicles.

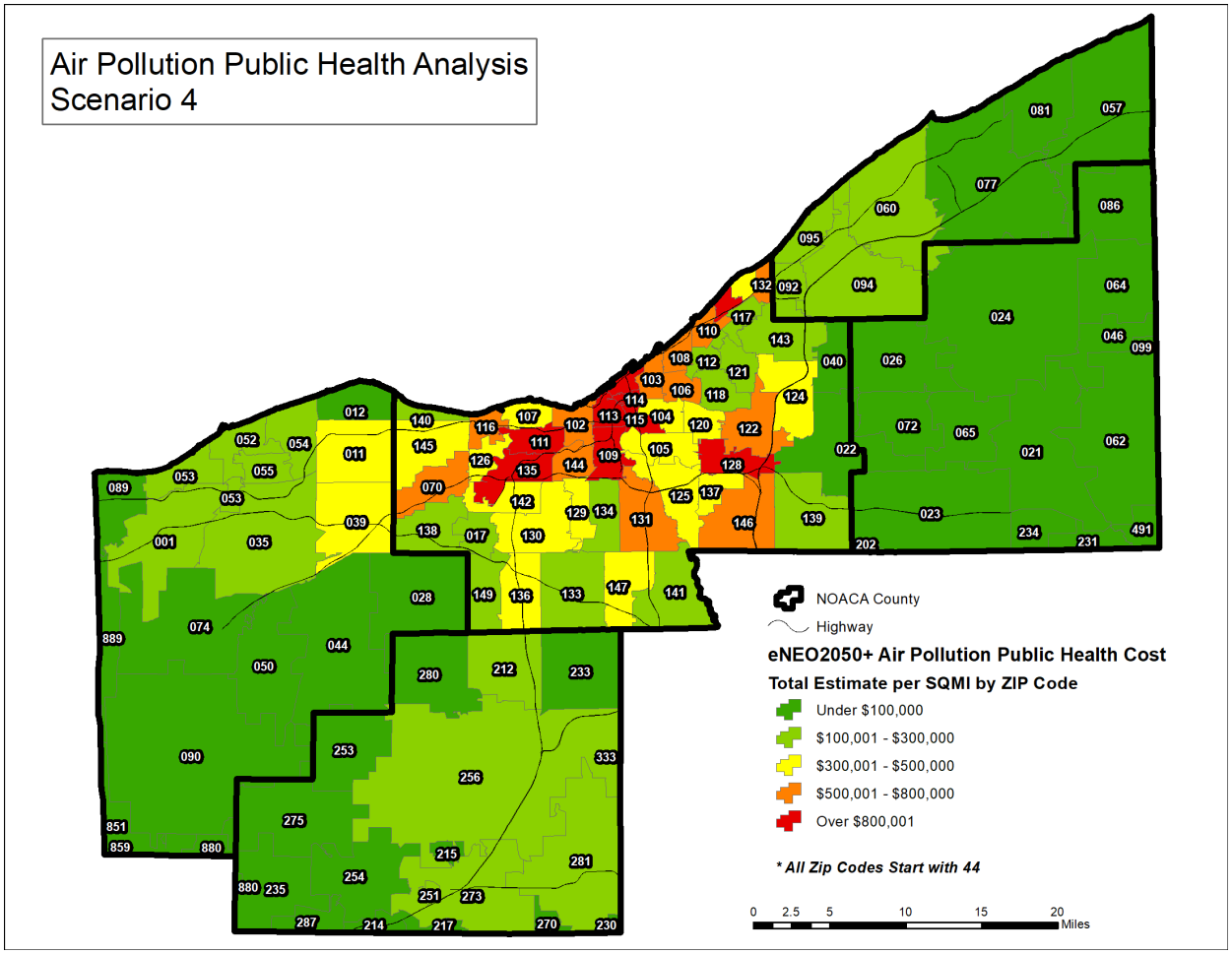
[47] US EPA, MOtor Vehicles Emissions Simulator (MOVES), version 4.0.1, https://www.epa.gov/moves/moves-versions-limited-current-use (accessed November 5, 2024)

Figure 8-8. Distribution of Mobile Emissions Health Costs by Zip Code for *eNEO2050* Scenario #4 (TOTAL) (2050)



This distribution changes when staff control for the size of different zip codes. The highest aggregate costs occur in Medina County's 44256 zip code because it is the largest by area. This zip code is 131.2 square miles, more than 96 times the size of the region's smallest zip code (Medina County's 44251), which is only 1.4 square miles. To account for this discrepancy, NOACA staff divided the total health costs of mobile emissions for each zip code by the total area (square miles), to obtain an area-adjusted quotient. NOACA staff discovered a far higher share of the health costs would occur in the region's EJ areas when they controlled for area (Figure 8-9) Downtown Cleveland zip codes 44115, 44113, and 44114, which are the third, eighth, and thirteenth smallest zip codes by area, respectively, become the three highest ranking zip codes for health costs per unit area.

Figure 8-9. Distribution of Health Costs per Unit Area by Zip Code in *eNEO2050* Scenario #4 (TOTAL) (2050)



Accounting for area also makes it clear that the distribution of the health impacts of mobile emissions will differ across the four scenarios. Because Scenarios 3 (TRANSIT) and 4 (TOTAL) result in more people, economic activity, and VMT in the urban core, the associated health effects also become more concentrated in a smaller number of core communities, most of which are home to EJ areas. Shifting from Scenario 1 to 4, for instance, increases health costs in 45.1% of zip codes; these zip codes are home to 56.5% of the region's population. More than half (51%) of the zip codes where health costs increase are located in the City of Cleveland, including all 10 zip codes with the largest increases and 16 of the top 20. As a result, Scenarios 3 and 4 create additional environmental justice concerns that the region must address to promote equity and improve quality of life for low-income and minority communities.

Climate Action Planning/Climate Pollution Reduction

Greenhouse Gas Emissions and Climate Change

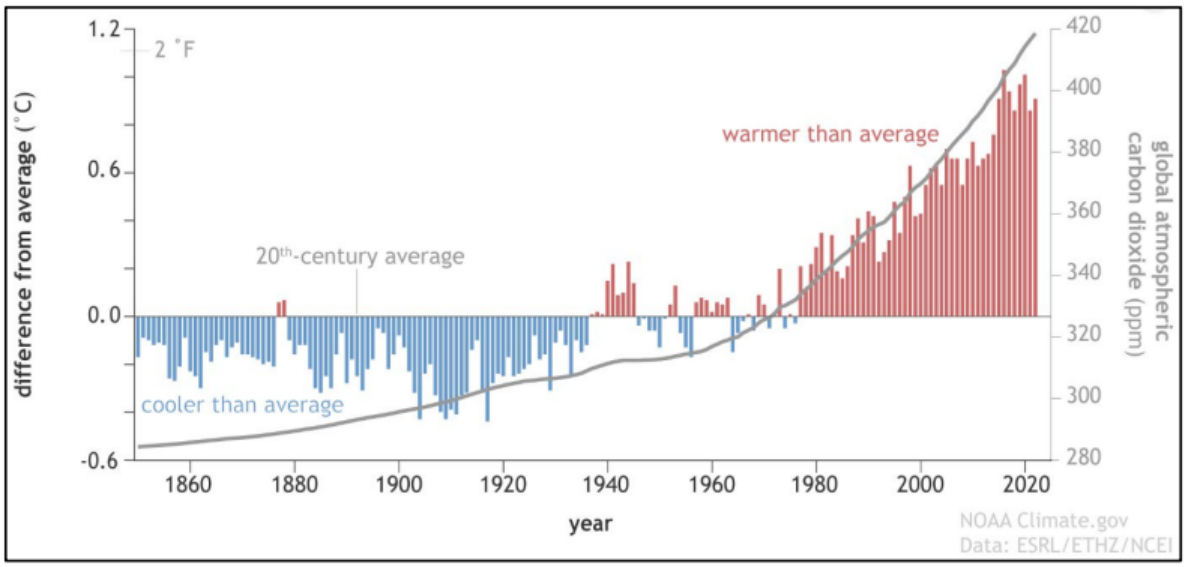
Climate change is a global phenomenon that includes any significant shift in the climate that lasts for extended periods of time. Global warming, which refers to the observed increase in average global surface temperatures over the past several decades, is one facet of climate change.[48] Other components include changes in precipitation, wind patterns, the cryosphere, and extreme

[48] US EPA, "Climate Change: Basic Information," https://19january2017snapshot.epa.gov/climatechange/climate-change-basic-information_.html (accessed April 8, 2021).

weather events. Over the past century, humans have released large amounts of CO_2 and other greenhouse gases (GHGs) into the atmosphere. Most of these emissions have come from the combustion of fossil fuels, such as coal, natural gas, and oil; however, land-use changes, such as deforestation and agriculture, are also major contributors, both due to direct emissions and the elimination of carbon sinks (which pull carbon out of the atmosphere and sequester it), such as forests. According to the Intergovernmental Panel on Climate Change (IPCC), human activities have increased atmospheric concentrations of GHGs to their highest levels in at least 800,000 years, and human actions are the dominant cause of changes to the global climate since the mid-20th century.[49]

GHGs act like a form of atmospheric insulation, trapping energy in the atmosphere and increasing global temperatures. GHGs allow ultraviolet radiation from the sun to enter the atmosphere; however, because they trap infrared radiation, they prevent a portion of that energy from escaping back into space. Though GHGs make up a tiny fraction of the composition of the atmosphere (0.04%), they can significantly affect the global climate. As a result, global average surface temperatures have increased by approximately 1ºC since 1880.[50] Figure 8-10 shows the strong correlation between the increase in CO_2 concentrations and global temperatures.

Figure 8-10. Atmospheric CO_2 and Earth's Surface Temperature (1880-2022)[51]



Although CO_2 is not a criteria air pollutant, US EPA has taken steps to regulate GHG emissions under the Clean Air Act. In its 2007 ruling in *Massachusetts v. EPA,* the U.S. Supreme Court ruled that GHGs, including CO_2, are pollutants covered by the Act.[52] The Court ordered the US EPA to determine whether GHGs contribute to air pollution and pose a threat to human health. US EPA issued its "endangerment finding" on December 7, 2009, ruling that GHGs exacerbate air pollution and threaten human health and welfare (74 FR 66496). In December 2015, leaders of 196

[49] Intergovernmental Panel on Climate Change, *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* (Geneva: IPCC, 2014); http://www.ipcc.ch/report/ar5/syr/ (accessed April 8, 2021

[50] Ibid.

[51] [49] Rebecca Lindsey, "If carbon dioxide hits a new high every year, why isn't every year hotter than the last?" https://www.climate.gov/news-features/climate-qa/if-carbon-dioxide-hits-new-high-every-year-why-isn%E2%80%99t-every-year-hotter-last (accessed April 8, 2021).

[52] Massachusetts v. EPA, 549 U.S. 497 (2007)

countries adopted the Paris Agreement, which commits the international community to hold the increase in global temperatures "to well below 2°C above pre-industrial levels and pursue efforts to limit the temperature increase to 1.5°C."[53] To remain below 2°C, global GHG emissions must peak by 2030, decline approximately 40-70% by 2050 (compared to 2010 levels), and reach near-zero levels by 2100.[54] To meet these benchmarks, emissions will need to decline by approximately 2.7% and 7.6% per year to keep warming below 2°C and 1.5°C, respectively.[55]

Scope of Climate Action Planning in Northeast Ohio

NOACA launched its preliminary climate action planning work in fall 2021 and partnered with the Cleveland Foundation and the George Gund Foundation to establish its commitment to this work in spring 2022. NOACA held a Climate Action Summit on March 15, 2022, as a kick-off event with more than 200 stakeholders. NOACA staff assembled both a climate action planning strategy committee and technical working group shortly thereafter.

As part of this framework, NOACA utilized support from the Foundations to contract with ICLEI USA and initiate a Regional CAP in the mold of the Global Covenant of Mayors (GCoM) for Climate & Energy Initiative to expand regional climate action in the United States. The GCoM initiative evolved from the International Urban Cooperation North America (IUC NA) project.[56] As part of this process, the project supported efforts by four US 'regions' or 'metropolitan areas' to join the GCoM and respond to the reporting requirements. The four pilot regions were Chicago, IL; Kansas City, MO; Minneapolis, MN; and Washington, DC (also some additional work in Denver-Boulder, CO).[57] Although NOACA was too late to participate as a pilot, NOACA's Board Policy Committee did support a comprehensive approach for NOACA climate action planning that would inventory both mobile and stationary sources of GHG emissions and develop both mitigation (reduce emissions) and adaptation (build resilience to climate change) strategies.

According to the IUC NA project's Terms of Reference, there were four major required outputs:

1. GHG Emissions Inventory
2. Climate Risk and Vulnerability Assessment (CRVA)
3. Regional CAP - Adaptation/Resilience Strategies
4. Regional CAP - Mitigation/Emissions Reduction Strategies

NOACA committed to emulate this model and completed both a published GHG emissions inventory (2022) and a draft CRVA (2023) in partnership with ICLEI USA. NOACA had also initiated efforts to develop adaptation and mitigation strategies prior to US EPA's release of its Notice of Funding Opportunity (NOFO) and Guidance for the CPRG Program in spring 2023.

U.S. EPA Climate Pollution Reduction Grants Program

The United States Environmental Protection Agency (US EPA) makes it clear in its Climate Pollution Reduction Grants (CPRG) Program Guidance that climate change is a serious issue for the United States and its population. Examples of extreme weather continue to increase in both

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[53] *Paris Agreement,* United Nations Framework Convention on Climate Change (UNFCCC), Dec., 12, 2015, FCCC/CP/2015/10/Add.1.
[54] IPCC, *Climate Change 2014*, 20.
[55] United Nations Environment Programme (UNEP), *Emissions Gap Report 2019* (Nairobi: UNEP, 2019); https://wedocs.unep.org/bitstream/handle/20.500.11822/30797/EGR2019.pdf?sequence=1&isAllowed=y (accessed April 8, 2021).
[56] International Urban Cooperation Programme - European Union (EU) (https://iuc.eu/na/home/).
[57] GCoM USA – Regional and Metro-scale Climate Leaders Terms of Reference (https://iuc.eu/fileadmin/user_upload/Regions/iuc_na/user_upload/GCoM_USA_Regions_ToR.pdf).

severity and frequency across many areas, with significant consequences for quality of life, environmental health, economic productivity, and future generations. US EPA recognizes that, "if unchecked, future climate change is expected to further disrupt many areas of life and exacerbate existing challenges to prosperity posed by aging and deteriorating infrastructure, stressed ecosystems, and longstanding inequalities."[58] As with most challenges, there is opportunity to make the necessary investments to clean the nation's economy and catalyze innovation for more equitable, resilient and vibrant states and regions.

Section 60114 of the Inflation Reduction Act (IRA) appropriates $5 billion to US EPA for its CPRG efforts. This money will support states, territories, municipalities, tribes, and similar groups in their development and implementation of greenhouse gas (GHG) emission reduction plans. The total amount of appropriated funds goes toward the following:[59]

- Phase I planning grants ($250 million for eligible entities to develop GHG emissions reduction plans)
- Phase II implementation grants ($4.6075 billion for grants to GHG emissions reduction measures from funded plans)
- Administrative costs ($142.5 million)

The Cleveland-Elyria MSA, comprised of the same five counties as the NOACA region, is one of the 67 most populous metropolitan areas in the U.S. Therefore, it received a $1 million CPRG planning grant from US EPA in summer 2023. NOACA and the City of Cleveland partnered to design a climate action plan that incorporates a variety of measures (i.e., actions) to reduce GHG emissions from across Northeast Ohio's economy in six key sectors (electricity generation, industry, transportation, buildings, agriculture/natural and working lands, and waste management).

In addition to development of a regional climate action plan, NOACA and the City of Cleveland also allocated support for local climate action planning and engagement (community projects funding) as part of their CPRG Program Phase I planning grant workplan and budget narrative. NOACA and the City of Cleveland outlined community projects funding and a scope through the narrative. Total funding for community projects equals $300,000, separate from the $700,000 allocated for a regional climate action plan through three major deliverables:

1. Priority Climate Action Plan (PCAP): $75,000
2. Comprehensive Climate Action Plan (CCAP): $600,000
3. Status Report: $25,000

Regional Greenhouse Gas Inventory

One of the required elements of the CPRG is a complete inventory of GHGs present in the Cleveland-Elyria Metropolitan Statistical Area (MSA). Northeast Ohio recognizes that greenhouse gas (GHG) emissions from human activity and natural sources contribute to climate change. The consequences pose substantial risks to the future health, well-being, and economic prosperity of our community.

As Figure 8-11 shows, transportation was the leading source of GHG emissions in the U.S. at 28.4% in 2020. It overtook the electric power sector in 2016, and projections indicate its share of

[58] US EPA Office of Air and Radiation. March 1, 2023. Climate Pollution Reduction Grants Program: Formula Grants for Planning - Program Guidance for States, Municipalities, and Air Pollution Control Agencies; https://www.epa.gov/inflation-reduction-act/about-cprgplanning-grant-information) (accessed January 31, 2024).
[59] Ibid.

emissions will grow further as coal continues to play a smaller role in electricity production. Since the release of eNEO2050 in 2021, NOACA has partnered with ICLEI USA and the City of Cleveland, respectively, to produce a 2018 Baseline Regional GHG Inventory and a 2022 Baseline Regional GHG Inventory. Transportation accounted for just over one-quarter of total GHG emissions in Northeast Ohio in the 2018 baseline report (just below residential energy) but had risen to 29% in the 2022 baseline report (see Figure 8-12).[60]

Transportation sector GHG emissions vary by county. In the 2022 Regional Greenhouse Gas Emissions Inventory, Cuyahoga County's GHG transportation emissions were 26% of the county total, below the regional share of 29%. However, each of the four other counties in the NOACA region had shares of GHG transportation emissions higher than the regional share (see Table 8-29).

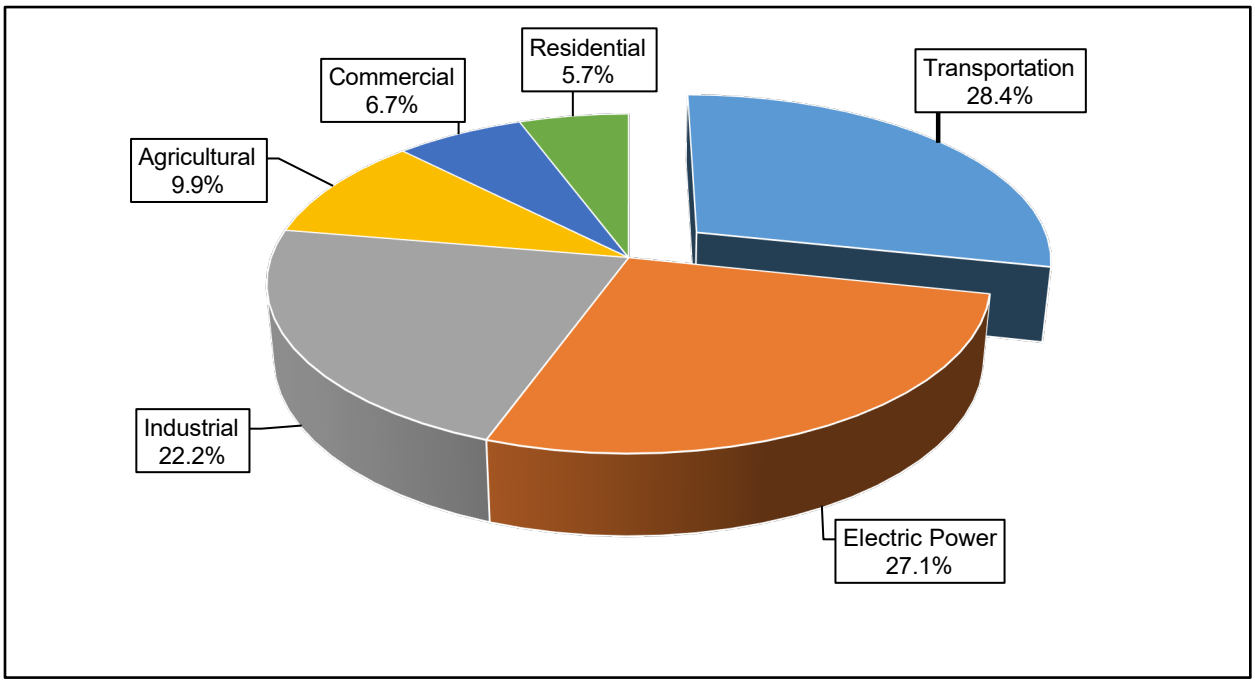
Table 8-29. GHG Emissions in NOACA Region and Counties (2018-2022)[61]

	EMISSIONS ($MTCO_2e$)							
				TRANSPORTATION				
	TOTAL			2018		2022		
COUNTY	2018	2022	% CHANGE	TOTAL	% SHARE	TOTAL	% SHARE	% CHANGE TOTAL
Cuyahoga	22,648,678	19,169,110	-15.4%	5,400,744	23.8%	5,075,639	26.5%	-6.0%
Geauga	1,441,821	1,334,679	-7.4%	422,580	29.3%	409,347	30.7%	-3.1%
Lake	3,725,227	3,392,180	-8.9%	1,007,399	27.0%	1,139,549	33.6%	13.1%
Lorain	4,227,680	3,705,403	-12.4%	1,313,400	31.1%	1,233,321	33.3%	-6.1%
Medina	2,922,867	2,549,792	-12.8%	1,000,469	34.2%	899,321	35.3%	-10.1%
TOTAL	**34,966,273**	**30,151,164**	**-13.8%**	**9,144,592**	**26.2%**	**8,757,177**	**29.0%**	**-4.2%**

Table 8-29 shows all counties experienced a decline in total GHG emissions (-7-15%); most counties experienced a decline in transportation GHG emissions (-3-10%), with the exception of Lake County (+13%); and all counties experienced an increase in transportation's share of their total GHG emissions (from 24-31% to 26-35%) between the 2018 and 2022 inventories. In each county (even Lake), there was improvement in fuel economy, which helped contribute to reduced transportation GHG emissions (except Lake).

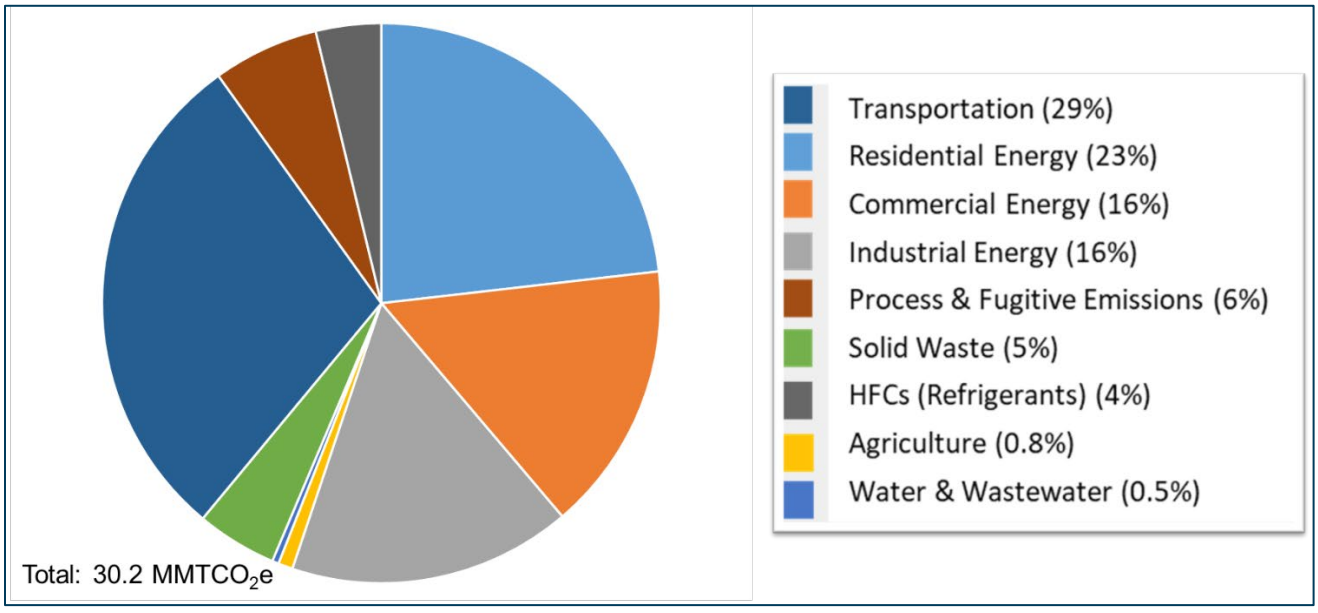
[60] City of Cleveland, NOACA, and ICLEI USA, 2022 Regional Greenhouse Gas Emissions Inventory; https://www.eneo2050.com/_files/ugd/9911f1_c2a252cd915141fc8e2eb003f8abb312.pdf (accessed April 16, 2025.
[61] Ibid.

Figure 8-11. Share of GHG Emissions by Sector- United States[62]



Source: US EPA; NOACA estimates using MOVES2014a.

Figure 8-12. Share of GHG Emissions by Sector- NOACA Region (2022)



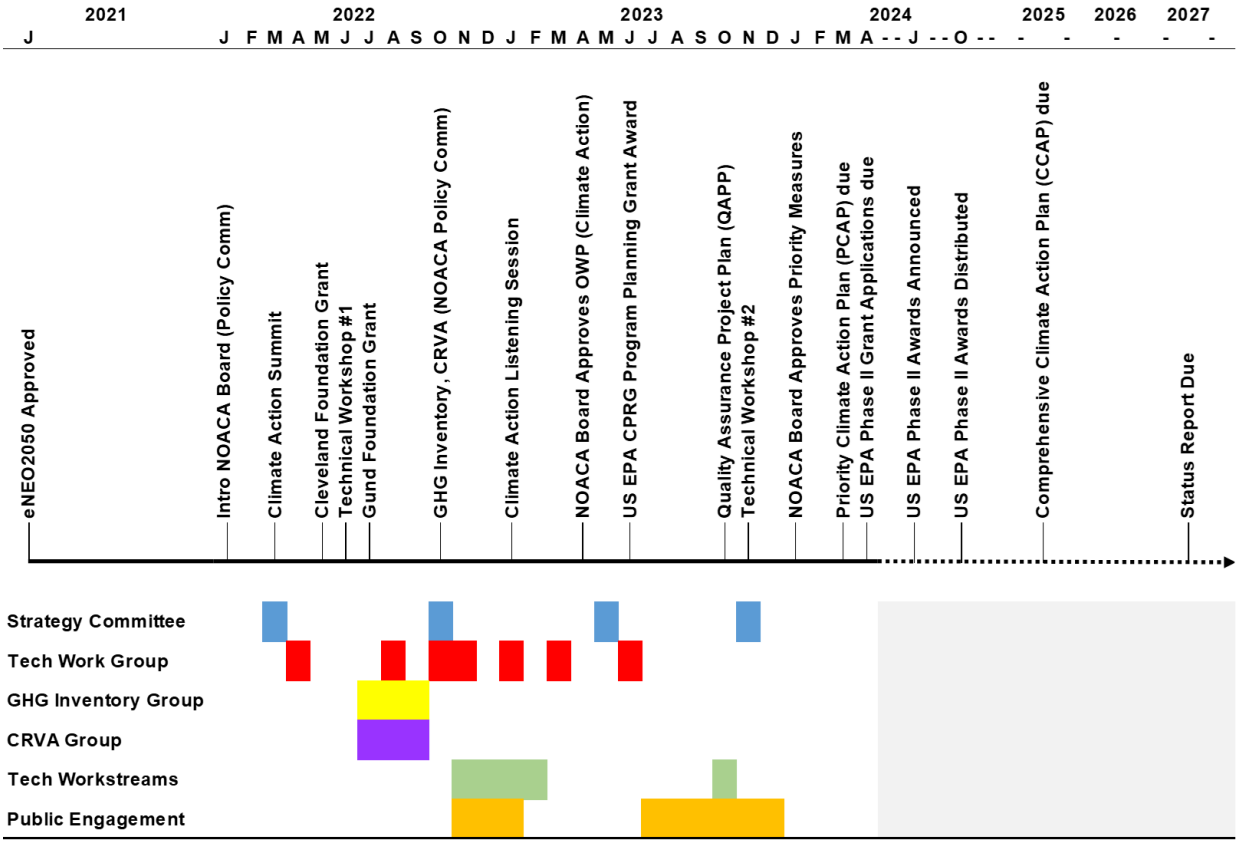
Key Decision-Maker and Technical Stakeholder Engagement

NOACA has engaged hundreds of key decision-makers and technical stakeholders since 2022. Figure 8-13 illustrates a timeline of significant climate action planning events and deliverables, along with key stakeholder groups and a schedule of engagement to achieve milestones. Figure

[62] US EPA, *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2018* (Washington, D.C.: US EPA, 2020), https://www.epa.gov/sites/production/files/2020-04/documents/us-ghg-inventory-2020-main-text.pdf.

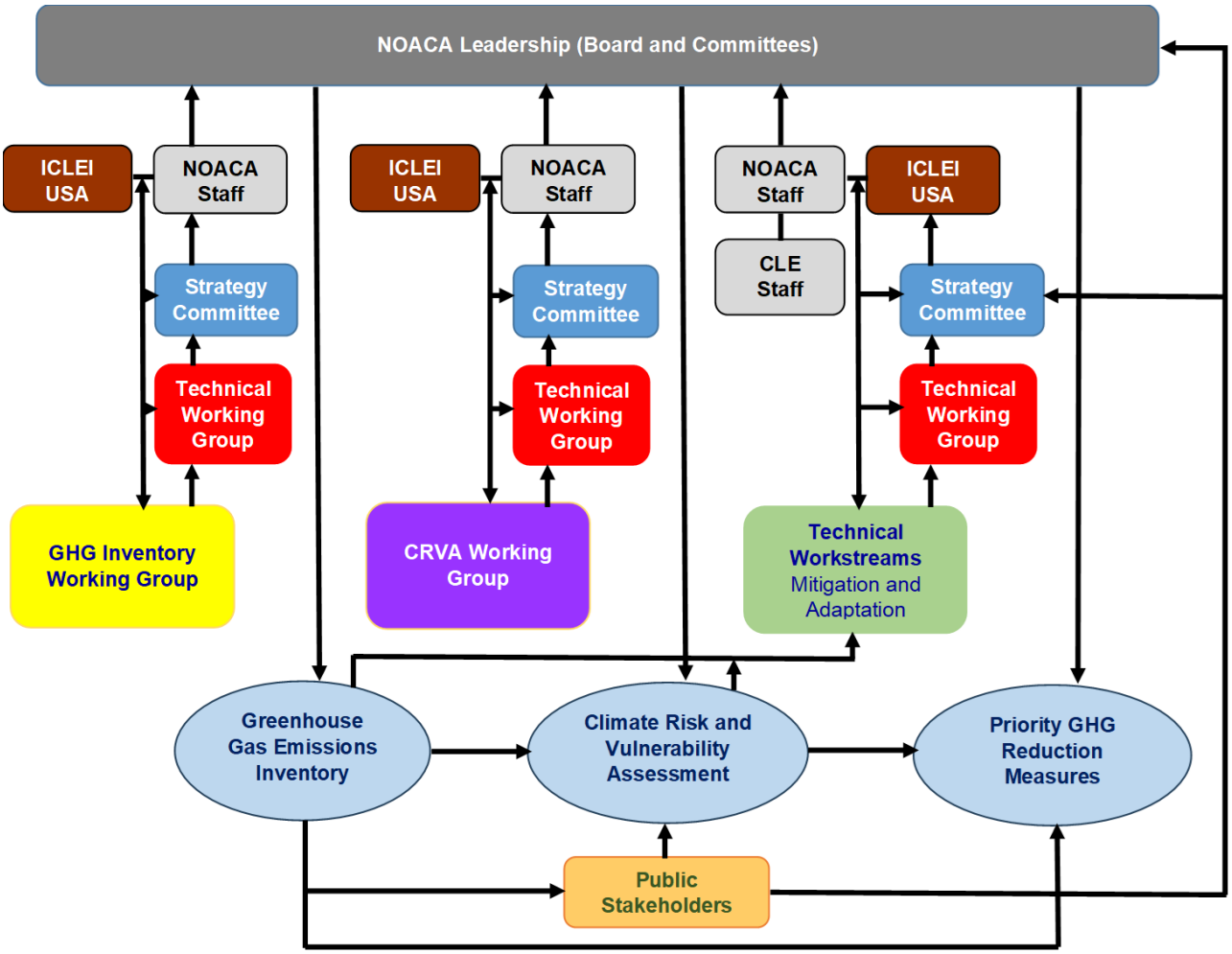
8-14 demonstrates the relational process by which these decision-makers and stakeholders interacted with one another to produce major deliverables.

Figure 8-13. Climate Action Planning Timeline of Key Events and Public/Stakeholder Engagement[63]



[63] NOACA and ICLEI USA, 2024, Cleveland-Elyria Metropolitan Statistical Area Priority Climate Action Plan; https://www.eneo2050.com/_files/ugd/2114d4_9aa04a96e04f43b4823270eb196196b6.pdf (accessed April 17, 2025).

Figure 8-14. Development of Key Deliverables from Professional, Technical Stakeholder, and Public Inputs[64]



Priority Climate Action Plan (PCAP) Measure Identification, Prioritization, and Selection

ICLEI USA presented 60 potential actions to stakeholders at a Regional Climate Action Priorities Workshop in November 2023. Attendees rated actions based on co-benefits, feasibility, and priority. Through additional discussion, attendees also generated requests for agricultural activity emissions and measures to reduce emissions from refrigeration. More input on priority measures came from the NOACA staff request of workshop invitees for post-workshop feedback.

NOACA staff analyzed all these inputs and prioritized potential actions that rated higher among the criteria of GHG emissions reduction potential, co-benefits, feasibility, priority, and inclusion in other local climate action plans. This prioritization exercise narrowed the list of potential actions from 60 to just under 40. NOACA staff then grouped these potential actions into 10 broader priority measures for the region. Table 8-30 shows the 10 measures, the sector(s) for which these measures will help reduce GHG emissions and a composite assessment of co-benefits, feasibility, and priority (high, medium, low) of each measure according to stakeholder feedback from the Regional Climate Action Priorities workshop and post-workshop.

[64] Ibid.

Table 8-30. Priority Measures and Stakeholder Assessment of Co-Benefits, Feasibility and Priority[65]

MEASURE	SECTOR(S)	CO-BENEFITS	FEASIBILITY	PRIORITY
Clean Electricity	Buildings, Electricity Generation, Industry			
Building Efficiency and Electrification	Buildings, Electricity Generation			
Green Steel Production	Industry			
Vehicle Miles Traveled (VMT) Reduction	Transportation			
Light Duty Vehicle Electrification	Transportation, Electricity Generation			
Heavy Duty Vehicle Electrification	Transportation, Electricity Generation			
Refrigerants Capture	Waste Management			
Solid Waste Diversion	Buildings, Waste Management			
Nature-Based Solutions	Agriculture/Natural and Working Lands, Carbon Removal			
Agriculture Actions	Agriculture/Natural and Working Lands			

ICLEI USA supported NOACA staff through use of its ClearPath model to project emissions reductions from the 10 priority measures presented in Table 8-30. These measures are implementable across the region and have sufficient impact and a high likelihood of moving forward. The projected emissions reductions are presented with the priority measures in Table 8-31 below.

[65] Ibid.

Table 8-31. Strategies with Net Reduction and Level of Impact (2030 and 2050)

Measure	Million MTCO2e reduced in 2030	2030 Level of Impact	Million MTCO2e reduced in 2050	2050 Level of Impact
Clean electricity	8.80	Very high	11.08	Very high
Building efficiency and electrification	3.28	High	8.39	Very high
Green steel production	1.49	Medium high	2.97	High
VMT reduction	0.96	Medium high	1.18	Medium high
EV - light duty vehicles	0.77	Medium high	2.71	High
EV - heavy duty vehicles	0.26	Medium low	2.22	High
Refrigerants capture	0.51	Medium low	0.08	Low
Solid waste diversion	0.43	Medium low	0.85	Medium high
Nature based solutions	0.15	Low	0.42	Medium low
Agriculture actions	0.06	Low	0.12	Low

Greenhouse Gas Emissions by Future Transportation Infrastructure Investment Scenario

In Scenario 1 (MAINTAIN), GHG emissions fall 58.2% between 2025 and 2050. The greatest decrease occurs in Cuyahoga County (60.3%), while the other counties experience smaller decreases (52-59%). This result reflects both the overall decline in regional population (-11.4%) and the fact that households will continue to expand outward, reducing Cuyahoga County's share of the region's population. VMT decreases by 7.5% overall, with considerable variability by county. Cuyahoga and Lake Counties will experience VMT decreases of 12.2% and 10%, respectively, while Geauga, Lorain, and Medina Counties will experience VMT increases of 6.7%, 1.4%, and 0.4%, respectively.

In Scenario 2 (CAR), which is similar to MAINTAIN but with a more fully developed highway system, GHG emissions fall by approximately the same percentage (58.1) between 2025 and 2050 as in Scenario 1. VMT decreases by 7.4% overall, with considerable variability by county. Cuyahoga and Lake Counties experience similar VMT decreases, while Geauga, Lorain, and Medina Counties experience similar, slight VMT increases.

In Scenario 3 (TRANSIT), population declines at a slightly lower rate (-8.5%) in the region, with the idea that often forecasts can be incorrect, and that alternate socioeconomic scenarios should be investigated to understand their potential regional impact (see Chapter 9). TRANSIT incorporates a more robust regional bus rapid transit (BRT) system and a better mix between jobs and housing development in the region. However, there remains very little difference between TRANSIT and the first two scenarios. GHG emissions fall by approximately the same percentage (57.9) between 2025 and 2050 as in Scenarios 1 and 2. VMT decreases by 6.8% overall (increased transit mostly offset by slower population decline), with considerable variability by

county. Cuyahoga and Lake Counties experience slightly lower VMT decreases (11% and 9%, respectively), while Geauga and Lorain experience VMT increases similar to Scenario 2; Medina County VMT is essentially flat.

In Scenario 4 (TOTAL), population declines at an even lower rate (-5.5%) compared to 11.4% decline in Scenarios 1 and 2, which represents about a 50% reduction in population loss (see Chapter 9). The TOTAL scenario encompasses slightly lower GHG emissions reductions (57.6%) and slightly lower VMT decreases (6.3%) with individual county VMT decreases reflective of this slightly lower number (due to slower population decline

Climate Action: Next Steps

Comprehensive Climate Action Plan (CCAP)

Upon approval of the PCAP by U.S. EPA on March 7, 2024, NOACA and the City of Cleveland redirected their focus to CCAP development. The CCAP (due December 1, 2025) will include the following elements:[66]

Greenhouse Gas (GHG) Inventory: Though NOACA prepared a regional GHG inventory for the PCAP, the baseline year was 2018 and newer data is now available. Both NOACA and the City of Cleveland agreed to update the regional inventory to reflect a 2022 baseline year and that work is now complete. The updated, comprehensive inventory includes all emissions and sinks by source and sink category following commonly accepted protocols for the following sectors: industry, electricity generation/use, transportation, commercial and residential buildings, agriculture, natural and working lands, and waste and materials management. NOACA and the City of Cleveland address GHG emission sources and sinks across the entire geographic scope of the Cleveland-Elyria MSA.

GHG Emissions Projections: The PCAP includes both near-term (2030) and long-term (2050) sector-based projections of GHG emissions under a “business-as-usual” scenario. The PCAP also includes projections of emission reductions through the implementation of each priority measure. However, the CCAP will include revised business-as-usual scenario projections based on a new GHG emissions inventory with a 2022 baseline year. The CCAP will also include projections for a “full plan implementation scenario.”

GHG Reduction Targets: NOACA and the City of Cleveland must develop economy-wide, near-term (2030) and long-term (2050) GHG emission reduction targets (on a gross or net GHG emission basis). The NOACA Board of Directors approved a 2030 emissions reduction target of 49% from 2018 baseline and a 2050 net zero emissions reduction target on December 13, 2024. NOACA and the City of Cleveland will also strongly consider sector-based emission reduction targets, especially for the highest priority sectors most targeted by emission reduction measures.

GHG Reduction Measures: The PCAP includes a full suite of implementation measures and projections of their impacts on emission reductions. However, NOACA and the City of Cleveland must update these measures for the CCAP, so the measures meet the newly-established GHG reduction targets. The CCAP measures will address the main GHG emission sectors: industry, electricity generation/use, transportation, commercial and residential buildings, industry, agriculture, natural and working lands, and waste and materials management. Like the PCAP, for each measure, the CCAP will identify the quantifiable GHG emissions reductions (or

[66] NOACA and ICLEI USA, 2024, Cleveland-Elyria Metropolitan Statistical Area Priority Climate Action Plan; https://www.eneo2050.com/_files/ugd/2114d4_9aa04a96e04f43b4823270eb196196b6.pdf (accessed April 17, 2025).

enhancement of carbon sinks), key implementing agency or agencies, implementation schedule and milestones, expected geographic location if applicable, milestones to obtain implementation authority as appropriate, identification of funding sources if relevant, and metrics to track progress. NOACA and the City of Cleveland will also include quantifiable cost information for each measure in the CCAP.

Benefits Analysis: NOACA and the City of Cleveland will assess benefits of GHG reduction measures across the entire MSA for the CCAP. Their analysis will include both base year estimates of co-pollutants (including criteria pollutants/precursors and air toxics) and anticipated co-pollutant emission reductions from plan measure implementation to meet GHG reduction goals. NOACA and the City of Cleveland will quantify estimates of co-pollutant reductions associated with GHG reduction measures. They will also track, minimize, and mitigate, to the extent possible, any potential disbenefits that result from plan measure implementation. NOACA and the City of Cleveland will also investigate a broader assessment of benefits associated with their GHG reduction measures including, but not limited to, analysis of air quality improvements (e.g., criteria air pollution and air toxics), improved public health outcomes, economic benefits, increased climate resilience, and other environmental benefits.

Low Income Disadvantaged Communities (LIDACs) Benefits Analysis: NOACA and the City of Cleveland identified LIDACs, recapped preliminary engagement of LIDAC stakeholders and provided a qualitative assessment of the impact of GHG reduction measures on LIDACs in the PCAP. However, the CCAP will include a quantitative analysis of the extent to which any GHG reduction measures will deliver co-pollutant emissions reductions and other benefits to LIDACs. NOACA and the City of Cleveland will also greatly expand on their engagement efforts in LIDACs, with focused guidance from LIDAC representatives who know best how to reach the most critical audiences in their jurisdictions. This expanded engagement is critical to ultimate buy-in from LIDAC stakeholders and a sense of ownership and optimism about their future in a world reshaped by climate change.

Review of Authority to Implement: As with the PCAP, NOACA and the City of Cleveland will indicate whether they have existing statutory or regulatory authority to implement each GHG reduction measure, or whether they must still obtain such authority. The CCAP will include a schedule of milestones for actions needed by key entities (e.g., legislature, administrative agency, etc.) to obtain any authority needed to implement each listed program or measure.

Intersection with Other Funding Availability: NOACA and the City of Cleveland will expand upon their initial identification of plan measure funding programs in the PCAP. This will include funding programs either available or secured from federal, state, local and private sources that could be leveraged to pursue CCAP objectives around the GHG reduction measures.

Workforce Planning Analysis: NOACA and the City of Cleveland will conduct an analysis of anticipated workforce shortages that could prevent them from achieving CCAP goals. They will also identify potential solutions and partners at the state, regional, and local levels that are equipped to help address those challenges. NOACA and the City of Cleveland will build upon the work of the recently completed Comprehensive Economic Development Strategy (CEDS) for Northeast Ohio and discuss workforce development priorities in accordance with GHG reduction measures. NOACA and the City of Cleveland will probe how activities or policies will lead to the creation of high-quality jobs in alignment with the U.S. Department of Labor's Good Jobs Principles.

Community Projects Funding Opportunities

The CPRG Program allows Northeast Ohio to expand climate action planning further through intentional engagement of additional communities and populations across the region. Implementation of this program will help Northeast Ohio entities integrate current parallel climate action planning processes and increase climate action planning capacity among local governments. Embarking on the effort described in NOACA's CPRG Program workplan (approved by US EPA) will enable the region to make far greater strides towards implementation of climate mitigation and adaptation projects than envisioned by NOACA and its partners at the CPRG Program's launch.

On February 18, 2025, NOACA opened an opportunity to fund community projects under the CPRG Program Phase I Planning Grant. NOACA seeks projects that aim to support climate action planning and climate pollution reduction in Northeast Ohio. However, GHG reduction implementation projects (e.g., clean energy installation, electric vehicle charging station installation, tree planting, etc.) are not eligible. The current funding opportunity is for planning and public engagement (outreach and education) purposes.

Specifically, applicants should consider projects that:

- Develop and expand public engagement to build support for the regional climate action plan and future implementation of strategies to reduce emissions. Potential stakeholders include:
    - urban, rural, and underserved or disadvantaged communities
    - general public
    - governmental entities
    - federally recognized tribes
    - Port Authorities
    - labor organizations
    - community and faith-based organizations
    - private sector and industry representatives.
- Climate action planning and support for plan implementation around areas of particular relevance to Geauga, Lake, Lorain, or Medina Counties (e.g., agriculture (including horticulture, livestock, nurseries, silviculture, viticulture, etc.), food processing and production, health care, light and heavy industry, manufacturing, recreation and tourism, research and development, and transportation).
- Climate action planning and support for plan implementation to ensure benefits to audiences that may be unique to Geauga, Lake, Lorain, or Medina Counties (e.g., rural populations, Amish communities, etc.).

NOACA also seeks projects that support one or more of the priority measures approved by the NOACA Board of Directors that form the foundation of the US EPA-approved Priority Climate Action Plan:

- Clean Electricity
- Building Efficiency and Electrification
- Green Steel Production
- Vehicle Miles Traveled Reduction
- Light Duty Vehicle Electrification
- Heavy Duty Vehicle Electrification
- Refrigerants Capture
- Solid Waste Diversion
- Nature-Based Solutions
- Agriculture Actions

The application window for this opportunity closed April 14, 2025. NOACA hopes to finalize

awardees at its September 12, 2025, Board of Directors meeting.

CPRG Implementation Grant

In addition to the CPRG Program Phase I Planning Grant opportunities, the City of Painesville (Lake County), the City of Cleveland, and Cuyahoga County were successful in their CPRG Phase II Implementation Grant application. On July 2024, those three entities received an award of $129.4 million from U.S. EPA. The selected application will support transition from reliance on a coal-fired power plant in Northeast Ohio. The grant will fund the deployment of 63 megawatts (MW) of solar installations on five brownfield and previous landfill sites and 10 MW of battery storage. The grant funds will also support the restoration of natural habitats and expand tree coverage on a blighted brownfield site along the shoreline of Lake Erie and create pollinator habitats at the Cleveland and Cuyahoga solar sites.[67]

The selected project will deliver the following benefits to reduce greenhouse gases and support communities:[68]

- Invest in the development of utility-scale solar to support the transition to clean energy production and reduction of community dependency on coal power.
- Revitalize contaminated brownfield sites through reforestation and conservation efforts.
- Create over 200 new jobs and offer job retraining and transition for individuals who are employed at a local coal-fired power plant.
- Plant 4,000 trees, reforesting 80 acres, and creating over 400 acres of native meadow and pollinator habitats that provide communities with accessible recreation.
- Improve the water quality of Lake Erie, which supplies drinking water to 11 million people, including all residents of Lake and Cuyahoga Counties.

Where Will We Go?

Future Development Scenarios

Looking forward to 2050, there are a number of different possible paths for the NOACA region to realize its future. The following four scenarios serve as predictions for what could be, based on levels and types of transportation investment. There will be particular focus on worker accessibility to jobs and equity. The scenarios—MAINTAIN, CAR, TRANSIT and TOTAL—are discussed in relation to impacts on air quality, water quality, and climate resilience in the region. Chapter 9 provides a more detailed presentation of the scenarios, their components, and performance measures used for scenario comparison and selection.

Scenario 1: MAINTAIN—State of Good Repair

Scenario 1 focuses on maintenance of the existing transportation system, with no expansion of roads, bridges, highways, or public transit. The scenario assumes no variation from the current population and employment forecasts for the region, which reflect recent trends (decreases in both population and employment).

Under Scenario 1, the continued outward movement of the workforce in Northeast Ohio will exacerbate the existing jobs-housing disconnect in the region. This form of job sprawl makes it difficult for many employers to recruit an adequate workforce, and it exacerbates existing racial

[67] U.S. EPA, 2024, General Competition Selected Applications Table: Cuyahoga County (Ohio); https://www.epa.gov/inflation-reduction-act/cuyahoga-county-ohio (accessed April 17, 2025).
[68] Ibid.

disparities by making it nearly impossible for many low-income minority workers to access those jobs without a private automobile.

One of the major drivers of mode shift—traffic congestion—is not a serious problem in most of Northeast Ohio, which may make it more difficult to increase the share of alternative modes. In Scenario 1, the improved roads and highways may increase the region's SOV rate. In turn, this induced demand may neuter any congestion reduction benefit.

Scenario 1 maintains the existing system and the persistent pattern of outward expansion of imperviousness into exurban and rural subwatersheds. These headwater streams and creeks may suffer the most from development, particularly without best practices such as those outlined in *Clean Water 2020.* Much of the work by local, grassroots watershed planning organizations is at risk, along with the health of Lake Erie.

Scenario 2: Captivating Auto Region (CAR)-Single—Occupancy Vehicles

In Scenario 2, road capacity expansion is the priority. This includes new and improved infrastructure (roads, highways, bridges, and interchanges), shorter travel times through traffic signal timing optimization, reduction of highway bottlenecks, ramp metering, and reduced commutes to job hubs. Like Scenario 1 (MAINTAIN), CAR assumes modest population and employment decline by the year 2050.

Under Scenario 2, the continued outward movement of the workforce in Northeast Ohio, facilitated by the expansion of the regional highway network, will exacerbate the existing jobs- housing disconnect in the region even more than in Scenario 1. This form of job sprawl makes it difficult for many employers to recruit an adequate workforce, and it exacerbates existing racial disparities by making it nearly impossible for many low-income workers and people of color to access those jobs without a private automobile.

In Scenario 2, the additional highway lane miles makes driving to work more attractive, slightly increasing the region's SOV rate. In turn, this induced demand eliminates any congestion reduction benefit and travel delays may increase.

Scenario 2 focuses on car travel throughout the region and exacerbates the spread of imperviousness through active widening of roads and highways and the addition of new highway interchanges. Scenario 2 would likely hasten degradation of headwater streams in exurban and rural areas that experience significant development, but also potentially increase the downstream impacts in more developed areas.

Scenario 3: TRANsportation System with Improved Transit (TRANSIT)—Multimodal Transportation System

Scenario 3, TRANSIT, is essentially the opposite of CAR (Scenario 2). TRANSIT expands all transit agencies in the region through implementation of BRT. TRANSIT also includes connections between transit stops and job hubs with autonomous shuttles and new pedestrian and bike routes. In Scenario 3, the projected 2050 population and employment is based on the same NOACA forecasts used in the MAINTAIN and CAR scenarios, plus reduced decreases.

The expanded BRT may increase the demand for TOD so people and employers can take advantage of greater modal choice, including transit, biking, and walking. More workforce housing in transit-accessible locations or near job hubs will be necessary. Housing demand, particularly demand for revitalized or repurposed housing in existing urban areas, may increase slightly.

There will continue to be a need for accessible, affordable housing of all types for the aging population, and improved transit will increase options for dining, entertainment, shopping, healthcare resources, and other essential needs.

While TRANSIT does not necessarily help drivers (expect increased costs from lack of roadway maintenance), individuals who cannot afford personal vehicles will have greater mobility and can more easily access jobs. A transit mobile workforce may encourage companies and other employers to focus on, and prioritize proximity to, transit/BRT during location decisions.

Scenario 3 focuses on increased residential density and economic growth in target areas. NOACA will need to take a holistic approach that includes multimodal transportation infrastructure, access to transit, and pollution mitigation features to address the region's air and water resource and climate resilience challenges.

Scenario 4: Transportation with Optimal Technology and Access for All (TOTAL)— Advanced Multimodal Transportation

The fourth scenario, TOTAL, incorporates all projects in the CAR (save highway interchanges) and TRANSIT scenarios. Additionally, the TOTAL scenario includes technological advances such as elected smart freeway lanes to autonomous cars and trucks; extra electric vehicle charging ports; and autonomous shuttle buses to improve workers' accessibility to the regional major job hubs and transit hubs. The projected 2050 population and employment in TOTAL is about half the decreases of the MAINTAIN and CAR scenarios.

Although Scenario 4 experiences increased costs due to both congestion and emissions, the increases are lower than the other four scenarios. The wholesale changes in the transportation system (both expanded transit service and arterial/highway network) create better connections between jobs and housing.
.
From a water quality standpoint, the expansion of the road network increases the spread of imperviousness, but that is tempered somewhat but the concentration of employment and population growth within the vicinity of major regional job hubs. More of the additional growth will take place within the developed footprint of the region, which will curb greenfield disturbance in exurban and rural areas.

Performance Measures and Targets

Although Chapter 9 will present a much more detailed discussion and analysis of the four future scenarios mentioned above, this section details performance measures to assess progress toward more efficient land use. The performance measures are variables used to assess the scenarios comparatively against each other. There are two important values associated with each performance measure: the baseline and the target. The baseline is the value of the performance measure in the current state (2024). The target is the value of the performance measure in the future state (2050). One of the four future scenarios will be the preferred scenario and its performance measures will be the target values NOACA will use to assess the region's progress from the current state to the preferred future state. Table 8-32 illustrates the performance measures and targets focused on efficient land use.

The outputs are presented in a specific way to help the reader digest the information clearly and concisely with the following guidelines:

1. The baseline represents current conditions (2024 conditions). The outputs reflect how the

performance measure will change from the baseline to the target year (2050) under each of the four scenarios.

2. The "-" and "+" signs shown as outputs for each performance measure under each scenario indicate the direction of change. A "-" sign indicates a decrease from the baseline and a "+" sign indicates an increase from the baseline. There are two sizes for each sign; they represent the magnitude of change (smaller signs indicate slight change; larger signs indicate more substantial change).
3. The colors of the signs and numbers for each output are also important. Red color indicates a negative impact on the region, while green indicates a positive impact on the region. While many people commonly associate "-" signs with a negative impact and "+" signs with a positive impact, that is not always the case. It is possible to have a red "+" sign, meaning the value of that performance measure will increase under a scenario, but that increase will have a negative impact on the region.
4. Some of the performance measures in Table 8-32 are qualitative. To help the reader interpret the differences across scenarios, consider the performance measure, "future population and employment in communities with peak population in 1970."
    a. MAINTAIN: Maintenance of the status quo will likely yield moderate decline of population in those communities whose population peaked in 1970, the same year the region's population peaked. These communities make up the region's peak population development footprint; after 1970, all growth essentially came at the expense of older, urban core neighborhoods that experienced decline, disinvestment, abandonment, and demolition.
    b. CAR: Prioritization of arterial and highway infrastructure expansion will likely yield moderate decline in the population and employment of the 1970 development footprint.
    c. TRANSIT: Investment in expansion of transit lines and stations instead of road/highway capacity will reduce some of the decline of the population and employment within the 1970 development footprint.
    d. TOTAL: Investment in both transit and road capacity expansion will reduce population and employment even further (about half that of the MAINTAIN and CAR scenarios) within the 1970 development footprint.

Table 8-32. Performance Measures and Targets (Air Quality, Water Quality, and Climate Resilience)

Performance Measure	Scenario 1 MAINTAIN	Scenario 2 CAR	Scenario 3 TRANSIT	Scenario 4 TOTAL	2020 Baseline
Regional Population	- (235,000)	- (235,000)	- (174,000)	- (114,000)	2,068,546
Regional Employment	- (113,000)	- (113,000)	- (83,000)	- (54,000)	1,188,488
Bike Lanes, Sidewalks and Bike/Walk Paths	SAME	SAME	+	+	Current bike infrastructure (lane miles of shared/separated service) and walk infrastructure (sidewalks, paths, crosswalks) in major regional job hubs

Ecologically Sensitive and Agriculturally Productive Lands	-	-	-	-	Current acreage of ecologically sensitive and agriculturally productive lands in Northeast Ohio
Future Population and Employment in Communities with Peak Population in 1970	-	-	-	-	Current estimate of total population and employment for all communities whose population peak occurred on or before 1970 (another option is to consider median age of single-family homes (1970 or earlier)
Attain National Air Quality Standards	-	-	-	-	Moderate Nonattainment for Ground-Level Ozone
Greenhouse Gas Emissions	+	+	+	+	Current greenhouse gas emissions for region
Flood Threat to Major Regional Job Hubs	+	+	SAME	+	current % major job hub areas within or proximal to designated floodplains or flood hazard zones

Principal Considerations for Transportation in the Context of Environment and Health

Given NOACA's role as the regional environmental planning agency for Northeast Ohio, it can play a major role in enhancing the region's water and air quality as well as in advancing the region's resilience to climate change. Overall, NOACAs efforts in these areas can improve equity and quality of life across the region. NOACA's continued investment in multimodal transportation infrastructure will be vital to reduce GHG emissions, improve public health, expanding transportation choice and access, and reduce racial and economic inequities.

To achieve the desired equitable future for Northeast Ohio, principal considerations must be contemplated in response to the anticipated challenges during the coming decades.

1. Populations can be disproportionately affected by impairments to water and air quality and the impacts of climate change.
2. Development of action plans to reduce greenhouse gas emissions substantially support state, regional, and local emissions reduction goals.
3. Substantial reduction of greenhouse gas emissions will reduce the impacts of climate change on the region.
4. Awareness of the region's air quality challenges and the linkages with air quality, transportation, land use, and public health will allow individuals to make informed transportation decisions.
5. Air quality planning integrated into proposed economic strategies can promote compact growth patterns, carbon neutral travel choices, and tree canopy and open space

protection.

6. Transportation network and land-use patterns significantly influence water quality conditions and watershed planning efforts.
7. Regional collaboration through data sharing reduces redundancy, identifies information gaps, and develops more effective programs.
8. Decisions on the expansion/extension of wastewater services and transportation access made in accordance with one another that take into account the development implications of expanding infrastructure into undeveloped land mediates negative outcomes.

Implementation Action Items

Looking forward to 2050, NOACA should implement the following actions to move the region toward a more equitable future:

1. Facilitate the Climate Action Next Steps outlined earlier in this chapter.
2. Provide technical assistance to NOACA membership on development of local Climate Action Plans/Climate Adaptation Plans.
3. Continue to monitor, evaluate, and publish air quality conditions (e.g., daily Air Quality Index (AQI), annual Air Quality Trends Report).
4. Support public policies that provide greater transportation choice, reduce mobile emissions, benefit public health, create economic opportunity, and enhance the quality of life in Northeast Ohio.
5. Maintain and regularly update Water Quality Management Plans, including the Areawide 208 Plan to address regional water quality and water infrastructure needs.
6. Promote strategies outside NOACA to change transportation and infrastructure policy to recognize funding needs for clean air and water quality enhancement projects. Continue to promote mode shift from private automobiles to active transportation through NOACA's Transportation for Livable Communities Initiative (TLCI), its ACTIVATE Plan for bicycle and pedestrian planning, and technical assistance to local communities.
7. Continue to increase employer participation in the Gohio Commute platform, Ohio's premier trip planning, logging, and matching platform (enables individuals to find information on how to get from point A to point B via every available travel mode, and it provides them with transparent information on the true costs and benefits of each travel mode).
8. Continue to host the Commuter Choice Awards, which recognize employers throughout the region who do the most to promote TDM and alternative commuting.
9. Modify or enhance NOACA's use of the FPA boundaries to facilitate more long-term and comprehensive planning in the region.