

Assessing Equity and Environmental Justice in the Great Lakes Restoration Initiative

by

Helena Garcia, Logan Murphy, Briana Wendland, and Tiffany Wu

A project submitted
in partial fulfillment of the requirements
for the degree of
Master of Science
(University of Michigan, School for Environment and Sustainability)
April 2021

Advisor: Dr. Paul Seelbach

Executive Summary

Since its inception in 2010, the Great Lakes Restoration Initiative (GLRI) program has completed more than 5,300 restoration projects across the larger Great Lakes region, representing a ~\$2.7 billion federal investment. This bipartisan federal effort annually appropriates \$300 million across the GLRI's five main focus areas, with one-third of this investment supporting the 43 most polluted sites in the Great Lakes basin—those identified through the Area of Concern (AOC) program back in the 1970s. In the last decade, the GLRI program has demonstrated significant ecological and economic successes, with much progress being made towards delisting AOCs.

Despite these environmental and economic successes, there is little documented evaluation of whether the GLRI program has served to minimize environmental risk and remediate legacies of environmental inequities. Few studies have examined social equity within the GLRI program, even though the initiative was formed to accelerate the restoration of the Great Lakes ecosystem and ensure a sustainable water-based future for the region. Groups like the Healing Our Waters—Great Lakes (HOW) Coalition, who work to educate members of Congress and the public about the far-reaching benefits of GLRI funding, have begun investigating how the program both considers and impacts social equity in its restoration work throughout the region. Specifically, HOW is interested in learning about how federal GLRI investments can be best implemented so that the benefits of restoration reach the full spectrum of Great Lakes socio-economic groups in an equitable manner.

We began this inquiry into emphasizing social equity across the GLRI. We aimed to illustrate how equity considerations need to play a critical role in the ongoing revitalization of the Great Lakes region and provided recommendations for ways HOW can advocate for equity-based policy and administrative considerations within the GLRI program. Our recommendations stemmed from case studies of four different AOCs in Michigan: White Lake, Muskegon Lake, the Rouge and Detroit rivers, and the River Raisin. Semi-structured participatory interview methods were used to build a clearer understanding of how communities have been impacted by their impaired freshwater resources, and how they perceive equity outcomes and considerations in current and past restoration efforts. In addition, ArcGIS geo-visualization software was used to map the distribution of GLRI restoration projects with social demographics for each study AOC community in order to illustrate social equity patterns and disparities and supplement community interview insights.

Our recommendations delineate actions the HOW Coalition can pursue with community organizations across the Great Lakes region, and equity considerations that HOW can advocate for at the federal level. Recommendations for HOW's federal advocacy work are further broken down into congressional policy recommendations and EPA program administration recommendations.

Actions HOW can pursue with community organizations in the Great Lakes:

- Connect and empower community organizations that work within Areas of Concern to restoration work and each other by facilitating more equitable information sharing and collaboration in restoration work and community engagement efforts.
- Facilitate information sharing across Areas of Concern about successful community organization and PAC efforts that have leveraged resources and partnerships to plan and complete projects with community input.
- Connect and empower underrepresented community organizations that serve people of color populations to build better avenues for engagement.
- Catalog and highlight example projects that consider equity outcomes across AOCs and GLRI projects.
- Partner with tribal nations and advocate for their interests in the GLRI program and in AOCs.

Equity considerations HOW can advocate for with Congress regarding GLRI program policies and legislation:

- Create additional funding and capacity resources to assist overburdened communities with granting applications and maintenance of GLRI and AOC projects.
- Allocate GLRI funding for educational efforts and public outreach within the AOC program's portion.
- Remove hurdles for securing GLRI funding through the implementation of a sliding scale, match percentage for local match requirements in GLRI and AOC projects. The matching program should be flexible to equitably allow for overburdened communities to still apply for and complete restoration projects under limited or eliminated match requirements.
- Include specific social justice language and goals as targets for GLRI planning, granting, and project evaluations.
- Shift policy focus from restoration to revitalization and reemphasize the use component of "Beneficial Use".
- Advocate for the inclusion of climate vulnerability considerations in the GLRI program in addition to equity considerations.

Equity considerations HOW can advocate for with Congress regarding EPA administration of the GLRI program:

- Support the formal involvement of local organizations in AOC processes through formal partnerships with PACs where applicable.
- Call for greater requirements and resourcing for public engagement in the restoration process.
- Develop intentional support channels to support ongoing stewardship after delisting.

Acknowledgements

This project would not have been made possible without the guidance and support of our project advisor, Dr. Paul Seelbach. Thank you for sharing your valuable insights and perspectives with us throughout our research process and for pushing us to continually think about our project as a compelling story about Great Lakes revitalization, not just restoration.

We would also like to sincerely thank Laura Rubin and her colleagues at the Healing Our Waters—Great Lakes Coalition for their engagement with our project and for their enthusiasm for our work. We would especially like to thank Anna Brunner for helping us get started with this project and for all the wonderfully long and inspired chats we had over Zoom amid the summer of 2020.

Finally, a sincere thank you to the many people we met virtually from across the Great Lakes basin throughout this project. Your stories of personal and professional connections to the Great Lakes inspired us and constantly reinforced our energy towards investigating environmental equity and justice in the Great Lakes.

Table of Contents

Chapter 1: Introduction	1
Chapter 2: Methods	10
Chapter 3: Defining Equity and Justice in the Context of Great Lakes and Environmental Restoration	29
Chapter 4: Assessing Community Perceptions of Equity and Social Value Given to GLRI Restoration Work, Using Community Interviews	33
Chapter 5: Highlighting Uses of Spatial Data and Geo-Visualization Tools for Investigating Patterns Between Historical Injustices, GLRI Project Distribution, and Community Demographics	53
Chapter 6: Discussion and Equity-Informed Recommendations for the HOW Coalition's GLRI Advocacy	67
Appendices	84
Appendix 1. GLRI and Social Equity Expert Interview Framework	84
Appendix 2. AOC Community Interview Framework	86
Appendix 3. Codebook	89
Appendix 4. Follow-Up Survey Questions	94
Literature Cited	96

Figures

- Figure 1.** List of Beneficial Use Impairments (BUIs).
- Figure 2.** GLRI 2019 Funding Allocation.
- Figure 3.** Historical Home Owners' Loan Corporation (HOLC) Residential Security Map for the City of Detroit.
- Figure 4.** Map of Great Lakes Areas of Concern in the Lower Peninsula of Michigan
- Figure 5.** River Raisin Area of Concern
- Figure 6.** Rouge River Area of Concern.
- Figure 7.** Detroit River Area of Concern.
- Figure 8.** Muskegon Lake Area of Concern.
- Figure 9.** White Lake Area of Concern.
- Figure 10.** Michigan EJ Score indicators.
- Figure 11.** Michigan EJ percentile scores distance from median state EJ score.
- Figure 11.** Summary themes and their respective social factors incorporated in the Social Vulnerability Index (SVI).
- Figure 12.** Map of the River Raisin Heritage Trail System.
- Figure 13.** CalEnviroScreen cumulative impacts indicators.
- Figure 14.** River Raisin AOC maps.
- Figure 15.** Resilient Monroe Green Map created by the River Raisin Institute.
- Figure 16.** Map of Indian Reservations and Treaty Cessions produced by the Nottawaseppi Huron Band of Potawatomi.
- Figure 17.** Rouge River and Detroit River AOC maps.
- Figure 18.** Muskegon Lake AOC maps.
- Figure 19.** White Lake AOC maps.

Tables

- Table 1.** Breakdown of community interviews by case study AOC.
- Table 2.** Key narrative themes highlighted for each AOC case study.

Acronyms

ADA	American with Disabilities Act
AOC	Area of Concern
BUI	Beneficial Use Impairment
COTE	City of Monroe’s Commission on the Environment and Water Quality
EPA	Environmental Protection Agency
EJ	Environmental Justice
GLRC	Great Lakes Regional Collaboration
GLRI	Great Lakes Restoration Initiative
GLWQA	Great Lakes Water Quality Agreement
HABs	Harmful algal blooms
HOLC	Home Owners’ Loan Corporation
HOW	Healing Our Waters—Great Lakes Coalition
MLWP	Muskegon Lake Watershed Partnership
NHBP	Nottawaseppi Huron Band of Potawatomi
PAC	Public Advisory Council
R2R2R	Remediation to Restoration to Revitalization
RAP	Remedial Action Plan
RRNBP	River Raisin National Battlefield Park
SVI	Social Vulnerability Index
WMSRDC	West Michigan Shoreline Regional Development Commission

Chapter 1: Introduction

The Great Lakes are invaluable freshwater resources that have sustained human communities for centuries. The Great Lakes ecosystem provided early regional inhabitants with a variety of ecosystem services by supporting key biophysical cycles that provided necessities for human health and prosperity. Importantly, these resources also helped form a strong regional culture around freshwater sustainability, recreation, and knowledge. Today, the Great Lakes continue to provide valuable ecosystem services to the many communities located within the region; providing clean drinking water supplies, food resources, areas for recreation, and transportation services. Many key ecosystem services also extend beyond the lakes and their hydrologic watershed boundaries. Following European settlement in the 1800s, the abundance and diversity of these services helped form many of the region's resource-based industries such as lumbering, steel, and agriculture. This combination of supporting and provisioning ecosystem services, coming from the resource capital inherent to the Great Lakes regional ecosystem, played a vital role in transforming the United States into a world economic leader capable of efficiently producing consumer goods and products, such as the automobile (Austin et al. 2008).

During the height of resource extraction (1850s-1900s) and industrial production (1950s-1970s) in the Great Lakes region, the economy flourished at the expense of environmental and human health (Dempsey 2004). Intensive industrialization and resource exploitation led to deforestation, the introduction of harmful invasive species in the Great Lakes basin, the contamination of coastal Great Lakes waters and sediments, contaminated tailings piles from mining operations, and the destruction of fish habitats vital to the region's economy and community food supply (Great Lakes Commission and Council of Great Lakes Industries 2018). A primary consequence of harmful industrial practices persists today as legacy contaminants in groundwater and soils. In some areas continued pollution activities exacerbate the impacts of these legacy contaminants. The proliferation of industry has also left Great Lakes coastlines hardened with structures and ports, leaving only a small fraction of the region's original coastal wetlands (Sierzen et al. 2012). Both current and past pollution of regional waters, and extensive habitat destruction, threaten the future health of the Great Lakes and the prosperity of the communities that rely on the provided environmental, economic, and social ecosystem services (Great Lakes Regional Collaboration 2005).

In 1972, Canada and the United States formed the Great Lakes Water Quality Agreement to protect the Great Lakes from further environmental degradation and to begin the process of restoring the region's vital freshwater resources (Hartig et al. 2019). Following this initial agreement, the United States and Canada identified 43 Areas of Concern (AOCs) throughout the Great Lakes basin (Hartig et al. 1998). Areas of Concern were identified based on a list of 14 Beneficial Use Impairments (BUIs) (Figure 1).

Beneficial Use Impairments in Great Lakes Areas of Concern

1. Restrictions on fish and wildlife consumption
2. Tainting of fish and wildlife flavor
3. Degradation of fish and wildlife populations
4. Fish tumors or other deformities
5. Bird or animal deformities or reproduction problems
6. Degradation of benthos
7. Restrictions on dredging activities
8. Eutrophication or undesirable algae
9. Restrictions on drinking water consumption, or taste and odor problems
10. Beach closings
11. Degradation of aesthetics
12. Added costs to agriculture or industry
13. Degradation of phytoplankton and zooplankton populations
14. Loss of fish and wildlife habitat

Figure 1. List of Beneficial Use Impairments (BUIs). BUIs were used to designate Areas of Concern in the Great Lakes. Impairments signify changes in water quality that impact the ability for humans to fish, swim, and drink in a given water body. (Source: IJC 2020)

Beneficial Use Impairments signify a change in the integrity of a water body's chemistry, biology, or physical makeup that impacts the fishable, swimmable, drinkable, or habitat goals for water quality outlined by the US Environmental Protection Agency (EPA) in the Clean Water Act. Many BUIs, such as "Restrictions on Fish and Wildlife Consumption", focus on the impact that degraded water quality has on the humans who rely on the integrity of waters for provisioning and other ecosystem services. In fact, these BUIs were conceptualized according to the impaired ecosystem services that they represent. Although the Great Lakes BUIs were established in the 1980s, work on removing BUIs in AOCs across the Great Lakes was slow until creation of the Great Lakes Regional Collaboration (GLRC) in 2004. This collaboration served to re-energize efforts to remove BUIs within the designated AOCs, while also calling for overall restoration of the Great Lakes regional ecosystem. The GLRC outlined the key elements necessary for large scale restoration, establishing the Great Lakes Restoration Initiative (GLRI) (Great Lakes Regional Collaboration 2005).

The GLRI program, since its inception in 2010, has completed more than 5,300 restoration projects across Areas of Concern and the larger Great Lakes region, representing a ~\$2.7 billion federal investment. This program is a bipartisan federal effort that annually appropriates \$300 million across the GLRI's five main focus areas (Figure 2). One-third of this annual investment into Great Lakes ecosystem restoration is dedicated to supporting the 43 most polluted sites in the Great Lakes basin—those identified in 1987 through the

AOC program. Each AOC has a Public Advisory Council (PAC) that is responsible for local AOC project oversight. With memberships composed of community volunteers, these councils are designed to be liaisons between federal agencies and the AOC communities receiving funding for restoration. The expenditure of AOC program funding is guided by Action Plans that outline goals for the AOC program and its use of GLRI funds over 5 year intervals. The AOC program, now in its tenth year of receiving funding from the GLRI, has just entered its third 5-year Action Plan that outlines funding and restoration goals from 2020 to 2025 (USEPA 2019). Individual AOCs are guided by their respective Remedial Action Plan (RAP) which outline how each AOC will delist its BUIs over the life of its AOC designation.

Percentage Allocation FY2019

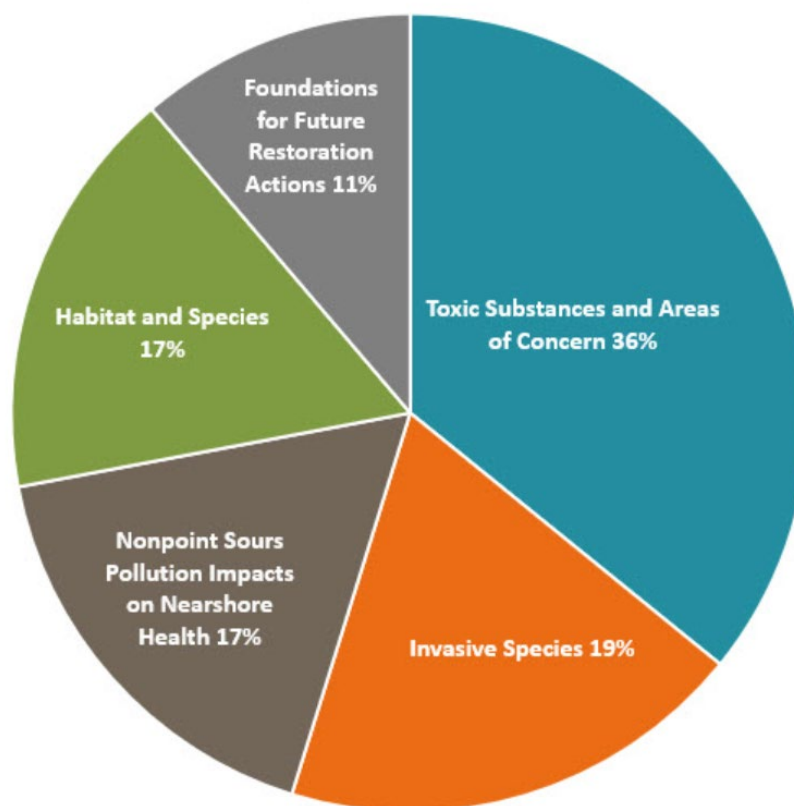


Figure 2. GLRI 2019 Funding Allocation. Distribution of GLRI funding across the program's five focus areas in the 2019 fiscal year. Since 2010, approximately \$300 million have been invested annually across these five focus areas by the federal government with bipartisan support. Each year, approximately one-third of the total investment is allocated for the remediation of toxic substances and the restoration of Areas of Concern. The projects in this focus area address the most dangerous and persistent contaminants located in the Great Lakes ecosystem, as identified in 1987. (Source: Great Lakes Restoration 2019)

While the Action Plans outline demonstrated goals for the GLRI program in five year cycles, or phases, they also provide a framework for the GLRI program to evaluate the work achieved in previous investment phases. Now having completed its second phase, the GLRI

and the restoration projects it has supported have demonstrated tangible progress in restoring parts of the region's environment and economy. Thus far, 100 of 255 BUIs have been delisted within US AOCs, 4.3 million cubic yards of sediment have been remediated, and more than 440,000 acres of habitat have been restored regionally (Great Lakes Restoration 2021). Additional economic studies have focused on the money spent in the GLRI program and have demonstrated that every federal dollar spent on restoration projects between 2010 and 2016 will result in an additional \$3.35 of economic activity, on average, across the region through 2036 (Great Lakes Commission and Council of Great Lakes Industries 2018). Regional leaders and experts have attributed this economic return on investment to the restoration of vital ecosystem services throughout the region as well as an increased sense of regional pride around Great Lakes waterfront areas (Hartig et al. 2019).

To ensure continued GLRI investment in the region's environment and economy through restoration of regional waters, advocacy groups like the Healing Our Waters—Great Lakes Coalition (HOW) works annually to educate members of Congress and the public about the far-reaching benefits of GLRI funding. Since 2004, the Coalition has been harnessing the collective power of more than 160 groups representing millions of people, whose common goal is to restore and protect the Great Lakes. In recent years, the Coalition, as well as other regional academic groups and agencies, has begun investigating how the GLRI both considers and impacts social equity in its work and projects throughout the region. The Coalition and others are specifically interested in learning if the benefits and values of GLRI investments are reaching the full spectrum of the region's socio-economic groups in an equitable manner.

The Great Lakes region, in part due to recent federal investments through the GLRI program, is at a critical point in its regional history where much of the coastal landscape is transitioning to a new economic model. This new model, nicknamed by some as a "blue economy", is shifting the economic focus of the region away from resource intensive and environmentally damaging industrial practices, back to a model that values and sustainably uses the freshwater resources that initially drew and supported settlers in the region (Enquist 2013). This is a historic opportunity for an entire culture of communities to define how they will use this one of a kind freshwater landscape more sustainably and equitably for current and future generations. Restoring the Great Lakes through GLRI investments is the catalyst for this transformation. Considerations of equity and justice in this restoration process are crucial for setting the tone of this new economic model and regional ethic; to ensure that it is centered around the sustainable and equitable use of freshwater resources, and the many benefits these resources provide to the many groups of people who call the Great Lakes region home.

Few studies have focused on the role of equity in Great Lakes environmental restoration. The majority of academic work in this space comes from the USEPA, Great Lakes Toxicology and Ecology Division Laboratory in Duluth, Minnesota. Here, aquatic and social scientists have together studied the relationships between ecosystems services, Great

Lakes restoration, and community wellbeing (Angradi 2019). Through this work they have created the Remediation to Restoration to Revitalization (R2R2R) framework (Williams and Hoffman 2020). The R2R2R framework specifically recognizes the connections between ecological integrity and social equity, and calls for more equitable participatory engagement in remediation projects to ensure that restoration outcomes lead to equitable revitalization benefits (Williams and Hoffman 2020). Even though the GLRI was formed to ensure a sustainable water future for the Great Lakes region, equity and justice analyses have not been a driving component of the program. Thus, groups like HOW are working to encourage that GLRI investments proceed with a purposeful focus on all three pillars of sustainability: environmental health, economic prosperity, and social equity (Savitz and Weber 2006).

In support of the third pillar of sustainability, social equity, we aimed to provide insight into how current GLRI restoration projects translate to social outcomes that can impact resource equity and quality of life for a community and its residents. Furthermore, by sharing personal narratives of residents living within and adjacent to Areas of Concern in Michigan, we aimed to highlight a connection between more equitable restoration outcomes and increased local interest in water resources, sustainability, and GLRI investments. We believe that using GLRI projects to reestablish this connection between Great Lakes people and the region's freshwater resources will form a cultural foundation for the continued protection of the Great Lakes and the region's economic, environmental, and social prosperities.

If equity is not placed at the forefront of such an important and monumental program, underserved populations are poised to be left behind in the reimagining of a new, less resource intensive economic model for the Great Lakes region. Equity was our foundational and operational focus, because as the GLRI program aims to establish a sustainable water future for the Great Lakes region, it is critical that GLRI benefits are far-reaching and supportive of the livelihoods of all residents. Environmental equity is defined by the EPA in the context of environmental risks:

“Environmental equity refers to the distribution of environmental risks across population groups and to [the EPA’s] policy responses to these distributions. While there are many types of equity, all of which are important to EPA, [this definition] focuses on racial minority and low-income populations.” [USEPA 1992].

This definition, from EPA’s 1992 report—Environmental Equity: Reducing Risk for All Communities Volume 2 report, was written at a time when EPA began to investigate the patterns of environmental problems and how they variously impacted the people who live in areas subjected to environmental degradation. Importantly, the report notes:

“The causes of these differences [in environmental risk] are often complex and deeply rooted in historical patterns of commerce, geography, state and local land use decisions and other factors that affect where people live and

work [and that] with respect to some types of pollutants, race and income, however, appear to be correlated with these distributions.” [USEPA 1992].

This point is particularly important when considering the Great Lakes region’s historical context. In the 1800s, white Europeans settled in the Great Lakes and confiscated lands from the region’s indigenous people to secure the establishment of a prosperous, resource-reliant culture and economy. During the region’s period of intense industrialization in the 20th century, the abundance of working-class jobs attracted minority, predominantly black workers, looking to escape the hostile slavery and Jim Crow conditions that prevailed in the American South for generations. During this wave of migration, also called the Great Migration (1916-1970), cities and urban areas across the United States, and particularly the Midwest, created Residential Security Maps with the help of the Home Owners’ Loan Corporation (HOLC)—a federal agency. These maps labeled high risk or hazardous areas with red lines and segregated many major US cities on the basis of environmental degradation, demographics, and race. Redlined, or hazardous areas, were neighborhoods where black residents were allowed to live, but importantly, these areas denied black residents access to federal housing loans afforded to their white counterparts. Often, as is apparent within the City of Detroit, redlined neighborhoods were located in undesirable, environmentally dangerous locations. Redlined areas in Detroit were all located near the heavily polluted industrial areas adjacent to the Rouge and Detroit rivers—two river AOCs that continue to struggle with the impacts of severe legacy pollution (Figure 3). As with this legacy pollution, the community impacts of this practice persist today with approximately 74% of redlined neighborhoods, all labeled in the 1940s and 1950s, still experiencing low to moderate levels of income across the country (Mitchell and Franco 2018). Overall, the Midwest region is second only to the South in terms of the least amount of change in income over the last 80 years for redlined communities (Mitchell and Franco 2018).

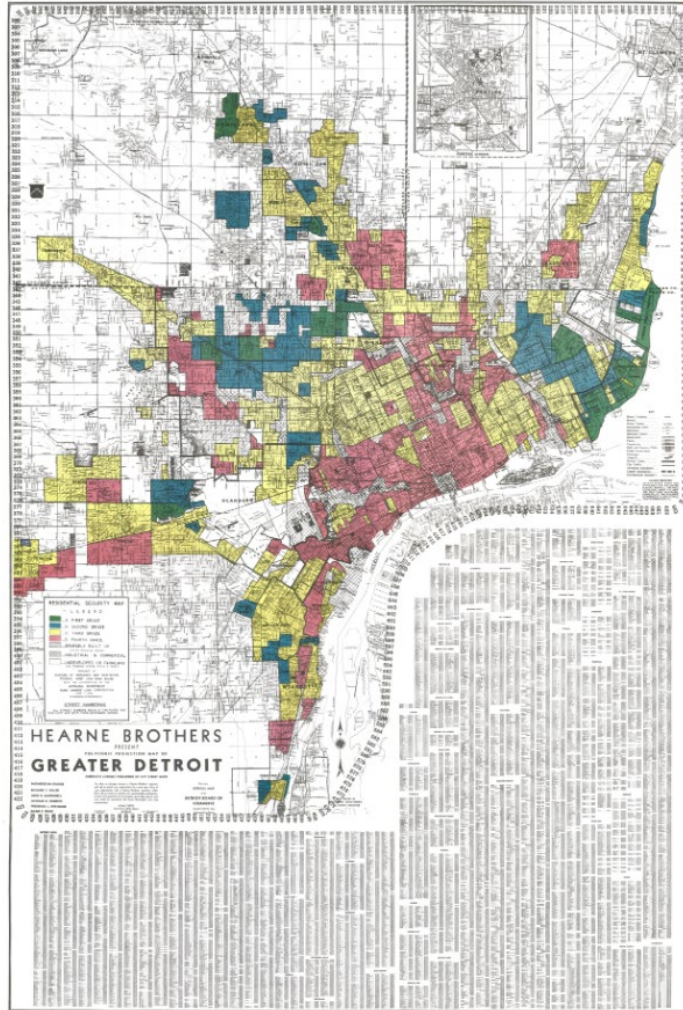


Figure 3. Historical Home Owners' Loan Corporation (HOLC) Residential Security Map for the City of Detroit. Redlined, or hazardous areas, are noted with red and are located close to the Detroit and Rouge Rivers. Yellow areas are noted as declining areas while blue and green areas are best and desirable, respectively. (Source: Nelson et al. 2021)

The role of the federal government in promoting future regional equity, and specifically within the context of environmental equity, is crucial to remediating both the physical-chemical and cultural degradations that many of their policies have allowed or exacerbated since the start of our democratic nation. Approximately 40 years after HOLC's inequitable segregation of landscapes across the United States, the EPA established its role in remediating environmental inequities, this time in the context of better protection and access for the future generations:

“Everyone has a stake in environmental equity because it results in better environmental protection generally. Environmental equity is an important goal in a democratic society. It involves ensuring that the benefits of environmental protection are available to all communities and an environmental policy-

making process that allows the concern of all communities to be heard, understood, and addressed.” [USEPA 1992].

While the formal GLRI program would not come for another 18 years, the EPA has long been in charge of the AOC program and tasked with helping steward Great Lakes ecosystems to again become swimmable, fishable, and drinkable. Although the GLRI has demonstrated economic and environmental success over its first ten years, there has been little evaluation of whether it has served to minimize environmental risk and remediate legacies of environmental inequities. Further, there is no concrete promise of how long the GLRI program will continue. Therefore, this is the moment to orient towards environmental equity in the Great Lakes while this program still has support, momentum, and work to complete. Waiting to address equity, and its relationship with freshwater restoration, will waste this enormous regional opportunity and will hinder the region’s progress towards forming a new blue economy and freshwater culture. Our study began this inquiry into emphasizing social equity across the GLRI and illustrating that equity needs to play a critical role in the revitalization of the Great Lakes region as it enters a new century—one that we and others hope will be defined by progress towards a more sustainable and equitable freshwater future.

Project Objectives

In this report, we examine the role of social equity in, and the social values of, the GLRI program by addressing the following four objectives:

Objective 1. To define equity and justice in the context of the Great Lakes and environmental restoration.

We compiled definitions of equity, justice, and social valuation to set the context for our investigation into social equity regarding the history and restoration of the Great Lakes.

Objective 2. To assess community perceptions of equity and social value given to GLRI restoration work, using community interviews.

We assessed dynamics within a set of communities adjacent to AOC study areas to build a clearer understanding of how communities have been impacted by their impaired freshwater resources, and how they perceive current and past restoration efforts. Within each AOC community we considered how people relate to their larger community and to the impaired water resource itself, taking into consideration how community extent is defined around each AOC body of water.

Objective 3. To highlight uses of spatial data and geo-visualization tools for investigating patterns between historical injustices, GLRI project distribution, and community demographics.

We highlighted existing data and mapping tools within the environmental justice field, including efforts that address redlining policies, and tools that incorporate pollution hazards and population characteristics to assess cumulative impacts. We explored relationships between spatial distributions of GLRI projects and social demographic data within each AOC case study to illustrate patterns and disparities using Geographic Information Systems (GIS) tools through Esri's ArcGIS platform. Social demographics of particular interest included: race, socioeconomic status, and social vulnerability indicators.

Objective 4. To provide equity-informed recommendations for the HOW Coalition's GLRI advocacy.

Our project findings highlight the roles that social equity and the social value of restoration have within each AOC case study community and can have within the larger Great Lakes Restoration Initiative effort. Our project recommendations reflect actions and changes that our client, the Healing Our Waters—Great Lakes Coalition, can use in their work advocating for the role of social equity and justice in the GLRI. Our recommendations outline (1) actions that HOW can pursue in connecting with and supporting community organizations in the Great Lakes region, and (2) actions and changes that HOW can advocate for at the federal level. The second set of recommendations are further broken down into congressional policy recommendations and EPA program administration recommendations.

Chapter 2: Methods

Study areas

We used four case study AOC communities as units of analysis. Study areas were chosen from the Great Lakes Revival report, which utilized robust economic analyses in six Great Lakes AOCs to determine future return on investment in GLRI restoration work (Hartig et al. 2019). We chose case study AOCs at varying levels of restoration progress that also represent a range of sociodemographic contexts. This resulted in a bi-coastal focus in the state of Michigan, with Muskegon Lake and White Lake serving as our western Michigan sites of interest, and Rouge River and River Raisin serving as our eastern Michigan sites of interest (Figure 4). Although not included in the Revival report, White Lake serves as a crucial analytical comparison as it is our only study site that has removed all of its BUIs and been delisted as an AOC. Notably, White Lake is one of only three delisted AOCs within the entire state of Michigan. Additionally, while not the primary focus of the analysis, due to its proximity to Rouge River, the Detroit River AOC was included in conjunction with the Rouge River AOC to provide necessary and important context for the status of restoration efforts within and across the large and diverse Detroit community.

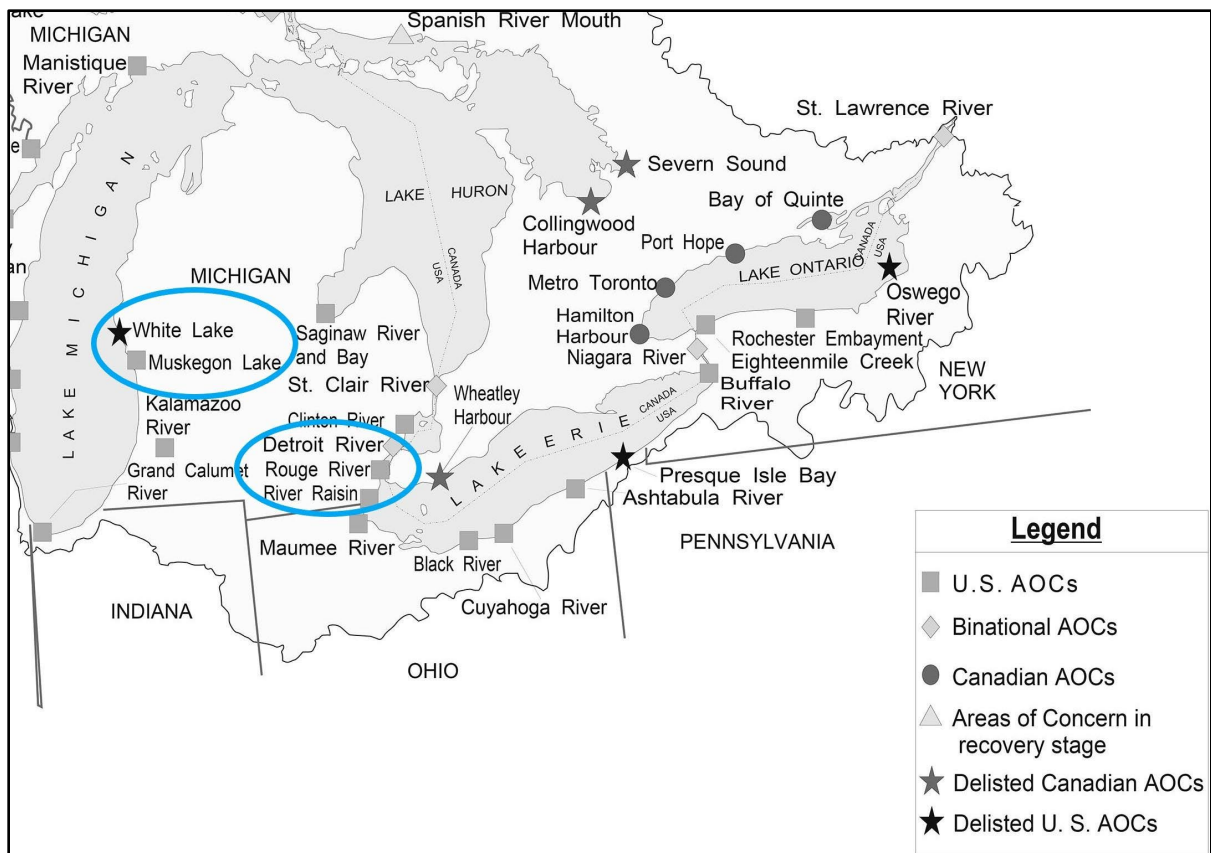


Figure 4. Map of Great Lakes Areas of Concern in the Lower Peninsula of Michigan. Blue circles indicate the bi-coastal AOCs we examined in the state of Michigan. (Modified from Hartig et al. 2019)

River Raisin AOC

The River Raisin AOC is located within southeast Michigan in Monroe County, adjacent to the western edge of Lake Erie (Figure 5). The extent of the AOC includes a 2.6 square mile portion of the river's mouth within the city of Monroe, plus a portion extending 0.5 miles into Lake Erie. The AOC designation stemmed from historical manufacturing practices and the presence of wastewater treatment plants, paper mills, landfill discharges, and agricultural runoff that led to significant local environmental degradation in this lower river segment. Five of the nine originally listed BUIs have been removed. Restrictions on fish and wildlife consumption, bird or animal deformities or reproduction problems, degradation of benthos, and restrictions on dredging activities are the four BUIs that persist. Although all necessary restoration and management actions for these remaining BUIs have been completed within the AOC, additional monitoring and maintenance of restored environments is needed before delisting can officially occur.



Figure 5. River Raisin Area of Concern. The AOC area is depicted in orange and covers the downstream most segment of the River Raisin where the watershed and river drain into the western portion of Lake Erie. This lower portion of the river was historically home to industry and is still the location of industrial activity. (Source: USEPA 2020a)

Rouge River AOC

The Rouge River AOC encompasses the main, upper, middle and lower branches of the river as well as the entire 466 square mile watershed in southeastern Michigan. The river system passes through 48 communities before emptying into the Detroit River (Figure 6). The oldest and most heavily industrialized areas of southeast Michigan lie along the lower segment of the Rouge River. Over 50% of the watershed land uses are commercial, industrial, or residential—a stark change from the area’s pre-settlement land uses. The most prominent environmental concerns include combined sewer overflow discharges, industrial discharges, nonpoint source pollution, and heavily contaminated sediments.

Nine use impairments have been identified for the Rouge River watershed: restrictions on fish and wildlife consumption, eutrophication or undesirable algae, degradation of fish and wildlife populations, beach closings, fish tumors or other deformities, degradation of aesthetics, degradation of benthos, restrictions on dredging activities, and loss of fish and wildlife habitat. Since these BUIs were designated in 1987, none have been removed. We focused on the lower Rouge channel in our analyses, particularly the segment running adjacent to southwest Detroit, as this area has the most restoration work to complete and is home to a number of underserved communities.

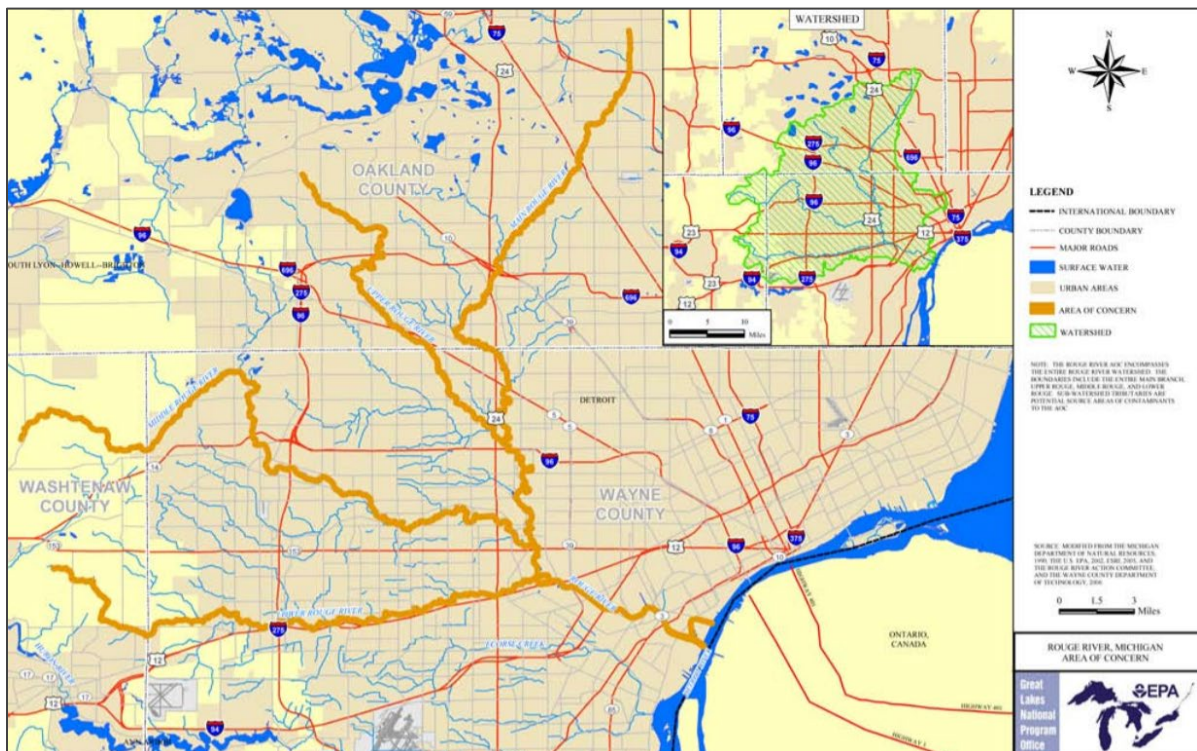


Figure 6. Rouge River Area of Concern. The Rouge River watershed, the extent of the AOC, is depicted green in the top right inset. The network of waterways and tributaries throughout the Rouge watershed are depicted in orange. There is a heavy industrial presence along the lower corridor of the river with residential and commercial land uses in the upper reaches of the watershed. (Source: USEPA 2021a)

Detroit River AOC

The Rouge River drains into the Detroit River, a binational waterway that has served as a vital resource for the industrialization of Detroit, MI and Windsor, ON. We added the Detroit River AOC to our study to broaden context for the social valuation of restoration within the Detroit community. The Detroit River AOC encompasses the channel's 32-mile-long stretch from the flashing navigation light near Peche Island to the Detroit River Light in Lake Erie (Figure 7). The river was the receiving body for numerous industrial and urban discharges throughout the development of the Detroit region, including substantial wastewater and stormwater runoff. Priorities within this AOC include combined sewer overflows, nonpoint source pollution, contaminated sediment, habitat restoration, and pollution prevention. Of the eleven BUIs originally designated in 1987, only two have been removed thus far.

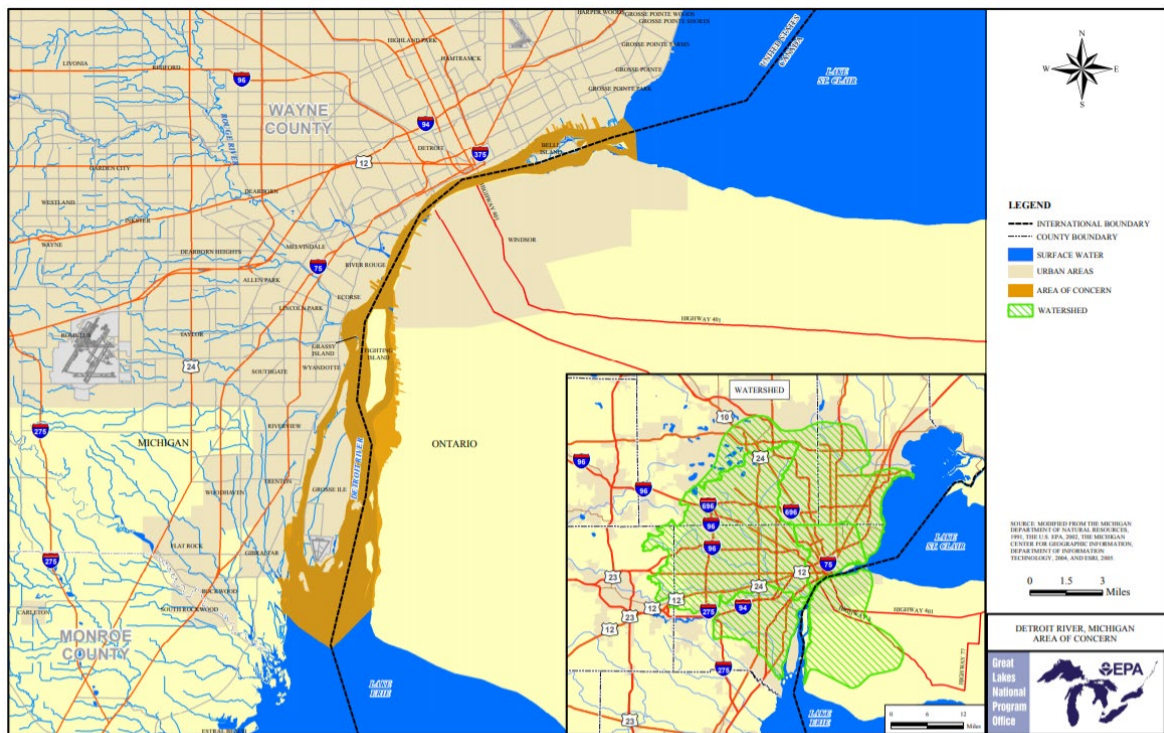


Figure 7. Detroit River Area of Concern. Outline of the AOC is depicted in orange. The boundaries of this AOC are defined by the United States and Canadian shorelines and also by Lake St. Clair and Lake Erie. The river was a common location for heavy industrial use and has been impacted by runoff and discharges from residential development. (Source: USEPA 2020b)

Muskegon Lake AOC

The Muskegon Lake AOC covers an area of 6.5 square miles in Muskegon County, along the coast of Lake Michigan (Figure 8). The city of Muskegon is prominently situated on the southern edge of the lake. The AOC encompasses the local waterways of Muskegon Lake, Ruddiman Creek, Ryerson Creek, Four Mile Creek, much of the Muskegon River, Bear Creek, Bear Lake, and up through Little Bear Creek. The AOC designation was established in 1987 due to ecological impairments resulting from industrial discharges, shoreline development, industrial debris filling water bodies, and localized groundwater contamination. The primary problems identified include contamination of sediments, loss of shoreline, impacted wetlands, high levels of nutrient and toxin loading in water bodies, and significant degradation of water quality.

Nine BUIs were identified for Muskegon Lake and its affected tributaries, four of which have been removed. Eutrophication or undesirable algae, degradation of fish and wildlife populations, degradation of aesthetics, degradation of benthos, and loss of fish and wildlife habitat still persist.

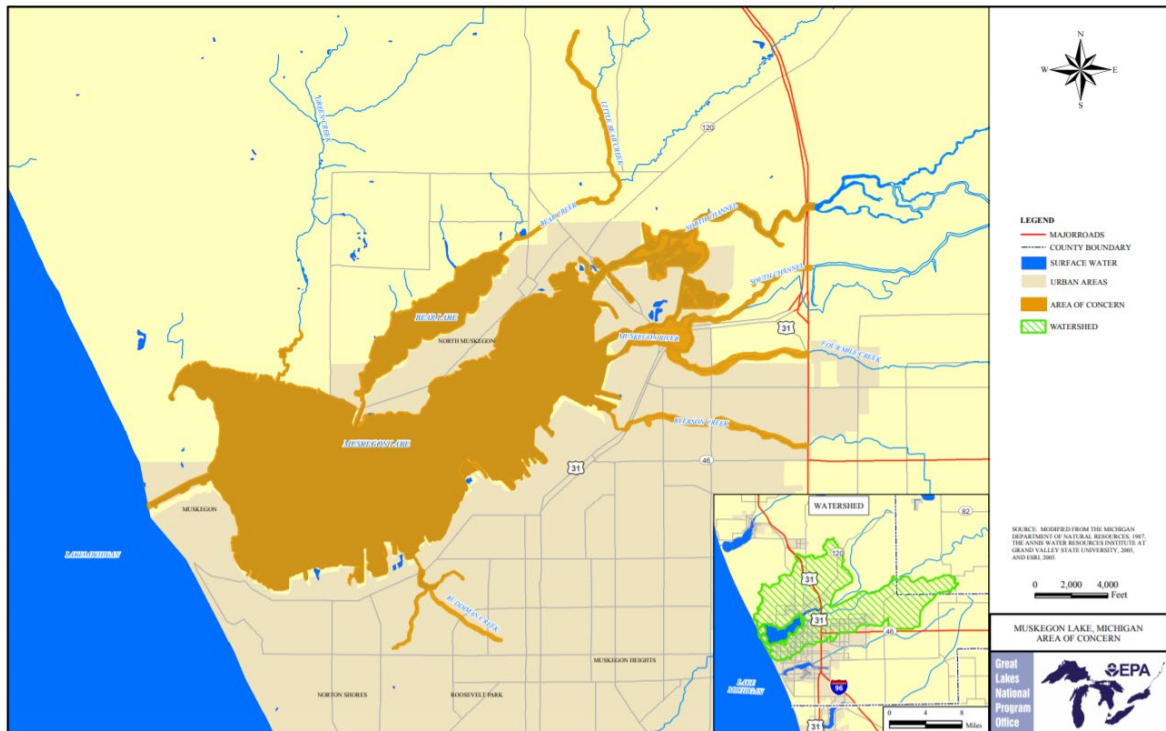


Figure 8. Muskegon Lake Area of Concern. Outline of AOC is depicted in orange and covers the majority of Muskegon Lake as well as the downstream portions of rivers that discharge to the lake. The southern shoreline was historically home to industry such as paper mills and machine shops. (Source: USEPA 2020c)

White Lake AOC

The White Lake AOC covered an area of 4 square miles, which included the lake itself and a source area around the lake (Figure 9). The lake is situated in northern Muskegon County along the eastern shore of Lake Michigan. White Hall and Montague are the two principal small cities that abut the lake. The lake was designated an AOC in 1987 under the Great Lakes Water Quality Agreement, and was officially delisted in 2014 after successfully removing all BUIs.

Environmental degradation occurred as a result of a long history of chemical manufacturing, industrial tannery operations, improper waste disposal, municipal discharges, and other activities in and near the lake. Groundwater contamination, heavy metal contamination of sediment, and excess nutrients were the most persistent environmental problems plaguing the water body. A total of eight BUIs were removed between 2011 and 2014. Throughout its life as an AOC, more than 100,000 cubic yards of sediment were remediated and over 50 acres of critical aquatic habitats were restored.

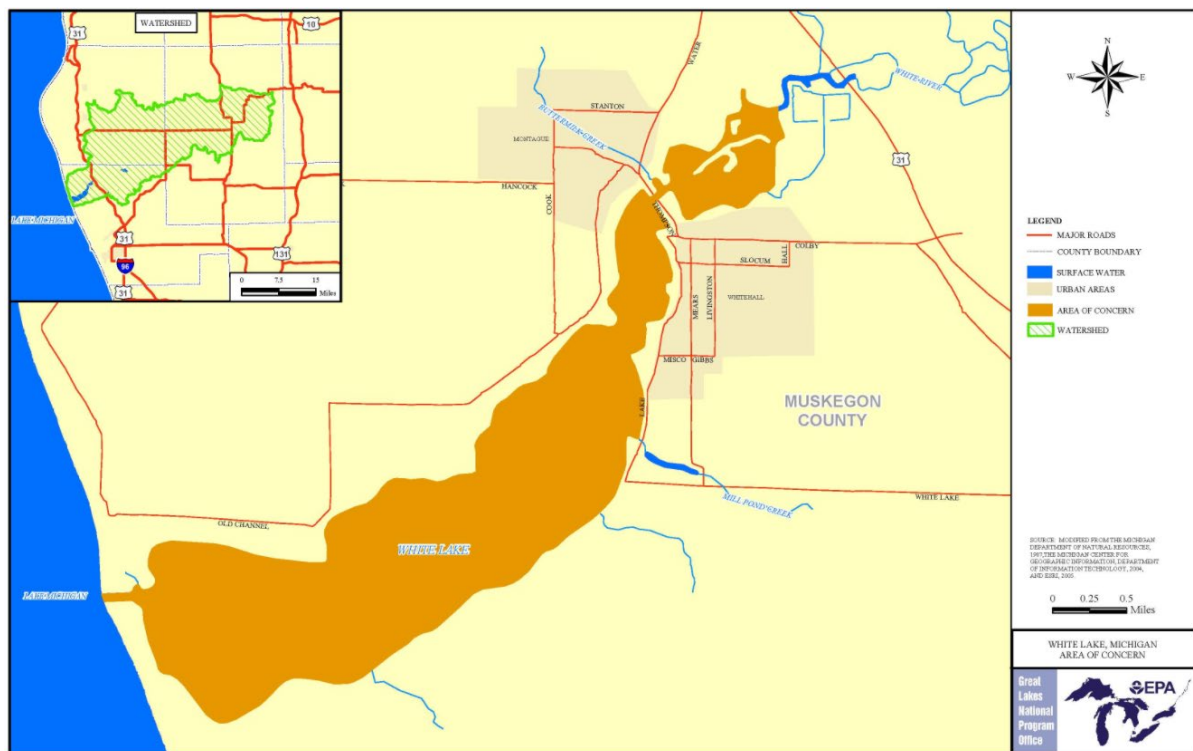


Figure 9. White Lake Area of Concern. Outline of AOC is depicted in orange and covers the majority of White Lake. White Lake historically had a strong industrial presence due to large chemical and tannery companies on its shorelines. (Source: USEPA 2021b)

Project Methods

Objective 1. To define equity and justice in the context of the Great Lakes and environmental restoration

To achieve this objective we researched and summarized current definitions of equity and justice. Definitions came from both literature sources and those used in practice by government agencies. We also included relevant definitions that HOW uses in advocating for environmental justice in the Great Lakes. This search also helped us compile and identify a list of commonly used social valuation metrics that informed our discussions with community members. These metrics are often used when discussing social equity and justice outcomes in restoration work. Many of these metrics come from ecosystem services assessments where there is specific focus on how services are distributed or are benefitting a study population.

Objective 2. To assess community perceptions of equity and social value given to GLRI restoration work, using community interviews

To learn about the broad narratives that exist around perceptions of equity and social values given to GLRI restoration work in the Great Lakes, we first spoke with GLRI and AOC Practitioners and Equity and Justice Practitioners. This step helped us to learn about GLRI and AOC processes as well as the context of equity and justice in current Great Lakes restoration programs. Next, we interviewed community members across our four AOCs to ask questions about community perceptions of equity in GLRI restoration work and how restoration work relates to larger community dynamics, and specific community concerns and priorities surrounding freshwater resources. Using a snowball technique, our interviewees included, but were not limited to, restoration and city leaders, representatives of local organizations, and community residents. Following our 26 interviews we used an iterative interview coding methodology that allowed us to bin and organize interview responses based on theme similarities across interviews. We first created an interview codebook based on the discussion themes we heard during interviews to start organizing our interview data. We then used the NVivo 12 qualitative data analysis software to digitally organize our interview data using the codebook's themes (QSR International 2020). Our team also used NVivo to quantitatively assess interview coding results. Our final step utilized narrative analysis to identify and summarize the key themes we heard in interviews across each AOC community. We also conducted a follow-up survey to ground-truth our findings and provide a space for community members to share additional thoughts.

Context Gathering Discussions

To establish project context, prior to our primary community research interviews, we identified and reached out to "key players", individuals considered to be at the forefront of thought and practice within their respective fields; fields included the GLRI program, AOC restoration, and environmental justice. We selected these individuals based on suggestions from our project advisor and client as well as from primary literature and reports relevant to our project. We contacted individuals via email, and followed up with those who responded

with interest in contributing knowledge and expertise to our project. We used a semi-structured interview methodology in each interview, guided by some primary and secondary questions prepared beforehand (See Appendix 1 for full practitioner interview framework). Additional probing questions were also asked spontaneously throughout the course of the interviews, depending on the topics and content discussed by each interviewee. Interviews were held online via the Zoom platform, for no more than one hour. A note taker was assigned for each discussion to facilitate reference to important points made in the future. We conducted context gathering interviews with two groups: GLRI/AOC Practitioners (N=13) and Equity/Justice Practitioners (N=6).

GLRI/AOC Practitioners. These were individuals with considerable expertise in some aspect of the GLRI or AOC programs, e.g., program coordinators and practitioners, political architects, authors of key academic reports, and previous University of Michigan AOC project team members.

Equity/Justice Practitioners. These were individuals demonstrating significant contributions to action and research in the fields of environmental justice, social justice, and community activism in the Great Lakes region. Many have worked and continue to work in Michigan coastal communities and urban centers like Detroit. Some practitioners have worked with equity in water resources related projects while others have not. Scholars, activists, and authors of foundational environmental justice theory were within our pool of respondents.

Community Interview Framework

A series of initial, project research questions guided the design of our interview process. These research questions were broken into two thematic categories: community definition and water resource connection, shown below. With these research questions, we created a community interview framework composed of primary and secondary research questions relating to personal connections to water resources and restoration work, overall community perceptions and concerns, and barriers to connecting with water resources, among others (See Appendix 2 for full community interview framework).

Community Definition. Within the first category, our research questions were:

1. How is community defined around each AOC water resource?
2. What services does the water resource provide to the community?
3. Which layer(s) of the community benefit from the services provided by the water resource?
4. Which layer(s) of the community are underrepresented in the GLRI and AOC project process?
5. Which layer(s) of the community are vulnerable to being negatively impacted by GLRI and AOC project outcomes?

Water Resource Connection. Within this second category, our research questions were:

1. When thinking of the geographically-proximal areas, how do members of each AOC community relate to and benefit from the water resource and GLRI community revitalization efforts (e.g., do they use it, only know of it, or have no knowledge of it)?
2. Which community organizations utilize this water resource or connect the community to this water resource?
3. How have organizations or community members been included or excluded from restoration efforts of the water resource?
4. Which social values are most important to members of the AOC communities for consideration in future GLRI and AOC projects?

Snowball Community Interviewing

We identified community interviewees using a snowball methodology. The initial pool of potential participants were identified based on recommendations from our context-gathering group of interviewees. The first round of community interviewees from each AOC were individuals with demonstrated dedication to the goals of freshwater restoration projects and others who had or have been active in restoration activities. We solicited recommendations during each successive interview, and the pool of potential community interview participants expanded. In each interview we used the Community Interview Framework as a conversational guide and supplemented it with spontaneous probing questions related to the specific conversation's context. We completed 26 total interviews across our four study sites. The number of interviewees were fairly evenly distributed across our case study AOCs (Table 1). All interviews were held online using the Zoom platform, were no longer than one hour; and were recorded and captioned using built-in Zoom functionalities, in addition to one research team member typing notes.

AOC Community	Number of Interviewees
River Raisin	7
Muskegon Lake	6
Rouge River (and Detroit River)	8
White Lake	5
Total	26

Table 1. Breakdown of community interviews by case study AOC.

Targeted Interviews of Underrepresented Stakeholders

As our project focused on equity and justice, it was important to supplement our snowball community interviewing with targeted outreach to underrepresented stakeholders. While snowball interviewees provided crucial information about restoration activities from the community perspective in each AOC, this outreach method limited our interviewee pool to just the “usual suspects”, those individuals who were already actively involved in some aspect of the restoration. We used Google, Facebook, and other social media platforms to research organizations and figures in each AOC community who represent underserved constituencies to ensure that our pool of interviewees included a diverse set of voices. This also ensured that we spoke with community members who may not be familiar with the GLRI and AOC restoration work in their community. COVID restrictions limited some of our outreach to these underrepresented voices in each community. With the snowballing outreach efforts and additional attempts to reach individuals through social media platforms and organizational channels, we interviewed one small business owner, one ADA (Americans with Disabilities Act) practitioner, three tribal members, and five individuals from underrepresented racial minority groups across the four AOC communities. Atypical stakeholders represented 38% of total interviewees.

Transcription and Coding Methodology

We transcribed each community interview using the auto-generated, Zoom captioning feature. Each interview transcript was then assigned to one team member who would correct the auto-generated transcript to create a final clean Word document that was ready for interview analysis. We cleaned the auto-generated transcriptions for each interview by listening to the recorded Zoom interviews, correcting errors, and adding missed information.

Theme Review for Codebook Creation. We then reviewed each interview transcript to pull out initial, broad narrative themes. To reduce bias, each transcript was read separately by two different team members. The themes produced from each reading were compiled into a spreadsheet and compared between readers. We used these themes to produce a codebook, which is a list of primary codes and subcodes, aligned with our research questions. The codebook was ultimately used as an analytical tool to qualify and assign meaning to responses from each interview. The use of a codebook analysis also helped translate qualitative interview responses into quantitative data that were easier to analyze, compare, and represent visually (See Appendix 3 for our codebook).

Coding Interviews in NVivo. After finalizing the codebook’s primary code and subcode definitions, we uploaded the cleaned transcripts into NVivo software to apply these codes to statements in each interview. Primary codes and their respective subcodes were manually added into NVivo as parent nodes and child nodes. These nodes were aggregated, meaning that statements coded as child nodes would automatically be rolled into the parent node for organizational and analytical purposes. Cases in NVivo were used to distinguish between speakers. All

interviewees were coded as “Interviewee” and team members conducting the interview were coded as “Interviewer”. Each interviewee was also assigned a case attribute to represent their AOC community and further inform comparative analysis across AOCs. To reduce bias, each interview was randomly assigned to a primary coder who would assign codes and subcodes to the clean interview transcript. After this first round of coding was complete, each interview was then reviewed by a second coder, who would make notes of disagreements and questions. After this step, the primary coder would then review the notes of the second coder, resolve comments, and finalize the interview’s codes.

Since only one team member was able to work in the software at a time due to NVivo license limitations, a full save of the entire NVivo project document was needed after each use. We established a check-out system through Google Sheets to manage NVivo revisions and versions. Upon saving their work, each team member resaved the NVivo working file under a new name, which included the user’s initials of and the date the revision was saved. Revision files were uploaded into a Google Drive folder, and each team member filled out the Google Sheet file after each use, noting the old file name, date, new file name, date of file upload, and notes of actions performed in the revised document.

Analyzing Coding Results

Our analysis of the coding results generated with NVivo software included a preliminary analysis using quantitative data, generated from NVivo, followed by a narrative analysis where each team member reviewed and summarized the major narratives present in the statements within each code and subcode.

Quantitative Analysis. Once codes were finalized across all interviews in NVivo, we explored the interview data using tables and charts. The NVivo software allowed for quick generation of the tables containing total numbers of coding mentions per code and subcode, as well as numbers of code and subcode mentions by AOC. We calculated the percentages of interviews in each AOC that mentioned specific codes with these tables (e.g., 6 out of 7, or 83% of interviewees in the River Raisin AOC spoke about Education). These quantitative results allowed us to compare the relative number of mentions of codes and subcodes across AOCs. We generated a preliminary list of key themes, approximately three or four, for each AOC based on these quantitative coding results.

Narrative Analysis. Although NVivo software allowed for the generation of quick quantitative results, these results were supplemental to the larger storytelling goal of this objective. Narrative analysis was the most important part of this study because it captured the experiences and thoughts of residents living within AOC communities. In support of this goal, after NVivo coding and preliminary quantitative analysis were complete, our team split up the codes and subcodes from across all the interviews to

review the final statements included in each code. The purpose of this was twofold. First, this process helped our team check for coding inconsistencies across interviews and AOCs. Second, this process also helped our team document the major narratives within each code within and across each AOC community. In this process each team member created a summary document for each code and subcode that listed the major narratives from the codes and subcodes they were assigned. This document also included a short comparative summary, about one paragraph in length, for other teammates to reference in the future. The summary documents for each code and subcode also contained representative interview quotes that could be included in this report.

Case Study Narrative Analysis

Following quantitative and narrative analyses of our coding results, we revised the final list of key themes drafted for each AOC from our comparison of quantitative coding results across AOCs. Selection of key themes was ultimately informed by the relative number of mentions the theme had in each AOC, and by a determination from our team whether the theme contributed to the larger narrative between equity and restoration in the AOC community. Some of the final key themes selected were present across multiple AOC communities, while others were not. At this stage each team member was assigned an AOC community and wrote a summary of the interview results that focused on telling the story around their assigned AOC's key themes. Interview results summaries used the narrative analysis documents produced in the previous analysis step and supplemental quantitative analysis results when appropriate. Interview results documents for each AOC were reviewed by all team members and then compiled into one results document.

Follow Up Survey

In order to ground-truth our results, we created a follow up survey that was distributed to all 26 community interview participants. This survey coalesced major themes that were identified during interview analysis in the form of statements that survey participants could respond to (e.g., "I feel comfortable participating in..."). In addition, we asked participants about their familiarity with certain equity and justice terms, as well as their relevance within their community. A Likert scale from 1 to 5 was used to allow for quantitative results. We created and administered the survey on Google Forms and asked participants to complete the survey in one week, with flexibility for late submissions. Survey data were used to refine our report recommendations (See Appendix 4 for follow-up survey questions).

Objective 3. To highlight uses of spatial data and geo-visualization tools for investigating patterns between historical injustices, GLRI project distribution, and community demographics

To highlight the value of spatial data and visualizations in understanding environmental justice and spatial patterns present in our AOC communities, we explored recent mapping initiatives and available data for the state of Michigan. By incorporating redlining data from the mid 1900s, we showed how these past structural policies relate to current environmental

impacts available in spatial Environmental Justice (EJ) screening tools. Furthermore, we emphasized how these spatial tools can inform more than just decision-making and policies to support vulnerable communities. We aimed to enrich the current understanding of Environmental Justice mapping efforts in Michigan and encourage the use of spatial tools in future environmental initiatives, including the GLRI.

We also explored relationships between spatial distributions of GLRI projects and demographic data within each AOC case study. We created maps to illustrate the community contexts of each AOC. These maps included spatial data on race and socioeconomic diversity, household composition, and overall social vulnerability across communities. With these maps we aimed to show how mapping spatial data can help tell the larger story of these AOC communities, alongside our qualitative and storytelling component from Objective 2.

Mapping Methodology

We developed map panels for the four AOC communities illustrating each of our datasets of interest, which are further described in the Data Sources and Indices section. We mapped GLRI project locations alongside redlining data when available, and used median home value and household income for AOCs that do not have historical redlining data. Race demographics, Social Vulnerability Index scores, and Michigan EJ Scores were also mapped for each AOC community.

ArcGIS Software. ArcGIS Pro 2.7.1 was used to organize and compile each dataset of interest. All maps were displayed and created using the NAD 1983 UTM Zone 17N projection.

GLRI and AOC Data Acquisition. We obtained GIS shapefiles of watershed and AOC boundaries for the River Raisin, Rouge River and Detroit River, Muskegon Lake, and White Lake AOCs from Mark Loomis, the USEPA Federal AOC Task Force Lead.

We visually explored the data in our AOC case studies to ensure that all relevant projects within our AOCs of interest were included in our mapping process. We included projects listed as “Multi-state” for their “Affected States” designation, and also included GLRI projects located just outside of the AOC boundaries if projects were within the same watershed and related to the AOC’s restoration work.

Data Sources and Indices

GLRI Projects. We acquired an Excel spreadsheet of all GLRI projects, last updated on March 31, 2020, from the official GLRI website to visualize project distribution within and across our four AOC communities. The 5-year GLRI Action Plans discuss and outline goals for five focus areas for restoration efforts in the Great Lakes region.

The five focus areas are: 1: Toxic Substances and Areas of Concern, 2: Invasive Species, 3: Nonpoint Source Pollution Impacts on Nearshore Health, 4: Habitats and Species, and 5: Foundations for Future Restoration Actions. While focus area 1 specifically addresses AOCs, we mapped projects from all five focus areas. Many projects in other focus areas were associated with each AOC and included restoration work relating to water quality, pollution cleanup, and community education.

Michigan EJ Scores. The Michigan EJ Scores tool quantifies cumulative impacts across the state of Michigan. The tool was developed by a team of Master’s students at the University of Michigan in collaboration with the Michigan Environmental Justice Coalition and Dr. Paul Mohai. This dataset is the current Michigan screening tool inspired by CalEnviroScreen, the first state EJ screening tool in the country (Grier et al. 2019). The State is currently working to add more health data to this tool and will publish a draft tool for comment in late 2021 (NWF 2021).

Much like CalEnviroScreen, the Michigan EJ Scores tool includes indicators representing both pollution burdens and population characteristics. Unlike CalEnviroScreen, this tool includes “Percent Minority” as a socioeconomic factor that contributes to the population characteristics portion of the final EJ score (Figure 10).

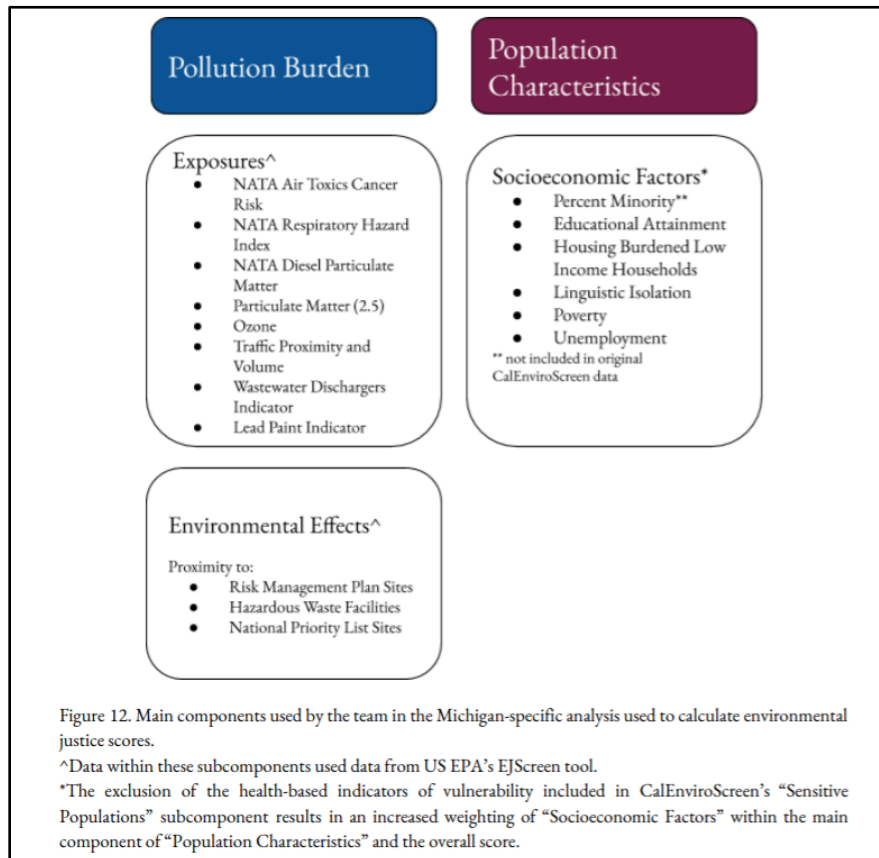


Figure 10. Michigan EJ Score indicators. Many indicators of Pollution Burdens and Population Characteristics in the Michigan EJ Score tool mirror many of those used in CalEnviroScreen. One important distinction is that CalEnviroScreen does not include an indicator for Percent Minority, although this indicator is often used as a compelling comparison to CalEnviroScreen's cumulative impact results. (Source: Grier et al. 2019)

The Michigan EJ Scores currently do not account for AOC designation in their calculations. Similar to other tools, there is a lack of data on how and where impacts from water borne pollutants impact humans. The only indicator related to water quality in the current scoring is "Wastewater Discharges". This indicator covers one current concern that is related to the goals of the AOC program but does not account for the industrial and legacy pollutants that impact many coastal communities in Michigan (**Figure 10**).

Although the Michigan EJ Scores do not include indicators relevant to some of the priorities of the GLRI program, they do help illustrate which communities are burdened by cumulative impacts in the state and provide some first steps towards understanding water-related burdens. The theory behind cumulative impacts suggests that communities who are burdened with environmental injustices are often also burdened with multiple environmental stressors that impact human health and community prosperity (Lee 2021). The magnitudes of EJ Scores across the state of Michigan further support this theory, as the census tracts within the highest percentiles of EJ cumulative impacts scores have much larger cumulative impacts compared to the State's median EJ score of 23.314 than those census tracts in the lowest EJ score percentiles (Figure 11).

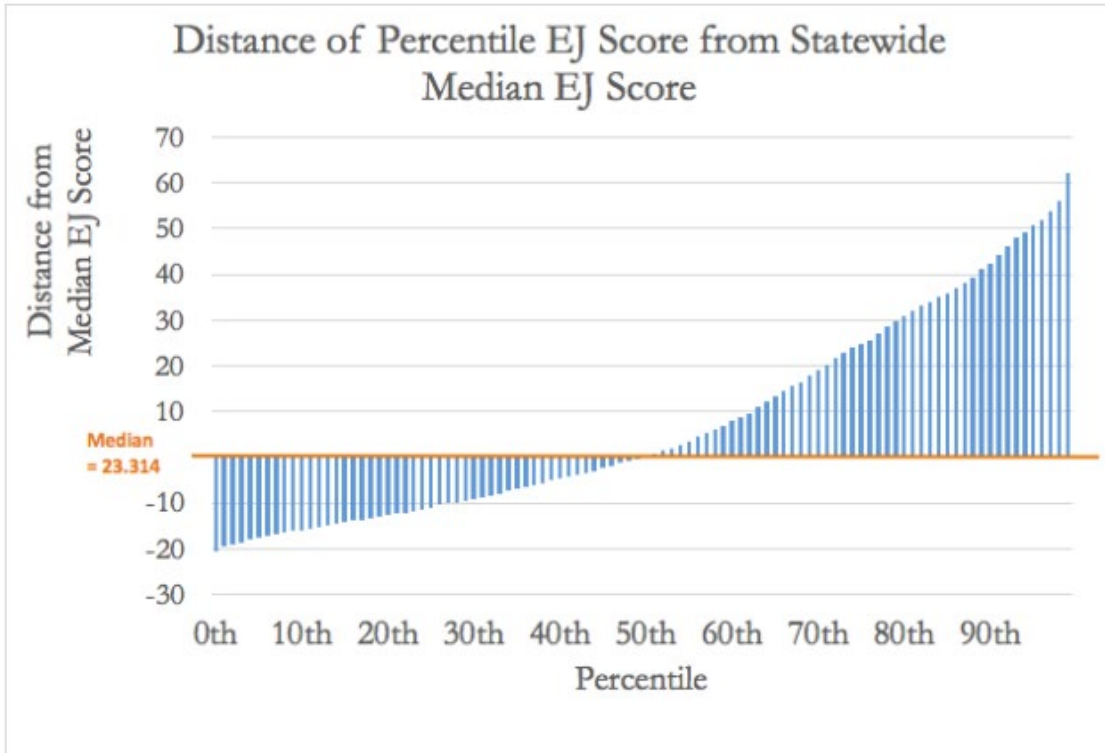


Figure 11. Michigan EJ percentile scores distance from median state EJ score. The differences between higher percentile EJ scores and the state median EJ score are larger than the differences between lower EJ scores and the state median. This indicates there is a non-linear exponential relationship across census tracts in Michigan, where communities who experience the most cumulative impacts experience a much higher amount of impacts compared to the state median than the communities who experience few cumulative impacts. (Source: Grier et al. 2019)

Redlining Data. We acquired GIS data and associated area descriptions of neighborhood grades designated by the Home Owners' Loan Corporation in the mid-1900s to examine past racial and environmental injustices through redlining data. These shapefiles and written historical documents of area descriptions are publicly available via the Mapping Inequality project developed by historians and scholars at the University of Richmond (Nelson et al. 2021). This documentation is monumental for our project as it allows us to visualize the historical and policy contexts that shaped community demographics and contributed to lasting injustices in two of our AOCs. In addition, this information can empower communities with a better understanding of how historically unjust policies have contributed to the development and intentional segregation of their current neighborhoods.

We mapped redlining data for two of our case studies: Detroit and Rouge Rivers, and Muskegon Lake as their populations were greater than 40,000 at the time these policies were created. In the 1930s, HOLC only produced redlining maps for cities with populations under 40,000 people. However, many zoning policies and deeds in

smaller cities contributed to similar patterns of segregation and injustice in cities and towns of all sizes across the country. By visualizing historical injustices, such as redlining, alongside more recently published social and demographic indicators, we were able to compare spatial patterns between explicit federal actions and our other current datasets.

Median Home Value and Income. To explore relationships between income and home value by census tract in each AOC community we used a median home value and median household income dataset from Esri's Living Atlas (Esri Demographics 2018).

We mapped median home value and income data for two of our case studies: River Raisin and White Lake, in lieu of redlining data, which were not readily available. This dataset is not a perfect proxy for redlining data but offers insight into the geography of home values that may have been impacted by similar policies that guided redlining practices. We attributed the dataset with a matrix of nine colors, each describing the relationship between home value and income from low to high gradients. We recognize that as restoration work along the shoreline can influence waterfront and residential development, these circumstances can impact the larger community, long-term housing affordability, and potentially create institutional barriers to access. Gentrification is also a concern in the AOC program. We did not find any datasets that quantified this potential outcome of restoration work but future areas of research could work to evaluate home value datasets like this one overtime to investigate if AOC restoration work and shoreline changes are outpricing long time AOC community residents.

Census Race Demographics. The 2010 US Census data, available through the US Census Bureau TIGER/Line Shapefiles database, contains data on population demographics based on ethnicity and race. Our team downloaded an Esri produced sub-dataset of the US 2010 Census titled "Race Demographics in the 2010 Census" that contains feature layer demographic data at the state, county, census tract, and census block group geographic scales (US Census Bureau 2017). We imported this dataset into ArcGIS and mapped multiple demographic layers within the census tracts in our AOC case study communities. Demographic layers of interest included White and Minority population sizes in each census tract. Minority is defined as "any race/ethnicity other than non-Hispanic white" (Esri 2020). Minority and White population sizes were displayed using dot-density symbology where the relative density of dots in a census tract polygon represents a defined number of observation units, in this case 1 dot = X number of people reported on the 2010 census.

Data on race and ethnicities are relevant in our AOC case studies, as racial discrimination has played a defining role in the historical injustices, such as redlining policies. Consequently, these data display the community demography and give

insight into the diversity of residents that live in these four AOC communities today. Many AOC community interviewees discussed the social and racial diversity of their community in terms of the geography of their community. These visualizations of spatial demographics helped our team see these patterns and therefore played an important illustrative role in understanding the larger story of each AOC.

Social Vulnerability Index. To better understand social vulnerability and community resiliency in response to hazardous events such as natural disasters, disease outbreaks, or chemical contaminations, we mapped the Social Vulnerability Index (SVI) dataset in the four AOC communities. The SVI combines four overarching themes that compare census tracts and their associated vulnerability scores across the US (CDC 2018). The developed themes, 1) Socioeconomic Status, 2) Household Composition and Disability, 3) Minority Status and Language, and 4) Housing Type and Transportation, contain social demographic data scores that are summed within each theme and are combined into an overall summary SVI ranking (Figure 11).

We explored the SVI because industrial practices are examples of past and current environmental hazards that communities historically close to industry experience. This dataset is also valuable in understanding the geographic and demographic context of our AOC communities as it not only includes socioeconomic and population data, but also information about languages spoken and transportation means. Both are important considerations in how communities relate to and engage with the water resources around them.

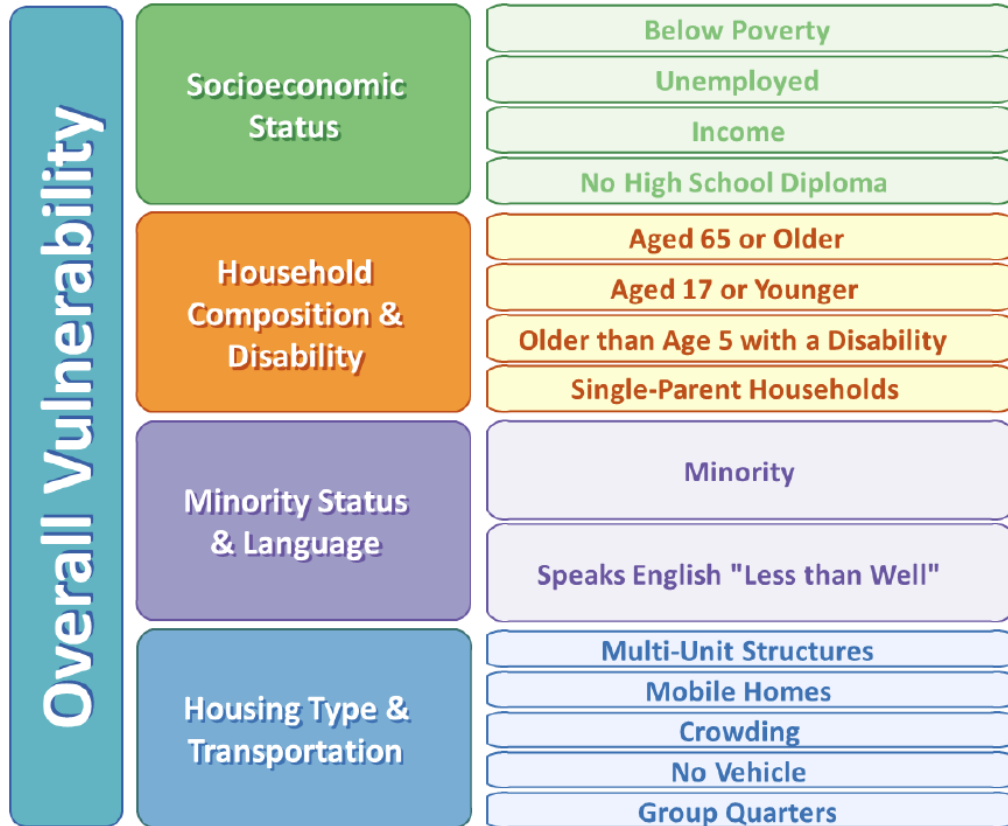


Figure 11. Summary themes and their respective social factors incorporated in the Social Vulnerability Index (SVI). These four categories are summed and compiled into the overall tract summary ranking variable for vulnerability. (Source: CDC 2018)

Objective 4. To provide equity-informed recommendations for the HOW Coalition’s GLRI advocacy

We synthesized project findings to highlight the broader implications of our study regarding overall community priorities, equity gaps across the AOC case studies, existing social equity considerations in the GLRI, and strategies for success through collaborating with and connecting local communities to the restoration work.

We developed project recommendations for our client, Healing Our Waters—Great Lakes Coalition, categorized by: 1) actions that HOW can pursue in connecting with and supporting community organizations locally, and 2) actions and changes that HOW can advocate for at the federal level. Recommendations for HOW’s federal advocacy work are further broken down into congressional policy recommendations and EPA program administration recommendations.

Chapter 3: Defining Equity and Justice in the Context of Great Lakes and Environmental Restoration

To establish context for our investigation of the success of GLRI restoration projects through the lens of social equity and value, we provide a brief discussion of key operational definitions used to inform our analysis.

Equity and Justice Definitions

We utilized Environmental Justice as the key theoretical framework for interrogating the extent of social success within the GLRI program. The EPA defines Environmental Justice as “the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies” (USEPA n.d.). The development and implementation dimensions of this definition of environmental justice are particularly pertinent to our study objectives. The EPA recognizes that Environmental Justice will be achieved when everyone experiences “the same degree of protection from environmental and health hazards, and equal access to the decision-making process to have a healthy environment in which to live, learn, and work” (USEPA n.d.).

The Taxonomy of Environmental Justice developed by Robert Kuehn, adds complexity to this theoretical framework by splitting Environmental Justice into four primary components: Distributive Justice, Procedural Justice, Corrective Justice, and Social Justice, which are the central justice tenets driving this analysis (Mohai 2017):

- Distributive Justice is defined as “the right to equal treatment, that is, to the same distribution of goods and opportunities as anyone else has or is given.”
- Procedural Justice is defined as “the right to equal concern and respect in the political decisions about how these goods and opportunities are to be distributed. This type of justice is a function of the manner in which a decision is made, and it requires a focus on the fairness of the decision-making process, rather than on its outcome.”
- Corrective Justice addresses the importance of “fairness in the way punishments for law breaking are assigned and damages inflicted on individuals and communities are addressed.”
- Social Justice has two components:
 - “That the members of every class have enough resources and enough power to live as befits human beings.”

- “That the privileged classes, whoever they are, be accountable to the wider society for the way they use their advantages.”

Alongside justice, important discussions in this report center on community impacts, particularly cumulative and disproportionate impacts.

According to CalEPA’s Environmental Justice Advisory Committee, Cumulative Impacts are defined as “exposures, public health or environmental effects from the combined emissions and discharges, in a geographic area, including environmental pollution from all sources, whether single or multi-media, routinely, accidentally, or otherwise released. Impacts will take into account sensitive populations and socioeconomic factors, where applicable and to the extent data are available” (California OEHHA 2017). Camden, New Jersey is an example of an environmental justice community facing cumulative impacts. It is the poorest city in the nation with 38% of the population falling below the poverty line. The city is predominantly Black and Latinx and suffers from high cancer and asthma rates due to air pollution and the presence of more than 100 toxic waste sites (Lee 2021). In Camden, the areas with the highest cumulative impacts are near the city’s waterfront in neighborhoods like Waterfront South, where 20% of the city’s contaminated sites are located (Lee 2021).

Similarly, EJ scholar Charles Lee defines Disproportionate Impacts as “combinations of demonstrably greater pollution burden and population vulnerability associated with socially and/or economically disadvantaged communities and populations. Disproportionate impacts may often reflect consistent patterns in the distribution of pollution and vulnerability, and are often a function of historical trends and policy decisions” (Lee 2021).

The majority of current Environmental Justice definitions do not focus solely on the inequities and impacts of water based pollution and resource management. Some water focused organizations, however, have created similar definitions for the water sector. For example, in their national Equitable Water Future briefing paper, the US Water Alliance conceptualizes water equity according to three pillars (US Water Alliance 2017):

- Pillar 1 is to “ensure all people have access to clean, safe, affordable water service.”
- Pillar 2 is to “maximize the community and economic benefits of water infrastructure investment.”
- Pillar 3 is to “foster community resilience in the face of a changing climate.”

All of these equity and justice concepts underpin discussions of water equity and justice more broadly and offer robust analytical foundations for this report.

Social Valuation Definitions

A key component of our analysis focused on establishing the values that environmental restoration projects provide to humans who live near, use, and benefit from freshwater resources. A useful theoretical framework for this work comes from the Social Valuation

literature, particularly from Felipe-Lucia et al. who understand that “the social approach [to the study of ecosystem services] is based on the values society attributes to each ecosystem service” (Felipe-Lucia et al. 2015). Although our report does not include a comprehensive analysis of ecosystem services provided by GLRI restoration projects, our team used this social framework approach for our qualitative investigation into how AOC communities attribute social values to GLRI restoration project outcomes. We used the following list of social value indicators to guide our community interviews to assess the social values that each AOC community has given to, or wants to see from their water resources:

- Water Quality and Fishable Resources - defined according to the GLRI goals of providing drinkable, swimmable, and fishable waters for all residents in the Great Lakes.
- Accessibility - defined as the ability of residents and visitors to access, navigate, or use restored environments. This social value can be further broken down into different types of accessibility:
 - Demographic Access - defined as the sociographic makeup of individuals accessing the water resource.
 - Transportation Access - largely defined as public transportation, or publicly available transportation resources that allow residents to access green spaces, public spaces, and water resources.
 - Access to Water - defined according to how connected waterways are to other public spaces and how residents are able to access water resources in their communities.
 - School Engagement Access- defined as the extent to which schools use water resources as educational and stewardship opportunities for students at all grade levels.
- Jobs - defined as the creation and availability of local jobs either directly related to restoration activities or indirectly resulting from restoration activities. Examples of indirect job creation include new business opportunities that are realized in the community following restoration.
- Recreation - defined as the myriad activities available to residents in and around restored water bodies. Example activities include swimming, kayaking, boating, fishing, walking, viewing, biking, bird watching, etc.
- Volunteerism - defined as the availability of opportunities for residents to engage with stewardship of natural environments and build a sense of pride and ownership over the resources in their community.
- Gentrification - defined as the displacement of lower income residents as property values increase and wealthier residents occupy housing adjacent to restored environments.
 - Affordable Housing - defined as the intentional maintenance of available housing units for lower income residents to help mitigate inequities from displacement and gentrification along waterfronts.

These definitions are examples of social ecosystem services that residents in Great Lakes freshwater communities value. While not all communities will value each type of social ecosystem service equally, these findings were important building blocks for our team to consider when speaking with community members about the equity and social outcomes of restoration work. Additionally, these social values are important to consider in the broader context of the GLRI to ensure that revitalization project benefits translate to equitable social outcomes for all Great Lakes communities.

Chapter 4: Assessing Community Perceptions of Equity and Social Value Given to GLRI Restoration Work, Using Community Interviews

We identified key narrative themes for each AOC through our qualitative and quantitative analyses of interview data. Key narrative themes capture interviewees' thoughts relating to restoration project processes and outcomes, as well as environmental and community context more broadly within each AOC (Table 2).

The narrative results of each theme are discussed within the context of each AOC. Although some themes overlap among AOCs, each is discussed separately. Themes take the form of both areas of program strength or program areas where additional improvement is needed to meet community needs.

Key Narrative Themes	Areas of Concern			
	River Raisin	Rouge River	Muskegon Lake	White Lake
GLRI and AOC Structure (+)	Local Groups and Leaders (+)	Local Groups and Leaders (+)	Sense of Pride (+)	
Education (+)	GLRI and AOC Structure (-)	Demographics and Justice	GLRI and AOC Structure (+)	
Sense of Pride (+)	Demographics and Justice	Community Concerns and Priorities	Community Concerns and Priorities	
	Community Concerns and Priorities			

Table 2. Key narrative themes highlighted for each AOC case study. Restoration process-related themes are colored in red, restoration outcomes-related themes are colored blue, and themes relating to the community context more broadly are colored in black. Themes with a more positive or negative sentiment in each AOC are denoted with a + or - symbol, respectively.

River Raisin AOC

The River Raisin AOC's work is concentrated in downtown Monroe, Michigan. This 2.6 mile area at the mouth of the River Raisin on western Lake Erie has leveraged close to \$30

million towards removing its nine Beneficial Use Impairments. The BUIs in this AOC were created during historical paper mill and manufacturing operations at the mouth of the River Raisin, the only Michigan port on Lake Erie (The River Raisin Legacy Project 2021a). Other sources of water quality degradation have come from wastewater effluent, landfill discharges, and agricultural runoff from the upper parts of the watershed. Restoration activities have focused on removing dams to restore fish habitat and passage, remediating contaminants in sediments, and restoring Lake Erie shoreline habitats.

GLRI and AOC Structure

The Public Advisory Council for the River Raisin AOC, unlike others in Michigan, is housed within the City of Monroe's Commission on the Environment and Water Quality (COTE). This unique structural approach to AOC work has allowed the PAC to leverage the city's resources and departments to support restoration work. For example, the PAC has used city water bills to inform residents about project plans and progress throughout restoration work. This structure has also allowed the PAC to use PAC Support Grants, given to each PAC in Michigan to support PAC functioning, for smaller projects within the AOC. In other AOCs, the money in PAC Support Grants is typically used for administrative fees and other forms of compensation. Because Monroe PAC members are paid through COTE and are city employees, they are able to use PAC Support Grants for additional projects and initiatives. One PAC Support Grant funded the installation of fishmounts, places where people can rest fishing rods off of a pier along the popular "Riverwalk" in Monroe along the River Raisin. The installation of these fishmounts has improved fishing access and accommodations.

Although the River Raisin PAC has leveraged its strong connection to the City of Monroe, the PAC also actively works with local community organizations that are involved in environmental restoration and watershed activities throughout the River Raisin landscape. Many of these organizations lead their own public outreach programs focused on environmental protection and restoration, which in this area heavily involves work around water quality. The PAC has partnered with these organizations to help with raising awareness of restoration projects and volunteer opportunities, including the now popular river clean up days. Importantly, many of the organizations have volunteer and educational events with local schools that are separate from PAC activities, but do focus on educating the next generation about the health of nearby water bodies like the River Raisin and western Lake Erie. Six out of seven River Raisin AOC interviewees spoke about the importance of education for connecting people to the restoration work on the River. Some of these interviewees noted that education efforts ultimately help ensure the sustainability and longevity of completed AOC projects in the area, as well as ongoing stewardship of the river ecosystem.

Education

The PAC is also developing educational materials to advertise restoration work. Some examples of completed work include the creation of a field guide to help people explore the River Raisin and its restoration. The guide points people to access points along the river and

describes how restoration has helped biota like osprey, eagles, lotus, walleye, and sturgeon return to the river. Another example is the 2019 River Raisin Legacy Project Mini Documentary. This narrative style documentary highlights the history of the River Raisin’s pre-settlement, settlement, and industrial eras. The documentary also walks through how restoration work was completed and how its goals, the removal of chemicals and the reconnection of the river for wildlife, have helped also restore the community’s interest in and connection to the River Raisin. These examples of communication about restoration work, both during and after projects have been completed, were cited by interviewees as key methods that should be continued to foster increased engagement with the AOC work and the River Raisin’s future sustainability and health.

The River Raisin AOC is close to delisting as an AOC, or removing all of its Beneficial Use Impairments, having completed the majority of its large restoration projects. The PAC is cognizant of the fact that the river will still need to be protected once it is no longer an AOC that is receiving money from the federal government through the GLRI’s AOC program. After delisting, the PAC and others can still apply for GLRI funding, just not through the AOC program. Continuing to apply for this funding will require similar organization and expertise that the PAC currently has. However, it will also require increased community interest and stewardship for projects to be pursued and completed. The PAC’s efforts in forming relationships with local community organizations has helped encourage increased engagement with the river through educational and volunteer opportunities. Relationships throughout city departments have also helped with the construction of new parts of the River Raisin Heritage Trail, or “Riverwalk” in downtown Monroe that connects popular parks, the downtown, and points of interest along the River Raisin (Figure 12).



Figure 12. Map of the River Raisin Heritage Trail System, also known as the Riverwalk. The trail connects the large parks along the River Raisin with attractions in downtown Monroe and the mouth

of the river where it discharges into the western basin of Lake Erie. This has become a popular attraction for residents and visitors. (Source: City of Monroe Michigan n.d.)

The proximity of the River Raisin National Battlefield Park (RRNBP), run by the US National Parks System, and Sterling State Park, also provides additional opportunities for the public to learn about the River Raisin's natural history and significance. The Nottawaseppi Huron Band of Potawatomi (NHBP) have worked with the RRNBP to retrace the history of their people's forced removal from Southeast Michigan as well as their return to the state. The RRNBP now focuses much of its narrative around the history of the tribe and their connections with the River Raisin. The park also looks at the aftermath of the War of 1812 battles fought on its grounds from a new viewpoint, citing the War of 1812 as a catalyst for the forced migration of native peoples throughout Michigan and the Northwest Territory (NPS 2016). The Nottawaseppi Huron Band of Potawatomi collaborate with the RRNBP in education efforts around their Wild Rice Restoration Program, a GLRI funded effort occurring across Michigan and other parts of the Great Lakes. The park and NHBP have created videos to educate the public about the cultural history and significance of wild rice in the Great Lakes. Educational material covers how to identify the rice, how to cultivate it, and information about how tribes are working to restore the rice and its ecosystems in Great Lakes rivers and nearshore waters.

Other education efforts in the River Raisin work directly with schools in the watershed. Some groups organize career days for 7th graders where students can experience Lake Erie aboard boats and learn about water quality issues in both the Lake and in the River Raisin watershed. These events emphasize the role that historical industries had in degrading the area's water quality, as well as the current threats to the area's water quality. One example often cited is agricultural practices, like fertilizer application, that leads to nutrient runoff in Lake Erie and the formation of harmful algal blooms (HABs). HABs in the western basin of Lake Erie can severely impact fish and general aquatic health.

Educational efforts also highlight different cultural and professional viewpoints of water resources. For example, in one program the students speak with the county Drain Commission and also have the opportunity to participate in a water ceremony conducted by a native Anishinaabe. In addition to school efforts, there are multiple public water festivals with programming for children, like the River Raisin and Lake Erie water festivals. There are also examples of educational recreation activities designed for teaching youth about water sports, like kayaking and fishing. These recreation programs have been led by various community organizations and some have been designed specifically for providing access to youth who otherwise may not have access to water sports based on their neighborhood opportunities. Some of these programs work with schools and organizations in the east side of Monroe where there are greater disparities in opportunities for engagement with water resources and recreation, despite their close proximity to the River Raisin and coastal Lake Erie.

Sense of Pride

The many restoration activities completed and underway in the River Raisin have contributed to an increased sense of pride and place in the community. The popularity of amenities like the Riverwalk that highlight the River's restoration activities and promote public access to the River Raisin have increased the community's awareness of the river. A majority of interviewees mentioned that the community is starting to see how lucky they are to have a river running through their downtown. More and more, businesses and the city itself are seeing the river as a core element in the community. Businesses in downtown Monroe, for example, are starting to add back patios to their restaurants and bars so patrons can enjoy views of the River Raisin. This trend is often called "turning our face to the river" and it represents how communities, like Monroe, are starting to embrace the restoration of the polluted and aesthetically displeasing rivers they had traditionally turned their backs to. Previously, businesses in this area did not take advantage of the river's proximity as a point of attraction because of the negative perceptions around the River and its cleanliness. As more people use and are taking interest in the River Raisin, the physical makeup of the structures and community development projects in Monroe are following too.

"So, you're just seeing a lot of people looking at the river more as an asset and I think one of our missions and one of the things that I would really like to see done is that people not only look at it as a recreational tool but as sort of a stewardship responsibility. You know I mean if you want that resource and you know it could have economic benefit in terms of, you know, fishing and recreation and stuff like that you need to take care of it. And every year except this year, because everything going on, we've had river cleanups in the last three years we've had over 100 people, and what warms my heart tremendously is the amount of young people involved."

-River Raisin restoration participant and advocate

Increased awareness of the river has, according to a majority of interviewees, been fostered through the many new opportunities available to the public to connect with the river. Many of these opportunities are recreation based, like kayaking and fishing. The work the PAC has completed to remove dam structures throughout the lower 23 mile portion of the River Raisin, from Lake Erie to Dundee, has benefited the community two-fold. First, the public can kayak a larger portion of the river continuously. Second, fishermen are enjoying the return of fish populations to the River Raisin thanks to the new fish passage for migratory species and the cleanup of the sediments which now support more macroinvertebrates—food for the fish to eat. Previously, many fishermen in the area would go to the Huron River to fish but now they see the River Raisin as a hidden gem for fishing. Importantly, the River Raisin, known as the Nummasepee, the River of Sturgeon, by the Nottawaseepi people has now seen sturgeon come back and spawn in the river (City of Monroe Michigan 2016). In Monroe, there are also some populations of subsistence fishers, primarily from the black population, that are reliant on the river as a source of food. Subsistence fishing was prominent before the restoration work began. New fishing piers at the mouth of the river and

along the Riverwalk have helped provide more access for fishermen. The fishing pier at the mouth of the river is near the DTE Monroe Power Plant whose operations can drastically alter local river flows and habitat especially in summer months during low river flows.

Despite the improvements that have been noted by those who lived in the area before the acceleration of restoration work, there are still water quality concerns in the River Raisin and its watershed. The river, near its mouth, still has an industrial presence with a scrap metal recycling facility, a crane and rigging operating company, a wind turbine manufacturer, and the Port of Monroe all located on the south banks of the river within the 2.6 mile AOC (The River Raisin Legacy Project 2021b). Municipal facilities like the Monroe Wastewater Treatment Plant and the DTE Monroe Power Plant are also located at the River's mouth on the south bank. Regulations have banned harmful discharges from the Monroe Wastewater Treatment Plant and the industrial facilities, but the stigma surrounding water contamination from industrial sources persists. In addition to harmful industrial chemicals, the PAC and others are also concerned about water quality contamination from E. Coli bacteria and nutrient runoff from the large agriculture presence in the watershed. Some of these contaminants have led to annual beach closures in the area in recent years. This concern has been amplified by the recent period of high lake levels that have stressed coastal areas and stormwater infrastructure. While there are still water quality threats and some negative perceptions of the river, there is a clear increase in use and interest around the River Raisin following restoration. This was a sentiment shared by 86% of River Raisin interviewees.

"I can tell you, you know, living on the river for 25 years, and being a part of this community, the amount of people kayaking, fishing, just playing in the river has just exponentially increased in the last like 10 years."

- River Raisin community member

As the River Raisin AOC looks towards delisting, the PAC and community organizations are concerned about the longevity of restoration projects once the PAC disbands and there are no longer formal investments into maintaining the River Raisin's health. The PAC and community organizations are working to engage the community's many stakeholders around the River Raisin's restoration through volunteer and educational opportunities. These opportunities present a chance for community members to establish a personal connection with the river that will hopefully inspire continued care for the restoration projects and the river's health. Others are looking to use the River Raisin as a focal point for rebranding the City of Monroe. As the river is restored, the community is hoping to leverage the asset to attract new businesses, residents, and development. However, in some areas around the River Raisin, there are concerns of overdevelopment. Some of these concerns are about habitat health while others would like to see a prioritization of green space connectedness with development along the river. Most important to our interviewees, was maintaining and fostering additional opportunities for people to connect with the River Raisin whether it be through recreation, tourism, or volunteer opportunities.

“I would really like to see people not only look at [the River Raisin] as a recreational opportunity but as a stewardship responsibility.”

-River Raisin restoration participant and advocate

Rouge and Detroit River AOCs

For more than two centuries, Detroit has served as an industrial hub for the entire Great Lakes region. Local waterways have been seen as “working rivers” and have historically provided essential services to support Michigan’s rapid growth in industrial, commercial, and residential sectors. With this unchecked development that helped form the backbone of the American economy in the 20th century, also came decades of untreated waste discharges and heavy contamination from myriad sources like industrial facility development, nonpoint source pollution, and extensive sewerage and stormwater systems.

The Rouge and Detroit rivers have now become important emblems for non-profit organizations and residents that reside within the community, given their positions as neighbors of Michigan’s largest urban center. As restoration of both rivers has progressed and accelerated under the GLRI, environmental restoration projects have started to come into focus for community organizations, who are seeking to improve equitable consideration of diverse voices and perspectives within project development, implementation, and management. Residents also seek to guarantee the longevity of projects through community stewardship and education. While annual apportionment of federal funds is regarded as a crucial component of local revitalization, concerns linger around how the money is distributed among those working on the Rouge and Detroit AOC restoration projects. Additionally, there are concerns about whether restoration outcomes are truly responding to the predominant needs and concerns of the Rouge and Detroit communities that are both comprised of a majority black and largely underserved populace. The results presented here must be in tune to the fact that within the Detroit community, police brutality, institutional racism, unemployment, and an underfunded school system are among the most pressing issues for residents and often take precedent and priority over environmental concerns. After analyzing community interview data, four narrative themes emerged as the most important points regarding restoration work and justice within the Rouge and Detroit AOC communities: local groups and leaders, GLRI and AOC structure, demographics and justice, and community concerns and priorities.

Local organizations and leaders

Discussions of local organization efforts and abilities dominated our Rouge and Detroit community interviews, with 100% of interviewees engaging with the topic. Specifically, respondents mentioned the important role of local nonprofit organizations in leading outreach efforts, building partnerships, and establishing volunteer and stewardship opportunities to connect community members with their built and natural environments. Friends of the Rouge, Greening of Detroit, Southwest Detroit Environmental Vision, and Southwest Detroit Business Association, among others, were noted for their efforts in

restoring and developing urban green spaces through their programs that involve community volunteers and voices in both planning and implementation.

Though lauded for their dedication to community progress in the environmental sphere, three out of every four interviewees noted that nonprofit organizations within the Detroit community are hindered in their efforts due to limitations in capacity and resources. A primary concern highlighted was the limited capacity of staff available to apply for grants and implement projects. This concern also extended to discussions of the partnerships between community organizations and the AOC restoration process and those who lead it, in this case the PACs. Two respondents within the Rouge River AOC specifically noted frustration with the fact that Friends of the Rouge, in particular, is an anchor of trust within the community with a wide network of followers; but is underutilized by the PAC in project planning, implementation, and in raising needed awareness with the community about the projects, of which residents are generally and broadly unaware. The role of spokespeople to represent community interests institutionally in project development is seen as a fundamental element of project success within underserved communities.

“It's really the communities that have the staff power to come to the meetings to say, ‘I want my project done, put me on the list.’ And if you don't have the people, if you don't have the person to represent your community, you just get left behind and you get left behind more and more and more.”

-Rouge River restoration advocate

In addition to community-based organizations, 75% of interviewees discussed the role of city government in environmental projects. Many citizens in Detroit see stormwater issues involving their roads and houses as the primary burden to their environmental safety and health related to water. With aging infrastructure and stressed municipal resources, the city is often criticized for neglecting stormwater issues. While the city is praised for their efforts to increase public access to natural resources and maintain public greenspaces, the many environmental stressors in the Detroit area, from air pollution to flooding concerns, are difficult for the city to handle with limited resources.

GLRI and AOC Structure

Within the topic of GLRI and AOC structure, 87.5% of interviewees discussed GLRI funding. Noted improvements in GLRI funding structure compared to AOC funding structure include the elimination of some eligibility criteria, such as Watershed Management Plans, which are required for AOC-funded grants. Others noted the limited funding for community outreach, public access, and public use projects, in addition to requirements of a localized match. Among Detroit community respondents, this was noted as a predominant program inequity, as it often necessitates external help to acquire the needed match funds. Since the community is poor and already heavily under-resourced, there are significant barriers to meeting this requirement. Interviewees offered that a sliding scale approach to funding matches could alleviate some of these inequities.

“The other part that's frustrating with GLRI funding is that it doesn't really allow for a lot of education outreach or community benefit. So it's just like, oh, there's just this project, we're just putting in a fish ladder. Period. But we're not going to pay for educational signage and ADA accessible trails, and a kiosk with information and a public meeting and making sure that the signs are translated in Arabic and Spanish and making sure that all that other stuff [is present] that makes a project so great, because then people know about it and know how to interact with it.”

- Rouge River restoration advocate

A variety of other concerns arose in discussions around the AOC project development and implementation process, particularly within the Rouge River AOC. A few interviewees noted frustration with the internal PAC process, pointing to insufficient information sharing between group members and regulating agencies. External processes were also highlighted, with exclusion of community voices, difficulty in sustaining engagement, and complex power dynamics targeted as the predominant issues hindering efficient and effective restoration progress. Half of interviewees discussed the role of state agencies in restoration efforts, sharing positive sentiments with regard to state handling of grants and allowing for notices of intent in order to increase equity in the process. We found tensions exist around federal involvement, as some interviewees noted the conflicts of interest present with a consulting firm that holds power in the Rouge River AOC and PAC decision making processes while also holding institutional influence with the EPA. One community organization in particular also expressed frustrations with the EPA hiring internally for public relations and outreach liaisons, instead of contracting local groups that already hold intimate knowledge of community dynamics, needs, and concerns.

“...if me as an advisory council member has to ask over and over for that information, imagine what the general public's getting, you know.”

- Rouge River PAC member

Demographics and Justice

Detroit's population diversity was reaffirmed by interviewees, who emphasized the city's residents as majority black, with prominent arab and hispanic clusters in the southwest portion of the city. Notable social demographics arose in interviews, such as the historical isolation felt by undocumented and Asian American residents due to concerns over personal safety in public spaces, as well the intimate link between socioeconomics and feelings of power and mobility for black Detroiters. Interviewees also noted spatial dynamics of particular relevance to restoration planning and implementation. Within the city, there is a prominent perception of a division between the Downtown areas (largely white and short-term residents) and the surrounding neighborhoods (largely black and generational residents), whose needs and perspectives differ broadly. Ultimately, interviewees

emphasized the need for greater diversity in the outreach strategies used to invite diverse, and sometimes disparate, communities to engage in the restoration process.

“There’s definitely a perception that real Detroiters that live in the neighborhoods don’t get the same kind of funding and services for their parks as the Downtown and Midtown parks.”

- Detroit resident and employee

Following analysis of interview data, four primary categories of justice arose as thematic discussion foci: Distributive Justice, Procedural Justice, Environmental Justice, and Social Justice. Distributive Justice emerged as the most prominent category for the Detroit community, with references from 67.5% of interviewees. Distributive Justice inequities were largely related to GLRI funding. Interview participants noted feelings of neglect for the needs of neighborhood parks and over-prioritization of Downtown parks, which, they expressed, largely cater to tourists and are hardest to access for a population largely reliant on public transportation. Detroit interviewees further emphasized the necessity for greater consideration of need and demographics in funding distribution. Lack of clear communication and lack of resident agency within decision-making structures were noted as prominent Procedural Justice inequities. One interviewee in particular expressed that the most vocal projects typically receive the most attention from funders, which presents injustices in the way that this further silences individuals and organizations with limited institutional voice. Local nonprofits were praised in their efforts to fill this gap through the development of restoration projects based on neighborhood needs that allow residents the agency to decide and control restoration goals and outcomes.

One resident noted Social Injustice as having a critical influence on the social success of restoration. They stated that Detroit suffers from persistent racism and institutional legacies tied to segregation, with the views and actions of some black residents toward public amenities and green spaces still influenced by historical legal restrictions. This is thematically linked to interviewee discussions of Environmental Injustices tied to the systemic devaluing of black and brown bodies, which has led to residents of color still feeling largely excluded from restored spaces. Some respondents recognized that these feelings of exclusion are sometimes linked to a critical disconnect between projects goals and outcomes and resident needs and expectations for restored environments.

“It’s important to understand that African-Americans may use parks differently from how others want to use them.”

- Detroit resident and activist

Community Concerns and Priorities

Interview analysis reaffirmed Detroit as a diverse community of residents with a diverse array of concerns and priorities. Among an array of restoration-related concerns, water

quality was the most pressing, with 87.5% of interviewees recognizing the importance of clean, accessible, and affordable water. Concerns about E. Coli bacteria and body contact are rising on Belle Isle recreation sites in the Detroit River, and, though the public stigma around pollution is decreasing, residents continue to show concern for water quality in the Rouge River, especially as it relates to full- and partial-body contact.

Pollution and contaminants, ecological health, and different communities' relationship with industry were mentioned as concerns by 62.5% of interview participants. Pollution concerns are not only tied to water quality or water resources. Within Detroit, air quality, fugitive dust, and truck traffic are prominent concerns among residents and pose complications to GLRI restoration progress. Several interviewees noted that even in revitalized green spaces, restoration progress is moot if residents are unable to utilize the spaces comfortably due to air pollution. Similarly, industry presence along the lower Rouge corridor can be particularly contentious due to persistent air pollutant discharges. While industries provide a significant portion of the tax base in the area and are generally respected by residents due to their local economic output, interviewees stressed that industry needs are typically prioritized over community needs, including health. They further emphasized that some industries have frowned upon increased recreation on the Rouge and have been largely resistant to working with community organizations to make restoration progress on their privately-held lands adjacent to the Rouge River. More broadly, one resident expressed concern over the potential for public lands to be co-opted for development in revitalized areas along the Detroit Riverfront. In terms of ecological improvements; native plants, dam removals, and increased biological diversity such as increased sturgeon, walleye, osprey, and eagle populations are high priorities. Lingering ecological concerns are channel catfish toxicity and log jams.

“People are also concerned about biological diversity, which I think is really improved even down in the most polluted zip code into Detroit. We see bald eagles now. You see the herring gull or the Ring-billed gull, we see the sturgeon that have returned to the Rouge river, the walleye populations have really increased.”

- Rouge River advocate

Half the participants emphasized subsistence fishing and public access as restoration priorities. In Detroit, subsistence fishing is common in the Detroit River and lower Rouge stem, regardless of water or fish quality, and interviewees expressed a need for GLRI funds to help create more amenities for fishers in areas of the Detroit River that abut neighborhoods. The beneficial uses of the restored water bodies are intimately linked to public access. Residents recognized that there is a need for better public transportation to green spaces, more attention paid to restoring easily-accessible neighborhood parks, and better multifunctionality with projects. For example, residents need both walking paths and piers as well as gathering spaces.

Additional concerns in the Rouge and Detroit AOC community relate to the built environment, particularly stormwater management and localized flooding, which were noted as concerns by 50% of interviewees. Most notably, interviewees noted that many parks in the floodplain flood completely every time it rains, canal communities experience water flooding directly into the streets, and in areas such as SW Detroit, residents without reliable transportation have to walk and bike through inches of water every time it floods. Some parks in Detroit are located in floodplain areas that are supposed to flood during storm events, therefore there is a need for more education about where flooding is and is not supposed to occur. Discussions around flooding were reminiscent of discussion about air pollution, with several interviewees emphasizing that, while restoration is great, all the hard work is undermined if parks are flooding every time it rains and are rendered unusable to the public. In regards to socioeconomics, two interviewees expressed that residents and business owners suffer cost burdens due to sewage and drainage-related impervious surface fees in water bills, and one respondent discussed the difficulty of finding funding to address problems such as failing seawalls at the municipal level. Water shutoffs, water affordability, and bureaucratic issues with regard to the water utilities were additional concerns raised in 37.5% of interviews. The majority of Detroit residents interviewed affirmed the need for prioritization of green stormwater strategies to mitigate flood impacts.

Finally, 25% of interviewees emphasized the need for local job creation, professional development, and financial literacy as a way to combat poverty and help create lasting change. They discussed restoration projects as being ideal avenues to provide jobs and skills-based training to local residents, with an eye toward improving the economy and quality of life locally.

“We work on other federal grants where they’re like ‘we need to create the most jobs possible, the most ‘this’ possible, the \$15 an hour’... and it’s hard to get all that because... the cost of it is not built into the work.”

- Detroit community representative

Muskegon Lake AOC

Historically, Muskegon Lake was a center of industrial practices on the western coast of Michigan, with many factories and foundries primarily on its southern shoreline. The contamination, pollution, and hazardous discharge from these industries have long caused the community to turn its face away from the lake. For decades the lingering impairments caused by industry has hindered the community’s ability to engage and connect with the lake. However, these perceptions have begun shifting and the community is now turning towards the lake as the shoreline and downtown waterfront undergo restoration efforts through the AOC program. With the help of GLRI investments, local residents are starting to recognize and take pride in the freshwater resources around them. The freshwater and natural resources present in Muskegon are what brought people to Muskegon to begin with, and with successful restoration efforts, the community is taking more pride in itself and the

lake. Muskegon is also unique in connecting city master planning efforts directly to the lake and watershed, seeing the water resource as an important component in their overall vision.

When Muskegon Lake was established as an Area of Concern in 1987, the region had nine BUIs, four of which have been removed since the GLRI was implemented in 2010. The \$10 million grant that Muskegon obtained following the start of the GLRI program was monumental in implementing restoration plans that had been sitting idle due to inadequate funding prior to the program. With several significant water restoration efforts in place, the region now provides a myriad of outdoor, recreational, and social opportunities for the community to engage with the lake.

“GLRI was really good timing. Good process, good timing. It was critical that if it hadn’t happened when it happened, we’d still be 10 years behind where we are. Because without the funding, we just can’t do the projects.”

- Representative from the Muskegon Lake Watershed Partnership (MLWP)

Within the last decade, due to improvements in water quality and access to the water, many residents in Muskegon have started to interact in and around the lake in a variety of ways: biking, walking, and kayaking, among others. Local residents we interviewed in Muskegon noted the increases in boating and marina use as well as residential use of the downtown lakefront area. Recreational businesses saw a surge in demand for those interested in renting boats and enjoying the lake.

Compared to the other AOCs, however, Muskegon had the fewest mentions of recreational fishing. Community residents who are interested in fishing, however, have expressed to city leaders that there is limited access and opportunity to do so. One interviewee mentioned the importance of subsistence fishing in communities regardless of their familiarity with restoration projects. As such, there is a need for greater resources to be put into expanding amenities for subsistence and recreational fishing, which can also help connect more people with the water resources around them.

Local Groups and Leaders

Muskegon Lake is often considered a success story among AOCs due to effective local leadership and efforts to engage the community. However, local leaders driving restoration forward recognize there is room for improvement in engaging marginalized communities who are more disconnected from the restoration process. Examples of these communities include the predominantly black neighborhoods on the south side of the lake. As noted by interviewees, this would involve ensuring that opportunities to provide input on projects are well-publicized and accessible so that underserved communities can partake in the restoration work and build a stronger connection with their local water resources.

With a unique local governance structure, much of the restoration work in Muskegon is organized and led by the West Michigan Shoreline Regional Development Commission (WMSRDC), a regional planning agency that serves many local governments in the area. WMSRDC not only provides staffing and other resources, but as a regional agency they also have a strong connection to state and federal entities, providing strong backbone support capacity not typically available to other Michigan AOCs. There is also a collaborative partnership between WMSRDC and the Muskegon Lake Watershed Partnership (MLWP), the group that serves as the Muskegon Lake PAC. Both groups work alongside other local organizations and individuals on many restoration efforts. Across these groups, WMSRDC is known as the planning operation that leads the grant processes and delegates responsibilities across the PAC. WMSRDC has played the primary role in obtaining funding, particularly larger grants, to drive restoration projects forward; the organization effectively leverages GLRI and AOC grants to support more restoration efforts.

“WMSRDC is the planning operation or office, and they play a very important part because I feel we’re really blessed to have them in our backyard, because I don’t know... I wouldn’t know the first step in the grant process to actually go down this road. WMSRDC does. And so, they keep a very close eye on what grants are available, match them up with what projects we have a desire to get done, and then they always come back to us, as a watershed group, [with] ‘here’s a great opportunity, but we really need some skin [in] the game’”

- Representative from the Muskegon Lake Watershed Partnership (MLWP)

Not only has the regional planning group organized efforts around restoration, but specific leaders in the watershed have also greatly supported continued restoration and community stewardship. Half of our interviewees in Muskegon mentioned Kathy Evans from WMSRDC as a local champion in the region due to her strong leadership and ability to move projects forward. She is known for her dedication to restoration efforts and her ability to form meaningful connections and encourage community members to be involved in restoration work—effectively organizing different parts of the restoration network in Muskegon to maximize work and progress. Mark Evans is another local champion who is often highlighted for his work in connecting the community through stewardship. For the past 25 years, he has led annual volunteer cleanup efforts in Grand Trunk, a local neighborhood area on the south side of Muskegon Lake where restoration has taken place. These cleanup efforts began with a small group of friends, which now has turned into a collaborative effort by more than 100 community members each year. By partnering with local schools, youth are encouraged to take part in the cleanups, learning the importance of stewardship and that individual actions can make a large difference. In addition to these community stewardship events, other volunteer and monitoring programs provide opportunities for the local community to be involved in the restoration process.

“So we saw the kids that used to come down and maybe be the ones that were throwing the trash around the site now becoming the defenders of the site, because they went down and they cleaned it up... of course we try to educate the kids about what they're doing and why they're doing it at the same time. And so we really think that we're helping them become future stewards, not only for that site, but even [with] the mindset that they as an individual can make a difference.”

- Community stewardship leader

Demographics and Justice

Local residents around Muskegon Lake are strongly connected with one another via neighborhood associations. However, this community ownership has not always extended to Muskegon Lake. Particularly in the east and south sides of Muskegon Lake, there is a larger proportion of lower-income households and communities of color, who are generally less connected with water restoration efforts. Some limitations hinder residents from personally connecting with the lake itself. For example, there is a general lack of knowledge within communities of color in Muskegon around how to directly engage with the lake (e.g., swimming). In addition, lack of prior experience with other water-based activities is often a barrier to engaging recreationally with the water resource or at all. There have been efforts to encourage local residents and youth to experience and enjoy the lake, in hopes that the community's overall familiarity, comfort, and use of the water resource will increase altogether.

Local leaders have made intentional efforts to spread awareness about restoration efforts, elicit public input and comments on the process, and engage the community further with the water resource in these communities through the neighborhood associations. Due to the close-knit structure of residential neighborhoods in Muskegon, increasing engagement can be more effective when information sharing is done through these trusted networks. WMSRDC and the PAC have previously engaged with neighborhood associations by attending community meetings. Community residents have suggested posting notices at other central locations, such as churches and barber shops. The PAC is interested in learning how to more effectively engage the broader community through alternating meeting times each month to encourage attendance and hosting social gatherings to bring the community together. Field trips often take place at various restoration sites, many of which are in close proximity to neighborhoods on the south side of the lake, both to engage the broader community and to highlight where restoration work is occurring.

“They made us aware of these problems because you see it, but you don't know what's being done or who's doing what about the issues.

So they really were good about coming out and spending time and hearing what people had to say.”

- Representative from a Muskegon Neighborhood Association

Greater effort is still needed for continued restoration outreach and exposure, and for engagement of the broader community with the lake and its resources. For example, some communities further south of the lake are less aware of the opportunities to recreate around Muskegon Lake. An interviewee highlighted Pere Marquette Park (Lake Michigan) and Mona Lake as popular places for social gatherings and engaging with nature. However, Mona Lake remains highly polluted with increased flooding concerns. The community around Mona Lake has also been interested in cleaning up this nearby lake that is not an AOC, but expresses a lack of resources for doing so.

Community Concerns and Priorities

The largest community concerns in Muskegon surrounding the health of local water resources related to lingering perceptions of groundwater and PFAS contamination, as well as public access opportunities related to city and waterfront development. While water quality overall is not necessarily a big concern in the broader community, for rural residents who source their water from wells, groundwater contamination is a constant concern. PFAS issues continue to persist in certain parts of the county, primarily closer to the airport and former waste sites. There are still lingering concerns regarding PFAS in the community, primarily for those who are less aware of the restoration work that has taken place.

Overwhelmingly, interviewees mentioned increasing and maintaining public access to Muskegon Lake as a primary concern for the broader community. Due to lack of exposure and awareness of these opportunities, some communities also may not know of available public access points to begin with, limiting more widespread use of the lake. However, those who have a stake in the planning process voiced dedication to increasing opportunities for public use and engagement of the water resource, showing that restoration leaders see public access as a priority. Many interviewees mentioned public access concerns in relation to increased city and downtown development around the waterfront, recognizing the challenges that exist in balancing public use over private and commercial development. An interviewee expressed concerns for how the city is prioritizing and allocating funds for housing development. As mentioned, the city often focuses their resources on waterfront development and more expensive homes, rather than helping communities in need by providing more affordable housing or reinvesting in older homes that could benefit from the AOC's restoration efforts.

“I feel like the cities and the governments decided to make that a priority to build those types of houses around that waterfront as opposed to focusing on some of the other communities that desperately need that type of investment too.” - Muskegon community member

We interviewed one representative from the Disability Network West Michigan, who has on-the-ground work and experience in ensuring that services and businesses are accessible to people with disabilities. It provided a unique, and needed, perspective on how disability considerations are proposed and implemented within the city and in public spaces. The

Disability Network West Michigan has had discussions on equity and access with the City of Muskegon and the Downtown Development Authority, fostering a good relationship with the city in advocating for more accessible spaces and resources. This partnership allows for a project review and input process, where the disability advocacy organization provides suggestions for current projects that incorporate accessibility considerations and ensure minimum compliance with the ADA. Some successful projects include improvements to playgrounds, such as ramped access and rubber matting, as well as to streetscapes and sidewalks for accessible parking spaces. However, as it relates to water restoration and cleanup, the city often prioritizes commercial and residential development rather than public access for the broader community, highlighting similar concerns mentioned by other interviewees.

“One of the key points... is the importance of making sure that people with disabilities have the same choices in regards to their participation in the community, and that the community is supporting individuals and meeting their desired participation goals without a preconceived notion about what is or isn't possible or desirable or acceptable.”

- Representative from the Disability Network West Michigan

Additionally, the interviewee from the Disability Network West Michigan expressed that they have not been specifically consulted in water restoration projects. Some accessibility considerations such as boardwalks, bike paths, and opportunities to be closer to the lake have been implemented at Veteran's Park, but more outreach and dialogue between disability advocacy groups and restoration leaders is needed. Some of these efforts have been done in the neighboring county of Newaygo, which contains part of Muskegon River. Accessible docks and kayak launches were installed here as well as mats on the beach for wheelchair access to the water. By more deliberately including these perspectives in water restoration efforts for Muskegon Lake, there is opportunity to build stronger collaborative partnerships across diverse organizations and increase overall community engagement. Specifically requiring intentional accessibility considerations in the funding and grant processes in the larger GLRI program can help advocate for more equitable access for all residents in AOC communities.

White Lake AOC

Located on the western shore of Michigan, White Lake was designated as an AOC in 1987. Restoration work was heavily focused on remediating BUIs in the eastern section of the lake where a substantial industrial presence, notably Hooker Chemical and Whitehall Leather tannery, had polluted the water body and lake sediments with hazardous chemicals and waste disposal pollutants. Also located on the eastern section of White Lake are the two major population centers of Montague and Whitehall that formed around the lake in the 1800s. Montague and Whitehall citizens expressed their reluctance to fish and recreate in White Lake due to the fear of contamination during the period of heightened pollution and prior to restoration. During the restoration process, prior to and after the creation of the

GLRI, the White Lake PAC worked steadily to remove BUIs to help restore the community's confidence in the safety of their waterbody. In 2014, White Lake became one of four US based AOCs to be delisted, after removing their eighth and final BUI.

The communities of White Lake have historically included a notable proportion of seasonal residents. These communities are heavily reliant on their tourism industry and the influx of tourists to summer homes that are abundant in the area, with many located around the lake itself. Those that remain year-round rely on blue collar work and are willing to travel to surrounding communities to find these jobs, so they can live in these bedroom communities near the lake. This was even the case prior to AOC delisting. Given the unstable nature of the job market in the area, all interviewees mentioned employment opportunities as a high priority for the area.

The area's historical heavy reliance on industry jobs came at a price during the restoration process. All interviewees from White Lake noted the AOC community's relationship with the industries that, in part, helped build the towns, as one that was complicated to reckon with and navigate during the restoration process. The damage caused by industrial pollution was easier to overlook for some residents in the area who were more concerned about the security of the local job market.

Job opportunities were created during the restoration process as local contracts were prioritized for work on AOC projects. The PAC also formed partnerships with local contractors that might not have had experience in certain areas of need, as was the case for a shoreline habitat restoration projects, and worked with them to ensure the job was completed satisfactorily. This not only helped keep jobs within the area but also helped bolster local buy in to the projects.

Completion of these restoration projects has also been positive for the overall job market in the area. In the summer following delisting, interviewees noted there was a substantial uptick in tourism to White Lake. Since then, one business owner mentioned that their business and others, particularly restaurants and recreation businesses, have continued growing since delisting in 2014.

"I was working... the year that we went off the list and it was like the population exploded. One year it was just kind of like sleepy, same old humdrum...and then the next year it was insane... people were coming in left and right, and it was just like all of a sudden we were off this list and everybody was like, holy cow this is what it's like."

- White Lake community member

Sense of Pride

Given White Lake's status as a delisted AOC, the area provides a unique opportunity for reflections about the delisting process and life after removal of the BUIs. Notably, the community has seen a significantly increased sense of pride. All interviewees mentioned a change in the local perception of White Lake after the restoration and delisting process was

complete. The lake that once was avoided out of fear of pollution has now been embraced by the surrounding community, as citizens and visitors once again feel comfortable to fish and recreate in White Lake. Previously, most citizens would use Lake Michigan for these purposes.

Most interviewees noted a noticeable local commitment to maintain projects that were completed during the AOC process. There is a desire within the White Lake community to ensure that the lake's water quality does not backslide, given the positive outcomes that have come out of delisting and the restoration investments. One interviewee noted that the increased sense of pride could have been leveraged further if the PAC had not immediately dissolved upon delisting. Maintaining the PAC could have ensured needed structure was in place to centralize and support some volunteer and organizing efforts that came after delisting.

Recreation opportunities have also increased. Most interviewees noted the important role that fishing and recreation opportunities have played in the lives of community members. Subsistence and recreational fishing have played an important role in the community, and the restoration work has made it possible to once again consume fish from White Lake that were previously deemed unsafe to eat. Fishing tournaments and other recreational based activities have also been brought to the area in the years since delisting. No longer plagued by historical pollution, people have once again been able to utilize the water to its full extent.

GLRI and AOC Structure

Restoration work within White Lake was heavily PAC driven with a bottom-up, self-directed approach to the process. Local community groups were not significantly involved in moving the delisting process forward. However, engagement and communication with the public was a focus for the PAC throughout the restoration process. The local newspaper was utilized extensively throughout the restoration and delisting process to communicate restoration progress and begin to change the narrative surrounding the safety and cleanliness of White Lake. The local newspaper was seen as a trusted source within the community and was, therefore, an effective tool for spreading the PAC's messages and intentions to the public.

This internally-driven PAC process played a role in how state and federal entities were involved in the White Lake AOC, especially during the delisting process. It was important to the community that the process remained procedurally just, with the PAC maintaining predominant decision making power. In some instances, the White Lake PAC pushed back against state pressure to complete BUIs and delist as fast as possible. The state was seen as wanting to push completion of projects that could be deemed "low-hanging fruit" and quickly move towards delisting to prove the effectiveness of the AOC program, a common goal for all states receiving AOC investments. However, pushback by the White Lake PAC was effective at establishing compromises and allowed the members some flexibility to set and proceed with their own timeline and agenda.

On the federal level, EPA involvement was significant during the restoration process, but generally in a supportive capacity. The White Lake PAC utilized the EPA as a resource for questions but otherwise drove the restoration process themselves. After delisting was complete, the connection between the EPA and the AOC became less formalized, resulting in less frequent communication. Remaining members of the White Lake PAC and restoration network have had to make a concerted effort to maintain communication with the EPA offices to gain information and receive updates on AOC work in general once the AOC was delisted.

Community Concerns and Priorities

Despite delisting from the AOC Program, White Lake residents still have lingering concerns in their community around the health and integrity of local water resources. There are lingering concerns, expressed by most interviewees, surrounding groundwater contamination and ongoing, long-term cancer risks. White Lake notably has a cancer rate that is abnormally high per capita, reflecting the long-lasting legacy of pollution in the White Lake community. There is concern that with delisting, and a decreased emphasis on monitoring, restoration, and maintenance that seepage and groundwater contamination could once again become an issue.

Other environmental factors, like invasive species and flooding, are also of concern in White Lake. Invasive zebra and quagga mussels are especially of note given the significant role that boating plays within the White Lake community. Climate change, and the resulting flooding from increased frequency and intensive rainstorms, coupled with elevated Lake Michigan water levels, is of particular note as a majority of the interviewees mentioned the issue. Rising water levels have led to flooded homes, businesses, and roads and the continued threat of property damage, or loss, is at the forefront of many resident's minds.

Chapter 5: Highlighting Uses of Spatial Data and Geo-Visualization Tools for Investigating Patterns Between Historical Injustices, GLRI Project Distribution, and Community Demographics

Geo-visualization tools and methods are often used to show spatial patterns in data that are otherwise not obvious. The power of mapping and displaying data in a geographic context has often been used to show spatial variation in different types of environmental data, such as the locations of plant species or the extents of wetlands. The natural and built aspects of the world are easily mapped and understood in geographic contexts. The addition of social and demographic data to these kinds of maps has the power to tell a new story about how humans interact with and could be impacted by the environments they live in. Mapping efforts have long changed the way humans see the world around them. Famously, the first geologic maps of England, Scotland, and Wales contributed to the society's broader understanding of Darwin's theories of evolutions and Earth's true age ("The map that changed the world", Winchester and Smith 2001).

In recent years, the field of environmental justice has advanced the use of mapping products that overlay environmental hazards and social demographics. Many EJ mapping initiatives at the state level have been used as tools for identifying areas that are impacted by environmental burdens and social vulnerability. Importantly, these tools also help quantify these impacts across geographies. California's CalEnviroScreen tool is the pinnacle example of mapping EJ impacts at the census tract level based on environmental hazards and social characteristics (California OEHHA 2017). Following the creation of CalEnviroScreen in 2013, the federal government created and released EJSCREEN in 2016 (Lee 2020). EJSCREEN is a nationwide tool that uses cumulative impact indicators at the census block level to identify candidate areas for further consideration and outreach in the development of federal policies and programs. However, since EJSCREEN is a national tool, it is most useful when utilizing consistent data across all states. Data limitations and the range of data availability across states can hinder the ability to include additional population characteristics in this tool, such as health data. States that have more specific data are also not able to upload these data to the EJSCREEN tool. Thus, EJ mapping efforts at a state-level can allow individual states to adapt their cumulative impact metrics to their specific sub-regions and communities.

Other states, including Michigan, are currently working to develop state-specific tools to aid in identifying communities that suffer from environmental injustices and cumulative impacts from social vulnerabilities. The goal of these tools is to help tell the story of injustice, and its impacts, in a spatial manner to promote more equitable environmental decision making. In California, for example, decision makers have used CalEnviroScreen to prioritize

environmental and infrastructure investments from revenue that is collected through the state’s industry Cap-and-Trade Program (Callahan and DeShazo 2014).

Most current geo-visualization tools, like CalEnviroScreen, focus on displaying cumulative impacts across study area domains. Cumulative impacts was defined by CalEPA’s Environmental Justice Advisory Committee in 2005 as:

“Exposures, public health or environmental effects from the combined emissions and discharges, in a geographic area, including environmental pollution from all sources, whether single or multi-media, routinely, accidentally, or otherwise released. Impacts will take into account sensitive populations and socioeconomic factors, where applicable and to the extent data are available.” [California OEHHA 2017].

The CalEnviroScreen tool embraced this definition with its intentional use of pollution burden indicators and population characteristic indicators in its formula for calculating cumulative impacts across California (Figure 13).

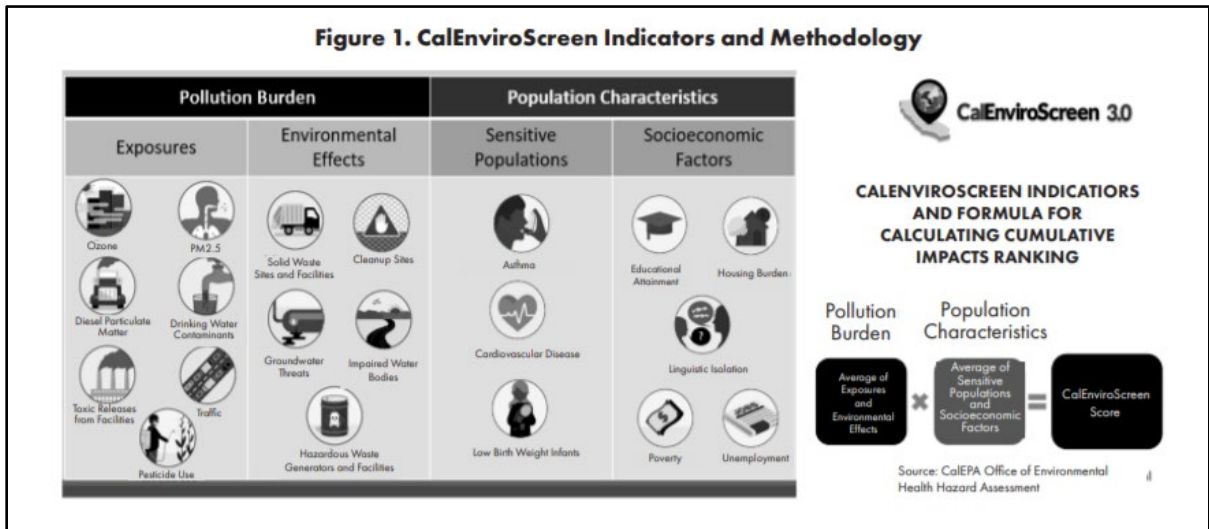


Figure 13. CalEnviroScreen cumulative impacts indicators used in calculating cumulative impact scores, or CalEnviroScreen Scores. Indicators represent datasets available across the state at the census tract scale. The screening tool combines pollution burden and sensitive population characteristics. (Source: Lee 2020)

Environmental Justice scholar, Charles Lee, makes a distinction between the use of cumulative impacts versus disproportionate impacts in the Environmental Justice field and emerging mapping methods and tools. Lee’s definition of Disproportionate Impacts places a greater emphasis on the role that historical policies have played in creating the current circumstances of communities who experience high pollution burdens and social vulnerability today. He defines the emerging concept of disproportionate impacts as:

“Disproportionate environmental and/or public health impacts are combinations of demonstrably greater pollution burden and population vulnerability associated with socially and/or economically disadvantaged communities and populations. Disproportionate impacts may often reflect consistent patterns in the distribution of pollution and vulnerability, and are often a function of historical trends and policy decisions.” [Lee 2021].

Environmental Justice advocates and scholars have also noted that many of the current EJ mapping tools are “air-centric” and would benefit from better accounting for water-based pollution impacts (Lee 2021). This is true in Michigan, and particularly in Detroit, where a major environmental justice concern is air pollution. As we found in our research, many nonprofits and community groups focus on air pollution in their advocacy work in Detroit. There is also more awareness of air pollution impacts compared to those from other sources of pollution.

Both EJSCREEN and CalEnviroScreen focus on the impacts of environmental burdens and social vulnerabilities. This reflects the trend of impact-based analysis that has dominated the Environmental Justice field since its start in the 1980s. A strong focus on environmental impacts has helped advocate for the equitable distribution of environmental burdens in communities across America but there has been little work on how environmental benefits should be equitably distributed as well. Framing environmental mapping tools in a benefits-distribution manner would help advocate for more equitable access to green spaces, healthy foods, water access, and affordability (Lee 2021). All of these benefits, and their distributions, are vital to consider as communities are looking to transition to more just energy and climate resilient economies. In the context of the GLRI, the benefits of restoration work equate to the Beneficial Uses that the GLRI was created to help restore. These benefits also represent the freshwater ecosystem services that are widely referenced in the fields of ecosystem science and ecology. There are very few scholars and groups who are currently mapping restoration benefits in and outside of water fields despite the growing collection of literature that exists surrounding the modeling of ecosystem services. Quantifying human social benefits has been at the center of the research efforts for the EPA Research and Development team in Duluth, MN. They have explored biophysical services and economic indicators to better understand water revitalization and its connection to community goals and social benefits (Angradi et al. 2016, Angradi et al. 2019). The Community Engagement, Environmental Justice & Health Lab at the University of Maryland is also a leading research team in this space that has created tools for the state of Maryland that incorporate impact data, like CalEnviroScreen, and benefits data through their Park Equity Mapper and other ongoing efforts (CEEJH n.d.).

In the following sections, we have compiled data to illustrate how some of the current trends in EJ mapping can be used in the context of the GLRI program. The data we have collected will illustrate the following across our four AOC case studies:

1. The current state of Cumulative Impact mapping data and Environmental Justice tools for the state of Michigan (Grier et al. 2019)
2. Patterns of historically unjust policies, like redlining, where data are available (Nelson et al. 2021).
3. Median home values and median household incomes, where redlining data are not available (Esri Demographics 2018)
4. Race demographics data from the US 2010 Census (US Census Bureau 2017)
5. Social vulnerability data calculated by the CDC's Social Vulnerability Index (CDC 2018)
6. Locations and types of GLRI projects (Great Lakes Restoration n.d.)

All datasets included in these results are publicly available. These six sources represent a sample of spatial datasets that could be used in the GLRI program to investigate the patterns of demographics and equity considerations. Many datasets are state-specific and availability of certain types of data could vary between Great Lakes states. All of our datasets illustrate impact-focused data. We did not find many examples of data relevant to our AOC case studies that was focused on restoration benefits. Mapping restoration benefits is a crucial next step to using mapping data in the GLRI program. We displayed our impact-focused data for each AOC in panel format to best tell the story of how these different components relate to one another and current GLRI projects.

River Raisin AOC

The federal government did not produce redlining maps for the City of Monroe in the 1930s, as it had a population under 40,000 people at the time. Although we do not have redlining data for Monroe, it is possible that historical local documents exist that show similar patterns of discrimination in housing and development policies and practices. One similar small city, Evanston, Illinois, worked with local historians to create a 77-page report documenting examples of local housing discrimination (Robinson and Thompson 2020). In absence of these data for the River Raisin AOC, we used a publicly available data source from Esri to illustrate patterns of current home values and household incomes in the watershed at the census block level (Figure 14a). Many of the census blocks in the upper watershed have high to low home values with high median incomes. This pattern is disrupted closer to the AOC boundaries where there are census blocks close to the River Raisin and Lake Erie with low home values and low median household income. This observation matches with some of the comments we heard from interviewees about the distribution of income and wealth within the watershed. Multiple interviewees also noted that, although there are not as many disadvantaged neighborhoods in the River Raisin when compared to the Rouge and Detroit AOCs, there are some located in east Monroe near the mouth of the river and Lake Erie.

When we asked interviewees about racial diversity in the AOC community, specifically in reference to how races use the aquatic resource, many noted that there is little racial diversity in the River Raisin watershed when compared to the Detroit area. Based on

mapped 2010 Census data, there are areas, like downtown Monroe and Adrian, with higher percentages of minority populations (Figure 14b). These areas also have the highest social vulnerability and EJ scores throughout the River Raisin watershed (Figure 14c and Figure 14d). The EJ scores in the River Raisin watershed have 5 census tracts in the top 20% of tracts with a higher cumulative impact in Michigan and 19 in the top 50% (Grier et al. 2019).

Local community groups and stakeholders in the River Raisin have also used mapping tools to highlight community environmental resources. One example from the River Raisin Institute highlights the locations of fresh local food that includes callouts for significant habitats, aquatic habitats, and waterfronts (Figure 15). This map is a potential example for what mapping benefits of restoration work could look like and how restoration benefits can intersect with other community priorities like the availability of fresh and local food. Mapping the benefits of restoration work can also improve awareness of restoration investments in communities and help connect people to restoration benefits they may not have been previously aware of. Including maps of benefits in public spaces can also help bridge some of the language barriers that exist in communities if maps are constructed to include accessible symbols and the common languages that are spoken in the community.

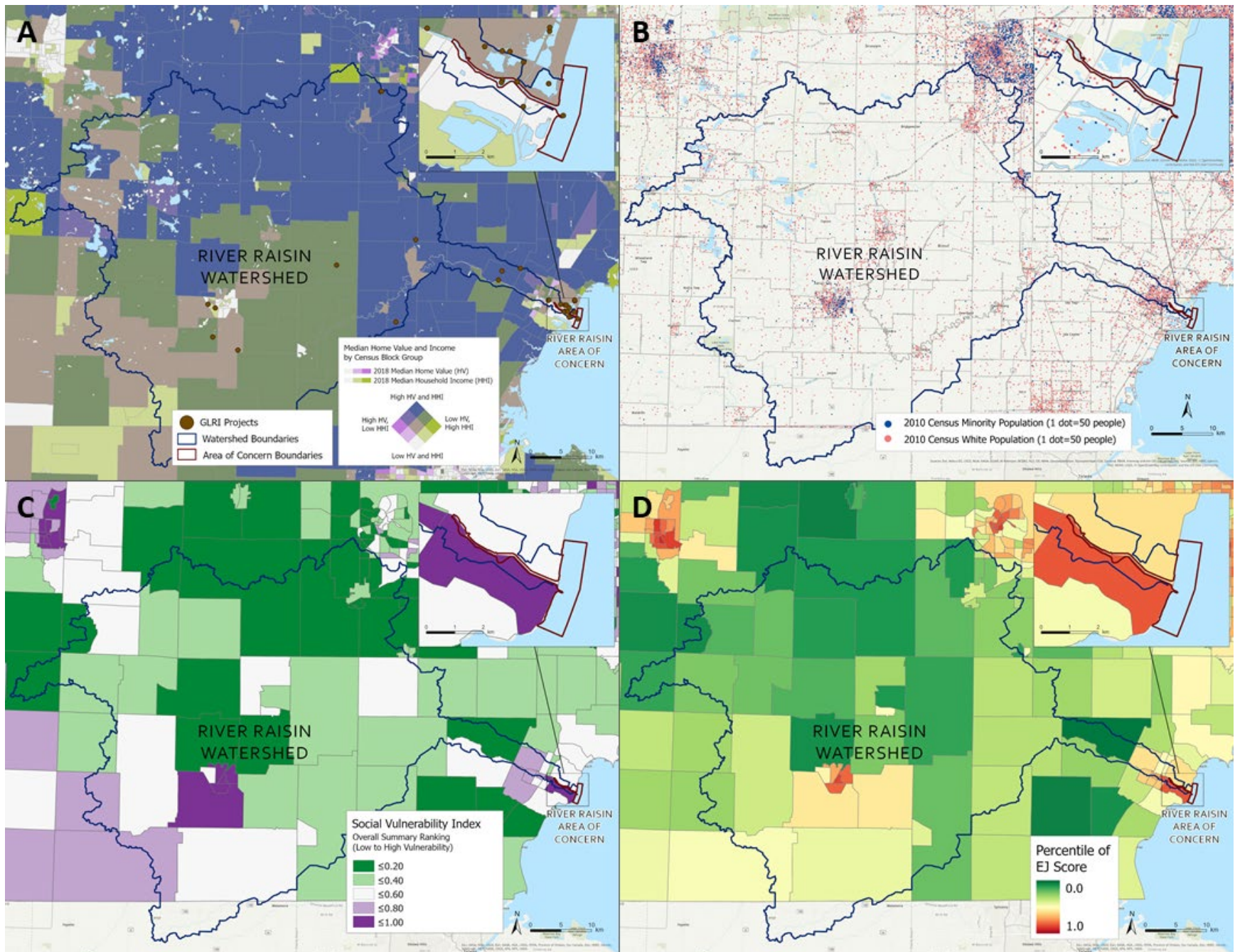


Figure 14. River Raisin watershed and AOC boundaries mapped with A) GLRI project distribution alongside median home value and household income by census block group, B) race demographics, C) the Social Vulnerability Index, and D) EJ score percentiles ranked by census tract.



Figure 15. Resilient Monroe Green Map created by the River Raisin Institute. Although the map is focused on local fresh food availability, it also highlights areas with significant habitat, aquatic habitat, and waterfronts in the legend. (Source: River Raisin Institute 2017)

The River Raisin, and all AOCs, were once home to indigenous people. One area of future consideration could include mapping the relationships between tribes and AOCs. This exercise could help define more of the history around environmental injustices in AOCs and help identify stakeholders and restoration efforts currently underway. For example, in Michigan and other Great Lakes states multiple tribes are working to restore wild rice beds using GLRI funds. Tribal members of the NHBP who we spoke to in our community interviews mentioned that the tribe uses mapping products for current wild rice restoration efforts. The tribe also uses mapping tools to show the history of land treaties between tribal nations and the US federal government in the 1800s (Figure 16).

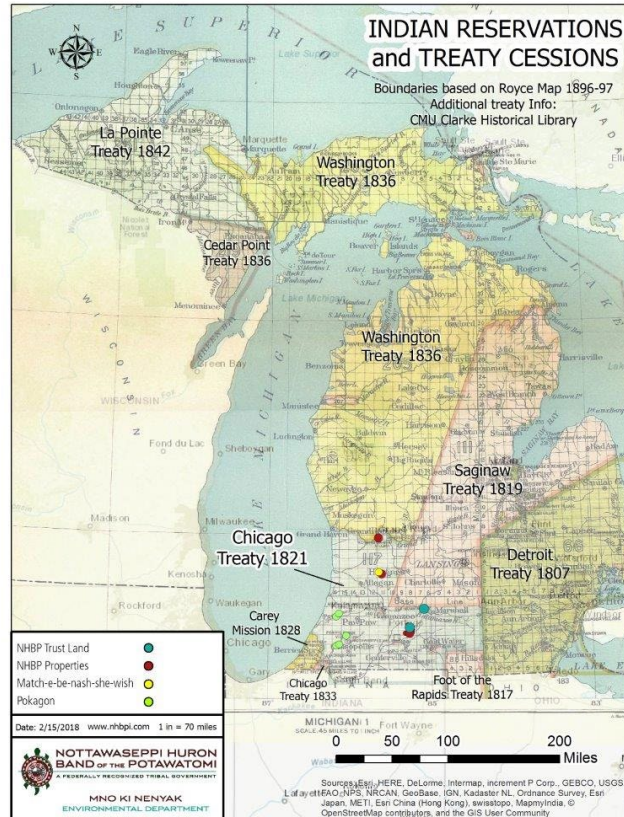


Figure 16. Map of Indian Reservations and Treaty Cessions produced by the Nottawaseppi Huron Band of Potawatomi. (Source: NHPB 2021)

Rouge and Detroit River AOCs

Redlined neighborhoods in Detroit in the 1930s included 239 neighborhoods with grade designations: 15 in grade A, 39 in grade B, 123 in grade C, and 62 in grade D (Nelson et al. 2021). Most neighborhoods were graded as “Hazardous” (D) and a few “Definitely Declining” (C) in the downtown Detroit area (Figure 17a). There is a clear relationship between environmental hazards, impacts, and overall vulnerability to race demographics within the community. Many neighborhoods that were given a C or D rating in the 1930s correspond to current areas with predominantly minority populations (Figure 17b). Many of these neighborhoods today also show environmental impacts and community vulnerability that closely mirror their 1930s assigned grades (Figure 17c and Figure 17d). Since the redlined neighborhood grades were designated based on racial discrimination and environmental conditions, these similar patterns are not surprising—but show the persistent impacts of inequitable historical policies on community conditions and geographic patterns today.

Some interviewees who were familiar with restoration efforts and surrounding communities provided context on certain towns and their ability to obtain GLRI funds and implement projects. These maps supplement, and are extremely relevant to, this geographic context shared by interviewees. A diverse mix of community vulnerability is shown across the entire

Rouge and Detroit AOCs. The headwater region of the watershed, including towns such as Plymouth, Canton, and Novi, have low vulnerability and were noted by interviewees as regions with less development and more public green spaces for the community (Figure 17c and Figure 17b). These towns do not have industrial legacies to the same extent as communities in and around Detroit, and they have greater access to resources and staffing capacity to complete projects. Dearborn and Dearborn Heights have higher vulnerability and greater environmental impacts (Figure 17c and Figure 17b). Despite these metrics, an interviewee involved in the restoration process expressed that both towns have made recent investments in water access and parks. They also possess significantly more resources to allocate towards restoration work compared to their neighboring communities.

Communities mentioned as having fewer resources correspond fairly well with the community vulnerability and EJ score metrics in our maps. For example, Melvindale, Detroit, and River Rouge are economically disadvantaged and lack capacity to support and maintain GLRI projects. Each of these towns are within the top 10% (within Michigan) for both community vulnerability and EJ score metrics. Census tracts around the City of River Rouge, for example, are within the top 2% of census tracts for EJ scores. Wayne, Westland, and Inkster, along the southern boundary of the Rouge River AOC, were also mentioned as communities that have few resources to allocate towards water restoration and access. Similarly, those towns have notably higher community vulnerability and environmental impacts based on EJ scores (Figure 17c and Figure 17b).

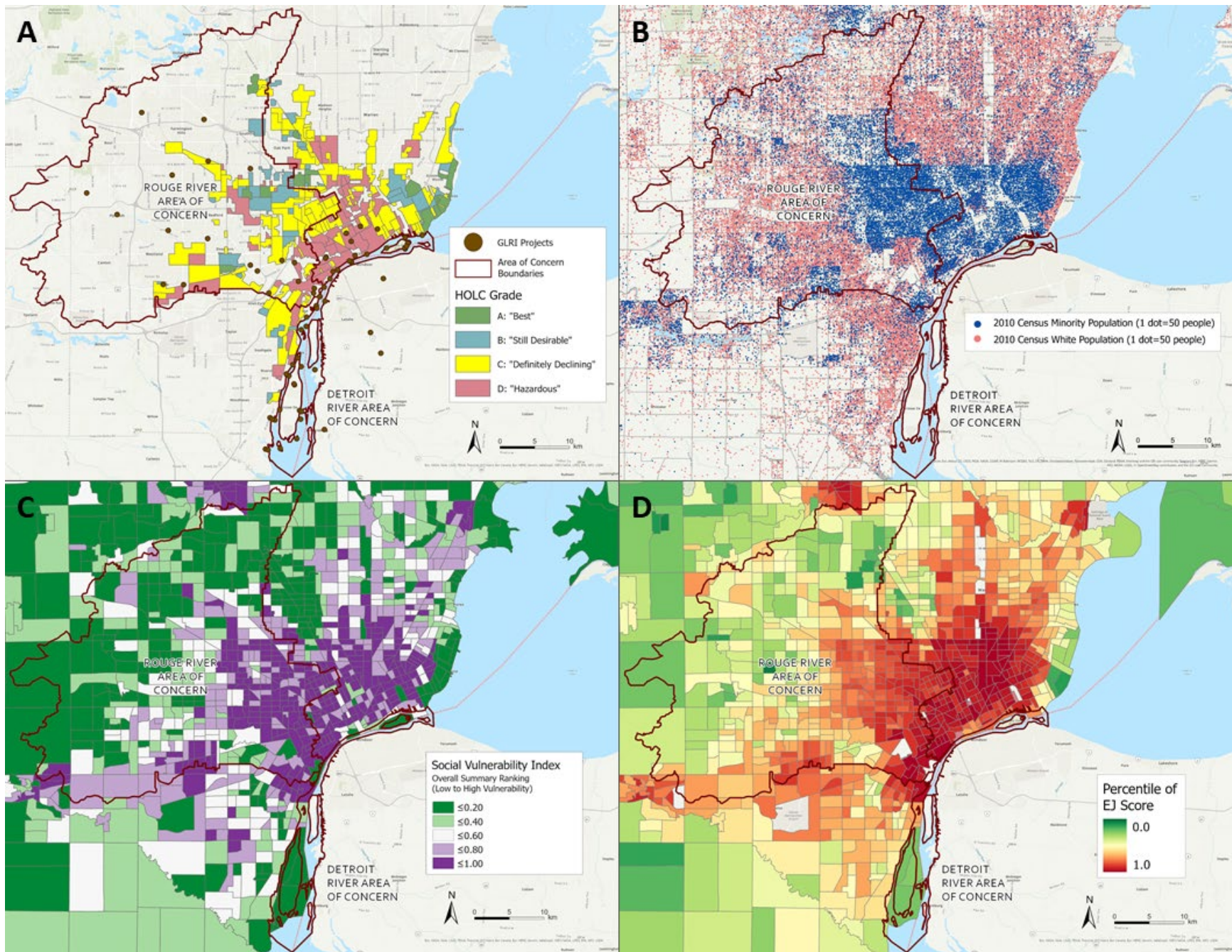


Figure 17. Rouge River watershed and Rouge and Detroit AOC boundaries mapped with A) GLRI project distribution alongside historical redlining data, B) race demographics, C) the Social Vulnerability Index from low to high vulnerability, and D) EJ score percentiles ranked by census tract.

Muskegon Lake

Disproportionate impacts to communities within and around the Muskegon Lake AOC are apparent, with the greatest disparities between communities located north and south of the lake (Figure 18). As industrial practices were historically located along Muskegon Lake's southern shoreline, communities who live south of the lake are more directly affected due to their proximity to environmental hazards (Figure 18c and Figure 18d). As a result, many restoration efforts and GLRI projects are distributed along the southern shoreline of Muskegon Lake. Forty percent of the GLRI funding grants in Muskegon were allotted to GLRI projects on the southern shoreline. These projects have addressed concerns such as benthos degradation and sediment contamination.

Many of the environmental impacts we see today can be attributed to the redlined neighborhood grades designated by HOLC, for 21 Muskegon neighborhoods: 1 in grade A, 5 in grade B, 7 in grade C, and 7 in grade D (Figure 18a). All neighborhoods designated as "Hazardous" (D) and the majority of "Definitely Declining" (C) are south of Muskegon Lake. Jackson Hill, Marquette, and Muskegon Heights were neighborhoods assigned the lowest grade in the 1930s and today are home to predominantly Black and lower income residents, as expressed by interviewees in Muskegon and visualized with demographic data (Figure 18b).

Where the map shows higher minority populations in Muskegon, we see very similar trends in our other social indicators such as community vulnerability and environmental impacts. The majority of neighborhoods south of Muskegon Lake have high social vulnerability and are within the top 20% within Michigan, with 7 of the 12 census tracts in the top 10% of most vulnerable communities (Figure 18c). The social vulnerability dataset shows spatial similarities to the EJ rankings; neighborhoods south of the lake also contain among the highest rankings of EJ score by census tract; nine fall within the top 10% of census tracts with the greatest cumulative impacts of health hazards and environmental exposure (Figure 18d).

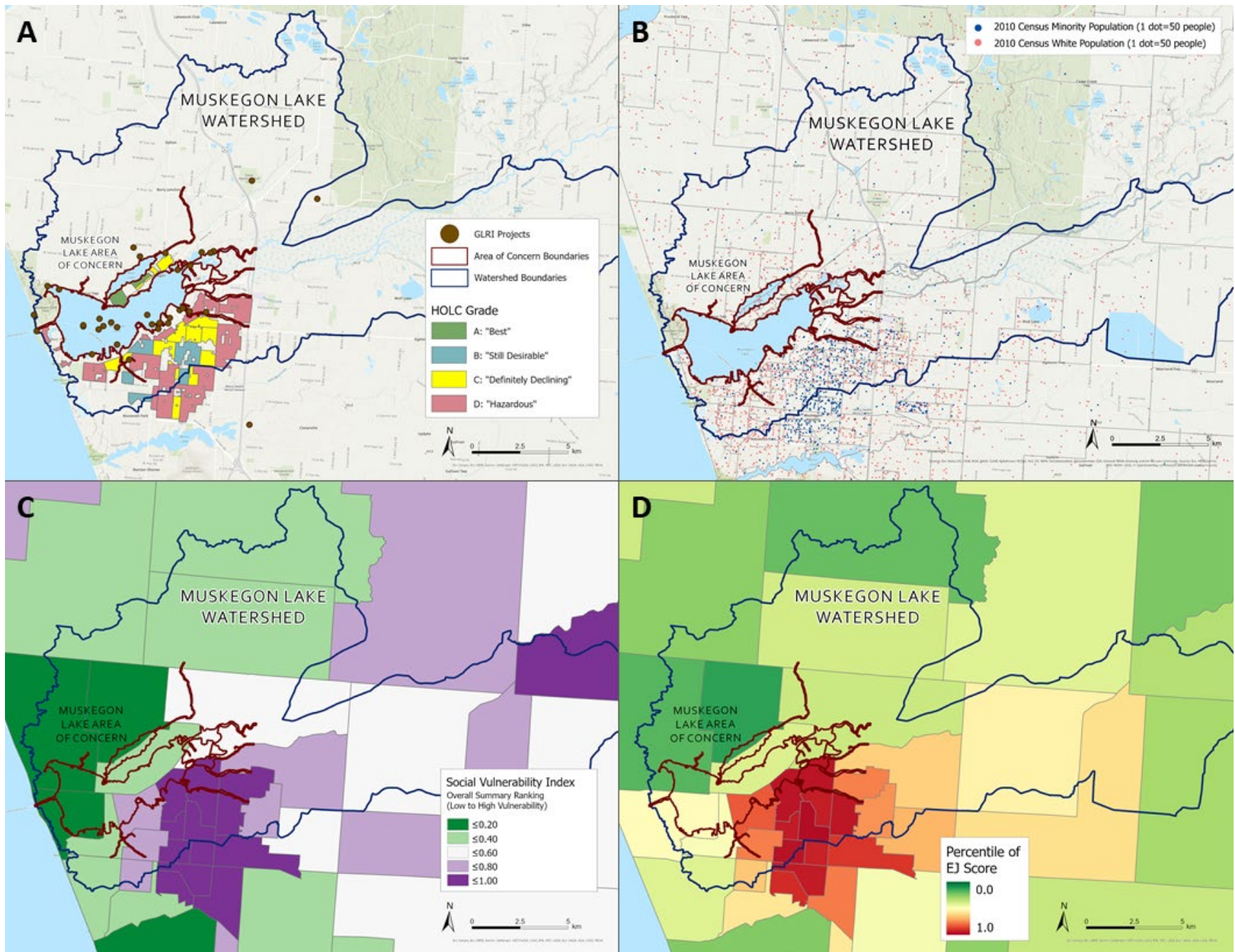


Figure 18. Muskegon Lake watershed AOC boundaries mapped with A) GLRI project distribution alongside historical redlining data, B) race demographics, C) the Social Vulnerability Index from low to high vulnerability, and D) EJ score percentiles ranked by census tract.

White Lake

White Lake serves as a good comparison case within our study, as it was delisted in 2014 and is our only delisted site. Seven GLRI funding grants were awarded to new projects and five additional grants were for continuing projects, only three of which were in close proximity, within 2 miles, to the AOC itself (Figure 19a). Despite where GLRI projects were completed, we observed fairly diverse median household income and home values in the region. Several census tracts around the watershed, most notably those in close proximity to the AOC, have high home value and median household income. The region west of White Lake is also evident as it has considerably high home value and moderately high household income (Figure 19a). Similarly, the region just east of White Lake has a high home value but low household income. These cases, as well as residents with high household income just south and further east of White Lake, provide spatial and quantitative context to interviewees' accounts of heavy demand for seasonal housing along the waterfront.

Community vulnerability across White Lake displayed a few noteworthy spatial relationships, such as much higher vulnerability in the larger watershed, particularly east and directly south of the AOC (Figure 19c). While the Social Vulnerability Index and the EJ Score percentile rankings have generally been consistent throughout the other AOCs, we see different and even contrasting results in White Lake. Those same regions that have high community vulnerability percentiles show fairly low EJ score percentiles (Figure 19c and Figure 19d). By exploring the SVI values further, the Household Composition & Disability and the Housing Type & Transportation themes are primarily contributing to the higher vulnerability value south of the AOC. For the census tracts outside of the AOC and in the larger watershed, the first theme, of Socioeconomic Characteristics also contributes to the high vulnerability score, although not as much compared to the two housing-related themes. The lower vulnerability values shown within the last theme, Minority Status & Language, correspond with our race demographics map as White Lake is not very racially diverse. That being said, the EJ Score metrics do not necessarily show that White Lake was an AOC with a heavy industrial pollution legacy that affected the community health in the region, especially relating to the environmental hazards and cancer risk across the broader White Lake community (Lynch 2014). These findings emphasize that spatial data should be supplemented with information about the real lived experiences of residents to truly understand the health, well-being, and quality of life considerations of a community.

As projects were completed and the AOC has been delisted for seven years, it could be useful to now map ecosystem services and social benefits to measure the longer effects of GLRI restoration. While our study focused on existing spatial datasets and demographics, mapping more specific metrics of accessibility (e.g., transportation routes, public green spaces) and visitation (e.g., tourist numbers, new residents, increased business) could provide additional information on how and where restoration efforts have provided tangible benefits across the communities.

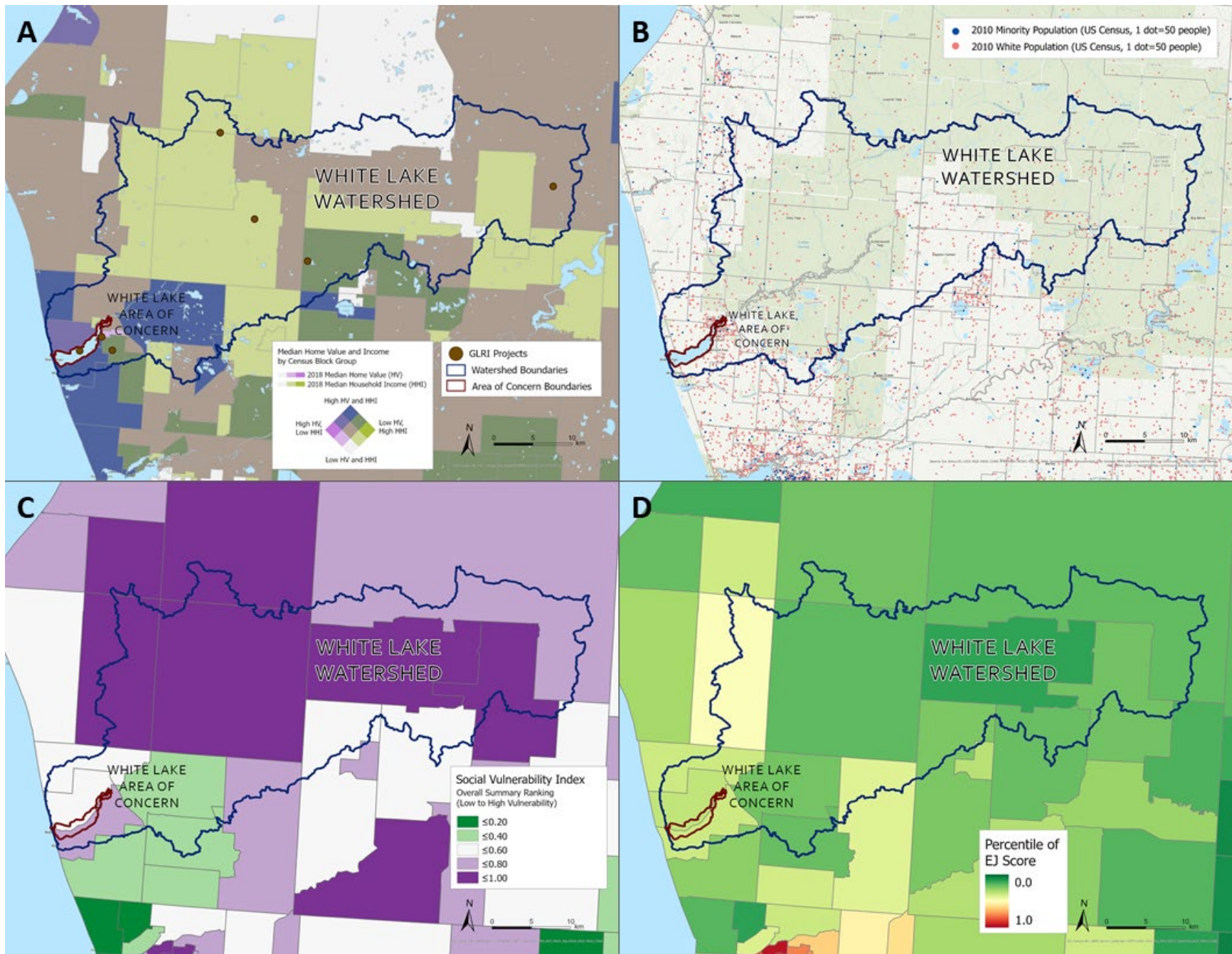


Figure 19. White Lake watershed and AOC boundaries mapped with A) GLRI project distribution alongside median home value and household income by census block group, B) race demographics, C) the Social Vulnerability Index, and D) EJ score percentiles ranked by census tract.

Chapter 6: Discussion and Equity-Informed Recommendations for the HOW Coalition's GLRI Advocacy

Incorporating Social Metrics of Restoration Success

Restoration success has many different definitions across the GLRI and AOC programs. The AOC program currently defines success as the delisting of BUIs. To the EPA, and ultimately Congress, this delisting process is deemed successful when BUIs are removed and AOCs are delisted quickly and efficiently. Past work with Michigan PACs highlights that many PACs define success differently. Previous projects that have interviewed PAC members have found that they define restoration success as “(1) continued restoration beyond BUI [delisting]; (2) a positive shift in perception of the water at a community level; (3) establishing a mechanism for continued momentum; and (4) an overall healthy environment” (Knauss et al. 2019). This definition, in contrast to the congressional and EPA definitions of success, focuses on the potential value that communities have to gain from restoration work and its long term sustainability.

Other definitions of success focus on the economic return that completed projects have generated within AOC communities. In 2007, the Brookings Institute calculated that an investment of \$26 billion into the Great Lakes to clean up AOCs, enhance coastal health and conservation, and assure sustainable development would result in long term economic benefits totaling at least \$50 billion, a 3-1 return on investment (Austin et al. 2007). Another study conducted by the Great Lakes Commission and Council of Great Lakes Industries estimated that every dollar of federal money spent between 2010-2016 will return \$3.35 in additional economic activity in AOC communities through 2036 (Great Lakes Commission and Council of Great Lakes Industries 2018). Both of these studies also noted that Great Lakes restoration will have unquantifiable benefits, like quality of life improvements, that will in turn help generate added economic activity in the newly restored region.

Although a number of studies have calculated economic benefits of Great Lakes restoration investments, few have done so at the scale of a single AOC. In Muskegon Lake, one study used hedonic modeling and economic impact analysis to determine the return on investment of \$10 million worth of restoration work along the Lake's southern shoreline. This study focused on the increased recreation and tourism opportunities, and the potential increase in home values that would result from restoration work. The study found that restoration improvements to the Muskegon Lake southern shoreline would create approximately \$60 million dollars in value over a 20 year period, so a 6-1 return on investment (Isley et al. 2018).

A similar local-scale economic study was conducted for the River Raisin National Battlefield Park based on park attendance between 2011 and 2017. Between these two years, annual attendance to the park rose from 36,206 to 238,813 visitors (Hartig et al. 2019a). Based on these visitation statistics, the National Park Service 2017 Economic Impact Study estimates that the park's increased attendance has produced \$16.4 million in economic benefits (NPS 2017). Michigan State University and the RRNBP also modeled that the park's attendance could reach approximately 635,000 annual visitors as the park expands. This expansion is projected to generate \$31.6 million and \$21.9 million in state and local economic impact, respectively (MSU 2017). The growing visitor numbers, and the resulting economic benefits, have been attributed to the increased positive perception of the River Raisin due to AOC restoration work (Hartig et al. 2018).

Similar studies of economic return on investment have been conducted for the Detroit Riverwalk and projects in other AOCs throughout the Great Lakes region. However, economic activity and success are not the only compelling reasons for continuing to fund restoration of the Great Lakes ecosystem through the GLRI. The Great Lakes also provide cultural services to the many urban, rural, coastal, and inland communities that reside within the basin. While the AOC program focuses mostly on coastal areas in the Great Lakes, both the GLRI and AOC programs are meant to do more than just remediate and restore Beneficial Use Impairments in Great Lakes nearshore waters. By focusing on the delisting of Beneficial Use Impairments of aquatic resources, both programs inherently aim to revitalize community connections to these resources.

Revitalization outcomes from remediation and restoration activities are those that specifically promote human well-being and social equity (Angradi et al. 2019). Scientists and engineers have worked to create tangible metrics to define and measure the success of remediation and restoration activities during the past three decades of the AOC program. In contrast, finding a coherent set of metrics for defining and measuring the success of revitalization outcomes resulting from restoration activities is a much newer objective (Williams and Hoffman 2020). Scientists at the EPA's Great Lakes Toxicology and Ecology Division Laboratory have created a new framework for identifying the quality of life changes that can result from restoration activities funded by the GLRI and AOC programs. Their current framework, the Remediation to Restoration to Revitalization (R2R2R) framework, uses ecosystem-based management principles to help managers identify tradeoffs and connections between engineering and ecosystem work and the revitalization of communities undergoing restoration. Although this framework has only been used in a case study in the St Louis River AOC, it specifically mentions the need for equity considerations in participatory processes, ecosystem services analyses, and decision support systems when working in social-ecological systems, like Great Lakes AOC communities (Williams and Hoffman 2020). A key component to equity considerations and the successful implementation of the R2R2R framework is the meaningful engagement with, and inclusion of, community perspectives. The framework calls for the inclusion of a wide range of stakeholders and community members, the collective identification of ecological and social

goals, as well identification of when projects are not meeting these goals (Williams and Hoffman 2020).

Our findings highlight a new, emerging definition of restoration success, centered around equity and justice benefits of the AOC and GLRI programs. Although some AOCs, like the St Louis River, and state and federal agencies across the country are already thinking about issues of equity in environment work, we advocate for more widespread and intentional considerations of equity throughout the GLRI and AOC programs. Successful GLRI and AOC outcomes should include equity considerations across the many phases of project evaluation, planning, construction, and AOC delisting.

Our background research and interview results suggest that focusing on equity in this program will help foster greater community connections to water resources and restoration work. As noted by Great Lakes researchers, GLRI advocates, AOC PAC members, and many of our interviewees; this broader community connection will ultimately lead to stronger community revitalization and more active community involvement in maintaining these water-based “blue investments”. The R2R2R concept outlines key components of considering equity within the context of our findings. Our mapping results demonstrate the potential uses of spatial data in determining a community's context and composition, which can be defined by historical and contemporary inequities. Additionally, these data can aid in identifying and ensuring a wide range of stakeholders are included within GLRI and AOC project considerations. Our findings also advocate for the collective identification of ecological and social goals by highlighting key social outcomes that community members would like to see prioritized in restoration projects. Key equity and justice gaps are highlighted to address problems that arise when meaningful community inclusion is not considered. These gaps also provide thoughtful consideration of components that can be considered in future iterations of the GLRI and AOC programs. Finally, the community-based results of our AOC case studies allowed us to draw out examples of successful initiatives of community inclusion and provide a basis for continued considerations of the R2R2R framework within GLRI and AOC work.

Overall, we found that there is a need to address community context and priorities in multiple phases of AOC work to help foster increased connections between restoration efforts and a diverse group of community stakeholders. Not addressing community concerns, priorities, and the potential benefits of restoration work in an equitable manner will limit the number of people who are able to form connections with the restoration work and who may ultimately learn to care for it. Not reaching out to underserved communities through educational opportunities, community involvement, and information sharing throughout the lifetime of AOC restoration work will limit the extent of social benefits of restoration work, impact the longevity of restoration investments, and inhibit a community's path towards revitalization. Providing these connections, by placing an emphasis on equity in the GLRI and AOC programs, will help accelerate the transition from restoration to

revitalization and help communities across the region more efficiently transition to a blue economy and freshwater future that is sustainable and just for all.

Mapping and Equity

Spatial data and maps give insight into how federal policies and structures, implemented nearly a century ago, have shaped communities that experience the greatest environmental and health hazards today. Comprised of lower-income residents, indigenous populations, and people of color, these overburdened communities experience visible and lasting impacts of industrial and waste processes, many of which are located in and around AOCs in the Great Lakes. The GLRI provides necessary funding for these restoration and cleanup projects; however, these efforts often fail to reach and engage both broader and underrepresented communities (Holifield et al. 2019).

Identification of these populations, with the assistance of spatial data and maps, is a key step in increasing the reach and engagement of the GLRI (Nguyen Thanh et al. 2019). Many communities may not have the capacity and resources necessary to effectively plan and implement restoration projects, and therefore should be identified for focused attention. Examining current project distribution alongside demographic and community patterns in maps and data can be useful tools in promoting the identification of underserved communities in the planning and implementation stages of GLRI projects.

By sharing the current spatial data on community demographics and other social factors, we argue that human and geographic contexts are very much intertwined with the environmental degradation and restoration needs of the Great Lakes region, and should be considered in GLRI program implementation. Understanding these structural injustices and processes through historical maps and existing data can also encourage greater awareness, community engagement, and more equitable distribution of resources and benefits. Spatial maps and data are tools that can inform how we understand historical and current patterns of inequity, and can change how we design, prioritize, and implement GLRI restoration projects on a larger scale.

The Social Vulnerability Index (SVI) underscores how communities can respond to environmental hazards and natural disasters; in other words, the four broader themes explore the idea of community resiliency. Environmental justice and equity are inherently connected to resiliency, as overall community resiliency and vulnerability to environmental hazards depends on the community's demography and the resources they have. These considerations are especially important in the Great Lakes region as climate change impacts can disproportionately affect coastal communities. Furthermore, observing the SVI alongside other metrics such as the cumulative impacts EJ score in the state of Michigan, can help identify different demographic data used in the calculations of these summary datasets and inform future tools and datasets such as those used in our study.

Spatial visualizations and patterns should not stand alone and should be supplemented with lived experiences of the residents when examining environmental inequities and impacts. Personal stories and experiences are crucial to understanding the bigger picture of environmental injustices and working towards more equitable policies. For example, demographic data and maps for White Lake did not necessarily reflect the lingering cancer concerns that residents experience (Lynch 2014). In contrast, community perspectives from Muskegon Lake and the Rouge and Detroit Rivers closely mirror the geographic patterns we see in both regions.

Community Priorities

Part of the R2R2R framework is the collective identification of ecological and social goals in order to address problems related to both society and the environment. Through this knowledge exchange between community members and GLRI and AOC practitioners, mutual learning is promoted (Williams et al. 2020). This approach is inherent to the design of the AOC program, and also provides opportunity for greater insight into, and connections with, communities (Krantzberg 2012).

Our work with community members offered insight into avenues of mutual learning through the consideration of priorities not always directly considered by GLRI and AOC work, but ones that can, nevertheless, greatly impact restoration outcomes. Priorities reflected by participants throughout all of the study areas include: (1) pride in their home, (2) concerns outside the scope of, but germane to, the GLRI and AOC programs, and (3) thoughts on economic models employed within their area.

A sense of pride in one's community can be a key avenue for promoting connection between the community and their revitalizing water resources. Although emotions regarding environmental degradation can be complex, the memories and associations attached to one's home often lead to profound affective investment in the area. There can be an overriding love for, and attachment to, an area that is home to so many personal associations (Lertzman 2012). These sentiments were best summarized by one interview respondent's thoughts that despite the pollution and harm done to the water bodies, the area was still home.

For the environmental movement, which has historically been guilty of being overly technocratic and distant, these emotions can be a key avenue through which to encourage and implement long lasting restoration efforts. Involvement of community perspectives helps foster attachment to, and pride in, proposed restoration projects (Doron and Wallis 2014). These attachments and feelings of pride can foster support for projects and help community members identify with the restoration work. Community buy-in also can help create a local network of care to ensure long term sustainability of restoration projects.

Community concerns outside the scope of the GLRI and AOC programs can prove to cloud the focus of restoration work. When community priorities rise to the level of a frequent concern, or have a demonstrable impact within a community, restoration work can become overshadowed.

This highlights that the GLRI and AOC programs do not operate within a vacuum. It is difficult for community members to fully engage with restoration work when more pressing concerns exist within a community. This is a limitation that the GLRI and AOC programs must navigate by working to understand the broader context and priorities of each community. While issues of stormwater management and flooding are not under the purview of the AOC program, both problems represent examples of water-based issues that have greatly impacted the lives of citizens within AOCs. These issues can potentially affect the health of the Great Lakes and represent additional issues for the GLRI program to consider. Therefore, understanding broader community concerns through community engagement in project planning can allow PAC members, and those who implement AOC and GLRI work, to orient projects to intersect with local community priorities.

The Great Lakes region's shift towards a new economic model, a "blue economy", must include public support. Public support makes short term acceptance, and long term sustainability, of this new economy possible (The World Bank 2017). Our follow-up survey demonstrated additional thoughts on economic priorities that were reflected across all of the study areas. Over 90% of participants agreed, or strongly agreed, with the idea that there is "value in my community moving towards a "blue economy"". This reaction, combined with subsequent positive comments by participants, demonstrates that there is groundwork and significant community sentiment present to support this new economic model as part of Great Lakes revitalization.

Equity and Justice Gaps

We highlight key equity and justice gaps to address problems that arise when meaningful community inclusion is not considered. Community interviews and our follow-up survey revealed these gaps in both the process and outcome stages of GLRI and AOC restoration work. Inequities in project outcomes are apparent through persistent accessibility barriers, which were discussed across all AOC case studies, but most prominently among Rouge River and Muskegon Lake interviewees.

Physical and emotional barriers play a role in how communities engage with aquatic environments. In the Rouge River AOC, fences, high-sloped terrain, and frequent log jams still render the Rouge River difficult to access and navigate. Although some progress has been made to improve water quality, residents are still largely emotionally affected by the stigma of pollution that has shrouded the Rouge River throughout its history. The psychological effects of this pollution stigmatization can create feelings of environmental melancholia. Environmental melancholia may manifest in the form of static, idealized relations with specific places that have since become degraded. The damage of this feeling

can lead to ambivalence, which, if widespread throughout the community, will hinder restoration efforts (Lertzman 2012).

Co-production of knowledge, between members of the public and officials, is a vital component of equitable restoration work. Residents, especially from underrepresented groups, must be able to influence decisions and engage with public services that affect their lives (Lee 2019, Frantzeskaki and Kabisch 2016). This co-production is only possible with a well-informed public, a component that is missing, or limited, in several AOCs. Both the Muskegon Lake and Rouge River communities acknowledged limited public knowledge with regards to general restoration awareness. Multiple interviewees in each of the two AOCs expressed that much of the broader community is still largely unaware of projects taking place in their communities. Even in communities like Muskegon that have placed considerable focus on engaging community stakeholders, additional implementation strategies are needed to reach the broader community.

A major process-related equity gap is the way that differences in PAC structure have led to differential project success across AOCs. In Monroe, where restoration is reaching completion, success has been driven through the actions and efforts of local groups partnering and aligning with the PAC and city government to complete projects, educate the public on the work being done, and spread awareness within the community. In Muskegon, the presence of WMSRDC, the regional development commission, has contributed immense capacity and resources to support community involvement and restoration success. Rouge River, in contrast, largely lacks institutional capacity to facilitate intentional connections between the PAC and local organizations that have strong community support with the desire and capacity to help.

Among these three communities, differences in success are closely tied to where the PAC is housed within the social structure of the community. The Muskegon PAC is contained within the Muskegon Lake Watershed Partnership that works closely with WMSRDC. This partnership provides operational capacity to complete projects and facilitates outreach to the wider community, allowing for greater buy-in from the public in restoration efforts. The River Raisin PAC is nestled under the City of Monroe's Commission on the Environment. River Raisin's unique structure allows for PAC staff support to come from city budget allocations, which frees up funding for public education and outreach programs, which are not activities covered under GLRI funding allocations. In contrast, the Rouge River PAC, as part of the Alliance of Rouge Communities, has neither capacity nor funding to dedicate toward outreach, education, and contracting and partnering with major community organizations, such as Friends of the Rouge. These gaps in the AOC process illustrate that since all AOCs are operating from different social structural baselines, there are going to be inherent injustices in the use of a standardized distribution of funding or planning template to complete projects.

Additional gaps are apparent at the community level in the operational differences between the AOC and GLRI programs. The AOC program is focused on Great Lakes nearshore habitats, while the GLRI is broader and generalized across inland and coastal environments. In Detroit, a city with two major coastal waterways touching the entire geographic extent of the community, some residents express feeling that coastal projects in the Downtown and Midtown areas are heavily over prioritized, while smaller neighborhood parks are largely under prioritized. Residents recognize the importance of robust restoration projects along Detroit's rivers due to their impacts on tourism and economics, but many long-term residents associate most closely with their local neighborhood parks. These parks are often within walking distance to their homes and more-easily accessible than the larger downtown parks. This demonstrates a considerable gap between community priorities and AOC-program intent. Thus, additional work is needed to ensure that GLRI-funded projects are attentive to these particular neighborhood-level needs, in order to supplement large-scale AOC shoreline work and provide for a more holistic revitalization culture within Detroit at large.

Establishing a shared language surrounding equity and justice considerations is key in integrating these concepts into GLRI and AOC work. A common language creates a narrative that simplifies the ability to communicate a commitment to justice and equity, while also creating a platform for coordinated work toward desired outcomes (Annie E. Casey Foundation 2021). Our follow-up survey revealed gaps in the way that justice concepts are understood versus how they are implemented within AOC projects in our case study communities. Most respondents acknowledged at least moderate familiarity with the concepts of Distributive Justice, Procedural Justice, and Environmental Justice. However, a majority of respondents felt that justice considerations were not thoroughly considered or emphasized in restoration projects.

Institutional gaps persist in the inclusion of intentional and measurable equity and justice goals in project design and implementation. For example, a measurable equity and justice goal in the public outreach stage of restoration should be to convene a community panel whose sociodemographics (e.g., class, race, and gender) match those of the broader community near where the project is being planned. Structured outreach such as this could also help to alleviate any disconnect that persists between the intended purpose of local natural resource features and restoration projects and the public's perception of and interest in these resources. For example, while the Rouge River's floodplain parks are an intentional stormwater management strategy to aid in temporary retention of storm flows, some community members engaging in work and leisure in these parks feel the flooding is an impediment to the parks' public utility. Additionally, in Muskegon Lake some residents were upset with the installation of large instream log features that looked like large and messy debris even though they were installed to increase fish habitat in a local stream.

Strategies for Restoration Equity and Success

Identified strategies for restoration success demonstrate the important role that community considerations play in working to accomplish restoration goals. Facilitation of restoration work in conjunction with community groups provides avenues for restoration longevity and more equitable outcomes. Not only do community groups provide greater project capacity through their additional resources, but they are generally deeply embedded within communities and have a greater understanding of needs present within the area. Therefore, they are inherently equipped with the ability to help advocate and implement projects that more accurately reflect the desires of a community. Additionally, close ties to the community allow these groups to more effectively spread awareness of the projects through education and outreach. The utilization of these groups allows projects to more closely align with the needs of communities, a key aspect of equity considerations, while also providing additional resources for this work.

In order to help organize a new “blue economy” and prioritize more equitable restoration, the Great Lakes need to be seen as a defining part of Michigan’s, and the surrounding states’, identity. A Great Lakes identity, centered around freshwater benefits, is already present in the predominantly white and privileged communities of the Great Lakes region. This identity, however, must be made available to all communities in the Great Lakes. GLRI and AOC restoration work represent the opportunity to make sure that communities who have been disproportionately impacted by freshwater impairments share in this identity vital to the region’s future. When the spectrum of diverse Great Lakes communities share this identity and recognize the importance of equitable freshwater benefits, then the region will be ready to fully embrace the shift towards a “blue economy” and a sustainable freshwater future.

One way to instill this identity is through education efforts. This strategy has been used successfully within AOCs to build community connections to projects as well as an overall sense of pride within the AOC communities. Interviewees, especially within the River Raisin AOC, noted significant education efforts within the community that helped increase public awareness about the importance of the restoration work. Recognition of the importance of restoration through education has also helped increase connections between the public and the restored river. These connections, according to one River Raisin interviewee, have deepened the community’s sense of pride and identity as a coastal Great Lakes city that is “lucky to have a river flowing through it.”

Limitations and Assumptions

We initially planned this project to engage directly with residents, representatives, and stakeholders within our AOC case study communities. Due to COVID-19 travel restrictions, we instead relied on email as our primary form of communication and Zoom as our primary teleconferencing interface. This virtual format was a barrier to our team being able to reach a large cross section of people in our case study AOC communities. Ideally, our objective was to make contact with members of the community who have been institutionally

disenfranchised from the restoration process and who may not have the resources to know or engage with the projects happening in and around their community. We imagined these efforts would allow us to deeply investigate and probe inequities in project awareness, processes, and outcomes. However, in a virtual space, our pool of outreach was drastically reduced to interviewees and potential interviewees having some level of institutional connection to the AOC program or privilege that afforded them access to stable internet connections, email services, and technical knowledge of online platforms. Future justice studies should engage with communities directly to better access underrepresented populations and those who may not have connections to the GLRI and AOC program. Our snowball interviewing methodology helped us identify community leaders and representatives from community groups that already have some connections to the AOC and GLRI programs so we had to work to find individuals to interview who did not have these connections. Reaching out to disconnected individuals was harder in an online space but necessary to ensure that our study would not continue to reinforce the voices of the “usual suspects” who have traditionally been active, engaged, and represented in the GLRI project process. By the end of the study, we were confident that we had engaged enough “unusual” constituencies to provide an effective contrast to our pool of “usual suspect” interviewees.

Across our AOC case studies we have the greatest gaps in representation in our set of Detroit River and Rouge River AOC interviewees. Detroit is predominantly a black city and our Rouge River and Detroit River interviewees were predominantly white. This study, and other justice studies, need to do a better job of bringing non-white viewpoints into environmental spaces.

There were additional limitations in conducting community-based research during the COVID-19 pandemic. Areas such as Detroit and Muskegon, with considerable minority populations, were disproportionately impacted by COVID-19 and many community organizations used their capacity and resources to aid and uplift residents during the public health crisis. This further limited our outreach to community representatives, as some did not have the time and resources to engage in a research study with so many other factors impacting their frontline work.

Recommendations

Here we outline recommendations for the HOW Coalition to use in their GLRI advocacy efforts. These recommendations are broken down into two categories: (1) actions the HOW Coalition can pursue with community organizations across the Great Lakes region and (2) equity efforts the HOW Coalition should prioritize in their GLRI advocacy work at the federal level. Recommendations in the second category are further broken down into congressional policy recommendations and agency administration recommendations. Policy recommendations are aimed at how the GLRI is written by Congress and administrative recommendations are aimed at how the program is administered by the EPA at the federal level.

Actions the HOW Coalition can pursue with community organizations across the Great Lakes

1. **Connect and empower community organizations that work within or adjacent to Areas of Concern to restoration work and each other by facilitating more equitable information sharing and collaboration in restoration work and community engagement efforts.** Some AOC communities, like Rouge River and Detroit River, are home to many local organizations that work on a diversity of environmental issues such as increasing park access, mitigating air pollution, and implementing green stormwater initiatives. Some of these local organizations are involved in AOC work, however many others are unaware of the AOC program or have only heard that the area is an AOC. Connecting community organizations to each other within each AOC, and also to the AOC work, will bring more awareness to water issues and build potential for intersect efforts between community priorities and GLRI and AOC projects.

2. **Facilitate information sharing across Areas of Concern about successful community organization and PAC efforts that have leveraged resources and partnerships to plan and complete projects with community input.** Our research highlighted several successful PAC and community partnerships in the Muskegon Lake and River Raisin AOCs. There is potential for all Michigan PACs to learn from such examples of unique partnerships. In Muskegon Lake the PAC's collaboration with WMSRDC has allowed the PAC to leverage this organization's resources to apply for GLRI grants to address issues other than the shoreline sediment remediation being addressed by the AOC program. In the River Raisin AOC, the PAC's relationship with the City of Monroe has fostered connections with the local River Raisin National Battlefield Park allowing for collaboration between the National Parks Service and the PAC. The River Raisin PAC's interest in education has also facilitated partnerships with multiple other community organizations. These partnerships have focused on spreading awareness about restoration work and creating opportunities for the community to volunteer and recreate in the River Raisin. AOCs, like Rouge River, can learn from these kinds of partnerships to develop community engagement efforts that progress restoration success.

3. **Connect and empower underrepresented community organizations that serve people of color populations.** Identifying existing trusted community organizations, like the neighborhood associations in Muskegon, can help engage communities in GLRI projects and processes. Building from existing trust and relationships within communities can be an avenue for introducing the GLRI program and asking for community input in restoration projects (Tett 2010, Vogelsong 2019). Community organizations are also great partners for educational outreach programs and volunteer activities. Working to identify and connect community organizations that represent people of color will serve to include their voices in planning for restoration outcomes and strengthen community connections to the restoration work. Utilizing

spatial maps and resources can assist in identifying these communities and engaging organizations in the restoration work.

4. **Catalog and highlight example projects that consider equity outcomes like increased public access and local job creation across AOCs and GLRI projects.** HOW should work to identify, keep track of, and celebrate projects across the AOC and GLRI programs that have demonstrated successful consideration of equity outcomes. Example outcomes could include: increasing public access to, and awareness of, water resources and restored areas, as well as prioritizing local job creation in restoration contracting. Other outcomes could highlight successful educational campaigns and collaboration with specific underserved community groups. In Muskegon, for example, the city has consulted with the Disability Network West Michigan to make sure that park areas are accessible and ADA compliant. Highlighting and cataloging these kinds of partnerships in AOC and GLRI projects could serve as a resource for other AOCs to reference.

5. **Partner with tribal nations and advocate for their interests in the GLRI program and in AOCs.** Multiple indigenous interviewees expressed feeling sidelined in the GLRI program and in AOC decision-making processes. These communities are particularly vulnerable as they are among the first to see the impacts of environmental degradation and usually the last to be consulted about environmental changes and policies. As such, Healing Our Waters should aim to develop stronger intentional partnerships with tribal nations and tribal organizations in order to ensure their values and perspectives are being brought to the forefront and their engagement is not just an afterthought or a checkbox. Advocating for tribal interests could include helping tribes with outreach efforts about their Wild Rice Restoration program, as well as making sure they are represented in PACs and the networks of restoration stakeholders and community organizations.

Equity efforts the HOW Coalition should prioritize through their GLRI advocacy work at the federal level

Policy Recommendations

1. **Additional funding and capacity resources should be made available to underserved communities through GLRI funding to assist with granting applications and maintenance of GLRI and AOC projects.** Multiple interviewees noted that some communities do not have the resources and staff to support grant-writing, project design, and maintenance. Large AOCs that have multiple municipalities often have a range of capacity and resources among departments that can oversee granting, and development and maintenance of projects. We propose that the GLRI should allocate funding within the AOC program and other focus areas to take into account the inequities that exist between communities. While there needs to be evidence of local enthusiasm and commitment to these investments, the

question of community capacity to apply for, develop, and maintain projects should not be a barrier for communities to pursue restoration projects. Spatial maps that overlay current GLRI projects and demographics within each AOC community can help channel resources to communities in need. PACs should explicitly identify which communities have inadequate resources to better be able to help municipalities apply for and maintain restoration projects.

2. **The GLRI should allocate specific funding for educational efforts and public outreach in the GLRI's AOC program focus area.** The AOC program is meant to help connect the community to the beneficial uses of the water resources that are being restored. We propose that educational and public outreach efforts should be explicitly funded through the GLRI funding of the AOC program. Funding for these efforts should serve to connect AOC communities to the restoration process in all phases of project life cycles. Funds should be used for planning and visioning meetings with community members that represent a diverse cross section of the given AOC community. Community organizations should either lead or be partners in these efforts if they are well-respected within the community. Funding should be used to compensate community organizations for their efforts in conducting community engagement and outreach. These funds should also be used in pre-, mid-, and post-construction phases to create education signage that explains restoration work and goals of AOC projects. Signage should be written in languages spoken in the community, as identified through community engagement efforts. Funds could also be used for educational campaigns to promote access to walking, viewing, kayaking, fishing, and other recreation activities in AOCs.
3. **Local match requirements in GLRI and AOC projects should have a sliding scale, match percentage to support under-resourced and disadvantaged communities.** Local match programs for GLRI projects were cited by some interviewees as a hurdle for communities to secure GLRI funding. The matching program should be flexible to equitably allow for overburdened and under-resourced communities to still apply for and complete restoration projects under limited or eliminated match requirements. Communities that would require additional funding for grant writing and project maintenance (see Policy Recommendation 1) should automatically be eligible for limited local match requirements. Project size should also be considered in a sliding scale of match requirements. We propose that smaller projects should not require local funding matches to allow more communities to complete smaller projects to practice applying for funding, and completing and maintaining projects.
4. **Specific social justice language and goals, like prioritization of local job creation, and increasing public access and use of restored spaces, should be included as targets for the GLRI planning, granting, and project evaluations.** Social justice definitions like Procedural Justice, Structural Justice, and

Environmental Inequity should be defined and included in GLRI program documents. This language should also be incorporated into guidelines that are set for granting and project evaluation processes. Projects should describe how they are addressing equity and justice in applications for GLRI and AOC funding. For example, projects should aim to increase local job creation, prioritize community input in planning for projects, and demonstrate evidence of community support. All case study AOCs we studied in this report cited increasing public access to water resources and restored spaces as a priority. Projects should prioritize this as well, if appropriate based on community input, and outline what types of access will be provided for community members in proposed projects. Money in the GLRI program should be awarded to projects that take these, and other steps, to promote social justice and equity goals.

Implementing equity and justice requirements in the AOC program could be a mechanism for the program to reward AOCs with additional funding after they have delisted all of their BUIs. PACs have identified that part of restoration success is continued water resources stewardship after delisting. The delisted PAC in our study noted that after delisting, communication and support from the EPA stopped and their mechanisms for organization around continued stewardship dropped significantly. Incentivizing PAC longevity, and by extension the longevity of a community organization network that is in place in AOCs, through equity and justice requirements is a possibility that should be considered in funding allocations within the AOC program of the GLRI.

5. **Shift policy focus from restoration to revitalization and reemphasize the use component of “Beneficial Use”.** Advocacy work needs to be done to re-engage policy with the original AOC Beneficial Use Impairment designations. Use implies human engagement with the water resource, and prioritization of habitat and ecological restoration outside of the use context loses sight of this goal. If the AOC program is understood as a checklist to complete ecological restoration objectives, it does not provide space for equity and justice considerations. This restoration work is ultimately being done for all people of the Great Lakes who benefit from the water-based uses, or ecosystem services, that the Great Lakes provide. Ecological restoration needs to be equitable so that these regional investments also serve to revitalize communities socially and economically. A revitalization lens toward GLRI projects will focus on communities and residents as the end users of restoration benefits and emphasize the incorporation of community context into GLRI policy. We propose shifting policy toward a revitalization focus that includes expanded funding channels to support robust community outreach and education, stewardship programming with an eye toward continued maintenance after delisting, and cooperative engagement with community organizations.
6. **Advocate for the inclusion of climate vulnerability considerations in the GLRI program in concert with equity considerations.** The Great Lakes will continue to

experience the impacts of climate change in cities, towns, and coasts across the region. We propose that, as the GLRI incorporates considerations of equity in its policies and administration, the program should also consider climate change impacts and vulnerabilities already present and expected to increase in AOC and adjacent coastal communities. All AOC communities in the Great Lakes are coastal communities that in recent years have also been burdened by record high lake water levels. The Great Lakes are projected to experience even greater variability in water levels in future climate scenarios in addition to more intense rainfall events (Gronewold et al. 2013). The combination of these climate predictions, often called compound flooding, can further local flooding in coastal environments due to increased flood events in rivers and higher coastal water levels. Mentions of increased flooding and high water level concerns in recent years came up in all of our case study AOCs.

Climate impacts on Great Lakes water levels and rainfall are important factors to consider in a program that aims to restore the health of coastal regions in the Great Lakes. While the GLRI was created to remediate Beneficial Use Impairments that were caused by past industrial practices in the region, the longevity of GLRI investments depends on incorporating considerations of current and future water and climate conditions. Climate changes have already started to disproportionately impact overburdened communities, particularly in urban areas like Detroit where there have been more recent flooding problems and urban heat islands that cause severe health risks across the city (Adler 2015). Beginning to identify climate risks in the Great Lakes related to water resources will help advocate for more equitable and resilient GLRI investments. The Social Vulnerability Index can be a useful toolkit to identify and provide support to the most vulnerable communities to climate impacts and events. Ultimately, ignoring climate impacts, and the equity considerations associated with climate risks, could hinder the region's ability to maximize the benefits of these restoration investments in the long term.

Administrative Recommendations

7. **Support the formal involvement of local organizations in AOC processes through formal partnerships with PACs where applicable.** In two of our case study AOCs, Rouge River and Muskegon Lake, multiple interviewees mentioned the value of specific local community organizations that have helped further restoration progress and community involvement. We recommend that organizations who have been successful in helping complete AOC projects and in engaging large portions of the community outside of PAC and AOC work should be formally involved in AOC processes moving forward. In some AOCs these organizations are present in the form of the regional planning association and in others in the form of a community organization. Formalizing these partnerships in AOCs can serve to help connect a trusted community partner to the AOC's decision-making and restoration processes. This will also allow for more equitable power-sharing between PACs and community

organizations in AOC communities and hopefully help integrate more community voices in AOC project administration.

- 8. Call for greater requirements and resourcing for public engagement in the restoration process.** Our most successful case studies, Muskegon Lake and River Raisin, feature unique PAC structures that facilitate robust public engagement. The River Raisin AOC is able to use PAC Support Grants toward outreach and education, such as school programs and documentaries. The Muskegon Lake AOC is able to use WMSRDC's connections and relationships with local neighborhood associations and community groups to more intentionally gauge public concern, feedback, and interest regarding project planning and implementation. HOW should advocate to provide greater administrative resourcing to PACs for public engagement. Not only should public engagement be required beyond just a couple of public meetings required to check a box, but there should also be funding allocated to PACs dedicated to the development of public engagement programs and greater capacity building through community organization partnerships to help facilitate public connections. To illustrate, a community forum that is demographically representative of the community could be convened to gather feedback on restoration projects prior to planning and development, during several stages of development, and after completion to ensure that the project is responding to the "Beneficial Use" needs of the community, and that the goals and intentions of the restored space are being co-produced alongside the community. In this way, communities may feel as though they have a greater stake in the restoration and hold a stewardship responsibility to continue its maintenance even outside of program oversight.
- 9. Develop intentional support channels for stewardship after delisting.** There are robust information pathways to inform the end-goal of delisting within the AOC program, but there is very little information dedicated toward helping communities maintain restoration progress and water resources stewardship after delisting has happened. Through the GLRI and AOC programs, the EPA needs to develop stronger institutional capacity to support delisted communities. This includes continued information sharing about restoration outcomes, impacts, and reemerging concerns; providing support (capacity and funding) for continued environmental stewardship programs within the community to maintain the longevity of restoration; and allocating additional funding to communities for ongoing maintenance and monitoring of restored environments. Relative to Policy Recommendation 4, communities that address equity and justice criteria and metrics within restoration planning and implementation could accumulate additional funding rewards to be stored and used over time for restoration actions that live beyond the AOC designation.

Avenues for Future Study

Although far from a complete and comprehensive analysis, we hope this study can serve as a launching point for future teams, organizations, and researchers to further interrogate the various equity and justice dimensions of environmental restoration within AOC communities. An important next step for research could include analysis of how partnerships with and perspectives of indigenous communities are included, within GLRI and AOC restoration projects, in particular those that directly impact sovereign lands and cultural sites. Indigenous communities and concerns are historically underrepresented with regards to restoration and conservation work, and their voices would provide valuable insight into continued avenues for GLRI work (United Nations n.d.).

Complementary studies could explore similar narrative themes identified in our study across other AOC communities, or even across GLRI project communities more broadly. This would allow data to be even more generalizable across the program as a whole and will allow for additional nuances that may have been missed in our study of only four AOC communities. Future researchers should prioritize an in-person, in-community approach, as feasible, to more fully reach a representative sample of the project community at large. Future studies should use targeted outreach to connect with non-usual suspects and individuals who have no involvement in the GLRI and AOC programs. Many of this study's weaknesses can be addressed through an in-person research methodology that centers around identifying community needs and produces outputs that can be used and adapted by the community themselves.

Appendices

Appendix 1. GLRI and Social Equity Expert Interview Framework

<u>Topic Sections</u>	<u>Lead Questions</u>	<u>Probing/Clarifying Questions</u>
Background	-Overview of our project, provide context/goals for the conversation (provide primer so they have info beforehand)	
Introductions	-Introduce Ourselves	
-Transition-	<i>We were interested in talking with you due to your connection (INSERT REASON HERE) but we hoped to first get to know you better and learn more about your background in the GLRI program.</i>	
Background / Connection to GLRI program	-How did you get started working with the water resources? How did this lead to work with the GLRI/AOCs? -What is your role within the GLRI/AOCs? -How would you describe the demographics of the AOC community?	
-Transition-	<i>Because of your deep connection to the GLRI/AOC program we were hoping to first learn more about the history of the GLRI.</i>	
History /Timeline / Program Evolution	-How has the AOC program changed over time and have these changes been reflected in your AOC community?	-Has there been a change in the focus for funding and project distribution?
Program Perspective (Motivations / Goals / Success Metrics)	-From your perspective, how has the AOC community benefitted (or not) socially from the projects funded by this AOC work?	-How much do you think GLRI communities value this investment? -Are there specific types of restoration projects (ex. Sediment cleanup vs. habitat restoration) that you have seen the community benefit from or connect with more?

		<p>-Do you think these benefits have been equitable across the community?</p> <p>-What work are you most proud of that you think has benefited the community?</p> <p>-Is there anything you would change or do differently to engage the community if you did these projects again?</p>
Metrics question	<p>-We are curious about your thoughts on establishing ways to measure the social success of AOC projects</p> <p>-Do you have any concerns about measuring the GLRI through the lens of social equity?</p>	<p>-Do you know if any attempts have been made to explicitly measure social equity in GLRI projects or similar regional restoration initiatives?</p> <p>-If attempts were made to consider social equity, how successful were they?</p> <p>-Has there been push back from any groups regarding social valuation/equity?</p> <p>-Do you have any concerns about measuring the GLRI through the lens of social equity?</p>
-Transition-	<p><i>Who has been initiating conversations regarding social valuation/equity? Could you direct us to community organizations or leaders who have been involved in restoration efforts? We are interested in speaking with community leaders about this topic.</i></p>	<p><i>-Do you have any suggestions?</i></p> <p><i>-Have there been key individuals in getting this restoration work done?</i></p>
Final question	<p>-Is there anything else you would like to share with us?</p>	

Appendix 2. AOC Community Interview Framework

<u>Topic Sections</u>	<u>Lead Questions</u>	<u>Probing/Clarifying Questions</u>
Background	<p>-Overview of our project, provide context/goals for the conversation (provide primer so they have info beforehand)</p> <p>Outline of things we would like to talk with you about in today's interview:</p> <ul style="list-style-type: none"> -Your individual perceptions on water resources in your community and your connections to natural resources -Next, we will ask you to speak about your perceptions on your community's thoughts and connections with local water resources and restoration work. -Finally we will introduce some of our ideas on social evaluation and how we would like to get your feedback on these ideas following this interview 	<p>-Ask if they have any follow-up questions or clarifications that need to happen in response to our project overview.</p>
Introductions	<ul style="list-style-type: none"> -Each team member shares a bit about themselves and their interests. (Can be less academic-focused depending on who we are talking to) -Allow interviewees to introduce themselves, what they do in their community, their interests, etc. 	
<i>-Transition-</i>	<p><i>Before we get started on our questions, with your permission, we will begin the recording via Zoom now.</i></p> <p><i>First we would like to ask you about your own connections with water and natural resources in your community.</i></p>	
Individual/Personal connections to restoration work and water resources	<ul style="list-style-type: none"> -How do you value/relate to water resources in your town? -How do you see yourself within the community? -How familiar are you with restoration work on water resources in your community? Are you familiar with the AOC program? 	<p>How do you value/relate to water resources in your town? (i.e. wildlife habitat, family, recreation, aesthetic beauty, economic opportunity, mental health, education, transportation, etc).</p>

	-Are you active in community/ restoration work? How did you become involved?	
<i>-Transition-</i>	<i>With our next set of questions, we are interested in gauging how you see the community that you [work/live] in in general.</i>	
Community Definition/Perceptions	<p>-What is the role of the water resource in your community?</p> <p>-How do people use the water resource, who are the people using/not using it? Why?</p> <p>-What do you think are the largest issues in your community surrounding the topic of water? Do you think these issues are priorities in your community?</p>	-Ex. What are most people worried about when we talk about water issues?
<i>-Transition-</i>	<p><i>As someone with direct experience working with or managing natural resource projects and/or sites in [city/AOC of interest], we are interested in hearing more about GLRI restoration work from your perspective!</i></p> <p>-OR-</p> <p><i>We know that dominant narratives around water resources often come from government officials and managers at various levels. Given this, we are particularly interested in your perspective on water resources as a member of the community that is experiencing the potential benefits of the restoration work.</i></p>	
Restoration Project Connection	<p>-How do you think the broader community perceives the water restoration work?</p> <p>-Who do you think benefits from restoration work in the area?</p> <p>-In your opinion, what potential value do you see for your community in the federal investment that is coming in to revitalize the water resources?</p> <p>-What concerns do you have about the water restoration work in your community?</p>	
<i>-Transition-</i>	<i>Though a lot of habitat restoration and other remediation work is happening to</i>	

	<i>increase the vitality of the water itself through the AOC program, we are particularly interested in understanding what barriers or exclusions might still exist to the community being able to interact with the water resource during and after restoration projects.</i>	
Barriers to Access	<p>-What do you see as the biggest barriers to connecting with the water resource in your town/community?</p> <p>-To what extent is there community exclusion/inclusion in regards to the water resource (public access/closed access/lots of business in the area)?</p>	-What would make you more likely to use or visit a water resource in your community (easy walking access, access to facilities, handicap accommodations, bus routes, recreation opportunities, etc?)
<i>-Transition-</i>	<p>Provide overview/list of different social valuation indicators/metrics for them to review beforehand</p> <p><i>State that we are interested in making recommendations for ways that social considerations can be more effectively implemented in the GLRI project process.</i></p>	
Ground-truth recommendations	<p>-Have them describe which social valuation metrics are most important to them.</p> <p>-Which ones are less important for them, personally?</p> <p>-Why?</p>	-Are there any that come to mind that we might have missed from our initial list?
<i>Final questions</i>	<p>We want to thank you for your time. As we move along and talk with more groups and more AOC communities, we will reconnect to share some of the themes and results that emerge from our interviews. <i>Is there any information that is particularly interesting or useful for you that we can make sure to touch base about when we reconnect? Are there any final thoughts that you have that you think are important for us to know or consider as we move forward with our project?</i></p>	

Appendix 3. Codebook

Code	Subcode	Definitions and Examples
Sense of Pride (outcome)	Sense of place or belonging	Why they live where they do, why other people in the community live in the area, comments on the area's history (general) and general sentiments about the community. Past connections or feeling of sense of place to the area.
	Sense of ownership and stewardship	Ownership of resources in the area, including AOC, how people feel about conserving and restoring nature (this can be before or after the restoration)
	Perceptions of resource	General feelings or perceptions about the water resource (dirty, unclear, unsafe; or safe enough for particular kinds of uses but not others)
Connecting Community (process)	Outreach efforts	Examples of current outreach efforts, comments on if outreach is sufficient - one-side communications including notifications to the community and flyers/info that are sent out to the community about restoration (Monroe water bills, for example).
	Public Input	Processes that allow the public to provide input into projects, provide feedback, examples might include planning charrettes, public forums or comments on how public input is received/included. Mentions of public input being insufficient are also coded.
	Project disconnect	Examples of when projects don't connect with community interests and project outcomes
	Modes of communication	Languages and types of communication (ex. mail, social media, in person)
	Community awareness of water resource and restoration	If community is aware of the water resource overall, the restoration work, and designation of AOC
Education (outcome)	General education efforts	Using education as a tool to connect the community with the water resource and restoration projects, and to foster stewardship efforts and sense of ownership/stewardship

	Student group programs	e.g. school engagement with clean up projects
	Park signage	For informing community about the natural features of an area and restoration work that is going on or has been done
Use of Resources (outcome)	Volunteer Opportunities	e.g. river clean ups
	Business and Tourism Opportunities	e.g. increased tourism, increased numbers of businesses, opportunities for businesses like kayaking etc.
	Recreation Opportunities	e.g. kayaking, swimming, boating
	Usage metrics	Existing usage monitoring systems or recommendations for measuring use
	Fishing	Can be recreation, for eating, or businesses or events around fishing
Barriers to Access (outcome)	Physical Barriers	Mentions of physical barriers to access, such as lack of transportation and available access points and presence of hilly/steep slopes and log jams in the water
	Institutional Barriers	Institutional barriers to access that exist and inhibit the community from engaging with the resource, driven by power dynamics, zoning ordinances, land ownership dynamics (private vs public access)
	Emotional Barriers	Community perceptions of safety or not feeling welcome or comfortable in restored spaces and waterfront areas
	Knowledge Barriers	General knowledge barriers such as a lack of awareness of public spaces and access points near the water
	Efforts to increase access	Mentions of efforts to increase access in any or all types of barriers - including educational signage, water trails, accessibility considerations, etc.
Local groups	Local organizations	Actions and efforts of local organizations in the community related to AOC restoration work,

and leaders (process)	abilities/efforts	mentions of successful projects, community engagement efforts, etc., also includes cross-group collaboration
	Lack of capacity and resources	Lack of support and challenges that local organizations, government, and leaders have experienced: staff/capacity limitations, writing grants, matching funds, implementing projects, maintaining restoration work
	Partnering with PACs	Mentions of sentiments and experiences partnering with PACs, how they perceive PAC involvement and effectiveness, and their own perceptions of collaborating with PACs in restoration work
	Local champions	Examples of local champions and leaders in the communities that have influenced project work and restoration success
	City involvement/priorities	Examples of when the city or local government is mentioned in relation to GLRI and AOC work and in broader contexts. This subcode includes mentions of partnerships and communication with city or government leaders.
GLRI and AOC structure (process)	Internal PAC processes	This code will reflect internal PAC processes like PAC structure, representation, priorities, and funding mechanisms. Examples include Raisin where PAC is embedded within the city government and how this influences how they use state PAC funding.
	External PAC processes	This code will reflect how PACs interact with other organizations, how they lead restoration efforts, and will be used to highlight power dynamics between PACs and other organizations. Comments on PAC ability to collaborate.
	State involvement/priorities	Examples of when the role that the State departments and agencies play in GLRI and AOC work. Comments on their involvement in other efforts in parallel to PACs in the community (ex. other grants and projects they are funding in the communities).
	Federal agency involvement/priorities	Examples of when people mention federal agencies involvement and work in the GLRI and AOC process. How federal agencies have supported or not supported PACs and if federal agencies are involved in other projects in the community (ex. Superfund site in White Lake).
	GLRI funding	Mentions of GLRI funding opportunities & limitations. Some interviewees mentioned that only

		some types of projects can go after GLRI funding because it is specific, barriers with matching, not a lot of money is allocated for community engagement. Some interviewees also gave examples of GLRI funding mechanisms that already ask for reporting on social impacts or metrics.
Community Concerns and Priorities	General priorities	Example of things residents and officials would like to see and prioritize in their community. This code is not in the context of specific restoration and more to capture where GLRI and AOC restoration fits into the hierarchy of other priorities and problems in the community (racial unrest could be examples of major priorities that predominate over restoration issues)
	Water quality	Mentions of water quality as a priority for the community.
	Water levels and flooding	Rising lake levels was a main priority brought up in many interviews, this code will capture these mentions and some of the impacts and concerns interviewees identified from lake levels.
	Water shut-offs, affordability	Water consumption concerns was another priority some interviewees brought up, many examples were in Detroit and Muskegon.
	Stormwater management	Stormwater and runoff issues were highlighted in many interviews, especially in Detroit, this code will capture issues of water management from infrastructure or natural areas and community perceptions of the management.
	Pollution and contaminants	Other pollution and contamination concerns, many people highlighted other environmental concerns in Detroit like air pollution. Groundwater contamination also came up in White Lake.
	Wildlife, fish health, biodiversity	Mentions of wildlife, fish and animal health, and biodiversity, mentions of if this is a priority for the community.
	Sustenance fishing and livelihoods	Mentions of fishing for livelihoods and maintaining fishing spots for this water use, this was mentioned in Detroit a number of times as a community priority.
	Public access	Examples of when people explicitly mention public access as a priority and interest of community members in planning or more informally.

	Relationship with Industry	Comments on community's relationship with industry (ex. need these for community tax base, supplies local jobs)
	Relationship with Development	Community's relationship/perceptions of development in the community (gentrification, housing unaffordability, positive perceptions of local growth/stimulus)
	Jobs	Mentions of job creation and opportunities as a priority for the community.
Demographics & Justice	Social Demographics	Statements relating to social composition of the community (race, SES, class, age)
	Spatial Demographics	Statements relating to spatial or geographic characteristics of the community (neighborhood demarcations, expansiveness/distance/size of community, stratification related to water resource)
	Distributive Justice	Statements relating to distribution of restoration outcomes, services, benefits, inequities in accessing resource (not barriers, but <i>inequities</i> specifically)
	Procedural Justice	Statements relating to decision making within the community (more broadly, not necessarily tied to PAC process)
	Social Justice	Explicit mentions of social justice & other sentiments expressing concern that people explicitly do not feel welcome or included in a restored space due to an identity they hold (race, SES, age, ability). This is similar to project disconnect, but there must be an explicit mention of an impacted identity in order for it to be included here.
	Environmental Justice	Explicit mentions of environmental justice & sentiments related to historical context that made community particularly susceptible to environmental justice issues - expressions of lingering impact/harm done to community/environment, specifically due to institutional and systemic factors in regards to social identities

Appendix 4. Follow-Up Survey Questions

Thank you again for your participation in our research project and for taking the time to complete this follow up survey. After completing initial analysis of our interview data we compiled major themes and ideas we heard throughout the four Area of Concern (AOC) communities we studied. The statements below reflect some of these themes and ideas as well as overall ideas of equity and justice. We ask that you note which AOC you most closely associate with, but leave the decision to note your name optional so you may remain anonymous if you so choose.

1. As our project is grounded in justice ideals we would like to gauge your familiarity with certain justice terms.
 - a. Environmental Justice: The EPA defines environmental justice as: “the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies.”
 - b. Distributive Justice: The equitable distribution of environmental risks, benefits, and impacts.
 - c. Procedural Justice: The ability of all people to have meaningful involvement in the decision-making process.

*After each definition would be the following scale:

Level of Familiarity

- 1 – not at all familiar
- 2 – Slightly familiar
- 3 – Somewhat familiar
- 4 – Moderately familiar
- 5 – Extremely familiar

2. I believe that justice considerations are taken into account in Area of Concern (AOC) projects.
 - a. 1- strongly disagree to 5- strongly agree
3. As part of our project process we are considering metrics or indicators that are focused on assessing the potential social impacts of AOC projects. Rank the following social valuation indicators in order of personal importance.
 - a. Public access
 - b. Fishing opportunities
 - c. Creation of jobs
 - d. Recreation opportunities
 - e. Sense of pride in community
4. I am aware of communication or education efforts as it relates to AOC projects.

- a. 1- strongly disagree to 5- strongly agree
- 5. I am aware of volunteer opportunities, related to water bodies, within my community.
 - a. 1- strongly disagree to 5- strongly agree
- 6. I know how to and/or feel comfortable getting involved with volunteer opportunities within my community.
 - a. 1- strongly disagree to 5- strongly agree
- 7. I am satisfied with the amount of public access to water bodies in my community.
 - a. 1- strongly disagree to 5- strongly agree
- 8. I have been positively impacted, personally, by AOC restoration work.
 - a. 1- strongly disagree to 5- strongly agree
- 9. I feel a greater sense of pride in my community due to AOC work.
 - a. 1- strongly disagree to 5- strongly agree
- 10. I am concerned about the quality of waterbodies in my community.
 - a. 1- strongly disagree to 5- strongly agree
- 11. There is a growing push towards a "blue economy" in the state of Michigan. This push is shifting the economic focus of the region away from resource intensive and environmentally damaging industrial practices back to a model that values and sustainably uses its freshwater resources. Given this context, respond to the following statement: I see value in my community moving towards a "blue economy".
 - a. 1- strongly disagree to 5- strongly agree
- 12. Do you have any additional thoughts or questions regarding our project that you wish to make known?

Literature Cited

- Adler, B. 2015. Think Detroit has it rough now? Just wait 'til climate change gets ahold of it. <https://grist.org/cities/think-detroit-has-it-rough-now-just-wait-til-climate-change-gets-ahold-of-it/>
- Angradi, T.R., J. J. Launspach, W. D. W. Bolgrien, B. J. Bellinger, M. A. Starry, J. C. Hoffman, A. S. Trebitz, M. E. Sierszen, and T. P. Hollenhorst. 2016. Mapping ecosystem service indicators in a Great Lakes estuarine Area of Concern. *Journal of Great Lakes Research* 42(3): 717-727. <https://doi.org/10.1016/j.jglr.2016.03.012>
- Angradi, T. R., K. C. Williams, J. C. Hoffman, and D. W. Bolgrien. 2019. Goals, beneficiaries, and indicators of waterfront revitalization of Great Lakes Areas of Concern and coastal communities. *Journal of Great Lakes Research* 45(5): 851-863. <https://doi.org/10.1016/j.jglr.2019.07.001>
- The Annie Casey Foundation. 2021. Equity vs. Equality and Other Racial Justice Definitions. <https://www.aecf.org/blog/racial-justice-definitions/>
- Austin, J. C., S. Anderson, P. Courant, and R. Litan. 2007. *Healthy Waters, Strong Economy: The Benefits of Restoring the Great Lakes Ecosystem*. The Brookings Institution.
- Austin, J. C., P. Dimond, and B. Katz. 2008. *Preserving the Vital Center: Renew the Economy of the Industrial Heartland*. Brookings. https://www.brookings.edu/wp-content/uploads/2016/06/PB_Competitiveness_Katz.pdf
- California OEHHA (Office of Environmental Health Hazard Assessment OEHHA). 2017. *CalEnviroScreen 3.0: Update to the California Communities Environmental Health Screening Tool*. CalEPA. <https://oehha.ca.gov/media/downloads/calenviroscreen/report/ces3report.pdf>.
- Callahan, C., and J.R. DeShazo. 2014. *Investment Justice Through the Greenhouse Gas Reduction Fund: Implementing SB 535 and Advancing Climate Action in Disadvantaged Communities*. UCLA Luskin School of Public Affairs: Luskin Center for Innovation. https://innovation.luskin.ucla.edu/wp-content/uploads/2019/03/Investment_Justice_Through_the_Greenhouse_Gas_Reduction_Fund.pdf

- CDC (Centers for Disease Control) and Prevention Agency for Toxic Substances and Disease Registry Geospatial Research Analysis and Services Program. 2018. CDC Social Vulnerability Index Database.
https://www.atsdr.cdc.gov/placeandhealth/svi/data_documentation_download.html
- CEEJH (Community Engagement, Environmental Justice and Health Lab). (n.d.). Mapping Tools. University of Maryland. <https://www.ceejhlab.org/mapping-tools>
- City of Monroe Michigan. (n.d.). River Raisin Heritage Trail Map.
http://www.rtrail.com/uploads/pdfs/rrht_map.pdf
- City of Monroe Michigan. 2016. River Raisin Legacy Project: Field Guide. Monroe, Michigan.
<http://www.riverraisinlegacyproject.com/wp-content/uploads/2016/11/City-of-Monroe-River-Raisin-Legacy-Project-Field-Guide-FINAL.pdf>
- Dempsey, D. 2004. On the Brink : The Great Lakes in the 21st Century, 1st Edition. Michigan State University Press, East Lansing, Michigan.
- Doron, N., and E. Wallis. 2014. Pride of Place Land, Community and a Popular Environmentalism. The Fabian Society. <https://www.fabians.org.uk/wp-content/uploads/2014/06/Pride-of-Place.pdf>
- Enquist, P. 2013. Recognizing a Global Resource: The Need for an 100 Year Vision for the Great Lakes & St. Lawrence River Region. Skidmore, Owings & Merrill, LLP.
https://www.som.com/projects/great_lakes_century_vision_plan
- Esri Demographics. 2018. Median Home Value and Income. Esri.
https://services.arcgis.com/P3ePLMYs2RVChkXj/arcgis/rest/services/Home_Value_and_Income/FeatureServer
- Felipe-Lucia, M. R., Comin, F. A., and J. Escalera-Reyes. 2015. A Framework for the Social Valuation of Ecosystem Services. *AMBIO* 44: 308-318. DOI:10.1007/s13280-014-0555-2
- Frantzeskaki, N., and N. Kabisch. 2016. Designing a knowledge co-production operating space for urban environmental governance-lessons from Rotterdam, Netherlands and Berlin, Germany. *Environmental Science & Policy* 62:90–98.
- Great Lakes Commission and Council of Great Lakes Industries. 2018. Assessing the Investment: The Economic Impact of the Great Lakes Restoration Initiative.

Great Lakes Regional Collaboration. 2005. Great Lakes Regional Collaboration Strategy to Restore and Protect the Great Lakes.

Great Lakes Restoration. (n.d.). Projects. <https://www.glri.us/projects>

Great Lakes Restoration. 2019. Funding. <https://www.glri.us/funding>

Great Lakes Restoration. 2021. Focus Areas and Results. <https://www.glri.us/results#focus>

Grier, L., D. Mayor, and B. Zeuner. 2019. Assessing the State of Environmental Justice in Michigan. Master's Project. University of Michigan, Ann Arbor, Michigan.
https://seas.umich.edu/sites/all/files/AssessingtheStateofEnvironmentalJusticeinMichigan_344.pdf

Hartig, J. H., S. Bentley, M. Conchran, and M. Foose. 2018. A great success story: River Raisin cleanup helps Monroe, Michigan, realize economic, environmental benefits.
http://iaglr.org/docs/items/RiverRaisinCaseStudy_NewsRelease_2018_06-15.pdf

Hartig, J. H., G. Krantzberg, J. C. Austin and P. McIntyre. 2019. Great Lakes Revival: How Restoring Polluted Waters Leads to Rebirth of Great Lakes Communities. International Association for Great Lakes Research.
<http://iaglr.org/aocdocs/GreatLakesRevival-2019.pdf>

Hartig, J. H., M. A. Zarull, and N. L. Law. 1998. An Ecosystem Approach to Great Lakes Management: Practical Steps. *Journal of Great Lakes Research* 24(3): 739–50.
[https://doi.org/10.1016/S0380-1330\(98\)70859-7](https://doi.org/10.1016/S0380-1330(98)70859-7).

Holifield, R., and K. C. Williams. 2019. Recruiting, integrating, and sustaining stakeholder participation in environmental management: A case study from the Great Lakes Areas of Concern. *Journal of Environmental Management* 230:422–433.

Human Impact Partners. 2011. A health impact assessment toolkit: A handbook for conducting HIA, 3rd edition. Oakland: Human Impact Partners.

IJC (International Joint Commission). 2020. Great Lakes Areas of Concern.
<https://www.ijc.org/en/what/glwg-aoc>

Isely, P., Isely, E.S., Hause, C., and A.D. Steinman. 2018. A socioeconomic analysis of habitat restoration in the Muskegon Lake area of concern. *J. Gt. Lakes Res.* 44, 330–339. <https://doi.org/10.1016/j.jglr.2017.12.002>

- Knauss, C., J. Lisuk, and B. Pollins. 2019. Life After Delisting: Sustaining Environmental Stewardship in Michigan Areas of Concern. Master's Project. University of Michigan, Ann Arbor, Michigan. <https://deepblue.lib.umich.edu/handle/2027.42/148804>
- Krantzberg, G. 2012. First off the List: The Collingwood Harbour Story. Pages 257–267 in Great Lakes: lessons in participatory governance. CRC Press, Taylor & Francis Group, Boca Raton, FL.
- Lee, C. 2020. A Game Changer in the Making? Lessons From States Advancing Environmental Justice Through Mapping and Cumulative Impact Strategies. Environmental Law Reporter 50(3): 10203-10215. <https://elr.info/news-analysis/50/10203/game-changer-making-lessons-states-advancing-environmental-justice-through-mapping-and-cumulative-impact>
- Lee, C. 2021. Confronting Disproportionate Impacts and Systemic Racism in Environmental Policy. Environmental Law Reporter 51(3): 10207-10225.
- Lee, K. 2019. Getting Ready for Racial Equity Work: Community Engagement. <https://livingcities.org/blog/1285-getting-ready-for-racial-equity-work-community-engagement/>.
- Lertzman, R. 2012. Researching psychic dimensions of ecological degradation: Notes from the field. Psychoanalysis, Culture & Society 17(1):92–101.
- Lynch, J. 2014. Families continue to question health effects of Hooker contamination. <http://blogs.detroitnews.com/specialreports/2014/06/25/families-continue-question-health-effects/>
- Mitchell, B., and J. Franco. 2018. HOLC “Redlining” Maps: the Persistent Structure of Segregation and Economic Inequality. National Community Reinvestment Coalition. https://ncrc.org/wp-content/uploads/dlm_uploads/2018/02/NCRC-Research-HOLC-10.pdf
- Mohai, P. 2018. Environmental Justice and the Flint Water Crisis. Michigan Sociological Review 32:1-41.
- MSU (Michigan State University). 2017. National Park Service Money Generation Model simulations. River Raisin Battlefield National Park, Department of Park, Recreation, and Tourism Resources; Michigan State University; East Lansing, Michigan, USA.
- Nelson, R. K, L. Winling, R. Marciano, N. Connolly, et al. 2021. Mapping Inequality. American Panorama. <https://dsl.richmond.edu/panorama/redlining>

- Nguyen Thanh, H., P. Y. Cheah, and M. Chambers. 2019. Identifying 'hard-to-reach' groups and strategies to engage them in biomedical research: perspectives from engagement practitioners in Southeast Asia. *Wellcome Open Research* 4:102.
- NHBP (Nottawaseppi Huron Band of Potawatomi). 2021. Tribal Waters of the Nottawaseppi Huron Band of the Potawatomi. <https://storymaps.arcgis.com/stories/2425e96dbf3044319658b95b226e0c3d>
- NPS (National Park Service). 2016. River Raisin National Battlefield Park: History and Culture. <https://www.nps.gov/rira/learn/historyculture/index.htm>
- NPS (National Park Service). 2017. 2016 National Park Visitor Spending Effects: Economic Contributions to Local Communities, States, and the Nation. Natural Resource Report NPS/NRSS/EQD/NRR—2017/1421. River Raisin National Battlefield Park. Monroe, Michigan, USA.
- NWF (National Wildlife Federation). 2021. Mapping Climate & Environmental Justice: Lessons Learned from State Tools. PowerPoint presentation.
- QSR International. 2020. NVivo (12.6.0.959). AppsAnywhere: University of Michigan.
- River Raisin Institute. 2017. Resilient Monroe Green Map. <https://www.greenmap.org/greenhouse/files/Resilient%20Monroe%20MI%20Green%20Map%202018-o.pdf>
- The River Raisin Legacy Project. 2021a. The River Raisin Legacy Project: Welcome. <http://www.riverraisinlegacyproject.com/>
- The River Raisin Legacy Project. 2021b. The River Raisin Legacy Project: Timeline of Industry. <http://www.riverraisinlegacyproject.com/timeline-of-industry/>
- Robinson, M., and J. Thompson. 2020. Evanston Policies and Practices Directly Affecting the African American Community, 1900-1960 (and Present). City of Evanston. cityofevanston.org/home/showpublisheddocument?id=59759
- Savitz, A. W., and K. Weber. 2006. *The Triple Bottom Line: How Today's Best-Run Companies Are Achieving Economic, Social and Environmental Success -- and How You Can Too*, 1st Edition. Jossey-Bass, San Francisco, California.
- Sierszen, M. E., J. A. Morrice, A. S. Trebitz, and J. C. Hoffman. 2012. A review of selected ecosystem services provided by coastal wetlands of the Laurentian Great Lakes.

- Aquatic Ecosystem Health & Management 15(1):92-106.
<https://doi.org/10.1080/14634988.2011.624970>
- Tett, L. 2005. Partnerships, community groups and social inclusion. *Studies in Continuing Education* 27(1):1–15.
- United Nations. (n.d.). Environment For Indigenous Peoples.
<https://www.un.org/development/desa/indigenouspeoples/mandated-areas1/environment.html>
- US Census Bureau. 2017. Race Demographics in the 2010 Census. Esri Federal User Community.
https://services2.arcgis.com/FiaPA4ga0iQKduv3/arcgis/rest/services/US_Census_Race/FeatureServer
- US Water Alliance. 2017. An Equitable Water Future: A National Briefing Paper.
http://uswateralliance.org/sites/uswateralliance.org/files/publications/uswa_waterequity_FINAL.pdf
- USEPA (United States Environmental Protection Agency). (n.d.). Environmental Justice.
<https://www.epa.gov/environmentaljustice>
- USEPA (United States Environmental Protection Agency). 1992. Environmental Equity: Reducing Risk for All Communities. USEPA, Report 230-R-92-008A, Washington D.C.
- USEPA (United States Environmental Protection Agency). 2019. Great Lakes Restoration Initiative Action Plan III. <https://www.epa.gov/sites/production/files/2019-10/documents/glri-action-plan-3-201910-30pp.pdf>
- USEPA (United States Environmental Protection Agency). 2020a. Great Lakes AOCs: River Raisin AOC. <https://www.epa.gov/great-lakes-aocs/river-raisin-aoc>
- USEPA (United States Environmental Protection Agency). 2020b. Great Lakes AOCs: Detroit River AOC. <https://www.epa.gov/great-lakes-aocs/detroit-river-aoc>
- USEPA (United States Environmental Protection Agency). 2020c. Great Lakes AOCs: Muskegon Lake AOC. <https://www.epa.gov/great-lakes-aocs/muskegon-lake-aoc>
- USEPA (United States Environmental Protection Agency). 2021a. Great Lakes AOCs: Rouge River AOC. <https://www.epa.gov/great-lakes-aocs/rouge-river-aoc>

USEPA (United States Environmental Protection Agency). 2021b. Great Lakes AOCs: White Lake AOC- Delisted. <https://www.epa.gov/great-lakes-aocs/white-lake-aoc-delisted>

Voglesong Zejnati, A. R. 2019. Why Remediation Progress Differs Among Great Lakes Areas of Concern: Factors That Enable and Constrain Michigan Public Advisory Councils. Thesis. University of Michigan, Ann Arbor, Michigan.
<https://deepblue.lib.umich.edu/handle/2027.42/148807>

Williams, K.C, and J. C. Hoffman. 2020. Remediation to Restoration to Revitalization: Engaging Communities to Support Ecosystem-Based Management and Improve Human Wellbeing at Clean-up Sites. Pages 543-559 *in* T. O'Higgins, M. Lago, T. DeWitt, editors. Ecosystem-Based Management, Ecosystem Services and Aquatic Biodiversity. Springer, Cham. https://doi.org/10.1007/978-3-030-45843-0_27

Winchester, S., and W. Smith. 2001. The Map that Changed the World. Harper Collins.

The World Bank. 2017. The Potential of the Blue Economy: Increasing Long-term Benefits of the Sustainable Use of Marine Resources for Small Island Developing States and Coastal Least Developed Countries.
https://sustainabledevelopment.un.org/content/documents/15434Blue_EconomyJun1.pdf