

Scoping and Recommendations for the Development of a Connecticut Environmental Justice Mapping Tool

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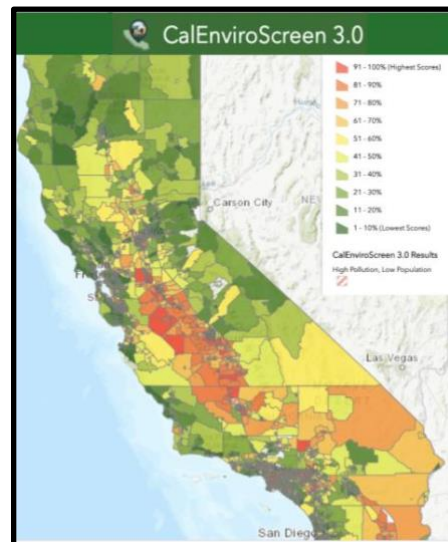
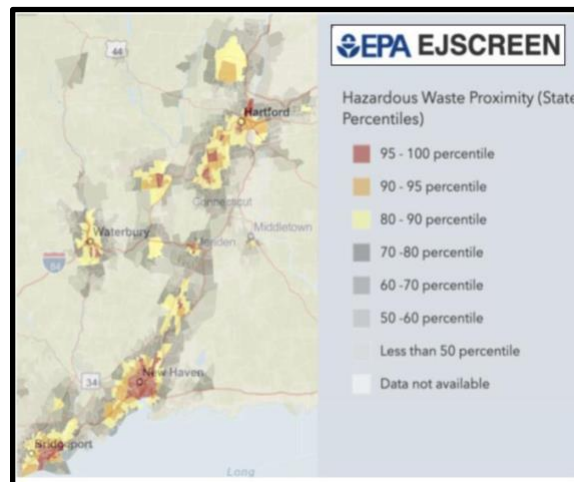
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Screenshots from the EPA's EJSCREEN mapping tool and California's CalEnviroScreen mapping tool. The images serve to demonstrate how a Connecticut mapping tool may ultimately look.

Executive Summary

The Environmental Justice (EJ) movement seeks policies and practices that promote the equitable distribution of environmental benefits and hazards. Low-income communities and communities of color are disproportionately exposed to environmental hazards such as air and water pollution, and as a result, are exposed to increased environmental health risks (Bullard & Johnson, 2000; Marmot, 2005; Morello-Frosch et al., 2002). These risks are further compounded by social stressors such as unemployment and substandard housing (Braubach, 2011; Brender et al., 2011; Sadd et al., 2011). Many of these stressors will be further exacerbated by climate change (Wilson et al., 2010). Though environmental policy typically focuses on single pollutants and point sources, scientists and advocates have argued that measuring the cumulative impacts of social vulnerabilities and environmental hazards provides a deeper understanding of the interacting burdens faced by EJ communities (Cushing et al., 2015). In support of the EJ movement and these communities, in 2008, Connecticut passed an Environmental Justice law—section 22a-20a of the Connecticut General Statutes—to bolster the state’s Environmental Justice program housed within the Connecticut Department of Energy and Environmental Protection (CT DEEP) (CT Gen Stat § 22a-20a, 2012; “Environmental Justice,” 2019).

In 2015, to support policy makers and regulators working to address EJ issues, the United States Environmental Protection Agency (US EPA) released EJSCREEN, an online, publicly available Geographic Information System (GIS) mapping tool that visualizes the spatial distribution of environmental health risks and social vulnerabilities (Sadd et al., 2011; Driver et al., 2019; Kuruppuarachchi et al., 2017). Following the tool’s release, several states, including California, Washington, Maryland and North Carolina, developed state-specific EJ mapping tools. These tools incorporate a variety of indicators of environmental impacts and exposures, sensitive populations, and socioeconomic factors in order to help state officials and other environmental decision-makers identify distressed communities, direct enforcement of environmental regulations, and remediate contaminated sites (Driver et al., 2019; Kuruppuarachchi et al., 2017; Min et al., 2019). Additionally, the EJ Movement also seeks the meaningful participation of stakeholder communities in decisions affecting their future, and these tools increase the agency of community members in governmental processes and support grassroots EJ outreach, education, and advocacy led by community organizations.

This report examines the opportunities for developing an EJ mapping tool for Connecticut. The report outlines findings from literature, an analysis of other state tools, and lessons learned from key informant interviews with Connecticut EJ advocates, tool developers from other states, and data and geospatial analysts in Connecticut. The report then makes specific recommendations for developing an effective tool.

Tool development requires four primary types of expertise: community engagement, data analysis and indicator selection, geospatial mapping, and policy formation. Many states brought together this expertise from a range of organizations during tool development, and there are significant opportunities for such collaboration in Connecticut. Tool development should be driven by an outreach process that is empowering and promotes co-learning and meaningful participation from communities. It is vital that this outreach be guided by principles of inclusion and equity so that residents can take an active role in the tool’s development and so the tool’s content reflects lived experience. Outreach can be achieved through focus groups or other participatory engagement sessions and through qualitative interviews with key community advocates, leaders, and organizers who will use the tool to advance their work.

This report, and its recommendations, builds on the ongoing work of CT DEEP and EJ advocates to identify and support communities most vulnerable to environmental injustices — including the impacts of climate change — throughout the state. To ensure the best outcome possible for the tool and its impact on EJ practices in Connecticut, we ultimately recommend that Connecticut takes the following steps, laid out in detail in this report:

1. Invest in the appropriate staff and resources to successfully build an environmental justice mapping tool.
2. Continue outreach in EJ communities through both focus groups and key informant interviews.
3. Leverage existing infrastructure and partnerships to develop the tool, especially around data, platform, and community engagement.
4. Establish ground rules to guide the inclusion of indicators and data.
5. Include core basic functionalities, tailored to uses and users, in an initial version.
6. Include indicators encompassing environmental exposures and effects, sensitive populations, and sociodemographic information.
7. Develop an index to measure relative cumulative impacts and identify EJ communities.
8. Budget for community engagement, data analysis and indicator selection, geospatial mapping, and policy formation, while leveraging efficiencies to manage cost.
9. Incorporate the tool into decision making processes with appropriate legislation and policy.

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1. Introduction

The Environmental Justice (EJ) movement is founded on the principle that no person, regardless of race, socioeconomic status, or any other aspect of his or her identity, should be disproportionately burdened by environmental hazards (Bullard & Johnson, 2000). Government institutions have historically neglected and disenfranchised communities of color and low-income communities. Due to the lack of procedural and distributive justice accorded marginalized communities, state and local governments often grant polluting industries permits to site facilities in these communities at a disproportionate rate relative to white and affluent communities.

While these facilities may provide economic opportunities and necessary services and goods to the region, they often expose the local communities to various environmental hazards, toxic substances, and forms of pollution, which result in negative health outcomes and reduced quality of life (Pastor et al., 2014). The effects of environmental factors on wellbeing are further amplified by intersecting vulnerabilities—such as pre-existing medical conditions, age, and chronic stress—that exacerbate health issues caused by environmental hazards (Lin et al., 2004; Sexton, 1997). These vulnerabilities are often referred to as “social determinants of health” (Marmot, 2005; “Health Impact Assessment: The Determinants of Health,” 2020). Environmental risk assessment methods are typically one-dimensional and do not rigorously examine these social determinants of health and the way in which chemical, physical, biological, psychosocial, and economic factors interact to produce negative health outcomes. Risk assessment methods need to consider the difference in the distribution of risk at different levels of a community and avoid inappropriately spatially projecting one community onto another (Schlosberg, 2007). This is equally true when considering the risks of climate change, which typically account for the biophysical risks of climate change, such as flood plains, without examining underlying non-climate factors and social vulnerabilities (Bassett and Fogelman 2013). The current COVID-19 pandemic, in which long-term exposures to air pollution appear to increase vulnerability to the most severe symptoms, and in turn hits low income communities and communities of color the hardest, brings the gravity of these cumulative impacts into sharp relief (Wu et al. 2020).

In an effort to rectify these issues, *Executive Order 12898 - Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations* instructs federal agencies to design and implement strategies for promoting EJ in communities of color and low-income communities that are vulnerable to environmental health risks (*Executive Order No. 12898*, 1994). One mechanism to support the implementation of the Executive Order was the development of EJSCREEN, a tool that provides a visual representation of environmental and demographic characteristics layered onto a map. This map allows viewers to easily identify communities facing cumulative impacts and multiple vulnerabilities. EJSCREEN was released to the public in 2015. Several states, including California, Washington, Maryland, North Carolina and others, followed with the development of their own state-specific EJ mapping tools to address specific concerns in their state by drawing on more granular available statewide data (Driver et al., 2019; Kurupparachchi et al., 2017; Min et al., 2019)

This report seeks to evaluate and provide input on the goals, potential scope, and feasibility of the development of a state-specific EJ mapping tool for the Connecticut Department of Energy and Environmental Protection (CT DEEP). This work aims to develop and implement an outreach plan for gathering community input on the uses and content of a statewide EJ tool, to evaluate the goals and need for such a tool in light of existing resources and projects, and to assess the overall feasibility of creating the tool, including specific expertise and resources necessary for development.

The report begins with a section on methods that describes the strategies used to conduct a literature review and carry out qualitative research in the form of key informant interviews. The following three sections, 3-

5, labeled Findings and Discussion, report and share our data and findings relevant to Environmental Justice in Connecticut & Mapping Tools, Outreach and Input from EJ Communities, and Tool Development and Scoping. We draw on these findings to then make specific recommendations for the development of a Connecticut mapping tool in section 6, “Recommendations for Connecticut & Steps for Tool Development.”

2. Methods

This project was carried out between September 2019 and May 2020. Methods included a combination of literature reviews and qualitative research in the form of key informant interviews. For the literature review, background information on the EJ movement, EJ mapping tools, EJ policies and initiatives in Connecticut, and best practices conducting outreach in EJ communities was gathered through a review of peer-reviewed and gray literature. Gray literature included news articles, community organization websites and materials, and information posted online by government agencies such as EPA, as well as guidelines for public participation and outreach developed by the National Environmental Justice Advisory Council and the Council on Environmental Quality, which coordinates policy pursuant to the National Environmental Policy Act. We also reviewed and compared uses, indicators, functionalities, and feedback on outreach from peer state mapping tools including, particularly, California’s CalEnviroScreen and Washington’s Health Disparities Map, two of the leading efforts among the states, and tools under development in Vermont and Massachusetts. This work was supplemented by participation in a convening on EJ Screening tools in Washington D.C. in October 2019, where EJ advocates discussed goals and processes for developing mapping tools, involvement of EJ communities, functionality, and preferred indices. Finally, the research team met bi-weekly with the project preceptor, Edith Pestana, Environmental Justice Administrator at DEEP. Pestana routinely shared updates on current state policy, directed the team to various state databases, and provided feedback on DEEP’s desired uses for an EJ mapping tool.

Pursuant to the research team’s outreach plan, we interviewed five environmental justice advocates or community leaders in CT. These interviews were critical for providing information on how a mapping tool would support ongoing EJ advocacy work, what challenges to anticipate, and what indicators and functionalities to include. Data from these interviews are included in the Findings and Discussions sections below and are flagged by reference to “EJ advocates.” The interview guide used for these interviews can be found in Appendix III.

This outreach plan also included conducting focus groups in selected distressed municipalities in Connecticut to gather input and feedback from residents on environmental and health issues affecting them. The research team developed a focus group guide, questions, and a consent form; conducted two pilot focus groups at the Adult New Haven Education Center with staff and students; completed Human Subjects training; and received approval from the Institutional Review Board to conduct this research. Unfortunately, due to the COVID-19 pandemic in March 2020, the necessary completion of focus groups was postponed.

Finally, to better understand the process for building mapping tools, our team interviewed twelve data scientists, tool developers, and geospatial analysts who have conducted similar work for other state mapping tools or on similar tools within CT. These interviews covered topics such as incorporating community input, identifying appropriate data sets and indicators, building and updating geospatial mapping tools, and the time, costs, and expertise required to complete construction of a state-specific tool. Data from these interviews are included in the Findings and Discussions sections below and are flagged by reference to “tool developers.” A diagram of our research and outreach strategy is displayed in Figure 1.

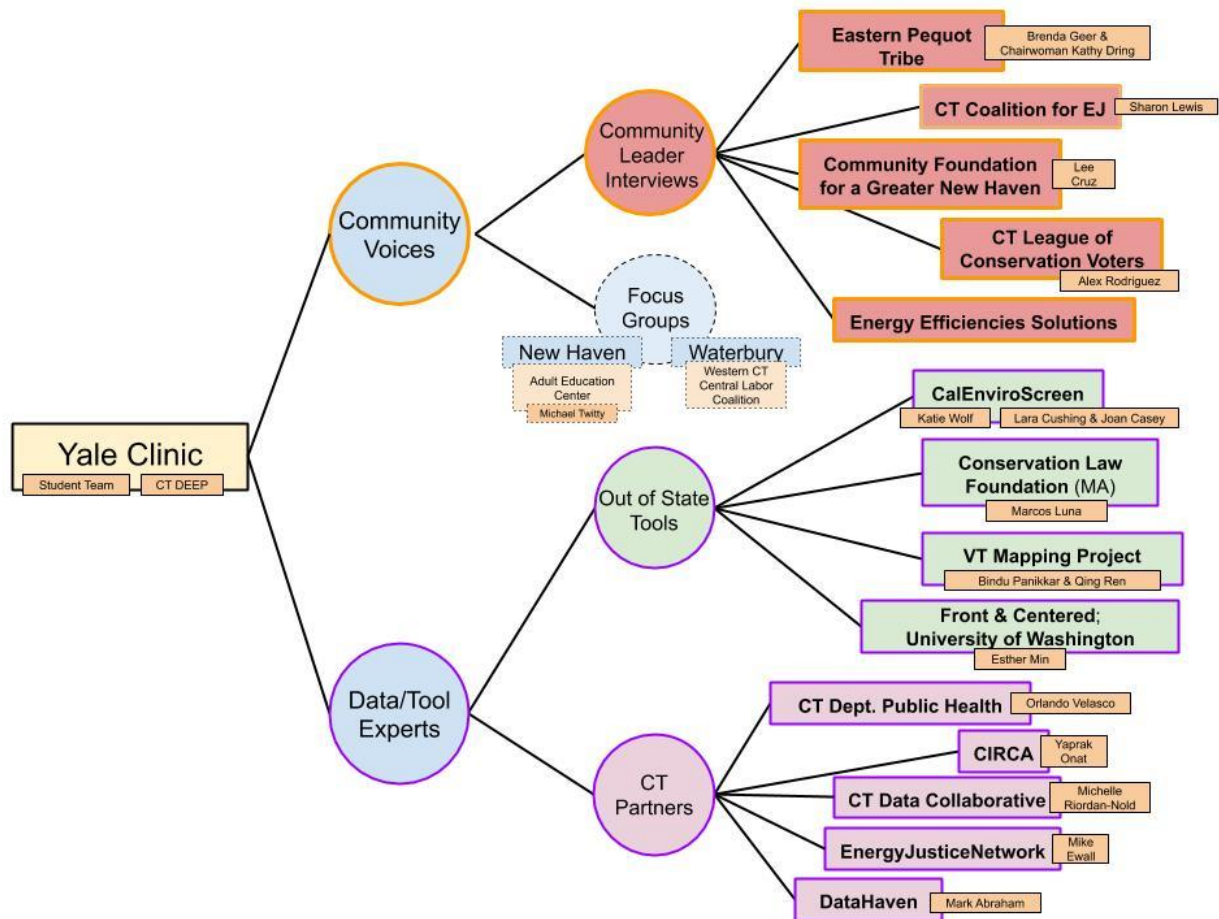


Figure 1. Diagram of the Research and Outreach Strategy

This figure depicts the constellation of organizations this team contacted for the development of the project. Please note that several of the structures above are outlined with dotted lines. This feature indicates that contacts have been made in these communities/organizations and the groundwork has been set for DEEP to continue outreach through focus groups and further interviewing.

3. Findings and Discussion: Environmental Justice in Connecticut & Environmental Justice Mapping Tools

3.a. Environmental Justice Statute & Program in Connecticut

CT DEEP's official website states that "All people should be treated fairly under environmental laws regardless of race, ethnicity, culture and economic status." The negative consequences of EJ issues disproportionately impact individuals who are low-income and communities of color in Connecticut (Chambers, 2007). Connecticut's five largest cities and towns—Bridgeport, Hartford, New Haven, Stamford and Waterbury -- represent 71% of the state's population of color and 51% of the state's population in poverty. They also account for 19% of the state's 600 potential pollution sources ("Overview - Environmental Justice Program," 2019). The state faces a unique combination of public health burdens as a result of hazardous waste management facilities, such as Hartford's trash incinerator, and other sources of air, water, and soil pollution. As environmental justice advocates repeatedly stated in interviews, communities of color and low-income communities face the worst impacts on public health and quality of

life in Connecticut. Connecticut indigenous communities are especially hard-hit, with many community members of the the Eastern Pequot Tribal Nation struggling to find consistent access to clean drinking water.

Even as Connecticut bore the burden of widespread environmental racism, the state was at the forefront of EJ legislation when it enacted its Environmental Justice Law, CT General Statute §22a-20a, in January 2009. This law provides for increased public participation in siting decisions for specific types of potentially polluting facilities, such as new or expanded landfills, power plants, sludge or solid waste incinerators, and major sources of air pollution. New or expanded facilities that would be sited in a designated EJ community are required to develop Environmental Justice Public Participation Plans as part of the permit application process. These plans must be filed and approved by DEEP before the application for the permit is submitted (“Environmental Equity Policy,” 2019).

The Connecticut Department of Economic and Community Development (DECD) identifies and ranks the state’s most fiscally and economically distressed municipalities to enable state agencies to direct housing, insurance, open space, brownfield remediation, and economic development funding to these municipalities. This list is updated annually using weighted components that are summed to rank the state’s 169 towns, with the 25 towns placed highest on that list designated “distressed municipalities.” Indicators used to calculate the score include high unemployment, poverty, aging housing stock, low or declining rates of growth in job creation, population, per capita income, and educational attainment. DECD relies on data from the US Census, the American Community Survey, the Department of Labor, and the Department of Education (“Distressed Municipalities,” 2019). Because of the linkages between socioeconomic vulnerability and environmental harms, DEEP considers these distressed municipalities EJ communities, along with other affected towns that have census block groups with 30% of their population living below 200% of the federal poverty level (“Environmental Justice Communities,” 2019).

The statute has been described by Connecticut community EJ advocates (who are discussed further below), as being an important initial step, but one that could be further strengthened to serve communities facing cumulative impacts. An EJ mapping tool would fortify the statute and environmental and climate change planning and implementation by geospatially representing the distribution of environmental and public health burdens across the state, situating each of these EJ communities within the context of the indicators included in the tool. The tool would also serve to test the extent of Connecticut’s GIS data collection efforts—many of the Connecticut-based data and mapping experts interviewed for this report noted the poor quality of geospatial data in the state and emphasized the need for a comprehensive statewide data-gathering effort. The creation of a tool that depends on this data will support the case for improved data quality by identifying major gaps in the data. Additionally, many advocates note the need for more funding for the EJ program, a process to better incorporate the voices of people of color, people who are low-income, and community members of limited English proficiency, and stronger legislative action to support enforcement of EJ policies. Notably, in 2015 Governor Malloy issued an executive order to establish the Governor’s Council on Climate Change (GC3) (Executive Order No. 46, 2015). In 2019, in part to address this demand for meaningful participation in decision-making, Governor Lamont issued Executive Order No. 3, expanding the scope of the GC3 to include a call for equity and environmental justice to be integrated within state climate planning and adding an Equity and Environmental Justice Working Group to the GC3 (Executive Order No. 3, 2019). Recent legislation, HB 5395 and HB 5103, was also introduced to evaluate the current statute and strengthen its requirements under the law. As of July 2020, HB5103 is still in committee (H.B. No. 5103, 2020).

3.b. EJ Advocacy in the State

The existing statute and EJ efforts underway across the state are made possible by continued advocacy from numerous community groups working across Connecticut. These groups elevate the voices of community

residents and raise concerns about the cumulative impacts of siting facilities in communities facing multiple sources of pollution, particularly communities of color and low-income communities. Facilities that have drawn particular attention from these groups include municipal landfills, pipelines, petroleum-based power plants, and waste incinerators. EJ advocates from these groups also monitor issues such as salt and sand storage, disposal of construction material, chemicals and metal recycling, sewer sludge, climate change, transportation access, air pollution, legacy pollution from tanneries, and drinking water contamination. They work to elevate community voices by educating residents about key environmental issues and resources available within the state and by empowering residents to participate in decision making processes related to their environment and health. Many of these leaders and advocates meet regularly to plan and coordinate ongoing advocacy efforts across the state. Many participated in the development of the Environmental Justice Statute and continue to push the state to address equity and justice issues today, including cumulative impacts. Advocates cite Connecticut's state water plan, plastic bag ban, and waste ban as major recent victories in their work to support communities and advance EJ in the state.

3.c. EPA EJSCREEN & State-Specific Mapping Tools

To further highlight areas that deserve greater resources and attention, mapping tools can supplement traditional risk assessments with spatial visualizations of environmental and health burdens, layering different indicators over a map using a Geographic Information System (GIS). Some tools also quantify cumulative impacts through indices, which provide a numerical basis on which to assess the aggregate effects of multiple stressors, including environmental impacts and health and sociodemographic vulnerabilities.

One national-level example of such a mapping tool is the EPA's EJSCREEN, in use as early as 2012, peer-reviewed in 2014, and made available to the public in 2015 ("How Was EJSCREEN Developed," 2016; "What is EJSCREEN?" 2019). A mapping tool like EJSCREEN can be used to integrate awareness of the social determinants of health into a variety of government policy-making decisions and community-based actions. The EPA designed EJSCREEN to guide key decision-makers in identifying areas for outreach and analysis, as well as to support aspects of permitting, enforcement, and compliance ("How Does EPA Use EJSCREEN?" 2016). The tool is publicly available to encourage stakeholders outside of the agency to consider EJ in decision-making and to identify areas where environmental issues affect minority and/or low-income populations.

While a useful tool, EJSCREEN has significant limitations. For instance, the EPA does not use EJSCREEN to quantify cumulative impacts in a single index, but rather, it calculates separate indices for various environmental indicators ("How Does the EPA Use EJSCREEN?" 2016). A single index allows for an immediate interpretation of the data that multiple, narrower environmental indices would not. Additionally, EJSCREEN is limited by its data; it uses only nationally-available data, so it does not take advantage of data that may be available at finer resolutions at the state level, nor does it respond to state-specific concerns. States have responded by developing their own EJ mapping tools. California and Washington were two of the first states to develop tools, and tools are in various stages in development in Maryland, Massachusetts, Michigan, Minnesota, North Carolina, and Vermont, among other states.

State-specific mapping tools provide policymakers and the public with a consistent, state-wide mechanism for measuring how environmental risks affect the wellbeing of residents. These maps can include data that may only be available within a particular state and allow users to visualize these effects. Some of these tools employ indices to identify and rank which communities experience the greatest cumulative impacts. The use of more granular, locally-available data allows states to more accurately assess local experiences and relative vulnerabilities. Most states with tools have released or anticipate releasing multiple versions, with updates including additional uses, functionalities, and data based on user and community feedback (EJ Screening Tool Convening, 2019). Sections 4 and 5 below draw from interviews with tool developers from

California, Washington, Massachusetts, and Vermont to consider how some of their methodologies, decisions, and processes may be applicable in Connecticut.

4. Findings and Discussion: Outreach and Input from EJ Communities

The development of an effective EJ mapping tool depends on the engagement of government agencies in an outreach process that is cooperative, empowering, and encourages co-learning and broad participation. Agencies must hold the core principles of inclusivity, equal participation, self determination, transparency, trust and community building as integral to the project's success (Chen et al., 2012; Israel et al., 2010; Wallerstein & Duran, 2010). This outreach should be informed by an understanding of how social status and privilege impact partnerships and by knowledge of the history and root causes of oppression, so that previously excluded communities can be effectively identified, exclusionary practices can be avoided, and outreach can be conducted with a sense of cultural humility (Chen et al., 2012). Communities should be centered within outreach work as equal partners with expertise and unique knowledge to contribute. During the COVID-19 pandemic, the process must be designed to maximize effectiveness in the context of a remote engagement.

In keeping with these principles and as discussed above, efforts in other states to develop EJ mapping tools have included outreach to residents and future tool users, such as community organizers and environmental justice advocates, to gather feedback on key environmental and health issues affecting those communities, and to identify additional vulnerabilities, tool functionality, and future uses (EJ Screening Tool Convening, 2019). Each state tool relied on different approaches to incorporate community input into their tool's design. The Washington tool's team conducted "listening sessions" from the early days of the tool's development to allow residents to raise issues that would guide selection of the indicators included in the tool. This "community-driven" framework made explicit efforts to integrate procedural justice throughout the project by negotiating goals of the project with partners and incorporating community input in early stages (Min et al, 2019). In California the outreach process was more iterative; after public calls for the Office of Environmental Health Hazard Assessment to broaden participation in the tool's design process, the developers brought beta versions of the tool to different groups of stakeholders and community organizations and then incorporated their feedback as they made improvements to early versions of the tool. Regardless of the approach taken in Connecticut, it is vital that any outreach efforts be guided by principles of inclusion and empowerment so that residents can take an active role in the tool's development and can make their voices heard.

4.a. Outreach in Environmental Justice Communities

In 1991, participants in the First National People of Color Environmental Leadership Summit adopted 17 principles that promoted a radical reorientation of environmentalism around justice for communities overburdened by pollution and lacking equal access to green space. EJ Principles developed during the Summit include the demand that people of color and other people whose livelihoods are threatened by EJ issues participate as equal partners at every level of EJ decision-making. Community members must be key decision-makers in community needs assessments, planning, implementation, enforcement and evaluation ("Principles of Environmental Justice," 1991). As with community-based research, outreach conducted by government agencies should be guided by relationships built with trusted community partners such as cultural advocacy, environmental, and other community organizations; local leaders; service providers; and local administrative or political officials who interface directly with community members (Cargo & Mercer, 2008). This guidance is consistent with the mandate on public involvement applicable to DEEP and other government agencies, and with a framework for public engagement proposed by the Equity and Environmental Justice Work Group of the GC3 in 2020 to guide its work (Model Plan for Public Participation, 2000; FTA 4703., 2012; CTDEEP, 2020).

These partners must continue to inform how research and outreach is tailored to the unique context of each focal community. Community members must directly guide the design of outreach mechanisms in order to secure broadest possible participation among residents. Before conducting outreach, residents must be provided with information on the purpose of the outreach or research, how they can learn more or participate, who is conducting the outreach, and other relevant details. Outreach strategies must also be reviewed and revised by community partners who are trusted in the community and know community members and their circumstances.

Outreach efforts in vulnerable communities can encounter many challenges. Due to the heterogeneity of languages, ethnic groups, interests, values, and concerns within vulnerable communities, it should not be assumed that all residents are in agreement on the major issues their community is facing and potential solutions to those issues (Guzman et al., 2018). Communities may also be less willing to engage with outreach teams whose backgrounds or identities may be different from their own (Yancey et al., 2006). This issue can be overcome by hiring and training outreach team members that are from the focus communities, who are able to build relationships based on trust, recruit participants, and empower their peers to engage in projects (Cargo & Mercer, 2008; Wilson et al., 2014). Other challenges include distrust of public engagement processes and the inability to reach the most marginalized individuals within a community, such as incarcerated individuals or individuals without reliable internet access (Wilson et al., 2014). Despite these challenges, outreach is still needed, and public engagement efforts should consider best practices to overcome these challenges.

4.b. Focus Groups

Efforts should be made to speak with both formal community leaders and individuals who do not have formal leadership positions or participate in representative organizations (Wilson et al., 2014). Outreach can include small group public meetings or focus groups, presentations to existing community groups at regularly scheduled times, door-to-door interviews or surveys, and availability sessions or open-house style events. The timing of these initiatives must be carefully selected to maximize the number of residents reached, including those with non-traditional work schedules. Creating multiple opportunities for engagement is ideal (Gallagher & Jackson, 2008).

In California, Washington, Maryland, and Vermont, focus groups have been used to gather community feedback on EJ mapping tools. Through focus groups, information can be gleaned both from individual answers to questions and from interaction among group members (Kitzinger, 1994; Ulin et al., 2012). This context allows participants to hear each other's perspectives, challenge one another, reassure one another, remember forgotten details, and build off of each other in their responses (Kitzinger, 1994; Ulin et al., 2012). In addition to providing the outreach team with key insights, the opportunity for this interaction may lead to collaboration among participants around shared challenges even after the project has ended (Ulin et al., 2012).

Focus groups for the purposes of this tool should follow several key guidelines as proposed by the literature and by our interviews with experts across the state. Focus groups should generally include 8-12 participants of diverse identities and backgrounds (Bozzi, 2019; Krueger, 1997). To allow for a broad range of EJ burdens to be identified, they should be conducted with residents from both rural and urban communities across the state, and from a diversity of communities within each location. DEEP should follow best practices outlined in the literature to ensure focus groups are successful, including the acquisition of informed consent from participation, confidentiality, respect for participants' time, a clear and logical focus group guide, and avoidance of leading questions (Krueger, 1997; Ulin et al., 2012; Bozzi, 2019).

The moderator should also pay attention to potential limits to participation that emerge before or during the session, such as group dynamics, language barriers, differences in communication skills, or attention levels

(Bozzi, 2019; Krueger, 1997). Building accessibility into the logistical aspects of an outreach plan should not be overlooked. Venues that are centrally located, public spaces, such as libraries, schools, community organization offices, or recreation centers, can help create community cohesiveness and encourage participation. As community advocates suggested, conducting focus groups in a setting that residents already know and feel comfortable in will allow for a more productive conversation.

Additionally, EJ advocates emphasized the need for: appropriate language translation of all materials, interpretation, childcare services, vehicles or funds for transportation, and disability access. Best practice is to compensate residents for their time participating by providing food during any meetings or focus groups and perhaps a stipend (Model Plan for Public Participation, 2000). Not every community will respond to a stipend in the same way, and ultimately the method of compensation should only be decided after careful deliberation with the community advocates that know their community needs best. Agencies pursuing outreach through focus groups should consult the sources cited in this report for further guidance.

It is critical to follow up on findings or next steps of the project and communicate these back to participants. Furthermore, our contacts consistently recommended that community residents be made key advisors to the project. Any agency conducting outreach for this project should return regularly to their focus group participants for consultation on the progress of the tool, and efforts should be made to make changes to the tool's design consistent with their recommendations. All efforts possible should be made to maintain and sustain relationships and partnerships established so that outreach and collaboration can be continued as the project progresses.

4.c. Key Informant Interviews

Though focus groups must be a central component to any outreach strategy, they should be complemented with qualitative, in-depth, structured or semi-structured interviews with key members of the community. For this tool, these should include organizers and advocates who are well-versed in EJ issues and have already done extensive work addressing the EJ burdens their communities face. Since these contacts will ideally be using the tool frequently for their work, it is imperative that they play a leading role in shaping its development so that it can prove useful to them. Additionally, the tool should serve to support, rather than supplant, any outreach work that has already been conducted to learn more about residents' needs and concerns.

Key informant interviews should follow a clear guide that opens with an introduction that makes clear exactly what the objective of the interview will be and how the interviewee's input will be applied. Outreach personnel should ask for consent before recording any interview and should make clear exactly how input will be included in the final report (direct quotations, paraphrases, etc). Questions can be more direct and use more technical language than those applied to focus groups, but generally the content of these questions should be similar. Interviews should always close with a catch-all question—along the lines of “Is there anything else you'd like to share/think is important that we hear from you?”—to ensure that all of the informant's input is considered. Informants should continue to be updated as the tool's development progresses. Future interviews may be necessary to ensure that informants continue to play a guiding role in the tool's creation.

5. Findings and Discussion: Tool Development & Scoping

5.a. Types of Indicators

As described above, the indicators used in mapping tools are meant to capture a range of different stressors, burdens, and characteristics that can interact to create cumulative impacts affecting a community's

vulnerability. Different frameworks for determinants of health often group these various factors into “meaningful buckets,” as one tool developer called them, or the broad categories of factors that tend to impact quality of life outcomes. The World Health Organization, for instance, includes three categories: 1) the social and economic environment, 2) the physical environment, and 3) the person’s individual characteristics and behavior (“Health Impact Assessment: The Determinants of Health,” 2020). Similarly, in their Healthy People 2020 initiative, the Center for Disease Control applies a “place-based” Social Determinants of Health framework that includes five key areas: 1) Economic Stability, 2) Education, 3) Social and Community Context, 4) Health and Health Care, and 5) Neighborhood and Built Environment (“Social Determinants of Health,” 2020).

For state-based tools, states must determine which components to prioritize across these different categories and then begin to select indicators that are most representative of the identified components. CalEnviroScreen, for example, categorizes its indicators into two main bins, Pollution Burden and Population Characteristics, and then further subdivides into four categories: within Pollution Burden, (1) environmental exposures, and (2) environment effects; and within Population Characteristics, (3) sensitive populations, and (4) socioeconomic factors (Figure 2).

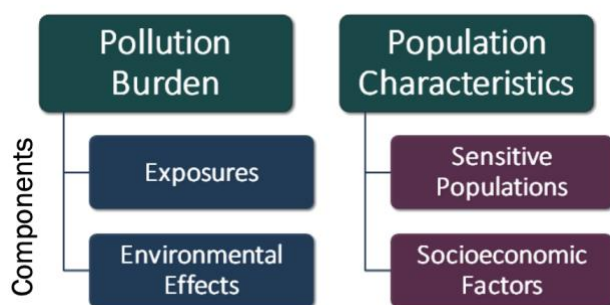


Figure 2. Classification of Indicators in CalEnviroScreen’s Mapping Tool. (Rodriguez & Zeise, 2017)

1. *Environmental Exposures*: These indicators measure or estimate the levels of direct contact of human beings with chemicals, such as ozone and particulate matter, in their environment, as channeled from sources such as air, water, food and soil. When layered with toxicity or epidemiological data in the community, they can be directly linked to projected health outcomes (Brody et al., 2009; Pastor et al., 2004; Mohai & Saha, 2015; Morello-Frosch, et al., 2001; Schulz et al., 2016).
2. *Environmental Effects*: These indicators reflect adverse environmental conditions caused by pollutants such as impaired water bodies and proximity to hazardous waste facilities.
3. *Sensitive Populations*: These indicators reflect populations with biological traits that result in increased vulnerability to pollutants, such as asthma hospitalizations and low birth weight (Rodriguez & Zeise, 2017). Additionally, children or the elderly can be more susceptible to adverse health impacts from pollutant exposure (Sexton, 1997). Some adverse health effects are amplified because of their interactions with genetics, restricted access to health services, food, or other health impairments (Morello-Frosch et al., 2011; Hilmer et al., 2012). Prevalence of vector-borne diseases, such as Lyme disease, would also fall into this category.
4. *Socioeconomic Factors*: These indicators include a variety of community characteristics that are related to increased vulnerability and poorer health outcomes, such as poverty, the rate of unemployment, and linguistic isolation. Race is an important social determinant of vulnerability and racial data should be included in a mapping tool (Sadd et al. 2011).

States may adhere to this existing framework, as Washington did with the Health Disparities Map (Min et al., 2019), or develop their own frameworks to guide the inclusion of indicators that capture a combination

of factors, including environmental factors, as well as the social, physical, and economic characteristics of a community that impact its vulnerability. A table of select state tools and the indicators they use is included in Appendix VII.

5.b. Indicator Selection

Though different approaches were taken to select the specific indicators to include in each tool, the processes have generally sought to balance the accurate representation of factors that contribute to vulnerability as supported by the literature and the observed reality in the state, issues and concerns expressed by communities, and the availability and quality of corresponding data.

Several tool developers recommended establishing base criteria, or “ground rules,” to guide and prioritize inclusion of indicators and corresponding datasets. In California, these initial ground rules for data included:

- Data must be available state-wide.
- Data must be publicly available.
- Data must be available at least at the census tract level or translatable to that level.

The full criteria for indicator selection in the most recent CalEnviroScreen 3.0 are:

1. An indicator should provide a measure that is relevant to the component it represents, in the context of the 2005 CalEPA cumulative impacts definition.
2. Indicators should represent widespread concerns related to pollution in California.
3. The indicators taken together should provide a good representation of each component.
4. Pollution burden indicators should relate to issues that may be potentially actionable by CalEPA boards and departments.
5. Population characteristics indicators should represent demographic factors known to influence vulnerability to disease.
6. Data for the indicator should be available for the entire state at the census tract level geographical unit or translatable to the census tract level.
7. Data should be of sufficient quality, and be Complete, Accurate, and Current (Rodriguez and Zeise, 2017).

Criteria or ground rules like these serve to filter out insufficient or poor-quality indicators, ensure consistency across indicators, and form the basis for a systematic approach to indicator identification that may be guided by certain principles (e.g. replicability).

As mentioned above, states took different approaches to incorporating community outreach and input into indicator selection. For instance, Washington state used a community-driven framework and initiated listening sessions at the beginning of their tool development process to ensure that indicators were determined foremost by community priorities, needs and concerns (Min et al. 2019). California developed a preliminary version of the tool based on expert opinion and literature that was then vetted using an intentional community input strategy. Additional community feedback was incorporated into subsequent versions of the tool. In some cases, the solicited input led to the consideration of additional indicators that were not initially included but may be incorporated in later versions of the tool. The community input process may also highlight topics of concern for which there is no readily available indicator data. States often tried to identify and test potential indicators that could capture these concerns or seek out previously unavailable sources of data.

For example, in California, asthma was a major concern emphasized by the community, and the tool development team wrestled with the correct way to represent asthma burden given the available data. Incidents of hospitalization due to asthma may have not captured the full burden by only including those who had access to a health facility and insurance, or were severe enough to seek care.

It is also recommended to check for anomalous groups that may inadvertently be included when a new indicator is added, but who may not be truly vulnerable. Testing the appropriateness of each indicator should therefore consider, as one tool developer mentioned, “who falls in, who falls out.” For instance, one tool developer noted that using certain income levels alone may lead to the inclusion of neighborhoods where college students live, who are not vulnerable by other measures. Furthermore, tool developers recommend conducting sensitivity analyses to determine how adjusting certain parameters in turn influences the areas of vulnerability that are highlighted. Massachusetts, for example, analyzed its demographic criteria used to identify EJ communities, evaluating ten alternative policies, each with slightly adjusted thresholds for minority and income criteria, to minimize both inappropriately classifying groups as EJ communities that should not be and inappropriately failing to classify groups that should (Luna, 2019).

Developers should also be sensitive to how different indicators may or may not meaningfully represent vulnerability across different parts of the state. For instance, studies have found that access to green space is associated with certain positive health outcomes, particularly in urban areas (Kondo et al., 2018, Nutsford et al., 2013). Therefore, while access to green spaces may be a good indicator for vulnerability in urban areas, it may not be as useful for rural areas and may therefore be inappropriate to include in a statewide index, though it should still be included as an additional layer for optional visualization. The fundamental variation between rural and urban EJ communities must be strongly considered throughout the construction of an EJ mapping tool. Developers should consider having two-tiered information available separately for cities and towns, or including in the index an adjustment factor for data disparities between towns and cities.

Covariation, in which variables display some degree of linear relationship, and collinearity, in which multiple independent variables are highly correlated with each other, are two issues that several tool developers encountered. In general, tool developers tried to avoid including multiple indicators that were likely to be representing the same issue and to select the indicator that was easiest for an external user to interpret. Some analysts ran multicollinearity and Spearman’s correlation tests to determine which indicators could be redundant and therefore removed. In other cases, certain variables were included even if they were correlated closely with another because they demonstrated a specific concern raised by the community.

When deciding on indicators to include, it may also be helpful to include ones that are benchmarked to existing legislation or regulatory standards. For instance, indicators could be used that are pegged to the specific units within the Clean Air Act or another standard to support enforcement. Indicators should primarily be tailored to potential tool uses and as actionable as possible.

Many tool developers emphasized the iterative nature of the tool development process, acknowledging as one informant mentioned, that initial indicators are “just a starting point” and the tool itself being “constantly in beta version.” The tool development team should expect and plan for subsequent revisions, based not only on continued community outreach and ground truthing, but also on refinement of methods and improvements and updates in the data themselves.

5.c. Sources of Data and Datasets

When it comes to specific datasets, mapping tools draw from a variety of sources. As mentioned, many are derived from publicly available data collected by government agencies at various levels. Limiting included data to what is publicly available allows for its democratization by ensuring that there are no proprietary issues or barriers to others downloading and using the data provided.

Some indicators draw on national data sources, such as the National Air Toxics Assessment and Toxic Release Inventory from the EPA for environmental indicators, the Center for Disease Control for health data, or the American Community Survey and Census for sociodemographic data. Others are based on

datasets from local state-based agencies, in particular states' public health and environmental protection or conservation agencies. Information from state and regional transportation agencies may also be relevant.

Health outcomes and identifying appropriate corresponding datasets present unique challenges due to both variations in resolution across the state and resulting comparability issues, and also the need to protect patient privacy. For example, in Connecticut, many health datasets may be available only at the county or municipality level. More granular data may be limited to certain larger municipalities. If using sources such as the All Payer Claims Databases, one may run into issues of confidentiality concerning sharing information without an explicit memorandum of understanding. Translating to the necessary spatial resolution may be particularly challenging when geographic units do not overlap or clearly form a spatial hierarchy, such as zip codes ("About the Health Equity Index," 2010).

For public health data, many states built on existing data dashboards, in particular ones that were already in development with support from the CDC's National Environmental Public Health Tracking Program (CDC NEPHT). Some of these data were already spatially projected, but others had to be prepared in order to be usable in the tool. In Washington, for instance, the Environmental Health Disparities map built on their state's CDC NEPHT work and data, and the tool was eventually rolled into and hosted by the initiative's existing infrastructure, allowing the state to lower the cost of tool development. Connecticut has also been supported by this program and developed its own Public Health Data Explorer dashboard, which may be leveraged in the development of a tool.

Translating a dataset to a different geographical resolution may introduce error, and there may therefore be tradeoffs between consistency and precision. Similarly, differences in temporal resolution may pose challenges. One tool developer discussed, for instance, the decision whether to use data from the American Community Survey (ACS) versus the decennial census. While the census has a finer spatial resolution than ACS, it is only published every 10 years and may not have specific data that is included in the ACS. ACS, on the other hand, generalizes results for populations based on a sample from that population, while the census ostensibly surveys every resident of that population directly. Tool developers will need to make decisions based on their needs and criteria, while acknowledging the tradeoffs and remaining transparent about rationale and any associated errors that may be embedded in those decisions.

In general, many states have chosen to use the census tract level as the geographical unit of analysis for the tool. This not only corresponds with the level at which many national datasets are available, but is also fine enough grain to be useful, while still managing concerns around confidentiality and data suppression. Census tract resolution may still present issues, however, missing particular pockets of vulnerability within tracts that are otherwise less vulnerable, particularly in rural areas. Several states use the census block group level for their definitions of Environmental Justice to be able to identify these particularly vulnerable communities that may be within a census tract. A table comparing these definitions and data sources used can be found in Appendix V.

As mentioned, statewide consistency has been an important ground rule of past tools. Several states only use data that is available across the entire state, thereby excluding data that is only partially available in certain areas and avoiding having varying levels of accuracy in different parts of the state. While this decision was adopted by developers of several tools, such as Washington's and California's, there may be reasons to explore including data that is not statewide. The Connecticut Institute for Resilience and Climate Adaptation (CIRCA) at University of Connecticut has developed several mapping tools in support of their mission to increase resilience and sustainability of vulnerable communities along Connecticut's coast and inland waterways ("Connecticut Institute for Resilience and Climate Adaptation."). CIRCA works across scales, including local, regional, state, and federal partners to obtain and produce data. Current projects target the municipal jurisdictional level, with particular focus on coastal or riverine areas susceptible to flooding. These projects will soon expand in geography and scope in the project area. Methodologies developed for tools that address flooding and other climate change impacts could be deployed throughout

the state. Though some datasets may be limited to the major municipalities within the state, which although would present inconsistency in the tool, they may still offer useful information. For instance, some community activists may be interested in more granular data only available in certain localities. Councils of Governments (COGs), Connecticut's regional planning agencies, may serve this need—COGs are often key partners with CIRCA in developing GIS data, especially where individual towns are unable to do so. They are also key potential users for CIRCA's tools, and may prove to be important collaborators as a Connecticut-based environmental justice mapping tool is developed. In addition, environmental justice advocates have also sought the capacity to integrate new data from community-based air, water and soil monitoring into mapping tools.

5.d. Updating Data

States have also considered data maintenance while developing their tools. Some states, such as Washington, prioritized data that was well-maintained and routinely updated in order to promote the sustainability of the tool and its ability to continually assess changing disparities as a community's conditions change over time (Min et al, 2019). Depending on the dataset, it may be possible to automate the process of updating data within the tool, for instance if the source has an Application Programming Interface (API) that enables doing so. New data, however, may require updates in methodology and new decisions. In Washington, tool developers were careful to review which communities may have "fallen out" after an update and considered allowing Environmental Justice communities to remain "grandfathered in" even if an update in the data excluded them. Another tool developer pointed out the need to update data based on new census boundaries following the 2020 census, so updates like that may also require other manual improvements and changes. Developers of a Connecticut EJ mapping tool should ensure that individuals and organizations that make regular use of the tool are updated as the data is updated as well. An email sign up may be of use in this endeavor.

5.e. Indicators & Data for CT

Many of the indicators that Connecticut may choose to include in its tool will likely resemble the types of indicators included in other state tools and that have been shown to correlate closely with health and quality of life outcomes.

Others may be unique to the state, guided by the community outreach process, availability of data, and an evolving understanding of elevated concerns throughout the state. For instance, while most of the other state tools do not have indicators on climate change vulnerability, Connecticut's leadership on resilience planning and tracking may allow for the incorporation of indicators related to flooding and sea level rise. CIRCA is currently developing mapping tools to identify areas of climate change vulnerability and opportunities for regional resilience projects. For health issues, certain vector-borne diseases such as Lyme disease may also be specific to the state, along with their potential increase due to climate change. Mental illness and opioid use disease were also mentioned by tool developers as unique health indicators to consider. Appendix V includes a list of possible indicators for inclusion in Connecticut's tool, existing databases that may be used for each, and notes on preliminary relevance and quality.

5.f. Index Development

As previously mentioned, some states have chosen to take a step beyond displaying layers of indicators in a map, and have used these indicators to create a composite index that incorporates a subset of indicators at various weights into a single score to provide a measure of that geographical unit's overall cumulative impact relative to others. Many of the challenges and considerations for indicator selection mentioned above relate as well to the development of an index and the choices around which of the indicators to include.

To construct indices, states must make decisions around which of the selected indicators to include, whether to weight each indicator differently or equally, and then how to calculate the score for each geographical unit based on an agreed upon model. States first create a ranking or otherwise normalize each indicator in order for them to be comparable with one another. In both California and Washington, for example, the indicator values for the census tracts for the entire state were ordered from highest to lowest and a percentile or decile was calculated from the ordered values (Rodriguez and Zeise, 2017, Min, et al 2019). As described earlier and demonstrated in Figure 1, each of the indicators falls into one of the four categories of (1) environmental exposures, (2) environment effects, (3) sensitive populations, or (4) socioeconomic factors, with the first two representing Pollution Burden and the second two representing Population Characteristics.

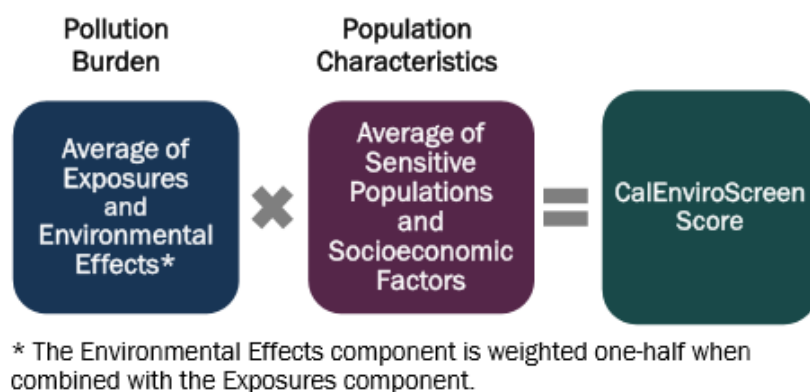


Figure 3. Representation of CalEnviroScreen's Index Calculation (Rodriguez and Zeise, 2017)

To calculate the total pollution burden for a given census tract, the percentiles for all of the indicators in a single component (e.g., environmental exposures) are averaged and then added with the other component (e.g., environment effects). Since the contribution of environmental effects were determined to be less than that of exposures, the average of environmental effects were first multiplied by 0.5 before being added to the exposures. The same is then done for the various indicators within the population characteristics, except with equal weight given to its two components. The overall score is then calculated by multiplying the pollution burden and population characteristics scores (Figure 3) (Rodriguez and Zeise, 2017).

Some developers may use averages for each indicator while others may decide to weight certain components or indicators more or less given their contribution. Developers can run a Principal Component Analysis or other tests to determine which variables are most influential in the model and inform appropriate weighting (Min et al 2019). Once the index is developed, additional sensitivity analyses can be done to validate its robustness in identifying vulnerable areas (Rodriguez and Zeise, 2017).

One important consideration in the construction of an index is whether or not to include self-identified race as an indicator. While racism is an important social determinant of vulnerability, some state developers explained that they chose not to include residents' self-identified race in their composite index in order to be able to use the index as a basis for decision-making while avoiding potential legal questions about the use of race for the allocation of funds. The decision whether or not to include racial data in an index should take into account the proposed uses of the index. Whatever the constituent factors in the index, it should be emphasized that racism is a social determinant of vulnerability and racial data should be included in a mapping tool (discussed above at 5.a. Types of Indicators).

Several initiatives in Connecticut have used indices to communicate the impact of cumulative effects, some of which may be informative for developing the state's environmental justice index. The Health Equity

Index, a past initiative of the Connecticut Association of Directors of Health, looked at the correlation between social determinants and health outcomes in select pilot health districts. This index combined 141 different indicators from more than 50 different data sources (“About the Health Equity Index,” 2010). The indicators were grouped into 13 health categories and 7 social determinants to calculate the index score. DataHaven, a nonprofit dedicated to data management and analysis for Connecticut communities, has constructed a Community Index for Connecticut that incorporates 12 indicators that cover a variety of economic, health and quality of life outcomes. These indicators range from the share of people with health insurance to severe housing cost burden to life expectancy.

Some states have decided not to construct an index, at least initially. One tool developer emphasized that creating a good and accurate index, although helpful in conveying the concept of cumulative impacts by layering in multiple burdens, requires a significant amount of work to develop, determine weighting, and then validate. Environmental justice indices, which include both physical and social variables, may be particularly complicated. Additionally, since many indicators are correlated, an index may not necessarily provide additional information beyond what could be communicated by a few select indicators. EJ advocates emphasize the benefits of having an index to assess cumulative impacts, and that the index, like other aspects of the tool, can be fine-tuned in subsequent iterations of the tool. While indices can play an important role in capturing and communicating multiple types of data in a single measure, the choices and assumptions used to create the index must also be clear and public.

5.g. Functionalities & Roll-out

Mapping tools can contain a range of different functionalities to increase tool transparency, usability, and accessibility. To enhance transparency, California and Washington allow users to download raw data and calculate percentiles for individual indicators as well as index scores. Printable versions of maps, shapefiles, and geodatabase files are also available for download. Accountability can be enhanced by offering a mechanism for users to raise questions, concerns, and suggestions as they navigate the tool. For a Connecticut-based EJ index, data experts emphasized the importance of making the subsidiary indicators separately available to users so that they might be able to examine the interacting dynamics of these indicators apart from the index.

Many features can be included to improve the usability of the tool for legislators, EJ advocates, and community members. Washington’s tool includes county lines, school district boundaries, school locations, and the location of clinics for the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC). Both California and Washington’s tools include zoom and search functions to allow users to focus on areas of interest, for instance their own neighborhood. These tools also allow maps to be shared digitally from the online interface. Several EJ advocates discussed the importance of connecting data displayed in tools to visuals, quotes, and personal stories highlighting the impacts of cumulative vulnerabilities on the lived experiences of residents. These stories or quotes could be incorporated into web pages with additional information on each indicator or in training or informational materials. Alternatively, they could be integrated into the mapping tool directly, for instance when a user selects a specific geographic area for more information. This has not yet been done by other tools but could provide valuable narrative and anecdotal data to further convey the effects of cumulative vulnerabilities. Toward this end, as suggested above, the tool might also integrate data from community-based air, water, and soil monitoring. Consideration of cultural competency was noted by one EJ advocate as important for making sure language and storytelling components are clear, comprehensible, and meaningful. Cultural competency, the integration of firsthand knowledge of cultural norms and values into the development of policy, must guide the narratives shared in the tool.

Tool accessibility can be enhanced by publishing explanatory videos and fact sheets about tool features and uses, providing translations for the tool and all accompanying materials in multiple languages, and

designing features to increase accessibility for people who are visually impaired. Adding a clear glossary of terms was suggested by several EJ advocates to help improve community health literacy and awareness of environmental justice issues. Most tools, such as the EJ maps from California and Washington, are streamlined, with relatively little text and a simple color scale that indicates ranges in vulnerability across areas for specific indicators. Users should be able to select indicators of interest and visually compare census tracts using the color scale. Offering a mobile-friendly version of the tool is important for users without regular access to a computer.

The tool should also allow users both to compare indicators across geographic areas and to assess characteristics of an area defined by a distance from a given location, a functionality that is particularly useful for stakeholders involved in permitting decisions. One data mapping expert suggested that it would be useful for a Connecticut-based tool to allow users to draw a polygon around an area and then receive the index score and all other relevant data for the highlighted region.

Overall, the particular functionalities of the tool should be informed by how the tool will be used by legislators, regulators, permit applicants, EJ advocates and residents. Additional functions can be incorporated over time in successive versions of the tool, making it increasingly more sophisticated. In general, several EJ advocates suggested starting off with a simple version that is easy to use and navigate and, as users build comfort with the tool, additional functionalities can be added based on their feedback. When considering the target user for the tool, developers must consider the complexity of a tool with statewide scope and multiple indicators, as well as an index of vulnerability. Outputs from the map may be highly nuanced and may be too complex for users without backgrounds in geospatial analysis to understand without support. Developers should consider multiple methods of data representation and should make their final aesthetic choices only after soliciting input from potential users—decision-makers, organizers, and community residents alike.

Finally, tool roll-out is an important step in initiating successful tool use. Both California and Washington offered in-person and webinar trainings with community members, organizations, and state legislators that covered tool use and features. Community partner organizations can play an important role in leading the roll-out process and sharing it with their respective members and constituents.

5.h. Strategies for Development, Leveraging Partnerships

Mapping tool development requires four primary types of expertise: community engagement and outreach, data analysis and indicator selection, geospatial mapping, and policy formation. Most tools have been developed through collaborative partnerships that bring together expertise from a range of organizations within a state. In California, Washington, Maryland and Vermont, and for similar mapping tools already developed in CT, data analysis, indicator selection, and geospatial mapping skills have been supported by a university research team. As one tool developer pointed out, faculty and students are able to “be nimble, get data, develop” and make a quality tool that shows proof of concept and lays a foundation for state policy makers to then develop further. Tool developers indicated that experience with GIS, coding (either in MatLab, R or Python), and running statistical analyses is critical for selecting indicators, developing indices, and designing an initial framework for geospatial visualization. These projects are appealing to universities because they offer students hands-on experience and can often be broken into discrete student projects and publishable papers. Universities also have the advantage of having access to the computer capacity needed to run analyses, store and back up, and support cloud data sharing. One tool developer emphasized the importance of developing a data management protocol in order to keep the various layers and datasets organized and consistent. In addition to universities, there are organizations in Connecticut, including DataHaven and CT Data Collaborative, that also have this expertise and capacity in-house.

Students at universities can also be leveraged to assist with community outreach. Many universities and state agencies have partnered with well-established EJ or other community-based organizations to lead the work on this important step. The research team at University of California, Berkeley partnered with an alliance of 10 different grassroots organizations to conduct community listening sessions and gather feedback on their initial list of indicators. Similarly, the University of Vermont is partnering with community organizers working with the Rural Environmental Justice Opportunities Informed by Community Expertise (REJOICE) project to gather input on environmental justice issues across the state. This effort builds on REJOICE's effort to gather input on the development of a state EJ policy. Often several rounds of outreach and community feedback are necessary before, during, and after tool development. One tool developer pointed out that having "existing strong relationships with organizers and leveraging pre-existing relationships means that you don't need to spend a lot of time developing trust and you are able to hit the ground running." Along these lines, organizations like DataHaven and CT Data Collaborative (CTData) typically partner with community organizations with which they have existing relationships to conduct community outreach and gather key input for tool development. In addition to EJ advocacy groups, they also work with churches, social service agencies, and consulting agencies to complete this work. CTData specializes in this community outreach work; in 2017 CTData launched the CTData Academy, which provides a series of workshops with the goal of increasing data literacy among data users across Connecticut. In 2019, the organization held 21 workshops attended by 337 people from 63 towns (CT Data Collaborative Annual Report 2019).

Once the initial components of the tool are developed, tool developers in California and Washington emphasized the importance of handing the tool over to a state agency with the capacity to update the tool, receive user feedback, and develop and maintain functionalities over time. This agency should also be responsible for championing inclusion of the tool in key policies and statutes. CalEnviroScreen, for example, is managed by the Office of Environmental Health Hazard Assessment. Washington's Health Disparities map is hosted by the Department of Health. Developers emphasized the need for state agencies to have a sense of "ownership" of the project and its outcomes as an important condition for sustainability and continuity of the tool.

One way to convene the diverse experts and stakeholders that contribute to the development of a mapping tool is through a steering committee or other advisory body. This strategy has been used in the development of several similar tools within CT, as well as with mapping tools in other states. This committee could include staff from relevant state agencies, community organizers and outreach experts, researchers, health equity experts, and residents of communities experiencing pollution burden and other EJ-related health impacts. The creation of a steering committee can lead to questions about how members are appointed and how decisions are made, so steps should be taken to ensure inclusivity, transparency, and accountability. One expert indicated that a university could play an important role as the facilitator of a steering committee, since universities are often seen as independent research institutions that are removed from the politics of state governance. Another structure is to have a tool advisory group that can provide support and feedback to the state agency that owns and manages the tool as needed. Any structure should include clear lines of authority and accountability to ensure that the project moves forward in a timely and organized way.

Fortunately, there are multiple sources of expertise within Connecticut and the New England region, in addition to several past and ongoing projects that offer opportunities for partnership in the development of an EJ mapping tool. CIRCA, at the University of Connecticut, currently maintains the Connecticut Sea Level Rise and Storm Surge Viewer, a tool that displays sea level rise projections and flood maps. This group is also currently developing the Coastal Vulnerability Index and other climate vulnerability indices using categories of exposure, sensitivity, and adaptive capacity to frame indicators that create, amplify, and/or mitigate climate change vulnerability at a local scale. These indices could potentially be combined or otherwise coordinated with an EJ tool. Many of these indicators, such as indicators of climate change

vulnerability and sociodemographic indicators such as employed population, health insurance, age, and building condition could be cross-referenced for inclusion in an EJ tool. The Public Health Data Explorer dashboard maintained by the CT Department of Public Health with funding from the CDC's National Environmental Public Health Tracking Program (CDC NEPHT), may present another opportunity for database and indicator sharing and potential collaboration on geospatial mapping of data, particularly for data on social determinants of health and sensitive populations. DataHaven is also currently working with SustainableCT to develop a sustainability tool that shows environmental data and may have overlap with an EJ tool. The Health Equity Index, mentioned above, that was previously developed and piloted by the CT Association for Directors of Health, offers a foundation for selecting health indicators and ranking and weighting them into an index. An EJ index could build on this existing foundation and incorporate additional indicators related to climate vulnerability and pollution burden pulled from the resources above. Finally, the Massachusetts Conservation Law Foundation, an environmental advocacy organization working to advocate on behalf of New England communities and natural spaces, is currently developing a New England Transport mapping tool that incorporates vulnerability and EJ indicators. This tool could offer another source of data and opportunities for cross-referencing and sharing of expertise. When considering how to build on similar projects, some tool developers noted the tradeoffs between having one complex tool that incorporates multiple indicators, and having multiple tools with specific objectives and uses that could be linked to other initiatives.

5.i. Funding and Timeline

The budget and timeline for developing mapping tools has ranged significantly across tools and depends on the driver behind tool development, the nature of partnerships formed to develop the tool, and access to state-specific resources. Often different phases of tool development are funded differently. Washington's mapping tool was developed over two years. The project was initiated by Front and Centered, a coalition of community-based organizations mobilized around climate justice and aiming to shape state climate policy and raise and invest revenue to address climate change. The group started tool development by coordinating community listening sessions across the state. Capacity and logistical costs for this outreach were funded by a patchwork of small grants from foundations – the Russell Family Foundation, the Rose Foundation, and the Seattle Foundation (Front and Centered, 2017). The group contracted a graduate student at the University of Washington School of Public Health to complete the data analysis for indicators highlighted in these listening sessions and to develop a methodology for creating an index. This graduate student's time was funded by a contribution from an individual donor (Front and Centered, 2017). Washington's Department of Health was already a recipient of funds from the CDC NEPHT program and had used that funding to develop several visualization tools for health data. The mapping tool team approached this department and they were able to use existing funds from the CDC program to add the EJ indicators to their existing map and include the indices. The agency agreed to update any indicators within the map as part of their existing program. This partnership kept costs for developing the tool interface very low.

Initial data analysis and indicator review for California's mapping tool was also completed by a research team at University of California, Berkeley. The research team received a roughly \$500,000, three-year grant with a no-cost extension for an additional year from the California Air Resources Board's Research Program. This grant funded collaborators at several other universities, community groups who supported outreach, and the time of an Outreach Coordinator. Approximately six to seven individuals worked on the data research team for the project and much of that time was not ultimately covered by the grant funding due to their decision to prioritize compensating community organizations for their contributions to the project. California's Department of Public Health is also a recipient of CDC NEPHT funding and built an early tracking tool for California. While CalEnviroScreen ultimately did not build off this existing foundation, the EJ mapping tool was able to use much of the data made available through that tool for their indicators. One challenge California's team encountered when applying for grants was resisting the need to

over-define the outcomes of the project for funders and instead leaving space for outcomes to be shaped by community engagement that would occur during the process.

Development of a tool by a research team in Vermont has been supported by a small amount of funding from a foundation and the University of Vermont. The research team continues to write proposals to fund graduate student research time. Their tool development project is broken out into three “core” teams: a community core responsible for community engagement, a policy core leading the drafting of policy and connecting the work to legislators, and the research core, led by the University of Vermont lab, working on the data and indicator development.

Within Connecticut, DataHaven bases the cost of their work to develop data visualizations and mapping interfaces on an hourly rate. They have capacity in-house to handle data analysis, spatial data, and index development. The number of hours required would depend on specific parameters such as the type of data and how to display it. Community outreach, depending on the scope and other partners involved, could be coordinated by junior level staff at the organization in collaboration with staff at DEEP or community organizations. DataHaven has done several projects in the past with community organizations, and would draw on that network to complete the outreach components of the project. It may be necessary to hire a dedicated project coordinator, 0.5 - 1 FTE for 1 year, to coordinate outreach efforts or work with consultants to complete this work. DataHaven recommends leveraging a steering committee structure not only to coordinate partners and avoid duplicating work, but to leverage existing resources that groups may have to contribute to a tool and to bring together project co-funders. Another and perhaps quicker path to creating a tool would be for DEEP to oversee tool development exclusively and to focus on using existing clean datasets to create a prototype map that could be modified over time based on input from other users and community consultation. This process would take only a few months.

CIRCA representatives noted that there are several paths to development with a range of costs, depending on the scope and desired outcomes for an initial tool. One tool developer suggested that two or three people, with at least one employee managing the GIS work and another developing the web-based tool, could use existing clean data from tools already developed in-state and a template from another EJ mapping tool to efficiently develop a tool working .5-1 year FTE. This timeline would only encompass the technical design of the tool itself, and would require sufficient funding to build and maintain the tool with the resources to complete it successfully.

Similarly, CT Data Collaborative developers were unable to provide a cost estimate at this early phase of the tool’s development, but identified two staff members to support the design of the tool. Additionally, CTData identified three primary areas of expertise for a statewide EJ mapping tool: a technologist with coding skills and familiarity with open source software, a data analyst for cleaning and preparing the data, and staff familiar with engaging community members and translating community needs into a workable technology resource. All three areas of expertise are available within CTData, if the organization is provided with the necessary support to apply itself fully to the mapping tool.

5.j. Uses and Accompanying Legislation

The ability to visually identify vulnerable communities and to quantify cumulative impacts through indices makes mapping tools well-suited to a number of uses by state agencies, legislators, permit applicants and community organizations. CalEnviroScreen has been used by state agencies and lawmakers to identify vulnerable communities in the state, to allocate funding and resources to communities with the highest vulnerability and pollution burden, to integrate environmental justice considerations into city and regional planning, to review permitting decisions for polluting facilities, to support intervention and enforcement of pollution under various statutes, and to prioritize site clean-up (EJ Screening Tool Convening, 2019). California EPA’s ability to identify disadvantaged communities using the tool is pursuant to Senate Bill

535 in the state, which requires their identification be based on geographic, socioeconomic, public health and environmental hazard criteria. Required investment plans developed and submitted to the Legislature must also allocate at least 25 percent of available proceeds from the carbon auctions held under California's cap and trade program—the Global Warming Solutions Act of 2006—to projects benefiting disadvantaged communities (Assembly Bill 1532) (Rodriguez & Zeise, 2017). EJ groups in the state have also used the tool to advocate for stronger EJ policy and to identify the impacts of polluting facilities. Finally, the tool has also been consulted for local and regional planning initiatives seeking to prioritize the concerns of underserved and at-risk populations. Examples include the City of Los Angeles' Mobility Plan and the City of San Diego's Climate Action Plan (EJ Screening Tool Convening, 2019).

Washington has used its Health Disparities Map in similar ways. Tool developers produced a memo to accompany the release of the tool outlining its potential policy applications. Since its release, the tool has been integrated into decision-making around the allocation of grants for toxic waste clean-up and the distribution of funds from the Volkswagen diesel class action settlement. The map was also included in a proposed bill to create an EJ definition for the state. This bill called for state agencies to use cumulative impacts analysis in decision-making, but as of April, 2020 had not yet passed (EJ Screening Tool Convening, 2019). However, today the map is being integrated into the Governor's EJ Task Force, a year-long process that includes community outreach to identify opportunities to enhance EJ through agency regulation and new innovative programs (Washington ESHB 1109, 2019). This group is also interested in understanding how the tool could complement climate impacts forecasting and resiliency planning in the state.

Within Connecticut, tools and reports produced by DataHaven and CTData have been used by academics and scientists for research, city planners for local decision making, nonprofits for grant writing, and community groups for advocacy to state legislators. Overall, EJ advocates felt strongly that a mapping tool in Connecticut be used to strengthen the existing EJ statute and program, and to integrate cumulative impacts analysis and community voices into additional legislation, climate change planning, policy implementation, and decision-making. Resource allocation to distressed communities was noted by several advocates as particularly important. One informant stated this need particularly clearly: "My concern is not just being able to have the tool, but what can the tool actually help us resolve or improve, because I've seen these great studies, this wonderful information, but they sit on the shelf and collect dust because the government was not allocating money and resources to take the next step." Advocates were clear that the existence of the tool and data visualization alone would not make a significant impact without integration into legislation, decision-making processes, and mechanisms for resource allocation. Using the tool to incorporate cumulative impacts analysis into permitting decisions around polluting facilities in vulnerable communities was another use highlighted by several EJ advocates. Finally, several advocates noted that consistent and ongoing integration of the tool into state policy would require a strong advocate within government who could speak to opportunities to use the tool's data and functionalities for decision-making across agencies.

It is important to note that this research and scoping process is occurring simultaneously with the new GC3 process initiated by executive order from Governor Ned Lamont (Executive Order No. 3, 2019). The Council includes an Equity and Environmental Justice Working Group involving EJ advocates alongside staff from DEEP's Environmental Justice program. The Working Group has had preliminary discussions about opportunities and uses for an EJ mapping tool within Connecticut and there may be opportunities to merge policy recommendations emerging from the Working Group and from this scoping process. For instance, a potential use for the tool that has been raised is guiding prioritization for distribution of the state's Energy Efficiency Funds. The Equity and Environmental Justice Working Group's Mapping Tool Subcommittee may be able to serve as a steering committee (see above, section 5h) through the tool's completion.

EJ advocates were also quick to identify many ways in which a mapping tool could support their work in Connecticut. These advocates would use the tool for planning advocacy operations and campaigns, educating residents in the communities where they work about environmental and health risks, as well as resources already available within the state to mitigate those risks, to identify specific polluting facilities and their spillover impacts, and to increase inclusion of residents from vulnerable communities in decision-making. For these uses, making the tool publicly available, accessible, and usable through specific functionalities is critical. Finally, for Tribal Communities in the state, it is particularly important that developers of the tool complement and build on the existing obligations of the state to Indian residents under Chapter 824 of the Connecticut General Statute, which outlines both the state's obligations to tribal members as full residents of the state and as members of a sovereign tribe. A more complete list of possible tool uses can be found in Appendix I.

6. Recommendations for Connecticut & Steps for Tool Development

Based on the findings discussed above, we present the following recommendations to CT DEEP as the agency considers the development of an EJ Screening Tool.

1. In order to support its ongoing work to advance environmental justice and address the unequal distribution of environmental and public health burdens throughout the state, Connecticut should invest in building an environmental justice mapping tool. Tool developers should keep the following purposes in mind to maximize utility for state agencies and community organizations upon the tool's completion.

- A. *Identification of Distressed Communities* (pursuant to CT statute CGS § 22a-20a). For the purposes of the statute, EJ communities are currently primarily identified at the level of municipalities and with consideration of fiscal and economic indicators of vulnerability. This tool could identify EJ communities on an even more granular scale and highlight those communities that are most affected by the cumulative impacts of environmental exposures and conditions in a way that is visible and quantified.
- B. *Guidance for decision making.* The tool could be integrated into decision-making around additional policies, disbursements, permits and resources that impact these communities. For example, the tool could guide the issuance of permits for infrastructure in these communities that is in the best interest of both local economies and the health and wellbeing of residents who live near and are impacted by those sites. A mapping tool, when coupled with other legal instruments, could play an important role in directing resources to communities that need them the most.
- C. *Support community outreach, advocacy, activism, and education.* The tool would be an important resource for community advocates and the wider public for raising awareness around issues communities are facing and building solidarity across communities facing similar burdens.

Refer to Appendix I: List of Potential Uses for EJ Screening Tools for more detailed suggestions on tool applications.

2. As a key step for tool development, CT DEEP should continue outreach in EJ communities, in particular in the form of focus groups and key informant interviews. DEEP can undertake this outreach through its own outreach efforts or by partnering with organizations that have existing networks within communities.

- A. *Focus Groups.* Qualitative data collected from key informant interviews, though rich, is not a substitute for input directly from community members. Focus group input and feedback is necessary for the selection of indicators that are relevant and important to communities and that reflect their lived experiences. This step would improve the tool's potential use by the public, advocates, and key decision-makers.
 - We suggest hosting these focus groups in municipalities already identified as EJ communities under section 22a-20a of the General Statutes and the Environmental Justice

Policy of CT. Selected municipalities should represent coastal, inland, urban, and rural locations from across the state. Given population size and racial diversity, we would recommend conducting at least two focus groups each in Bridgeport, Hartford, and New Haven—the three largest cities in the state, with the largest percentage of low-income populations and communities of color—at least one focus group in each of two smaller, rural municipalities, and at least two focus groups that include members of tribal communities for a total of at least ten focus groups.

- Resources for conducting focus groups are available in Appendix II. These include a focus group guide, a consent form in English and Spanish, and a list of potential questions.
 - If the Governor’s Council on Climate Change (GC3) were to adopt the development of the mapping tool under the auspices of the Mapping Tool Subcommittee of the Equity and Environmental Justice Working Group, these focus groups could happen through the public comment period throughout the fall of 2020 and/or during public comment periods in 2021.
- B. *Key Informant Interviews.* Interviews should be conducted with individuals and organizations that have expressed interest in future involvement with the project. These contacts will be helpful with respect to the identification of indicators and other key aspects of tool design. An interview guide and questions for these interviews can be found in Appendix III.
- C. *Post-completion feedback.* After the initial tool is developed, outreach should be built into the ongoing maintenance and improvement of the tool. Individuals and organizations that were involved in earlier phases of outreach should have the opportunity to be trained in, review and test the tool and provide feedback on opportunities for further development. This could include integration of additional indicators, functionality, and applications in future iterations. Records and contact information for individuals involved in outreach as participants or community partners should be documented as much as possible so that DEEP can maintain contact with community members who have engaged in the process to facilitate this process of training and further input on the tool.

3. DEEP should leverage existing partnerships and infrastructure to develop the tool, particularly where systems for data collection or analysis and online platforms already exist, and where trusted relationships with the community have been established.

- A. *Relevant organizations.* Initial outreach to explore partnership should include the following organizations, which have conducted extensive mapping and indicator work on their own and have expressed willingness to be involved in the project.
- DataHaven
 - CT Data Collaborative
 - CIRCA and other UCONN centers that have partnerships with DEEP
 - CT Department of Public Health, including the Health Equity office and CT Environmental Public Health Tracking Program

DEEP should continue to partner with community organizations, several of which it already works with via the GC3 and other initiatives. These may include, but are not limited to: the CT Coalition for Environmental Justice, CT League of Conservation Voters, Energy Efficiency for All, the Western CT Central Labor Coalition, the Community Foundation for a Greater New Haven, the New Haven Adult Education Center, and other groups.

- B. *Steering Committee or Advisory Board.* DEEP should consider assembling a committee of representatives of these organizations, along with community partners, to provide input and serve as a sounding board, so that the tool can benefit from the shared expertise of data-management and mapping experts within the state. This advisory board could also demonstrate the state’s interests in promoting collaboration and reduce the duplication of tools with similar objectives.

4. In order to provide useful, accessible information to state decision-makers and the public, an initial version of the tool should include several basic functionalities, tailored to its various uses and users.

At a minimum, it should include the following functionalities and features:

- A. *Ability to view information along legislative districts, county lines, and municipal*
- B. *Ability to view information within geographic areas defined by distances from a given location*
- C. *Ability to select, view, and download individual layers, and access index scores.*
- D. *Ability to print maps and generate reports & graphs.*
- E. *Zoom & search functionality.*
- F. *Glossary of terms and factsheet (with language translation)*
- G. *Clear explanatory videos or instructions (with language translation).* Video tutorials may be necessary to educate users on how to make effective use of the tool (see “Technical Design” for more information). Workshops or webinars, conducted in multiple languages, can further ensure that residents and community organizers can harness the full capacity of the tool. While videos are ideal, comprehensive written instructions for tool use and in-person training sessions should be part of the rollout of the initial version.
- H. *Mechanism for users to raise questions, concerns, and suggestions.*
- I. *Mobile compatibility.* Mobile access may not be realistic for initial development, but it is vital for community use. Whether via upfront or later effort, developers should focus on mobile accessibility.
- J. *Enhanced storytelling capabilities.* Though it may not be possible for the initial version, subsequent versions should explore incorporating community stories, voices, and information directly into the tool, via, for instance, narratives and testimonies or multi-media features that convey qualitative lived experiences of residents affected by cumulative impacts in a relatable and comprehensible way. These capabilities should be guided by cultural competency and respect for participants’ (dis)comfort in sharing their stories. DEEP should also explore the possibility of integrating information from community-based monitoring.

5. DEEP should include indicators encompassing environmental exposures and effects, sensitive populations, and sociodemographic information in order to cover multiple stressors and impacts. In keeping with the discussion of indicator selection above, an initial version of the tool should at minimum include indicators from each of the following four categories. Example indicators listed below were explicitly mentioned by EJ advocates during our preliminary outreach. **DEEP should ground truth the importance of these indicators in community outreach and consider prioritizing them in the tool’s first version.**

- A. *Environmental Exposures.* These include air pollution, climate change exposure, groundwater or drinking water contamination, noise and light pollution, and urban heat island effects.
- B. *Environmental Effects.* These include impaired water bodies and proximity to power generation plants and waste incinerators.
- C. *Sensitive Population Indicators.* These include chronic disease prevalence, infant mortality rate, Lyme disease prevalence, maternal health, and opioid use.
- D. *Sociodemographic Information.* These include civic engagement (e.g., voter turnout, volunteer rates), housing burden, housing stock quality, home ownership rates, linguistic isolation, race, and unemployment rates.

A full list of possible indicators is included in Appendix V.

6. Ground rules should be established to systematically guide and prioritize inclusion of indicators and corresponding data in the tool. We recommend the following set of basic ground rules for indicator inclusion. Note that some rules, such as quality of data, require further decisions on specific criteria for inclusion. For such rules, we have provided examples of potential methods, but those responsible for data gathering will need to make a determination on what is most appropriate.

- A. *Ground truthing*. All indicators should be informed by important topics raised by communities during outreach.
- B. *Inclusion*. Data should be inclusive of a broad range of state populations.
- C. *Quality*. Data should be of sufficient quality—that is, data should be Complete and Accurate (see Rodriguez and Zeise 2017).
- D. *Resolution*. Data for the indicator should be available for the entire state at least at the census tract level geographical unit or translatable to the census tract level.
- E. *Coverage*. We recommend that data initially be available statewide. Future iterations could consider including data that is not available statewide, as long as it clearly indicates where data has or has not been collected and is excluded from the index.
- F. *Accessibility*. Using publicly available data is recommended to maintain transparency and accessibility; however, in the case of critical indicators that are highlighted during outreach, data that can be acquired but is not publicly available should be considered for inclusion in the tool.
- G. *Updated*. The tool must reflect the most recent data available for each indicator, and efforts must be made throughout the tool’s development to maintain the most up-to-date data possible.

7. The tool should include an index to provide a quantitative measure of relative cumulative impacts on communities and further support identification of EJ communities. Not every indicator must be included in the index and component indicators should be weighted appropriately. The index should be validated for robustness and covariation of component indicators. Methodology used to calculate the index must be published, accessible, and clearly justified. The index should be continually refined as further iterations of the tool are released, as part of an ongoing process.

8. The tool’s budget should provide funding for four primary types of expertise: community engagement and outreach, data analysis and indicator selection, geospatial mapping, and policy formation. Although the tool will require investment from DEEP, certain efficiencies may help manage costs and improve the feasibility of the project. Initial technical development can be accomplished with minimal resources, but the longer-term effort must consider the costs of outreach, the roll-out process, training, and ongoing maintenance.

- A. *Geospatial expertise*. At least one GIS expert will be required to work full-time on this project, though multiple employees with GIS experience working collaboratively could also meet the need for the mapping component of the tool.
- B. *Community engagement and outreach*. As described earlier, community engagement is critical before, during, and after tool development. Partnerships must support this process, but resources should be allocated to ensure that community partners and participants are compensated adequately for their roles and that outreach is made logistically accessible to residents through provision of food, childcare, and language translation.
- C. *Data analysis and indicator selection*. Universities can play an important role in the development of these tools, particularly with data analysis and indicator/index development, as they can provide necessary research while giving students hands-on experience. University faculty and students served as the primary developers for several other state tools. DEEP must ultimately take the lead on the tool’s development, but it may be efficient to delegate the component parts of the development process according to expertise and resources available, as other states have.
- D. *Policy formation*. While tool development should benefit from existing resources, staff, and initiatives to link the tool to decision making processes, these efforts, such as CT DEEP’s Environmental Justice program, must be resourced adequately to be able to advance work on the tool alongside other necessary programming.

9. In order to maximize its impact, a mapping tool for Connecticut must be incorporated into decision-making processes, and be accompanied by appropriate legislation, regulation, policy and enforcement capacity, and mechanisms for resource allocation. As EJ advocates have emphasized, the

tool is valuable insofar as it supports the integration of cumulative impacts analysis and community voices into new and existing policy and decision-making, in partnership with and in the service of EJ communities.

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APPENDIX I: List of Potential Uses for EJ Mapping Tools

Uses listed below compiled through key informant interviews with Connecticut-based experts and organizers, as well as developers of EJ mapping tools from elsewhere in the country,

- Identify vulnerable populations and disadvantaged communities
 - Create visual representation of how pollution and other environmental risks, including climate-related risks, are distributed geographically and affect resident wellbeing
 - Identify areas where people experience relatively high health impacts
 - Evaluate areas experiencing cumulative impacts of multiple sources of pollution and other indicators of vulnerability
 - Enable comparisons between communities and within the state as a whole
 - Provide framework for agencies to designate disadvantaged communities and use to prioritize environmental and public health resources and action
 - Integrate considerations of equity into climate action planning
- Land-use planning and permitting
 - Consider cumulative impacts in processes for approving new or expanded infrastructure for environmentally polluting sources
 - Use in evaluation of compliance with environmental and civil rights laws
 - Direct inspection and enforcement efforts toward areas most impacted
 - Integrate considerations of equity into town and municipal master planning
- Prioritize site-cleanup and environmental enforcement
 - Direct resources toward the most vulnerable communities
- Grants and Funding
 - Direct grants toward the most vulnerable communities
 - Direct investment and resources to census tracts with high cumulative impacts
- Strengthen community activism and education
 - Hold agencies and local and state government accountable to EJ commitments
 - Direct community members toward resources (hospitals, health services, community organizations, legislators)
 - Enable community groups, regional environmental agencies and local government to identify vulnerable communities and direct efforts, resources, and programs toward those communities
 - Identify key communities for outreach and information dissemination to cultivate civic engagement and participation in decision making. This could include funding for child care, transportation, language barriers to increase participation in public activities.
 - Increase engagement in public health programming in vulnerable census tracts
 - Identify point source pollution
 - Provide communities with accessible information on indicators of health and cumulative impacts
- Support sustainable economic development
 - Utilize as a reference for hiring criteria for jobs and skills for workers in communities with high cumulative impacts
- Policy and program development
 - Provide relevant information on vulnerabilities in communities in multiple areas of policy and program development, including, e.g., climate change, clean energy, urban forestry, public transportation, weatherization, and smart growth projects
- Identify opportunities for future data collection that can be used for indicators

APPENDIX II: Community Outreach Materials: Process Outline, Focus Group Agenda, Focus Group Questions, & Consent Form in English and Spanish

Note: These materials were produced by the Yale student research team to receive Institutional Review Board Approval and to guide focus group outreach that was planned for Spring of 2020. Due to the COVID-19 pandemic, in-person focus groups were indefinitely put on hold and will have to be completed at a later date. These materials may need to be modified depending on who completes this outreach and what form the outreach takes in light of new social distancing guidelines and public health precautions. A developer of the Washington tool expressed satisfaction with virtual meetings via videoconference client—virtual meetings may be an imperfect but suitable substitute for in-person focus groups, if public health precautions continue to mandate strict social distancing for the foreseeable future.

Community Outreach Process:

1. Identify community partners.
 - a. In municipalities where multiple focus groups will be hosted, it is best to connect with multiple community partners so as to reach different sub-communities in each metropolitan area.
 - b. Conduct background research. Adapt focus group questions accordingly.
 - c. Before a focus group, the research team should become familiar with key local EJ and health issues by reading articles, talking to selected community partners, and discussing specific issues and concerns with staff at CT DEEP. This research will equip the research team to understand issues that may be raised by participants or dynamics that could affect the facilitation of each focus group.
2. Plan logistical aspects of outreach.
 - a. Focus groups should consist of 8-12 individuals. If holding multiple focus groups, days, times, and locations should be varied. The location for each focus group should be selected in consultation with the community partner. Ideally, the space would allow for residents to face one another. Accessibility should be strongly considered. Each focus group should be run by one moderator and two note-takers. Verbal consent must be solicited from all participants before beginning and focus groups should be recorded for reference during the analysis phase.
 - b. Food should be provided. Compensation for participants should be discussed with the community partner. Childcare and language access services, including translation and interpretation, should be provided where needed. Finally, participants should be provided with transportation or transportation vouchers/reimbursements if the focus group is held in a more remote location.
3. Create budget.
 - a. Funds should be allocated for each focus group to cover participant compensation, organizer capacity, food, childcare, materials & advertising (e.g., flyers, postings & announcements, paper & pens), travel/travel vouchers, and language interpretation. Some of these services may be provided by a volunteer or organization staff member for reduced cost. Additional expenses may be required according to community needs.
4. Recruit participants.
 - a. This process should be led or co-led by the community partner. Effort should be made to reach residents both with and without prior experience in community advocacy and EJ work.
5. Run focus group.
 - a. An example focus group agenda and questions are provided below. Focus groups should include no more than 8-12 residents and are designed to run 90-120 minutes in length. The goal of the focus group is to gather feedback on the lived experiences of residents in

their communities, particularly related to their environment and health. These insights will inform what indicators should be included as layers in the tool and in composite indices. Minimal emphasis should be placed on introducing the tool and gathering feedback on uses and functionalities. Residents should also be able to provide this feedback at a later point.

6. Conduct post-focus group follow-up.
 - a. A sign-in sheet should be available for focus group participants who want to leave their name and stay informed about the development of the mapping tool. Names from this sign-in sheet should be entered into a contact database. Additionally, all residents should be given contact information for where to direct questions following the focus group. Mechanisms for staying in touch post-focus group should be discussed with community partners.
7. Analyze results.
 - a. Following each focus group, notetakers should merge their notes to make sure all issues covered in the discussion have been captured. Key points for follow-up should be identified. Outcomes from outreach should be used to inform the selection of indicators and functionalities to be included in the tool.

Focus Group Agenda

Welcome (10 minutes)

- Eat and socialize
- Review and sign consent forms

Introduction (15 minutes)

- Name and gender pronouns (explain what that means)
- Ice breaker—What’s your favorite place in New Haven?

Overview of project & tool: (15 minutes)

- Mention that there will be notetaker and ask if everyone is comfortable with it
- Explain that conversation is confidential
- What does EJ mean?
- What is an EJ mapping tool?
- Why is community outreach & feedback important?
- What are our goals for this conversation?

Questions (1 hour, 10 minutes)

- See questions below

Future Collaboration (10 minutes)

- Do folks want to stay involved in this project? (Examples of what this could look like & sign-in sheet with names, email, neighborhood, affiliation to any organization(s))
- If so, how should we stay in touch as the project evolves?
- If you have any comments, questions, or concerns, please feel free to reach out to us. (Recap who we are and contact info.)

Focus Group Questions

In keeping with the iterative nature of qualitative research, these questions are subject to change.

1. **Tell us about your communities and where you live?**

2. **What does a healthy environment mean to you? What does an unhealthy environment mean to you?**
 - What does the word “environment” mean to you?
3. **In what ways does your environment impact you and those around you?**
 - What are your top concerns about the environment’s impact on you and your community?
 - **Possible follow up questions:**
 - In what ways does water impact you and those around you?
 - i. What about drinking water?
 - ii. What about water in the rivers nearby or the Sound? (contextualize this)
 - iii. What about the water that is available at schools, work, etc?
 - iv. Do you live near any of the rivers? Do you ever go to the rivers or the Sound to fish or go to the beach? Do you worry about whether those waters are safe? Why or why not?
 - In what ways does the quality of the air impact you and those around you?
 - How might the ground—dirt—impact you and those around you?
 - i. What do you think about the safety of children playing in dirt in your community?
 - ii. What do you think about having gardens or growing fruit or vegetables in your community?
 - Tell us about parks (outdoor spaces, green space) to you?
 - i. Do you ever go to the park? Why or why not? Can you describe parks around where you live?
 - ii. Are there places nearby to go outside and walk or for children to play?
 - iii. Have you noticed any diseases carried by bugs or animals spreading to individuals in your community? How often have you noticed occurrences of these diseases over your time in your community?
 - Tell us about what you eat. Where do you get your food?
 - i. Where is the closest grocery store in relation to your home?
 - ii. Where is the closest corner store or bodega in relation to your home?
 - iii. We talked earlier about gardens, do you have a garden or do you participate in a community garden – why or why not?
4. **Do you have concerns about changing weather or climate events impacting your community? (flooding, extreme heat, sea level rise, or hurricanes, i.e. climate change)**
5. **Have you noticed or heard about products (cleaning, hygiene, building materials) used in the home that seem questionable or dangerous? What were they?**
 - i. Mold
 - ii. Lead paint or other sources of lead
6. **What connections can you think of between transportation -- cars, buses, trains, highways, bicycles, walking -- and a healthy environment?**
 - What forms of transportation do you use?
7. **What connections can you think of between health issues in your community and the environment or the quality of the environment?**
8. **Is there pollution in your neighborhood? Where does it come from?**
 - Have you noticed any potential sources of pollution in your neighborhood, and if so, what are they?
 - i. What effects do they have on the neighborhood
 - Follow Up: do you have any of the following in your neighborhood and what is your opinion about them?
 - i. Scrap metal or recycling plants

- ii. Fenced in lots that used to have a building and that have signs suggesting they are in the process of being cleaned up (brownfields)
 - iii. Gas stations or sites where there used to be gas stations
 - iv. Highways
 - v. Places where chemicals are stored
 - vi. Waste disposal sites/landfill
 - vii. Overflow from storm drains or combined wastewater/stormwater systems
 - viii. Factories or manufacturing sites
 - ix. Power plant
 - x. Animal/livestock operation
 - xi. Other facilities or operations that you've noticed?
- Do these places impact your health or the health of your family or community?
9. **Are there any sources of noise or odor in your neighborhood that we haven't discussed?**
10. **Within your communities, who is most impacted by environment and health issues? Who is most affected by each of these issues (air, water, ground, open space)?**
- What health issues are affecting you and your community?
 - Have you or someone you know been diagnosed with a chronic disease or illness?
 - Do any of these health conditions seem to be on the rise? Why might this be?
11. **Is there anything else related to these issues (the potential impacts of the environment and pollution) that we haven't asked about that you would like to share?**
- Is there anything else you'd like to share?

[ENGLISH] Consent Form: Environmental Justice Mapping Tool Focus Group

You have been invited to participate in a focus group conducted by students at Yale University under the direction of professors at the Yale Schools of Public Health and Forestry & Environmental Studies (contact information below). The purpose of this focus group is to get feedback from community members on environmental and health risks in their communities. The information learned in this focus group will be used by the Connecticut Department of Energy & Environmental Protection to inform its work on environmental risks across Connecticut. Our hope is that this information could eventually be used to create a map of risks that could also be used by residents, community organizations, and other stakeholders involved in making decisions that affect the future of community health and well-being.

As part of this study, you are invited to participate in a discussion and will be asked several questions. Students will be taking notes and recording audio during the conversation. Although we will ask everyone in the focus group to not share what they hear, the researchers cannot promise that the information you share during the focus group will remain confidential because of the nature of the group. We will not include any identifying information in the final report.

Only the researchers involved in this study will have access to this written information. When you sign in, you will also be invited to indicate if you would like to continue to receive information about this project and remain updates on its status. If you indicate that you would like to remain updated, the researchers will put your contact information on a list for further communication. The primary benefits associated with this study include the benefits that communities may receive if a mapping tool is developed and used to reduce environmental risks in communities. [Insert appropriate language here about compensation.]

Risks associated with this research are the same as the risk assumed in any normal conversation about personal topics. You can choose whether or not to participate in this focus group, and you may stop at any time during the course of the session or refuse to answer any question. Should you choose to participate, you will be asked to respect the privacy of other focus group members by not sharing what is discussed during the conversation.

If you have any questions or concerns regarding this study, please contact:

Professor Marianne Engelman-Lado, Yale School of Public Health at marianne.engelman-lado@yale.edu.

AND/OR

Yale University Institutional Review Board at cheryl.danton@yale.edu at 367 Cedar St, ESH A, New Haven, CT, 06520, United States.

[ESPAÑOL] Mapeo de la Justicia Ambiental: Formulario de Permiso Consentimiento del Grupo de Discusión

Usted ha sido invitado a participar en un grupo de discusión dirigido por estudiantes de la Universidad de Yale bajo la dirección de profesores de *Yale School of Public Health* y *Yale School of Forestry and Environmental Studies* (información de contacto al final del formulario). El objetivo de este grupo de discusión es obtener retroalimentación de los miembros de nuestra comunidad sobre los riesgos ambientales y de salud en sus propias comunidades. El Departamento de Energía y Protección del Medio Ambiente de Connecticut utilizará la información recaudada en este grupo de discusión para informar su trabajo sobre los riesgos ambientales de todo Connecticut. Nuestra meta es que esta información eventualmente se pueda usar para crear un mapa de riesgos que también puedan usar los residentes, las organizaciones comunitarias y otras partes interesadas involucradas en las decisiones generales que afectan el futuro de la salud y el bienestar de la comunidad.

Como parte de este estudio, usted participará en una discusión y se le harán varias preguntas. Los estudiantes tomarán notas y grabarán audio durante la conversación. Aunque les pediremos a todos en el grupo de discusión que no compartan lo que escuchan, los investigadores no pueden asegurar que la información que ustedes compartan durante el grupo de discusión se mantenga de forma confidencial debido a la naturaleza del grupo. No incluiremos ninguna información personal en el informe final.

Cuando se registre en el grupo de discusión, los investigadores le preguntarán su nombre, dirección, vecindario y edad. Solo los investigadores involucrados en este estudio tendrán acceso a esta información escrita. También se le invitará a indicar si desea continuar recibiendo información sobre este proyecto y mantenerse al día sobre su progreso. Las principales ventajas asociadas con este estudio incluyen los beneficios que las comunidades pueden recibir si se desarrolla un mapeo de información y se utiliza para reducir los riesgos ambientales en las comunidades.

Los riesgos asociados con esta investigación son los mismos que los riesgos asumidos en cualquier conversación normal sobre temas personales.

Usted puede elegir participar en este grupo de discusión, y puede parar en cualquier momento durante el curso de la sesión o negar a responder cualquier pregunta. Si elige participar, se le pedirá que respete la privacidad de otros miembros del grupo de discusión al no compartir lo que se discute durante la conversación.

Si tiene alguna pregunta o inquietud con respecto al estudio, comuníquese con:

Profesora Marianne Engelman-Lado, *Yale School of Public Health* a su correo electrónico: marianne.engelman-lado@yale.edu.

Y / O

Yale University Institutional Review Board al correo electrónico: cheryl.danton@yale.edu o a la oficina: 367 Cedar St, ESH A, New Haven, CT, 06520, Estados Unidos.

APPENDIX III: EJ Advocate Key Informant Interview Guide and Questions

EJ advocate interview goal: Hear from community organizers, organization leaders, activists, and advocates who are working on environmental justice, environmental health, and cumulative impacts in specific communities in Connecticut. Information from these interviews may help inform what data is included in the tool in order to best capture and visually show what is being experienced on the ground, and would also inform potential uses of the tool, functionalities, what role out and training would look like etc. (See questions below)

Criteria for EJ advocate key informants:

- Leads/runs a community organization that works directly on environmental justice/environmental health issues or social justice issues in one of our target communities or statewide or did in the past.
- If they do not lead or run a community organization, they hold some other leadership position in the community that positions them to advocate/make policy changes/interventions on EJ/EH issues or in which they are hearing from residents about issues they are experiencing.
- This person may or may not actually reside in the community they work in
- These individuals may work in multiple communities in CT, separate from where they live and where their organization is based. They may be able to speak to cross-city/regional issues & efforts, and how the tool could be used in support of that collaborative work.

Key Informant Interview Structure:

- Preference for Zoom, but over phone as backup
- One interviewer, one notetaker
- Ideal time 1-1.5 hours, depending on availability
 - Need to be mindful of time management, e.g. be sure to at least cover the tools questions within timeframe
- Ask permission to also record (via Zoom or phone)
- Consent process
 - Will ask for consent. Their responses may be used in a report to DEEP, identifying information will not be used without consent
 - Need to modify consent form to request consent to use any quotes, with understanding that will come back and get permission to use specific quotes
- Send guiding language on overarching questions beforehand, e.g.
 - **EJ Advocate:** The interview will cover your experiences and perceptions around the types of environment-related issues faced by your communities (in which you live or work) and how an EJ mapping tool might fit in with the work you do, including:
 - Assets, resources, strengths within the community
 - Top issues, concerns, and challenges within the community related to the environment, for instance, in the areas of water, air, pollution, green space, climate change, housing, proximity to hazard/toxic sites, etc.
 - Tools and resources you use in your advocacy work and challenges in addressing the issues discussed
 - Your thoughts on a potential EJ mapping tool for CT, including how it would be useful to your work, challenges or concerns you might anticipate, and important issues to consider in its development and roll out
- Semi-Structured - flexibility to move around, ask additional question as needed
- Follow up emails - we may ask post-interview questions for clarification, they may reach out if anything else they want us to know, let them know how to remain involved with the project.

EJ Advocate Key Informant Interview Guide

I. Ice breaker (as relevant)

- *Acknowledge what is going on -- how are you? How are you coping with COVID-19? Human level acknowledgment that there is A LOT going on!*
- *Confirm understanding of what they do & their responsibilities.*
- How did you become involved in Environmental Justice/community organizing?
- Do you currently live or work in a community in CT that is affected by environmental justice issues? Do you experience these issues first hand in your daily life? Which communities? How long have you lived/worked in your community?
- Besides residing/working here, what else do you do here? What kinds of things are you involved in, locally?

II. Positive aspects of the community:

If the interviewee lives in the community where they work, start here (may leave out if time is limited) :

- What about your community do you enjoy?
- What about things in your community that others seem to like?
- What's your favorite place to spend time in this community?

If the interviewee does not live in the community, start here:

- What is your perception of where people like to spend time?
- What is your perception of what people in the community enjoy?
- What is going well in terms of environmental justice in your community, the community you work with or CT broadly?
 - Have there been any recent wins?
 - Where there have been successes, what brought them about?
- What assets, services, resources in the community do people appreciate having access to?

III. Challenges in the community:

- What are the top issues/challenges in your community or the community where you work or that come up in your role/work?
- Prior to COVID 19, what health issues were affecting you and your community?
- Prior to COVID-19, What are your perceptions of health issues affecting the communities you work with?
 - What health issues are affecting you and your community apart from COVID-19?
 - What health conditions make your community more vulnerable to pandemics like COVID-19?
 - Were there/Are there health issues affecting you related to pollution? Exposures in your home and environment? Access to green space?
 - Have you or someone you know been diagnosed with a chronic disease or illness?
 - Do any of these health impacts seem to be on the rise? Why might this be?

Specific issue areas:

- In what ways does the environment impact your **health**, the health of those around you, the health of the communities you work in/with?

- In what way are you/residents concerned with **household hazards**? Cleaning products, hygiene products, building materials? Mold? Lead paint or other sources of lead?
- In what ways does **water** impact you and those around you/whom you work with?
 - What about drinking water?
 - What about water in the rivers nearby or the Sound?
 - Do people in the community fish? Do they eat fish that they catch?
 - What about the water that is available at schools, work, etc?
 - Recreational access to and use of water
- In what ways does the **air** impact you and those around you/whom you work with?
- How does **soil quality** impact you and those around you/whom you work with?
 - Do people in the community garden?
 - How else do people in the community interact with soil?
- Tell us about **parks** (outdoor spaces, green space) to you/whom you work with?
 - Do you ever go to the park? Why or why not? Can you describe parks around where you live?
 - Are there places nearby to go outside and walk or for children to play? Do children play in community playgrounds or parks?
- How about **vector-borne diseases**? (diseases carried by insects or animals, e.g. West Nile virus) How often have you noticed occurrences of these diseases over your time in your community?
- How about **food** issues in your community or your perception of food access where you work?
 - How about grocery store access? Corner stores or bodegas?
 - Do you/residents garden or participate in a community garden?
- Tell us about what types of **transportation** are used.
- How do you or the people you work with think about or experience any effects of **climate change**?
 - E.g. flooding, extreme heat, sea level rise, or hurricanes
- Is there **pollution** in your neighborhood/the neighborhoods where you work? Where does it come from?
 - Do you have any of the following in your neighborhood?
 - Scrap metal or recycling plants
 - Fenced in lots that used to have a building and that have signs suggesting they are in the process of being cleaned up (brownfields)
 - Gas stations or sites where there used to be gas stations
 - Highways
 - Places where chemicals are stored
 - Waste disposal sites/landfill
 - Overflow from storm drains or combined wastewater/stormwater systems
 - Factories or manufacturing sites
 - Power plant
 - Animal/livestock operation
 - Other potential sources of pollution?
 - Do these places impact your health or the health of your family or community?

Cross-cutting issue questions:

- Within your community/the community you work with, who is most impacted by environmental and health issues? Who is most affected by each/any of the specific issues discussed (air, water, ground, open space)?
- Is there anything else about your environment that bothers you or gets in the way of your quality of life/seems to affect the people you work with?
- What are challenges you face or see in addressing these issues?
- How has COVID-19 highlighted or exacerbated any of these issues?
- Do you know of other communities or areas in CT that face the same or similar challenges?

IV. Advocacy tools:

- Tell me about any information, data, or tools that you have used to advocate for your community, particularly advocacy around issues of pollution and health
 - What are they?
 - How have you used them?
- What resources are you aware of that could help you or others with these issues?
- How does your work intersect with the EJ Program at DEEP, CT's Environmental Justice statute, and/or the Governor's Council on Climate Change's (GC3) Equity Working group?
 - How have you interacted with DEEP or the EJ program at DEEP?
 - What are your thoughts on the EJ statute?
 - *If the person is familiar with the GC3 and the Equity WG:*
What would you like to see come out of the Equity WG?
 - *If not familiar with GC3 workgroup but interested, may provide information for how to get involved*

EJScreen and/or a mapping tool

- Have you used a tool like EPA's EJScreen to find out about environmental issues in your community?
 - a. If yes: How recently? How frequently?
If not recently or frequently go to b, if not familiar with at all go to c
 - Tell me about a (recent) time when you used it. What impacts did it help you identify?
 - Earlier in the interview you mentioned some of the challenges you experience in your community. How well do you think the tool is able to capture those challenges?
 - If you worked for the EPA and had the power to change this tool, what would you change/add/subtract?
 - What other resources, besides changes in the tool itself, could make it easier or more effective to use (e.g. training or promotional materials)?
 - b. *If no, not recently, or not frequently:*
 - Are there any reasons that have prevented you from using this tool?
 - Do you know of others who use the tool? Why or why not might they use it?
 - c. *If not familiar with EJScreen at all:*
 - How could a map that indicated where different environmental and health issues are occurring or highlighted communities facing multiple environmental and health impacts in the state be helpful in your work?
 - Does the community in which you work face multiple sources of pollution? How useful would it be to be able to see these locations on a map or have information about them in one place?
- Could you see any challenges with developing and using this type of tool in CT?
- Do you have any concerns around these types of tools?
- What are important things to think about in designing and rolling out this type of tool?
- Is there a way for community members to report an issue related to environmental justice?
 - To whom would they report?
 - What are your thoughts on this process?

V. Concluding questions

- Are there any issues that you think are important for our study that I have not asked you about?

- Do you know of other EJ advocates that you think could contribute to our study?
 - If yes, would you be willing to provide their names and contact information?
- Do you have any guidance for us and/or DEEP on the best way to conduct a focus group in the communities where you live or work to gather feedback from residents on what they are experiencing?
 - During the COVID-19 crisis?
- Is there anything else that we didn't cover that you want to share?

APPENDIX IV: Table of Indicators for Consideration in Connecticut Tool

	INDICATOR CATEGORY	SPECIFIC INDICATOR EXAMPLE	SOURCE	YEAR	RESOLUTION	USE IN OTHER TOOLS	PRIORITIZE FOR CT TOOL*	DATA LINKS	
ENVIRONMENTAL EFFECTS	ENVIRONMENTAL EFFECTS								
	Landfills	Sum of weighted solid waste sites and facilities	Connecticut Department of Energy and Environmental Protection: Active Landfill Sites in Connecticut	2020	Address	CalEnviroScreen (as solid waste facilities); Vermont	Yes	CT DEEP Landfill Data	
	Incinerators/Resource Recovery Facilities	Sum of weighted solid waste sites and facilities	Connecticut Department of Energy and Environmental Protection: Connecticut Resource Recovery Facilities	2020	Address	CalEnviroScreen (as solid waste facilities)	Yes	CT DEEP Waste Management	
	Storm Surge Inundation	Storm surge inundation from hurricanes along the Connecticut coastline for category 1-4 hurricanes	CT ECO: Hurricane Surge Inundation	2008	1:24,000	CIRCA's Connecticut Sea Level Rise and Storm Surge Viewer (can provide info about other storms, too); CIRCA Climate Vulnerability Map	Yes	CT ECO Hurricane Data	
	Cleanup Sites/Contaminated or Potentially Contaminated Sites	Count of sites within 5 km, divided by distance, presented as population-weighted averages of blocks in each census tract; Sum of weighted scores for sites within each census tract.	Connecticut Department of Energy and Environmental Protection: Contaminated or Potentially Contaminated Sites	2020	Address	CalEnviroScreen; Washington Environmental Health Disparities Map	Yes	CT DEEP Cleanup Sites	
	Significant Environmental Hazards/ Proximity to facilities with highly toxic substances	Sum of weighted scores for sites within each census tract; Count of RMP facilities within 5 km, divided by distance, presented as population-weighted averages of blocks in each census tract	Connecticut Department of Energy and Environmental Protection: Significant Environmental Hazards; EJSCREEN	2019; 2017	Address/cordinates ; Census tract	Washington Environmental Health Disparities Map; EPA EJSCREEN; MD EJSCREEN	Yes	CT DEEP Environmental Hazards Mapper	
	Impervious Area and Urban Heat Island	Impervious surfaces	USGS: Impervious Surface - Conterminous United States 100 Meter	2016	100m grids	CIRCA's Climate Vulnerability Map	Yes	USGS National Geospatial Program	
	Brownfields	Sum of weighted scores for sites within each census tract.	Connecticut Department of Energy and Environmental Protection: Brownfields Site Inventory	2017	Address	CalEnviroScreen (as Cleanup Sites); Vermont	Yes	CT DEEP Brownfields Site Inventory	
	Hazardous Waste Facilities	Sum of weighted permitted hazardous waste facilities and hazardous waste generators within each census tract.	Connecticut Department of Energy and Environmental Protection: Commercial Hazardous Waste and Non-Hazardous (Connecticut Regulated) Waste Facilities	2019	Address	CalEnviroScreen; Washington Environmental Health Disparities Map; Vermont	Yes	CT DEEP Hazardous Waste Facilities	
	Impaired water bodies	Water classifications	Connecticut Department of Energy and Environmental Protection: Surface and Ground Water Classifications	2011, 2017	1: 24,000	CalEnviroScreen	Yes	Water Quality Classification Maps	
Recycling Processing Facilities / Materials Recovery Facilities	Sum of weighted solid waste sites and facilities	Connecticut Department of Energy and Environmental Protection: Recycling Processing Facilities/Materials Recovery Facilities (MRFs)	2018	Town	CalEnviroScreen (as solid waste facilities)		CT DEEP Recycling & Materials Processing Data		

	Municipal Transfer Station	Sum of weighted solid waste sites and facilities	Connecticut Department of Energy and Environmental Protection: Registered Municipal Transfer Stations	2016	Address	CalEnviroScreen (as solid waste facilities)		CT DEEP Municipal Waste Disposal Data
	Housing Stock/Lead Risk and Exposure	Total number of houses and proportion of houses by year of construction	American Community Survey: Housing	2016; 2014—2018 (5-year estimate)	Census block group	Washington Environmental Health Disparities Map; MD EJSCREEN		US Census Housing Data
	Proximity to Superfund site	Count of sites proposed and listed on the National Priorities List (NPL)	EPA National Priorities List	2019	Address/c coordinates	CalEnviroScreen; Washington Environmental Health Disparities Map; EPA EJSCREEN; Vermont; MD EJSCREEN		EPA Superfund Mapper
	Wastewater discharge	Toxicity-weighted concentration in stream reach segments within 500 meters of a block centroid, divided by distance in meters, presented as the population-weighted average of blocks in each block group	EPA Risk Screening Environmental Indicators (RSEI) (Calculated from RSEI modeled toxic concentrations to stream reach segments)	2019	Modelled from point source	Washington Environmental Health Disparities Map; EPA EJSCREEN		EPA Risk-Screening Environmental Indicators Model
	Underground Storage Tanks (USTs) - Active Facilities	Sum of weighted scores for sites within each census tract.	Connecticut Department of Energy and Environmental Protection: Underground Storage Tanks (USTs) - Active Facilities	2020	Address/c coordinates	None		CT Gov Underground Storage Tanks Data
	FEMA Flood Risk Areas	Designated flood risk areas	FEMA Flood Map Service Center	1980s-2020, depending on zone	Address	None		Flood Risk Database; National Flood Hazard Viewer
	Sea Level Rise	Sea-level rise projections (1 foot and 20 inches), above a Mean Higher High Water (MHHW) along the Connecticut coastline and the adjacent inland	CT ECO: Hurricane Surge Inundation	2008	1:24,000	CIRCA's Connecticut Sea Level Rise and Storm Surge Viewer; CIRCA Climate Vulnerability Map	Yes	CT ECO Hurricane Data
ENVIRONMENTAL EXPOSURES								
ENVIRONMENTAL EXPOSURES	Toxic Releases from Facilities	Toxicity-weighted concentrations of modeled chemical releases to air from facility emissions and off-site incineration (averaged over 2011 to 2013)	EPA Toxic Release Inventory (TRI) EPA Risk Screening Environmental Indicators (RSEI); Potentially Connecticut Department of Energy and Environmental Protection: Bureau of Air Management;	2018 (TRI) 2017 (RSEI)	Facility address/co ordinate (modeled to census tract)	CalEnviroScreen; Washington Environmental Health Disparities Map; Connecticut Assoc of Health Directors - Health Equity Index	Yes	EPA Chemical Release Report
	Drinking water contaminants	Drinking water contaminant index for selected contaminants (e.g., arsenic, cadmium, lead, etc.), using water system boundaries, contaminant metric calculation, and re-allocation from water system boundaries to census tracts	CT Department of Public Health: Connecticut Environmental Public Health Tracking Program - Water Quality	2016	Water System, County	CalEnviroScreen	Yes	CT Public Health Data Explorer: Water Quality
	Ozone (air pollutant)	Mean of summer months (May-October) of the daily maximum 8-hour ozone concentration (ppm), averaged over three years;	Potentially Connecticut Department of Energy and Environmental Protection: Bureau of Air Management;	2019; 2016	Monitoring sites address/co ordinate	CalEnviroScreen; Washington Environmental Health Disparities Map; EPA	Yes	CT DEEP Ozone Page

			EPA, OAR fusion of model and monitor data		(modeled to census tract)	EJSCREEN; Vermont; MD EJSCREEN		
	Particulate matter 2.5 (particle pollutants smaller than 2.5 micron)	Annual mean concentration of PM2.5 (average of quarterly means, µg/m3), over three years (2012 to 2014).	CDC's National Environmental Public Health Tracking Network; EPA, Office of Air and Radiation (OAR) fusion of model and monitor data	2014	Census Tract	CalEnviroScreen; Washington Environmental Health Disparities Map; EPA EJSCREEN; Vermont; MD EJSCREEN	Yes	CDC PM2.5 Emissions Data
	Diesel PM emissions	Spatial distribution of gridded diesel PM emissions from on-road and non-road sources for a 2012 summer day in July (kg/day);	EPA National Air Toxics Assessment	2014	Census Tract	CalEnviroScreen; Washington Environmental Health Disparities Map; EPA EJSCREEN; MD EJSCREEN	Yes	EPA 2014 Air Toxics Assessment
	Noise	Percent of population exposed to A-weighted 24-hour equivalent sound levels (LAEQ) (a-weighted, average sound level for the day) from aviation and Interstate road noise	National Transportation Atlas Database (NTAD) - National Transportation Noise Map i	2014	Modeled from point source	Vermont	Yes	National Transportation Noise Map
	NATA Cancer Risk	Lifetime cancer risk from inhalation of air toxics	EPA National Air Toxics Assessment	2014	Census Tract	EPA EJSCREEN; MD EJSCREEN		EPA 2014 Air Toxics Assessment
	NATA Respiratory hazard index	Air toxics respiratory hazard index (ratio of exposure concentration to health-based reference concentration)	EPA National Air Toxics Assessment	2014	Census Tract	EPA EJSCREEN; MD EJSCREEN		EPA 2014 Air Toxics Assessment
	Traffic density	Traffic density – Sum of traffic volumes adjusted by road segment length (vehicle-kilometers per hour) divided by total road length (kilometers) within 150 meters of the census tract boundary; Count of vehicles (AADT, avg. annual daily traffic) at major roads within 500 meters, divided by distance in meters (not km)	Potentially CTDOT; U.S. Department of Transportation (DOT) traffic data	2017	Census Tract	CalEnviroScreen; Washington Environmental Health Disparities Map; EPA EJSCREEN		CT DOT Traffic Monitoring Count Data
	Pesticide use	Total pounds of selected active pesticide ingredients (filtered for hazard and volatility) used in production-agriculture per square mile, averaged over three years (2012 to 2014).	Potentially Connecticut Department of Energy and Environmental Protection: Pesticide Management Program	Unknown	Unknown	CalEnviroScreen		CT DEEP Pesticides Management Program
SOCIOECONOMIC FACTORS								
SOCIOECONOMIC FACTORS	Housing Burden	Percent of households in a census tract that are both low income (making less than 80% of the HUD Area Median Family Income) and severely burdened by housing costs (paying greater than 50% of their income to housing costs); Modeled percent of income spent on housing for a four-person household making the median household income	American Community Survey - Median Household Income, Rent as Percent of Income National low-income housing coalition; Housing and Urban Development (HUD); Comprehensive Housing Affordability Strategy	2014—2018 (5-year estimate)	Census block group	CalEnviroScreen; Washington Environmental Health Disparities Map; Connecticut Assoc of Health Directors - Health Equity Index; MD EJSCREEN	Yes	US Census Housing Characteristics Data

Linguistic isolation	Percent of limited English-speaking households	American Community Survey: Language Spoken at Home	2014—2018 (5-year estimate)	Census block group	CalEnviroScreen; Washington Environmental Health Disparities Map; Vermont; ; MD EJSCREEN	Yes	US Census Social Characteristics Data
Poverty/Low income	Percent of the population living below two times the federal poverty level ; Percent of the population living below 185 percent of the federal poverty level	American Community Survey: Poverty	2014—2018 (5-year estimate)	Census block group	CalEnviroScreen; Washington Environmental Health Disparities Map; EPA EJSCREEN; Connecticut Assoc of Health Directors - Health Equity Index; Vermont; MD EJSCREEN	Yes	US Census Poverty Status Data
Unemployment	Percent of the population over the age of 16 that is unemployed and eligible for the labor force. Excludes retirees, students, homemakers, institutionalized persons except prisoners, those not looking for work, and military personnel on active duty	American Community Survey: Unemployment	2014—2018 (5-year estimate)	Census block group	CalEnviroScreen; Washington Environmental Health Disparities Map; Connecticut Assoc of Health Directors - Health Equity Index; Vermont; MD EJSCREEN	Yes	US Census Economic Characteristics Data
Race/People of Color	Sum of all race/ethnicity categories except White/Non-Hispanics, including Black, American Indian/Alaskan Native, Asian, Native Hawaiian other Pacific Islander, and two or more races	Connecticut Department of Public Health - Health Statistics and Surveillance ASRH; American Community Survey	2011-2014; 2014—2018 (5-year estimate)	Town; Census block group	Washington Environmental Health Disparities Map; EPA EJSCREEN; Connecticut Assoc of Health Directors - Health Equity Index; Vermont; ; MD EJSCREEN	Yes	CT DPH Town Population with Demographics Data
Educational attainment	Percent of the population over age 25 with less than a high school education	American Community Survey: Educational Attainment	2014—2018 (5-year estimate)	Census block group	CalEnviroScreen; Washington Environmental Health Disparities Map; EPA EJSCREEN; Connecticut Assoc of Health Directors - Health Equity Index; Vermont; MD EJSCREEN		US Census Educational Data
Transportation expense	Transportation costs based on percentage of income for the regional moderate household	Unknown	Unknown	Unknown	Washington Environmental Health Disparities Map		
Income	Median Household income for block group; Per capita income	American Community Survey: Income	2014—2018 (5-year estimate)	Census block group	CIRCA's Climate Vulnerability Map; Connecticut Assoc of Health Directors - Health Equity Index; Vermont		US Census Poverty Status Data
Young Population	Percent of people in a block group under the age of 5.	American Community Survey: Age	2014—2018 (5-year estimate)	Census block group	CIRCA's Climate Vulnerability Map; Connecticut Assoc of Health Directors - Health Equity Index; Vermont; ; MD EJSCREEN		US Census ACS Demographic and Housing Estimates
Elderly Population	Percent of people in a block group over the age of 64.	American Community Survey: Age	2014—2018 (5-year estimate)	Census block group	CIRCA's Climate Vulnerability Map; Connecticut Assoc of Health Directors - Health		US Census ACS Demographic and Housing Estimates

						Equity Index; Vermont; ; MD EJSCEEN		
Health Insurance	Percent of pop with/out health insurance	American Community Survey: Health insurance	2014—2018 (5-year estimate)	Census block group	CIRCA's Climate Vulnerability Map; Vermont			US Census Economic Characteristics Data
Population Density	Population Density per Square Mile/Km	American Community Survey: Population Density	2014—2018 (5-year estimate)	Census block group	CIRCA's Climate Vulnerability Map; Connecticut Assoc of Health Directors - Health Equity Index			
Literacy	Percent of pop literate	CDC's National Environmental Public Health Tracking Network	2015	Census tract	CIRCA's Climate Vulnerability Map			CDC National Environmental Public Health Tracking Network
Mobile Home	Percent of mobile home housing units	CDC's National Environmental Public Health Tracking Network - Community Characteristics - Percent of mobile home housing units	2015	Census tract	CIRCA's Climate Vulnerability Map; Vermont			CDC National Environmental Public Health Tracking Network
Multi-Unit Home	Percent of multi-unit home housing units	CDC's National Environmental Public Health Tracking Network - Community Characteristics - Percent of housing units >10	2015	Census tract	CIRCA's Climate Vulnerability Map; Vermont			CDC National Environmental Public Health Tracking Network
Rent-ownership ratio	Number of homeowners who are the principal residents of the home, out of all housing units in the area.	American Community Survey: Owner Occupied Housing	2014—2018 (5-year estimate)	Census block group	Connecticut Assoc of Health Directors - Health Equity Index			US Census Housing Characteristics Data
Public Transportation Use	Percent of pop that use public transportation	CDC's National Environmental Public Health Tracking Network	2015	Census tract	CIRCA's Climate Vulnerability Map; Vermont			CDC National Environmental Public Health Tracking Network
Single Parent	Percent of pop in single parent home	CDC's National Environmental Public Health Tracking Network - Percent of Single Parent Households	2015	Census tract	CIRCA's Climate Vulnerability Map; Vermont			CDC National Environmental Public Health Tracking Network
Food security	Percent of people receiving SNAP; Free/reduced lunch enrollment	American Community Survey - Household Received Food Stamps/ SNAP in the past 12 months	2017	Census block group	None			US Census Economic Characteristics Data
SENSITIVE POPULATIONS								
SENSITIVE POPULATIONS	Asthma rate	Spatially modeled, age-adjusted rate of emergency department (ED) visits for asthma per 10,000	Connecticut Department of Public Health: CT Public Health Data Explorer - Asthma	2016	County	CalEnviroScreen; Connecticut Assoc of Health Directors - Health Equity Index; MD EJSCEEN	Yes	CT Public Health Data Explorer: Asthma
	Cardiovascular disease	Spatially modeled, age-adjusted rate of emergency department (ED) visits for AMI per 10,000; Mortality rate from cardiovascular diseases for 2012–2016 per 100,000 population	Connecticut Department of Public Health: CT Public Health Data Explorer - MI	2016	County	CalEnviroScreen; Washington Environmental Health Disparities Map; Connecticut Assoc of Health Directors - Health Equity Index; MD EJSCEEN	Yes	CT Public Health Data Explorer: Heart Attack

Low birth rate infants	Percent low birth weight; Number of live born singleton (one baby) infants born at term (at or above 37 completed weeks of gestation) with a birth weight of less than 2500 grams (about 5.5 lbs.)	Connecticut Department of Public Health: CT Public Health Data Explorer - Reproductive Health Outcomes	2016	County	CalEnviroScreen; Washington Environmental Health Disparities Map; ; MD EJSOREEN	Yes	CT Public Health Data Explorer: Reproductive Health Outcomes
Lyme Disease	Annual crude rate of Lyme Disease per 100,000 population	CT Department of Public Health: Connecticut Environmental Public Health Tracking Program - Lyme disease	2016	County	None	Yes	CT Public Health Data Explorer: Lyme Disease
Cancer	Spatially modelled Annual age-adjusted incidence rate per 100,000 population	Connecticut Department of Public Health, Health Disparities Project/ CT tumor registry/ Caner Statistics Center	2016	County	Connecticut Assoc of Health Directors - Health Equity Index	Yes	CT Public Health Data Explorer: Cancer Index
Drug use	Age-adjusted mortality rate or years of potential life lost for drug-induced deaths; Drug inpatient hospitalization and emergency department treatment per thousand residents	Connecticut Department of Health, Office of Vital Records - Death Certificate; Connecticut Hospital Association, CHIME Hospital Discharge Data	2005-2008	Census block group; Zip Code	Connecticut Assoc of Health Directors - Health Equity Index	Yes	Health Equity Alliance: Drug-Induced Deaths (aamr)
Mental Health	Mental health inpatient hospitalization and emergency department treatment per thousand residents	Connecticut Hospital Association, CHIME Hospital Discharge Data	2005-2010	Zip Code	Connecticut Assoc of Health Directors - Health Equity Index	Yes	Health Equity Alliance: Mental Health Hospitalizations
Heat Stress	Heat Related Emergency Department Visits Rate per 100,000 by Census Tract	CT Department of Public Health: Connecticut Environmental Public Health Tracking Program - Heat Stress	2016	Census tract	None		CT Public Health Data Explorer: Heat Stress
Diabetes	Age-adjusted mortality rate or years of potential life lost for diabetes mellitus	Connecticut Department of Health, Office of Vital Records - Death Certificate	2005-2008	Census block group	Connecticut Assoc of Health Directors - Health Equity Index		Health Equity Alliance: Diabetes Mellitus (aamr)
Chronic Lung Disease	Age-adjusted rate of emergency department visits for COPD among persons 25 and older per 10,000 population	CT Department of Public Health: Connecticut Environmental Public Health Tracking Program - COPD	2016	Census tract	None		CT Public Health Data Explorer: COPD
Childhood elevated lead levels	Children under 6 years of age in a zip code area who received a confirmed lead screening from 2004-10, and had elevated blood lead levels equal to or exceeding 10 micrograms of lead per deciliter of blood as measured in a venous blood specimen.	Connecticut Department of Health, Lead Poisoning Prevention and Control Program, lead screening surveillance data	2004-2010	Zip Code	Connecticut Assoc of Health Directors - Health Equity Index		CT Public Health Data Explorer: Childhood Elevated Lead Levels
Emergency Dept Visits	The rate of emergency department visits per 100,000 persons	Connecticut Hospital Association, CHIME Hospital Discharge Data	2005-2011	Zip Code	Connecticut Assoc of Health Directors - Health Equity Index		Health Equity Alliance: ER Visits
Disability	Percent of population with disability status	American Community Survey: Disability status of the civilian population	2014—2018 (5-year estimate)	Census block group	Connecticut Assoc of Health Directors - Health Equity Index; Vermont		US Census: Selected Social Characteristics

* Indicators that are recommended for prioritization in a CT tool were either referenced during interviews with EJ advocates in the state or were included in multiple other state tools. **All indicators must be ground-truthed via the community engagement process.** This list is not exhaustive and indicators may be added or removed as a result of the community engagement process and tool development.

Contacts at DataHaven have urged Connecticut mapping tool developers to refer to the organization's Community Index, which includes many of the socioeconomic and sensitive population indicators listed in the table above at the zip code and town level. The Index is funded by most of the state's community foundations, hospitals, and local health departments, so is widely used by area non-profits, and cover the entire state. Data from the Community Index are reported in publications throughout the state (especially Community Health Needs Assessments required of all hospitals), as well as on the DataHaven website.

APPENDIX V: Comparisons of State Environmental Justice Definitions and Economic Criteria Used

State	Name	Definition	Economic Criteria Data Source	Resolution	Reference
MA	Environmental Justice community/populations	<p>In Massachusetts a community is identified as an Environmental Justice community if any of the following are true:</p> <ul style="list-style-type: none"> Block group whose annual median household income is equal to or less than 65 percent of the statewide median (\$62,072 in 2010); or 25% or more of the residents identify as a race other than white; or 25% or more of households have no one over the age of 14 who speaks English only or very well - English Isolation <p>Economic definition detail</p> <ul style="list-style-type: none"> From ACS 2006-2010 estimates tables: Table B19013 Median household income in the past 12 months (in 2010 inflation-adjusted dollars). The 2010 Massachusetts state median income used is \$62,133, released by the USDA Economic Research Service. 65.49% of this value is \$ 40,673. <p>==> Any Block Group with a median household income in 2010 (B19013) less than or equal to this value was selected as an EJ population.</p>	ACS 2006-2010: B19013 Median household income	Census Block group	<p>Environmental Justice Communities in Massachusetts</p> <p>MassGIS Data: 2010 U.S. Census Environmental Justice Populations</p>
PA	Environmental Justice area	<p>An EJ area is any census tract where</p> <ul style="list-style-type: none"> 20 percent or more individuals live in poverty, and/or 30 percent or more of the population is minority. <p>This is based on the most current census tract data from the U.S. Census Bureau and the federal guidelines for poverty.</p> <ul style="list-style-type: none"> EJ Area of concern is within 0.5mi of EJ area 	ACS 2011-2015: S1701 Poverty Status In The Past 12 Months	Census Tract (new proposed draft map is at Census block group)	<p>PA Environmental Justice Areas</p>
NY	Potential Environmental Justice Area	<p>As established in DEC Commissioner Policy 29 on Environmental Justice and Permitting (CP-29), Potential EJ Areas are U.S. Census block groups of 250 to 500 households each that, in the Census, had populations that met or exceeded at least one of the following statistical thresholds:</p> <ul style="list-style-type: none"> At least 51.1% of the population in an urban area reported themselves to be members of minority groups; or At least 33.8% of the population in a rural area reported themselves to be members of minority groups; or At least 23.59% of the population in an urban or rural area had household incomes below the federal poverty level. <p>Economic definition detail</p> <ul style="list-style-type: none"> The federal poverty level and urban/rural designations for census block groups are established by the U.S. Census Bureau. See CP-29 for more information. Low-income community means a census block group, or contiguous area with multiple census block groups, having a low-income population equal to or greater than 23.59% of the total population. 	<p>US Census 2010 (not specified – likely</p> <p>ACS 2006-2010: Table B19013 Median household income)</p>	Census block group	<p>Maps & Geospatial Information System (GIS) Tools for Environmental Justice - NYS Dept. of Environmental Conservation</p>

		<ul style="list-style-type: none"> Low-income population means a population having an annual income that is less than the poverty threshold. For purposes of this policy, poverty thresholds are established by the U.S. Census Bureau. 			
IL	Environmental Justice Area	<ul style="list-style-type: none"> All EJ areas (polygons) are derived from the 2010 US Census Block Groups. A one-mile buffer was generated for each Block Group. Each buffer takes on the EJ value of the Block Group it was formed from. However, all overlapping buffers with different EJ values are given the EJ value of Both (3). The Minority data were derived from tables within the ACS 5-year Estimates for each 5-year estimate span. <ul style="list-style-type: none"> Tables: B02001 Race Each year the data will be updated to reflect the new 5-year estimates. The changes will be applied in March of each year. The State Averages will be determined and a value of twice the State Average will be used to set the thresholds for each criterion. Minority has been calculated as greater than or equal to twice the State Average for the current ACS 5-year Estimate for the population being a minority within each Block group. 	ACS 2006-2010: Table C17002 Ratio of Income to Poverty In The Past 12 Months; Table B02001 Race	Census block group	Definitions and Sources for the Environmental Justice website
		<p>Economic definition detail</p> <ul style="list-style-type: none"> Low Income has been calculated as greater than or equal to twice the State Average for the current ACS 5-year Estimate for individuals with Incomes below Poverty within each Block group. The Individuals with Incomes Below Poverty (Low Income or LowInc) data were derived from tables within the ACS 5-year Estimates for each 5-year estimate span. <ul style="list-style-type: none"> C17002 Ratio of Income to Poverty In The Past 12 Months 			
CA	Disadvantaged communities	<p>Disadvantaged communities are defined as the top 25% scoring areas from CalEnviroScreen along with other areas with high amounts of pollution and low populations.</p> <p>Socioeconomic factors</p> <ul style="list-style-type: none"> Educational attainment (percent of population over the age of 25 with less than a high school education) Housing burden (fraction of low-income households that pay more than 50% on housing costs) Linguistic isolation (percent of limited English-speaking households) Poverty (percent of the population with income with less than twice the federal poverty level) Unemployment (over 16 years old out of work and able to work are considered unemployed) 	ACS 2011-2015: S1701 Poverty Status In The Past 12 Months	Census tract	SB 535 Disadvantaged Communities CalEnviroScreen 3.0 Report
		<p>Economic definition detail</p> <ul style="list-style-type: none"> Percent of the population living below two times the federal poverty level (5-year estimate, 2011-2015). The US Census Bureau's American Community Survey maintains information on the rate of poverty in different areas in California. The indicator is the percent of the population with incomes less than two times the federal poverty level. The data are from the years 2011-2015. A complete description of the Poverty indicator can be found in the CalEnviroScreen 3.0 report. 			

WA	N/A	<p>No defined EJ community, but Washington Tracking Network Tool use various economic indicators:</p> <ul style="list-style-type: none"> • Median Household Income • Poverty - Children under 18 living in Poverty • Poverty - Individuals Living Below Poverty Level • Population Living in Poverty <=125% of Federal Poverty Level (%) • Population Living in Poverty <=185% of FPL • Transportation Expense (%) for Moderate Income Families • Unaffordable Housing (>30% of Income) <p>Economic definitions</p> <p>Median Household Income</p> <ul style="list-style-type: none"> • Statewide and County Measures: The Washington State Office of Financial Management (OFM) forecasts mid-Census estimates of household income. The median household income divides households into two equal groups, with half of households earning less than the median household income and the other half earning more. The median household income is a better indicator than the average household income as it is not affected by unusually high or low values. • Census Tract Measure: Data is from ACS Census Bureau. <p>Poverty indicators</p> <p>The American Community Survey (ACS) asks respondents a variety of detailed questions on social and economic topics. WTN displays a selected subset of these measures.</p>	WA OFM; ACS 2011-2015: B19013 Median household income	N/A (Census tract used in tool)	Washington Tracking Network (WTN)
MN	Areas of Concern	<p>The MPCA considers tribal areas and census tracts with higher concentrations of low-income residents and people of color as areas of increased concern for environmental justice. This screening tool allows users to identify census tracts where additional consideration or effort is warranted to ensure meaningful community engagement and to evaluate the potential for disproportionate adverse impacts using three criteria:</p> <ul style="list-style-type: none"> • At least 40% of people reported income less than 185% of the federal poverty level • 50% or more people of color • Federally recognized tribal areas <p>The data are from the US Census Bureau. The MPCA considers a census tract to be an area of concern for environmental justice if at least 40% of people reported income less than 185% of the federal poverty level. This data is from a five-year summary of American Community Survey data.</p>	ACS 2011-2015: S1701 Poverty Status In The Past 12 Months	Census tract	Understanding environmental justice in Minnesota

APPENDIX VI: Comparison of Select State Tools and Indicators Used

ST	TOOL	INDICATORS: Pollution Burden	INDICATORS: Population Characteristics
California	CalEnviroScreen	<p>Environmental effects indicators:</p> <ul style="list-style-type: none"> - Cleanup sites (brownfields) - Hazardous waste facilities (recycle, treat, store or dispose of waste) - Groundwater threats (chemicals stored in containers on land or in underground tanks) - Impaired water bodies (impairments can restrict recreational use, harm wildlife habitat and contaminate fish that people may eat) - Solid wastes facilities (landfills, composting and recycling facilities) <p>Exposure indicators:</p> <ul style="list-style-type: none"> - Ozone (air pollutant) - Particulate matter 2.5 - Diesel PM emissions - Toxic releases from facilities - Drinking water contaminants (includes natural and human sources of contamination) - Pesticide use (used for agricultural purposes) 	<p>Socioeconomic indicators</p> <ul style="list-style-type: none"> - Educational attainment - Housing burden - Linguistic - Poverty - Unemployment <p>Sensitive populations indicators:</p> <ul style="list-style-type: none"> - Asthma rate - Cardiovascular - Low birth rate babies
Washington	Environmental Health Disparities Map	<p>Environmental exposures:</p> <ul style="list-style-type: none"> - NOx-diesel emissions - Ozone concentration - PM 2.5 concentration - Populations near heavy traffic roadways - Toxic release from facilities <p>Environmental effects:</p> <ul style="list-style-type: none"> - Lead risk from housing - Proximity to hazardous waste treatment, storage and disposal facilities - Proximity to National Priorities List sites (superfund) - Proximity to Risk Management Plan facilities - Wastewater discharge 	<p>Sensitive populations:</p> <ul style="list-style-type: none"> - Death from cardiovascular disease - Low birth weight <p>Socioeconomic factors:</p> <ul style="list-style-type: none"> - Limited English - No high school diploma - Poverty - Race - Transportation expense - Unaffordable housing - Unemployed
North Carolina	DEQ North Carolina Community Mapping System / Environmental Justice Tool	<p>Layers on map that relate to environmental exposures:</p> <ul style="list-style-type: none"> - Aboveground storage tank incidents - Air quality permitted facilities - Animal operation permits - Brownfields programs sites - Coal ash structural fills - Contaminated dry-cleaning sites - Hazardous waste sites, inactive hazardous sites - Land clearing and inert debris notifications - Stormwater permits - Wastewater treatment facility permits - Permitted solid waste landfills - Petroleum contaminated soil remediation permits - Possible dry-cleaning contamination - Pre-regulatory landfill sites - Solid waste septage sites - Underground storage tank active facilities - Underground storage tank incidents 	<p>Demographics:</p> <ul style="list-style-type: none"> - Asian, Black or African American, Hispanic or Latino, Non-Hispanic White - Disability - Federal poverty level - Household income (median household income in 2017 was \$60,336) <p>Health (measured in people per 100,000):</p> <ul style="list-style-type: none"> - Asthma hospitalizations - Cancer - Cardiovascular disease - Child mortality rate - Diabetes - Heart Disease - Infant death rates - Preterm birth rate - Primary care physicians (the number per 10,000 residents) - Stroke

<p style="writing-mode: vertical-rl; transform: rotate(180deg);">Vermont</p>	<p>DRAFT Environmental Health Disparity Index</p>	<p>Environmental Risks -Brownfields and hazardous sites -Superfund Sites -Traffic noise -Landfills -Air pollution -PFAS in drinking water</p> <p>Access to Environmental Resources -Public recreational sites -Trails</p>	<p>Socio-economic: -Poverty -Unemployment -Per capita income -Education -Health Insurance -Free and Reduced lunch enrollment</p> <p>Population Vulnerability: -Children -Single Parent -Elderly -Disability -Minority -Limited English</p> <p>Housing/Transportation: -Large apt. Buildings -No vehicle -Group quarters -Crowding -Mobile Homes</p>
<p style="writing-mode: vertical-rl; transform: rotate(180deg);">Maryland</p>	<p>MD EJSCREEN</p>	<p>Environmental effects indicators: - Lead Paint - Proximity to risk management sties - Proximity to treatment storage facilities - Proximity to NPL sites - Proximity to Major Direct Water Discharges - Watershed Failure</p> <p>Exposure indicators: - NATA Air Toxics Cancer Risk - NATA Respiratory Hazard Risk - Ozone (air pollutant) - Particulate matter 2.5 (air pollutants smaller than 2.5 micron) - NATA Diesel PM emissions (contains hundreds of different chemicals) - includes a traffic density indicator - Traffic Proximity and Volume</p>	<p>Socioeconomic indicators - Percent non-white - Percent Low-income - Educational attainment - Housing burden (fraction of low-income households that pay more than 50% on housing costs) - Linguistic isolation (percent of limited English speaking households) - Individuals under 5 - Individuals Over 64 - Unemployment (over 16 years old out of work and able to work are considered unemployed)</p> <p>Sensitive populations indicators: - Asthma Emergency discharge - Cardiovascular disease discharge - Low birth rate babies - Asthma Emergency Visits</p>
<p style="writing-mode: vertical-rl; transform: rotate(180deg);">Massachusetts</p>	<p>Environmental Justice Viewer</p>		<p>Income Percent minority population English language isolation</p>

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