SCIENCE ADVISORY BOARD
A Federal Advisory Committee to the U.S. Environmental Protection Agency

November 20, 2023

EPA-SAB-24-002

The Honorable Michael S. Regan
Administrator
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue, N.W.
Washington, D.C. 20460

Subject: Transmittal of the Science Advisory Board report *Review of the Updated Methodology of EPA's Environmental Justice Screening and Mapping Tool (EJScreen version 2.1)*

Dear Administrator Regan,

Please find enclosed the final report from the Scientific Advisory Board (SAB). The EPA's Office of Environmental Justice and External Civil Rights (OEJECR) requested that the SAB review the EPA's Environmental Justice Screening and Mapping Tool (EJScreen) and provide advice to the Agency on the updated EJScreen scientific methodology and calculations released publicly in October 2022. EJScreen is an environmental justice mapping and screening tool that provides EPA with a nationwide consistent approach for combining environmental and demographic indicators to identify areas with potential environmental justice (EJ) concerns. In response to the EPA's request, the SAB identified subject matter experts to augment the SAB Environmental Justice Science Committee (EJSC) and assembled the SAB EJScreen Review Panel to conduct the peer review for the updated scientific methodology, computations, and other aspects of the mapping tool calculations, as requested.

The SAB EJScreen Review Panel met virtually to receive a briefing from the EPA on the EJScreen tool on March 31, 2023. The SAB EJScreen Review Panel met in-person on May 8-10, 2023, to deliberate on the Agency's charge questions and held one videoconference on June 22, 2023, to review its integrated responses to the charge questions. On August 14, 2023, the Panel met virtually to discuss and finalize their draft report. The full SAB discussed and approved the report with revisions in a public meeting held September 21-22, 2023. Oral and written public comments were considered throughout the advisory process. This report conveys the consensus advice of the SAB.

Overall, the SAB commends the EPA for the impressive detail included in the EJScreen tool, as well as its scientific quality, functionalities, and ease of use in identifying areas with potential

environmental justice concerns for a wide range of users. The SAB appreciates the amount of effort and time the EPA staff have invested in developing, refining, and advancing the tool. Many issues raised in previous reviews regarding limitations of the tool and its methodologies have been considered and addressed by the EPA. While the SAB agrees that the EPA should continue to use its updated methodology and calculations for the EJScreen tool, the SAB finds that EJScreen can be further enhanced in several different ways as detailed in our report.

The SAB provides a wide range of recommendations in response to charge questions 1-16 to improve the EJScreen tool and its technical documentation. Based on these recommendations, we would like to highlight the following ones as highest priority (in no particular order) with additional details described within the full report.

1. The SAB recommends that the EPA better articulate its justification associated with EJScreen indicators and methodology in the technical documentation, including data sources and various definitions, as well as revise other EJScreen support materials to improve the accessibility of this documentation to a wider audience that comprises both technical and non-technical users.

2. The SAB recommends that the EPA establish a systematic collaboration or workgroup with other relevant federal agencies and state partners to discuss data resolution constraints and potential databases for inclusion of additional indicators in EJScreen.

3. The SAB recommends that the EPA continue to implement its recently revised calculations for the EJScreen tool, specifically the EJ and Supplemental Indexes. However, the measurement of low-income should be reconsidered because the current indicator does not account for geographic differences and may not match current economic realities confronting many households across the nation.

4. With respect to the use of percentiles and buffer analyses for representing the tool's indicators, the SAB did not identify limitations that require immediate revisions. However, several recommendations are provided to address issues related to comparisons among locations, differences among demographic, socioeconomic, and environmental factors summarized in the EJScreen indexes, and data uncertainty.

5. The SAB recommends that the EPA include other currently available and geographically detailed datasets relevant to issues impacting communities with environmental justice issues, but not yet included in EJScreen.

6. The SAB considers the threshold map to be a very significant improvement to the EJScreen tool and recommends minor adjustments to improve its utility for an audience that has many different needs. The EPA should provide options for displaying data from external sources via a map service or GeoPlatform to help users explore cumulative effects within the threshold maps.

7. The development of a single cumulative score or index within EJScreen might not serve its intended purpose at this time. However, the SAB strongly recommends that the EPA continue to identify appropriate approaches to educate EJScreen users of cumulative

effects, organize workshops, panel discussions, webinars, and other forms of intra-/inter-agency dialogue with various groups to advance current thinking on cumulative effects and inform the development of a cumulative score.

8. The SAB does not support any systematic weighting scheme for combining environmental indicators, as there is insufficient scientific basis for determining such weights. Detailed data and scientific knowledge on the human health and environmental impacts of these indicators necessary to quantify relative weights is currently limited or unavailable.

9. The SAB recommends that the EPA solicit input from rural states, organizations, and communities, and use field observation or ground-truthing to select the best-suited datasets for integration within EJScreen, as well as examine if EJScreen results match the lived experiences of local residents and communities facing environmental burdens.

10. The SAB recognizes that environmental justice issues in rural areas are significantly different from those in urban areas and provides multiple recommendations for: (a) defining rural areas in EJScreen; (b) identifying nationally consistent datasets for documenting environmental justice issues specifically for rural communities; and (c) enabling users to distinguish rural from urban areas in examining or exploring core EJScreen indexes.

As the EPA continues to improve its EJScreen tool, the SAB encourages the Agency to address the concerns raised in the enclosed report and consider the advice and recommendations to inform key scientific issues, as well as the development of future versions of the tool.

The SAB appreciates this opportunity to review the updated methodology of the Environmental Justice Screening and Mapping Tool and looks forward to the EPA's response to these recommendations.

Sincerely,

/s/

Alison C. Cullen, Sc.D.
Immediate Past Chair
EPA Science Advisory Board

/s/

Jayajit Chakraborty, Ph.D.
Chair
EPA EJScreen Review Panel

Enclosure

NOTICE

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The SAB is a chartered federal advisory committee, operating under the Federal Advisory Committee Act (FACA; 5 U.S.C. 10). The committee provides advice to the Administrator of the U.S. Environmental Protection Agency on the scientific and technical underpinnings of the EPA's decisions. The findings and recommendations of the Committee do not represent the views of the Agency, and this document does not represent information approved or disseminated by EPA.

U.S. Environmental Protection Agency
Science Advisory Board
Environmental Justice Screening and Mapping Tool (EJScreen) Review Panel

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Review of the Updated Methodology of EPA's Environmental Justice Screening and Mapping Tool (EJScreen version 2.1)

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ACRONYMS AND ABBREVIATIONS

ACS	American Community Survey
AHRQ	Agency for Healthcare Research and Quality
AHRF	Area Health Resources Files
CAFO	Confined Animal Feeding Operations
CDC	Centers for Disease Control and Prevention
CEJST	Climate and Economic Justice Screening Tool
CSO	Combined Sewer Overflow
DOE	Department of Energy
DOD	Department of Defense
ECHO	Enforcement and Compliance History Online
EDF	Environmental Defense Fund
EIA	Energy Information Administration
EJ	Environmental Justice
EJMAP	Environmental Justice Map Tool
EJSC	Environmental Justice Science Committee
EJScreen	Environmental Justice Screening & Mapping Tool
EPA	U.S. Environmental Protection Agency
ERS	Economic Research Service
ESRI	Environmental Systems Research Institute
FAR	Frontier and Remote Area
FEMA	Federal Emergency Management Agency
GAP	Gap Analysis Project
GIS	Geographic Information Science
HUD	U.S. Department of Housing and Urban Development
HRSA	Health Resources and Services Administration
ICD-10	International Classification of Diseases, tenth revision
K-12	Kindergarten to 12 Grade Education
km	Kilometer
LNG	Liquefied Fossil Natural Gas
LUST	Leaking Underground Storage Tanks
MOE	Margin of Error
NAAQS	National Ambient Air Quality Standards
NaNDA	National Neighborhood Data Archive
NAS	National Academy of Sciences
NCHS	National Center for Health Statistics
NCUP	Healthcare Cost and Utilization Project
NDI	National Death Index
NHANES	National Health and Nutrition Examination Survey
NLCD	National Land Cover Database
NOAA	National Oceanic and Atmospheric Administration
NPL	National Priority List
NPPES	National Plan and Provider Enumeration System
OEJECR	Office of Environmental Justice and External Civil Rights
PCA	Principal Component Analysis
PLACES	Population-Level Analysis and Community Estimates of Health

PM	Particulate Matter
ppb	Parts Per Billion
RMP	Risk Management Program
RUCA	Rural-Urban Commuting Area Codes
RUCC	Rural-Urban Commuting Area Codes Rural Urban Continuum Codes
SAB	Science Advisory Board
SVI	Social Vulnerability Index
SWD	Salt-Water Disposal
U.S.	United States of America
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey
U.S. SEC	U.S. Securities and Exchange Commission
UST	Underground Storage Tank
YMCA	Young Men's Christian Association

1. INTRODUCTION

The U.S. Environmental Protection Agency (EPA) has developed the Environmental Justice Screening and Mapping Tool (EJScreen). The EPA's Office of Environmental Justice and External Civil Rights (OEJECR) requested the review and advice from the Science Advisory Board (SAB) regarding the updated EJScreen scientific methodology and calculations released publicly in October 2022, as well as other aspects of the mapping tool calculations. EJScreen is an environmental justice mapping and screening tool that provides the EPA with a nationwide consistent approach for combining environmental and demographic indicators to identify areas with potential environmental justice (EJ) concerns.

The SAB was charged with providing expert input on the EJScreen methodology and updated calculations for the EJ Indexes and other components of the tool including, but not limited to, the use of percentiles, representation of the scores, buffer analysis, and methods to consider multiple geographies.

The SAB Staff Office identified subject matter experts to augment the SAB Environmental Justice Science Committee (EJSC) and assembled the EJScreen Review Panel to conduct the peer review. The Panel was composed of individuals with demonstrated expertise in the following disciplines and research topics: applications of geographic information science (GIS), including mapping and geospatial analyses; cartography; environmental justice tools; index development; modeling; screening tools; environmental pollution; environmental economics; sociology; exposure assessment; environmental indicators; demographics; spatial mathematics or analysis; statistics and coding; and individuals with demonstrated experience working with overburdened and vulnerable communities, or communities with environmental justice concerns. The Panel met virtually on March 31, 2023, to hear a presentation by EPA staff, followed by an in-person meeting on May 8-10, 2023, to deliberate on the agency's charge questions. The Panel also held public virtual meetings on June 22, 2023, to discuss their integrated responses to charge questions, and on August 14, 2023, to discuss their draft report.

This peer review provides feedback to the EPA on five topic categories related to the EJScreen methodology and updated calculations: (1) Scientific Defensibility and Logic of the EJScreen Calculations, (2) Technical Accuracy of the EJScreen Methodology, (3) Recommendations on the Demographic and Environmental Considerations in the EJScreen Equations, (4) Advice on the Incorporation of Cumulative Impacts and Scoring, and (5) Input on Better Consideration of Rural Geographies within EJScreen. Oral and written public comments have been considered throughout the advisory process.

This report is organized by topic category and states each charge question raised by the Agency followed by the SAB's consensus response and recommendations. Many of the topics and responses are intertwined. Recommendations are prioritized to indicate relative importance during EPA's revisions. Priorities are defined as follows:

- Tier 1: Major – Actions that are necessary to improve the critical scientific concepts, issues and/or narrative within the tool/assessment/document/model/guidelines.

- Tier 2: Short-term – Actions that are strongly encouraged in a timely manner to strengthen scientific concepts, issues and/or narrative within the assessment/document/model/guidelines. Other factors such as the Agency's needs and resources should be considered before undertaking these revisions.

- Tier 3: Long-term – Useful and informative scientific exploration that may inform future considerations and/or evaluations of key scientific issues as well as the development of future versions of the tool/assessments/documents/models/guidelines. These recommendations are likely outside the immediate scope and/or needs of the current review and may require additional research activities and/or intra- or inter-agency collaboration.

All materials and comments related to this report are available on the SAB website at: advisory activity page.

2. RESPONSE TO CHARGE QUESTIONS

2.1. Topic 1: Scientific Defensibility and Logic of the EJScreen Calculations *(Charge Questions: 1, 2, 3, and 4)*

The SAB commends the EPA for the impressive detail included in the EJScreen tool, as well as its scientific quality, and ease of use. Many issues on appropriate use and known limitations of the tool have been clearly considered and documented by the EPA. The amount of effort and time the EPA staff have invested in developing, refining, and improving the tool should be commended.

The SAB agrees that the EPA should continue to use its revised calculations for the EJScreen tool, specifically the EJ and Supplemental Indexes. The SAB finds the methodology to be logical and scientifically defensible. The SAB agrees that the updated calculation changes regarding population weighting, subtraction of national demographic scores, environmental percentiles, and the rounding of scores are improvements from the prior approach.

The SAB provides several recommendations to enhance the tool including specific areas where the EPA should better articulate its justification for the methodology in the technical documentation and other EJScreen support materials for different audiences, including technical and non-technical users. The SAB also notes other areas to improve the tool as presented below.

2.1.1. Charge Question 1: *The EJScreen EJ and Supplemental Indexes are designed to examine the intersection of environmental pollution and community vulnerability. Please comment on whether the calculations achieve this goal using a method that is logical, clearly articulated, and scientifically defensible? Do you have any specific suggestions for how to improve the calculations?*

EJ Index and Supplemental Index Calculations

The SAB finds that the current calculations for the EJ Index and Supplemental Index effectively examine the intersection of environmental pollution and community vulnerability. The SAB agrees that the index calculation methodology is logical, clearly articulated, and scientifically defensible, and that this methodology is sufficiently explained in the EJScreen technical documentation. The recent modifications made to the calculations regarding the removal of population weighting, the subtraction of national demographic scores, and changes to environmental percentiles are improvements from prior approaches. Regarding population weighting, the SAB finds that population weighting may still be informative in some circumstances as a way to highlight more populated areas where improvements toward environmental justice may benefit more people.

The SAB finds that the change to the rounding of scores is appropriate and provides a more intuitive approximation. The calculations related to the proximity to traffic are useful indicators, which include descriptions of different distances used in the literature and their exposure zones for health impacts, including traffic volume and distance. Additionally, descriptions of calculations related to particulate matter 2.5 ($PM_{2.5}$) and ozone provide limitations of the data and

models published in the literature, which supports EPA's reasoning for using specific algorithms and models.

For the air pollution indicators (e.g., $PM_{2.5}$, Ozone, Diesel PM) included as environmental indicators, the SAB finds that additional clarification is needed about how the decision was made to focus on the average concentrations as opposed to some other metrics with more public health implications (e.g., the % days with air pollution levels exceeding the National Ambient Air Quality Standards (NAAQS) standards). The SAB notes that the usage of average concentrations should be justified and included in the technical documentation.

Supplemental Index Indicators

The SAB agrees that, generally, calculations are based on basic arithmetic equations; distance weighted calculations for certain indicators; and modeling approaches for other indicators. Each of these approaches are logical, clearly articulated, and scientifically sound. However, there are some questions about the specific indicators that the EPA included in the Supplemental Index. The Supplemental Index includes five socioeconomic measures: low life expectancy, poverty, unemployment, limited English speaking, and education. The SAB finds that adequate justification for the inclusion of these indicators is lacking. The SAB seeks clarification about why age-related variables are included in EJScreen as separate socioeconomic indicators but are excluded from the Supplemental Index given evidence that young and older populations are especially susceptible to many types of environmental exposures (Research on Health Effects from Air Pollution | US EPA). The SAB recommends that the EPA provide rationale for why these five demographic factors were chosen to construct the Supplemental Demographic Indexes. The SAB finds that a parallel rationale section would be helpful for the demographic and socioeconomic indicators, similar to what is already included on page 23 of the EJScreen technical documentation (e.g., the EPA should list their considerations for the selection of demographic and socioeconomic indicators, similar to the environmental indicators).

Income Measurement

The SAB finds that the current 'income' measurement included as an indicator within the tool deserves more scrutiny because of its impact on all aspects of a person's quality of life, from nutrition to health care to education. The SAB notes that there are some questions about the current measurement of low-income, which is an indicator utilized in both the EJ Index and the Supplemental Index. The current indicator for low-income is the percentage of the population in a block group with income that is less than or equal to twice the federal poverty level threshold. The SAB first notes that the impact of percent low-income may not be linear (e.g., individuals with a Ratio of Income to Poverty of 1.0 versus 2.0, may be multiple times more susceptible than what a factor of 2.0 implies). Moreover, the federal poverty measure is adjusted annually, but it is the same across the country (e.g., only Alaska and Hawaii have different values), which is potentially problematic given vast differences in the cost of living (including, but not limited to, cost burdens from utility payments and disconnections) across and within regions. The EJScreen technical documentation (page 7) notes that the EPA uses twice the poverty guideline to address differences in income across the country. The SAB finds that the use of a single value may result in a mischaracterization of income, as both upward and downward biases are possible. As an example, the poverty guideline of $52,992 for a family of four living in New York compared to a

small county in the Midwest/Central U.S. is not an equal comparison. Despite doubling the standard poverty guideline, and taking into account the cost of living, the concept of a uniform low-income measurement is not appropriate.

Therefore, the SAB offers the following alternative measures that the EPA might consider to better inform an income measurement: including 80% of the area median income (U.S. Dept. of Housing and Urban Development's definition of 'low-income' for Section 8 program eligibility), an indicator of wealth such as home ownership, median home value, or a regionally adjusted income calculation. Other related comments and recommendations on this issue are included in the responses to charge questions for Topic Category 3.

Demographic and Supplemental Demographic Index

The SAB recommends that the EPA clarify the relationship between the individual socioeconomic indicator and the Demographic and Supplemental Demographic Index. At the beginning of the EJScreen technical documentation, there are seven socioeconomic indicators. These indicators are different from what was used in the Demographic and Supplemental Demographic Index. For example, percent of individuals under age 5 and percent of individuals over age 64 are not used in the Demographic and Supplemental Demographic Index; low life expectancy is used in the Supplemental Demographic Index but not listed as one of the seven socioeconomic indicators. The SAB suggests that the EPA clarify its rationale for which demographic indicators are included in the Supplemental Index in the EJScreen technical documentation and in other EJScreen supporting materials.

Additional Indicators to Consider

Executive Order 14096 on *Revitalizing Our Nation's Commitment to Environmental Justice for All* identifies people with disabilities as a population group that should be considered as part of the definition of environmental justice. In recognition of this updated definition, the SAB suggests that the EPA should consider adding disability status to the Supplemental Index.

Relating to air pollution indicators, the SAB finds that the EPA could consider updating the air pollution data from the census tract level to other sources at finer spatial resolution such as 1 kilometer (km) by 1 km grid (such as Di et al., 2019 for $PM_{2.5}$ and Di et al., 2017 for Ozone), as these are used extensively in environmental epidemiological research. The SAB recommends that the EPA explore the possibility of using more observational data, satellite-based measurements, or modeled air pollution levels if they can provide more spatially granular results.

Regarding climate, the SAB notes that the EPA should consider including calculations for the EJ Index and supplemental scores for climate measures, given that vulnerability to climate change and related disasters is increasingly important. The SAB recommends that the EPA consider adding a measure of excessive heat days or heatwave risk to EJScreen, as discussed elsewhere in this report.

Furthermore, the SAB notes that the EPA should consider including violations data from EPA's Enforcement and Compliance History Online (ECHO) into EJScreen (e.g., include violations data for major sources of pollution sources regulated under laws such as the Clean Air Act,

Clean Water Act, Resource Conservation and Recovery Act, and the Safe Drinking Water Act). Since ECHO data are currently not adequately detailed to understand why violations happen, more descriptive information may be necessary to clarify how/why facilities got classified.

Recommendations:

Tier 1 (Major):

- The SAB recommends that the EPA continue to use its revised calculations for the EJScreen tool, specifically the EJ and Supplemental Indexes.

- The SAB recommends that the EPA better articulate its justification for the inclusion of specific indicators in the Supplemental Index in its technical documentation and other EJScreen support materials.

- The SAB recommends that the EPA reconsider its measurement of low-income. The current measure of low-income used in EJScreen is twice the federal poverty level. The SAB believes that this representation of low-income does not adequately capture geographic differences in income stability across various regions of the country.

- The SAB finds that some important factors impacting vulnerability are not included in the current EJ and Supplemental Indexes. For example, age has important implications on health vulnerability. The SAB recommends that the EPA consider adding younger and older age groups to the Supplemental Index, as well as consider indicators of climate change and related disaster vulnerability.

Tier 2 (Short-term):

- The SAB suggests that the EPA consider adding disability status to the Supplemental Index given its inclusion as part of the environmental justice definition in the Executive Order 14096 on *Revitalizing Our Nation's Commitment to Environmental Justice for All*.

Tier 3 (Long-term):

- The SAB finds that the removal of population weighting is an improvement over the previous methodology, but that the EPA should consider offering population weighting as an option in EJScreen. In certain cases, using population weighting may be useful to highlight communities where improvement in environmental justice can benefit more people.

- The SAB concludes that the weighting of indicators is not currently feasible due to lack of scientific evidence, as discussed more in detail in Topic Category 4.

2.1.2. Charge Question 2: *The EJ and Supplemental Indexes are designed to examine the intersection of environmental pollution and community vulnerability. Please comment on whether the calculations produce intuitive and expected results towards that goal?*

Results Produced by EJScreen

The EJ Index and Supplemental Index provide intuitive and expected results in representing the geographic intersection of environmental pollution and community vulnerability (i.e., socioeconomic indicators). The SAB acknowledges that this is a difficult intersection to fully assess, since it requires detailed knowledge of local circumstances and local perceptions of vulnerability. One strategy to systematically evaluate how well EJScreen performs is to conduct "ground-truthing" exercises in specific communities to analyze the "match" between the tool's calculations and actual conditions or lived experiences on the ground. This type of exercise should be completed in close coordination with communities, and in the long-term this exercise could provide an opportunity for the communities to provide local data inputs and recommendations into EJScreen. The SAB encourages the EPA to document these "ground-truthing" exercises and present them as case studies.

Other strategies to assure that the tool produces intuitive and expected results is to carefully evaluate how EJScreen characterizes communities over time through data and methodological updates to EJScreen. The SAB also suggests that the EPA compares community characterizations from EJScreen with those from state-level tools, where available, to corroborate the results produced by EJScreen.

Life Expectancy as Socioeconomic Indicator

The SAB finds that the inclusion of life expectancy as a socioeconomic indicator in the Supplemental Index complicates its interpretation. Low life expectancy is not a socioeconomic indicator, but rather an outcome that may be impacted by several factors including health burdens resulting from environmental exposures. The EJScreen technical documentation justifies the inclusion of life expectancy based on the former interpretation, which raises questions about why additional measures of health burden are not included. Under the latter interpretation, the SAB suggests that life expectancy should be excluded as an indicator from the Supplemental Index and included as an additional index calculation. At a minimum, the EPA should provide a more comprehensive justification about the inclusion or exclusion of health burden measures in the technical documentation.

Recommendations:

Tier 1 (Major):

- The SAB recommends that the EPA reconsider and further justify the selection of socioeconomic indicators included in the Supplemental Index, and specifically the measure of a health outcome such as low life expectancy. The SAB recommends that the EPA consider removing low life expectancy from the Supplemental Index, and perhaps moving low life expectancy to a separate list or adding more health indicators to the Supplemental Index.

Tier 2 (Short-term):

- The SAB recommends that the EPA consider conducting empirical analyses across methodological updates to EJScreen to identify communities with considerable changes in EJ Index and Supplemental Index between versions. The EPA should also consider conducting empirical analysis between EJScreen and state-specific environmental justice screening tools to assess alignment of the same community's score across different platforms/tools.

Tier 3 (Long-term):

- The SAB suggests that the EPA invest in systematically "ground-truthing" key environmental inputs utilized in the EJ and Supplemental Indexes to ensure that the percentile scores created in the calculations reflect situations that individuals, households, and communities themselves experience. Ground-truthing is best accomplished by selecting a variety of location types, including urban and rural examples. The SAB encourages the EPA to document this direct field observation ("ground-truthing") effort and present it as case studies. A systematic ground-truthing effort also has the potential benefit of providing communities with opportunities to provide additional information for inclusion in EJScreen. The SAB notes that one important consideration is for the EPA, in collaboration with states, to provide technical infrastructure and related resources to support communities in the "ground-truth" activity, and to avoid putting extra burden on the communities.

2.1.3. Charge Question 3: *EJScreen combines environmental and socioeconomic information into EJ and Supplemental Indexes to examine the intersection of vulnerable communities and pollution. Please comment on whether the use of both EJ and Supplemental Indexes in EJScreen is logical, whether the differences between these indices are clearly documented, and whether the documentation clearly indicates why both of these indices are used in the tool?*

Use and Rationale for EJ and Supplemental Indexes

The EJScreen employs two indexes to represent the intersection of environmental and socioeconomic information. The EJ Index includes a Demographic Index that combines measures of people of color and poverty with an environmental indicator, whereas the Supplemental Index includes an index that combines measures of low life expectancy, poverty, unemployment, limited English speaking, and education with an environmental indicator. In so doing, EJScreen presents information on environmental pollution and community vulnerability in two different ways, which the SAB observes can produce some different results in specific locations.

The SAB agrees that the use of both the EJ Index and the Supplemental Index is logical, and that the differences between the indexes are clearly explained by the EPA in its technical documentation and other support materials (e.g., the EJScreen website). However, while the EPA clearly explains the distinction between the indexes, the SAB finds that the justification for having two indexes is not clear. The technical documentation (page 26) provides a clear justification for the use of income and people of color as part of the Demographic Index used in

the EJ Index, but the rationale for the Supplemental Index is less specific. The technical documentation (page 29) notes that the Supplemental Index may be more appropriate than the EJ Index for decision-making, but few details are provided to assist the array of EJScreen users in decision-making.

As part of any rationale for maintaining two separate indexes, the SAB finds that it is important for the EPA to consider meaningful differences in outcomes. If the indexes produce similar results (e.g., comparable national or state percentile rankings for each environmental indicator), then keeping two indexes is less appropriate. However, if the indexes produce divergent results, the implications for how and when each indicator should be used needs to be considered. The SAB finds that adequate justification should also be provided for why percent low-income is used in both the Demographic and the Supplemental Demographic Indexes. The overlap makes it harder for the user to understand why the two indexes are different. Currently, the difference between the EJ and Supplemental Indexes is mainly on the demographic side, which poses the question of why not on the environmental side as well (e.g., having an expanded list of environmental indicators even though they may only meet some but not all of the selection criteria related to resolution, coverage, relevance, and public health significance).
As part of an effort to refine the rationale for two indexes and guidance as to when one index should be used instead of another, the SAB concludes that the EPA should rename the indexes with labels that are more intuitive. Both indexes are "EJ Indexes" in their intent, they just use different indicators.

The SAB also suggests that more information be provided within the EJScreen tool itself to explain the differences between the EJ Index and Supplemental Index, including guidance about for what purpose a user should use each index. Furthermore, the SAB recommends numerous additional socioeconomic and environmental indicators that could be included in EJScreen, and these suggestions are discussed extensively in responses to other charge questions.

<u>Intersection of Vulnerable Communities and Pollution</u>

The SAB also notes additional areas for the EPA to consider related to the EJ and Supplemental Indexes when examining the intersection of vulnerable communities and pollution, as described below.

Water Pollution

An important aspect of environmental pollution is water contamination. Based on information provided to the SAB by the EPA during the public meeting on March 31, 2023, there are ongoing efforts to include data on water quality into the EJScreen Tool (e.g., the incorporation of violations data on drinking water). The SAB commends the EPA for these efforts and suggests that these efforts include groundwater quality. The SAB notes that in the Western United States and in many rural areas, groundwater is the main water source and is seldom regulated. Therefore, groundwater pollution, or seawater intrusion into aquifers for coastal regions, can be a critical environmental justice issue. The SAB suggests that the EPA consider adding groundwater quality and other relevant water pollution sources to the toolbox and/or list of main EJ Indexes.

Borderlands

The SAB finds that U.S.-Mexico border regions are not well represented in EJScreen. For example, some communities suffer from sewage spills regularly in these locations (e.g., case of Nogales, Arizona). Since sewage spills are not listed on the tool as pollution sources, the SAB encourages the EPA to explore these types of events such as spills, that may affect border communities as they may be considered "fenceline communities" in the context of the tool.

Wastewater Discharge in Arid Lands

The SAB notes that in the desert, having treated wastewater discharged into the rivers is valuable in arid lands. This type of wastewater discharge is clean and has enabled the existence of riparian ecosystems and the thriving of communities. Therefore, this event is not considered an environmental justice issue (e.g., area north of Nogales). The SAB encourages the EPA to complete case studies related to wastewater discharge to ensure the tool is highlighting the areas as intended.

Aging Infrastructure

The SAB notes the issue of lack of inclusion or acknowledgment of aging infrastructure within the tool, particularly as it relates to drinking water or utilities (heat, electricity, etc.). The SAB encourages the EPA to explore this issue within the context of the tool. The SAB recognizes that there may not be infrastructure layers with consistent nationwide coverage, and this may take time to develop.

Landfills

The SAB notes that a factor not considered in the tool is landfills and solid waste transfer stations. The SAB believes that the EPA should explore the incorporation of landfills information into the tool.

Heat

The SAB finds that climate change related events or hazards that affect minority populations disproportionately should be included in the tool. The SAB recommends that the EPA includes extreme heat exposure (e.g., surface temperature and/or frequency of heatwave occurrence) as an indicator. The SAB notes that heat as an indicator could be combined with other indicators (e.g., lack of air-conditioning or vegetation) that could exacerbate this threat. Additional recommendations about climate change indicators are discussed elsewhere in this report.

Recommendations:

Tier 1 (Major):

- The SAB recommends that the EPA update the EJScreen technical documentation to justify the rationale for the calculations used in the Supplemental Index, including the choice of indicators for inclusion and exclusion in this index, as detailed on pages 8 and 9.

- The SAB recommends that the EPA articulate in its technical documentation for what purposes the EJ Index should be used and for what purposes the Supplemental Index should be used, recognizing that EJScreen has multiple categories of users. The EPA should also continue to emphasize the importance of EJScreen as a screening level tool.

Tier 2 (Short-term):

- The SAB recommends that the EPA update the EJScreen technical documentation, specifically the terminology around the EJ and Supplemental Indexes to ensure it is clear and consistent. As part of these updates, the EPA should reconsider the labeling of the indexes, so that they are more intuitive to multiple user categories.

Tier 3 (Long-term):

- The SAB suggests that the EPA carefully compare calculations of the EJ and Supplemental Indexes to identify areas of divergence and to use that comparison to inform when each index should be used by different users.

- The SAB also suggests additional issues for the EPA to consider related to the EJ and Supplemental Indexes that focus on the intersection of environmental pollution and socially vulnerable communities (e.g., water pollution, aging infrastructure, landfills, and heat).

2.1.4. Charge Question 4: Please comment on whether the EJ and supplemental index calculations use an appropriate balance of socioeconomic and environmental considerations in the equations? Do you have recommendations on how they could be improved?

Balance between Socioeconomic and Environmental Factors

The current calculations in EJScreen's EJ Index and Supplemental Index give equal weight to socioeconomic and environmental considerations. In general, the SAB finds this to be a reasonable approach that provides users with a clear and intuitive score (displayed in percentiles) for comparing block groups. The SAB recommends that the EPA continuously evaluate other sources of data, particularly from federal agencies, to incorporate additional, nationally consistent, and relevant socioeconomic and environmental information into EJScreen.

Although the SAB finds the use of equal weights scientifically defensible, additional indicators should be incorporated to better represent rural geographies and Native American and/or

Indigenous communities. In addition, the SAB recommends the separation of "people of color" into distinct racial and ethnic groups using categories already available in the Census Bureau's American Community Survey (ACS). The SAB notes that these categories can be viewed in EJScreen now, although they are not part of the indexes.

In addition, as noted in response to Charge Question 1, the SAB recommends the inclusion of additional health indicators in the socioeconomic component of the Supplemental Index or in an additional Index such as a Health Index. The SAB also recommends that the EPA explore the possibility of adding environmental and climate indicators (as enumerated under Charge Question 10; with possible datasets described under Charge Question 15) to the tool.

The SAB notes that a good first step will be for the EPA to ascertain whether susceptible communities are being missed by EJScreen, and if so why. A similar approach could be taken for EJ calculations related to potential exposures. It is important to identify which environmental considerations are missing. See related comment under Charge Question 2.

Another issue in the balance of socioeconomic and environmental data is the lack of available data that meets the requirements for inclusion in EJScreen (e.g., data may not be available at the block group level). The SAB recognizes that the EPA has more access to and in-depth knowledge of its own environmental data and indicators and that environmental data from other agencies may not be as readily available. For example, U.S. Department of Agriculture (USDA) environmental data relevant to rural areas are lacking. Similarly, additional socioeconomic or health indicators that could be useful (e.g., infant mortality, etc.), are not available at the geographic scale that allows inclusion in EJScreen. Therefore, the SAB recommends further systematic review of other agencies' databases for inclusion in EJScreen and documentation of such efforts to increase the transparency and integrity of the activities/updates of the tool.

Health Data

As mentioned above, the SAB encourages the EPA to explore adding additional health data and/or health indicators to the supplemental demographics index. Although the SAB recognizes that some of these data are not available at a block group level, given that EJScreen currently includes three health indicators (i.e., low life expectancy, cardiovascular disease, and asthma), the SAB notes that there may be opportunities to further expand the existing list of health indicators. Exploring other health conditions available through the Centers for Disease Control and Prevention's (CDC) Environmental Public Health Tracking platform may be a potential approach. There are other data sources on the health indicators as well, primarily provided by other federal agencies such as the Agency for Healthcare Research and Quality's (AHRQ) Healthcare Cost and Utilization Project (HCUP) and Health Resources and Services Administration's (HRSA) Area Health Resource Files (AHRF). HCUP is one of the largest publicly available all-payer healthcare databases designed to produce area-level estimates of healthcare utilization, access, cost, quality, and outcomes. It can be used to investigate a broad range of health outcomes using the International Classification of Diseases, tenth revision (ICD-10) codes. AHRF contains information on the healthcare profession, health facilities, and population characteristics, and would be useful to provide information on access to healthcare resources. Both HCUP and AHRF are updated on an annual basis. The SAB recommends establishing a systematic collaboration with other federal agencies and state partners to discuss

data resolution issues and potential databases for inclusion of health indicators into EJScreen. Other related comments and recommendations on this issue are included in the responses to charge questions for Topic Category 3.

Green Spaces

The SAB notes that a few metrics are not included in the toolkit. For urban communities, access to green space is an issue of environmental justice. As a result, the SAB finds that the EJScreen tool should include "proximity to green spaces" or "lack of green spaces" as an indicator. Given the heterogeneity of green spaces and uses, additional data would be helpful. The SAB suggests the inclusion of the U.S. Geological Survey (USGS) Protected Areas data that includes all Federal and most State and local lands. This is a national inventory of U.S. terrestrial and marine protected areas that are dedicated to the preservation of biological diversity and to other natural, recreation and cultural uses. It includes the "Gap Analysis Project (GAP) Status Codes" of these lands, which indicate how they are being managed for conservation purposes and is a measure of public access for recreation.[1]

Environmental Crime

The SAB notes that environmental crime could also be viewed as an indicator of environmental justice. The EPA released a memorandum "Strengthening Environmental Justice Through Criminal Enforcement" (dated June 21, 2021) on the need to strengthen tools for the detection of environmental crimes in overburdened communities. Consequently, the information collected from the criminal enforcement program can further environmental justice by strengthening current tools. The EPA should consider including an indicator that identifies where environmental crimes are occurring.

Indigenous Communities

The SAB notes that environmental issues affecting all Indigenous communities, regardless of their federal recognition status, and their lands in the U.S. are not well represented in the tool. Standard environmental and demographic factors may not capture the ways in which Indigenous Peoples experience environmental harm, including the unique situation of Indigenous Peoples when it comes to cultural and spiritual connections to specific places. These connections can manifest as the continuance of traditional food ways (e.g., fishing, hunting, gathering) and spiritual practices (e.g., daily water ceremonies), the protection of cultural landscapes and sacred sites, and in other ways. Activities that weaken or sever those connections, whether through air and water pollution, landscape fragmentation, or other processes, can place disproportionately high and adverse burdens on Indigenous Peoples by limiting the ability to pass down their cultures and collective identities to future generations.

The EPA should consider including tribes and Indigenous Peoples as part of the socioeconomic data and not only as a place or as an additional demographic group. For example, some Native American or Indigenous communities (e.g., Navajo Nation) live in sparsely populated areas, including disproportionate proximity to radioactive materials (e.g., waste from uranium mines).

[1] U.S. Geological Survey (USGS) Gap Analysis Project (GAP) Status Codes." Available at: https://www.usgs.gov/programs/gap-analysis-project/science/pad-us-data-overview

In some cases, groundwater is the only water source and is polluted with uranium and arsenic. Consequently, they need to haul potable water for many miles for their daily activities. They cannot use their groundwater for farming or livestock, so they need to also haul food from far away. Furthermore, the Navajo Nation is only flagged under the Ozone EJ Index, which does not accurately capture its level of vulnerability. It is unclear whether this type of environmental justice issue for tribes and Indigenous Peoples is represented in EJScreen.

Rural Communities

The SAB notes that when identifying vulnerable rural communities, additional measures of healthcare access from CDC's Population-level Analysis and Community Estimates of Health (PLACES), as well as additional measures that gauge lack of access to other resources would be a good improvement (e.g., lack of access to food and to other social/community resources from the USDA food access and National Neighborhood Data Archive (NaNDA) datasets noted above, respectively). Other related comments on this issue are included in the responses to charge questions for Topic Category 5.

Recommendations:

Tier 1 (Major):

- The SAB recommends that the EPA continue to review datasets from other federal agencies, such as the USDA and CDC, to identify potential additional indicators that could complement the current Supplemental Index indicators.

- The SAB recommends establishing a systematic collaboration with other relevant federal agencies and state partners to discuss data resolution issues and potential databases for inclusion of additional indicators in EJScreen.

- Because the use of weighting factors for indicators is so complex and not currently feasible, the SAB recommends that the EPA should maintain its use of equal weighting of socioeconomic and environmental indicators as part of the EJ and Supplemental Index calculations.

Tier 2 (Short-term):

- The SAB recommends that the EPA consider adding more indicators to better capture rural geographies, unique characteristics of Native American/ Indigenous communities and their lands, and specific racial/ethnic groups. However, when adding indicators to the Demographic and Supplemental Demographic Index, EPA should take extra caution that differences in one indicator do not dilute the contribution of other indicators in the Indexes.

- The SAB recommends that the EPA consider the inclusion of additional health indicators and indexes as part of future updates of EJScreen. This effort should be done in collaboration with other federal agencies and state partners who have access to data and are developing similar data tools. Other related comments on this issue are included in the responses to charge questions for Topic Category 3.

Tier 3 (Long-term):

- There are no long-term recommendations for this question.

2.2. Topic 2: Technical Accuracy of the EJScreen Methodology *(Charge Questions: 5, 6, and 7)*

The SAB has examined charge questions that revolve around the issue of accuracy and scientific plausibility for some of the methodologies implemented within EJScreen. In particular, the SAB was asked to comment on two major changes with respect to a previous version of EJScreen, namely the use of percentiles instead of population-weighted indicators to compare locations across the state or the nation, and the derivation of indicators when performing buffer analyses.

The SAB commends the EPA for having worked on the recommendations raised in previous reviews and have found and implemented solutions that are scientifically sound and appropriate. With respect to the major methodological innovations relative to the use of percentiles and buffer analyses, the SAB has not identified major limitations that require immediate revisions.

However, recognizing the complexity of the problem and the desire and need to be able to capture the multiple factors and nuances that contribute to environmental burdens and environmental injustice, the SAB provides several recommendations that address issues related to comparisons among locations, differences between rural and urban populations, differences among social, demographic and environmental factors that are summarized in EJScreen indexes and indicators, uncertainty in the data, etc. The SAB also provides several major recommendations to revise the EJScreen technical documentation to improve the accessibility of the document to a wider audience that comprises both technical and non-technical users.

2.2.1. Charge Question 5: *EJScreen represents the tool's indexes and indicators as percentiles to show how a given location compares to the rest of the state or nation. Please comment on whether the methodology for use of percentiles to represent the various scores is logical, clearly articulated, and scientifically defensible?*

The environmental, demographic, and social variables that are used to calculate the indices and indicators employed in EJScreen all display significant spatial variability and, very often, are characterized by distributions that are neither symmetric nor normal. To enable comparisons between EJScreen indicators and indexes at different locations within a state or the U.S. some form of "standardization" is needed. The SAB recognizes and agrees that percentiles are a good solution, scientifically defensible (Raftery, 2016), and, perhaps, the most logical solution in this situation.

With respect to the appropriateness of the percentiles, members observed that while potential approaches for standardization involve either deriving a z-score or considering percentiles, the use of z-scores, that is, the number of standard deviations a certain value is above or below the mean, is not recommended when a variable does not follow a symmetric distribution. Given that environmental, demographic, and social factors are often characterized by non-symmetric

distributions, the use of percentiles as an approach to compare different locations is likely the most appropriate choice for this purpose.

The use of percentiles to compare locations with respect to EJScreen indexes and indicators is also scientifically supported by the adoption of such methodology in other environmental justice mapping tools. A review conducted by Konisky et al. (2021) indicates that of the 19 state or local environmental justice mapping tools reviewed, 10 employed percentiles to either derive environmental justice indices and/or to enable comparisons among locations or areal units.

The SAB expresses wide support for the use of percentiles and provides several recommendations for the EPA's consideration. The SAB recognizes that some recommendations are more quickly implementable than others.

Recommendations:

Tier 1 (Major):

- As the SAB concurs with the use of percentiles, there are no major recommendations for this question.

Tier 2 (Short-term):

- ***Improve the interpretability of the EJScreen indices and indicators for the intended users of the tool: local communities.***

While the adoption of percentiles to enable comparisons between EJScreen indexes and indicators at different locations is justifiable, the SAB describes several issues related to clarity and ease with which the intended users of the tool, local communities, could interpret the results provided by EJScreen. The SAB recommends that the EPA focus on the following actions to improve interpretability:

- ***Improve the interpretation of percentiles provided in the technical documentation.***

The SAB recommends eliminating text that is unnecessarily confusing and disorienting, and possibly developing clear, easy-to-understand, illustrative examples, perhaps with visual explanations, that could be more easily understood by a non-technical user audience. The SAB provides a specific example that the EPA could use as a template in this effort (i.e., the example where the Underground Storage Tank (UST) variable and the UST indicator were discussed; see page 22 of the technical documentation). The SAB notes that the discussion and interpretation of the UST indicator provided in the technical documentation was easy-to-follow and understandable.

Furthermore, the SAB notes that the word "percentiles" might not be well understood by non-specialized users, who might interpret "percentiles" as "percent." To facilitate understanding as for what a percentile is communicating, the SAB suggests the EPA consider this issue and use the word "rank" rather than the word "percentile" in EJScreen.

The SAB recommends that the interpretation and discussion of percentiles be provided not only in the technical documentation of EJScreen, but also in the webpage for EJScreen as well as in other locations. The SAB stresses the importance of redundancy and consistency with respect to the information provided, to ensure that users (regardless of the audience) can easily access and interpret the information in front of them.

To enhance clarity and more transparency about how percentiles are calculated within EJScreen, the SAB recommends that the EPA provide more details regarding the calculation and derivation of percentiles in the technical documentation, particularly with respect to how zero values are handled. It would be particularly useful to clarify how zeros are incorporated in the percentile calculations, in terms of lack of a particular environmental hazard or missing values in a given block group. Several members have expertise related to other environmental justice mapping tools developed by some States such as California, Maryland, Michigan, Colorado, New Jersey, Washington, Connecticut, among others. Based on the members' expertise, when comparing the use of percentiles in EJScreen to two other mapping tools, namely, CalEnviroScreen and an environmental justice mapping tool used in the state of California, the SAB notes a lack of clarity as for how EJScreen handles instances where the raw, underlying variable has value of 0 when it comes to deriving percentiles. The SAB finds that the environmental justice tool CalEnviroScreen does not allow comparisons of census tracts where the value of the underlying environmental or demographic variable at the tract is equal to 0. In CalEnviroScreen, the comparison among locations is only possible for those locations where "a hazard effect or a population characteristic is present."

- ***Provide better visual representation of the percentiles by using a more appropriate color scheme and relaying additional, useful information.***

In EJScreen, percentiles for indexes and indicators can be calculated and displayed with respect to two different levels of spatial resolution. Specifically, the percentile of a block group can be shown with respect to the distribution of a selected index or indicator across the nation or it can be given with respect to the distribution of the selected index or indicator across census block groups within an individual state. Given that there are two possible comparison groups, for greater clarity and ease of interpretability, the SAB suggests that the EPA revises EJScreen so that the "comparison group considered" is explicitly acknowledged. There are different ways in which information on the comparison group can be relayed. In one case, EJScreen can display a map showing all the census block groups within the comparison group with values of the percentile for each block group in the map shown using colors. Alternatively, EJScreen could simply report the total number of block groups that are part of the comparison group.

The SAB also proposes additional considerations regarding the visual display of the map and the color scheme used. Currently, for each index or indicator, EJScreen presents maps for the percentiles where only percentiles above the 80^{th} are shown in color (in either yellow, orange, or red); census block groups that correspond to percentiles below the 80^{th} are displayed in grey color.

The SAB encourages the EPA to consider using a continuous color scale to represent the entire range of values for a percentile in a continuous fashion.

Still on the issue of color scheme used to depict percentiles on a map, the SAB suggests that the EPA considers the example shown in JusticeMap (https://www.justicemap.org/) where two different variables are displayed at the same time, with the two variables grouped into a finite number of categories, each of which is represented with different, gradually increasing hues.

The SAB recommends that the EPA considers using a different color palette to indicate different types of indexes and indicators within EJScreen. For example, EJScreen could use the same type of color palette for all the Demographic Indexes and indicators, while it could adopt a different color palette to represent environmental indexes and indicator variables, and so forth. The EPA should also consider color blind friendly palettes for users when updating the current color palette.

Finally, while the unitless nature of percentiles is what enables the comparison between different census block groups, the SAB notes that high-level percentiles might raise unnecessary alarms, particularly if the raw values of the underlying indicators are low and well below health risk thresholds. To alleviate this problem and provide a more complete picture, the SAB suggests that in addition to a display of the percentiles for the index or indicator on a map, EJScreen should also present information on the raw values of the underlying environmental, demographic, and social indicators and develop a feature to only show values above health risk thresholds.

Tier 3 (Long-term):

- ***Incorporate or account for the inherent uncertainty in the raw data when deriving percentiles for EJScreen indexes and indicators***.

Derivation of indices and indicators in EJScreen involves the use of data on environmental, demographic, and social variables. In the majority of cases, the raw data used in EJScreen refer to estimates instead of actual observed data. Specifically, in the case of environmental indicators, the data often refer to estimates of an environmental variable obtained via a statistical model that combines data from multiple sources (e.g., monitoring sites and the output of numerical, deterministic models). Estimates were derived from a statistical model. These estimates are also accompanied by measures – which may include standard errors and quantify the uncertainty in the estimates. In the case of socio-demographic variables, the data are typically obtained from the U.S. Census Bureau and consist of estimates obtained from the decennial Census or the ACS. These estimates are surrounded by uncertainty, which are quantified through the margin of error (MOE). The SAB remarks that the magnitude of the MOE is typically considerable for estimates obtained at the census block groups, and that this issue increases in rural areas with lower population counts. For example, if one considers the percentage of the population in a block group with limited English speaking, and one compares two census block groups the difference between the two block groups with respect to this percentage might not be equal to zero but might be smaller than the corresponding MOE's, thus indicating no significant difference between the two block groups with respect to the percentage of the population with limited English speaking. This suggests that the percentiles for the two block groups should be the same and not different as one would conclude if only the values of the percentages of the population with limited English speaking in each block group is considered and the MOE was not taken into account.

Currently, derivation of EJScreen indexes and indicators does not acknowledge nor account for the uncertainty in the raw data. The SAB strongly suggests that the EPA develop an approach that allows incorporation of uncertainty in the raw data and communicates the uncertainty in the percentile values themselves, stemming from the uncertainty in the data. The SAB suggests that the Agency considers adding 95th confidence intervals to the percentiles, following examples of other national public health and environmental health data products that have been used in the past (such as National Health and Nutrition Examination Survey (NHANES).

- ***Develop a more appropriate approach than the current definition of percentile used for EJScreen Supplemental Indexes or indicators that involve multiple demographic variables.***

EJScreen also provides percentiles for the Supplemental Indexes that involve multiple demographic variables. The SAB notes that the derivation of the percentile for the Supplemental Indexes is unusual, given that the demographic variables are first averaged and then the average of the demographic variables is used to multiply the percentile for the environmental indicator.

This approach to derive the percentile for Supplemental Indexes appears to weigh the environmental, demographic, and social indicators differently, with the difference in weighting being driven mostly by differences in the range of values that some demographic variables can attain compared to others. At the same time, while the interpretation of percentiles for individual indexes and indicators can be justified as representing the probability that an average individual, living in a random census block group within the U.S. or within a given state is experiencing a level of an environmental, social, or demographic variable as high as the level observed in a specified census block group, such interpretation is not valid for the Supplemental Indexes' percentiles. From a statistical point of view, it is hard to justify the approach undertaken by the EPA to derive the Supplemental Indexes percentiles. Thus, the SAB recommends that the EPA develop a framework to calculate percentiles for Supplemental Indexes that is more coherent and consistent with the approach used for individual EJScreen indexes and indicators.

- ***Consider a finer spatial resolution or a more well-specified comparison group when calculating percentiles for EJScreen indexes and indicators.***

The SAB highlights that while EJScreen provides the flexibility to calculate percentiles at both the U.S. and an individual state level, such large-scale spatial domains might not be particularly relevant for local communities that might be considered of potential environmental justice concern. From the perspective of users, the appropriate community may be a neighborhood, but the large spatial resolution of many of the databases limits the utility of EJScreen in ranking communities with regard to EJ indicators because the average value of an indicator of concern in the smallest area represented in the data may be different from its value in the community of interest. In addition, the SAB finds that large spatial domains do not allow to differentiate between urban and rural communities. To address these issues, the SAB urges EPA to consider smaller spatial resolutions for the calculations of the percentiles (e.g., county level).

The SAB recognizes that, while deriving percentiles of EJScreen indexes and indicators at county level could allow one to highlight and screen census block groups within rural areas as having elevated percentiles, there is a potential that this might not happen simply because the

range of the raw data in rural communities is significantly different (and lower) than that of urban communities, and a county might include a mix of urban and rural block groups. The SAB suggests as potential solution to address this issue to perform the derivation of percentiles among only urban or only rural block groups. It is also possible that the inclusion of indexes and indicators within EJScreen that are important from an environmental justice perspective and are more relevant for rural communities, could address these issues. There are additional concerns with respect to the fact that rural block groups might have a lower opportunity of being highlighted as communities with environmental justice concerns when percentiles are calculated using extensive comparison groups, as is the case when percentiles are calculated at the national or state level.

- ***Consider an improved approach that allows a comparison between percentiles for different indexes and indicators of different nature simultaneously.***

The SAB notes the difference between the ranges of values and the distribution that environmental and social indicators have across the U.S. This heterogeneity can in turn translate into a difficulty in comparing percentiles across different EJScreen indexes and indicators. For example, the fact that a census block group is above the 50th percentile for a certain EJScreen index but below the 50th percentile for another one does not necessarily mean that the block group is experiencing a risky level of the environmental or social/demographic variable with respect to the variable associated with the first index and it is not experiencing any risk with respect to the variable associated with the second index. In fact, for indicators whose raw values are generally low, the 50th percentile may erroneously highlight areas of environmental justice concern. Conversely, for indicators whose raw values are generally high, percentiles above the 50th might already be areas of environmental justice concern.

While there might not be an approach that allows for comparisons among percentiles relative to different EJScreen indexes and indicators, the SAB invites EPA to consider devising a methodology that enables comparisons among census block groups with respect to a specific index or indicator and comparisons among block groups with respect to multiple indexes or indicators.

2.2.2. Charge Question 6: *EJScreen uses buffers to consider the populations surrounding a given location. Please comment on whether the methodology for considering affected populations using buffer analyses is logical, clearly articulated, and scientifically defensible? Do you have suggestions on how the buffer analysis methodology could be improved?*

In examining this charge question, the SAB used a broad interpretation of the expression "buffer methodology" and commented not only on the approach used to determine the value of an indicator within a buffer but discussed also other aspects of the EJScreen methodology that involves buffers, as it is the case in the definition of proximity-based environmental indicators.

The methodology proposed by the EPA to calculate the value of an indicator within a buffer involves calculating a population-weighted average of said indicator, averaged over all the census blocks that are contained within the buffer. As in EJScreen indicator variables are all defined at the block group, the value of an indicator in a census block is set equal to the value of

the indicator in the block group that contains said block. On the other hand, deriving a population-weighted average requires calculating the size of the population included within a buffer from a user-specified location.

The approach currently adopted in EJScreen to calculate the size of the population within a buffer is the main novelty of the proposed buffer methodology. Previous approaches involved mostly areal apportionment, which implicitly assume a uniform distribution of individuals across all the census blocks within a block group. The SAB strongly supports the EPA's decision to forego previous approaches and focus on developing a new methodology that addresses the concerns and comments raised during a previous evaluation of EJScreen.

The approach that the EPA proposes to use to determine the population size within a buffer is based on: 1) the definition of internal point of a census block, available from the decennial Census; 2) the size of the population within each block and each block group, as provided by the decennial Census; and 3) the size of the population in each block group as indicated by the 5-year ACS estimates. For computational ease, it is assumed that if the internal point of a census block falls within the buffer, then the entire population of the block lives inside the buffer. Conversely, if the internal point of the block does not fall within the buffer, then the entire population of the block is assumed to live outside the buffer. Even though the SAB believes that the methodology proposed for the buffer analysis is logical and scientifically defensible, members have expressed a few concerns and the text below reports some of their recommendations, stratified depending on whether they are easily implementable or would require further development and testing.

Recommendations:

Tier 1 (Major):

- As the SAB is supportive of the methodology proposed for buffer analyses in EJScreen, the Board does not have major recommendations for this charge question.

Tier 2 (Short-term):

- ***Improve the clarity of the technical documentation.***

Despite carefully reading the technical documentation, several members were unclear about how the population-weighted average was calculated within EJScreen, and erroneously believed that the methodology adopted for the buffer analysis was still based solely on areal apportionment, as in previous versions of EJScreen. The SAB strongly encourages that the EPA explicitly explain the steps for calculating the population-weighted average and provide supporting visualization, if possible. This can be achieved, for example, by including additional text after the formula in page 37 of the technical documentation. The new text could present an example that clearly illustrates the computations performed within EJScreen to derive the population-weighted average of an indicator in a buffer.

The SAB also finds it unclear how the internal point of a census block is determined. For better clarity, the SAB recommends that either the explicit definition of internal point of a census block

is included in the technical documentation or a link to the Census Bureau documentation is added to the technical documentation.

Tier 3 (Long-term):

- ***Address the temporal mismatch between the information from the decennial Census estimates and the ACS 5-year estimates.***

The newly proposed methodology for buffer analyses involves the calculation of population-weighted average values of indicators obtained by adding, over all census blocks contained in a buffer, the value of an indicator at each of the blocks contained within a block group multiplied by a factor that should represent the fraction of the population of the block group contained in the block. The multiplying factor is obtained by using estimates of the population from both the decennial Census and 5-year ACS estimates. Since the former provides the size of the population for each block every 10 years, and the latter provides information only on the population size in a block group, averaged across 5-years, the EPA proposes to account for this temporal mismatch by multiplying the most recent estimates of the total population size in a block group provided by the ACS in the last five years by the fraction of the total population in the block group that reside in a given block, as estimated by the decennial Census. While this approach is logical and defensible based on the population estimates currently available, it is also based on the implicit assumption that there are no significant changes in the distribution of the population within a block group in the course of 10 years. This assumption might not be true within urban block groups or within block groups that experience significant turn overs. There might be spatial variations across the U.S. and there might be differences between urban and rural block groups as for the validity of the implicit assumption underlying the new methodology proposed for buffer analysis. The SAB strongly encourages the EPA to assess the validity of this implicit underlying assumption.

- ***Investigate the use of datasets that provide spatially resolved information on population density and population distribution for buffer analyses.***

As elaborated above, the methodology used for the buffer analysis reports involves the calculation of population-weighted averages for indicators within a buffer. These calculations use estimates of population sizes obtained from both the decennial Census, which provide population sizes for Census blocks every 10 years, and from the ACS, which provide estimates of the population with Census block groups averaged over a period of 5 years.

Besides population estimates provided by the U.S. Census Bureau, other datasets exist with information on population density and distribution. For example, Oak Ridge National Laboratory has developed fine-scale spatial resolution estimates of population density for the entire globe. These estimates are released annually and have a resolution of 1 kilometer (km) (LandScan). The SAB encourages the EPA to evaluate the appropriateness and the use of these other resources for the buffer methodology.

Recommendations about Proximity Indicators:

Besides discussing the new methodology for buffer analysis, the SAB notes some comments and recommendations regarding proximity indicators (i.e., indicators that aim to characterize the potential health risks and environmental exposure for communities that are within a certain distance from a point or a line source). Below please find recommendations regarding proximity indicators, separated into their respective tiers.

Tier 1 (Major):

- The SAB did not identify major recommendations on proximity indicators.

Tier 2 (Short-term):

- ***Provide more scientific justification for the decisions used in deriving proximity indicators.***

In deriving proximity-based environmental indicators, several decisions have been made by the EPA. The Agency has determined which environmental exposures and hazards to consider for the proximity indicators and identified which distances are appropriate for each point and line source. Not much scientific justification for the use of certain distance thresholds is provided in the technical documentation. The SAB recommends that the Agency improves the clarity of the documentation by:

  - *Providing scientific references to clarify why certain pollution sources are considered and others are not.* For example, the SAB suggests that liquefied fossil natural gas (or LNG) export facilities are added to the list of point sources considered. LNG export facilities store hundreds of thousands of gallons of supercooled, frozen methane. Although these facilities should normally be required to produce Risk Management Plans, due to a loophole, they are exempted from producing such plans, despite storing large quantities of explosive and dangerous chemicals.

  - *Providing scientific justifications for why certain thresholds are used for distances to different point and line sources and explain how distances are calculated.*
    The SAB notes that limited scientific justification is provided for the distance thresholds applied in deriving the proximity indicators. For example, it is unclear why 5 km was chosen as a threshold for the distance from National Priority List (NPL) sites, Risk Management Program (RMP) facilities, and hazardous waste facilities. The SAB invites the EPA to provide more robust, scientific justifications regarding the use of such thresholds. The SAB also recommends the EPA to better explain how distances to RMPs, Superfund sites, and hazardous waste facilities are calculated. The SAB also seeks clarification regarding: 1) the derivation of the centroids for the facilities, and 2) whether the centroids of polygons enclosing the facilities are used to measure the "distance-to" measure. The SAB recommends that if for RMPs, the centroids of the facilities are used to calculate distances, then a modeled diameter or buffer around the facility premises should be utilized instead, so that proximity indicators reflect the distance to the fence lines of a facility, as opposed to distance to the centroid of a facility.

Tier 3 (Long-term):

- ***Consider other (quantitative) aspects of a population's environmental exposure besides distance when deriving proximity indicators.***

The SAB has commented on the fact that distance is not the only factor that matters when representing a population's exposure to environmental hazards, pollution, or health risks. For RMPs, Superfund sites, and hazardous waste facilities, the length of time that a facility has been at that same location producing pollution should also be factored in. The "weight" of the facility should be greater if the facility has been at its location longer to capture a more intense effect of legacy pollution. Given the variety in facilities' size, the size of the facility (premises) should also be considered and used when assigning a "weight" to a facility. Additional factors that could be utilized for weighting individual facilities include average or total annual emission quantities, total quantity of hazardous substances stored, used, or handled, and toxicity-weighted emission quantities.

Directionality should also be taken into consideration when EJScreen is used. While for a screening tool, creating isotropic buffers without any directional biases is acceptable, directionality should be considered for downwind or downstream analysis, since it affects the level of exposure experienced by populations in a community. Examples are wind direction affecting population's exposure to air pollution and groundwater flow for exposure due to the presence of hazardous sites and underground storage tanks.

The size of the facility is also another aspect to consider and along with distance from the pollution source. The technical documentation discusses the fact that when dealing with large facilities or sites, representing the pollution source with a point may not be adequate. If a polygon of a facility is not available, then a shape representing the area of the site must be substituted and used, as opposed to a centroid of a facility. For this type of situation, the SAB suggests using remote sensing data (e.g., aerial photography) to calculate the distance of communities from the source of pollution more accurately.

- ***Enable users to add other data (in various formats) or apply different distance thresholds to enrich the list of environmental exposure or environmental hazards considered.***

To provide more flexibility to users in defining aspects of environmental exposure and hazards that might be relevant to given local communities, the SAB suggests that EJScreen allow local communities to tailor the tool to their needs. Specifically, users could determine their own distance thresholds when defining environmental proximity-based indicators. EJScreen could provide a few options for distance thresholds using both imperial and metric distance thresholds. In the same spirit, the SAB also proposes that EJScreen allows users to export and/or upload additional data in multiple formats (not only in the form of shapefiles, but also in the form of Excel or comma-delimited text files, and .kml format for GoogleEarth users). This would enable local communities to capture other environmental hazards that are more pronounced locally and are more representative of the environmental burden experienced by the local populations. To differentiate between the user-inputted data and preloaded data available within EJScreen, it is recommended that different symbology be used when displaying the two types of data. Finally, the SAB suggests that the EPA considers enriching the list of environmental exposures and

environmental hazards accounted for within EJScreen to provide a better representation of the cumulative environmental burden experienced by local communities. To this end, the SAB suggests that the EPA investigate the possibility to include information on railroads and treat them as line sources of environmental pollution in the same way EJScreen incorporates and accounts for road traffic. The SAB suggests that the EPA explore and incorporate these data sources, as well as gas pipeline data, when the data are ready with sufficient quality control. Other related comments on this issue are included in the responses to charge questions for Topic Category 5.

Additional Considerations:

The SAB also notes other potential considerations that may be relevant to the EPA.

- ***Consider other qualitative aspects of a population's exposure when deriving proximity indicators or when performing buffer analyses.***

It was remarked that the effect of environmental exposure from a point or a line source has a different impact depending on the type of boundary that surrounds the pollution source. For example, there is variability in the local environment around freeways: some segments of freeway are surrounded by a buffer of vegetation, thus reducing the impact of air pollution and noise in surrounding areas; others have a wall, again to limit the impact of pollution on the local populations, while others do not have any barrier around it. Some freeways have been converted into tunnels in some areas, while in some cities, freeways have been covered by platform parks. The SAB suggests that features of the built environment surrounding point and line sources of environmental hazards and pollution be considered when deriving proximity indicators or when performing a buffer analysis.

The SAB also commented on the importance and necessity to take into consideration also other aspects of exposure – not only environmental – when performing a buffer analysis. Focusing on the example of communities that have been bisected and fragmented by the highway system in the 1960s, the SAB reflected on the impact freeways had on the quality of life experienced by the affected communities. Businesses suffered as they were suddenly located next to a freeway or an underpass, and people no longer traveled through streets. The economic impact was not the only aspect that potentially took a toll on the health of these communities. Also, the isolation and worsening of quality of life for these communities contributed and affected their health status. Because of these considerations, the SAB invites the EPA to develop an approach that allows users to incorporate these more qualitative aspects linked to the built environment surrounding a community when developing proximity indicators and carrying forward buffer analyses.

2.2.3. Charge Question 7: *Please comment on whether the EJScreen website and technical documentation are clear, accurate, and transparent? Do you have any specific suggestions on how to improve EJScreen documentation?*

The SAB commends the Agency for the amount of work devoted to developing the EJScreen website, which presents itself as a comprehensive resource with an impressive amount of information. Although the website offers a great deal of information, it could be overwhelming

to users, specifically first-time users as well as local communities, and targeted audiences. To improve its utility and documentation accessibility, the SAB provides several recommendations.

Recommendations:

Tier 1 (Major):

- ***Differentiate between technical documentation and a user guide for a less technical audience.***

Despite the fact that the technical documentation is already filled with a great deal of useful information, the SAB feels that more scientific justification and details are needed for technical audiences. Because additional information might be cumbersome and not of interest to a less technical audience, the SAB suggests that two types of documentation be developed:

1) A technical document that details EJScreen calculations and provides references and scientific justifications for the approaches and the EPA's choices in deriving indicators, conducting buffer analyses, why certain approaches were not entertained, etc.; and

2) A user guide tailored to a less technical audience to assist users navigate the tool. The user guide could contain links to tutorial videos to address questions such as "How do I ..?", include a list of frequently asked questions, and have a "Fact sheet/At glance summary sheet" for making the tool more easily approachable by community users and associations working with them.

One of the tutorial videos addressing "How do I..?" could show how a user can add shapefiles or any other data format (e.g., Excel spreadsheet, a file with street addresses, etc.). For shapefiles, the video could discuss what system of projections EJScreen uses, what needs to be included in the additional data source, etc. In developing the user guide, the SAB strongly urges the EPA to develop material that is more visual to engage a wider audience and cater to users who learn in different ways, not simply by reading.

Tier 2 (Short-term):

- ***Increase transparency and accessibility with respect to the data used within EJScreen.***

To increase the transparency and accessibility with respect to the data used in EJScreen, the SAB recommends that the Agency should:

  - Create a table with acronyms used throughout the documentation and the user guide.

  - Create a table with a hyperlinked list of all the data used in EJScreen to derive the different indexes and indicators. The Table should provide information on the data source, who collected/created the data, the spatial and temporal resolution of the data, indicate whether the data refers to observations/actual measurements or is the result of a statistical/computer model. Additionally, the list should provide the most recent date of data retrieval and uploading. Finally, if the data refer to estimates or outputs of a

statistical or computer model characterized by uncertainty, data tables should indicate whether measures of data uncertainty are available.

- Create a table providing summary and descriptive statistics for each variable used to derive the indexes and indicators generated within EJScreen.

- Include more information on the EPA website regarding the 'Office Hours' hosted for users of EJScreen and its purpose, as well as the potential list of topics to be discussed during that time period. This activity has the potential to create a systematic mechanism to obtain information and feedback from users (or feedback loop) on how to enhance the tool. Other related comments and recommendations on this issue are included in the responses to charge questions for Topic Category 3.

- Include a table that lists all the distance thresholds specified with EJScreen and employed for the different proximity indicators in the technical documentation.

- The EPA should also include a clear definition of the term "nationally consistent" in the EJScreen technical documentation since this term represents the criterion for inclusion or exclusion of datasets utilized by EJScreen, as described previously.

Finally, the technical documentation and user guide should be sufficiently standalone with minimal reliance on additional information from the EPA website and/or other data websites.

- ***Add a high-level description of each data source and justification cited in EJScreen documentation and avoid depending solely on links that may become invalid over time.***

Other comments related to data justification are included throughout this report.

- ***Consider redundancy with respect to access to information.***

The SAB recommends that the EPA increase the accessibility of the tool with respect to where a user could access information. The technical documentation, user guide, and information on the data, data sources and indicators should be available online for download and could be reinforced by pop-up windows as a user navigates through the tool.

Tier 3 (Long term):

To ensure that EJScreen can be used effectively and benefit local communities, the SAB recommends the following:

- ***Develop tutorial video centered around specific case studies that are of relevance to local communities.***

In determining case studies, the SAB suggests that the EPA carefully develop and vet specific case studies with proactive local community users.

- ***Conduct formal user testing involving the user interface team.***

The SAB recommends that the EPA conduct formal effectiveness testing on the user guide and video tutorials based on local community use of the tool and conduct with certain tasks and exercises. The experience, feedback and difficulties experienced by users in working with EJScreen should be surveyed and used to update the tool. A user interface team should be involved in these testing sessions to prioritize users' issues, experiences and improvements. These efforts should include:

  - Producing videos based on recording of office hours and

  - Creating a walkthrough of the tool for the EJScreen app.

Additional recommendations to enhance EJScreen users' interface are included in Topic Category 3.

Detailed comments on the current version of the technical documentation (with their specific pages) are in Appendix B.

2.3. Topic 3: Recommendations on the Demographic and Environmental Considerations in the EJScreen Equations *(Charge Questions: 8, 9, and 10)*

The SAB examined charge questions on the demographic and environmental considerations in the EJScreen equations with a focus on demographics inputs used in the calculation of the EJ and Supplemental Index calculations, whether the average of the demographic factors in the Demographic Indexes (both main and supplemental) is appropriate and scientifically defensible, and reviewed current nationally available datasets used in the tool and additional datasets that should be included in the tool.

The SAB agreed that people of color and low-income should be included as demographic inputs into the main index. The SAB provided several recommendations on how to improve the main EJ Index and Supplemental Index including adding indicators and datasets that better represent populations who may experience environmental injustice in urban and rural areas and on tribal lands due to underlying social, economic, and geographic vulnerabilities, susceptibility factors, health status, work conditions, and the lack of or access to infrastructure and resources. The SAB agreed that the use of the demographic factors in the main and expanded indexes was appropriate and scientifically defensible and useful for ranking and comparing communities with environmental justice issues. However, due to uncertainty associated with the inclusion of multiple indicators and calculations used to obtain the average, the SAB recommends improvements in the scientific rigor with more details on the assumptions and limitations, associated with its use of averages in the indexes, and sensitivity analyses as discussed below.

The SAB agreed that having nationally consistent datasets was important, but also emphasized the importance of including indicators and datasets that populations and communities experience at the local level. The SAB provides a few major recommendations on including better rationale descriptions and more complete documentation on datasets and indicators as well as how the data

were collected. Additionally, the SAB recommends that the EPA improve the relevance and utility of the tool for rural areas, Indigenous Peoples and tribal communities, and communities of color; and improve its functionality, interoperability, and ease of use at different resolutions, scales, and granularity.

2.3.1. Charge Question 8: *EJScreen averages data on low-income and people of color to form the Demographic Index which is used to create the EJ Indexes. The Supplemental Indexes use an average of data on low-income, unemployment, less than high school education, limited English speaking, and low life expectancy to form the Supplemental Demographic Index. Please comment on whether the demographic inputs used in the EJ and Supplemental Index calculations reflect the peer-reviewed literature and current understanding of the demographics on environmental justice/vulnerable communities and if there are any suggested additions, deletions, or other changes to how these two Demographic Indexes are calculated?*

The SAB finds that the use of low-income and people of color to develop the Demographic Index was appropriate and reflected the weight of the evidence in peer-reviewed literature, particularly evidence indicating that people of color and low-income populations are differentially burdened by and exposed to environmental hazards and stressors. However, further discussion is needed to ensure geographic and regional variation of income and poverty is considered for communities with environmental justice concerns.

Regarding the Supplemental Demographic Index, the SAB expressed concern about the name of the index. The SAB suggests that the EPA change the name to "Enhanced Demographic Index" or "Comprehensive Demographic Index" and encourages the EPA to explore other options. Even though the SAB generally agreed about the inclusion of people of color, some members felt that Indigenous populations were not accurately represented in the Demographic Index. It was suggested that survey data from Bureau of Indian Affairs be used to obtain more accurate data for inclusion in EJScreen.

There were a number of comments about the limited English-speaking variable, suggesting that more work on this indicator may be needed. Careful consideration should go into whether an indicator of "limited English speaking households" captures, and does not underestimate, race as a key driver/predictor to environmental justice issues," particularly for Black/African American groups who may or may not be linguistically isolated. The SAB notes that the indicator could be a race-related indicator because it conflated both race/ethnicity or that "while limited English speaking" indicator and race/ethnicity data are related and often highly correlated to each other, each indicator represents and captures different community vulnerabilities. The SAB agrees that more work is needed to improve the utility of this indicator, especially when used in the Supplemental Demographic Index where race as an indicator is excluded. For instance, the "limited English speaking indicator" may not fully capture the Indigenous People who lost native languages due to colonization practices in history or Black/African American and other groups who are descendants of persons enslaved in the U.S. Additional analyses should consider ways to include populations such as Indigenous or Native American people.

The SAB suggests that the EPA explore the possibility of including more income-related indicators that better capture the vulnerability that increases the risk of a socioeconomically

disadvantaged group outside of the current unemployment indicator. The SAB notes that using the current unemployment indicator may be problematic because it does a poor job of capturing social vulnerability in comparison to other socioeconomic status indicators. The indicator also has the potential to dilute the effects of other indicators like poverty and less than high school education. In general, there was consensus on the need for new income-related indicators to be used in EJScreen. For example, the use of an employment indicator that captures underemployment may better reflect the socioeconomic conditions in communities experiencing environmental injustice.

Another suggestion is to include the percentage of household income used for paying property taxes as a new measure of economic burden. Other possibilities include per capita income, median household income, and percentage of renter-occupied housing units. Additionally, the EPA could use extremely low-income as an indicator to help us highlight and focus on highly vulnerable groups in almost a hyperlocal way which is very important because environmental justice is very local and location-based. Furthermore, single parent households and the percentage of free or reduced meals provided in public schools were suggested as indicators to capture the economic burden of populations of concern, particularly school-age children.

As mentioned in Charge Question 2, the SAB recommends that the EPA explore the possibility of the inclusion of low life expectancy, which needs more clarification and examination. Some members argued that low life expectancy is not a demographic or socioeconomic indicator and should not be included in the main EJ Index or the Supplemental Index. One member suggested that its inclusion in the current Supplemental Index may act as a race-proxy/racism-proxy indicator or to capture cumulative health vulnerability. Others thought that if its inclusion was meant to capture cumulative biological susceptibility, then other health-related indicators should be added to EJScreen.

For health-related indicators, more data from CDC PLACES could be added to the Supplemental Index to capture health outcomes. It would be important to add health data beyond respiratory disease and cardiovascular disease outcomes. However, the SAB notes the limitations of CDC PLACES data, as the smallest geographic unit of data available is at the census tract level. For other indicators, the SAB suggests the EPA consider mental health data, health insurance, health care access data, Medicaid, and Medicare populations, and whether an area was medically underserved or a healthcare professional shortage area.

If EPA includes health-related indicators in the EJScreen tool, then a public health index may be necessary. This index should include health-related indicators, including disease status (prevalence data), and data on well-being including mental health, quality of life, and the life expectancy indicator. Low life expectancy is a good indicator; however, it should not be included in the Supplemental Index. Rather a low life expectancy indicator should be moved to a separate index. Other related comments and recommendations on this issue are included in the responses to charge questions for Topic Category 1.

There was a wealth of discussion and consensus that a number of populations were missing from the existing Supplemental Index. The SAB notes the need to include children below the age of 5 and adults above the age of 65 due to their life stage as a susceptibility factor for increased risk of exposure and poor health outcomes associated with living in an area with hazards or

stressors.[2] [3] The SAB suggests that the EPA uses contextualized age groups in the tool based on the region or whether it is an urban or rural area. For example, individuals 20-44 years old have been disproportionately impacted by the opioid epidemic in rural communities, and this age group is disproportionately impacted by incarceration in urban communities. Additional discussion occurred on the need to have more context-specific demographic indicators in the tool that may be more representative of the populations of concern in rural and remote areas compared to populations of concern in urban areas. For example, the SAB suggests that the EPA include populations residing in remote and isolated areas with access to limited infrastructure.

The SAB recommends that the EPA incorporate non-census and non-ACS data into the EJScreen tool to better capture socioeconomic vulnerability of groups who may be experiencing environmental injustices. One reason to use other datasets is because the data from the Census generally captures populations through their residential addresses but may not accurately capture the social and economic vulnerability that are related to places where people spend their time during the day. The census data focuses more on residential environments and does not adequately capture exposures in other microenvironments like schools or workplaces. The SAB also recommends that the EPA consider these microenvironments (e.g., schools or workplaces) and add kindergarten to 12th grade education (K-12) data to include school environment data, as well as workplace data (e.g., data from OSHA as additional layers in the tool).

The SAB recommends that the EPA include other important vulnerable populations either in the main EJ Index, Supplemental Index, or as context layers. It is also important to include migrant workers who have greater exposure to pesticides and could experience greater exposure to heat and other physical stressors due to their work environments. Migrant child labor is also a concern that the EPA may want to explore as an indicator in the tool. The SAB recommends that the EPA also include homeless populations and incarcerated individuals (including individuals currently in a prison) or formerly incarcerated and back in their home communities. Additionally, as addressed in Charge Question 1, based on the new Presidential Executive Order 14096 on Environmental Justice, the SAB suggests the addition of an indicator to capture individuals with disabilities (i.e., physical, mobility-related, and disease-related).

There was rich discussion among the members that more vulnerability-related indicators should be included in the EJScreen tool, and that the EPA should explore the possibility of including the indicators in the main EJ Index, Supplemental Index, or a different index. The SAB further notes the connection between environmental justice and resources. In traditional environmental justice work, the scientific community reviews data to assess differences in burden, exposure, and risk associated with environmental hazards and chemical and non-chemical stressors. The SAB suggests that the scientific community should take more of a social determinant of health approach to screening for environmental justice and use relevant indicators and/or indices, as well as explore other research areas conducted by social scientists (e.g., capabilities justice, among others).

[2] U.S. EPA Children's Health Protection Advisory Committee (CHPAC). Letter to the EPA Administrator on Future Direction of the America's Children and the Environment (ACE) Report (dated February 28, 2023). Available at docket number: EPA-HQ-OA-2023-0030.

[3] U.S. EPA Children's Health Protection Advisory Committee (CHPAC). Letter to the EPA Administrator on Climate Change Report (dated August 28, 2023). Available at docket number: EPA-HQ-OA-2023-0030-0025.

The SAB notes a number of health-promoting resources and/or infrastructure information that should be included in the tool such as: 1) access to supermarkets and grocery stores; 2) access to transportation; 3) access to safe and healthy housing; 4) access to parks and green space; 5) access to clean rivers and streams; 6) access to ecological goods and services; 7) access to cultural wellness centers; 8) access to civic organizations; 9) access to churches, mosques, temples, other faith groups; 10) access to libraries; 11) access to community centers, Young Men's Christian Association (YMCAs), clubs, among others; and 12) access to healthcare infrastructure. One issue to recognize is access to insurance to not only include access to health insurance, but access to homeowners or renter's insurance. This could be an issue in communities and be costly in said communities because of climate change and the constant threat of climate related perturbations such as frequent floods, hurricanes, forest fires, and tornadoes.

The SAB offers suggestions about adding more mathematical rigor to the selection of indicators that should be used in the primary Demographic Index or Supplemental Index. The EPA could explore the option of using Principal Component Analysis (PCA). There could be a need to perform a sensitivity analysis since multiple versions of EJScreen are now available. The SAB agrees that whatever indicators are included or excluded, there needs to be some discussion about inclusion, exclusion, and limitations in appropriate documentation. The EPA should engage with impacted residents and populations of concern to help select the most appropriate demographic indicators for both nationally representative datasets and more regionally focused datasets.

The EPA should be aware of long-term consistency of metrics and duplicative efforts. This level of awareness will ensure that the tool has nationally consistent datasets. To improve the quality and rigor of demographic indicators used in the tool, the EPA could use data available from other federal agencies. Although the EPA could consider including social vulnerability-related indicators, it should be noted that the CDC already has a Social Vulnerability Index (SVI), and it may involve duplication of efforts. However, the CDC dataset and the SVI are only available at the census tract level and not at the block group level.

Recommendations:

Tier 1 (Major):

- There are no major recommendations for this question.

Tier 2 (Short-term):

- The SAB recommends that the EPA conduct a sensitivity analysis, and/or leverage a previous peer review report completed on EJScreen that includes a sensitivity analysis.

- The SAB recommends that the EPA include additional rural environmental and demographic specific indicators – particularly when looking at rural communities, as discussed in the charge questions for Topic Category 5.

- The SAB recommends that the EPA include other important vulnerable populations and microenvironments either in the main EJ Index, Supplemental Index, or as context layers, including socially disadvantaged or marginalized groups that are not included in U.S. Census or ACS residential data.

    - The SAB recommends that the EPA include immigrants, Indigenous People, and single-parent households as context layers in the Supplemental Index.
    - The SAB also recommends that the EPA add kindergarten to 12th grade education (K-12) data to include school environment data, as well as workplace data such as data from OSHA as additional layers in the tool.

- The EPA should align with the Executive Order 14096's new environmental justice definition. Specifically, the SAB recommends that the EPA include persons with disabilities as a demographic indicator for environmental justice communities.

Tier 3 (Long-term):

- The SAB recommends that the EPA consider the best way to incorporate homeless individuals, incarcerated residents, and Amish/Mennonite communities in the Demographic Index, Supplemental Index, or supplemental layers based on the representativeness of the data, availability of data, etc.

- The SAB recommends that the tool allow users to define what Demographic Index is included as a layer.

- The SAB recommends that the EPA develop more regionally specific Demographic Indices that are based, for example, on EPA regions or National Climate Assessment regions. The EPA should also engage impacted communities to help select appropriate demographic indicators and develop these and supplemental indices.

2.3.2. Charge Question 9: *Please comment on whether the use of an average of the demographic factors in the Demographic and Supplemental Demographic Indexes is appropriate and scientifically defensible. Details on the calculations can be found in the EJScreen technical documentation. Do you have recommendations on how these calculations could be revised to better address the targeted communities?*

There was a robust discussion among members about the use of an average of the demographic factors in the Demographic and Supplemental Demographic Indexes and if it is appropriate and scientifically defensible. The average is a measure that is commonly used in statistics by helping to normalize data across different units and ranges. The average has been used in screening tools like EJScreen because it is one of the simplest, most transparent, and easiest measures for the general public to understand and follow. In communicating information about the ranking of communities, it increases the ease of use, understandability, and inclusivity that is helpful for populations and communities of concern that are experiencing environmental justice issues. Since EJScreen is a screening tool, the ability to rank and compare communities is an important

aspect of making sure that the tool is responsive to the needs of those populations and communities that are experiencing environmental injustices.

The SAB recommends that the EPA furnish an accurate evaluation, description, and reflection of the phenomena and/or relationships that the average is trying to represent. The SAB requests that the EPA provide more details on the assumptions that underlie its application of average for the main Demographic Index and Supplemental Demographic Indexes. Based on the EJScreen technical documentation, the focus of the Demographic Index on people of color and low-income population is justified by Executive Order 12898 – *Federal Actions to Address Environmental Justice in Minority Populations and Low-income Populations*. The wording in Executive Order 12898 seems to suggest that particular attention ought to be focused on people of color and low-income populations with respect to environmental justice. Clarity is needed in the technical documentation on whether implementation of the Executive Order is accomplished with the union (*and*) versus the intersection (*or*) of these groups. In probability and statistics, "AND" and "OR" do not mean the same thing. Assuming that the Executive Order 12898 wanted to focus on the "OR" rather than the "AND", there is an implicit mathematical assumption that the use of the Demographic Index as the fraction of the proportion of people of color and the proportion of people of low-income.

To determine whether the demographic index is appropriate and justifiable is important to understand whether those implicit mathematical assumptions hold across the U.S. Note that the same implicit mathematical assumptions would hold if the Executive Order 12898 refers to the union or intersection. In addition, EPA should discuss impacts from the assumption of independence among demographic indicators (i.e., people of color, low-income, etc.) and environmental exposures. For example, if the assumption is that at least 50% of the people of color were low-income and at least 50% of the low-income persons were people of color across the entire country does not hold true, then the use of the average for the main Demographic Index and Supplemental Demographic Indexes for the entire country may be problematic. Other related comments and recommendations on this issue are included in the responses to charge questions for Topic Category 1.

The SAB members could see variation at the subnational level, including at the regional and state levels, that would support more sophisticated, representative, and accurate measures than the average. Because Census data collection and reporting cannot be changed, the SAB considers the EJScreen calculation to be appropriate given its primary goal of ranking communities (not ranking percentages). Thus, the SAB can assume that the communities who score higher on a particular index or set of indices also have higher raw values. This means that the use of the average calculation is justified and sufficient for the intended purpose without raw percentages.

Additionally, the members discussed that the 50% percent threshold for both people of color and low-income persons does not capture all individuals who experience environmental injustice. As numerous studies have shown, race is the single most important predictor of the distribution of environmental hazard and exposure in the U.S. Many people of color, particularly African Americans who live in middle- and high-income neighborhoods have been shown to experience environmental injustices. These areas (census tracts or block groups) should still be classified as areas with environmental justice issues. Due to the history of racism, disinvestment and divestment, barriers to wealth accumulation (generational wealth) and economic capital,

differential access to infrastructure and services, redlining, segregation, and limited political voice, many middle- and higher-income people of color neighborhoods experience environmental injustice in addition to their lower-income counterparts. The SAB also acknowledges that white, low-income communities experience disproportionate burden of environmental hazards and stressors, and questions if those communities should also be categorized and represented within the tool. The SAB also discussed the need to remove Indigenous or Native American people from the people of color indicator. There needs to be specific accounting of Indigenous People and separating them from percent non-white is an important first step. The SAB recommends that the EPA explore creating a separate average for Indigenous or Native American populations, given that qualitative differences exist, and they are highly regional, and often local. These changes have the potential to make EJScreen an even more powerful tool for Tribes and Indigenous Peoples.

To address concerns on use of the average in the main EJ Index and supplemental indices, the SAB recommends that the EPA performs sensitivity analyses. The SAB expressed concerns that the integration of people of color and low-income in the main Demographic Index or the integration of the five demographic indicators in the Supplemental Demographic Index can lead to dilution or masking at the census block group level. Sensitivity analyses would be useful for addressing accuracy of the measure at the national level and variation when using different combinations of demographic indicators.

The SAB recommends that the EPA enhance communication on how to use the tool and what the average means in the context of the main Demographic Index and Supplemental Demographic Indices. Through community engagement and integrated educational programming, the EPA can use the EJScreen interface to increase the spatial and scientific literacy of user populations, particularly those users who live in communities facing environmental justice issues. Through enhanced community engagement, the EPA could create a systematic mechanism to obtain feedback from users (or a feedback loop) to enhance the ease of use, navigability, and utility of EJScreen while seeking information to improve its scientific and mathematical rigor. Other areas of the report provide specific recommendations about how to enhance the technical documentation, the interface and obtaining feedback from users (see Topic Category 2). The average can be used as an initial starting point, but through bidirectional communication with user populations, additional more robust and advanced measures could be added to the tool. This approach would also allow the EPA to add important demographic factors such as race in the Supplemental Demographic Indices. Due to the wealth of scientific research on the role of race as the primary factor driving environmental injustices, it is recommended that the EPA include race as a demographic indicator in all relevant indices.

EJScreen should continue to be advanced as a tool that many different user groups will or could use, particularly individuals who are experiencing environmental injustice. The tool should be more intuitive, include clickable links allowing users to go more in-depth and navigate beyond the national level to explore more complex relationships. The tool should have flexibility in allowing users to add or remove specific demographic indicators in the Supplemental Index, as well as more detailed documentation on how calculations were performed, and which variables were included. Additionally, the tool should have a help desk for users to ask questions and get assistance on using the tool regardless of their level of knowledge in environmental justice or familiarity with using screening tools like EJScreen. Finally, changes made to EJScreen versions

should be documented and described so the users are aware of differences to previous EJScreen versions beyond the current "Change Log."

Recommendations:

Tier 1 (Major):

- There are no major recommendations for this question.

Tier 2 (Short-term):

- The use of an average of the demographic factors is appropriate and scientifically defensible. However, the SAB notes that by averaging indicators that can be of different ranges, there is the potential to mask the variability in the smaller indicators. Therefore, the SAB recommends that the EPA conduct additional sensitivity analysis to address this potential issue.

- The SAB recommends that the EPA focus on Native American and Indigenous communities more specifically within the tool (also as noted in the recommendations for Charge Question 8). The SAB also encourages that the EPA continue to engage with Tribes and Indigenous Peoples via webinars and/or other approaches on various aspects of environmental justice, including EJScreen.

- The SAB recommends that the EPA provide clarity on the assumptions and limitations of each indicator.

- The SAB recommends that the EPA provide clarity on what using the average means for the national comparison.

Tier 3 (Long-term):

- The SAB recommends that the EPA include spatial statistical approaches that allow hotspots to be identified, based on block groups: (a) with significantly higher values of socio-demographic and environmental indicators (separately); and (b) where significantly higher values of both socio-demographic and environmental indicators converge spatially.

- If the EPA adds additional measures to the demographic and supplemental indexes, the SAB recommends that the EPA expand its communication resources to help obtain systematic mechanisms to obtain feedback from the community of users to increase their capacity to utilize the tool. Additional considerations about this recommendation were described on Topic Category 2.

2.3.3. Charge Question 10: *Please identify other currently available, nationally consistent, environmental datasets that are germane to the issues impacting EJ communities but not yet included in EJScreen. Please provide input on the efficacy of the current indicators in terms of highlighting issues relevant to EJ communities; as well as feedback on criteria to ensure future indicators meet this goal and are not duplicative of other existing datasets.*

The SAB recommends that the EPA include other available, nationally consistent datasets relevant to issues impacting communities with environmental justice concerns but not yet included in EJScreen. Since many of the current indicators capture the presence of a hazard or stressor that may disproportionately burden certain racial/ethnic groups, socioeconomic groups, and geographies (rural versus urban), the SAB finds that it is important for nationally consistent data to be collected in a standardized and unified way. Data quality is fundamental; it is important to validate data included in the tool. There should be robust documentation explaining how the data were collected. Documentation and justification of datasets and indicators should be strengthened, compared to what currently exists for EJScreen. The EPA should engage various stakeholders in the development of the criteria for additional environmental data/indicators/variables for EJScreen. The SAB suggests that the EPA prioritize justifying the purpose of each dataset/indicator/variable and ensure that there is no duplication (added a new variable/indicator that is not similar to one already in use). Data agreements should also be in place on data ownership and permissions for use, because some of the most relevant nationally consistent datasets are privately owned, and to this end, the EPA must establish and maintain datasets that are durable and have longevity.

A general consensus of the SAB finds that the clarity of the datasets used for the tool would be improved if the EPA clarified the definition of "nationally consistent datasets" as the criteria used for indicators in EJScreen. However, having only nationally available and consistent datasets could be problematic since environmental justice or injustice is place-based, neighborhood-level, and hyperlocal (related comments on this issue are included in the responses to Topic Category 2 - Charge Question 7). Many communities impacted by environmental injustice and related health issues want to see a tool that captures their experiences with being overburdened by hazards or stressors; experiences with environmental racism, classism, or political marginalization; and/or their experiences with the lack of access to health-promoting social, environmental, economic, and health infrastructure (including green spaces, parks, grocery stores, living wage jobs, high quality schools, ecologic goods and services, healthy housing, among others). It should be noted, however, that some indicators (e.g., climate risks) are often positively correlated with income, wealth, and presence of certain ethnic groups. For example, high coastal flood and wildfire risks often coincide with desirable environmental amenities such as waterfront views and recreation, areas which are often occupied by high SES groups. This distinction between exposure and vulnerability implies that at least some of the suggested indicators may fail to capture the intersection of environmental risk and social vulnerability.

There was extensive discussion about how the current indicators are not relevant for various parts of the country. The tool seems to overemphasize urban areas and does not adequately

capture the experience of Indigenous Peoples and tribal communities. For example, the tool does not include indicators/variables/dataset that reflect the disproportionate impacts of the fossil fuel industry and related industries on rural communities. Some members suggested that flexibility is needed in defining nationally consistent datasets. In some cases, instead of using census tract or block group level data, county level data may be more appropriate. Members discussed the need to use units of analysis that were more appropriate for the geographic area such as census block groups may be useful for urban areas, but other units of analysis may be more appropriate for rural areas.

When trying to compare with the national average, having nationally consistent datasets was important, but having too many indicators could lead to some indicators masking more important ones or diluting the effects. The SAB agrees that criteria need to be developed on the type of indicators that would be included, data quality, data reproducibility, and data utility. There is a need to develop criteria on how the data would be used (i.e., would the particular indicator be included in the main EJ Index, Supplemental EJ Index, or as a layer that could be added to demonstrate a particular distribution or visualize an environmental phenomena). The SAB cautions the EPA on how many of these new indicators should be included in the main EJ Index. The EPA should describe how a particular indicator like oil and gas wells, or confined animal feeding operations (CAFOs) would only be represented as a count variable (e.g., number of wells or operations) for each block group and may not lend themselves well to a nationally consistent dataset. Other members thought that by using the American Petroleum Institute unique well identifier for oil and gas wells, a nationally consistent dataset could be developed.

The SAB finds that adding indicators would not negatively impact the integrity of the percentile ranking or scoring methodology (if a scoring methodology is developed in the future). Additional indicators would be beneficial for demonstrating areas with high vulnerability, burden, or risk. For example, the idea of adding some socioeconomic indicators that captured very low-income populations such as extremely low-income would be better suited as a map layer and not to be included in the EJ Index. The use of this indicator will allow decision-makers to micro-target areas where these populations are, populations that may be severely limited in their access to infrastructure, economic opportunity, care, insurance, social services, and political power. For example, environmental conditions in the arid parts of the U.S. Southwest and where people live in the borderlands are not adequately captured in this tool. The SAB seeks clarification about how the EPA address regions of the country where the tool misses the underlying environmental or socioeconomic factors that contribute to environmental injustices for these populations.

The SAB is interested in the EJScreen evolving into a national platform where users, including impacted populations, could access multiple tools, indices, indicators, and datasets. The SAB recognizes that there are limitations with EJScreen's ability to capture environmental injustice for all overburdened and underserved groups at a more local level. There is a potential that the one size fits all approach could be inappropriate. The SAB notes for future development, having multiple EJScreen tools including national level, regional level, and state-level tools could be beneficial for environmental justice communities. There are many state-level screening tools that work better than EJScreen because they have context-specific, spatially relevant indicators. Screening tools like CalEnviroScreen and others have many datasets including pesticides and CAFOs that are not currently available in EJScreen. The SAB suggests that the EPA should work on developing multiple screening tools (e.g., a national screening tool as well as regional tools),

with the long-term goal of a EJScreen tool for every region since many states do not have their own EJScreen tool. For example, the tool Maryland-EJScreen is currently available and there are discussions about developing a regional EJScreen tool for EPA Region III. The SAB finds that having tools that are flexible with multifunctionality is important. The SAB highlights the need for the EPA team to focus on scalability, interoperability, resolution, and targeted scale which would allow EJScreen to provide comparisons nationally with the capability to zoom into regional and local scales.

Several members noted that fit for purpose in the use and application of the tool is important. This "fit for purpose" construct should help drive what environmental indicators are added to the tool, and how and when the specific indicators are used. The SAB also suggests that the EPA work through its inter-agency collaborations and partnerships to bring more relevant health data into the tool from Health and Human Services particularly the CDC and additional data from other agencies including USDA, Federal Emergency Management Agency (FEMA), National Oceanic and Atmospheric Administration (NOAA), Department of Energy (DOE), and USGS.

Attached below is a list of data/variables/indicators mentioned during the discussion:

- Pesticides
- Climate-related Indicators
    - Extreme Temperatures (including extreme heat and cold)
    - Hurricanes
    - Wildfires
- Health
    - Cancer Incidence
    - Health Disparities
    - Mental Health
    - Quality of Life Indicators
    - Individuals with Disabilities
- Salutogenic and Resiliency-related Indicators
    - Housing Infrastructure
    - Food Infrastructure
    - Transportation Infrastructure
- Rural-Focused Indicators (as discussed in Topic 5)
- Energy-Related Indicators
    - Pipelines
    - Power Plants
    - Oil and Gas Wells
    - Fracking Sites
    - Liquefied Fossil Natural Gas (LNG) Facilities
    - Natural Gas Processing Plants
- Energy Burden Indicators
- Wealth Indicators
    - Percent Renters
    - Percent Homeowners
- Water-related Indicators
    - Water Quantity
    - Water Quality

    - Wetlands
    - Groundwater Contamination
    - Drinking Water Wells
    - Reclaimed Water Use
- Noise/Sound Indicators
    - Aviation Noise
    - Roadway Noise
    - Natural Noise
    - Man-made Noise
- Methane
- Confined Animal Feeding Operations (CAFOs)
    - Type of Animals
    - Weight of Animals
    - Number of Animals
    - Amount of Waste
    - Size of the Operation
- Age, Quality, and Access to Infrastructure
- Drinking Water Infrastructure
- Septic Tanks
- Publicly Regulated Sewer Infrastructure
- Combined Sewer Systems and Overflows
- Flooding Risk
- Impervious Surfaces
- Permit Compliance

Recommendations:

Tier 1 (Major):

- The SAB recommends that the EPA provide adequate justification for the inclusion or exclusion of indicators representing conditions that communities with environmental justice concerns experience (e.g., whether the indicators were included in the tool, and why that was the outcome). For example, in the event an indicator was considered, justify why it was not included in the main EJ Index or Supplemental Index. This step is necessary to increase the transparency, accessibility, and validity of the tool. Other related comments on this issue are included in the responses to charge questions for Topic Category 2 – Charge Question 7.

- The SAB recommends that the EPA include documentation explaining data collection with more detail and justification for datasets and indicators in the current tool.

Tier 2 (Short-term):

- The SAB recommends that the EPA use census block groups and tracts for urban areas, but other units of analysis may be more appropriate for rural areas.

- The SAB recommends that the EPA develop criteria on use of the data (i.e., would the particular indicator be included in the main EJ Index, Supplemental EJ Index, or as a layer that could be added to demonstrate a particular distribution or visualize an environmental phenomena).
- The SAB seeks clarification on how the EPA will adequately address regions of the country where the tool misses the environmental or socioeconomic factors contributing to environmental injustice. Populations of arid regions of the U.S. Southwest and where people live in the borderlands are examples.

- The SAB recommends that the EPA team focus on scalability, interoperability, resolution, and targeted scales. This would allow EJScreen to provide comparisons nationally as well as the capability to zoom into regional and local scales.

Tier 3 (Long-term):

- The SAB recommends that the EPA include indicators that would not negatively impact the integrity of the percentile ranking or scoring methodology (i.e., if a scoring methodology is developed in the near future). This activity would be beneficial for demonstrating areas with high vulnerability, burden, or risk.

- The SAB recommends that the EPA develop criteria on the type of indicators that would be included in the tool, data quality, data reproducibility, and data utility. These criteria should be well-documented and publicly available.

- The SAB recommends that the EPA evolve EJScreen into a more robust national platform or portal where users could access multiple tools, indices, indicators, and datasets.

- The SAB recommends that the EPA work through its inter- and intra-agency partnerships to bring more relevant health data into the tool (i.e., Health and Human Services particularly the CDC and additional data from other agencies including USDA, FEMA, NOAA, DOE, and USGS).
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2.4. Topic 4: Advice on the Incorporation of Cumulative Impacts and Scoring *(Charge questions: 11, 12, and 13)*

The SAB recognizes that multiple pollutant exposures and population vulnerabilities can result in a cumulative burden and understands that cumulative impacts and effects on individuals and communities are of great concern to EJScreen users. The SAB is aware that users want to have a means of characterizing cumulative effects using a single number, or "score" that provides a meaningful and fair comparison of these effects among different places, with higher/lower scores indicating greater importance in terms of policy relevance.

Threshold maps provide one effective way for EJScreen users to characterize cumulative effects, and to look for patterns regionally, and the SAB recommends some improvements on enhancing effectiveness. As a way of identifying areas with greater cumulative effects, some researchers have developed single scores usually by aggregating or summarizing indicator values. Similar

efforts have been developed by state regulatory agencies, such as California, Maryland, Michigan, Colorado, New Jersey, and Washington. These efforts represent important steps toward understanding and characterizing cumulative effects, and the Agency should continue to develop that understanding.

The SAB provides several recommendations related to cumulative impacts to enhance the tool, including specific areas where the EPA could further leverage and/or expand some approaches that are already included in EJScreen.

2.4.1. Charge Question 11: *EPA introduced the threshold maps to EJScreen in 2022 for the first time. These allow EJScreen users to look across all twelve indexes at once, providing a cumulative outlook on vulnerable populations facing higher pollution burdens. Please comment on the suitability of the threshold maps for examining the cumulative environmental and social burdens on a community.*

The threshold map is a significant improvement to the EJScreen tool as it provides a more meaningful insight into cumulative impacts (however it is defined by the EPA) than single indicator maps or summary scores. Threshold maps also address the overarching need to be flexible and useful to many different users with different, often targeted, concerns. In particular, the capability to select and combine specific EJ indexes and specify percentile ranges with upper and lower bounds facilitates data exploration and analysis tailored to users' interests, allowing users to emphasize or remove metrics as their problem dictates. These new features are unique to this tool, making them particularly useful. The SAB finds the function to download a flat file of metrics and indexes, at either a state or national level, to be very useful, as it allows users to query individual block groups with the cursor and conveniently turn the selected block groups layer on and off during map exploration. The SAB finds that threshold maps also allow users to explore cumulative effects of multiple indicators as defined by their selection of indicators.

Given the utility and potential of the threshold maps, the SAB suggests that the tool allow users to export (i.e., in addition to a flat file of metrics and indices) the block group boundary files with descriptive attributes of the selected polygons, both in geodatabase and/or shapefile format, and in .kml format for GoogleEarth users. The SAB believes that the EPA could improve the maps' utility when comparing selected block groups to one another by symbolizing selected block group polygons with a color ramp (i.e., when including the saturation associated with the degree to which the selected variables exceed the minimum bound). This approach could provide a crude way to differentiate the highest/lowest attainment of the thresholds.

The option to have percentiles calculated using national vs. state samples is excellent, and the SAB urges that the EPA expand that option to other geographic regions. Because policy remedies for different environmental justice issues vary, it would be very valuable to non-technical stakeholders and communities to allow calculations by city, county, and different administrative district levels (e.g., EPA Region, air quality management district, political districts – City Council, County Supervisory, State or Federal political district etc.) Although this calculation is very simple, the SAB recognizes challenges on collecting the boundary files for these various geographic entities and organizing the choices on the dialogue interface to present them clearly and intuitively.

Recommendations:

Tier 1 (Major):

- The SAB considers the threshold maps to be a very significant improvement to the EJScreen tool and that the threshold maps are a suitable tool for users to understand multiple exposures and vulnerabilities in resident populations using the metrics available in EJScreen. The SAB recommends minor adjustments to improve their utility for users with different needs. In general, this recommendation includes options to aggregate and export data using different geographic units and improving symbology to display areas of increasing threshold exceedances in map view.

Tier 2 (Short-term):

- The SAB recommends that the EPA allow users to export (in addition to a flat file of metrics and indices) the block group boundary files with descriptive attributes of the selected polygons, both in geodatabase and/or shapefile format, and in .kml format for GoogleEarth users. The option to have percentiles calculated using national vs. state samples is useful, and the SAB urges EPA to expand that option to other geographic regions. Because policy remedies for different environmental justice issues vary, it would be very valuable to non-technical stakeholders and communities to allow for calculation by city, county, and different administrative district levels. The SAB also recommends that the EPA expand the option to have percentiles calculated using national vs state samples.
- The SAB recommends that the EPA improve the maps' utility to compare selected block groups to one another by symbolizing selected block group polygons using a color ramp, with saturation associated to the degree to which the selected variables exceed the minimum bound. This approach would provide an intuitive way to differentiate the highest/lowest attainment of the thresholds.

Tier 3 (Long-term):

- There are no long-term recommendations for this question.

2.4.2. Charge Question 12: The agency is interested in creating a cumulative score within EJScreen. Please comment on potential appropriate uses of a cumulative score in the tool.

The SAB recognizes that multiple pollutant exposures and population vulnerabilities can result in cumulative burden, and understands that cumulative impacts, its effects, and burdens on communities are of great concern to EJScreen users. Members are also aware of the desire of users to have a means of characterizing cumulative impacts using a single number, or "score" that is a meaningful and fair way to compare these effects among different places, with higher/lower scores indicating greater importance as such a score can have great policy relevance. Some researchers have attempted to develop metrics of this type, usually by aggregating or summarizing indicator values; similar efforts have been developed by some States

such as California, Maryland, Michigan, Colorado, New Jersey, Washington, Connecticut and potentially more. These efforts represent important steps toward understanding and characterizing cumulative effects, and it is the responsibility of the Agency to continue to develop that understanding. Methods inspired by States could be further explored at a national level along with the SAB recommendations provided below.

This charge question relates to potential uses of a cumulative score. Because no such score is currently available in EJScreen, the SAB comments on the process of developing such a score and inherent complications with creating a score that is both useful and well-supported by the scientific understanding of cumulative impacts, effects, and burden.

This task is first complicated by the absence of clear definitions of key terms, such as:

- "cumulative effects;"
- "cumulative impacts;" and
- "cumulative impacts assessment."

Clearly defined terms are necessary to focus meaningful analysis of this task. For example, "cumulative impacts" is increasingly being used by many different stakeholders in the environmental justice debate. This use is complicated and potentially confusing because there is no single standard definition, and there is a tendency for different stakeholders to adopt or assume their own definition. The lack of a standardized definition only serves to complicate and obfuscate progress in understanding environmental justice problems and solutions. To date, EJScreen has wisely avoided use of the term "cumulative impacts" or "cumulative risks" in technical documentation, the Frequently Asked Questions document, and within the mapping tool interface, but the EPA should lead the development of these necessary definitions and do so in a comprehensive and transparent manner prior to developing such a score.

Development of a cumulative score within EJScreen is complicated by concerns about how current EJScreen indicator metrics relate to cumulative impacts and limitations of these metrics for quantifying cumulative effects. The SAB finds that EJScreen currently lacks the appropriate metrics and a defined approach to quantify cumulative impacts. Current indicators reflect exposure or potential exposure and do not include information required to determine how they relate to actual impacts or effects. Several EJScreen indicators capture exposure to the same hazard ("double counting"), which would impose differential weighting among hazards that is a product of how and what data are collected, not their contribution to cumulative effects. The SAB finds that existing methods of calculating a single cumulative score would not fully address these challenges. A prematurely developed cumulative score that neither realistically nor fairly characterizes cumulative impacts carries a significant risk of misinterpretation and erosion of user confidence.

EJScreen is used for different purposes by a variety of stakeholders. For example, it is used by the public to better understand potential community-wide environmental concerns, and it is increasingly being used by federal and state regulators to inform permitting decisions and new health-based regulations. Because of EJScreen's widespread and cross-cutting applications, it is not feasible to expect a single score or index to provide meaningful results in all contexts. If a score or index is developed, the EPA will need to describe in detail the limitations and

assumptions associated with it and provide clear guidance on how results should be interpreted in different contexts.

Because not all environmental justice challenges will require users to utilize all of the EJScreen indicators to characterize cumulative effects, the SAB believes there may be value in organizing individual indicators into groups that address a common concern (e.g., organize indicators into categories and calculating "cumulative effects" for a given category). Categorical indices may also better support targeted decision making and the ability to conduct a targeted fit-for-purpose assessment. This approach could ensure that categories with more indicators would not have an outsized influence over other categories with a fewer number of indicators. These categories may include:

- Air impacts/risks
- Water impacts/risks
- Climate factors
- Health factors
- Housing factors
- Green space/ecological services

To advance the science of understanding cumulative effects, impacts and burdens within the context of environmental justice, the SAB recommends that the EPA organize a series of workshops, panel discussions, webinars, and other forms of intra-/inter-agency dialogue to advance current thinking on cumulative effects and drivers of adverse health impacts, as well as other environmental injustices. Specific groups present at these conversations should include, but not limited to, internal EPA staff, research staff from federal agencies, state agencies and regional bodies, federal advisory committees (e.g., National Environmental Justice Advisory Council Cumulative Impacts Workgroup and Board of Scientific Counselors), academic researchers, tribal and community leaders. Suggested topics of discussion should include:

1. Coordination of data sharing across jurisdictional boundaries (among state and federal partners);
2. Data gaps and data availability;
3. Methods and ways to account for exposure regional variability (see Topic Category 3);
4. Definitions of nationally consistent data for the purpose of EJScreen considering regional variability and uniqueness of place-based harms; and,
5. Methods to account for under- and over-estimation of risk, impacts, and burden.

Recommendations:

Tier 1 (Major):

- The SAB recommends that the EPA increase the prominence of the option to display data from other sources via a map service or GeoPlatform as means to channel discussions on potential cumulative impacts or cumulative effects within the threshold maps (e.g., CalEnviroScreen, Climate and Economic Justice Screening Tool (CEJST), Environmental Defense Fund (EDF) Proximity Mapping Tool, among others).

- The SAB recommends that the EPA evaluate the feasibility and utility of "cumulative indices" that are based on subsets of the available indicators. These indicators could be organized into relevant categories for addressing specific concerns.
- When defining specific terms expressed as numbers (one single value), such as "score" in EJScreen, the SAB recommends that the EPA use the term "index" or "assessment" instead, as it is both more accurate and prudent. If the Agency decides to include a "score" or "index" of cumulative impacts in the context of EJScreen, the EPA should first define key terms clearly to ensure their consistency and correct use. Examples include "cumulative score," "index," or "metric" of cumulative effects, and "cumulative impacts." If EPA develops or uses any metric or indicator of cumulative impacts/effects/burden, the SAB recommends a comprehensive explanation of what such "metric" or "indicator" does and does not say about a location or population to guard against misinterpretation.
- The SAB recommends that the EPA organize a series of workshops, panel discussions, webinars, and other intra-/inter-agency dialogue to advance the current thinking on cumulative effects and explore options for developing a cumulative score in EJScreen. Specific groups participating in these conversations include, but not limited to, National Environmental Justice Advisory Council Cumulative Impacts Workgroup and Board of Scientific Counselors.

Tier 2 (Short-Term):

- The SAB recommends that the EPA include a review of "cumulative impacts" analyses that have been completed by the Agency and/or others in the EJScreen technical documentation.
- The SAB recommends that the EPA identify appropriate ways for EJScreen to inform users of cumulative "effects."
- If the EPA develops a single cumulative "score" or "index," the SAB recommends that the EPA associate the cumulative impact metric to a very-well-defined purpose or question that the cumulative impacts metric is intended to address.
- The SAB recommends that any indicator or metric that the EPA develops by aggregating data values into a single number be consistent with the context of EJScreen as a tool for screening purposes.

Tier 3 (Long-Term):

- There are no long-term recommendations for this question.

2.4.3. Charge Question 13: One technical difficulty in creating a cumulative score is the weighting of environmental indicators. Please advise on specific approaches for combining the environmental indicators together into a single score, including how to appropriately weight the various indicators to represent the risk burdens more accurately. Please comment on methods to incorporate other factors into the score, such as climate, health, and other social factors.

At this time, the SAB does not support any systematic weighting scheme or a structured weighting strategy due to the many complications related to characterizing highly correlated variables, lack of quantitative analysis or evidence on specific relative weights or values for the types of indicators used in EJScreen and the subjective judgements that would be needed. A structured weighting system could also hinder the addition of new relevant indicators as they become available. Specifically, there is limited scientific knowledge and data of the human health and environmental impacts that would be necessary to quantitatively weight relevant indicators based on their severity. In this regard, no change to EJScreen is recommended by the SAB at this time. Instead, the SAB recommends a capability for individual users to apply customized weighting schemes, although it should be made clear that the EPA is not applying relative weights and does not sanction any particular scheme or structure. The SAB cautions that the technical difficulties associated with justifying users' weighting decisions are significant.

In any scoring system of the type suggested here, it is important to note that if indicators are added, averaged, ranked, or otherwise aggregated using simple arithmetic, the relative weights of the various components are assumed equal. There are several examples of attempts to change these relative weights, but there is not a great deal of evidence-based demonstration that can provide guidance for expressing these weights specifically or quantitatively. However, risk assessment principles, first advanced by the National Academy of Sciences (NAS), commonly apply numerical factors or multipliers to account for potential human sensitivity (as well as other factors such as data gaps) in deriving acceptable exposure levels. There are also few examples of this type of weighting from attempts to develop some sort of "cumulative score" to look to for guidance.

The current version of CalEnviroScreen's screening tool has provided the most thoughtful and careful rationale for their weighting decisions (this is different from their decision to treat their "population characteristics" indicators as effect modifiers to their "pollution burden" metrics, mentioned earlier). Their technical documentation[4] for the current tool includes this rationale and the evidence used to guide their weighting decisions. A careful reading of these explanations reveals that, in many cases, relative weights were assigned based on recognition of "principles" that are "widely used and accepted" by other agencies, or of their own assessment of relative importance between indicators; for this reason, these weighting decisions are largely subjective. Examples include their decision to weigh the "environmental effect indicators" less heavily than the "exposure indicators" based on the premise that people may not necessarily be exposed to the former, their "weighted sum" approach to define the Final Lead Risk from Housing Score, and their "weighting matrix" for sites undergoing cleanup actions due to the presence of hazardous

[4] Information available at: CalEnviroScreen 4.0.

substances. Another source of information on relative weighting is provided by the Centers for Disease Control and Prevention in their recently released an Environmental Justice Index tool.[5]

The SAB agrees with EPA that combining this diverse array of indicators is challenging, and that the problem will become more fraught with the addition of more indicators. Another key challenge is that many indicators are correlated with each other, and subject to double counting as mentioned earlier, ultimately allowing some indicators to exert a disproportionate impact on any cumulative score. As an example, New Jersey's EJMAP tool uses separate indicators for $PM_{2.5}$, cancer risk from diesel particulate matter, and measures of mobile sources of air pollution - three separate indicators that all reflect different estimates of $PM_{2.5}$ exposure. However, each is counted separately in their cumulative score, with a weight equal to other indicators. Similarly, indicators related to a lack of greenspace - such as inadequate recreational spaces, rural areas, low percentage of tree canopy, and abundant impervious surfaces[6] are measures of very similar characteristics that are highly correlated but are added separately into a cumulative risk score. Any cumulative score can benefit from numerous indicators, but those that measure or reflect similar factors must be carefully considered in the scoring process.

Although the SAB does not recommend a specific method to incorporate other factors into a cumulative score, such as climate, health and other social factors, careful attention must be paid to the relative contribution of any one indicator or factor (at its relative weight) on the overall score to avoid biasing the score by "overweighting" a given metric or issue. CalEnviroScreen researchers have used sensitivity analysis extensively to determine the impact of weighting choices on their final scores. Separating indicators into categories, as described earlier, will allow for the incorporation of many indicators in one category (if they exist) without overwhelming the importance of other categories. This is especially important in a more fit-for-purpose analysis. For example, if EJScreen were to be considered in a National Pollutant Discharge Elimination System (NPDES) permit approval, existing local water impacts would be a primary concern, with potential climate impacts being of less importance. Similarly, a categorical approach could help address the problem of screening metrics bias in favor of urban or industrial areas, as the available data used by EJScreen and other screening tools is more focused on activities that are far less common in rural areas.

While there is lack of support for a systematic weighting scheme within EJScreen currently, there is significant interest among users to have some capacity to emphasize some indicators over others for fit-for-purpose applications. The SAB recommends that the EPA consider providing mechanisms within the context of EJScreen where users can apply their own relative weights. The Agency should avoid specifying weights or providing any guidance on what weights might be appropriate but might consider commenting that different states could (and should) apply weights differently.

Recommendations:

Tier 1 (Major):

- The SAB does not support any systematic weighting scheme as there is insufficient scientific basis for determining such weights. Specifically, there is limited scientific knowledge and

[5] Information available at: https://www.cdc.gov/media/releases/2022/p0810-environmental-burdens.html.
[6] Note that these indicators do not currently exist in EJScreen but these indicators, or other like them, were suggested additions.

data on the human health and environmental impacts that would be necessary to weight relevant indicators based on their severity. In addition, most of the EJScreen metrics do not include or provide the information needed to determine relative weights. The SAB recommends that the EPA avoid specifying weights or providing any guidance on what weights might be appropriate.

Tier 2 (Short-term):

- There are no short-term recommendations for this question.

Tier 3 (Long-term):

- The SAB recommends that the EPA consider providing mechanisms within the context of EJScreen so that users can apply their own relative weights.
- While the SAB currently does not recommend the weighting of indicators, if EPA decides to pursue this approach, a comprehensive sensitivity analyses should clearly communicate the contribution of any one indicator (at its relative weight) on an overall score, to avoid biasing the score by "overweighting." It should also be clear that a high value for a score or index does not by itself demonstrate greater health or other adverse impacts.

2.5. Topic 5: Input on Better Consideration of Rural Geographies within EJScreen

(Charge Questions: 14, 15, and 16 – the original CQ14 is now 16, the original CQ15 is now 14, and the original CQ16 is now 15)

EJScreen is impressive in its detail, scientific quality, and ease of use, and documents appropriate applications and known limitations of the tool with adequate clarity. Recent revisions to the tool are logical and enhance functionality overall. The SAB commends the EPA for the effort expended to develop, refine, and improve the tool.

The representation of rural communities is a major consideration for EJScreen, a consideration which is a common theme throughout this report. The SAB offers both general and specific feedback pertaining to each of the charge questions under Topic Category 5, in terms of: (a) defining rural areas; (b) identifying nationally consistent datasets to document environmental justice issues for rural communities; and (c) distinguishing rural from urban areas and incorporating calculations or comparisons between rural and urban areas. The following points summarize overarching issues and themes for Topic Category 5.

The SAB recognizes that environmental justice issues in rural areas are to some extent qualitatively different from environmental justice issues in urban areas. Rural environmental justice issues are defined by the typically peripheral status of communities and their economic integration as sites of extractive, primary sector industrial activities, as well as by communities' particular resources, capacities, and environmental assets. The SAB is concerned that, through the process of selecting indicators and developing calculation approaches, EJScreen inadvertently introduces biases that work against the goal of identifying environmental justice issues in rural communities.

In rural areas, a lack of access to resources often underpins environmental justice issues. This includes a lack of access to healthcare, food, social services, and basic public infrastructure such as clean water and sanitation, broadband internet, and recreational spaces (e.g., greenspace). Environmental justice issues among tribes, Indigenous Peoples, and migrant individuals are also of particular concern in rural areas, as is the proximity of vulnerable population groups to pesticides, hazardous and industrial waste, animal feeding operations, transportation noise, open dumping, and designated landfills, among other environmental health hazards. The SAB agrees that indicators gauging the lack of access to resources are not well represented in EJScreen and that user quantification of the lack of access to resources in many rural U.S. communities should be systematically integrated within the core indexes of EJScreen. Several nationally consistent data sources, described under Charge Question 15, were identified by the SAB to enable this quantification.

The SAB finds that pollution exposures related to primary sector economic activities including agriculture and extractive industries (oil and gas or mining, etc., and infrastructures to process and transport resources), as well as other environmental indicators (including environmental assets) that are especially relevant to rural areas, are not well represented in EJScreen. The SAB highlights nationally consistent data sources, described under Charge Question 15, that can enable better integration of environmental indicators relevant to rural community environmental justice issues in EJScreen. Additionally, while EJScreen has included "climate change data" indicators relevant to rural communities (e.g., flooding, wildfire, heat), those indicators are not integrated into the core EJScreen indexes.

Finally, EJScreen should enable users to distinguish rural areas from urban areas in examining or exploring core EJScreen indexes. A topic of extensive discussion was how to operationally define rural areas, given various alternatives. Several of the standardized and nationally consistent datasets with definitional assumptions highlighted by the SAB can enable stratification of rural from urban areas within EJScreen.

2.5.1. Charge Question 14: Currently there is not a definition of rural communities in EJScreen. To implement different calculations for rural and urban communities, EJScreen will need to start by defining this term. What is an appropriate and scientifically defensible definition of rural communities for use in an EJScreen context? *(Original Charge Question 15)*

There are common characteristics of rural areas that shape community experiences (e.g., in terms of populations, land uses, social services, community resources, infrastructure, isolation or lack of connectivity, and environmental assets). There is no single definition of *rural communities* that EJScreen should adopt because rural EJ issues differ regionally, and communities are situated along the rural-urban continuum. While it is unnecessary for EJScreen to adopt a single definition of rural communities, for the purpose of better considering rural environmental justice issues, operational rural-urban continuum definitions based on existing, nationally consistent, datasets could be adopted for use in EJScreen.

The SAB recognizes the challenges with developing a definition for rural communities in the context of EJScreen. Federal agencies do not have agreement on how to classify rural versus urban areas and the estimates of rural populations range by orders of magnitude between about 7

million and about 70 million (Long et al., 2021). According to the Census Bureau, rural areas are defined as any territory, population and housing units that are not located in an urbanized area or urban cluster. An urbanized area is an area with a population of 50,000 or more, while an urban cluster has a population of at least 2,500 but less than 50,000. The U.S. Department of Housing and Urban Development (HUD) definition is based on the Census Bureau's criteria of population density, geographic characteristics, and proximity to urban areas. HUD defines rural areas in three ways: 1) a place having fewer than 2,500 inhabitants, 2) a county or parish with an urban population of 20,000 inhabitants or less, and 3) any place with a population not located in a Metropolitan Statistical Area and less than 20,000 inhabitants (Davis et al., 2022). The USDA's Rural-Urban Commuting Area Codes (RUCA) and Rural-Urban Codes (RUCC) datasets are based on underlying rural-urban continuum definitions that are applicable in the U.S. Definitions are typically based on population size and density, proximity to larger population concentrations, and commuting patterns or linkages. The FEMA does not have a specific definition for rural areas, but uses the definition provided by Census Bureau to determine eligibility for some of its programs and grants.

The SAB advises that the EPA also explore the utility of nationally consistent land-use and land-cover datasets for the purposes of distinguishing places along the rural-urban continuum. The USDA has had a long-time focus on rural areas and Land-Use, Land Value and Tenure data are available from its Economic Research Service.[7] The publicly available 30-meter resolution National Land Cover Database (NLCD) dataset from the U.S. Geological Survey (USGS) can be used for this purpose. The last publication of the NLCD was in 2016. There are other more expensive, but higher resolution and more frequently updated options, like those found at Planet.com. Converting these raster data to polygons and calculating areas of a given land-cover classification could provide reliable proxy measures for rural and urban areas.

For the purpose of environmental justice, there should be a focus on where rural communities reside and the presence or absence of hazards, critical infrastructure and services. The SAB provides the following guidance on how the EPA can develop an appropriate definition of "rural" for the purposes of EJScreen, if such a definition is indeed required.

Access to Resources

Rural areas are located outside of urban or suburban areas, often situated in agricultural or natural resource-dependent regions and have low population densities. These areas are commonly associated with limited access to critical infrastructure (e.g., sanitation, drinking water, paved roads, electricity, internet) and services (e.g., health care, transportation, education, food, social services, legal services), with populations that struggle with economic and social isolation, poverty, and limited job opportunities. One among several specific issues confronting many rural communities (in comparison to urban communities) is the relatively poor access to healthcare. Also, transportation could be a big expense in rural areas with limited access to public transportation and where travel distances are greater.

One challenge with defining rural communities pertains to differences between states and regions of the U.S. For example, Thomas et. al (2014) identified distinct cultural, geographic, and

[7] ERS Source – Land-Use, Land Value and Tenure data. Available at: https://www.ers.usda.gov/topics/farm-economy/land-use-land-value-tenure/

economic differences between three rural counties within the state of Georgia alone. Similarly, characteristics of rural Wisconsin differ from those of rural North and South Dakota or eastern Montana. If the EPA moves forward with a single definition of rural, the metric will need to be carefully researched and vetted. The Am I Rural? Tool offers a comparison of what is currently used for federal definitions of rural. The RUCA and Frontier and Remote Area (FAR) codes offer a potential metric to use for "ruralness." FAR codes appear to be a good first choice for further exploration, since they consider goods and services that are typically found in larger cities. For rural communities, the SAB considers goods and services to be a key metric. However, the SAB does not recommend a preferred option, and notes that the EPA would need to research further before incorporating the metric into the EJScreen tool.

Recommendations:

Tier 1 (Major):

- The SAB recommends that the EPA systematically examine rural-urban continuum classifications in existing, nationally consistent datasets, to determine which classification is best-suited for integration within EJScreen. Nationally consistent definitions that would be appropriate are RUCA, RUCC or FAR Codes. Some of these classification systems implicitly incorporate the limited or lack of critical infrastructure and access to services that in many ways are defining characteristics of rural communities captured by the U.S. Census Bureau urban and rural definitions. The EPA should use direct field observation (i.e., ground-truthing) as well as rural states and rural community input to identify the best-suited classification systems (other comments related to ground-truthing approaches are included in the responses to charge questions for Topic Category 1 – Charge Question 2).

- The SAB recommends that the EPA research, with input from rural states, organizations, and communities, how to optimally integrate a rural-urban continuum classification into the EJScreen platform to enable stratification of census block groups and comparisons at national and state levels, and then implement rural-urban stratification functionality within EJScreen.

Tier 2 (Short-term):

- There are no short-term recommendations for this question.

Tier 3 (Long-term):

- The SAB recommends that the EPA revisit whether an explicit definition of *rural communities* (or *urban communities*, or other communities situated along the rural-urban continuum) is needed based on user feedback and research regarding the strengths and limitations of implementing rural-urban stratification functionality in EJScreen.

- The SAB recommends that the EPA consider the use of national land use land cover datasets for classifying areas along the rural-urban continuum.

2.5.2. Charge Question 15: What currently available, nationally consistent, environmental datasets could be used to identify vulnerable rural communities overburdened by pollution? *(Original Charge Question 16)*

Nationally consistent datasets exist that can be used to identify rural communities as well as other communities across the rural-urban continuum. While the integration of new "climate change" indicators or data within EJScreen improves its capacities for considering rural geographies, additional environmental, social, health, and infrastructural datasets exist that can be used for the purpose of better identifying rural community environmental justice issues (e.g., datasets from the EPA, CDC, DOE, Department of Defense (DOD), USGS, etc.). Use of *environmental* datasets alone is insufficient for this purpose, and environmental datasets selected for use in EJScreen should encompass more than indicators of *pollution*.

Climate Impact Datasets

The First Street Foundation flood risk and wildfire risk datasets would be useful for rural areas. One measure especially useful would be "federally-overlooked 100-year flood zone risks," a measure based on erasing FEMA 100-year flood zones (i.e., "Special Flood Hazard Areas") in areas of overlap with First Street Foundation-delineated 100-year flood zones. Those federally overlooked areas have very low rates of flood insurance and other resources to protect against flooding, and many are in rural areas (unmapped by FEMA; Flores et al., 2023). An additional resource for climate change related hazards (i.e., floods and wildfires) would be Environmental Systems Research Institute (ESRI) Climate mapping for resilience and adaptation (https://resilience.climate.gov/). This mapping tool displays drought, inland flooding, coastal flooding, wildfire, and extreme heat.

Healthcare Access and Health-Related Datasets

Healthcare issues associated with the potential health impacts of pollution could be a proxy for pollution data themselves. Access to healthcare would be an indicator, since rural communities tend to have far fewer doctors, specialists and hospitals in their neighborhoods as compared with urban communities. As cited in Long et al. (2021), the Provider of Services dataset (hospitals) and National Plan and Provider Enumeration System (NPPES) are both available for the nation. The NPPES datasets containing both physicians and dentists, are available by zip code. Additional social indicators such as health insurance status could be used to identify vulnerable populations.

A tract level dataset is the Healthcare Access Indicators, CDC PLACES. The following two measures might provide a gauge for low healthcare access in EJScreen (perhaps as part of the supplemental index): Current lack of health insurance among adults aged 18–64 years and Visits to doctor for routine checkup within the past year among adults aged ≥18 years.

The CDC through its National Center for Health Statistics (NCHS) https://www.cdc.gov/nchs/data_access/ftp_data.htm provides downloadable public-use data files related to multiple national health care statistics and health care surveys. NCHS also provides data linkages to other federal agencies' health-related data (e.g., National Death Index (NDI) mortality data).

The Rural Health Information Hub provides information and resources on rural health issues. The site provides access to recent and reliable resources and tools to help understand rural needs and how to address them.

Infrastructure Datasets

Some nationally consistent data that could speak to infrastructure include the U.S. Energy Information Administration (EIA) Natural Gas Processing Plants data found here and their pipeline data, EPA's own Facility Level Information on Greenhouse Gas Tool (FLIGHT), and hazardous material accident/incident data from the U.S. Department of Transportation's Pipeline and Hazardous Materials Safety Administration (PHMSA). The EIA inventory of producing and idle coal mines available here is also useful, although the SAB cautions the EPA that the EIA Plants data are out of date in places, including Southwest Pennsylvania, the Panhandle of West Virginia, and Eastern Ohio. The SAB has the concern that the EIA Pipeline data and similar polyline files are being generalized in the name of National Security. In order to incorporate the FLIGHT data accurately they would need to be coded across industries and that is something that FracTracker Alliance has done here. The coal mine data needs to be more fully explored as much of this data are represented as point features. However, deep and surface mines should be represented as polygons instead of points because of their larger size, which is something for the EPA to consider with respect to accessing Federal Government satellite repositories.

It would be beneficial for communities with environmental justice concerns if the EJScreen tool were to separately include plastics producing facilities or producers. Regarding plastics and the need for a nationally consistent dataset, the U.S. Securities and Exchange Commission (SEC)'s EDGAR database may be a potential source. This database is a valuable source of information as it pertains to plastics producers as well as fertilizer producers with concentrated footprints in more rural areas of Florida and Louisiana's "Cancer Alley."

Additionally, the types of nationally consistent data that would address environmental justice issues in rural areas include controversial but established renewable energy sources like wood pellet facilities in lower income and minority communities in the Southeast. Other aspects to consider incorporating into a mapping tool to address rural area concerns especially around air quality and noise pollution include biodiesel plants, ethanol refineries, and potentially even large-scale methane digesters. These types of nationally consistent data do exist as organizations have generated them by way of data scraping exercises from industry websites.

Title V facilities are continuing to modify their permits and are clearly point sources of pollution and a source of environmental justice concern in rural areas like West Virginia.

The EPA could add a comprehensive inventory of facility incidents like major fires or hazardous chemical spills from facilities and due to failures transportation infrastructure in EJScreen. These incidents frequently occur at refineries around the country and appear to be increasing in recent years. Communities with related environmental justice concerns include Southwest Detroit adjacent to Marathon Refinery, Southeastern Philadelphia, and several neighborhoods in Corpus Christi and Houston, Texas. Exposure to potential chemical or toxic spills from proximity to transportation routes is an additional consideration that in particular can expose rural

communities. The 2023 train derailment in East Palestine, Ohio is a recent example of such an event.

Datasets for Environmental and Social Indicators to Identify Rural Communities Nationwide

For datasets with county level information, the EPA could consider using Pesticide Pollution; USGS Pesticide National Synthesis Project (public). The EPA would want to first select block groups within a buffer distance from agricultural areas based on land cover classification (e.g., using Land Cover Classification, National Land Cover Database (public)), and then assign pesticide risks for those block groups within counties. To effectively utilize the dataset the EPA would have to select pesticides of particular concern, as many pesticides are included in the database.

For a dataset at the census tract level that includes social indicators highlighting lack of resources relevant to the environmental justice issues in rural areas, the EPA could consider utilizing Social Environment Indicators; National Neighborhood Data Archive. Examples of social indicators include: food (grocery stores, convenience stores, and restaurants); health care services (e.g. physicians, dentists, mental health providers, hospitals, nursing homes, pharmacies); social services (food banks, child day care services, family social service agencies); law enforcement organizations; voter registration, turnout, and partisanship. To highlight food access issues in rural areas, the EPA could consider utilizing Food Access Research Atlas; USDA (public). This may be perceived as diverging from the focus of EJScreen, however it would not diverge any more than measures of health vulnerability. National Agricultural Imagery Program (NAIP) provides high resolution aerial imagery of agricultural lands across the U.S. The data can be used to identify areas with intensive agriculture and potential sources of pollution, such as fertilizer and pesticide runoff.

The National Wetlands Inventory (NWI) provides information on the locations, types, and extent of wetlands across the U.S. The data can be used to identify areas that are at risk of flooding or other water related hazards, as well as access to amenities (e.g., hunting, fishing, and recreational activities) for populations living in rural areas. USDA Natural Resources Conservation Services (NRCS) Soil Survey provides detailed information on soil properties, including soil types, depth, and drainage. The data can be used to identify areas with high levels of soil contamination, which could potentially affect the health of rural communities.

To separate noise estimates by transportation source, including aviation, road, and rail, the EPA could consider using the National Transportation Noise Map (Bureau of Transportation Statistics, public). In particular, the rail noise estimates might be relevant to rural contexts.

For a census block group method, the EPA could consider Domestic Well Locations and Populations Served in the Continuous U.S. Domestic wells could be highly correlated with reliance on septic tanks. Utilizing this dataset might require collaboration with USGS. Water quality in wells would be a critical environmental justice indicator to include, and the EPA may have data readily available.

Under the "Pollution and Sources" drop down tab, the tool speaks to "Wastewater Discharge" and is a good metric that appears to be relatively granular. The SAB suggests strengthening this metric by exploring the addition of Combined Sewer Overflow (CSO) point sources of pollution.

The following agricultural indicators of environmental justice could include: biosolids spreading operations and rates of spreading, The USDA Agricultural Census digitized here, CAFOs and associated manure slurry impoundments, and Carbon Capture and Storage Pipeline Infrastructure, which has the potential to be a significant environmental justice issue in rural areas.

The SAB cautions the EPA in the language of talking about "pollution" and the realities of the economy of rural America. The economy of rural America can include farming, ranching, and energy or mining or extractive industries. People who live in rural communities want both a clean environment and a good paying job that can keep them living in their community. The SAB urges the EPA to maintain, and if needed establish, a good working relationship and partnership with state agencies and rural communities to ensure proper consideration of rural communities with environmental justice concerns. Additionally, USDA Rural Data Gateway dashboards are easy-to-use tools that highlight critical Rural Development investments for people in rural America, including projects that have helped people in socially vulnerable communities access the resources they need to thrive.

The types of data that would enhance the view of rural areas and bring their environmental justice scores down include proximity to national parks and forests, wildlife refuges, etc. This would be something that would lift their scores while lowering those of urban environments. Similarly, the "Food Desert" indicator seems to need significant improvements given its failure to capture so much of what is a food desert in cities like Cleveland, Ohio and Detroit, Michigan.

Other sources of data that need to be incorporated include legacy and unconventional wells all over rural America. This should also include all manner of associated infrastructure including but not limited to natural gas compressor stations, gas gathering pipelines which have altered more of the Marcellus/Utica region of the Pennsylvania, West Virginia, and Ohio than coal mining, wastewater impoundments, and Class II Salt-Water Disposal (SWD) Wells which tend to be nationally-consistent even in states where EPA does not have primacy. The latter oftentimes are clustered in thin bands of states like Michigan or replete across whole states like Oklahoma and Kansas. This infrastructure has a particularly acute environmental justice impact on reservations like Standing Rock and Fort Berthold Reservations in The Dakotas or the Osage Reservation in Oklahoma, which is surrounded by Class II SWD wells.

An additional source of data on rural areas is the USDA Economic Research Service (ERS) Typology Code[8] that provides different categories based on economic dependence and policy relevance. More specifically, it classifies all U.S. counties "according to six mutually exclusive categories of economic dependence and six overlapping categories of policy-relevant themes. The economic dependence categories include farming, mining, manufacturing, Federal/State government, recreation, and nonspecialized counties. The policy-relevant categories include low

[8] U.S. Department of Agriculture Economic Research Service (ERS) Typology Code. Available at: https://www.ers.usda.gov/data-products/county-typology-codes/

education, low employment, persistent poverty, persistent child poverty, population loss, and retirement destination."

Inter-Agency Coordination

Using agriculture as an example, more coordination between the EPA and USDA could be helpful. For example, in addition to other agricultural data, USDA Economic Research Service (ERS) research and analysis covers a broad range of economic indicators related to nutrition such as U.S. food security, food and nutrition assistance programs, food access and store proximity, food retailing and marketing, and food prices. While some of these indicators overlap with percent low-income, they could assist in identifying vulnerable rural communities.

Input on Datasets Currently *Not* Available/Known

The SAB notes these *potential areas for future research* to inform rural communities and related databases:

- A nationally consistent oil and gas well or fracking database.
- A database on agricultural pesticide risks.
- A dataset on residential reliance on private water wells or tanks and/or residential reliance on septic tanks.

Recommendations:

Tier 1 (Major):

- The SAB recommends that the EPA engage and solicit input from rural states, organizations, and communities, as well as utilize direct field observation (i.e., ground-truthing) to select the best-suited datasets for integration within EJScreen. This SAB advice applies to all recommendations for this charge question. Other comments related ground-truthing approaches are included in the responses to charge questions for Topic Category 1 – Charge Question 2.

- The SAB recommends that the EPA systematically examine nationally consistent datasets to determine which are best suited for integration within EJScreen. The SAB provides a list of possible rural geographies databases for EPA's consideration in Appendix A.

Tier 2 (Short-term):

- The SAB recommends that the EPA systematically examine environmental, social, health, and infrastructural datasets identified by the members and select indicators that are applicable to rural environmental justice issues for inclusion in EJScreen (see Appendix A: Possible Rural Geographies Databases for EPA's Consideration). While the SAB recognizes that the EPA wishes to utilize only nationally consistent datasets, we recommended more flexible utilization of high-quality datasets in EJScreen because some environmental justice concerns in rural communities are regionally distributed, and in such cases the concept of "nationally consistent" is inapplicable.

Tier 3 (Long-term):

- The EPA should consider integrating indicators of pro-environmental actions (e.g., safe drinking water compliance or lack of significant non-compliance violations, infrastructure investments, environmental justice project implementation, etc.).

- The EPA should determine how to optimally integrate calculation approaches in the EJScreen platform for the newly selected environmental, social, health, and infrastructural indicators to ensure fuller representation of places along the rural-urban continuum. This includes determinations regarding how to perform indicator calculations and how to include newly selected indicators within the EJScreen tool (i.e., as Environmental Justice Indexes, Supplemental Indexes, as standalone indicators, or within new domains/buckets).

2.5.3. Charge Question 16: Currently there is no differentiation between urban and rural communities within EJScreen. The tool uses the same calculations and indicators for the entire country. Please comment on: (a) whether EJScreen should incorporate different calculations or levels of comparison for rural vs urban locations to ensure fuller representation of both locations in the tool; (b) how the tool could better represent rural and urban locations? *(Original Charge Question 14)*

The SAB recognizes that it can be difficult to incorporate data and indicators and develop calculations to adequately address environmental justice issues for every community across the diverse geography and demographics of the U.S. Assessing environmental justice nationwide requires a comprehensive approach that considers both environmental and social factors as well as how those factors vary across the rural-urban continuum. Environmental justice assessment in rural areas also requires consideration of factors that contribute to vulnerability and injustice that are unique to rural areas. Therefore, it is critical to work with rural states, community members and organizations to ensure that EJScreen, including the selection of indicators and calculations included in the tool, are informed by local knowledge and priorities. A major benefit of the EJScreen tool is that it provides flexibility for users to add their own data and develop a screening level assessment for their community. The SAB believes, however, that the current tool can be improved to better help people in rural communities and rural states screen for environmental justice issues in their communities.

Charge Question 16A: Discussion about whether EJScreen should incorporate different calculations or levels of comparison for rural vs urban locations in the tool.

Rural areas are among the frontline communities that experience continuing injustice due to a legacy of systemic, largely racialized, inequities that influence their living and working places, the quality of their air and water, and their economic opportunities (Mohnot et al., 2019). The SAB recommends that the EPA research, as proposed in recommendations in other charge questions under Topic Category 5, how to best incorporate different calculations for rural and urban locations to include the contextual relevance of environmental burdens of rural populations compared to urban centers for EJScreen.

The SAB recommends that the EPA consider the relative importance of different indicators across the rural-urban continuum. This is because some factors (e.g., pesticide exposures, wildfire hazards) may be more relevant in rural contexts, while other factors (e.g., traffic-related air pollution, extreme heat) may be more relevant in urban settings.

Charge Question 16B: Discussion about How the tool could better represent rural and urban locations.

Rural Indicators

Rural indicators include environmental hazards directly related to air, soil, and water contaminants from both point and nonpoint sources such as agricultural operations (e.g., CAFOs, manure and other waste byproducts, sprayfields, pesticides, synthetic fertilizers) (Galarraga et al., 2022; Hall et al., 2021; Khanjar et al., 2021; Oun et al., 2014; Thundiyil et al., 2008; Wilson and Serre, 2007). Pesticides are a major source of occupational injury for farmworkers. Many dangerous pesticides that have been banned or categorized as "extremely hazardous" by international organizations continue to be sold and sprayed in the U.S. When unaccounted for, particularly among "hidden" populations such as migrant workers, the tool fails to capture the neurocognitive and respiratory health effects associated with exposure. The tool should also include indicators related to rural energy generation, burden, and infrastructure (i.e., Wi-Fi, well water) (Ravichandran, 2021).

Rural indicators should track the lack of basic amenities that characterizes many rural communities. Studies have shown that unincorporated areas tend to have "hidden" populations which are abandoned by environmental protections. For example, the unincorporated, highly Latino, farm working communities in San Joaquin Valley, California, have been suffering from high drinking water contamination as well as indoor penetration of chemicals from heavy oil combustion activities (Balazs and Morello-Frosch, 2013). The Roger's Road landfill is another case study of environmental injustice pertaining to the neglect of unincorporated areas. In their decision to position a landfill, Orange County commissioners cited the area's sparse population (roughly 85 households) and considered it less objectionable than the previous proposed site. A study found poor private household water quality and sewer infrastructure failures within this community, attributed to the nearby landfill (Heaney et al., 2013). The West End Revitalization Association (WERA) is a community-based organization in Mebane, North Carolina. Many of the communities that WERA represents are unincorporated post-slavery Black neighborhoods established during Reconstruction. These communities are between 85-95% Black, primarily elderly and retired citizens; 53% earn less than $20,000 per year (WERA, 2002). Residents in these communities have been threatened by the 119-bypass/interstate, a 27-mile four-lane highway connecting Interstate 85 and 40 from Mebane to Danville, Virginia. This is further exacerbated by the fact WERA communities have been lacking sewer and water infrastructure, paved roads, and stormwater management for decades. This, in turn, depresses affordable housing and impedes upgrades in housing quality. The impact of the lack of unincorporated areas within the framework of the EPA EJ Index and not assigning different weights for rural indicators may undermine the effectiveness of the tool.

The IEc Advancing EJScreen Report (Mohai et al., 2022) provides suggestions for additional environmental indicators for rural areas that are not included in EJScreen, although the challenge

is whether nationally consistent datasets are currently available for these indicators. This effort of including additional indicators for rural areas could also consist of adding more items to the "critical service gaps" menu in the EJScreen tool that include all the above-mentioned critical infrastructure and services.

Rural communities are more likely to experience proximity to agricultural fields, animal feeding operations, extractive industries (mines) or landfills and be exposed to the negative impacts of such facilities (e.g., pesticides, heavy metals, leachate). Migrant workers, for example, are disproportionately affected by the use of pesticides in agriculture (Carvert et al., 2008; Forte at al., 2023). Therefore, the tool could incorporate proximity to agricultural fields, mines, energy plants, and other natural resource-dependent areas.

Furthermore, it would be ideal to add immigration status as a demographic indicator, although this demographic indicator is not included in the U.S. Census or ACS and there are sensitive issues for reporting this information. However, the tool should be able to identify a population especially vulnerable to environmental justice issues, particularly as climate change unfolds and immigration will likely continue to increase.

Another key population to consider is tribes and Indigenous Peoples who live in rural areas (reservations) and are isolated from critical infrastructure and services. They are disproportionately exposed to hazardous waste from uranium mines and water contamination. Indigenous People's communities are at the forefront of justice issues (McGregor et al., 2020).

A key issue with rural communities is the lack of opportunities for youth to remain there, so the population tends to include older adults that lack the support of younger family members or a younger workforce in general (Redford, 2019; Smith et al., 2019). Aging population should be added to the demographics to calculate the EJ Index for rural areas.

Climate change-related disasters disproportionately affect the agriculture industry, which is the backbone of rural communities (Rosenzweig et al. 2002). Floods and wildfires kill animals (livestock and wildlife) and people and displace people. Communities without insurance suffer the most. The tool could incorporate the level of insurance protection in rural areas.

In many cases, rural communities face a lower level of connectivity with other communities. For example, when there is only one road leading to a rural community and this road is damaged during a storm event, the community would find itself completely isolated. The EPA could consider developing a rural isolation indicator based on road access to characterize that dimension of vulnerability.

Rural, suburban, and urban should be treated differently in the context of EJScreen. For example, each block group could be classified as rural, urban, or suburban, using the FAR codes' rural classification scheme set forth by the Department of Agriculture. This classification scheme was recently found to capture the rural urban divide most effectively when considering public health (Long et al., 2021). Then a "disadvantage" metric or multiplier could be added to rural coded block groups, since those block groups have less access to medical care and specialists overall. Or a "rural health disparity" indicator could be added to the EJScreen list of indicators. Then a "rural" toggle should be made available for the percentiles, so that the user can specify to only

compare to the same rurality in block groups in the county, state, or country. By comparing rural-to-rural block groups, some of the disparities that are not captured by lumping urban and rural groups together could be illuminated.

A major challenge is that many of the environmental pollution indicators currently in EJScreen are geared more towards urban areas rather than rural areas. In terms of anthropogenic pollution specifically, extractive, or primary sector industrial pollution exposures are not well-represented in U.S. environmental databases. In particular, the integration of health indicators to represent challenges to accessing healthcare would be useful to address rural vulnerability.

The option to stratify block groups for analysis in EJScreen based on urban-rural status using RUCA codes is another option. The SAB recommends providing this option to users interested in distinguishing environmental justice issues in rural areas.

- RUCA codes at the census tract level based on the 2010 Decennial Census are currently available; 2020 RUCA codes are in production. See: https://www.ers.usda.gov/data-products/rural-urban-commuting-area-codes/. It would be easy to apply the tract codes to the block groups within tracts.

- An alternative would be to define all block groups in a county as urban-to-rural based on RUCC codes. See: https://www.ers.usda.gov/data-products/rural-urban-continuum-codes/. These are at the county level. The most recent codes are for 2013; updated codes will be available later this year.

- There are other rural-urban classification schemes (e.g., FAR codes, noted above), but those two (RUCA and RUCC) are tailored to the US context and widely used.

Recommendations:

Tier 1 (Major):

- The SAB recommends that the EPA conduct research, with input from rural states, rural organizations, and communities, on how to optimally integrate indicators into the EJScreen tool and enable stratification of census block groups and comparisons at national and state levels, and then implement rural-urban stratification functionality within EJScreen.

The SAB recommends that the EPA conduct research on how different calculations or levels of comparison for rural versus urban locations can be incorporated to ensure fuller representation of both locations in the tool. By incorporating different calculations for rural and urban communities, EJScreen can provide a more accurate understanding of localized environmental justice issues. This helps policymakers and community groups develop targeted strategies to address environmental injustices and promote environmental equity more efficiently. As discussed earlier in this report, there are multiple existing rural-urban classifications that can be integrated in EJScreen to better represent the variation in environmental justice issues across the rural-urban continuum as well as multiple nationally or regionally consistent datasets that could incorporate rural environmental justice concerns.

Tier 2 (Short-term):

- The EPA should consider relaxing criteria for nationally consistent datasets to provide high-quality data that can be used in calculation or as regional indicators of environmental concern specifically for rural areas.

Tier 3 (Long-term):

- The SAB recommends that the EPA systematically and empirically assess the impact of adding specific rural indicators to the tool and assess whether those added indictors provide a better representation of the environmental justice aspects of rural communities.

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APPENDIX A: POSSIBLE RURAL DATASETS FOR EPA CONSIDERATION

Appendix A (Topic Category 5): Possible Rural Datasets for EPA Consideration.							
Dataset Name	**Source Organization**	**Source URL**	**Current Temporal Coverage**	**Temporal Coverage**	**Spatial Resolution**	**National Regional**	**Caveats**
Pesticide Data Program	USDA	https://apps.ams.usda.gov/pdp	Annual			National	
Estimated Annual Agricultural Pesticide Use	USGS	USGS NAWQA: The Pesticide National Synthesis Project	2018-2022	Average 5-year	County	National	
National Land Cover Dataset	Multi-Resolution Land Characteristics Consortium	North American Land Change Monitoring System | Multi-Resolution Land Characteristics (MRLC) Consortium	2020		30m	North America	
FEMA Flood Zones (100 year; 500 year)							
National Transportation Noise Map	Bureau of Transportation Statistics	National Transportation Noise Map | Bureau of Transportation Statistics (bts.gov)	2018	Biennial Updates		National	Intended use is to track noise trends not assessing impact at specific locations. Note: The same type of legal statement that is included in the NATA/

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Dataset Name	**Source Organization**	**Source URL**	**Current Temporal Coverage**	**Temporal Coverage**	**Spatial Resolution**	**National Regional**	**Caveats**
							AirToxScreen data that are already integrated in EJScreen.)
Railroads, Marine, Transit, Roads, Aviation Data	Bureau of Transportation Statistics Open Data Site	Geospatial at the Bureau of Transportation Statistics (arcgis.com)			Multiple	National	
Food Access		USDA ERS - Download the Data	2019			National	Currently based on 2010 census blocks; updating to 2020.
Estimate Domestic wells	USGS	Domestic Wells in the United States (arcgis.com)	2000-2010			National	Proxy for connectivity to rural/municipal water systems; Story map published in 2020; use with caution/collaboration with USGS.
Places Data Portal / Healthcare access indicators	Center for Disease Control	PLACES: Local Data for Better Health | CDC	Various	Various	Multiple	National	

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Dataset Name	**Source Organization**	**Source URL**	**Current Temporal Coverage**	**Temporal Coverage**	**Spatial Resolution**	**National Regional**	**Caveats**
National Neighborhood Data Archive	University of Michigan-Institute for Social Research	Data | Nanda (National Neighborhood Data Archive) (umich.edu)	Various	Various	Multiple	National	
Radon Zones	EPA	EPA Map of Radon Zones | US EPA	1993		County	National	Potential important EJ/health indicator.
Climate Related Hazards	U.S. Climate Resilience Toolkit / Global Change.gov	Climate Mapping for Resilience and Adaptation	Various	Various	Various	National	
FERC Permits (electric, oil, hydropower, natural gas)	Federal Energy Regulatory Commission	Home Page | Federal Energy Regulatory Commission (ferc.gov)					
Energy infrastructure (electricity, natural gas, crude oil, petroleum, coal, etc)	US. Energy Information Administration	Open data - U.S. Energy Information Administration (EIA)		Monthly		National	
Facility Level Information on GHG Tool	EPA	EPA Facility Level GHG Emissions Data	2021			National	

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Dataset Name	**Source Organization**	**Source URL**	**Current Temporal Coverage**	**Temporal Coverage**	**Spatial Resolution**	**National Regional**	**Caveats**
Electronic Data Gathering, Analysis, and Retrieval System	Security and Exchange Commission	SEC.gov | EDGAR—Search and Access		Daily		National	Include manufacturing industry specifics, such as plastics.
Agricultural Census	USDA	List of Reports and Publications | 2017 Census of Agriculture | USDA/NASS	2017				Include 8 variable in Ag chemicals.
Gas gathering pipelines	US DOT Pipeline and Hazardous Materials Safety Administration	Gas Gathering Regulatory Overview | PHMSA (dot.gov)					
Significant Non-Compliance (SNC) for NPDES permits	EPA - ECHO	Enforcement and Compliance History Online | US EPA			Point		SNC only.
Rural Health Information Hub	Health Resources and Services Administration of U.S. HHS	Rural Health Information Hub	Various	Various	Various	National	
County Health Rankings	University of Wisconsin - Population Health Institute	County Health Rankings & Roadmaps	2023		County	National	Civic infrastructure and civic participation; starting point for

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Dataset Name	**Source Organization**	**Source URL**	**Current Temporal Coverage**	**Temporal Coverage**	**Spatial Resolution**	**National Regional**	**Caveats**
							community conversation.
Rural Data Gateway	USDA	Rural Data Gateway | Rural Development (usda.gov)					Data dashboards.
National Wetlands Inventory	US Fish and Wildlife Service	National Wetlands Inventory | U.S. Fish & Wildlife Service (fws.gov)					
Safe Drinking Water Information System	EPA	SDWIS Federal Reports Search (epa.gov)	1st Quarter 2023	Quarterly Summary		National	May be disconnect between state SDWIS systems and Federal; Inaccuracies noted in EPA Region 8.
US Combined Sewer Overflows (CSOs)	EPA	US EPA CSO Program, Mohammed Billah primary contact	Unknown	Unknown	Lat-Lon to 4-5 digits	National	
Hazardous Waste Incinerators/Land fills	EPA	Shapefile of facilities geolocated using EPA data found here	Unknown	Unknown	Lat-Lon to 6 digits	National	Should be linked to individual site characteristics to somehow weight facilities by tonnage processed per year - "Hazardous Waste Site Summaries."

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Dataset Name	**Source Organization**	**Source URL**	**Current Temporal Coverage**	**Temporal Coverage**	**Spatial Resolution**	**National Regional**	**Caveats**
Wood Pellet Facilities	Industry Reported		Annually to 2023	Annually to 2023		National (with regional data in the Southeast)	
Oil Refineries	EIA		Current	Current		National	
Biosolids Spreading Operations	EPA	Biosolids Program at EPA should have this data	Unknown	Unknown	Unknown		
Source Water Protection Areas	Unknown but likely EPA				Variable	National	
Vacant Lot Data			Annual County Auditor Census	Annual County Auditor Census	Determined by lot classification scheme for each county	National (with an urban, Midwestern perspective)	
Opioid Epidemic Metrices	CDC		Unknown	Unknown	Include concentration by zip code	National	
Libraries/Cultural Gathering Places (i.e., YMCAs, YWCAs, Boys and Girls Clubs)	US Department of Education	Institute of Museum and Library Services has US libraries data to 2020 here	Current to 2020	Current to 2020	Street address and population served	National	

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Dataset Name	**Source Organization**	**Source URL**	**Current Temporal Coverage**	**Temporal Coverage**	**Spatial Resolution**	**National Regional**	**Caveats**
EPA Walkability Index	EPA	EPA.MAPS.ARCGIS.COM link here	Unknown	Unknown			
Trust For Public Land's Urban Heat Island Index	Trust for Public Land	Link to data layer here	Unknown	Unknown		National (with an urban theme to the data)	
Oregon State's PRISM Climate Group	Oregon State	Link to Platform here	Annual	Annual		National	
Intermodal Transportation Facility Database	US DOT	Link to Transportation data here				National	Include significant EJ factors in urban areas.
Assisted Living Facilities	Unknown (but likely CDC or HHS)						
Department of Defense Military Installations, Ranges, and Training Areas	Department of Defense		Current	Current		National	Significant EJ actors in rural areas especially those historically abutting reservations.
USDA Atlas of Rural and Small Town America	USDA	Link to Atlas Mapping Tool here	2020-2021	2020-2021		National	

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Dataset Name	**Source Organization**	**Source URL**	**Current Temporal Coverage**	**Temporal Coverage**	**Spatial Resolution**	**National Regional**	**Caveats**
Title V Permits	EPA		Current	Current		National	
Intact Habitat Cores, Part of ESRI's Green Infrastructure Initiative	ESRI	Link to ArcGIS Living Atlas	2017	2017		National (with a rural theme to the data)	
ESRI's Living Atlas	ESRI	Link to the platform is here					
US NLCD Impervious Surface Time Series	NLCD by way of Multi-Resolution Land Characteristics Consortium (MRLC)	Link to ArcGIS data here	2001-2019	2001-2019		National (with an urban theme to the data)	
Some Index(s) of Soil Quality and Susceptibility to Erosion		Link to SSURGO/NRCS Soil data by way of Living Atlas here					
Bureau of Indian Affairs - American Indian Population and Labor Force Reports	US DOI BIA	Link to reports with data file for most recent report in 2013 with another coming out in the next year	1982 to present	1982 to present		National	

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Dataset Name	**Source Organization**	**Source URL**	**Current Temporal Coverage**	**Temporal Coverage**	**Spatial Resolution**	**National Regional**	**Caveats**
Air Pollution (PM1 in addition to PM2.5 if underlying data used to model PM2.5 has capacity to measure PM1)	EPA	Link to EPA's AMTIC PM2.5 Monitoring Network here				National	
US Dams	US Army Corps of Engineers	Link to ESRI Federal Data Hub "National Inventory of Dams" here				National	Extremely important to tribal communities especially any variable that speaks to EJ around the amount of area impacted by floods.
USDA/USFS Landscape Change Monitoring System (LCMS)	USDA/USFS	Link to Data Explorer here	1985-2021	1985-2021		National	

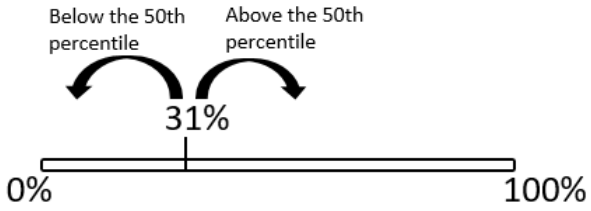
APPENDIX B: EDITIORIAL CORRECTIONS

Appendix B (Topic Category 2) – Detailed comments on the current version of the technical document. Below please find a list of detailed comments that members have raised. These comments refer to specific pages in the current version of the technical documentation:

Page 4: At first mention of census block groups, it would be helpful to define or provide a link to the U.S. Census Bureau definition of a block group. This would help users understand the level of spatial resolution of the tool.

Page 5: The Summary Overview of Socioeconomic Indicators states that "EJScreen uses socioeconomics indicators as very general indicators of a community's potential susceptibility to the types of environmental factors….". However, no justification is provided as for why these indicators are deemed "very general".

Page 6: It might be more useful to provide a visual representation of the described calculations. For example, when describing a demographic variable "Percentage of People of Color", in addition to the text, it could be less ambiguous if a diagram like the one below showing what a percentile is, is included in the documentation as well.



Page 7: In describing the calculations used to derive the percentage of the population living below the poverty line, it was mentioned the adoption of twice the poverty limit as threshold for identifying people in poverty. Despite the technical documentation stating that 'many studies in various fields use 2x poverty', no specific references to support this decision is provided.

Page 11: The formula to calculate the percentage of the population with less than high school education is missing B15002.027 from the numerator.

Page 13: Please spell out PM2.5 and Diesel PM the first time these terms are mentioned in the documentation. It would be helpful to provide a link to the EPA webpage that gives basic information on Particulate Matter (PM) rather than the one currently linked.

Page 17: No explanation for HI. Please spell this word out and provide an explanation and a reference for the user.

Also, there is a typo under "What is the air toxics respiratory HI indicator?" This paragraph refers to the non-cancer health effects, and the word "carcinogens" is unintended.

Page 14 and Page 22: There is inconsistent information. On page 14, wastewater discharge is described as "RSEI modeled Toxic Concentrations at stream segments within 500 meters,

divided by distance in **km."** On page 22, it is described as "divided by distance in **meters.**" Even though this might not change the results quantitatively, the documentation should be as consistent as possible.

Pages 20 - 23: As done for other environmental indicators, please provide resources and links to other EPA webpages for readers to access more information about Superfund sites, RMP facilities, and underground storage tanks (UST) and leaking underground storage tanks (LUST).

Page 26: It is unclear why a user would use the Demographic Index vs the Supplemental Demographic Index. The documentation says that the Supplemental Demographic Index 'replaces' the current Demographic Index. When using EJScreen, the Supplemental Demographic Index is not replacing the Demographic Index, instead the user has the choice to use one or the other. It would be great to provide some documentation that justifies this choice.

It is unclear why it is not allowed to use these two indices (Demographic Index and Supplemental Index) together (combined as one) as well as separately. It is not clear why the Supplemental Index include income and not race/ethnicity. The current session 'What is the Supplemental Demographic Index in EJScreen' does not sufficiently answer these questions nor does the section 'Why is the Supplemental Demographic Index in EJScreen?' on page 29. The text refers to communities needing to contact a legal office, but no explanation or justification for this sentence is provided. There seems to be an underlying current of knowledge that the user is supposed to know about this index that is not plainly stated.

Page 29: For the EJ Index example and others throughout the document, what was the reasoning for choosing to use 15 significant figures? This can feel and seem a little cumbersome to the reader.

Page 29: The text states "EJScreen features two sets of indexes—12 EJ Indexes and 12 Supplemental EJ Indexes, which are described in detail below. The indexes are a combination of environmental indicators described above and the Demographic Index, or the Supplemental Demographic Index described above." It is unclear if the text is referring to individual environmental indicators or to combined indicators? It would be helpful to bring clarity to this language. Similar language is used on page 30.

Page 30: It is unclear what "Supplemental Index Percentile in USA = 50" means at the end of the calculation on this page.

Page 31: No page number. In the section on color-coding of percentile bins, the documentation states that "There is no official policy significance assigned to each individual color on the maps...". It would be helpful to understand the motivation for choosing to display the 80^{th} percentile and not, for example, the 75^{th} percentile. Providing some documentation on the choice of the percentile cutoffs adopted would be extremely helpful.

Page 31: Last paragraph, beginning "Percentiles at or above the 95th percentile..." there is reference to "region" as if there is a comparison between state, national or region. There is not an option for comparison between EPA regions within the current tool. The comparison choices are between U.S. and state. Additionally, if a user creates a Printable Standard Report for an area,

the fine print indicates "These percentiles provide perspective on how the selected block group or buffer area compares to the entire state, EPA region, or nation." The SAB recommends that the EPA remove references to "comparison by EPA region." Alternatively, if EPA intends to add this comparison option in the future, indicate that this option is not currently available, but will be in the future.

Page 33: The documentation states that percentiles are calculated using functions like wtd.quantile() and wtd.Ecdf(). However, it is not clear what weights were used in these functions. It seems that the current percentile is unweighted, but it is not clear. The paragraph above 'How Percentiles are Calculated' could benefit from a visual example to clearly show the differences and/or similarities of State versus U.S. in terms of both indicator values and percentiles.

Page 34: It is unclear what the expression '101 Percentile bin counters (0 to 100)' refers to.

Page 35: The sentence in the last paragraph, "This 80th percentile filter is for internal EPA use and is not intended to apply to States or other organizations" seems out of place. The entire paragraph suggested the 80^{th} percentile as a starting point and described its use but the last sentence seems very "legalese."

Page 36: Third paragraph, last sentence. It seems that "areal apportionment of blocks" should in reality be "population apportionment of blocks" since the sentence before referred to how areal apportionment is less accurate.

Page 40: Like the suggestions provided above, a graphical/visual representation of the calculation used to derive proximity to facilities would be helpful and would enhance comprehension of these topics.

Page 42: It would be beneficial to have access to the references the EPA team reviewed in coming up with solutions to the problem of small d_{ij} values. In general, decisions regarding what methodology to use or what distance threshold to use, should be supported by scientific evidence. With the exception of links to EPA webpages, there are no references provided with the entire technical documentation. If these are available, they should be included.

Page 48: According to the CDC, "PLACES is a collaboration between CDC, the Robert Wood Johnson Foundation, and the CDC Foundation." It would be great if the Agency could elaborate more on what is the expected continuity of these data and the expected availability in the future. Additionally, it would be helpful to know whether EPA has engaged in discussions with other Federal agencies about data sharing and data continuity, both fundamental for the longevity of comprehensive tools like EJScreen.

Although, potentially out of the scope of EJScreen, it might be helpful for users and researchers to know whether Federal agencies have coordinated or are working on coordinating data use between various group so to facilitate and optimize the tools that each federal agency produces. This question is due to the fact that the PLACES dataset was started as a project that developed further partnerships.

Such information would allow users to get a better idea about the longevity of certain data sources. Given the reliance of EJScreen on multiple data sources, information regarding the longevity and quality control of the raw data is important as it will ultimately impact EJScreen either in a positive or negative way.