Burdens, Benefits, Perceptions, and Planning: Developing an Equitable Environmental Justice Assessment Toolkit (EEJAT 2016) for Long-range Transportation Planning in Roanoke, Virginia

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ACADEMIC ABSTRACT

This research presents a new environmental justice assessment toolkit, the Equitable Environmental Justice Assessment Toolkit 2016 (EEJAT 2016). The purpose of this toolkit is to enable urban planners to more effectively measure whether "environmental justice" populations (low-income, non-white, Limited English proficiency, disabled, or elderly persons) are disproportionately burdened by long-range transportation plans. This toolkit is based on the concept that effective assessment of environmental justice (EJ) in transportation planning requires assessment frameworks that methodologically unify three sometimes divergent interests: those of federal and state bodies enforcing EJ assessment requirements, those of metropolitan planners who face capacity constraints and need guidance on how to conduct these assessments, and, most importantly, those of the protected populations themselves. This thesis involved analysis of current requirements, exploration of existing environmental justice assessment tools, case studies, decision theory, and principles of equity, and stakeholder engagement through surveys, interviews, and public meetings, all towards the development of the toolkit designed for the Roanoke Valley Transportation Planning Organization (RVTPO)'s Constrained Long-range Multimodal Transportation Plan 2040 (CLRMTP 2040) released in 2016. The resulting toolkit is a multi-step framework. The first step is a GIS map-based EJ Index, structured by normalized population distributions for each EJ demographic, and mapped by block group compared to regional (MPO) averages. This z-score based mapping was done in lieu of Roanoke's former linear model in effort to more systematically compare effects, and to more accurately represent the data, and by extension, the people. Second, the Community Profile expands upon the EJ Index to include documentation of community elements and social and economic systematic injustices in the area. Next, a "Benefits and Burdens" matrix guides planners to an appropriate model or method of assessment for each EJ effect for the project at hand, based on project scale and type, data availability, and skillsets of the assessor. The results of these assessments of each EJ effect are compiled for an overall Project Impact Assessment. Checks on assessor bias based on stakeholder feedback and decision theory are incorporated into this Project Impact Assessment. Cumulatively, the toolkit is designed to incorporate equity as a defining element of both processes and outcomes, to be flexible in order to be applicable to multiple projects, and to be usable by practitioners.

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GENERAL AUDIENCE ABSTRACT

In the United States, it is often the case that populations who are non-white, low-income, non-English speaking, disabled, or elderly are disproportionately burdened by our transportation systems. These populations are more likely to be displaced by highways, exposed to transportation-related air, noise, water, or land pollution, denied high-quality public transportation, suffer a drop in land values due to transportation infrastructure, and a number of other factors. These issues are called "environmental justice" or "EJ" issues. The reasons behind these trends are complicated, deeply rooted in our history and development patterns, and out of the scope of this thesis. This thesis instead focuses on the *measurement* of these disproportionate burdens and benefits. It is a federal requirement for transportation planners to consider environmental justice, but there is little guidance on how exactly to do this. Without this guidance, planners resort to ineffective assessments or mere "checking of boxes." Many academic theorists have created models to measure individual effects such as air quality or water quality, but few have combined those models to create an easy-to-use "toolkit" for planners to use in assessing a full range of environmental justice effects. This thesis presents EEJAT 2016, an environmental justice assessment toolkit designed for Roanoke, VA, that attempts to meet the needs of EJ populations, transportation planners, and state and federal enforcement agencies. This toolkit was created based on a literature review of environmental justice theories and models, federal and state requirements, and decision theory, analysis of former Roanoke EJ assessments, GIS and statistical analyses of the Roanoke area, and engagement of EJ advocates and stakeholders. The toolkit includes GIS maps of EJ populations, a Community Profile, a flowchart that guides planners to the "tools" to use to assess the specific project at hand for EJ benefits and burdens, prompts for engagement of EJ populations, and checks on bias to help the planners understand their own biases in assessing EJ.

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER 1: INTRODUCTION

1.1: Overview of Research Topic

Transportation infrastructure in Roanoke today is built with intentions of providing an array of benefits to community members of all demographics. However, like all transportation planning agencies, the Roanoke Valley Transportation Planning Organization (RVTPO) faces a reality that even well-intended transportation projects may disproportionately *burden* certain populations, especially low-income, minority (non-white), Limited English Proficiency (LEP), Hispanic, disabled, and elderly communities. These communities may suffer from a range of transportation project externalities, including displacement, neighborhood fragmentation, air pollution, noise, diminished housing values, lack of access to services, land degradation, exposure to toxins, and traffic danger. Conversely, there are many *benefits* that come with transportation projects, such as access to employment, food, and social services, community cohesion, and improved quality of life. Therefore, a *lack* of transportation projects may also disproportionately burden these communities, so it is critical that both positive and negative potential effects of transportation projects are considered in transportation planning decisions.

It is often the case that these burdens on disadvantaged communities arose not spontaneously from current projects, but instead developed over decades through deeply rooted historical systems of economic and social injustice (Smith, 2015; Cole & Foster, 2001; Wilson et al., 2011). These historical and current systems have left a legacy of built and durable infrastructure that still negatively affects today's neighborhoods. Critically, even if *current* urban planning processes and

legal structures take environmental justice into account, the accumulated effects of historical environmental injustice on project sites must not be overlooked when planning new projects. Considering all of these factors, in order to achieve equitable transportation planning, it is critical to weigh the "benefits and burdens" of transportation plans, within the context of historic injustices, in effort to ensure that populations are not disproportionately burdened or deprived of benefits associated with transportation plans.

This assessment of disproportionate burden or deprivation of benefits is not only critical from an ethical standpoint, but is also a federal and state requirement. In 1994, President Clinton implemented Executive Order 12898, requiring federally funded agencies to identify these disproportionate burdens and to work towards goals of human health and environmental protection for all communities (Executive Order 12898, 3 C.F.R., 59 FR 7629, 1994). The federal government designated "environmental justice" the official term to describe this goal, and officially defines the term as "*the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies*" ("What is Environmental Justice?" 2016). Clinton's action expanded upon Title VI of the Civil Rights Act of 1964, which "prohibits discrimination on the basis of race, color, and national origin in programs and activities receiving federal financial assistance" (Title VI, 42 U.S.C § 2000d et seq., 1964).

In addition to Executive Order 12898 and Title VI, a number of other federal and state laws also establish requirements and guidelines relating to environmental justice, including the National Environmental Policy Act (1969), Federal-Aid Highway Act (1970), the Uniform Relocation

Assistance and Real Property Acquisition Policies Act (1970, amended in 1987), the Age Discrimination Act (1975), Environmental Impact and Related Procedures (1987), Guidance for Preparing and Processing Environmental and Section 4(f) Documents (1987), FHWA Environmental Policy Statements (1990 & 1994), Americans with Disabilities Act (1990), FHWA Environmental Policy Statements (1990, 1994), Intermodal Surface Transportation Efficiency Act (ISTEA) (1991), the OMB's Revisions to the Standards for the Classification of Federal Data on Race and Ethnicity (1997), Proposed Department of Transportation Order on Environmental Justice (1996), The Transportation Equity Act (TEA-21)(1998), the Joint Memorandum of FHWA and FTA on Implementing Title VI Requirements in Metropolitan and Statewide Planning (1990), SAFETEA-LU (2005), Memorandum of Understanding on Environmental Justice (2011), DOT Order 5610.2(a) (2012), FHWA Order 6640.23A (2012), the Department of Transportation Environmental Justice Strategy (2012), and the FTA Circular 4703.1 Environmental Justice Policy Guidance for Federal Transit Administration Recipients (2012), among others.

These laws establish requirements to assess environmental justice issues, but the ways in which to do so are largely left up to interpretation. Transportation planning organizations like the RVTPO strive to accurately measure the benefits and burdens of projects on minority and low-income communities, but with limited capacities, funding, and assessment tools, resort to using sometimes outdated, ill-fitting, overly subjective frameworks from much larger cities. On the other side of the equation, when EJ populations *are* disproportionately burdened by projects, these populations struggle to prove this "disproportionate burden" in court if there are not processes in place for data collection, public involvement, and measurement of benefits and burdens.[1] To enable planning

[1] Specific cases of such injustice are discussed in "case studies" section of the literature review, page 47.

agencies and communities to effectively identify and address environmental justice issues, and to enable burdened communities to obtain amelioration of burdens through our legal system, it is essential that reliable, flexible, and usable environmental justice assessment frameworks are made available. Without effective assessment techniques, there is a large risk that environmental justice populations will suffer the consequences if ineffective assessments lead to either approval of disproportionately burdensome projects or cancellation of projects that would have been beneficial. Effective assessment of environmental justice (EJ) in transportation planning requires assessment frameworks that methodologically unify three interests: those of federal and state bodies enforcing EJ assessment requirements, those of metropolitan planners facing capacity constraints, and, most importantly, those of the protected populations themselves.

There are a multitude of methodological approaches to the measurement of EJ for transportation plans. Environmental justice is partly qualitative and wholly complex idea, making it very difficult to measure quantitatively. Within the past decade, a full range of EJ frameworks and models have been developed that involve a variety of data sources, assessment scales, population indicators, statistical methods, skills needed and effects measured. Based on an analysis of over 30 modern frameworks,[2] most modern EJ frameworks use U.S. Census Bureau data and ever-improving Geographic Information Systems (GIS) software, and include poverty and racial characteristics in their evaluation. Outside of these core elements, though, there is great variation in the new methods and theories being used across the country. Because each project and each community is highly unique, and because there is an arguably endless range of "effects" that could be measured depending on context, there is arguably no one framework or model that "best" assesses EJ burdens

[2] See Literature Review section,

and benefits for all transportation situations. However, there are several new highly recommended methods that each work well in specific contexts. With the abundance of new research and analytical methods for transportation EJ assessment, now is a great time to update the RVTPO's 2005 Environmental Justice Assessment Framework to incorporate these methods for the RVTPO Constrained Long-range Multimodal Transportation Plan 2040 (CLRMTP 2040), which is to be released and reviewed in 2016.

This report describes the findings of research that involved exploration of existing environmental justice assessment tools, federal and state requirements, principles of equity, and decision theories, and stakeholder engagement through surveys, interviews, and public meetings, all towards the development of a new environmental justice assessment framework for the CLRMTP 2040. The key results of the study are as follows: first, equity must be a defining element of both the processes and the outcomes of the framework. Second, an EJ framework must be designed to be flexible (to be applicable to multiple projects), and usable (not so time-consuming, complex, or expensive that it goes unused). Third, the methodologies used to map EJ populations and to assess disproportionate effects must be based on sound statistical methods and community engagement that most accurately represent the data, and, by extension, the people. Fourth, there must be checks on decision-making processes built into the framework to eliminate unintended bias. Fifth, there should be consideration of overlapping issues, especially the overlap of workforce issues and transportation issues. Finally, and perhaps most importantly, assessment must include consideration of historical systems of social and economic injustice that still affect communities today. To incorporate these components, the new decision-supporting toolkit is based upon principles of equity defined by EJ communities, includes regular stakeholder engagement and

checks on bias, and is in the form of easy-to-use matrices that guide planners to the best models and methods of assessment for the specific project at hand.

This toolkit differs from other EJ assessment frameworks for a number of reasons. First, the EJ Index is based not on linear arbitrary scoring, but on normalized population distributions, where a block group receives an additional "EJ point" for every 0.25 standard deviations above the MPO average, for each of the six EJ demographics (i.e., a block group that has a minority population concentration that is 2.25 standard deviations above the regional average would receive 10 points for the minority demographic). This normalization is done in effort to more logically compare and consolidate effects.

Second, EEJAT 2016 differs from other EJ assessment methodologies because rather than depending on only *one* model to measure only one EJ effect such as air quality or displacement, the toolkit *compiles* a number of recently published models for many social, economic, and environmental EJ effects into one matrix. The planner answers a series of questions about the project size and type, data availability, and planner skillsets, to find a model for each EJ effect that works well for the specific context. The planner then runs a model for each EJ effect to determine if the proposed project will result in burdens or benefits for the EJ community for each effect (air quality, water quality, displacement, aesthetics, employment access, etc.) For cases of planning agencies that are severely limited in capacity, the matrix includes a simple "checklist" option for each effect that can be completed with extremely limited or no funding or skillsets. The results of all assessments, the benefits and burdens for all effects assessed, are compiled in the Project Impact Assessment step. Checks on bias are incorporated through a series of questions for the planner

during this step, which is a third primary difference between EEJAT 2016 and other assessments. Because effects differ substantially (air quality benefits cannot be rationally weighed against economic burdens) the planner does not numerically summate the results for an overall EJ assessment. Instead, the planner documents all positive and negative effects, and documents his or her overall assessment of EJ effect, and shares this documentation with EJ communities for feedback.

It is hoped that TPOs of conditions and capacities similar to RVTPO will be able to make use of this assessment toolkit, and that, with further research and collaboration, the toolkit can be expanded upon to be eventually applied at the state or national levels. To enable the expansion of this toolkit, there is need for integration of the toolkit into an online "portal" that includes not only the toolkit but also documentation of results and places for stakeholder feedback, incorporation of more assessment models and regularly updated data, and research on how to better incorporate overlapping issues such as workforce development, social services, and transportation access.

1.2: Roanoke Valley Transportation Planning Organization (RVTPO) Overview

This research and assessment model was based upon the Roanoke, VA area upon request by The Roanoke Valley Transportation Planning Organization (RVTPO). Because EJ assessments are highly context-dependent, it is critical to provide a brief background on the area itself before delving into assessment of the area. The Roanoke Valley Alleghany Regional Planning Commission (RVARC), is the fiscal agent and lead staffing agency for the RVTPO, and is a political subdivision of the Commonwealth of Virginia. There are 21 Planning Districts in VA, and RVARC is the fifth. The purpose of the planning commission is to coordinate local efforts to address problems on a regional basis. Federal law mandates the formation of a Metropolitan

Planning Organization (MPO) for any urbanized area that has a population of more than 50,000 people, and a Transportation Management Area (TMA) for areas with populations over 200,000, so Roanoke, with a population 230,000 has both. The RVTPO is staffed by RVARC, and covers the City of Roanoke, City of Salem, Town of Vinton, and urbanized portions of the counties of Bedford, Botetourt, Roanoke, and Montgomery. The RVTPO is funded by the federal government, member localities, and the Virginia Department of Transportation (Roanoke Valley Alleghany Regional Planning Commission (RVARC), 2015; McCaskill, 2015).

The key functions of the TPO are to produce the Long-Range Transportation Plan (LRTP), the Transportation Improvement Program (TIP), the Congestion Management Plan, and the Unified Planning Work Program. TPO activities are directed by a 15-member Policy Board that establishes transportation policy, approves the LRTP and the TIP, and adopts the annual plans and work programs. The TPO Policy Board includes representatives of the member localities, representatives of the Greater Roanoke Transit Company, the Roanoke-Blacksburg Regional Airport, and VDOT, and non-voting members from RVARC and federal and state agencies. The RVTPO is assisted by the Transportation Technical Committee and the Citizen's Advisory Committee. This Environmental Justice Assessment Framework is part of the TPO's Long Range Transportation Plan for 2016 (RVARC, 2015; McCaskill, 2015).

1.3: Research Objectives

This study was conducted upon request by the Roanoke Valley Transportation Planning Organization (RVTPO) to answer this overarching research question:

What assessment framework can the RVTPO use to assess environmental justice burdens and benefits of long-range transportation projects in a way that a) fulfills federal and state requirements b) is feasible given constraints on staff and financing and c) incorporates principles of equity, as defined by the protected populations themselves?

This overarching research question prompted the following sub-questions:

1. Which populations should be identified as "environmental justice" populations?
    a. Should certain populations be weighed more heavily in consideration of EJ effects than other EJ populations (i.e., low-income and minority populations weighed more heavily than elderly, LEP, and disabled populations)?
2. What is the baseline population or average that EJ populations are compared to? At what scale should this baseline population be measured (block group, census tract, state average, national average?)
3. Which effects of transportation networks should be measured (i.e. air quality, land use, displacement, mobility, accessibility, etc.?)?
4. How can "disproportionate burden" by transportation networks be measured? What percentage of disproportion is significant?
5. How can benefits of transportation networks be measured?
6. What are the federal and state requirements faced by the TPO?
7. What are the constraints of the TPO?
8. What are principles of equity as defined by EJ populations themselves?
9. What is the basis for decision-making in the framework?

In answering these research questions, the following objectives were pursued. Because of the nature of this research, some of these objectives had to occur simultaneously rather than chronologically.

Objective 1: Document all federal and state requirements for environmental justice assessments faced by the RVTPO, and determine where gaps or lack of specific direction exist in federal and state instructions for environmental justice assessments**.**

Objective 2: Update RVTPO's documentation of national "best practice" environmental justice assessment tools.

Objective 3: Gain information directly from environmental justice leaders on principles of equity that should be incorporated into environmental justice assessments.

Objective 4: Gather complete information on the constraints of the RVTPO.

Objective 5: Using the information gathered in objectives 1-4, reevaluate the 2005 framework's methods and assumptions.

Objective 6: Update all demographic maps used in the formation of the EJ Index.

Objective 7: Create checks on bias in decision-making for environmental justice assessments.

Objective 8: To fold all information gathered from objectives 1-7 into the creation of a new environmental justice assessment framework that takes the form of easy-to-follow matrices of tools for transportation planners.

Objective 9: Throughout the process, gather input from experts, EJ activists, and stakeholders on the new framework.

1.4: Methodology

To achieve these objectives, the following methodology was used.[3]

Table 1: Objectives & Methodology

Objective	Methodology
1: Document all federal and state requirements for environmental justice assessments faced by the RVTPO, and determine where gaps or lack of specific direction exist in federal and state instructions for environmental justice assessments.	A thorough literature review was conducted of federal and state requirements for environmental justice assessments. From this literature review, documentation was created of all requirements the RVTPO must meet. In the documentation created, all instances of non-quantitative, or non-measurable, or non-specific language were highlighted. These instances are items that are left up to the definitions set by the EJ Framework.
2: Update RVTPO's documentation of national "best practice" environmental justice assessment tools.	A literature review was conducted of existing environmental justice assessment tools, including both case studies of assessment frameworks and academic theory. All tools relevant to RVTPO (those that applied to long-range transportation plans of mid-size TPOs) were documented in a matrix. For each tool, the following components were documented: type of EJ effect assessed, estimated severity of effect assessed, type of EJ population assessed, scale of project, type of project, data needed, expertise needed.
3: Gain information directly from environmental justice leaders on principles of equity that should be incorporated into environmental justice assessments.	A survey population of environmental justice leaders (identified as leaders of environmental-justice focused NGOs in the U.S.) was created. Each leader was emailed to request a phone conversation surrounding the question "what should be included in environmental justice assessments to ensure equity?" Upon an email response, a phone conversation was scheduled. Conversations lasted from 10 minutes to one hour.
4: Gather complete information on the constraints of the RVTPO.	An inventory was conducted of staff available, hours of staff time available, and budget allocated to work on EJ assessments. This inventory was created based on inputs from staff at the RVTPO. These constraints were applied to the original matrix to create a customized matrix suitable for Roanoke, with tools that would be infeasible given RVTPO's budgetary and capacity-related constraints

[3] Because of the nature of this project, some of these steps had to occur concurrently, rather than chronologically.

	eliminated. A copy of the unconstrained matrix was kept for the purposes of other municipalities, and for Roanoke in case of changes in budgetary and capacity-related constraints.
5: Using the information gathered in objectives 1-4, reevaluate the 2005 framework's methods and assumptions.	A thorough assessment was conducted of Roanoke's existing environmental justice framework, to identify all potential opportunities for improvement within the existing framework. These "issues" were identified by fitting one of the following descriptions: a. Issues that have been flagged by staff at the RVTPO as being of concern; b. Items in the framework that may differ between Delaware and Roanoke, for which the differences have not yet been accounted; c. Areas of discrepancy between the existing framework and "best practices" identified through the literature review on existing environmental justice assessment tools, including both case studies and theory; and d. For each of these issues identified, "best practices" identified in the literature review were consulted for alternative approaches.
6: Update all demographic maps used in the formation of the EJ Index	Using ACS 2013 data, the following demographic maps were updated at the Census Block Group level: poverty zones (percentage of households below federal poverty guidelines, minority (percentage non-white), elderly (percentage over 65), Limited English Proficiency (percentage who speak English "not at all" or "not well"), disability (percentage), and Hispanic (percentage Hispanic or Latino). The ACS data for the State of Virginia was clipped to the irregular shape of the RVTPO using the ArcGIS "clipping" tool. In cases where the RVTPO boundaries crossed partially into a block group, the data for the block group was included. The concentrations of each demographic for each block group were compared to the regional (TPO) average. Block groups were assigned an EJ point for each 0.25 standard deviation above the regional average, for a maximum of 10 points per demographic, and a maximum of 60 points per block group. (If a block group had a demographic concentration with a z-score of 2.25 compared to the TPO average, that block group would be assigned the maximum 10 points for that demographic.) The z-score method was used to ensure that the scores assigned for each demographic match the population distributions of that demographic in the region, (rather than being based on the former linear model). Poverty, LEP, minority, and Hispanic were overlaid for a "Core EJ Index," and Disability and Immobility were overlaid to form an "Immobility Index" to allow for flexibility of data depending on projects. All maps were combined to form the Total EJ Index. These Total EJ Index scores have a total possible

	range of 0-60, and were also scaled according to 0.25 standard deviations to create a 10-level scale. Block groups with higher "EJ scores" were indicated with darker colors.
7: Create checks on bias in decision-making for environmental justice assessments	A literature review was conducted of decision theory and methodologies for checks on decision-making bias. Based on this literature review, checks on bias were incorporated into the framework.
8: To fold all information gathered from objectives 1-7 into the creation of a new environmental justice assessment framework that takes the form of an easy-to-follow matrix of tools for transportation planners.	Each EJ assessment framework and tool discovered in the literature review was analyzed and sorted by the following components: type of EJ effect assessed, estimated severity of effect assessed, type of EJ population assessed, scale of project, type of project, data needed, expertise needed. From this information, a master matrix of assessment tools was created. The matrix was reformulated into flow-chart style, that guides the practitioner to the recommended assessment technique, based on the assessed project's size, scope, type, EJ population, data availability, and tool availability. The matrix includes rows for "benefits," "benefit score" and "burdens," and "burdens score" for each effect. The B&B Score = (the % of the block group population affected by the benefit or burden) x (the EJ Score of that block group). The total project score is automatically calculated in the spreadsheet by subtracting total burden scores from total benefit scores. A positive project score would indicate greater benefits than burdens; a project score of zero would indicate equal benefits and burdens; a negative project score indicates more burdens than benefits (would need to be reconsidered).
9: Gather input from experts, EJ activists, and stakeholders on the new framework.	Stakeholder feedback was gathered throughout the framework formation process. A survey population of environmental justice experts and activists, community leaders, workforce development specialists, planners, and Roanoke locals was created using the snowball method of sampling. Surveys were sent and collected via a Google Forms survey with the following 8 questions: 1. In general, what should transportation planners consider when they are assessing whether EJ populations are disproportionately burdened (or denied benefits of) transportation projects? 2. Which populations should be considered "EJ Populations?" (Minority, Low-income, Disabled, Elderly, Limited English Proficiency, Hispanic, Other.) 3. Currently, EJ populations are identified based on U.S. Census data at the Census Block Group level. Do you agree with this approach? 4. How do you define equity relating to EJ and transportation?

	5. When transportation planners are measuring transportation-related EJ effects, which effects should they consider? (Check as many as you wish.) 6. How should planners achieve meaningful stakeholder engagement of EJ populations? 7. Insert any additional comments here: 8. Who else should I contact? (Please enter names and contact information). In cases where stakeholders were unfamiliar with assessment frameworks and so had no feedback to give on the survey questions, the stakeholders were spoken to in person, via email, or over the telephone and asked for feedback on the following broad question: 1. What should be included in environmental justice assessments for transportation? (Or, more simply, when transportation planners are deciding whether a project will disproportionately burden a low-income, minority, disabled, elderly, or LEP community, what should they consider?) Additional Roanoke stakeholder feedback was also gathered March 2nd, 2016 at a public meeting run by representatives of the FHWA and the FTA. Three participants agreed to provide contact information, and were emailed the following questions: 1. Do you know of instances of current disproportionate burden on predominantly minority, low-income, disabled, elderly, Hispanic, or Limited English populations? (This can be lack of service, accessibility, air pollution, noise, displacement, lack of mobility, etc.?) If so, could you tell me specific locations where this occurs? 2. Do you know of instances of current disproportionate benefit to predominantly wealthy, white populations? (For example, sometimes greenways, bus routes, or other transportation amenities are made available to wealthy populations but not to the populations who may need those services more). If so, could you tell me specific locations where this occurs? 3. Is there anything else you think I should make sure to have included in this framework? 4. Contact information for other people I should talk to?

1.5: Thesis Outline

This thesis began with an overview of the research, the RVTPO, and the research objectives and methodology. Following this introduction, Chapter Two contains a review of literature and requirements, which details environmental justice-related legal requirements and guidelines, academic theories on challenges and values of EJ frameworks, concepts of equity, and bias and decision theory, legal cases involving EJ, and case studies and methodologies used by municipalities and regions across the United States. Chapter Three describes the results of the research, including stakeholder feedback, the evaluation of the 2005 framework methods and assumptions, documentation of the RVTPO constraints, the new EJ assessment framework (EEJAT 2016), including the new EJ Index, Benefits and Burdens Instrument, and Project Impact Assessment. Chapter Four details conclusions and future research.

CHAPTER 2: REVIEW OF LITERATURE AND REQUIREMENTS

2.1: Overview

This literature review provides an overview of environmental justice-related federal and state requirements, court cases, assessment theory, principles of equity, methodologies and frameworks, and case studies. In recent years, environmental justice assessment has grown in prominence as a recognized topic of importance, but assessment methodology has cumulatively seen very few significant changes or upgrades, and has been permeated with inconsistent definitions, scales, foci, and statistical measures. Environmental justice activism and requirements are well established, but the ways in which to fulfill those requirements and calls to action are not. The Federal Highway Administration website itself still features outdated case studies from the 1990's, and federally recommended practices have changed very little since these case studies took place ("FHWA: Environmental Justice," 2016). Each environmental justice framework is presented as "new and improved," but very few deviate from the same core methodology that was promoted in the 90s: Census data is used to identify EJ populations, some form of public outreach is conducted, there is a subjective and arguably weak assessment of anticipated benefits and burdens, and there is little evidence that the EJ assessments substantially influenced project selection.

In most cases, researchers and practitioners delve deeply into the assessment of only one specific effect, and, for example, measure *only* air pollution or *only* safety. In some cases, a large number of anticipated EJ effects are included in the assessment, but the measurements of these effects are largely subjective. As of yet, there hasn't been a recognized effort to create an easily usable tool that *combines* well-developed models for multiple transportation-related EJ effects, to allow for semi-objective assessment by transportation planners of the comprehensive impact of a project on

EJ populations. David J. Forkenbrock and Jason Sheeley have created monumental collections of "effective" environmental justice assessment methods (Forkenbrock & Sheeley, 2004), but these collections are hundreds of pages long, and are intended to provide assessors a lengthy overview of techniques that *could* be used, rather than providing a highly usable step-by-step tool for planners to realistically use in the midst of assessment.

The most recent and most comprehensive tool released as of June 2016 is the U.S. EPA's highly impressive EJSCREEN ("EJSCREEN, 2016). This tool combines twelve environmental justice indices using our nation's most comprehensive environmental data and overlays this data with U.S. Census demographic data. However, even this state-of-the-art tool is does not fulfill all the needs of a transportation planner conducting a complete environmental justice assessment, because it is predominantly focused on air quality, and is primarily designed for public viewing of air quality assessment conducted by the agency itself, rather than for transportation planning purposes. However, while no existing tool currently fits all of the needs of long-range transportation planners, exemplary components of each tool can serve as inspirations for more comprehensive frameworks such as the EEJAT 2016 framework.

2.2: Requirements: Documentation of Federal and State Requirements

2.2.1: Overview of Requirements

In 1994, then-President Bill Clinton passed Executive Order 12898: "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations" (59 FR 7629) which requires federal agencies to "identify and address the *disproportionately* high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations" (Federal Register 1994, Executive Order 12898). The order also

requires federal agencies to create strategies to address such disproportionate effects. Clinton's action expanded upon Title VI of the Civil Rights Act of 1964, which "prohibits discrimination on the basis of race, color, and national origin in programs and activities receiving federal financial assistance" (Title VI, 42 U.S.C § 2000d et seq., 1964). The 1969 National Environmental Policy Act (NEPA) established a requirement for interdisciplinary assessment of "environmental impact of proposed actions," and the development of "methods and procedures" to "insure that presently unquantified environmental amenities and values may be given appropriate consideration in decision-making." These three requirements provide the authority and basis for a number of federal, state, and municipal policies that establish more detailed requirements or guidelines for the assessment of environmental justice.

These policies, rules, and manuals that provide requirements and guidance on EJ evaluation based on the three aforementioned acts include the following:

- Title VI of the Civil Rights Act (1964);
- Federal-Aid Highway Act (1970);
- The Uniform Relocation Assistance and Real Property Acquisition Policies Act (1970, amended 1987);
- Environmental Impact and Related Procedures (1987);
- The 1987 Guidance for Preparing and Processing Environmental and Section 4(f) Documents (6640.8A);
- 1990 and 1994 FHWA Environmental Policy Statements;
- 1997 Office of Management and Budget's Revisions to the Standards for the Classification of Federal Data on Race and Ethnicity;

- The 1998 FHWA Actions to Address Environmental Justice in Minority Populations and Low-Income Populations;
- The 1998 Transportation Equity Act for the 21st Century (TEA-21);
- The 1999 FHWA Action: Implementing Title VI Requirements in Metropolitan and Statewide Planning, Joint Memorandum of FHWA and FTA;
- The 2000 Fiscal Year Apportionments: Allocations and Program Information, 2000 Bulletin No. 00-02 Guidance on Aggregation and Allocation of Data on Race for Use in Civil Rights Monitoring and Enforcement, the 2000 State Transportation Planning: Metropolitan Transportation Planning: Proposed Rule: Federal Register 33922-33958,
- The 2001 Title VI Legal Manual: U.S. Department of Justice Civil Rights Division,
- The 2001 Title 49 Section 21.9: Nondiscrimination in Federally-Assisted Programs of the Department of Transportation-Effectuation of Title VI of the Civil Rights Act of 1964;
- The 2005 Safe, Accountable, Flexible, Efficient Transportation Equity Act (SAFETEA-LU);
- The 2006 FAA Order 1050.1E, CHG 1, the 2011 Title 23 CFR 200.9(b)(4);
- The 2011 Memorandum of Understanding on Environmental Justice;
- The 2012 "Moving Ahead for Progress in the 21st Century" Act (Map 21);
- The 2012 Department of Transportation Updated Environmental Justice Order 5610.2(a);
- The 2012 FHWA Order 6640.23A;
- The 2012 Department of Transportation Environmental Justice Strategy;
- The 2012 FTA Circular 4703.1: Environmental Justice Policy Guidance for Federal Transit Administration Recipients;
- The FTA "Preparing a Residential Demographic Profile" and "Know Your Community" Guides, and

- The Federal Transit Laws, Title 49, United States Code, Chapter 53.

These policies and guidelines are designed to be flexible enough to apply to a wide range of project types, scales, populations, locations, and effects. Given this need for flexibility, these policies establish *what* needs to be done for EJ assessment, (and provides general suggestions for tools like US Census data and GIS), but leaves *how* to do so largely up to interpretation by planners. Without instruction on how to conduct EJ assessments, planners often struggle to conduct effective assessments, which then puts EJ communities at risk if projects are passed that create disproportionate burden.

Table 3.3.2.A in Chapter 3 documents thoroughly the federal and state requirements and guidelines for EJ, and the items that are left up to interpretation within each policy. A "breakdown" or organized summary of these policies is below.

2.2.2: Breakdown of Guidelines and Requirements

Many federal and state policies and guidelines relating to environmental justice assessment overlap, expand upon, or relate to one another. It can be difficult for planners to sort through these numerous overlapping policies to extract, in a clear, practical sense, which decisions are applicable, what needs to be done, and what needs to be avoided. For the convenience of planners, the key takeaways from these policies are sorted and described in this summary.

Types of Transportation Decisions Applicable

Federal and state policies and guidelines for environmental justice apply to the following types of transportation decisions: preliminary design, final design engineering, policy decisions, right-of-way, construction, operations and maintenance, project development and environmental review under NEPA, systems and regional planning, and metropolitan and statewide planning (NEPA, 1969; Washington DOT, Appendix L; Title 23, 2015).

Discrimination Prohibited

The following types of discrimination are prohibited: on the ground of race, color, or national origin, disproportionate injuries as a result of projects, or high and adverse human health and environmental, social, and economic effects (Uniform Relocation Assistance, 1970; FTA Environmental Justice Circular, 2012), discrimination under any program or activity receiving Federal financial assistance (Title VI, 1964), exclusion from participation under any program or activity receiving Federal financial assistance (Title VI, 1964), denial of benefits of any program or activity receiving Federal financial assistance (Title VI, 1964), and denial of, reduction in, or significant delay in receipt of compensation or benefits given in exchange for burdens as a result of transportation projects (FTA Environmental Justice Circular, 2012). It is largely left up to interpretation how the groups facing discrimination should be identified, and what steps should be taken to avoid discrimination.

Groups Considered

In assessing environmental justice, transportation agencies must include the following demographics: race (Black, Asian, American Indian and Alaska Native, Native Hawaiian or Other Pacific Islander), poverty (households below the poverty line), Hispanic or Latino populations,

Limited English Proficiency (households with residents who speak English "not well" or "not at all," Disability, Age (over 65 years of age), and "general social groups specially benefited or harmed by the proposed project." (Title VI, 1964; Age Discrimination Act, 1975; Guidance for Preparing and Processing Environmental and Section 4(f) Documents, 1987.) It is largely left to interpretation how these groups should be identified, on which scales, by which data, and by which proportions.

Effects Considered

The following environmental justice effects resulting from transportation projects must be considered: general social, economic, and environmental impacts, air pollution, noise pollution, water pollution, community cohesion and the availability of public facilities and services, adverse employment effects, and tax and property value losses, accessibility and changes in travel patterns, including vehicular, commuter, bicycle, or pedestrian travel patterns, displacement of people, businesses and farms and disruption of desirable community and regional growth, and quality of transportation systems near minority and low-income communities (DOT Environmental Justice Strategy; Environmental Impact and Related Procedures; Federal Aid Highway Act, 1970; FTA Environmental Justice Circular, 2012; Uniform Relocation Assistance, 1970). The definitions of "social, economic, and environmental" impacts are left to interpretation, as are the methodologies or models to measure any of the other listed impacts.

Analysis

To assess whether the aforementioned groups are disproportionately burdened by or denied the benefits of the aforementioned effects, transportation planners should conduct the following analyses "where relevant appropriate, and practical." First, there must be an analysis of the population served and/or affected by the transportation plan, sorted by race, color or national origin, and income level. Second, there should be an analysis to see whether programs, policies, or activities will have an adverse or burdensome human health or environmental effect on minority and low-income populations, and whether that adverse effect will be disproportionately high. There should also be an evaluation of the present and proposed membership in any planning or advisory body that is part of the program policy or activity, analyzed by race, color or national origin (Department of Transportation Updated Environmental Justice Order, 2012; FHWA Environmental Policy Statements, 1990; Guidance for Preparing and Processing Environmental and Section (f) Documents, 1987).

The definition and measurement of the core concept of "benefits and burdens" is largely left up to interpretation. Transportation agencies must determine which factors to consider to ensure that the required "all possible" adverse effects are considered, and which of these factors they consider to be "beneficial" and which they consider to be "burdensome." This is extremely complex, because the planners must select from a huge range of possible indicators that measure "environmental, social, and economic" effects, determine methodologies of measuring each of these indicators (i.e., what distance is considered "accessible," which jobs should be considered in economic analysis, or what level of exposure to air pollution is considered "burdensome"). Then, they must determine how to weigh these widely varying, often qualitative and incomparable effects in relation to one another, and decide how to determine overall "burden" and "benefit."

In this weighing process, planning agencies must not only determine how to aggregate the results of "burden and benefit" measurements for a number of indicators, but also must determine what level of burden is considered "disproportionately high," "severe," "substantial," or "of extraordinary magnitude." If the level is set too low (where, for example, any instance where there is a greater percentage of EJ communities burdened than the percentage of non-EJ communities burdened, even if that difference is only 1%), there is risk that the results will become cluttered, and areas of true burden will be lost in the data. If the level is set too high (where only extreme differences between the burdens faced by EJ and non-EJ communities are counted), there is a large risk that very serious EJ burdens experienced by low-income and minority communities will be unjustly dismissed as insignificant, enabling continued discrimination. Where is the perfect line in between? Which statistical methods should be used to determine this line? It is up to planning agencies to devise these answers.

Methodology

To conduct these analyses, the following methodologies are recommended. Generally speaking, the analyses should use a "systematic, interdisciplinary approach," including an "integrated use of natural and social sciences, and environmental design arts in planning and decision making" (NEPA, 1969). Further, "to the fullest extent possible, all environmental investigations, reviews, and consultations should be coordinated as a single process" rather than as separate and siloed processes for each analyses (Environmental Impact and Related Procedures, 1987). More specifically, these analyses should be based on the latest available US Census, American Community Survey (ACS), and local data (FTA Environmental Justice Circular). With this data,

Geographic Information Systems (GIS) technology should be used to map the locations and percentages of minority and low-income populations, overlaid with the project impact area (FTA Environmental Justice Circular, 2012). This mapping exercise will help planners visually identify any patterns.

These mapping exercises and use of Census data and GIS software are common practices in environmental justice assessment. However, it is partly left up to the agencies to determine how such analyses should be conducted, which populations should be considered EJ populations, and whether certain demographics should be weighed more heavily than others. For example, some federal requirements suggest that EJ includes only race and poverty, while some guidelines employ a broader definition of EJ that includes demographics like disability, limited English proficiency, Hispanic, or elderly populations. For example, should the presence of an elderly white person be given the same weight in an EJ index as the presence of an African American person or an impoverished person? Is the elderly person at a comparable level of disadvantage? For that matter, is a minority individual at the same degree of disadvantage as an impoverished person who is white? If not, how does one determine the degree of disadvantage that should be afforded to each demographic? Should there be considerations for "double counting," or should someone who is impoverished, a minority race, of limited English proficiency, disabled, and elderly be justifiably counted five times in an EJ Index because that person is at a greater degree of disadvantage than if he or she was included in only one or two of those demographics?

Planners also must determine how to draw lines between "general social groups," in cases where federal requirements specify that the disadvantages may be seen between social or cultural groups rather than between demographics. In a similar vein, where federal requirements advise the

planners to group people based on "geographic proximity," planners must determine how to define "proximity," and justify this choice (Guidance for Preparing and Processing Environmental and Section 4(f) Documents, 1987).

Public Involvement

There should be "meaningful involvement" of environmental justice populations in these assessments, and there should be "full and fair participation" in public involvement (FTA Environmental Justice Circular, 2012). Policies clearly establish the requirement for "full and fair" public involvement and participation, but the definitions and methodologies relating to such involvement are largely left to the interpretation of the planning agencies. What number of stakeholders counts as "full" participation? What type of interactions and outreach count as "fair?" What are "reasonable opportunities" for participation in the planning process? What counts as "convenient and accessible" public meetings? Is there a minimum of outreach attempts that should be met, or a baseline for public meeting amenities like childcare or transportation or timing that should be established? How should information be effectively disseminated? How does one determine that public involvement has met the federal requirement for being "meaningful," or that issues raised by minority and low-income persons are "appropriately" considered? How should the extent of public involvement in *processes and planning* of transportation projects (in addition to effects) be measured? Many of these questions are highly dependent on the context of the project and community, so it is difficult for set guidelines or definitions to be established. However, without clear guidelines, with each project or plan, planners must interpret how to fulfill public participation requirements.

Reports, Plans, and Strategies Required

Annually, transportation agencies are required to compose a Title VI compliance report and a NEPA compliance report, both of which include environmental justice (Title VI, 1964; NEPA, 1969). Agencies must have documentation of all development that is federally funded, the potential impact of this development, and actions taken to mitigate these impacts. For NEPA analyses, projects can be labeled as a "categorical exclusion," or can be determined to need an environmental assessment, or an Environmental Impact Statement (NEPA, 1969). Transportation agencies also must pass program certification reviews by the federal government, and these reviews include Title VI and environmental justice.

Beyond annual reports, transportation agencies must also have documentation for each project proposal throughout the year. For each project proposal, agencies must describe the overall environmental impact of the proposed action, any adverse environmental effects which cannot be avoided if the project comes to fruition, any alternatives to the proposed project, and justification for selection of the project amongst these alternatives (NEPA, 1969). Agencies also must show that project decisions were made in the best overall public interest, "taking into consideration the need for fast, safe, and efficient transportation, public services, and the costs of eliminating or minimizing such adverse effects" (23, USC 109 (h)).

Further, agencies must document proposed steps to guard against disproportionately high and adverse effects on persons on the basis of race, color, or national origin, and income level. They must also develop and document methods and procedures "to ensure that presently unquantified

environmental amenities and values may be given appropriate consideration in decision-making" (NEPA, 1969).

Exceptions

Projects, programs, policies, or activities that create disproportionate impact on EJ populations can be brought to fruition despite this impact if certain conditions are met. These conditions are as follows: a "substantial need for the program, policy, or activity exists, based on the overall public interest," "alternatives that would have less adverse effects on protected populations either (a) would have other adverse social, economic, environmental or human health impacts that are severe or (b) would involve increased costs of extraordinary magnitude," "further mitigation measures or alternatives that would avoid or reduce the disproportionately high and adverse effect are not practicable," (DOT Updated Environmental Justice Order 5610.2(a), 2012), and if the "proposed mitigation represents a reasonable public expenditure after considering the impacts of the action and the benefits of the proposed mitigation measures" (Title 23, 771: Environmental Impact and Related Procedures, 1987).

The definitions of these criteria to justify exceptions are largely left to interpretation. Exceptions of course must be approved at the state or federal level, but in crafting their arguments, planners must largely decide how to determine what counts as a "substantial need," how to gauge "overall public interest" (and critically, who is included in that public interest). Planners also must determine which "social, economic, environmental, or human health impacts" to consider for adverse effects, how to determine whether an alternative is "practicable," determine what counts

as “minimizing” adverse effects or how to know when an effect has been minimized, and how to determine a level of money that is “reasonable public expenditure.”

2.3: Concepts and Theories

In order to fulfill the aforementioned federal and state requirements and to define the items left up to interpretation, planners need environmental justice assessment frameworks and defined methodologies. These frameworks and methodologies, like all methodologies, are inherently based upon concepts and theories about environmental justice and assessment thereof. Therefore, before delving into specific technical assessment models, this literature review will first given an overview of concepts and theories behind EJ assessment, including the value of EJ assessment, challenges of EJ assessment, and principles of equity.

2.3.1: Challenges of EJ Frameworks

There is a reason that usable, thorough, and agreed-upon EJ frameworks are rare. There are a number of lofty challenges involving the development of such frameworks. Some have criticized the very idea of using a quantitative environmental justice assessment framework as a means of ameliorating environmental justice issues (Kuehn, 1996; Purvis, 2001). There are valid assertions that any tool that aims to *quantitatively* measure something as *qualitative* and socially complex as environmental justice is inherently flawed. These arguments are not off base. There will indeed always be valuable information lost when systematic injustice is condensed to a series of scales and numbers. There is a wide range of transportation project types, sizes, scales, and contexts, and a multitude of community types, conditions, locations, effects, and histories. Each project and EJ community is unique, so creating an assessment framework that is flexible enough to fit the needs of many assessments is a great challenge (Purvis, 2001). Further, the concepts of “benefits” and

"burdens" are inherently philosophical and subjective. The same project may be of "benefit" to one group of people but a "burden" to a different group of people. For example, a train project could increase the mobility of some residents who depend on public transit, but could displace other residents who are forced to move for the project construction. The extent to which projects are beneficial or burdensome is also endlessly debatable. There will always be room for criticism of assignment of numeric values to qualitative issues.

The quantitative components of environmental justice assessments are also by no means without their challenges. Even if effects such as air pollution, water pollution, hazardous materials, displacement effects, economic opportunity access, mobility, and other environmental justice issues are theoretically quantitatively measureable, often the extent and location of these effects are unknown, and are therefore difficult to be measured (Mills & Neuhauser, 2000). The only data that we know for certain is data of past conditions, so present and future data can never be entirely accurate (Purvis, 2011).

Identifying the presence of protected populations, and identifying the comparison "average" populations are also not straightforward, despite being theoretically quantitative. Low-income and minority populations are almost always included in assessments, but there is debate surrounding EJ assessment of populations that have disabilities, are elderly, or are white but don't speak English, and whether those populations face the same disproportionate burdens faced by communities of color and low-income populations. Even the classification of "low income" populations can be debatable, as low-income level doesn't always indicate poverty. For example, if assessments are purely income-based, college towns and wealthy retirement villages, where

many people are well-off but have little to no income, may be marked as EJ communities (McCaskill, 2015). The classification of race is also not straightforward; the Census has issues involving undercounting of minorities, issues of self-identification among people of mixed race (McKenney & Bennett, 1993), and a complete lack of data on Middle Eastern populations (Awad, 2016). These classifications are critical to EJ analyses, as the choice, definition, and scale of EJ populations and reference populations can influence the results of the assessment and can fore-ordain outcomes (Most et al., 2004). Within identical project situations, one assessor could find "no disproportionate impact," and another could find significant impact, if populations are defined differently (Most et al., 2004).

Even if populations are well defined, determining the scale of effective EJ assessment is a challenge. Large scale assessments, such as those based at the Census Tract level, are more realistic to conduct but are also more likely to gloss over EJ effects (Day, Hedgpeth, & Cockburn, 2012). Small-scale assessments, such as those based at the Census Block Group level, are more detailed and thus more likely to catch instances of environmental injustice. However, data is often unavailable at smaller scales, making such detailed assessments not feasible (McCaskill, 2015).

Further, there are significant discrepancies between the EJ assessment methods that are discussed in a theoretical sense by academics and those that can be realistically achieved in practice. Environmental justice is hugely important, but in the context of transportation planning, it is one of many considerations that must be assessed within limited time periods and with limited capacities. Environmental justice advocacy in planning sometimes conflicts with other planning goals (cost efficiency, time efficiency, mobility, economic development, etc.), and therefore the

most robust EJ analyses may be difficult for planners and policy makers to successfully implement (McCaskill, 2015).

2.3.2: Value of EJ Frameworks

Even in light of the numerous and serious challenges of EJ assessment, it is often argued that environmental justice assessment frameworks *are* still valuable and worth developing. There are three major arguments that support the value of environmental justice frameworks. The first argument is that assessing qualitative issues in a quantitative way is better than not assessing the issues at all. Realistically, without credible and usable ways in which to assess environmental justice, agencies are much less likely to devote staff time to doing so. Agencies are likely to fulfill the federal requirements by merely documenting an estimation of "no predicted environmental justice impact" without taking a deeper dive, especially if planners are not aware of obvious effects (McCaskill, 2015).

Even if effects like air pollution exposure, displacement, or mobility limitation are in essence qualitative, they *can* be assessed quantitatively when valued in relation to themselves, and within a consistent framework and scoring system. With a usable framework, planners are better able to incorporate EJ measurements into what environmental economists deem to be the "true costs" and benefits of a project (costs that account for environmental and other externalities) (Bateman, Lovett, & Brainard, 2003). That is, if planners have a method of measuring the environmental justice costs of a project on a protected population, they can then take those costs into consideration alongside financial and other classically considered costs, and can therefore make project decisions that are hopefully equitable. From a planning agency's perspective, conducting and documenting

EJ assessment of projects can also help to ensure that there are not issues relating to EJ lawsuits down the road.

The second argument in support of environmental justice assessment frameworks states that in order to ensure that negative effects from projects do not fall *disproportionately* on disadvantaged communities, there must be a way to establish data on proportional effects (Gerrard & Foster, 2008). Yes, one could assert broadly that a highway system is harming the health of minority communities. However, it is a much stronger argument in a legal or planning context to be able to say, for instance, that 80% of the people within an air pollution buffer around the highway project are minorities. In fact, without these statistics, EJ communities who have attempted to obtain injunctions of disproportionately burdensome projects through our judicial system have been denied relief.[4] Considering the very quantitative nature of policy enforcement, if progress is to be made in ameliorating the disproportionate burden faced by EJ communities, there must be measurement of this disproportionate burden.

The third argument in support of environmental justice assessment frameworks states that the actual process of conducting thorough EJ assessments helps planners identify and connect with the EJ populations, effects, and sites that are present within their communities. Any viable urban plan needs a direction determined by indicators most important to the communities being served. The process of engaging and involving low-income, minority, limited English proficiency, elderly, and disabled populations can only be beneficial for the public involvement and planning process.

[4] See *NYCEJA v. Giulliani* 214 F.3d 65, 69-71, or *Darensburg v. MTC,* 2011 US App Lexis 3007.

2.3.3: Concepts of Equity

Environmental justice involves the amelioration of "disproportionate" impact, and therefore inherently involves concepts of equity or fairness. To ensure that impact is not "disproportionate," there need to be clear definitions of equity. However, because equity is an inherently philosophical term that is arguably dependent on context, equity can be defined in a number of different ways. The "Stakeholder Feedback" section of this report will describe how survey respondents for this study defined equity, but this section will focus on prominent definitions of equity found through the review of literature.

According to Litman (2007), there are three types of transportation equity: horizontal equity, vertical equity with regard to socioeconomics, and vertical equity with regard to mobility and disability. "Horizontal equity" occurs when costs and benefits are shared equally across persons within the same level of ability and need. In this scenario, all low-income people would face the same costs and benefits, and all high-income people would face the same. This is not the classic environmental justice conception of "equity." Under horizontal equity, subsidies are discouraged, and costs are borne by the users of the transportation system. "Vertical equity with regard to socioeconomics" is the classification of equity that we associate with classic environmental justice. Costs and benefits are distributed evenly across groups and persons have *different* abilities and needs (Litman, 2007). Vertical equity often requires subsidies, because people of low socioeconomic status may not be able to afford the same transportation access as those of higher socioeconomic status. Finally, "vertical equity with regard to mobility and disability" occurs when transportation networks provide services equitably to those with and without disabilities and special needs. (Litman, 2007). Because "Disability" and "Elderly" demographics are increasingly

incorporated into environmental justice assessments, this third classification of equity should be incorporated into EJ assessment frameworks that consider mobility and disability in addition to race and income.

Jouni Paavola (2003) presents a more nuanced and complicated approach to environmental "justice," arguing for "defendable norms of distributive justice" that require "different rules … for different distributive dilemmas." Paavola expanded beyond Litman's focus on equitable outcomes, to also stress the importance of equitable *procedures.* He argued that distributive justice in outcomes will grow increasingly muddled and difficult to define, because outcomes are rivalrous (justice for one group is injustice for another), stakeholders are widely varying, and concepts of equitable outcomes are increasingly heterogeneous. Instead, if we focus on instilling equitable *procedures* (power distributions in decision-making bodies, making sure burdened voices are involved in decision-making, stakeholder outreach), we may be more able to achieve equitable outcomes down the road. Paavola defines equitable outcomes as situations where known negative impacts are *randomly distributed* throughout a community, crossing all demographics (Paavola, 2003). Schlosberg (2007) seems to agree, arguing that environmental justice must incorporate both "distributive justice" (outcomes), and "procedural justice," the latter of which he defines as "recognition, capabilities, and participation" by stakeholders (Schlosberg, 2007).

The Equity Caucus at Transportation for America, composed of national leading environmental justice, economic justice, racial justice, community development, women's rights, and other justice-based organizations, structures the definition of "equity" a bit differently. The Caucus' principles are as follows: "create affordable transportation options for all people, ensure fair access to quality jobs, workforce development, and contracting opportunities in the transportation

industry, promote healthy, safe, and inclusive communities, and invest equitably and focus on results" ("Statement of Principles," 2014). The Caucus focuses on equity in terms of access to investment, mobility, employment, and affordability for those who are "low-income," "rural," "underserved", "disadvantaged," "older," "disabled," and "people of color" ("Statement of Principles," 2014). This concept of equity is broader than Litman's definitions, but could fit within his "vertical equity" structures.

Ferguson et al. (2012) explored principles of equity in terms of "equitable access to basic amenities" such as food, healthcare, and employment for "low-income" or "disadvantaged populations." In this case, the researchers seem to be defining equity as a more focused interpretation of Litman's "vertical equity," focusing on equitable access between those who are financially able to own cars and those who are not. Feng & Zhang (2014) used a similar access-based definition of transportation equity in their study of the tradeoffs between "equity maximization and cost minimization of network construction." The researchers defined equity as "the spatial distribution of accessibilities across zone areas" (Feng & Zhang, 2014). Because their research was based on spatial distribution rather than demographics, this definition would ostensibly combine Litman's vertical and horizontal equity.

Because the objective of environmental justice is to achieve equity and justice for protected populations through "meaningful involvement" (DOT Updated Environmental Justice Order 5610.2(a), 2012), it is critical that our conceptions of equity also consider the term as defined by those who identify as EJ populations themselves. The "Jemez Principles for Democratic Organizing" are principles of equity defined, created, and commonly supported by environmental

justice leaders (Solis, 1996; Molina, 2015; WeACT for Environmental Justice, 2016; Southwest Network for Environmental and Economic Justice (SNEEJ), 1996). These principles were created at the Jemez "Working Group Meeting on Globalization and Trade," hosted by the Southwest Network for Environmental and Economic Justice in 1996, and were presented at the Environmental Justice panel of the U.S. Climate Action Network Conference in 2015 by prominent EJ activist Lily Molina. According to Molina, these principles should be incorporated into environmental justice assessments whenever possible.

1. **Be Inclusive**

   "This requires more than tokenism. It cannot be achieved without diversity at the planning table, in staffing, and in coordination. It may delay achievement of other important goals; it will require discussion, hard work, patience, and advance planning. It may involve conflict, but through this conflict, we can learn better ways of working together. It's about building alternative institutions, movement building, and not compromising out in order to be accepted into the anti-globalization club" (SNEEJ, 1996).

2. **Emphasis on Bottom-Up Organizing**

   "To succeed, it is important to reach out into new constituencies, and to reach within all levels of leadership and membership base of the organizations that are already involved in our networks. We must be continually building and strengthening a base which provides our credibility, our strategies, mobilizations, leadership development, and the energy for the work we must do daily" (SNEEJ, 1996).

3. **Let People Speak for Themselves**

   "We must be sure that relevant voices of people directly affected are heard. Ways must be provided for spokespersons to represent and be responsible to the affected constituencies.

It is important for organizations to clarify their roles, and who they represent, and to assure accountability within our structures" (SNEEJ, 1996).

4. **Work Together in Solidarity and Mutuality**

   "Groups working on similar issues with compatible visions should consciously act in solidarity, mutuality and support each other's work. In the long run, a more significant step is to incorporate the goals and values of other groups with your own work, in order to build strong relationships. For instance, in the long run, it is more important that labor unions and community economic development projects include the issue of environmental sustainability in their own strategies, rather than just lending support to the environmental organizations" (SNEEJ, 1996).

5. **Build Just Relationships Among Ourselves**

   "We need to treat each other with justice and respect, both on an individual and an organizational level, in this country and across borders. Defining and developing "just relationships" will be a process that won't happen overnight. It must include clarity about decision-making, sharing strategies, and resource distribution. There are clearly many skills necessary to succeed, and we need to determine the ways for those with different skills to coordinate and be accountable to one another" (SNEEJ, 1996).

6. **Commitment to Self-Transformation**

   "As we change societies, we must change from operating on the mode of individualism to community-centeredness. We must 'walk our talk.' We must be the values that we say we're struggling for" (Molina, 2015; SNEEJ, 1996).

2.3.4: Bias and Decision Theory

Decision Theory, or the "reasoning underlying an agent's choices" (Steele & Stefansson, 2015) involves theories of choice, preference, beliefs, attitudes, rationalities, uncertainties, and statistics. Because decisions are inherent in each component of environmental justice assessment, decision theory is a critical element of environmental justice assessment frameworks at every level of the framework. At the highest level, there is substantial decision theory involved with the policies that drive the requirements for the assessments. This level is dependent upon the decision theories of policy makers and is largely out of the scope of the framework. At the next highest level, environmental justice assessment frameworks themselves are "decision-aiding" strategies (Weber, 1990), and therefore should be assessed for overarching decision theories built into the structure of the framework.

The frameworks assist with all four of the classic core steps of decision-making: recognition of an issue, evaluation of the agent's objectives, analysis of the decision problem and development of alternatives, and choice among alternatives (French, 1986; Witte, 1972; Kiersten & Szpakowicz, 1994). Third, within the framework itself, decision theory infiltrates nearly every element. The assessor has to make innumerable decisions on the context, timing, methodology, scale, and definitions of populations, relevant effects to be studied, levels of significance, and levels of detail for the assessment. Each of these elements in turn contains its own set of decisions that are based on the context within which the decision-maker operates (Brezillion, 2010).

To make good decisions throughout these levels of the framework, decision-makers need to be equipped with "good information, experience, and regular feedback" (Thaler & Sunstein, 2008). In this context, "good information" could pertain to solid data and community engagement,

"experience" could relate to planner skills or knowledge of the area, and "regular feedback" could be achieved through regular stakeholder engagement, transparency, and self-assessment.

Classic decision theory involves two central concepts: "preferences" and "prospects." Decision theory explorations in the field of Behavioral Economics (BE) have delved into "prospect theory" since 1979 (Kahneman & Tversky, 1979), in ways that can be related directly to EJ assessments, although such a relation between EJ and BE hasn't been prominently done as of yet. BE "prospect theory" delves into the choices that people make between "prospects" (like transportation project alternatives), where the probabilities of the outcomes of those decisions are unknown. BE-based prospect theory is unique and especially useful to EJ assessments because it takes into account predictable human irrationality. This stance stands in opposition to classic decision "utility theory," which is based on the unrealistic idea that people make decisions rationally and based upon optimal outcomes. Instead, BE-based prospect theory brings to light a whole number of consistent irrationalities and tendencies in human decision-making processes that can help decision-makers account for their biases rather than assuming there exist none (Kahneman & Tversky, 1979).

There are many examples of BE "heuristics" or "predictable irrationalities" (Ariely, 2008) that should be highlighted in relevance to EJ assessment. For example, Behavioral Economists have found that humans have an "inequity aversion," which makes them prone to desiring "fairness" or "equitable" reciprocity (Fehr & Schmidt, 1999). This human tendency would appear to be good news for support of concepts of "equity" in the context of environmental justice. However, Behavioral Economists have also found that human valuing of fairness or severity of effect is

highly based upon points of reference (Huettal, 2014; Ariely, Loewenstein, & Prelec, 2003; Biswas, 2009). For example, if there were a highway built in the middle of a pristine, environmentally friendly open space, the severity of the environmental effect of the highway would be seen as very high. If however, a highway were added to the expansive network of DC's interstates and highways, the environmental effect would be seen as much smaller, *even if* the highways had in reality contributed the exact same amounts of pollution, fragmentation, and noise.

Another example of a relevant human decision-making tendency observed by Behavioral Economist decision theorists is that of loss aversion (Kahneman & Tversky, 1979; Gachter, Orzen, Renner, & Starmer, 2009). For humans, the pain of loss is stronger than the positive emotion of gain. If we were perfectly rational beings, this would not be the case, because an equal "cost" and the "benefit" would cancel each other out perfectly. Instead, we perceive a loss of equal value to the benefit to be larger than the benefit. Huettal (2014) uses the example of a mug gift to illustrate this; if someone is given a mug and then later asked to sell it, they will set the price of that mug higher than the price they were willing to pay for the mug before they owned it. To understand why this is relevant to transportation EJ, consider a common scenario where a highway is built through a neighborhood, and the displaced residents are compensated monetarily. A classic cost-benefit analysis would deem the compensation as sufficient, but stakeholders would still be distraught, because the loss of the neighborhood would be perceived as larger than the gain of compensation that is financially equivalent. This is a critical trend to keep in mind in "Benefit and Burden" analysis. Benefits cannot easily "cancel out" burdens.

On the more technical or numerical side of decision-making, Behavioral Economists have made relevant discoveries of trends such as the tendency for humans to undervalue the value of high probabilities (like 98% and 99%), overvalue the value of low probabilities (like 1% and 2%), and fail to differentiate between mid-range probabilities (like 35% and 45%) (Huettal, 2014; Dolan et al., 2010). For example, if there was a 2% chance that a toxic hazard would affect a population, if this was communicated as a 98% chance that the toxic hazard would *not* affect a population, the latter framing would likely lead to decision-makers perceiving a larger threat, despite being identical. If air pollution increased from 35% to 45%, we would fail to value that change as being the same percentage change as, say 5% to 15% (Huettal, 2014; Dolan et al., 2010). Similarly, humans overvalue "free" items, perceive increases between "free" and a price as greater than an identical increase between one price and another price, and overvalue the importance of monetary cost as an indicator of quality (Shiv, Carmon, & Ariely, 2005). These are relevant observations for transportation EJ not only for decision-makers but also for stakeholders like transit riders, users of public (free) infrastructure, and general users of transportation systems.

Other relevant Behavioral Economics-based decision theories include the "availability heuristic," where we believe conditions (like EJ burdens or lack thereof) are more prevalent if we can easily bring them to mind (Tversky & Kahneman, 1974), the "affect heuristic" which leads to closed mindedness if the decision-maker happens to have strong emotions tied to the subject (Finucane, Alhakami, Slovic & Johnson, 2000), the "salience heuristic," which prompts people to deem *prevalent* practices (like prominent EJ models) as the *"best"* practices, "status quo bias," which prompts people to be resistant to change (Samuelson & Zeckhauser, 1988), and "present time bias," which pushes us to overestimate importance of immediacy and underestimate the

importance of future projects (Frederick, Lowenstein & O'Donoghue, 2002). Further, critically, decision-makers make decisions based on their perceptions that are dependent on the contexts, conditions, and knowledge to which they've been exposed (Kahneman, 2003), so if a planner was raised in a privileged environment, and lacks exposure to EJ issues, he or she is less likely to make decisions that are "optimal" for those who live with EJ issues. The bottom line is this: even if we weigh "costs and benefits," our decisions are not always (or ever) perfect.

If we are striving for assessment frameworks that are as accurate as possible, an understanding of decision theory can be of huge assistance. We cannot eliminate our biases or irrationalities, but we *can* bring to light our reference points and decision processes, to help ourselves see where inherent irrationalities may be lurking in our assessments. Systematically recognizing irrationality is far more productive than merely assuming rationality. In fact, EJ assessment frameworks can be greatly improved upon if an unearthing of the decision theories behind such frameworks is built into the process. The gaps between decisions made at the policy level and the strategy level (like the gap between Executive Order 12898 and current EJ frameworks) can shrink if the reasoning behind decisions at each level is made explicit (Brezillion, 2010). For this reason, the new EJ framework will include prompts for recognition of each of these heuristics, and requirement of an explanation of decision-making processes.

2.4: Legal Cases

In order to understand the importance of effective environmental justice assessment, it is critical to understand historical (and unfortunately too recent) cases where a lack of such assessment led to grave results for environmental justice populations. This section of the literature review will highlight environmental justice court cases that rose to high legal prominence. Despite this

prominence, many of these cases did not result in an equitable or just outcome for disproportionately burdened communities, and decisions predominantly ruled in favor of project implementers. To prove a violation of Title VI, plaintiffs have to show a causal connection between the policy and the adverse impact on protected populations, and they must show discriminatory effects that disproportionately burden protected populations (U.S. Department of Justice, 2001). Proving these connections requires robust data and environmental justice assessment.

The first civil rights lawsuit in the U.S. involving environmental burdens on minority populations was *Bean v. Southwestern Waste Management*, Inc. (1979), where residents of an African-American neighborhood fought a landfill site that was set to be built in their neighborhood. The following years saw the rapid building of the environmental justice movement, including a protest of a PCB landfill in Warren County, NC in 1982 that lead to 500 arrests, and a study in 1983 that revealed that 75% of hazardous waste facilities were located in African-American neighborhoods, even though African Americans made up only 20% of the population (Bullard and Johnson, 2000). These statistics were (and are) of course not a result of chance or accident but are a result of the United States' shameful history of systematic racism, segregation, and discrimination. Unfortunately, even today, 45 years after *Bean v. Southwestern Waste Management, Inc*. our judicial system does not always ameliorate or give justice to these issues and trends.

For example, in 1994 in Los Angeles, the Labor/Community Strategy Center and the Bus Riders Union filed a civil rights lawsuit against the LA County MTA because of a policy that would increase rates for predominantly African American bus riders in order to fund rail services for predominantly white neighborhoods. After many years of complication involving a court-

approved Consent Decree, an unfulfilled five-year plan, an appeal to the 9th Circuit Court of Appeals, and a Supreme Court rejection of a certiorari request, the case closed with a ruling in favor of the MTA, denying motions for extension of the Consent Decree, and opinion that the MTA was in compliance despite the favoring of predominantly white neighborhoods, and despite failure to fulfill the requirements listed in the Consent Decree (*Labor/ Community Strategy Center v Los Angeles County Metropolitan Transportation Authority*, 2009)

In 1999, Jersey *Heights Neighborhood Association v. Glendening* (1999) involved a highway project in Maryland that was routed through a predominantly (90%) black community. There was another route considered for the project that would have placed the highway in a predominantly white area of the city. The residents of the predominantly white community received prompt individual notice of the planning process in 1983, while options were still being considered, and changes were still possible. The residents of the predominantly black neighborhood did not receive such notices. The white neighborhood, having been informed, voice strong objections to the proposed route that would have gone through their neighborhood. The black neighborhood, without awareness of the project, of course did not voice such opposition, so the plans moved forward to build in the black neighborhood (*Jersey Heights Neighborhood Association v. Glendening* (1999). In 1992, only after the planning process was finished and a decision had been made were the residents of the black community informed.

Upon being informed, the residents of the black neighborhood sought administrative remedies and then judicial actions under Title VI. The court ruled that the actions of the residents of the black neighborhood were too late because they did not occur within the three-year limitation period of

the planning process. In making this decision, the court set a precedent that Title VI timelines are dependent upon the dates of local decision-making, and not the dates of the allocation of federal funding or final approval of the projects. The project also did not qualify for a "continuing violation" because it was not a "continual unlawful act" but instead a continued effect from the same original action (*Jersey Heights Neighborhood Association v. Glendening* (1999). Therefore, because the planners failed to notify the affected communities in a timely manner, the affected communities suffered the consequences. Effective environmental justice assessments could have prevented this outcome because they would have ostensibly shown disproportionate burden, and would have ideally necessitated prompt and effective public involvement.

In 2000, New York City saw a similar case when the New York City Environmental Justice Alliance attempted to gain an injunction against Mayor Rudolph Giuliani concerning an urban renewal project that would have eliminated over 600 community gardens in predominantly black areas of the city. The Plaintiffs argued that the white residents of New York City already have access to larger areas of open space, and that the elimination of these 600 gardens only exacerbates that discrepancy. The court ruled against the Environmental Justice Alliance, arguing that the plaintiff could not prove causation, that their claim "consisted of broad conclusive statements," and lacked formal statistics to verify their claim *(NYCEJA v. Giuliani* 2000). If the city had been regularly conducting effective environmental assessments for proposed projects, and had created a thorough environmental justice index that highlighted areas with high concentrations of protected populations, the plaintiffs would have had access to statistics to verify their claims, and their attempt to obtain an injunction may have been successful. This case again, highlights the need for thorough, regularly updated, and publically accessible EJ assessment.

Court cases ruling in opposition to EJ populations are unfortunately not only a thing of the past. In 2011, in *Darensburg v. Metropolitan Transportation Commission*, (2011) the plaintiffs argued that the Metropolitan Transportation Commission (MTC) in San Francisco was significantly favoring the rail system (BART) over the bus system (AC Transit) in its allocation of funding. Because AC Transit riders are predominantly (78%) minorities, and BART riders are split fairly evenly (54% minority, 46% white), the District Court ruled that the plaintiffs had a prima facie case of disparate impact. However, the Ninth Circuit court voted unanimously to reject findings of disparate impact because the plaintiffs could not provide a detailed statistical analysis showing disproportionate burden as a result of the specific project at hand (*Darensburg v. MTC,* 2011). Here again, likely disproportionate burden was allowed to move forward because of a lack of formal quantitative statistics showing the burden that was qualitatively recognized. Thorough environmental justice assessment of the project while in the planning stages could have provided the needed statistical analysis to avoid the allowance of likely disproportionate burden.

In the same year, in *St. Paul Branch of the National Association for the Advancement of Colored People v. U.S. Dept. of Transportation,* 2011, the District Court dismissed an environmental justice claim relating to a light rail construction project that would displace a predominantly African-American neighborhood. The plaintiffs argued that there wasn't sufficient consideration of the disproportionate burden on protected populations included in the Environmental Impact Statement. The court ruled that the agencies had conducted some level of consideration of EJ, and that presence of EJ consideration (regardless of the quality or methodology of consideration) was sufficient, and the project was justified because the DOT had decided that the project would

provide "substantial benefits" to the community (*Colored People v. U.S. Dept. of Transportation*, 2011). Here, if there were a standard methodology for environmental justice assessment, there would not have to be question of whether EJ had been sufficiently evaluated. "Consideration" of EJ effects alone should not suffice, as any subjective checking of boxes could count as "consideration." Establishing clear expectations, requirements, and recommended models for EJ assessment would assist both planners and affected communities in avoiding these circumstances.

2.5: Case Studies and Methodologies

Methodologies that measure the effects of transportation projects on environmental justice communities are widely varying and in need of agreed-upon standards. There is no consensus on which effects should be measured to assess environmental justice, and many researchers focus in depth on one or two specific measurable effects, rather than incorporating a number of effect assessments into a comprehensive framework. This section of the literature review gives an overview of case studies and methodologies for environmental justice assessment.

2.5.1: Public Involvement

Public involvement relating to environmental justice has followed a similar trend as the aforementioned court cases. The concept of "public involvement" relating to environmental matters was formalized in U.S. policy through NEPA in 1970, and, as shown in the "requirements" section above, most environmental justice assessment policies requires public involvement in some capacity. Public involvement is crucial to environmental justice because EJ is an inherently ethical issue, and ethics are based upon value judgments of *people* rather than technology (Larsen & Claussen, 2004). However, as Bailey, Grossardt, and Ripy (2012) point out, despite this longevity of the concept and these enforced policies, there is no formal direction on the "form,

content, or objectives" of this public involvement, or *how* exactly to successfully conduct public involvement relating to environmental justice.

As a result, planners are left to cobble together what they believe will be effective or "meaningful" public involvement, which leads to a number of challenges. The most common tactic for public involvement is the targeting of groups that we label as "EJ groups" based on the Census (Bailey et al., 2012), but this tactic can create issues when those groups do not self-identify as being EJ, dispute designated labels of "disadvantage" and "privilege," or feel like they are being placed in opposition to groups of different demographics (Capek, 1993; Shilling, London, & Lievanos, 2009). Planners also struggle to gather substantial numbers of people for public involvement, and are not sure how to determine effective timing, locations, conversation tactics, mediums for outreach, or measures of effectiveness for public outreach (McCaskill, 2015). As a result, planners often resort to ineffective public involvement strategies that draw in too few people, are not representative of protected populations, and/ or do not result in real change in project strategy as a result of the public input.

Researchers differ in methodologies for addressing environmental justice issues of public participation. Bailey et al. (2012) argue that public involvement procedures in transportation-related environmental justice assessments should employ effective "large group processes" based upon John Rawls' theories of "procedural justice" and "access to justice." They argue that processes should seek to eliminate barriers to participation and maximize participant numbers rather than targeting certain Census-based demographics, that performance indicators should be transparent and stakeholder driven, and that public involvement should be thoroughly integrated

into the entire system, rather than being seen as a tagged-on extra and inconvenient step (Bailey et al., 2012). Purvis shares this skepticism of Census-based targeting, but rather than promoting large group processes, focuses on engagement of Citizens Advisory Committees (CACs), and asserts that effective methodology requires that planners be transparent with their CACs about the limitations and margins of errors in their data

The City of Madison's public involvement strategy is a case study of theorist-recommended practice because of its attempt to eliminate barriers to participation, customization to the area at hand, thorough integration of public participation into the processes of planning (and not just announcement of results), and for robust efforts to engage a high number of stakeholders. When conducting an environmental justice assessment of their Verona Road / West Beltline project, the City held 70 public meetings, involved the local middle school in the project, and reduced barriers to involvement by offering free childcare at the public meeting and free transportation to the event. The City also ensured that Allied Drive (an EJ neighborhood) representatives were always represented in the Mayor's Advisory Committee, and took into account the perspectives of all stakeholders, including not only drivers but also cyclists, transit users, neighborhood residents, pedestrians, and businesses.

Notably, public engagement was conducted *before* the project, and not after the project had already been approved (Wisconsin Department of Transportation, 1997). As a result of these efforts, the City of Madison is currently highlighted by the Federal Highway Administration as a case study of exemplary public involvement. However, while these efforts are laudable and should be highlighted, and while these theories of successful public involvement are worth exploring, there

are no widely agreed-upon standards for what renders exemplary public involvement "exemplary," or how to measure this "success," and thus there is much room for future research.

2.5.2: Air Quality

One of the most common effects featured in environmental justice assessments is air quality, ostensibly because of the prevalence of regularly updated air quality data. These air quality assessments tend to follow the same general pattern (use of Census data overlaid with air quality data using GIS), but vary in assessment methodologies, scales, and definitions of environmental justice groups. There are also a number of hypocritical elements of these assessments, where the researchers argue for certain stringent methodologies, but do not employ those same methodologies in their own case studies.

For example, David Forkenbrock and Lisa Schweitzer in 1999 presented a method of EJ analysis that focused on air pollution and noise effects. This model, based on a case study of Waterloo, Iowa, included the classic components of GIS and U.S. Census data, combined with emission and dispersion air pollution models and noise propagation models. Environmental justice communities in this model were defined as communities with high proportions of non-white or low-income residents. Interestingly, despite their insistence that EJ assessments be applied as early as possible in project stages (pre-development), the authors used a corridor in Iowa that was already developed for their assessment. Throughout the report, the authors were emphatic that planners must put the knowledge gained from EJ assessment frameworks into the hands of the people who are affected by the projects being tested, but there was no explicit explanation of how to do so, or evidence that the authors themselves completed such a task (Forkenbrock & Schweitzer, 1999).

Forkenbrock and Schweitzer argued that the assessment scale for analyses should be at the census block level, so as not to overlook effects that may be averaged away at larger scales. The use of the census block level is rare in practice, because there are substantial amounts of data not available at such a small scale. To compensate for this lack of data, the authors created an equation (P= 69.8865 - 0.0002651v -0.5318h - 0.5800e where p = percentage of persons in households with annual incomes below the poverty line, v = median home value, h = percentage of homes that are owner-occupied, and e = percentage of population over 65 years old) that uses the data that *is* available at the block level to predict the missing elements. It is important to note that this equation would have to be re-created for each location, and could not simply be used by planners across the country. The air pollution assessment was based on chemical dispersion models that found that most roadway pollutants dilute to "background level" between 500 and 1000 meters from the roadway. The noise assessment was based on the standard that each increase by 10dBA in volume is perceived as a doubling of loudness to the human ear (Forkenbrock & Schweitzer, 1999).

2.5.3: Environmental Hazards

"Environmental hazards" are also a common effect chosen for in-depth environmental justice assessment. Hazards aren't always relevant to transportation plans unless they relate to highway or rail transport of hazardous materials. However, methodologies used for environmental justice assessment of environmental hazards in some circumstances are instructive regardless of whether or not they were used directly for transportation assessments. Like assessments of air quality, these environmental hazard assessments have varied widely in methodologies and definitions.

Circular buffer zones are staples in the methodology for EJ assessment of environmental hazards. However, Jayajit Chakraborty and Mark P. Armstrong argue that the common use of circular buffer zones to represent the dispersion effects of environmental hazards may not be useful, because in reality, chemicals hardly ever disperse in perfect symmetry. Focusing on toxic sites listed in the EPA 1994 Toxic Release Inventory in Des Moines, Iowa, the researchers argued instead for geographic plume analysis, and analyzed each site with each of the two methods. The areas of study in the circular buffer zones analyses were set at radii of 0.5 and one mile around the hazards. The areas of study in the plume analyses were based on the dispersion rates of the most prominent chemical (highest quantity) and the weather conditions at each toxic site. Demographic profiles of the affected areas were created based 1990 U.S. Census Bureau economic and racial data at the block group level. The demographic profiles of the affected areas were then compared to areas unaffected in the city, and to the profiles of the city as a whole. Chakraborty and Armstrong found that, as expected, the results of the environmental justice assessment differed depending on the technique used. The geographic plume analyses, based on chemical properties rather than human-chosen boundaries, showed higher rates of minorities and low-income people affected by the hazards (Chakraborty and Armstrong 1997). In spite of these findings, the use of geographic plume analyses in lieu of circular buffer analysis has not been widely seen.

G. Scott Mills and K. Sieglinde Neuhauser (2002) present an alternative method of assessment of environmental hazards, and push for extremely detailed, kilometer-by-kilometer analysis and the use of chi-square tests to show statistical significance. Focusing on hazardous materials transported by highway and rail, the authors argue that GIS, software from the Sandia National Laboratories, and U.S. Census data at the block level should be used to analyze potential EJ effects along the

entirety of a transportation corridor. This emphasis on incredibly detailed block level data is rare and is often declared to be impractical for a transportation planner with many assessments on his or her plate (McCaskill, 2015). Rather than comparing an EJ population with a regional average, Mills and Neuhauser argue that the demographics of one route should be compared to alternative routes, or the demographics of a proposed route should be compared with the surrounding area. Each demographic along the proposed route was analyzed separately, and then the histograms of these demographics were summed and normalized to show cumulative distributions.[5] The software used in their analysis includes RADTRAN, which is a computer code that estimates radiological risks of radioactive materials transported along highways. This very detailed and very specific methodology is notable for its emphasis on chi-square statistics (in lieu of illogical linear methods), and it is useful for planning agencies with high capacities and high anticipated environmental hazard risk. However, the methodology may have too high of software and data requirements for the average urban transportation planner (Mills & Neuhauser, 2000).

Harner, et al. (2002) use a framework that differs completely from that of Chakraborty and Armstrong or Mills and Neuhauser, and instead developed seven indices for the assessment of environmental justice effects from environmentally hazardous sites. Like Chakraborty and Armstrong, the authors' purpose in creating these indices was to create a standardized measure for the assessment of environmental justice issues relating to hazardous sites. Protected populations were defined as minority groups and those below the poverty line, so there was no inclusion of Hispanic, LEP, elderly, or disabled populations. The indices were as follows: The Comparative Environmental Risk Index (to assess the likelihood that EJ communities will be more exposed to

[5] This methodology of summing and normalizing demographic distributions is being used in EEJAT 2016 in lieu of the 2005 framework's linear model.

risk), The Toxic Demographic Difference Index (to assess whether the demographics of the area vulnerable to toxicity differ from the demographics of the region at large), The Toxic Demographic Quotient Index (to assess whether the proportions of EJ populations are greater in affected areas than in unaffected areas), The Toxic Concentration Equity Index (to assess whether toxic sites are concentrated more heavily in areas where EJ populations live), The Concentration Risk Comparison Index (to assess whether EJ populations are more likely to live in areas with high concentrations of toxic sites), The Concentration Demographics Index (to assess whether the demographics of areas with high concentrations of toxic sites differ from the demographics of the region at large), and The Toxicity Equity Index (to assess whether areas with EJ populations contain more types of toxic sites than other areas) (Harner et. al, 2002).

Juxtaposing these hazard assessment frameworks illustrates the difficulty in forming any sort of consensus on effective assessment techniques. Even when measuring the same very specific effects on EJ populations, approaches differs so drastically in structure, definition, and methodologies, that determining "best" practices is exceedingly difficult.

2.5.4: Socioeconomics and Equity

This issue of diverging assessment techniques is even more apparent in transportation EJ effects that are more qualitative in nature, like "accessibility" or "socioeconomic burden" or "equity." These concepts are arising in the literature with increasing prevalence, but agreed-upon standards of measurement have not been established.

In 2004, Deka stood out in the literature for having the unique focus of socioeconomic burdens and financial expenses relating to transportation-related environmental justice, and asserted that attention needed to be paid to the fact that low-income populations, who need public transit the most, are often overly burdened by the financial expenses of those transportation systems, and that this trend was prevalent and stark inequity (Deka, 2004). Also in 2004, Forkenbrock and Sheeley in their book "Methods for Effective Environmental Assessment" repeatedly emphasized that equity needs to be incorporated not only into the outcomes of EJ assessments, but also into the *process* of those assessments (Forkenbrock and Sheeley, 2004). In 2007, Sanchez made a similar argument in his article "The Right to Transportation," which asserted the theory that "transportation accessibility" was an important factor to be considered in evaluations of environmental justice. Sanchez argued that public transportation has long been an important part of the civil rights movement, and remains today a civil rights issue, as those who cannot afford person vehicles rely on public transportation for access to employment, education, medical care, social services, food, and other necessities. Sanchez stated that an "equitable transportation system" is one that a) ensures that protected populations have opportunities for public involvement in the process b) is financially transparent c) attempts to distribute benefits and burdens of the transportation system equally among populations of various demographics, d) provides high quality service enabling mobility, and e) balances equally the two top priorities of expanding transportation infrastructure and using transportation systems to revitalize low-income and minority communities (Sanchez, 2007). These ideas are as noble as they are unfortunately difficult to measure and implement.

In 2011, Davis and Jha attempted to address this measurement issue for socioeconomic effects, and developed a method for the assessment of the socioeconomic effects of highway construction on environmental justice communities. (Note that this framework looked only at highway construction.) The dynamic modeling method was based upon a North Carolina, and used Census Bureau and county level data for the creation of demographic profiles, mapped with GIS, and then overlaid with highway systems generated by Genetic Algorithms. Minorities were identified as Black, Hispanic, Asian American, American Indian, and Alaskan Native, which is a more extensive list than those used by some of the aforementioned frameworks. Low-income groups were defined as those with a median household income below the poverty line, as determined by the U.S. Department of Health and Human Services. Davis and Jha emphasized the importance of a broad view that integrates local and regional effects (Davis & Jha, 2011), but did not provide explicit guidance on how that integration should be achieved.

In 2013, Duthie, et al. also explored environmental justice and concepts of equity, but again, used a completely different research question structure, making comparisons and consensus difficult. Duthrie et al. approached the issue by starting very broadly, exploring three key challenges of implementing environmental justice concerns into transportation planning. The first major challenge they identified was that there is far greater data needed than there is data available to assess environmental justice. MPOs often lack sufficient data on spatial distributions of race and income, on future plans of developers, on *desired* transportation options (rather than merely *existing* options), on transportation network reliability based on *performance* and not just *expected* conditions, and on accurate costs for proposed improvements.

The second major challenge identified is that of establishing a consistent definition of "equity." Because equity is the goal of environmental justice initiatives, it is critical that this definition is agreed upon. However, because equity is a subjective term with a range of definitions, MPOs struggle to tie meaningful calculations to the concept. The authors assert that the four primary types of equity are "opportunity," "equality," "market based," and "basic needs."

The third challenge the authors identified was the determination of appropriate units for analysis of EJ effects. EJ effects are currently measured in individual, group, or geographic units of measurement. Geographic units of measurement are the most feasible in terms of data availability, but present a whole host of issues, especially if minority or low-income groups are not clustered geographically, or if data zones shift. Duthie, et al. recommend that planners clearly define the type of equity they strive for, justify their decisions for units of analysis, and make careful decisions to not limit disproportionately burden specific communities (Duthie, Cervenka, & Waller, 2013). Unfortunately, these clear definitions have still not become commonly established.

2.5.5: Comprehensive Frameworks

While the prevalent trend in environmental justice assessment is to focus on one or two specific effects per assessment framework, over the past 15 years, several researchers have proposed comprehensive frameworks that consolidate a number of effects into a unified assessment. However, like the assessments that are focused on individual effects, these frameworks diverge widely in assessment theories and methodologies, and many of them refute one another. As a result, there is not a consensus on "effective" assessment frameworks.

Naturally, the first comprehensive framework that will be discussed is RVTPO's 2005 "Benefits and Burdens" assessment framework that is being improved upon through this thesis research. RVTPO's 2005 assessment framework was based on a model by the Delaware Regional Planning Commission (DRPC). Delaware's model was chosen because it was "the only reasonable choice at the time," as the DRPC was one of the few regional bodies at the time that attempted to evaluate environmental justice with a quantitative method based on regional demographic information (McCaskill 2015). Data for the framework was based at the US Census Bureau Tract and Block Group levels (RVTPO, 2005). There were three components of the 2005 framework: 1) The Community Profile; 2) the Benefits and Burdens Instrument; and 3) The Project Impact Assessment Instrument.

The first component, the Community Profile, was a profile of the area that was developed for the selected project location based on the Environmental Justice Index in that location. The EJ Index was developed ahead of time for all areas, and included identification of concentrations of low income, minority, Hispanic, elderly, Limited English Proficiency, and disabled populations. Concentrations of these protected populations in the study area were compared to the regional (MPO) average concentrations of these populations, to determine whether the concentrations of EJ communities in the study area exceed regional averages, and if so, by what percentage. For each instance in which the population of a census block group exceeded the regional average by 100%, the tract was given one point or "degree of disadvantage" (DOD).[6] For example, if a Census Block Group's population of low-income households were 200% of the regional average, that Block Group would be awarded two points. (The issues with this linear model will be discussed

[6] 2005 EJ Index Score = (Block Group's percentage above the regional average / 100).

later in this chapter.) The degrees of disadvantage from each of the EJ populations were totaled to produce a Total DOD score for the Block Group. These DOD scores for each Block Group could be represented as a single layer for an EJ evaluation map base. The Community Profile, expanded from the EJ Index, was developed to paint a picture of the economic, cultural, historic, and physical characteristics of the study area where a transportation project was planned (RVTPO, 2005). The profile should include community boundaries, residences, public facilities, infrastructure, land use plans and zoning, businesses, tax base, property values, community history, security and privacy, demographic data, and any other information relevant to the project area. The Community Profile information could be represented through text, maps, or charts.[7]

The second section of the 2005 framework featured the "Benefits and Burdens Instrument." Using the Community Profile, the instrument assessed the positive and negative potential effects of the project. The instrument was a spreadsheet containing "indicators" along one axis and "areas of impact" along the other. The following indicators were included: safety, economy, social, and environmental. The areas of impact included the following: aesthetics, barrier effects and isolation, business impact, business visibility, business displacement, changes in population, community interaction, compatibility, crime, emergency response, land use patterns, noise, pedestrian and bike access, physical intrusions, property values, public facility displacement, and vehicle access. Relationships between the indicators and the areas of impact could designated as positive, negative or no effect, as determined by the assessing planner.

[7] Methodology documented in "An Environmental Justice Evaluation of the FY 2005-2007 Transportation Improvement Program."

The third section of the 2005 framework was the "Project Impact Instrument," which was a spreadsheet used to document ranking of the overall project impact level based on the first two sections of the framework. The goal of the instrument was to "estimate the overall impact a project will have on a community." The planner subjectively weighs pros and cons of the project based on the Benefits and Burdens Instrument, and assigns a score between 1-5, where 1 is "very negative," and 5 is "very positive" anticipated impact (Roanoke Valley Alleghany Regional Commission, 2005).

In 2004, David Forkenbrock and Jason Sheeley put together a hugely helpful and comprehensive book for comprehensive frameworks entitled, "Effective Methods of Environmental Justice Assessment," published by the Transportation Research Board. This book compiles the best environmental justice assessment methods for transportation systems for a range of EJ assessments including identifying protected populations, air quality, hazardous materials, water quality and drainage, safety, transportation user effects, community cohesion, economic development, noise, visual quality, land prices and property values, and cultural resources. Each chapter outlines the best methods for assessment for the issue at hand, explains what is needed to conduct each assessment, and which circumstances are best for each method. The "effective" methods that made it into the book were chosen for six reasons: 1) they are predictive; 2) they can be used to evaluate effects on EJ populations; 3) they can be integrated into a planning process that allows for public participation; 4) they meet regulatory, legal, and scientific standards; 5) they are flexible; and 6) collectively, they provide a range of assessment options that allow for differences in circumstances. Throughout the book, Forkenbrock and Sheeley emphasize that there is no "one size fits all" approach to environmental justice assessment, and therefore, a range of effective

methods need to be available to planners. This argument is certainly well justified, but it is also confusing, because in essence, the authors presented a framework for "best practice" environmental justice assessment that while arguing that there should not be "best practice" environmental justice assessment.

In 2006, Chakraborty built upon his work to jump deeper into the comprehensive framework camp, and published two quantitative indices for environmental justice assessment of transportation projects. The indices were based on case studies of capacity improvement projects in Volusia County, Florida, and were designed to help agencies meet federal requirements. Like Chakraborty's earlier methodologies, the indices used census data and GIS software. The first is called the Buffer comparison index (BCI), and is used to assess whether minorities and low-income populations are more *likely* to live in areas burdened by transportation projects than are other racial groups. This addresses "proximate cause" of environmental injustice, where more inexpensive land is likely to be chosen for burdensome projects, and because of historic, economic, and social systems of injustice (the "ultimate cause,") this inexpensive land is also likely to be inhabited by EJ populations (McCaskill, 2015).

The second is called the Area comparison index (ACI), and is used to assess whether the *proportions* of minorities and ethnic minorities in areas burdened by transportation projects are higher than the proportions of such groups outside the burdened areas (Chakraborty, 2006). These indices challenged the predominant method of measuring EJ effects using proportions of EJ populations in comparison to regional averages, and highlighted the fact that there is not even a widely agreed upon statistical analysis method for environmental justice assessments. Theorist Fietelsen's earlier paper (2002) took this criticism of classic EJ assessment a step further, and

argued that even the most basic, *core structure* of the primary method used for environmental justice analysis, comparing affected areas to unaffected areas, is likely unhelpful and ineffective. In lieu of such analyses, Feitelsen asserts, the focus should be on the environmental justice implications of policies that are aimed towards mitigating environmental externalities (Fietelsen, 2002). These criticisms are deeply valuable, but certainly do not lead us closer to any agreed-upon methodologies for environmental justice.

However, perhaps that lack of agreement is itself the common takeaway point. In 2007, Ann Hartell released a report that agreed with Forkenbrock and Sheeley's assertion that there should be no "one size fits all" methodology for EJ. Entitled "Methodological Challenges of Environmental Justice Assessments for Transportation Project Road Widening," this report asserted the theory that environmental justice should include a variety of methods available, and the method that "most fairly represents the data" should be used for the assessment of the particular project at hand. Hartell reached this conclusion by showing that the results of an EJ assessment can vary widely based on the choice of elements including the methodology, effects analyzed, location, and definitions of protected populations. She further supported this conclusion by showing that the core statistical methodologies that are inherent in frameworks may not be applicable to all assessment situations. In 2014, Ryan Holifield further supported this argument in a report entitled "Environmental Reviews and Case Studies: Accounting for Diversity in Environmental Justice Screening Tools: Toward Multiple Indices of Disproportionate Impact." Holifield asserted, like Hartell, et al. that the idea of having one unified environmental justice index is inherently flawed. Instead, Holifield asserts, there should be tools that incorporate multiple reliable indices, to allow for flexibility of environmental justice settings, effects, and populations

(Holifield, 2014). The new RVTPO EJ assessment framework incorporates a flow chart of many methods largely because of theories proposed by Hartell, Holifield, Forkenbrock and Sheeley.

As of June 2016, the US EPA has released the latest version of an Environmental Justice Assessment Tool called EJSCREEN, which also incorporates this theory of multiple indices. EJSCREEN contains twelve EJ Indices, but five of these indices are focused on air quality, and several indices do not relate directly to transportation planning. The twelve indices are as follows: National Scale Air Toxics Assessment Air Toxics Cancer Risk, National Scale Air Toxics Assessment Respiratory Hazard Index, National Scale Air Toxics Assessment Neurological Hazard Index, National Scale Air Toxics Assessment Diesel PM (DPM), Particulate Matter (PM2.5), Ozone, Lead Paint Indicator, Traffic Proximity and Volume, Proximity to Risk Management Plan Sites, Proximity to Treatment Storage and Disposal Facilities, Proximity to National Priorities List Sites, and Proximity to Major Direct Water Dischargers. The EJSCREEN tool is extremely useful for the air quality and traffic proximity components of transportation-related environmental justice assessment, but is lacking other indices that are of relevance, such as displacement and economic effects. EJSCREEN is intended to assist the EPA itself in "meeting the Agency's responsibilities related to the protection of public health and the environment" ("How was EJSCREEN Developed," 2016) and is therefore not designed for use by municipalities specifically.

Cumulatively, decades after the official start of the "environmental justice" movement and it's sister, environmental justice assessment, we are hardly closer to agreed-upon methodologies or models for assessment of environmental justice. Perhaps that is the point. Each community is

different, each case is different, each project size, scope, and scale is different, and each effect must be measured differently depending on context, severity, political climate, the history of the community, and the people involved. Environmental justice, at the core, is about *people* and *equity* and *justice,* which are each deeply philosophical and arguably immeasurable topics. We cannot agree on how to measure these effects, because there is no one way to measure these effects that can be applied to all instances of environmental justice. However, when we acknowledge this complexity, we should not resort to throwing our hands up and declaring EJ assessment impossible. There *are* concepts that are agreed upon: equity is critical and must be defined by EJ populations themselves, frameworks must be flexible to allow for differences in context, public involvement must be deeply incorporated throughout the life of the project, and there must be *some* reliable measurement of benefits and burdens on EJ populations. We must continue to build off of and wrestle with the frameworks, methodologies, and theories outlined in this literature review, and continue to improve upon our processes, using input from those affected by these processes.

CHAPTER 3: RESULTS & DISCUSSION

Chapter Three of this report includes the results and discussion of this study, which in this case consist of stakeholder feedback, evaluation of the 2005 framework and changes made for EEJAT 2016, and the EEJAT 2016 framework itself (or at least the components that can be provided in report format), including relevant documentation of requirements, guidelines, categorical exclusions, constraints, and the current RVTPO Constrained List of projects, the EJ Index, descriptions of the Benefits and Burdens instrument and Project Impact Assessment, and GIS examples of assessments that could be created through EEJAT 2016.

In this report, because these results are more practical than they are conventional research results, and because there are a number of different sections of results that are extensive and widely varying, the discussion for each component of the results is included conveniently within the same section as the accompanying results. This format is in lieu of the classic report format, where results and discussion are separated into two different chapters. The purpose of this organization is to reduce confusion and repetition, and to spare the reader from alternating between separate results and discussion chapters for each of the many components of this framework.

3.1: Stakeholder Feedback

3.1.1: Stakeholder Survey and Interview Results

For the purposes of this study, "stakeholders" were considered to be environmental justice advocates (leaders of regional or national environmental justice non-profit organizations), community leaders of populations deemed to be "EJ populations," environmental justice-related policy-makers, planners, workforce development specialists, researchers, and local residents of the Roanoke Valley Alleghany Region. Stakeholders were contacted through surveys, emails, phone conversations, and in-person conversations. Because the purpose this thesis was to create a *framework* to assess EJ issues, and not to immediately address the EJ issues, the goal of this stakeholder engagement was to gather feedback on assessment methodology, rather than on actual instances of burden or benefit. This goal made stakeholder feedback challenging, because the average stakeholder does not have a background in assessment methodology. This created a "chicken and egg" situation, where a stakeholder needed to see the completed framework to understand the question and provide feedback, but to create the framework in the first place, stakeholder feedback was needed. In effort to gather feedback despite this dilemma, survey questions were kept relatively broad and simple, but also focused on assessment methodology.

Surveys were individually sent to 95 people belonging to one of the aforementioned stakeholder classifications. Surveys were also posted en masse to the Virginia Natural Resources Leadership Institute listserv, posted on the Urban Sustainability Directors Network website, and sent by U.S. Climate Action Network to the network's 10 environmental justice partners. From these efforts, 42 survey responses were gathered. Stakeholder feedback was also gathered through 20 phone and in-person conversations, and through a public meeting held March 2nd, 2016, where FHWA and

FTA representatives were present. While this feedback is lower than desired, it is important to remember that the stakeholder survey and interview results are only *one* of six results sections in this thesis. The results and discussion of the survey are described in section 3.1.1.1 below. The results and discussion of the phone and in-person stakeholder interviews are described in section 3.1.1.2 following.

3.1.1.1: Stakeholder Survey Results and Discussion

The stakeholder survey resulted included 42 responses from environmental justice leaders, activists, non-profit organization community leaders of populations deemed to be "EJ populations," environmental justice-related policy-makers, planners, workforce development specialists, researchers, and local residents of the Roanoke Valley Alleghany Region. The names of these respondents has been kept confidential for the stakeholders' protection and privacy. The full tables of verbatim results can be found in Appendix 3. This section of this study does not claim to adequately represent stakeholder feedback on environmental justice assessment systems. However, the key pieces of feedback gathered are worthy of consideration and further exploration.

The first survey question read as follows, "in general, what should transportation planners consider when they are assessing whether EJ populations are disproportionately burdened (or denied benefits of) transportation projects?" This question received a wide range of results, which was expected given the open nature of the question. To analyze these results, responses were sorted into categories based on keywords used. If a respondent provided multiple ideas, each individual idea was sorted into the appropriate category, rather than being kept clumped into a larger response

that cannot be categorized. This means that the number of responses for this question is greater than the number of respondents.

The categories of answers to question one are listed below. Each category name is followed by an example and the number of responses for that category indicated in parentheses.

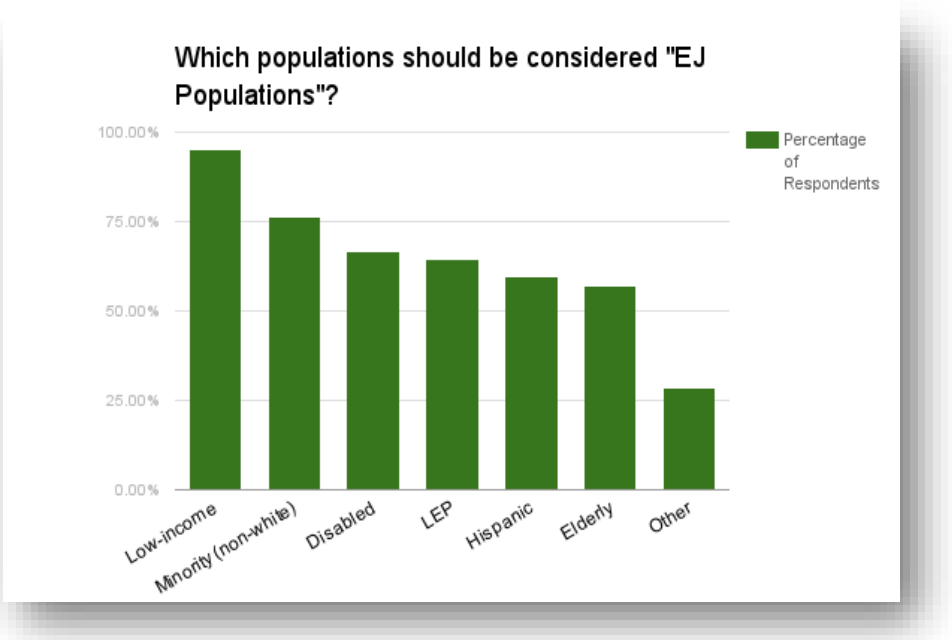
- **Access**, such as "ease of access to transportation," (8)
- **Financial and economic** considerations, such as "fare prices" and "economic impacts," (7)
- **Environmental** considerations, such as "pollution" and "asthma," (6)
- **Mobility and route design**, such as "routes that consider connection between EJ homes and essentials" (6)
- **Displacement and gentrification** such as "routing that does not break up communities" (5)
- **Disproportionate impact**, such as "the proportion of these projects benefit or harm white or middle/upper class neighborhoods versus minority and low-income neighborhoods," (5)
- **Representation and engagement**, such as "are those impacted … given sufficient voice in the decision making process" (4)
- **Bike and pedestrian**, such as "safe pedestrian access," (3)
- **Social**, such as "how to mitigate social impacts" (3)
- **Demographics**, such as "know the demographics of the area" (2)
- **Intersections of vulnerabilities**, such as "the ways that multiple vulnerabilities can intersect to amplify the …level of burden" (2)
- **Benefits and burdens** considerations, such as "positive benefits such as access to jobs" (2)
- **History**, specifically "history of racial discrimination, especially from past transportation projects," (1)
- **Housing**, such as "partnering with housing improvement agencies," (1)
- **Aesthetics,** verbatim (1)

The top ranking categories of responses, relating to accessibility, financial and economic considerations, and environmental issues, all fit into the classic definition of environmental justice. These answers could indicate a greater *awareness* of those issues within EJ considerations, and may not necessarily indicate a greater level of *importance* over less common survey responses. Overall, there was a clear push for transportation planners to consider human factors outside of

conventional route planning and traffic models. Respondents expressed desire to see consideration of environmental, social, economic, accessibility-related, demographic, and interrelated factors from transportation planners. They cumulatively pushed for models that are people-based, that are drawn from community engagement, and that enable people, especially vulnerable populations, to have convenient and fair access to work, school, community, and other necessities.

The second survey question, "which populations should be considered 'EJ Populations?'" gathered interesting results, some of which intriguingly do not align with federal definitions of EJ populations. For example, "minority" populations are included in every federal definition of disadvantaged communities since Title VI in 1964, but only 76% of respondents agreed that "minority" populations should count as EJ populations. However, "low-income," the other population that is by federal definition always an EJ population received 95% of respondent votes. "Elderly" and "Disabled" populations received only 57% and 66% of respondent votes, respectively, which seems to counter more modern and inclusive definitions of EJ that have expanded to include these groups. These low percentages for elderly and disabled

Figure 1: Stakeholder Survey Results: Which Populations should be considered EJ Populations?

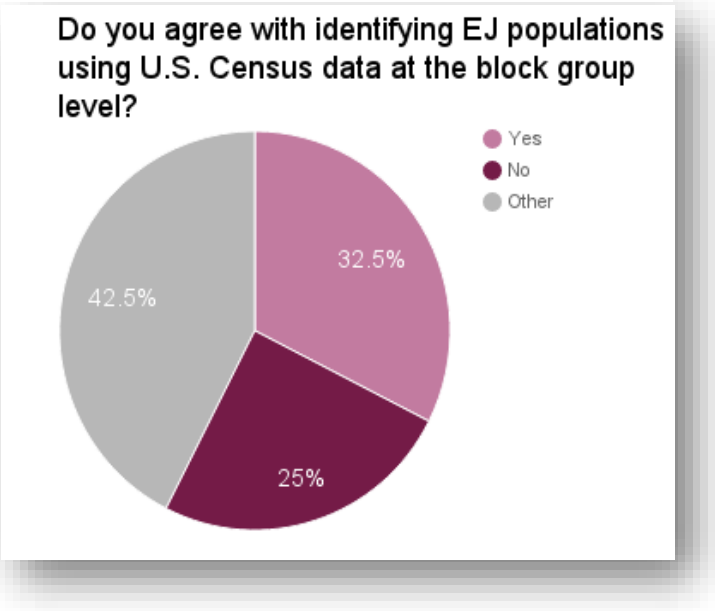


populations could indicate that respondents do not perceive these populations as facing the same injustices as minority or low-income groups, or it could indicate a lack of familiarity with the expansion of EJ definitions to incorporate these groups.

It is impossible to determine the rationale behind these answers without further exploration, but they are notable nonetheless. “Limited English Proficiency” and “Hispanic” populations also received lower than expected percentages of votes, with rates of 64% and 60% respectively. It is possible that these lower votes are due to perceived overlap between these two groups and perceptions of “double counting,” but it is again impossible to determine for certain without further exploration. The “Other” responses included “Middle Eastern,” “I wouldn’t use a list like this to describe EJ but would instead use the ability of those being impacted to adapt successfully and at a minimal cost,” “children,” “young riders,” “those who can’t drive - teens and children,” “functionally illiterate populations,” and “renters, lessees, and temporarily housed persons/families.” The prevalence of the suggestion of children and young people is striking, and would be worthy of further research, in addition to the other suggestions.

The third survey question, which read, "currently, EJ populations are identified based on U.S. Census data at the Census block group level. Do you agree with this approach?" also had striking results worthy of further exploration. Only 33% of respondents answered "yes," and 25% of respondents answered "no," indicating a severe lack of approval in the predominant EJ population identification methodology. This is alarming if the sentiment extends to a statistically significant portion of the population. However, critically, the most common answer was "other" (43%), with most of the explanation responses stating sentiments that the Census data was the best method we had, but that it wasn't sufficient, or that respondents feared there would be gaps in the Census data. This result is reasonable considering its alignment with the literature review findings, where academics and practitioners expressed similar caution towards Census data methodology.

Figure 2: Stakeholder Survey Results: EJ population data

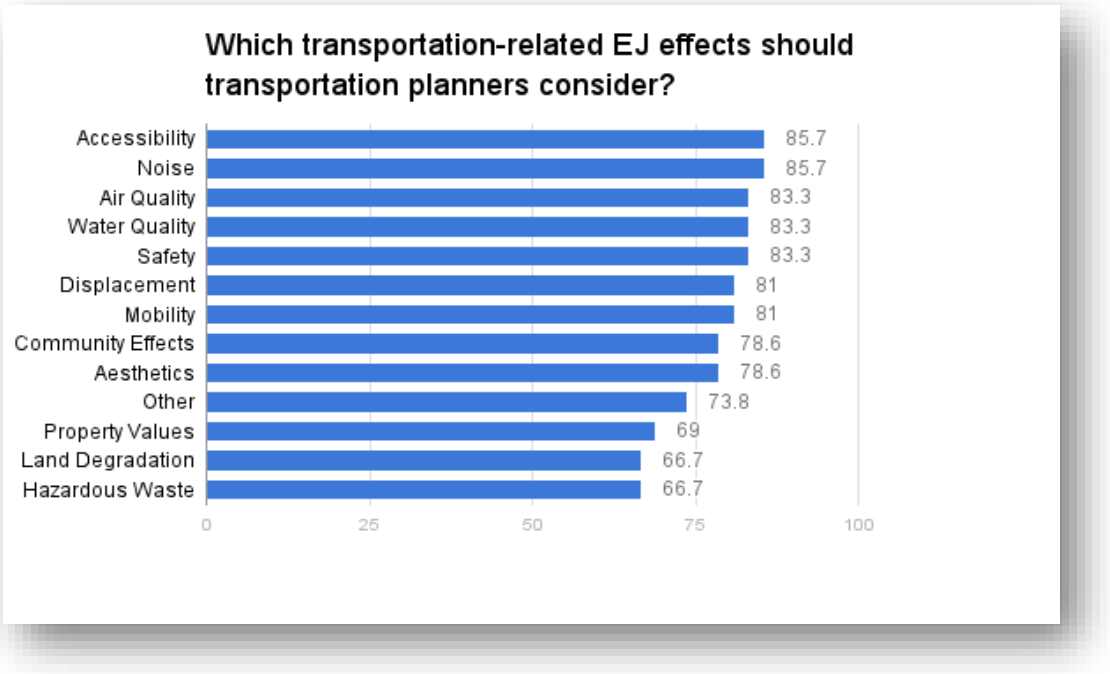


The fourth survey question, which asked respondents to define "equity" relating to environmental justice transportation, received responses that are as widely varying as the literature review definitions of equity. Some described vertical equity, with responses like "the poorest member of the community and richest member of the community can get to and from daily priority locations

with the same ease and convenience, or "all citizens rich and poor, old and young gain 'equity.'" Others defined equity by specifically mentioning access to transportation by those who do not have cars. A few defined equity based on a Benefits and Burdens-type model, with definitions such as "benefits greater than adverse impact." Still others focused on procedural equity, focusing on "planners acknowledging inequalities" or "listening to those who would be affected." Intriguingly, this array of equity definitions provides more informal versions of the same core concepts of procedural and distributional equity presented in the literature review.

Question five on the stakeholder survey asked respondents which EJ effects should be considered. Accessibility (85%) and noise (85%) ranked highest, closely followed by air quality, water quality, and safety, which each received 83% of respondent votes. These are perhaps the highest ranked effects because they are effects that are commonly tied to environmental justice or transportation issues, so they may be higher on the radars of the respondents (see "Prevalence Bias" as described in the Decision Theory section above). Displacement and mobility received 83% of the votes, community effects and aesthetics each received 79% of the votes, and "other" received 74% of votes. Land degradation, hazardous waste, and property values came in last with between 67-69% of votes. Certain conclusions cannot be made about why these rankings are such, but a possible explanation could be the degree of clear connection between transportation projects and each effect. For example, it may be easier for people who witness traffic-related air pollution regularly to understand the "air quality" EJ effect, but it may be more difficult for the average stakeholder to understand the connection between "property values" and transportation projects, unless that person has personally witnessed scenarios such as a bus yard or highway creating a drop in real estate value of an EJ neighborhood.

Figure 3 : Stakeholder Survey Results: EJ effects to consider



Stakeholder answers to question six, "how should planners achieve stakeholder engagement of EJ populations," are especially important for planners to note. EJ stakeholders should theoretically know how best to engage EJ stakeholders. The most common answers related to "meeting people where they are," coordinating with local EJ organizations and leaders, engaging EJ stakeholders in the decision-making process, and providing services like childcare and transportation that enable people to participate. These, again, align with the literature review and with the input gathered from the more in-depth interviews.

Cumulatively, there is great potential for these results and feedback to be expanded upon, but the responses gathered already provide useful and critical information for planners. EJ populations need to be represented in decision-making, planners need to acknowledge and explore historical injustices, time and energy needs to be invested in earning the trust and feedback of EJ populations, and plans and decisions need to be transparent and adequately publicized to those affected. If

planning agencies are earnest about achieving environmental justice for ethical purposes in addition to legal ones, these concepts are well worthy of further exploration.

3.1.1.2: Stakeholder Interview Results

In addition to the surveys, stakeholder engagement was conducted through interviews conducted via telephone, in person, and through a public meeting. These conversations obtained less structured but more robust and thorough results than the surveys. From these conversations there were four resounding pieces of feedback from stakeholders.

The first common piece of feedback from stakeholder interviews was that in order to achieve environmental justice, it is critical that the people affected by the decisions of planners are included in decision-making. In the words of one environmental justice leader who shall remain anonymous, "if we (in this case referring to minorities) aren't at the table, we're on the menu." Many stakeholders emphasized that public outreach is only useful if the feedback from that outreach is incorporated into decision-making. One stakeholder, for example, expressed frustration because she stated that she regularly attended public engagement meetings, but felt that the meetings were merely conducted to "check boxes" of requirements, and felt that feedback from African-American communities was not earnestly considered in actual decision-making processes. Another stakeholder expressed a similar sentiment, stating that predominantly white decision-making boards will not realistically make decisions that adequately take into consideration the needs of minority communities. A local stakeholder made statements that followed the same theme, but she focused on low-income and disabled residents, stating that the needs of people who work night shifts or who cannot afford transportation are not adequately considered in transportation planning.

The second common piece of feedback followed the theme that "data (such as Census data or GIS data) does not show everything." One resident of the region, for example, noted that the US Census does not have any consideration for Middle Eastern populations, so the highly prevalent refugee populations in Roanoke go completely unaccounted for in an EJ Index based on Census data. Others expressed doubt that quantitative data can show the qualitative potentials for injustice.

The third common piece of feedback gathered from stakeholders was that there is a need for planners to look at the environmental justice area through the lenses of historic, economic, and systematic injustices that have occurred in their planning regions. Even if current projects do not seem to create environmental injustice on the surface, those projects may face resistance because they are located in the footprints of former injustices, or because they have been enabled due to systematic injustices that have been ongoing. One stakeholder felt that "meaningful" public engagement could occur if planners admitted privilege and acknowledged former injustices rather than becoming defensive about proposed projects. Another stated that environmental justice situations are "just like trauma; if you've been abused, before you can move on, you have to go through therapy." To this stakeholder, "therapy" could be achieved partially by planners documenting historical information about EJ areas, including "why these people are living where they are, what legal tactics were historically used to push them there, how did the city invest economically, where were businesses placed, how did the city disperse services, what are the historical health and employment issues, whether there was a history of Klansmen, and whether the cities allowed companies to pass costs on to minority areas."

A fourth resounding theme in the stakeholder interviews was that transportation in the RVTPO is *the* top key barrier to employment for low-income, minority, LEP, Hispanic, disabled, and elderly populations. Every single workforce development specialist interviewed gave this response in some form, including "the biggest barrier to employment in this area is transportation" and "transportation is our biggest obstacle, followed by daycare availability." Workforce specialists expressed frustration that even if they assist EJ populations in obtaining employment, that assistance has no benefit if the populations have no means of transportation to that employment. This is of particular issue in rural areas, and with employees who must work after 8pm, when buses stop running. Workforce specialists also stressed that there was a "huge race relations issue" in the region, noting that when there are job openings, they are most often filled by white individuals, regardless of qualifications of minorities. This feeds into EJ transportation issues, because if minorities have lower opportunities for employment, they are also likely to be less able to afford a reliable personal vehicle, increasing the need for reliable public transportation.

3.2: Evaluation of 2005 Framework and Changes Made

In order to create an improved Environmental Justice Assessment Framework for the RVTPO, in addition to conducting the literature review and stakeholder engagement, it was also necessary to first evaluate the 2005 framework to identify opportunities for improvement. This evaluation includes identification of opportunities for improvement to the EJ Index and community profile, the benefits and burdens instrument, the project impact assessment, and general improvements. These opportunities for improvement were based on requests by RVTPO staff, "best practices" identified in the literature review, and stakeholder feedback. Below each identified opportunity for improvement is an explanation of the relevant changes made for the new EEJAT 2016 framework.

3.2.1: Evaluation of the EJ Index & Community Profile

The following opportunities for improvement were identified for the first step of the environmental justice assessment framework, the EJ Index and Community Profile. Each description of the opportunity for improvement is followed by the changes made (or the need for future research if changes were out of the scope of this work).

EJ Population Identification

EJ Population Identification: Identified Opportunities for Improvement

The 2005 framework assessed the following environmental justice populations: Minority (all racial categories other than "white"), Hispanics, Elderly (all persons over 65), Limited English Proficiency (those who speak English "not well," or "not at all"), Low-income (household income below the Department of Health and Human Services federal poverty guidelines), and Disability. RVARC requested evaluation of these population definitions, and exploration of the following questions:

a. Minority: Should the framework group all "non-white" persons into "minority" populations for EJ assessment?
b. Low-Income: Should low-income populations be identified through households below the federal poverty line? Should low-income be expanded to include those are above the federal poverty line but who live under "livable wage?"
c. Hispanics: Should groups other than Hispanics be included for ethnicity? Could Hispanics be triple counted (minority, Hispanic, LEP)?
d. Limited English Proficiency Rates: The 2005 EJ Index framework is based on Delaware. In Delaware, language proficiency is a substantial issue, but in Roanoke, rates of Limited English Proficiency hover around 1-2%. It needs to be explored whether Limited English Proficiency should be considered with equal weight in Delaware and Roanoke.
e. Disability: Which categories of "Disability" should be considered?

f. Methodology: Should all of these identified populations be considered equally in environmental justice assessment, or are the "classic" EJ populations (low-income and minority) populations priority? Should populations identified in the EJ Index be based on comparisons to regional averages? Should national, state, or city averages be used instead?

EJ Population Identification: Changes Made

For EEJAT 2016, the majority of these determinations of EJ populations remained consistent with the 2005 framework, with a few expansions. However, data was updated to reflect 2013 ACS data, and robust changes were made in *how* these populations were measured and mapped, which will be described in the next section. It was determined that because US Census data is our most thorough widespread demographic data source, that the US Census determinations of minorities are currently the best we have available. Each racial demographic measured by the Census should be measured separately, but should also continue to be overlaid as a "minority" layer, because federal and state requirements specifically ask for such (see the documentation of federal and state requirements in Documentation section below).

Low-income groups should continue to be classified based on the federal poverty line for the time being, but because there are ostensibly many people living technically above the poverty line but without "livable wage," there is a pressing need for research on "livable wage" in the Roanoke Valley, and these maps should incorporate livable wage as soon as such data is available. Additional ethnicities should be considered other than Hispanic, but because Hispanic is currently the only ethnicity measured by the US Census, EJ population identification is currently limited to this category. Limited English Proficiency should be considered regardless of perceived importance in the region. The EJ Index mapping methods described below will account for any

smaller percentages of LEP in comparison to other EJ groups, so that smaller representations are not considered with equal weights as larger representations of people. Similarly, "disability" at this time must be classified according to US Census data determinations of disability, but further research into which disabilities lead to "environmental justice discrimination" should be explored by future researchers. Changes to methodology are described in the "Scaling and Scoring System" section below.

Scaling and Scoring System

Scaling and Scoring System: Identified Opportunities for Improvement

Upon review of the 2005 framework, consultation of decision theory, and through conversations with the RVARC, it was determined that the linear scaling of concentrations of EJ communities to determine "degrees of disadvantage" for the 2005 EJ Index may not have been rational. For example, there may exist thresholds for concentrations of protected populations beyond which an assignment of a full "degree of disadvantage" point for each increment increase is not representative. Further, there exists great variability between types of EJ populations (minority, low-income, etc.), and between block groups, so the use of the same linear scoring for all types and all areas does not take variation into consideration, and therefore may not be representative.

Consider for example a scenario where the regional average for LEP was 200 persons per block group, and the regional average for minority populations was 2,000 persons per block group. If Block Group One had 400 LEP persons, under the linear model, this block group would be assigned two degrees of disadvantage (Index Score = percent above regional average / 100). If Block Group Two had a population that included 4,000 minorities, this block group would also be

assigned two degrees of disadvantage. These two block groups would be seen as equivalent on the EJ Index. The idea of 400 LEP persons being equivalent to 4,000 minorities could be challenged. In 2005, there was acknowledgment of issues with the linear model, and an idea was proposed to establish a system of weights or priorities to place more emphasis on certain variables such as race or poverty. However, according to McCaskill, "it was understood, of course, that an arbitrary assignment of weights would be dangerous, therefore, the idea was abandoned altogether," and the linear scaling method was kept (McCaskill, 2015).

Scaling and Scoring System: Changes Made

Significant changes were made in the EJ Index scaling and scoring system between the 2005 framework and EEJAT 2016. There was a creation of two sub-indexes of the EJ Index. The "Core EJ Index" includes Poverty, Minority, Limited English Proficiency, and Ethnicity classifications. These are labeled the "core" index because they are the demographics that are specifically requested by federal and state requirement. The "Disability EJ Index" includes Disability and Elderly (above 65) classifications. The division of these two components of the EJ Index is a significant change, and was done because the official definition of environmental justice focuses on low-income, minority, and LEP populations, and because the concerns presented by populations of the Disability EJ Index differ in some ways from those relevant to the populations in the Core EJ Index. The idea is that with this separation, the two EJ Indexes can be either overlaid for a comprehensive view, or can be analyzed separately for factors where such separation is appropriate. For example, a wealthy, Caucasian, elderly person may have transportation needs that differ vastly from a young, low-income, African American person. Therefore, both groups should be considered, but not consolidated.

Additionally, there is a new EJ Index Scoring System. As described above, the 2005 EJ Index scoring system assigned points according to percentage above the regional average divided by 100. (Index score = Percent Above Regional Average / 100). A block group with a minority population that was 500% of the regional average would receive 5 points. This scoring system needed improvement because it did not detect EJ groups that were present in numbers that were significant but not enormous enough to be hundreds of percentage points above the regional average, and was based on a linear equation that did not account for differences in populations distributions for each EJ demographic. The new scoring system is based on standard deviations rather than percentages above the regional average for each EJ demographic, to account for differences in population distributions for each demographic. To ensure that the scoring system is sensitive enough, an additional point is given for every 0.25 standard deviations above the regional average.

$$\boldsymbol{EJ\ Index\ Score} = \frac{(\boldsymbol{Block\ Group\ Mean} - \boldsymbol{Regional\ Mean})}{(\mathbf{0.25} \times \boldsymbol{Standard\ Deviation})}$$

For example, consider a region where an average of 30% of households are in poverty, with a standard deviation of 12. A block group within that region has an average of 45%, well above the regional average. The EJ Poverty Score would be calculated as follows:

$$\boldsymbol{EJ\ Index\ Score\ for\ Poverty} = \frac{(\boldsymbol{Block\ Group\ Mean - Regional\ Mean})}{(\mathbf{0.25} \times \boldsymbol{Standard\ Deviation})} = \frac{(\mathbf{45 - 30})}{(\mathbf{0.25} \times \mathbf{12})} = 5 \text{ points.}$$

Under the old scoring system, this block group would have received (45 - 30) / 100 = 0.15, or not even one point. The same equation is used for each EJ factor (Poverty, LEP, Minority, Ethnicity, Elderly, and Disabled), and the points from each factor are added together to obtain the full EJ Score for the Block Group.

3.2.2: Evaluation of the Benefits and Burdens Instrument

The following section details the evaluation of the 2005 Benefits and Burdens Instrument, including opportunities for improvement and changes made.

Documentation of "Benefits" Side of "Benefits and Burdens"

"Benefits": Identified Opportunities for Improvement

A primary request of the RVTPO was for there to be a larger emphasis on the "benefits" portion of the "benefits and burdens" EJ framework. Mark McCaskill, Director of Transportation Planning Organization Programs, explained that in assessment of environmental justice for transportation projects, the potential *burdens* of new projects on EJ communities are often focused upon, but the potential *benefits* of new projects for these communities often go unaccounted for. If projects are looked at only in the context of burdens, and are therefore routinely avoided in EJ communities, the communities may end up suffering *more* from lack of transportation projects than they would have suffered from the presence of the projects (McCaskill, 2015). For example, if a bus route project for a low-income community is avoided because of environmental EJ concerns, the community will have lost the EJ *benefit* of increased mobility and accessibility. As a result, there is need for adequate assessment of both benefits and burdens.

"Benefits": Changes Made

In EEJAT 2016, the Benefits and Burdens Instrument includes a column for benefits and a column for burdens for each EJ effect measured (air quality, aesthetics, accessibility, etc.) to ensure that each category is considered for both positive and negative effects.

Objectivity and Measurable Assessment

Objectivity and Measurable Assessment: Identified Opportunities for Improvement

The 2005 Benefits and Burdens Instrument was limited to a simple spreadsheet with "indicators" (such as safety, economic, social, and environmental) as the column headers, and "areas of impact" (such as displacement, land use patterns, and physical intrusions) as the row headers. The assessor subjectively determined whether there was an estimated positive, negative, or neutral effect for each area of impact for each indicator. Indicators and areas of impact such as "business impact" and "environmental impacts" were not assessed using economic or environmental measurements, but instead given a score by the planner. This left ample room for unintended bias, because any impacts that did not fall into the planner's personal awareness would go unreported. Assessments conducted by two different planners could end with two entirely different results, as one planner could estimate "no effect" across the board, and another could estimate "positive effect" or "negative effect" for all indicators.

It was also found upon assessment of the 2005 framework that there were overlaps between the "indicators" and "impacts" of the Benefits and Burdens instrument, so placing them on opposing axes did not always provide useful information. For example, with "noise" as a row header, and "environmental," "social," "economic" and "aesthetic" as column headers, it was unclear what useful information is gained from the subjective assessment by the planner of noise as "positive"

or "negative" environmentally, socially, economically, and aesthetically. In this case, an objective documentation of typical levels of noise from similar transportation projects in decibels or other units of sound, for example, may be more useful. Then, with that measurement, the argument could later be made that the noise level will have environmental, social, economic, or aesthetic effects.

Further, some of the "indicators" fit more easily into environmental, social, economic, and aesthetic categories than others, so the instrument could result in highlighting effects that are easily categorized, rather than highlighting the effects that are most severe. An area of impact could be very serious, but if it is not easily defined as a social, environmental, economic, or aesthetic impact, it could be labeled as "no effect" under each or most of these categories, and therefore erroneously weighed to be less significant than other impacts. For example, say there was an extreme case where a transportation project completely eliminated the mobility of a minority neighborhood, and they were no longer able to access employment. This indicator "mobility," cannot be easily classified as an "aesthetic" or "environmental" impact, so would likely receive a maximum of two negative points, for "social" and "economic." A land use change, however, could be more easily classified for each impact, so could receive four negative points and be weighed more heavily, without necessarily being more important than the mobility case.

Objectivity and Measurable Assessment: Changes Made

The EEJAT 2016 goes far beyond the 2005 spreadsheet, and involves instead an elaborate but easy-to-use matrix that guides planners to an objective assessment model for each EJ effect, based on the scale of project, data level available, type of project, and skills of the assessor. The matrix includes multiple models for each effect measured (air quality, natural resource depletion, noise pollution, employment opportunities, etc.), and includes results columns for "benefits" and for

"burdens" for each of these assessments. Models were selected from "best practices" found through a literature review. Improvements and additions to this matrix will doubtlessly be needed, but this will hopefully help to ensure a more objective and meaningful benefits and burdens assessment.

3.2.3. Evaluation of the Project Impact Assessment Instrument

Impacts on Surrounding Communities

Impacts on Surrounding Communities: Identified Opportunities for Improvement

In the 2005 framework, no consideration exists of the impacts of Roanoke's transportation projects on surrounding communities. The framework takes into consideration only the project site area itself, and not adjacent areas that may also be affected by the project (McCaskill, 2015; Roanoke Valley Alleghany Regional Commission, 2005).

Impacts on Surrounding Communities: Changes Made

Some of the environmental, social, and economic models included in the EEJAT 2016 Benefits and Burdens framework inherently include the impacts of Roanoke's transportation projects on surrounding communities. For example, the EPA's EJ model considers local and regional air quality data, and commuter data used to measure effects on employment accessibility inherently involves bordering regions.

Objectivity and Measurable Assessment

Objectivity and Measurable Assessment: Identified Opportunities for Improvement

In the 2005 framework, The Project Impact Assessment Instrument was used to estimate the overall impact a project would have on the community, but was conducted when a planner subjectively assigned a value to a project based on the Benefits and Burdens instrument. There was need for enhanced objectivity, or at the very least, descriptive language to justify the scoring system.

Objectivity and Measurable Assessment: Changes Made

The EEJAT 2016 Project Impact Assessment is an assessment based upon the documented Benefits and Burdens outcomes of each model assessed for each effect. Because it is impossible to rationally create a summation from outcomes of thoroughly different models, this Project Impact Assessment is not a summation of scores. Instead, this assessment takes into consideration the presence of positive and negative outcomes, and severity of those outcomes, and requires justification of the decision made, including documentation of each of those outcomes. The planners should publicize the results of the project impact assessment, which will ostensibly create public pressure for the justifications of findings (of EJ effect or no effect) given the transparently reported results of the Benefits and Burdens Instrument.

3.2.4: Evaluation of Opportunities for Improvement Overall

This section documents opportunities for improvement to the EJ assessment framework for Roanoke overall. These items apply to the assessment as a whole, rather than to a particular piece of the framework like the EJ Index or Benefits and Burdens Instrument.

Documentation of State and Federal Requirements for EJ

Documentation of State and Federal Requirements: Opportunities for Improvement

The 2005 framework did not include a clear documentation of state and federal requirements for environmental justice assessments. Such clear documentation could be useful for planners to reference during assessment of environmental justice concerns, and could help ensure that requirements are met.

Documentation of State and Federal Requirements: Changes Made

The research for EEJAT 2016 included a thorough literature review of state and federal requirements and guidelines relevant to environmental justice. An overview of the requirements and items left to interpretation can be found in the literature review above, and the table documenting the requirements can be found in the EEJAT 2016 Documentation section in the next section.

Documentation of Categorical Exclusions for EJ

Documentation of Categorical Exclusions for EJ: Opportunities for Improvement

In the 2005 framework, there was no documentation of project types and project areas that count as categorical exclusions (CEs) for EJ. The RVTPO requested exploration and documentation of such CEs. NEPA's CE's are well-defined, but as researcher Uma Outka pointed out in her report "NEPA and Environmental Justice: Integration, Implementation, and Judicial Review," (Outka, 2006), because environmental justice issues encompass more than classic environmental impact issues, a project that is categorically excluded by NEPA standards may still need to be considered for EJ effects. For example, it is possible that a categorically excluded monetary action (like compensation or displacement), or a planning activity (like stakeholder engagement) could involve injustice to EJ populations, even if there isn't direct physical environmental impact. The standards that determined which areas qualify for categorical exclusion from EJ testing were not in writing

for the 2005 RVTPO Framework, which left planners to determine on a case-by-case basis whether projects should be categorically excluded.

Documentation of Categorical Exclusions for EJ: Changes Made

Following the request made by the RVTPO, an exploration and documentation of CE's for environmental justice was conducted. A full table of categorical exclusion definitions, and the projects in the RVTPO Constrained List that qualify for CEs can be found in the EEJAT 2016 Framework documentation, detailed in the next chapter.

Documentation of RVTPO Capacity

Documentation of RVTPO Capacity: Opportunities for Improvement

The RVTPO staff expressed the sentiment that academic theories present ideal methods for environmental justice assessments that are at times unrealistic for municipalities like the RVTPO. Many of these "best practice" methodologies depend on expensive equipment, access to significant amounts of data, and substantial planning staff time. In order to filter these ideal methodologies into a framework that is feasible for Roanoke, there was need for documentation of relevant capacity of the Roanoke Valley Transportation Planning Organization.

Documentation of RVTPO Capacity: Changes Made

As requested, documentation of RVTPO capacity was created based on feedback from RVTPO staff. The table outlining these capacity constraints can be found in the EEJAT 2016 Framework documentation section below.

Community Involvement

Community Involvement: Opportunities for Improvement

The 2005 Benefits and Burdens framework described community involvement processes that were to be used, particularly in the Community Profile section. However, specific prompts for such involvement, and methodologies for such involvement were not included.

Community Involvement: Changes Made

As part of the EEJAT 2016 research, the literature review included methodologies of community involvement, and question on the stakeholder survey asked stakeholders how "meaningful public involvement should be achieved." As a result in the EEJAT 2016, there are prompted steps for community involvement in each stage of the assessment process, so that meaningful engagement is included in the project planning, design, and consideration of alternatives phases, rather than being only part of the Community Profile and announcement of decisions already made.

Comparison of Alternatives

Comparison of Alternatives: Opportunities for Improvement

The 2005 framework was designed to be a "4-step model to identify potential transportation projects … (and) filter various scenarios to determine which projects would be most appropriate" (Roanoke Valley Alleghany Regional Planning Commission, 2005). However, in reality, the 2005 framework has not been used in the project selection process or to compare alternative projects, but has instead been used primarily to show that a transportation project that is already close to approval in an already-selected location does not violate environmental justice regulations (McCaskill, 2015). The Community Profile can include places outside the immediate study area that will be affected socially, economically, or environmentally, but there isn't current significant use of the EJ framework in early project stages.

Comparison of Alternatives: Changes Made

The fourth tier of the EEJAT 2016 is a comparison of alternatives, where the results of the Benefits and Burdens assessment and Project Impact Assessment for one project can be compared to the assessments for project alternatives.

Equity Incorporation

Equity Incorporation: Opportunities for Improvement

Environmental justice assessments are routed in goals of ensuring equity. For an assessment to truly strive for such a goal, equity needs to be included in both the process *and* in the outcomes of the framework (Forkenbrock and Sheeley, 2004). Upon analysis, it was clear that the 2005 EJ framework included only consideration of "equitable" outcomes, and did not explicitly define or discuss environmental justice principles of equity.

Equity Incorporation: Changes Made

For the EEJAT 2016, a literature review of principles of equity was conducted, and a question on the definition of equity in terms of environmental justice was included on the stakeholder survey. It is the goal of EEJAT 2016 to continually incorporate and adjust principles of equity inherent in the framework's assumptions and structure. This will be done through prompts for consideration of historic structures of socioeconomic injustice that feed into disproportionate burden at project sites today, and through ongoing and earnest stakeholder engagement guided by the Jemez Principles of Equity.

Proactive EJ Testing

The timing of the application of the framework also was in need of improvement. The 2005 framework was applied only after a project is already well in progress, to comply with federal requirements of assessing EJ.

The EEJAT 2016 framework is designed to be used proactively, before a project is already decided upon (Forkenbrock and Sheeley, 2004). The framework could be used to aid decisions between project proposals, between proposed locations for projects, or ideally, in the actual design of projects before proposal.

3.3: New EJ Assessment Toolkit: EEJAT 2016

3.3.1: Overview of Toolkit

This section of the report contains the EEJAT 2016 framework or "toolkit" itself. It is included in the results chapter because the framework was the primary "result" of this study. The EEJAT 2016 framework cannot be included here in its entirety, because the Benefits and Burdens matrix is a substantial portion of the matrix, and due to formatting and size, cannot be provided on a report document. However, the matrix is provided in a separate spreadsheet, which can be found here. This section of the report includes an overview of EEJAT 2016, documentation of requirements, constraints, and categorical exclusions that were determined through this research, snapshots of the EJ Index for the Roanoke Valley area, descriptions of the Benefits and Burdens and Project Impact Assessment Instruments, and examples of the EJ assessment.

The 2016 Equitable Environmental Justice Assessment Toolkit (EEJAT 2016) expands upon the

2005 Benefits and Burdens Framework and draws upon the literature review, stakeholder feedback, and updated data to incorporate greater demographic data accuracy, higher objectivity in assessment of effects, the enabling of multiple assessment methods to be used depending on the context of the project, incorporation of Principles of Equity and checks on decision-making bias. EEJAT 2016 is multi-tiered, and designed to be as usable and useful as possible. Critically, each tier will now include opportunities for community input, so that those who will potentially be affected by the projects are given the chance to be involved in the decision process if they so choose. The new framework will be comprised of five main tiers, with intermediate steps for community involvement and checks on decision theory.

1. Environmental Justice (EJ) Index

The purpose of the EJ Index is to flag areas in the RVTPO that have high rates of poverty, limited English proficiency, minority populations, Hispanic populations, and elderly and disabled residents. The updated EJ Index reflects recent American Community Survey 2013 data, projected at the census block group level, and has an indexing system based on standard deviations from the average for each demographic, rather than being based on a rigid linear formula indiscriminately applied to all demographics. The EJ Index is in the form of a GIS map that shows through color codes the overall EJ score of each block group within the RVTPO. The darker the color, the higher the EJ score for the block group. The overall EJ Score for a block group is the summation of the EJ scores for each demographic (low-income, minority, Hispanic, LEP, elderly, and disabled), for that block group. The EJ Index will be ready ahead of assessments, so this first step will require no additional work from the assessor.

2. Community Profile Based on EJ Index

When a project is proposed, a community profile for the project site will be created. The community profile will be based on the updated EJ Index, but will expand beyond the Index to also include relevant information such as economic assets, history, social structure, real-estate values, aesthetics, and other factors. Critically, the development of the Community Profile must include acknowledgement of historic and current systematic injustices in the project area. Even if projects under current consideration would create apparent benefit, or would not create apparent burden for the EJ community, the community may be justifiably hesitant or resistant to trust in the predicted outcomes of the project if historic injustices have not been acknowledged.

Intermediate Step: Share the Community Profile with the affected communities, adjust as needed.

3. Benefits and Burdens Toolkit Matrix

The third tier will be the determination of the assessment method itself. This step is the crucial difference between the old and new frameworks for Roanoke. This tier will be set up like an easy-to-follow flow chart, guiding planners to the recommended assessment method for each EJ effect based on a series of questions about data available, skill sets, time frame, project scale, predicted effects, and location. Some projects (such as small sidewalk segments or other very small projects) will be categorically excluded from further assessment here through the "project scale" question.

Intermediate Step: Justify Selection of Assessment Method. The assessor will document the reasons that the flow chart was followed in the way that it was to choose the assessment method that was chosen. This step will be an easy form to fill in. Questions will be based on Behavioral Economics decision theory (see Huettal, 2014).

4. Project Impact Assessment

The third tier will be the Project Impact assessment based on the methods chosen during the second

tier. This third tier will be as systematized as possible with the models already in place, enabling planners to merely input data when possible. Critically, this assessment, regardless of method chosen, will include not only the potential burdens of the project (air quality, noise, etc.), but also the potential benefits of the project (accessibility, mobility, etc.) to help ensure that EJ decisions being made on the project are truly for the best of the community.

Intermediate Step: Share results of the assessment with the communities affected.

5. Comparison of Alternatives

The fourth tier will compare the results of the benefits and burdens assessment with project alternatives whenever possible, to ensure that the least burdensome feasible option is chosen.

3.3.2. Documentation

This pre-section of the EEJAT 2016 framework provides documentation that was gathered during this study that may be useful to planners using EEJAT 2016 to conduct environmental justice assessments for transportation plans. Table 9 provides documentation of all federal and state requirements and guidelines for environmental justice. The table provides the order or policy name, the requirement or guideline provided in that order or policy, and the items left to interpretation by the planner for that policy. Table 11 provides documentation of categorical exclusions for environmental justice. Table 10 provides the RVTPO Constrained List of projects as of August 2016, and their likely categorical exclusion designation. Table 12 provides capacity constraints of the RVTPO.

3.3.2.1: Documentation of Federal Requirements for Environmental Justice

Table 2: Federal Requirements for Environmental Justice

Order/ Policy	Requirement / Guideline	Items left to Interpretation
1964: Title VI of the Civil Rights Act of 1964	"No person in the United States shall, on the ground of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving Federal financial assistance." Title VI of the Civil Rights Act of 1964, 42 U.S.C § 2000d et seq (1964)	A) Measurement of demographics based upon what data, with what methods? B) How to measure that no person is denied benefits or subjected to discrimination in transportation plans? B) What is included in 'benefits?"
1969: National Environmental Policy Act (NEPA), Title I, Section 102	" ...all agencies of the Federal Government shall— (A) Utilize a systematic, interdisciplinary approach which will insure the integrated use of the natural and social sciences and the environmental design arts in planning and in decision-making which may have an impact on man's environment; (B) Identify and develop methods and procedures, in consultation with the Council on Environmental Quality established by Title II of this Act, which will insure that presently unquantified environmental amenities and values may be given appropriate consideration in decisionmaking along with economic and technical considerations; (C) Include in every recommendation or report on proposals for legislation and other major Federal actions significantly affecting the quality of the human environment, a detailed statement by the responsible official on— (i) the environmental impact of the proposed action, (ii) any adverse environmental effects which cannot be avoided should the proposal be implemented, (iii) alternatives to the proposed action, (iv) the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity, and (v) any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented." National Environmental Policy Act of 1969, 42 U.S.C. § 4321 (1970)	A) How to create this systematic, interdisciplinary approach? B) How to develop methods and procedures; Standards? C) How to weigh environmental amenities for "appropriate" consideration? D) How to measure adverse environmental effects? Which types of environmental effects are included? How to determine alternatives?
1970: Federal-Aid Highway Act	"Not later than July 1, 1972, the Secretary, after consultation with appropriate Federal and State officials, shall submit to Congress, and not later than 90 days after such submission, promulgate guidelines designed to assure that possible adverse economic, social, and environmental effects relating to any proposed project on any Federal-aid system have been fully considered in developing such project, and that the final decisions on the project are made in the best overall public interest, taking into consideration the need for fast, safe and efficient transportation, public services, and the costs of eliminating or minimizing such adverse effects and the following: 1) Air, noise, and water pollution;	A) What counts as "adverse economic, social, environmental effects?" B) What counts as "fully considered?" C) How to ensure that all possible adverse effects are considered? D) How to weigh "best overall public interest?" (i.e. in the interest of which subset populations of the public?) E) How to assess air, noise, water, destruction of manmade

	2) Destruction or disruption of manmade and natural resources, aesthetic values, community cohesion and the availability of public facilities and services; 3) Adverse employment effects, and tax and property value losses; 4) Injurious displacement of people, businesses and farms; and 5) Disruption of desirable community and regional growth. Such guidelines shall apply to all proposed proj-ects with respect to which plans, specifications, and estimates are approved by the Secretary after the issuance of such guidelines." Federal Aid Highway Act of 1970, 1 U.S.C § 84 (1970)	and natural resources, employment effects, displacement, disruption of community growth, etc.?
1970: Uniform Relocation Assistance and Real property Acquisition Policies Act (amended in 1987)	"To ensure that persons displaced as a direct result of Federal or federally-assisted projects are treated fairly, consistently, and equitably so that such persons will not suffer disproportionate injuries as a result of projects designed for the benefit of the public as a whole; and to minimize the hardship of displacement on such persons." Uniform Relocation Assistance and Real Property Acquisition Policies Act, 42, U.S.C. § 4601 (1970)	A) How to measure displacement B) How to measure that people are treated "fairly," "consistently" and "equitably" C) "Disproportionate" is based upon what comparison population? D) What counts as "minimizing hardship?"
1975: Age Discrimination Act	"No person in the United States shall, on the basis of age, be excluded from participation, be denied the benefits of, or subject to discrimination under any program or activity receiving Federal financial assistance."	A) How to measure age discrimination? B) Which age groups should be measured?
1987: 23 CFR 771: Environmental Impact and Related Procedures	"(a) To the fullest extent possible, all environmental investigations, reviews, and consultations be coordinated as a single process, and compliance with all applicable environmental requirements be reflected in the environmental document required by this regulation. (b) Alternative courses of action be evaluated and decisions be made in the best overall public interest based upon a balanced consideration of the need for safe and efficient transportation; of the social, economic, and environmental impacts of the proposed transportation improvement; and of national, State, and local environmental protection goals. (c) Public involvement and a systematic interdisciplinary approach be essential parts of the development process for proposed actions. (d) Measures necessary to mitigate adverse impacts be incorporated into the action. Measures necessary to mitigate adverse impacts are eligible for Federal funding when the Administration determines that: (1) The impacts for which the mitigation is proposed actually result from the Administration action; and (2) The proposed mitigation represents a reasonable public expenditure after considering the impacts of the action and the benefits of the proposed mitigation measures. In making this determination, the Administration will consider, among other factors, the extent to which the proposed measures would assist in complying with a	A) How to conduct "balanced consideration?" B) Which impacts are included in "social, economic, and environmental impacts," and what methods should be used to measure these? C) What counts as "public involvement? And "systematic interdisciplinary approach?" What are methods for each? D) The policy defines what makes "measures necessary" eligible for federal funding, but doesn't define *what* the "measures necessary" are or how the adverse impacts should be measured. E) Whose needs are considered when "reasonable public expenditure" or assessed F) Methods of measuring handicap, age, race, color, sex, national origin (which scale, populations, data, compared to

	Federal statute, Executive Order, or Administration regulation or policy. (e) Costs incurred by the applicant for the preparation of environmental documents requested by the Administration be eligible for Federal assistance. (f) No person, because of handicap, age, race, color, sex, or national origin, be excluded from participating in, or denied benefits of, or be subject to discrimination under any Administration program or procedural activity required by or developed pursuant to this regulation." 771.117 FHWA categorical exclusions: '(a) categorical exclusions (CEs) are actions which meet the definition contained in 40 CFR 1508.4, and, based on past experience with similar actions, do not involve significant environmental impacts."	which base populations?)
1987 TA 6640.8A Guidance for Preparing and Processing Environmental and Section 4(f) Documents	The TA 6640.8A provides guidance for preparing and processing environmental and Section 4(f) documents. This includes but is not limited to the following: "Social Impacts: Where there are foreseeable impacts, the draft EIS should discuss the following items for each alternative commensurate with the level of impacts and to the extent they are distinguishable: 1. Changes in the neighborhoods or community cohesion for the various social groups as a result of the proposed action. These changes may be beneficial or adverse, and may include splitting neighborhoods, isolating a portion of a neighborhood or an ethnic group, generating new development, changing property values, or separating residents from community facilities, etc. 2.Changes in travel patterns and accessibility (e.g., vehicular, commuter, bicycle, or pedestrian). 3.Impacts on school districts, recreation areas, churches, businesses, police and fire protection, etc. This should include both the direct impacts to these entities and the indirect impacts resulting from the displacement of households and businesses. 4.Impacts of alternatives on highway and traffic safety as well as on overall public safety. 5. General social groups specially benefited or harmed by the proposed project. The effects of a project on the elderly, handicapped, non-drivers, transit-dependent, and minority and ethnic groups are of particular concern and should be described to the extent these effects can be reasonably predicted. Where impacts on a minority or ethnic population are likely to be an important issue, the EIS should contain the following information broken down by race, color, and national origin: the population of the study area, the number of displaced residents, the type and number of displaced businesses, and an estimate of the number of displaced employees in each business sector. Changes in ethnic or minority employment opportunities should be discussed and the relationship	A) What counts as a "social impact?" What counts as a "foreseeable impact?" What if planners are privileged, biased, or unaware of future impacts? B) How to measure these benefits or adverse effects? C) How to determine direct and indirect effects? D) How to draw lines between "general social groups"

	of the project to other Federal actions which may serve or adversely affect the ethnic or minority population should be identified. 6.The discussion should address whether any social group is disproportionately impacted and identify possible mitigation measures to avoid or minimize any adverse impacts. Secondary sources of information such as census and personal contact with community leaders supplemented by visual inspections normally should be used to obtain the data for this analysis. However, for projects with major community impacts, a survey of the affected area may be needed to identify the extent and severity of impacts on these social groups."	
1990: Americans with Disabilities Act, revised 2008	The ADA prohibits discrimination and ensures equal opportunity for persons with disabilities in employment, State and local government services, public accommodations, commercial facilities, and transportation. This includes but is not limited to the following: "SEC. 226. NEW FACILITIES. For purposes of section 202 of this Act and section 504 of the Rehabilitation Act of 1973 (29 U.S.C. 794), it shall be considered discrimination for a public entity to construct a new facility to be used in the provision of designated public transportation services unless such facility is readily accessible to and usable by individuals with disabilities, including individuals who use wheelchairs." "(a) PUBLIC TRANSPORTATION PROGRAMS AND ACTIVITIES IN EXISTING FACILITIES- (1) IN GENERAL- With respect to existing facilities used in the provision of designated public transportation services, it shall be considered discrimination, for purposes of section 202 of this Act and section 504 of the Rehabilitation Act of 1973 (29 U.S.C. 794), for a public entity to fail to operate a designated public transportation program or activity conducted in such facilities so that, when viewed in the entirety, the program or activity is readily accessible to and usable by individuals with disabilities." SEC. 242. INTERCITY AND COMMUTER RAIL ACTIONS CONSIDERED DISCRIMINATORY. (a) INTERCITY RAIL TRANSPORTATION- (1) ONE CAR PER TRAIN RULE- It shall be considered discrimination for purposes of section 202 of this Act and section 504 of the Rehabilitation Act of 1973 (29 U.S.C. 794) for a person who provides intercity rail transportation to fail to have at least one passenger car per train that is readily accessible to and usable by individuals with disabilities, including individuals who use wheelchairs, in accordance with regulations issued under section 244, as soon as practicable, but in no event later than 5 years after the date of enactment of this Act."	A) How to determine disability? All mental and physical disabilities included? B) How to ensure that transportation systems do not discriminate against any disability?

1990 & 1994 FHWA Environmental Policy Statements	The 1990 and 1994 Federal Highway Administration Environmental Policy Statements included guidance relating to EJ populations including but not limited to: "Ensure that Federal-aid and Federal Lands Programs and projects benefit all segments of society, including those who have historically been underserved and underrepresented. Improve accessibility for all persons, especially elderly persons, persons with disabilities, and the economically disadvantaged in both rural and urban areas. Consistent with Title VI of the 1964 Civil Rights Act and Executive Order 12898 on Environmental Justice, all program and project actions and decisions must ensure that minority and low-income populations are not disproportionately adversely affected by transportation programs or projects."	-Methods of ensuring these goals -How these populations are defined -Disproportionate by what measures of proportion?
1994: Executive Order 12898 on Environmental Justice	EO 12898 on Environmental Justice addresses persons belonging to any of the following groups; 1. Black - a person having origins in any of the black racial groups of Africa. 2. Hispanic - a person of Mexican, Puerto Rican, Cuban, Central or South American, or other Spanish culture or origin, regardless of race. 3. Asian - a person having origins in any of the original peoples of the Far East, Southeast Asia, or the Indian subcontinent. 4. American Indian or Alaskan Native - a person having origins in any of the original people of North America and who maintains cultural identification through tribal affiliation or community recognition. 5. Low Income - a person whose household income (or in the case of a community or group, whose median household income) is at or below the U.S. Department of Health and Human Services poverty guidelines.	A) Considerations for Middle Eastern populations? B) What proportions of these populations is considered significant in terms of environmental justice? By number? By percentage? At what scale?
1997: Office of Management and Budget's (OMB) Revisions to the Standards for the Classification of Federal Data on Race and Ethnicity	The 1997 OMB Revisions included new standards for race categories, described as the following: "The revised standards will have five minimum categories for data on race: American Indian or Alaska Native, Asian, Black or African American, Native Hawaiian or Other Pacific Islander, and White. There will be two categories for data on ethnicity: 'Hispanic or Latino' and 'Not Hispanic or Latino.'	A) What scale or percentage non-white population is considered "significant"? B) Considerations for Middle Eastern populations?
1998: The Transportation Equity Act for	TEA-21 included considerations for "disadvantaged populations" and meaningful involvement of all populations in decision-making. The four hundred page document includes the following:	A) Disproportionate compared to what base population? B) What counts as "adverse"?

the 21st Century (TEA-21)- Public Law 105-178	"(2) ALTERNATIVES.—In considering fixed guideway alternatives and selecting any revised preferred alternative … Metropolitan Transportation Authority shall— (C) identify and address any disproportionately high and adverse effects on minority and low income populations, in accordance with the Executive Order on Federal Actions to Address Environmental Justice (EO 12898; February 11, 1994); Disadvantaged Business Enterprises---(1) General rule.--Except to the extent that the Secretary determines otherwise, not less than 10 percent of the amounts made available for any program under titles I, III, and V of this Act shall be expended with small business concerns owned and controlled by socially and economically disadvantaged individuals."	
1999: "ACTION: Implementing Title VI Requirements in Metropolitan and Statewide Planning" Joint Memorandum of FHWA and FTA, October 7, 1999. <http://www.fhwa.dot.gov/environment/ejustice/ej-10-7.htm	The 1999 memorandum included background and guidance for implementing Title VI, including review questions for planners to ask themselves. The related guidance includes but is not limited to the following: "Title VI bars intentional discrimination as well as disparate impact discrimination (i.e., a neutral policy or practice that has a disparate impact on protected groups) ... While Title VI and EJ concerns have most often been raised during project development, it is important to recognize that the law also applies equally to the processes and products of planning. Does the planning process have an analytical process in place for assessing the regional benefits and burdens of transportation system investments for different socio-economic groups? Does it have a data collection process to support the analysis effort? Does this analytical process seek to assess the benefit and impact distributions of the investments included in the plan and TIP (or STIP)? Does the public involvement process have an identified strategy for engaging minority and low-income populations in transportation decision-making? What strategies, if any, have been implemented to reduce participation barriers for such populations? Has their effectiveness been evaluated? Has public involvement in the planning process been routinely evaluated as required by regulation? Have efforts been undertaken to improve performance, especially with regard to low-income and minority populations? Have organizations representing low-income and minority populations been consulted as part of this evaluation? Have their concerns been considered? What efforts have been made to engage low-income and minority populations in the certification review public outreach effort? Does the public outreach effort utilize media (such as print, television, radio, etc.) targeted to low-income or minority populations? What issues were raised, how are their concerns documented, and how do they reflect on the performance of the planning process in relation to Title VI requirements? What mechanisms are in place to ensure that issues and concerns raised by low-income and minority populations are appropriately	A) How to measure disparate impact discrimination? B) How to measure EJ in processes and products of planning? C) Definition of "benefits and burdens?" D) What type of analytical process? E) Which strategies are recommended for public involvement? F) How to measure effectiveness of public involvement? G) What type of mechanisms are recommended to "ensure that issues and concerns raised by low-income and minority populations are appropriately considered?

	considered in the decision-making process? Is there evidence that these concerns have been appropriately considered? Has the metropolitan planning organization (MPO) or State DOT made funds available to local organizations that represent low-income and minority populations to enable their participation in planning processes?"	
2000: Bulletin No. 00-02, "Guidance on Aggregation and Allocation of Data on Race for Use in Civil Rights Monitoring and Enforcement."	The 2000 Bulletin No. 00-02 added to the previous standard delineations of race/ethnicity was the category of: "Native Hawaiian or Other Pacific Islander - a person having origins in any of the original peoples of Hawaii, Guam, Samoa, or other Pacific Islands."	n/a
2000: State Transportation Planning; Metropolitan Transportation Planning; Proposed Rule; Federal Register, pp. 33922-33958	The 2000 proposed rule required development of a "discrimination assessment," which includes but is not limited to the following: a) Geographic and demographic profile, including low-income, minority, elderly, and persons with disabilities populations, b) Description of transportation services available and planned for population segments c) Description of disproportionately high and adverse environmental impacts or reduction in benefits along with: 1) Public comment consideration 2) Efforts to mitigate adverse impacts 3) Documentation made available for public review.	A) How to measure these populations? By what scales? Compared to what base populations? B) What methodologies should be used to create the geographic and demographic profile? C) What counts as "adverse impacts? What counts as "efforts to mitigate" these impacts?
2001: Title VI Legal Manual, U.S. Department of Justice Civil Rights Division	The 2001 Title VI Legal Manual included environmental justice considerations including but not limited to the following: "The core tenet of environmental justice- that development and urban renewal benefitting a community as a whole not be unjustifiably purchased through the disproportionate allocation of its adverse environmental and health burdens on the community's minorities - flows directly from the underlying principle of Title VI itself" "Executive Order 12898 requires each federal agency to develop, under the guidance of an Interagency Working Group on Environmental Justice, a written strategy to identify and address disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority and low-income populations. That strategy is to reflect agency efforts to re-focus and, if necessary re-tool, its programs, policies, planning and public participation processes, enforcement, and/or rulemaking related to human health or the environment." "In drafting guidance or conducting program reviews, agency	A) How to create this strategy to "address disproportionately high and adverse human health or environmental effects?" B) How to conduct sufficient public notice and public participation?

	officials should focus specific attention on the public notice and participation procedures employed by themselves and their recipients to ensure compliance with the public consultation requirements of Executive Order 12898."	
2001: Title 49, Section 21.9 - Nondiscrimination in Federally-Assisted Programs of the Department of Transportation-Effectuation of Title VI of the Civil Rights Act of 1964	Title 49, Section 21.9 addressed discrimination in federally-assisted DOT programs, through statements including but not limited to the following: "(b) In general recipients should have available for the Secretary racial and ethnic data showing the extent to which members of minority groups are beneficiaries of programs receiving Federal financial assistance …. (d) Information to beneficiaries and participants. Each recipient shall make available to participants, beneficiaries, and other interested persons such information regarding the provisions of this part and its applicability to the program under which the recipient receives Federal financial assistance, and make such information available to them in such manner, as the Secretary finds necessary to apprise such persons of the protections against discrimination assured them by the Act and this part."	A) What types of data? B) How to effectively disseminate information?
2005: The Safe, Accountable, Flexible, Efficient Transportation Equity Act (SAFETEA-LU)	The 2005 SAFETEA-LU act described requirements for long-range plans and public engagement in the planning process, including but not limited to the following: "*Local officials, in cooperation with the State and transit operators, remain responsible for determining the best transportation investments to meet metropolitan transportation needs. MPOs are responsible for adopting the long range transportation plan (Plan); Governor and MPO approve the transportation improvement program (TIP). The Plan and TIP remain separate documents. A 20-year planning perspective, air quality conformity, fiscal constraint, and public involvement established under ISTEA. Plan must contain: operational and management strategies to improve the performance of existing transportation facilities; investment and other strategies that provide for multimodal capacity increases based on regional priorities and needs; and proposed transportation and transit enhancement activities. [6001(i)] A Congestion Management System is still required in Transportation Management Areas (TMAs) (urbanized areas larger than 200,000 population). The planning process in TMAs requires DOT certification. Long Range Transportation Plan will be updated every 4 years."* *"... include a discussion of potential environmental mitigation activities along with potential sites to carry out the activities to be included. The discussion is to be developed in consultation with Federal, State, and tribal wildlife, land management, and regulatory agencies … The Plan is to be published and made available electronically, such as on the Web ... MPOs are required to consult with State and local agencies responsible for land use management, natural resources, environmental protection,*	A) Whose needs are considered for "best transportation investments?" B) Methods for air quality measurement, public involvement? C) What are "reasonable opportunities" for participation? D) What counts as "convenient and accessible?"

	conservation, and historic preservation concerning development of the Plan ... Representatives of users of pedestrian walkways, bicycle transportation facilities, the disabled are specifically added as parties to be provided with the opportunity to participate in the planning process … The MPO is to develop a participation plan in consultation with interested parties that provides reasonable opportunities for all parties to comment … To carry out the participation plan, public meetings are to be: conducted at convenient and accessible locations at convenient times; employ visualization techniques to describe plans; and make public information available in an electronically accessible format, such as on the Web. [6001(i)]"	
2006: ***FAA Order 1050.1E, CHG 1***	The 2006 FAA Order 1050.1E provided some specific examples of environmental injustice, and declared that environmental injustice is likely if impacts affect low income or minority populations at a disproportionately higher level than other populations. The text relating to EJ includes but is not limited to the following: *"The requirements in this order apply to, but are not limited to, the following: all grants, loans, contracts, leases, construction, research activities, rulemaking and regulatory actions, certifications, licensing, permits, plans submitted to the FAA by state and local agencies which require FAA approval, and legislation proposed by the FAA ...* *When performing analyses of environmental justice impacts, NEPA practitioners should be aware that the Department of Health and Human Services (HHS) poverty guidelines specified for use by DOT Order 5610.2, and the Census Bureau's poverty threshold specified for use in the CEQ and EPA environmental justice guidance, differ slightly (e.g., $12,100 and $12,674, respectively, for a family of four in 1989). EIS's should discuss the significant impact that a project would cause, then identify affected populations. If an impact would affect low income or minority populations at a disproportionately higher level than it would other population segments, an environmental justice issue is likely.16.3c.* *Socioeconomic Impacts. Factors to be considered in determining impact in this category include, but are not limited to, the following: (1) Extensive relocation of residents is required, but sufficient replacement housing is unavailable. (2) Extensive relocation of community businesses, that would create severe economic hardship for the affected communities. (3) Disruptions of local traffic patterns that substantially reduce the levels of service of the roads serving the airport and its surrounding communities. (4) A substantial loss in community tax base."*	A) How to determine "significant" impact? B) How to measure disproportionate impact on low-income and minority populations? C) What counts as "extensive" relocation? D) What counts as "severe" economic hardship? E) What counts as "substantial" reduction of levels of service?
2012: Moving Ahead for Progress in the 21st Century Act (MAP 21)	MAP 21 included consideration for EJ in its discussion of "transportation equity," below: *"The Secretary may enter into such contracts, cooperative agreements, and other agreements to assist providers of public transportation to … (5) address transportation equity with regard*	A) Definition of transportation equity B) How to measure effect on low-income and minority individuals

	to the effect that transportation planning, investment and operations have for low-income and minority individuals …"	
2012: Department of Transportation Updated Environmental Justice Order 5610.2(a)	*The 2012 Updated Environmental Justice Order 5610.2(a) updates the 1997 Order, clarifies definitions of "minority" populations, clarifies distinction between a Title VI analysis and a NEPA Environmental Justice analysis, and affirms the importance of considering EJ principles during early planning activities. The relevant text includes but is not limited to the following:* *"Planning and programming activities for policies, programs, and activities that have the potential to have a disproportionately high and adverse effect on human health or the environment shall include* ***ex****plicit consideration of the effects on minority populations and low-income populations …* *Procedures shall be established or expanded, as necessary, to provide meaningful opportunities for public involvement by members of minority populations and low-income populations during the planning and development of programs, policies, and activities (including the identification of potential effects, alternatives, and mitigation measures) …* *Steps shall be taken to provide the public, including members of minority populations and low-income populations, access to public information concerning the human health or environmental impacts of programs, policies, and activities, including information that will address the concerns of minority and low-income populations regarding the health and environmental impacts of the proposed action ...* *Under Title VI, each Federal agency is required to ensure that no person, on the ground of race, color, or national origin, is excluded from participation in, denied the benefits of, or subjected to discrimination under any program or activity receiving Federal financial assistance. This statute affects every program area in DOT ...* *In implementing these requirements, the following information should be obtained where relevant, appropriate and practical:* - *Population served and/or affected by race, color or national origin, and income level;* - *Proposed steps to guard against disproportionately high and adverse effects on persons on the basis of race, color, or national origin, and income level;* - *Present and proposed membership by race, color, or national origin, in any planning or advisory body that is part of the program, policy or activity.* *Statutes governing DOT operations will be administered so as to identify and avoid discrimination and avoid disproportionately high and adverse effects on minority populations and low-income populations by:* *(1) identifying and evaluating environmental, public health, and interrelated social and economic effects of DOT programs, policies, and activities,* *(2) proposing measures to avoid, minimize and/or mitigate disproportionately high and adverse environmental and public health effects and interrelated*	A) What counts as "explicit consideration?" B) What counts as "meaningful opportunities?" C) What "steps shall be taken" in cases of disproportionate burden? D) What counts as "relevant, appropriate, and practical?" E) Standards for data collection? F) What counts as "disproportionately high? To what degree? By what percentage? G) Methods of identification and evaluation? H) Determination of what is "beneficial" or "enhancing?" I) What counts as "minimizing?" J) Standards for public involvement procedures? K) How are impacts compared? Which social, economic, and environmental effects? And how are they to be weighted? L) What counts as a "relevant" number of existing system elements? M) Standard for "substantial" need? N) Standard for "severe?" O) Standard for "extraordinary magnitude?"

	social and economic effects, and providing offsetting benefits and opportunities to enhance communities, neighborhoods, and individuals affected by DOT programs, policies, and activities, where permitted by law and consistent with the Executive Order, *(3) considering alternatives to proposed programs, policies, and activities, where such alternatives would result in avoiding and/or minimizing disproportionately high and adverse human health or environmental impacts, consistent with the Executive Order, and* *(4) eliciting public involvement opportunities and considering the results thereof, including soliciting input from affected minority and low-income populations in considering alternatives.* *Following the guidance set forth in this Order and its Appendix, the head of each Operating Administration and the responsible officials for other DOT components shall determine whether programs, policies, or activities for which they are responsible will have an adverse human health or environmental effect on minority and low-income populations and whether that adverse effect will be disproportionately high ...* *In making determinations regarding disproportionately high and adverse effects on minority and low-income populations, mitigation and enhancements measures that will be implemented and all offsetting benefits to the affected minority and low-income populations may be taken into account, as well as the design, comparative impacts, and the relevant number of similar existing system elements in non-minority and non-low-income areas ...* *The Operating Administrators and other responsible DOT officials will ensure that any of their respective programs, policies or activities that will have a disproportionately high and adverse effect on minority populations or low-income populations will only be carried out if further mitigation measures or alternatives that would avoid or reduce the disproportionately high and adverse effect are not practicable. In determining whether a mitigation measure or an alternative is "practicable," the social, economic (including costs) and environmental effects of avoiding or mitigating the adverse effects will be taken into account ...* *The Operating Administrations and other responsible DOT officials will also ensure that any of their respective programs, policies, or activities that will have a disproportionately high and adverse effect on populations protected by Title VI ("protected populations") will only be carried if:* *(1) a substantial need for the program, policy, or activity exists, based on the overall public interest; and* *(2) alternatives that would have less adverse effects on protected populations (and that still satisfy the need identified in subparagraph d(1) above), either* *(a) would have other adverse social, economic,*	

	environmental or human health impacts that are severe; or *(b) Would involve increased costs of extraordinary magnitude.*	
2012: FHWA Order 6640.23A http://www.fhwa.dot.gov/legsregs/directives/orders/664023a.cfm	*This directive is limited to improving the internal management of the FHWA .* *-Low-Income: Person whose median household income is at or below the DHHS guidelines* *-Minority: Black, Hispanic or Latino, Asian American, American Indian or Alaskan Native, Native Hawaiian or Other Pacific Islander* *-Low-Income Population: "readily identifiable group of low-income persons who live in geographic proximity* *-Minority Population: "readily identifiable group of minority persons…or geographically dispersed/transient persons who will be similarly affected by a proposed FHWA program, policy, or activity* *-Adverse Effects: The totality of significant individual or cumulative human health or environmental effects, including interrelated social and economic effects, which may include but are not limited to: bodily impairment, infirmity, illness or death; air, noise and water pollution and soil contamination, destruction or disruption of human-made or natural resources, destruction or diminution of aesthetic values; destruction or disruption of community cohesion or a community's economic vitality; destruction or disruption of the availability of public and private facilities and services; vibration; adverse employment effects; displacement of persons, businesses, farms, or nonprofit organizations; increased traffic congestion, isolation, exclusion or separation of minority or low-income individuals within a given community or from the broader community, and the denial of, reduction in, or significant delay in the receipt of, benefits of FHWA programs, policies, or activities* *-Disproportionately High and Adverse Effect on Minority and Low-Income Populations: An adverse effect that (1) is predominantly borne by a minority population and/ or a low-income population or (2) will be suffered by the minority population and/ or low-income population and is appreciably more severe or greater in magnitude than the adverse effect that will be suffered by the non-minority population and/ or low-income population* *The FHWA managers and staff will ensure that the programs, policies, and activities that will have disproportionately high and adverse effects on minority populations and/or low-income populations will only be carried out if further mitigation measures or alternatives that would avoid or reduce the disproportionately high and adverse effects are not practicable. In determining whether a mitigation measure or an alternative is "practicable," the social, economic (including costs) and environmental effects of*	-What is "readily identifiable?" -What is "geographic proximity?" -What is "significant" human health or environmental effects? -"Disproportionate" by what proportions? -What counts as "appreciably more severe?" -What counts as "practicable?" -What counts as "substantial need?" -What counts as "extraordinary magnitude?"

	avoiding or mitigating the adverse effects will be taken into account. *The FHWA managers and staff will also ensure that any of their respective programs, policies, or activities that have the potential for disproportionately high and adverse effects on populations protected by Title VI ("protected populations") will only be carried out if:* *(1) a substantial need for the program, policy or activity exists, based on the overall public interest; and* *(2) alternatives that would have less adverse effects on protected populations have either:* *(a) adverse social, economic, environmental, or human health impacts that are severe; or* *(b) would involve increased costs of an extraordinary magnitude.*	
2012: Department of Transportation Environmental Justice Strategy	The 2012 DOT EJ Strategy provided more specific guidance for EJ decision making, planning and public engagement, including but not limited to: *"Public engagement and participation in decision making is a fundamental principle of EJ, and is critical to achieving outcomes that reflect the needs of all affected stakeholders to the greatest extent feasible. DOT is committed to engaging low-income and minority populations in the transportation decision making process across all relevant OAs, from the earliest stages of planning through project implementation.* *DOT encourages coordination with community leaders to develop locally appropriate outreach plans, recognizing that community leaders are ideally positioned to champion the public engagement process and disseminate information to their constituents.* *C. In addition, each relevant OA shall focus as appropriate for its mission on the following areas: transportation access to jobs, particularly for non-driving segments of the population; quality of transportation systems near minority and low-income communities; implementation of NEPA; implementation of Title VI; impacts and benefits from commercial transportation and supporting infrastructure (goods movement); and impacts from climate change."*	A) How to measure transportation access? Which jobs are included? What distance is considered "accessible?" B) Determination of "quality" of transportation systems near minority and low-income communities? (What components go into "quality?" How high quality is high enough?) C) How low-income and minority populations are defined? D) Which impacts and benefits are measured, and how are they measured?
2012: FTA Circular 4703.1: Environmental Justice Policy Guidance for Federal Transit Administration Recipients ("EJ Circular") https://www.transit.dot.go	The 2012 EJ Circular removed CEQ thresholds and replaced them with disproportionate effects on EJ populations, based on presence of effect rather than size of population. The Circular also specified that Census data should be supplemented by local data, clarified definitions of minority and low-income populations, and provided specific steps that should be taken to assess EJ issues. The relevant text includes but is not limited to the following: *"The guiding EJ principles followed by DOT and FTA are briefly summarized as follows:* *To avoid, minimize, or mitigate disproportionately high*	A) How to ensure "full and fair participation?" B) How to measure disproportionately high burden? C) What counts as "significant delay in receipts?

v/sites/fta.dot.gov/files/docs/FTA_EJ_Circular_7.14-12_FINAL.pdf	*and adverse human health and environmental effects, including social and economic effects on minority populations and low-income populations* *To ensure the full and fair participation by all potentially affected communities in the transportation decision-making process* *To prevent the denial of, reduction in, or significant delay in the receipt of benefits by minority and low-income populations* *... FTA has removed any reference to adopting the CEQ threshold. In its place is a discussion of the importance of considering whether there are disproportionately high and adverse effects on EJ populations; these effects are the basis for addressing environmental justice concerns, not the size of the EJ populations. A very small minority or low-income population in the project, study, or planning area does not eliminate the possibility of a disproportionately high and adverse effect on these populations. Thus, FTA has concluded that recipients should make EJ determinations based on effects, not on population size. Under DOT Order 5610.2(a), whether an adverse effect is ''disproportionately high'' on minority and low-income populations depends on whether that effect is* *(1) predominantly borne by an EJ population, or* *(2) will be suffered by the EJ population and is appreciably more severe or greater in magnitude than the adverse effect that will be suffered by the non-EJ population.* *The ACS and Census are not the exclusive sources of demographic data, and local data can be used to refine ACS and Census data. Multiple commenters also wanted more guidance and flexibility regarding area of study and data sets, including information that goes beyond where EJ populations reside to where they work and receive benefits ...* *Recipients may use a more inclusive definition of low-income, e.g., 150% of poverty level, or incomes at a certain percentage of median household income, etc., if they choose, provided the threshold is at least as inclusive as the HHS poverty guidelines.* *Under DOT's Title VI regulations, as a recipient of DOT financial assistance, you are prohibited from, among other things, using "criteria or methods of administering your program which have the effect of subjecting individuals to discrimination based on their race, color, or national origin ...* *While there may be overlap, engaging in an EJ analysis under Federal transportation planning and the NEPA provisions will not satisfy Title VI requirements, as outlined in FTA's Title VI Circular. Similarly, a Title VI analysis will not necessarily satisfy environmental justice, given that Title VI does not include low-income populations ...* *"Minority Population" means any readily identifiable group or groups of minority persons who live in geographic proximity, and if circumstances warrant, geographically dispersed or*	

	transient persons such as migrant workers or Native Americans who will be similarly affected.. *"Low-income" means a person whose median household income is at or below the HHS poverty guidelines. However, you are encouraged to use a locally developed threshold, such as that used for FTA's grant program, or a percentage of median income for the area, provided that the threshold is at least as inclusive as the HHS poverty guidelines."* *Step 1: Know Your Community by analyzing demographic data* *Source: Census, ACS, TIGER files, GIS, ESRI provides free block group geographic files* *Level: Census block or block group, tract if not smaller* *… The unit of geographic analysis is the area impacted by the proposed action. Depending on the nature of the proposed action, the unit of geographic analysis may be a governing body's jurisdiction, a transit provider's service area, a neighborhood, Census tract, or other similar unit. However, when establishing the boundaries of the geographic unit, you will want to be careful not to choose boundaries that artificially dilute or inflate the affected EJ population ...* *Method: use GIS to overlay the percentage of minority populations with the low-income populations relative to the planning or project impact area* *Step 2: Develop Public Engagement Plan that responds to community ...* *Step 3: Consider Proposed Project and Likely Adverse Effects and Benefits ...* *-Step 4: Select alternative, incorporate mitigation as needed …"*	

3.3.2.2 Documentation of categorical exclusions for environmental justice

Categorical exclusions (CEs) for EJ analysis can be beneficial if they save resources by eliminating unnecessary EJ analysis of projects like small sidewalk repairs, electronic traffic messaging, or small-scale landscape maintenance. However, if categorical exclusions go too far, they could be eliminating important EJ analysis. Therefore, it is important for planning agencies to clearly establish guidelines for categorical exclusion based on both federal policy and recommendations derived from EJ stakeholder input.

Generally, CE's for EJ follow NEPA guidelines for categorical exclusions from environmental impact analysis (EIA). However, because environmental justice issues encompass more than classic environmental

impact issues, NEPA's definitions of CEs may leave gaps in terms of environmental justice; therefore, EJ CE's are a bit more stringent than EIA CE's. For example, NEPA would categorically exclude a monetary action (like compensation for displacement), because it does not directly involve physical environmental effects. However, it is possible that a monetary action could involve injustice to EJ populations, even if there isn't direct physical environmental impact associated. EJ CE's are also more stringent because EJ encompasses decision-making that pertains to both disproportionate "benefits and burdens." Therefore, even if a project is environmentally beneficial, it may be disproportionately beneficial to predominantly white populations. For example, if all new greenways and pedestrian upgrades are scheduled for white neighborhoods, and there are no such beneficial projects in predominantly African American neighborhoods, this may be an environmental justice consideration. Table 3.3.2.B details the likely categorical exclusion determination for each project on the RVTPO Draft of Financially Constrained List of Projects. Table 3.3.2.C details the references for such determinations. CE determinations were based upon federal policy for CE's, and on Washington State DOT's guidelines for EJ categorical exclusions (Washington State DOT, 2016).

Table 3: RVTPO 2040 Categorical Exclusions

Project	Categorical Exclusion?
Road/ Highway/ Interstate Projects	
Valley View Boulevard Extension	Unlikely to qualify for CE, depends on size and EJ populations in area
Jefferson St - Elm to McClanaham (road diet)	Potentially qualifies for CE, depends on size and EJ populations in area
East Main Street Phase II - Brand Ave. to Kessler Mill	Potentially qualifies for CE, depends on size and EJ populations in area
East Main Street/ Downtown Salem Streetscape	Likely CE, especially if streetscape is within existing right-of-way limits
Airport Road/ Route 118 Tunnel Rehabilitation	Likely CE, because counts as "roadway surface replacement or repair … that does not expand the existing wearing surface"

Auxiliary Lane Projects	
I-81 Auxiliary Lane Projects	Likely CE, because counts as "construction of turning lanes and pockets or auxiliary lanes."
Studies	
Colonial Avenue Improvements- Brandon Ave to Winding Way (streetscape, C&G, sidewalk, widen 1-ln, drainage)	Likely CE, if it is just a study (because counts as "non-construction)
Bike/Pedestrian/ Transit Access Projects	
King St. – Gus Nicks to Orange (add turn lanes, C&G, sidewalk, bike lanes, drainage, reconstruct signal)	Likely CE, depends on amount of new infrastructure, and whether it would alter traffic or development patterns in EJ areas
Liberty Rd. - Burrell to Hollins (add turn lanes, C&G, sidewalk, bike lanes, drainage, reconstruct signal)	Likely CE, depends on amount of new infrastructure, and whether it would alter traffic or development patterns in EJ areas
Melrose/Salem Turnpike/Orange (dev. Of village ctrs., bike/ped impr, parking, drainage)	Likely CE, depends on amount of new infrastructure, and whether it would alter traffic or development patterns in EJ areas
Valley View Blvd. Transit Access/Pedestrian Improvements	Likely CE, depends on amount of new infrastructure, and whether it would alter traffic or development patterns in EJ areas
Bus Stop Accessibility	Likely CE, depends on amount of new infrastructure, and whether it would alter traffic or development patterns in EJ areas
Real Time Information System (short-term)	Yes, CE - because electronic system
Various Bus Stop Access Improvements/Enhancements	Yes CE - because counts as enhancement of existing infrastructure
Electric Road/419 & Brambleton to Postal Multimodal Improvements	Likely CE, depends on amount of new infrastructure, and whether it would alter traffic or development patterns in EJ areas
West Main Street Pedestrian Improvements – Phase II	Yes, CE for pedestrian and bikeways; but may need to check for disproportionate benefit to non EJ
Brambleton Avenue – Transit/Bike/Ped Improvements	Yes, CE for pedestrian and bikeways; but may need to check for disproportionate benefit to non EJ

Transit Facilities Projects	
Downtown Roanoke Intermodal Station	Depends on size and location
Carilion Transfer Facility	Depends on size and location
Crossroads Transfer Facility	Depends on size and location
Roanoke County Transfer Facilities (various)	Depends on size and location
Lewis Gale Transfer Facility	Depends on size and location
Downtown Salem Transfer Facility	Depends on size and location
VA Medical Center Transfer Facility	Depends on size and location
Transit Vehicles Projects	
Ongoing Bus Replacement and Rebuild Program	Yes CE for replacement of equipment in existing systems, but may need to check for disproportionate benefit to non EJ populations
Six (6) Additional Vehicles (short-term)	Yes CE for replacement of equipment in existing systems, but may need to check for disproportionate benefit to non EJ populations
Greenway Projects	
Mason Creek Greenway	Yes, CE for pedestrian and bikeways; but may need to check for disproportionate benefit to non EJ
Roanoke River Greenway from Rotary Park to Roanoke City Corporate Limit	Yes, CE for pedestrian and bikeways; but may need to check for disproportionate benefit to non EJ
Glade Creek Greenway, Phase II	Yes, CE for pedestrian and bikeways; but may need to check for disproportionate benefit to non EJ
Glade Creek Greenway, Phase III	Yes, CE for pedestrian and bikeways; but may need to check for disproportionate benefit to non EJ
Tinker Creek Trail Extension	Yes, CE for pedestrian and bikeways; but may need to check for disproportionate benefit to non EJ

ITS Projects	
Traffic signal improvements at Electric Road/419 & Brambleton Ave. (traffic & video control sensors, upgrade to LED lights)	Yes, CE

Table 4: EJ Categorical Exclusions Reference Table

Reference	CE Type	Description
Title 23, §771.117, 118	Non-construction activities	**EIS exclusions that may also be EJ exclusions:** ● Activities which do not involve or lead directly to construction, such as planning and research activities, grants for training; engineering to define the elements of a proposed action or alternatives.., federal-aid system revisions which establish classes of highways on the federal-aid highway system. ● Promulgation of rules, regulations, and directives. ● Planning and administrative activities which do not involve or lead directly to construction, such as: training, technical assistance and research; promulgation of rules, regulations, directives, or program guidance; approval of project concepts; engineering; and operating assistance to transit authorities to continue existing service or increase service to meet routine demand. ● Determination of payback.
Washington DOT Appendix L; Title 23, §771.117, 118	Utility installations	**Specifically EJ exclusions:** ● Utility installations and/or replacements within the existing right-of-way limits. **EIS exclusions that may be EJ exclusions:** ● Approval of utility installations along or across a transportation facility. ● Acquisition, installation, operation, evaluation, replacement, and improvement of discrete utilities and similar appurtenances (existing and new) within or adjacent to existing transportation right-of-way, such as: utility poles, underground wiring, cables, and information systems; and power substations and utility transfer stations.
Washington DOT Appendix L; Title 23, §771.117, 118	Pedestrian or bicycle	**Specifically EJ exclusions:** ● Installation of bicycle and pedestrian lanes, paths and facilities within existing right-of-way limits. **EIS exclusions that may be EJ exclusions:**

		● Construction of bicycle and pedestrian lanes, paths, and facilities. ● Acquisition, construction, maintenance, rehabilitation, and improvement or limited expansion of stand-alone recreation, pedestrian, or bicycle facilities, such as: a multi-use pathway, lane, trail, or pedestrian bridge; and transit plaza amenities.
Title 23, §771.117	Ridesharing	**EIS exclusions that may be EJ exclusions** ● Ridesharing activities.
Title 23, §771.117	Noise barriers	**EIS exclusions that may be EJ exclusions** ● The installation of noise barriers or alterations to existing publicly owned buildings to provide for noise reduction.
Washington DOT Appendix L Title 23, §771.117	Small installations with little to no land acquisition, or landscaping	**Specifically EJ exclusions:** ● New installation, replacement or repair of lighting, signs, signals, and other traffic control devices, informational signage/kiosks, and street furniture within existing right-of-way limits. **EIS exclusions that may be EJ exclusions:** ● Installation of fencing, signs, pavement markings, small passenger shelters, traffic signals, and railroad warning devices where no substantial land acquisition or traffic disruption will occur. ● Landscaping.
Title 23, §771.117. 118	Scenic easements	**EIS Exclusions that may be EJ exclusions** ● Acquisition of scenic easements. ● Acquisition or transfer of an interest in real property that is not within or adjacent to recognized environmentally sensitive areas (e.g., wetlands, non-urban parks, wildlife management areas) and does not result in a substantial change in the functional use of the property or in substantial displacements, such as: acquisition for scenic easements or historic sites for the purpose of preserving the site. This CE extends only to acquisitions and transfers that will not limit the evaluation of alternatives for future FTA-assisted projects that make use of the acquired or transferred property.
Title 23, §771.117, 118	Environmental restoration or pollution abatement	**EIS exclusions that may be EJ exclusions** ● Environmental restoration and pollution abatement actions to minimize or mitigate the impacts of any existing transportation facility (including retrofitting and construction of stormwater treatment systems to

		meet Federal and State requirements under sections 401 and 402. ● Activities designed to mitigate environmental harm that cause no harm themselves or to maintain and enhance environmental quality and site aesthetics, and employ construction best management practices, such as: noise mitigation activities; rehabilitation of public transportation buildings, structures, or facilities; retrofitting for energy or other resource conservation; and landscaping or re-vegetation.
Title 23, §771.117	Highway safety plan activities	**EIS exclusions that may be EJ exclusions** ● Activities included in the State's highway safety plan under 23 U.S.C. 402.
Title 23, §771.117	Federal land transfer	**EIS Exclusions that may be EJ exclusions** ● Transfer of Federal lands pursuant to 23 U.S.C. 107(d) and/or 23 U.S.C. 317 when the land transfer is in support of an action that is not otherwise subject to FHWA review under NEPA.
Washington DOT Appendix L Title 23, §771.117	Emergency repairs or replacements	**Specifically EJ exclusions:** ● Emergency repairs to maintain the structural integrity of a bridge or roadway and to remove landslide and rockslide material from travel lanes and shoulders. **EIS exclusions that may be EJ exclusions** ● The following actions for transportation facilities damaged by an incident resulting in an emergency declared by the Governor of the State and concurred in by the Secretary, or a disaster or emergency declared by the President pursuant to the Robert T. Stafford Act (42 U.S.C. 5121): (see §771.117 for details and time constraints after emergency, etc.)
Washington DOT Appendix L; Title 23, §771.117, 118	Actions within existing right-of-way, upgrades, continued existing service, Improvements to existing infrastructure and vehicles	**Specifically EJ exclusions**: ● Roadway surface replacement, overlays, shoulder treatments, pavement repair, seal coating, pavement grinding, and pavement marking, that do not expand the existing wearing surface; ● Repair or replacement of curb and gutter, sidewalks, and catch basins within the same location ● Construction of turning lanes and pockets, auxiliary lanes (for example, truck climbing acceleration and deceleration lanes), sidewalks and shoulder widening within existing right-of-way limits ● Bridge-painters and/ or bridge maintenance activities that do not require detours **EIS exclusions that may be EJ exclusions:**

		● Occurs within the existing right-of-way and in a manner that substantially conforms to the preexisting design, function, and location as the original (which may include upgrades to meet existing codes and standards as well as upgrades warranted to address conditions that have changed since the original construction); and (B) Is commenced within a 2-year period beginning on the date of the declaration. ● Projects, as defined in 23 U.S.C. 101, that would take place entirely within the existing operational right-of-way. Existing operational right-of-way refers to right-of-way that has been disturbed for an existing transportation facility or is maintained for a transportation purpose. This area includes the features associated with the physical footprint of the transportation facility ● Activities, including repairs, replacements, and rehabilitations, designed to promote transportation safety, security, accessibility and effective communication within or adjacent to existing right-of-way, such as: the deployment of Intelligent Transportation Systems and components; installation and improvement of safety and communications equipment, including hazard elimination and mitigation; installation of passenger amenities and traffic signals; and retrofitting existing transportation vehicles, facilities or structures, or upgrading to current standards ● Maintenance, rehabilitation, and reconstruction of facilities that occupy substantially the same geographic footprint and do not result in a change in functional use, such as: improvements to bridges, tunnels, storage yards, buildings, stations, and terminals; construction of platform extensions, passing track, and retaining walls; and improvements to tracks and railbeds. ● Assembly or construction of facilities that is consistent with existing land use and zoning requirements (including floodplain regulations) and uses primarily land disturbed for transportation use, such as: buildings and associated structures; bus transfer stations or intermodal centers; busways and streetcar lines or other transit investments within areas of the right-of-way occupied by the physical footprint of the existing facility or otherwise maintained or used for transportation operations; and parking facilities. ● Preventative maintenance, including safety treatments, to culverts and channels within and adjacent to transportation right-of-way to prevent damage to the transportation facility and adjoining property, plus any necessary channel work, such as restoring, replacing, reconstructing, and rehabilitating culverts and drainage

		pipes; and, expanding existing culverts and drainage pipes. ● Improvements to existing rest areas and truck weigh stations. ● Bus and rail car rehabilitation. ● Track and railbed maintenance and improvements when carried out within the existing right-of-way. ● Alterations to facilities or vehicles in order to make them accessible for elderly and handicapped persons. ● Modernization of a highway by resurfacing, restoration, rehabilitation, reconstruction, adding shoulders, or adding auxiliary lanes (including parking, weaving, turning, and climbing lanes), with constraints. ● Highway safety or traffic operations improvement projects, including the installation of ramp metering control devices and lighting, with constraints. ● Bridge rehabilitation, reconstruction, or replacement or the construction of grade separation to replace existing at-grade railroad crossings, with constraints.
Washington State DOT Appendix L	Safety Appurtenances	**Specifically EJ exclusions:** ● Installation, replacement, or repair of safety appurtenances including but not limited to guardrails, barriers, glare screens, rumble strips, snow and ice detectors and energy attenuators.
Title 23, §771.117	Purchases, rehabilitation, maintenance, etc. of vehicles or equipment, that can be accommodated within existing programs	**EIS exclusions that may be EJ exclusions:** ● The purchase of vehicles by the applicant where the use of these vehicles can be accommodated by existing facilities or by new facilities which themselves are within a CE. ● Purchase and installation of operating or maintenance equipment to be located within the transit facility and with no significant impacts off the site. ● Purchase, construction, replacement, or rehabilitation of ferry vessels (including improvements to ferry vessel safety, navigation, and security systems) that would not require a change in the function of the ferry terminals and can be accommodated by existing facilities or by new facilities which themselves are within a CE. ● Rehabilitation or reconstruction of existing ferry facilities that occupy substantially the same geographic footprint, do not result in a change in their functional use, and do not result in a substantial increase in the existing facility's capacity. Example actions include work on pedestrian and vehicle transfer structures and associated utilities, buildings, and terminals. ● Acquisition, installation, rehabilitation, replacement, and maintenance of vehicles or equipment, within or accommodated by existing facilities, that does not result

		in a change in functional use of the facilities, such as: equipment to be located within existing facilities and with no substantial off-site impacts; and vehicles, including buses, rail cars, trolley cars, ferry boats and people movers that can be accommodated by existing facilities or by new facilities that qualify for a categorical exclusion.
Title 23, §771.117	Development of facilities on, above, or adjacent to existing transit facilities that do not substantially enlarge those facilities	**EIS exclusions that may be EJ exclusions:** ● Development of facilities for transit and non-transit purposes, located on, above, or adjacent to existing transit facilities, that are not part of a larger transportation project and do not substantially enlarge such facilities, such as: police facilities, daycare facilities, public service facilities, amenities, and commercial, retail, and residential development.
Title 23, §771.117	Electronics to improve efficiency, safety, security, or convenience	**EIS exclusions that may be EJ exclusions:** ● Deployment of electronics, photonics, communications, or information processing used singly or in combination, or as components of a fully integrated system, to improve the efficiency or safety of a surface transportation system or to enhance security or passenger convenience.
Title 23, §771.117, 118	Federally funded projects that meet CE requirements	**EIS Exclusions that may be EJ exclusions:** ● That receive less than $5,000,000 of Federal funds; or ● With a total estimated cost of not more than $30,000,000, and Federal funds comprising less than 15 percent of the total estimated project cost (as adjusted annually by the Secretary to reflect any increases in the Consumer Price Index prepared by the Department of Labor, see *www.fhwa.dot.gov* or *www.fta.dot.gov*).
Title 23, §771.117	Geotechnical, archaeological investigation, surveys	**EIS Exclusions that may be EJ exclusions:** ● Localized geotechnical and other investigation to provide information for preliminary design and for environmental analyses and permitting purposes, such as drilling test bores for soil sampling; archeological investigations for archeology resources assessment or similar survey; and wetland surveys.
Title 23, §771.118	Bridge removal	**EIS Exclusions that may be EJ exclusions:** ● Bridge removal and bridge removal related activities, such as in-channel work, disposal of materials and debris in accordance with applicable regulations, and transportation facility realignment.
Title 23, §771.117, 118	After Administration approval and	**EIS Exclusions that may be EJ exclusions:** ● Additional actions which meet the criteria for a CE in the CEQ regulations (40 CFR 1508.4) and paragraph (a)

	documentation, Additional actions which meet the criteria for a CE in the CEG regulations (40 CFR 1508.4) (These **may** qualify for a CE, but require approval first).	of this section may be designated as CEs only after Administration approval unless otherwise authorized under an executed agreement pursuant to paragraph (g) of this section. The applicant shall submit documentation which demonstrates that the specific conditions or criteria for these CEs are satisfied and that significant environmental effects will not result. Examples of such actions include but are not limited to: ● Transportation corridor fringe parking facilities, ● Construction of new truck weigh stations or rest areas. ● Approvals for disposal of excess right-of-way or for joint or limited use of right-of-way, where the proposed use does not have significant adverse impact, ● Approvals for changes in access control., ● Construction of new bus storage and maintenance facilities in areas used predominantly for industrial or transportation purposes where such construction is not inconsistent with existing zoning and located on or near a street with adequate capacity to handle anticipated bus and support vehicle traffic. ● Rehabilitation or reconstruction of existing rail and bus buildings and ancillary facilities where only minor amounts of additional land are required and there is not a substantial increase in the number of users. ● Construction of bus transfer facilities (an open area consisting of passenger shelters, boarding areas, kiosks and related street improvements) when located in a commercial area or other high activity center in which there is adequate street capacity for projected bus traffic. ● Construction of rail storage and maintenance facilities in areas used predominantly for industrial or transportation purposes where such construction is not inconsistent with existing zoning and where there is no significant noise impact on the surrounding community. ● Acquisition of land for hardship or protective purposes. Hardship and protective buying will be permitted only for a particular parcel or a limited number of parcels. These types of land acquisition qualify for a CE only where the acquisition will not limit the evaluation of alternatives, including shifts in alignment for planned construction projects, which may be required in the NEPA process. No project development on such land may proceed until the NEPA process has been completed. ● Modernization of a highway by resurfacing, restoring, rehabilitating, or reconstructing shoulders or auxiliary lanes (e.g., lanes for parking, weaving, turning, climbing);

		• Bridge replacement or the construction of grade separation to replace existing at-grade railroad crossings; • Acquisition of right-of-way. No project development on the acquired right-of-way may proceed until the NEPA process for such project development, including the consideration of alternatives, has been completed. • Facility modernization through construction or replacement of existing components; • Minor transportation facility realignment for rail safety reasons, such as improving vertical and horizontal alignment of railroad crossings, and improving sight distance at railroad crossings; • Modernization or minor expansions of transit structures and facilities outside existing right-of-way, such as bridges, stations, or rail yards.

3.3.2.3 Documentation of all federal and state requirements and guidelines for environmental justice

The following table shows the current constraints on Roanoke for Environmental Justice Evaluations. The constraints outlined in the table are based upon discussions with the Director of Transportation Planning Organization Programs for the Roanoke Valley Alleghany Regional Commission. These constraints help planners answer questions in the Benefits and Burdens matrix, to help them select assessment models to use, given the context and capacity available.

Table 5: Constraints on Environmental Justice Assessments for Roanoke, VA

Measure	Constraint	Notes
# Staff devoted to public participation & environmental justice initiatives	# Staff devoted to public participation & environmental justice initiatives	"equivalent" = combined work of multiple staff members
# Hours per year devoted to public participation and EJ initiatives	1,275 hours per year	Calculation based on an average of 1700 hours worked per year per staff member (1800 for new hires, 1600 for those with more vacation time built up) x 0.75 of a worker

Prominence of EJ framework in work programs	The EJ framework cannot currently be a standalone initiative, but must instead be streamlined with other project assessments within the existing TPO work program	There are a number of assessments for each transportation project (safety, financing, durability, social perception, etc). EJ assessments are critical, but realistically, will be one of many assessments, and not the sole deciding factor.
Funding Available for EJ Assessments	Less than $5000 per fiscal year	Anything above $5000 would need to be funded by an outside grant, which is possible, but Roanoke does not currently have relationships with foundations for such purposes.

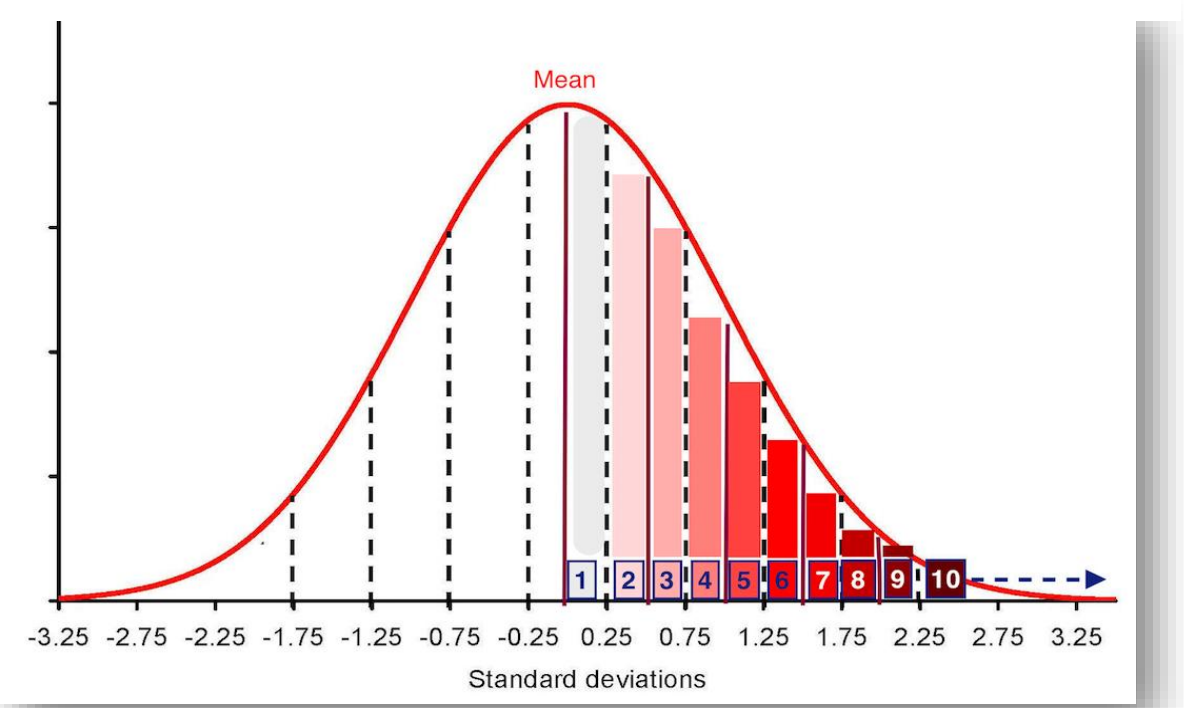
Source: Mark McCaskill, Director of Transportation Planning Organization Programs. Roanoke Valley Alleghany Regional Commission. Personal Interview. May 2014.

3.3.3: EEJAT 2016 EJ Index

The following tables and maps provide an overview of the EEJAT 2016 EJ Index, which is the first step of the EEJAT 2016. The purpose of the EJ Index is to calculate, map, and "highlight" the block groups in the region that have a high prevalence of EJ populations. Transportation planners can then use ArcGIS to "overlay" planned transportation projects on a map of EJ scores for the region, and be prompted to conduct especially thorough EJ analysis in areas with high EJ scores. This thorough EJ analysis is conducted through the next steps in the EEJAT 2016 toolkit, the Benefits and Burdens Instrument and the Project Impact Assessment. Through this project, this first step of EEJAT 2016, the EJ Index, has already been completed for the Roanoke Region, enabling planners to more quickly and feasibly utilize the later steps of the EEJAT 2016 assessment for the 2016 Long Range Transportation Plan. Other municipalities using the EEJAT 2016 toolkit can use Roanoke's EJ Index as an example or guide, but will need to conduct customized demographic analysis towards an EJ Index that represents their region.

As described earlier in this report, the EEJAT 2016 EJ Index differs significantly from other EJ Index models including Roanoke's 2005 framework partly because the EEJAT 2016 EJ Index employs standard deviations and z-scores to assign EJ "points" rather than employing linear scoring. This helps to ensure that the EJ points assigned to each block group are statistically representative of the population therein. The EEJAT 2016 EJ Index is also notably different from other indexes because it assigns an additional point for each 0.25 standard deviation above the mean, rather than assigning points only when populations are monumental 100% or 200% above the regional average. These quarter standard deviations lend sensitivity to the scoring system,

Figure 4: EJ Index Scoring System



which helps to ensure that differences between block groups are more thoroughly accounted for. The figure below provides a visualization of the EJ Index scoring system. One EJ point is given for each 0.25 standard deviations above the regional average. The maximum number of points for each EJ demographic is 10. Because there are six EJ demographics measured (Poverty, Minority,

LEP, Hispanic, Elderly, and Disabled), the maximum number of EJ points that a block group can receive is 60. Higher points indicate higher concentration of protected populations within a block group. For example, if a block group had a minority population that had a z-score of 2.25 (i.e., at 2.25 standard deviations above the regional average), that block group would be assigned a EJ Minority Score of 10. If that same block group had a z-score of 1.5 for Poverty (6 points), 0.5 for Disability (3 points), 2.0 for LEP (9 points), 2.5 for Hispanic (10 points), and 1.25 for Elderly (6 points), that block group would have a total EJ score of 44 out of 60 possible points. The ratio between the given points and possible points is not as important as the ratio between the given points of block groups in relation to each other. No block groups in the RVTPO reach the full 60 points. However, there are block groups, especially in the central Roanoke City area that have EJ Scores that are significantly higher than block groups in the wealthier county areas.

The tables and maps below show the EJ Index for the RVTPO. The EJ Index is divided into the Core EJ Index (Poverty, Minority, LEP, and Hispanic) and the Immobility Index (Elderly and Disability). The Core EJ Index is named such because it consists of populations that are specifically identified as EJ populations by federal policy. Both EJ Index components are combined for the Cumulative EJ Index. The purpose of the separation between the Core EJ Index and Immobility Index is to enable planners to see layers that may be more relevant for particular projects. For example, a population of wealthy, predominantly white, elderly people may have different needs and potential disproportionate burdens than a community of low-income or minority residents. All projects should take into consideration the Cumulative EJ Index, but for some projects, it may be instructive to see each “layer” of the EJ Index individually.

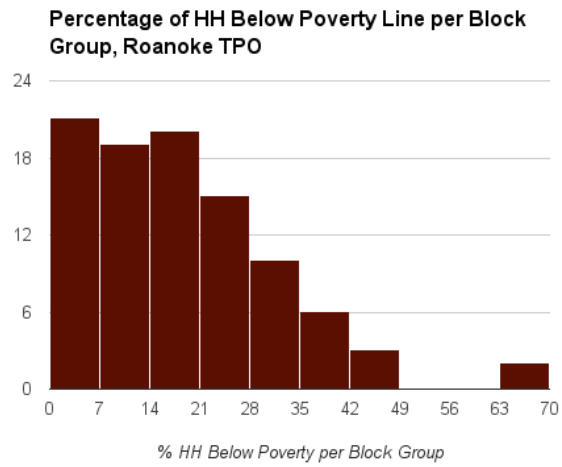
Below, each component of the EJ Index (Poverty, Minority, LEP, Hispanic, Elderly, and Disability) is shown with a table, graph, and at least one ArcGIS map. The table for each component includes the regional (MPO) average, the block group count, the minimum percentage of the demographic in the region, the maximum percentage of the demographic in the region, the standard deviation for the region, the 0.25 standard deviation (because points are assigned by 0.25 standard deviation), the number of block groups with each EJ Score for the demographic, and the calculations for those EJ Scores. The Arc GIS maps below each table show a visualization of the EJ Scores for that particular demographic. In these maps, darker colors indicate a higher EJ score. In this EJ Index, red represents Poverty, blue represents Minority, teal represents LEP, dark blue represents Hispanic, purple represents Core EJ Index (blue + red), lavender represents Elderly, yellow represents Disabled, and black represents the Cumulative EJ Index.

3.3.3.1: Core EJ Index

Table 6: EJ Index: Core EJ Index: Poverty

EJ Index: Core EJ Index: Poverty (Percentage of HH Below Poverty Line per Block Group)

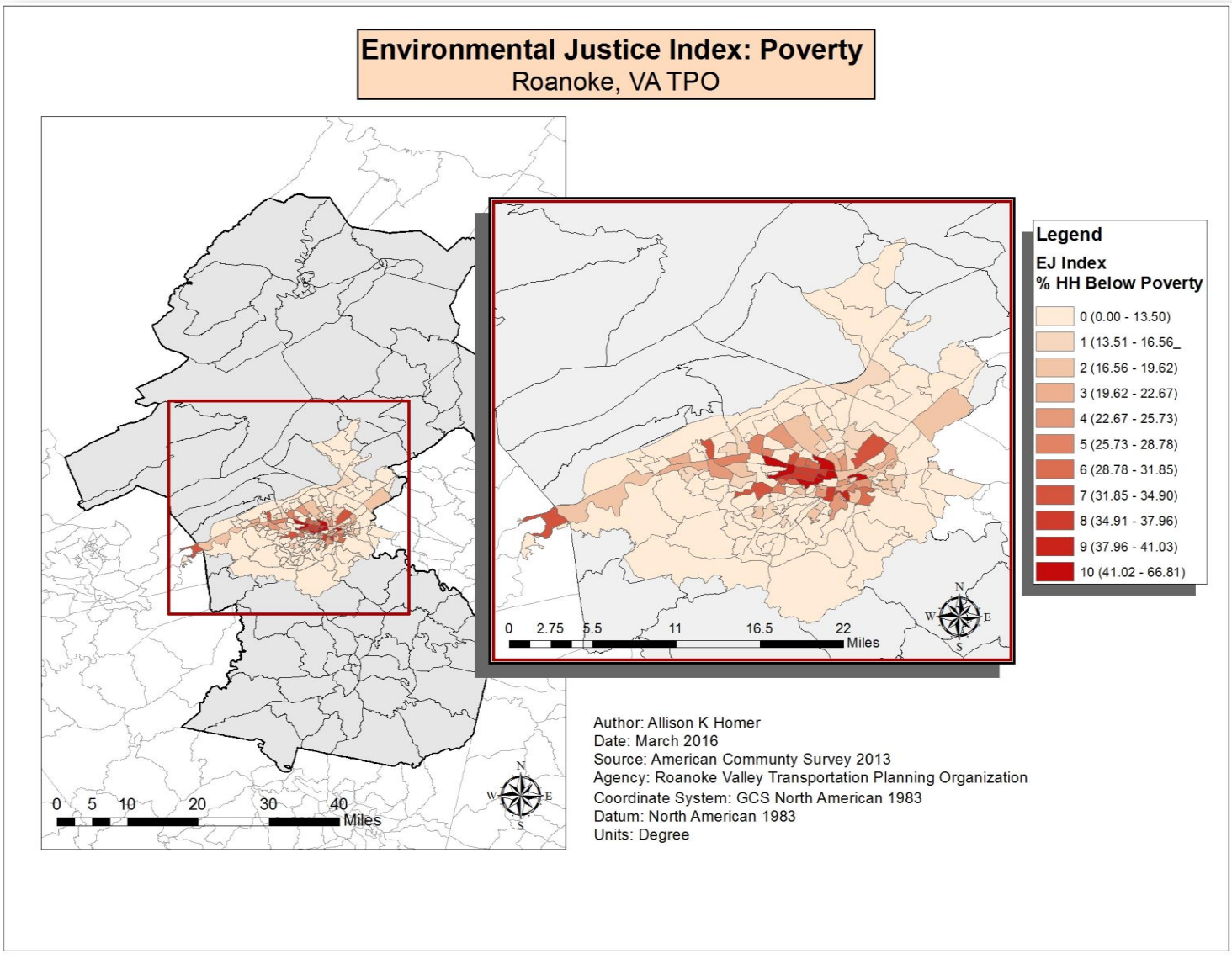
Regional Average 2016	13.5%
Block Group Count	96
Minimum	0%
Maximum	66.8%
Standard Deviation	12.23
0.25 Standard Deviation	3.05



Calculation	Percentage of HH Under Pov Line	Block Group Count	EJ Score
0 - mean	0 - 13.5%	**38**	**0**
(mean - z=0.25)	13.5%- 16.56%	**12**	**1**
(z = 0.25 - 0.50)	16.57%- 19.62%	**8**	**2**
(z = 0.50 - 0.75)	19.63%- 22.67%	**6**	**3**
(z = 0.75 - 1.00)	22.68- 25.73%	**7**	**4**
(z = 1.00 - 1.25)	25.74- 28.78%	**5**	**5**
(z = 1.25 - 1.50)	28.78 - 31.85%	**4**	**6**
(z = 1.50 - 1.75)	31.85%- 34.90	**4**	**7**
(z = 1.75 - 2.00)	34.91- 37.96	**4**	**8**
(z = 2.00 - 2.25)	37.97- 41.028	**1**	**9**
(z = 2.25 +)	Above 41.028	**6**	**10**

Figure 5: EJ Index: Core EJ Index: Poverty

The Poverty layer of the Environmental Justice Index for the RVTPO shows a concentration of the highest EJ scores in the central Roanoke City area, where six block groups the highest possible EJ score of 10 (41.02- 66.81% of households below the poverty line). The surrounding county,



however, shows much lower EJ scores for poverty, with the vast majority of block groups (38) receiving a score of 0 for poverty (0.0- 13.5% of households below the poverty line).

Figure 6: Poverty Reference Maps

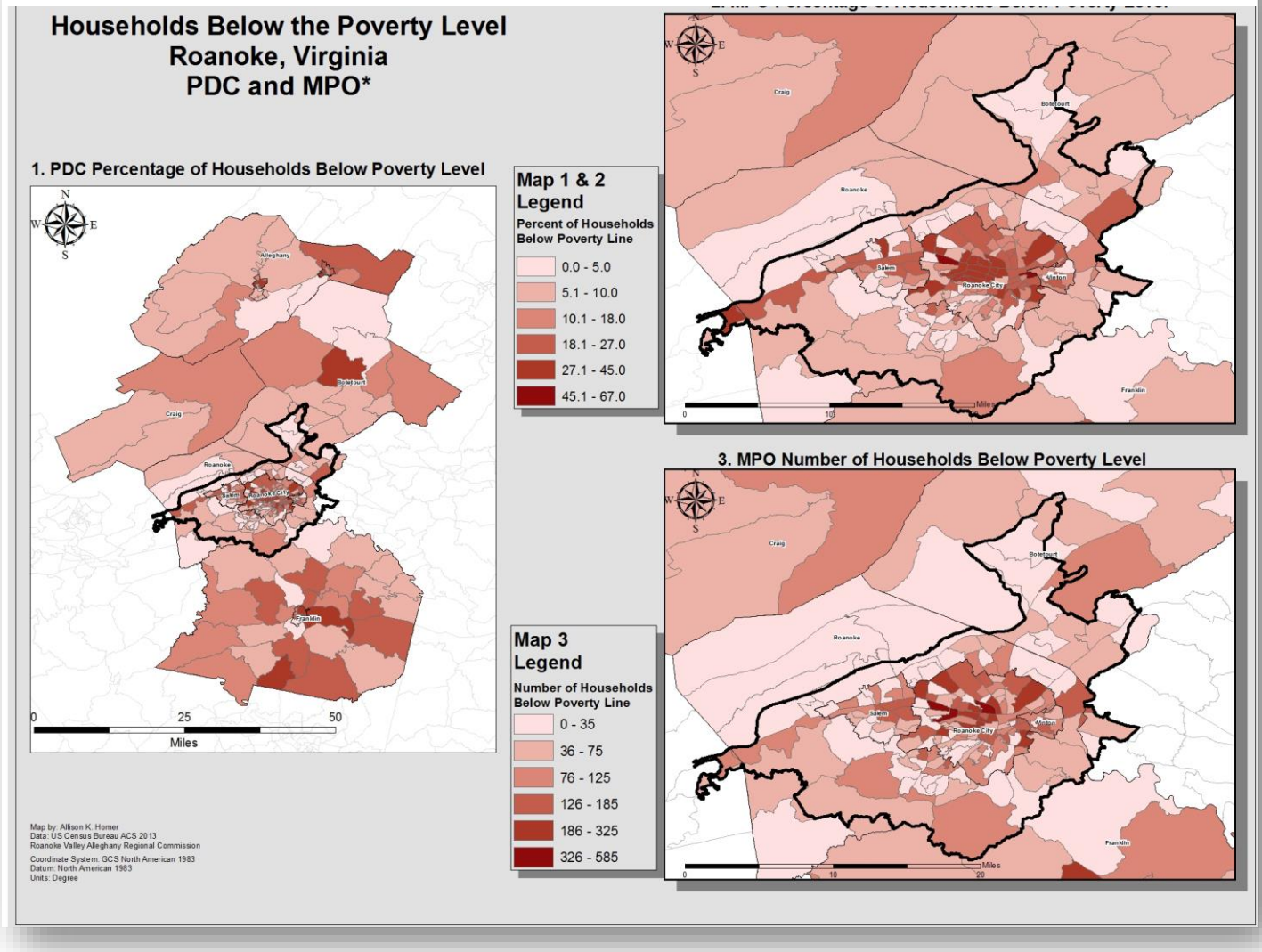


Figure 6 shows poverty for the entire PDC portrayed both by number and percentage of households below poverty level. This map is provided for reference, to show how mapping according to z-score based EJ score portrays a slightly different distribution that follows the same general pattern.

Table 7 : EJ Index: Core EJ Index: Minority

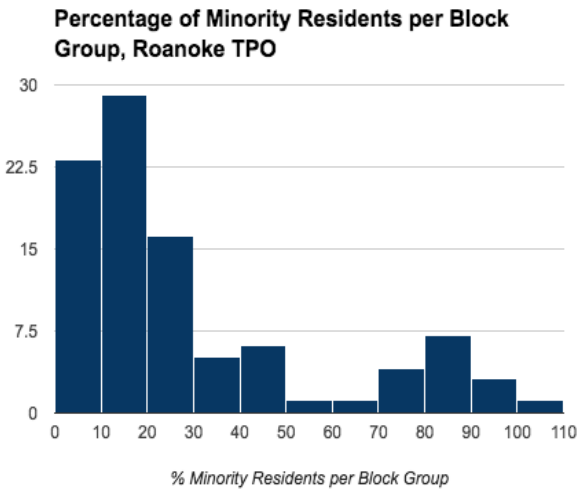
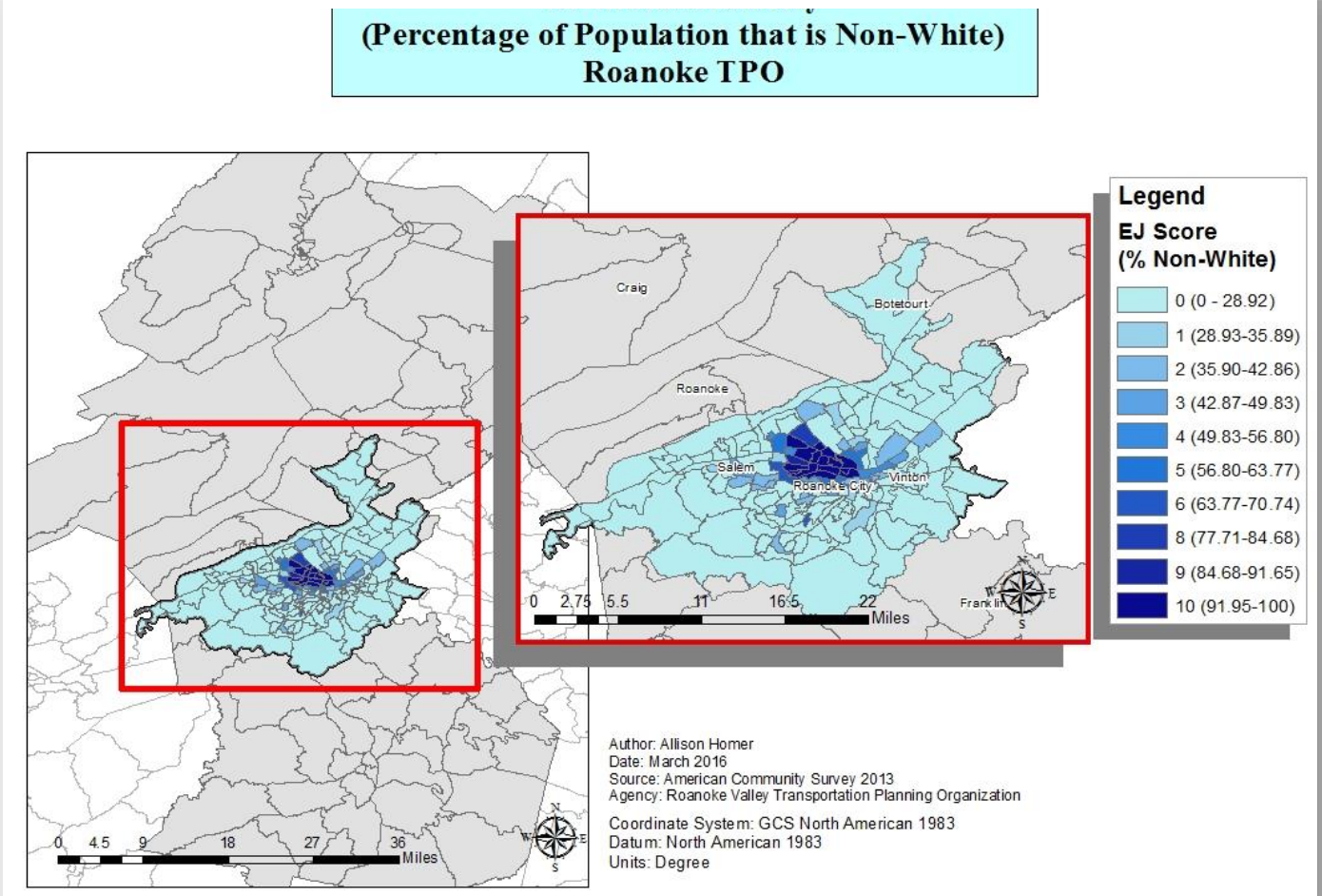
EJ Index: Core EJ Index: Minority						
Regional Average 2016	28.92		**Calculation**	**Percentage Minority**	**Block Group Count**	**EJ Score**
Block Group Count	96		**0 - mean**	0 - 28.92	67	**0**
Minimum	0		**(mean - z=0.25)**	28.93 - 35.89	4	**1**
Maximum	100		**(z = 0.25 - 0.50)**	35.90-42.86	5	**2**
Standard Deviation	27.89		**(z = 0.50 - 0.75)**	42.87-49.83	3	**3**
0.25 Standard Deviation	6.97		**(z = 0.75 - 1.00)**	49.83-56.80	0	**4**
			**(z = 1.00 - 1.25)**	56.80-63.77	1	**5**
			(z = 1.25 - 1.50)	63.77-70.74	2	**6**
			(z = 1.50 - 1.75)	70.74-77.71	1	**7**
			(z = 1.75 - 2.00)	77.71-84.68	4	**8**
			(z = 2.00 - 2.25)	84.68-91.65	6	**9**
			(z = 2.25 +)	91.65+	3	**10**

Figure 7: EJ Index: Core EJ Index: Minority



The minority layer of the EJ Index shows generally the same pattern as the poverty layer, with the block groups with the highest EJ scores clustering in the Roanoke City center. Three block groups hold an EJ score of 10 (91.95-100% non-white), and six hold an EJ score of 9 (94.68-91.65% non-white). This means that these block groups were over 2.0 standard deviations above the regional average. In the county, by contrast, 67 block groups hold a minority EJ score of 0 (0-28.92% non-white). Notice that there is a much higher number of block groups with a 0 minority score than block groups with a 0 poverty score (67 compared to 38), indicating low overall diversity in the MPO outside of the city, and a prevalence of white poverty.

Figure 8: Minority Reference Maps

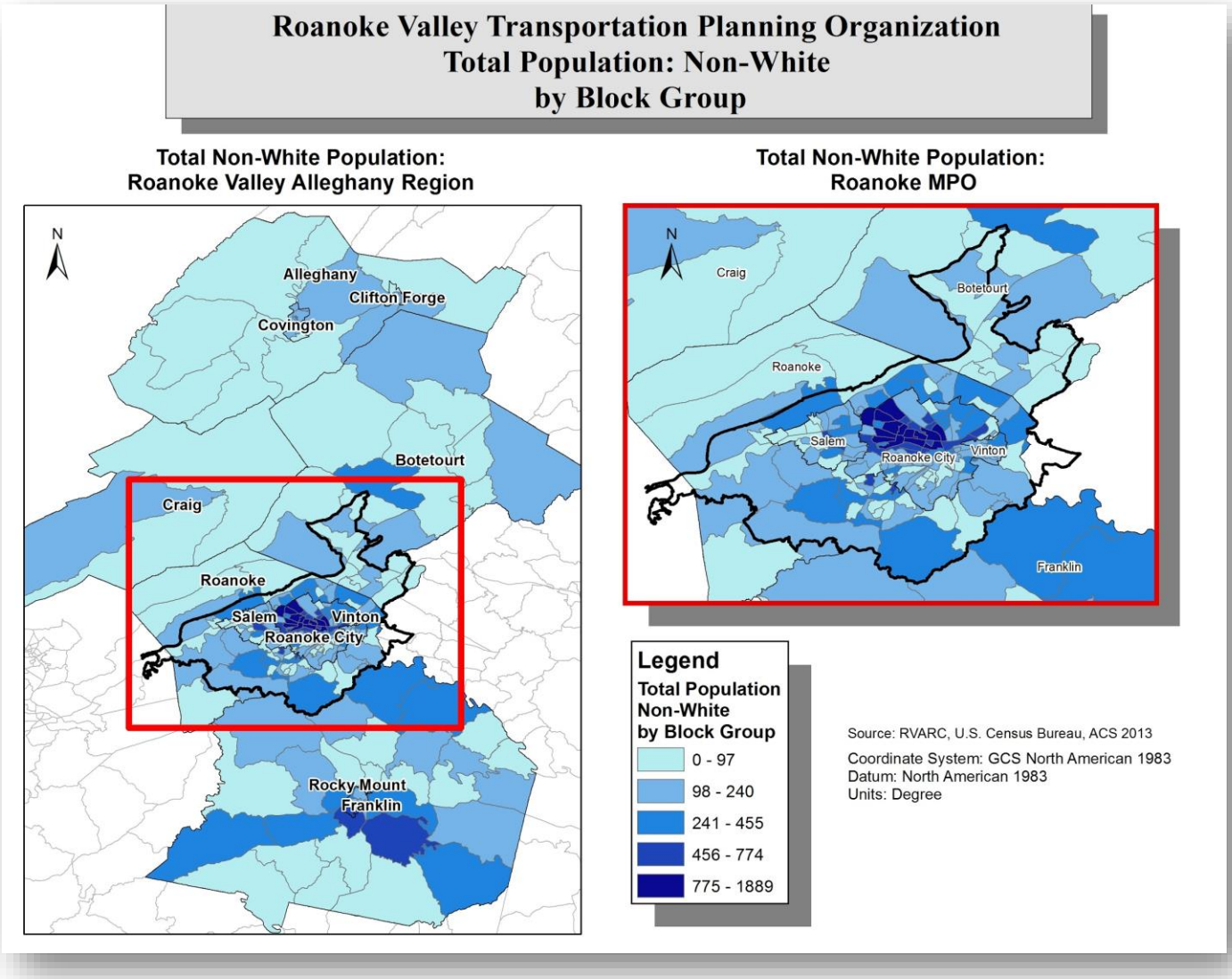
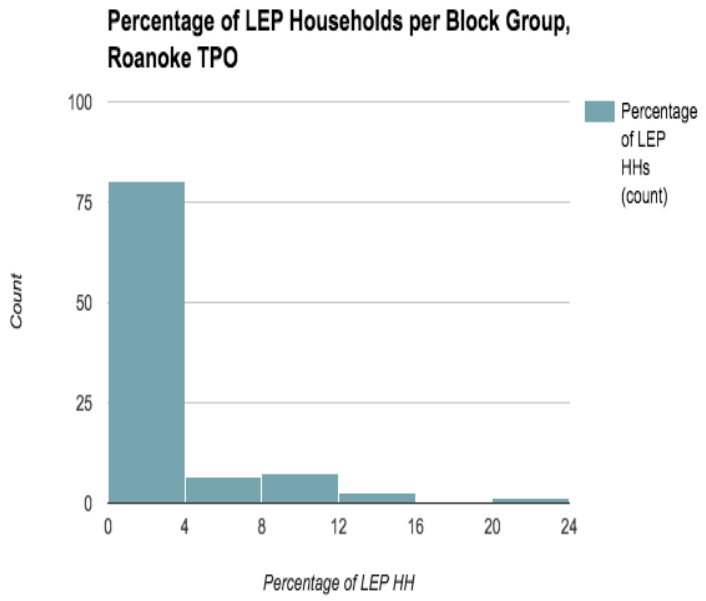


Figure 8 shows, for reference, minority mapped according to numbers of people classified as minority per block group. Like the poverty reference map, this shows a different representation of the data, but generally aligns with the patterns shown in the EJ Index, with the highest prevalence of minorities located in the city center.

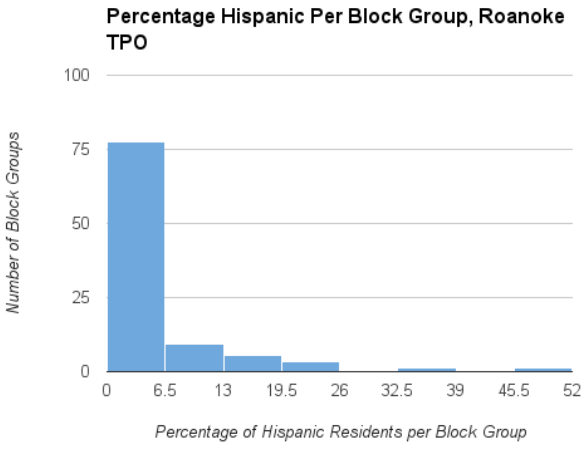
Table 8: EJ Index: Core EJ Index: LEP

EJ Index: Core EJ Index: LEP (Perc LEP HH per Block Group)						
Regional Average 2016	2.16		**Calculation**	**Percentage LEP HHs**	**Block Group Count**	**EJ Score**
Block Group Count	96		**0 - mean**	0 - 2.16	69	**0**
Minimum %	0		**z= 0 - 0.25**	2.17 - 3.18	6	**1**
Maximum %	23.95% (176 HH)		**z = 0.25 - 0.50**	3.19 - 4.19	5	**2**
Standard Deviation	4.07		**z = 0.50 - 0.75**	4.20 - 5.21	2	**3**
0.25 Standard Deviation	1.02		**z = 0.75 - 1.00**	5.22 - 6.22	0	**4**
			**z = 1.00 - 1.25**	6.23 - 7.24	2	**5**
			z = 1.25 - 1.50	7.25 - 8.26	3	**6**
			z = 1.50 - 1.75	8.27 - 9.27	3	**7**
			z = 1.75 - 2.00	9.28 - 10.29	1	**8**
			z = 2.00 - 2.25	10.29 - 11.31	1	**9**
			(z = 2.25 +	11.31 +	4	**10**

The LEP layer of the EJ Index shows a pattern that aligns with the minority layer, with 4 block groups in the city center showing an EJ score of 10 (11.31+ % LEP), and the vast majority of block groups (69) showing an EJ score of 0 (0 - 2.16% LEP). It is important to note here how much lower the percentages of LEP per EJ point are in comparison to the percentages of poverty per EJ

point. This is because LEP is overall much less prevalent in the region (max of 23% per block group, with a regional average of only 2.16% LEP). If points on the EJ Index were assigned linearly rather than according to standard deviation to enable matching EJ score rubrics for poverty, minority, and LEP, LEP populations would be almost entirely eliminated from the map. This would erroneously tie lower prevalence in the region to lower importance of LEP populations in EJ assessment. An LEP neighborhood that is displaced by transportation projects is just as important as an impoverished neighborhood facing the same, regardless of how common or uncommon each type of neighborhood is.

Table 9: EJ Index: Core EJ Index: Hispanic

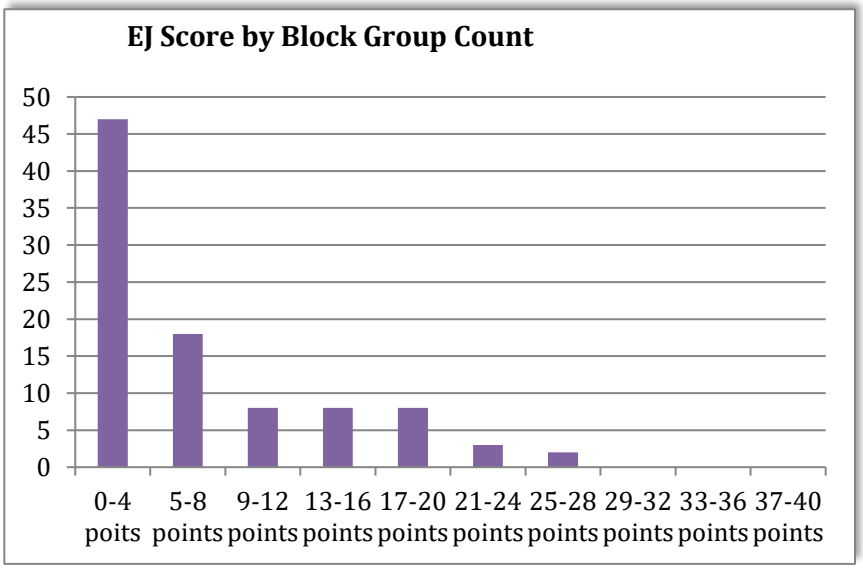
EJ Index: Core EJ Index: Hispanic (Percentage Hispanic by Block Group)						
MPO Average 2016	4.28		**Calculation**	**%Hispanic**	**Block Group Count**	**EJ Score**
Block Group Count	96		**0 - mean**	0.00 - 4.28	**70**	**0**
Minimum	0		**(mean - z=0.25)**	4.29 - 6.25	**6**	**1**
Maximum	51.051		**(z = 0.25 - 0.50)**	6.26 - 8.22	**5**	**2**
Standard Deviation	7.87		**(z = 0.50 - 0.75)**	8.23 - 10.19	**2**	**3**
0.25 Standard Deviation	1.97		**(z = 0.75 - 1.00)**	10.20 - 12.16	**2**	**4**
			**(z = 1.00 - 1.25)**	12.17 - 14.13	**2**	**5**
			(z = 1.25 - 1.50)	14.14 - 16.10	**2**	**6**
			(z = 1.50 - 1.75)	16.11 - 18.07	**2**	**7**
			(z = 1.75 - 2.00)	18.08-20.04	**0**	**8**
			(z = 2.00 - 2.25)	20.05 - 22.01	**3**	**9**
			(z = 2.25 +)	22.02 +	**2**	**10**

In this Hispanic layer of the EJ Index we see again the same general pattern, with the core EJ block groups located in the city center. However, the Hispanic EJ population appears to be less prevalent

than the Minority or Poverty layers, with two block groups receiving a score of 10 points (22.02% + Hispanic). A score of 10 indicates that these block groups were over 2.25 standard deviations above the regional average. The number of block groups with an EJ score of zero is also higher than other Core EJ layers, with 70 block groups having populations that are 0.0-4.28% Hispanic. Hispanic is the only ethnicity measured by the Census, but this does not mean that it is more important than other ethnicities in the Roanoke region that should be considered for EJ. For example, considering Roanoke's high presence of refugee populations, there should be an analysis done of the locations and transit access of these populations in the near future.

Table 10: Cumulative Core EJ Index

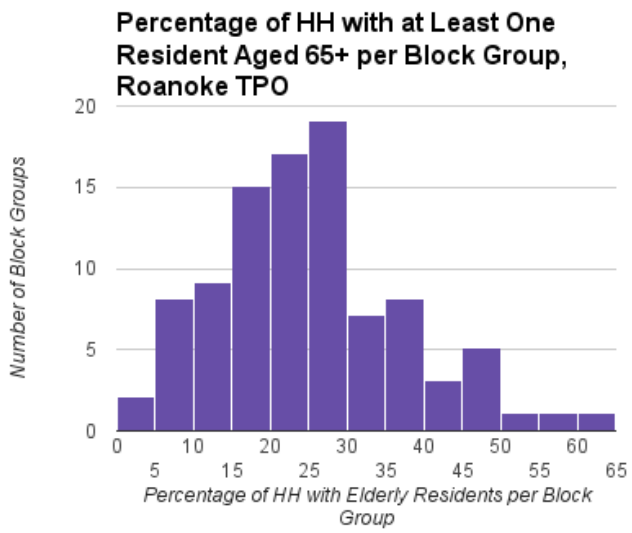
Cumulative CORE EJ Index		
Calculation	**Block Group Count**	**EJ Score**
Poverty Score + Minority Score + LEP Score + Hispanic Score (z = 2.25 +)	47	**0-4**
	18	**5-8**
	8	**9-12**
	8	**13-16**
	8	**17-20**
	3	**21-24**
	2	**25-28**
	0	**29-32**
	0	**33-36**
	0	**37-40**



In the Cumulative Core EJ Index, we see a distribution skewed to the right, with the majority (47) of block groups receiving a combined Core EJ score of 0-4. This means that those block groups received on average less than one EJ point per Core EJ Index layer. The maximum score possible for the Core EJ Index is 40 (a score of 10 for each Core EJ Index layer), which would indicate extremely high presence of "disadvantaged" populations. No block groups have the highest Core EJ score possible, but 13 block groups received notably high scores of 17-28. This means that transportation planners must take extra caution, conduct even more thorough EJ analysis, and strive to provide EJ benefits in these block groups, because there is risk of disproportionately burdening or denying benefit to populations that include high proportions of minority, impoverished, LEP, and Hispanic populations.

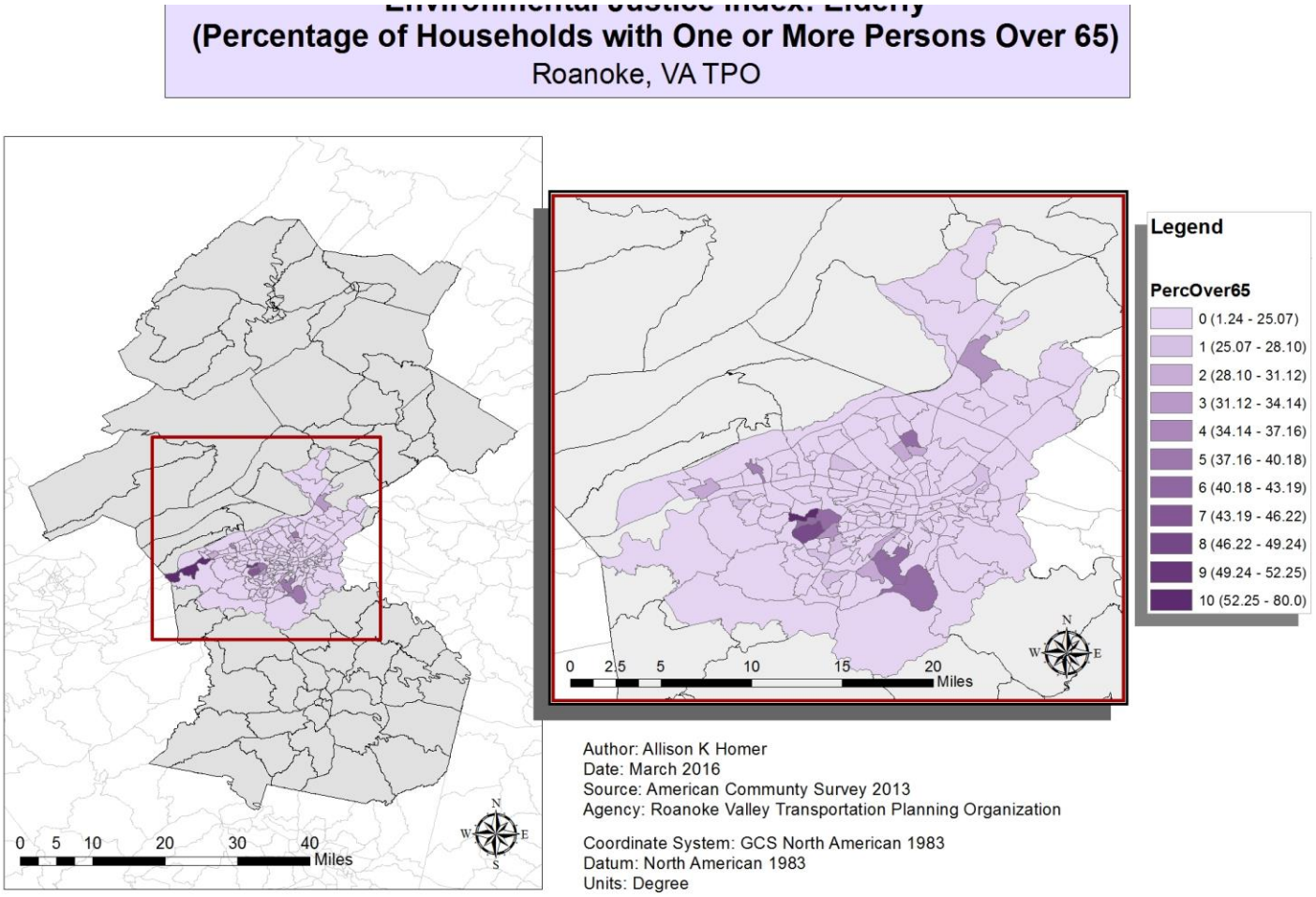
3.3.3.2: Immobility Index

Table 11: EJ Index: Immobility Index: Elderly

EJ Index: Immobility Index: Elderly (Percentage of HH with one or more residents above 65)						
MPO Average 2016	25.07		**Calculation**	**Percentage Elderly**	**Block Group Count**	**EJ Score**
Block Group Count	96		**0 - mean**	0 - 25.07	**53**	**0**
Minimum %	3.04		**(mean - z=0.25)**	25.08 - 28.09	**10**	**1**
Maximum %	62.56		**(z = 0.25 - 0.50)**	28.10-31.11	**8**	**2**
Standard Deviation	12.06		**(z = 0.50 - 0.75)**	31.12-34.13	**4**	**3**
0.25 Standard Deviation	3.02		**(z = 0.75 - 1.00)**	34.14-37.15	**6**	**4**
			**(z = 1.00 - 1.25)**	37.16-40.17	**3**	**5**
			(z = 1.25 - 1.50)	40.18-43.19	**2**	**6**
			(z = 1.50 - 1.75)	43.20 - 46.21	**2**	**7**
			(z = 1.75 - 2.00)	46.22 - 49.23	**4**	**8**
			(z = 2.00 - 2.25)	49.24-52.25_	**0**	**9**
			(z = 2.25 +)	52.25 +	**3**	**10**

The "elderly" layer of the EJ Index shows a very different picture than any of the Core EJ Index layers, reinforcing the idea that the Core EJ Index and Immobility EJ Index should be visualized separately. There are clusters of elderly populations to the South and Southwest of the city, and

Figure 9: EJ Index: Immobility Index: Elderly



in the far North of the MPO. These block groups should be focused on for projects that pertain especially to elderly populations, such as accessible transit options.

Table 12: EJ Index: Immobility Index: Disability

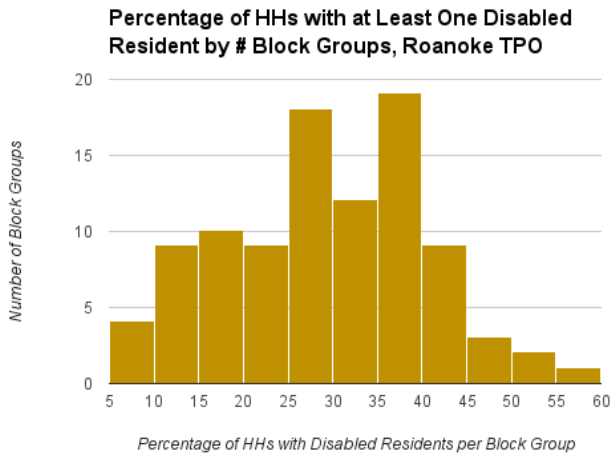
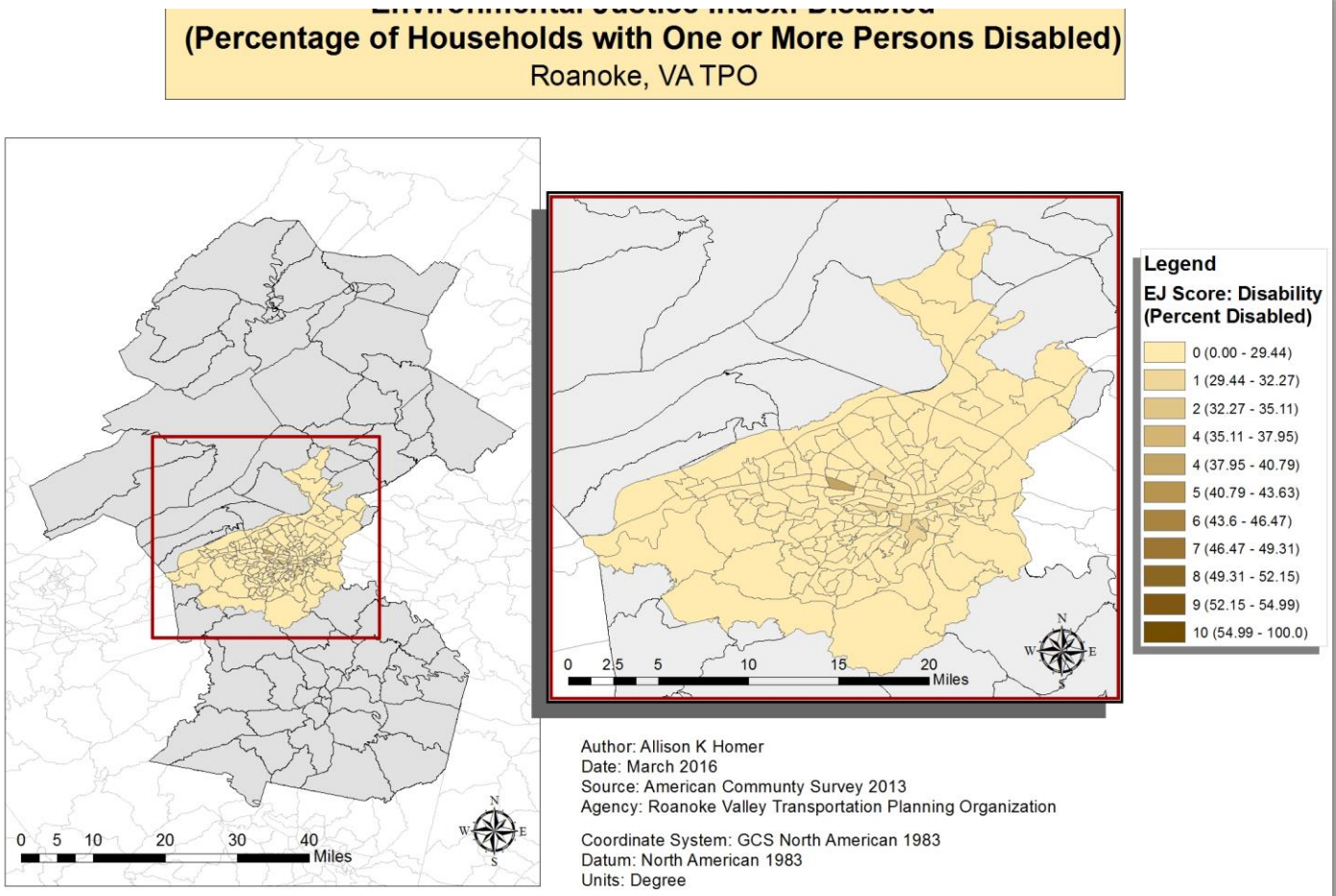
EJ Index: Immobility Index: Disability (Percentage of HHs per block group w/ at least one Disabled Resident)						
MPO Average 2016	29.43		**Calculation**	**% HH**	**Block Group Count**	**EJ Score**
Block Group Count	96		**0 - mean**	0 - 29.43	48	**0**
Minimum	5.41		**(mean - z=0.25)**	29.44 - 32.27	7	**1**
Maximum	57.14		**(z = 0.25 - 0.50)**	32.27-35.11	7	**2**
Standard Deviation	11.34		**(z = 0.50 - 0.75)**	35.12-37.95	8	**3**
0.25 Standard Deviation	2.84		**(z = 0.75 - 1.00)**	37.95-40.79	12	**4**
			**(z = 1.00 - 1.25)**	40.80-43.63	6	**5**
			(z = 1.25 - 1.50)	43.64-46.47	2	**6**
			(z = 1.50 - 1.75)	46.47-49.31	1	**7**
			(z = 1.75 - 2.00)	49.31-52.15	1	**8**
			(z = 2.00 - 2.25)	52.15-54.99	2	**9**
			(z = 2.25 +)	55.00+	1	**10**

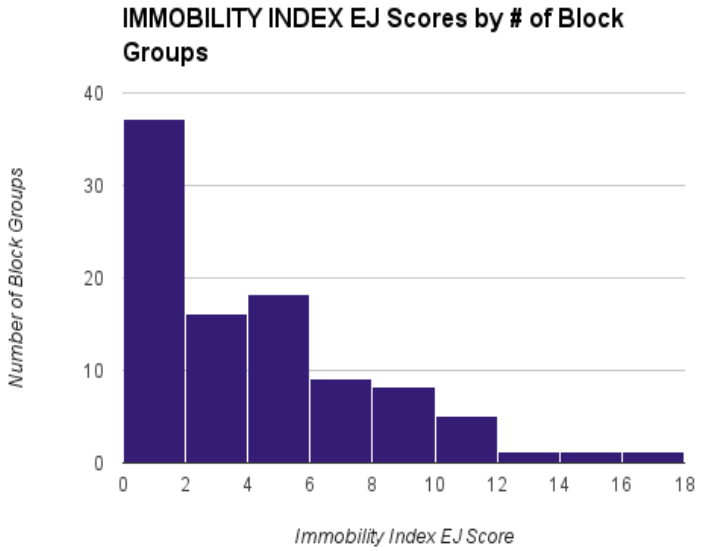
Figure 10: EJ Index: Immobility Index: Disability



In this disability layer, we see that the majority of the MPO contains a low level of disabled residents (48 block groups have 0-29.43% households with at least one resident with a disability). Because "disability" can include anything from a range of physical and mental disabilities, and temporary or permanent, it is difficult to interpret with certainty which types of transportation projects might be especially relevant. However, we again see the pattern where the higher concentrations of disabled residents are clustered in the city center, so extra ADA best practices should be ensured in transportation systems in this area.

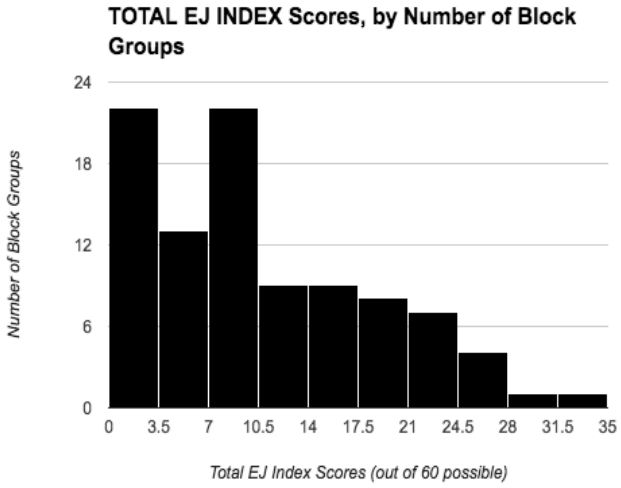
Table 13: Cumulative Immobility Index

Cumulative Immobility EJ Index		
Calculation	**Block Group Count (out of 96)**	**EJ Score**
Disability EJ Index Score + Elderly EJ Index Score (by Block Group)	28	**0**
	15	**1-2**
	18	**3-4**
	13	**5-6**
	8	**7-8**
	9	**9-10**
	1	**11-12**
	1	**13-14**
	1	**15-16**
	0	**17-18**
	0	**19-20**



The Cumulative Immobility Index combines the Disability and Elderly layers of the EJ Index. These layers are combined because those with disabilities and those who are elderly may face a similar (but of course not identical) list of needs and restrictions in terms of mobility and accessibility. When combined, we see that 3 block groups receive relatively high Immobility scores (between 11-16 points). This means that these block groups received average scores of 5-7 for each Immobility Index layer, which means that the populations within these block groups had z-scores of 1.00 to 1.75 above the regional average.

Table 14: EJ Index: Total EJ Index[8]

TOTAL EJ INDEX **(Poverty Score + Minority Score + LEP Score + Hispanic Score +Elderly Score + Disability Score)**					
Average Block group Total Score for 6 indicators	10.46		**Calculation**	**Block Group Count**	**Total EJ Score**
Block Group Count	96		**0 - mean**	53	**0-10**
Minimum EJ Score	0		**(mean - z=0.25**)	6	**11-12**
Maximum EJ Score	32 (60 is max possible)		**(z = 0.25 - 0.50)**	6	**13-14**
Standard Deviation	8.01		**(z = 0.50 - 0.75)**	3	**15-16**
0.25 Standard Deviation	2.0		**(z = 0.75 - 1.00)**	3	**17-18**
			**(z = 1.00 - 1.25)**	7	**19-20**
			(z = 1.25 - 1.50)	3	**21-22**
			(z = 1.50 - 1.75)	4	**23-24**
			(z = 1.75 - 2.00)	4	**25-26**
			(z = 2.00 - 2.25)	0	**27-28**
			(z = 2.25 +)	2	**28+ (max 60 possible)**

[8] See Appendix for full Total EJ Index Scoring Data, including geographic information.

The total EJ Index combines all layers from the Core EJ Index (minority, poverty, Hispanic, LEP) and the Immobility EJ Index (elderly, and disability), to create a cumulative index of "EJ" populations. When combined, as expected, we see a strong presence of EJ populations in the city center, but also notable block groups of interest throughout the MPO. The total scores for block groups were analyzed for distribution and standard deviation, following the methodology for each layer. This was done because a linear model (i.e., one where the max possible points of 60 were divided evenly into 10 point levels in even increments of six) would not be sensible given the z-score model used by each layer forming the total scores. Such a linear model would also fail to show significant EJ populations, because no block groups received the maximum score of 60. Therefore, the total scores were mapped according to standard deviation and z-scores, with block groups who received 28+ EJ points (2.25 standard deviations above the average) given the highest EJ grade. It is important to note that ALL of these block groups that are above a score of 10 (38 block groups) have a presence of EJ populations, with populations that have a Cumulative EJ Index score that is at least 0.25 standard deviations above the mean.

3.3.4: EEJAT 2016 Benefits and Burdens Instrument

The second step of the EEJAT 2016 framework (after the EJ Index) is the Benefits and Burdens Instrument. Through this instrument, potential projects are overlaid onto the EJ Index, and assessed for a number of potential EJ effects. To do this, for each potential EJ effect, the Benefits and Burdens Instrument guides planners through a series of questions about the project (scale, type, data needs, etc.), and the planner is guided to the best assessment model to be used to measure that effect. The process is repeated for each relevant effect, for each project that does not qualify for a categorical exclusion (see Categorical Exclusion table in the "Documentation" section of this chapter, above). The Benefits and Burdens Score for each effect equals the percentage of the population affected (positively or negatively) multiplied by the EJ Score of that Block Group. This equation ensures that the presence of EJ populations (the result of the EJ Index) is factored in to the assessment, in addition to the affect being measured.

$$\boldsymbol{B\&B\ Score} = (\%\ \boldsymbol{of\ population\ in\ BG\ affected\ by\ A})\ \boldsymbol{x}\ (\boldsymbol{EJ\ Score\ of\ BG})$$

Benefits and Burdens Example:

For an example of how the Benefits and Burdens instrument would be used, imagine that a new highway is being built, and the transportation planner needs to assess the potential environmental justice effects of this new highway. For the sake of simplicity, we will say that the planner is only looking at "air quality" and "employment" as EJ effects, but in reality, more effects would be measured. The planner goes through the EEJAT 2016 matrix, answering questions about the highway project's size & type, and about his or her skillsets and data availability. He or she is lead

to the 500-meter pollution buffer model to assess air quality (see Figure 12), and the employment accessibility model to assess employment.

The planner finds that the 500-meter pollution buffer around the highway overlaps 10% of a predominantly white, wealthy block group that has an EJ score of 5 out of 60, and overlaps 70% of a predominantly black, low-income block group that has an EJ Score of 28 out of 60. We'll call the predominantly white block group a "Non-EJ Block Group," and the other an "EJ Block Group." The equations for the air quality assessment would be as follows:

$$\boldsymbol{Non - EJ\ Block\ Group\ Air\ Pollution\ B\&B\ Score} = (\mathbf{0.10}\ \boldsymbol{x}\ \mathbf{5}) = \mathbf{0.5}$$
$$\boldsymbol{EJ\ Block\ Group\ Air\ PollutionB\&B\ Score} = (\mathbf{0.70}\ \boldsymbol{x}\ \mathbf{28}) = \mathbf{19.6}$$

Air pollution is a negative effect, so these results would be placed in the "burdens" column of the matrix. Already, we can see that the EJ Block group is facing disproportionate burden from the project (19.6 burden score compared to 0.5 for the non-EJ block group). However, if there is an enormous employment benefit to the EJ block group from this project, the benefits may balance out the burdens. (For a highway project, this is unlikely, because EJ communities may lack access to cars).

Next the planner finds through the employment access model that the highway connects 50% of the Non-EJ Block Group to employment and 10% of the EJ Block Group to employment. The equations for employment access would be as follows:

$$\boldsymbol{Non - EJ\ Block\ Group\ Employment\ B\&B\ Score} = (\mathbf{0.50}\ \boldsymbol{x}\ \mathbf{5}) = \mathbf{2.5}$$
$$\boldsymbol{EJ\ Block\ Group\ Employment\ B\&B\ Score} = (\mathbf{0.10}\ \boldsymbol{x}\ \mathbf{28}) = \mathbf{2.8}$$

Employment access is a positive effect, so these results would be placed in the "benefits" column of the matrix. These B&B scores are similar to one another, because more access is provided to the Non-EJ block group, but the EJ block group has a population with a higher EJ Index Score being provided access. Now we have negative points from the air quality assessment and positive points from the employment access. The overall Benefits and Burdens score from these two effects would be as follows:

$$\boldsymbol{Non - EJ\ Block\ Group\ Overall\ B\&B\ Score = 2.5 - 0.5 = +2.0}$$

$$\boldsymbol{EJ\ Block\ Group\ Overall\ B\&B\ Score = 2.8 - 19.6 = -16.8}$$

Here we can see that the EJ Block Group (the area that is predominantly low-income and African-American) has a negative score of -16.8, and the predominantly white Non-EJ Block Group has a positive score of +2.0. Because there are inherent issues with summations of the very different effects of air quality and employment, this number cannot be interpreted to mean more than an indication that there is high likelihood that disproportionate impact results from this highway. That is, it is likely that the highway is providing mostly benefits to Non-EJ areas, and mostly burdens to EJ areas. The planner would then provide the results of each of these assessments to affected communities, and ask for feedback. Any project decisions made on the highway project would need to acknowledge the results of these assessments. As stated before, a real B&B assessment would involve more effects than two.

The Benefits and Burdens matrix with all effects and models itself is too large to be included fully in this document, but a link to the instrument can be found here, and screenshots are shown later in this section. First, we will discuss the EJ "effects" that are included in the Benefits and Burdens Instrument.

3.4.4.1: EJ Considerations to be measured for Roanoke

The new EJ Framework includes only environmental justice concerns that directly relate to long-range transportation plans. Other environmental justice concerns, such as hazardous materials, are excluded from this framework. Table 3.4.4.1 outlines the environmental justice concerns that are

included in this framework. The table includes the EJ category, examples of EJ benefits measured, examples of EJ burdens measured, and the relevance to transportation plans.

Table 15: Environmental Justice Effects Included in EEJAT 2016

EJ Category	EJ Benefits	EJ Burdens	Relevance to Transportation Plans
Physical Environment Effects	Positive air quality effects (i.e., green infrastructure that absorbs pollution or public transit that takes cars off the road)	Negative air quality effects (i.e., transportation pollution)	Pollution from cars, trucks, and buses degrades air quality. If bus yards, roads, and highways are located disproportionately in low-income, minority neighborhoods, the air quality of these communities will be disproportionately affected.
	Positive water quality effects (i.e., porous pavement or green infrastructure)	Negative water quality effects	Runoff from highways pollutes groundwater. If transportation projects are located disproportionately in low-income, minority neighborhoods, the water quality of these communities will be disproportionately affected.
	Noise reduction	Noise pollution	Transportation projects, particularly highways, may create an auditory burden on communities in close proximity. Noise pollution is associated with sleep deprivation and degraded mental health.
	Natural Resource Preservation	Natural Resource Destruction	Transportation projects may be designed in such away that either preserves or degrades natural resources in and around EJ populations.
Safety and Health	Pedestrian Safety Enhancement	Pedestrian Safety Degraded	Transportation projects, such as highways with fast-moving traffic, present a number of safety concerns. Communities living in proximity to these projects may be at risk.
	n/a	Bodily Impairment or Death	Transportation projects may (in a hopefully very unlikely event) cause bodily impairment or death disproportionately to EJ populations.
Social and Economic Effects	Enhanced community cohesion	Disruption/ destruction of community cohesion	Transportation projects may either enhance or disrupt community cohesion of EJ populations. For example, a bus stop or bike path may increase community cohesion by bringing people together to wait for the bus or to ride bikes. A transportation project that provides accessible transit to only part of the community may decrease community cohesion.
	Increased mobility	Decreased mobility	Transportation projects may increase or decrease the mobility of EJ populations. *Note: mobility that is focused on highways tends to disproportionately benefit higher-income people who can afford to travel by car.
	Increased accessibility	Decreased accessibility	Roadways and public transportation provide residents access to jobs, schools, food, and public services. It is essential to ensure that EJ communities are not disproportionately denied access to such needs and opportunities.

	Enhancement of aesthetics values (Prozzi et al., 2006)	Degradation of aesthetics	Transportation projects can either enhance the aesthetics of a neighborhood (if they are attractive projects), or degrade the aesthetics (if they are unsightly or create visual burden). This is significant because aesthetics are correlated with the livability and safety of an area.
	Positive employment effects (Prozzi et al., 2006	Adverse employment effects	Transportation is critical to creating employment opportunities (i.e. bus routes to work), or can create adverse employment effects (i.e. highway is built that displaces businesses).
	n/a	Displacement of households and businesses (Prozzi et al., 2006)	Transportation projects may result in the disproportionate displacement of low-income or minority communities. For example, if a highway were built through a predominantly black neighborhood, those residents would be displaced from their homes and livelihoods.
	Prompt receipt of benefits from DOT programs	Significant delay in receipt of benefits from DOT programs (Prozzi et al., 2006)	Transportation programs may owe financial compensation to communities in exchange for burden caused by transportation projects.
	Land Prices and property values enhanced without causing gentrification	Land prices and property values degraded or cause gentrification	Transportation projects have potential to positively or negatively affect property values. For example, a nearby bus stop or greenway that connects a neighborhood to jobs may make housing in that neighborhood worth more. Conversely, a neighborhood that contains bus yard and high levels of air pollution may see a drop in housing value due to that bus yard.

3.3.4.2: Visual of EEJAT 2016 Benefits and Burdens Instrument

The EEJAT 2016 Benefits and Burdens Instrument is an elaborate but easy-to use matrix that can be found here. A screenshot of a section of the instrument, featuring "air quality" effects and "water quality effects," can be seen in Figure 3.4.4.2, below. Ultimately, this spreadsheet should be integrated into a web format where the user can merely click a series of buttons to answer each question, rather than scrolling to the correct answer. Currently, the planner follows the flowchart matrix, by answering the following questions:

1. **What EJ effect are you measuring?**
2. **What is the spatial scale of the project?**

   For the purposes of this thesis which is meant to be applied to Roanoke's LRTP, there was no separation of assessment models based on spatial scales.

3. **What is the type of project?**

   The tool includes assessment models for highway and road projects, transit or bus projects, and pedestrian or bicycle projects.

4. **What level of assessment is needed?**

   Levels of assessment can be classified as either “basic overview” or “detailed.”

5. **What level of data is available to you?**

   Level of data available to the assessor can be classified as either “low,” “medium,” or “high.”

6. **What skillsets to you or those in your agency possess?**

   Skillsets needed for the assessment model are sorted into basic (Excel spreadsheets, GIS, surveys), medium (statistical analyses), or advanced (advanced modeling).

By answering each of these questions, the planner is guided to the model or assessment method recommended for each effect. Columns are provided for “benefits” and “burdens,” where planners can document positive or negative results of each assessment for each effect.

1) What EJ effect are you measuring?		What is the spatial scale of this project?*	What is the type of project?	What level of assessment do you need?	What is the level of data available to you?	What skill sets do you/ those in your agency possess?	Method Suggested	Method Notes	OUTCOME: BENEFITS	OUTCOME: BURDENS	Meth
Physical Environment Effects	Air Quality	Small-Medium (Project or Corridor) or Large (Long Range Plans)	Pedestrian or Bicycle	Detailed		Statistical Analysis					
						Advanced Modeling					
					Medium	Excel/ Spreadsheet + GIS	EJSCREEN by the EPA	The latest version of EJScreen was released June 2016, and includes the nation's best air quality data, mapped by block group and demographics	Positive results of EJ Screen (varies)	Negative results of EJ Screen (varies)	
						Statistical Analysis					
						Advanced Modeling					
					High	Excel/ Spreadsheet + GIS	EJSCREEN by the EPA	The latest version of EJScreen was released June 2016, and includes the nation's best air quality data, mapped by block group and demographics	Positive results of EJ Screen (varies)	Negative results of EJ Screen (varies)	
						Statistical Analysis					
						Advanced Modeling					
Physical Environment Effects	Water Quality	Small-Medium (Project or Corridor) or Large (Long Range Plans)	Road or Highway	Basic Overview	Low	Excel/ Spreadsheet + GIS, Survey, Interview	Land Aquisition Checklist	use when acquisition of land could affect the water quality of Ej populations	positive water quality results	negative water quality results	
						Survey, Interview	Water Accessibility Checklist	use when project could affect access to water resources for EJ populations	positive water quality results	negative water quality results	
						Statistical Analysis, Visual quality design	Visual Quality Checklist	use when project could affect visual qualities of water for EJ populations	positive water quality results	negative water quality results	
						Advanced Modeling					
					Medium	Excel/ Spreadsheet + GIS					
						Statistical Analysis					
						Advanced Modeling (GMS)	Goundwater Quality Checklist	Use when project could affect groundwater quality or quantity	positive water quality results	negative water quality results	
						Advanced Modeling (HEC-RAS, HEC-2, SWMM)	Surface Water quality Checklist	use when project could affect surface water	positive water quality results	negative water quality results	

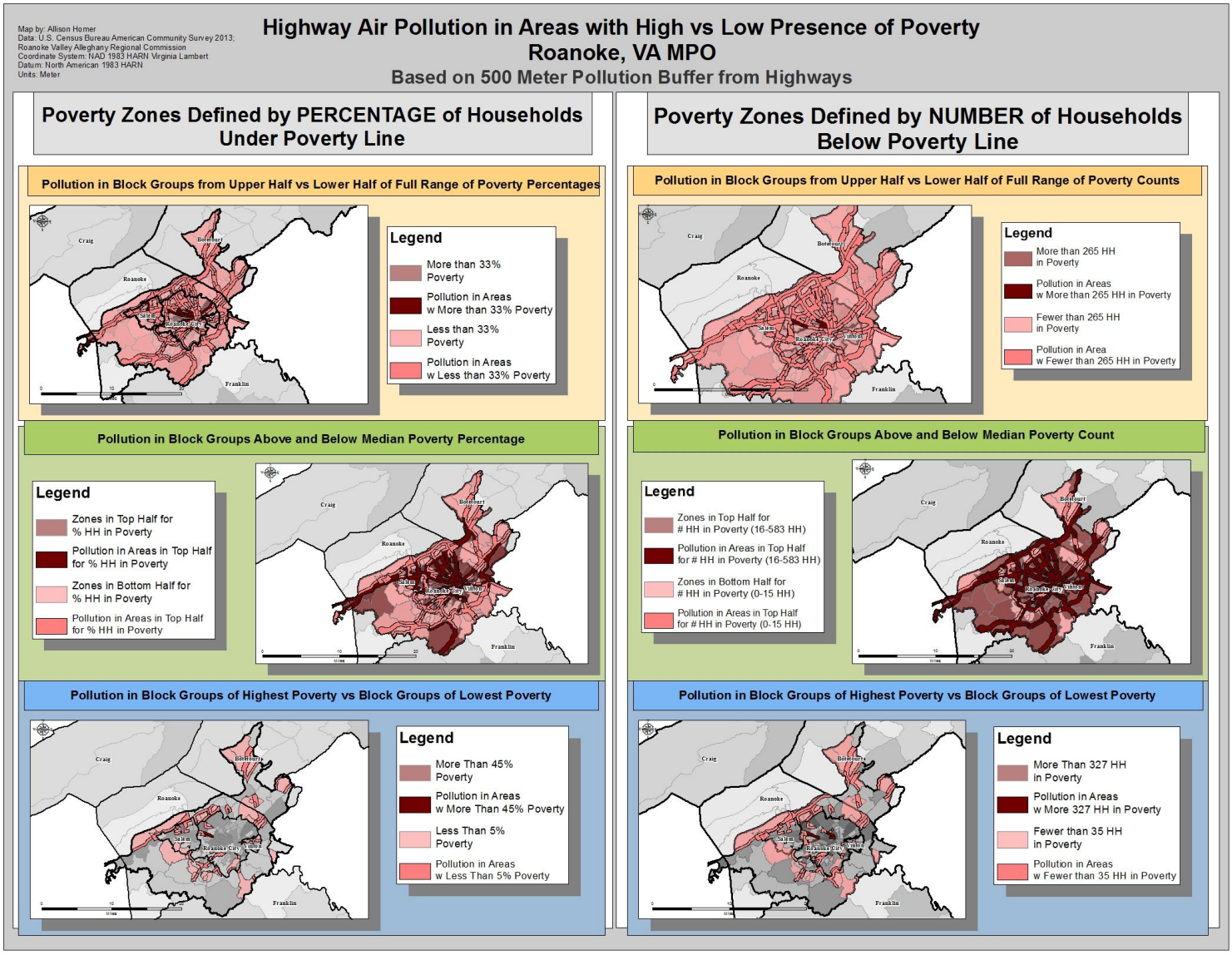
3.4.4.3: Examples of EEJAT Benefits and Burdens Assessment

Below are visual examples of some of the models that can be run through the Benefits and Burdens Instrument.

Air Quality

This “Highway Air Pollution” map shows the Chemical Dispersion model air quality assessment, which relies on the calculations that highway air pollution is highest within 500 meters of the highway. This model is a large-scale project, for highway type, high data availability, and ArcGIS skillsets needed.

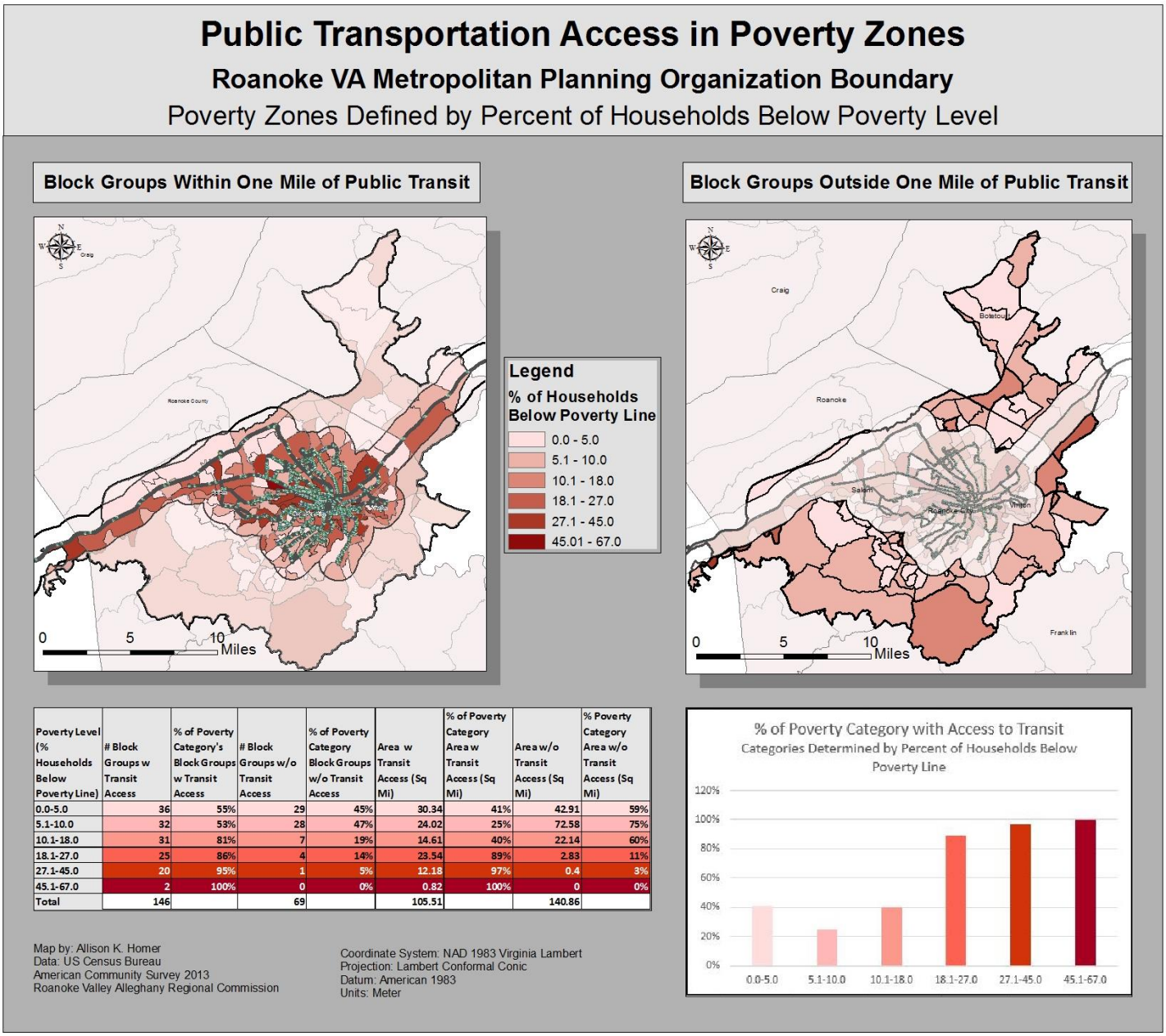
Figure 11: Example: Highway Air Pollution



Transportation Access

This “Public Transportation Access in Poverty Zones” map is one of the more basic models, and

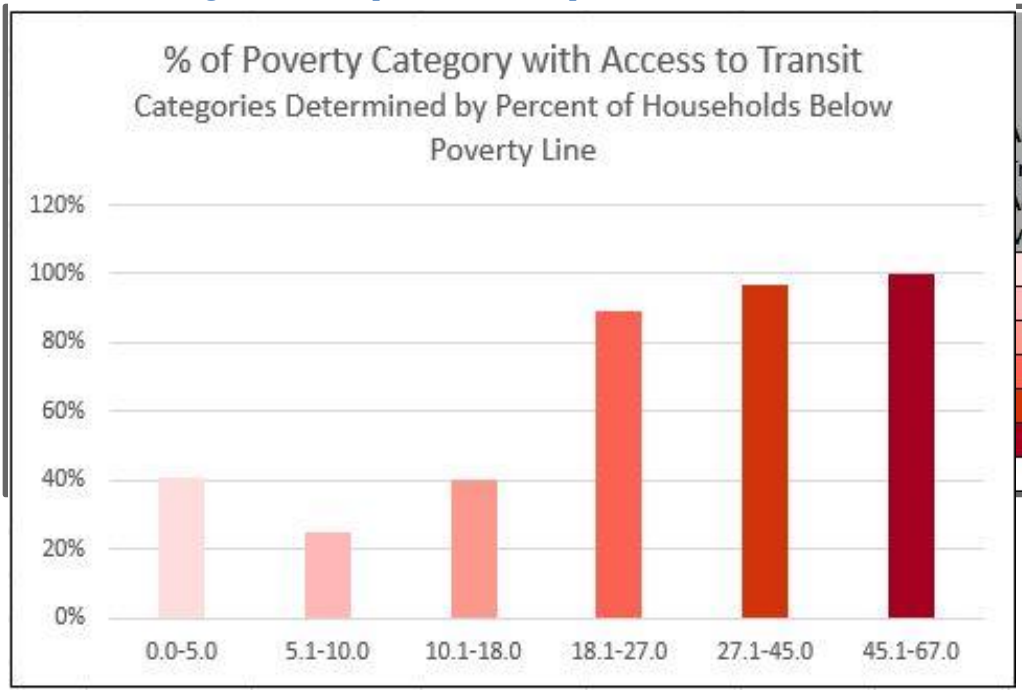
Figure 12: Example: Public Transportation Access



Poverty Level (% Households Below Poverty Line)	# Block Groups w Transit Access	% of Poverty Category's Block Groups w Transit Access	# Block Groups w/o Transit Access	% of Poverty Category Block Groups w/o Transit Access	Area w Transit Access (Sq Mi)	% of Poverty Category Area w Transit Access (Sq Mi)	Area w/o Transit Access (Sq Mi)	% Poverty Category Area w/o Transit Access (Sq Mi)
0.0-5.0	36	55%	29	45%	30.34	41%	42.91	59%
5.1-10.0	32	53%	28	47%	24.02	25%	72.58	75%
10.1-18.0	31	81%	7	19%	14.61	40%	22.14	60%
18.1-27.0	25	86%	4	14%	23.54	89%	2.83	11%
27.1-45.0	20	95%	1	5%	12.18	97%	0.4	3%
45.1-67.0	2	100%	0	0%	0.82	100%	0	0%
Total	146		69		105.51		140.86	

is based on an assumption that a distance of one mile is “accessible.” This is a large-scale project size, transit type, low-level of assessment, high level of data, requiring ArcGIS skills.

Figure 13: Example: Public Transportation Access Table
Figure 14: Example: Public Transportation Access: Chart



rea w/o ransit ccess (Sq Mi)	% Poverty Category Area w/o Transit Access (Sq Mi)
42.91	59%
72.58	75%
22.14	60%
2.83	11%
0.4	3%
0	0%
140.86	

The results of these particular example analysis show that the areas with the highest levels of poverty are within an "accessible" distance to transit, which is a positive result.

3.3.5: EEJAT 2016 Project Impact Assessment

The third step of the EEJAT 2016 toolkit, The Project Impact Assessment, draws from the results of the EJ Index (cumulative EJ score for the block groups affected by projects), the Benefits and Burdens Instrument (from the Outcome: Benefits; Outcome: Burdens columns), stakeholder

feedback, and documentation of historic injustices to create a comprehensive Project Impact Assessment for the proposed project or plan. If the project has higher rates of benefits to and positive stakeholder feedback from protected populations of the area, the project passes the EJ assessment. If the project has higher rates of burdens and negative stakeholder feedback from protected populations, the project does not pass the EJ assessment and must be justified as "the best alternative" or option of least impact. In such cases, planners should draft a statement of this justification, and affected communities should be notified promptly upon the justification draft. Communities should also be provided results of the assessment, any relevant data, and clear explanations of the benefits and burdens of the proposed projects.

3.3.6: FEEDBACK: Creation of System for Regular Feedback on 2016 Framework

The success of the EEJAT 2016 is dependent upon continual incorporation of new environmental justice assessment models, and on continuous engagement of stakeholders, particularly low-income, minority, LEP, Hispanic, elderly, and disabled residents. Federal policy establishes requirements for updates to Long Range Plans and Transportation Improvement Plans to occur on 4 or 5-year cycles. EEJAT should be updated at minimum with each of these LRPT and TIP updates, and ideally each year.

This feedback about the framework should be conducted through expansion of the stakeholder engagement process that was initiated with this study. The stakeholder engagement survey should be expanded to additional EJ activists, DOT employees, planners, academics, and local residents. This outreach should be done not only through continued email and online distribution of the survey, but also through in-person stakeholder meetings. These in-person stakeholder meetings should be structured in ways that follow the recommendations discussed in the literature review, and the recommendations given by the stakeholders themselves thus far, particularly through responses to the question "How should planners achieve meaningful stakeholder engagement of EJ populations?" Below is a tentative plan for continued stakeholder feedback:

Plan for Stakeholder Feedback:

- **August - September 2016:**

- 30-day public comment period.
- The first draft of the Constrained and Vision Lists will be presented at the RVTPO's August TPO Meeting.
- Email and online distribution of the survey should continue, with a goal of increasing responses from 33 to at least 100.
- Local organizations and churches that work with EJ populations should be contacted to set up dates for in-person meetings that discuss the completed framework and any adjustments that should be made.
- DOT representatives, planners, and academics should also be contacted to establish dates for phone interviews or personal meetings about the completed framework and any adjustments that should be made.

❖ **September 2016**:

- Public Meeting, Final action on the Long Range Transportation Plan.
- Childcare and transportation to the public meeting should be provided if possible.

❖ **October- December 2016:**

- Stakeholder meetings held to discuss the framework, with the help of the local organizations and stakeholders that were contacted in August and September. The topic should be potential issues with the potential framework, and suggestions for adjustments. These meetings should also be used to supplement documentation of historical, social, and environmental justice in region. Childcare and transportation to the public meeting should be provided if possible.
- If RVTPO faces capacity constraints that limit these possibilities, RVTPO should continue to partner with the Virginia Tech Master of Urban and Regional Planning (MURP) program to engage students to assist with these meetings.
- Stakeholder meetings should also be held with DOT and planners, to discuss potential adjustments to the framework.

❖ **January-May 2017**

- Adjustments incorporated into the framework.
- EJ brought up at stakeholder engagement meetings, continued documentation of historical, social, and environmental injustice in the area to help inform EJ decisions of future projects.

- **May 2017-August 2017**
  - Data updated in the EJ Index to reflect new ACS data.
  - Year review of framework, including stakeholder engagement and potentially a reevaluation project by another graduate student at Virginia Tech or other area universities.
- **August 2018**
  - Data again updated in the EJ Index to reflect new ACS data.
  - Year review of framework, including stakeholder engagement and potentially a reevaluation project by another graduate student at Virginia Tech or other area universities.

CHAPTER 4: CONCLUSIONS AND FUTURE RESEARCH

4.1: Conclusions

This thesis has presented EEJAT 2016, a new environmental justice assessment framework that seeks to incorporate the often divergent goals of three parties in environmental justice: federal and state enforcers of policy, planners conducting EJ assessments, and EJ populations themselves. The

framework combines these goals by ensuring alignment with requirements, by guiding planners through a thorough matrix of existing techniques to relevant methods of assessment for their projects at hand, and by incorporating checks on bias, stakeholder engagement, prompts for acknowledgment of social, historical, environmental, and economic injustices that lead to EJ conditions in the first place, and principles of equity as defined by EJ populations themselves.

This research, and the resulting EEJAT 2016 provide significant improvements upon Roanoke's 2005 Benefits and Burdens Assessment through achievement of and expansion from the requested research objectives. First, thorough documentation was created of all requirements and prominent guidelines for environmental justice assessments, and gaps or items left up to interpretation by planners were identified and compiled in an easy-to-use requirements table. Second, RVTPO's documentation of national "best practice" environmental justice assessment tools was significantly updated with a literature review of EJ assessment case studies, court cases, and theories. Third, information was gathered directly from environmental justice leaders on principles of equity through academic review, surveys, personal interviews, public meetings, and attendance of EJ-related conferences. Fourth, information was gathered on the constraints of the RVTPO through interviews of TPO staff, and these constraints were conveniently documented in the same "documentation" section that holds the requirements table.

Fifth, the 2005 RVTPO Benefits and Burdens framework was reevaluated using the information gathered in objectives 1-4. A number of significant opportunities for improvement were identified, and the majorities of these opportunities were brought to fruition. Sixth, all demographic maps were updated with new ACS data, and an updated EJ Index was created that includes two sub-

indexes, the “Core EJ Index,” and the “Immobility Index,” The EJ Index maps were based on standard deviations of EJ population demographics, rather than on the former illogical linear scaling model. Seventh, checks on bias in decision-making for environmental justice assessments were created through studies of decision theory and behavioral economics, and incorporation of prompted checks on decision bias for the planner throughout the assessment process. Eighth, the information gathered in objectives 1-7 were folded into the creation of the full EEJAT 2016 toolkit that takes the form of an easy-to-follow matrix of tools for transportation planners. This matrix improves upon the 2005 instruments by striving for an equal emphasis on benefits and burdens, by including prompts for the aforementioned checks on bias and community involvement, and by replacing the former subjective assessment with a compilation of assessment tools and methodologies for various project types, scales, data needs, and skillset needs. Finally, but perhaps most importantly, input was gathered throughout the entire process from academic experts, EJ activists, and stakeholders.

4.2 Future Research

While EEJAT 2016 is an improvement upon Roanoke’s prior environmental justice assessment framework, the framework is by no means a conclusive solution, and continuous research and improvements are always needed. Roanoke has the opportunity to launch from this project to become a national leader in environmental justice assessment, and to spark meaningful change across the country but additional work is needed to reach that point.

First, and foremost, there is need for more robust feedback on this framework from EJ activists, planners, and policy enforcement representatives. The framework was presented to representatives of the FHWA and FTA, and surveys, interviews, and public meetings were conducted, but a more

robust assessment of the assessment framework needs to be conducted. There is always a need for more thorough exploration of theories of equity, of documentation and acknowledgment of privilege and injustice, and of bias and decision theory. It is likely that adjustments will need to be made following this continued feedback. There will also need to be incorporation of continual additions to the matrix as new and improved assessment techniques are released.

Also, critically, the framework should be integrated into an easily accessible web format that enables planners to visit a website, click buttons in response to questions, and be guided to the recommended EJ assessment methodology for the project at hand. This online portal should also include GIS maps for the EJ Indices, and should include a resource database of stakeholder feedback, documentation of requirements, and documentations of historical conditions and decisions that lead to disproportionate burdens in project areas. Stakeholders and EJ community members should have access to this documentation portal, so that they can submit reports of any historical and current injustices to enhance awareness by planners. This "one-stop" EJ portal can also be the location for publication of EJ assessment results. Coordination with the EPA's EJSCREEN would be a huge catalyst for this portal.

There is also need for more thorough information on the EJ populations of Roanoke and beyond. There should especially be exploration and mapping of Roanoke's refugee and Middle Eastern populations, because these populations are significant and unaccounted for in US Census data. Further, assessments should include not only protected populations places of residence but also where they work, shop, and receive benefits. Along this same line, there are exciting possibilities for analysis of integrated or overlapping EJ effects, including how belonging to multiple EJ groups

may create disproportionate burden that is greater than the "sum of the parts." The stakeholder feedback gathered from the survey also provided intriguing research ideas that should be explored, such as the incorporation of the needs of female heads-of-households, vulnerable children and teens, and those who are unable to drive into EJ assessments.

During this research, the author simultaneously conducted other sustainable development research projects across the United States, in India, and in Morocco, where many anecdotal observations of EJ and transportation were made that were out of the scope of this already ballooned thesis. However, there exists significant opportunity to delve into these connections, and to expand EEJAT 2016 beyond its humble beginnings in Roanoke to become a groundbreaking and useful tool for planners across the United States or even internationally. Regardless of location, there are always populations who are disproportionately burdened, and there are always transportation networks that can either exacerbate this burden, or ameliorate it. Regardless of specific models or methodologies chosen, planners should seize the opportunity to use environmental justice assessments not for mere compliance with federal regulations, but to spark powerful and meaningful amelioration of historic and current grave injustices, to genuinely involve those affected by decisions into decision-making, to acknowledge privilege and unjust systematic disadvantage, to humbly and open-mindedly engage in continual difficult adjustment and learning about the communities at hand, and to drive community connectivity, livability, and vitality.

REFERENCES

Ariely, D. (2008). *Predictably Irrational.* New York: Harper Collins.

Ariely, D., Loewenstein, G., & Prelec, D. (2003). "Coherent arbitrariness": stable demand curves without stable preferences. *Quarterly Journal of Economics, 118,* 73-105

Awad, G.H. (2016, Jan 3). "Arab Americans shouldn't be classified as white." *Aljazeera America.* Retrieved from http://america.aljazeera.com/opinions/2016/1/arab-americans-shouldnt-be-classified-as-white.html

Bailey, K. and T. Grossardt. (2004). Towards Structured Public Involvement: Improving community involvement in transportation decision making. B. Warf, D. Janelle and K. Hansen (eds.) In *WorldMinds: Association of American Geographers Centennial Volume*. Ch. 89: 547-552. Kluwer, Netherlands.

Bailey, K., Grossardt, T., Ripy, J., (2012). Toward environmental justice in transportation decision-making with structured public involvement. *Transportation Res. Rec. J. Transp. Res. Board,* 2012, 2320, 102-110.

Bateman, I.J., Lovett, A.A., Brainard, J.S. (2003). Applied Environmental Economics: A GIS Approach to Cost-Benefit Analysis. Cambridge University Press. Cambridge, United Kingdom.

Bean v. Southwestern Waste Management, Inc. 482 F.Supp. 673 (1979)

Biswas, D. (2009). The effects of option framing on consumer choices: Making decisions in rational vs. experiential modes. *Journal of Political Economy*, 100, 992-1026.

Bowen, W. (2002). An analytical review of environmental justice research: What do we really know? *Environmental Management, 29* (1), 3-15. doi: 10.1007/s00267-001-0037-8

Brezillion, P., Pomeral, J.C. (2010). Framing Decision Making at Two Levels. B*ridging the Socio-technical Gap in Decision Support Systems*. IOS Press, Inc.

Bullard, R.D., Johnson, G.S. (2000): Environmental Justice: Grassroots Activism and Its Impact on Public Policy Decision Making. *Journal of Social Issues,* 56(3), 2000, pp. 555-578 http://www.unc.edu/courses/2005spring/epid/278/001/Bullard2000JSocIssues.pdf

Capek, J. (1993). The Environmental Justice Frame: A Conceptual Discussion and an Application. *Social Problems,* Vol. 40, No. 1, 1993, pp. 5–24.

Carrier, M., Apparicio. P., Seguin, A., Crouse, D. (2014)"The application of three methods to measure the statistical association between different social groups and the concentration of air pollutants in Montreal: A case of environmental equity." *Transportation Research Part A: Policy and Practice.* Volume 30, July 2014, Pages 28-52. doi:10.1016/j.trd.2014.05.001

Chakraborty, J. (2006). Evaluating the environmental justice impacts of transportation improvement projects in the US. *Transportation Research Part D: Transport and Environment*, *11* (5), 315-323. doi: 10.1016/j.trd.2006.06.003

Chakraborty, J. & Armstrong, M.P. (1997). Exploring the use of buffer analysis for the identification of impacted areas in environmental equity assessment. *Cartography and Geographic Information Systems*, *24* (3), 145-157. doi: 10.1559/152304097782476951

Chakraborty, J., Schweitzer, L.A., & Forkenbrock, L.A. (2002) Using GIS to assess the environmental justice consequences of transportation system changes. *Transactions in GIS*, *3*, 239–258. doi: 10.1111/1467-9671.00020

Chakraborty, J., Maantay, J.A., Brender, J.D. (2011). Disproportionate proximity to environmental health hazards: Methods, models, and measurement. *American Journal of Public Health*, *101* (1), 27-36.

Civil Rights Act of 1964 §2000D Et Seq., 42 U.S.C (1964).

Colored People v. U.S. Dept. of Transportation, (2011). U.S. Dist. LEXIS 8111 (D. Minn Jan 27, 2011).

Darensburg v. Metropolitan Transportation Commission. (2011). US App Lexis 3007

Davis, C. & Jha, M.K. (2011). A dynamic modeling approach to investigate impacts to protected and low-income populations in highway planning. *Transportation Research Part A: Policy and Practice, 45* (7), 598-610. doi: 10.1016/j.tra.2011.03.011

Day, J., Hedgpeth, J., Cockburn, H. (2012). Environmental Justice: PTRPO Data Scan. Piedmont Triad Rural Planning Organization. http://www.ptrc.org/modules/showdocument.aspx?documentid=1570

Deka, (2004D). Social and environmental justice issues in transportation. S. Hanson, G. Guiliano (Eds.), *The Geography of Urban Transportation*, Guilford Press, New York.

Dolan, P., Hallsworth, M., Halpern, D., King, D., & Vlaev, I. (2010). MINDSPACE: Influencing behavior through public policy. London, UK: Cabinet Office.

DOT Updated Environmental Justice Order 5610.2 (a), (2012)

Duthrie, J. Cervenka, K., Waller, S. (2013). Environmental Justice Analysis: Challenges for Metropolitan Transportation Planning. *Transportation Research Record: Journal of the Transportation Research Board*, 2013. DOI: http://dx.doi.org/10.3141/2013-02

"EJSCREEN: Environmental Justice Screening and Mapping Tool." (2016). Environmental Protection Agency. Retrieved from https://www.epa.gov/ejscreen

Environmental Impact and Related Procedures, (1987). Title 23 C.F.R. § 771

Executive Order 12898. (1994). Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations. Federal Register, Vol. 59, No. 32, Feb. 16,

Federal Aid Highway Act of 1970. 23 U.S.C. 101 (1970)

Fehr, E., & Schmidt, K.M. (1999). A theory of fairness, competition, and cooperation. *The Quarterly Journal of Economics*, 144, 817-868.

Feitelson, E. (2002). Introducing environmental equity dimensions into the sustainable transport discourse: issues and pitfalls. *Transportation Research Part D, 7*, 99–118. doi: 10.1016/S1361-9209(01)00013-X

Feng, T., Zhang, J., (2014). Multicriteria evaluation on accessibility-based transportation equity in road network design problem. *Journal of Advanced Transportation.* 48(6), pp. 526-541

Ferguson, E.M., Duthrie, J., Unnikrishnan, A., Waller, S.T. (2012). Incorporating equity into the transit frequency-setting problem. *Transportation Research Part A: Policy and Practice.* 46 (1), pp 190-199. doi:10.1016/j.tra.2011.06.002

"FHWA: Environmental Justice." (2016). Federal Highway Administration. Retrieved from http://www.fhwa.dot.gov/Environment/environmental_justice/

Finucane, M.L., Alhakami, A., Slovic, P., Johnson, S.M., (2000). The affect heuristic in judgments of risks and benefits. *Journal of Behavioral Decision Making.* 13 (1), pp. 1-17. 10.1002/(SICI)1099-0771(200001/03)13:1<1::AID-BDM333>3.0.CO;2-S

Frederick, S., Loewenstein, G., O'Donoghue, T., (2002). Time Discounting and Time Preference: A Critical Review. *Journal of Economic Literature.* 40(2), pp. 351-401.

French, S. (1986). Decision Theory. An Introduction to the Mathematics of Rationality. New York: Wiley.

Forkenbrock, D. & Schweitzer, L. (1999). Environmental Justice in Transportation Planning. *Journal of the American Planning Association, 65* (1), 96-112. doi: 10.1080/01944369908976036

Forkenbrock, David J., and Sheeley, Jason (2004). Effective Methods for Environmental Justice Assessment. *NCHRP Report 532.* Transportation Research Board. Washington D.C.

G¨achter, S., Orzen, H., Renner, E., Starmer, C. (2009). Are Experimental Economists Prone to Framing Effects? A Natural Field Experiment. *Journal of Economic Behavior and Organization*, Elsevier, 70 (3), pp.443. 10.1016/j.jebo.2007.11.003.hal-00661975

Gerrard, M.B., Foster, S.R. (eds) (2008). The Law of Environmental Justice: Theories and Procedures to Address Disproportionate Risks, Second Edition. ISBN: 978-1-60442-083-8

Harner, K., Warner, K., Pierce, J., & Huber, T. (2002). Urban environmental justice indices. *The Professional Geographer*, *54* (3), 318-331. doi: 10.1111/0033-0124.00333

Hartell, A. (2007). Methodological Challenges of Environmental Justice Assessments for Transportation Projects. *Transportation Research Record: Journal of the Transportation Research Board.* 2013. pg 21-29.

Holifield, R. (2014). Environmental Reviews and Case Studies: Accounting for Diversity in Environmental Justice Screening Tools: Toward Multiple Indices of Disproportionate Impact. *Environmental Practice*. Volume 16, Issue 01,pp 77-86 DOI: http://dx.doi.org/10.1017/S1466046613000574

"How was EJSCREEN Developed?" (2016, Jun 2). EJScreen: Environmental Justice Screening and Mapping Tool. U.S. Environmental Protection Agency. https://www.epa.gov/ejscreen/how-was-ejscreen-developed

Huettal, Scott. (2014). Behavioral Economics: When Psychology and Economics Collide. Duke University. *The Great Courses.* Audiobook.

Jersey Heights Neighborhood Association v. Glendening (174 F.3d 180 4th Cir 1999)

Kahneman, D. (2003). Maps of bounded rationality: Psychology for behavioral economics. The *American Economic Review*, 93, 1449-1475.

Kahneman, D., Tversky, A. (1979). Prospect Theory: An Analysis of Decision Under Risk. *Econometrica, 47(2),* pp. 264-291.

Kiersten, G.E. & Szpakowicz, S. (1994). Decision Making and Decision Aiding: Defining the Process, Its Representations, and Support. *Group Decision and Negotiation*, 3:237-261. Kluwer Academic Publishers.

Krohe Jr., J. (2008). Environmental Justice: Have we Made Any Progress in the Last 25 Years? *Planning*, pg 20.

Kuehn, R. (1996). The Environmental Justice Implications of Quantitative Risk Assessment. *University of Illinois Law Review,* 1996*(1)*

Labor/ Community Strategy Center v Los Angeles County Metropolitan Transportation Authority 2:94-cv-05936-TJH-mc (C.D. Cal.)

Larsen, J., and J. Claussen. (2004) Statistical Environmental Justice Assessment for a Transportation Corridor. *Environmental Practice,* Vol. 6, No. 1, 2004, pp. 71–78

Li, H., Young, S., Low, S., Lum, G. (1983). Environmental Justice Assessment in Racially Diverse Areas. *Transportation Research Record: Journal of the Transportation Research Board.* Volume 1983. DOI: 10.3141/1983-09

Litman, T. (2002). Evaluating Transportation Equity. World Transport Policy & Practice, 8(2), Summer, pp. 50-65. www.vtpi.org/equity.pdf

Litman, T. (2007). Community Cohesion as a Transport Planning Objective, Victoria Transport Policy Institute. Retrieved from : www.vtpi.org

Litman, T. (2016). Evaluating Transportation Equity: Guidance for Incorporating Distributional Impacts in Transportation Planning. Victoria Transport Policy Institute. Retrieved from

http://www.vtpi.org/equity.pdf

Liu, F. (2001). *Environmental justice analysis: Theories, methods, and practice*. Boca Raton: Lewis Publishers

Marshall, A.W. and Olkin, I. (1997). Inequalities: Theory of Majorization and Its Applications, Academic Press (New York).

Martens, K., Golub, A., Robinson, G. (2012). A justice-theoretic approach to the distribution of transportation benefits: Implications for transportation planning practice in the United States. *Transportation Research Part A: Policy and Practice.* Volume 46, Issue 4, Pages 684-695. doi:10.1016/j.tra.2012.01.004

McCaskill, M. (2015). Director of Transportation Planning Organization Programs. Roanoke Valley Alleghany Regional Commission. Personal Interview.

McKenney, N.R., Bennett, C.E. (1994). Issues regarding data on race and ethnicity: The Census Bureau experience. *Public Health Reports*. 109 (1): 16-25

McKenney, N., Bennett, C., Harrison, R. and del Pinal, J. (1993). "Evaluating Racial and Ethnic Reporting in the 1990 Census," Proceedings of the Section on Survey Research Methods of the American Statistical Association, pp. 66-74.

Mills, G. Scott; Neuhauser, K.S. (2000). Quantitative Methods for Environmental Justice Assessment of Transportation. *Risk Analysis*. Volume 20, Issue 3, pages 377-284. DOI: 10.1111/0272-4332.203036 http://onlinelibrary.wiley.com.ezproxy.lib.vt.edu/doi/10.1111/0272-4332.203036/epdf

Molina, Lily. (2015). Personal Interview. U.S. Climate Action Network Annual Conference.

Most, M., Sengupta, R., Burgener, M. (2004). Spatial Scale and Population Assignment Choices in Environmental Justice Analyses. *The Professional Geographer*, 56(4), pp. 574-586.

New York City Environmental Justice Alliance v. Giulliani,. 214 F.3d 65, 69-71 (1999)

Paavola, J. (2003). Environmental decisions and theories of justice Implications for economic analysis and policy practice. *Forum for Social Economics, 33(1),* 33-43. DOI: 10.1007/BF02778964

Purvis, Charles L. (2001). Data and Analysis Methods for Metropolitan-Level Environmental Justice Assessment. Metropolitan Transportation Commission. Transportation Research Board, Washington, DC.

Roanoke Valley Alleghany Regional Commission. (2005). RVAMPO Environmental Justice Benefits and Burdens Framework. Roanoke Virginia.

Robinson, G., et.al. (2010). Building on the Strength of Environmental Justice in Transportation: Environmental Justice Toolkit. Federal Transit Administration.

Sanchez, T., Brenman, M. (2007). The Right to transportation: moving to equity. *Planners Press Book*. Chicago: American Planning Association.

Samson, A. (2014). "An Introduction to Behavioral Economics." Behavioral Economics Guide 2014. Behavioral Science Solutions Ltd. https://www.behavioraleconomics.com/introduction-to-be/

Samuelson, W., Zeckhauser, R. (1988). Status Quo Bias in Decision Making. *Journal of Risk and Uncertainty*, 1: 7-59. Kluwer Academic Publishers, Boston

Schlosberg, D. (2007). Defining environmental justice: theories, movements, and nature. *Oxford University Press.* New York.

Schweizer, L. & Valenzuela, A. (2004). Environmental injustice and transportation: The claims and the evidence. *Journal of Planning Literature, 18* (4), 383-398. doi: 10.1177/0885412204262958

Shampanier, K., Mazar, N. & Ariely, D. (2007). Zero as a special price: The true value of free products. *Marketing Science, 26,* 742-757.

Shilling, F., London, J.K., Levanos, R., 2009. Marginalization by collaboration: Environmental Justice as a Third Party in and beyond CALFED. Environmental Science and Policy 12 (6),694–709

Shiv, B., Carmon, Z. & Ariely, D. (2005). Placebo effects of marketing actions: Consumers may get what they pay for. *Journal of Marketing Research 42*(4), 383-393.

Smith, D. (2015). Personal Interview. Pearl Coalition.

Solis, R. (1997). Jemez Principles for Democratic Organizing. *Southwest Organizing Project.* Retrieved from http://www.epa.illinois.gov/Assets/iepa/environmental-justice/jemez-principles.pdf

Southwest Network for Environmental and Economic Justice (SNEEJ). (1996). Jemez Principles for Democratic Organizing. Jemez, New Mexico.

"Statement of Principles." (2014). Transportation Equity Caucus. The Leadership Conference. PolicyLink. Equitycaucus.Org.

Steele, K.& Stefánsson, H.O. (2015). "Decision Theory," *The Stanford Encyclopedia of Philosophy* (Winter 2015 Edition), Edward N. Zalta (ed.), http://plato.stanford.edu/archives/win2015/entries/decision-theory/

St.Paul Branch of the National Association for the Advancement of Colored People v. U.S. Dept of Transportation, (2011) U.S. Dist. LEXIS 8111 (D. Minn Jan 27, 2011)

Steinberg, M.W. (2000). Making Sense of Environmental Justice. Forum for Applied Research & Public Policy. Vol. 15, No. 3, Fall 2000.

Thaler, R.H., & Sunstein, C. (2008). *Nudge: Improving decisions about health, wealth, and happiness.* New Haven, CT: Yale University Press.

Triplett, K.L., Johnson, G.S. (2011). Environmental Justice and Transportation: An Analysis of Public Involvement at Pennsylvania Department of Transportation. *Race, Gender & Class,* Vol 18. Issue 3/4 p 348.

Tversky, A., Kahnerman, D. (1974). Judgment under Uncertainty: Heuristics and Biases. *Science*, New Series, Vol. 185, No. 4157. (Sep. 27, 1974), pp. 1124-1131

Uniform Relocation Assistance and Real Property Acquisition Policies Act, 42, U.S.C. § 4601 (1970)

U.S. Department of Justice. (2001). Civil Rights Division. Title VI Legal Manual. https://www.justice.gov/sites/default/files/crt/legacy/2011/06/23/vimanual.pdf

U.S. Department of Transportation Order on Environmental Justice. www.fhwa.dot.gov/Environment/ejustice/dot_ord.htm.

Washington State DOT. (2016). NEPA Categorical Exclusions: A Guidebook for Local Agencies. Appendix L. Retrieved from https://www.wsdot.wa.gov/NR/rdonlyres/87901EB4-008A-43A0-9DB7-2179E0BC939F/0/CEGuidebookSecure.pdf

WeACT for Environmental Justice. (2016). "Jemez Principles for Democratic Organizing." Environmental Justice Leadership Forum on Climate Change. Accessed Jan 21, 2016. http://www.ejleadershipforum.org/jemez-principles-for-democratic-organizing/

Weber, A.U. and O. Coskungulu. (1990). "Descriptive and Prescriptive Models of Decision-making: Implications for the Development of Decision Aids." *IEEE Transaction on Systems, Man, and Cybernetics* 20(2), 310-317.

Wilson, A., Patterson, J., Wasserman, K., Starbuck, A., Sartor, A. (2011). Coal Blooded: Putting Profits Before People. Morris, M.W. (ed). NAACP. Indigenous Environmental Network. LVEJO. http://www.naacp.org/page/-/Climate/CoalBlooded.pdf

Wisconsin Department of Transportation, (1997). Verona Road/ West Beltline Needs Assessment Study. Retrieved from http://www.fhwa.dot.gov/environment/environmental_justice/case_studies/madver1.pdf

Witte, E. (1972). Field Research on Complex Decision-Making Processes- The Phase Theorem. *International Studies of Management Organization (Summer).* pp. 156-182.

APPENDICES

Appendix 1: Logical Framework

Objective	**Methodology**
Objective 1: Document all federal and state requirements for environmental justice assessments faced by the RVTPO, and determine where gaps or lack of specific direction exist in federal and state instructions for environmental justice assessments.	1.1 Conduct a thorough literature review of federal and state requirements for environmental justice assessments.
	1.2 Create easily-accessible documentation of all requirements the RVTPO is required to meet. In the documentation created, identify all instances of non-quantitative, or non-measurable, or non-specific language. These gaps will need to be filled by the new environmental justice framework.
Objective 2: Update RVTPO's documentation of national "best practice" environmental justice assessment tools.	2.1 Conduct a literature review on existing environmental justice assessment tools, including both case studies and academic theory.
	2.2 Document all tools relevant to Roanoke in a matrix

Objective 3: Gain information directly from environmental justice leaders on principles of equity that should be incorporated into environmental justice assessments.	3.1 Create a survey population of environmental justice leaders locally and across the U.S.
	3.2 Contact each leader for their qualitative input on the general question, "What should be included in environmental justice assessments?"
	3.3. Document all responses
Objective 4: Gather complete information on the constraints of the Roanoke Valley TPO.	4.1 Create an inventory of staff available to work on EJ assessments, hours of those staff members' work time allocated to EJ assessments, and budget allocated to EJ assessments
Objective 5: Using the information gathered in objectives 1-4, reevaluate the 2005 framework's methods and assumptions	5.1 Conduct a thorough assessment of Roanoke's existing environmental justice framework.
	5.2 Identify all potential opportunities for improvement within the existing framework. These "issues" are identified by fitting one of the following descriptions: 1. Issues that have been flagged by staff at the RVTPO as being of concern, 2. Items in the framework that may differ between Delaware and Roanoke, for which the differences have not yet been accounted 3. Areas of discrepancy between the existing framework and "best practices" identified through the literature review on existing environmental justice assessment tools, including both case studies and theory
Objective 6: Update all demographic maps used in the formation of the EJ Index	6.1 Use the latest available U.S. Census Bureau data to update the following demographic maps: poverty zones, minority (non-white), elderly (over 65), Limited English Proficiency, disabled, and Hispanic
	6.2 Combine all maps to create an updated cumulative EJ Index map
Objective 7: Create checks on bias in decision-making for environmental justice assessments	7.1 Identify any potential areas of bias flagged by environmental justice leaders in the current RVTPO EJ Framework
	7.2 Identify any potential areas of bias flagged by environmental justice leaders in the "best practices" EJ frameworks identified in Objective 4

	7.3 Identify the Behavioral Economics-based decision theory behind the current RVTPO EJ Framework
	7.4 Identify the Behavioral Economics-based decision theory behind the "best practices" EJ frameworks identified in Objective 4
	7.5 From this information, create a list of checks on bias and decision making for the new EJ framework
Objective 8: To fold all information gathered from objectives 1-7 into the creation of a new environmental justice assessment framework that takes the form of an easy-to-follow matrices of tools for transportation planners.	8.1 Document all tools in the matrix 8.2 Organize in a logical step-by-step process
Objective 9: Gather input from experts, EJ activists, and stakeholders on the new framework	9.1 Create a survey population including transportation experts, EJ activists, and stakeholders in Roanoke
	9.2 Send each member of the survey population a description of the new framework, and a survey of questions on the new framework
	9.3 Document all responses, and consider for framework improvement
	9.4 Establish schedule of periodic review (look for best practices on review schedule, or every 4 years for federal review)

Appendix 2: EJ Index Scoring

Appendix 2.1 : Total EJ INDEX SCORING, In Order by Block Group

GEO.id	GEO.id2	GEO.display-label	**CORE EJ INDEX**				**IMMOBILITY EJ INDEX**		**TOTAL EJ INDEX**
Id	Id2	Geography	Poverty EJ Score	Minority EJ Score	LEP EJ Score	HISP EJ SCORE	**Elderly EJ Score**	Disability EJ Score	
1500000US517700001001	5.18E+11	Block Group 1, Census Tract 1, Roanoke city, Virginia	7	9	0	0	1	3	20

1500000US517700010001	5.18E+11	Block Group 1, Census Tract 10, Roanoke city, Virginia	10	2	0	0	0	7	19
1500000US517750101001	5.18E+11	Block Group 1, Census Tract 101, Salem city, Virginia	1	0	1	0	0	0	2
1500000US517750102001	5.18E+11	Block Group 1, Census Tract 102, Salem city, Virginia	7	0	0	1	2	0	10
1500000US517750103001	5.18E+11	Block Group 1, Census Tract 103, Salem city, Virginia	1	0	0	0	0	0	1
1500000US517750105011	5.18E+11	Block Group 1, Census Tract 105.01, Salem city, Virginia	0	0	0	0	10	0	10
1500000US517750105021	5.18E+11	Block Group 1, Census Tract 105.02, Salem city, Virginia	1	0	0	0	6	4	11
1500000US517700011001	5.18E+11	Block Group 1, Census Tract 11, Roanoke city, Virginia	0	0	0	0	0	0	0
1500000US517700012001	5.18E+11	Block Group 1, Census Tract 12, Roanoke city, Virginia	8	0	2	0	0	3	13
1500000US517700018001	5.18E+11	Block Group 1, Census Tract 18, Roanoke city, Virginia	0	0	0	0	0	0	0
1500000US517700019001	5.18E+11	Block Group 1, Census Tract 19, Roanoke city, Virginia	6	0	0	0	0	5	11

1500000US517700021001	5.18E+11	Block Group 1, Census Tract 21, Roanoke city, Virginia	0	0	0	0	8	1	9
1500000US517700022001	5.18E+11	Block Group 1, Census Tract 22, Roanoke city, Virginia	0	0	0	0	0	3	3
1500000US517700023001	5.18E+11	Block Group 1, Census Tract 23, Roanoke city, Virginia	1	8	3	0	0	2	14
1500000US517700024001	5.18E+11	Block Group 1, Census Tract 24, Roanoke city, Virginia	6	9	0	0	4	0	19
1500000US517700025001	5.18E+11	Block Group 1, Census Tract 25, Roanoke city, Virginia	10	9	7	2	0	4	32
1500000US517700026001	5.18E+11	Block Group 1, Census Tract 26, Roanoke city, Virginia	4	0	0	0	3	0	7
1500000US517700027001	5.18E+11	Block Group 1, Census Tract 27, Roanoke city, Virginia	3	0	0	0	1	4	8
1500000US517700028001	5.18E+11	Block Group 1, Census Tract 28, Roanoke city, Virginia	4	0	2	0	0	3	9
1500000US517700029001	5.18E+11	Block Group 1, Census Tract 29, Roanoke city, Virginia	1	0	0	0	2	0	3
1500000US517700003001	5.18E+11	Block Group 1, Census Tract 3, Roanoke city, Virginia	0	2	6	7	0	0	15

1500000US517700030001	5.18E+11	Block Group 1, Census Tract 30, Roanoke city, Virginia	0	0	0	0	1	2	3
1500000US517700031001	5.18E+11	Block Group 1, Census Tract 31, Roanoke city, Virginia	0	0	0	4	0	0	4
1500000US517700004001	5.18E+11	Block Group 1, Census Tract 4, Roanoke city, Virginia	0	0	0	0	2	2	4
1500000US517700005001	5.18E+11	Block Group 1, Census Tract 5, Roanoke city, Virginia	3	3	6	5	0	1	18
1500000US517700006011	5.18E+11	Block Group 1, Census Tract 6.01, Roanoke city, Virginia	1	0	2	2	2	0	7
1500000US517700006021	5.18E+11	Block Group 1, Census Tract 6.02, Roanoke city, Virginia	2	1	0	10	0	1	14
1500000US517700009001	5.18E+11	Block Group 1, Census Tract 9, Roanoke city, Virginia	10	9	2	0	0	3	24
1500000US517700001002	5.18E+11	Block Group 2, Census Tract 1, Roanoke city, Virginia	0	6	0	2	4	5	17
1500000US517700010002	5.18E+11	Block Group 2, Census Tract 10, Roanoke city, Virginia	8	8	5	5	0	5	31
1500000US517750101002	5.18E+11	Block Group 2, Census Tract 101, Salem city, Virginia	5	0	0	0	0	4	9

1500000US517750102002	5.18E+11	Block Group 2, Census Tract 102, Salem city, Virginia	0	0	0	0	8	4	12
1500000US517750103002	5.18E+11	Block Group 2, Census Tract 103, Salem city, Virginia	4	0	0	1	0	0	5
1500000US517750105012	5.18E+11	Block Group 2, Census Tract 105.01, Salem city, Virginia	0	0	10	9	0	0	19
1500000US517750105022	5.18E+11	Block Group 2, Census Tract 105.02, Salem city, Virginia	1	0	0	2	0	0	3
1500000US517700012002	5.18E+11	Block Group 2, Census Tract 12, Roanoke city, Virginia	3	2	8	7	0	5	25
1500000US517700018002	5.18E+11	Block Group 2, Census Tract 18, Roanoke city, Virginia	1	0	0	0	0	0	1
1500000US517700019002	5.18E+11	Block Group 2, Census Tract 19, Roanoke city, Virginia	0	0	0	0	0	0	0
1500000US517700021002	5.18E+11	Block Group 2, Census Tract 21, Roanoke city, Virginia	0	0	0	0	10	4	14
1500000US517700022002	5.18E+11	Block Group 2, Census Tract 22, Roanoke city, Virginia	0	3	1	0	3	3	10
1500000US517700023002	5.18E+11	Block Group 2, Census Tract 23, Roanoke city, Virginia	4	5	0	6	0	0	15

1500000US517700024002	5.18E+11	Block Group 2, Census Tract 24, Roanoke city, Virginia	0	10	0	0	6	4	20
1500000US517700025002	5.18E+11	Block Group 2, Census Tract 25, Roanoke city, Virginia	10	9	0	0	1	3	23
1500000US517700026002	5.18E+11	Block Group 2, Census Tract 26, Roanoke city, Virginia	1	0	6	0	0	2	9
1500000US517700027002	5.18E+11	Block Group 2, Census Tract 27, Roanoke city, Virginia	9	0	0	0	1	4	14
1500000US517700028002	5.18E+11	Block Group 2, Census Tract 28, Roanoke city, Virginia	0	0	7	1	4	0	12
1500000US517700029002	5.18E+11	Block Group 2, Census Tract 29, Roanoke city, Virginia	2	0	0	0	3	0	5
1500000US517700003002	5.18E+11	Block Group 2, Census Tract 3, Roanoke city, Virginia	1	0	0	4	0	1	6
1500000US517700030002	5.18E+11	Block Group 2, Census Tract 30, Roanoke city, Virginia	0	0	0	0	5	0	5
1500000US517700031002	5.18E+11	Block Group 2, Census Tract 31, Roanoke city, Virginia	0	0	0	0	0	0	0
1500000US517700004002	5.18E+11	Block Group 2, Census Tract 4, Roanoke city, Virginia	2	0	10	9	5	0	26

1500000US517700005002	5.18E+11	Block Group 2, Census Tract 5, Roanoke city, Virginia	2	2	7	0	1	0	12
1500000US517700006012	5.18E+11	Block Group 2, Census Tract 6.01, Roanoke city, Virginia	7	0	0	0	0	0	7
1500000US517700006022	5.18E+11	Block Group 2, Census Tract 6.02, Roanoke city, Virginia	0	0	2	3	0	0	5
1500000US517700009002	5.18E+11	Block Group 2, Census Tract 9, Roanoke city, Virginia	0	9	0	0	4	4	17
1500000US517700001003	5.18E+11	Block Group 3, Census Tract 1, Roanoke city, Virginia	5	2	0	0	0	3	10
1500000US517750101003	5.18E+11	Block Group 3, Census Tract 101, Salem city, Virginia	0	0	0	1	2	1	4
1500000US517750102003	5.18E+11	Block Group 3, Census Tract 102, Salem city, Virginia	0	0	0	0	2	0	2
1500000US517750103003	5.18E+11	Block Group 3, Census Tract 103, Salem city, Virginia	2	0	0	0	1	0	3
1500000US517750105013	5.18E+11	Block Group 3, Census Tract 105.01, Salem city, Virginia	0	0	0	0	2	0	2
1500000US517750105023	5.18E+11	Block Group 3, Census Tract 105.02, Salem city, Virginia	0	0	0	0	0	0	0

1500000US5177000 12003	5.18E+11	Block Group 3, Census Tract 12, Roanoke city, Virginia	4	0	0	0	0	0	4
1500000US5177000 18003	5.18E+11	Block Group 3, Census Tract 18, Roanoke city, Virginia	0	0	0	0	0	0	0
1500000US5177000 19003	5.18E+11	Block Group 3, Census Tract 19, Roanoke city, Virginia	5	1	5	9	0	0	20
1500000US5177000 21003	5.18E+11	Block Group 3, Census Tract 21, Roanoke city, Virginia	7	0	0	0	10	6	23
1500000US5177000 23003	5.18E+11	Block Group 3, Census Tract 23, Roanoke city, Virginia	0	8	9	0	8	0	25
1500000US5177000 24003	5.18E+11	Block Group 3, Census Tract 24, Roanoke city, Virginia	6	10	0	0	1	5	22
1500000US5177000 25003	5.18E+11	Block Group 3, Census Tract 25, Roanoke city, Virginia	8	10	0	0	0	4	22
1500000US5177000 26003	5.18E+11	Block Group 3, Census Tract 26, Roanoke city, Virginia	10	0	0	1	0	9	20
1500000US5177000 27003	5.18E+11	Block Group 3, Census Tract 27, Roanoke city, Virginia	2	0	0	0	5	5	12
1500000US5177000 28003	5.18E+11	Block Group 3, Census Tract 28, Roanoke city, Virginia	0	0	0	0	0	8	8

1500000US517700029003	5.18E+11	Block Group 3, Census Tract 29, Roanoke city, Virginia	0	0	1	0	1	0	2
1500000US517700003003	5.18E+11	Block Group 3, Census Tract 3, Roanoke city, Virginia	2	0	10	10	0	0	22
1500000US517700030003	5.18E+11	Block Group 3, Census Tract 30, Roanoke city, Virginia	0	0	0	0	4	2	6
1500000US517700031003	5.18E+11	Block Group 3, Census Tract 31, Roanoke city, Virginia	0	0	0	6	0	0	6
1500000US517700004003	5.18E+11	Block Group 3, Census Tract 4, Roanoke city, Virginia	0	0	0	0	8	0	8
1500000US517700005003	5.18E+11	Block Group 3, Census Tract 5, Roanoke city, Virginia	4	0	1	0	3	4	12
1500000US517700006013	5.18E+11	Block Group 3, Census Tract 6.01, Roanoke city, Virginia	1	0	0	0	2	2	5
1500000US517700006023	5.18E+11	Block Group 3, Census Tract 6.02, Roanoke city, Virginia	3	0	0	0	4	2	9
1500000US517700009003	5.18E+11	Block Group 3, Census Tract 9, Roanoke city, Virginia	0	8	0	0	0	0	8
1500000US517750101004	5.18E+11	Block Group 4, Census Tract 101, Salem city, Virginia	1	0	0	0	1	0	2

1500000US517750102004	5.18E+11	Block Group 4, Census Tract 102, Salem city, Virginia	3	0	1	0	0	9	13
1500000US517750103004	5.18E+11	Block Group 4, Census Tract 103, Salem city, Virginia	3	0	0	0	1	4	8
1500000US517750105024	5.18E+11	Block Group 4, Census Tract 105.02, Salem city, Virginia	0	0	0	0	0	1	1
1500000US517700018004	5.18E+11	Block Group 4, Census Tract 18, Roanoke city, Virginia	2	1	0	0	0	0	3
1500000US517700019004	5.18E+11	Block Group 4, Census Tract 19, Roanoke city, Virginia	0	0	0	0	0	0	0
1500000US517700023004	5.18E+11	Block Group 4, Census Tract 23, Roanoke city, Virginia	5	3	0	2	0	0	10
1500000US517700025004	5.18E+11	Block Group 4, Census Tract 25, Roanoke city, Virginia	8	7	3	0	0	6	24
1500000US517700027004	5.18E+11	Block Group 4, Census Tract 27, Roanoke city, Virginia	5	0	10	0	0	0	15
1500000US517700028004	5.18E+11	Block Group 4, Census Tract 28, Roanoke city, Virginia	6	0	1	0	0	1	8
1500000US517700029004	5.18E+11	Block Group 4, Census Tract 29, Roanoke city, Virginia	0	0	0	0	7	0	7

1500000US517700031004	5.18E+11	Block Group 4, Census Tract 31, Roanoke city, Virginia	0	0	0	0	0	0	0
1500000US517700005004	5.18E+11	Block Group 4, Census Tract 5, Roanoke city, Virginia	0	1	0	3	0	0	4
1500000US517700009004	5.18E+11	Block Group 4, Census Tract 9, Roanoke city, Virginia	10	6	0	0	0	10	26
1500000US517750102005	5.18E+11	Block Group 5, Census Tract 102, Salem city, Virginia	0	0	0	0	7	0	7
1500000US517700027005	5.18E+11	Block Group 5, Census Tract 27, Roanoke city, Virginia	4	0	0	1	0	4	9

Appendix 2.2 : Total EJ INDEX SCORING, Top Scoring Block Groups (Highest Concentration of EJ Pops)

GEO.id	GEO.id2	GEO.display-label	**CORE EJ INDEX**				**IMMOBILITY EJ INDEX**		**TOTAL EJ INDEX**
Id	Id2	Geography	Poverty EJ Score	Minority EJ Score	LEP EJ Score	HISP EJ SCORE	**Elderly EJ Score**	Disability EJ Score	
1500000US517700025001	5.18E+11	Block Group 1, Census Tract 25, Roanoke city, Virginia	10	9	7	2	0	4	**32**
1500000US517700010002	5.18E+11	Block Group 2, Census Tract 10, Roanoke city, Virginia	8	8	5	5	0	5	**31**
1500000US517700004002	5.18E+11	Block Group 2, Census Tract 4, Roanoke city,	2	0	10	9	5	0	**26**

		Virginia							
1500000US51770009004	5.18E+11	Block Group 4, Census Tract 9, Roanoke city, Virginia	10	6	0	0	0	10	**26**
1500000US51770012002	5.18E+11	Block Group 2, Census Tract 12, Roanoke city, Virginia	3	2	8	7	0	5	**25**
1500000US51770023003	5.18E+11	Block Group 3, Census Tract 23, Roanoke city, Virginia	0	8	9	0	8	0	**25**
1500000US51770009001	5.18E+11	Block Group 1, Census Tract 9, Roanoke city, Virginia	10	9	2	0	0	3	**24**
1500000US51770025004	5.18E+11	Block Group 4, Census Tract 25, Roanoke city, Virginia	8	7	3	0	0	6	**24**
1500000US51770025002	5.18E+11	Block Group 2, Census Tract 25, Roanoke city, Virginia	10	9	0	0	1	3	**23**
1500000US51770021003	5.18E+11	Block Group 3, Census Tract 21, Roanoke city, Virginia	7	0	0	0	10	6	**23**
1500000US51770024003	5.18E+11	Block Group 3, Census Tract 24, Roanoke city, Virginia	6	10	0	0	1	5	**22**
1500000US51770025003	5.18E+11	Block Group 3, Census Tract 25, Roanoke city, Virginia	8	10	0	0	0	4	**22**
1500000US51770003003	5.18E+11	Block Group 3, Census Tract 3, Roanoke city,	2	0	10	10	0	0	**22**

		Virginia							
1500000US51770001001	5.18E+11	Block Group 1, Census Tract 1, Roanoke city, Virginia	7	9	0	0	1	3	**20**
1500000US51770024002	5.18E+11	Block Group 2, Census Tract 24, Roanoke city, Virginia	0	10	0	0	6	4	**20**
1500000US51770019003	5.18E+11	Block Group 3, Census Tract 19, Roanoke city, Virginia	5	1	5	9	0	0	**20**
1500000US51770026003	5.18E+11	Block Group 3, Census Tract 26, Roanoke city, Virginia	10	0	0	1	0	9	**20**

Appendix 3: Stakeholder Survey Results

Stakeholder Survey: Question 1	
1) In general, what should transportation planners consider when they are assessing whether EJ populations are disproportionately burdened (or denied benefits of) transportation projects?	
Answers (Category)	**Answers (Verbatim)**
Access	1. Ease of access to transportation 2. Accessibility 3. Access to transit 4. Disabled access to services 5. Access to benefits measured as access to points of interest by multiple modes 6. Accessibility/presence of sidewalks, crosswalks, ped signals that are ADA friendly. Is there a less impactful alternative? Impacts on residential areas. 7. Safe pedestrian access since many people either walk, ride bikes to get to shopping areas, etc.; 8. Transportation planners might consider the effects of their decisions on EJ communities' access to grocery stores, health services, schools and place of employment

Aesthetics	1. Aesthetics
Benefits & Burdens	1. Are we adding benefit to them as well? For example, a passenger or light rail system that has a stop close to this population would have benefit. A highway splitting farmlands or encroaching on a neighborhood would not. 2. Positive benefits such as access to jobs, social and other activities should be considered as well. The last thing we would want EJ to do is to unintentionally guide planners toward some unintended de facto isolation of said communities. In short some sort of "net benefit" or "net burden" determination should be made to the extent that it is possible.[9]
Bike/ Pedestrian	1. Bike lanes 2. Accessibility/presence of sidewalks, crosswalks, ped signals that are ADA friendly. Is there a less impactful alternative? Impacts on residential areas. 3. Safe pedestrian access since many people either walk, ride bikes to get to shopping areas, etc.;
Demographics	1. Know the demographics of the area
Displacement	1. Displacement 2. Relocations 3. Routing that does not break up communities.
Disproportionate Impact	1. They should examine the proportion of these projects that benefit or harm white or middle/upper class neighborhoods versus minority and low-income neighborhoods. 2.They should consider specific impacts the project(s) will have on the neighborhood, both direct (i.e. accessibility to public transport, traffic changes, etc.) and indirect (i.e., water quality, land degradation, change in public services such as schools as a result of changing property values and accessibility). 3. Evaluate which residents will be burdened/impacted and of those ... who will have or not have the capabilities to afford evolving around the proposed action. 4. Will the environmental burden of the project disproportionately impact a community 5. If highways are being built in an area primarily populated by minorities.
Environmental	1. Pollution 2. Exposure to cumulative risk of air toxics 3. Ground level ozone. Asthma 4. The incorporation of stormwater treatments that not only treat water but also beautify their communities (rain gardens, tree boxes) and the inclusion of more trees and possibly pocket parks or working landscapes (gardens) within or adjacent to ROW 5. Air and water quality
Financial/ Economic	1. Discounted rates for EJ populations 2. Fare prices 3. Distribution of funding to EJ areas 4. Economic impacts 5. Does the project amplify pre-existing social/economic vulnerabilities?

[9] This EEJAT 2016 does indeed have a "Benefits and Burdens" matrix

	6. To really try to avoid the "easy, cost-effective engineering 'thing' to do" this might usually mean the straightest path of a highway and simply cut off or remove EJ populations. 7. Whether a project brings economic benefit to an area which could realistically be created in another area.
Gentrification	1. Gentrification 2. Whether the project divides a community or drastically changes its character
History	1. History of racial discrimination, especially from past transportation projects.
Housing	1. Where possible, partnering with housing improvement agencies to do home repairs or helping older residents with home access issues
Intersections of Vulnerabilities/ Amplifications	1. They should consider the ways that multiple vulnerabilities can intersect to amplify the relative inaccessibility or level of burden when it comes to transportation access. For example: gender and poverty intersections when a female head of household is using public transport to not only get herself to and from work, but to access childcare. Or mobility and poverty intersections.
Mobility/ Route Design	1. Routes that consider connection between EJ homes and essentials or key shopping centers or areas of employment 2. Enough bus stops/routes 3. Routes that take into account EJ populations 4. How structure changes, cuts off or isolates existing community. Will transportation project link community to needed resources not available in community. What are alternatives for routing the project that have solid data behind why a different alternative is better. 5. Mobility changes 6. Routing that does not break up communities; Consideration in general of how those individuals move through their landscape and how projects can work with their needs.
Noise	1. Noise
Representation/ Engagement	1. Ignoring the opinions and ideas of the majority of those affected and listening to those who profit from it or have enough status to relocate a route away from their properties is not justice. 2. Are those impacted community given sufficient voice in the decision making process. 3. Public involvement 4. Work with the affected population to determine how best to improve the allocation of funds to improve the quality of life for the affected population.
Social	1. How to mitigate social impacts 2. Does the project amplify pre-existing social/economic vulnerabilities? 3. I recommend the addition of social scientists being involved in the transportation planning phases. See the work of William Julius Wilson and others who share insights on the demographics, etc. of minority populations who might also overlap into the "EJ" population category.
Other	1. Many factors such as age, race and ethnicity, income, disability, and vehicle availability by household.

Stakeholder Survey: Question 2

2) Which populations should be considered "EJ populations?" (N=42)	
Population	**Percentage of Respondents who Selected this Population**
Low-income	95.2%
Minority (non-white)	76.2%
Disabled	66.7%
Limited English Proficiency	64.3%
Hispanic	59.5%
Elderly	57.1%
Other	28.6%

Stakeholder Survey: Question 3

3) Currently, EJ Populations are identified based on U.S. Census data at the Census block group level. Do you agree with this approach? (N=42)	
Answer	**Percentage of Respondents**
Yes	32.5%
No	25%
Other	42.5%

Stakeholder Survey: Question 4

4) How do you define “equity” relating to environmental justice and transportation? (N=42; not all survey respondents responded to question)
Responses

Jemez Principles is a good start.
The poorest member of the community and richest member of the community can get to and from daily priority locations with the same ease and convenience.
People without cars should be able to travel safely and reliably.
Listening to those who would be affected directly and working to either alter a route, or if impossible, to eliminate as many hardships as possible, regardless of the monetary value.
Access and impacts of transportation investments and infrastructure should be equitably shared across the community. Environmental Injustice as it relates to transportation systems would mean a disproportionate level of adverse impacts (air pollution, pedestrian fatalities, fragmented communities, degradation of natural ecosystems, isolation from nature, car-dependency) would tend to fall on populations with limited political and economic capital to push back against those decisions.
Rich white people don't need to have tons of bus routes because they have cars. Bus routes and bike lanes should be provided for those who are less able to afford cars and have greater needs for transportation. For example, it's not necessary for McLean in NOVA to have a whole metro line built there. They all have cars. There should be more access to transportation for minorities and low-income houses. Also, when making decisions on where to build highways, low income or minority neighborhoods should not be picked to build through before white neighborhoods. If those types of changes are happening, the community also should be properly informed before decisions are finalized.
Equity" could refer to the equal treatment and development of transportation projects in neighborhoods regardless of race or economic class, or a slightly larger proportion of beneficial projects in EJ populations to help balance the existing societal inequalities that decrease transportation accessibility and quality of life for EJ populations.
A fair process that distributes the negative effects below without disproportionately penalizing the groups above.
Equity = Not being significantly impacted or moved from the current state of being. All actions have some effect but the impact needs recoverable with minimal change to current financial or social status.
Measured Benefits which address historical, current, and future transportation actions
When transportation projects are based on area needs rather than service to a specific group. No transportation projects should be undertaken unless they can be proven as a need or will boost the economy.
Equal access and availability; not disproportionately affected by negative consequences of transportation projects
Fair and Just.
No group has disproportionate exposure to environmental hazards and lack of political capacity.
I think transportation needs to include sidewalks and neighborhood safety
Benefits to those impacted are equal to or greater the adverse impact.

All citizens rich and poor, old and young gain 'equity' (in the sense of community 'equity value') when a transportation system is properly constructed and accessible by all.
Benefits and adverse effects of project are not distributed justly to populations project serves
Are the projects benefit to the impacted community proportional to the environmental impacts put on the community.
Whether EJ populations have the transit access they need to get to work, education, recreation and worship.
I would define equity in its most basic and broad sense - equal treatment for all people.
EJ populations shall not be denied access to benefits of the transportation system or disproportionately exposed to harm
Planners acknowledging inequalities in income, education, and opportunity and developing transportation solutions that assist these disadvantaged populations in closing the quality of life gap between themselves and those who have the most material wealth and opportunity in their communities.
When planning decisions are made equally among all residents not just on how much a house costs or value of land.
Parity or State of parity.
Equal consideration of the effect of transportation construction on the quality of life of adjacent populations. Attempt to insure equal opportunity by transportation choices to access educational facilities, libraries, medical facilities, potential places of employment, etc.
The increased access to transportation facility or modes. For example, if a new highway is coming, then maybe have several direct access points to the new highway. These access points serve all modes: public transit, pedestrian, biking, sidewalks, pedestrian bridges, etc.
"Equity" might be if access and environmental quality are held to the same or greater standards in EJ neighborhoods.
Benefits of transportation facilities are shared evenly among population and outweigh negative impacts to individuals.
People who would not otherwise have reliable access to transportation to get to work, shopping centers, medical appointments, etc.
Don’t have an answer.
As an effort to provide transportation improvements that do not fracture intact communities and in some cases are even designed to bring people together.
Since I live in a suburban county where you literally can’t get to any services without a car, I would say equity would be providing safe and connected bike/ped infrastructure at a minimum, perhaps transit and other alternatives, too.
Providing equal access to jobs, housing, and leisure activities that others have.

Offering a variety of transit options- not just emphasizing one mode and no others. Not denying transit options to a segment of the population due to their built environment.
Equity would be providing access to various modes of transportation that can be used be people of all abilities. ie. ADA considerations for bike/ped facilities.
The transportation system has the same level of quality throughout, regardless of the makeup of the population in the area.
Affordable and easy access to neighborhood, work, and leisure destinations.
All people get the same representation and consideration.
For me, equity is an opportunity and access based concept. Outcomes are important, but it is extremely difficult to ensure equity in outcomes. Ensuring equity in opportunity and access is a good first step toward improving outcomes.

Stakeholder Survey Question 5

5) When transportation planners are measuring transportation-related EJ effects, which effects should they consider? (N=42)	
Effect	**% of Respondents**
Accessibility	85.7%
Noise	85.7%
Air Quality	83.3%
Safety	83.3%
Water Quality	83.3%
Displacement	81%
Mobility	81%
Aesthetics	78.6%
Community Effects	78.6%
Other	73.8%

Property Values	69%
Land Degradation	66.7%
Hazardous Waste	66.7%

Stakeholder Survey Question 6

6) How should planners achieve meaningful stakeholder engagement of EJ populations? (n=42; not all survey respondents answered question.)	
Answers (Category)	**Answers (Verbatim)**
Forums	1. Community forums
Organizations	1. Coordination with organizations that represent and work with EJ populations 2. Through partnership with local service organization and outreach meetings 3. They need to connect meaningfully to groups representing low income people from impacted neighborhoods as well as individual stakeholders. 4. Coordinate with a local church in an economically disadvantaged or minority community to set up a visioning charrett in a fellowship hall, or work to get information out through the school system and set up a meeting in the gym or cafeteria with third-party facilitators. A personal concern is the piecemeal nature of analysis and what may be a minimal emphasis on an integrative and comprehensive analysis of cumulative effects, which is a required component of NEPA analysis. 5. Outreach in existing social groups, i.e. church & civic groups. 6. Find an established elderly group, families, parents, activists, etc. and build a rapport with them.
Leaders	1. Coordinated efforts with elected officials representing these communities 2. Meet with community leaders 3. Develop partnerships with key community leaders 4. Poor disadvantaged populations need an experienced advocate to represent their interests. 5. Choose advocates for people when they can't or don't know how to advocate for themselves. 6. Community leaders should be involved in the process as early as possible to guide the planning of the project so that the community will reap more benefits than costs. 7. Consult with council members who represent the involved neighborhoods. 8. Working with the population, finding local champions
Engagement in decision-making	1. Include EJ community leaders in meetings with technical team and decision-makers, to assist with transparency, stakeholder feedback, and

	education of constraints 2. Include them meaningfully in transportation planning decisions from the earliest feasible stage of a transportation project 3. Community involvement at all levels of planning 4. By engaging the public early in the transportation planning process and reaching out to advocates for vulnerable populations who may assist development of the long range transportation plan. 5. Maybe if there were more dialogue between EJ populations and planners, if people felt heard. 6. Asking for their solutions not telling them our solutions.
Meeting people where they are / invest time	1. Meet people where they are, even if you need to bring buses to the neighborhoods multiple times. 2. Many meetings and discussions held in and around the potentially affected areas, giving those affected ample opportunity to engage and voice their concerns. One or two in an area not easily accessible by those stakeholders is not acceptable. 3. Community-relevant outreach 4. Listen to their stories and act on them 5. Purposely and sincerely invite engagement. Have people who look like and sound like stakeholders inviting and participating in engagement. Take the public meetings to the public and welcome discourse. 6.Time invested in the community, learn what their perceived needs are and work to address them prior to the planning process 7. Door to door- churches other community gathering places to speak where they are at. Dont make them come to you. 8. In my opinion, a goal of equitable treatment would be to focus on ways to ensure EJ populations are engaged in the process by developing methods to better equalize their access to information, resources, engagement opportunities, etc. In terms of engagement, I think a particular emphasis should be placed on early "visioning"-level planning on proposed transportation solutions vs. later stage design considerations. This might be accomplished through particular targeted efforts, such as meeting them where they are. 9. Take the time to target the EJ population and engage them. Literally, go to the heart of the particular EJ area and demonstrate, explain, communicate the proposed changes to the people. 10. Hold public input meetings in the affected areas 11. This takes going to the community to receive input in various ways whether that involves community workshops, online surveys, small group meetings, or any other form of communication that facilitates discussion. 12. Meeting people in their neighborhoods at their convenience, variety of outreach tools (meetings, door-door, website, social media, etc.) 13. Reach out to gathering places in the community, possibly churches or schools and get feedback from residents on what they envison from the community.
Enabling services/ provisions	1. Food and drink should be served, and child care offered.

	2. Get into the neighborhoods and provide childcare, beverages and snacks.
Surveys	1. More surveys like this one! 2. Phone surveys 3. Survey residents and have real open honest conversations as many times as they can. 4. Consider surveys or charettes.
Notifications / Transparency	1. Also properly notifying neighborhoods of either changes or opportunities for change. 2. I do not know specific methods that this would be effective, but it is important that EJ populations are aware of the effects projects may have on their home and community and have the ability to participate in a discussion of the project and its effects on their quality of life. It is difficult to find an effective means to achieve this, as many EJ populations have lower accessibility to public transport, longer work weeks and thus less free time to participate in these discussions, and/or speak English as a second language. 3. Transparency 4. Public outreach and early participation. 5. Public meetings 6. Be truthful about the basis and reasoning of "environmental justice" 7. Public meetings, personal outreach.
Networks	1. Figure out their "weak ties" and go through them to build engagement and involvement (maybe medical and social services networks?) 2. By leveraging existing community networks
Multimedia	1. Multimedia and community outreach
Impact assessment	1. Social impact assessment. Public interest design. Environmental justice collaborative problem solving model.
Incentives	1. Using a “small wins” approach in a variety of efforts and communications channels. Contests and prizes may even be appropriate to encourage participation.
Other	1. Planners tend to exclude meaningful stakeholders such as Urban Foresters in planning decisions.

Stakeholder Survey Question 7

7) Insert any additional comments here
Comments

Thank you for bringing attention to this hugely divisive topic.
I love this survey
I do think that access to affordable transportation to get to work is vital. Expanding bike and pedestrian facilities can be effective.
The "Goods Movement" is a real, verifiable, critical phenomenon.
You are mixing too many legal issues in your list of "EJ effects" and drifting away from the true 'environmental' issues (which apply equally to everyone already). Be truthful and recognize that transportation planning often incorporates urban renewal. So the real question is how best to accomplish urban renewal with minimal environmental impact and appropriate engineering controls, regardless of the make-up of the neighborhood, village, community..
My experience has been that EJ issues are typically considered by state and local governmental agencies only where federal funding will be applied to a project. Agencies/governments typically have great discretion about what discrete projects federal funding is applied to. Since addressing EJ severely complicates big projects and agency inertia is typically against dealing with EJ issues, I have seen the segmentation of large projects and avoidance of the putting federal funding into areas where EJ is likely to apply. Same is true of historic resources and water resource/wetland impacts. Pretty big loophole.
I believe when trying to improve engagement in disadvantaged/ underrepresented populations with respect to transportation, the local-level of government is the most important group to lead the effort. Helping local officials and grassroots organizations accomplish this by providing guidance and resources from other various levels would be ideal - as many communities may wish to do something along these lines, but lack the resources (funding, experience, staff, time, etc.) to do so.
The biggest issue I see with planning around EJ is no one cares until a tragedy or hazard happens. People ask why did this happen but by then it's too late. It's not an issue until it becomes one. Minorities and disadvantaged people have way to much on their plates to have EJ issues be on their radar until someone draws a line between the their quality of life and the injustices. Even then, most people don't know how make change or become heard. The time to say, "Not in my backyard" is in the beginning, not the end.
https://www.epa.gov/environmentaljustice/equitable-development-and-environmental-justice
Yes, great research! You seem to be single-handedly solving the problem, wow! You made me think of something: I once took the regular AMTRAK train and while I was waiting the AMTRAK Acela (high-speed train) ferociously, yet smoothly passed by the station where I was (New Carrollton, MD). The Acela does not stop at all stations along its route. I wondered if New Carrollton, MD would be considered an EJ population. In other words, there are not comfortable benches to sit down on the station's upper platform and the train comes through between 120-160 miles per hour? It was dangerous and scary. How many stations along the Acela's path are just speedily and dangerously sped by? (The Acela is the business class train of AMTRAK).
Provide reliable transportation. I lived in a college town and relied on the city bus. I would get to the bus stop two hours early of where I needed to be. If the bus did not come within the first hour, I'd call a taxi because I knew that the bus had broken down. The poor bus service would not work for people who had to rely on it.
This is very important because in many cases, cities and transportation agencies have not kept

community needs in mind and their actions have led to fractured neighborhoods, negative health effects, crime and a feeling that there is a lack of concern for their overall quality of life. Inclusion at the earliest stages of a project is critical and can result in more meaningful projects that not only solve transportation concerns but also result in multiple benefits for the citizens who live there.
Sometimes a workforce development issue masquerades as a transportation issue and sometimes a transportation issue masquerades as a workforce development issue. Figuring out a better connection between workforce development and transportation will help with EJ efforts in a very direct way. Workforce development may even move some communities that are currently evaluated as “low income” to improve to an “average income” status.