

**Equal Partners at Every Level of Decision Making:  
Environmental Justice and the Policy Process**

**DISSERTATION**

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By

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## **Abstract**

Public policies affect a wide range of stakeholders, intentionally and unintentionally, individually and collectively. Environmental policy, in particular, can affect the social and natural environments, and have broad effects beyond those intended by policymakers. This dissertation represents an effort to confront these complications by focusing on the socioeconomic equity effects of a set of environmental policies. Using a framework that encompasses a holistic approach to public policy and management research, the dissertation consists of three related projects that, taken together, describe in deep detail the how environmental policy decision making is affected by concerns over environmental justice. The first project is an aggregate evaluation into how the U.S. Environmental Protection Agency (EPA) prioritizes the cleanup of hazardous sites nationwide. Using data from the EPA and U.S. Census, quantitative analysis reveals that the EPA tends to prioritize those sites deemed most risky, and that sites located in predominantly minority communities may proceed more slowly through the initial phases of the cleanup process, but are not less likely to ultimately be cleaned up than other sites. The second study is an investigation of three cases of localized projects that affect community environmental conditions. Using the comments provided during the preparation of three Environmental Impact Statements (EISs), this qualitative, exploratory project sheds light on the propensity of high socioeconomic status residents

to engage in collectively organized action as compared to lower socioeconomic status residents, but finds that such collective action is of limited efficacy in achieving parochial interests of community residents. The third project is an attempt to explore the potential effects on neighborhoods of the mitigation of environmental risk. With little empirical data available to directly assess these affects in the aggregate, this project uses an agent-based model to simulate several counterfactual policy alternatives to determine the relative advantages of different strategies in terms of mitigation environmental risk, and of doing so as equitably as possible.

Dedicated to:

Stephanie Eckerd

Mike and Sally Eckerd

Earl and Beverly Scott

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### **Fields of Study**

Major Field: Public Policy and Management

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*“Environmental Justice demands the right to participate as equal partners at every level of decision-making, including needs assessment, planning, implementation, enforcement and evaluation.”*

Principle 7 (of 17) adopted by the *First National People of Color Environmental Leadership Summit* (Washington, DC, 1991).

## **Chapter 1: Introduction**

The process through which an idea becomes a public policy is unquestionably complicated. On paper, the track is simple; the legislative branch passes a bill to an executive who signs and submits it to an agency or set of agencies to implement. The policy gets implemented, and the social system changes accordingly. In reality, this simple process is complicated by considerations regarding how an issue becomes important enough to be considered by the legislature, how the legislature designs a policy, how a bureaucratic structure determines the process through which the policy will be implemented, and if and how the policy ultimately affects individuals and society. Furthermore, policies affect more than individuals; they affect organizations and societies as well, and analyzing results at one level may miss important activities that occur at other levels. Policies take effect in societies that are constantly in flux, with people and organizations constantly acquiring and reacting to new information and new sets of

circumstances. Much like the societies in which they operate, policies are dynamic. As the people who affect and are affected by the rules acquire new information, they change policies and the contexts in which policies operate. Sometimes these changes are substantial, and sometimes they are subtle, but the one constant with public policy, a constant that creates an unending challenge for scholars of public policy and management, is change.

This dissertation is an effort to, in part, embrace this challenge. In this introduction, I will first describe how my theoretical framework, which uses a multi-disciplinary lens of environmental justice policy, may help public policy and management scholars make sense of complicated policy areas. I will then describe how a multi-method approach to the study of this complex policy area can help scholars and practitioners see issues from a holistic perspective rather than a disjointed amalgam of diverse points of view. Finally, I will describe how a dynamic, interactive view of the public policy lifecycle process may help scholars understand how and when certain actors' roles are comparatively more important in a policy system's lifecycle.

#### Theoretical framework: A multi-disciplinary lens

No longer thought of as a linear set of stages with a well defined starting point and subsequent discrete steps, contemporary public policy process frameworks tend to place public policy activity within a political subsystem perspective (Sabatier, 2007). Instead of a focus on the machinations of some nebulous elite set of individuals (Mills, 1956) that create policy and hold it steady to ensure their place in society, today the

policy process is mostly thought about in the context of interactions and relationships between various coalitions, organizations, interest groups and political actors. Political relationships between stakeholders play a key role in these contemporary views, whether the advocacy coalition framework (Sabatier and Weibel, 2007), a specific stakeholder perspective (Ingram, Schneider and deLeon, 2007) or the policy windows framework (Kingdon, 2003). This emphasis on political activity rightly accounts for one of the key problems with the traditional “stages” (Lowi, 1964) approach, in which political activity, to the extent that it played a role, was minimized, with the elite “iron triangle” framework being the most explicit example of a politics-minimizing framework.

These more recently devised points of view, however, tended to overstate the political abilities and capacities of political actors. Issue networks (Heclo, 1978) essentially limited policy discussion to ephemeral groups that formed and disbanded as politically necessary. The advocacy coalition framework suggested a long-term structure to these networks, but also made a crucial assumption that the coalitions were constantly tuned in to the policy subsystem of interest. This overemphasis on issue attention and politics has subsequently set the tone for the largely task and goal oriented network governance frameworks (Adam and Kriesi, 2007), which once again tend to deemphasize politics, but overemphasize the capacity for cooperation and compromise.

Difficulties finding consistent empirical evidence about the relevance of these frameworks may be due to their inability to account for a process that seems at once to be both stable yet prone to rapid change, to be politically contentious but yet often foster a high degree of consensus, and to involve people at different levels of activity from the

individual, organizational and societal. A viable policy process framework must on the one hand acknowledge the central importance of politics, but on the other hand, recognize the limits of political activity due to power imbalances and the issue attention cycle (Cobb, Ross and Ross, 1997). Individual stakeholders, organized interests, and public organizations are important in the policy process, but not equally important at all times. Legislators and public managers are important, but again, not equally important at all times. At certain points in the policy lifecycle, some actors, be they individuals or organizations, take center stage while at other points, these actors' roles recede. The decisions made by central actors at one stage affect the boundaries of available decisions by actors later (Ostrom, 2011). Different actors make multiple decisions throughout the process that affect the policy outcomes as well as potentially change the content, goals and even the stakeholders and groups interested in the policy. At any point, actions taken in previous stages of the policy lifecycle inform as well as constrain the decisions that actors can make going forward (Kay, 2005).

As a result of these complications, in many policy areas, multiple, often contradictory, theoretical frameworks appear empirically valid. My framework for this dissertation is of policy lifecycle framework using the example of environmental justice policy. Environmental justice is an issue area in which different theoretical views all appear to offer cogent explanations for the empirical evidence that lower socioeconomic status populations tend to live with lower environmental quality (Ringquist, 2005). Thus, lower socioeconomic groups (however defined) may be less likely to politically organize and engage in collective action, thereby limiting their ability to influence policy decisions

(Rich, et al., 1995). Or the problem might be that elites, looking to benefit other elites, make decisions that explicitly keep lower environmental quality in lower status neighborhoods (Mohai and Bryant, 1992). Or, the outcome may simply be the result of market-based interactions, whereby in a dynamic residential environment, those who can afford it are willing to pay a premium to live with higher environmental quality, leaving those with fewer resources in lower quality areas (Hamilton, 1995). Each of these three explanations is plausible, and in fact, empirical evidence can be found to support each idea (Pastor, Sadd, and Hipp, 2001; Hamilton, 1995; Campbell, Peck, and Tschudi, 2009; Daley and Layton, 2004; Ringquist, 2005; Kriesel, Centner and Keeler, 1996). It is likely that some combination of these three disparate processes working together is responsible for empirical results, but this combination of processes is difficult to describe under existing policy process frameworks, and neither the Schonian (1979) “swampland” nor the Kingdonian (2003) “primordial soup” metaphors provide satisfying explanations for a policy system that appears to have at least some systematic basis.

Furthermore, each of these three different processes may take place at different levels of social interaction, at different stages of the social system lifecycle. When framing environmental justice in the market context, the unit of analysis tends to be at the individual or household level, and research tends to find that individuals and households make decisions based on their ability to pay for environmental quality. When framing it in a political context, researchers tend to see that a lack of political/social organization is a key to unequal environmental outcomes. When framing the study in an organizational context, researchers tend to find evidence that elite decision makers use their own

individual frames of reference when they make decisions that affect low status communities with the result that lower status communities are less likely to be policy beneficiaries.

These complications get to the heart of what differentiates the study of public policy and management. As a practically oriented field of study, scholars must keep an eye on the applicability of their research to the practice of public policy and management. To do so requires a multi-disciplinary lens that can make sense of different, not necessarily congruent, theoretical frameworks that appear to explain some phenomenon. Dealing with such complications requires a holistic view of the policy area in question; narrow frameworks often yield adequate evidence of narrow results. In the traditional social science disciplines, a narrower framework makes sense. Economists are interested in how individuals make decisions, while sociologists and political scientists tend to be more interested in groups and organizations. These foci enable scholars in those fields to test relevant theories and contribute to the canons of their discipline. In public policy and management, scholars must focus not only on contributions to the disciplinary canon but also on contributing useful analysis to governmental decision makers. Therefore, a different lens is required, one that is open to finding the congruencies between diverse theoretical points of view, and understanding a policy or management area holistically rather than narrowly.

Throughout this dissertation, I frame the study of the environmental equity implications of a set of environmental policies with a recognition that, much like the societies in which policies operate, policies themselves are dynamic and they function at

different levels of social interaction. This dissertation is an effort to understand the complexities of environmental justice by applying different theoretical frameworks and methodological approaches to a holistic study of environmental justice across different units of analysis and levels of social interaction. The basic framework is provided in Figure 1.

**Figure 1: Framework for holistic understanding of environmental justice**

<b>Level of activity</b>	Societal	Organizational	Individual
<b>Key actors</b>	Interest groups, legislators, experts, media	Public organizations, decision-makers, nonprofits, for-profit firms	Individuals
<b>Social science perspective</b>	Political science	Sociology	Economics
<b>Decision-making criteria</b>	Political rationality	Organizational rationality	Individual rationality
<b>Unit of analysis</b>	Collectives	Organizations/Organizational decision makers	Individuals
<b>Theories</b>	Pluralism, power theories	Elitism, structuralism	Market theories
<b>Why is there environmental injustice?</b>	Insufficient access to decision-makers; power imbalances	Elite/technocratic decision-maker biases	Reaction to changes in market conditions; poor cannot afford environmental quality
<b>Solution</b>	Participation by stakeholders	Prioritization/targeting beneficiaries	Incentives to share risk/burden

As illustrated in Figure 1, I try to make sense of a policy area where the causes of a problem are overdetermined and the appropriate solutions to address the problem are not necessarily congruent. If we assess environmental injustice from a societal level, we

are likely to conclude that collectives without political power have insufficient access to policy makers. Since policy makers cannot weigh unheard points of view, these points of view do not affect the decision making process and are thus ignored. By ensuring that groups without political power have access to policy makers, we can address the problem and ensure that all voices are heard and decision makers can select alternatives with the full breadth of information required. Indeed, since attention first became focused on the problem of environmental injustice, a key solution has been to open access to policy makers through open comment periods, public scoping requirements and other inducements to include the public in decision making. The focus of Chapter 3 is an effort to determine how these public participation mechanisms affect environmental justice outcomes.

If we assess environmental justice from an organizational level, we are likely to conclude that elite decision makers opt for policy alternatives that, at best, ensure the viability of the status quo for other elites, or more nefariously, create worse environmental scenarios for low status groups. That is, whether intentionally or subconsciously, decision makers will favor policy solutions that favor their own social classes and the solution to this problem is to procedurally compel decision makers to include the effect of their decisions on lower socioeconomic classes in their assessment of policy alternatives. Thus, we have seen a wide array of different environmental policy decision making criteria that incorporate an assessment of the effect of policy choices on traditionally underserved groups. In Chapter 2, I assess the relative efficacy of a policy that mandates such a consideration on addressing environmental inequities.



Finally, if we view environmental justice as an individual-level phenomenon, we will likely conclude that each individual or household makes decisions about where to live based, in part, on the environmental quality found in a community. If the individuals have sufficient wealth, they will locate in neighborhoods with good environmental quality, and if they do not have wealth, they must maximize their welfare by choosing homes in communities with lower prices, but also with lower levels of environmental quality. The result of environmental injustice is simply a function of the price premium one must pay for better environmental quality. We have therefore seen policy remedies that attempt to address these issues through the targeted cleanup of environmental hazards in low status communities, and targeted economic development to spur the private sector into cleaning up (or at least not polluting) such neighborhoods. Chapter 4 is an exploratory exercise to understand how individuals making decisions about where to live can aggregate into substantial changes in neighborhoods and environmental quality differences between social classes.

#### Methodology: Fischer's levels

Although my emphasis in this dissertation is on using the framework presented in Figure 1 to understand a set of policies within one policy area, my methodological approach follows quite closely with the policy evaluation procedure and framework described in Fischer's *Evaluating Public Policy* (1995). Fischer laid out a framework that depicts a holistic approach to evaluating a public policy, as illustrated in Figure 2. He moves beyond an emphasis on evaluation based on some quantifiable output, to

incorporating a variety of perspectives and methods in order to consider not only these outputs, but also outcomes, meanings, and the contingencies associated with a policy area. Fischer conceives of policy evaluation as taking place on two distinct levels: first-order (or first level), and second-order (second level). First-order analysis is the nuts and bolts of policy evaluation; outputs and outcomes are tracked in order to grasp the extent to which the policy has successfully met its goals. Analysis at this level tends to be done via traditional quantitative policy analysis methods, and also via more qualitatively oriented research in order to assess the extent to which the policy has fostered positive outcomes that may not be easily quantifiable. Second-order analysis moves beyond consideration of how well a particular policy met its goals, to investigate how well the policy reflects the social system from whence it came. Analysis at this level is more philosophically-oriented, focusing on the meaning of the policy, and the assumptions underlying its design. Researchers may assess whether the behavioral assumptions of the policy actually match the observed behavior of actors in the system, or they may try to determine how the policy fits within a broader framework of rules governing action in the society. Where first-order analysis is an evaluative estimation of a policy's effects (either quantitative or qualitative), second-order analysis is an exploration of the policy's implications and meaning.

Fischer's (1995) approach combines useful insights from quantitative/empirical research, modeling/experimentation techniques, and qualitative/interpretative studies. The methodological plan sketched out aims to take advantage of the various strengths of each approach, while mitigating weaknesses in an effort to create an end result that

provides both context and generality to policy analysis, and a fuller picture of the effect of a given public policy. First-order evaluation attempts to deal with the specifics of a particular policy with the goal of providing useful information to policymakers and the public about the efficacy of a policy by using statistically oriented quantitative analysis techniques, as well as interpretive or in-depth case study qualitative approaches. The emphasis in the first order is empirical. Chapters 2 and 3 are first-order analyses of a set of environmental policies.

**Figure 2: Fischer's policy analysis framework**

<b>Level of analysis</b>	First-order	Second-order
<b>Focus</b>	Specific policy	Policy context
<b>Concerns</b>	Verification and validation	Vindication and social choice
<b>Criteria</b>	Outcomes and objectives	Goals and values
<b>Methodological approach</b>	Empirical, evaluative	Philosophical, exploratory
<b>Methods</b>	Statistical, interpretive	Argumentation, simulation

Second-order analysis could be conducted through a variety of methods such as simulation, complexity analysis, philosophical techniques and critical analysis. The effort on the second level is to determine a policy's coherence with a society's values, and/or to determine whether the behavioral assumptions underlying the policy in question fit with the society in which the policy is implemented. Rather than an empirical evaluation of the

policy's efficacy, the emphasis turns to exploring the policy's fit with society and the potential consequences it could engender. At the second level of analysis, the possibility to provide insight for overarching theory is perhaps more promising than with first-order analysis. Whether a given policy is an effective and valid means through which to accomplish social change is a practical matter, an extremely important practical matter perhaps, but outputs and direct outcomes may be dependent on a host of factors, such as policy design, implementation factors, and politics. Estimating individual policy outputs may enable researchers to test the validity of an underlying theory, but will not likely provide insights thorough enough to derive theory. To derive theory, research must be exploratory, and the analysis must be broader (Sabatier, 2007). The analysis undertaken in Chapter 4 is from a second-order perspective.

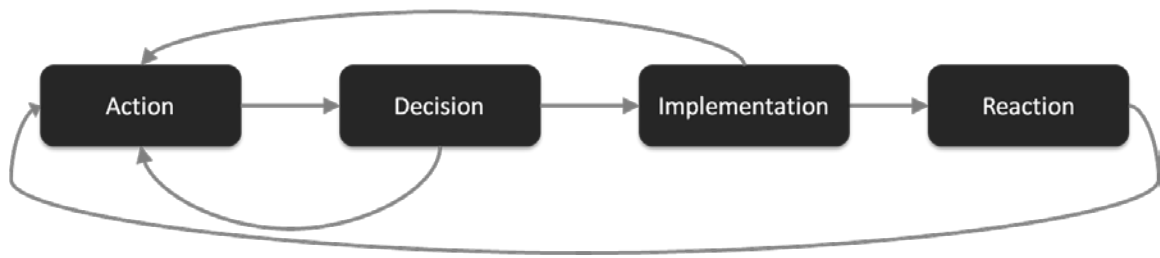
#### Context: Dynamic public policy

A further complication for scholars of public policy and management is that public policies do not come out of thin air – they are products of an underlying structure of society. A policy at any given time is a manifestation of the rules and norms, institutional processes, and actions taken in the past (Hodgson, 2000) by a given society, that followed some path through its history to arrive at its current incarnation (Ostrom, 2011). That history is irreversible, and future events are bounded by the past and by societal and institutional rules (Brown, et al., 2005). From this point of view, policies can be thought of as “generative” in the sense that while they emerge from complex dynamic systems (societies in the case of a policy), such emergence is neither necessarily chaotic

nor unpredictable (Chomsky, 2006). As the rules under which we agree to live (either explicitly through action, or implicitly through inaction), policies are the manifestations of our society's view on the most appropriate way in which to govern ourselves at any given time.

This dissertation is undertaken from a point of view that the policy lifecycle is a dynamic process, where different actors at different points in time are more influential than others. Rather than a linear progression from beginning to end, I view the policy process similar to most contemporary frameworks, as a path-dependent lifecycle system where decisions previously made provide feedback (either as information or constraints) for subsequent decisions (Sabatier, 2007). As illustrated in Figure 3, sets of actors and stakeholders undertake actions that augur in the alterations that policies undergo, which in turn affect policy maker decisions. The policy is implemented and has some operational lifespan during which time actors and stakeholders react to the changes brought about by the policy, which in turn may constitute a set of actions that once again alter the context of policy maker decisions. Stability can be disrupted at any time by the actions or reactions of interested people, whether stoked to action due directly to the policy itself or due to some change in circumstances. There may be periods of stability, but not of stasis; a policy is constantly in flux. At all times, actors are reacting (even if only subtly) to how the policy has affected the social system(s) in question.

**Figure 3: A dynamic policy process framework**



Theory, methods, and context

Thus, this dissertation is undertaken via three key frames of reference in order to inform public policy and management scholarship and practice. First at a theoretical level, I am interested in understanding the complex interactions that occur within a policy area on three different levels of human interaction: the individual level, the organizational level and the societal level. Through this effort, I hope to contribute to public policy and management scholarship by offering a framework that may enable researchers to acknowledge the multi-disciplinary nature of our field of inquiry while also providing a context for the complexity of doing so. By incorporating theories at three different levels of human interaction, I hope to make an incremental improvement in how we, as public policy and management scholars, can make sense of cases where multiple, potentially incongruent theories appear equally empirically valid.

Second, at a methodological level, I attempt to understand a policy area holistically by considering both specific policies as well as the social systems in which those policies are implemented. To address this interest, I utilize the Fischer (1995) framework consisting of policy analysis at two distinct levels utilizing the strengths of three different methodological approaches. Through this effort, I hope to assist public

policy and management scholars by providing an example of a multi-method approach that may be useful when considering complex policy areas. Furthermore, by trying to match the right method to the research question asked, it is my hope that the sum total of this research endeavor will better inform policy decision making for addressing environmental justice by providing decision makers with a more thorough point of view, rather than disjointed snippets of research from divergent social science points of view.

Third, my contextual view is of the policy process as a dynamic lifecycle where policy is rarely settled, and information is constantly flowing between different actors in the process. I use this contextual framing mechanism to understand the ways that the different theoretical lenses depicted in Figure 1 actually affect the environmental justice policy area as depicted in Figure 3. Through this effort, I hope to couch my study within generally existing policy models that describe the dynamic, interactive nature of the process. Using this policy process model as a guide, I now turn to a discussion of the specific policy issue addressed, environmental improvement and environmental justice, and describe the three projects undertaken in an effort to develop a deep understanding of this issue.

### Environmental justice

The environmental policy realm is complicated – environmental policy decisions affect both the physical and social environments (Wolverton, 2002). While the impacts of policy on the physical environment have long been a core of environmental science study, consideration of the effects of environmental policy on the social environment,

particularly in terms of the social equity implications of environmental policy, is relatively young. Beginning with the Commission for Racial Justice (CRJ) Study for the United Church of Christ in 1987, research on ‘environmental injustice’ has generally found that lower socioeconomic status populations tend to live with lower levels of environmental quality than do higher socioeconomic status populations. Although variable according to how one defined “low socioeconomic status”, empirical research has generally lent credence to this proposition, consistently finding evidence of a gap in the environmental quality with which different demographic populations live (Mohai and Bryant, 1992; Ringquist, 2005). However, despite this evidence that lower socioeconomic status groups, particularly racial minorities, are more likely to live in proximity to lower environmental quality, there is much disagreement regarding the cause (Kriesel, Centner and Keeler, 1996; Campbell, Peck, and Tschudi, 2010).

As described previously, there are generally three distinct explanations of the phenomenon (Hamilton, 1995). First is an elite view exemplified by the CRJ report, commonly associated with *environmental justice* or *environmental racism* research, whereby it is posited that elite decision makers avoid exposing themselves (and other elites) to environmental risk, and therefore, at best, inadvertently site risk with low socioeconomic status groups, or more nefariously, actively work to place more risk in lower status areas (Agyeman and Evans, 2003). A second causal explanation is based on an economic or a market-based view, centered on the Tiebout sorting hypothesis (1956) and the Coase Theorem (Hamilton, 1995). Under this view, individual residents have a variety of preferences in determining where to live, and two prominent preferences are



low prices and low environmental risk. Those with the means to do so value environmental quality and pay a housing premium to live in areas with low environmental risk (high environmental quality). The poor, having no ability to pay the premium for high environmental quality, tend to settle in areas that have higher environmental risk (lower quality), but lower prices. In these higher risk areas, land values are depressed making them more attractive locations for owners or policy makers to site new hazardous facilities, both in terms of initial purchase prices, but also in terms of the potential liability associated with the increase in risk to the area posed by the facility. Should an accident occur, subsequent costs will be lower if land in the vicinity is also valued lower. The third causal view is based on collective action and political power, and posits that when considering where to site hazardous facilities, owners or policymakers will opt for locations where they expect relatively little political conflict, or where the political opposition will tend to be disjointed and ineffective. Not coincidentally, areas where political action tends to be either weak or disorganized also tend to be poorer neighborhoods or those with more minority residents (Hamilton, 1995).

In a policy system, action can take any form of behavior undertaken by interested actors (Ostrom, 2011). There may be collective action, whereby some set of individual actors coordinate efforts for the purposes of affecting policy, but there may also be individual actors who undertake activities in isolation. Broadly, Sabatier and his coauthors' Advocacy Coalition Framework (2007) offer a discussion of the various types of actions, collective and otherwise that can be undertaken, but action may well extend beyond the political system, into personal relationships, business activities, and more

general actions that occur at the societal level that may initially appear to have little to do with any individual policy. Nevertheless, when discussing environmental justice, the focus centers on the importance of collective action, both as an explanation of, and potential strategy useful to mitigate environmental injustice.

A widely accepted explanatory view of environmental injustice is based on a presumption that the absence of collective action increases the probability that a community will be the site of an environmental hazard (Hamilton, 1995). There is ample evidence of the effectiveness of NIMBY (not in my back yard) efforts at thwarting the placement of environmental hazards (Dear, 1992; McAvoy, 1998; Fischer, 1993), and thus bringing about more preferable outcomes for the residents that do organize against a proposed undesirable land use (environmentally hazardous or otherwise) (Kraft and Clary, 1991; Wolsink, 1994). Since collective action is more likely amongst higher socioeconomic status groups (Dear, 1992), lower status populations are more likely to see environmental hazards in their neighborhoods as both private firms and governments seek to avoid political controversy, as well as the transaction costs associated with related political maneuverings (Hamilton, 1995). It seems evident that, all else equal, organized communities are better able to achieve more desirable outcomes, at least for themselves (or, from another perspective, force undesirable outcomes on disorganized communities). Furthermore, it is likely that as residents successfully thwart undesirable land uses, they become more emboldened by victory and organize for other purposes, perhaps to encourage desirable land uses (Rich, et al., 1995). Trust builds amongst individuals in the

collective as the organized communities' efforts are rewarded, more desirable outcomes follow, and the community becomes part of the local governing regime (Stone, 1989).

Similarly, when residents are unorganized and haphazardly oppose undesirable land uses, siting disamenities in their community becomes far easier for decision makers. Furthermore, failure in collective efforts instills a sense of frustration, reducing the likelihood that future collective efforts will be successful. Over time, this frustration results in a probability that whenever an undesirable land use is necessary, the unorganized community will be an attractive site (Rich, et al., 1995).

Expressed more generally, over time, collective action is rewarded with favorable outcomes which encourage further collective action. Lack of collective action likely leads to less favorable outcomes, discouraging future collective action. Collective action informs the decisions made by policymakers, whether directly in the case of public input having a specific effect on the decisions by policymakers, or indirectly when political decision makers seek to avoid political opposition and controversy. In either case, policymakers receive information from organized interests whether in the form of direct pleas for preferred outcomes, or through perceived constraints on considered options as policymakers seek to avoid creating a need for action by an interest whose preferences and proclivities toward collective action are known (or at least strongly suspected) in advance. Ultimately decision making authority rests with policymakers; information from an organized interest is a source, but not the only source, of information that policymakers consider. It may vary by importance with other factors to be discussed, but at the very least, the political action (or expectation of political action) by a concerned

community almost certainly places boundaries around the options that policymakers perceive are available to them.

Environmental policy decisions are often amongst the most politically contentious decisions that policymakers face (Fischer, 1993). With well organized interests, strong values, inflexible norms at stake, and little room for compromise or consensus building, decisions tend to be seen as creating winners and losers (McAvoy, 1998). Making a decision that affects environmental quality is necessarily an effort to coordinate vast amounts of information and determine which trade-offs are appropriate, with the understanding that some amount of environmental degradation is assured if the general standard of living is to be maintained. Information flows from community interests, but also from economic interests, environmental interests, policy analysts, and others. Whether the policy in question is an effort to improve environmental conditions or a project that will create environmental externalities, policymakers help define the rules under which a policy will be implemented, stakeholders will be affected, and firms will operate. In short, the policy sets the rules for the context in which the policy has its effect, and in setting these rules, policymakers must necessarily determine who wins and who loses, and to what extent various trade-offs affect this calculation.

Since information flows to policymakers from the actions and activities of various sources, it is extremely unlikely that collective action by interests will be the sole source of information driving the decision, but when interests engage in collective action, they ensure that their preferences are, at the very least, heard. Those policymakers may or may not make an optimal decision (from the interest's perspective), but at the very least are

aware group preferences. However, since trade-offs must be made, not all of the information policymakers receive will be given equal weight, and some will be less heeded in favor of other information. What is certain, though, is that information not received by policymakers is information that cannot be considered and that action not undertaken by interested stakeholders cannot affect the revisions to the policy that emerges from the social system.

This is not a controversial statement, of course. The same can be (and has been) said about virtually all policy decisions. Decisions are bounded by the extent of information available to policymakers, and information that is missing (for whatever reason) cannot be considered in the decision making process, and while decisions may ultimately be based on partisan identity or ideology, most policy decisions are local in nature, not especially salient with the broad public and not particularly ideologically charged (Kettl, 2000). However, even in cases where ideology is the predominant factor, information can be useful for affirming or rationalizing an ideological predilection or potentially for swaying an ideologically conflicted policymaker, or even bring the power of democracy to bear in creating a level of awareness and interest amongst the general public that is strong enough to affect specific decisions (Weiss, 1989). In policy areas where ideology is more tempered, information regarding stakeholder preferences and the likelihoods of potential outcomes can be an especially important basis for the decisions made by policy makers (Thomas, 2010).

However, decisions are not end points in a policy lifecycle, and one of the innovations of the advocacy coalition framework (Sabatier and Jenkins-Smith, 2007) is

the acknowledgement that policy is rarely “settled”. Although the advocacy coalition framework does not explicitly coordinate theories of policy processes with those of organizational theory and public management, there was at least an understanding that policy continues to be adapted and readapted even after it has been implemented.

Environmental policies operate over several dynamic systems in which a change in one system necessarily affects other systems. When an environmentally hazardous facility is built, it affects residential patterns, the natural environment, the local economy, etc. And changes in each of these systems can, in turn, change the other systems. Thus, the adaptation can be quite radical, and what emerges from the actions taken by interested parties and the reactions that bring in new stakeholders can be very different from the policy that existed before.

During the implementation and operational phases, public managers and street level bureaucrats are responsible for most of the decision-making, and these decisions could potentially be amongst the most important in the policy lifecycle (Pressman and Wildavsky, 1973). Decisions made during implementation and subsequently during the day-to-day operation of a policy/law would tend to be those that are least subject to, but not completely divorced from, the political process (Thomas, 2010). Once policymakers have determined that a particular location will be the site of a hazardous facility (or will be redeveloped), various decisions made along the way affect the outcomes near the location. Public managers ultimately decide which projects to prioritize, how quickly to proceed, to what extent risk should be minimized, and what sorts of adjustments need to be made as new information becomes available. The public has been given the

opportunity to be increasingly involved in these activities and decisions (Yackee, 2005), but ultimately, the decision lies with public employees trained in an atmosphere of neutral competence, but not especially well trained in public engagement or seeking harder to reach populations (Jewell and Bero, 2006). Thus, implementation and operational decisions are likely to be made on the basis of institutional norms (Nixon, et al., 2002). These institutional norms within a public organization or government may dictate the types of decisions that public managers are expected to make (Tolbert and Zucker, 1996), regardless of the activities of affected populations. Decisions that may appear to be elitist or made without consideration of environmental justice, may in fact be decisions that were made under information and institutional constraints (although, of course, they may also have been elitist or racist/classicist). Nevertheless, the implementation and operation of a policy is what leads to the reactions and subsequent activities that keep policies in flux. Day-to-day decisions alter the context of the policy system, and affect the individuals and organizations that are most directly affected by the policy. From the initial implementation, then, early outcomes feed information back to the public managers who make incremental alterations to the operation of the policy machinery. These incremental changes then incrementally change outcomes and so on (Lindblom, 1959).

It is the aggregation of these incremental changes and affects on individual stakeholders that constitute the outcomes of and the effect of the policy. The most individually-focused part of the policy lifecycle is period during which policy stakeholders react and adapt to the implemented policy. Since residential (or Tiebout

(1956)) sorting is one of the primary means through which people are expected to react to changes in environmental quality, outcomes can either be viewed as neighborhood changes, which are the aggregate sum of individual outcomes or with regard to the residential location effect a policy has had on a specific stakeholder. When the environment in an area is degraded, wealthier families will have a tendency to move away from an environmental hazard, relocating to an area with better environmental quality (Banzhaf and McCormick, 2007). Similarly, when the environment improves, demand by the wealthy for residences in the site's vicinity is also expected to rise, increasing prices and potentially forcing a relocation of the poor away from the cleaned up site to areas where the environmental quality remains relatively low (Eckerd, 2011). These changes affect both how the policy itself operates, as well as the subsequent decisions regarding the general structure and operation of the policy. For instance, sorting about a site that has been cleaned and redeveloped may encourage policymakers to target a neighborhood for further redevelopment in the hope of encouraging substantial economic redevelopment. As this sorting and economic redevelopment occurs, it likely decreases the odds that a future hazardous facility will be built in the same area.

Furthermore, people do not just react to policy outcomes economically, they may also react politically. The consequences of policy may engender further collective action, may bring new stakeholders into the policy system, or alter or reinforce existing community power structures. Generally speaking, individual level outcomes affect what becomes of a policy. Individuals are motivated by their individual outcomes to either engage or not in collective action for the purposes of altering the design of the policy.



They may also be motivated (or not) to individually contact policymakers or public managers in the hope that they can affect incremental decisions on an individual level. In the aggregate, as policies are evaluated, information is fed back to each set of stakeholders and decision makers. Interest groups use information to illustrate to policymakers or the larger public as to why policies need to either be changed or maintained (Herrnson, et al., 2005). Policymakers use information and influence from the public to determine for themselves whether policies should be altered, continued or terminated. Public managers use evaluation information to determine prioritization and refinement in the rules for policy operation. These changes, in turn, affect policy outcomes which are then evaluated and changes are made once again.

#### Dissertation

This framework will generally guide the series of three research papers to follow. The dissertation is divided into three sections, each considering aspects of environmental improvement, justice, and the interactions between people and policies. The next chapter is an evaluation of the relationship between the implementation of brownfield site remediation and the characteristics of neighborhoods. This section is first-order (Fischer, 1995), establishing the context of the current situation regarding the relationship between environmental justice and environmental improvement from the perspective of organizational decision making. It investigates how the Environmental Protection Agency (EPA) balances its organizational mandate to improve environmental outcomes generally, while also improving environmental equity and keeping an eye on the economic

implications of redevelopment efforts. Using data regarding the grants that the EPA provides for the cleanup of brownfield sites, I investigate the extent to which the demographic nature of the community in which the site is located predicts the probability that the site will be cleaned. I assess these data quantitatively on an aggregate scale, finding that sites located in minority communities tend to proceed through certain phases of the cleanup process more slowly than sites located in predominantly white communities.

In Chapter 3, I investigate the relationship between implementers (public managers) and stakeholders to determine how the public participates in environmental decision making, and the extent to which this participation alters public managers' implementation. This section, while also a first-order (Fischer, 1995) investigation of several specific projects, is more interpretive than evaluative, with an interest toward understanding the social-level structures that underlie the relationship between public managers and the public at large. Using content analysis procedures, I interpret the activities of various interested actors in the Environmental Impact Analysis (EIA) process in order to more fully understand the context of collective action and decision making in the implementation of projects that affect environmental conditions on a micro rather than aggregate scale. In this research, I arrive at a set of conclusions that seem to point to a lack of trust between the public and government agencies, which endangers the legitimacy of environmental improvement projects while also discouraging genuine discourse regarding priorities.

Finally, in Chapter 4, through the use of a unique agent-based simulation model (ABM), I conduct a second-order analysis (Fischer, 1995) of the extent to which the behavioral assumptions underlying environmental improvement policies seem appropriate for the individual-level behavior that actually occurs in the system that they are intended to affect. The ABM models an environmental redevelopment scenario in order to test the potential relative efficacy of different policy prioritizations in a controlled environment. Through the data observed from the simulation trials, I find that different policy prioritization strategies may be required depending upon the goals of the policy, and that when policies are aimed at changing the policy context rather than the behavior of the individuals involved, individuals appear to be relatively resilient and adaptive to the changes to the system brought about by the policy.

## **Chapter 2: Going Green Together? Brownfield Remediation and Environmental Justice**

### **Introduction**

The U.S. Environmental Protection Agency (EPA) defines a brownfield as “a property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant.”<sup>1</sup> While much attention has been given to equity considerations in the siting of hazardous facilities that can eventually become brownfields (Been and Gupta, 1997; Banzhaf and Walsh, 2008), considerably less attention has been given to the decontamination and redevelopment of such sites or more generally to environmental improvement. This paper assesses whether there is a second side to what the literature refers to as “environmental justice” concerns. Do relatively lower socioeconomic status areas tend to see less environmental improvement than their higher status counterparts? Addressing this question is important not only because it expands investigation of environmental injustice to include cleanup as well as degradation, but also because if brownfield sites are both more likely to be located in poor and minority areas as well as less likely to be cleaned up, then this “second side” of environmental justice will show that the existing environmental equity gap addressed by prior study (focused on environmental

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<sup>1</sup>See <http://www.epa.gov/brownfields/overview/glossary.htm>. Web site viewed by author on November 2, 2010.

degradation rather than improvement) may be expanding at an even greater rate than suggested by scholarship on the topic.

In this paper, I investigate the prioritization of cleaning up brownfields using a framework that is based primarily on the argument most commonly seen in the environmental justice literature – that environmental quality in low status communities is likely to be worse than in higher status communities (Ringquist, 2005). I apply the framework to environmental improvement rather than degradation, detailing the pace with which brownfield sites progress through the cleanup process and including site-specific characteristics such as a unique hazard score in addition to community characteristics. The findings of my investigation are mixed; brownfield sites located in lower socioeconomic status areas are no more or less likely to be cleaned, but they tend to move more slowly through the early assessment stages of the cleanup process. In the next section, I provide a background review of environmental justice literature and describe why it is useful and important to address cases of environmental improvement in addition to the typical focus on environmental degradation. Next, I explain the empirical model, present hypotheses, and describe the data. The general hypothesis is that there are demographic inequalities in environmental improvement, much as there are demographic inequities in environmental degradation. In the last sections, I discuss the results and conclude with suggestions for policy development.

## Environmental justice

Awareness of and investigation into the issue of environmental justice largely began with the Commission for Racial Justice (CRJ) Study for the United Church of Christ in 1987. Since that study, a consensus has emerged among scholars that there is a robust relationship between minority status and living in proximity to lower environmental quality. Research has found that lower socioeconomic status populations tend to live with lower levels of environmental quality than higher socioeconomic status populations, particularly with regard to variation in environmental equity across different racial groups (Hamilton, 1995; Arora and Cason, 1999; Pastor, Sadd, and Hipp, 2001; Ringquist, 2005; Mohai and Saha, 2006; Campbell, Peck and Tschudi, 2009). However, while the correlation appears robust, the causal evidence is not conclusive (Kriesel, Centner and Keeler, 1996; Campbell, Peck, and Tschudi, 2009).

Within the environmental justice literature, three distinct explanations of the phenomenon are prevalent (Hamilton, 1995). First, in a view exemplified by the CRJ report (1987) commonly associated with the social activist tradition and *environmental racism* research, it is posited that elite decision makers, at best, inadvertently site risk with low socioeconomic status groups to avoid exposing higher socioeconomic status groups to environmental risk, or worse, they are actively discriminatory and seek to place more risk in lower status areas (Agyeman and Evans, 2003). A second causal explanation is based on an economic or a market-based view, centered on the Tiebout sorting hypothesis (1956) and the Coase Theorem (as described in Hamilton, 1995). Under this view, residents have a variety of preferences in determining where to live, two of which relate to the interaction between prices and environmental quality. Those with the means

to do so value environmental quality and choose to live in areas with high environmental quality, while the poor, having no ability to pay the premium for high environmental quality, tend to settle in areas that have lower quality. In these areas, land values are depressed making them more attractive locations for owners or policymakers to site new hazardous facilities, further depressing prices, which attracts even poorer residents to the area (Banzhaf and Walsh, 2008). The third causal view is based on the theory of collective action (Olson, 1965) and political power, and posits that when considering where to site hazardous facilities, owners or policymakers will opt for locations where they expect relatively little political conflict, or where the political opposition will tend to be disjointed and ineffective. Not coincidentally, areas where political action tends to be either weak or disorganized also tend to be poorer neighborhoods or those with more minority residents (Hamilton, 1995).

Regardless of the explanation, and regardless of the causal mechanisms to which one ascribes, findings have consistently shown that where there are hazardous facilities and poor environmental quality, there are also likely to be poor, and very likely minority, residents (Bullard, 1990; Goldman and Fitton, 1994; Wolverton, 2002; Ringquist, 2005, Kriesel, Centner and Keeler, 1996, Been and Gupta, 1997). The dominant way to describe this result is as a problem of “environmental justice.” The EPA defines this 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.”<sup>2</sup> A problem with regard to

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<sup>2</sup> <http://www.epa.gov/environmentaljustice/>

environmental justice would therefore indicate an “environmental injustice.” Although the term environmental justice could be argued to possess normative connotations regarding the cause of the phenomenon (Zimmerman, 1994), since it is the dominant term I will use it here to describe the field of literature investigating socioeconomic variations in environmental equity. I will refer to instances of an unequal distribution of environmental quality by race or economic status as “environmental injustice.” The primary focus of this paper is to examine the pace and prioritization of environmental cleanup from the environmental justice perspective that, regardless of procedural intent, decision-makers are likely to provide greater environmental improvement benefits to comparatively higher socioeconomic groups.

#### Environmental improvement: The other side of environmental justice

Virtually all existing environmental justice research relates to increased environmental risk or degradation (Ringquist, 2005). However, as the American economy transitions to post-industrial realities, decisions are increasingly likely to focus on environmental improvement and abatement of environmental risk (De Sousa, 2004). Thus, there is a second side of environmental justice outcomes that has not yet been considered extensively; in addition to living with higher levels of environmental risk, the poor and/or minorities may be the beneficiaries of less environmental improvement or of a slower abatement of environmental risk. To explore this second side of environmental injustice, I investigate the probability of brownfield site remediation and the length of time through which these remediation efforts complete phases of the cleanup process as a



function of the demographic makeup of the communities in which they are located. Based on the findings that minority populations and hazardous sites tend to be collocated, I posit that sites located in communities with larger minority populations are less likely to be remediated, and those that are, will move through the process at a slower pace.

By looking at the environmental justice issue through the pace and likelihood of sites being cleaned up, I am able to focus attention on the discrimination and political explanations more exclusively than in previous studies, where it was often difficult to separate the economic argument. Considering environmental cleanup in the economic sorting framework, one would expect that changes in environmental quality will appeal to certain types of residents (Banzhaf and Walsh, 2008). If environmental quality in a community decreases, then comparatively wealthier residents will leave and the demand for homes in the community will fall amongst other wealthier potential residents (Seig, et al., 2004). This will depress property values, making the homes affordable to those for whom environmental quality is a secondary consideration to price, if it is a consideration at all (Kohlhase, 1991). Thus, under this argument, the community in which a hazardous facility has been sited will come to be made up of poorer residents than those who were there prior to the siting – variations by minority status are taken as a function of the correlation between poverty and minority status. In the reverse situation, when the environment improves, wealthier residents and investors may see properties that are undervalued in a neighborhood that had, but no longer has, low environmental quality (Dale, et al, 1999). Subsequently, demand for these properties will increase, causing values to rise, incentivizing poor property owners to sell for a profit and relocate to an

area with lower prices, and potentially lower environmental quality (Seig, et al, 2004). That is, if one accepts this economic rationale, sorting behavior is most likely to occur reasonably close in time to either environmental degradation or environmental improvement.

An advantage of focusing on the period well after degradation has occurred (over 10 years in most cases used in this analysis) but before any improvement activities have begun, is that residential sorting factors are likely to be minimized. The environment in the community is likely not in significant flux prior to the cleanup of brownfields, thus even if we assume explanatory power of the residential sorting hypothesis, the extent to which sorting is occurring should be no more than would be normally expected at any random time. Hazardous facilities go through a lifecycle similar to any other facility. They are constructed, have some operational lifespan, and then are closed (Taboas, Moghissi, and LaGuardia, 2004). For a hazardous site, the operational period is likely the period of the most intensive environmental degradation, but unless a cleanup takes place, substantial pollution remains (Church and Nakamura, 1993). Sites become brownfields only after a facility has closed, and they become brownfields because pollution at the site makes reuse problematic without remediation and redevelopment. Thus, during the brownfield phase in the lifecycle of a hazardous facility, the site may not be actively producing pollution, but the pollution produced during the site's operational period remains. Little actual change in environmental quality is thus taking place; the site is already polluted, but it is not likely to be creating additional hazards, and the environment is also not improving unless the cleanup is quite far along (Church and Nakamura, 1993).

In such a period where there are no significant environmental quality changes taking place, there is little reason to suspect that economic incentives based on environmental quality are driving residents to sort either into or out of an area (although other economic incentives certainly could be). Thus, while external economic pressures may be a factor in determining cleanup, I expect that the decision will be more strongly influenced at this point by decision-maker preferences than by economic pressures, especially considering that most cleanup efforts are funded in large part by public organizations.

### Brownfields and risk

Brownfield sites can vary considerably in their extent of contamination and environmental risk posed. When a brownfield is especially contaminated, it is often included on the EPA's National Priority List (or NPL – but more commonly referred to as Superfund). Superfund sites receive considerable federal money (and scrutiny) and, while being the most hazardous, are also usually the most salient with the public (Messer, et al, 2006). As implied by the name of the program, NPL sites are the top EPA cleanup priorities and thus receive considerable policymaker attention, although there is also much variation with regard to the prioritization of different Superfund sites (Daley and Layton, 2004). Non-Superfund brownfield sites, which constitute the vast majority of brownfields, can still receive EPA funds through a variety of different grant programs. While some brownfields are assessed and cleaned exclusively with private funds, most cleanups receive some funding benefit, either in the form of grants and direct loans or via indirect methods such as tax incentives from federal, as well as state and local

governments (Meyer and VanLandingham, 2000). The prioritization of this second set of sites is less clear than with regard to Superfund sites; however, a key directive of the “Brownfields Law” requires the EPA to consider “the extent to which the [cleanup] grant would facilitate the identification and reduction of threats to the health or welfare of children, pregnant women, minority or low-income communities, or other sensitive populations” as well as give priority to grantees when “a community has an inability to draw on other sources of funding for environmental remediation and subsequent redevelopment of the area in which a brownfield site is located because of the small population or low income of the community.”<sup>3</sup>

Thus, the EPA is specifically directed to ensure that grants for brownfield cleanups are provided to low income and minority communities. However, provision of grants is not the same as prioritization of cleanup. The EPA has recently investigated the distribution of grants, finding that communities receiving brownfield grants tend to have larger minority populations and higher levels of poverty as compared to the national average, but this may simply be a factor of more sites being located in such communities, and again provides no indication about the prioritization of cleanups nor actual funding provided, only the distribution of grants<sup>4</sup>. In terms of prioritization, Hird (1990; 1993) investigated the cleanup prioritization of Superfund sites, finding that Superfund sites were neither more likely to be located in predominantly poor or minority counties, nor did the county’s characteristics predict the prioritization of the cleanup effort. Daley and Layton (2004) find that the EPA prioritizes remediation of those Superfund sites that are

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<sup>3</sup> Public Law 107-118 (H.R. 2869): "Small Business Liability Relief and Brownfields Revitalization Act"

<sup>4</sup> See: [www.epa.gov/brownfields/policy/ej\\_brochure\\_2009.pdf](http://www.epa.gov/brownfields/policy/ej_brochure_2009.pdf)

comparatively less risky especially in districts with influential Congressional representatives. Several studies tangentially consider justice outcomes by investigating changes in land values. Values decrease while brownfield sites in the Superfund subset are being cleaned up (McCluskey and Rausser, 2003) and increase once the cleanup has been completed (Dale, et al, 1999), however this increase may be limited by the visibility of the site and its salience with the public (Messer, et al, 2006). Some research has also considered how neighborhoods change after environmental conditions improve. Seig, et al (2004) noted increased land values in school districts after air quality improvements, while at a smaller unit of analysis, Eckerd (2010) found that neighborhoods in which environmental risk was reduced were no more or less likely to gentrify than other neighborhoods.

None of these analyses consider whether the current composition of a neighborhood predicts whether an existing site is cleaned, and they also mostly consider only highly salient Superfund sites. It is possible that there are inequalities not only in the distribution of environmental quality, but also in environmental remediation, and Superfund sites constitute a small subset of brownfields. Very few brownfield sites are actually on the NPL, perhaps 10% – and in fact, most brownfields are relatively low risk with comparatively low levels of contamination (or suspected contamination) (McCluskey and Rausser, 2003). Furthermore, most studies aggregate to the county level (Hird, 1993) or zip code level, (Arora and Cason, 1999; Seig, et al, 2004) almost certainly missing important effects at the neighborhood or community scale. Given the size of some counties and zip code regions, most residents are unlikely to be affected in any way

by a brownfield site, but when the site is located in their immediate neighborhood, it is significantly more likely to be close to their home. It should be acknowledged that focusing on census tracts, as I do here, may dampen effects that could be more pronounced by considering concentric rings surrounding a facility (Mohai and Saha, 2006), and that census tracts may not conform well to actual neighborhoods (Eckerd, 2010). Even given these possible shortcomings, my (our) analysis broadens the scope and context of Hird's (1993) analysis by considering a fuller range of hazardous facilities (all brownfield sites that receive any EPA funding, not just Superfund), and by investigating at a much more local geographic level (census tract).

My formal hypotheses flow from the discrimination argument, balanced by consideration of economic and collective action factors. Given the preponderance of evidence of environmental injustice by race (Ringquist, 2005), my primary hypotheses posit that brownfield sites will be disproportionately located in communities with relatively larger proportions of low socioeconomic status residents (H1), and that such sites will flow through the cleanup process more slowly and will be less likely to be cleaned up than sites located in predominantly higher status communities (H2). I also test a tertiary hypothesis rooted in the theory of collective action (Olson, 1965) positing that, controlling for racial and economic characteristics of local populations, sites in communities with less politically active residents will also proceed more slowly and be less likely to get cleaned up (H3). In other words, I expect that collective action on the part of community residents may have a mediating effect on the extent of environmental injustice that is likely in a community as a result of its racial and/or income

characteristics. Where residents are active and engaged in community interests, decision-makers may be more likely to adopt policies that are more favorable to community residents, even if those residents are perceived as being lower in socioeconomic status.

### Data and methods

To test these hypotheses, I use data regarding contamination at brownfield sites and their progress through the remediation process, census tract-level demographic data from the communities in which these sites are located, and tract-level voting data from three states. Information about the status of the cleanup process and extent of contamination at brownfield sites is self-reported from grant recipients to the EPA, which tracks detailed information about each site to which it provides some level of funding, including the site's geographic location, history, and an inventory of known and suspected contaminants. Information about the risk characteristics of these contaminants was acquired from the Indiana Relative Chemical Hazard Score (IRCHS)<sup>5</sup> data set, in which chemicals are scored and scaled based upon toxicity to human health and persistence in air, land and water, to allow for the comparison of the hazardous content of different types of chemicals. Demographic information for assessing socioeconomic status was derived from the 1990 and 2000 censuses – if a site cleaning was initiated during the 1990s, 1990 census data was used, and if a site cleaning began during the period from 2000-2009, 2000 census data were used. Finally, in an attempt to account for

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<sup>5</sup> The IRCHS is a product of the Clean Manufacturing Technology Institute at Purdue University. For a detailed description of the IRCHS, please see: [engineering.purdue.edu/CMTI/IRCHS/](http://engineering.purdue.edu/CMTI/IRCHS/)

the effect of political activity on cleanup decisions, state level voting data were acquired for three states: California, North Carolina, and Minnesota.

Three different sets of analyses are used to test the hypotheses. In the first (hereafter model 1), spatial patterns of brownfield locations are assessed using comparisons between characteristics of census tracts that contain brownfields with those that do not. These comparisons are used to understand the current distribution of brownfield sites to determine if brownfields tend to be distributed more heavily in lower socioeconomic status tracts, as one would expect given direction from environmental justice literature. Throughout this analysis, lower socioeconomic status tracts are defined as having some combination of low income levels, high proportions of minority residents, and low proportions of residents with bachelor's degrees. The second set of analyses (model 2) assesses the pace of site cleanups through survival analysis models predicting the likelihood of movement through phases of the cleanup process given the demographic characteristics of the tract in which a brownfield is located. I expect that sites in lower status tracts move through the process at a slower pace. The third set (model 3) uses logistic regression techniques to estimate the likelihood of a brownfield being cleaned up, holding all else constant, given the characteristics of the tract in which the site is located. I hypothesize that sites in lower status communities are, overall, less likely to be cleaned up.

For model 1, I compare census tracts that contain at least one brownfield site that received or receives some level of EPA funding with those tracts that do not contain a site. Thus, the dependent variable for this set of models is a dichotomous indicator



variable regarding the presence or absence of a brownfield site in a census tract; I use this differentiation for some basic comparisons and also to estimate a logistic regression equation predicting the presence of an EPA funded brownfield site. The unit of analysis is the full set of 2000 census tracts, normalized to use either 1990 or 2000 data, depending upon whether the site(s) in the tract began the cleanup process before or after 2000<sup>6</sup>. For the identification of tracts containing brownfield sites, all 6309 sites listed (as of October 2009) as having received EPA funding since 1990 are used in model 1, with subsets used for the estimates in models 2 and 3 based on data availability. It should be noted that the full sample of 6309 brownfield sites used here is likely not representative. There are various estimates of the total number of brownfield sites, ranging into the hundreds of thousands<sup>7</sup>. The sample used here is not representative in that sites that receive EPA funding are likely amongst the most hazardous and the most well-known. Further, as can be seen in Figure 4, the sites are almost certainly not distributed evenly geographically. As would be expected, brownfields tend to be concentrated near large populations in traditional industrial areas in the Northeast and Midwest. It is also clear from looking at the map that some states are clearly better at identifying brownfield sites and securing EPA grants for their cleanup (for example, see the border area between Oregon and Washington, between Maryland and Virginia, and the overall dearth of EPA funded sites in Texas). Nevertheless, this sample is representative of the most salient sites, and those sites for which remediation is perceived as beneficial to their community.

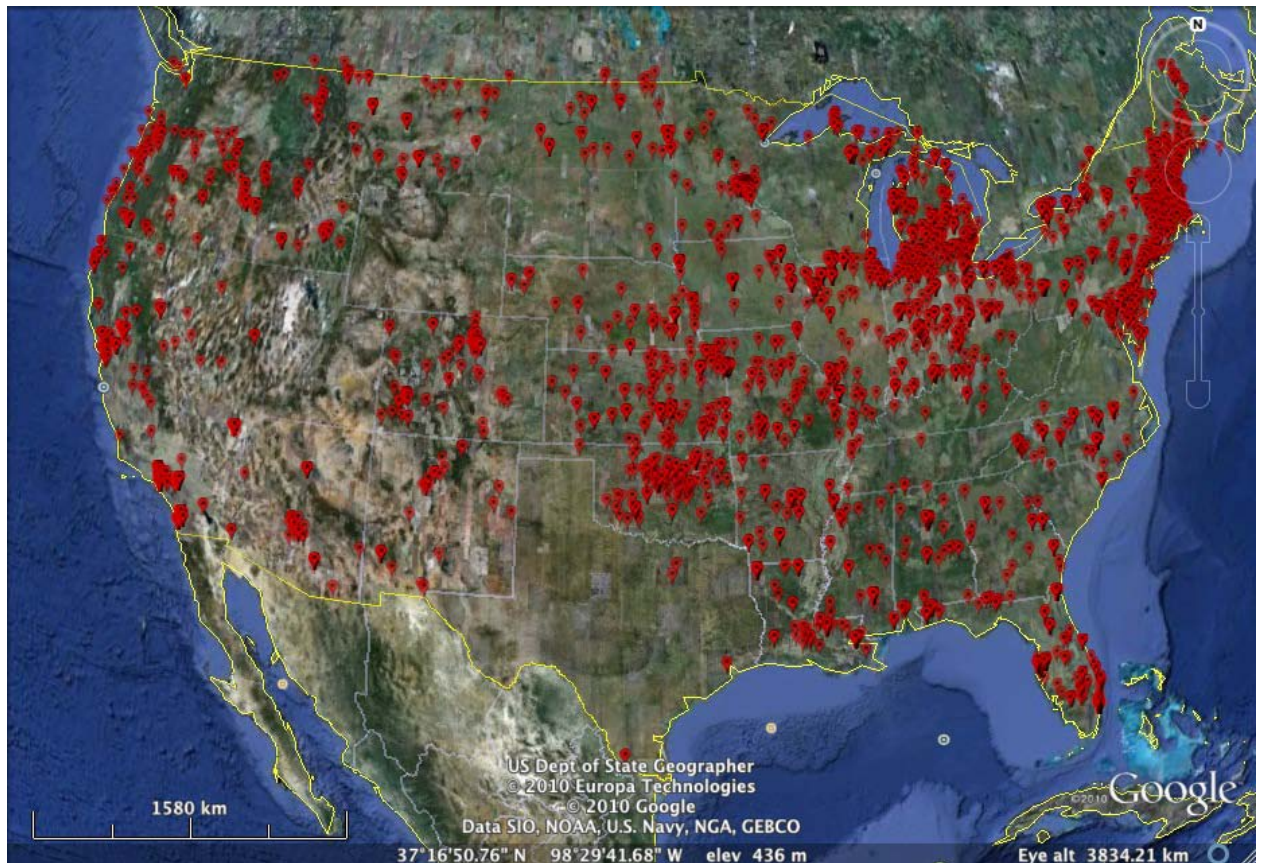
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<sup>6</sup> In cases where a tract had more than one site, for which cleanups began both before and after 2000, 2000 data was used for model 1.

<sup>7</sup> The US Government Accountability Office estimated in 2004 that there were between 450,000 and 1,000,000 brownfield sites nationwide, although this is probably a conservative estimate. See: <http://www.gao.gov/new.items/d0594.pdf>

These sites also constitute the entire set of brownfields considered under the EPA's environmental justice directive.

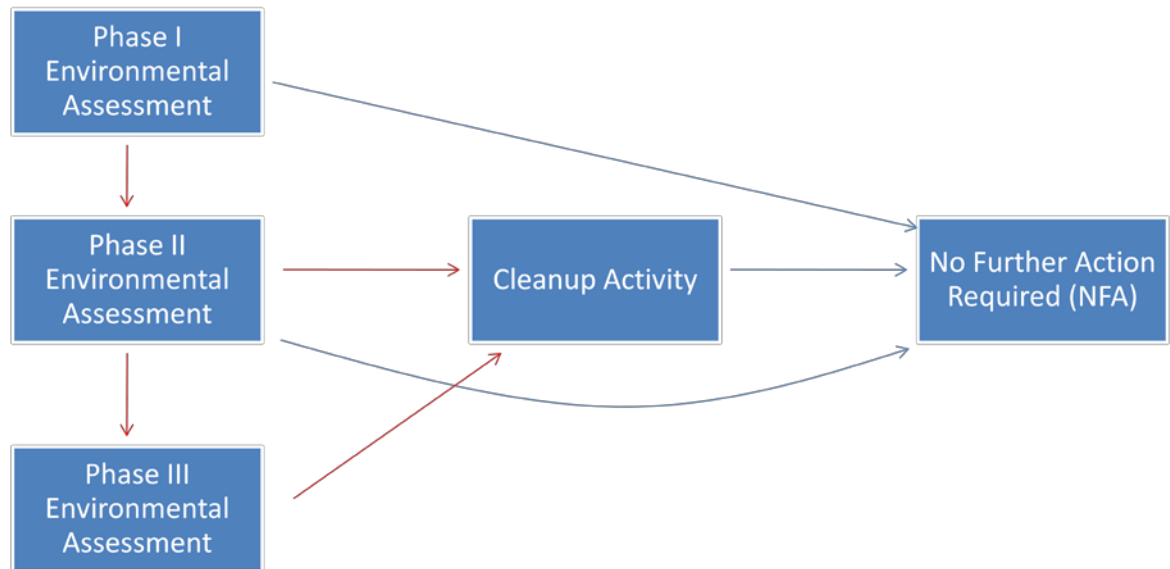
**Figure 4: Geographic distribution of brownfield sites receiving EPA funding**



Models 2 and 3 make predictions based on the process through which a brownfield is cleaned up. For EPA purposes, during the brownfield cleanup process, a specific procedure is followed, with a site usually progressing through four distinct stages. In order, they are: 1. Phase I Environmental Assessment; 2. Phase II and, in some cases, Phase III Environmental Assessments; 3. Cleanup Activity and; 4. No Further Action Required (NFA). During Phase I, sites are visually assessed, relevant stakeholders are interviewed, and a risk assessment is carried out – Phase I assessment

procedures are non-intrusive and indicate whether subsequent action is required on the site. A Phase II assessment is intrusive, with measurements of contaminants collected and a full site remediation planned (Phase III is more intrusive, and carried out only when a Phase II assessment indicates that a site is particularly contaminated). After the assessment and remediation planning processes are complete, cleanup (if necessary) actually begins and continues until the site has been issued an NFA designation indicating that for all intents and purposes, the site is safe for reuse. An NFA designation may also be issued at any time if the result of any of the assessment phases indicates no cause for concern if the property in question were reused for another purpose. That is, if a Phase I assessment shows no sign of visual contamination, an NFA letter will be issued and the site can be reused without remediation. If a Phase I assessment shows cause for concern, a Phase II assessment is conducted, after which a site can a) receive an NFA designation if there is no cause for concern; b) enter a Phase III assessment if more specific planning and testing is required; or c) begin the cleanup process. A visual depiction of this process is provided in Figure 5. Thus while a highly contaminated site could go through all stages in order, not all sites will. Nevertheless, the end point for any of the sites included in this study is NFA designation, which even if not indicative of a thorough cleanup, is indicative of a perception of environmental improvement, which can be as important in terms of reuse and community recognition of an improvement of environmental conditions as an actual cleanup (McMillen and Thorsnes, 2003).

**Figure 5: The brownfield remediation process**



Using survival analysis procedures, the time to complete three different milestones of the remediation process is assessed in the second set of analyses. First, the total project time is measured in months from the start of the Phase I Environmental Assessment through the receipt of an NFA designation, censored to October 1, 2009 if no NFA designation has yet been received (Allison, 1984). Second, Phase I assessment time is measured once again through the number of months that a site was undergoing a Phase I assessment, or until October 1, 2009 if Phase I was not yet complete. Total assessment time is the number of months until either an NFA designation was received if the site did not require a full-scale cleanup, or the total amount of time a site required to complete all assessment and planning projects before cleaning could begin (or October 1, 2009 if assessment was not yet complete).

For model 2, similar to the procedure through which Daley and Layton (2004) estimate the time to remediation of Superfund sites, Cox proportional hazard regression equations (Allison, 1984) predict the probability that sites move through a given phase during a specific period (the next month for these analyses). For these models, hazard rate predictions assess the likelihood of a site moving through a Phase I assessment, through a complete assessment and planning process, or through a total project signified by the awarding of an NFA designation, at one-month increments, which is the smallest unit of time available for these data. Looking at one month increments over a long period of time, the dependent variable is conceived a continuous-time-dependent indicator of whether a site has completed the project or phase in question (Allison, 1984). Cox proportional hazard models have been used extensively in medical research, commonly assessing the probability of patient survival (or hazard) through time, given some treatment and exogenous factors, although they have also been used in recent years in other contexts to predict the probability of time-to-event occurrences, such as an individual's movement into home ownership (Turner and Seo, 2007), job retention (Stroupe, et al., 2001), and enrollment in welfare programs (Marton, 2007). In this case, the hazard rate  $\lambda_i(t)$  is the likelihood that site  $i$  completes the phase in question at time  $t$ , excluding any sites that have already achieved a status change prior to  $t$ . The Cox model is used when the baseline hazard function  $\lambda_0(t)$  is unknown as it is in this case. In the Cox model, the hazard rate is modeled as  $\lambda_j(t|Z_{jt}) = \lambda_0(t)e^{Z_{jt}\beta}$ , where  $Z_{jt}$  is a matrix of covariates for site  $j$  at time  $t$  (Allison, 1984); the hazard rate provides the probability that a site progresses to the next stage in its cleanup at any given time period.

Cox proportional hazard models are used here for three key reasons. First, use of an event history procedure provides more detail regarding site prioritization than simply assessing whether or not a particular phase change has occurred. Since sites entered the cleanup process at different times, it is useful to assess prioritization at the site-month level of analysis in order to compare how long particular sites would be expected to be in one phase or another. However, progress is slow for many sites, and for some, status changes do not occur; that is, if a site has not reached NFA status, this does not mean that it never will, it just means that the site is not there yet. However, excluding these observations would bias the results since they contribute valuable information regarding the time-to-completion of the various remediation phases (Allison, 1984). Cox models get around this censoring problem by observing outcomes at the site-month level of analysis in this case, without any expectation with regard to the distribution of the hazard rate at which any site may undergo a phase change in the next month. Second, since most of the information is self-reported from EPA grant recipients, data may not be up to date and important information could be missing, akin to the patient in a drug experiment with whom the researcher loses contact. Nevertheless, dropping consideration of these sites may bias the results. Third, Cox models are also appropriate to use when the dependent variable is time-varying (time to status change in this case), but variables that do not change over time are important predictors (Allison, 1984). Due to the lack of longitudinal information at less than 10 year intervals for census tracts, and the generally unchanging nature of the characteristics of the tract, the explanatory variables in these models are not time-varying. A key assumption to using the Cox model is that across time, the hazard

function for each observation is proportional to the base hazard function. A Schoenfeld test was conducted for each Cox model run in the analysis, with results indicating that this proportionality assumption has not been violated.

For the final set of analyses, model 3 uses logistic regression estimation to predict the probability that a site has received an NFA designation independent of the length of time required to complete the remediation effort. Sites are coded 1 if they have reached the NFA stage and 0 otherwise. Although this set of models disregards the time variable, it should provide an indication with regard to the aggregated prioritization of site cleanups. That is, if certain types of sites are more or less likely to have achieved NFA status, it may be possible to make broad generalizations about the types of sites that have historically been more likely to be identified and prioritized during cleanup.

**Table 1: Clean up stage and time descriptive statistics**

	Mean	SD	Min	Max	N
<b>For all sites</b>					
No Further Action (NFA) status achieved*	0.059	0.237	0.00	1.00	6401
Phase I Environmental Assessment complete*	0.985	0.121	0.00	1.00	7443
All Environmental Assessments complete*	0.448	0.497	0.00	1.00	7443
Months to NFA status**	46.910	24.540	2.00	212.00	4921
Months to Phase I completion**	6.156	10.511	1.00	162.00	3178
Months to Assessment completion**	45.530	24.702	2.00	201.00	4958
<b>For sites with political characteristics included</b>					
No Further Action (NFA) Status achieved*	0.019	0.137	0.00	1.00	1152
Phase I Environmental Assessment complete*	0.992	0.088	0.00	1.00	1152
All Environmental Assessments complete*	0.169	0.375	0.00	1.00	1152
Months to NFA status**	47.188	16.055	8.00	126.00	1018
Months to Phase I completion**	8.502	6.787	1.00	59.00	207
Months to Assessment completion**	47.442	15.839	9.00	126.00	1007

Note: \*Each variable is coded as a dichotomous (0/1) indicator of whether the particular clean up milestone has been met. \*\*Months for sites that have not yet achieved the specified milestone are indicative of total time either in the stage, or for the entire process as of 10/1/2009.

Independent variables generally fall into four categories: resident status characteristics, characteristics of the overall nature of the neighborhood, site specific characteristics, and political activity indicators. Neighborhood socioeconomic status is

measured via a number of identifiers commonly included in socioeconomic status indices, from either the 1990 or 2000 census as appropriate (Santiago, Galster, and Tatian, 2001).

**Table 2: Other variable descriptive statistics**

<b>For census tract-level analysis (Model 1)</b>					
	<b>Mean</b>	<b>SD</b>	<b>Min</b>	<b>Max</b>	<b>N</b>
Brownfield in tract (yes=1)	0.039	0.195	0	1	64931
Population density (people/square mile)*	5318	12044	0.002	223600	64931
Proportion of housing units built before 1940*	0.172	0.189	0	1	64931
Proportion of residents with bachelor's degree*	0.232	0.169	0	1	64931
Median household income*	46817	23405	2497	199985	64868
Proportion of residents over age 65*	0.130	0.072	0	1	64931
Proportion of residents under age 18*	0.253	0.068	0	0.714	64931
Proportion of Hispanic residents*	0.115	0.190	0	1	64931
Proportion of black residents*	0.140	0.238	0	1	64931
Proportion of tract classified as urban*	0.775	0.375	0	1	64931
More than one brownfield in tract (yes=1)	0.012	0.107	0	1	64931
<b>For site-level analysis (Model 2)</b>					
Population density (people/square mile)*	3596	4296	0.002	124614	6308
Proportion of housing units built before 1940*	0.257	0.197	0	1	6298
Proportion of residents with bachelor's degree*	0.136	0.115	0	0.852	6302
Median household income*	32435	15700	2497	133519	6294
Proportion of residents over Age 65*	0.124	0.058	0	0.865	6308
Proportion of residents under Age 18*	0.271	0.077	0	0.536	6308
Proportion of Hispanic residents*	0.129	0.187	0	1	6308
Proportion of black residents*	0.279	0.347	0	1	6308
Proportion of tract classified as urban*	0.830	0.343	0	1	6308
More than one brownfield in tract (yes=1)	0.710	0.453	0	1	6308
Hazard score	16.319	28.687	0	160	6308
Superfund site (yes=1)	0.150	0.357	0	1	6308
Period in which project began**	3.580	0.609	1	4	7443
<b>For site-level analysis in tracts with political characteristics (Models 2 &amp; 3)</b>					
Population density (people/square mile)*	4157	3779	1.93	37294	1152
Proportion of housing units built before 1940*	0.157	0.169	0	0.7	1152
Proportion of residents with bachelor's degree*	0.124	0.107	0.001	0.709	1152
Median household income*	30393	17087	11148	124741	1152
Proportion of residents over age 65*	0.116	0.058	0.018	0.311	1152
Proportion of residents under Age 18*	0.268	0.086	0.021	0.524	1152
Proportion of Hispanic residents*	0.272	0.222	0	0.941	1152
Proportion of black residents*	0.207	0.273	0	0.956	1152
Proportion of tract classified as urban*	0.974	0.119	0	1	1152
More than one brownfield in tract (yes=1)	0.905	0.293	0	1	1152
Hazard score	16.233	28.857	0	140	1152
Superfund site (yes=1)	0.034	0.181	0	1	1152
Period in which project began**	3.501	0.517	2	4	1152
2000 election turnout (percent of registered)	0.668	0.014	0.385	0.955	1152
Proportion of voters registered Democrat in 2000	0.549	0.157	0.242	0.914	1152
Proportion of voters registered Republican in 2000	0.253	0.135	0.026	0.629	1152

Note: \*Includes data from both 1990 and 2000 census where appropriate. \*\* Period = 1 if project began in 1990-1995, 2 if it began from 1995-2000, 3 if 2000-2005 and 4 if 2005 - present.



These variables are included in all of the models described. Racial characteristics are assessed for both African-American and Hispanic communities via the focal tract's black and Hispanic population proportions. Income is measured via the tract median household income level (logged). Additionally, the proportion of the tract population possessing at least a bachelor's degree is included. All models also include neighborhood level control variables, also with data from the 1990 or 2000 census. Population density, the proportions of residents under age 18, the proportion over age 65, and the percent of the tract that is categorized as urban are included, and the proportion of homes built prior to 1940 differentiates tracts with an older, potentially architecturally valuable housing stock from tracts with a concentration of newer homes (Eckerd. 2010).

Model 1 predicts the presence of at least one brownfield site in a census tract, with the above variables as the predictors (holding state level effects constant through dichotomous indicators of state location) and census tracts as the unit of analysis. Models 2 and 3 are estimated with brownfield sites as the unit of analysis, and in addition to the census tract-level variables described above, also include some site-specific characteristics. First, an indicator is included to identify Superfund sites, which should help differentiate between the most salient sites and all others (Messer, et al, 2006). Secondly, a unique proxy for risk is included based on information about the specific contaminants known or suspected to be present at the site. Unfortunately, the quantities (or suspected quantities) of the contaminants are usually unknown or unreported, so the hazardous potential for each site can only be assessed assuming constant contaminant quantities across sites. Hazardous potential is assessed using the IRCHS scores for the

pollutants found at each site. The IRCHS score for each chemical is a standardized and thus comparable indicator of the level of toxicity to humans and the persistence of the chemical in soil, air and water. Table 3 displays some of the IRCHS scores for common brownfield pollutants. For each site, hazard scores of each chemical known or suspected to be present are summed for a total site hazard score<sup>8</sup>. Given chemicals for which information is available, the maximum hazard score possible is 203.7, with 0 as the minimum. As can be seen in Table 2 (summarizing all descriptive statistics), the mean hazard score is 16.3, indicating that most sites are likely relatively low risk.

Although this consideration for risk is an imperfect one, its inclusion is unique in environmental justice studies of hazardous sites, and should provide a useful contextual improvement to environmental justice research. Moreover, it is unlikely that residents would have access to more comprehensive risk information either, making the hazard index a plausible proxy for the extent to which residents are aware of local risk. Also, at the site level, an indicator variable is included to identify sites that are located in census tracts within which at least one other site is also located. Hazardous sites tend to be located in proximity to other hazardous sites, and this indicator will identify the effect of this clustering on the likelihood of site cleanup (Wolverton, 2009). Finally, a categorical variable was included to specify the time period during which activities at the site began. Inclusion of this variable should help control for factors of efficiency improvements as more sites finish the remediation process, as well as account for technological innovation

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<sup>8</sup> It may well be that the actual hazard is more multiplicative than additive when more than one pollutant is present, but without knowing specific quantities of contaminants at the site, additive effects seem to be the more conservative assumption.

that may make cleanups easier. Time period is a categorical variable differentiating four different periods during which projects could have started: 1990-1995, 1995-2000, 2000-2005, and 2005-present.

**Table 3: Hazard scores for some common brownfield pollutants**

<b>Pollutant</b>	<b>Hazard Score</b>
Aluminum	10.5
Asbestos	25.6
Iron	7.3
Lead	33.3
Mercury	28.7
Methane	9.6
PCBs	20.5
Petroleum	16.6
Polyaromatic Hydrocarbons (PAHs)	21.7
Propane	11.9
Volatile Organic Compounds (VOCs)	18.0

In models 2 and 3, additional regression equations are estimated to include variables that relate to political activities, in order to test H3, the collective action hypothesis that sites in communities with politically active residents tend to be prioritized in cleanup, mediating occurrences of environmental injustice. Secondary models are estimated only for sites located in California, Minnesota and North Carolina with variables included to assess the effect of political participation and political ideology. For sites in these three states, models include the proportion of registered voters who cast votes in the 2000 election, as well as the proportions of voters registered as Republicans and as Democrats in 2000. This measurement of the likelihood to be politically active is admittedly rough but substantially the same as in previous efforts (Arora and Cason, 1999). Election participation is, at best, a poor proxy for collective political activity

(Campbell, Peck, and Tschudi, 2010); nevertheless, the variables are included here as a rough gauge of the potential effect of broad based political activity and ideology in communities.

Formally, model 1 is specified in equation 1, model 2 in equation 2, and model 3 in equation 3.

$$Prob(T_i = 1) = \frac{e^{\beta_1 X_i}}{1 + e^{\beta_1 X_i}} \quad (1)$$

$$Prob(P_{jt} = 1) = \frac{\lambda_j(t|Z_{ijt})}{1 + \lambda_j(t|Z_{ijt})} = \frac{\lambda_0(t)e^{\beta_1 X_i \beta_2 S_j \beta_3 V_i}}{1 + \lambda_0(t)e^{\beta_1 X_i \beta_2 S_j \beta_3 V_i}} \quad (2)$$

$$Prob(C_j = 1) = \frac{e^{\beta_1 X_i \beta_2 S_j \beta_3 V_i}}{1 + e^{\beta_1 X_i \beta_2 S_j \beta_3 V_i}} \quad (3)$$

In all cases,  $X$  is the vector of the socioeconomic characteristics of census tract  $i$  described above,  $S$  is the vector of the characteristics of brownfield site  $j$  described above, and  $V$  is the vector of the voting characteristics of census tract  $i$  described above, and is only included for the subset of sites for which voting characteristics of the census tract were available.  $Prob(T_i = 1)$  is the probability that census tract  $i$  contains a brownfield site,  $Prob(P_{jt} = 1)$  is the probability and  $\lambda_j(t|Z_{ijt})$  is the hazard rate of site  $j$  completing phase P at time  $t$ , and  $Prob(C_j = 1)$  is the probability that site  $j$  is cleaned up.

## Results and discussion

In testing H1, it is clear that brownfield sites are indeed more likely to be located in lower socioeconomic status neighborhoods than in higher status areas. As can be seen in Figure 6 and Table 4, tracts with brownfield sites have lower income levels as well as larger proportions of black residents. Sites are unlikely to be located in areas with high

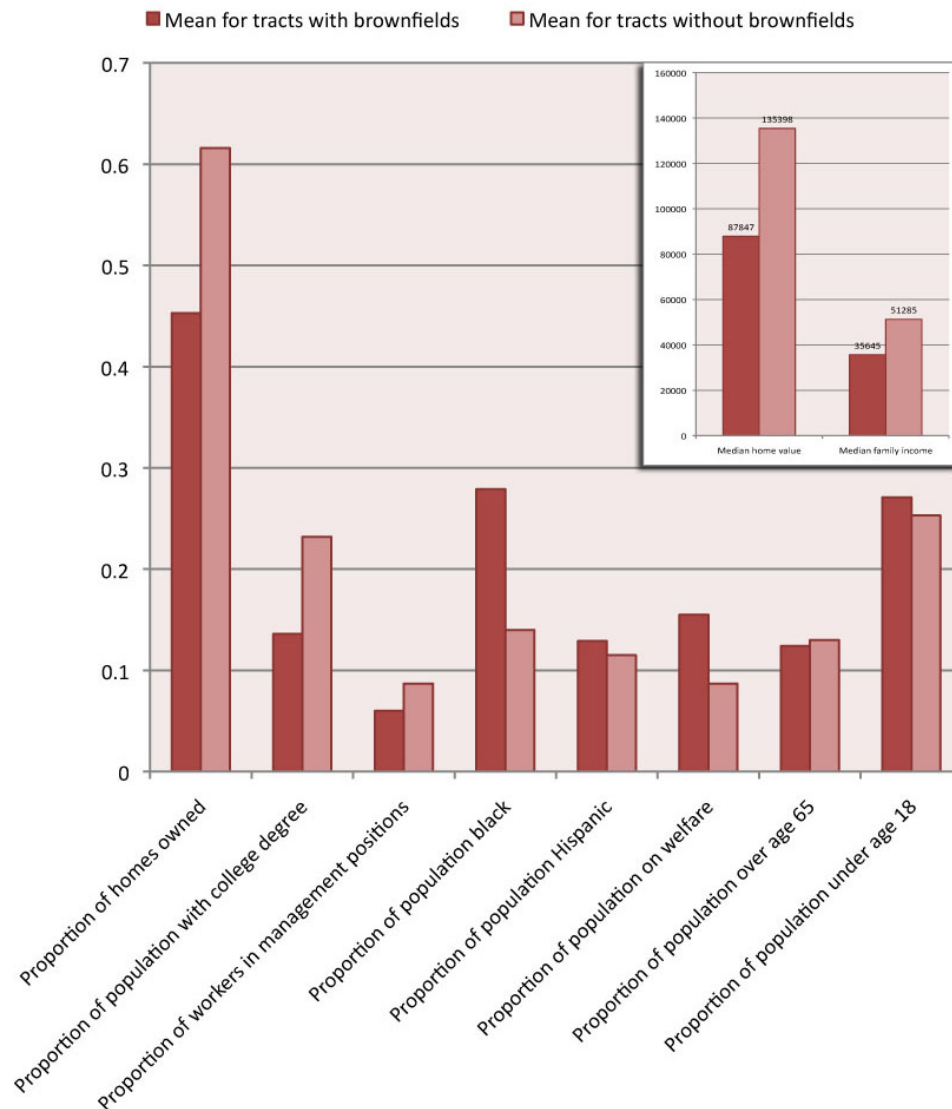
levels of income and education. Care must be taken, however, with regard to causality. This collocation result is similar to other investigations into environmental justice issues (Ringquist, 2005; Campbell, Peck, and Tschudi, 2009), but in and of itself, provides little insight with regard to whether hazardous sites or poor/minority residents came first. In fact, since the sites in question are those receiving EPA funding, this result may be indicative of the EPA following its environmental justice mandate to consider ways to reduce the environmental threats to “minority or low-income communities” when providing brownfield grants. Or, it may also be the case that over the years, residential sorting occurred nearby these sites such that the current community demographics near brownfield sites tend to be poor with larger black populations even if that was not initially the case. Regardless of the specific cause, however, this result indicates that, similar to studies of other types of undesirable land uses, the communities in which brownfield sites are located tend to be lower socioeconomic status areas.

**Table 4: Logistic regression: Presence of a brownfield site in a census tract**

	Odds Ratio	Standard Error
Population density (people/square mile)	<b>0.999*</b>	0.001
Proportion of housing units built before 1940	<b>10.515*</b>	1.328
Proportion of residents with bachelor's degree	<b>0.334*</b>	0.078
Median household income (logged)	<b>0.341*</b>	0.027
Proportion of residents over age 65	<b>0.292*</b>	0.111
Proportion of residents under age 18	<b>0.388*</b>	0.153
Proportion of Hispanic residents	1.388	0.264
Proportion of black residents	<b>1.744*</b>	0.194
Proportion of tract classified as urban	<b>1.002*</b>	0.001
Likelihood ratio pseudo R2	0.168*	

\*p<.05; N=64252

**Figure 6: Comparisons of demographic characteristics between census tracts that contain brownfield sites and all census tracts**



For model 2, three different dependent variables are listed in Table 5, which constitute a site's progression through 1) the Phase I environmental assessment, 2) all assessment and planning phases, and 3) full site remediation, indicated by achieving NFA status. Overall, the results from models 2 (Table 5) and 3 (Table 6) assessing the probability of brownfield cleanup offer a complicated picture of the influences on

environmental improvement decisions. Table 5 details survival analysis results estimating time-to-status-completion using a series of Cox proportional hazard regressions; odds ratios report the change in the predicted odds that given a one unit increase in the independent variable, all else equal, the site will complete the phase in the next time period (Allison, 1984).

**Table 5: Cox regression: Likelihood of milestone accomplishment per month**

Status variable	Phase I complete		Assessment complete		NFA complete**
	Without voting variables	With voting variables	Without voting variables	With voting variables	Without voting variables
Time variable: Months	Odds ratio (Standard error)				
Population density (people/square mile)	0.999 (0.001)	0.999 (0.001)	0.999* (0.001)	1.000 (0.000)	1.00 (0.001)
Proportion of housing units built before 1940	<b>1.335*</b> (0.181)	0.499 (0.456)	<b>2.909*</b> (0.602)	0.626 (0.906)	<b>6.563*</b> (3.808)
Proportion of residents with bachelor's degree	<b>2.283*</b> (0.802)	151.174 (390.346)	0.948 (0.470)	0.738 (1.962)	7.705 (9.287)
Median household income (logged)	<b>0.701*</b> (0.063)	<b>0.078*</b> (0.058)	<b>1.060*</b> (0.156)	2.114 (1.478)	0.720 (0.274)
Proportion of residents over age 65	1.575 (0.816)	0.174 (0.960)	2.791 (1.813)	0.027 (0.136)	15.021 (26.210)
Proportion of residents under age 18	<b>3.933*</b> (1.855)	0.028 (0.055)	0.566 (0.375)	<b>0.001*</b> (0.001)	1.759 (3.367)
Proportion of Hispanic residents	<b>0.493*</b> (0.084)	2.155 (3.794)	<b>0.306*</b> (0.107)	2.800 (7.107)	1.837 (1.491)
Proportion of Black residents	<b>0.672*</b> (0.074)	0.380 (0.391)	0.852 (0.161)	18.275 (25.056)	0.667 (0.398)
Proportion of tract classified as urban	<b>1.000*</b> (0.001)	<b>1.045*</b> (0.021)	0.998 (0.001)	1.004 (0.013)	0.992* (0.003)
More than one brownfield in tract (yes=1)	1.035 (0.061)	0.647 (0.224)	<b>0.779*</b> (0.068)	<b>0.178*</b> (0.076)	<b>0.455*</b> (0.107)
Hazard score	<b>1.000*</b> (0.001)	0.999 (0.003)	<b>1.013*</b> (0.001)	1.001 (0.005)	<b>1.017*</b> (0.003)
Superfund site (yes=1)	<b>2.307*</b> (0.496)	28.146 (64.763)	<b>0.174*</b> (0.054)	1.640 (1.583)	<b>0.377*</b> (0.160)
Period in which project began	<b>2.349*</b> (0.192)	<b>4.827*</b> (2.218)	<b>12.604*</b> (1.327)	<b>177.71*</b> (121.73)	<b>7.108*</b> (1.842)
2000 election turnout (percent of registered)	--	<b>3025.37*</b> (7858.9)	--	0.252 (1.089)	--
Proportion of voters registered Democrat in 2000	--	<b>0.001*</b> (0.001)	--	272.15 (1443.1)	--
Proportion of voters registered Republican in 2000	--	0.001 (0.003)	--	192.43 (1089.5)	--
Wald chi <sup>2</sup>	198.64*	93.37*	1648.2*	68.54*	232.82*
N	2273	207	4710	116	4909

Note: \*p<.05; \*\* Of 1018 sites in tracts with time/phase change and voting data, only 2 have achieved NFA status.

For example, if the odds ratio related to the proportion of educated residents were 2, this would indicate that the odds of a site completing the status in question during the subsequent month would double for every additional one percent increase in the proportion of educated residents in its neighborhood.

Odds ratios for sites in communities with larger Hispanic populations indicate that assessment periods tend to take longer than for other sites, all else equal. Similarly, completion of the Phase I Environmental Assessment stage appears to be slower in communities with higher proportions of black residents. However, progression through subsequent assessment phases does not appear to be hampered in these communities. Interestingly, relatively wealthier communities (as indicated by higher levels of median household income) tend to also move slowly through the Phase I assessments, but more rapidly through subsequent phases. Overall, the results indicate few substantial trends in socioeconomic status variables, including the results of the logistic regression model estimating the probability of a site achieving NFA status, shown in Table 6. Sites in tracts with more highly educated residents are more likely to be cleaned up, but no other socioeconomic variables indicate any significant relationship with increased probabilities that sites are cleaned up.

While the collocation hypothesis (H1) is strongly supported, there is some evidence to support the prioritization hypothesis (H2), but the results are much more mixed.



**Table 6: Logistic regression: Likelihood of sites reaching NFA status**

Dependent variable	NFA Status achieved	
	Odds ratio (Standard error)	
	Without voting variables	With voting variables
Population density (people/square mile)	1.00 (0.000)	1.00 (0.000)
Proportion of housing units built before 1940	<b>3.452*</b> (1.146)	0.235 (0.602)
Proportion of residents with bachelor's degree	<b>18.065*</b> (12.260)	3.598 (17.038)
Median household income (logged)	0.889 (0.201)	3.632 (5.402)
Proportion of residents over age 65	2.761 (3.311)	0.001 (0.013)
Proportion of residents under age 18	0.933 (1.015)	0.003 (0.017)
Proportion of Hispanic residents	1.380 (0.641)	0.120 (0.369)
Proportion of black residents	0.833 (0.258)	0.162 (0.441)
Proportion of tract classified as urban	<b>0.993*</b> (0.002)	1.010 (0.023)
More than one brownfield in tract (yes=1)	<b>0.357*</b> (0.046)	0.884 (0.716)
Hazard score	<b>1.022*</b> (0.002)	1.036 (0.010)
Superfund site (yes=1)	0.774 (0.207)	1.954 (2.331)
Period in which project began	<b>2.206*</b> (0.308)	5.324 (4.552)
2000 election turnout (percent of registered)	--	0.237 (1.181)
Percent of voters registered Democrat in 2000	--	1749.4 (16182.1)
Percent of voters registered Republican in 2000	--	37.619 (368.525)
Wald chi <sup>2</sup>	469.01*	31.93*
N	6294	184

Note: \*p<.05

Although brownfield sites in communities with large Hispanic populations tend to move through the cleaning process more slowly than sites in other types of neighborhoods, these sites are no more or less likely to actually end up being cleaned. Sites located in predominantly minority neighborhoods (either higher black or Hispanic populations) tend to take longer to get through the early assessment phases, although again they are no less

likely to end up being cleaned. Environmental assessments and planning for cleanups could be relatively contentious in minority neighborhoods; cleanup efforts can be complicated and potentially disruptive to a community (McCluskey and Rausser, 2003), but they can also provide short-term employment and carry the potential for economic redevelopment (McMillen and Thorsnes, 2003). In minority neighborhoods, this process may be more contentious owing to historical trends in power and mistrust of political elites (Stone, 1989) especially given that one of the key activities of a Phase I assessment involves talking with local stakeholders about the history of the site. It may also be more difficult for assessors to reach minority populations, especially those for whom English is not their primary language.

This result can also be considered in the context of the finding that sites in wealthier communities tend to move more slowly through the initial assessment phase as well. Various powerful interests may choose intractable positions and keep a consensus cleanup plan from emerging as each side attempts to write its preferences into the assessment plan, or agency coordination of many disparate points of view may become overly cumbersome (Daley and Layton, 2004). Regardless, some aspect of political activity appears to be important in the initial stages of a brownfield cleanup, leading to this mixed result on H2. On the one hand, sites in minority areas take longer to get through initial phases of the cleanup process, but, on the other, do not take longer to be cleaned up overall. Other measures of socioeconomic status show little indication of having an effect on the pace of site cleanup, perhaps due to the inclusion in all models of contextual characteristics of the site itself. The effects of contextual site-level variables

appear to mute any socioeconomic effects of the site's community. It is worth noting, however, that relatively few sites have actually gone through the entire cleanup process and achieved NFA status. As more sites complete the cleanup process, trends relevant to environmental justice may become more apparent.

Beyond practical consideration of the environmental justice implications of brownfield site remediation, this analysis also provides findings relevant for future research assessing the collocation of populations and environmental disamenities. The most consistent predictors of both site cleanup and the pace of that cleanup relate to the characteristics of the site and its proximity to other brownfields. Higher hazard scores consistently increase the odds of a site progressing through each of the stages of cleanup. This appears to indicate a prioritization of more environmentally risky sites, as one might expect given EPA's stated priorities (Daley and Layton, 2004). Superfund sites, expected to be amongst the most environmentally risky, tend to progress quickly through the first assessment phase, but then slow through the actual cleanup. Daley and Layton (2004) find that the riskiest Superfund sites tend to take longer to be cleaned up, suggesting that EPA may have a tendency to "pick the low hanging fruit". However, by looking at the cleanup process in finer detail, this result indicates that riskier Superfund sites are assessed quickly, but bog down during cleanup, possibly because cleanup is complicated at the most hazardous Superfund sites. Another clear result through all models is that the more recently a site cleanup has begun, the more likely it is to progress through each of the phases more quickly; this may indicate that learning, technological innovation, and institutionalization of the cleaning process facilitate more efficient movement through

site remediation (Hamilton and Viscusi, 1999). Lastly, sites that are clustered together tend to make less progress through the cleaning process. When a site is located in a neighborhood with at least one other brownfield site, it is much less likely to be cleaned up, and is much less likely to move quickly through the cleanup process. While comparatively riskier sites tend to be prioritized for cleanup, a higher concentration of brownfields in a neighborhood tends to dampen this effect. This could suggest a prioritization of cleaning sites in areas where redevelopment might be comparatively more economically viable.

The results of the models that include political participation characteristics do not provide much support for H3, the collective action hypothesis that cleanups are likely to be prioritized in politically active communities. Although limited to just three states, political and ideological characteristics of neighborhoods do not appear to indicate much of a relationship with site cleanup. Of course this may be due to the limitation of including these characteristics for so few states and sites; nevertheless, the limited sample (which does include sites in California, a state commonly used a proxy for the nation) shows no indication that there would be a larger trend if more robust political participation data were available. It is also worth noting that election participation and collective action are, at best, poor proxies for one another. While voting behavior may indeed indicate a higher propensity towards collective action, it is not a measure of actual collective action related to specific sites, which may involve individual actors within a neighborhood, but may also involve organizational actors from outside the community as well. While many environmental justice researchers acknowledge the central importance

of collective action behavior regarding environmental quality in communities (Hamilton, 1995; Wolverton, 2009; Campbell, Peck, and Tschudi, 2009), specific research on this behavior remains underdeveloped.

A final consistent result worth mentioning regards the general age of the housing in the tract. Brownfield sites are much more likely to be located in communities with larger share of older homes (those built prior to 1940). But in communities with the largest share of such homes, sites are consistently predicted to move much more quickly through all phases of cleanup (see Table 5), and are much more likely to reach NFA status (Table 6). This result may indicate the effect of economic pressures of redevelopment prioritization. An older housing stock with potentially historic architecture is thought to be one of the major predictors of neighborhood revitalization efforts and gentrification (Kolko, 2007; Eckerd, 2010). In the case of brownfields, sites located in neighborhoods with such a housing stock may be under more pressure to be cleaned by developers or gentrifiers, or local officials may be pressing for cleanup in areas where they can expect the cleanup to foster economic redevelopment and revitalization. These potential economic pressures merit future consideration; all else equal, it appears that remediation efforts focus on cleaning up sites where they are expected to contribute to neighborhood redevelopment. Sites that exist in clusters, perhaps in areas where revitalization is thought to be comparatively less likely, move more slowly through the remediation process.

## Conclusion

In this paper I have assessed the environmental justice implications for environmental improvement via a detailed view of the patterns, pacing, and prioritization of cleaning up brownfields. This approach to analyzing environmental justice is unique in several ways. First, I assessed a second side of environmental justice through an exploration of the prioritization of cleaning up existing sites, rather than the placement of new environmental risks. Second, I used a much more detailed view of the decision-making process by employing event history analysis methods to assess both the amount of time that sites spent in the overall cleanup process and the amount of time spent in various phases of that process. Third, I included detailed site-specific characteristics, including a measure of the hazard potential of site contamination, in order to better isolate the effect of nearby population characteristics on decision-making from contextual characteristics of the site itself.

I found that sites in communities with larger proportions of minority residents move through the initial assessment and planning phases of the cleanup process more slowly than their counterparts in other neighborhoods, but these sites are no less likely to ultimately be cleaned up. So while this research seems to indicate that cleanup and redevelopment policies, at least at the federal level, are conducted with environmental justice in mind, the question of why assessing sites and planning cleanups in minority neighborhoods takes longer is left open.

Although possibly indicative of discriminatory environmental injustice, this result could also be a reflection of economic and political factors. Economic factors appear to be influential in that cleanup is much more likely to happen and happen quickly when a

brownfield is relatively isolated from other brownfield sites, and where the housing stock is more conducive to residential redevelopment. This might indicate an effort by policymakers to target cleanup resources on sites where they expect that redevelopment and revitalization of the community are more likely than areas where pollution is more concentrated and intractable. This may be due to economic pressures from developers and gentrification pressures from higher income individuals interested in reconditioning architecturally valuable land or properties (Smith, 1979) or it may simply be a reasonable assumption on the part of policymakers interested in acquiring economic development benefits from site remediation efforts in addition to expected health benefits (Hamilton and Viscusi, 1999).

These same outcomes may be affected by the political machinations occurring during the assessment and planning phases of the cleanup. In communities with relatively low levels of environmental risk, there may be less general political debate about the merits of one cleanup plan versus another. Economic interests might be aligned with those already in the community in wanting redevelopment to occur as quickly as possible. A lack of political disagreement may enhance administrative convenience (Daley and Layton, 2004) and move sites more quickly through the initial planning phases. Conversely, in those neighborhoods where there is less consensus, the political debate regarding the future of the site might be carried out through the assessment and planning process. When there is disagreement about the plan for cleaning up a site, the realm for this debate might be the period during which a brownfield site is assessed and the cleanup planned, with the expectation that the cleanup plan will dictate how the site is to be used

in the future. A deeper understanding of the political behavior that occurs in relation to brownfield site remediation would be helpful in light of the results indicating that, contrary to expectations, an increased propensity of residents to be politically active had an no significant effect on the prioritization of brownfield cleanups in their communities.

Beyond the socioeconomic status hypotheses posed, I also found that the inclusion of site-specific variables regarding the extent and nature of contamination provides a more detailed view of environmental injustice than assuming the homogeneity of risk at different sites, as has been the norm in this area of research. By including these characteristics, I found that the more contaminated a site is, the more likely it is to be a priority for cleanup, and the more recently a cleanup began, the faster it went through the process. I also found that Superfund sites tend to be assessed rather quickly, but physically cleaned up slowly. These findings suggest that while the EPA stresses the importance of environmental justice in dissemination of brownfield grants and it certainly provides grants to underserved communities, its priorities for cleanup tend to be those sites whose cleanup will provide the most benefits in terms of environmental improvement regardless of their location. More generally, these contextual results indicate that models investigating the collocation of hazardous facilities and low socioeconomic status populations might be better specified by inclusion of site-specific characteristics.

This research ends on a generally positive note if one is concerned about environmental justice. Since the early 1990s, the EPA has been mandated to consider the environmental justice consequences of the distribution of resources used for



environmental improvement. Although the planning process in some communities may be more complicated than in others, the EPA appears to have done a good job working under its mandate. For those remediation projects to which the EPA contributes funds, sites in poor or minority neighborhoods appear as likely to be cleaned up as their counterparts in other communities. While this result may or may not hold when considering the broader view of all brownfield sites beyond just those that receive EPA funding, at the very least it supports a finding that the federal government has taken its environmental justice mandate seriously while still maintaining a focus on cleaning up those sites that are most potentially environmentally hazardous to their communities.

### **Chapter 3: No Longer in Our Back Yard: Collective Action and Environmental Justice**

#### **Introduction**

The link between environmentally-based collective action and thwarting proposed degradations to local environmental conditions is well established. Research on the NIMBY (not in my back yard) phenomenon has shown that politically active, organized residents are much more likely to delay or obstruct the placement of environmental hazards in their communities than residents who do not act and are not organized (Renn, et al., 1995). Moreover, it may also be the case that when decision makers perceive that certain resident populations *might* act collectively, they appear to be less likely to choose such neighborhoods as proposed sites (Rich, et al., 1995). Thus, actual or expected collective action appears to enable residents to shield their communities from becoming sites for environmentally hazardous facilities, or disamenities in general, even though such facilities may be necessary to retain a level of environmental quality for the society at large.

Much of this research focuses on the NIMBY strategies that are employed by interested stakeholders, and discusses the relative costs and benefits of decisions made, both for those stakeholders and for the larger region or society being studied. As government initiatives increasingly seek to involve the public in policy decision making,

particularly in the environmental realm (Beierle and Konisky, 2000), it is important to not only investigate the strategies of public involvement, but also the extent of involvement, i.e., who gets involved, and the process of involvement itself. In the related literature, a connection between the perceptions of stakeholders and the perceptions of public managers and agency decision makers is missing, as is a contextual understanding of the processes that are employed for involving the public in environmental decision making (Schively, 2007). Moreover, most past research has investigated the siting of facilities that are clearly local disamenities, but that are necessary for regional quality; many projects are more complex than this. They often involve trade-offs of some environmental degradation for some environmental (or other) improvement, and little is known as to how the public participates in the decisions to move forward with such projects, who gets involved, whether they tend to focus on perceptions of harm or perceptions of improvement, and how public managers ultimately use (or do not use) the feedback received to alter project implementation.

In this chapter, I explore these and other questions by assessing the extent of participation and organization by community interests in the Environmental Impact Analysis (EIA) process. I do so through a content analysis of comments provided during the Environmental Impact Statement (EIS) preparation period for three projects in Washington, DC that aim to, in part, improve environmental conditions, albeit with the potential for localized degradation as well. In the sections that follow, I first describe the NIMBY literature and explain why we might expect collective action to not only to keep a disamenity out of a community, but also to spur the removal of those disamenities that

currently exist. I will then discuss how variations in political power may mitigate the effectiveness of such NIMBY-like efforts not only in political processes, but also in bureaucratic processes. I then describe the content analysis procedure used to collect data regarding collective action and discuss the results. I conclude by offering a set of questions that may be explored in the future with a more robust set of EISs.

## NIMBY

All else equal, when residents are organized and active, they are much more likely to thwart efforts to establish disamenities in their neighborhoods (Kraft and Clary, 1991). With a background understanding of the collect action framework (Olson, 1965), this is not surprising. We would expect that organized interests would be more likely to see their interest reflected in any type of policy. In any policy realm, when advocates speak with one consistent voice, policymakers are more likely to know where constituents stand, and also more wary of making a decision that may alienate a large, politically active group of people. Therefore, the interests of the active group are not only more likely to be heard by policymakers, but policymakers are more likely to heed the input they have received and make decisions that favor the organized groups' preferences (Sabatier, 2007).

The NIMBY phenomenon tends to be treated differently than most other instances of organization of interests in the literature, however. Where pluralistic approaches to organized interests tend to be seen as beneficial (Walzer, 1984), NIMBY organizations tend to be viewed as parochial, misinformed, selfish, and overly emotional (Kraft and Clary, 1991). NIMBY opposition to the siting of environmental hazards is viewed as a

‘problem’, ‘plague’ or ‘syndrome’ (McAvoy, 1998) that keeps necessary facilities from being built and keeps currently operating, inefficient facilities online, making aggregate environmental outcomes worse for everyone (Freudenburg and Pastor, 1992). NIMBY is usually treated a problem that must be overcome in order for public managers to implement the public’s interest (Ibitayo and Pijawka, 1999), not a reasonable effort by concerned citizens to ensure that they are not overexposed to potential risks (McAvoy, 1998).

In part, viewing NIMBY as a problem to be overcome is due to legal mandates that the public be involved when the siting of an environmental hazard is proposed. The Resource Conservation and Recovery Act of 1976 (RCRA) specifically requires that states, as part of their hazardous waste policies, include public participation through the entirety of the process through which a facility is planned, a site is selected and a plan is approved<sup>9</sup>. Although the intent of the policy was to ensure that affected stakeholders were active participants in the decision-making process, the policy has tended rather to result in distrust, anger, and intractable disagreement on both the government and citizen side, and delays or the termination of plans to build needed facilities (Matheny and Williams, 1985). These issues appear to be partially due to differences in the propensity to participate by certain stakeholders, and divergent (potentially incongruent) views on risk between decision makers and affected populations.

#### *Participation in the siting process*

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<sup>9</sup> 42 U.S.C. §6901 – See: <http://www.epa.gov/lawsregs/laws/rcra.html>

The effect of participation is problematic in environmental decision making if it simply reinforces existing inequalities, given that the experience of a participation effort (either successive or unsuccessful) is reinforcing. When NIMBY groups successfully thwart the siting of an environmental hazard, it encourages them to continue working in the future. Unsuccessful efforts are likely to result in frustration, decreasing the likelihood that a community will organize again in the future (Rich, et al., 1995). Since higher socioeconomic status populations are more likely to organize than lower status populations, this reinforcing mechanism can result in even lower levels of environmental equity for poor and/or minority communities (Cohen, 1995).

NIMBY has therefore tended to be viewed somewhat skeptically as it relates to the siting of environmentally hazardous, but necessary facilities. If certain communities are never considered as potential sites for environmental hazards either due to explicit NIMBY activities or policymaker efforts to avoid potential NIMBY activities (Hamilton, 1995), then environmental quality cannot be distributed equally. Since higher socioeconomic status communities are expected to be more likely to engage in collective action, and collective action is likely to be successful in terms of keeping environmentally hazardous sites from being sited in higher status communities, sites end up being built in lower status communities (King, et al., 1998). This argument was explored in a previous chapter, but it is worth considering the relationship between NIMBYism and environmental justice in more detail.

In planning and sociological literatures, NIMBY is a nuisance and privilege of the upper class (McAvoy, 1998). Thus, it is often taken for granted both by policymakers and

researchers that high socioeconomic status communities will organize and act, and therefore high status communities will not be considered as potential sites for disamenities. Under the assumption that this population will engage in NIMBY opposition, sites are chosen in lower status communities (Hamilton, 1995). In addition to concerns over prioritizing parochial matters over societal needs, skepticism with regard to the NIMBY phenomenon is based on the view that NIMBY activism is a strategy that is only available to high status groups, and that these NIMBY efforts serve only to reinforce existing expectations that lower status communities will become the locations at which hazardous facilities are built. NIMBY therefore is not a tool for the potential use of any population to see its interests reflected in policy, but is an obstruction strategy specifically available to those populations that least need it, to prioritize their needs over societal needs. Policies encouraging participation are therefore usually framed in terms of creating the circumstances through which lower socioeconomic status populations may have access to interact with policymakers, and resources available to ensure that their interests are at best, integral to a process of collaborative governance (Lubell, 2004), or at the very least, heard (King, et al., 1998; Abelson, et al., 2003; Cohen, 1995; Novotny, 1995).

One's view of the nature of participation and collaborative governance therefore likely informs how one categorizes NIMBY. If NIMBY is a 'syndrome', then it is likely treated as an obstacle that must be overcome in order to meet the public's interest. However, if one subscribes to a view of collaborative management, or network governance, NIMBY actors might be integral to the derivation of 'good policy', provided

that actors recognize the need to share costs. Governments from the local level (Agranoff and McGuire, 2003) to the supranational (Scheuer, 2005) have looked for ways to institute and encourage the growth of collaborative, network structures as an alternative to traditional hierarchies. The ideal of the governance network is as a system of collaboration between governments, businesses, nonprofits and interested parties. Normatively, this ideal assumes that the hierarchical systems of the past have failed to provide the efficiency and effectiveness necessary to meet policy goals. By working through a system of collaborative exchanges, rather than often conflictual top-down directives, policy should better reflect the needs of the stakeholders, involve these stakeholders and result in higher levels of performance, in terms of both efficiency and effectiveness (Fischer, 1993), encouraging a consensus balancing societal-level goods with more local concerns. A key assumption of such efforts is that horizontal collaboration will result in better outcomes than in a bureaucratic system that is characterized by top-down hierarchical processes in which certain stakeholders are likely to dictate outcomes. With more stakeholders involved in the process it is expected that decisions will not only be more fair and equitable, but also more credible and legitimate as all the relevant parties were invested in the effort and the decision made.

However, this pro-collaboration approach tends to ignore the likelihood that different actors within the collaboration possess greater power than others (Klijn and Skelcher, 2007). Whether due to historic influences, resources, or the dominant ideas, it is probable that some actors in a network will have greater influence on policy and policy outcomes, and these differences are rarely accounted for when assessing the potential for



successful, widely inclusive collaboration (Foster, 2002). Klign and Skelcher (2007) in fact conjecture that the move toward collaborative governance may increase the ability of powerful interests to shape policy via a strategic use of networks. In NIMBY terms, this may simply reinforce existing NIMBY efforts, or provide easier access for NIMBY groups to overwhelm the discussion with their parochial concerns. Further, Walti, et al., (2003) suggest that within collaborative frameworks, governmental actors use their legitimate power to force compliance with the ‘official’ view of problems and subsequent solutions, and power may be held by those private actors with more resources, by those perceived to have moral or reputational authority, or by actors that represent the dominant social view of the policy issue in question (Novotny, 1995), and such groups are unlikely to be those for whom policies encouraging more collaboration are intended to benefit.

These variations are philosophically rooted in the arguments regarding participation and discourse articulated by Habermas (1970) and Foucault (1972). For Habermas, communicative rationality and ideal discourse could supersede the influence of power relations; for Foucault, the power of actors and of ideas was inextricably woven into the fabric of discourse, and governance could not be understood without understanding the power relationships involved. For Habermas, what one says, absent power, is the key to communicative discourse. For Foucault, who is speaking is potentially more important than what one says. Most literature advocating for collaborative governance, especially in the environmental realm, implicitly accepts that the Habermasian view of discourse should be strived for and is achievable (Renn, et al., 1995). However, as collaborative networks have become officially codified, researchers

are noting that the Foucaultian view has been overlooked (MacKinnon, 2000).

Collaborative activities tend to simply provide more access to those groups that already have power, making NIMBY efforts even more likely to successfully keep needed facilities from being built (particularly in high socioeconomic status areas).

These existing power structures may be particularly important in policy areas characterized by a high degree of conflict, of which environmental policy is an excellent example (Fischer, 1993). General network research has tended toward policy systems characterized by relatively little conflict, where goals are largely shared (Agranoff and McGuire, 2003). When conflict over goals is higher, collaboration may be less likely, and the influence of power may come more into play (Adam and Kriesi, 2007). The Habermasian ideal is overreliant on actors prioritizing public needs over individual need, and therefore often fails in practice (Santos and Chess, 2003), and furthermore, collaboration efforts have a tendency to focus on the process with little regard to the outcomes (Bickerstaff and Walker, 2005). Bickerstaff and Walker (2005) support the conclusions of Walti and Kubler (2003); participants in stakeholder discourse tended to feel co-opted rather than empowered. The process of governance discourse was more often used to institutionalize predetermined policy ideas, and this seems to be particularly true of participation in environmental policy decision making (Rich, et al., 1995).

An alternative approach to conceiving of policy discourse is framed on the work of Foucault. Traditionally, power was assumed to emanate from state actors, using their official capacity and power to compel. As collaborative governance is foremost an effort to infuse top-down power structures with more democracy and participation, it is

assumed to be a treatment for the problem of hierarchical power structures. However, governance theory makes two strong assumptions with regard to power: first, that collaborative processes result in an equal sharing of power between the government and stakeholders, and second that stakeholders are also on equal footing. While a collaborative approach may well bring the power differential between governmental actors and stakeholders more in balance, there is little reason to expect that each potential stakeholder of a policy will have an equal voice in the discourse. This could be due to existing strands of political power in a community, but it may also simply be due to the fact that it takes resources to be able to participate and some groups lack access to sufficient resources to do so.

Additionally, however, power is almost certainly more complex in governance systems than in the traditional state directed model. Power is no longer presumed to solely belong to state actors, and it may be difficult to ascertain from whence power is derived. For Foucault, power is implied in the very nature of the statements made by actors in the process (Richardson, 1996). As such, ideal speech is not possible, because equality of power is not feasibly achievable and participation in the policy process is bound to result in satisfactory and positively reinforcing outcomes for those who currently possess influence, and unsatisfactory and negatively reinforcing outcomes for those who are not influential (Rich, et al., 1995). Further, Fischer (1993) notes the importance of the credibility of the stakeholders with whom the decision makers interact. Credibility and power are not necessarily the same – power is about the potential for coercion in a political process, whereas credibility refers to the esteem with which a

particular group is held (French and Raven, 1960). Credibility may well be more important than power for discourse, and particularly with regard to discourse involving bureaucratic decision makers. In either case, *who* the stakeholder is may be vastly more important than *what* the stakeholder says. If this is the case, then participation may be, at best, irrelevant for lower status groups or, at worst, counterproductive, especially if we assume that public sector decision makers tend to see participation as a delay-inducing hurdle that must be cleared rather than as an effective means of creating policy (Ibitayo and Pijawka, 1999).

Moreover, since the amalgam of issues related to the siting of environmental hazards may constitute a wicked problem (Fischer, 1993), it is not clear that collaboration would yield useful policy designs or outcomes (Kenney, 2000). Coming from the point of view of expertise honed in the scientific framework (Fischer, 1993), decision makers may not be able to reconcile “good” environmental policy decisions that minimize risk in the aggregate with a stakeholder perspective much more rooted in local interests and value judgments of fairness and equity (McAvoy, 1998). If both sides view risk incongruently, then consensus is unlikely with an end result of reinforcing the view that participation is more about co-opting interests than collaborating with them (Beierle and Konisky, 2000).

## Risk

At the root of the potential problem building consensus is the potentially divergent views of risk and consequences held by stakeholders and by decision makers. Decision makers and policy experts tend to view risk from the *objectivist* perspective –

given any hazard, there is some assessable risk defined by the probability of a negative outcome and the severity of the consequences (Cvetkovich and Earle, 1992). Risk is not perceptual; it is definable and measurable. However, stakeholders tend to have a much wider view of risk, ranging from potential economic consequences to value judgments regarding what is fair and just (Schively, 2007). This is the *constructivist* view of risk, encompassing a more diverse set of philosophical and perceptual consequences beyond the scientifically measurable (Cvetkovich and Earle, 1992). Decision makers can therefore be frustrated by what appear to be parochial or irrational concerns (Ibitayo and Pijawka, 1999), but may in fact be reasonable reactions based on a different perspective regarding what is fair in terms of balancing increased localization of environmental risk in exchange for decreasing aggregate environmental risk (McAvoy, 1998).

One of the key areas in which the broad view of risk, associated with living in proximity to environmental hazards, has been studied is the fluctuation of land values pre and post environmental change. Kohlhasse (1991) and Hird (1993) both showed that land values were lower, all else equal, when a hazardous site of some sort was nearby. Dale et al. (1999) and McCluskey and Rausser (2003) similarly found that land values in proximity to hazardous sites tended to increase after the site had been cleaned up. However, complicating the divergent views of risk between policy makers and stakeholders, objective measures of risk may not be the key change factors. The perception of risk reduction may be enough to explain changes in residential behavior and demand for homes in proximity to hazardous sites. In fact, when comparing the results of actual environmental improvement with the perception of improvement,

McMillen and Thorsnes (2003) showed that property values near hazardous sites actually began to increase after a facility ceased operations, regardless of whether the site is actually cleaned up or not. This finding is line with a constructivist view of risk: once the site is no longer actively producing pollutants, people view this as a reduction in risk, and react accordingly, even though many pollutants likely remain on the site.

Because of incongruent points of view amongst participants, collaborative environmental institutions may therefore be doomed to failure. Divergent views of the risks associated with environmental hazards may lead to frustration for decision makers who see collaboration as procedurally necessary, but a nuisance. Frustration from decision makers can be seen in the increasingly aggressive use of disparaging acronyms in the planning literature from NIMBY (not in my back yard) to CAVE (citizens against virtually everything) to BANANA (build absolutely nothing anywhere near anyone) (Schively, 2007). This frustration can mitigate any possibility of consensus or usefulness of collaboration, reinforcing negative expectations that collaboration is pointless (Rich, et al., 1995) and discouraging future collective action amongst a population already less disposed to organizing than higher status groups (King, et al., 1998).

Beyond issues of point of view, it is unclear that consensus necessarily leads to future collaboration. Collaborative frameworks are increasingly the norm in environmental policy (Bardach, 1998), despite much evidence that such frameworks produce results that are not substantially different than traditional top-down approaches to environmental policy decision making (Langbein and Kerwin, 2000). Collaboration between policy makers and stakeholders may address the power differential that exists

between governmental authorities and citizens (John, 1994), but the complexities associated with most environmental policy decisions might further exacerbate existing power differentials between stakeholders, pitting powerful interests with resources against disorganized, low socioeconomic status citizens (Kenney, 2000). Rather than encourage cooperation and foster trust, such efforts could engender further distrust of government officials (a common theme in NIMBY literature) (McAvoy, 1998), and further discourage participation by those for whom collaborative institutions have been set up to assist (Rich, et al., 1995). Collaboration efforts tend to focus on the process of creating consensus without investing effort into resolving the fundamental difference in risk perceptions: policy makers focus on the aggregate level of risk to the social system of interest, while residents and parochial stakeholders focus on the specific level of risk to their immediate community and perceptions of the fairness of the distribution of that risk (Lubell, 2004). Whether due to historic influence, resources, or the dominant ideas, it is probable that some actors in a collaborative network will have greater influence on policy and policy outcomes, and there can be a fine line between consensus and coercion (Lukes, 1974)

Moreover, environmental policies are complex, requiring a substantial scientific background in order to understand the issue sufficiently to provide meaningful input (Lubell, 2004). The complexity of an issue is likely to create a further chasm between objectivist policy makers and constructivist stakeholders, and may also affect the extent to which the public feels confident enough to ‘enter the fray’ and involve itself in the collaborative process. Gormley (1986) suggests that powerful groups will be most

influential when projects have low public salience and high technical complexity. They will have slightly less influence when projects have low salience and are not terribly complex. Powerful groups will have less influence, but still much when projects have high salience and high complexity, but they will have the least influence on those projects that have high salience and low complexity. We might expect environmental policies to trend toward highly levels of complexity, but they also tend to be highly salient. The influence of powerful groups might be lessened whenever a policy is very salient, and this might be the ideal area in which traditionally underserved stakeholder groups can yield the greatest influence (which tends to be the goal of collaborative policy institutions).

Thus, there are two very different views on the potential availability and efficacy of collaboration with policy makers or more traditional NIMBY efforts (McAvoy, 1998). On the one hand, efforts by high status groups may exist mainly to reinforce the existing status quo, but on the other hand, policy designs increasingly encourage participation by lower status communities under the assumption that participation in the process will increase the likelihood that such populations see more favorable policy outcomes. The first proposition rests on the assumption that power resides solely with those who have either resources or traditionally have been favored in policy, or more basically, on elite theory (Mills, 1956). The second rests on the assumption that by being engaged and organized, traditionally underserved groups can see their interests ultimately reflected by getting a seat at the table, or more basically, on pluralism theory (Dahl, 1961). These two divergent views on power color our expectations with regard to whether collective



actions in bureaucratic processes are worthwhile and whether such efforts will be effective or not. In order to scan the full view of these possibilities, I now turn to a discussion on political power in the policy process, and how we might expect political power to affect decisions made by public managers.

### Power in the policy process

Few concepts are as important to understanding the public policy process as power, yet the term itself is ill defined (Williamson, 1981), has a variety of different meanings (Riker, 1964) and is heavily dependent upon context (Flyvbjerg, 1997). There is no shortage of theoretical consideration given to the concept, yet most empirical studies in public administration and policy tend to take power relationships as a given, unobservable variable. Studies of power have long pervaded social science research. Seminal works by Dahl (1961) and Mills (1956) set the groundwork for studying power. Dahl (1961) studied New Haven, CT in depth to understand how interests influenced the bureaucratic system in the city. His findings backed a pluralist view, whereby many groups compete for influence, but given the fragmented nature of power, no one group is capable of dominating. This contrasted with Mills (1956) view of power being held by a homogenous elite, made up primarily of the military, corporations and the elite levels of bureaucracy.

Shortly after this research was published, Bachrach and Baratz (1962) effectively critiqued both pluralist and elitist assumptions of power as driving the research findings; if a researcher goes into a community and asks “who has power?” invariably respondents

will name some set of elites. However, this does not mean that these people possess actual power; if one goes in search of the elite, one will inevitably find them, but those elites may not truly have more influence than would be expected. Pluralism (and Dahl in particular) was critiqued for its strict focus on the process of exercised power. To Bachrach and Baratz (1962), the power that has been exercised is only half of what power is. Dahl (1961) investigated only those issues that had made it onto the city's agenda, and found that once on the agenda, no group tended to dominate policy outcomes. However, there could be great power in keeping things off the agenda in the first place, which Bachrach and Baratz termed "non-decision making", or unexercised power. In a further revision, Lukes (1974) noted a third dimension of unexercised power in a group's ability to not only keep issues off the agenda, but to convince other actors that their interests coincided with the powerful group's interests, which may be a particularly concerning issue for collaborative environmental management considering the effectiveness of NIMBY strategies.

If we define power as a group's or individual's ability to define or modify issues on, or exclude issues from an agenda, then there is one dimension of exercised power, used whenever an issue is already on a jurisdictional agenda, and two dimensions of implicit power that relate to the ability to either keep issues off an agenda, or convince other stakeholders that their own interests are at stake, when in fact, they are not. Some groups will keep discussion off an agenda, others will define issues in a manner most beneficial to themselves (Stone, 1989), while others will attempt to redefine, modify, or

institutionalize the definitions of issues that are currently open for discussion on an agenda (Cobb, Ross and Ross, 1976).

To the extent that public affairs researchers have empirically considered power, it is almost exclusively related to explicit uses of power whereby groups attempt to “win” once an issue is already on the agenda (Lowi, 1979), or how groups try to expand interest in issues to get them on the agenda (Cobb and Ross, 1997). A smaller literature set attempts to empirically investigate the implicit uses of power, in excluding issues from an agenda or defining them such that others agree to an outcome that is against their own interests. For the most part, prior to the late 1990s, most investigations of power followed the deep case study method utilized by Dahl. Researchers would investigate jurisdictions in great detail, and/or examine some particular policy as it moved through the policy process. Flyvbjerg (1997) exemplifies this type of research, going into great detail investigating and interpreting power relationships in the context of transportation policy in a mid-sized city in Denmark. He interviewed actors who were involved in the process throughout a multi-year period, beginning with a decision to write a new transportation policy, through the process of drafting, receiving comments and ultimately implementing the policy. At various points, general themes are seen to influence the entire process; Flyvbjerg (1997) found that timing is key for having the ability to influence the process, and that, for the most part, rational policy analysis tends to be used only to rationalize political decisions that had already been made. Power itself is viewed as the ability to influence the process, and Flyvbjerg assumes a group has power if others in the process

indicate that it does, and if the group has a tendency to see its wishes reflected in the policy output.

Flyvbjerg's (1997) study is but one example of many similar case studies, but is illustrative in its focus on power. Similar detailed studies have been Stone's (1975) study of Atlanta, Furlong's (1997) studies of interest group activity in Congress, and Hill's (2002) comparison of city bureaucracy decision making in North Carolina and Michigan. Others assess a policy or policy area in great detail, where jurisdiction may not be quite as fixed. This type of study tends to focus on environmental issues, with two prominent examples of this type from Clarke and McCool (1998) and Koontz, et al. (2004). Clarke and McCool investigated natural resources policies in various jurisdictions, creating a typology of power held by certain types of interest groups and bureaucratic agencies. Koontz, et al. (2004), studied the workings of local level environmental protection, finding that groups have more influence whenever their organizational culture matches best with the government's expectations of partner action. While these types of studies are instructive, they are not generalizable, and mostly serve to reinforce the notion that power is contextual and potentially cannot be generalized, although with a refinement acknowledging that power relationships may be altered from expectations depending upon the normative view of the audience.

Another set of papers attempts to collect information over a large enough and varied enough area to be generalizable. This work tends to follow a process similar to that utilized by Weiss (1989). Weiss investigated how Congressional committees utilized expert policy analysis during policy drafting and decision making periods, with a finding

similar to Flyvbjerg (1997) – expertise tends to be used to rationalize decisions already made, rather than for its informative value. Weiss collected various types of analysis that was presented to members of Congressional staffs and combed the Congressional record for how, if at all, the source was utilized. In a large scale study, Also on the more political side of the policy process, Wiggins, et al (1992) conducted a similar study at the state level, combing through lobbying records to see whether interest groups had much influence with powerful legislators and governors. On the more bureaucratic side, Rinquist, et al. (2003) investigated the influence of Congressional oversight of the bureaucracy, both as an investigation of Congressional power over the bureaucracy, and bureaucratic expertise over policy rules. They found that Congress tended to use its oversight powers more when the issue was more highly salient with the public, but that the bureaucracy tended to have more power to defer Congressional oversight when the policy in question was highly complex.

With regard to the inclusion of non-expert input as well as that of experts, a related set of studies consider the official open comment periods initiated by the Administrative Procedures Act (APA). Before bureaucratic agencies issue final rules detailing the implementation procedures for certain (usually regulatory) policies, the APA requires that rules be proposed first in the Federal Register, followed by an open comment period enabling any interested party to provide comments regarding the proposed rules. Golden (1998) investigated this process, collecting the comments and comparing proposed rules to final rules to determine which comments influenced changes from the proposed rules to the final rules. She found that business groups provide the

most comments (a finding reinforced time and again), but that business group comments were no more influential than comments from other organized interests or the general public. Nixon, et al. (2002) corroborated this finding in an investigation of comments provided to the Securities Exchange Commission (SEC) for a variety of proposed rule changes. The SEC would be exactly the sort of agency in which one would expect to see powerful interests capture the decision making process (Lowi, 1979), given the high complexity and low salience of most SEC rules. Nevertheless, while Nixon, et al. (2002) found that that regulated businesses did indeed provide the most comments, there was no indication that those comments influenced final rules any more than other comments that were provided.

Using the same procedure of comparing comments to final rules, Yackee (2005) investigated several rule changes at different agencies, varying by salience and complexity. She found that rule changes were most likely to occur whenever comments tended to be more uniform, and that whichever side provided the most comments was more influential, providing some credence for the idea that organized community interests are likely to see more favorable results than unorganized individuals. Yackee and Yackee (2006) corroborated this finding by differentiating comment providers; they found, once again, that businesses provide the most comments and that business groups have the most influence in rule making decisions, but reason that this is chiefly due to the probability that more thematically similar comments have more influence regardless of source, and business groups tend to comment the most.

These studies do not tend to account for power differentials between the different interests that provide comments, however. Although Yackee and Yackee (2006) stipulate that number of comments is the key causal variable for seeing interests reflected in final rules, the important causal factor could well be that businesses have more power than other interests in bureaucratic decision-making. Walzer (1982) indicates that there are two sources of legitimate exercise of power: ownership and expertise. That businesses comment more and seem to have more influence may be an indication that in most of the policy areas studied, ownership power is more influential than expertise. However, Weiss (1989) did observe that expert analysis could be influential, and work by Cigler and Loomis (2002) indicated that decision makers in government are likely to respond most substantively to comments that are clear, concise, and well-informed in advocating a group's point of view. We might expect political decision makers to respond to pluralities in order to secure their political standing, but it is less clear that bureaucratic decision makers have similar goals. Given the professional norms and expectations of behavior and decision-making in bureaucratic processes, more professional, technical, or rational argumentation might be more effective than sheer volume when attempting to influence the organizational decisions of public agencies.

Cuellar (2005) investigated this idea noting that bureaucratic decision makers tended to respond most positively to "sophisticated" comments and those provided by "high status" groups. Building on this work, Jewell and Bero (2006) investigated comments provided for a highly salient ergonomics rule change in California. Jewell and Bero (2006) recorded both who provided a comment, and what sort of argument was

made. They found, once again, that businesses provided the most comments and their comments had the most influence on the final rule that was decided upon. However, they also found that business groups tended to use more scientifically based discourse, with more citations and statistics. Labor groups and the general public provided more anecdotal evidence, or argued in moral terms of right and wrong. Therefore, it may be that businesses only appear more influential because they utilize a more effective form of argumentation given the context of the decision making agency, and that if resident groups were organized and provided more objectively based argumentation than morally based argumentation, then they might be better able to ensure that their interests are reflected in the final policies adopted.

A note of caution is in order, however. It may also be that comments, regardless of who provides them or how they are presented, have little influence on bureaucratic decision-making at all. Using a similar procedure, West (2004) found that most comments appeared to have little, if any, effect on decision making, because official comment periods occurred far too late in the actual process of rule making to have any impact. By the time a rule is submitted for official comments, it is most likely to only change slightly when the final rule is issued. The real power of groups occurs much earlier in the process, before the agency even begins writing proposed rules. West (2004) suggested that interest power should be investigated far earlier in the process. This finding is corroborated by Naughton, et al. (2009), who studied comments provided both during a scoping phase prior to issuance of proposed rules, and later in the process, just before issuing final rules. They found that, indeed, the earlier a comment is provided, the



more influential it is, and this is particularly true of comments that are substantiated by data of some sort. Table 7 details how what strategies may be effective in affecting bureaucratic decision making.

**Table 7: How interests affect bureaucratic decisions**

<b>Study</b>	<b>Proposed effective strategy</b>
Golden (1998)	No strategies seem particularly effective
Yackee (2005); Yackee and Yackee (2006)	Provide many comments of similar tone and content
Cuellar (2005); Jewell and Bero (2007)	Use objective rather than moralistic argumentation
West (2004); Naughton, et al. (2009)	Provide comments as early in the process as possible

The end conclusion of these studies suggests that the power of different interests vis a vis one another is still largely a black box. Although these papers investigate power in the bureaucratic rule making process, power is only implicitly operationalized as a dichotomous variable concerning whether the commenting organization was a business group or not. The APA was intended as a pluralistic mechanism to allow interests to have more access to governmental decision making (Yackee, 2005). Yet, research in this area implicitly assumes that power follows Mills (1956) elite view that business groups will have more power. It is far from clear that this should always be the case, and may explain why Golden (1998) and Nixon, et al (2002) find that businesses do not have undue influence, while Yackee (2005) and Yackee and Yackee (2006) find that they do. Further, these studies investigate only whether groups have an ability to influence a policy already on the agenda. Nicholson-Crotty and Nicholson-Crotty (2004) studied the more hidden influences of power by surveying public managers (school superintendents) to determine who they believe has power in their district, under the theory that unexercised power is

the ability to constrain the decision making of public managers without actually having to specifically lobby for anything. The result of their survey indicates that the managers' views of who has power are directly related to how frequently groups have access to them. Thus, parent groups that get more face time with school superintendents are perceived to have more power, according to those superintendents. Similarly, Brudney and Hebert (1987) asked public managers who they believed had power in their policy area; managers tended to view interest groups mostly as sources of information, not influence. Going even further in turning the expected view of power around, Chase and Reveal (1983) surveyed a variety of actors in a policy environment, asking which interests had power, with the finding that the most powerful groups tended to be co-opted early in the process in order to provide a legitimacy cover for decisions that governmental actors had already made. Lynn (1990) conducted a similar survey also finding that public agencies strategically co-opt powerful interests in order to legitimize their decisions. Thus, it is implied in the APA-related papers that interests have power over public managers, but it may be that public managers are truly the power brokers, co-opting interests or using their information only for rationalization or political cover.

All in all, this research gives us some notion that business groups tend to have more influence in rule making by overwhelming decision makers with comments, and using more sophisticated argumentation than others. We also can note a correlation between access to policy makers and the perceived influence groups have and how timing affects influence. It seems that the status of the commenter and the content of the argument are likely to affect the amount of influence that a comment has in the decision

making process, but at this point, there is little more than speculation to indicate what this influence might be. In the rest of this paper, I look in more detail at variations in the type and source of the comments, the context of the jurisdictions in which the projects take place, and differences between the public agencies charged with making decisions, in order to determine how direct, external power is manifested in bureaucratic decision making. I investigate these issues in the context of public participation in the EIA process.

### Environmental Impact Analysis

EIA offers an ideal arena through which to explore these issues. Multiple agencies at multiple levels of government are involved in the EIA process; decisions can be made by local, state or federal level agencies, alone or in conjunction with one another, and projects subject to EIA often involve a wide range of different stakeholders and interests. Thus, investigating through EIA engenders a look across multiple levels of government at a large number of different public agencies making decisions based on input from a diverse set of interested parties. In the US, the result of an EIA is often an EIS. The process of creating an EIS is set forth in detail through the President's Council on Environmental Quality (CEQ); this process is followed closely by federal agencies complying with the National Environmental Policy Act of 1969 (NEPA). NEPA stipulates that whenever any federal agency is considering a project that will have a

“significant”<sup>10</sup> impact on the environment, an EIS must be prepared, following CEQ guidelines. NEPA requires that the EIS should be authored in such a manner that “most” non-technical people can understand it, and the public should be included at several steps, from determining the likely environmental impacts to selecting the final set of alternatives to be considered. A number of states have EIA rules modeled after NEPA, requiring state and local agencies to follow the same (or similar) procedures (see Bonorris, 2004).

A thorough scoping process must occur at an early stage in the process, whereby stakeholders are consulted for their interests and expertise regarding what the potential alternatives to be considered may be. A full draft EIS (DEIS), subsequently detailing these alternatives is then open for public comment. Usually, agencies do not express a particular preference to any of the alternatives at this point, at least not explicitly. Any interested party or individual may comment (although publicizing of DEISs is not necessarily broad), and comment periods are usually open for at least 30 days, with extensions commonplace. Written comments are received, and public hearings are usually also held, and the subsequent drafts of the EIS and the final EIS include these public comments and summaries of the meetings. The agency uses any relevant information or public comment(s) to determine its preferred alternative, which can be one of the alternatives from the DEIS, a hybrid of several of the DEIS alternatives, or a different plan altogether. In the final EIS, the public agency justifies its decision, and

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<sup>10</sup> The Supreme Court has taken a very liberal interpretation of “significant” such that federal agencies usually undertake the EIA process (which may or may not include preparation of an EIS) anytime there is likely to be any environmental impact.

must respond specifically to the comments that have been provided (although grouping similar comments together under one response is permitted), while also detailing the implementation plan for that alternative, which may or may not have changed from the draft EIS as well.

Thus, in an EIS, there is a clear process from which alternatives are proposed through public participation in the decision regarding which alternative ought to be selected, to the actual decision that was made (with agency justification). Therefore, not only can comments be assessed for the type of argument, and category of interest, but also for how much influence the agency specifically indicates the comment had.

EIA is also a useful area in which to study power and the efficacy of collective action due to the long history of studying implicit power in environmental policy. The NIMBY argument has tended to be framed as an instance of implied power in action – as high socioeconomic status populations work to ensure that their communities do not become sites for hazardous facilities, policymakers and firm owners take note and thereafter restrict such neighborhoods from future consideration. Although much of the NIMBY research describes specific instances of successful (or unsuccessful) NIMBY-based opposition, the greater concern for social commentators has been the implied power assumed to follow a successful NIMBY effort (Agyeman and Evans, 2003). Less explored is how these trends of NIMBY effects alter decisions that are expected to result in environmental improvements, or where there are trade-offs that make the end environmental quality effect difficult to discern. According to NEPA, federal agencies that undertake any project that has any environmental impact must go through the EIA

process, both if that impact is expected to be an environmental degradation, and also if it is expected to result in environmental improvement. For this project, I describe projects that are expected to result in net improvements in regional or local environmental quality, although those improvements may be counterbalanced by localized negative impacts. Given the paucity of previous work investigating participation in EIA in the United States, this project is an exploratory effort to understand the nature of public involvement in EIA, and the impact of such involvement on agency decision making. As such, I explore the following questions through a content analysis of public participation in EIA:

- Who participates in the collaborative framework established in EIA?
- What types of argumentation do stakeholders use to make their points?
- Do different types of stakeholders participate differently?
- How responsive are agency decision makers?
- Are agency decision makers more responsive to different types of stakeholders or different types of argumentation?
- Does the extent to which it appears that residential interests are organized affect the likelihood that agencies alter implementation plans in order to address stakeholder concerns?
- Are agency decision makers more responsive to concerns when a project is highly salient with a wider set of stakeholders than when the project is very localized or when stakeholders appear disinterested?
- Does the complexity of the project affect the extent to which agency decision makers are responsive to stakeholder comments?

## Data and methods

The data I use to explore these questions are derived from a purposive sample (Jewell and Bero, 2007) of three EISs from projects undertaken by three different federal agencies all within Washington, DC. The EISs were chosen purposefully in order to vary the technical nature of the lead agency involved, as well as the demographic characteristics of the communities most likely to be affected by the project. However, in order to maintain regional and jurisdictional consistency, all three projects were located in Washington, DC during the time period between approximately 2004 and 2009. I use a content analysis procedure similar to Kraft and Clary (1991), Yackee (2005), and Jewell and Bero (2007). Each EIS includes a variety of different types of public involvement, including formal written correspondence and comments provided at public meetings. Each EIS also includes responses from the lead federal agencies to the comments provided, indicating how the agency addressed (or did not address) a particular concern and whether the comment seemed to affect the scope of the agency's decision.

The analysis of three EISs resulted in 1243 comments and agency responses. In the sections that follow, I first provide some background description of the three projects assessed in this analysis, before I describe the content analysis procedure in detail, and discuss qualitative and quantitative findings with the comment as the unit of analysis, investigating the extent to which various aspects of each comment (and context) seemed to alter agency decision making.

### *Case 1: Armed Forces Retirement Home*

The Armed Forces Retirement Home (AFRH or Home) was established in 1851 as a care facility for aging veterans of the Mexican War. The Home was built on a hill in rural Washington, DC, overlooking the Capitol and the Potomac River in the distance, and has served retired veterans from every conflict since it was established. Many of the buildings on the Home site were constructed between the 1850s and the early 1900s, with several listed on the National Register of Historic Places. The most famous building on the site is the *Lincoln Cottage*, a home that Abraham Lincoln often retired to during the Civil War both for relaxation and as a more securable location for the President than the White House at the time. As the city grew, the area around the Home began to develop, most notably the Petworth neighborhood to the north/northwest, the Park View neighborhood to the west (so named due to its adjacency to the park like setting of the Home) and the establishment of Catholic University to the east in the early 1900s. The neighborhoods surrounding the site are mostly residential, with middle density townhome and duplex developments. The communities to the north and west are poor compared to the region as a whole, but not as poor as other areas of the city. Neighborhoods south of the Home are some of the poorest in the city, although the proximity of the site to downtown and the new convention center have led to recent demographic changes. The Home site is nearly 300 acres including wooded areas, ponds, a golf course, and walking trails. Prior to the 1960s, the grounds were open to the public and were often used as a gathering place for community residents. The site was fenced in for security purposes



during the 1960s, although the green space remains an integral, if inaccessible, feature to the local area.

In the late 1990s it was recognized that numerous modernization updates were necessary for the Home's facilities. Moreover, in the early 2000s, the Home began experiencing problematic financial shortfalls. The Home is self-sustaining, relying on a trust fund supported by payroll deductions of active military personnel. As the trust fund was increasingly depleted, the Home began investigating alternative revenue options. As real estate values in the immediate area had escalated substantially, the Home recognized that its land was its most valuable asset and could potentially close funding gaps by developing some of its acreage for commercial and residential uses in this transitional community. The Home began planning to develop a portion of the site to provide needed revenue, and also pledged to investigate how to reopen portions of the remaining undeveloped land to local residents. Although the plan would develop undeveloped land, the Home hoped that by providing commercial services and potentially access to the site for community residents the development would constitute a net gain for local residents. Further environmental improvement would be provided through the removal of many underground storage tanks and related leakage of fuel into the communities' soil, and the thorough cleanup of dry cleaning facilities located on the site.

An EIS was required as the project would impact environmental conditions in the community both during and after construction. The EIA process, with the Armed Forces Retirement Home as the lead agency, began in 2004, a DEIS was issued in May 2005 and open for public comment, and the Final EIS was released in November 2007. Four

alternative plans were considered, three of which included developing land on various parts of the campus, and a no action alternative as required by CEQ's EIS preparation guidelines. The Home held one public meeting in July 2005, during which 33 individuals offered comments on the DEIS in addition to written comments the Home received from 67 individuals, agencies, and organizations constituting a total of 320 separate comments.

### *Case 2: 11<sup>th</sup> Street Bridges*

The 11<sup>th</sup> Street bridges are two one-way bridges that cross the Anacostia river, connecting downtown Washington to the easternmost portions of the city. The western side of the river in this area includes the Navy Yard and the recently constructed baseball stadium, and neighborhoods that have experienced recent redevelopment. The eastern side includes many of the poorest communities in the city, including the Anacostia neighborhood, a historic African American neighborhood that also tends to be one of the poorest and least economically developed neighborhoods in the city. Over the last several decades the 11<sup>th</sup> Street Bridges have become overwhelmed by traffic congestion, owing to a location connecting Interstate 395 (I-395) and the Southeast Freeway with Interstate 295 (I-295) and the Baltimore-Washington Parkway. The bridges were never intended to carry freeway traffic, and as such, there are no direct linkages between the Southeast Freeway on the western side of the river, and north-bound I-295 on the eastern side, nor from south-bound I-295 to the Southeast Freeway. Without these linkages, traffic is heavily congested as commuters traveling between downtown Washington and Maryland take to side streets in the neighborhoods to find alternates.

The story of the 11<sup>th</sup> Street bridges is really a story about freeway development in Washington. Interstate 95 (I-95) was originally intended to follow a path through downtown Washington, connecting with the existing route between Springfield, Virginia and College Park, Maryland. However, strong neighborhood opposition in the 1960s and 1970s in the District kept much of the freeway from being built. Residents strongly opposed construction of the highway through District neighborhoods, and as such only the portion of the highway running from Springfield, Virginia to downtown Washington was actually completed (and is now I-395). I-395 ends in downtown Washington, while the Southeast Freeway is a spur connecting I-395 to the 11<sup>th</sup> Street and Pennsylvania Avenue bridges over the Anacostia River. Since the original intent was to have I-95 run through the city, connections between the Southeast Freeway on the western side of the river and I-295 on the eastern side were not fully constructed. As the Maryland suburbs grew, traffic increased on these freeways and without direct freeway connections, congestion increased on the bridges with clogged left turn lanes and in the residential communities nearby. The 11<sup>th</sup> Street bridge project is intended to address the lack of a connection between the freeways on both sides of the river, allowing traffic to flow at speed without diverting to neighborhood streets. Environmental improvement would be provided in several ways: the removal of traffic from neighborhood streets and the elimination of traffic congestion on bridges would improve air quality; increased capacity for safe bicycle and pedestrian travel across the bridges would decrease car trips and facilitate use of public transportation; and park land would be added as part of an enhanced Anacostia waterfront.

As the bridges and construction would impact the environment, potentially both positively and negatively, an EIS was required, with the Federal Highway Administration (FHA) as the lead agency. Scoping for the project began in 2004, and a DEIS was issued in June 2006 after which public comment was solicited via six public meetings and various media outreach efforts. In addition to a no-build alternative, five build alternatives were considered, all of which included provisions to connect the freeways on each side of the river. There were 392 distinct comments received from approximately 200 individuals, agencies, and organizations. The final EIS was issued in October 2007.

### *Case 3: Washington Aqueduct*

The Washington Aqueduct is the authority that provides drinking water for Washington, DC, Arlington, Virginia, Falls Church, Virginia, and parts of Fairfax County, Virginia. The Aqueduct consists of a series of reservoirs, tunnels, and piping systems throughout this area. Water for the reservoirs comes from the Potomac River upstream from Washington through Montgomery County, Maryland. The Aqueduct is managed by the Army Corps of Engineers (ACE) who are responsible for maintenance, expansion and delivery of water to residents in the area. In order to comply with provisions of the Clean Water Act (U.S.C. §§1251-1387) regarding iron and aluminum particulates that may be safely redistributed to the river, it was necessary for ACE to derive some method through which to remove these residuals from the water it intakes from the Potomac. Residuals could be returned to the river potentially, but only at a level of dilution higher than the capacity that currently existed at the Aqueduct's facilities. As

the initial intake reservoir, ACE determined that the residual processing capacity would be constructed at the Dalecarlia Reservoir.

The Dalecarlia Reservoir is bisected by the boundary between Washington and Montgomery County Maryland, located predominantly in the upper northwest portion of the city proper. The area is amongst the wealthiest in the city, with a much larger proportion of white residents than the rest of the city at large. Land is expensive in the area, and the Spring Valley and Palisades neighborhoods to the east and south of the site are quite wealthy, as is the Brookmont section of Bethesda, Maryland to the north. The Reservoir is surrounded by parkland and woody forests to the west, north, and east, on land owned by the Aqueduct, and it has been in operation since it was built in 1858. The plan calls for the removal of residuals from the water at the Dalecarlia site, with options for subsequently removing the residuals from the site either by trucking them out of the city, piping them back to the river at the appropriate level of dilution required by the Clean Water Act, or retaining the residuals at the Reservoir in a landfill (technically referred to as a monofill since the fill would contain only one type of material). Environmental improvement in this case is much more of a trade-off than in the other two cases. Water quality in both the Potomac and the regional drinking water supply would be improved, but environmental quality local area of the Dalecarlia site would likely be degraded, either through pipe construction, increased truck traffic, or the presence of the monofill.

The planning process began in early 2004, and the DEIS was issued in April 2005, after which a 45 day public comment period began. The final EIS was issued in

September 2005. Five alternatives were considered, including the no-action alternative, ranging from a monofill (landfill) to retain the residuals onsite, to various trucking and piping plans to remove residuals from the Dalecarlia site. A total of 530 comments were received from a combination of about 200 written comment submissions and participation at five public meetings.

### Content analysis procedure

#### *Comments*

I developed the content analysis framework both inductively from theory, and deductively from a preliminary reading of the three EISs. I read fully through each document, including all comments prior to developing and implementing the content analysis plan. The theoretical categorizations described below were thus altered to the extent that theorized relationships were likely to be explorable in the comments provided in the three statements. After this initial read through, I developed the plan described below and read each comment in careful detail, coding it accordingly.

Each distinguishable comment was coded individually in the content analysis procedure. One commenter could have provided multiple comments, but since the agencies responded to each thematic comment rather than to each individual commenter, the comment is the unit of analysis employed throughout rather than the commenter. Comments were coded according to the procedure outlined in Table 8, and agency responses were categorized according to the procedure presented in Table 9. Contextual factors related to the project itself were coded as shown in Table 10.

### *Commenter*

Throughout the three statements, comments were provided by a variety of different commenters, ranging from residents, nonprofits, government agencies at all levels, and government representatives. As such, the type of commenter was collected for each comment provided. For written comments, organizational actors tended to use letterhead and clearly identify themselves as speaking for the agency or organization in question. Comments from governmental actors were coded according to six possible types, regarding whether the commenter was a federal, state, or local agency, or a federal, state, or local political representative. Non-governmental organizations were coded according to six possible types as well: locally based business/business interest group, nationally based business/business interest group, locally based environmental interest group, nationally based environmental interest group, locally based other type of interest group, and nationally based other type of interest group. Individual commenters were coded in three possible ways: individual non-resident, individual resident, or resident/neighborhood association representative. Individuals were only coded as resident association representatives when they clearly indicated that they were speaking on behalf of their community and/or utilized a resident association letterhead. Individuals were only coded as residents when it was clear in their comment that they lived in proximity to and/or their home would be affected by the proposed project, or when they included their local address with the comment. Individuals were otherwise coded as non-residents, as were individuals that included addresses or substantive indications that their interests in

the proposed project were based on factors other than the project's proximity to their residence.

### *Location of risk*

Each comment was coded according to whether the comment indicated that risk was conceived of from an individual perspective or from an aggregate or collective perspective. This differentiation is an attempt to clarify the approach of commenters to either discuss how they perceived a project would affect them individually, or how they perceived the project would affect the broader society. From a theoretical perspective, this differentiation is an attempt to discern the relative influence that comments from these perspectives would have on agency decision making. One might expect that the more technical the agency, the more likely that agency decision makers would have an aggregate based perspective as well (Koontz, et al., 2004). In practice, many comment included aspects that were both individual as well as collective. As such, during the coding procedure, comments were coded according to which of these perspectives appeared to be the most important to the comment in question. For example, comments by residents often discussed how projects would affect both themselves as well as their neighborhoods, including both an individual as well as collective argument. The decision was made to code comments like this according as viewing risk from the individual level, while comments that included references to the larger Washington, DC region, or to the nation overall were coded as aggregate. In effect, this variable assessed the extent to which the commenters' interests tended to be more parochial or more regional/national.



Examples of comments coded as individual are:

*“I am personally concerned about the combined health and safety impacts of having trucks enter the dewatering facility at the same time Sibley Hospital is engaged in a major expansion of its facility, the air quality impact of trucking and potential increase in the number of asthma or cancer cases resulting from this volume of diesel emissions, and the safety implications of sending 132 trucks a day through Maryland and DC in an area where there is already major congestion.”*

*“Right now the green space and view of the AFRH property greatly increases the value of my home, both financially and in my quality of life. I am not opposed to the idea of developing parts of the Retirement Home land. However, I am concerned about the details of that development and how it will affect my home and the surrounding neighborhood.”*

*“Under current plans, our boathouse will most likely be demolished to provide a flat space for construction equipment. This seems to be a very poor trade off. Our boathouse is more than just a storage space. It is the center of a vibrant community built around a love of water sports and the outdoors.”*

The following are examples of aggregate comments:

*“Work with Maryland to develop better mass transit options into the District from areas of Maryland to the east and NE of Capitol Hill. It is traffic from these areas which are primarily to blame for the traffic issues we are trying to deal with.”*

*“This city has limited large tracts of land for development. When large parcels become available for use a variety of possibilities should be considered that maximize the benefits to the community both financially and substantively.”*

*“Or put another way, if the Aqueduct has 1 million customers, and it is going to cost \$50 million to build the facility, will each ratepayer get a bill for \$50.00? Or will/has WASA, Arlington and Falls Church simply advance the ACE their share...then charge their ratepayers portions accordingly?”*

### *Object of risk*

The object of risk variable differentiated those comments that indicated a view that risk is something predominantly borne by humans, versus risk being a focused on the natural environment. Investigating this difference was an attempt to understand what drove people to comment on the EIS, and whether their concerns related to how projects would directly affect people, or whether their concerns were more environmental in nature (thus affecting people indirectly). While there were no specific expectations regarding whether human concerns or environmental concerns were more likely to have

an effect on agency decisions, this differentiation could show whether or not agencies tended to be more responsive to one type of argument or another. Again, many comments ranged over both of these areas, with commenters expressing concern about the impact of projects on both humans as well as upon the natural environment. However, it was usually clear in such comments that environmental concerns were mainly expressed as they related to the indirect effect of environmental conditions on human health and well being. Thus, comments that expressed concern about the effect of a project on people in any way was coded as viewing humans as the object of risk, while comments that spoke toward the importance of environmental stewardship or only regarding the effect of a project upon the natural environment were coded as viewing the object of risk as external to humans.

Comments coded as viewing the object of risk as human are:

*“The people of the Brookmont neighborhood of Bethesda have had to put up with the jet travel to Reagan National Airport, helicopters roaring overhead and it certainly doesn’t need a dewatering plant parked next-door (Alternate B) with the noise, pollution and more than 130 trucks a day. Another solution should be found, regardless of cost (piping).”*

*“The proposed site is close to my home where I have lived for years, and would destroy the tranquility of this idyllic, quiet, wooded community. I am absolutely appalled that such a structure would have been planned, literally, in my community, unbeknownst to me and my neighbors.”*

*“Also my problem is you have in your master plan you want to respect the character of the adjacent community. And I’m really concerned, and I’m concerned with the whole plan, but in Zone 6 from your map you have alternatives of do nothing, residential, and you want it compatible with the area. And I hear condos. That are from Park Place to, I guess, Georgia Avenue and beyond is basically single-family homes, maybe town houses. You’re talking about putting eight-story, four-story condos. That doesn’t fit in with the structure.”*

The following illustrate examples of comments coded as viewing the object of risk as external or environmental:

*“In addition, I am concerned about the loss of wildlife and bird habitat in the reservoir area, which connects biologically to the riverine system.”*

*“All aspects of this project should be considered [sic] a manner to positively mitigate the existing environmental and pollution conditions associated with the Anacostia River.”*

*“The description of wildlife that use the home is very brief and incomplete. Area residents regularly see deer on the property as well as raccoons and possum. Further analysis is needed.”*

### *View of risk*

The view of risk differentiates those comments where risk is perceived as something that can be known and is inherently controllable (at least to an extent) from those where risk is perceived as being an human construct that is more philosophical, encompassing not just aspects of scientifically testable risk, but also aspects of fairness, equity, and the potential cumulative consequences of actions. Coding thusly enables an exploration of whether commenters tend to view risk as *objectivist* or *constructivist* as described in a preceding section (Cvetkovich and Earle, 1992). Comments were coded as objectivist when there was an indication that risk was something that could be controlled through proper planning and implementation, and where it was either implied or stated that the potential risks of the project in question could be known in advance. Constructivist comments were those that expressed concern that risks were not only unknown, but potentially unknowable, and that actions taken or not taken today may lead to unintended risks in the future. Constructivist comments were also those that focused on issues of fairness and equity regarding the placement of risk, rather than focusing on efforts to control risk. This difference gets to the heart of the EIA process, and the potential impasse between how commenters view risk and how agency decision makers do. The EIA process is inherently objectivist; the point of the process is to investigate *all* potential consequences of some action that is being considered. The development of the EIS is an effort to describe those consequences in detail and evaluate policy alternatives according to balancing the most effective alternative in achieving project goals while minimizing the impact on the natural and human environment. Comments were usually

easily distinguishable in this regard; commenters usually tended to either describe risk as something that could be studied, analyzed and controlled through proper evaluative techniques, or as unknown, unknowable, or as having effects beyond that which could be physically described.

For example, the following comments illustrate an objectivist view:

*“In addition, the area surrounding the Navy Yard was settled early in the development of the District, as can be seen by the archaeological discovery of the original Eastern Market (1804). The potential exists for other early resources to be extant in the area. Depending on which alternative is selected, there is bound to be effects to archaeological, and perhaps to paleontological, resources.”*

*“The indicators of impact on natural resources are inadequate. The current set of indicators is limited to impact on ponds on the Soldier’s Home property itself. The perennial stream running through the center of the project area is hydrologically connected to other water bodies flowing into the Anacostia and/or Potomac Rivers. Increased run-off from the dense development proposed under the EIS will have adverse impacts on the Anacostia and Potomac Rivers....These likely impacts need to be further quantified in the EIS.”*

*“Although the Hay’s spring amphipod is known only from the Rock Creek watershed in D.C., it is possible that it also inhabits adjacent watersheds such as that of Little Falls Creek. Therefore, surveys for this species, by a species expert,*

*are recommended in the area to be affected by the monofill, should this alternative be pursued.”*

Constructivist comments are those such as:

*“The DEIS employs language that, although standard in transportation engineering, is inherently biased towards road construction. Words in transportation planning are biased when their general usage implies a good (or bad) thing, and the actual thing they are describing is only good (or bad) for motorists and perhaps bad (or good) for pedestrians, bicyclists, transit users, the environment or urban design.”*

*“The ground we stand on today is precious ground not only for the Armed Forces Retirement Home, but for the entire community and indeed the nation. President Lincoln spent a quarter of his presidency here. He walked these grounds. He saw graves being dug for Union troops, he shaped thoughts about the Emancipation Proclamation here, and he talked with soldiers who lived here at the time. The impact study talks about having no impact on historic monuments. Considering the historic value of these grounds, we ask what is the rush. What is the rush to lease this precious surrounding land for eight story condos, massive buildings with huge asphalt parking lots, and the accompanying traffic jams and smog. Once the land is developed, it’s gone forever.”*

*“You have several of the most beautiful neighborhoods in the Washington Metropolitan Area that will be affected by this proposal. The traffic on the Mass. Avenue corridor is congested enough as it is and the noise level is high for the neighborhoods. Also, there is a question of pedestrian safety as many people including many students walk to the bus stops along Mass. Avenue. Additionally, young children walk from the neighborhood to Westland Middle School and Little Flower school along Mass. Avenue. 132 ten ton trucks routed onto Dalecarlia Parkway, a beautiful stretch of parkway I might add, would add to an already dangerous situation for pedestrians.*

#### *Tone of comment*

Comments were also coded according to whether the type of argumentation used was of a technical/scientific nature or of an emotional nature. While some comments did convey both values based statements and technically based statements, most were either clearly technical questions or comments regarding aspects of the project, the alternatives, or potential consequences, or they were emotional arguments regarding the fairness of the project or expressing frustration regarding the process through which the decision was being made. Very few comments were both technical and emotional, although some commenters did provide separate comments that were technical followed by comments that were emotional. Prior to the content analysis, it was expected that a differentiation would need to be made between emotional arguments that were supportive versus those that were unsupportive, but very few comments or questions in any of the statements



were of unqualified support. Virtually all comments were either questions, comments indicative of frustration, comments suggesting revisions to the alternatives, or qualified support for one alternative over another as better than the others, if still not ideal.

Some of the technical comments were:

*“Overall the information provided did not make the case that any of the solutions would meaningfully improve the traffic conditions in the corridor – on the freeways or on local streets. The bridges connect to freeways that are at, or close to, capacity many hours of the day, and it is a goal of the project not to add to local street congestion. Thus adding at least 50 percent more capacity to the bridges is largely wasted effort and money.”*

*“Further, local air pollution is linked to increased incidence of respiratory illness. Three different recent studies being published this month in Epidemiology find a significant link between daily ground-level ozone in cities and mortality rates in the next 3 days...The deteriorated local air quality from the proposed AFRH development would worsen such health problems in this predominantly African American neighborhood. The heat-retention effect of the loss of current AFRH green space would also promote additional ground-level ozone formation.”*

*“The proposed pipeline would pass through the C&O Canal National Historic District, Georgetown Historical District and nearby monuments. A major concern*

*would be the aesthetic and environmental impacts on the Potomac River, C&O Canal, other access points to the river, and the parks during construction and afterwards. The pipeline will pass through five different national parks, two different activities of the Department of the Navy and the Department of the Air Force. Obtaining easements and rights of way along the pipeline will be administratively difficult.”*

More value laden or emotional responses follow:

*“This boathouse brings people from all over the region and from all walks of life into the community and businesses in the Southeast and introduces them to something much different than the troubled stereotype of the Southeast that many people fear. They come to know a thriving community with tremendous potential with many valuable resources to offer.”*

*“Think our Congress and Lawmakers should SUPPORT OUR RETIRED TROOPS!! That the AFRH is low on money is unconscionable.”*

*“I live in Brookmont and have lived here my entire life. The plant is only a few feet from where I live. It is far too close to many of our homes. You are destroying our living space. It would destroy the tranquility of this ideal, quiet, wooded community. The noise and pollution, both from the sounds of the plant and from*

*the constant truck traffic would be extremely bothersome. The smells would be horrible, and I am concerned about the air quality. Moreover, you are trying to build a plant to fix a problem that you are not directly dealing with and instead just making a quick fix. In other words, you are taking pollution from the Potomac and instead polluting my small residential community.”*

#### *Problem noted*

Comments were also coded according to whether some problem or potential problem was noted with the EIS, the project, the alternatives, or the decision making process. Virtually all comments raised a problem of one of these kinds, with only a handful raising questions or making comments where some problem was not either directly stated or strongly implied. Coding was clear when a problem was clearly stated, but for example, strongly implied problems often took the form of questions like the following:

*“What impact will these emissions have on global warming?”*

*“Do you agree that air toxics must be considered during the NEPA process?”*

#### *Solution proposed*

Each comment was also coded according to whether or not a solution was proposed to either address a problem, revise a potential issue with an alternative, or change the decision making process. A strict procedure was followed in coding this variable, in order to try to differentiate actual workable solutions from those that were

expressed mainly in frustration or that were intended to convey a problem rather than actually propose a solution. For example, many commenters, particularly in the Washington Aqueduct case proposed new alternatives that they suggested ACE open for consideration, such as:

*“An alternative that would use existing pipelines to convey residuals to the River, and then transfer residuals to a new pipeline constructed along the bed of the Potomac River should be considered.”*

While others, like the following, proposed solutions, but were effectively meant as delay tactics to either scuttle the process or present infeasible alternatives:

*“The following pages contain 72 possible alternatives for your consideration. As you will see, many of them are variations on a theme, differing only in the size of the pipe, material of the pipe, route, etc. Nonetheless, each and every one is an alternative that should be considered.”*

### *Content*

Finally, for each comment some key words were recorded so as to accomplish several tasks. Key words were recorded in an effort to find common themes or common interests among different comments and commenters, and were used to find indications of similar types of statements and arguments that could provide evidence for some level of coordination between and among different individuals that provided comments for each of the cases.

**Table 8: Coding procedure for public comments**

<b>Construct</b>	<b>Code</b>	
Commenter type	1 = Individual resident 2 = Individual nonresident 3 = Resident/neighborhood association 4 = National environmental interest group 5 = Local environmental interest group 6 = National interest group 7 = Local interest group 8 = National business/business interest 9 = Local business/business interest 10 = Federal government 11 = State government 12 = Local government	
Location of risk	0 = Individual Key words: <i>My, I, our, quality of life, home, personal</i>	1 = Aggregate Key words: <i>Community, region, Washington, DC, taxpayers, nation, city</i>
Object of risk	0 = External Key words: <i>Wildlife, pollution, water quality, watershed, river, air quality, animals, trees, green space</i>	1 = Human Key words: <i>People, home, live, health, peaceful, safety</i>
View of risk	0 = Objectivist (risk is known, and is external to people) Key words: <i>Study, cumulative, risk, control, science, technically</i>	1 = Constructivist (risk is unknown, but affected by people) Key words: <i>Unknown, afraid, fear, beautiful, values, precious, question, history</i>
Tone of comment	0 = Comment appealed to scientific or technical audience Key words: <i>Study, ozone, pollutants, capacity, impacts</i>	1 = Comment indicated emotion and/or public values such as fairness Key words: <i>Community, support, living space, quality of life, tranquility, fear</i>
Problem	0 = Comment does not raise any problems 1 = Comment raises a problem	
Solution	0 = Comment offers no solutions 1 = Comment offers solutions	
Content	Keywords recorded	

### *Responses*

As part of the EIS preparation process, agencies are not only required to allow for substantial public participation, but they are also required to respond in-kind to each

comment provided. In coding agency responses, emphasis was placed on assessing the extent to which the particular comment appeared to affect agency decision making.

### *Thoroughness of response*

CEQ guidelines stipulate that agencies are required to reply to each individual comment, but they are not necessarily required to reply with a great deal of substance. Some responses are detailed and deliberative, while others merely acknowledge the comment without further elaboration. Agency responses were coded on a four-point scale from no thoroughness to high thoroughness. The least thorough response was an acknowledgement of the comment with no elaboration. Comments could also be addressed, in a bit more detail than a mere acknowledgement, but with no elaboration. Such responses usually pointed commenters to read a particular section of the EIS or otherwise indicate that the comment had already been attended to. The third category included those responses that offered further elaboration, providing a few sentences to describe the agency's point of view in more detail, and the fourth category were those responses that offered substantial elaboration on the comment, usually in several paragraphs. Differentiating between these last two categories was the most complicated part of the response coding process, with the difference usually pertaining to the overall length of the response. When a response was several sentences, but only one paragraph, comments were coded in the third category (comment addressed with some elaboration), while those responses that were more than one paragraph long were coded in the fourth

category (comment addressed with substantial elaboration). Examples of each response category are included below.

Acknowledged only:

*“Comment noted.”*

Addressed with no elaboration

*“AFRH has assessed a range of alternatives which are consistent with the requirements of the National Defense Authorization Act of 2002.”*

Addressed with some elaboration

*“For safety purposes, the ACBA operations will need to be temporarily relocated to an alternative site during the period of construction. DDOT, in close cooperation with NPS and ACBA, has designated a site for this purpose. See Appendix H. DDOT and the project team have held several meetings with both the leadership and the membership of ACBA to gain a fuller understanding of the organization’s operational requirements. DDOT has committed to the maintenance of operations during the period of construction. The temporary site will provide the functional equivalent of the current site, including storage, security, and river access. Following construction, ACBA operations will return to the current site.*

Addressed with substantive elaboration

*“Based on the public’s concern about the peak number of residual trucks identified in the DEIS, Washington Aqueduct re-analyzed whether the peak number of truck loads could be further reduced within the current project budget.*

*The peak residuals truck load values listed in the DEIS (i.e., 33 truck loads per day during the maximum design wet year) assumed that a portion of the water treatment residuals generated in the Georgetown Reservoir would be stored within the reservoir temporarily before pumping them to the residuals thickening and dewatering facility. This approach lessens the peak theoretical dewatered residuals truck loads per day predicted for this worse-case event. Due to the nature of the existing basins and the proposed residual removal equipment, liquid residuals cannot be similarly stored in the Dalecarlia sedimentation basins. However, the gravity thickeners located downstream of the sedimentation basins provide some opportunity to further equalize residuals flows. This capability was not taken into consideration in the DEIS analysis. Limited temporary storage of thickened residuals is possible in the gravity thickeners if they are deepened slightly (approximately 1 foot) and operated such that some thickener storage volume is reserved to store the peak residuals quantities associated with storm events. Consideration of this additional residuals flow equalization capability could allow the peak number of anticipated dewatered residuals truck loads per day to be lowered from 33 truck loads per day (maximum design year wet weather conditions) to a maximum design wet year rate of between 20 and 25 truck loads per day depending upon the demand for finished drinking water. Washington Aqueduct is committed to providing this additional thickener depth and operating the thickeners in such a manner so as to restrict the peak number of truck loads leaving the dewatering site to a maximum of 25 truck loads per day. The*



*increased depth should be able to be designed so that it does not increase the overall height of the thickener structures.*

#### *Individuality of the response*

In addition to having no requirement that agency responses be particularly thorough, although they are required to respond to each comment, agencies are not necessarily required to respond individually to each and every comment. Comments with a similar theme can be lumped together and responded to once, or agencies may choose to use the same response to each comment that addresses a similar topic, repeating this response throughout the comment and response section of the EIS. Thus the individuality of the responses was coded in order to differentiate between those comments that elicited specific responses and those that were either lumped together or received the same response as many other comments that had similar themes or raised similar issues. Coding for this variable was done subsequent to the rest of the procedure, in order to recognize when responses were repeated throughout the EIS. Responses were only coded as *non-individual* when they were either repeated, using the same text, for multiple comments, or when the agency lumped together multiple comments with one response.

#### *Decision influence/implementation influence*

In their responses, agencies sometimes indicate that a comment or set of comments significantly affected their subsequent decisions. As a rule, the totality of the public comment period almost always affects the alternative selection process, or adjusts

how the alternative is implemented. As a result of public participation, selected alternatives are often a hybrid of proposed alternatives, or at least see some variation between the alternative proposed in the DEIS and that selected in the final EIS. When many commenters make similar points, it is likely not possible to pinpoint the affect of any one comment in particular, and as such, this variable is intended to differentiate between those individual comments that the agency specifically indicated caused them to alter their decision making, versus those that either did not appear to affect decision making or that did not have a specific individual effect. As such, very few individual comments appeared to have a dramatic specific effect, but this variable represents an attempt to identify those comments that appeared to be the most influential during the public comment period. An example of a response indicating a change in agency decision making is provided below.

*“[This] alternative, suggested by the public, which was found to be consistent with the screening criteria, involves a new site at the Dalecarlia Reservoir, located adjacent to Little Falls Road, for the residuals thickening and dewatering facilities. This alternative is carried through for detailed evaluation in the EIS as Alternative E. It offers some advantages from a trucking perspective because it does not require trucks to travel loaded with residuals to travel uphill on Loughboro Road.”*

**Table 9: Coding procedure for agency responses**

<b>Construct</b>	<b>Code</b>
Implementation influence	0 = Comment did not affect implementation plan 2 = Implementation plan altered, comment appeared to affect this decision
Thoroughness of response	0 = Acknowledged only 1 = Comment addressed with no elaboration 2 = Comment addressed with some elaboration 3 = Comment addressed with substantial elaboration
Individuality of response	0 = Agency response was not tailored to the individual comment 1 = Agency response was specific to the comment in question

*Project and context*

Finally, each of the three projects has some defining characteristics, both with regard to the project itself and with regard to the locational context in which the project is taking place. Projects can cover a wide range of possible activities and the effects of these activities can affect very different sets of people.

*Project complexity*

Federal projects that require an EIS can vary significantly in their level of technicality or complexity. A requirement of NEPA and CEQ guidelines is that the EIS be written in such a way so as to be understandable by the general public; while the documents can have a tendency to get technical and use jargon, for the most part, they are written for a broad audience, not strictly for an audience familiar with the technicalities of the project at hand. It can be difficult to explain very complicated projects to a general

audience, so many EISs can be quite lengthy, although for relatively straight forward projects, documents need not be thousands of pages long (Ringquist, et al., 2003). Rather than code complexity through an interpretation of the complexity of a project like Yackee (2006), the number of pages, excluding the public comment and response sections, of the EIS was used as a proxy for the level of complexity of the proposed project. Each EIS follows the same general format required by CEQ, and includes the same general information. Although it may be arguable that page count equates to complexity, from a reader's perspective, more pages will require more effort to understand, making a higher page indicative of more effort required by readers. Moreover, the measure appears to accurately capture the relative complexity of the three cases included here: the Home project is a relatively straight forward commercial and residential development plan, and its EIS contains only 268 pages, as compared to the much more technically complex bridge project (1551 pages) and aqueduct project (1268 pages).

### *Salience*

Along with the variability of the complexity of a project, salience may be an important consideration as well (Ringquist, et al., 2003). For projects that are much more salient with the public, agency decision makers may be more responsive to public concern than for those projects that the public is comparatively less interested in. In selecting cases for this analysis, an effort was made to pick project examples with roughly levels of public salience, as operationalized by the number of comments

received, although the aqueduct project was more salient than the bridges or Home projects (503 comments, compared to 392 and 320, respectively).

### *Lead agency technicality*

The relative influence of technical versus emotional argumentation may also vary according to the level of technicality in the work that the lead agency general performs (Ringquist, et al., 2003). Some agencies do work that is very complex and technical as a rule, and may have an orientation toward giving greater credence to comments that conform with organizational norms (Koontz, et al., 2004), whereas others that are more human service oriented may respond more to comments with a more human orientation. For this analysis the three agencies vary, to an extent on the level of technicality of the work they do. In general, the work performed by the ACE is the most clearly technical; ACE projects usually revolve around issues of water delivery and flood plain management, requiring a high degree of technical and engineering proficiency, but little direct interaction with human clients. The AFRH is clearly at the other end of the spectrum, managing a retirement facility for veterans. Though medically oriented, the AFRH is a tiny federal agency whose only function is to manage two Homes for retired veterans (the Washington, DC Home upon which the case in this analysis is based, and a second home in Biloxi, Mississippi), with a clear human services orientation. FHA likely lies somewhere in between; it is responsible for large scale highway engineering projects, but also for road, bicycle and pedestrian safety. However, to simplify the analysis, both

ACE and FHA were categorized as technical agencies, and AFRH was categorized as non-technical.

### *Residential context*

The three cases selected for the analysis were also chosen purposefully to vary the residential context in which projects were taking place. As a study of environmental justice and the relative effectiveness of different types of commenters in seeing their preferences reflected in final policies, one of the goals was to differentiate between participation from and responses to low versus high socioeconomic status residents. As such, the three projects selected here all take place in different types of neighborhoods, affecting different socioeconomic status residents. The Washington Aqueduct project is located in one of the wealthiest areas of the entire Washington, DC region, with home values in the nearby Spring Valley and Palisades neighborhoods generally well over \$1 million with a home ownership rate around 75%<sup>11</sup>. Median household income in the area is about \$300,000 and the area has a much higher proportion of white residents than the rest of the city at large (about 85% versus about 40% overall).

Conversely, the neighborhoods directly impacted by the 11<sup>th</sup> Street Bridges project are amongst the poorest in the city, where the largest proportion of African Americans in the city lives, particularly on the eastern side of the Anacostia River. The Anacostia and Fairlawn neighborhoods are almost entirely African American (about 97%), with median household income of only around \$35,000 and well over a third of

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<sup>11</sup> Neighborhood data based on US census estimates, and downloaded from <http://www.neighborhoodinfodc.org/nclusters/nclusters.html> in March, 2011.

residents living in poverty. Homes cost an average of about \$250,000 with a low home ownership rate of about 25%. The Near Southeast/Navy Yard area on the western side of the Anacostia is mostly industrial, although there are pockets of residential homes. Demographics on the western side are similar to those on the east, although since the construction of the Washington Nationals baseball park in the area, the western portion has become wealthier and whiter.

The neighborhoods near the Home are neighborhoods in transition. Much of Washington has been going through a gentrification cycle since the 1990s (see Smith, 1979 and Ley, 1986 for a discussion of the gentrification cycle; see Byrne, 2003 for a discussion about gentrification in Washington, DC), and neighborhood change has been taking place in Park View, and Petworth. Over the last 20 years, the white population has increased substantially in these areas and the black population has decreased, although African Americans still make up over 50% of the population and Hispanic constitute an additional 25%. Poverty has decreased during that time from over 25% of the population to about 12%, while incomes have risen steadily over time and the median household currently earns about \$85,000 per year. Home ownership is approaching 50% with values of over \$400,000.

These three projects serve to assess how participation takes place in three different types of communities: a wealthy, predominantly white area, a poor area that is historically and currently almost completely African American, and a middle class area with a more balanced racial mix and a wider range of economic diversity. The three projects were thus coded with the aqueduct project taking place in a high socioeconomic

status area, the Home project taking place in a mid-range socioeconomic status area, and the bridge project in a low socioeconomic status area.

**Table 10: Coding procedure for project**

<b>Construct</b>	<b>Code</b>
Salience	Total number of comments provided during EIA process
Complexity	Number of pages in the final EIS, excluding public comments and responses
Residential context	Three categories: high status, mid status, low status
Lead agency technicality	0 = Not highly technical 1 = Highly technical

## Results

In describing the goals this exploratory study, I posed several questions above regarding participation in the EIA process. I now return to each of these questions, discussing how these three EIA cases may help shed light on public participation in EIA.

### *Who participates in the collaborative framework established in EIA?*

One of the major rationales for the establishment of NEPA and the EIA process was to provide the general public with access to bureaucratic decision makers. Projects requiring an EIS usually are funded through general agency funds and are not projects specifically funded through Congressional mandate and as such, the political process tends to be somewhat divorced from the EIA process. Project decisions tend to be made by public managers, following their professional judgments and institutional norms, rather than taking direction from either political authorities or the public at-large. By



specifically ensuring the involvement of the public, the EIA process gives the general public access to decision makers, and also provides input to decision makers that they otherwise would not likely receive. With an open comment process wherein any interested party may contribute a comment, it is therefore important to understand who tends to participate in these processes. For all but three of the 1243 comments, it was possible to determine the capacity in which the commenter was acting. A full breakdown is shown in Table 11.

**Table 11: Proportion of comments provided by type of commenter**

<b>Commenter type</b>	<b>Number of Comments</b>	<b>Percent of total comments</b>
Individual resident	715	58%
Resident association	134	11%
Federal government agency	80	6%
Individual non-resident	77	6%
National environmental interest group	71	6%
Local government agency	54	4%
Local interest group	39	3%
Local political representative	22	2%
Local environmental interest group	19	2%
Local business	11	1%
National interest group	8	1%
Federal political representative	6	< 1%
State government agency	4	< 1%
Total	1240	100%

It is immediately apparent that in these cases, local interests heavily outweigh more regional interests with local residents or local resident associations providing nearly seven in ten of the comments for these three projects. Moreover, individuals who are non-residents, but have some interest in the project or project area make another 6% of the comments; in their capacity as speakers for their constituents, local political

representatives provided 2% of the total comments, and locally based interest groups (environmental or other interest based) make another 5% of the comments. All told, people who live in the Washington, DC area provided over 80% of the comments in these three projects (either as individuals, or through collective organizations). The only other significant providers of comments were other federal government agencies, local government agencies, and national environmental interest groups. Besides local community residents, federal agencies were the most likely to comment, which is not surprising since lead agencies often solicit technical feedback from other federal agencies that may have more expertise in a particular area. Local government agencies provided similar types of comments, and it is worth noting that since most of the impacts of these projects were located within the District of Columbia, state government agency involvement is almost certainly underrepresented than it might have been in a different jurisdiction.

Much of the previous research assessing public participation in federal agency decision making focused on open comment periods regarding proposed regulatory rule changes (Yackee, 2006; Yackee and Yackee, 2005; Jewell and Bero, 2006; Nixon, et al., 2002). In these investigations into participation in the process, it was generally found that businesses and business interest groups provided the plurality, if not the majority, of comments regarding rule changes. Given the context of the rules considered in much of this work (investing regulation, ergonomics rules, employment standards, etc) it is not surprising that business organizations tended to dominate. The projects considered here appear to have less direct impact on businesses generally or any business in particular,

but it is nevertheless surprising that only 11 comments were provided by business interests, with all provided by locally based businesses. While comments regarding proposed governmental rule changes may be dominated by business interests, such interests were effectively absent from the comment periods of these three projects. Comment periods here were dominated by people who lived in the vicinity of the project location.

Looking at the major comment providers for each of the individual projects reveals similar trends to the aggregate view in terms of who is most likely to comment overall, but with some interesting trends in between. Table 12 provides a breakdown of the percent of comments provided for each project. Comments for the aqueduct project are heavily local, with residents, local political representatives, or local interest groups providing well over 90% of the total comments. Moreover, resident associations provided substantially more comments for the aqueduct (20%) than for the bridges or Home projects (8% and 0% respectively). This differentiation in the likelihood to organize and comment through resident associations tells an interesting story about these three areas. Neighborhoods near the aqueduct have long been stable and wealthy, and residents appeared to be well organized. Those near the 11<sup>th</sup> Street bridges, while not wealthy, have tended to be stable, and while there appears to be less organization, there is still some commenting by resident associations. Near the AFRH, where the neighborhoods appeared to be in transition, there were no comments provided by an association of interested residents, despite the fact that this project saw the largest proportion of comments provided by individual residents of any of the three. Further, the bridge project

is the only one of the three in which local residents, either speaking individual or through resident associations, did not provide the majority of the comments received, with less than 40% of the total comments provided directly by residents. In fact, virtually all of the non-resident participation over the three projects took place in the bridges project; nearly all of this external participation related to the fate of the Anacostia Community Boathouse (ACB), a theme to which I will return in a subsequent section.

**Table 12: Proportion of comments provided for each project by type of commenter**

Commenter type	AFRH	11 <sup>th</sup> Street Bridges	Aqueduct
Individual resident	73%	31%	69%
Resident association	0%	8%	20%
Federal government agency	12%	7%	3%
Individual non-resident	1%	18%	< 1%
National environmental interest group	0%	18%	0%
Local government agency	6%	8%	1%
Local interest group	< 1%	9%	< 1%
Local political representative	< 1%	2%	3%
Local environmental interest group	3%	0%	2%
Local business	2%	0%	1%
National interest group	3%	0%	0%
Federal political representative	0%	0%	1%
State government agency	0%	0%	1%

The 11<sup>th</sup> Street Bridges project also included all of the participation by national environmental interests groups. With a potential direct impact on the Anacostia River and several parks along the waterfront, large groups like the Sierra Club and Potomac Conservancy provided many comments regarding this particular project. Finally, it is interesting to note that the only case where Members of the U.S. House of Representative and the U.S. Senate chose to provide comments were those provided in support of their

constituents near the aqueduct. While this may be due to the more direct impact of that particular project on Maryland residents, this was also the only case where the District of Columbia's non-voting House Delegate was involved.

*What types of argumentation do stakeholders use to make their points?*

Broadly speaking there was a wide range of different types of arguments presented, but some trends were clear across all of the cases, as shown in Table 13. First, comments were far more likely to focus on the human impact of a project than on the environmental impact. Across all three projects, 80% or more of the comments regarded the affect of the projects on human or social conditions and less than 20% focused on the effects to the natural environment. It is also clear that participation in EIA is problem focused. In each case, virtually all the comments provided indicated some problem with either the plans presented in the EIS or with the EIA process itself. Over 97% of the comments received noted a problem, and only 4% of the total comments received in these three projects offered a solution.

Comments to each project did vary some according to whether the comments tended to focus on individual impacts versus aggregate impacts, with more than half of the comments regarding the AFRH focused on impacts beyond the individual level, while 70% of the aqueduct comments dealt with individual impacts. Technical arguments were a bit more likely to be made in the AFRH case as well, which is somewhat surprising given that AFRH is the least technically oriented of the agencies involved in these projects. However, this may also be due to the fact that the AFRH case is much less

complex than the other two, allowing for commenters to more readily understand the technical details and likely impacts than in the other two cases. Related to this, potential solutions were much more likely to be offered for AFRH, although it is worth noting that in the aqueduct case, many potential, very detailed solutions were offered by commenters, although such comments were clearly in the minority of the overall count of comments provided. Finally, the view of risk was fairly consistent across the cases, with comments presenting risk as something that can be objectively assessed and mitigated clearly in the minority. Comments tended to relate to risk as generally unknown and usually underestimated both in terms of potential human impacts and environmental impacts.

**Table 13: Percent of argumentation type used in comments overall and by project**

		<b>AFRH</b>	<b>11<sup>th</sup> Street</b>	<b>Aqueduct</b>	<b>Total</b>
<b>Risk location</b>	Individual	49%	56%	70%	60%
	Aggregate	51%	44%	30%	40%
<b>Object of risk</b>	Human	78%	89%	81%	83%
	Nature	22%	11%	19%	17%
<b>View of risk</b>	Objectivist	41%	28%	41%	37%
	Constructivist	59%	72%	59%	63%
<b>Tone of argument</b>	Technical	58%	38%	39%	43%
	Values based	42%	62%	61%	57%
<b>Problem noted</b>	Yes	96%	96%	99%	97%
	No	4%	4%	1%	3%
<b>Solution offered</b>	Yes	10%	1%	1%	4%
	No	90%	99%	99%	96%

*Do different types of stakeholders participate differently?*

When considering the nature of comments provided by different types of commenters, trends that might be expected seem to emerge, as shown in Table 14. This is most clearly reflected by government agencies, which predominantly take an aggregate

view of risk, and nearly always assert that risks are knowable, assessable, and can be mitigated. Somewhat surprisingly, government agencies are just as likely as other commenters to note problems without providing potential solutions. Residents and their associations tend to focus on individual and human aspects of risk, and tend to be much less objectivist and technical than other commenters. Also somewhat surprisingly, interest groups tend toward values based arguments, rather than technical comments, and focus almost exclusively on human aspects of risk, usually at the aggregate level, rather than risks toward the environment. This is particularly surprising since the most common type of interest group to comment were nationally based environmental nonprofit groups. Despite an environmental protection mission, such organizations tended to focus on human impacts, not environmental impacts in their comments.

**Table 14: Percent of argumentation type used in comments by commenter type**

		<b>Individual residents</b>	<b>Resident association</b>	<b>Government agency</b>	<b>Interest group</b>
<b>Risk location</b>	Individual	69%	60%	10%	36%
	Aggregate	31%	40%	90%	64%
<b>Object of risk</b>	Human	87%	87%	42%	94%
	Nature	13%	13%	58%	6%
<b>View of risk</b>	Objectivist	32%	34%	93%	38%
	Constructivist	68%	66%	7%	62%
<b>Tone of argument</b>	Technical	38%	40%	99%	51%
	Values based	62%	60%	1%	49%
<b>Problem noted</b>	Yes	98%	99%	94%	100%
	No	2%	1%	6%	0%
<b>Solution offered</b>	Yes	4%	0%	2%	0%
	No	96%	100%	98%	100%

*How responsive are agency decision makers?*

As previously stated, CEQ guidelines stipulate that agencies must respond to the comments they receive, but the guidelines do not require any specific length or type of content in those responses. As such, responses could merely acknowledge a comment or they could provide an in-depth answer to commenter questions, and they could provide individual responses to each comment or lump similar comments together, and provide one response to all comments of similar content. As shown in Table 15, agencies usually respond to similar types of comments either by lumping them together and providing one response, or by using the same response language multiple times through the document. Only 13% of the responses provided in these cases were individualized to a particular comment. All of the remaining responses were either repeated throughout the EIS or were indicated as the response to multiple comments.

**Table 15: Percent of individualization of agency responses to comments**

	<b>AFRH</b>	<b>FHA</b>	<b>ACE</b>	<b>Overall</b>
<b>Individual response</b>	16%	27%	1%	13%
<b>Repeated response</b>	84%	73%	99%	87%

Comparing how the three different agencies respond, ACE was quite unlikely to provide individualized responses, and in fact, in the Washington Aqueduct EIS, ACE assigned codes to each comment and provided responses based on these codes, rather than responses to the particular comments. AFRH provided more individualized responses, and FHA provided unique responses to over a quarter of those received. Nevertheless, each agency was far more likely to provide boilerplate responses to the comments received, and all three agencies were quite unlikely to provide responses to the more personal or emotional points that commenters provided. Agency responses were



initially coded similarly to comments, as either technical or values based, but during the content analysis, it became quickly apparent that such coding was unnecessary. Virtually all agency responses were technically oriented, and virtually all addressed the most technical points possible in each comment, usually providing a technical counterpoint to values based arguments, rather than addressing the value issue itself.

**Table 16: Percent of individualization of agency responses to comments**

	<b>AFRH</b>	<b>FHA</b>	<b>ACE</b>	<b>Overall</b>
<b>Acknowledged only</b>	16%	21%	16%	18%
<b>Addressed with no elaboration</b>	65%	45%	7%	33%
<b>Addressed with some elaboration</b>	13%	28%	2%	13%
<b>Addressed with substantive elaboration</b>	6%	7%	75%	36%

With regard to the substance of the responses provided, there are wide disparities in how agencies chose to respond to comments. AFRH either simply acknowledged or addressed responses with no elaboration over 80% of the time. In contrast, ACE provided substantive responses to three quarters of the comments it received, albeit usually not unique responses to each individual comment. FHA was not likely to provide substantive comments, but was more likely to provide at least some elaboration in its responses. Given the complexity of the Washington Aqueduct project, the prevalence of substantive responses is not surprising, although given the comparable complexity of the 11<sup>th</sup> Street Bridges project, these differences may also reflect the norms of the different agencies.

*Are agency decision makers more responsive to different types of stakeholders or different types of argumentation?*

Across the three projects, agencies did not seem to be particularly responsive to any particular group, nor to any particular type of comment style. The one instance where an agency did seem to alter its decision making was with regard to the 11<sup>th</sup> Street Bridges project, where FHA adjusted project alternatives in response to a high degree of coordinated action undertaken by people who did not live in, but had recreational interests in the communities near the bridge sites (this is described in detail in the next section). ACE also appeared somewhat responsive to residential concerns by relatively quickly taking the residents' most objectionable alternative off the table. AFRH did not appear to be particularly responsive to any particular set of stakeholders. Thus in one case, an agency was quite responsive to non-residents, in another the agency was somewhat responsive to residents and in the third, the agency was not terribly responsive to any commenters, although it is worth noting that all three agencies did appear to incorporate comments from other federal agencies into their final selected alternatives, but this did not extend to the comments provided by state or local authorities.

Responses tended to be technical, regardless of the nature of the comment involved. Even the most emotional, values driven, human oriented comments tended to either receive mere acknowledgement, or technical responses, rather than direct responses to the particular nature of the comment. Overall, it did not appear that comments from any particular perspective made in any particular style were either more or less likely to ultimately change the policy that ended up being implemented. Some comments surely

did affect implementation decisions; these comments were few and far between, and it was difficult to pinpoint the effect of any one comment upon the final decision made.

Given the complexity of assessing the extent to which any one comment affected decisions made, Tables 17 and 18 assess agency responsiveness by displaying results of models testing the extent to which agencies were more likely to provide individualized responses, or provide more detailed responses based upon the nature of the commenter and the comment provided. First, a logistic regression predicts the probability that agencies would provide an individualized response to a comment, rather than a boilerplate response that was repeated often through the EIS. As compared with the referent commenter of federal agencies, individualized responses were much more likely to be provided to comments made by non-residents of the affected areas, a finding almost certainly due to the influence that it appeared non-residents had on FHA decision making. No other type of commenter was more or less likely to get an individualized response from the lead agencies. When commenters seemed to view risk in human, rather than on external/environmental terms, agencies were quite a bit less likely to provide individualized responses, a finding that is not surprising given that the vast majority of comments provided overall had a human risk orientation. Although, it is somewhat surprising that despite the presence of many more comments with this orientation, human risk comments were still more likely to receive individualized responses. Finally, also surprisingly, comments that were technical in nature were less likely than values based comments to receive an individualized response. Given that virtually all agency responses were technical in nature, one might have expected that individualized, technical

responses would be provided to technical comments. The opposite appears to be the case; individualized responses were more likely with emotional or values driven comments.

**Table 17: Logistic regression of individuality of agency responses by comment types**

Dependent Variable: Agency provides individual response = 1; Agency provides boilerplate response = 0

	Odds Ratio (Standard Error)
Commenter is a local resident†	1.35 (0.50)
Commenter is a non-resident†	<b>24.76*</b> (26.76)
Commenter is a residential association†	0.84 (0.42)
Commenter is a local general interest group†	1.22 (0.66)
Commenter is a local environmental group†	1.94 (2.16)
Commenter is a national environmental group†	0.49 (0.21)
Commenter is a local government agency†	1.60 (0.72)
Commenter views risk as at an individual rather than aggregate level	1.14 (0.25)
Commenter views risk in human terms rather than environmental terms	<b>0.51*</b> (0.17)
Commenter views risk as objectively measureable	1.14 (0.31)
Comment is technically based rather than values/emotionally based	<b>0.41*</b> (0.11)
Salience (number of comments received)	<b>7.60*</b> (2.36)
Complexity (EIS page count, excluding comments and responses)	<b>1.15*</b> (0.02)
Wald chi2	249.25*
N††	1172

Note: †Referent commenter is federal agency; †† Only comments received from most frequent commenters included; \*p<.05

Similarly, Table 18 displays an ordered logistic regression model predicting the thoroughness of agency responses given the characteristics of the comment and the

commenter. Following the same order as in Table 9, agency responses were coded 1-4, with comments only being acknowledged, being addressed but with no elaboration, being addressed with some elaboration, and being addressed with substantial elaboration. Again with federal agencies as the reference category of commenter, non-residents were much more likely to receive more substantive responses, as were local (non-environmental) interest groups. Although there were very few comments provided by businesses, their comments were quite unlikely to receive substantive responses from agencies, an overall trend that is in stark contrast to virtually all other research investigating the effectiveness of different types of commenters in affecting public agency decision making (Yackee, 2006; Nixon, et al., 2002; Naughton, et al. 2008; Jewell and Bero, 2006). In those cases, the policies in question tended to have a more direct effect on a larger number of businesses. For projects that are more geographically parochial, where the effect on business is more indirect, businesses generally appeared disengaged, and those that were engaged did not seem to have much effect on the decisions that were ultimately made.

With regard to the nature of the comment, comments that had a human risk orientation were not only more likely to receive individualized responses, but also were more likely to receive detailed responses. This finding remains surprising; with the small number of cases considered, we probably cannot infer larger trends regarding human oriented comments being taken more seriously, but these three agencies appeared to do so. It may be a function of the institutional points of view of these particular agencies. AFRH is a human services agency, providing care to elderly residents. FHA and ACE are both organizations whose primary purposes are to serve human rather than environmental

interests, by facilitating mobility and by harnessing the destructive forces of water and providing water for human uses.

**Table 18: Ordered logistic regression of extensiveness of agency responses by comment types**

Dependent Variable: Agency response acknowledges comment only = 1; agency addresses comment without elaboration = 2; agency addresses comment with some elaboration = 3; agency addresses comment with substantial elaboration = 4

	Odds Ratio (Standard Error)
Commenter is a local resident†	1.24 (0.30)
Commenter is a non-resident†	<b>6.46*</b> (2.11)
Commenter is a residential association†	1.69 (0.53)
Commenter is a local general interest group†	<b>2.65*</b> (1.01)
Commenter is a local environmental group†	0.69 (0.35)
Commenter is a national environmental group†	1.84 (0.59)
Commenter is a local government agency†	0.71 (0.23)
Commenter is a local business†	<b>0.19*</b> (0.13)
Commenter views risk as at an individual rather than aggregate level	0.90 (0.13)
Commenter views risk in human terms rather than environmental terms	<b>1.55*</b> (0.29)
Commenter views risk as objectively measureable	<b>1.77*</b> (0.32)
Comment is technically based rather than values/emotionally based	1.10 (0.19)
Salience (number of comments received)	<b>4.43*</b> (0.40)
Complexity (EIS page count, excluding comments and responses)	<b>1.11*</b> (0.07)
Wald chi2	475.30*
N††	1172

Note: †Referent commenter is federal agency; †† Only comments received from most frequent commenters included; \*p<.05

With agencies that perhaps had more of an external focus, such as the National Park Service or the EPA, this human orientation effect may not be as prevalent. Finally, also

possibly reflecting agency perspectives, when comments viewed risk as something that could be quantified, assessed and controlled to an extent, agencies were more likely to provide detailed responses.

*Does the extent to which it appears that residential interests are organized affect the likelihood that agencies alter implementation plans in order to address stakeholder concerns?*

Evidence of collective action abounds in two of the three projects assessed. As previously discussed, none of the comments received regarding the AFRH project were discernibly from resident or neighborhood associations. This general lack of organization amongst residents in these neighborhoods was further evidenced by a paucity of evidence of commonalities in the comments from individual residents. In the AFRH case, some residents talked about similar issues, but nearly always in a very individualistic way. There was no evidence that any of the comments were coordinated; residents shared some common concerns, but they did not appear to share those concerns amongst one another prior to presenting them individually to AFRH. The most common theme of the relatively disparate comments in this case related to the preservation of the greenspace surrounding the Home, and the potential for neighborhood residents to access this land. The Home is surrounded by well manicured grounds, with trails, trees, and ponds, which are amenities otherwise not especially prevalent in the surrounding neighborhoods. Residents tended to express concern about the loss of this amenity, and also indicated that residential access to these natural resources would make development efforts on other

parts of the Home's property more palatable. AFRH, while not specifically indicating that local residents would indeed have access to parkland within Home grounds, did ultimately select sites for development that would preserve most of the existing greenspace on the property. The agency further stipulated that every effort would be made to ensure that local residents could access portions of the greenspace on the property, provided proper security arrangements would allow it. As of this writing, it is unclear as to whether indeed local residents can access the site, but it is clear in the EIS that AFRH was receptive to this request. Nevertheless, comments on these topics did not appear to be coordinated in any way, and the interest in access to and preservation of greenspace may have been underestimated by AFRH as a result.

In contrast, there was clear evidence of coordination in the 11<sup>th</sup> Street Bridges case, and an abundance of coordination in the Washington Aqueduct case. The trends of this coordination are interesting, however. With 8% of the comments received from resident associations in the bridges case, it was clear that there was at least some coordination amongst people in the area. Of these comments, most related to issues of traffic congestion, or commuter use of neighborhood streets (61%); traffic was also the theme of 22% of the total comments received in this case. Most of the remaining comments from resident associations dealt with access to parkland or public transportation options for residents. Most traffic congestion concerns came from the comparatively wealthier associations on the western shore of the Anacostia River, while concerns about access and greenspace came from associations on the poorer eastern shore. The most interesting evidence of coordination of effort with regard to the 11<sup>th</sup>



Street Bridges case related to the Anacostia Community Boathouse (ACB). The ACB is a facility located on the eastern bank of the river, almost immediately under the proposed span of the 11<sup>th</sup> Street Bridges. It houses a host of rowing and canoeing associations and equipment that residents throughout the greater Washington region regularly access. One of the alternatives proposed in the DEIS would have torn down the ACB, replacing it either up or down river from the new bridges, while the other alternatives posed the possibility of closing the ACB during construction of the new bridge spans. These propositions are the basis for 28% of the total comments received about the EIS, with 58% of these ACB-related comments coming from people who are not residents of the impacted neighborhoods. Further, nearly all of the comments relating to the boathouse use not only common themes regarding recreation, environmental stewardship, and community education, but over half of these comments also use identical language, modeled on the following, in part:

*“Home to five high school and collegiate rowing programs, and three community rowing and paddling programs, the Anacostia Community Boathouse facility is a thriving symbol of the recreational and community-building benefits of the Anacostia River. In fact, it’s one of the few existing initiatives that constantly introduce Washingtonians to the river’s beauty and potential.”*

Although FHA does not specifically indicate that this effort led it to abandon any plans to demolish the ACB, the ultimate decision made ensured that the ACB would not be

destroyed, and would only be closed during construction of the bridges is absolutely necessary for the safety of users.

The final case, the Washington Aqueduct project offers the clearest example of coordination of efforts by affected residents. Virtually all comments were from the local neighborhoods, with 20% coming from representatives of resident or neighborhood associations. Further, this case includes the only substantial involvement of elected representatives with 4% of the comments coming from political actors, likely an indication that residents were not only commenting directly to ACE, but also appealing to their government representatives to do the same. Similar to the 11<sup>th</sup> Street Bridges case, many of the individual resident comments not only included similar themes, but also nearly identical language, a further indication of a high level of coordination amongst affected residents. These coordinated efforts nearly all related to one or both of two topics: the impact of the removal process itself and subsequently trucking residuals from the aqueduct (34% of total comments related to this theme), or concern about the comment process itself (20% of total comments received related to this theme). About 90% of the concerns related to trucking were expressed either by individual residents or by their resident associations, with 25% of these comments using identical language, opening with the following:

*“I am writing to express my concern about the 80-foot industrial dewatering facility you are proposing behind Sibley Hospital (Alternative E) and the impact it will have on my neighborhood. I favor finding a piping solution that will send the residuals to a non-residential area closer to the beltway. I ask you to carefully*

*review and respond to Concerned Neighbors' concerns"*

In virtually all cases, residents wanted trucking residuals through the community taken off the table in favor of constructing pipes to move residuals elsewhere underground, which ACE did not completely acquiesce to in the final EIS. Through the iterations of the public comment period, it did appear, however, that ACE altered and improved its efforts to facilitate public participation even if that participation did not appear to ultimately have much of an impact on the final decision. The one area in which ACE did appear to line up with public opinion was in quickly abandoning a plan to store residuals in a monofill on the aqueduct property. In the early stages of the comment period, the monofill dominated the public response. ACE then made clear relatively early that the monofill was extremely unlikely to be selected as the best alternative, although it is not clear if ACE was responding to public opinion in making that decision, or whether trucking, or some combination of trucking and piping as was the final selected alternative, was their preference all along.

*Are agency decision makers more responsive to concerns when a project is highly salient with a wider set of stakeholders than when the project is very localized or when stakeholders appear disinterested?*

*Does the complexity of the project affect the extent to which agency decision makers are responsive to stakeholder comments?*

These two questions arise from a set of studies assessing the extent to which salience and complexity should be expected to affect the level of public participation in agency decision making (Rinquist, et al., 2003). We might expect that agencies will be more responsive when projects are highly salient and when they are less technically complex. In these three projects, the Home project was the least complex, requiring only 289 pages to explain, and also the least salient with 320 comments. The 11<sup>th</sup> Street Bridge project and the Washington Aqueduct project were similarly complex, requiring 1551 and 1268 pages respectively. The Aqueduct project was the most salient with the public, with 530 comments received, while the 11<sup>th</sup> Street Bridges project was the most salient with people outside the direct geographic impact area, with 70 of the 393 comments received coming from individuals who were non-residents of neighborhoods near the bridge site.

Despite its project being clearly more salient with the local community, ACE was not an especially responsive agency to community concerns. While it did exclude serious consideration of the monofill option, it was not clear whether or not it preferred position all along, and ACE largely responded to public complaints by offering technically complex responses, like the following:

*“Noise impacts associated with the proposed residuals thickening and dewatering facility are evaluated in the EIS. In general, the dewatering building is not anticipated to contribute noise to the surrounding neighborhood due to the distance from the facility to the neighbors and the use of sound absorbing building materials. Truck noise entering and exiting the dewatering facility will be minimized by prohibiting idling before loading, providing enclosed loading*

*bays, and providing berms around the loading area that will function similar to sounds walls along area interstates by directing noise away from neighbors. With this mitigation, noise impacts are determined to be not significant.”*

Thus, despite high salience, which we might expect to alter agency decision making, the agency used the high complexity of the project often as a rationale for not hewing to public opinion. ACE responses tended to be the most technical of agency responses, usually using the high costs of residential preferences as a rejoinder to public comments.

FHA was clearly responsive to concerns regarding the ACB. Although not entirely assuring interested parties that the boathouse would remain open during construction, the agency seemed to recognize the political support the ACB had from a large swath of regional actors and acquiesced to not only retaining the boathouse facility, but to meeting with representatives of the boathouse and ensuring that boathouse activities would remain open even during construction, with the agency footing the bill for establishing a temporary facility should there be safety issues with keeping the ACB open during the construction period.

*“[T]he project team [has] held several meetings with both the leadership and the membership of ACBA to gain a fuller understanding of the organization’s operational requirements.”*

On the other side, FHA was not terribly responsive to concerns about the traffic impact of creating a freeway connection through Washington, DC. While some local residents saw

the freeway connection as a means through which to remove congestion from local streets, the far more common opinion (70% of cases where traffic was the primary concern) echoed the trepidation of District residents from the 1970s – that opening a freeway connection through the city would dramatically increase through traffic and thus overall traffic would actually get worse with increased freeway capacity. FHA recognized this concern of residents near the proposed connector, but did not appear to seriously consider any alteration of its plan to create a freeway connection. Thus, FHA was responsive to the high salience with the broader public, but was not terribly responsive to more local interests, often retreating into the technical details of traffic studies to refute commenter concerns that increased capacity would be quickly overwhelmed with increased overall traffic.

*“The project would not result in thousands more cars and trucks entering local streets. There would be increases and decreases on local streets. Most of these differences on local streets would result from redistributing the traffic that is already in the area, with more decreases than increases on local streets.”*

The least complex and also the least salient project, AFRH was not especially responsive to public concerns in any way, mostly pledging to make efforts to meet community concerns, but committing to nothing. Without much of a complexity argument available, AFRH responses mostly centered on noting that meeting commenter preferences would not address the budgetary issues that the Home faced. Most AFRH responses acknowledged a preference to not develop land near the Home, but dictated

that such a preference was untenable due to the need of the Home to be self sustaining. A handful of comments came from people who did not live or do business directly in the area of the Home, with these usually expressing concern about the impact of development on the veterans who were residents of the Home itself. AFRH was generally receptive to these comments, repeatedly justifying the need for economic stability as well as the preservation of the park like setting around the Home as being in the interests of the residents residing within the Home.

*“The goals of the AFRH-W Master Plan have been established to ensure that the Master Plan is developed in a manner that meets the long-term needs of the AFRH while recognizing the importance of the AFRH-W resources and the local community.”*

Complexity did not appear to affect the propensity of people to comment on an EIS. Despite having fewer pages than the 11<sup>th</sup> Street Bridges EIS, the Washington Aqueduct project was probably the most technically complex, requiring multiple pages to explain the purpose and need to remove residuals from the water supply, and the process to do so. Regardless of this complexity, the project was by far the most commented upon despite having lower density neighborhoods surrounding the affected site. Both FHA and ACE tended to use the complexity of their projects as a justification for not altering project plans to suit common public preferences.

*“Trucking at night was suggested by the public as an alternative to daytime trucking. While potentially favorable from a traffic standpoint, night trucking*

*would likely result in more noise impacts on the surrounding neighborhoods due to lower ambient nighttime noise levels. Moreover, the residuals receiving facilities typically do not operate at night.”*

*“Exhibit 8-3 and Section 8.3.4 demonstrate that the build Alternative do not draw traffic from surrounding regional roadways through the District.”*

Considering the propensity to respond, rather than the content of the response, as Tables 17 and 18 illustrate, as both saliency and complexity increased, agencies were both more likely to respond with individualized responses as well as provide more substantive elaboration to their responses, all else equal. Although these substantive responses did not appear to necessarily affect agency decision making, the more comments received, the more agencies tended to provide substantive elaboration, a finding which was primarily driven by the substantive detailed technical responses usually provided by ACE. Similarly, likely driven by the fact that 75% of ACE’s responses were substantive, higher complexity predicted more substantive responses. More individualized responses were also more likely to be provided as saliency and complexity increased, with this finding likely reflecting FHA’s propensity to provide individualized responses (27% of cases).

## Discussion



From the three cases assessed, the above answers show some trends with regard to participation in EIA by the public, the responsiveness of public agencies to public concerns, and how these were affected by project factors, comment characteristics, and neighborhood contexts. Moving to bigger questions regarding the role of the public in environmental decision making, the discussion now turns to addressing and posing some questions raised by this analysis, which could be elaborated upon with a more robust set of cases.

*Is the public a participant in the EIA process?*

A major push of open government rules was to increase the involvement of the public in all manner of government decision making, with the environmental policy realm being an early and robust adopter (McAvoy, 1998). There is much evidence that the public participates in the process, but this does not necessarily mean that the public is viewed as an active participant (Ibitayo and Pijawka, 1999). Throughout all three of the projects, a common theme was frustration by commenters that the process was “for show” or to meet the requirements of NEPA; people often expressed doubt that agencies had any interest in hearing their comments or would take any steps to incorporate their preferences into the final alternatives selected, particularly in the Washington Aqueduct project.

*“The entire process has been fundamentally flawed, beginning with the Corps’ failure to appropriately involve the community when it started the scoping process for this project in January 2004.”*

Indeed, from the qualitative perspective, it did not appear that any of the three agencies were especially responsive to public comments during the alternative evaluation process. None of the three dramatically altered the main substance of the alternatives presented for public comment in the final alternative selected. AFRH clearly intended to develop a portion of its property in order to address its budgetary issues, and it did so in the final alternative despite opposition. FHA intended to create a freeway grade connection between existing freeways on the eastern and western shores of the Anacostia River, and despite more opposition than support for this idea, it did so. ACE intended to use the Dalecarlia site to construct a processing facility to remove residuals from the city's drinking water, and despite intense, nearly universal opposition by nearby residents, it did so in the final alternative selected.

Public comments, however, did seem to affect agency decision making on the margins. AFRH selected a plan that minimized the amount of greenspace that would be lost to development. FHA ensured that residents on the eastern side of the river would have freeway access, and pledged to retain the Anacostia Community Boathouse. ACE abandoned any plans to retain residuals on the Dalecarlia site, opting to focus on plans to use the site only to extract residuals and move them elsewhere. Public participation did therefore seem to have some effect, but to call the public active participants in decision making would probably be misleading. It was clear throughout each of the three documents that authority rested with the lead agencies and that the public was there to assist agency decision making, not to engage in open discourse toward finding mutually

agreed upon solutions. In many ways, the process did appear to be undertaken mostly in order to meet NEPA requirements rather than to arrive at better solutions. That said, public participation was overwhelmingly focused on opposition. Although the agencies did not exactly welcome public comments, the public came into the process with expectations that their concerns would not be addressed and thus were far more likely to focus on problems without offering solutions.

*“In addition, as a father of young children, I am personally concerned about the safety implications of sending 132 trucks a day through the Maryland suburbs where my family lives. The risks to all of us posed by such heavy traffic, on top of the already full-capacity levels of regular commuter and public transportation through our streets, are intolerable.”*

*“I know that if I in fact decide on joining the armed forces and one day I will in fact be a senior, I would want somewhere to go when I am too tired to take care of a house or other property that I might own. This estate was created for veterans, people that have served their country well... I say no construction on the soldier's home.*

Those motivated to participate were those who wanted problems addressed to their meet their preferences. Thus, while one could take the position that government agencies did not enter the process seeking Habermasian discourse, neither did the members of the public that participated.

*Is NIMBYism alive and well?*

NIMBYism can be clearly spotted in each of these cases, both in terms of residential interests in keeping things out of their back yard, but also in removing things from or improving their backyards. Although these three cases are presented as environmental improvement policies, they are all more complex than that, of course. While the Home project would remove underground pollution and possibly open green space to area residents, it is mainly a mixed use development plan. The 11<sup>th</sup> Street Bridges may reduce congestion both on the bridges and side streets nearby, but would also potentially increase the overall level of traffic moving through the community. The Washington Aqueduct plan is the clearest trade-off of environmental improvement in the region in exchange for localized degradation. In each of the three cases, there are ample examples of residents expressing parochial concerns to benefit their own communities over the needs of the greater public. This contrast is most prevalent in the Washington Aqueduct plan.

Even to most of the people who provided comments regarding the aqueduct EIS, the trade-off between regional improvement and localized degradation was clear. It was recognized that ACE had to make alterations to meet the Clean Water Act, and that the removal of residuals from the Potomac and the water supply needed to happen somewhere. Nevertheless, fairly quickly in the open comment period, many of the commenters who live near the Dalecarlia plant indicated a strong preference to simply avoid removing potentially harmful residuals or to site removal operations elsewhere.

*“In the draft EIS, the Corp dismisses the no action alternative claiming its hands are tied by the EPA and its permit. However, the Aqueduct’s permit limits are not required by the statute and they can be renegotiated. There are no provisions in the federal statutes that prohibit the discharge of residuals into the Potomac River.”*

Commenters in all three cases had a tendency to show frustration and strong opposition to whatever plans were proposed, but the level, extent, and near universality of anger evident in comments provided in the aqueduct plan were unmatched in either of the other cases, particularly with regard to the process.

*“The current decision making process is a sham.”*

*“The Corp cannot continue this charade.”*

*“Since it is apparent that you are not giving proper consideration to health and other environmental considerations and are not handling this matter in a good faith fashion with those in the various communities that are impacted, I will be asking my Representatives in Congress and others with whom I deal on Capital Hill to hold up funding for the Corps on this project until you come up with a piping alternative following freeway routes rather than a trucking one, and will also request, so that you get the message, that your entire administrative budget be withheld until you do so, if you continue to proceed in this fashion and with*

*this alternative.”*

*“When I was younger, I resided briefly in a totalitarian country, whose leaders smiled and claimed that their citizens enjoyed a democratically elected government, meaning that the citizens were allowed to vote for the one and only candidate running for a particular office. This process reminds me of that time in my life because from the outset there was only one choice.”*

Residents were quickly organized, even going so far as to create a regional interest group *Sludge Stoppers* to coordinate efforts amongst the disparate affected communities located in both Washington, DC and Maryland. Virtually none of the comments received from residential interests were in any way supportive of any of the alternatives, although many did recognize the usefulness of removing drinking water residuals and acquiesced to accept options to pipe removed residuals to a processing facility rather than storing them at or trucking them from Dalecarlia.

NIMBY activities were a bit more complicated for the 11<sup>th</sup> Street Bridges project. There did not appear to be a general consensus amongst nearby communities as to whether the proposals were beneficial (environmental or otherwise) to the nearby neighborhoods or not. On the one hand, overall congestion might decrease leading to improved air quality, but on the other hand, overall traffic would likely increase potentially mitigating these improvements. However, most residents expressed parochial interests in an effort not to thwart the project like those involved in the aqueduct, but

rather to adjust the project to best meet their interests. Thus, residents on the western side of the river were interested in keeping commuter traffic off side streets, while those on the eastern side were more interested in ensuring that they had access to transportation options to make it easier to get to the downtown area. Nearby residents were also clearly interested in both preserving existing greenspace and adding to it. Several parks line the eastern shore of the Anacostia River and those residents that mentioned park land, wanted to ensure that local residents had adequate access to, and a sufficient amount of nearby greenspace.

*“I am opposed to the current plan for the bridge specifically because it would destroy up to 12 acres of parkland and effectively create an interstate highway shortcut through the District, adding thousands of cars and trucks to neighborhood streets each day.”*

The collective action undertaken by non-residents of the community was the most interesting instance of public involvement in the 11<sup>th</sup> Street Bridges project. Although not residents, these commenters tended to express a NIMBY-like opposition to anything that might disrupt activities at the Anacostia Community Boathouse. The concern was not to keep something out of, or improve their backyards, but to preserve a recreational amenity that they regularly accessed. The collective effort was evident through the common, often identical language used by people who described themselves as rowers, canoers, or paddlers, and while many expressed an interest in retaining boathouse operations for these purposes, they more often appealed to the importance of the boathouse to the local

community, which was a view expressed but not overly so by actual community residents. Nevertheless, this organized effort to ‘keep something in my recreational area’ was amongst the most effective NIMBY-like efforts to be seen in these three projects.

Similarly, in the Home case, residents often recognized the importance of securing a sustainable funding stream for retired veterans, but balked at the perception that they would be the ones paying for it. Many wondered why development at the site was the preference rather than increasing fees paid by active military members for the Home. They saw the development plan as way to reward profiteers while bringing unneeded commercial development to the site, which they worried would not fit within the generally residential nature of the area. Although there was little evidence that residents near the Home were organized, they expressed common concerns and many were the most obviously interested in bringing environmental improvements to the community. There was a strong interest in seeing the Home’s grounds opened back up to the public, so that residents would be able to use and enjoy the park setting upon which the Home is located. Residents viewed the Home’s grounds as an amenity in their neighborhood, but an amenity out of reach to them. Many residents, particularly those residents who indicated that they had lived in the general vicinity their entire lives expressed a preference that the grounds be opened for public use.

#### *How does power affect participation and decision making?*

At its root, the effort to involve the public in public agency decision making is pluralistic. By opening access to the bureaucracy, the hope is that interests who might



otherwise not have been expected to influence decisions could be able to at least have their voices heard by decision makers. In other words, it is an effort aimed at decreasing the authority of the power elite, exemplified by the iron triangle of moneyed interests, relevant legislators, and bureaucratic decision makers. Past research on these efforts has generally found that the moneyed interests still tend to loom large, as business interests are most likely to both participate and see their interests reflected in final policies (Yackee, 2005). The cases assessed here tend to show different trends, although there are clear power differences amongst the various groups that participated in the three EIA processes – public participation in EIA does not meet a pluralistic ideal.

For these projects, however, business interests clearly have very little interest and therefore influence. By focusing on projects that had direct impacts on communities, rather than on regulations that could potentially affect a large number of businesses, it was unlikely that business influence would be as great in EIA as in other areas. Nevertheless the paucity of business involvement and influence is nevertheless surprising as each of these projects could potentially affect local businesses significantly. This may be particularly true regarding the AFRH development plan. One of the concerns commonly expressed was the lack of need for further development due to existing development that was already taking place in several areas close by. Residents were concerned that development on the Home grounds would be redundant. Nevertheless, interests from those other nearby developments (developers, retailers, etc) did not provide any input to the Home EIS. Nor did potential developers or retailers interested in sites on the Home's grounds. The 11<sup>th</sup> Street Bridges project could also affect local business in

several ways. First, diverting traffic off of residential streets could divert foot traffic to small community businesses, yet none expressed such a concern in the EIS. Businesses involved in shipping or delivery in the area stood to benefit substantially through the decrease in congestion and faster trips made possible through a freeway connection, but none offered such feedback. The Washington Aqueduct plan perhaps had the least potential impact on business, but local shops dependent upon foot traffic did not express concerns about large trucks constantly hauling residuals past their storefronts (although many residents did). Moreover, with a hospital directly adjacent to the Dalecarlia site, health care providers could have expressed concern regarding the proximity to potentially hazardous materials, but the only such comment received was from the hospital itself, generally expressing support for the ACE plans.

As far as differences amongst the different types of participants, the context of the three projects provides interesting comparisons. The Washington Aqueduct project affects one of the wealthiest areas of the city, while the 11<sup>th</sup> Street Bridges project affects one of the poorest. The Home project affects an area in transition. The differences in the type of and reaction to participation suggest some of the ways that power variability seeps into public participation in the bureaucracy. In the grand scheme of research on the siting of environmental disamenities (Campbell, et al., 2010), given the location of the Washington Aqueduct project it is surprising that the site was even considered for the residual removal facility. One would expect wealthy neighborhoods to epitomize the ability to “use” unexercised power to keep their communities from being considered as hosts of disamenities (Bachrach and Baratz, 1962). Nevertheless, ACE honed in on the

Dalecarlia site early in the EIS scoping process as the only viable site upon which to build the facility, to the near shock of local residents.

*“I am extremely concerned both about the process that you have used to arrive at your current proposed siting of an 80-foot tall dump site for heavy mineral and toxic materials extracted by the proposed industrial dewatering facility you are proposing.”*

Moreover, once chosen as a site by ACE, past NIMBY literature would suggest that the wealthy residents would almost certainly successfully thwart plans to build the facility at the site. Nevertheless, although ACE altered plans a bit, it did not appear to be terribly responsive to these local residents. They selected an alternative that was clearly not palatable to local residents, although they did not select the alternative that was most clearly objectionable to the local residents. The inability of these wealthy residents to thwart the proposed facility is particularly surprising given the unanimity of their opposition to the placement of the facility in their area; there were no comparatively poorer residents offering contrary opinions, nor any substantive support for ACE’s proposals amongst the comments from any source. It was clear in this case that despite expectations that wealth and power are two sides of the same coin, ACE was the empowered actor and it largely followed through according to its stated preferences.

At the other end of the spectrum, the changing nature of the communities near the Home was reflected in the lack of coordination apparent in the comments provided to AFRH. Although many commenters offered similar themes, they did so through different

arguments and types of argumentation. There was no sense that any particular commenter was particularly powerful in the process, although comments from veterans who either lived at the Home or who urged AFRH to ensure that any plans improved the lives of veterans at the Home seemed to be the most salient to the agency. Since AFRH's mandate is to care for these very clients, it is not surprising that their influence would be important, but once again, the empowered interest in this case appeared to be the agency itself. With no apparent organization amongst external stakeholders, the exercise of AFRH's power appeared to be far less controversial than ACE's, but it was no less absolute. AFRH largely followed through on its stated preferences regardless of the strong opposition to development occurring at the Home site. An interesting difference can be noted between comments to ACE and to AFRH home, however. In the ACE case, universal opposition tended to be treated as a fairness issue. Commenters decried their lack of input in the process, and reacted with vehement, often starkly angry opposition to ACE's plans. Residents' single minded effort was to ensure that the facility was never sited in their community. In the more modest, changing neighborhood context of the Home, commenters were neither nearly as angry, nor as single minded. Although generally opposed to the development plans, commenters were much more likely to take as a given that some form of development would occur and try to ensure that nearby residents benefited in some way from this development.

*"I am a resident of Columbia Heights on Princeton Place, NW. I ask that the EIS look into having a public park instead of selling the land to developers. I also ask that the community have strong voice in the development of the land."*

*“Substantial efforts (e.g.: a set aside of jobs) should be made to ensure that DC residents benefit from job opportunities associated with construction and development.”*

Whereas the wealthy residents near the Washington Aqueduct focused on avoidance, the middle income residents near the Home focused on ensuring some form of benefit from the plan. Granted, the residual removal plant is more clearly a disamenity than retail development on current greenspace, but this difference in points of view amongst different types of residents is also clear in the 11<sup>th</sup> Street Bridges project.

The Bridges project is in many ways the most interesting in terms of the role of power. The Bridges are located in predominantly poor, minority-majority neighborhoods, particularly those neighborhoods located on the eastern bank of the Anacostia River. The residents commenting from these local communities tended to focus on ensuring the viability of their community and ensuring that residents would have access to any of the improvements that would be made to the freeway system. They tended to treat the new bridges as a given, and did not often express much opposition; the focus of most comments from local residents was on ensuring that they benefited through improved access to jobs downtown, public transportation, and the potential economic development that might follow improved access for others to come into their community.

*“I want to emphasize how important it is for the residents of Anacostia to have the same access to I395 as we do now...Additionally, there needs to be a way to*

*get onto 295 south from the neighborhood. No matter what happens, Anacostia residents do not want to lose highway access. We want it improved.”*

They wanted to ensure access to parks and greenspace, and maintain the historic nature of the Anacostia community, perhaps the most historically important African-American site in the District of Columbia.

In contrast, most of the commenters that were non-residents listed addresses generally outside the city of Washington, in places like Bethesda, Maryland or Alexandria, Virginia – suburban areas where residents could be expected to be considerably wealthier than those living in neighborhoods near the bridges. These non-residents were concerned, almost exclusively, with ensuring access to the Anacostia Community Boathouse. Although they often expressed their views through appealing to the importance of the ACB to the community, their interest was clearly in maintaining their individual access to the facility, and similar to the residents near the Aqueduct, they were organized, often emotional, and sought to thwart the project, or at the very least ensure that the ACB remained upright and open at all times rather than seek any sort of compromise.

*“I am concerned that a valuable community resource is in danger of being displaced. The future of the Anacostia Community Boathouse is threatened by plans to renovate the 11<sup>th</sup> Street Bridge.”*

This difference is ultimately the clearest view of the power variability of people participating in the process. Through these three different contexts, we can see exercised power on the part of agencies largely making decisions regardless of opposition, and more subtle forms of socially based power through the different behavior of different types of actors. Those from wealthier areas were not seeking to compromise; they felt that agency plans were disruptive and unfair and they sought to stop the agencies from carrying out any action. They had an expectation that decisions should not go against their preferences.

*“I hope that the Corps takes the Concerned Neighbors’ position seriously and adopts a more reasonable approach to the dewatering process. It would be pointless to have to resolve this issue through litigation rather than an agreed-upon solution that accommodates the reasonable needs of all parties.”*

People from poor or middle income areas were much more likely to accept that the government was going to undertake the action, and focused on trying to ensure access to some benefit of the project for their community rather than to focus efforts on thwarting agency plans. Their comments reflected acceptance and efforts to compromise, rather than taking offense and seeking to stop anything from occurring.

*“I am personally willing to suffer this lack of access because this same lack of access should provide the benefit of less drive-through commuter traffic. In an ideal world, we can have it both ways, but this is the real world.”*

The hidden power underlying our social system comes into clear view comparing these two different strategies. The poor accepted that they might have to pay a cost for some activity and sought some benefit, whereas the wealthy refused to accept the cost in the first place and never actually spent much effort looking for any benefits.

As to which strategy proved more effective with agency decision makers, it is difficult to say. ACE clearly did not respond to the wealthier resident opposition, but FHA was receptive to concerns over the boathouse. Residents seeking some benefit from the projects largely did receive at least some of what they asked for – development at the Home was set to remove the least amount of greenspace, and the 11<sup>th</sup> Street Bridges would ensure that neighborhoods to the east would have freeway access, as well as bike, pedestrian and eventually, public transportation options. However, these variable outcomes may have more to do with the agencies themselves. ACE may simply avoid being responsive to any public input in any EIS case. FHA may be an agency that generally seeks compromise, as it appeared to do by ensuring both access for local residents and preservation of the ACB. This is an area worth further exploration; this study only included three agencies, but different types of agencies (and perhaps different levels of government) may treat public input quite differently and may have different trends of responding to different types of comments and commenters. Nevertheless, issues of power are clearly important aspects of public participation in the EIA process. Agencies have ultimate decision making authority, and different types of public actors appear to have varying levels of power, and moreover, act according to the existing power relationships of society.



## Conclusion

In this chapter, I applied a NIMBY and political power framework to a study of public participation in environmental decision making. I described how and why we might expect collective action to be undertaken by stakeholders in order to see their interests reflected in final policies that are implemented. Using Environmental Impact Analysis processes, I detailed the steps through which bureaucratic decision makers enable the public to interact with government agencies when policy alternatives are being selected for projects that will affect the environment. The three cases presented were, in part, efforts to improve environmental conditions, albeit sometimes at a cost to other environmental outcomes, which often pitted localized interests against the regional public interest. The three projects took place in Washington, DC, in three different types of neighborhoods with different lead agencies. In all three cases, the public was involved early and often in the process, predominantly residents living nearby the project site. In all cases, residents or resident associations provided the bulk of the comments to aid agency decision making, although non-residents, other government agencies, and organized interest groups were also active participants. I found that the three lead agencies did alter their implementation plans to address public concerns, but only in marginal ways. In all three cases, the agencies ultimately set out implementing a plan very close to the plan that they appeared to prefer from the start of the process.

I described how different types of participants make arguments to public agencies, and the extent to which residents in the three distinct neighborhoods acted collectively. I

found that residents in the wealthiest neighborhood were much more likely to be organized than in the poor neighborhood or the transitional area, but also found that this collective action was no more effective at changing agency implementation plans than the more disorganized opposition in the other locations. I also found that the three different agencies tended to respond differently to different types of commenters, and to different types of argumentation. In the end, however, issues of power in collaborative decision making in the bureaucracy are most clearly illustrated through the near absolute decision making authority that the agencies themselves possess.

This conclusion calls into question the fundamental usefulness of public participation in bureaucratic decision making. Although residents in all three cases hewed closely to what may be called NIMBY strategies, in none of the cases were those strategies particularly effective. With bureaucratic decision makers one step removed from political authorities, their responses largely indicated an interest in receiving public input, but little evidence that it was used to fundamentally alter decisions that were made. Political representatives were not especially likely to be involved, at least officially, in the public comment periods, and without these intermediaries intervening extensively, agencies did not seem to feel a need to dramatically shift priorities from agency purposes to public purposes. This may be a product of the fact that the three projects in question took place substantially in Washington, DC, and were undertaken by federal government agencies. With no voting representation in the federal government, the agencies may have felt little need to adjust plans to account for public preferences. It may also be the case, however, that despite what NIMBY and interest group power research suggest, power

ultimately resides with public decision makers placing aggregate interests over parochial interests.

Whatever the case, this study illustrates some problems with the application of institutional arrangements intended to give the public a voice in bureaucratic decision making; projects were bogged down through the public comment phases, despite agencies not altering plans. The NIMBY phenomenon may be more nuanced than it has generally been portrayed; public involvement neither improved residents' ability to alter policies, nor did it help the project process move more efficiently. Moreover, for the most part, there was very little counterbalancing to the parochial concerns most frequently presented (Lober, 1995). For those interested in effectively disabling the "NIMBY problem", this study may be good news. Despite the employment of NIMBY strategies, parochial concerns went largely unaddressed. However, for those interested in making bureaucratic decision more collaborative and democratic, there is little evidence that the decisions made were based on anything beyond the preferences of the bureaucratic elite.

#### **Chapter 4: Siting, sorting, and selecting: Simulating the neighborhood equity effects of hazardous site remediation**

##### **Awareness of environmental injustice**

Over the last several decades, policymakers and researchers have become increasingly aware of the discrepancies in environmental quality for different populations (Campbell, Peck, and Tschudi, 2010). The weight of academic evidence, while conflicted regarding the cause of this “environmental injustice”, supports the view that environmental quality has not historically been distributed evenly across the socioeconomic spectrum, particularly when considering racial variation (Ringquist, 2005). Many state and federal environmental quality remediation efforts have specific, codified recognition of the importance of environmental justice and dictate that one consideration in the determination of the prioritization of site remediation is location in a neighborhood with a traditionally underserved population (Canter, 1996). In its brownfield remediation regulations, the U.S. Environmental Protection Agency (EPA) is specifically required to consider the demographic characteristics of the population that will be most affected by a site’s cleanup in its assessments regarding the dispersal of grants and other cleanup funding. In Chapter 2, I found that despite EPA’s efforts to address past inequities by ensuring a focus on the environmental justice implications of

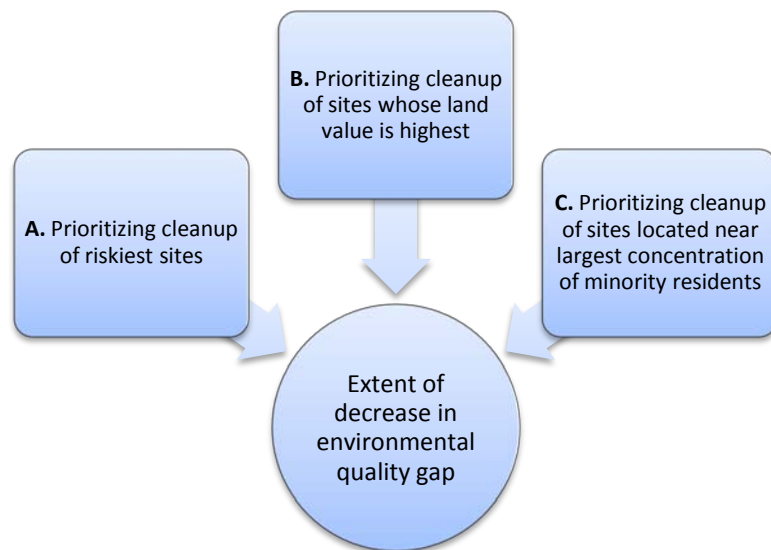
cleanup projects, inequities remain with regard to the pace of cleanup efforts in predominantly minority neighborhoods.

However, does this slower pace of cleanup necessarily mean that improvements in environmental quality are provided inequitably? The previous chapter also showed evidence that the EPA tends to focus its resources on those projects it deems most environmentally risky, such as sites classified under the Superfund program or those contaminated with particularly toxic materials, regardless of the demographic makeup of the communities in which they are located, and on those sites that appeared most likely to facilitate economic development in the surrounding community. A policy targeting cleanup efforts to lower status communities will only be effective at addressing the environmental quality gap if the demographic makeup of those communities is unchanging. That is, if a community is dynamic, then cleanup benefits may be predominantly accrued by new residents moving into a community, rather than by previous residents who have moved elsewhere; and the preponderance of evidence suggests that communities are far more likely to be dynamic than they are to be static (Benenson, 1998; Barredo, et al., 2002). In a dynamic regional residential environment, it is possible that prioritizing the remediation of the most potentially hazardous sites actually improves environmental quality for underserved populations more than if sites in minority neighborhoods were prioritized instead.

In this chapter, I analyze this counterfactual effect of different hazardous site remediation policies on the environmental quality gap that exists between high status and low status populations. As depicted in Figure 7, I compare potential consequences on the

environmental quality gap of prioritizing the cleanup of those sites that are (a) the largest polluters, (b) have the highest land values, or (c) have the most minority residents in their proximity. Given unavailability of an actual natural experiment to test the counterfactual, I do so by creating an artificial world and simulating alternative policy scenarios through an agent-based model. In the rest of this chapter, I will describe why policymakers increasingly consider the importance of environmental justice, but why we might expect that such an emphasis may not necessarily lead to better environmental outcomes for lower socioeconomic status groups. I will then describe how an agent-based model can be used to explore this counterfactual via sets of simulations assessing alternative policy options. I then describe the development and behaviors of the agent-based model used in this analysis, and finally, I discuss the policy analysis exploration conducted and review the results.

**Figure 7: Counterfactual policy prioritizations assessed and their consequences**



## Environmental justice and risk mitigation

One of the limitations of advancing knowledge in environmental justice research is the difficulty of assessing the levels of risk posed by environmental hazards. For the most part, previous research has treated risk homogeneously – all hazardous sites are considered equally hazardous (Campbell, Peck and Tshuchi, 2010), with the risk calculation consisting entirely of the relative location of an individual to the hazardous site. Thus, environmental quality tends to be measured only through proximity to hazardous sites, rather than through an assessment of the nature and state of the contamination at a site and the subsequent risk posed by the site, of which proximity is only part of the risk calculation. To the extent that risk is assessed, the tendency is to consider only accumulative measures of air quality such as ozone or particulate volume (Seig, et al., 2004) that are difficult to trace back to a specific source. This level of detail is not necessarily a limitation of the research, but a limitation of data; with a preponderance of hazardous sites, most of which are privately owned, self reporting and enforcement are somewhat haphazard (Konisky, 2009), and data are often unreliable. Lacking good information regarding the nature of the pollutants at a site, and the manner in which those pollutants are stored and handled, it is extremely difficult to assess the risk posed by a site. Even among those sites that have been targeted for cleanup and therefore assessed in detail, determining the level of risk posed can be quickly become complicated due to the large number of factors that affect risk, and the uncertainty regarding the nature of the relationships amongst those factors with one another, and with subsequent risk (Freudenburg, 1988).

This focus on proximity in research has engendered a similar focus by policymakers. To the extent that public agencies consider environmental justice implications, they do so via the proximity of the site to underserved populations, for example by investigating if a site is located in a community with high poverty, or with a large minority population. Due to the difficulty of the task and the resources required to conduct environmental risk assessments, most sites do not undergo formal risk assessments until the decision has already been made to prioritize their cleanup. In Chapter 2, I attempted to account for this divergence by considering the type of the pollutants that have been found at a site, but the analysis is somewhat hampered by unreliable information regarding the level and nature of contamination and the condition of the site itself. Although I found that EPA funds tended to go to those sites at which the most hazardous chemicals were known or suspected to be present, without information about the quantities and nature of the pollution, risk has been very roughly estimated at best.

The environmental justice literature leaves little doubt that hazardous sites tend to be clustered in lower status areas, and surely this translates to increased risk for nearby populations (see Ringquist's 2005 meta analysis for an overview). However, it is difficult to discern whether those clustered sites constitute a relatively higher risk to the local population than one highly contaminated site a little further away. For instance, how many nearby gas stations does it take to be more risky than one slightly more distant nuclear facility? Is a closed chemical plant one mile away riskier than a city dump three miles away?



### *Economics and residential sorting*

These questions are further complicated when considering the dynamic nature of communities. Existing policy is premised on the idea that targeting cleanup to those communities with high poverty and large minority populations will address the environmental quality gap by ensuring that policy benefits flow directly to these intended beneficiaries. This premise, however, is based on an assumption that communities are largely static; for benefits to flow to targeted beneficiaries, those beneficiaries must remain in the targeted community. There is ample evidence that communities are dynamic – that the character and characteristics of neighborhoods are constantly in flux as old residents leave and new residents move in (Ley, 1986; Smith, 1979). If neighborhoods are dynamic, then policies targeting neighborhoods will benefit whoever happens to be in the neighborhood at a given time, whether those individuals are the intended beneficiaries or not.

Following Tiebout's (1956) lead, the residential sorting framework posits that individuals are mobile and will enter and leave communities as their individual situations change, either pricing them into or out of their current neighborhood, or as the basket of public goods provided in a community changes. The residential sorting framework is useful for considerations beyond environmental justice, and in fact serves as the framework for much research in housing (Schuetz, 2009; Gould and Voicu, 2006; Wassmer and Baass, 2006), crime (Katzman, 1980; Bickers and Stein, 1998; Gibbons and

Machin, 2008), and other policy areas where the unit of analysis tends to be akin to a neighborhood.

In the environmental justice framework, both the environmental quality gap and environmental gentrification (Seig, et al., 2004; Eckerd, 2011) have been investigated through the residential sorting lens. Taking changes in the environmental quality in a community as the substantive change in the basket of public goods provided, this work investigates how both degradation of and improvement in environmental quality alter the economic and demographic makeup of communities. When the environmental quality in a community degrades, for example after the siting of a hazardous facility, we may expect that demand for housing in the community will fall, lowering real estate values, and encouraging those who have invested in real estate in the community to leave (Been and Gupta, 1996). As demand falls and the supply of available homes increases, prices fall making the community more affordable for the poor. The basket of public goods available in the community has thus changed: worsening environmental conditions have had the effect of decreasing demand for and increasing the supply of available land. Those who can afford to leave the community will do so, leaving the housing stock available for decreased prices and appealing to those potential residents unable to afford the premium for higher environmental quality (Kriesel, et al., 1996). According to this line of reasoning, we tend to see a collocation between environmental hazards and poor residents due not to discrimination, but to neighborhood dynamics and residential sorting. Regardless of who predominantly bears the costs of environmental degradation initially, the poor are most likely to end up bearing most of the costs.

On the other side, when the environment in a community improves, it is plausible that just the opposite set of circumstances is possible. The remediation of a hazardous facility and subsequent redevelopment of the site can improve environmental conditions in the community in a salient way. This improvement may appeal to residents from outside the neighborhood who might now consider moving to the community, driving up demand for housing and increasing land prices. This increase in prices may raise rents beyond levels to which current residents can afford, and they may be forced to move elsewhere for more affordable housing. Thus, the benefits of environmental improvement will tend to be reaped by incoming residents who were not the intended targets of the benefits, while the original residents (who were the intended targets) not only do not receive the benefits, but are faced with the personal costs associated with relocation.

Environmental degradation could therefore result in blight, while environmental improvement may encourage gentrification (Eckerd, 2011). In short, it seems likely that environmental changes can subsequently change the economic and demographic makeup of the surrounding area. Most existing policy approaches to address environmental disparities do not take this likelihood into account (Bonnorris, 2004). Policies regarding the siting of environmental hazards tend to provide incentives to keep hazards away from minority areas, or restrictions from considering such areas as potential sites. Cleanup policies specifically target funds to projects that are based in low socioeconomic status communities. But for these policies to be effective at addressing the environmental disparity, the neighborhoods must be relatively static. Such an assumption appears flawed

in the face of substantial evidence that the alteration of environmental quality changes the economic conditions and the demographic character of focal communities.

It has long been established that housing values tend to vary according to their proximity to amenities and disamenities. In the housing literature, hedonic modeling, a procedure based on marketing principles (Lancaster, 1962) that looks at the attributes of both individual houses and the communities in which they are located, have found that people purchase attributes of houses, not necessarily houses themselves (Ridker and Henning, 1967; Rosen, 1974; Kahn, 2004). Such research has found that housing values are lower near disamenities like hazardous facilities (Kohlhase, 1991) and fetid land (Garrod and Willis, 1992), and higher near amenities, like open space (Irwin, 2002), forests (Garrod and Willis, 1992), and water frontage (Leggett and Bockstael, 2000). In these hedonic models, it has been shown that those who can afford to do so place a monetary value on proximity to amenities, which makes land near disamenities more affordable. Therefore the poor (and minorities who are much more likely to be poor) tend to cluster around disamenities. As evidence that residential sorting is a better explanation for the environmental quality gap than is discrimination, Been and Gupta (1996) and Kriesel, et al. (1996) both show that new hazardous facilities tend to not be predominantly sited in lower status neighborhoods (with some caveats), but that after a facility has been sited, the neighborhood has a tendency to subsequently have higher poverty and more minority residents. Banzhaf and Walsh (2008) similarly find that when a facility is sited, comparatively wealthier residents nearby are more likely to move away from the community seeking better environmental conditions, and they tend to be

replaced by poor minority residents. Wolverton (2002) shows that hazardous sites may actually be a bit less likely to be constructed in poor neighborhoods, but that once the site is built, the community nearby tends to become poorer.

Similar results are seen when considering the changes that take place in communities after environmental hazards have been cleaned up. Dale, et al (1999) found that after Superfund sites have been cleaned up, the value of land nearby tends to increase. With a bit more refinement, McCluskey and Rausser (2003) investigated trends near Superfund sites, finding that land values nearby have a tendency to decrease while a site is being cleaned, but increase once the cleanup is complete, although these changes may be mitigated when there is substantial negative publicity association with a site (Messer, et al, 2006), in which case values nearby may continue to decline. For hazardous facilities that are less salient than Superfund sites, closure may be the critical factor in the subsequent increase in land values, whether a cleanup has occurred or not (McMillen and Thorsnes, 2003). Beyond land value changes, Seig, et al (2004) found that demographic shifts consistent with gentrification (Nelson, 1988) tend to occur in neighborhoods after environmental improvements take place, although at a smaller unit of analysis, Eckerd (2011) did not find much demographic change in neighborhoods where hazardous sites are cleaned up.

It is therefore likely that, at minimum, economic changes in land valuation occur in communities when environmental conditions change, and quite probable that demographic shifts follow in turn. In fact, subsequent land value increases and changes in land use tend to be a major focus for both those requesting funds for cleanup and the

organizations that provide cleanup funding. In a detailed case study of 20 brownfield sites that have been redeveloped as park or open space, De Sousa (2004) found that economic development and reduction of urban blight were two of the primary reasons for redevelopment, and were subsequently cited as benefits of the projects. Remediation projects are often intended to spur economic development in communities, but largely under the assumption that the beneficiaries of both the improvement in environmental conditions and the increase in economic activity will be residents who currently live in the neighborhood. This assumption only holds if the changes in land values that we see occur after environmental improvements do not also coincide with demographic changes in the communities as well.

### *Cumulative risk*

Beyond complications associated with discerning the effect of a site remediation upon a community, is discerning the effect of site remediations (or sites not being remediated) upon one another. Each site has some level of risk potential associated with it, and no site is completely unaffected by what takes place at others. Funding the remediation of one site likely means that another site will not be cleaned (at least in the short term) which may change the hazardous potential of the deferred site in addition to that of the site that is being cleaned. Moreover, the effects of changing levels of risk at spatially proximate sites interact with one another, altering levels of risk to affected populations. These interactive and cumulative impacts of risk are another important consideration in the prioritization process (Canter, 1996). Each site has some relationship

with each of the other potentially remediable sites. The result of any activity (either degradation or cleanup) at one site can be significant if the interactive and/or cumulative impact on other sites is considerable.

Thus, although considering the risks associated with one facility is a necessary part of the decision making process, it is insufficient for considering the broader impact of the process. Each site must be considered in concert with other sites and the decisions being made on those other sites in order to fully assess the actual reduction in risk for targeted populations, rather than just viewing the cleaning up of any one sight as a net risk reduction (which may not actually be the case). While the cleanup of one site surely does reduce risk pertaining to that site, it may have little impact on the overall risk to nearby targeted populations. Thus, an explicit prioritization of sites located in minority neighborhoods might only improve overall environmental quality for the residents of that neighborhood if those neighborhood sites are comparatively riskier than other sites in other locations nearby. In addition to the problematic assumption of neighborhoods not changing, this basis for a policy solution aimed at targeting sites in poor and/or minority areas for remediation may be tenuous. It is not clear that cleaning up a larger number of sites in such neighborhoods necessarily decreases environmental risk more for residents than would a policy with a specific focus on the most environmentally hazardous sites, regardless of their location.

These two complications make the study of the effects of environmental improvement challenging. Statistical modeling methods may not be able to appropriately account for what is likely a dynamic relationship between environmental quality changes,

risk, and neighborhood composition. Moreover, a study of the effect of environmental improvement is furthered hampered at this time due to the fact that most environmental remediation is still in process. As seen in Chapter 2, studying the effects of site-based environmental improvement is very much a work in progress. Comparatively few sites have been completely remediated which limits the generalizability of interpreting trends of the results of those cleanups. Given this data limitation and the complex nature of neighborhood change, empirical studies can only be illustrative with significant limitations. However, governments at all levels are increasingly prioritizing the remediation and redevelopment of hazardous sites based on the cues provided from this significantly limited empirical literature. A more robust view of the social effects of environmental improvement is needed even in the absence of substantial data. To address this important question under these limitations, through the rest of this chapter, I describe how the use of an agent-based simulation model of environmental change dynamics can provide insight for both policy and research to help understand the complicated nature of the relationships between communities and the natural environment.

### Simulating public policy

An agent-based simulation model is used in this analysis, but these types of models belong to a larger family of computer-based tools that in the policy sciences referred to as policy informatics (Johnston, Kim, and Ayyangar, 2007). The focus of policy informatics is to advance knowledge via the use of complex, dynamic computational models. By taking advantage of available computational power, policy



models can be more sophisticated representations of reality, providing greater insights into the workings of a policy subsystem (Kim and Desai, 2010). Such models provide not only greater insight with regard to final simulation results, but also during the model design phase and through the iterative stages of model development, a process known as generative social science (Epstein, 2006). As a model is being designed and developed, model builders work with policy experts to operationalize concepts and formalize assumptions (Richardson, 2006). Through this iterative, collaborative process, researchers and policymakers explicate assumptions regarding the policy system in question, often garnering insights and clarity through the process, independent of the actual formal model derived (Johnston, Kim, and Ayyangar, 2007). The derivation of the model offers a chance for further knowledge generation as the operationalization of variables and relationships is formalized (Mohring and Troitzsch, 2001). Policy informatics methods encompass a variety of different computational techniques such as system dynamics modeling, cellular automata models, and hybrid approaches. Agent-based modeling can be used in policy informatics context to investigate how individual choice mechanisms affect social structures and policy outcomes. An agent-based model is a “bottom-up” operationalization of interaction (Axelrod, 1997) – within the computer simulation program, individual, autonomous agents interact with one another according to a set of decision rules defined according to theoretical assumptions regarding behavior. Through an iterative, dynamic process, macro-level social structures and processes can be investigated as a result of these individual decisions and interactions (Holland, 1998; Axelrod, 1997; Epstein and Axtell, 1996).

Although a relatively new research tool, agent-based models have an established history of providing insights to urban and regional analysis. Schelling's (1978) early work on residential segregation illustrated how, in an artificial society, simple micro-level behaviors can accumulate to profound macro-level results. In his segregation model, autonomous agents were randomly placed in a region, varying only by the color they were assigned. Agents then scanned the region and opted to move according only to a simple preference regarding the proportion of same color agents nearby. If their current location met this preference, they did not move; otherwise they moved to another location that met this preference. Schelling shows how, over a relatively short period of time, even a small preference for being near similar agents, results in an equilibrium of segregation. Simulation techniques have also been used to study traffic patterns and flows (Nagel and Rickert, 2001), land-use (Engelen, et al., 1995) and urban dynamics (Batty, Xie, and Sun, 1999). More relevant to the current analysis, they have been used to investigate neighborhood change in urban settings (O'Sullivan, 2002; Torrens and Nara, 2007).

O'Sullivan's (2002) model simulates gentrification, based on Smith's (1979) rent gap hypothesis. The rent gap hypothesis poses that gentrification is more likely to occur where the gap between a property's actual value and the potential value of the land are wide. O'Sullivan (2002) creates a cellular automaton representation of space, and analyzes dynamic interactions of properties within a London neighborhood. Torrens and Nara (2007) extend the O'Sullivan model (2002) to include not just a graphical cellular automaton piece, but an agent model as well. Inclusion of both enables an analysis at the individual level via the agent model, and at the land level via the automaton model,

applying their model to a set of three neighborhoods in Salt Lake City. These models of neighborhood dynamics importantly reveal how micro-level interactions of agents and real estate markets can accumulate to large scale, potentially unexpected settlement patterns.

Building on this research, Heather Campbell, Yushim Kim and I developed an environmental justice agent-based model assessing the likelihood of differences in majority and minority quality, given a set of siting choices for hazardous facilities. In that model, we found, similar to Schelling (1978), that even a relatively modest similarity preference by individuals seems to lead to clustering and significant differences in environmental quality for different types of individuals, regardless of where hazardous facilities were initially sited. Taking this line of research one step further, in this chapter, I describe extending that model by exploring whether different prioritization decisions to cleanup hazardous facilities have an effect on subsequent levels of environmental quality for different types of agents, or whether any differences are more related to sorting based on agent similarity preferences.

#### Agent-based models in policy analysis

In the policy sciences, agent-based models can be used to provide insight to policymakers when social experimentation is either impractical, impossible, or consequentially problematic (Gass, 1983; Casti, 1997; Johnston, Kim, and Ayyangar, 2007). Agent-based models have been used in this laboratory sense to help explore diverse, unreplicable phenomena ranging from historical eras where vital information is

missing, such as the disappearance of the Anasazi (Dean, et al., 1999), to worst case scenarios in the presence of significant congestion (de Silva and Eglese, 2000). Dynamic simulations models are particularly useful for what have been termed *ill-structured* or *wicked* problems (Rittel and Webber, 1973), or those problems whose solutions are unclear, unstructured, and often lead to other, unanticipated and unintended consequences. Urban dynamics are complex, and especially so when including exploration related to changes in environmental conditions, making exploration of the potential effects of urban policy complicated (Fischer, 1995).

Fischer (1995) uses this view of complexity to note a difficulty that plagues policy analysis. On one hand, practitioners want specific (what Fischer refers to as *first-order* or *first level*) information relating to the direct impacts and outcomes of specific government programs. On the other hand, these specific analyses have done little to actually predict specific outcomes or contribute to our understanding of the relationships that are important in a policy area (Fischer's *second-order* or *second level*). The development of simulation models addressing policy options may be key to bridging this schism in policy analysis, providing a means through which to explore the potential impacts of policy prior to implementation. That is, simulation methods can address Fischer's (1995) second order level of analysis prior to the point at which data are available to evaluate on the first order.

#### Exploration and Fischer's second level

Exploration requires a different orientation than estimation. With estimation, interest centers on the statistical or interpretative recognition of trends related to a set of conditions altered through some policy. Exploration requires the relaxation of a singular focus on the outcomes or performance of a specific set of policies, to a broader view of how the interactions of various social actors affect the contexts in which policies are implemented. While there may be many techniques for exploring such social system-level affects, simulation is a methodological approach that focuses on exploration rather than estimation (Epstein, 1999). The difficulty with such an approach, and in fact, of using simulation modeling in practice-oriented research, is that it is extremely difficult to assess the reliability and relevance of policy models to the actual policy in question (Yucel and van Daalen, 2009). If the intention of researchers or of policymakers is to develop a simulation model to predict specific outcomes, the project is doomed to failure – social systems are too complex for simulation to arrive at estimates that are within an actionable range of certainty. As with any model, an agent-based model is a simplification of reality; in an agent-based model, the simplification occurs with respect to the set of behaviors that drive individual decision-making. Agent-based models create a generative reality (Epstein, 1999) in which a simplified world consisting of heterogeneous agents interact dynamically under a very specified set of decision rules. As such, the presentation of agent-based (or other simulation) modeling in the policy sciences requires a careful derivation. An agent-based model will not replicate reality; actual reality is far too complex. Instead, an artificial environment is created in which the actors are simplified and generalized (rather than the context, as is the simplification level

for most policy analysis methods) and differentiated by only a few key characteristics and otherwise assumed homogeneous in every other way (Johnston, Kim, and Ayyagar, 2007). An agent-based model can address questions as to the emergence of dynamic outcomes under a certain set of assumptions regarding the behavior of autonomous individuals. The advantage of this exploratory laboratory of an agent-based model is that exogenous factors can be completely controlled in a manner unavailable to field researchers or through statistical techniques. Of course, completely excluding exogenous factors constrains realism and the ability to use such models to estimate policy outcomes.

Thus, while simulation models may fit well within the context of Fischer's (1995) second order of policy analysis, they do not fit as well in the first order, where the focus is on the evaluation of the past performance of existing policy. Where simulation modeling assists is by providing a generative aid to understand how individual motivations may affect or be interacting with a policy apparatus and creating circumstances that were unanticipated or unexpected (Epstein, 2006; Johnston, Kim, and Ayyagar, 2007; Yucel and van Daalen, 2009). However, given that these models produce general expectations under a certain set of behavioral assumptions rather than pinpoint estimates of quantitative policy analysis results, it can be difficult to achieve the necessary levels of confidence (with either researchers or policymakers) that the model is a valid simplification of reality. A model is only useful to the extent that it is a valid representation of reality (Barlas, 1996), and this can be especially difficult with modeling procedures that are new or unfamiliar to researchers or policymakers.

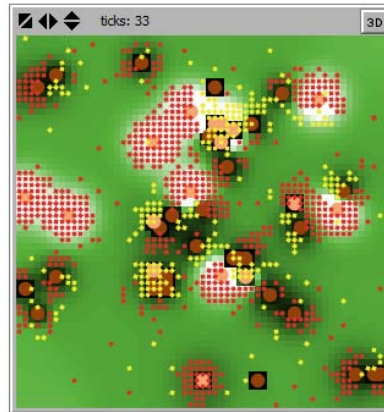
The analysis presented in this chapter fits within the context of Fischer's (1995) second-order analysis, informed by the first-order analyses conducted in the previous chapters of this dissertation. Chapter 2 presented a first-order statistical analysis of the trends of prioritization of cleaning up existing disamenities (brownfields), hypothesizing that sites located in poor and/or minority communities would be less likely to be cleaned up, and lower priorities for cleanup. Chapter 3 built on the findings of Chapter 2, investigating why sites located in minority communities might take longer to get through the cleanup process, hypothesizing that the lack of political organization amongst residents in affected communities led to delays as policy makers struggled to ascertain the needs and preferences of people in these communities. Both of these analyses focused testing theoretical expectations using empirical data, both clearly studies that fit well within Fischer's (1995) first-order analysis. In this chapter, the orientation changes; instead of a focus the empirical assessment of hypothesized trends, I explore potential policy outcomes under different scenarios given a set of assumptions regarding the behavior of individuals within a society. As such, rather than testing a set of hypotheses, I use the agent-based model described below to explore the potential efficacy (in terms of addressing the gap in environmental quality between majority and minority populations) of prioritizing the cleanup of hazardous facilities based on three criteria: focusing efforts on those areas where higher prices indicate areas where redevelopment might be most likely to occur, those sites that are most polluted (and thus riskiest to nearby populations), and those sites that are located in neighborhoods with large proportions of minority residents.

## Environmental redevelopment model

The key factors that affect how an agent-based model performs are the spatial context, sets of agents, and temporal rules of behavior. The spatial context is some landscape consisting of the computer display pixels that make up the visual representation in the model, as seen in Figure 8. Each pixel is spatially defined relative to all other pixels in computer memory, and as such form the basis for the spatial context of the agent-based model. In the model, cells are set according to a predefined number of pixels (for instance, 25 pixels make up 1 cell), and each cell is, in turn, defined spatially relative to all other cells in a Cartesian plane. In agent-based model parlance, these cells are usually referred to as *patches* or *plots* – I will refer to these landscape demarcations as either patches or plots of land through the rest of this chapter. The agents, sometimes called *turtles*, in an agent based model can be representations of any individual and/or autonomous actor. Agents need not be representations of sentient actors, although many agent-based models focus on the behavior of people or animals. The common theme of agents is that they either act or are acted upon according to a set of predefined rules that allow researchers to assess model outcomes over time. Rules can apply to the behavior of individual agents, or they can apply globally to the model's context, with the common theme that the model proceeds in time, with agents adapting according to rules applied to them, and the context adapting according to its rules at each move forward in time. Time intervals can be defined according to any specified frame, and each time interval is referred to as a *tick*, which is the term I will use going forward.



**Figure 8: Visual representation of the agent-based model**



The environmental redevelopment model for this analysis was built using NetLogo 4.1. Since this analysis is conceived as assessing environmental cleanup and redevelopment on the regional scale, the model has been developed by considering the model landscape as akin to a small, spatially constrained city. Agents cannot leave the city, but are free to move within the confines of the city landscape. The model dynamics are bottom-up (Benenson, 1998), determined via a series of micro-level residential sorting decision rules that agents act according to, in order to assess environmental quality outcomes at a macro-level. As is the norm in agent-based modeling, the model consists of a *spatial context*, *agents*, and a set of behavioral *temporal rules*. The simulation model includes two distinct types of agents, firms and residents, who interact within a 50 by 50 landscape of plots upon which they can reside. Thus, the *spatial context* is an artificial environment consisting of 2,500 plots of land (patches). The *agents* are either (a) individual firms or (b) individual residents who may choose to occupy any previously unoccupied patch at any given time. No more than one agent may occupy a plot of land. The central *temporal rules* of the model are that (1) firms provide

jobs for residents, (2) each resident is employed at one firm, and environmental quality is dependent upon (3) the location of firms that produce pollution (decreasing environmental quality) and (4) amenities that improve environmental quality in their vicinity. The attributes of the agents and plots of land will be described, followed by a discussion of the temporal procedure of the model and the agents' decision rules.

### *Agents*

Firms are agents that possess two attributes: a number of residents that they can employ and an amount of pollution that they produce. For each simulation run, firms do not vary in the number of jobs they provide, nor in the nature of those jobs, only in the extent of pollution produced. For all simulations run in this analysis, each firm can employ 10 individuals. When the residential population exceeds the number of jobs available, a new firm is established. When a new firm is established, the amount of pollution it produces is a randomly assigned variable within a range from 0 to 20 from a uniform distribution. A value of 0 indicates a firm that produces no pollution, while 20 indicates a high polluter. When the value assigned for a firm is greater than 5, the firm is categorized as a toxic polluting facility, or TRIF (Toxic Release Inventory Facility in the parlance of EPA), and otherwise the firm is considered non-toxic (Non-TRIF). TRIF and Non-TRIF firms behave somewhat differently with respect to their effect on environmental quality, with TRIFs acting as disamenities and Non-TRIFs as amenities. At the initial setup of the model, one Non-TRIF firm and one TRIF firm are established near the center of the landscape. Since the creation of firms is wholly dependent upon the

labor demand for employment, firms do not close (or *die* in agent-based model parlance) except during the environmental remediation phase of the simulation when TRIF sites are closed according to a specified redevelopment policy.

Similarly, there are two types of residential agents: majorities and minorities. In the initial setup of the model, there are 50 residents, 70% of which are categorized as majority and 30% as minority, and all are initially constrained to be located within 20 plots of the center of the landscape. Residents are otherwise assumed to be homogenous in all other attributes and strategic initiatives; they each seek a location based on the maximization of their individual utility function, and work at a firm without differentiating between TRIF and Non-TRIF work locations.

#### *Land attributes*

Each of the 2,500 plots of land is available for agents to occupy, according to the decision rules described below. Plots of land have two key attributes that affect agent decision rules: environmental quality and price. At the initial seeding of the model, both of these attributes are set to a value of 50, with both environmental quality and price functioning as relative variables ranging from 0 to 100 with an expected value of 50. As values decrease below 50, they can be considered “low”, while those above 50 can be considered as “high”. The introduction of firm and resident agents to the landscape influences the quality and price of patches, depending upon their location decisions.

Environmental quality at patches varies according to their proximity to amenities and disamenities. The positive effects of amenities and negative effects of disamenities

decay rapidly with distance, such that patches closer to amenities see a larger increase in quality than do patches further away (and similarly, the negative effects of disamenities are more pronounced when patches are closer). A patch's quality is both increased due to how close it is to the nearest amenity, and decreased according to how close it is to the nearest disamenity, as shown in equation (1).

$$q_j^t = q_j^{t-1} + (q_j^{t-1} * (\frac{1}{d_j^x})^{d_j^x}) - (q_j^{t-1} * (\frac{1}{d_j^y})^{d_j^y}) \quad (1)$$

Quality for patch  $j$  at time  $t$  is therefore a function of its quality at time  $t-1$ , and its distance  $d$  to amenity  $x$ , and disamenity  $y$ . Since both functions decay with distance to amenity  $x$  and disamenity  $y$ , patches must be located close to either type of firm in order for the environmental quality effect to be substantial. Patches very close to disamenities therefore see substantial degradation in environmental quality while the polluting firm exists, with little positive impact from amenities unless an amenity happens to be similarly close.

Patch prices follow a demand function based on the extent to which a particular patch satisfies the resident utility function (which will be described in detail in the next section), as well as the vacancy rate of the surrounding patches (the number of residents located on the nearest 16 patches), and the quality of the patch itself. Prices increase when patch quality is higher than its price would indicate and decrease when quality is lower than its price would indicate.

$$p_j^t = p_j^{t-1} + ((q_j^t - p_j^{t-1}) * U_{ij}^t * v_j) \quad (2)$$

The price of patch  $j$  at time  $t$  is a function of the price of patch  $j$  at time  $t-1$ , the difference between the quality  $q$  of patch  $j$  at time  $t$  and the price of patch  $j$  at time  $t-1$ , the utility

score  $U$  of patch  $j$ , and vacancy near patch  $j$ ,  $v$ , operationalized as the proportion of the nearest 16 patches that have a resident agent occupying them. Note that price and quality are relative variables, both with an expected value of 50. Therefore the parameter  $q_j^t - p_j^{t-1}$  provides an indication as to whether a patch is overpriced, given a relatively low level of quality at time  $t$ , but a high price at time  $t-1$ , resulting in a negative impact on price at time  $t$ , whether it is underpriced, with a level of quality that is comparatively higher than the  $t-1$  price, resulting in a positive impact on price at time  $t$ . If price and quality are both relatively proximate, there is little effect on the subsequent patch price.

### *Temporal aspect*

In addition to the spatial basis operationalized through the plots of land described above, the simulation also functions according to a temporal dimension. When making location decisions, agents scan and select the patch that best suits their preferences; over time, patterns emerge as a result of the aggregation of the various agents' decisions. At each "tick" forward in time, agents make decisions within the context of the landscape adjusted by the decisions made previously by other agents. For all the simulation conditions assessed in this analysis, the models ran for 100 ticks. During these model runs, resident agents are born and die and new firms form when there is labor demand requiring them to do so. At each tick forward, a population growth function, that can moderate expectations with regard to the growth characteristics of the region being modeled, increases the population according to a pre-defined growth-rate.

During the initial seeding, 50 residents are placed randomly within a radius of 20 patches of the center of the region, along with one Non-TRIF firm and one TRIF firm. Once the simulation begins, the population growth mechanism behaves as follows. For the first 40 ticks, population growth is set at 7%, such that at each tick new residents are “born” to equal 9% of the current population, and the oldest 2% of the existing population “dies”. If there is not a clear relevant proportion who are the oldest, agents are selected randomly from those tied as oldest. For the growth aspect, the appropriate number of existing residents is chosen randomly to replicate themselves (or more accurately, their attributes). This builds in some stochasticity with regard to residential proportions of majority to minority, but since random residents are asked to replicate themselves, the split between majority and minority remains roughly around 70% to 30%, but can vary a bit in either direction. Growth is set high during the first 40 ticks in order to create an established region so that during the cleanup up phase, each trial is a function of the unique settlement pattern established during these first 40 ticks. Hazardous facilities are cleaned up during the final 60 ticks, at which point the growth rate is set at a much more modest 2%.

### *Model behavior*

One purpose of an agent-based model is to discern macro-level trends from micro-level behavior (Johnston, Kim, and Ayygabar, 2007). The micro-level behavior in this model is based on the location choice decisions made by both firm agents and resident agents, assuming no zoning or land use constraints. When there are a sufficient

number of residents for a new firm to form, 100 empty patches (out of 2,500 total patches) are randomly selected as potential site choices, similar to the procedure utilized by Brown, et al. (2005). Limiting alternatives to 100 ensures some level of bounded rationality, in that firms are not presumed to have access to full information regarding all potential location choices, but are constrained to only those patches within a specified purview (Brown, et al., 2005). Although it has been argued in the environmental justice literature that polluting firms do not behave in a strictly economically rational manner (see Campbell, Peck and Tschudi, 2010 for a discussion), it has also been shown that firm decisions affect quality differentials more on the margins than directly, especially under an assumption that residents have a similarity preference constraint (Eckerd, Campbell, and Kim, *in review*). Since, in this analysis, I am more interested in redevelopment decisions than in siting decisions, all firms are assumed to be economically rational, while government policy decisions regarding cleanup prioritization are variable. Thus, when firms seek their optimal patch at any point during the simulation, they select the plot of land (out of the 100 patches possible for them to choose) with the lowest price.

When resident agents make location choices, they aim to equally balance proximity to a firm/job, environmental quality, and plot price. Their utility function, more formally is:

$$U_{ij} = \left(\frac{1}{p_j}\right)^\alpha * q_j^\beta * \left(\frac{1}{d_{ik}}\right)^\gamma \quad (3)$$

where the utility,  $U$ , of plot  $j$  for resident  $i$  is determined by the price and quality of  $j$  and distance between a resident  $i$  and a firm  $k$ . The  $\alpha$ ,  $\beta$ , and  $\gamma$  are balancing parameters which were set at 0.5 in each simulation trial, indicating that residents evenly balance the desire

for a high quality plot with low price and proximity to firm locations (Pratt, 1964), although in the model, this balance can be adjusted to change the relative importance of one or another factor. This utility function can be subject to a constraint based on the residential makeup of locations nearby. Following Schelling's (1978) lead, this similarity preference constraint eliminates certain locations from resident consideration if the location does not meet the preference criteria. A conservative estimate of 20% is used throughout all trials, such that it is assumed that resident agents prefer that at least 20% of the plots nearby are currently occupied by a resident agent of the same racial status (Clark, 1992). A higher similarity preference is likely more realistic, but a conservative estimate is used to ensure that this preference does not overwhelm other explanatory variables, as would likely be the case at a higher level of preference (Schelling, 1978; Eckerd, Campbell, and Kim, *in review*).

#### *Government policy decision*

Policy decisions are made with regard to the process through which TRIF sites are prioritized for remediation. The initial setup of the region takes place over 40 ticks. During this period, both types of firms are sited and residents sort according to the decision rules explained above. After 40 ticks, a TRIF remediation policy is implemented whereby existing TRIFs are eliminated, one every two ticks for the remaining 60 ticks of each simulation trial. During the entire process, differences in the average levels of environmental quality for majority agents and minority agents are compared. The relative



improvements are assessed for three different governmental policy decision making procedures, which are:

- ***EP*** – Economic pressure: the TRIF that is remediated is that which is located on the highest priced plot of land at time  $t$ .
- ***EJ*** – Environmental justice: the TRIF that is remediated is that which is located on the plot of land with the largest concentration of minority residents nearby at time  $t$ .
- ***ER*** – Eliminating risk: the TRIF that is remediated is that which emits the largest amount of pollution at time  $t$ .

With these three scenarios, I try to isolate the effect of three priorities that appear to be important considerations to the EPA when determining the prioritization of cleaning up hazardous sites. In Chapter 2, I found that economic pressures may be a consideration as those sites that may be expected to contribute most to an economic revitalization are likely to be priorities for cleanup, an effect that I capture with the EP scenario. The EJ scenario accounts for EPA's mandated prioritization of those sites that are located in communities with traditionally underserved populations, and the ER scenario reflects the consistent finding in Chapter 2 that sites with comparatively higher risk tend to be priorities for cleanup. Although EPA appears to balance consideration of these three priorities, with the agent-based model, I can isolate their effects and explore whether it is indeed the case that prioritizing cleanup of sites in communities with a high proportion of minority residents is the most effective way to reduce the environmental quality gap that exists.

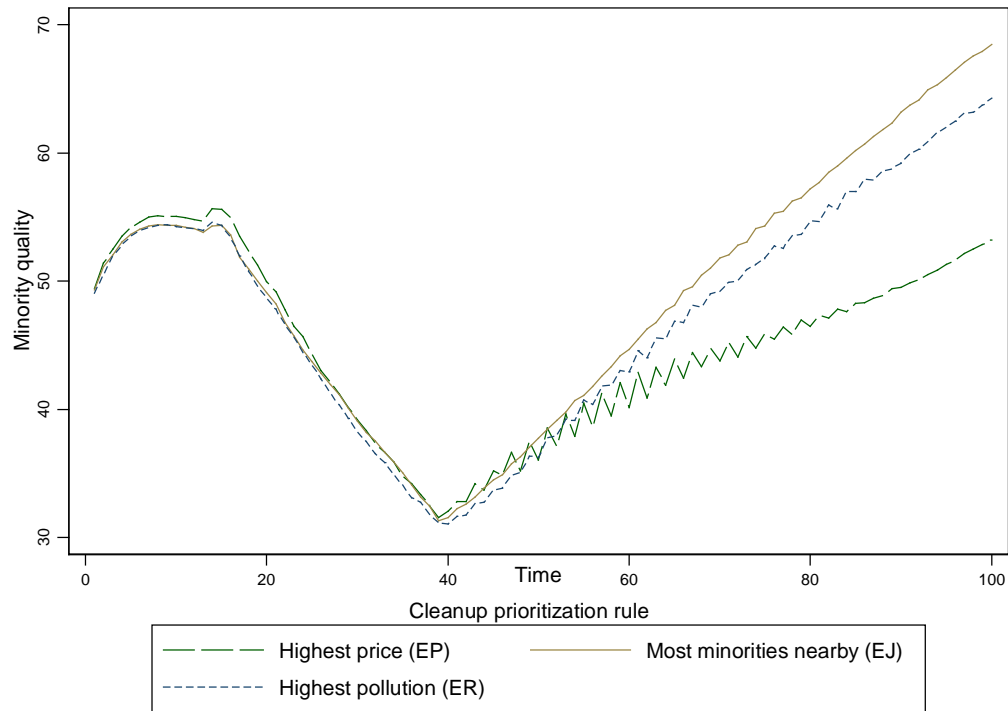
For each of these three scenarios, I ran 100 simulation trials. The key variables tracked during each trial were the average quality of patches upon which majority residents were located at each tick, the average quality of patches upon which minority residents were located at each tick, the p-value assessing whether or not average majority quality was statistically significantly different from average minority quality, and finally, the number and distribution of types of firms. The full code for the model is included in Appendix A.

### Analysis and results

For each scenario, 100 trials were conducted, resulting in 300 total simulation runs. At 100 trials each, enough data should be acquired to discern trends with regard to the comparative efficacy of each policy option at addressing the gap in environmental quality between majorities and minorities. Because I am interested in exploring how effective each of these policy alternatives are at addressing gaps in environmental quality, I analyze the results of the simulation in several different ways. First, I tabulated the average environmental quality for both sets of resident agents over each tick for each policy option, and compared the trends of the changes in those average quality variables over time. Second, I compared the length of time (in ticks) that certain milestones in environmental gap quality closure were achieved under each scenario, and finally I ran a series of Cox proportional hazard models to isolate the effect of each policy alternative on the likelihood that these milestones were achieved more quickly in one alternative versus another.

In the first set of analyses, I created line plots for several variables to investigate changes through time in the model. In Figure 9, the line plot depicting changes over time in the average level of quality with which minority agents live is shown. As would be expected, prior to the implementation of the cleanup procedure, the average level of environmental quality for minority residents follows a similar pattern for each scenario for the first 40 ticks (as do all other variables that will be discussed). Quality initially increases as there are ample choices for plots upon which to locate with a small population. As time ticks forward and the residential population grows, choices become constrained and the average level of environmental quality dips well below the initial model seed value. After tick number 40, when cleanup efforts begin, some variation in outcome does become apparent. When the priority is cleaning up the site with the highest price (EP), minority quality clearly improves less than under the other two options. Quality appears to improve most when minority communities are specifically targeted (EJ), and that improvement continues on a relatively steep slope, despite the potential for dynamic residential sorting that can take place around cleaned up sites. Improvement also appears to be sustained when targeting the most contaminated areas (ER), while targeting the highest priced area shows some leveling off as the ticks approach 100. In the short term, none of the three scenarios appears more preferable over another; between roughly ticks 40 and 50 (the first 10 ticks after cleanup begins), trends for each scenario show improvement at similar rates. After tick 50, however, the EP trend line begins to level somewhat, while the ER and EJ trends continue an upward trajectory, although the EJ trend follows a slightly steeper improvement.

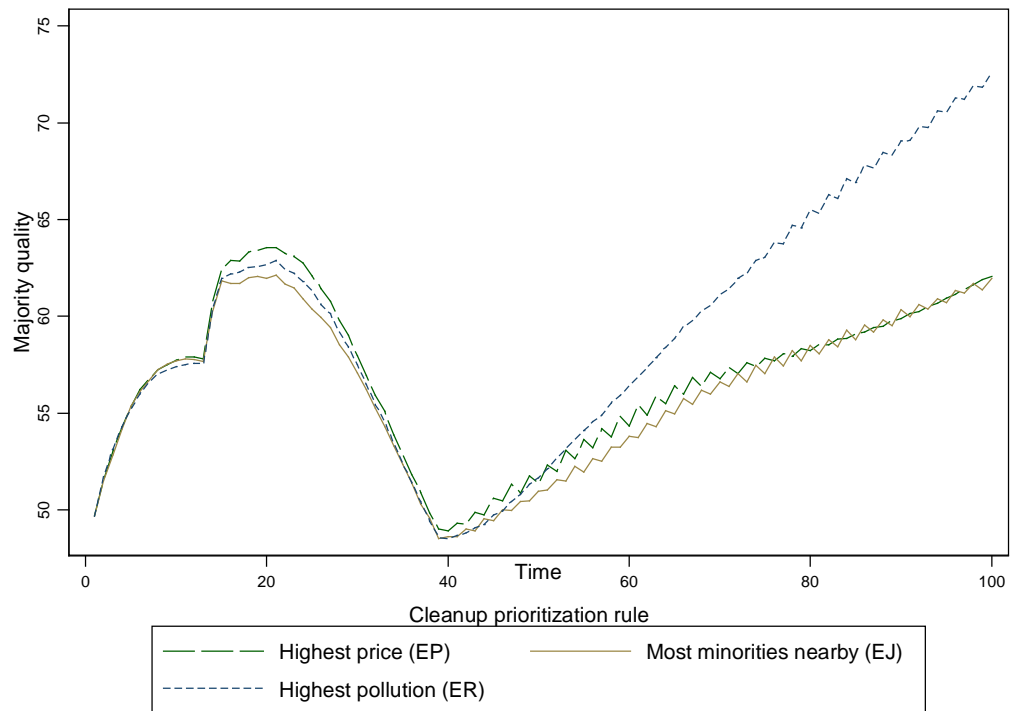
**Figure 9: Average minority environmental quality over time**



These trends can be contrasted with the changes in the average quality level for majority agents, depicted in Figure 10. Minority quality bottoms out a much lower level than majority quality (as would be expected when there is a gap in environmental quality), so majority quality is mostly improving throughout the simulation, excluding the period between about ticks 20 and 40 when population growth constrains majority agent choices. After the cleanup process begins, majority quality also improves regardless of the scenario employed, and the improvement under the EJ and EP scenarios is roughly the same through all the trials. Majority agents clearly see the most sustained and significant improvement both in the short term and the long term when the most polluted areas are prioritized for cleanup. Thus, in the EP scenario, neither majorities nor

minorities fare better than in other scenarios, while both see substantial improvements under the ER scenario and minorities see the most improvement under the EJ scenario.

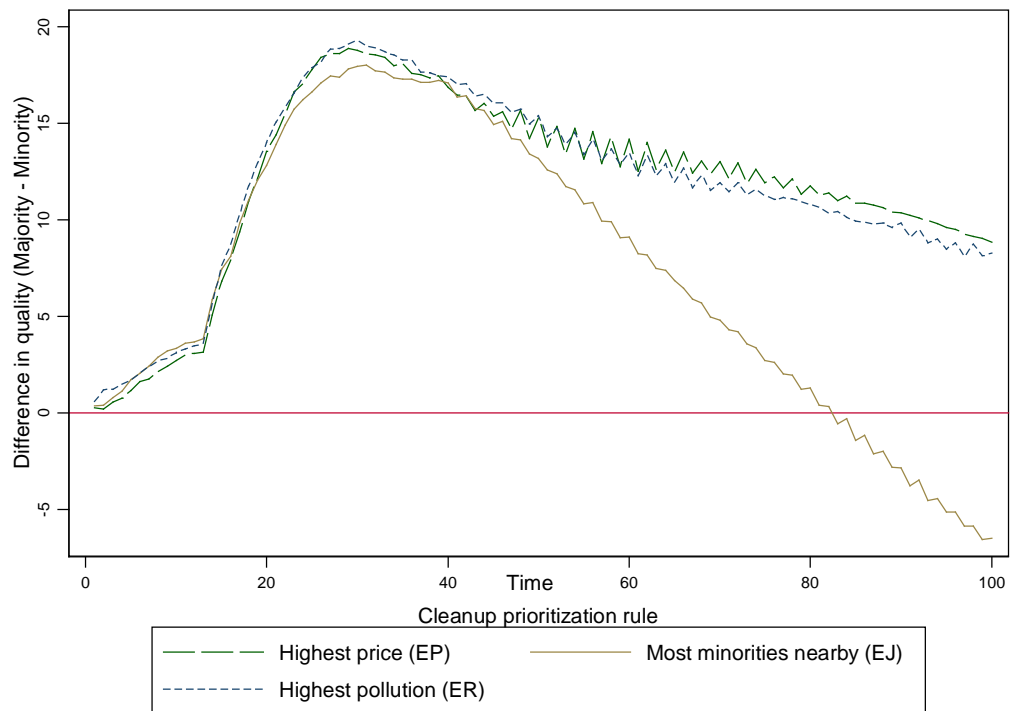
**Figure 10: Average majority environmental quality over time**



However, these two views only consider the changing nature of the quality for these two sets of groups for each of the scenarios. For environmental justice outcomes, the larger concern may be the gap in environmental quality that exists between the two groups. Figure 11 depicts changes in this gap over time, tracking trends in this difference through the three scenarios. The figure illustrates the value of average majority quality less average minority quality, with parity in quality equaling zero, larger positive values indicating the extent to which majority quality is better than minority quality, and smaller negative values indicating how much better minority quality is than majority quality.

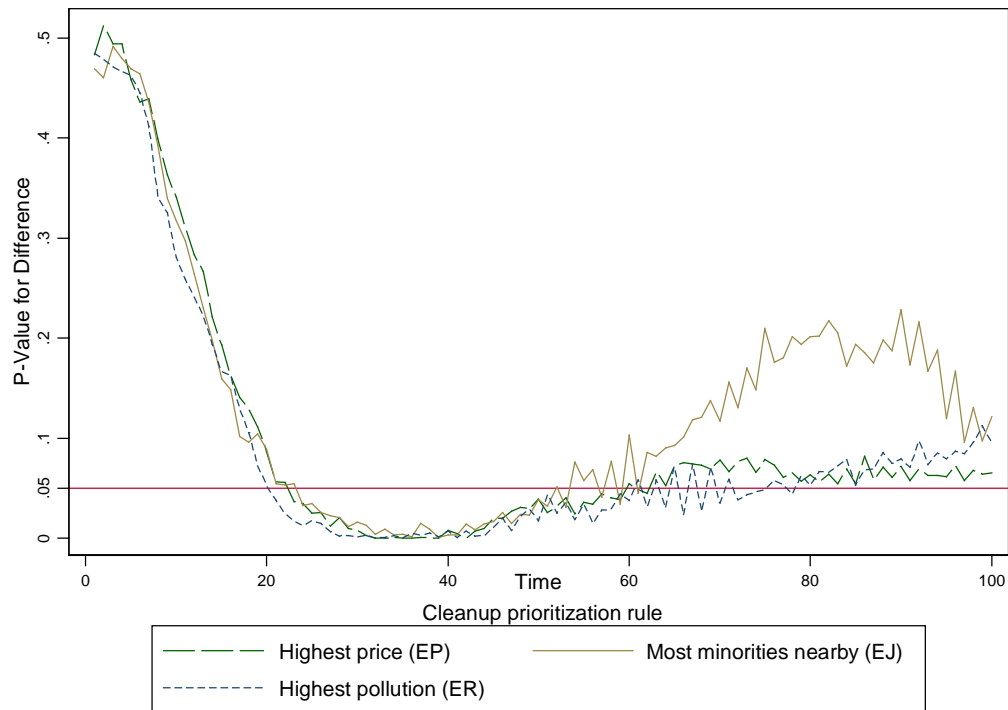
First, it is worthwhile to note that the difference is rarely below zero, indicating that majorities tend to live with higher levels of quality than do minorities, an expected empirical outcome (Ringquist, 2005), peaking at about tick 30. It is also worth noting that, regardless of the prioritization option selected, the gap decreases after the cleanup begins at tick 40. However, it is also clear that prioritizing sites located near the most minority residents, the EJ scenario, is the most effective at reducing the level of the gap, even to the extent that environmental quality gap appears to be eliminated completely and possibly even reversed, such that minorities may end up with higher levels of average environmental quality by the time tick 100 is reached.

**Figure 11: Difference between average majority and average minority quality over time**



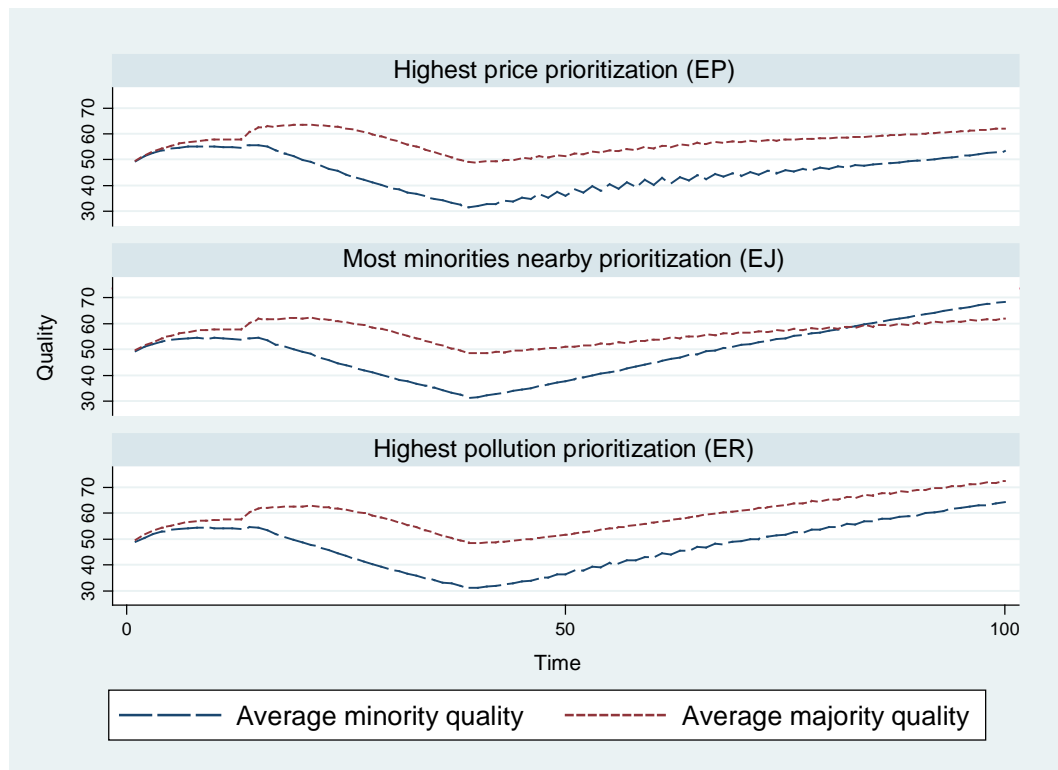
The closure of the gap appears to be quite comparable whether the highest prices or most contaminated sites are prioritized, with both lines leveling off somewhat as time ticks forward. There is no such leveling off for the EJ scenario trend, again, despite the dynamic nature of the residential location preference choice. Figure 12 tracks whether or not these differences in the average level of quality achieve a level of statistical significance over time. These p-value trends indicate that the differences are statistically significant with 95% confidence between ticks 20 and 50 for all scenarios, with the difference clearly being eliminated most quickly and consistently under the EJ scenario; in fact, there is an ending trend at tick 100 that almost approaches a statistically significant gap whereby minority residents' quality exceeds that of the majority agents.

**Figure 12: P-Value trend for statistical significance of the difference between average majority and average minority quality over time**



The differences also appear to be eliminated, at least at this 95% confidence level under the other two scenarios as well, with the ER trend line appearing to show evidence of a decreasing level of difference and the EP trend showing that the difference may be leveling off.

**Figure 13: Comparison of average quality for each prioritization alternative**

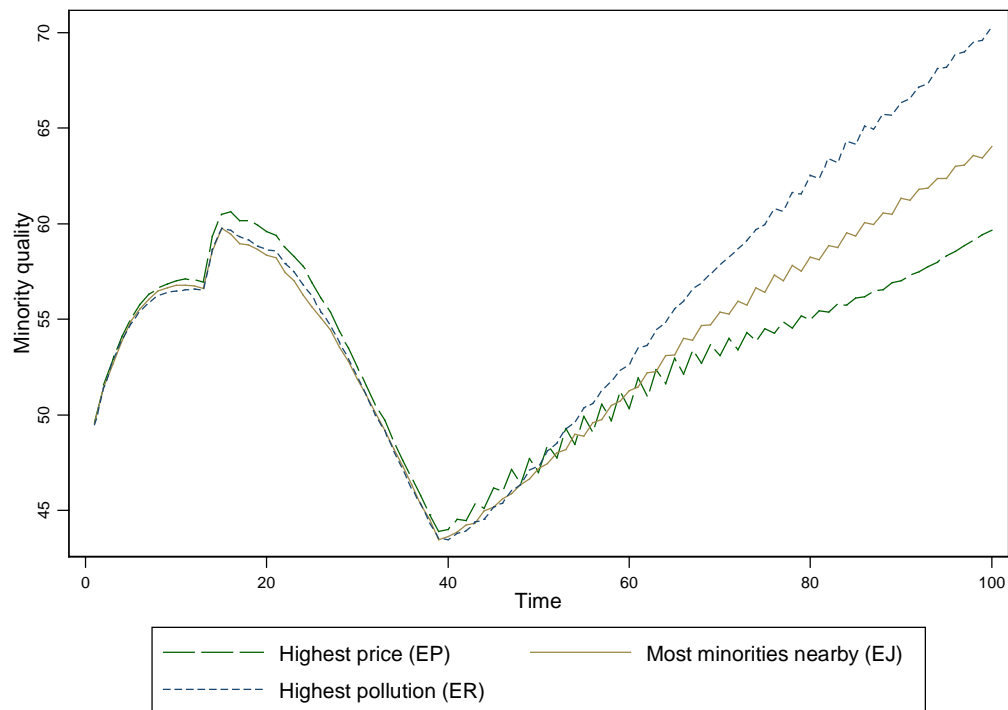


In Figure 13, the gap itself is depicted visually for each policy option, showing the trends for both majority and minority quality for each scenario. These charts lead to the same general conclusion, whereby the EP scenario does not appear to close the gap much, and improvement for both sets of residents progresses less dramatically than in the other



scenarios. In the EJ scenario, the gap is completely eliminated, as minority quality overtakes majority quality at about tick 80, while under the ER scenario, both groups see sharp increases in environmental quality with trend lines also appearing to indicate a closure of the environmental quality gap.

**Figure 14: Average total quality over time**



In Figure 14, one can discern evidence of what is suggested by Figure 13. When considering the overall level of environmental quality for all residents, the trend line in Figure 14 shows that regional environmental quality improves most when the ER scenario is employed. This is not a surprising result, insofar as the priority is to eliminate the most hazardous sites first, but this strategy seems to indicate that overall welfare improves the most dramatically when the riskiest facilities are targeted for cleanup even

though this may not be the best option if the goal of a policy is to address the environmental quality gap. Figure 14 also makes clear that not only is targeting the highest priced areas for cleanup the least effective in terms of addressing the environmental quality gap, but it is also the least effective in increasing the overall level of environmental quality for the region.

Looking at these results in more detail, Table 19 displays the time required for the environmental quality gap to close, and the time for average minority quality to recover to that of the beginning of the simulation. As would be expected from a view of the figures above, the EJ strategy once again appears to be the most effective at reducing the environmental quality gap and addressing environmental injustice. The EJ scenario is the only one of the three in which the quality gap is closed for more than half of the trials. In 90% of these trials, parity is achieved, on average 78 ticks into the simulation (or 38 ticks after the cleanup process has begun). In the ER strategy, only 26% of the trials achieve parity, and only 15% do under the EP strategy, meaning that the average time to parity is beyond the 100 ticks that the simulation ran for. If we focus instead on the average level of minority quality independent of majority quality, Table 19 shows that the EJ and ER policies appear to be about equally efficacious. For nearly all trials in both of these cases, average minority quality at least returns to the point it was at the start of the simulation before environmental degradation occurred. Both also achieve this restoration about 25 ticks after the cleanup process has begun. Only about two thirds of the EP trials see minority environmental quality fully recover, and it takes nearly the entire simulation for this to occur in most cases.

**Table 19: Comparison of time to outcomes under different policy alternatives†**

	<b>Difference between majority and minority average quality is zero</b>		<b>Average minority quality reaches initial value of model seed</b>	
	Average time to milestone (out of 100 ticks)	Proportion of trials that meet milestone	Average time to milestone (out of 100 ticks)	Proportion of trials that meet milestone
Cleaning the highest priced lot (EP)	100+	15%	91	66%
Cleaning the lot with the highest pollution (ER)	100+	26%	65	99%
Cleaning the lot with most minority residents nearby (EJ)	78	90%	67	99%

†Redevelopment efforts begin at tick 40.

In Table 20, the results of several Cox proportional hazard models regressions are shown that provide more detail with regard to the summary statistics in Table 19. Cox models are used because my interest is with regard to the time it takes to achieve several milestones, which are all time-varying dependent variables, but the key independent variables, the three policy alternatives used, are not time-varying (Allison, 1984). The time variable in all cases is a model tick, and four different milestone dependent variables are assessed. As in Table 19, I use the time taken to achieve elimination of the environmental quality gap, as well as the time to achieve restoration of average minority quality to that which it was when the simulation started. In addition, I also ran models assessing the time it takes average majority quality to be restored, and the time it takes total average quality for all residents to be restored. Control variables are included to account for variation related to the number of polluting firms that are established in the simulation trial, the number of residents at any given time in the trial, and the lowest

values observed for both average minority and average majority quality. The results in Table 20 lead to conclusions that are similar to those presented so far.

**Table 20: Cox regression results†**

Status variable	Difference between majority and minority average quality is zero		Average minority quality reaches initial value of model seed		Average majority quality reaches initial value of model seed		Average total quality reaches initial value of model seed	
	Hazard ratio	Standard error	Hazard ratio	Standard error	Hazard ratio	Standard error	Hazard ratio	Standard error
Cleaning the lot with most minority residents nearby (EJ)	<b>14.36*</b>	4.18	<b>11.92*</b>	2.55	1.07	0.15	<b>1.37*</b>	0.21
Cleaning the lot with the highest pollution (ER)	<b>2.12*</b>	0.69	<b>8.61*</b>	1.76	<b>1.36*</b>	0.20	<b>2.33*</b>	0.37
Count of hazardous sites	0.99	0.03	0.95	0.02	0.96	0.02	<b>0.94*</b>	0.02
Count of residents	1.00	0.01	1.01	0.01	1.01	0.01	<b>1.02*</b>	0.01
Minority quality floor	<b>0.88*</b>	0.02	1.02	0.02	<b>1.23*</b>	0.02	<b>1.29*</b>	0.03
Majority quality floor	<b>1.15*</b>	0.03	1.16	0.02	0.97	0.01	<b>1.07*</b>	0.02
Likelihood ratio	<b>177.32</b> *		<b>270.60</b> *		<b>210.50</b> *		<b>334.45</b> *	

†Time variable: Simulation ticks; 300 cases in each model; Reference policy option: Cleaning the lot with the highest price

As compared to the EP strategy (the reference strategy in the case of all models presented in Table 20), the EJ strategy dramatically improves the odds that the environmental quality gap is closed and that average minority quality is at least fully restored. Hazard rates associated with the EJ strategy indicate that the odds of achieving these milestones increase by more than a factor of 10 in both cases, relative to the EP strategy. However, the EJ strategy does not increase the odds of majority quality being restored as compared with the EP strategy, and only slightly increases the odds that

overall total quality for all residents is fully restored (again, as compared to the EP strategy). Implementation of the ER strategy appears to increase the odds of milestone achievement across the board. Although the effect sizes are smaller for reducing the environmental quality gap and restoring minority quality, the ER policy does substantially increase the odds of both occurring, with a large effect on the likelihood of minority quality being restored. Majority quality is also more likely to be restored, and the odds of overall quality being restored are increased with the ER strategy more than either the EP or the EJ alternatives.

## Discussion

As indicated previously, none of these results should be considered as definitive estimates predicting how some policy *will* function in the real world. The world of this agent-based model is simplified, and as such, the results must be interpreted in the context of this simplification. The results are best considered as an exploration of what would occur in a world consisting of simple, yet autonomous individuals. Taken thusly, the results suggest some interesting conclusions and possible policy implications.

Chapter 2 two presented evidence that the EPA appears to consider the environmental risk, environmental justice implications, and the potential revitalization effect when providing resources for the cleanup of brownfields. In the model presented here, the effects of each of these strategies could be assessed in isolation from one another to explore the relative efficacy of each in achieving the goals of equitable environmental improvement written into EPA's mandate. One clear conclusion of the

simulations is that an effort to target cleanup efforts at those sites that can most reasonably be expected to contribute to economic redevelopment (those sites with the highest latent demand, as indicated by the highest relative prices) is the least likely to improve overall environmental conditions and the least likely to close the environmental quality gap that exists between majority and minority residents. However, it is worth noting that this model did not consider the economic consequences of the cleanup strategies, only the environmental consequences. Nevertheless, if this model is taken to be an assessment of the potential consequences of prioritization of grants by the EPA or a state level equivalent, prioritization according economic considerations appears to be an inferior approach to emphasizing equity or risk, if the cleanup goal is either addressing the environmental quality gap, or improving environmental quality most effectively for all. The most bang for the buck in environmental or equity terms is not achieved when sites that are in relatively higher demand are prioritized, a potentially concerning finding given the results in Chapter 2 suggesting that redevelopment demand may be amongst the most important criteria that the EPA considers when providing cleanup funds.

Second, efforts to address both environmental quality and equity with the same policy may be complicated by the possibility that one strategy is best environmentally while another is best for achieving equity. It is not surprising to find that focusing cleanup efforts on the riskiest sites results in the best overall environmental outcomes. It is, however, somewhat surprising that this strategy is not also the most effective at reducing the gap that exists in environmental quality between majority residents and minority residents. With the dynamic nature of urban settlement patterns, it is possible

that targeting cleanup in low socioeconomic status communities may fundamentally change the nature of those communities (Eckerd, 2011). With an improved environment, but lower relative prices, recently improved areas may be ripe for gentrification – these areas may appeal to wealthier (or in the case of this model, majority) residents who, over time, displace the original residents of a community. The displaced residents may then be expected to relocate to areas where environmental quality is not improved (Banzhaf and Walsh, 2008). However, the results of this simulation do not show evidence that environmental improvement benefits flow disproportionately to incoming residents at the expense of existing residents. If the goal of policy is to improve equity by decreasing the environmental quality gap, then it is clear that in this simplified world, targeting cleanup funding to areas with the largest proportion of minority residents is best, both in the short term and over the long term. Whether or not gentrification/displacement occurs, use of this strategy results in the most substantial and consistent improvement in environmental quality for minority residents.

Beyond consideration of the best use of cleanup resources, this finding is important for urban policy generally. Similar to Eckerd (2011), these results suggest that policy makers may not need to be concerned that targeting cleanup funds to underserved communities will result in gentrification. This model did not assess whether gentrification occurred, but it is clear that even if it does, the environmental equity gap is best addressed through targeted cleanup than by focusing on the most hazardous sites. This may be less important for the EPA than it is for state and local agencies that provide cleanup assistance. As shown in Chapter 2, the EPA tends to focus its efforts on the most

hazardous sites, leaving the vast majority of relatively low risk sites for either local or private interests to clean up. A focus on the remaining riskiest sites may improve overall quality marginally better than targeting resources on underserved communities, but the positive effect on equity is clearly larger when targeting sites in minority areas versus the riskier sites. This suggests that communities may be more resilient to environmental change than has been assumed. Although it is certainly possible that cleaning up a disamenity in a minority community may well encourage that community to change, it is by no means assured, even in this simple urban dynamics model.

### Conclusion

This exploratory effort to understand the effects of environmental improvement policies in a dynamic residential environment, finds that it is unlikely that there is “one best way” to improve both environmental conditions and address environmental inequities. In a simple world consisting of majority and minority residents, amenities and disamenities, targeting environmental cleanup to minority neighborhoods is the most effective way to address environmental inequities, while cleaning up the most polluted sites improves overall environmental outcomes most effectively. In and of themselves, neither of these results is surprising; using traditional policy analysis methods where we assume that policies are implemented in a relatively static world, we would expect that when we target specific populations, those populations would benefit most. However, this result shows that even when we relax the assumption of a static world in which a policy



is implemented and allow the changes brought about by policy to interact with a dynamic world, communities may be more resilient to demographic change than we would expect.

While the results must be considered in the context of the model used, this exploration of the consequences of different cleanup prioritizations enhances the findings of the previous chapters in this dissertation. In the introductory section, I sketched out a view of the policy process as a dynamically evolving interaction between various actors and activities that can alter the mechanics of a given policy at any time. The agent-based model used in this chapter is an effort to understand how people react to changes brought about by varying policy alternatives. While such an exploratory endeavor is not intended to dictate that one alternative is necessarily more appropriate than another, the effort is an attempt to understand what set of consequences may arise from different alternatives when a natural experiment is infeasible, impractical, or impossible. In the traditional view of the policy process, the arrow between implementation and outcomes is usually unidirectional, with an implemented policy leading directly to some set of outcomes, independent of context. The agent-based model used in this analysis conceptualizes this more as a bidirectional and dynamic relationship with feedback. Not only do policies alter outcomes, but they also alter the context. In this case, using a simple model of a dynamic urban region, I attempted to explore how the reactions of individuals to new circumstances brought about a policy change subsequently affect the outcomes that can be attributed to the policy. In the short term, of course, targeting environmental improvement to minority neighborhoods will almost certainly be effective at improving environmental circumstances for the residents of that neighborhood. However, the policy

will also have the outcome of fundamentally changing the nature of the neighborhood and its potential desirability to other regional residents, which could change who benefits from the policy over the longer term. In fact, the Tiebout sorting hypothesis (1956) suggests that this is exactly what would happen.

In this policy exploration, however, I found that even in a dynamic environment with no relocation costs, neighborhoods are more resilient to demographic change than we might expect. Thus, targeted environmental improvement might well be beneficial not only in the short term, but in the long term as well. Economic theory and empirical evidence show that communities do change (Banzhaf and Walsh, 2008; Smith, 1979; Ley, 1986); however, they do not appear to change overnight. Individuals react to the changes brought about by policy, but they do so within the context of their individual circumstances. In the simulation used here, residents had four key preferences regarding their preferred location: low price, high environmental quality, a short commute to work, and a modest preference that one in five of their neighbors be demographically similar to themselves. These are simplifying assumptions, but are more complex than the price versus environmental quality assumption used in most of the economic sorting models that warn about the potential negative consequences of targeted environmental improvements (Banzhaf and McCormick, 2007). Yet, with this simple set of assumptions, we see relatively resilient communities that change over time but not generally rapidly and not generally at the expense of those to whom policy benefits are targeted.

From a practical perspective, this is a useful insight; policy makers may be able to target environmental benefits to specific geographic areas without concern that these

benefits will be primarily enjoyed by unintended beneficiaries. However, this may also indicate that ‘sustainability’ projects currently underway to enhance economic prospects in communities via environmental improvements may not accomplish intended goals. Even in a model where environmental improvement is the sole public good that individuals consider when making a location decision, I found that if individuals also have price, similarity, and proximity preferences, these environmental changes do not appear to foster substantial demographic shifts to occur in neighborhoods, even over the long term.

From a theoretical perspective, this exercise has been a useful means through which to enhance understanding of how a set of policy alternatives may affect a reactive population. Individuals react to policies and the changes that those policies bring about; but if we assume that individuals have priorities and preferences that extend beyond one individual policy, the model presented here suggests that these other preferences may temper the extent to which policy changes fundamentally alter the context of a community. That is, when the changes brought about by a policy change the context of a region without fundamentally altering the behavior of individuals, the effect of and reaction to the policy may be muted. In the case of targeted environmental improvement, this is not a bad thing. If the effect of the policy is generally limited to improving environmental conditions in a specific neighborhood, without causing displacement of the intended beneficiaries, then the policy could reasonably improve environmental conditions in communities with such a need without harming the people who live in there. If however, the intent of the policy is to bring about neighborhood change through

the mechanism of environmental improvement, the policy may not be strong enough to bring such change about. The outcomes of the policy may not effect change at the intended level, and individual reactions to the policy may not be as extensive as would be necessary to achieve the desired ends. Referring back to the process map presented in Figure 3 in Chapter 1, the lines from *Implementation* to *Reaction* and from *Reaction* to *Action* may indicate relatively weak effects in cases where policies do not alter (or attempt to alter) individual behavior. Even in an extremely simplified environment where individuals have few preferences, the unintended consequences of a policy change were relatively few, a finding consistent with my empirical research finding that the unintended consequence of gentrification tended not to occur subsequent to environmental improvement (Eckerd, 2011), at least in the short term.

Finally, the results also point to the usefulness, as well as the challenges of using simulation models in policy analysis. As an exploratory exercise, the agent-based model simulation developed here leads one to a hypothesis that policies targeting specific populations may be effective at benefiting those populations when the policy's intent is to change the context of behavior, but not behavior itself. However, the simulation only hints at this possibility, it does not lend evidence to either support or refute it – to do so requires empirical data with specific estimates regarding how effective an implemented policy has been at achieving its intended goals. Simulation modeling fits well within the Fischer second-order framework (1995), of exploring whether the underlying assumptions of policy mesh with the design of and implementation of the policy itself. As an exploratory exercise, the simulation presented here suggests that under a reasonable

set of assumptions regarding residential location preferences, certain results are more likely than others. Without an ability to “test” the long term effects of various policy alternatives in the real world, this type of exploration can be a useful means through which to enhance the design of and expectations for policies. What a simulation model cannot do, however, is estimate how a policy will actually work when implemented in the real world; a simulation can help us explore potential consequences and broaden the perspective of policy makers, and this could prove to be an extremely useful function for such analysis. But the key finding here, that communities may be more resilient to demographic change in the face of environmental change, is merely a suggestion at this point. Before such a finding can aid and inform policy decisions, it will be necessary to acquire empirical data from which we may either support or refute the validity of the simulation model used. Nevertheless, these results can inform, and perhaps orient, if not dictate, future policy design as well as help derive testable hypotheses to help build our theoretical understanding of how policies affect the public and how the public in turn affects policies.

## **Chapter 5: Equal partners at every level of decision making?**

In this dissertation, I investigated policies designed to improve environmental conditions in communities from several different perspectives. Using a multi-theoretical and multi-methodological approach, I created a framework for making sense of a complex policy area. First, I assessed in the aggregate how public managers appear to prioritize the cleanup of environmental disamenities. Second, I investigated in detail how the public participates in and attempts to alter the decisions that are made by public managers regarding specific environmental improvement projects. Third, I explored the potential effects of different priorities and the consequences of policy changes in a dynamic, interactive urban model. These analyses fit together in a conceptual framework that is an attempt to provide a holistic understanding of a complex policy subsystem that combines views of a set of policies from the individual, organizational, and societal level. For scholarship, I hope that my framework and approach helps address the complications of studying public policy and management by providing a manner through which researchers can differentiate where and when certain social science theoretical approaches are most appropriate based upon the nature of social interaction that underlies the study in question. For the practice of policy, it is my hope that this dissertation is taken as a holistic example of policy analysis, and enhances our understanding of the consequences of environmental improvement policies on environmental equity, and

whether policy may be able to close the environmental quality gap that exists between high socioeconomic status populations and low socioeconomic status populations by improving environmental outcomes for everyone.

### Policy recommendations and contributions to practice

The key advantage for practice of the approach I have used is its wide lens. While each of the three individual projects provide some specific suggestions for their more narrow foci, the dissertation as a whole offers a wider angle. With three related projects investigating similar issues from different points of view and at different levels of social interaction, I set about to create a detailed and contextualized overview of environmental justice and efforts to remediate the problem. Rather than providing decision makers with a disjointed set of research papers all coming from different social science perspectives and methodological approaches, I have provided an overview that encompasses different social science perspectives and methodological approaches into a more coherent whole. The larger picture can suggest some general ways to understand environmental justice, and specific policy recommendations are framed within a context of the larger picture. Moreover, these specific suggestions can be derived so as to interact well with one another in a manner that precludes one solution from derailing another.

If environmental improvement tends to be slow in coming to minority neighborhoods, as was reported in Chapter 2, then this can have very real consequences for improving environmental equity. Targeted environmental improvement appears to be a good short and long term strategy for improving environmental equity and the longer

that the cleanup process takes, the longer underserved communities live with worse environmental conditions. Moreover, as reported in Chapter 3, decision makers had a tendency to focus efforts on economic development in communities, viewing environmental improvement as a means through which to achieve desired and targeted economic growth. This emphasis on economic growth and the potential resulting demographic changes such growth could bring about in neighborhoods tended to be the most salient concern of residents who were involved in the decision making process. Viewing these results with those of Chapter 4 suggests that policy makers may be hoping for too much, and residents may be too concerned about such outcomes. The simulation suggests a level of resiliency of communities; this resiliency may be good if the goal is to improve environmental outcomes for residents, but it may be frustrating if the goal is economic redevelopment. With supporting results already evident (Eckerd, 2011), this question is worth, and in fact requires, further empirical exploration. In any event, the dissertation makes clear that the relationship between equity, economics, and the environment is more complex than it is often portrayed to be.

### Theoretical contributions

Returning the framework from Figure 1 in the introductory chapter, Figure 15 summarizes the findings of here and also directs attention to the cautions derived from the approach I used. Using the Fischer (1995) framework of deep policy evaluation, chapters 2 and 3 are first-order attempts to evaluate how effective policies have been to address and prioritize improving environmental equity and encourage substantive



participation in policy decision making by affected populations. Chapter 4 is a second-order attempt to understand how and whether the assumptions that drive policy designs could alter the consequences of a policy in unintended ways.

**Figure 15: Theoretical framework and conclusions**

<b>Level of activity</b>	Societal	Organizational	Individual
<b>Social science perspective</b>	Political science	Sociology	Economics
<b>Unit of analysis</b>	Collectives	Organizations/Organizational decision makers	Individuals
<b>Decision-making criteria</b>	Political rationality	Organizational rationality	Individual rationality
<b>Solution</b>	Participation by stakeholders	Prioritization/targeting beneficiaries	Incentives to share risk/burden
<b>Has solution worked?</b>	Stakeholders participate, but are not participants; power variations between stakeholders and decision makers, lack of trust.	Progress is slow in the early stages of targeted cleanup of sites in minority areas; so much variability in risk posed by sites, difficult to discern the effect of a cleanup	Even with risks and burdens shared equally, injustice is resilient; individuals remain resistant to change and unwilling to share costs

Each of these projects viewed the policy solutions from different levels of social interaction. In Chapter 2, the focus was on organizational decision making, finding that despite policy mandates to address environmental injustice in decision making, targeted cleanup is somewhat slower in minority communities. In Chapter 3, the perspective was on broader social interaction in a political process, finding that efforts to address environmental injustice by ensuring that individuals have access to agency decision

makers does not appear to be an especially effective means to solve the problem. Chapter 4 focused on individual decision making, and how the aggregation of these decisions affects communities. Together, however, these projects point to a larger complication in studying public policy and analysis. In this policy realm, I assessed three different attempts at solving the environmental justice problem. These three approaches fall under three different social science perspectives and are not necessarily congruent with one another. The strength of my approach is to shed light on how looking at problems holistically may enable researchers to avoid the overdetermination of causes and thus incongruence of solutions.

Complicated policy realms are not easily amenable to simple solutions. While the results from Chapter 2 suggest that public managers need to place more emphasis on speeding up the remediation of site cleanups in minority communities, Chapter 3 indicates that doing so without honest community involvement may not adequately address perceived social justice problems. Moreover, as seen in Chapter 4, any solution targeting cleanup to minority communities may actually contribute to environmental injustice rather than resolve it, as environmentally improved communities may be ripe for gentrification, making the intended beneficiaries worse off than they were before the policy mechanism was in place. Chapter 4 shows this is not a definite outcome, but it is certainly a possible one, meaning that one solution in Figure 15 may actually counteract another.

Nevertheless by looking at this policy area from different perspectives, I have effectively delineated some circumstances under which it is better to use different

theoretical approaches. If a policy analysis concern is at the social level, then it makes sense to frame the study in theory, literature, and methods that apply to human interaction on the level of society or culture, such as those traditionally associated with political science or anthropology. Similarly, if the concern regards individual decision making, then it is worthwhile to conduct such investigation from social science perspectives that focus on the individual level, such as economics and psychology. At the organizational level, sociological and management science approaches are likely the best fits. The function of the public policy and management scholar is to make sense of these different theoretical traditions and units of analysis for the purposes of both building broader public policy and management theory and informing the practice of governmental decision making.

### Conclusion

Much like the dynamic environment in which a policy is implemented, policy itself is dynamic. Today's exploration and evaluation research informs tomorrow's policy design and implementation decisions, and tomorrow's policy changes the context and the individuals who are affected. A policy is a set of rules that, in any given time, we have either explicitly via participation, or implicitly, via Rousseau's social contract, collectively agreed to live according to. As we change, our rules change. Sometimes we favor tradition and sometimes we favor progress. Sometimes we lean on values, and sometimes we focus on objective evidence. Whatever the current mood, the public policies that we create, change, and eliminate are, at their root, reflections of us at any

given time. In this dissertation, I have tried to account for the dynamic nature of public policy and management, and present a multi-theoretical, multi-methodological view of a particular policy arena. I have endeavored to not only estimate the effects of these policies, but also to explore what those policies mean and how they change over time.

In the end, it is my hope that this work has practical as well as theoretical implications. For practice, I hope that my research helps improve environmental equity and ensure that environmental improvement is not distributed as inequitably as environmental degradation has been. For theory, I hope to move public policy and management theory incrementally forward by noting the importance of viewing policy through a framework that accounts for the dynamic and interactive nature of individuals, societies, in addition to accounting for different theoretical and methodological approaches. Finally, I hope that this effort improves public policy and management scholarship by encouraging others to embrace the intellectual, theoretical, and methodological flexibility required to grapple with understanding how it is that we can collectively do something as complex as govern ourselves.

## References

- Abelson, J., Forest, P.G., Eyles, J., Smith, P., Martin, E., and Gauvin, F.P. 2003. Deliberations about Deliberative Methods: Issues in the Design and Evaluation of Public Participation Processes. *Social Sciences & Medicine*. 57: 239-251.
- Adams, S., and Kriesi, H. 2007. *The Network Approach: Theories of the Policy Process*. Davis, CA: Westview Press.
- Agranoff, R., McGuire, M. 2003. *Collaborative Public Management*. Washington, DC: Georgetown University Press.
- Agyeman, J. and T. Evans. 2003. "Toward Just Sustainability in Urban Communities: Building Equity Rights with Sustainable Solutions," *Annals of the American Academy of Political and Social Science*. 590: 35-53.
- Anderton, D., Anderson, A., Oakes, J., and Fraser, M. 1994. Environmental Equity: The Demographics of Dumping. *Demography*. 31(2): 229-248.
- Arora, S., and Cason, T. 1999. Do Community Characteristics Influence Environmental Outcomes? Evidence from the Toxics Release Inventory. *Southern Economic Journal*. 65(4): 691-716.
- Axelrod, R. 1997. *The Complexity of Cooperation: Agent-Based Models of Competition and Collaboration*. Princeton, NJ: Princeton University Press.
- Bachrach, P., and Baratz, M. 1962. Two Faces of Power. *The American Political Science Review*. 56(4): 947-952.
- Banzhaf H., & Walsh, R. 2008. Do People Vote with Their Feet? An Empirical Test of Tiebout's Mechanism. *American Economic Review*, 98(3), 843-863.
- Banzhaf, H., & McCormick, E. 2007. Moving Beyond Cleanup: Identifying the Crucibles of Environmental Gentrification. *Andrew Young School of Policy Studies Research Paper Series*, Working Paper 07-29.
- Bardach, E. 1998. *Getting Agencies to Work Together: The Practice and Theory of Managerial Craftsmanship*. Washington, DC: Brookings Institution Press.

Barlas, Y. 1996. Formal Aspects of Model Validity and Validation in System Dynamics. *System Dynamics Review*. 12(3): 183-210.

Barredo, J., Kasanko, M., McCormick, N., and Lavallo, C. 2003. Modeling Dynamic Spatial Processes: Simulation of Urban Future Scenarios Through Cellular Automata. *Landscape and Urban Planning*. 64: 145-160.

Batty, M., Xie, Y., and Sun, Z. 1999. Modeling Urban Dynamics through GIS-Based Cellular Automata. *Computers, Environment and Urban Systems*. 23(3): 205-233.

Been, V., & Gupta, F. 1997. Coming to the Nuisance or Going to the Barrios? A Longitudinal Analysis of Environmental Justice Claims. *Ecology Law Quarterly*, 24(1), 1-56.

Beierle, T., and Konisky, D. 2000. Values, Conflict, and Trust in Participatory Environmental Planning. *Journal of Public Policy Analysis and Management*. 19(4): 587-602.

Benenson, I. 1998. Multi-Agent Simulations of Residential Dynamics in the City. *Computers Environment and Urban Systems*. 22(1): 25-42.

Bickers, K., and Stein, R. 1998. The Microfoundations of the Tiebout Model. *Urban Affairs Review*. 34(1): 76-93.

Bickerstaff, K., and Walker, G. 2005. Shared Visions, Unholy Alliances: Power, Governance and Deliberative Processes in Local Transport Planning. *Urban Studies*. 42(5): 2133-2144.

Bonorris, S. 2004. *Environmental Justice For All: A Fifty-State Survey of Legislation, Policies and Initiatives*. Berkeley, CA: Hastings College of Law, University of California.

Bowman, A. 1985. Hazardous Waste Cleanup and Superfund Implementation in the Southeast. *Policy Studies Journal*. 14(1): 100-110.

Brown, D., Page, S., Riolo, R., Zellner, M., and Rand, W. 2005. Path Dependence and the Validation of Agent-Based Spatial Models of Land Use. *International Journal of Geographical Information Science*. 19(2): 153-174.

Brudney, J., and Hebert, F. 1987. State Agencies and their Environments: Examining the Influence of Important External Actors. *The Journal of Politics*. 49: 186-206.

- Bullard, R. 1990. *Dumping in Dixie: Race, Class, and Environmental Quality*. Boulder, CO: Westview Press.
- Byrne, J. 2002. Two Cheers for Gentrification. *Howard Law Journal*. 46: 405-430.
- Campbell, H., Peck, L., and Tschudi, M. 2010. Justice for All? A Causal Analysis of Toxics Release Inventory Facility Location. *Review of Policy Research*. In press.
- Canter, L. 1996. *Environmental Impact Analysis*. New York: McGraw-Hill.
- Casti, J. 1997. *Would-Be Worlds: How Simulation is Changing the Frontiers of Science*. Toronto: Wiley.
- Chase, G., and Reveal, E. 1983. *How to Manage in the Public Sector*. Reading, MA: Addison-Wesley.
- Chomsky, N. 2006. *Language and Mind*. Cambridge: Cambridge University Press.
- Church, T., and Nakamura, R. 1993. *Cleaning Up the Mess: Implementation Strategies in Superfund*. Washington, DC: Brookings Institution Press.
- Cigler, A., and Loomis, B. 2002. *Interest Group Politics*. Washington, DC: CQ Press.
- Cobb, R., and Ross, M. 1997. *Cultural Strategies of Agenda Denial: Avoidance, Attack and Redefinition*. Lawrence, KS: University of Kansas Press.
- Cobb, R., Ross, J., and Ross, M. 1976. Agenda Building as a Comparative Political Process. *The American Political Science Review*. 70(1): 126-138.
- Cohen, N. 1995. Technical Assistance for Citizen Participation: A Case of New York City's Environmental Planning Process. *The American Review of Public Administration*. 25: 119-135.
- Commission for Racial Justice for the United Church of Christ. 1987. *Toxic Wastes and Race in the United States: A National Report on the Racial and Socio-Economic Characteristics of Communities with Hazardous Waste Sites*.
- Clark, W. 1992. Residential Preferences and Residential Choices in a Multiethnic Context. *Demography*. 29(3): 451-466.
- Clarke, J., and McCool, D. 1998. *Staking Out the Terrain: Power Differentials among Natural Resource Management Agencies*. Albany, NY: State University Press of New York.

- Cuellar, M. 2005. Rethinking Regulatory Democracy. *Administrative Law Review*. 28: 7-107.
- Cvetkovich, G., and Earle, T. 1992. Environmental Hazards and the Public. *Journal of Social Issues*. 48(4): 1-20.
- Dahl, R. 1961. *Who Governs: Democracy and Power in an American City*. New Haven, CT: Yale University Press.
- Dale, L., Murdoch, J., Thayer, M., & Waddell, P. 1999. Do Property Values Rebound from Environmental Stigmas? *Land Economics*, 75, 311-326.
- Daley, D., and Layton, D. 2004. Policy Implementation and the Environmental Protection Agency: What Factors Influence Remediation at Superfund Sites? *Policy Studies Journal*. 32(3): 375-392.
- de Silva, F., and Eglese, R. 2000. Integrating Simulation Modeling and GIS: Spatial Decision Support Systems for Evacuation Planning. *The Journal of the Operations Research Society*. 51(4): 423-430.
- De Sousa, C. 2004. The Greening of Brownfields in American Cities. *Journal of Environmental Planning and Management*. 47(4): 579-600.
- Dean, J., Gumerman, G., Epstein, J., Axtell, R. Swedlund, A., Parker, M., and McCarroll, S. 1999. Understanding Anasazi Culture Change through Agent-Based Modeling. In Gumerman, G., and Kohler, T. (eds.). *Modeling Small Scale Societies*. New York: Oxford University Press.
- Dear, M. 1992. Understanding and Overcoming the NIMBY Phenomenon. *Journal of the American Planning Association*. 58: 288-300.
- Eckerd, A. 2011. Cleaning Up without Clearing Out? An Assessment of Environmental Gentrification. *Urban Affairs Review*. 47(1): 31-59.
- Eckerd, A., Campbell, H., and Kim, Y. 2011. Helping Those like Us or Harming Those Unlike Us. *Manuscript Under Review*.
- Engelen, G., White, R., Uljee, I., and Drazan, P. 1995. Using Cellular Automata for Integrated Modeling of Socio-Environmental Systems. *Environmental Monitoring and Assessment*. 34(2): 203-214.
- Epstein, J. 1999. Agent-Based Computational Models and Generative Social Science. *Complexity*. 4(5): 41-60.



- Epstein, J. 2006. *Generative Social Science: Studies in Agent-Based Computational Modeling*. Princeton, NJ: Princeton University Press.
- Epstein, J., and Axtell, R. 1996. *Growing Artificial Societies: Social Science from the Bottom Up*. Washington, DC: Brookings Institution Press.
- Fischer, F. 1993. Citizen Participation and the Democratization of Policy Expertise: From Theoretical Inquiry to Practical Cases. *Policy Sciences*. 26: 165-187.
- Fischer, F. 1995. *Evaluating Public Policy*. Chicago: Nelson-Hall Publishers.
- Flyvbjerg, B. 1997. *Rationality and Power*. Chicago: University of Chicago Press.
- Forrester, J., and Senge, P. 1980. Tests for Building Confidence in System Dynamics Models. *TIMS Studies in Management Sciences*. 14: 209-228.
- Foster, S. 2002. Environmental Justice in an Era of Devolved Collaboration. *Harvard Environmental Law Review*. 26: 459-498.
- Foucault, M. 1972. *The Archaeology of Knowledge*. New York: Pantheon Books.
- French, J., and Raven, B. 1960. The Bases of Social Power. In Cartwright, D., and Zander, A. (eds.), *Group Dynamics*. New York: Harper and Row.
- Freudenberg, W. 1988. Perceived Risk, Real Risk: Social Science and the Art of Probabilistic Risk Assessment. *Science*. 242(4875): 44-49.
- Freudenburg, W., and Pastor, S. 1992. NIMBYs and LULUs: Stalking the Syndromes. *Journal of Social Issues*. 48(4): 39-61.
- Furlong, S. 1997. Interest Group Influence on Rule Making. *Administration and Society*. 29(3): 325-347.
- Garrod, G., and Willis, K. 1992. Valuing Goods' Characteristics: An Application of the Hedonic Price Method to Environmental Attributes. *Journal of Environmental Management*. 34(1): 59-76.
- Gass, S. 1983. Decision-Aiding Models: Validation, Assessment, and Related Issues for Policy Analysis. *Operations Research*. 31(4): 603-631.
- Gibbons, S., and Machin, S. 2008. Valuing School Quality, Better Transport, and Lower Crime: Evidence from Housing Prices. *Oxford Review of Economic Policy*. 24(1): 99-119.

- Ginsberg, A. and N. Rhett. 2003. "Building a Better Body of Evidence: New Opportunities to Strengthen Evaluation Utilization." *American Journal of Evaluation*. 24(4): 489-500.
- Golden, M. 1998. Interest Groups in the Rule-Making Process: Who Participates? Whose Voices Get Heard? *Journal of Public Administration Research and Theory*. 8: 245-270.
- Gormley, W. 1986. Regulatory Issue Networks in a Federal System. *Polity*. 18(4): 595-620.
- Gould Ellen, I., and Voicu, I. 2006. Nonprofit Housing and Neighborhood Spillovers. *Journal of Policy Analysis and Management*. 25(1): 31-52.
- Grasso, P. 2003. "What Makes an Evaluation Useful? Reflections from Experience in Large Organizations." *American Journal of Evaluation*. 24(4): 507-514.
- Grob, G. 2003. "A Truly Useful Bat is One Found in the Hands of a Slugger." *American Journal of Evaluation*. 24(4): 499-505.
- Habermas, J. 1970. Knowledge and Interest. In: Emmet, D., and MacIntyre, A. (eds.), *Sociological Theory and Philosophical Analysis*. London: Macmillan.
- Hamilton, J. 1995. Testing for Environmental Racism: Prejudice, Profits or Political Power? *Journal of Policy Analysis and Management*. 14(1): 107-132.
- Hamilton, J., and Viscusi, K. 1999. How Costly is 'Clean'? An Analysis of the Benefits and Costs of Superfund Site Remediations. *Journal of Policy Analysis and Management*. 18(1): 2-27.
- Heclo, H. 1978. Issue networks and the executive establishment. In King, S, ed. *The New American Political System*. Washington: American Enterprise Institute.
- Helland, E., and Whitford, A. 2003. Pollution Incidence and Political Jurisdiction: Evidence from the TRI. *Journal of Environmental Economics and Management*. 46: 403-424.
- Henry, G. 2003. "Influential Evaluations." *American Journal of Evaluation*. 24(4): 515-524.
- Herrnson, P., Shaiko, R., and Wilcox, C. 2005. *The Interest Group Connection: Electioneering, Lobbying, and Policymaking in Washington*. Washington, DC: CQ Press.

- Hill, H. 2002. Understanding Implementation: Street-Level Bureaucrats Resources for Reform. *Journal of Public Administration Research and Theory*. 13: 265-282.
- Hird, J. 1990. Superfund Expenditures and Cleanup Priorities: Distributive Politics or Public Interest? *Journal of Policy Analysis and Management*. 9: 455-483.
- Hird, J. 1993. Environmental Policy and Equity: The Case of Superfund. *Journal of Policy Analysis and Management*, 12(2), 323-343.
- Hodgson, G. 2000. What is the Essence of Institutional Economics? *Journal of Economic Issues*. 34(2): 317-329.
- Holland, J. 1998. *Emergence: From Chaos to Order*. Reading, MA: Perseus.
- Ibitayo, O., and Pijawka, K. 1999. Reversing NIMBY: An Assessment of State Strategies for Siting Hazardous Waste Facilities. *Environment and Planning C: Government and Policy*. 17: 379-389.
- Ingram, K. 2007. Social Construction and Policy Design. in P. Sabatier, ed., *Theories of the Policy Process (2nd Edition)*. Cambridge, MA: Westview Press.
- Irwin, E. 2002. The Effects of Open Space on Residential Property Values. *Land Economics*. 78(4): 465-480.
- Jewell, C. and Bero, L. 2006. Public Participation and Claimsmaking: Evidence Utilization and Divergent Policy Frames in California's Ergonomics Rulemaking. *Journal of Public Administration Research and Theory*. 17: 625-650.
- John, D. 1994. *Civic Environmentalism*. Washington, DC: CQ Press.
- Johnston, E., Kim, Y., and Ayyangar, M. 2007. Intending the Unintended: The Act of Building Agent-Based Models as a Regular Source of Knowledge Generation. *Interdisciplinary Description of Complex Systems*. 5(2): 81-91.
- Kahn, M. 2006. *Green Cities: Urban Growth and the Environment*. Washington, DC: Brookings Institution Press.
- Katzman, M. 1980. The Contribution of Crime to Urban Decline. *Urban Studies*. 17(3): 277-286.
- Kay, A. 2005. A Critique of the Use of Path Dependency in Policy Studies. *Public Administration*. 83(3): 553-571.

- Kenney, D. 2000. *Arguing about Consensus*. Boulder, CO: University of Colorado School of Law.
- King, C., Felty, K., and Susel, B. 1998. The Question of Participation: Toward Authentic Public Participation in Public Administration. *Public Administration Review*. 58(4): 317-326.
- Kingdon, J. 2002. *Agendas, Alternatives, and Public Policies*. New York: Pearson.
- Klijn, E., and Skelcher, C. 2007. Democracy and Governance Networks: Compatible or Not? *Public Administration*. 85(3): 587-608.
- Kohlhase, J. 1991. The Impact of Toxic Waste Sites on Housing Values. *Journal of Urban Economics*. 30: 1-26.
- Kolko, J. 2007. *The Determinants of Gentrification*. Unpublished Manuscript.
- Konisky, D. 2009. Inequities in Enforcement? Environmental Justice and Government Performance. *Journal of Policy Analysis and Management*. 28(1): 102-121.
- Koontz, T. 1999. Administrators and Citizens: Measuring Agency Officials' Efforts to Foster and Use public Input in Forest Policy. *Journal of Public Administration Research and Theory*. 9(2): 251-280.
- Koontz, T., Steelman, T., Carmin, J., Korfmacher, K., Moseley, C., and Thomas, C. 2004. *Collaborative Environmental Management: What Roles for Government?* Washington, DC: Resources for the Future.
- Kraft, M., and Clary, B. 1991. Citizen Participation and the NIMBY Syndrome: Public Response the Radioactive Waste Disposal. *Political Research Quarterly*. 44: 299-328.
- Kraft, M., and Kraut, R. 1985. The Impact of Citizen Participation on Hazardous Waste Policy Implementation: The Case of Clermont County, Ohio. *Policy Studies Journal*. 14(1): 52-61.
- Kriesel, W., Centner, W., and Keeler, A. 1996. Neighborhood Exposure to Toxic Releases: Are There Racial Inequities? *Growth and Change*. 27(4): 479-499.
- Krueger, R. and L. Savage. 2007. "City-Regions and Social Reproduction: A 'Place' for Sustainable Development?" *International Journal of Urban and Regional Research*. 31(1): 215-223.
- Lancaster, K. 1966. A New Approach to Consumer Theory. *The Journal of Political Economy*. 74(2): 132-157.

- Langbein, L., and Kerwin, C. 2000. Regulatory Negotiation versus Conventional Rule-making: Claims, Counter-claims and Empirical Evidence. *Journal of Public Administration Research and Theory*. 10(3): 599-632.
- Leggett, C., and Bockstael, N. 2000. Evidence of the Effects of Water Quality on Residential Land Prices. *Journal of Environmental Economics and Management*. 39(2): 121-144.
- Leviton, L. 2003. "Evaluation Use: Advances, Challenges and Applications." *American Journal of Evaluation*. 24(4): 525-535.
- Ley, D. 1986. Alternative Explanations for Inner-city Gentrification: A Canadian Assessment. *Annals of the Association of American Geographers*. 76(4): 521-535.
- Lindblom, C. 1959. The Science of 'Muddling Through'. *Public Administration Review*. 19(2): 79-88.
- Lober, D. 1995. Why Protest? Public Behavioral and Attitudinal Response to Siting a Waste Disposal Facility. *Policy Studies Journal*. 23(3): 499-512.
- Lowi, T. 1964. American Business, Public Policy, Case-Studies and Political Theory. *World Politics*. 16(4): 687-713.
- Lowi, T. 1979. *The End of Liberalism*. New York: Norton and Company.
- Lubell, M. 2004. Collaborative Environmental Institutions: All Talk and No Action? *Journal of Policy Analysis and Management*. 23(5): 549-573.
- Lukes, S. 1974. *Power: A Radical View*. London: Macmillan.
- Lynn, L. 1990. Managing the Social Safety Net: The Job of the Social Welfare Executive. In Hargrove, E., and Glidwell, J. (eds.) *Impossible Jobs in Public Management*. Lawrence KS: University of Kansas Press.
- MacKinnon, D. 2000. Managerialism, Governmentality and the State: A Neo-Foucauldian Approach to Local Economic Governance. *Political Geography*. 19: 293-314.
- Matheny, A., and Williams, B. 1985. Knowledge Vs. NIMBY: Assessing Florida's Strategy for Siting Hazardous Waste Disposal Facilities. *Policy Studies Journal*. 14(1): 70-80.

- McAvoy, G. 1998. Partisan Probing and Democratic Decisionmaking: Rethinking the NIMBY Syndrome. *Policy Studies Journal*. 26(2): 274-292.
- McCluskey, J., & Rausser, G. 2003. Stigmatized Asset Value: Is it Temporary or Long-term? *Review of Economics and Statistics*, 85(2), 276-285.
- McMillen, D., & Thorsnes, P. 2003. The Aroma of Tacoma: Time Varying Average Derivatives and the Effect of a Superfund Site on House Prices. *Journal of Business & Economics Statistics*, 21, 237-246.
- Messer, K., Schulze, W., Hackett, K., Cameron, T., & McClelland, G. 2006. Can Stigma Explain Large Property Value Losses? The Psychology and Economics of Superfund. *Environment and Resource Economics*, 33, 299-324.
- Mills, C. 1956. *The Power Elite*. Oxford: Oxford University Press.
- Mohai, P. and B. Bryant. 1992. "Environmental Racism: Reviewing the Evidence," in B. Bryant and P. Mohai eds., *Race and the Incidence of Environmental Hazards*. Boulder, CO: Westview Press.
- Mohai, P., and Saha, R. 2006. Reassessing Racial and Socioeconomic Disparities in Environmental Justice Research. *Demography*. 43(2): 383-399.
- Mohring, M., and Troitzsch, K. 2001. Lake Anderson Revisited. *Journal of Artificial Societies and Social Simulation*. 4/3/1.
- Nagel, K., and Rasmussen, S. 1994. Traffic at the Edge of Chaos. In Brooks, R. (ed.). *Artificial Life IV*. Cambridge, MA: MIT Press.
- Naughton, K., Schmid, C., Yackee, S., and Zhan, X. 2009. Understanding Commenter Influence During Agency Rule Development. *Journal of Public Administration Research and Theory*. 28(2): 25-277.
- Nelson, K. 1988. *Gentrification and Distressed Cities*. Madison, WI: University of Wisconsin Press.
- Nicholson-Crotty, S., and Nicholson-Crotty, J. 2004. Interest Group Influence on Managerial Priorities in Public Organizations. *Journal of Public Administration Research and Theory*. 14(4): 571-583
- Nixon, D., Howard, R., and DeWitt, J. 2002. With Friends Like These: Rule-Making Comment Submissions to the Securities and Exchange Commission. *Journal of Public Administration Research and Theory*. 12(1): 59-76.

- Noonan, D. 2008. Evidence of Environmental Justice: A Critical Perspective on the Practice of EJ Research and Lessons for Policy Design. *Social Science Quarterly*. 89(5): 1153-1174.
- Novotny, P. 1995. Where We Live, Work and Play: Reframing the Cultural Landscape of Environmentalism in the Environmental Justice Movement. *New Political Science*. 32: 61-79.
- Olson, M. 1965. *The Logic of Collective Action*. Cambridge, MA: Harvard University Press.
- O'Sullivan, D. 2002. Toward Micro-Scale Spatial Modeling of Gentrification. *Journal of Geographic Systems*. 4: 251-274.
- Ostrom, E. 2011. Background on the Institutional Analysis and Development Framework. *Policy Studies Journal*. 39(1): 7-27.
- Padgett, D. 1994. Technological Methods for Improving Citizen Participation in Locally Unacceptable Land Use Decision-making. *Computers, Environment and Urban Systems*. 17(6): 513-520.
- Pastor, M., Sadd, J., and Hipp, J. 2001. Which Came First? Toxic Facilities, Minority Move-in, and Environmental Justice. *Journal of Urban Affairs*. 23(1): 1-21.
- Powell, J. 1985. Assault on a Precious Commodity: The Local Struggle to Protect Groundwater. *Policy Studies Journal*. 14(1): 62-69.
- Pressman, J., and Wildavsky, A. 1973. *Implementation: How Great Expectations in Washington are Dashed in Oakland*. Berkeley, CA: University of California Press.
- Renn, O., Webler, T., and Wiedemann, P. 1995. *Fairness and Competence in Citizen Participation*. New York: Springer.
- Richardson, G. 2006. Systems Thinkers, Systems Thinking. *System Dynamics Review*. 10(2-3): 95-99.
- Ridker, R., and Henning, J. 1967. The Determinants of Residential Property Values with Special Reference to Air Pollution. *Review of Economics and Statistics*. 49(2): 246-257.
- Ringquist, E. 1997. Equity and the Distribution of Environmental Risk: The Case of TRI Facilities. *Social Science Quarterly*. 78(4): 811-829.
- Ringquist, E. 2005. Assessing Evidence of Environmental Inequities: A Meta-Analysis. *Journal of Policy Analysis and Management*. 24(2): 223-247.

- Ringquist, E., Worsham, J., and Eisner, M. 2003. Saliency, Complexity, and the Legislative Direction of Regulatory Bureaucracies. *Journal of Public Administration Research and Theory*. 13(2): 141-164.
- Rich, R., Edelstein, M., Hallman, W., and Wandersman, A. 1995. Citizen Participation and Empowerment: The Case of Local Environmental Hazards. *American Journal of Community Psychology*. 23(5): 657-676.
- Richardson, T. 1996. Foucauldian Discourse: Power and Trust in Urban and Regional Policy Making. *European Planning Studies*. 4(3): 279-292.
- Riker, W. 1964. Some Ambiguities in the Notion of Power. *The American Political Science Review*. 58(2): 341-349.
- Rittel, H., and Webber, M. 1973. Dilemmas in a General Theory of Planning. *Policy Sciences*. 4: 155-169.
- Rosen, S. 1974. Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition. *Journal of Political Economy*. 82: 34-55.
- Sabatier, P. 2007. *Theories of the Policy Process*. Cambridge, MA: Westview Press.
- Sabatier P., and Jenkins-Smith, H. 2007. "The Advocacy-Coalition Framework: An Assessment," in P. Sabatier, ed., *Theories of the Policy Process (2nd Edition)*. Cambridge, MA: Westview Press: 189-220.
- Santiago, A., Galster, G., and Tatian, P. 2001. Assessing the Property Value Impacts of the Dispersed Subsidy Housing Program in Denver. *Journal of Policy Analysis and Management*. 20(1): 65-88.
- Santos, S., and Chess, C. 2003. Evaluating Citizen Advisory Boards: The Importance of Theory and Participant-Based Criteria and Practical Implications. *Risk Analysis*. 23(2): 269-279.
- Schelling, T. 1978. *Micromotives and Macrobehavior*. New York: W.W. Norton and Company.
- Scheuer, S. 2005. *EU Environmental Policy Handbook: A Critical Analysis of EU Environmental Legislation*. Brussels: European Environmental Bureau.
- Schively, C. 2007. Understanding the NIMBY and LULU Phenomena: Reassessing Our Knowledge Base and Informing Future Research. *Journal of Planning Literature*. 21: 255-266.



Schlosberg, D. 2004. Reconceiving Environmental Justice: Global Movements and Political Theories. *Environmental Politics*. 13(3): 517-540.

Schon, D. 1979. *The Reflective Practitioner*. New York: Basic Books.

Schuetz, J. 2009. No Renters in My Suburban Backyard: Land Use Regulation and Rental Housing. *Journal of Policy Analysis and Management*. 28(2): 296-320.

Sieg, H., Smith, V.K., Banzhaf, H., & Walsh, R. 2004. Estimating the General Equilibrium Benefits of Large Changes in Spatially Delineated Public Goods. *International Economic Review*, 45(4), 1047-1077.

Smith, N. 1979. Toward a theory of gentrification: A back to the city movement by capital not people. *Journal of the American Planning Association*, 45, 538-548.

Spence, D. 1997. Agency Policy Making and Political Control: Modeling Away the Delegation Problem. *Journal of Public Administration Research and Theory*. 7(2): 199-219.

Sridharan, S. 2003. Introduction to Special Section on 'What is a Useful Evaluation?' *American Journal of Evaluation*. 24(4): 483-487.

Stone, C. 1989. *Regime politics: Governing Atlanta, 1946-1988*. Lawrence, KS: University Press of Kansas.

Taboas, A., Moghissi, A., and LaGuardia, T. 2004. *The Decommissioning Handbook*. New York: ASME Press.

Tiebout, C. 1956. A Pure Theory of Local Expenditures. *The Journal of Political Economy*, 64(5), 416-424.

Thomas, J.C. 2010. When Should the Public be Involved in Public Management? In eds O'Leary, R., Van Slyke, D., and Kim, S. *The Future of Public Administration Around the World: The Minnowbrook Perspective*. Washington, DC: Georgetown University Press.

Tolbert, P., and Zucker, L. 1996. The Institutionalization of Institutional Theory. In Clegg, S., Hardy, C., and Nord, W. (eds.). *Handbook of Organization Studies*. Thousand Oaks, CA: Sage.

Torrens, P., and Nara, A. 2007. Modeling Gentrification Dynamics: A Hybrid Approach. *Computers, Environment and Urban Systems*. 31: 337-361.

- True, J., Jones, B., and Baumgartner, F. 2007. Punctuated-Equilibrium Theory: Explaining Stability and Change in American Policymaking. In Sabatier, P. (ed.). *Theories of the Policy Process*. Cambridge, MA: Westview Press.
- Walti, S., Kujbler, D., Papadopoulos, Y. 2003. How Democratic is 'Governance'? *Governance*. 17(1): 83-113.
- Walzer, M. 1983. *Spheres of Justice: A Defense of Pluralism and Equality*. New York: Basic Books.
- Wassmer, R., and Baass, M. 2006. Does a More Centralized Urban Form Raise Housing Prices? *Journal of Policy Analysis and Management*. 25(2): 439-462.
- Weiss, C. 1989. Congressional Committees as Users of Analysis. *Journal of Policy Analysis and Management*. 8(3): 411-431.
- Wen, M., Hawkey, L., & Cacioppo, J. 2006. Objective and Perceived Neighborhood Environment, Individual SES and Psychosocial Factors, and Self-Rated Health. *Social Science & Medicine*. 63(10): 2575-2590.
- West, W. 2004. Formal Procedures, Informal Processes, Accountability, and Responsiveness in Bureaucratic Policy Making: An Institutional Policy Analysis. *Public Administration Review*. 64(1): 66-80.
- Wiggins, C., Hamm, K., and Bell, C. 1992. Interest-Group and Party Influence Agents in the Legislative Process: A Comparative State Analysis. *The Journal of Politics*. 54: 82-100.
- Williamson, O. 1981. The Economics of Organization: The Transaction Cost Approach. *The American Journal of Sociology*. 87(3): 548-577.
- Wolsink, M. 1994. Entanglement of Interests and Motives: Assumptions behind the NIMBY Theory on Facility Siting. *Urban Studies*. 31(6): 851-866.
- Wolverton, A. 2002. Does Race Matter? An Examination of a Polluting Plant's Location Decision. National Center for Environmental Economics. Washington, DC: Environmental Protection Agency.
- Wolverton, A. 2009. Effects of Socio-Economic and Input-Related Factors on Polluting Plants' Location Decisions. *The B.E. Journal of Economic Analysis and Policy*. 9(1): 1-30.

Yackee, S. 2006. Sweet-Talking the Fourth Branch: The Influence of Interest Group Comments on Federal Agency Rulemaking. *Journal of Public Administration Research and Theory*. 16: 103-124.

Yackee, J., and Yackee, S. 2006. A Bias Towards Business? Assessing Interest Group Influence on U.S. Bureaucracy. *The Journal of Politics*. 68(1): 128-139.

Yucel, G., and Van Daalen, C. 2009. An Objective-Based Perspective on Assessment of Model-Supported Policy Processes. *Journal of Artificial Societies and Social Simulation*. 12(4): 3.

Zagonel, A., Rohrbaugh, J., Richardson, G., and Andersen, D. 2004. Using Simulation Models to Address “What if” Questions about Welfare Reform. *Journal of Policy Analysis and Management*. 23(4): 890-901.

## Appendix A: Agent-based model programming code

```
extensions [r]
breed [ jobs job ]
breed [ residents a-resident ]
residents-own [ race qual candidate-patches ]
jobs-own [ pollution trif val trif-opt candidate-patches ]
patches-own [quality price sddist trifiedist ntrifiedist trif-pollute prop-min
prop-maj prop-trif prop-non-trif utility local-vacancy ]
globals [ view-mode growth n-run view sig labor-demand ]
to setup
  reset-ticks
  clear-turtles
  clear-patches
  clear-all-plots
  set similarity-preference .8
  set growth-rate .08
  set n-run n-run + 1
  if n-run > 200
  [ set cleanup-policy "high pollution" ]
  if n-run > 100 and n-run <= 200
  [ set cleanup-policy "high price" ]
  if n-run > 300
  [ stop ]
  set growth 0
  set view-mode "quality"
  setup-jobs
  setup-patches
  setup-residents
  ask patches [ update-patch-color ]
end
to reset-runs
  set n-run 0
end
to setup-jobs
  create-jobs 2
  ask jobs [ set trif 1 ]
  ask one-of jobs
  [
    set shape "circle"
    set pollution 0
    set trif 0
    set color orange + 2
    set size 3
    let radius 20
    setxy ( ( radius / 2 ) - random-float ( radius * 1.0 ) ) ( ( radius / 2 ) -
random-float ( radius * 1.0 ) )
  ]
  ask one-of jobs with [ trif != 0 ]
  [
```

```

    set shape "circle"
    set pollution 10
    set trif 1
    set color orange - 2
    set size 3
    let radius 20
    setxy ( ( radius / 2 ) - random-float ( radius * 1.0 ) ) ( ( radius / 2 ) -
random-float ( radius * 1.0 ) )
  ]
end
to setup-patches
  ask patches [
    set quality 50
    set price 50
  ]
  ask patches
  [
    set sddist min [distance myself + .01] of jobs
    set trifdist min [distance myself + .01] of jobs with [ trif = 1 ]
    set ntrifdist min [distance myself + .01] of jobs with [ trif = 0 ]
    set trif-pollute [ pollution ] of min-one-of jobs with [ trif = 1 ] [
distance myself ]
  ]
  pollute
  ask jobs
  [
    if trif = 0
    [
      raise-value
      raise-price
    ]
  ]
end
to setup-residents
  create-residents 50
  ask n-of 35 residents
  [
    set color red
    set shape "box"
    set race 1 ;majority
    let radius 20
    setxy ( ( radius / 2 ) - random-float ( radius * 1.0 ) ) ( ( radius / 2 ) -
random-float ( radius * 1.0 ) )
    evaluate
  ]
  ask residents with [ race != 1 ]
  [
    set color yellow
    set shape "box"
    set race 2 ;minority
    let radius 20
    setxy ( ( radius / 2 ) - random-float ( radius * 1.0 ) ) ( ( radius / 2 ) -
random-float ( radius * 1.0 ) )
    evaluate
  ]
end
to decrease-value
  ask patch-here [ set quality ( quality * 0.70 ) ]
  ask patches in-radius 5
  [ set quality ( quality - ( quality * ( 1 / trifdist ) ^ trifdist ) ) ]

```

```

end
to raise-price
  ask patch-here [ set price ( price * 1.06 ) ]
  ask patches in-radius 3
  [ set price ( price + ( price * ( 1 / ntrifdist ) ^ ntrifdist ) ) ]
end
to raise-value
  ask patch-here [ set quality ( quality * 1.01 ) ]
  ask patches in-radius 3
  [ set quality ( quality + ( quality * ( 1 / ntrifdist ) ^ ntrifdist ) ) ]
end
to decrease-price
  ask patch-here [ set price ( price * 0.94 ) ]
  ask patches in-radius 5
  [ set price ( price - ( price * ( 1 / trifdist ) ^ trifdist ) ) ]
end
to go
  if ticks > 39
  [
    set similarity-preference .2
    set growth-rate .00
  ]
  locate-residents
  set labor-demand count (residents) / count (jobs)
  if labor-demand > residents-per-job
  [
    locate-service
    trif-effect
  ]
  ifelse ticks <= 40
  [ if count (residents) >= 500 [kill-residents] ]
  [ if count (residents) >= 1500 [kill-residents] ]
  update-view
  calc-utility
  do-plots
  r
  export-data
  if ticks > 39 and remainder ticks 2 = 0
  [ cleanup ]
  tick
end
to calc-utility
  ask patches
  [
    let res-count count residents in-radius 2
    if res-count > 0
    [
      set prop-min ( count residents with [ race = 2 ] in-radius 2 ) / ( res-count )
      set prop-maj ( count residents with [ race = 1 ] in-radius 2 ) / ( res-count )
    ]
    set local-vacancy res-count / 16
    set utility ( quality ^ quality-preference ) * ( ( 1 / price ) ^ price-preference ) * ( ( 1 / ( sddist + .01 ) ) ^ ( distance-preference ) )
    set price price + ( (quality - price ) * utility * local-vacancy)
  ]
end
to trif-effect
  ask jobs

```

```

[ if trif = 0
  [ raise-value ]
]
let qualdif random-normal .5 .25
if qualdif > 1 [ set qualdif 1 ]
if qualdif < 0 [ set qualdif 0 ]
let pricedif random-normal .5 .25
if pricedif > 1 [ set pricedif 1 ]
if pricedif < 0 [ set pricedif 0 ]
diffuse quality qualdif
diffuse price pricedif
end
to locate-residents
  ifelse growth-rate > 0
  [
    set growth count (residents) * growth-rate * 1.20
    set growth ceiling (growth)
  ]
  [
    set growth count (residents) * .11
    set growth ceiling (growth)
  ]
  ask n-of growth residents
  [
    hatch 1
    [
      evaluate
    ]
  ]
end
to evaluate
  ifelse ticks < 60
  [ set candidate-patches n-of random 100 patches with [ not any? turtles-here ] ]
  [ set candidate-patches n-of random 50 patches with [ not any? turtles-here ] ]
  if (not any? candidate-patches)
  [ stop ]
  if race = 1
  [
    let qualifying-patches candidate-patches with [ prop-min <= ( 1 -
similarity-preference ) ]
    if (not any? qualifying-patches)
    [ set qualifying-patches candidate-patches ]
    let best-candidate max-one-of qualifying-patches
    [ utility ]
    move-to best-candidate
  ]
  if race = 2
  [
    let qualifying-patches candidate-patches with [ prop-maj <= ( 1 -
similarity-preference ) ]
    if (not any? qualifying-patches)
    [ set qualifying-patches candidate-patches ]
    let best-candidate max-one-of qualifying-patches
    [ utility ]
    move-to best-candidate
  ]
end
to kill-residents

```

```

ifelse growth-rate > 0
[
  set growth count (residents) * growth-rate * .20
  ask max-n-of floor (growth) residents [who]
  [ die ]
]
[ set growth count (residents) * .10
  ask max-n-of floor (growth) residents [who]
  [die]
]
end
to locate-service
  let empty-patches patches with [ not any? turtles-here ]
  if any? empty-patches
  [
    ask n-of (labor-demand - residents-per-job) empty-patches
    [
      sprout-jobs 1
      [
        set shape "circle"
        ifelse ticks < 40
        [ set pollution random 20 ]
        [ set pollution random 4 ]
        if pollution > 5
        [set trif 1
          set color orange - 2]
        if pollution <= 5
        [set trif 0
          set color orange + 2
        ]
        set size 3
        evaluate-trif
      ]
    ]
    ask patches
    [ set sddist min [distance myself + .01] of jobs
      set trifdist min [distance myself + .01] of jobs with [ trif = 1 ]
      set ntrifdist min [distance myself + .01] of jobs with [ trif = 0 ]
      set trif-pollute [ pollution ] of min-one-of jobs with [ trif = 1 ] [
distance myself ]
    ]
  ]
  pollute
end
to cleanup
  if any? jobs with [ trif = 1 ]
  [
    ask jobs
    [ set val [ price ] of patch-here ]

    if cleanup-policy = "high price"
    [
      ifelse nfa? = "Off"
      [ask max-one-of jobs with [ trif = 1 ] [ val ]
        [ die ]]
      [
        ask max-one-of jobs with [ trif = 1 ] [ val ]
        [ set pollution 0
          set trif 0
          set color 117 ]
      ]
    ]
  ]

```



```

] ]
if cleanup-policy = "high pollution"
[
  ifelse nfa? = "Off"
  [ ask max-one-of jobs with [ trif = 1 ] [ pollution ]
    [ die ] ]
  [
    ask max-one-of jobs with [ trif = 1 ] [ pollution ]
    [ set pollution 0
      set trif 0
      set color 117 ]
  ] ]

if cleanup-policy = "near majority"
[
  ifelse nfa? = "Off"
  [ ask max-one-of jobs with [ trif = 1 ] [ prop-maj ]
    [ die ] ]
  [
    ask max-one-of jobs with [ trif = 1 ] [ prop-maj ]
    [ set pollution 0
      set trif 0
      set color 117 ]
  ] ]
if cleanup-policy = "near minority"
[
  ifelse nfa? = "Off"
  [ ask max-one-of jobs with [ trif = 1 ] [ prop-min ]
    [ die ] ]
  [
    ask max-one-of jobs with [ trif = 1 ] [ prop-min ]
    [ set pollution 0
      set trif 0
      set color 117 ]
  ] ]
]
ask patches
[ set sddist min [distance myself + .01] of jobs
  set trifdist min [distance myself + .01] of jobs with [ trif = 1 ]
  set ntrifdist min [distance myself + .01] of jobs with [ trif = 0 ]
  set trif-pollute [ pollution ] of min-one-of jobs with [ trif = 1 ] [
distance myself ] ]
end

to evaluate-trif
ifelse trif = 0
[ let best-candidate min-one-of patches [price]
  move-to best-candidate ]
[
  if trifs-choose = "random"
  [ set trif-opt random 3 ]
  if trifs-choose = "near minority" or trif-opt = 0
  [ let best-candidate max-one-of patches [prop-min]
    move-to best-candidate ]
  if trifs-choose = "away from majority" or trif-opt = 1
  [ let best-candidate min-one-of patches [prop-maj]
    move-to best-candidate ]
  if trifs-choose = "low price" or trif-opt = 2
  [ let best-candidate min-one-of patches [price]

```

```

    move-to best-candidate ]
  ]
end
to pollute
  ask jobs with-min [who]
  [
    ask patch-here
    [
      set quality ( quality - ( quality * ( trif-pollute / 100 ) ) )
    ]
  ]
ask patches
[
  set quality ( quality - ( quality ^ ( 1 / trifdist ) * ( trif-pollute / 100 )
) )
]
ask patches with [ not any? turtles-here ]
[
  if local-vacancy = 0 and trifdist > 20
  [
    set quality ( quality + ( quality * .01 ) )
  ]
]
end
to update-view
  ask patches [ update-patch-color ]
end
to update-patch-color
  if quality > 100 [ set quality 100 ]
  if price > 100 [ set price 100 ]
  if quality < 1 or quality = "NaN" [ set quality 1 ]
  if price < 1 or price = "NaN" [ set price 1 ]
  if view-mode = "quality"
  [
    set pcolor scale-color green quality 0 100
  ]
  if view-mode = "price"
  [
    set pcolor scale-color cyan price 0 100
  ]
end
to do-plots
  set-current-plot "Quality"
  set-current-plot-pen "majority_quality"
  plot mean [ quality ] of patches with [ any? residents-here with [ race = 1 ]
]
  set-current-plot-pen "minority_quality"
  plot mean [ quality ] of patches with [ any? residents-here with [ race = 2 ]
]
  set-current-plot-pen "mean_quality"
  plot mean [ quality ] of patches with [ any? residents-here ]
end
to export-data
  file-open "quality.csv"
  file-type ticks
  file-type ","
  file-type mean [ quality ] of patches with [ any? residents-here with [ race
= 1 ] ]
  file-type ","

```

```

    file-type standard-deviation [ quality ] of patches with [ any? residents-
here with [ race = 1 ] ]
    file-type ","
    file-type count residents with [ race = 1 ]
    file-type ","
    file-type mean [ quality ] of patches with [ any? residents-here with [ race
= 2 ] ]
    file-type ","
    file-type standard-deviation [ quality ] of patches with [ any? residents-
here with [ race = 2 ] ]
    file-type ","
    file-type count residents with [ race = 2 ]
    file-type ","
    file-type count jobs with [ trif = 1 ]
    file-type ","
    file-type count jobs
    file-type ","
    file-type n-run
    file-type ","
    file-type cleanup-policy
    file-type ","
    file-type sig
    file-type ","
    file-print similarity-preference
    file-close
if ticks = 100
[
    setup
]
;]
end
to r
    ask residents
    [
        set qual [ quality ] of patch-here
        r:putagent "majority" residents with [ race = 1 ] "qual"
        r:putagent "minority" residents with [ race = 2 ] "qual"
    ]
    r:eval "t <- t.test(majority$qual, minority$qual, alternative='two.sided',
var.equal=TRUE, conf.level=.95)"
    set sig r:get "t$p.value"
    set sig precision sig 4
    set-current-plot "T Test"
    set-current-plot-pen "p"
    if r:get "t$p.value" <= .05
    [ set-plot-pen-color green ]
    if r:get "t$p.value" > .05
    [ set-plot-pen-color red ]
    plot r:get "t$p.value"
    set-current-plot-pen "sig"
    plot .05
end

```