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Estimating Errors: the Politics of Environmental Impact Assessment Along the Savannah River

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ESTIMATING ERRORS: THE POLITICS OF ENVIRONMENTAL IMPACT
ASSESSMENT ALONG THE SAVANNAH RIVER

by
Ryan Covington

A Dissertation Submitted in
Partial Fulfillment of the
Requirements for the Degree of

Doctor of Philosophy
in Geography

at
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ABSTRACT
ESTIMATING ERRORS: THE POLITICS OF ENVIRONMENTAL IMPACT
ASSESSMENT ALONG THE SAVANNAH RIVER

by
Ryan Covington

The University of Wisconsin-Milwaukee, 2015
Under the Supervision of Professor Ryan Holifield

In this dissertation research, I investigate three interrelated conflicts which emerged as part of an environmental impact assessment along the Savannah River in the late 1990s: a controversial plan to improve water quality through supplemental oxygen injection; a lengthy struggle over federal funding policies that constrained efforts to address scientific uncertainty; and an entrenched refusal to investigate human health risks from air toxics at the Port of Savannah. In each of these conflicts, I trace the dismantling of controversy, investigating how, and with what effect, the slow and tedious work of building consensus has reshaped the governance of the lower Savannah River. Drawing on extensive archival and ethnographic work in Savannah, Georgia, I find that different constitutions, manipulations, and deployments of space—in the form of habitat suitability maps or containerized cargo forecast projections—enabled long-standing and intensified controversies to be channeled into consensus. In doing so, I argue that environmental impact assessment in Savannah is aimed at constituting the city and the river as sites of both modern industrial port operations *and* sleepy, moss-covered, bucolic Southern landscapes, in a tension-filled effort to remain articulated with both the tremendous flows of financial capital from global shipping and historic tourism that converge on the city. First, my analysis of efforts to improve water quality through supplemental oxygen

highlights the intricate spatial arrangements necessary to make these efforts work. Next, my study of adaptive management politics reveals the ways in which memory and its material traces erode institutional risk-aversion, opening new opportunities for better resource management and increased ecological resilience. Lastly, my investigation of air toxics at the Port of Savannah reveals how different constructions of space are combined, intersected, and overlapped in ways that erase human health risks and construct compliance with federal environmental justice policy. Taken together, these conflicts suggest that space serves as a strategic resource in environmental impact assessments, contributing to how problems get defined and solutions get proposed. Further, this research underlines the need for greater attention to the active role of spatial constructs—boundaries, networks, scales, or pathways—in environmental impact assessment practice and policy.

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“The question appears to be simply this, whether Savannah Harbor is of sufficient importance to warrant the outlay of a large sum of money...”

(Colonel Quincy Gilmore, Chief of Engineers at Savannah Harbor, cited in Barber and Gann 1989, p.87)

- Chapter 1 - Introduction

This dissertation analyzes three interrelated controversies that emerged along the Savannah River in the late 1990s. Plans to deepen the river and improve navigation at the Port of Savannah had been met with virulent criticism in the wake of the plan's projected environmental impacts, including widespread losses of freshwater wetlands in the Savannah National Wildlife Refuge from saltwater intrusion, losses of critical fisheries habitat for striped bass and the endangered shortnose sturgeon from increased salinity and reduced dissolved oxygen, increased contamination of municipal drinking water for city residents from saltwater intrusion, and increased sediment erosion along the beaches of Tybee Island. The project was tremendously controversial from the outset; the Georgia Ports Authority had fast-tracked the project's initial environmental impact studies, and opponents argued that the rush had led to severely flawed assessments that substantially underestimated the costs for long-term environmental mitigation and erased significant risks to human health (Citizens for Environmental Justice 2011; Hricko 2011). The refuge, managed by the U.S. Fish and Wildlife Service and located just upriver from the port, had lost several hundred acres of rare tidal freshwater wetlands from saltwater intrusion and witnessed a spectacular collapse of the river's striped bass fishery following years of deepening, widening, and engineering projects by the U.S. Army Corps of Engineers to improve the navigation channel. In South Carolina the deepening was viewed as a catastrophic blow to the economic future of the Port of Charleston, and the death knell for plans to build a bi-state port located in Jasper County. "I call it the rape of the river," said Glenn McConnell, then state senator from Charleston's 41st District.

“That’s what it is. This is as bad as when the Indians sold Manhattan for \$27 in trinkets, but at least they got trinkets. All we get is toxic sludge” (Slade 2012).

In many ways, the conflict in Savannah is one that has played out numerous times: contested histories, shared political territory, overlapping institutional jurisdictions, and competing economic agenda that result in incendiary accusations, political fallout, and bureaucratic dysfunction. But in other respects the conflict in Savannah has been distinct—unique, even. Indeed, perhaps the most fascinating part of the story in Savannah has been how the project—so intensely controversial at its outset—became, for all intents and purposes, so *agreeable*. By 2013, the project had been deemed one of the seven “nationally and regionally significant infrastructure projects” fast-tracked as part of the Obama administration’s “We Can’t Wait” initiative (Mayle 2014, n.p.). State and federal resource agencies had dropped their objections, legal challenges in South Carolina were settled, and Vice President Joe Biden visited the docks at the Port of Savannah, promising the harbor deepening would get done “come hell or high water” (Mayle 2013, n.p.).

In the chapters that follow, my overarching goal has been to explore how the tremendous controversy that initially characterized the deepening project has been slowly dismantled and delegitimized, only to be replaced by consensus and agreement. Drawing from three interrelated conflicts—over water quality, adaptive management, and human health risk—I argue that environmental impact assessment is, at its most basic, a technomanagerial practice of place-making, one aimed at constituting Savannah as a site of both modern industrial port operations *and* sleepy, moss-covered, bucolic Southern landscapes, in a tension-filled effort to remain articulated with both the tremendous flows

of financial capital from global shipping *and* historic tourism that converge on the city. In the next section, I offer a brief background on the Georgia Ports Authority’s “Savannah Harbor Expansion Project.” Next, I sketch out the structure of the dissertation, outlining the three case-study controversies and their corresponding research questions, and the primary data sources and methods of analysis used to investigate each.

Orientations: the Georgia Ports Authority’s “Savannah Harbor Expansion Project”

The Port of Savannah sits roughly 30 miles from the coast up the Savannah River, the border shared by Georgia and South Carolina. At 1,200 acres, the port’s Garden City Terminal is North America’s largest single-terminal container facility; Savannah is the fastest growing port in the nation, and the 2nd busiest container exporter in the U.S (Georgia Ports Authority 2013). In 2014, the Port of Savannah moved more than 3 million TEUs, or twenty foot equivalent units (Georgia Ports Authority 2015).

Nonetheless, all other things being equal, the Savannah River is a terrible place for a deep-water port. The Savannah carries substantial amounts of silt, and like other lowland coastal rivers, its “natural” condition contains a number of islands dividing the river into a series of slow-moving, shallow, and meandering channels in its lower reaches - a condition that tends to markedly complicate maintaining commercial navigation. As a result, the river has been subject to a near constant series of deepening, widening, and engineering projects aimed at improving the navigation channel, the most recent of which is designed to accommodate the growing number of increasingly super-sized vessels calling at the port.

Over the last several decades container vessels have exploded in size, many of which are now too large to pass through the locks of the Panama Canal. New classes of

“post-Panamax” or “New Panamax” vessels are simply too large to fit through the locks, and although they currently make up only a small portion of the world’s fleet, they account for nearly half of its cargo capacity (Hricko 2008). In an effort to keep pace with trends in global shipping, Panama has been building a third set of locks to accommodate these larger vessels. And although most ports along the Gulf and Atlantic coasts will be unable to handle the new vessels, the Panama Canal Expansion has nonetheless set off a fierce competition between port authorities for federal cost sharing dollars to dredge deeper harbors, raise bridges, and improve rail lines and highways to accommodate larger ships and higher cargo volumes (Hricko 2008).

The project in Savannah is designed to dredge more than 30 miles of the river’s navigation channel to a mean-low-water level of 47 feet. Combined with Savannah’s nearly 8 foot daily tidal range, the port’s Garden City Terminal would be able to regularly serve vessels with drafts greater than 50 feet, and with its superior proximity to Interstate 95, would be well positioned to handle expanding cargo volumes. The Georgia Ports Authority submitted a *Feasibility Study Report* and *Tier I Environmental Impact Statement* to the U.S. Army Corps of Engineers and Congress for adoption and approval in the summer of 1998. Congress gave the project conditional authorization the next year but, in the face of significant opposition from state and federal resource agencies, it included two additional provisions before construction could begin (WRDA 1999). First, the Corps of Engineers, in consultation with affected federal, state, and local entities, was required to prepare a new, comprehensive Environmental Impact Statement (EIS). The document is a requirement of the National Environmental Policy Act (NEPA), and describes the full range of environmental consequences, feasible project alternatives,

expected economic development benefits, and the mitigation plans for any proposed federal actions significantly affecting the environment.

Second, the provisions required that the U.S. Fish and Wildlife Service, the Environmental Protection Agency, and the National Marine Fisheries Service approve the selected plan for navigation and its associated mitigation plans (WRDA 1999). The Savannah River is subject to a complex jurisdictional governance structure: the National Marine Fisheries Service is charged with the role of protecting the short-nose sturgeon, an endangered species found primarily in east coast rivers and estuaries, under threat from the loss of suitable habitat from the conversion of freshwater wetlands and the drastic reductions in the amounts of dissolved oxygen necessary to support bottom-dwelling fish species. The U.S. Fish and Wildlife Service is charged with protecting the Savannah National Wildlife Refuge – particularly the preservation of tidal freshwater marsh. Lastly, the Environmental Protection Agency is responsible for setting and maintaining water quality standards in the river. Following nearly fifteen years of additional studies and assessments, the project completed its NEPA compliance requirements on October 26, 2012 following a favorable Record of Decision by the Assistant Secretary of the Army for Civil Works.

Navigating: questions, approach, and contributions

The dissertation is structured around three inter-related, yet distinct, controversies that have unfolded within the larger political conflict over the Savannah Harbor Expansion Project, and which are presented in chapters two, three, and four as stand-alone papers. Although these papers are presented as a sequence, the negotiations that I discuss did not unfold as such, and should not be read as a progression from one conflict

to the next. Indeed, one of the most complex characteristics of the Savannah Harbor Expansion Project was that the debates and conflicts presented here—as well as many others—occurred simultaneously. In the final chapter of the dissertation I summarize its major findings and contributions, closing with a discussion of its limitations and the possibilities for future geographic scholarship that these suggest.

Controversies and research questions

In Chapter two, I begin by investigating the “improvement” of the Savannah River’s dissolved oxygen regime. Initial water quality modeling indicated that the deepening would exacerbate the harbor’s already degraded dissolved oxygen levels, threatening vital fisheries habitat and causing significant concern among waterfront industries that feared the potential effect of the deepening on the future of their point source discharge permits. In response, the Ports Authority and the Corps of Engineers proposed a system to artificially oxygenate the river, “offsetting” the potential water quality impacts from the deepening and “restoring” its ability to both support vital fisheries habitat *and* metabolize point source discharges. Despite having never been applied at such a grand scale or to such a complex estuarine system, the approach—the injection of superoxygenated river water via Speece Cones—became the central, and most controversial, feature of the Corps’ mitigation plan. In this chapter, I trace the history of the water quality modeling and mitigation effort, asking: *How, and with what consequences, has oxygen injection intersected with and transformed modes of water quality regulation in the harbor?*

In Chapter three, I turn my attention to stakeholders’ lingering concerns over scientific uncertainty. While several of the Corps mitigation measures were being

proposed for the first time, others were saddled with a relatively dismal record of success. A series of unintended impacts from previous harbor deepening and engineering projects had left the lower Savannah River a landscape full of *already failed* mitigation strategies: a deteriorating system of freshwater controls in the Savannah National Wildlife Refuge, a collapsed striped bass fishery, and devastating losses of freshwater wetlands. In response, stakeholders adopted a memo outlining a comprehensive process of adaptive management, recognizing that no predictions made by the Corps would be entirely accurate or mitigation strategies entirely effective. And while newly passed federal legislation required that the Corps include and implement adaptive management as part of its mitigation projects, neither Congress nor Corps Headquarters had issued any guidance on what adaptive management *actually* entailed. Consequently, the question of how to fund it, how to coordinate it, what triggered an intervention and by whom, became points of intense controversy. In this chapter, I trace the development of the project's post-construction monitoring and adaptive management plans, asking: *How have the institutional resistance and inertia that undermine adaptive management implementation been overcome in Savannah?*

In Chapter four, I shift my focus to investigate claims of environmental injustice in the port's surrounding neighborhoods. Despite projected growths in container traffic, the Corps predicted an overall *reduction* in the port's future air emissions, ultimately concluding that the project posed no potential risks to human health. The assessment drew sharp criticism from both the U.S. Environmental Protection Agency (EPA) and local environmental justice advocates, who maintained that the assessments systematically misrepresented the port's air emissions, particularly its landside truck and

rail operations. The neighborhoods of Hudson Hill, Woodville, and West Savannah—which compose Savannah’s predominantly African American west side, and have received numerous EPA grants and awards for environmental justice advocacy—are crisscrossed by highways and rail lines that service the port, and air toxics from the operation of the Garden City Terminal’s truck and rail corridors have long been a major concern among residents. Despite strident objections from local environmental justice advocates, the Savannah District refused to conduct either a detailed dispersion modeling assessment of air toxics or a screening level risk-based assessment of the health effects associated with the deepening, maintaining that project posed no risks to human health, a claim to which the EPA, ultimately, conceded. In this chapter, I trace the history of the project’s air quality and emission inventory, asking: *How has the Savannah District demonstrated that the deepening project poses no risk to public health and complies with federal environmental justice policy?*

Primary data sources and methods of analysis

To answer these questions, I rely on archival and ethnographic methods, drawing heavily from two sets of digital records: first, the project’s *Final Environmental Impact Statement* and *General Re-Evaluation Report* released in 2012 and maintained online at the homepage of the U.S. Army Corps of Engineers Savannah District¹; and second, the documentary record compiled for the project’s Stakeholders Evaluation Group and maintained online at the Georgia Ports Authority’s Savannah Harbor Expansion Project

¹ <http://www.sas.usace.army.mil/Missions/CivilWorks/SavannahHarborExpansion.aspx> (last accessed 4 February 2015)

Information Site². These digital records include an extensive archive of supplemental engineering studies, technical assessments, inter-agency review comments, correspondence between state and federal cooperating agencies and their consultants, meeting summaries, inter-agency memoranda, as well as agenda, transcripts, meeting notes, and correspondence, technical advisory and committee reports, public comments, decision documents, news releases, presentations from public meetings, work plans, Corps of Engineers policy guidance, public notices, supplemental studies, and meeting summaries produced in the nearly fifteen year development and negotiation of the project's *Final Environmental Impact Statement*. This extensive archive provides some of the richest opportunities to follow the negotiations of agency scientists, public officials, industry representatives, non-profit organizations, and concerned citizens in the development of the project's impact assessments and mitigation strategies. Each chapter draws on these extensive resources selectively, and I provide a more detailed discussion of the specific primary sources used in each within.

In many respects, the archive of the Stakeholders Evaluation Group proved to be more helpful than either the *Final Environmental Impact Statement* or *General Re-Evaluation Reports*. While each of these documents are an exhaustive record in and of themselves—each containing an extensive record of the more or less “official” interagency coordination between the federal and state cooperating agencies (e.g., letters, comments and responses on technical assessments, Memoranda for Record)—in almost every case, and certainly in the case of the three controversies I analyze further below, the most heated exchanges and frank discussion occurred at length in earlier meetings of

² <http://sav-harbor.com/> (last accessed 4 August 2014)

the Stakeholders Evaluation Group or one of its working committees.³ While the site was maintained by the Ports Authority, the content was largely unregulated, and was designed to facilitate information exchange between Group members by allowing any and all parties to submit documents (e.g., meeting notes, correspondence, news articles, committee summary reports, draft reports) to the archive with the understanding that it did not represent official positions, decisions, or consensus of the membership.

Nonetheless, the digital record compiled and maintained by the Stakeholders Evaluation Group suffered from inherent limitations. First, while only part of the documentary record made available to the Group was ultimately included in the *Final Environmental Impact Statement* and *General Re-Evaluation Report*, their membership, and by proxy my research, did not have access to documents considered classified, privileged, or confidential. This constitutes perhaps the most important—yet insurmountable—limitation to my archival analysis. Second, there is the problematic notion of the Group’s *membership*. The Group was initially formed to serve as an advisory body to the Ports Authority; raising a number of questions about how it would be incorporated into the formal coordination process of the federal and state agencies. For instance, how would it measure “consensus” decisions, and could they be authoritative in light of each agency’s jurisdictional responsibility? These questions became even more critical in 2001, following a Memorandum of Understanding between the Corps and the Ports Authority, officially making the Corps the lead agency on the project and, from the perspective of several stakeholders, substantially reducing the

³ SEG working committees included: Aquifer Committee, Beach Erosion Committee, Communications Committee, Dredging Committee, Economics Working Group, Fisheries/Aquatic Resources Committee, Modeling Technical Review Group, Operating Guidelines, and Striped Bass Committee.

Group’s influence. Not all members of the Group were considered equally, and on several occasions documents, or parts of documents, were shared selectively between resource agencies and other members. While the Group was initially imagined to include representatives from the relatively small group of state and federal cooperating agencies—principally, the Corps, the Ports Authority (the project’s local sponsor), NOAA Fisheries, EPA, Fish and Wildlife Service, the Georgia Department of Natural Resources, and the South Carolina Department of Health and Environmental Control—it ultimately became a much more diverse, albeit relatively privileged, exclusive, and still problematic, body including representatives from local branches of major environmental organizations (e.g., Sierra Club, League of Conservation Voters, Georgia Conservancy) and interest groups (e.g., the Savannah Manufacturers Council, City of Tybee Island).

But there is another reason for my use of the Group’s archives: although certainly an incomplete and partial record of the negotiations over the Savannah Harbor Expansion Project, it *does* consist of the documents made openly available to project stakeholders involved in the most extensive public involvement campaign in the history of the Savannah District—and the first time a stakeholder group has been included in a deep-draft navigation project. It can therefore be seen as representative of the level (in terms of “publicity” or “accessibility”) at which participation and collaborative governance have been organized in the project’s impact assessment and mitigation planning. Using this archive, then, is to have available as close to the same set of resources as the stakeholders themselves had as they negotiated the project’s rationale, impacts, and mitigation.

At least initially, my intention was to schedule formal interviews with representatives of the Stakeholders Evaluation Group and the project's cooperating agencies. But in March of 2011, the Southern Environmental Law Center challenged the project in South Carolina court on behalf of the Savannah Riverkeeper, South Carolina Coastal Conservation League, South Carolina Wildlife Federation, and Conservation Voters of South Carolina. In April of 2012, the Ports Authority was advised by its attorneys to no longer host Stakeholders meetings. The organizations of several Group participants had either filed or were representing multiple challenges in court, and had listed other Group participants as witnesses, and it was not until May of 2013 that a settlement agreement was reached. While the legal challenges to the deepening project were ultimately settled, they proved to be a significant challenge to securing "official" interviews with Stakeholders participants and the agencies involved in the project's planning. The Ports Authority and the Savannah District, for example, refused multiple requests for interviews, citing the legal challenges and referring me to the websites and documents for information about the project, its benefits, impacts, and proposed mitigation plans.

Some agencies and organizations involved, however, were willing to speak with me about the project under the explicit provision that the discussion was "off the record." Most commonly, these "interviews" took the form of informal conversations—over coffee and a walk through Forsyth Park, for example—providing invaluable insights used less to "triangulate" my research findings than to enrich my readings of the documents. Additionally, the people with whom I spoke frequently referred to me to key documents included in the record—as well as to relevant press releases, interviews, and other news

accounts not included in the record but delivered by a representative in some “official” capacity—citing gaps in their own knowledge or a desire not to “misrepresent” what “actually” happened. Although the Stakeholders Evaluation Group’s meetings had officially ended, I was able to regularly attend monthly meetings of the Savannah Metropolitan Planning Commission and the City of Tybee Island’s “Beach Task Force.” Although not directly related to the deepening project, Planning Commission meetings were focused on the development of city’s new “Unified Zoning Ordinance” and “Tricentennial Plan,” which involved remaking much of west Savannah in order to better accommodate port operations, while Beach Task Force meetings focused on shoreline protection and beach nourishment, projects within which the Corps was centrally involved. These meetings—and the informal conversations that developed afterwards—proved immensely helpful for informing my documentary analysis.

Although the majority of my analysis consisted of the project’s documentary record supplemented by semi- and unstructured interviews with project stakeholders, I also rely on twelve months of ethnographic work in Savannah, conducted from August 2012 to August 2013. In the summer of 2012, I moved into the home of my 89-year old maternal grandmother, Katherine Floyd, and it was everyday life among family and friends in Savannah that ultimately provided much of the most important data for, and insights into, my analysis. Situated near the Vernon River just a few miles south of the city, it is the place where I have spent nearly every summer since my early childhood - fishing, crabbing, and swimming in the tidal creeks that carve up the landscape into countless islands and hammocks. Over the years, I’ve spent hours wandering the city’s Historic District or the wildlife refuge, first with my grandfather, and then later with my

own father, listening to stories about the city's history. A significant portion of my extended family lives in the city: my uncle and aunt, Steve and Laura Floyd, and their three children, Conor, Sarah, and Sam, live right next door. In many ways, it was my position as a "grandson" and "nephew" that opened some of the most productive, although informal, avenues for my research: conversations that developed after church services on Sundays or in the bleachers during high school baseball games on weekday evenings. Truthfully, I think that I was something of a curiosity for many people. Strangely, I often found myself being approached by friends-of-friends of someone in the family curious to hear about why I had come to Savannah, and quite frequently found myself awash in homeowners, parents, business owners, and past and current port workers – longshoremen, line-handlers, tug operators, and harbor pilots – all ready and willing to share their thoughts and opinions about the city, its problems, and possibilities.

Still, the overwhelming majority of persons with whom I encountered regularly could arguably be described as Savannah's "old guard" – white, suburban, upper-middle class, life-long residents troubled by many of the city's more recent trends. I arrived in Savannah during a particularly interesting historical "moment": the departure of city manager, Rochelle Small-Toney. The council nominated Small-Toney after a bitter, months-long fight that led to what some described as Savannah's worst race relations since the 1960's (Montoya 2011). After less than two years on the job, Small-Toney was asked to resign. She was Savannah's first African-American city manager, and following a reprimand by city officials over questionable hiring practices and a \$6 million backlog in the city's Purchasing Department, accusations flew. Those calling for her resignation were accused of outright racism. Small-Toney's supporters were accused of favoritism,

and former Mayor Otis Johnson’s express desire to hire someone “that looks like me to be the city manager” led to accusations that Small-Toney had not been the most qualified candidate (Montoya 2011, n.p.).

During this same time period, the city was enduring a lengthy battle of another kind: the question of whether to allow double-decker tour buses in its Historic District. For nearly the last two decades, Savannah has had a blanket ban on double-decker buses – opposed by downtown residents who claim the buses invade their privacy and allow tourists to peer over garden walls and look into upstairs bedroom windows. A Boston-based tourism operator had submitted a proposal to bring several of the double-decker buses to Savannah, and was asking the city council to lift the blanket ban. The proposal generated significant opposition from city residents – from both within and outside of the Historic District. While Historic District residents expressed immediate concerns over privacy violations, wider debates and conversations focused on the city’s exploding tourism industry – estimated at nearly \$2 billion as of 2011 (Associated Press 2011). Nearly 12 million tourists visit Savannah each year, and tensions over traffic and parking in the Historic District have greatly intensified in the last several decades (Conn 2013, n.p.).

My point here is this: I arrived in Savannah at a time when the desire for agreement was somewhat palpable. Long, drawn-out controversies on numerous fronts had taken a significant toll on residents and public officials alike, and there appeared to be a very deliberate effort to emphasize recent points of political agreement and the benefits of consensus decision-making. Undoubtedly, these related conflicts and disagreements—and the desire for resolution and agreement that they seemed to

encourage—affected my conversations in Savannah. There certainly exists the possibility that the desire to *maintain* the consensus that ultimately developed in Savannah resulted in a selective remembering or forgetting of the tensions and negotiations that animated the wider controversy over the deepening project, unwittingly romanticizing the project as more or less controversial than it actually was.

Despite their inherent limitations, the final *Environmental Impact Statement* and *General Re-Evaluation Report*, the documentary record compiled and maintained by the Stakeholders Evaluation Group, and my ethnographic work constitute an extremely rich body of material for analysis. In each of the following chapters, my methodological approach draws broad inspiration from actor-network theory (Latour 1999, 2004, 2005) and related approaches at the intersection of political ecology and science studies (Bennett 2005; Braun and Whatmore 2010; Hennessy 2013; Heynen et al. 2007; Robbins 2007). Drawing from this framework, the central unit of analysis is a controversy, a conflict over what Latour (2004, 2005) terms a *matter of concern*. These are situations in which the facts are not yet fully established; where disputes over facts previously identified as “technical” – what he calls a *matter of fact* – become increasingly tangled with issues conventionally described as “political.” For Latour, the distinctive contribution of the actor-network approach is the ability to “trace a network,” producing a descriptive account of events and following the series of connections that make things happen as they “transform, translate, distort, and modify the meaning or the elements they are supposed to carry” (Latour 2005, p.39).

Thus, the analyses presented in each of the following chapters are not about evaluating whether any particular mitigation strategy “worked” nor are they about

uncovering some “truth” about what “actually” happened. Rather, my primary interests are the particular and contingent spatial orderings that the documents imply, and the political implications that follow from them. How, for instance, was a diverse (and, in some cases, seemingly unrelated) set of human and non-human elements—hydrodynamic models, ultra-low-sulfur diesel fuel, and the National Director of the U.S. Fish and Wildlife Service—sembled, combined, and arranged in ways that produced profound effects—more flexible water quality standards, compliance with federal environmental justice policy, and more comprehensive post-construction monitoring—to the point that controversy and disagreement no longer made sense? And how have these new combinations of people and things remade the landscape of capitalism, the state, and the lower Savannah River estuary, and with what effects? My interests, then, are not in what the documents are “really” saying, or whether they are actually “true.” Rather, I am concerned with the consequences of their combination: how—and with what—they constitute problems, define solutions, and arrange possible futures.

In each chapter, I began with at the end of a controversy: oxygen injection had been agreed upon as a feasible mitigation strategy; the project’s monitoring and adaptive management plan had been successfully expanded; and claims of human health risks and environmental injustice had been successfully eliminated. To understand how these controversies were resolved – or, in Latour’s terms, moved from *matters of concern* to *matters of fact* – I began with Appendix A of the project’s *Final Environmental Impact Statement*. This appendix included all of the Corps of Engineers’ responses to comments received from the review of its 2010 *Draft Environmental Impact Statement* and *Draft General Re-Evaluation Report* during their 60-day public comment period (as required

by the National Environmental Policy Act). Using these responses, I was able to systematically trace the resolution to each of my case study conflicts: identifying the key documents, people, or ideas that supported each one of the Corps of Engineers' arguments and claims. The structure and layout of the public comments and the Corps' responses to them were surprisingly helpful; the reviewers – whether a federal or state resource agency, advocacy organization, business group, or concerned citizen – tended to lay out their claims, critiques, and concerns point-by-point, taking great pains to identify each one as clearly as possible using bullet-points, numbered lists, or section headings and sub-headings. The Corps responded in kind, addressing each one of the critiques or concerns individually, identifying each of the essential technical reports, policy initiatives, or decision documents that supported their claims. Using these responses, I was able to identify the key actants – anything, human or nonhuman, to which agency was attributed – and trace the sequence of events and connections that worked to support oxygen injection as a feasible mitigation strategy, to expand the project's monitoring and adaptive management plan, and to eliminate claims of human health risks and environmental injustice. In the chapters that follow, my aim is to describe the process of impact assessment and mitigation planning as it unfolded in Savannah, from a perspective that is both incomplete, and one that is in favor of some arrangements of human and non-humans (and some urban-ecological futures) over others.

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- Chapter 2 -

Adding acres: oxygen injection, acceptable fish habitat, and the remaking of water governance in the Savannah Harbor

Abstract. When water quality modeling indicated that plans to further deepen the Savannah River would threaten the future of point source polluters in the harbor, the Georgia Ports Authority quickly introduced a plan to offset the impacts of the deepening and secure the future of dischargers. The plan replaced draconian reductions in point-source discharges with a new hydro-technical logic, centered on the construction of a massive oxygen injection system in the harbor as a means to manage its increasingly contradictory set of dissolved oxygen demands. In this chapter, I explore a delicate and tenuous assembling of hydrodynamic models, suitable fish criteria, and water quality targets that produced oxygen injection as a “hydro-social fix” (Swyngedouw 2013) for the Savannah Harbor. I show how these efforts enabled scientists, engineers, and regulators to more effectively manage the river’s dissolved oxygen demands in space and time, focusing oxygen injection to the sites where it could most effectively support and protect vital fisheries habitat and thereby eliminate the need for point source discharge reductions. In doing so, I argue that oxygen injection and the assemblages of improvement that make it work have facilitated increasingly flexible water quality standards and regulation in the Georgia and South Carolina lowcountry, and encouraged the river’s transition to a devolved, market-led water governance framework. The case extends work on the political ecology of water by highlighting the intricate spatial arrangements necessary to resolve the contradictions of capital accumulation associated with water quality crises and make “hydro-social fixes” work.

Over the course of thirty-nine days in the summer of 2007, the Georgia Ports Authority pumped more than one million pounds of supplemental oxygen into a three mile segment of the Savannah River (MACTEC 2008). The “Savannah Harbor ReOxygenation Demonstration Project”, or “ReOx” as it was called, was designed to demonstrate the feasibility of a controversial mitigation strategy to improve dissolved oxygen levels in the Savannah Harbor and offset impacts from the Authority’s proposal to again deepen the river to improve navigation (MACTEC 2008). Initial water quality

modeling indicated that the proposed deepening would exacerbate the harbor's already degraded dissolved oxygen levels, threatening vital fisheries habitat and causing significant concern among waterfront industries that feared the potential effect of the deepening on the future of their point source discharge permitting (U.S. Army Corps of Engineers 1998a, 1998b). In response, the Ports Authority and the U.S. Army Corps of Engineers Savannah District proposed a system to artificially oxygenate the river, offsetting impacts from the deepening and restoring its ability to assimilate oxygen-demanding wastes and support important fisheries habitat in the estuary (U.S. Army Corps of Engineers 1998a, 1998b).

Over the last decade, offsets have emerged as a key strategy for mitigating adverse environmental impacts (most notably, perhaps, those associated with climate change). Offsets are based on the notion that overall environmental quality can be improved by compensating for excess adverse impacts (e.g., carbon emissions) in one location through comparable (or superior) protections in another (e.g., reforestation programs). Yet critical geographic research suggests that offsets and credits are equally (if not more) about reorganizing “specific instances of environmental degradation into new opportunities for profit,” as they are about restoring a degraded nature (Bumpus and Liverman 2008, p.131; Bakker 2010; Castree 2008a, 2008b; Lohmann 2005). On the one hand, offsets provide a “spatial fix” to crises of capital accumulation, eliminating the need for costly reductions at the source through cheaper alternatives elsewhere (Bumpus and Liverman 2008; Bakker 2010; Castree 2008a, 2008b; Lohmann 2005). On the other hand, the production of offsets requires translating non-traditional resources (e.g. carbon

dioxide, wetlands) into calculable and marketable abstractions capable of bearing value and circulating as commodities (Bumpus and Liverman 2008; Robertson 2007, 2012).

In this chapter, I investigate the efforts to improve dissolved oxygen levels in the Savannah Harbor, asking how, and with what consequences, oxygen injection has intersected with and transformed modes of water quality regulation in the harbor. I find that the translation of dissolved oxygen from a biological concentration measured in milligrams per liter into a geographic object measured in acres of critical habitat gained or lost allowed mitigation efforts to be concentrated in specific space-times, producing an aggregate effect of improved water quality and restored habitat without requiring significant overall reductions in point-source pollution loads. I argue that oxygen injection and the assemblages of improvement that sustain its operation focus on producing a “win-win-win” scenario for the harbor’s major users, and increasingly facilitate water quality’s remaking into forms more amenable to governance and markets. I show how the predictability afforded by more accurate hydrodynamic modeling combined with supplemental oxygen injection and the identification of essential fish habitat enabled scientists, engineers, and regulators to more effectively manage the harbor’s dissolved oxygen demands in space-time, allowing the states of Georgia and South Carolina to develop increasingly flexible mechanisms that enable increased point source pollution loads despite more stringent state water quality standards. In doing so, the study extends work on the political ecology of water by highlighting the intricate spatial arrangements necessary to resolve the contradictions of capital accumulation associated with water quality crises and make “hydro-social fixes” work.

In the next section, I offer a brief review of water quality regulation in the U.S., with a particular emphasis on new modes of water governance. Next, I situate my research in relation to recent geographical debates on the political ecology of water, followed by a short discussion of my primary data sources, and methods of analysis. I develop my arguments through a detailed narrative account of the efforts to improve dissolved oxygen levels in the Savannah Harbor, showing how the Corps of Engineers and the Georgia Ports Authority were able to deploy an intricate assembling of hydrodynamic models, fish habitat, and water quality targets to support super-oxygenation as a “hydro-social fix” (Swyngedouw 2013), resolving threats to capital accumulation and rebalancing the estuary’s contradictory set of dissolved oxygen demands. In the final section of the chapter, I conclude with a discussion of the practical implications of the Savannah case for water quality policy in Georgia, as well as its theoretical implications for future geographic work on the political ecology of water.

Background: dissolved oxygen and water quality regulation in the U.S.

Supplemental oxygen injection is most commonly used as a treatment for wastewater. Point source discharges place added pressure on rivers by raising their biological oxygen demand—the amount of dissolved oxygen necessary to support aquatic resources like fisheries *and* to break down wastewater from regulated facilities.

Wastewater is typically rich in organic nutrients like nitrogen or phosphorous, and while these pollutants can be decomposed by aquatic bacteria, their excess availability sparks explosive bacterial growth that consumes tremendous amounts of oxygen. The net result is that dissolved oxygen levels drop to the point that larger organisms, like fish, are unable to survive.

In coastal river systems like the Savannah, dissolved oxygen levels are largely a function of *flow*, and can generally be divided into three issues: first, as channel depth increases, the ability of oxygen to reach the river bottom decreases, causing lower average levels of dissolved oxygen at the bottom; second, as the channel dimensions expand, saltwater is able to move farther upstream, reducing the ability of that water to accept oxygen from the air; and third, as the channel dimensions increase, the average flow slows down, further reducing the mixing of oxygen through the water column. The end result tends to be fairly grim: heavy point source pollution loads combined with increasing salinity and slow-moving water creates the conditions for treacherously low levels of dissolved oxygen for aquatic life.

While supplemental oxygen injection has emerged as a relatively recent approach for restoring dissolved oxygen levels, the most common have included reducing pollution loads or altering flow regimes to meet applicable water quality standards. Dissolved oxygen levels are governed primarily the Clean Water Act. Passed in 1972, it was directed mainly at regulating point and nonpoint source water pollution. Among its most important provisions, the Clean Water Act introduced the National Pollutant Discharge Elimination System (NPDES)—a permitting system for point-source dischargers based on national standards—and established the requirement for developing Total Maximum Daily Loads (TMDLs)—a calculation of the maximum amount of a pollutant that a water body can receive and still safely meet water quality standards—in impaired waterbodies. TMDLs are more stringent point source pollution limitations, and are developed for waterbodies when NPDES permits alone are not enough for them to meet applicable state or federal water quality standards (U.S. EPA 2014). Typically, TMDLs result in

significant reductions for point source dischargers. Once a TMDL is issued, the NPDES permits for all point source dischargers in that watershed are revised to reflect the new wasteload allocation limits (i.e., that portion of the total load allocated to point sources).

But TMDLs emphasis on improving overall water quality brings a distinct change in the way that pollution loads are distributed and managed, and they have become the sites of newer approaches to water governance. They have been particularly important in the development of water quality trading schemes. Trading is designed to provide greater flexibility to dischargers struggling to reduce their point source pollution loads, allowing them to meet their permitting limits by purchasing “credits,” or units of pollution reduction, generated by other facilities. The overall goal is to produce the same aggregate improvement in water quality at the lowest cost (U.S. EPA 2014).

One of the more recent strategies has been allowing water treatment facilities to purchase offsets through supplemental oxygen injection (ECO₂ 2014). Dissolved oxygen impairment is most frequently identified as the cause of TMDL violations, and advocates maintain that oxygen-injection – combined with water quality credit and trading programs – presents an easier, cheaper, and faster way of meeting water quality targets (ECO₂ 2014). At the most basic level it enables regulated facilities to discharge above their permitted limits, as long as enough additional oxygen is supplied to the receiving waters to keep the facility in compliance (ECO₂ 2014).

The political ecology of water

The political ecology of water has received sustained attention by critical geographers in recent years. Scholars have explored ongoing attempts to commodify and privatize water (Bakker 2004, 2005, 2010; Swyngedouw 2007), as well as the mediating

role of technological innovations and infrastructures in the provision of water (Gandy 2002; Loftus 2006; Sultana 2013), and changing configurations of socio-political power in allocating access to and decision-making power over water (Loftus 2005). For these scholars, water is a “hybrid” object, a technonatural assemblage co-produced through inseparable socio-political and techno-scientific configurations of humans, nonhumans, and technologies (Sultana 2013; Swyngedouw 2007, 2013). This work demonstrates how waterscapes and hydraulic environments are historically and actively produced, the result of struggles to refashion and reconfigure hydrological systems in the interest of continued or renewed capital accumulation (Swyngedouw 2009).

Water technologies and infrastructures play a critical role in refashioning hydrological systems (Gandy 2002; Giglioli and Swyngedouw 2008; Kaika 2005; Swyngedouw 2013). Gandy (2002) demonstrates how water infrastructure constantly reshaped New York’s water supply. Swyngedouw (2004) similarly demonstrates how water technologies and infrastructure urbanize water, taming an unruly resource and making it more amenable to new strategies of accumulation. For these scholars, massive infrastructure projects designed to control and harness water resources are underpinned by a logic of modernization (Bakker 2010; Mitchell 2002; Swyngedouw 1999). Swyngedouw (2004) argues that the hydraulic mission of the state involved remaking water flow, availability, and value, in order to produce a new waterscape. For these scholars, re-engineering water resources is a crucial mechanism through which the state secures the continued functioning of new regimes of accumulation.

Water technologies and infrastructures are saturated with power relations, and they become key sites for struggle over access to, control over, and distribution of parts

of hydrological systems (Swyngedouw 2009). Much of the critical geographic work on these topics has focused on issues of commodification, privatization, and marketization, especially in the developing world (Bakker 2010; Loftus 2006). Bakker (2010, 2013), for instance, has investigated the role of water infrastructures and governance in broader processes of privatization in the developing world. Von Schintzler (2008) argues that political subjectivities and notions of citizenship in South Africa are produced through and bound up in water technologies, infrastructure, and modes of governance. Similarly, Loftus (2006) shows how water meters regulate social relations and political opportunities in everyday life. Sultana (2013) demonstrates how tube wells become important sites for challenging narratives of development, pointing to the ways that specific technonatural failures reconstitute development subjects and discourses. This work points to the multiplicity of ways that water technologies and infrastructures produce or challenge inequitable socio-hydrological conditions.

Water technologies and infrastructure have also proved crucial in providing “fixes” to crises and contradictions of capital accumulation. Swyngedouw (2013) argues that desalination provides a “hydro-social” fix to Spain’s recurrent water crises. The ability to produce more water out of ostensibly “free” ocean water has allowed Spain to rebalance an increasingly contradictory set of demands on its water resources without requiring significant reductions or changes in its modernization logic. For Swyngedouw (2014), desalination represents a transition from a state-centered hydro-structural to a decentralized market-based environmentalist water framework.

But fixing water *quality* presents a slightly different challenge than fixing water *quantity*. For example, fisheries habitat is not distributed evenly throughout a river

system, and in coastal rivers it is defined as much by salinity levels and water temperature as it is by dissolved oxygen. Each of these elements varies tremendously within a river, based on a complex interplay of river flow, tide, or point-source discharge levels. Similarly, not every point source discharger has the same degree of impact on the river system. A small point source discharge into important upstream spawning habitat, for instance, may have a more detrimental impact on the system than a larger discharger down river. Conversely, more oxygen does not simply improve water quality outright; it has to be located in specific places and times that contribute to habitat or waste metabolization. In short, fixing water quality is a decidedly spatial activity; the “where” of fisheries habitats, point source discharges, or oxygen injection are essential to the process.

Primary data sources, and methods of analysis

Drawing on a range of documentary and archival sources, I offer a detailed narrative account of the effort to improve dissolved oxygen levels, highlighting the assemblages of improvement brought together to support superoxygenation as a “hydro-social fix” and more effectively manage the estuary’s contradictory dissolved oxygen demands. But improving water quality through superoxygenation has required more than just adding oxygen to the river system, and my primary interest is in the spatial arrangement of oxygen injection sites, point source discharge reductions, and critical fisheries habitat necessary to make superoxygenation “work.”

The primary source of data for this research consists of the documentary record maintained by the U.S. Army Corps of Engineers for its “Savannah Harbor Expansion Project,” the impetus for efforts to restore the river’s dissolved oxygen levels. I rely

primarily on the project’s documentary record, compiled in its *Final Environmental Impact Statement* and *General Re-Evaluation Report* and maintained online at the homepage of the U.S. Army Corps of Engineers Savannah District. In particular, I draw heavily from “Appendix C” of the *General Re-evaluation Report* and “Appendix N” of the *Final Environmental Impact Statement*. The first contains the project’s supplemental engineering studies, and includes the technical assessments, inter-agency review comments, and correspondence between state and federal cooperating agencies and their consultants involved in the ReOxygenation demonstration project. The second contains the project’s official record of inter-agency coordination, and includes an extensive archive of meeting summaries, inter-agency memoranda, as well as agenda, transcripts, meeting notes, and correspondence between the state and federal cooperating agencies.

In addition to these documents, I draw extensively from a second set of records: those maintained by the project’s “Stakeholders Evaluation Group.” First convened by the Georgia Ports Authority in 1999, the group was tasked with reviewing and approving project impacts and mitigation strategies, and consisted of scientists, representatives, and advocates from a range of state and federal regulatory agencies, industry, non-profit organizations, and local communities. These records, maintained by the Georgia Ports Authority at its Savannah Harbor Expansion Project information site, contain an extensive archive of agenda, meeting transcripts, attendees, meeting notes, correspondence, technical advisory and committee reports, public comments, decision documents, news releases, presentations from public meetings, work plans, Corps of Engineers policy guidance, public notices, supplemental studies, and meeting summaries

produced in the project's fifteen year development.⁴ In particular, I draw on documents generated by the "Modeling Technical Review Group," a smaller group of technical modelling experts from state and federal resource agencies as well as Georgia Ports Authority consultants tasked with reviewing study proposals and providing recommendations to stakeholders. These documents include detailed discussions of negotiations between agency scientists and Ports Authority consultants as they reworked model inputs and calibration to produce the most acceptable and defensible modelling results.

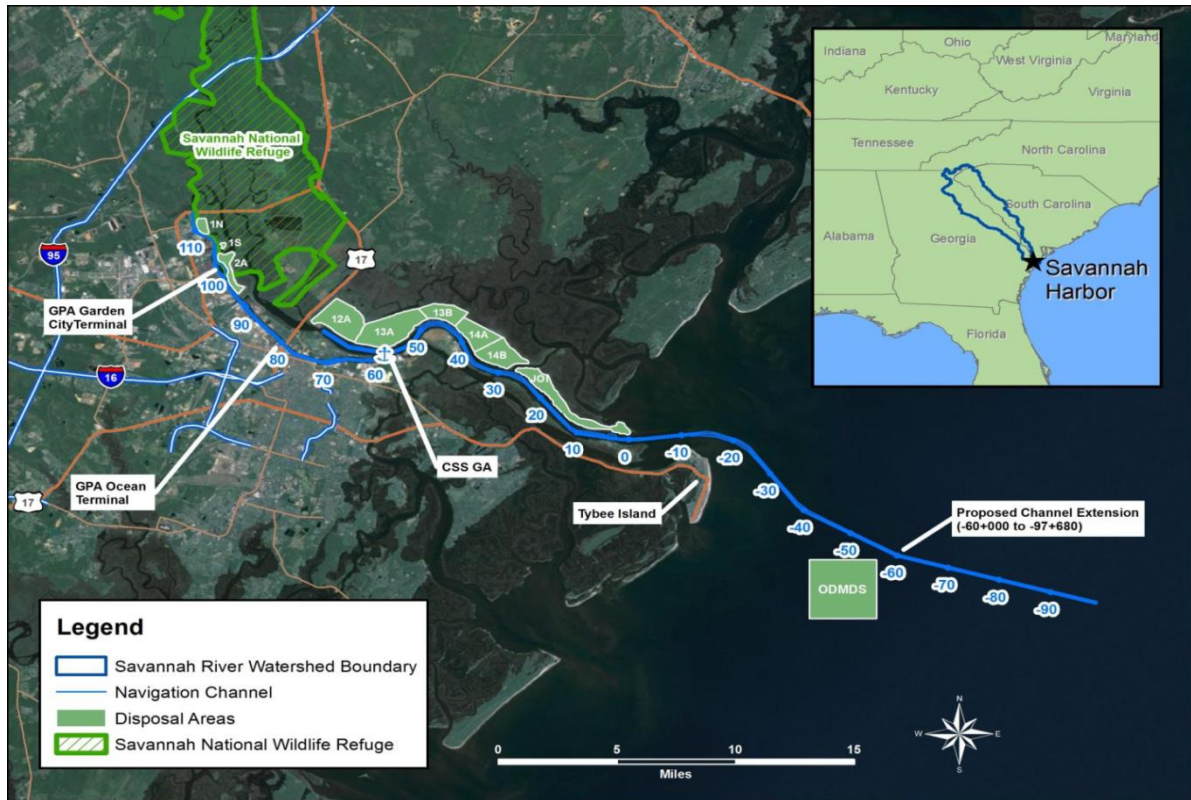
Assembling improvement: superoxygenation as hydro-social fix

In 1989, U.S. Environmental Protection Agency (EPA) Region 4 rejected a site-specific dissolved oxygen criteria proposed by the Georgia Environmental Protection Division for the Savannah Harbor (Figure 1). EPA Region 4 concluded that the proposed seasonal variation of no less than 3.0 mg/L from June through October was inadequate to protect aquatic life in the upper part of the water column. Despite its rejection, the seasonal dissolved oxygen standard remained in place until more suitable criteria could be adopted. But during the initial water quality monitoring conducted in 1997 and 1999 in support of the Savannah Harbor Expansion Project, the harbor was placed on Georgia's Section 303(d), or impaired waters, list under the Clean Water Act after failing to meet the dissolved oxygen criteria for its designated use of "Coastal Fishing." The harbor's listing as an impaired waterway required that the EPA develop and issue a Total Maximum Daily Load (TMDL) for the failed standard, placing a new, more stringent

⁴ Retrieved from: <http://sav-harbor.com/> (last accessed 27 August 2014).

limitation on the amount of oxygen-demanding wastes that could be discharged into the harbor.

But the TMDL process was complicated by ongoing plans to again deepen the Savannah River in order to improve navigation and better accommodate the increasingly larger container vessels that had begun calling at the port. Even with a controlling depth of 42ft and the river's 8 foot daily tide range, many of the vessels calling at the port had to come in light-loaded, or wait off-shore for several hours for the necessary tidal window, in order to make the trip upriver to the docks. Somewhat unexpectedly, the Georgia Ports Authority suddenly faced strong opposition from Savannah's waterfront manufacturers, who voiced serious concern over the impact that the deepening would



(Figure 1. Overview map of the Savannah Harbor. *Source:* U.S. Army Corps of Engineers 2012, p.1-2)

have on the future of their point-source discharging limits. The initial water quality modeling indicated that the deepening could exacerbate the harbor's dissolved oxygen deficit by as much as 1mg/L, and combined with the development of new TMDL restrictions *and* a more stringent state water quality standard for the harbor, waterfront industries began to voice opposition. While the deepening project was meant to secure new rounds of capital flow at the port, it also posed a tremendous threat to local industries, whose profits and productivity would be greatly reduced by any major reductions in their point source permitting levels. In response, the Ports Authority and the U.S. Army Corps of Engineers Savannah District proposed a system to artificially oxygenate the river, offsetting impacts from the deepening and restoring its ability to assimilate oxygen-demanding wastes and support important fisheries habitat in the estuary (U.S. Army Corps of Engineers 1998a, 1998b). But the technology had never applied to such a complex estuarine system, and there were tremendous doubts that it could boost dissolved oxygen levels in the harbor to the point that the river could meet the applicable water quality standards.

Resolving the problems of quantity – better models, more oxygen, and revised standards

As early as 1998, the Georgia Ports Authority had begun exploring Speece Cone superoxygenation technology. That summer, Dr. Richard Speece, the designer of the technology, prepared a preliminary assessment of the anticipated reductions in the harbor, concluding that the approach was “technologically feasible” (U.S. Army Corps of Engineers 1998b, p.178). Dr. Speece’s assessment, however, had only been performed at the level of “conceptual design,” and while the Georgia Ports Authority recognized that the technology would require further investigation in later phases of the project, their Tier

I Environmental Impact Statement concluded that “alternatives to mitigate for decrease in [dissolved oxygen] are feasible and practicable” (U.S. Army Corps of Engineers 1998b, p.178).

The first major challenge came in 2003, when federal and state agencies began expressing serious reservations about the technical defensibility of the hydrodynamic models being developed for the deepening project. The models’ accuracy was critical; changes in the river’s geometry (i.e., the size and shape of the navigation channel) would radically change its hydrodynamics – altering water volume, velocity, aeration rates, and vertical mixing. The models would be used to characterize the current spatial and temporal deficiencies in dissolved oxygen in the harbor, and then be used to predict those same deficiencies in the “with-project scenario.” These spatial and temporal deficiencies would, in turn, inform the decisions regarding optimal placement of the oxygen-injection system and additional mitigation measures to offset impacts to water quality. Early in the modeling effort, the Georgia Ports Authority’s contractor, Applied Technology & Management, chose to develop a modified vertical turbulence formula to characterize the hydrodynamics of the estuary (Applied Technology & Management 1998, n.d.). While a standard method would have been preferred, ATM concluded that the dynamic movements of salinity in the harbor could be more accurately modeled with a site-specific variation (Applied Technology & Management 1998, n.d.). During the first several years of the modeling effort, the models’ performance had been almost the exclusive concern of federal and state reviewers, and the site-specific vertical-mixing method went relatively unnoticed. But in 2003, during a review of the draft dissolved oxygen model calibration report, questions arose over ATM’s choice of vertical-mixing

methodology. The approach used an empirically-derived turbulence formula to determine a vertical-mixing time series, which reviewers described as “not based on the proper physics of the system” (Applied Technology & Management n.d., Part II p.9). The final modeling package was delivered in January 2004, but by that time technical modelers from the Federal agencies, then titled the “Savannah Multi-Agency Review Team,” expressed serious concerns regarding the site-specific vertical-mixing approach and the technical defensibility of the models as predictive tools.

In response to growing concerns over the technical defensibility of the models developed by Applied Technology & Management, the Savannah District requested the position of federal agencies on models being developed by the EPA for the dissolved oxygen TMDL in the harbor. The effort used the same 1997/1999 data set collected for the deepening project but was using a different 3-D hydrodynamic model already accepted and widely used by the EPA in developing TMDLs. The Corps proposed using the same model with only minor enhancements to assess impacts from the deepening project. In April of 2004, the regional heads of the federal agencies informed the Ports Authority of their intention to reject the models based on the site-specific vertical-mixing modifications. In May, the federal cooperating agencies submitted a final decision rejecting the hydrodynamic and dissolved oxygen models being developed by the Ports Authority as “fundamentally flawed and not technically defensible due to the unique modifications” (Gerber 2004, p.1). As a result, the federal cooperating agencies chose instead to pursue refinement of the Plan-B models being used by the EPA in the development of a TMDL for dissolved oxygen on the lower Savannah, and in 2006, accepted the models for use in evaluating impacts from channel deepening. The models

would then be used to quantify (and render spatial) potential project impacts to salinity, dissolved oxygen, chlorides, wetland conversion, fishery habitat, and others. Most importantly, the models would be used to identify and predict the temporal and spatial distribution of dissolved oxygen deficiencies under varying estuary conditions, allowing the Savannah District to focus mitigation efforts to the sites where it could most effectively support and protect vital fisheries habitat while eliminating the need for point-source discharge reductions.

With the harbor's hydrodynamics and water quality predictably characterized by the models, the Savannah District began exploring potential technologies to boost dissolved oxygen levels. In August of 2004, the EPA had released its draft TMDL for dissolved oxygen in the Savannah Harbor. In it, the EPA noted that the existing Georgia standard was unattainable under any conditions without an artificial injection of dissolved oxygen, and indicated that it would pursue limiting point-source discharges in the harbor to zero pounds per day (EPA 2004). The announcement was met by an uproar from local industry, who expressed intensified opposition to the deepening project and serious doubts that such draconian reductions were even in the realm of possibility. EPA acknowledged the challenge of such drastic reductions – identifying the site-specific water quality standard as an inappropriate water quality standard for the harbor – and endorsed “any administrative or regulatory tools available [...] to provide flexibility in such implementation,” noting that it embraced the concept of water quality trading as mechanism to meet the new limits as long as the total TMDL was not exceeded (EPA 2006, p.11).

In 2005, the Savannah District contracted with MACTEC Engineering and Consulting for a study to identify potential measures for improving dissolved oxygen levels in the estuary. While the Ports Authority and the Savannah District were only required to mitigate the incremental impacts of the harbor deepening, the draft TMDL and looming revision to the state water quality standard resulted in a search for a technology that was potentially scalable, and could, if demonstrated to be successful, be expanded to bring the entire river up to the applicable (and future) state water quality standards. Ultimately, MACTEC concluded that the injection of superoxygenated river water via Speece Cones presented the most cost-effective means for improving dissolved oxygen levels in the harbor. The technology had been explored by the Ports Authority as early as 1998, having been used to achieve TMDL targets in other water-bodies – primarily stagnant canals and reservoirs – but it had yet to be applied to such a complex estuarine system. In 2007, the Ports Authority contracted with MACTEC to build, operate, and monitor a full-scale, “exceptionally fast-track” demonstration project of the Speece Cone superoxygenation technology in time for the critical summer season of 2007 (MACTEC 2008, p.ii). MACTEC designed two 12-ft diameter cones—each capable of injecting 15,000 pounds of dissolved oxygen per day—and operated the system from a floating barge along the river. The ReOx project ran over a 40-day period from August 7, 2007 to September 16, 2007, and sought to add nearly 20,000 pounds of dissolved oxygen per day to the harbor (Figure 2).

Following the conclusion of the demonstration project, the Ports Authority declared the technology a success. In its 2008 summary report, MACTEC concluded that, “the ReOx system operation reduced the mid-channel average low tide [dissolved

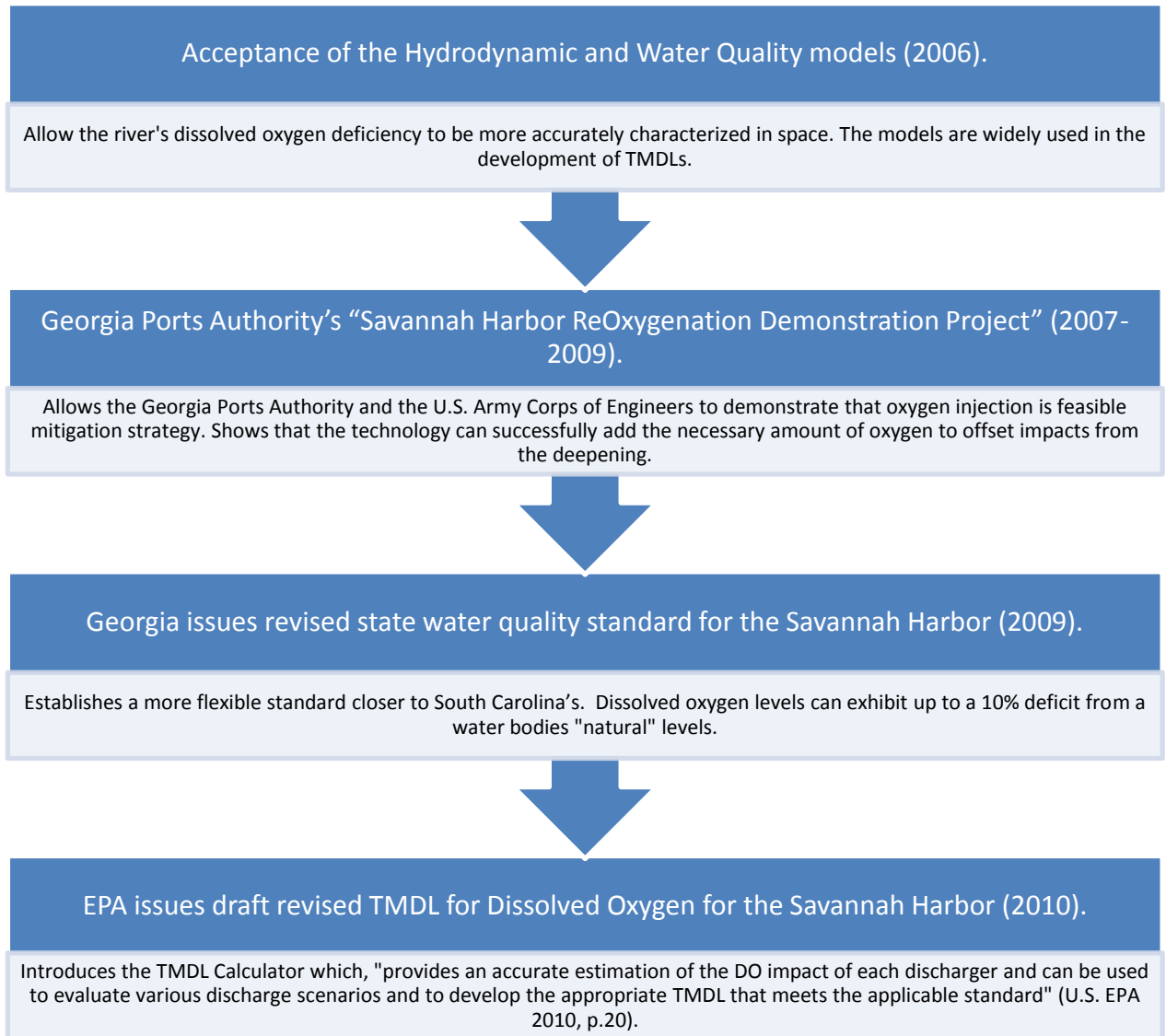


(Figure 2. Savannah Harbor ReOxygenation Demonstration Project. Source: Tetra Tech 2008, p.15)

oxygen] deficit along the three-mile-long target segment by about 0.6 mg/L” (MACTEC 2008, p.ES-2). But according to a review of MACTEC’s summary report by the U.S. Geological Survey, the report’s claim that the oxygen-injection system had been able to boost dissolved oxygen levels in the estuary by 0.6 mg/L was a gross over statement, charging that “the data and discussion in the report did not present a defensible quantification of contribution of the ReOx injection to the dynamic [dissolved oxygen] variability of the system. None of the information reviewed supports the conclusion the ReOx system had a substantial impact on [dissolved oxygen] in the Front River” (Conrads 2008, n.p.). In fact, the U.S. Geological Survey was able to demonstrate

similar reductions in the harbor's dissolved oxygen deficit based on the natural variations of the moon and tides (Conrads 2008, n.p.). MACTEC provided a supplemental data report in 2009, revising its claims and arguing that “[c]ontinuous monitoring data from the barge monitors showed a definite [dissolved oxygen] response due to operation of the ReOx system indicating that oxygen was added to the harbor particularly in the deeper layers of the channel where it was injected” (MACTEC 2009, p.3-13) and that “[m]id-channel profiles for both high and low slack tides showed evidence of an oxygenated plume of water in the vicinity of the ReOx system. Also, transects made at 5 locations showed definitive evidence of the impact of the ReOx system on [dissolved oxygen] water quality in the river” (MACTEC 2009, p.4-1). Additionally, MACTEC pointed to modeling of the ReOx system performed by Tetra Tech which indicated “an increase in dissolved oxygen concentrations in the harbor area of at least 0.1 mg/L over a 10-mile reach [...] modeling clearly shows a positive effect (or increase) of adding oxygen to the Savannah Harbor” (Tetra Tech 2009, p.24). But agency modelers raised questions over Tetra Tech's near- and far-field modeling approaches. Both the near-field plume modeling and the far-field modeling were run based on an ambient river time series of temperature, salinity, and velocity at the injection sites during the summer of 2007 when the ReOx project occurred. Agency modelers pointed out that these characteristics vary considerably within the harbor, noting that the injected oxygen may not “perform” in quite the same way depending on the location of the injection (Tetra Tech 2009).

The modeling effort and the ReOx Demonstration Project were complemented by a series of regulatory changes by the EPA and the Georgia Environmental Protection Division which helped to reduce the required amount of dissolved oxygen improvement



(Figure 3. Resolving the problems of quantity)

(Figure 3). In 2010, the EPA released a revised draft dissolved oxygen TMDL for the Savannah Harbor. The revision incorporated Georgia's new state water quality standard, which more closely matched the stricter standard of South Carolina. More importantly, the revised TMDL outlined the implementation of a new "TMDL Calculator" to distribute the waste-load allocations for dischargers on the river. In 2006, EPA Region 4 had set the wasteload allocation for the harbor at zero pounds per day, but by the 2010

revision the increased predictability afforded by the hydrodynamic and dissolved oxygen models combined with the potential offsets provided oxygen injection, EPA set the “initial TMDL target [of dissolved oxygen] is a daily average delta [of dissolved oxygen] of 0.1 mg/L” (U.S. Environmental Protection Agency 2010, p.22).

The TMDL Calculator had been conceived by Jim Greenfield, with EPA Region 4, and included during the 2002 development of a dissolved oxygen TMDL for the Charleston Harbor (Cantrell 2013). Effectively, the TMDL Calculator was a spreadsheet which allowed regulators and industry to calculate numerous scenarios under which a TMDL’s numeric target could be achieved:

“More than a hundred [Environmental Fluid Dynamics Code] water quality model simulations were completed to determine the unit response of delta DO in each TMDL segment per pound of effluent [carbonaceous biochemical oxygen demand], ammonia, and DO individually for each outfall location. The responses are linear and additive so once the individual responses are determined, they can be stored in spreadsheet tables and added together to get the total delta DO from all discharges. Users adjust effluent loads on the interface tab and the delta DO results are recalculated instantly [...] After the TMDL is finalized, the TMDL calculator can be used for future reallocations. As long as the DO standard is maintained as evidenced by the TMDL calculator, future reallocations will be considered to be consistent with this TMDL and reopening or revision of the TMDL is not necessary” (Cantrell 2013, p.24).

Based on the hydrodynamic model the tool allowed users to identify critical segments of the river and, based on a weighting factor for each discharger, take into account each discharger’s location in the system and impact on the critical segments in order to isolate the impact of each individual discharger. The calculator was thus able to predict the

dissolved oxygen deficit associated with almost any combination of loadings. The result is not a fixed number - a single available load for the system or a series of loads for various model segments. Rather, the calculator could predict a series of loadings, any of which could result in a deficit consistent with the TMDL target of 0.1mg/L allowable dissolved oxygen depression, allowing for a more flexible approach to discharge permit allocations. The total wasteload allocation could vary depending on the locations of the individual loads in relation to the critical segments. The TMDL Calculator computes the dissolved oxygen depression at the critical locations in the estuary in response to various combinations of individual wastewater loads, which can then be allocated based on the decision of the states. The TMDL Calculator can be used to divide up the loading to the system “more efficiently,” based on factors like waste treatability. Most importantly, “[f]uture reallocations, and changes in the total [wasteload allocation], are possible without further revision of the TMDL provided the TMDL target is maintained as shown by the EFDC model and/or TMDL Calculator” (Cantrell 2013, p.iv).

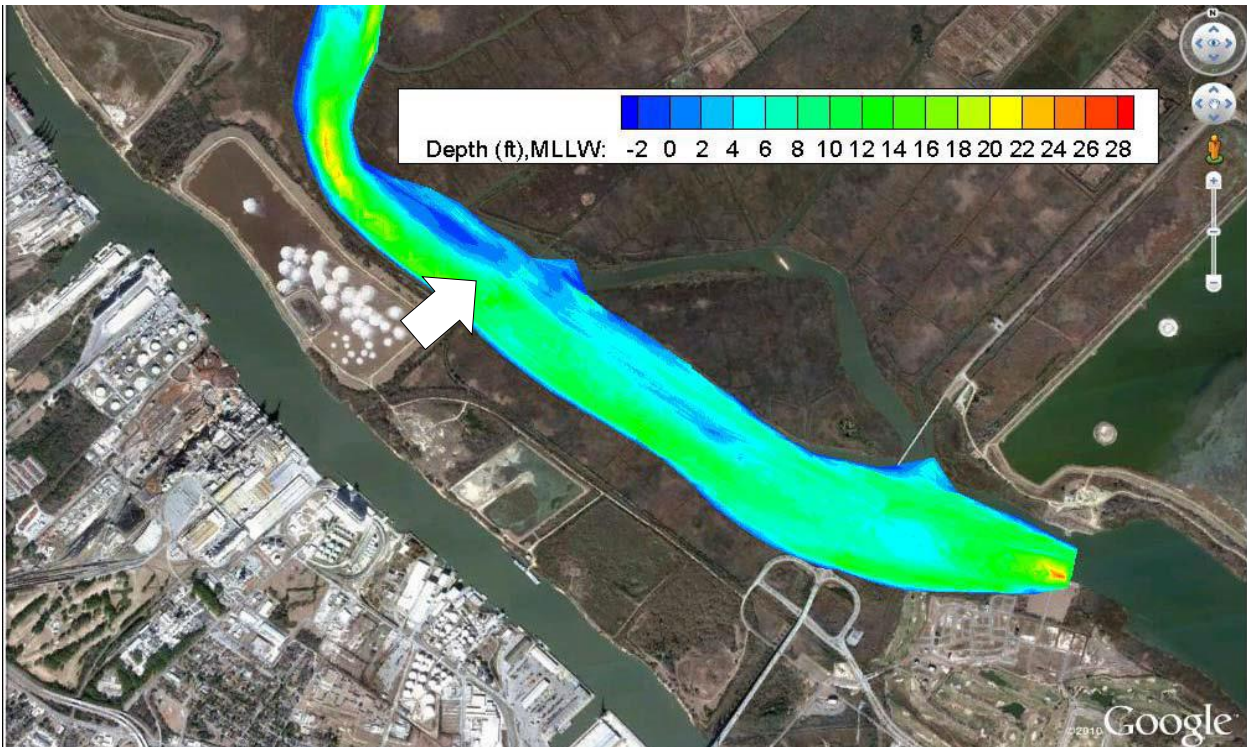
The TMDL Calculator provides regulated industries greater flexibility in meeting point source reductions. In the case of the Charleston Harbor, for example, the Calculator allows “additional loading compared to the previous TMDLs due in part to a more accurate model. The new model more accurately represents estuarine circulation [...] resulting in higher predicted dilution and allowable effluent loading throughout the system” (Cantrell 2013, p.iii). Calculated in this way, the potential wasteload allocation in pounds per day falls within a tremendous range, one made significantly larger by supplemental oxygen injection. The initial target of a 0.1 mg/L dissolved oxygen deficit resulted in a loading range between 80,000 to 115,000 pounds per day depending on how

the load was distributed throughout the system (U.S. Environmental Protection Agency 2010, p.27). But based on an “up to 10% deficit” from the “natural” conditions identified for the waterbody (as allowed by the state standards), the potential deficit could be substantially higher than 0.1 mg/L.

Resolving the problem of location – fish-passage ramps and “restored” spawning habitat

In 2011, the South Carolina Department of Health and Environmental Control met with the Corps to discuss a number of remaining issues over proposed injection sites. A study of Speece Cone application for the San Joaquin River shipping channel suggested that the technology was not suitable for shallower waters, like many segments of the Savannah River estuary. The claim was substantial – river depth in the navigation channel would be nearly 50 feet at high-tide, but other segments of the estuary targeted for oxygen injection would only be around 15 feet deep (Figure 4). The South Carolina Department of Health and Environmental Control requested additional modeling runs, and in July the Corps of Engineers contracted with Tetra Tech to “provide greater assurance that the Speece cones would perform as designed at the Back River location” (Tetra Tech 2011, p.2). At issue was how well modeling results of the ReOx project (operated from a temporary barge in the deepest segments of Front River) could be extrapolated to permanent Speece Cone installations in other parts of the estuary, the locations of which were constrained by a number of issues: they needed to be located on land that was not privately owned, they could not be located in the Savannah National Wildlife Refuge, they needed to be accessible by road, and they needed electrical utilities in place to run the Speece Cones.

Most importantly, however, the locations needed to maximize the system’s



(Figure 4. Back River bathymetry of proposed injection site. Source: Tetra Tech 2011, p.28)

overall impact on the river's dissolved oxygen levels, especially in relation to areas identified as known or potential fisheries habitat. As the Corps, the Ports Authority, and Tetra Tech continued to try and work out the remaining issues of where to locate the Speece Cones, subsequent modeling runs indicated that the oxygen-injection system would, at best, be capable of removing the incremental effect of a deeper channel in only 97 percent of the cells in the bottom half of the water column (U.S. Army Corps of Engineers 2012b, p.5-58). At the same time, some cells showed significant improvement while others show only marginal improvement. And while the Corps argued that, "the minor impact at distances away from the injection location is balanced by the higher [dissolved oxygen] levels that would occur close to where the oxygen is added," state and federal resource agencies remained unconvinced (U.S. Army Corps of Engineers 2012b,

p.5-54). Initially, resources agencies expressed concerns over the potential toxicity of superoxygenated water. However, following several site visits by resource agency staffs in which there were no observable impacts to fisheries, and based on modeling that suggested the superoxygenated plume diluted to non-threatening levels within a few feet, those concerns were resolved.

Despite several flow rerouting and oxygen injection scenarios proposed by the Corps, additional modeling indicated that a number of impacts to fisheries remained and endangered shortnose sturgeon were poised to lose several dozen acres of habitat (Figure 5). Fisheries habitat is determined equally by temperature and salinity, and while the ReOx project seemed to demonstrate, at least conceptually, the ability of the system to provide the necessary amount of dissolved oxygen to the harbor (resolving, in theory, the issue of point source reductions for industrial dischargers), it remained unclear as to whether it could add oxygen in the necessary places to mitigate impacts to fisheries, and maintain levels of acceptable fish habitat. The National Marine Fisheries Service argued that using the bottom half of the water column was an inaccurate representation, since sturgeon are bottom feeders and would encounter dissolved oxygen levels only in the deepest parts of the water column. While modeling runs showed adult sturgeon gaining several acres of habitat in the summer, juveniles—unable to tolerate higher salinities or low dissolved oxygen levels—experienced a substantial loss. Despite gains in adult habitat from oxygen injection, the loss of spawning habitat from salinity increases created an additional problem for mitigating impacts to sturgeon, further complicating the usefulness of superoxygenation. This was an especially important moment: the ability to

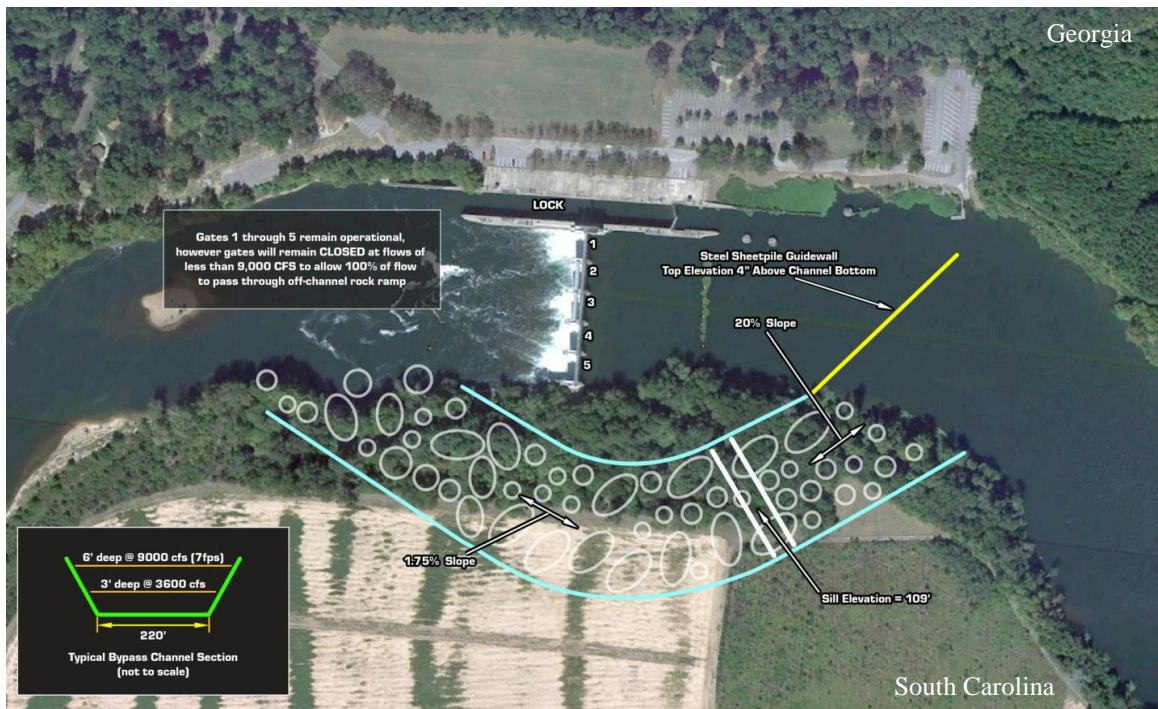
	----- DEPTH ALTERNATIVES -----				
	44-Foot	45-Foot	46-Foot	47-Foot	48-Foot
Fisheries	Loss (-) or Gain (+) of Acceptable Habitat				
- Striped bass spawning	- 2.9 % (-30.0 acres)	- 9.2 % (-96.0 acres)	- 10.0 % (-104.0 acres)	-13.5 % (-140.0 acres)	- 16.1 % (-167.0 acres)
- Striped bass eggs	- 9.4 % (-157.0 acres)	+5.2 % (+87.0 acres)	0 %	-11.1 % (-186.0 acres)	-10.8 % (-181.0 acres)
- Striped bass larvae	-5.6 % (-32.0 acres)	+ 1.7 % (+9.0 acres)	+ 5.6 % (+32.0 acres)	-5.0 % (-28.0 acres)	-3.5 % (-20.0 acres)
- American shad (Jan)	-0.2 % (- 9.0 acres)	-0.2 % (-9.0 acres)	- 0.2 % (-9.0 acres)	-0.2 % (-9.0 acres)	- 0.2 % (-9.0 acres)
- American shad (May)	- 0.2 % (-12.0 acres)	- 0.2 % (-11.0 acres)	- 0.2 % (-11.0 acres)	-0.2 % (-11.0 acres)	- 0.2 % (-11.0 acres)
- American shad (Aug)	-0.3 % (-16.0 acres)	-0.3 % (-15.0 acres)	-0.2 % (-11.0 acres)	-0.2 % (-11.0 acres)	-0.2 % (-11.0 acres)
- Shortnose sturgeon adult (January)	-3.9% (-153.0 acres)	- 4.6 % (-179.0 acres)	-6.2% (-240.0 acres)	-6.9 % (-266.0 acres)	- 8.4 % (-326.0 acres)
- Shortnose sturgeon adult (August)	+ 19.0 % (+ 260.0 acres)	+ 9.8 % (+ 134.0 acres)	+ 7.3 % (+ 100.0 acres)	+6.5 % (+ 89.0 acres)	+ 2.8 % (+ 39.0 acres)
- Shortnose sturgeon juvenile (January)	-6.7 % (-220.0 acres)	- 7.0 % (-231.0 acres)	-7.3 % (-238.0 acres)	-7.6 % (-251.0 acres)	-11.5 % (-376.0 acres)
- Southern flounder	+74.1 % (+1387.0acres)	+ 54.2 % (+1014.0acres)	+ 57.3 % (+1072.0acres)	+57.3 % (+1072.0acres)	+ 52.9 % (+989.0 acres)

(Figure 5. Habitat losses for fisheries with mitigation. Source: U.S. Army Corps of Engineers 2012b, p.5-86)

mitigate impacts to dissolved oxygen becomes directly linked to the ability to mitigate impacts to sturgeon and provide suitable fisheries habitat.

Unable to identify any other ways to improve sturgeon habitat in the estuary, the Corps began exploring ways to improve habitats further upstream. One possibility for improved sturgeon habitat included the historical spawning grounds up near Augusta Shoals. For sturgeon to access this upstream habitat the Corps suggested the removal of the New Savannah Bluff Lock and Dam. Although dam removal was identified as the most preferred method, it was not a viable option. The dam had been authorized for repair and upgrade by Congress in 2000. Additionally, local governments upstream of the dam opposed removal because of the upstream pool provided recreational uses for local users. Adding upstream habitat was predicated on the notion that the oxygen

injection system and flow rerouting would work downstream. If the oxygen injection system did not work as well as the models predicted, the impacts to fisheries would be higher than expected. Plus, supplemental modeling runs showed that acceptable sturgeon habitat was substantially reduced when the 2004 point source loads were added to average river flows. While only a preliminary assessment, the modeling demonstrated risks from the compounded impacts of deepening and point source pollution. Unable to remove the dam, the Savannah District designed a fish-passage ramp in order to provide access to upstream spawning habitat (Figure 6). The National Marine Fisheries Service rejected the Corp's initial design, based on concerns that it would be unable to handle sufficient river flows and too small for the fish to find. Even more concerning was that the Corps had no evidence that sturgeon would actually use the ramp, or would try to move further upstream to spawn. In addition to concerns with the design of the fish passage, the Service raised concerns that juvenile habitat as shown on the suitability maps developed by the Corps did not show good agreement with documented habitat. The conservative estimate of salinity tolerance for juveniles appeared to constrain habitat that was already actually in use by larger juveniles, in particular a larger "fish hole" in the upper segments of the river. As a result, the Service proposed increasing the maximum tolerable salinity for juveniles - from less than 4 parts per thousand to nearly 15 parts per thousand. After this revision, the habitat maps showed a more accurate depiction of already existing habitat for juvenile sturgeon. The revisions also reduced the amount of new habitat that the Corps needed to provide. Despite the increase in juvenile salinity tolerance, the Fisheries Service continued to voice concerns over areas identified by the



(Figure 6. Fish-passage at the New Savannah Bluff Lock and Dam.
Source: U.S. Army Corps of Engineers 2012b, Appendix C p.75)

Corps as recovered or restored habitat. Modeling runs continued to produce conflicting results, and ground-truthing efforts by the Service indicated that areas of the river identified as “suitable habitat” based on salinity and dissolved oxygen conditions may not actually be used by or accessible to sturgeon – making the “gains” irrelevant.

Following several more weeks of negotiations, the Fisheries Service accepted the Corps design for a fish ramp, theoretically “restoring” hundreds of acres of sturgeon habitat and resolving the locational problems which had plagued the oxygen injection system. South Carolina continued to express doubts about the ability of the oxygen injection system to work in upper portions of the harbor, but following a series of commitments by the Georgia Port Authority and the Corps of Engineers on plans to build

a bi-state port in Jasper County, South Carolina, they too approved a state water quality certification approving the project. A protracted legal battle between the Corps of Engineers and several South Carolina environmental organizations ensued, but it too, was brought to a conclusion after a series of commitments and concessions from the Georgia Ports Authority. In 2014, the project was finally included in President Obama's budget, and that summer the Corps of Engineers began the initial construction and operation of the new oxygen injection system.

Conclusions: flexible water quality in the Low Country

The Corps of Engineers' effort to further deepen the Savannah River seriously threatened the future of point source permitting levels for Savannah's waterfront industries—a situation made vastly worse by the EPA's parallel effort to develop a new TMDL and state water quality standard for dissolved oxygen in the harbor. But a combination of new technologies and practices of spatialization deployed by scientists, engineers, and regulators provided a way to meet the needs of multiple users in the harbor, and more effectively manage the river's dissolved oxygen demands in space-time. Despite their strikingly unstable combination, the developments described above gradually provided the conditions to meet the needs of multiple users in the harbor: to offset the impacts of deepening for the Ports Authority and the Corps, to ease the need for major reductions by point source dischargers, and to restore fisheries habitat for shortnose sturgeon. Instead of reducing point source loads, it could be regulated spatially - based on increasingly accurate hydrodynamic and dissolved oxygen models, supplemental oxygen injection, and the maintenance of acceptable habitat. More accurate hydrodynamic models allowed scientists to better predict the spatio-temporal

deficiencies in dissolved oxygen levels and target specific areas needing improvement. The ReOx project enabled the Ports Authority to demonstrate that oxygen injection was technologically feasible, and that the process could successfully increase the amount of dissolved oxygen throughout the water column. The development of suitable habitat criteria permitted the Savannah District to translate dissolved oxygen into acres, and to identify sites where oxygen injection could be the most effective in preserving or increasing acceptable fisheries habitat. Suitable habitat criteria also facilitated the District's identification of potential "restored habitat" above the New Savannah Bluff Lock and Dam, and the development of a fish-passage ramp enabled the Corps to include this new acreage in the calculations of habitat lost and gained. Lastly, the development of a new TMDL Calculator provided greater flexibility to regulated industry in reducing pollutant loads, allocating point source discharge permits based on the impacts of each facility relative to the critical segments of the river. Combined, these efforts were able to eliminate the threat of draconian, across-the-board reductions to point source permit loads, and resolve the barriers to capital accumulation posed by the deepening project.

But superoxygenation and the assemblages of improvement brought together to sustain its realization have also increasingly transferred the governance of Savannah's water quality to non-state and market actors. The developments described above have increasingly facilitated more flexible water quality. In 2013, a combined discharger group along the Savannah River—the Savannah Harbor Committee and the Central Savannah River Area TMDL Group—came together to negotiate a year-long wasteload allocation distribution process. Instead of assigning wasteload allocations to dischargers, EPA and state regulators followed the model recently used in Charleston, allowing

dischargers to determine among themselves the distributions. This could prove to be a very slippery slope, and it remains to be seen whether the Corps' oxygen injection system will actually improve dissolved oxygen levels in the long-term. Regardless, it has delivered a mechanism for rebalancing the estuary's increasingly contradictory dissolved oxygen demands, providing a "hydro-social fix" to a potential crisis of water quality.

This study contributes to a growing body of scholarship on the political ecology of water, showing how dissolved oxygen—and the ecological functions it performs—is remade into a form more suited to governance and markets. And while geographic scholarship has suggested that water has several unique values and entitlements attached to it which make it particularly resistant to commodification, its biophysical components (dissolved oxygen, chlorides, or salinity) or its ecological functions (fisheries habitat or the metabolization of oxygen-demanding wastes) may not present the same challenges. As the contradictory demands on rivers continue to grow, future empirical work should focus on the efforts—and consequences—of scientists, engineers, and regulators remaking them to be simultaneously more protected *and* more productive.

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- Chapter 3 -

Activating memory: adaptive management planning and the politics of remembering in the Savannah National Wildlife Refuge

Abstract. Increasingly, federal and state regulatory agencies have embraced adaptive management as an approach for dealing with the uncertainty inherent in governing complex natural systems. But accepting that policy initiatives and technical science may (and quite often do) fail has made the approach difficult to implement in practice and few successful examples exist. And despite a significant body of theoretical scholarship outlining what adaptive management *should* entail, little work examines how it is actually negotiated in practice. In this chapter, I examine the role of remembering failed policy and faulty science in reconfiguring adaptive management, and argue that memory-work and the politics of remembering/forgetting provide important analytic and strategic tools for understanding how institutional barriers to its implementation are overcome. Through a case study of a controversial harbor deepening project on the Savannah River, the border between the U.S. states of Georgia and South Carolina, I demonstrate how practices of remembering worked to activate the unintended consequences from past harbor deepening and engineering projects—particularly the fifteen year operation of a Tidegate structure across the river—legitimizing a substantial reconfiguration of the river’s governance arrangement. In doing so, this study contributes to a fuller understanding of adaptive management, revealing the ways in which memory-work and practices of remembering contribute to adaptive capacity and ecological resilience, and facilitate its translation from policy to practice.

Early in 2008, the U.S. Army Corps of Engineers released an initial summary of the mitigation plans it would include as part of its proposal to deepen the Savannah River and improve navigation at the Port of Savannah. The project was expected to have a number of adverse environmental impacts, and several of the Corps’ mitigation strategies were being proposed for the first time, including a controversial system to artificially oxygenate the river. Others, including an extensive series of freshwater diversions and flow rerouting, were already saddled with a relatively dismal record of success (Winger and Lasier 1994; Reinert and Peterson 2008). A series of unanticipated impacts from

previous harbor deepening and engineering projects—a deteriorating system of freshwater controls in the Savannah National Wildlife Refuge, a collapsed striped bass fishery, and devastating losses of tidal freshwater wetlands—had left the lower Savannah River a landscape full of *already failed* mitigation strategies, and firmly entangled the District’s proposed mitigation plans with past failures and long-held grievances.

As concerns over the adequacy of the Corps’ proposed mitigation plans intensified, the project’s Stakeholders Evaluation Group (SEG) adopted a proposal advocating for a comprehensive adaptive management approach to provide for the long-term viability of the mitigation measures and ensure the health of river. Over the last several decades, the concept of adaptive management or governance has gained attention as a strategy for dealing with uncertainty in natural resource management, and it emphasizes long-term ecological learning as the basis for continually refined management actions and policies (Stankey et al. 2005; Engle et al. 2011; Williams and Brown 2013). The Corps agreed to include a post-construction monitoring and adaptive management as part of the project’s overall mitigation costs, but the SEG maintained that the plan was vastly inadequate: arbitrarily limiting the post-construction monitoring period to five years, failing to include funding guarantees for the long-term operation and maintenance of the mitigation measures, and lacking any specific acceptability criteria or performance measures that identified what triggered a management intervention and by whom.

Despite widespread support for integrating adaptive management into resource decision-making, the concept is notoriously difficult to translate into practice (Lee 1999; Stankey et al. 2005; Gunderson and Light 2006). In particular, adaptive management’s

emphasis on social learning, large-scale experimentation, stakeholder decision-making, and acceptance that policy initiatives may and often do fail, present a number of major institutional challenges for resource agencies (Gunderson and Light 2006; Stankey et al. 2005; Williams 2011). Resource managers and policymakers tend to be especially risk-averse, and continue to encourage more traditional techno-scientific management approaches to support policy decisions and funding allocations prior to the implementation of an action (Gunderson and Light 2006; Stankey et al. 2005). And while there is relatively widespread agreement on the reasons that adaptive management tends to fall short on delivery, little scholarly work examines how adaptive governance arrangements are actually negotiated in practice. In light of the considerable barriers to adaptive management, I investigate the strategies and tactics deployed by advocates, asking how institutional resistance and inertia that undermine its implementation are overcome in practice. I argue that advocates of adaptive management have to demonstrate that significant opportunities for ecological learning and better resource protections have been, or are being, overlooked or, at worst, have been categorically dismissed. One important strategy for doing so is by activating and deploying degraded landscapes as “sites of counter-memory” (Legg 2005b), those places where the conventional narrative of techno-scientific management is revealed as inadequate.

In order to secure more comprehensive monitoring and adaptive management, SEG members activated a landscape full of already failed mitigation strategies as evidence of overwhelming scientific uncertainty, a tremendously unclear bureaucracy of agency responsibility, and brazen political obstinacy by the Corps of Engineers and the Georgia Ports Authority. As debates over mitigation costs raged, remembering these

failed projects, and refusing to forget them, became key components of the stakeholders' struggle to ensure more comprehensive adaptive management. I conceptualize this process as *memory-work*, the ways in which the past is mobilized as a political tool in the present (Till 2005). In this chapter, I trace the legacy of one such failure—the fifteen year operation of a Tidegate structure along a segment of the Savannah River—asking how, and with what consequences, its collective remembering and forgetting have intersected with adaptive management and water governance in Savannah. In what follows, I argue that stakeholders constructed the Savannah National Wildlife Refuge and the Tidegate as “sites of counter-memory” (Legg 2005b) that undermined the Savannah District’s techno-scientific knowledge claims and their ability to credibly mitigate project impacts or protect the estuary. I show how the SEG’s activation of past mitigation failures and unforeseen impacts reinforced a representation of the Savannah River estuary as uncertain and fragile, gradually justifying significant expansions of the project’s mitigation costs and securing significant victories over numerous institutional barriers to adaptive management. In doing so, this study contributes to a fuller understanding of adaptive management, revealing the ways in which memory and its material traces are mobilized as a political resource in disputes over ecological resilience, resource management, and environmental governance.

In the next section, I offer a brief review of adaptive management policy and practice, highlighting its key tenets and recent debates that emphasize barriers to its development and implementation. Next, I situate my analysis in relation to contemporary scholarship on memory-work and the politics of remembering. I develop my arguments by tracing the legacy of the Tidegate in Savannah, showing how SEG members activated

and deployed it as a “site of counter-memory” (Legg 2005b) in order to secure more comprehensive and protective adaptive management in the harbor and wildlife refuge. In the final section of the article, I conclude with a discussion of the implications of the Savannah River case for adaptive management policy and practice, arguing that memory-work and the politics of remembering/forgetting provide important analytic and strategic tools for addressing the numerous challenges of “translating adaptive management from rhetoric to reality” (Stankey et al. 2005, p.56).

Adaptive management development and implementation in the United States

In 2007, Congress reauthorized the Water Resources Development Act, approving flood control, navigation, and environmental projects by the U.S. Army Corps of Engineers. Additionally, the law required that the Corps include and implement adaptive management in all of its projects, although neither Congress nor Corps of Engineers Headquarters issued any guidance on what an adaptive management approach might *actually* entail. Currently, the Corps identifies adaptive management as one of several “cross-cutting strategies” for implementing its new Integrated Water Resource Management framework, and describes it as “a decision process that promotes flexible decision making that can be adjusted in the face of risks and uncertainties [...] as outcomes from management actions and other events become better understood through monitoring and improved knowledge” (U.S. Army Corps of Engineers 2011, p.17; also National Research Council 2004). Adaptive management “accounts for uncertainty through flexible planning, knowledge sharing—especially between scientists and decision makers—and enhanced capacity to respond reflexively to multiple and uncertain processes of change” (Scott et al. 2013, p.281).

Adaptive management is considered to be one of the most important developments to have emerged in water resource planning in the past several decades (Engle et al. 2011). It is perhaps most broadly conceptualized as a management strategy designed to deal with the inherent uncertainty of governing complex natural systems (Williams and Brown 2013). The key focus of an adaptive management approach is ecological and managerial learning through improved knowledge generation in which “policies become hypotheses and management actions experiments to test these hypotheses” (Kallis et al. 2009, p.636). A central component of this knowledge process involves a new emphasis on post-decision monitoring, whereby a continuous process of monitoring, evaluation, and adjustment are used to better manage complex ecological systems and bring projects in line with stakeholder goals and objectives. Adaptive management also outlines a new role for scientists, who are transformed from the only technical experts to “one of several actors in the learning and knowledge generation process” (Folke et al. 2005, p.445). A central premise of adaptive management is that ecological knowledge is not simply incomplete but that it is also elusive (Stankey et al. 2005, p.8; Walters and Holling 1990).

Adaptive management is almost always framed in terms of linked socio-ecological systems, a concept used to emphasize the dynamic feedback between changes in the physical environmental and the human systems which alter it. Adaptive management is closely related to the concept of resilience, or “the capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity, and feedbacks” (Walker et al. 2004, n.p.). Rather than manage a resource or ecosystem to maintain stability, proponents of

adaptive governance often aim to increase the resilience of that particular socio-ecological system, improving feedbacks between the physical environment and the social institutions that manage it so as to facilitate its long-term existence in different states of being.

Although adaptive management has been lauded by resource managers, it has proven immensely difficult to implement in practice and very few successful examples exist (Kallis et al. 2009). Indeed, Engle et al. (2011, n.p.) suggest that “[w]hile integrated systems may be more legitimate and accountable than top-down command and control ones [...] systems that exhibit stronger remnants of centralization, e.g., technical bodies, sectoral dominance, etc., seem to be more equipped to make rapid and conjectural decisions in response to surprises than those that have successfully transformed into deliberative, participatory, and pluralistic forums.” In particular, scholars argue that the primary impediments to adaptive management are political: risk-averse resource agencies and institutions reluctant to admit (much less learn from) failed management or policy decisions (Kallis et al. 2009; Stankey et al. 2005).

Collaborative governance arrangements—including those that emphasize adaptive management—increasingly represent the new paradigm for managing resources (Lemos and Agrawal 2006). Advocates maintain that they lead to higher-quality decisions, the result of increased empowerment, accountability, and cost-efficiency from involving more actors at the local scale (Reed 2008). Yet critics suggest that the rescaling of governance embodies what Brown and Purcell (2005) call the “local trap,” often falling victim to an implicit assumption, “that a shift in scale downward to the local implies greater empowerment for local actors and that rescaling implies that nation-states become

less important in water management” (Norman and Bakker 2009, p.100). Yet critical scholarship has demonstrated that such rescaling risks inappropriately characterizing the “local” as a scale of democratic engagement, one which inherently offers more equitable and meaningful participation, influence over decision making, agency accountability or public empowerment (Raco and Flint 2001; Evans 2004).

Despite the emphasis on stakeholder participation, especially as a source of new knowledge production, these types of arrangements seldom translate into long-lasting changes in how agencies manage resources. Often, collaborative decision-making fails to generate the deep institutional changes necessary to alter funding regimes or realign agency missions with a long-term adaptive approach. Indeed, scholars suggest that collaborative governance arrangements delegitimize more radical options and opinions by emphasizing the power of consensus-based decisions, and suggesting that they represent the ideas agreed upon by all (Kallis et al. 2009). In spite of these challenges, there have been few case studies that examine how advocates of adaptive management secure these types of deep institutional changes that bring adaptive management practice more into line with its ideal, overcoming institutional inertia and structural resistance to get more protective plans implemented.

Memory-work and the politics of remembering

If the primary impediments to “true” adaptive management lie in the politics and institutional practices of regulatory agencies, how are advocates to overcome these barriers? For advocates, this means that the challenge is to demonstrate specific institutional and programmatic failures; to locate them in specific policies and practices that can be challenged and changed. A particularly useful way of conceptualizing the

politics of this demonstrating is through the politics of memory. The politics of memory pays particular attention to the way that memories are inscribed on the landscape, with specific emphasis on how these memories come to validate a particular narrative of the past and, by extension, a particular set of claims on the future. In this chapter, I extend these ideas to the study of a less obviously “cultural” landscape to those previously researched in cultural geography: the landscape as produced by technomanagerial interventions.

The study of memory has attracted renewed attention by cultural geographers in the last decade (Hoelsher and Alderman 2004; Lorimer 2006; Foote and Azaryahu 2007; della Dora 2008, 2013). Much of this scholarship has approached the study of memory as a cultural politics of heritage and identity, exploring how conflicts over public commemoration or remembrance come to shape the inscription of the material landscape (Alderman 2000, 2002). This work on the “politics of memory” convincingly demonstrates how practices of inscription or expression on the landscape work to bestow legitimacy on political identity (Alderman 2000; Crang and Travlou 2001). One of the central notions for this body of scholarship is that memory is connected to specific, visible sites. Nora (1996) describes these concrete, physical places as “sites of memory.” Being able to be “anchored in place” provides legitimacy and stability to the claims, concerns, and histories of different groups, validating particular readings of the past (Hoelsher and Alderman 2004, p.349). Often, these anchors come in the form of non-human actants: commemorative markers, historical designations, and other signs that are active participants in the continual (re)making of landscapes.

The material landscape is one of the most important components of collective and personal memory (Till 2005; Legg 2007; della Dora 2008; Wylie 2009). The sights, sounds, smells, and feel of a person's physical surroundings act as an "aide-mémoire...[that] seeps into, and provokes, memory" (Legg 2007, p.458). Physical landscape features like mountains or rivers can also become powerful symbols of memory (Baird 2008; Dwyer 2004). Nora (1996) describes these as "topographical memory places," those physical landscape features which evoke an intensified continuity with the past through their specific location or rootedness (Nora 1996, p.18; Samuel 1996, p.39). Thanks to their ability to remain in place, Ricoeur (2004, p.43) describes such topographical features as probably the most substantial "guardians of personal and collective memory."

Yet, memorials—and the physical landscapes in which they are embedded—can hide as much as, if not more than, they reveal (Alderman 2002). Different memories result in different places and landscapes becoming embedded with different meanings. Landscapes are continuously made and remade, authored by competing political agendas and saturated with contradictory meanings and values. Part of what makes landscape so politically powerful is its ability to naturalize appearances, disguising "the historical dependencies and exploitations through which it and its constituent social relations have been produced" (Barraclough 2009, p.170; Mitchell 1996; Schein 2006). Mitchell (1996) demonstrates how the landscape works to hide many of the very forces responsible for its appearance.

One way of dealing with the selectivity of memory and the power relations that produce landscape has been to author "sites of counter-memory": places where the

conventional or accepted narrative of history is openly challenged. Legg (2005b) explores the production sites of counter-memory in India, demonstrating how these sites work to actively resist narratives of partition. Sites of counter-memory are constructed to actively remember, challenging the state's practices of collective forgetting that are intended to narrativize the past in beneficial ways. Legg (2005b, p.182) describes these sites as sites which "mark times and places in which people have refused to forget. They can rebut the memory schema of a dominant class, caste, race, or nation, providing an alternative form of remembering and identity." Often these sites address the more melancholic, nostalgic, or emotional dimensions of memory.

Geographers have shown how places with a difficult or traumatic past—Civil War battlefields, former concentration camps in Germany, or American Indian reservations—prove particularly challenging to incorporate into wider narratives of national purpose or identity (Till 2005). These places become sites of collective or organized forgetting, in an effort to erase difficult or shameful events from the past. A growing number of scholars have explored the practices and politics of remembering and forgetting trauma or tragedy (Foote 2003; Colten 2005; Gentry and Alderman 2007). Till (2005), for example, investigates Berlin as a "haunted" landscape, exploring how lingering presences and absences continue to reshape the landscape.

Building from these themes, I contribute to conversations in geography on adaptive management by focusing on the ways in which collective remembering and forgetting undermine technomanagerial approaches to resource management as it is forced to account for flawed science and failed policy present on the landscape. Cultural geographic work has convincingly shown the importance of the material landscape in

justifying and legitimizing different political claims over others (Alderman 2002; Schein 2006; Barraclough 2009), and it can help us understand the politics of adaptive management, which is on the surface a very different kind of politics, dealing with a very different kind of landscape. Scholarship on adaptive management has insufficiently considered the influence of traumatized landscapes on the credibility of techno-scientific knowledge claims and management decisions. But if the landscape, conceptualized as a cultural artifact shaped by uneven power relationships, lends legitimacy to some political claims over others, then the landscape of the lower Savannah River—a collapsed fishery, failing freshwater control system, and diminishing freshwater tidal marsh—certainly seems to work *against* the Ports Authority and the Corps of Engineers. It is a history of scientific mismanagement, poor planning, and unaccountability writ large across the estuary. The goal, then, has been for the Ports Authority and the Corps to deactivate the memory of the Tidegate, perhaps the most prominent challenge—and potentially destructive “site of memory”—to the Corps’ narrative of technical expertise and engineering science.

Primary data sources and methods of analysis

Despite the numerous challenges that continue to frustrate efforts to implement adaptive management on a large scale, stakeholders in Savannah confronted institutional inertia and a techno-scientific culture of risk-aversion in order to secure a more open-ended, flexible, and experimental adaptive management plan. The goal of my analysis in the following sections has not been to determine whether the monitoring and adaptive management plan developed in Savannah was a “success,” or if it lives up to the ideals of adaptive management identified in the literature. Instead, my aim has been to provide an

analysis of tactics, in which memory and its material traces are mobilized as a political resource in disputes over water resource governance and adaptive management implementation. To do so, I rely primarily on archival data, and offer a detailed narrative account of the plan's development and evolution, paying specific attention to the ways that stakeholders actively wielded the memory of the Tidegate—and the landscape left in the wake of its operation—in order to justify their demands for a more comprehensive monitoring and adaptive management plan and secure more protections for the estuary.

I draw heavily from two sets of primary sources: the final *Environmental Impact Statement* released by the U. S. Army Corps of Engineers Savannah District in January of 2012, and the documentary record of the project's Stakeholder Evaluation Group compiled and maintained by the Georgia Ports Authority. Combined, these collections provide a rich body of material for analysis, including an extensive documentary archive of agenda, meeting transcripts, attendees, meeting notes, correspondence, technical advisory and committee reports, public comments, decision documents, news releases, presentations from public meetings, work plans, Corps' policy guidance, public notices, supplemental studies, and meeting summaries produced in the fifteen year development and negotiation of the project's final *Environmental Impact Statement* and *General Re-Evaluation Report*. In particular, I draw extensively from SEG meeting transcripts and official correspondence between the project's federal cooperating agencies from 2008 to 2012—those years near the latter-end of the project's planning when negotiations over mitigation were at their most intense. These documents provide some of the richest opportunities to follow agency scientists, public officials, industry representatives, non-profit organizations, and concerned citizens as they negotiated the finer details of the

Corps' monitoring and adaptive management plan. Additionally, I draw from twelve months of ethnographic fieldwork in Savannah, conducted from August 2012 to August 2013. By August of 2012 the SEG meetings had ended and the deepening project had moved into federal court in South Carolina, but during this time I made numerous trips to the wildlife refuge, attended and observed at public meetings throughout the city, and conducted semi- and unstructured interviews with members of the SEG.

Translating Policy into Practice: Securing Adaptive Management in Savannah

Starting in the mid-1990s, the Georgia Ports Authority began work on a proposal to deepen the Savannah River. The project was designed to improve navigation for the growing number of increasingly larger container vessels that service the Port of Savannah, many of which now have to come in light-loaded or on high-tide to avoid dragging the river bottom. The Savannah carries substantial amounts of silt, and like other lowland coastal rivers, its “natural” condition contains a number of islands dividing the river into a series of slow-moving, shallow, and meandering channels in its lower reaches - a condition that tends to markedly complicate maintaining commercial navigation. But the near continuous series of engineering and deepening efforts designed to improve and stabilize the navigation channel has left a number of unexpected and damaging effects on the river—including tremendous losses of rare, tidal freshwater wetlands and vital fisheries habitat in the Savannah National Wildlife Refuge—that fueled intensified opposition to the Ports Authority’s most recent deepening proposal from local environmental groups and federal, state, and municipal resource agencies.

In response, the Ports Authority chose to organize a “Stakeholders Evaluation Group” (SEG) – composed of agency scientists, public officials, industry representatives,

non-governmental organizations and concerned citizens – to review the deepening’s potential environmental impacts and approve a consensus mitigation plan. But suspicion and in-fighting among participants remained high, and the SEG made very little progress over the course of its first several months as stakeholders struggled to agree on the extent and magnitude of potential impacts. But as the SEG gradually transitioned into the second component of its mission—the development of a consensus mitigation plan—the group’s debates increasingly shifted to the realm of memory: how, stakeholders asked, would the Ports Authority and the U.S. Army Corps of Engineers account for the project’s high levels of scientific uncertainty, particularly in the face of so many unanticipated and nearly devastating impacts in the refuge?

On the one hand, several of the Corps’ proposed mitigation measures were being implemented for the first time, including a massive oxygen injection system designed to offset the project’s impact on water quality and a fish-passage ramp around the New Savannah Bluff Lock and Dam intended to mitigate impacts to fisheries. Although oxygen injection had been used to help improve dissolved oxygen levels in other impaired waterbodies—primarily reservoirs and stagnant canals—it had never implemented on so large of a scale, and had never been applied to a dynamic estuarine system like the Savannah Harbor. On the other hand, the Corps’ hydrodynamic and water quality models tended to perform poorly on the river’s Back River and Middle River segments, both of which flowed through the wildlife refuge and were identified as critical fisheries habitat. Modeling runs produced a series of contradictory results, predicting reduced salinity levels *and* increased shifts to saltwater marsh species in the same locations. As Steve Willis of the Center for a Sustainable Coast lamented, “If we

can't predict and measure what might likely happen, and what the consequences would be at this one point on Abercorn Creek, you know, what about everywhere else" (SEG 2007, p.103).

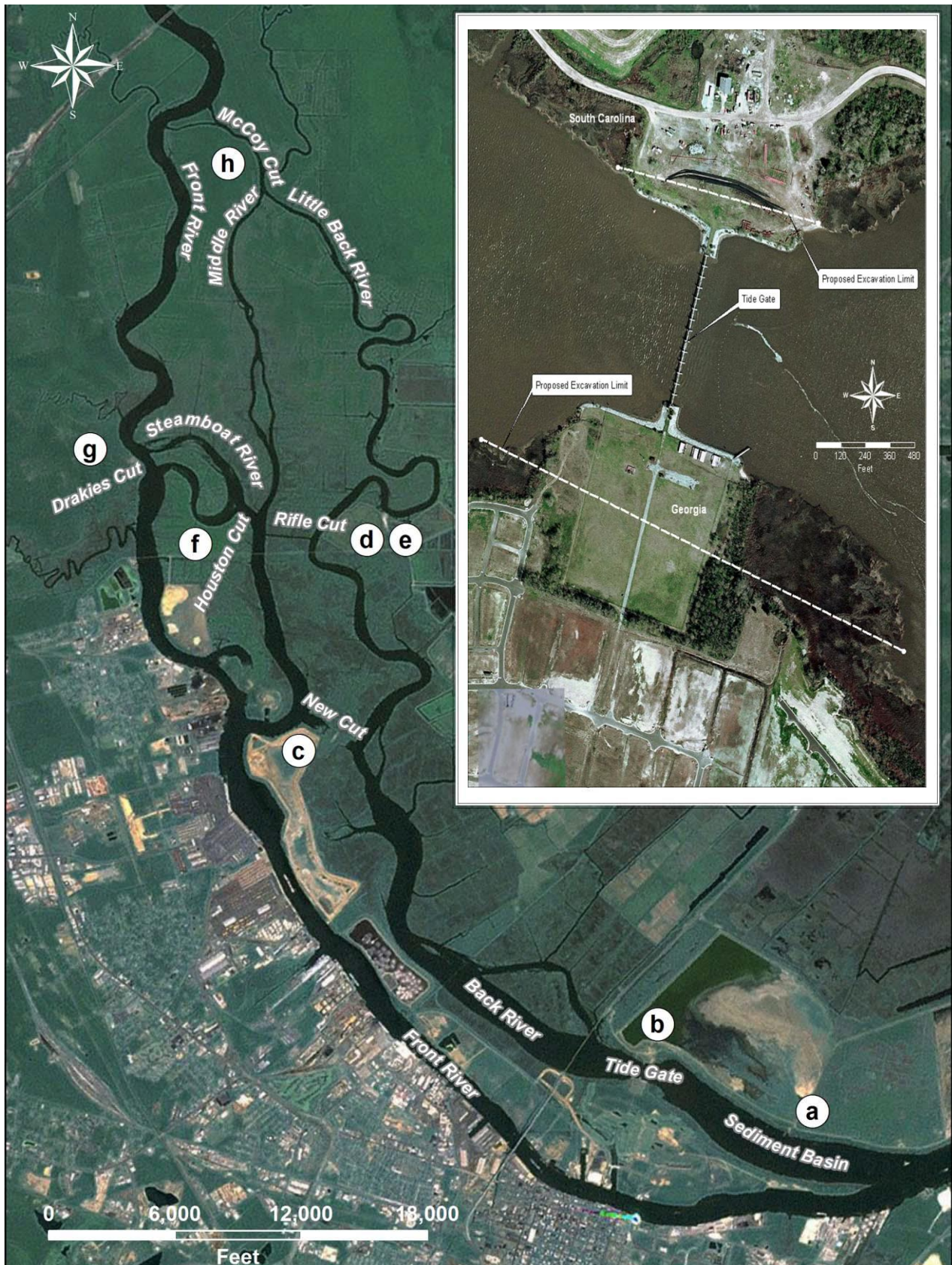
Activating the Tidegate as a "site of counter-memory"

In the face of growing scientific uncertainty, stakeholders recommended a process designed to systematically address the inevitable shortcomings and uncertainty in the mitigation plan. In May of 2008, the SEG approved a memo calling for an adaptive management approach, recognizing that no predictions made by the Corps would be entirely accurate or mitigation strategies entirely effective. The memo called for a series of "contingency procedures" that included the "specification of all assured sources of funding that will be available to cover the costs of any previously unforeseen corrective actions or compensation for cost overruns that may need to be pursued to protect public resources," the identification of "the criteria to be used to trigger enactment of contingency plans for controlling adverse effects if and when they arise," and the "threshold of conditions that must be ensured to enable the project to remain feasible in the public interest. If these conditions cannot be maintained, procedures must be clearly outlined for intervening to prevent the project or its mitigation from causing further damage to public resources" (SEG 2008, p.1). Will Berson of the Georgia Conservancy, summed up the feeling succinctly:

"...I want to put this as politely as I can. We could be facing a situation where the project does not perform as modeled. Let's just pick on something – oxygenation. It is not – it – there really isn't a warranty here that the Corps and the federal agencies will make it right, if oxygenation as approached doesn't work. I mean, as we evaluate this project through the EIS and the final statement, we're

assuming oxygenation is going to work. If it doesn't, then we have to hope that the federal agencies can come up with a plan B. And if they don't, hard cheese. Is that basically the way it goes? [...] The project will already be done by the time we understand the oxygenation system doesn't work. So, you know, where's the leverage to make the federal agencies do the right thing or come up with something? [...] There isn't ample responsibility on the Corps or the resources agencies to make it right. I mean, it's kind of like do the best you can” (SEG 2010c, p.69-73).

The “Memo of ’08,” as it became called, was tied to a long history of techno-scientific mismanagement and political obstinacy by the Corps of Engineers, particularly its long-standing refusal to repair the freshwater control system in the wildlife refuge—built by the Corps in the 1970s as mitigation for a previous deepening project. As Dave Kyler, then Executive Director of the nonprofit Center for a Sustainable Coast, made clear, “[t]hose kinds of egregious, flagrant deviations from the management of the project are why I developed this (adaptive management) memo in the first place” (Kyler quoted in Landers 2011, n.p.). From 1977 to 1992, the U.S. Army Corps of Engineers operated a series of sediment control works as a general navigation feature of the Savannah Harbor Navigation Channel. The primary features of the control works included a Tidegate structure across the Back River and the excavation of a new drainage canal, known as “New Cut” (Figure 7). The Tidegate would open during incoming tides and close at high water, forcing the outgoing flow through New Cut and into the Front River. Combined, the control works were designed to increase water velocities and reduce shoaling in the navigation channel, ultimately reducing the cost of maintaining the navigation channel. But as the Corps developed the two projects, in conjunction with an earlier deepening project authorized in 1965, it became evident that the changes would allow saltwater in



(Figure 7. The lower reaches of the Savannah River: Front, Middle, Back, and Little Back River segments. Inset: The Tidegate. Adapted from: U.S. Army Corps of Engineers 2012b, Appendix C p.13, 38)

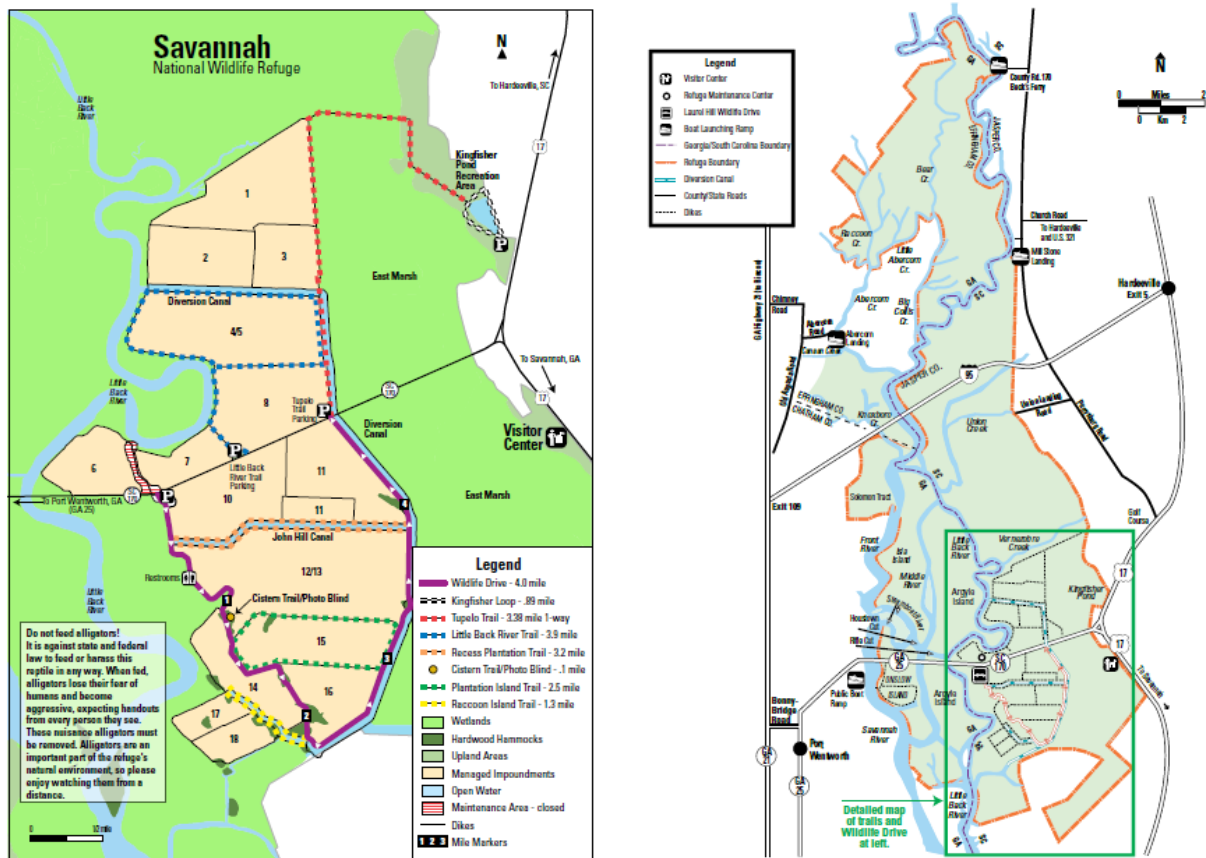
the estuary to move further upstream, to the point of threatening the freshwater supply of the wildlife refuge (Figure 8). As a result, a system of freshwater control works was built to offset the movement of salinity, including a diversion channel from Little Back River—a 28,000-foot long freshwater supply canal—and the installation of 17 water control structures in order to manipulate water levels in the impoundments that make up the refuge’s managed wetlands (COE 2012b).

Following their installation, the sediment control works dramatically reduced the cost of maintaining the navigation channel, but they also had a number of unexpected and nearly devastating effects. Salinity levels in the Back River proved to be much greater than predicted and the freshwater control structures rusted and failed soon after construction. Particularly detrimental was New Cut canal, which flushed striped bass eggs into Front River with the outgoing tide, damaging the fishery to the point that the “once thriving population nearly collapsed in the late 1980’s due to changes in bathymetry and increased salinity levels in critical spawning grounds located in the Back River” (Forester 2010, n.p.).

The control works are essential for the refuge to manage its freshwater impoundments, an ability which, if lost, would leave the refuge subject to the tides. Despite calls for the removal of the Tidegate throughout the 1980s, it was not until 1990 that the U.S. Fish and Wildlife Service was finally able to demonstrate conclusive evidence that its operation was responsible for the saltwater intrusion into the refuge and the near collapse of the striped bass fishery. New Cut Canal was closed and the Tidegate taken out operation in 1992, and while the refuge began showing improvement following the removal of the Tidegate, the fresh water controls continued to deteriorate. The

Service had been petitioning the Corps to repair the freshwater control system since its failure in the 1970s, but the Corps insisted that the long-term maintenance and operation of the system was not their responsibility, saying “once we turn over the project to Fish and Wildlife, as we have with the refuge, there is not much we can do to help them out . We don’t know whether it was poorly constructed or a lack of maintenance on their part” (Lowry quoted in Wills 2001, p.33).

But at the SEG meeting in July of 2008, when the Corps indicated that it would include an adaptive management approach as part of the project’s mitigation plan, the legacy of the Tidegate was mobilized by stakeholders who objected to significant



(Figure 8. The Savannah National Wildlife Refuge. Source: U.S. Fish and Wildlife Service 2015, n.p.)

discrepancies between the proposal outlined by the Corps and the approach recommended in the “Memo of ’08.” The plan included a limited amount of funding for adaptive management at the end of a five year post-construction monitoring period. According to the Savannah District, the monitoring period would determine “whether the mitigation is performing as it was intended. So if it is, then there's -- Nothing to adapt. If something isn't working quite right, then you would change it” (SEG 2010c, p.27). But the vagueness of the approach prompted a response from David Kyler, of the nonprofit Center for a Sustainable Coast, who indicated that he understood adaptive management to be a much more comprehensive process which, “in its widest sense, it [is] also institutional changes, not just changes in the project; who's doing what and how the project is administered and managed” (SEG 2006c, p.14-15).

In particular, stakeholders objected to the limited monitoring period and the Corps’ failure to identify the conditions that would constitute “successful” mitigation. The omissions prompted a response from Will Berson of the Georgia Conservancy, who pointed to the Corps’ longstanding refusal to acknowledge the adverse impacts from the operation of the Tidegate, as evidence of the need for explicit performance criteria, including specific biological indicators for wetlands and fisheries, which would trigger an adaptive management intervention:

“I think in some ways it's very difficult to divorce what's happened in the past with respect to the Savannah River...I guess you might want to have some people, in addition to the Corps, reviewing impacts at that stage. *I'm sort of thinking back to the tide gate question where people were saying it's causing a problem and the Corps said it wasn't causing a problem. It ended up being a long time fixing the problem because you had to prove that there was a problem.* I think that's something you don't want to get into in adaptive management. I think you would

do well to have a spectrum of folks that were sort of evaluating what the results of monitoring was [...] I think that makes—that increases the confidence level in what you’re doing and that’s what everybody wants” (emphasis added, SEG 2008b, p.84-86).

Here, Berson mobilizes the memory of the Tidegate to challenge a specific institutional arrangement in Savannah that inhibits adaptive governance: conflicting agency missions that limit their ability to work together. This lack of collaborative decision making prevents feedback between the social and ecological systems, thereby limiting learning and inhibiting better management decisions. For instance, the Corps’ primary mission is maintain navigation, and while they are required to mitigate any adverse environmental impacts resulting from their activities, the “success” of this mitigation is almost always seen through the lens of this mission.

Following installation, two of the project’s most controversial mitigation features—the oxygen injection system and the fish-passage ramp at the New Savannah Bluff Lock and Dam—were to become general navigation features of the Savannah Harbor Navigation Project. This meant that like the Tidegate, they would be maintained solely by Corps of Engineers, that they would be funded through the Corps’ annual appropriations process, and that the evaluation of their success would likewise be at the discretion of the Corps. As Berson points out in the quote above, one of the more significant problems with the operation of the Tidegate was that the Savannah District assessed the performance of its own mitigation features, and did so within the context of its mission to maintain navigation. Without any type of ecological or biological performance measures the Tidegate—or any future mitigation feature—would, inevitably, been seen as a success, at least according to the Savannah District, as long as

it continued to reduce the cost of maintaining the harbor (or, worked in the interest of maintaining navigation). Without an authoritative mechanism to require the Savannah District to respond to evaluative criteria other than its own (i.e., reducing the costs to maintain navigation), stakeholders had no substantive capacity to force the Corps to correct problems. In theory, Georgia or South Carolina could withdraw their state water quality certifications but, again, that does not guarantee a timely or even complete response.

But stakeholders' most strident objections were to the Corps' plans to fund several key components of the mitigation plan, including post-construction monitoring and adaptive management, through its annual appropriations process. In the face of lingering doubts that the District's key mitigation features could even work, and the requirement that several of them be maintained in perpetuity, the National Marine Fisheries Service and Fish and Wildlife Service expressed strong opposition to such an insecure funding stream, noting that "[t]he COE's record of not providing adequate maintenance of the mitigation features within the Savannah National Wildlife Refuge partially substantiates this claim" (Crabtree 2011, p.180), and indicating that "the Corps' ability to honor past commitments for mitigation affects agency expectations for the success of future project mitigation" (O'Kane 2009b, p.644). David Kyler, of the nonprofit Center for a Sustainable Coast, voiced significant frustration with the requirement to go back to Congress to ask for a separate allotment of funding to address problems as they arose, lamenting that mitigation costs could be significantly underestimated and, should corrective measures be necessary, the limited funds would be

either quickly exhausted or not available in a sufficient timeframe, if at all, relying on Congressional appropriations:

“What if a mitigation effort, either because of interactive effects of different mitigation steps taken for different purposes, or because of some just counterintuitive effect of a mitigation has a greater adverse impact, deviant impact than just a minor adjustment would allow; what kind of contingency will be built into the adaptive management process for that? [...] In my mind, that deviates significantly from the recommendation we made [...] building in the costs for all conceivable contingencies as part of the cost of the project. So that *delay in correcting deviant mitigation or deviant impacts of any kind would not be a problem in future projects as it has been in the past project* [...] it seems to me since we base, for example the dynamics of the hydraulics and salinity on modeling from historic data and historic characteristics of the river, likewise *would we not present an alternative vision for a future that's different than what we predicted, based on previous failures to predict the future? So if you have examples of worst case scenarios that have occurred previously, why not use them as a basis for determining the contingency fund to deal with like deviations in the future*” (emphasis added, SEG 2008b, p.93-96).

These passages worked to mobilize the memory of the Tidegate in order to challenge a specific set of institutional rigidities in mitigation practice that limit adaptive governance: funding restrictions that constrain experimentation, monitoring, and learning. Federal policy restricts the Corps from setting aside unused funds, requiring that any and all mitigation efforts be given a specific dollar amount beforehand. Similarly, the Corps is required to treat monitoring and adaptive management as a mitigation cost which, by 2008, had soared to almost \$300 million, nearly 50% of the project’s entire cost, and every additional dollar spent was seen to ultimately reduce both the project’s benefit-to-cost ratio and the likelihood that the project would be approved and reauthorized by

Congress (O’Kane 2009c). As Kyler points out in the above quote, one of the biggest challenges to fixing the freshwater control works in the refuge was securing the necessary funding. But the politics of funding were compounded by the history of antagonism between the Corps and Fish and Wildlife, as neither agency wanted to be held responsible for the costly repairs, and at the time, there were no real mechanisms in place to identify who had responsibility over the maintenance and operation of mitigation procedures (Landers 2011). Although the unintended impacts from the operation of the Tidegate were from technical uncertainty (i.e., the complex movement of salinity in the harbor), their solution was largely political: allocating the necessary funds for monitoring, repairing the freshwater controls, or closing the Tidegate and resuming regular maintenance dredging. For Kyler, securing a significant contingency fund reduced the risks from technical uncertainty and increased the river’s adaptive capacity.

The Effects of Remembering on Adaptive Management

By 2009, the Corps’ post-construction monitoring and adaptive management plan was firmly entangled with its long-standing refusal to repair the freshwater control works in the refuge (Figure 9). As the late Sam Hamilton, Director of the U.S. Fish and Wildlife Service had made clear, “a prerequisite to any decision by them on further deepening was a firm demonstration by the Corps that the existing mitigation (water control system on the Savannah National Wildlife Refuge) will be or are repaired. The Service views action by the Corps on the existing mitigation systems as providing assurance that future mitigation will be implemented and maintained in the future” (USACE 2012b, p.N-670). Prior to his appointment as the National Director of the U.S. Fish and Wildlife Service, Hamilton had served in Atlanta, Georgia as the Southeast

Regional Director, and had been frequently involved with conflicts in the Savannah National Wildlife Refuge during his career. In fact, it was Hamilton who received the apology from the Georgia Ports Authority, following the release of correspondence between Authority executives indicating that they wanted to “kick F[ish] &W[ildlife]’s ass in the paper” (Krueger 1999, n.p.). Following an indication that the failing freshwater control system would be a substantial enough reason for the Service to exert its “kill switch” authority and deny the project’s approval, the impasse came to an end (Landers 2011, n.p.). Although Corps officials maintained that the threat to the politically sensitive harbor project was not the primary motivator, the first phase of repairs to the refuge’s freshwater control structures began in June 2010, months before the release of the Corp’s *Draft Tier II Environmental Impact Statement* (Landers 2011; USACE 2012b, p.E-9).

Activating the techno-scientific management failures of the Tidegate enabled the project’s federal cooperating agencies to outline several new requirements for approving the project, primarily in the form of funding guarantees and additional mitigation commitments. At the SEG meeting in May of 2010, the Corps indicated that they were exploring the option of setting aside contingency funding through the Ports Authority:

“[T]he last thing we were looking at—well, the basic answer is having a pot of money is not the way the Corps normally does things—never done that before. It’s not written policy, but they don’t have a policy. Well, they have a policy, but it’s not following the policy. So we are still working that, and now we are looking at being able to give the Port Authority credit, if they put the money—just put it up there as part of their cost share for the whole project. If they just said well, here’s a pot and you can use that, could we give them credit or would we give them credit for that” (SEG 2010c, p.12-13).



(Figure 9. The freshwater supply canal and water control structures. *Photo: author.*)

Such an approach represented a dramatic change for the Corps, and suggested that stakeholders' activation of the failures associated with the operation of the Tidegate were eroding institutional constraints that undermined the implementation of adaptive management. The federal agencies agreed that this would be an acceptable compromise, and at the Executive Steering Committee meeting in September, the Ports Authority indicated that it would be willing to set aside, in advance, their cost-shared portion of the monitoring and adaptive management funds in order to satisfy the concerns of the resource agencies (O'Kane 2010). Nonetheless, many SEG members remained frustrated by the Corps' refusal to commit to more extensive adaptive management provisions, and

in March of 2011 the Southern Environmental Law Center challenged the project in South Carolina court on behalf of several of the SEG’s long-term members, including the Savannah Riverkeeper, South Carolina Coastal Conservation League, South Carolina Wildlife Federation, and Conservation Voters of South Carolina. A protracted legal battle over regulatory jurisdiction ensued.

But following several months of court-ordered arbitration, the two sides reached a compromise—one with a heavy price for the Ports Authority and the Corps. The settlement agreement consisted primarily of two components: first, the Ports Authority would pay \$33.5 million for additional mitigation, including \$3 million to be used “solely and exclusively” for water quality monitoring, \$3 million to be used for monitoring and researching fisheries habitat in the estuary, and the remaining \$27.5 million for wetland conservation and restoration efforts in the lower Savannah River watershed (Settlement Agreement 2013, p.7). Second, and more importantly, the Ports Authority would be required to establish and maintain an escrow account at the level of \$2 million (to be adjusted annually for inflation), for a period of no less than 50 years after completion of the project should the Corps fail to provide funding in order to operate and maintain the long-term integrity of the mitigation measures (Settlement Agreement 2013).

The repairs to the refuge’s freshwater control system were completed in December 2011, one month before the release of the project’s *Final Environmental Impact Statement* in January 2012 (Landers 2011). Although the Settlement Agreement still failed to provide complete funding guarantees to for the mitigation measures, the potential for the Savannah River Maritime Commission and the South Carolina Department of Health and Environmental Control to issue conditional permits and

authorizations, and then to revoke the water quality permits and cancel the agreement if certain criteria are not met, nonetheless represented a small victory for stakeholders.

According to the Savannah River Maritime Commission attorney Randy Lowell, “The key conditions of the permits and authorizations by [the Department of Health and Environmental Control] and the commission is that if the Corps cannot demonstrate the dissolved oxygen system will mitigate for the impacts of the project, [the Department of Health and Environmental Control] and the commission both reserve the right to revoke the permits, terminate the settlement agreement and re-initiate and re-file the litigation” (Chourey and Mayle 2013, n.p.). These reassurances, although not officially a component of the Corps “Monitoring and Adaptive Management Plan,” pointed to the material effects of remembering the impacts from the Tidegate and its operation on the Corps mitigation planning in the Savannah Harbor.

Combined, these concerns worked to activate the Tidegate as a “site of counter-memory.” Although the Corps failed to include explicit biological criteria or funding guarantees for specific components of the mitigation plan, the Corps did agree to extend the monitoring period to ten years, to identify “acceptability criteria” for several water quality and biologic parameters in the estuary, and to conduct several new studies during post-construction monitoring, particularly a long-term evaluation of the effectiveness of the fish-passage ramp at the New Savannah Bluff Lock and Dam among others. The Corps’ long-standing refusal to repair the freshwater control works in the wildlife refuge undermined their ability to credibly maintain the deepening project’s mitigation measures over the long-term. The memory of these failures—both the technical failure of the freshwater control system, and the political failure of refusing responsibility—were

mobilized by stakeholders to secure a more comprehensive set of protections for the estuary. This included an adaptive management plan that consisted, at least partially, of a victory over one of the most challenging dimensions of “true” adaptive management: the politics of funding.

Conclusion

The memory of the Tidegate’s operation played a central role in the SEG’s negotiations over scientific uncertainty and risk, with stakeholders embedded in a politics of memory over how impacts and the scientific claims about them are, or should be, remembered. In Savannah, the credibility of the Corps’ claims about hydrodynamic modeling, ecosystem remediation, and adaptive management were intimately bound with the memory of the Tidegate and its impacts. Although not always explicitly present in the SEG’s debates the failure of the Tidegate and the unanticipated impacts that resulted from its operation proved immensely difficult to fold into the Corps’ narrative of engineering science and technical expertise. Instead, the lingering presence of the Tidegate’s failures that was activated by the SEG ignited a long-standing antagonism between the Corps and the U.S. Fish and Wildlife Service, ultimately making a significant difference in the development of the project’s mitigation plan and calculation of its risks and costs. This became most clear in the case of adaptive management and monitoring, where concerns over funding guarantees led to the Ports Authority setting aside funds in order to ensure the long-term viability of mitigation strategies, while concerns over the viability of the mitigation strategies themselves led to the extension of the monitoring period to the maximum length of 10 years and the inclusion of specific mitigation acceptability criteria.

This work contributes to geographic scholarship on adaptive management by revealing how it has been implemented in practice, and how institutional resistance to a more comprehensive approach to adaptive management was overcome. Despite the numerous challenges that continue to frustrate efforts to implement adaptive management on a large scale, memory-work and the politics of remembering/forgetting provide important analytic and strategic tools for confronting institutional inertia and a techno-scientific culture of risk aversion in order to secure a more open-ended, flexible, and experimental adaptive management plan. In particular, this work points to the ways in which memory and its material traces are mobilized as a political resource in disputes over resource management and environmental governance.

The Savannah Harbor Expansion Project also carries potential policy implications, especially as the Corps continues to develop implementation strategies for its recently required adaptive management approach. Federal policy placed two distinct yet related constraints on the Corps ability to meet the requirements laid out by state and federal resource agencies. First, the Savannah District was prohibited from setting aside a cache of unused money in the event that impacts *could* exceed predictions. Rather, mitigation measures had to be translated into *specific* dollar amounts, which could then be used to calculate the project's potential benefit-to-cost ratio. The potential risks, then, from "scientific uncertainty" had to be translated into the fiscal language of mitigation: the location and number of monitoring sites, the instrumentation, and the duration of the monitoring period. Second and perhaps more problematic, was that the necessity of an estimated cost required an a priori designation of what could be considered an adaptive management intervention: a list of pre-approved (and pre-priced) adaptive management

features which placed artificial constraints around the realm of possible responses should impacts prove different or greater than expected.

The Savannah Harbor Expansion Project also represents a significant shift in the way that mitigation funding is allocated, specifically the ability to set aside funds into an escrow account by the non-federal sponsor. Doing so will, at least potentially, allow decision-makers to respond to ecosystem changes more quickly, reducing the possibility for long-term irreversible changes to the estuary. The delineation of specific performance measures and shared decision-making by the resource agencies means that the Corps will be held accountable to non-human nature as other agencies (with competing missions) become part of the long-term management and evaluation of the mitigation features. Adaptive management will, at least for the time being, fall short of many of the goals identified in the “Memo of ’08,” but as federal policy continues its slow transition toward a new paradigm of integrated water management, an ability to remember and thoroughly account for past environmental mistakes becomes more important.

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- Chapter 4 -

Harboring risk: making environmental injustice make sense along the Savannah River

Abstract. Increasingly, geographic research on environmental justice has moved away from its conventional focus on proximity and spatial distribution, driven, in part, by a growing conviction that these analyses are both unable to fully account for the complex ways that space is entangled with environmental injustice, and second, that they fail to provide powerful explanations of the processes that foster, sustain, and perpetuate it. In this paper, however, I draw from the political thinking of Jacques Rancière to explore a different way of conceptualizing distributive justice, and argue that it provides scholars with a productive set of theoretical tools to examine the ways in which different spatialities are woven together and deployed as strategic resources in environmental justice disputes. Drawing from an environmental justice dispute over air toxics in Savannah, Georgia, I demonstrate how different constitutions of space—as relational, networked, scalar, and bounded—overlapped, intersected, and combined in ways to slowly dismantle claims of human health risk, consolidating a particular way of seeing and thinking about Savannah’s urban space in which environmental injustice is not and cannot be present. In doing so, I demonstrate how Rancière’s theorization of space and politics contributes to a fuller understanding of the spatiality of environmental justice, revealing the ways in which distribution serves as a mechanism for defining the boundaries of what becomes sensible, intelligible, and possible.

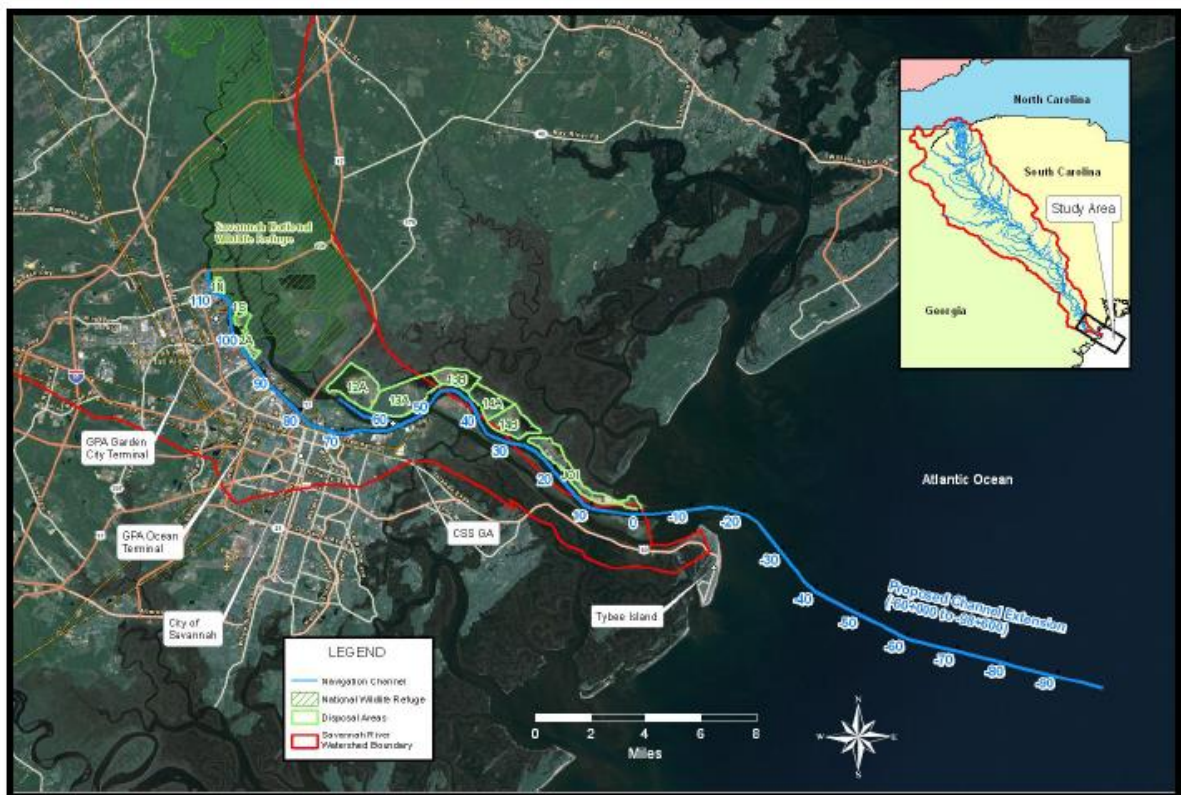
During its early years in the United States, environmental justice scholarship and activism focused principally on documenting unequal distributions of hazardous wastes in low-income and communities of color (e.g., United Church of Christ 1987, Bullard 2000). Increasingly, however, scholars and activists have argued for approaches that place greater emphasis on other dimensions of environmental justice – including recognition and participation – in an effort to move beyond simply demonstrating unjust patterns of distribution and toward explaining the processes that foster, sustain, and perpetuate them (Schlosberg 2002, 2004, 2007; Walker 2009, 2012). Although these

scholars argue that the different dimensions of environmental justice are inextricably intertwined, and that attention to recognition and participation are meant to enrich rather than replace distributional approaches, the implication has nonetheless been that distributive questions and approaches are insufficient. Indeed, Walker (2009, p.25) calls for a “move beyond the distributional,” arguing that such approaches are grounded in a relatively simplistic notion of Cartesian space that treats risks and injustices largely as a function of distance and proximity. Early GIS-based analyses operated within this type of framework, assuming, for instance, that greater numbers of localized polluting facilities translated directly into higher localized exposures and risks (e.g., United Church of Christ 1987; Bullard 2000). But the pathways of pollutants are more complex, with risk and vulnerability dependent upon myriad contributing factors (including age, gender, access to healthcare, and relative mobility of people and pollutants among others) not accounted for in simple proximity measures (Kuehn 1997; Bowen 2002; Buzzeli 2007; Walker 2009).

While endorsing Walker’s (2009) call for a fuller and more robust theorization of what the spatiality of environmental justice can constitute, I suggest that Walker relies on a particular conceptualization of distribution, to which I offer an alternative. In this chapter I draw from the political thinking of Jacques Rancière (1999, 2004, 2009), whose theorization of politics, I argue, reveals a different spatial dimension of distribution and provides environmental justice scholars with a set of conceptual tools to examine “the very space” in which environmental injustice is given to sensory experience and made to make sense (Rancière 1994, p.152). Specifically, Rancière’s work draws attention to the ways that configurations and partitions of space—what he calls the “distribution of the

sensible”—encourage, support, and extend particular orders of governance, ultimately setting the boundaries of what becomes sensible, intelligible, and possible (Dikeç 2007). Rather than pursue distribution as a matter of what is already distributed in an empty Cartesian space (e.g., risks, impacts, vulnerability, or responsibilities in their proper places and roles), Rancière’s work offers environmental justice scholars an understanding of distribution as the creation of a shared world of sensibilities that “provides to thought its picture of the world, supplying the evidence of what can be conceived, discussed, and disputed” (Tanke 2011, p.2).

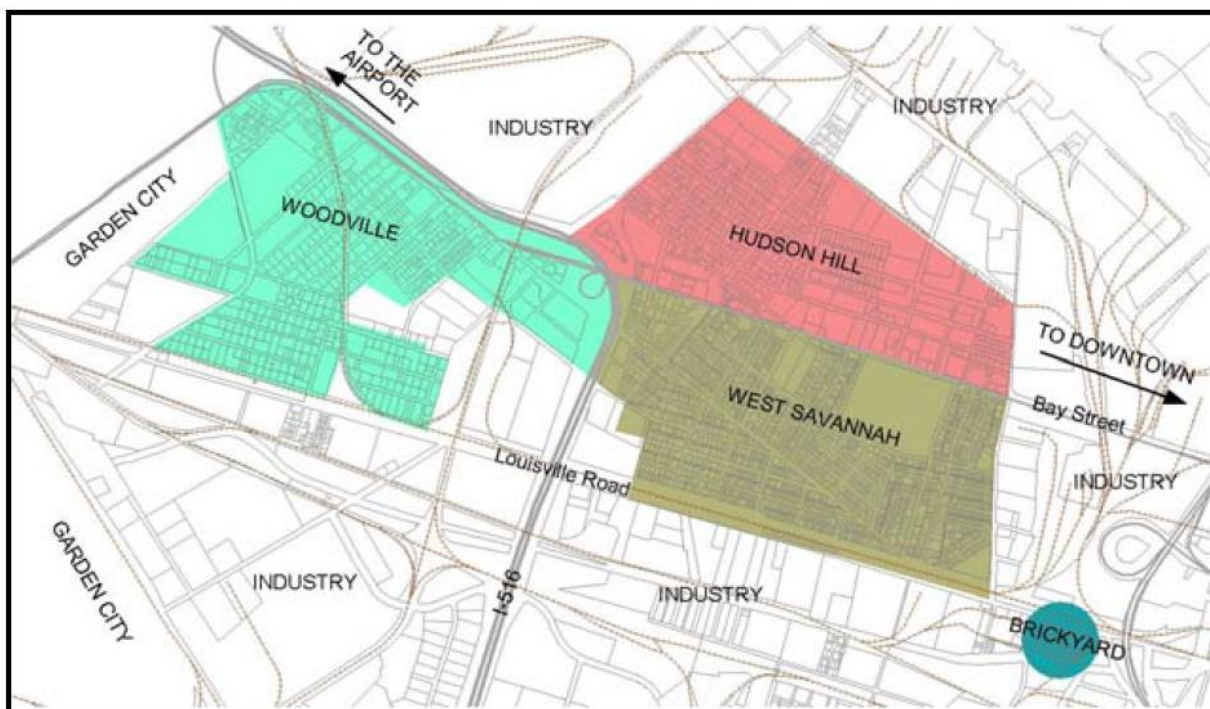
To illustrate the usefulness of Rancière’s thought for environmental justice scholars, I develop these arguments through a case study of environmental impact assessment at the Port of Savannah in Savannah, Georgia. Over the last two decades, the



(Figure 10. The Savannah Harbor Expansion Project. Source: U.S. Army Corps of Engineers 2012a, p.2.)

Georgia Ports Authority and the U.S. Army Corps of Engineers Savannah District have been involved in a massive harbor improvement project designed to further deepen the Savannah River and better accommodate increasingly larger container vessels calling at the port (Figure 1). Surprisingly though, despite projected growths in container volume traffic, the Corps' environmental impact assessment predicted an overall reduction in the port's future air emissions. It ultimately concluded that the harbor deepening project posed no potential risks to human health and complied with federal environmental justice policy, noting that “[n]o one identified impacts to environmental justice communities or children as issues of concern,” and that “representatives of the environmental justice population have not expressed substantial concerns about the project” (U.S. Army Corps of Engineers 2010b, p.5-145).

The assessment drew sharp criticism from environmental justice advocates, who maintained that the Corps' impact assessments systematically misrepresented the port's air emissions, pointing to the District's failure to perform a Health Impact Assessment, and its adapted methodology for calculating air toxics from landside truck and rail operations (Citizens for Environmental Justice 2011a, 2011b; Hricko 2011; EPA). The neighborhoods of Hudson Hill, Woodville, and West Savannah—which compose Savannah's predominantly African American west-side—are crisscrossed by highways that service the port (Figure 2), and air toxics from the operation of the Garden City Terminal's truck and rail corridors have long been a major concern among residents (Citizens for Environmental Justice 2011). Despite years of recognized environmental justice activism in the port's surrounding neighborhoods and sustained participation by advocates in the planning and development phases of the deepening project, the port's



(Figure 11. The port's surrounding neighborhoods. *Source:* Metropolitan Planning Commission 2004, p.6)

representation as a space in which air emissions would be measurably declining, undermined the possibilities for claiming environmental injustice in its surrounding neighborhoods.

In what follows, I argue that a shifting series of spatial constitutions—and their effects on cargo estimates, air quality, truck traffic, diesel reductions, and sustainability initiatives—enabled the Corps of Engineers to slowly dismantle concerns over human health risk and disproportionate impact, and legitimize the deepening project's compliance with federal environmental justice policy. Drawing primarily from the project's documentary record, I demonstrate how a series of “state's statements,” (Corrigan and Sayer 1985, p.3) – policy documents, descriptive names, spatial designations, categorizations, definitions, mappings, and statistics – are used to constitute

the space of the port differently at different points in the assessment, each of which had a specific implication for the possibilities of claiming environmental injustice (i.e., each spatial constitution undermined a slightly different dimension of advocates' claims, and reinforced varying components of the Corps' own assessments). I show how these different conceptualizations of space—as relational, networked, scalar, and bounded—overlapped, intersected, and combined in ways that worked to consolidate and normalize a particular way of seeing and thinking about Savannah's urban space in which environmental injustice is not and cannot be present. After reviewing how space has been conceptualized in relation to environmental justice and environmental justice activism, I review the political thinking of Jacques Rancière (1999, 2005, 2009), and argue that his theorization of politics provides a framework for investigating how configurations of space delegitimize concerns over human health risk and construct compliance with federal environmental justice policy. In the final section, I conclude by discussing the implications of redistributing risk in Savannah, both for future geographic work on environmental justice and for the practice of environmental impact assessment.

The spatial dimensions of environmental (in)justice

Over the last two decades, geographic scholars have increasingly recognized the multiple ways that space is entangled with environmental justice (Walker 2009). On the one hand, scholars and activists have sought to emphasize other conceptualizations of justice at work in the environmental justice movement (Schlosberg 2002, 2004, 2007, 2013). When environmental justice scholarship and activism emerged in the U.S., it was primarily concerned with distributive injustices, or “who gets what” with respect to environmental “bads.” To a large degree this has remained the analytical focus of

environmental justice and activism in the U.S., and analyses have tended to orient around documenting unequal distributions of hazardous wastes in low-income and communities of color in the U.S. But as the environmental justice movement has expanded in scope and extent, scholars and activists have increasingly sought to incorporate other dimensions of “justice” – particularly as recognition and participation – into their analyses, in an effort to move from demonstrating injustice to explaining it (Schlosberg 2004, 2007, 2013; Walker 2009). This scholarship points to the ways that procedural injustices—failures to recognize particular people and place identities, or inadequate access to and participation in environmental decision-making—sustain and support environmental inequalities.

On the other hand, environmental justice scholars and activists have increasingly sought to rethink many of the key concepts (i.e., acceptable risk, race, waste, health) that animate the struggle and condition its political possibilities. The work of Laura Pulido (1996, 2000), for example, has provided an exceptionally important intervention, rethinking environmental racism and injustice through the lens of white privilege, “the hegemonic structures, practices, and ideologies that reproduce whites’ privileged status” (2000, p.15). Rather than locate environmental racism and injustice in intentional, discriminatory acts of hazardous waste facility siting, Pulido demonstrates how distributive injustices are produced and maintained through a more subtle operation of white privilege which allowed whites to move away from polluted spaces and low-income communities of color, consolidating spaces of homogeneous whiteness in the suburbs and helping make the benefits of white privilege possible. This work has convincingly demonstrated the myriad ways that social processes operating in other

places and at broader spatial scales link to and fosters the conditions that create distributional injustices. Reworking the spatiality of environmental racism and injustice as white privilege draws attention to the historical-geographical production of places, and points to the relatively mundane urban land-use practices of zoning, real estate development, or historic preservation through which uneven environmental conditions are produced and maintained in places.

Other scholars have deployed these insights to rethink the spatiality of risk itself. Holifield (2012) shows how environmental injustice emerges from the affirmation and translation of misrecognized historical-geographical relationships of place and territory in the measurement and calculation of risks. In his analysis of human health risk assessment on the Leech Lake Reservation in northern Minnesota, Holifield (2012) demonstrates how the risk assessment process failed to account for the distinctiveness of the reservation, and the unique historical and geographical relationships that shaped it as a place and territory. In this case, environmental injustice was not simply the result of distributive injustices and increased exposures. Instead, those distributive injustices were the result of failing to recognize the reservation as a unique space with a distinct assemblage of human and non-human relations that differed considerably from EPA's standard approach to calculating exposure scenarios.

This increasing spatial complexity of risk, exposure, and injustice has been met by a range of different strategies from environmental justice activists, and a significant body of geographical scholarship has productively theorized their efforts as a politics of scale (e.g. Towers 2000; Kurtz 2003; Bickerstaff and Agyeman 2009). This work points to the ways that activists activate different spatial scales in order to construct grievances, assign

responsibility, or mobilize resources. The work of Hilda Kurtz (2002, 2003) has been particularly influential, theorizing environmental justice activism through the lens of scale frames, “the discursive practices that construct meaningful (and actionable) linkages between the scale at which a social problem is experience and the scale(s) at which it could be politically addressed or resolved” (2003, p.894). Through her analysis of the scale frames activated in response to a controversial siting proposal in Louisiana, Kurtz demonstrates the different ways that activists construct and mobilize geographic scales in order to access necessary resources (be they economic, political, or social) in order to respond to and challenge perceived injustices.

While numerous scholars have demonstrated how environmental justice activism can be a politics of scale (Kurtz 2002, 2003; Towers 2000; Bickerstaff and Agyeman 2009), others have shown how it can also be a politics of place, territory, and networks. In his study of an environmental justice dispute surrounding a risk assessment, Holifield (2009) shows how locally situated actors constructed a “counter-network” in order to challenge the prevailing representation of water quality in an underground aquifer. But rather than see this process merely as a politics of (re)scaling – connecting to ostensibly “bigger” or more powerful actors in other places – Holifield demonstrates how activists deployed a strategy of differential positioning in order to construct a credible counter-representation of the risk assessment. He suggests that it results from the prevailing view of the science-policy interface in which credibility is established through a boundary-making process that distinguishes science (a set of impartial outsiders) from politics (a set of partial insiders).

Despite these insights, the spatiality of environmental justice remains under theorized and little attention is given to the active role of different spatial constructs in configuring the spaces of injustice and of activism (although see Kurtz 2003; Bickerstaff and Agyeman 2009; Towers 2000 for exceptions). Walker (2009) has called for more nuanced theoretical and methodological approaches for investigating the multiple spatial dimensions of environmental injustice, and that focus analytical attention on how different spatialities are deployed simultaneously in ways that can either support or erode environmental justice claims. Doing so requires attending to the practices through which different dimensions of space are constituted in environmental justice disputes, and how they are deployed as strategic resources that define the areas to be treated, associate particular sets of problems with them, and encourage a particular way of thinking about them. I contribute to ongoing research in geography on the spatiality of environmental justice by investigating how multiple spatial constructs are deployed simultaneously, and showing how different spatial configurations are used to destabilize different dimensions of justice at once. In short, how space is conceptualized matters for the expression and realization of environmental justice. In the next section, I argue that the political thinking of Jacques Rancière provides a useful theoretical framework for analyzing the ways that different conceptualizations of space combine, overlap, and intersect to destabilize justice claims.

Rancière's politics, police, and distribution of the sensible

Geographers have drawn on Rancière's influential rethinking of politics to explore how systems of distribution and legitimization work to consolidate a particular spatial order and circumscribe political possibilities in the interest of capital and the state

(Dikeç 2007a, 2013; Swyngedouw 2011). This work builds on Rancière’s notion of the police, which refers to an established set of spatial orderings in place to organize and arrange things and people in their “proper places,” determining the make-up and arrangement of possible experience (Rancière 1999, p.28).

The police is based on a particular regime of representation, what Rancière describes as the distribution of the sensible, defined as “that system of sensible evidences that discloses at once the existence of a common [i.e. the whole to be governed] and the partitions that define the respective places and parts in it” (Rancière quoted in Dikeç 2007a, p. 18). The system of sensible evidences – the distribution of the sensible – arranges the perceptible givens of a situation, defining how and what is within the realm of possible experience, or what is made common to the senses. The police, then, is a system of organizing and arranging space, the essence of which “is not repression but *distribution* – distribution of places, people, names, functions, authorities, activities, and so on – and the normalization of this distribution” (emphasis original, Dikeç 2007a, p.19). The inherent spatiality of the police forms the basis of Rancière’s conception of politics, which he describes simply as any activity which “shifts a body from the place assigned to it or changes a place’s function. It makes visible what had no business being seen, and makes heard a discourse where once there was only place for noise; it makes understood as discourse what was once only heard as noise” (Rancière 1999, p.30). Politics, too, is an explicitly spatial activity, as it puts into question the very distributions of the police and its partitioned spaces.

But why is the consolidation of the police – as a system of organizing and arranging space “properly” – important, and how is it useful for analysis of

environmental justice? Perhaps most importantly, the police delineates the “givens” of a situation; it sets the boundaries of what a place is, what happens within it, and who can speak for it. Rancière’s theorization is important because it draws attention to the ways that space is constructed and deployed. Rancière’s conceptualization of the police points to the need attend to environmental injustice as the system of distributing and legitimizing people and things in their “proper place.” In this vein, it requires attending to the contested processes and practices of place-making that have shaped, “not merely the collection of discourses or systems of ideas; it is the configuration of the ‘very space’, as Rancière put it, in which certain discourses and ideas are inscribed and articulated, certain objects are given to sensory experience, and made to make sense” (Dikeç 2013, p.30). Environmental impact and human health risk assessment are guided by particular ways of imagining space, which have in turn, specific implications for the constitution of problems and formulation of possible solutions.

Data and methods: the “state’s statements”

Following Dikeç (2007a), my approach to impact assessment starts from a central premise to consider space not as given, but as produced through various practices of articulation. The environmental impact assessment process does not merely act on a predefined space of the “lower Savannah River estuary.” Rather, impact assessment is the very process that creates it; defining what is in, what isn’t, which things are related, and how, which things aren’t and why. Different ways of conceiving space, then, have different implications for the composition of problems and the formulations of solutions to them. I see impact assessment as a particular regime of representation that consolidates a certain spatial order through descriptive names, spatial designations,

categorizations, definitions, mappings, and statistics. In this sense, it is place-making practice that spatially defines the areas to be treated, associates problems with them, generates a certain discourse about them, and proposes solutions accordingly.

My primary interest here is the way in which the environmental impact assessment process puts into place certain “sensible evidences,” – policy documents, descriptive names, spatial designations, categorizations, definitions, mappings, and statistics – that, in turn, produce particular effects: they “help to consolidate a particular spatial order and encourage a certain way to think about it” (Dikec 2007a, p.6). But how to get at these “sensible evidences”? In practice, this is where I draw on Corrigan and Sayer’s (1985) notion of “state’s statements,” in order to trace how space is constituted by the State—and by ‘the State’ here I mean the US Army Corps of Engineers and the Georgia Ports Authority—and to explore how particular characteristics (i.e. safety or sustainability, for instance) become articulated with different places, and with what effect:

“States, if the pun be forgiven, *state*; the arcane rituals of a court of law, the formulae of royal assent to an Act of Parliament, visits of school inspectors, are all statements. They define, in great detail, acceptable forms and images of social activity and individual and collective identity; they regulate, in empirically specifiable ways, much—very much, by the twentieth century—of social life. Indeed, in this sense ‘the State’ never stops talking” (Corrigan and Sayer 1985, p.3)

Specifically, I ask: How has the Savannah District demonstrated that the deepening project poses no risk to public health and complies with federal environmental justice policy? Secondly, how have the Savannah District’s impact assessments (re)made the

urban-ecological spaces of the city, and with what consequences? In what follows, I examine 4 of these “state’s statements” – the Corps of Engineers’ *Multiport Analysis* issued in 2006, its *Air Emission Inventory* issued in 2010, and the draft and final versions of its *Environmental Impact Statement* issued in 2010 and 2012, respectively. The *Multiport Analysis* is included in Appendix A of the project’s *General Re-Evaluation Report* (GRR), which documents the project’s planning process and the identification of its National Economic Development benefits – those accrued to the nation as a result of the project. The *Air Emission Inventory* is included as Appendix K of the project’s *Environmental Impact Statement* (EIS), which is a detailed evaluation of the proposed action, its affected environment, the environmental consequences of the action, and any feasible alternatives.

Rearranging a problematic space: making environmental injustice make sense

Late in the fall of 2010, the U.S. Army Corps of Engineers Savannah District released the draft *Environmental Impact Statement* (EIS) for its proposal to further deepen the Savannah River and better accommodate the increasingly larger vessels calling at the port. Despite projected growths in container volume traffic, the District predicted an overall reduction in the port’s future air emissions, ultimately concluding that the project posed no potential risks to human health, complied with federal environmental justice policy project, and would contribute to a long-term improvement in air quality (USACE 2010). At the same time, the District maintained that environmental justice communities were “essentially absent” (p.5-192) from the proposed project area, and had themselves failed to raise any “substantial concerns” (p.5-145) about the deepening (USACE 2010).

The assessments drew sharp criticism from environmental justice advocates, who argued that the District’s adapted methodology for calculating air toxics from landside truck and rail operations systematically misrepresented the port’s air emissions and erased significant risks to human health (Citizens for Environmental Justice 2011a, 2011b; Fleming 2011; Hricko 2011). The EPA voiced strident objections to the Corps’ refusal to include a screening level risk assessment in the port’s surrounding neighborhoods, noting that it had provided guidance – and examples from other ports – several times over the years regarding air quality assessment and environmental justice in goods movement corridors (Fleming 2011). In a press release from the Savannah-based Citizens for Environmental Justice, Reverend Vernell Cutter responded to the draft EIS saying, “This is an affront to our community to claim we have no concerns when in fact many of us have attended the past public meetings and have questioned their documents which claim that there will be no impacts to our environment and health” (Citizens for Environmental Justice 2011a, n.p.).

Capping port growth: relational space

At the center of the conflict was the production and application of a customized economic model—the first in the country developed for container cargo and designed to be the new standard for harbor improvement projects—which, according to the USACE, was necessary to more fully account for the changing trends in global shipping: increasing containerization, fewer yet larger container vessels, and the consolidation of trade routes (USACE 2010a). In defending its assessments, the Savannah District pointed to its 2006 *Multiport Analysis*, the source of one of the project’s foundational—and most controversial—economic assumptions: that the rate of growth in the volume of

container traffic entering Savannah would not increase with or without the deepening. The multiport analysis is a systematic assessment of the effects of the deepening, or the “with-project condition,” on other ports, and it is one of the primary components of determining a project’s potential “National Economic Development” benefits. These are benefits that would accrue to the nation as a result of the project’s construction, and help to determine its benefit-to-cost ratio. The multiport analysis also includes the effects of authorized projects at other ports on the with-project and without project conditions.

According to the report:

“The analysis determined that with-project conditions would not result in a diversion of containers from other ports...there would be no substantial changes in the origins and destinations of imports and exports to key U.S. markets served by Savannah. Given this study’s findings, a basic assumption for the SHEP Economic Appendix would be no substantial changes in hinterland service area and therefore no change in overall cargo without and with channel improvements at Savannah harbor” (p.163-4)

The report identified Savannah’s position in a wider relational geography, one where leases with shipping lines, wharfage fees, pilotage costs, tariffs, and expected population growth in major cities that fell within each port’s respective hinterland proved to be more important than the new depth of the harbor. According to the report, a deeper channel was not projected to alter the port’s competitive advantage among Gulf and East coast ports, and while cargo volumes would continue to grow, no *new* cargo would be diverted to Savannah. What this meant was that there would be no diversions of cargo that traditionally went to other ports. According to the District, it was a relatively

conservative estimate. To argue that the deepening project would alter the port's competitive advantage would be to artificially inflate its benefit-to-cost ratio.

The major consequence of locating the Garden City Terminal within this wider relational space was to cap the port's potential future cargo growth. According to the District's assessments, cargo volumes would continue to grow at the same rate with or without the project. However, a deeper channel would allow for this projected growth to be consolidated onto fewer, larger container vessels. The end result would be that the same amount of cargo could be moved with fewer ship, train, and truck trips, and without any new growth diverted from other ports, the Corps concluded that the deepening would result in fewer overall vessel trips. With no new growth resulting from the deepening, the physical constraints of the river channel and the landside handling capacity of the terminal would ultimately limit the amount containers that could be processed at the port. Accordingly, fewer vessels, despite their increased size and larger loads, would result in fewer emissions. The report identified the year 2030 as the time when the Garden City Terminal would reach its landside handling build-out capacity of 6.5 million containers, at which point the physical dimensions of the river and the size of the terminal simply would not allow container volume to continue to grow. Based on the assumptions and constraints provided by conceptualizing the Garden City Terminal within this relational space, the Savannah District estimated that current and future port emissions (including air toxics) would hold constant beyond the year 2032—based on the assessment that cargo volumes will have already reached their peak. Simply, if cargo volumes could not grow past a certain point, then neither could emissions.

Reducing emissions: scalar space

The *Multiport Analysis*—and its conclusion that the deepening project would not alter the port’s competitive advantage—drew sharp criticism in the years following its release. But it was Corps’ *Air Quality Analysis*, also issued in 2006, that generated more strident objections. The analysis was meant to determine the project’s effect on the port’s overall contribution to county emissions—calculating how more truck and rail movements, on-terminal container handling, and larger container vessels would impact local air quality. The assessment was dismissed by EPA, who rejected the Corps’ decision not to include landside cargo handling equipment, air toxics, or ship movements from private terminals in the harbor in the analysis.

In 2010 the Savannah District released its updated *Air Emission Inventory*, pointing to a suite of ongoing initiatives by the EPA, the Ports Authority, and the Georgia Department of Transportation which had drastically reduced diesel consumption (and, by extension, air toxics) at the port, noting that, “In 2008—two years ahead of the federal mandate—GPA completed its conversion of yard cranes, trucks and other equipment to cleaner-burning ultra-low-sulfur-diesel (ULSD), cutting emissions by an additional 10 percent” (USACE 2010c, p.100). In May of 2004, the EPA issued its Clean Air Nonroad Diesel Rule, designed to reduce the amount of sulfur present in diesel fuel. Prior to 2006, stationary diesel engines, which are primarily used for power generation, were not regulated at a federal level. Then, in March 2007 – and as an extension of the Nonroad Diesel Rule – the EPA announced new emission standards, to be phased in over several years, for locomotives and marine diesel engines. The recent emphasis on emissions reductions has been expanded into a wider Sustainability Initiative by the GPA. The

transportation cost savings initiated by reductions in diesel consumption have been accommodated by new capital investments, including refrigeration systems, a new lighting control system, and “green” building materials.

The report identified Savannah’s position in a wider scalar space, one where federal policy initiatives—especially EPA’s Clean Air Non-road Diesel Rule—and newly opened sources of federal funding had systematically reduced the risks associated with emissions from port operations. In 2009, the GPA issued its new “Environmental Policy,” initiating a series of new capital investments to further reduce diesel consumption and associated emissions from landside handling equipment, noting that “In 2010, the EPA awarded the GPA a ‘Diesel Emissions Reduction’ Grant to convert 17 rubber tire gantry cranes (RTGs), one of the primary types of container handling equipment, from diesel to electricity” (USACE 2010c, p.101).

The major consequence of locating the Garden City Terminal within this scalar geography was to dramatically reduce projected emissions. The report identified the efforts of the EPA and the GPA to reduce diesel consumption as the reason behind adapting the calculation of air toxics—using lower emission estimates for truck, rail, and diesel engines based on future transitions to ultra-low-sulfur-diesel, including emissions standards not set to take place for several years. Transitions to ultra-low-sulfur-diesel would substantially reduce the amount of emissions produced by ships while improvements to landside handling equipment reduced the amount of diesel used to move containers within the terminal, substantially reducing the level of emissions coming from the port.

Moving emissions: networked space

Among the GPA's upgrades were four electric super-post Panamax cranes, intended to both reduce emissions and increase the speed with which cargo was unloaded. According to the Savannah District, these aggressive upgrades – the result of locating the Garden City Terminal within a wider scalar hierarchy – not only reduced the amount of diesel, they also increased the mobility with which containers, and presumably air toxics, moved out of the space of the port. The reductions in diesel fuel accompanied by a greater use of rail to move containers and the addition of a third set of gates to reduce truck idling all resulted in significant calculated reductions in fuel consumption and toxic air emissions. In its assessment of potential impacts to low-income communities, the District's draft *EIS* included reference to substantial investments by the Georgia Ports and the State of Georgia to improve the highway system outside the terminal and the port's on terminal rail connections, noting that:

"In 2010, the State of Georgia approved \$120 million in bond revenue for use toward completing the Jimmy DeLoach Highway from Interstate 95 to the Garden City Terminal...Additionally, the Georgia Department of Transportation's long-term highway plan includes construction of the Brampton Road Connector which will provide direct access from the Garden City Terminal to Interstate 516...The completion of those roads will remove terminal traffic from neighborhoods and lessen congestion and the accompanying air quality impacts" (USACE 2010b, p.5-194).

The report identified the Garden City Terminal's location within a wider networked space, one where new interstate highway connections and the intensified use of rail lines to move freight, were dramatically improving the speed and efficiency with which



(Figure 12. Proposed road improvements surrounding Garden City Terminal.
Source: U.S. Army Corps of Engineers 2012b, p.5-196)

containers were being moved out of the port (Figure 3). Aggressive upgrades made by the GPA to reduce turn-around times in the harbor, increased on-terminal rail connectivity, and new highway projects designed to increase truck access to Interstate-95 had made the GCT the most connected port in the Southeast. In short, more intensified network connections increased the Georgia Ports capacity to move containers and their associated emissions through the Garden City Terminal. The major consequence of locating the Garden City Terminal within this wider networked geography was to increase the spatio-temporal mobility of containers at the port.

Defining the proper site at risk: bounded space

In addition to highlighting the variety of ongoing efforts to improve air quality at the port, the Savannah District also pointed to Chatham County's history of consistently meeting or exceeding National Ambient Air Quality Standards. According to the District, Chatham County's designation as "in attainment" for the EPA's six criteria pollutants eliminated the need to perform a screening level risk assessment. The District was also able to compare its estimated port emissions with National Emission Inventory data from 2002 and 2005. According to these comparisons, the Savannah District was able to show that the port was only a minor contributor to the county's overall air quality emissions. In general, the air toxic values for the port in 2008 are significantly lower than the 2002 values for Chatham County (USACE 2010c).

Another consequence of locating the Garden City Terminal within a wider networked space was to extend the area over which potential emissions were spread. Following the release of the draft *EIS*, the EPA raised concerns over the Savannah District's environmental justice assessment – especially its calculation of the project area's demographics. The Corps' analysis included two variables – "poverty levels" and "percent minority" – mapped by Census tract in the upper end of the harbor. The report argued that "[m]ore detailed analyses - such as dispersion analyses to identify 'hot spots' of pollution - could be conducted. However, the Port is not a major contributor to the overall emissions in the County. When coupled with the dispersed nature of many of those 'Port' emissions along the 34-mile length of the navigation channel...such additional analyses are not warranted" (USACE 2010, p.K-108).

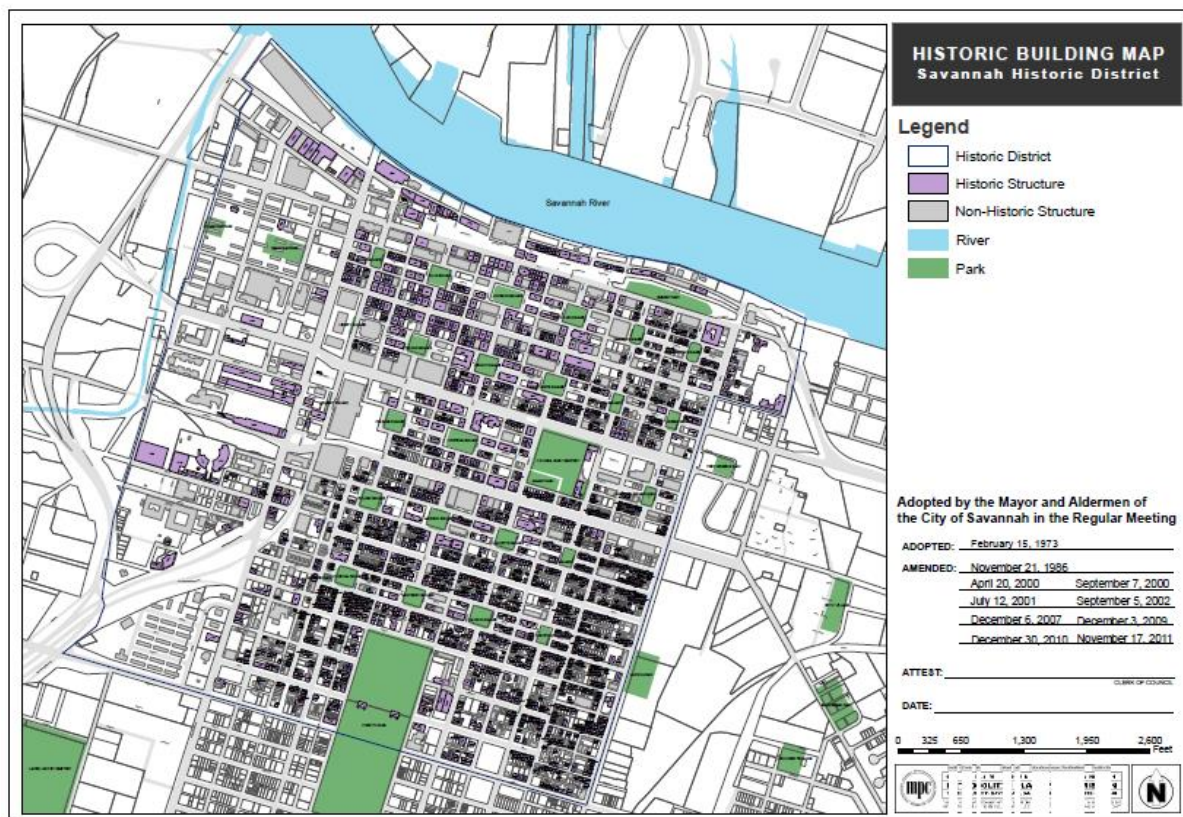
EPA’s major criticism was the Corps’ failure to include a comparative analysis of these areas to surrounding towns, and wider Chatham and Jasper Counties. In its 2012 final *EIS* the Savannah District expanded its demographic analysis – comparing what it called the project’s “Area of Interest” with two “Base Areas.” The “Area of Interest” included the census tracts located along the navigation channel from the Garden City Terminal to the mouth of the river, while the two “Base Areas” included: one, the populations of the surrounding towns and cities (Savannah, Garden City, Port Wentworth, Pooler); and two, the populations of Chatham and Jasper Counties. Doing so, however, allowed the Savannah District to include the affluent and overwhelmingly white National Historic Landmark District, Whitemarsh, Wilmington, and Tybee islands, in its demographic analysis, vastly reducing the percentage of low-income communities of color in the “Area of Interest” and making it more decidedly more similar when compared to the surrounding cities or counties (Figure 4).

Additionally, the report argued that the proximity of Savannah’s iconic “National Historic Landmark District”—the area of Savannah’s downtown laid out according to James Oglethorpe’s original town plan of wards, squares, and garden lots—effectively eliminated the possibility for potential disproportionate impacts based on an absence of environmental justice populations, noting that:

“[H]arbor deepening alternatives consist of deepening the navigation channel from the ocean past the City’s Historic District to the existing Garden City Terminal...The residential area along River Street (located in the center of Savannah) contains a relatively affluent community...As a result, dredging activities and shipping activities will not have a disproportionate impact on

environmental justice populations in Georgia, because they are essentially absent from the areas adjacent to the proposed construction” (USACE 2012b, p.5-191-2).

The report identified the Garden City Terminal’s location within a bounded political space – Chatham County – where affluent white residential areas line the riverfront over the majority of its course. Activating the National Historic Landmark District as the closest residential area to the proposed construction resonated deeply with conventionally held definitions of environmental injustice as an outcome of proximity and distance. But the real importance of this passage was that it redefined the proper site at risk. The resulting logic was subtle but powerful: even if there are possible human health risks that would occur as a result of the project, these risks would be incurred by affluent whites.



(Figure 13. Savannah’s National Landmark Historic District.
Source: Metropolitan Planning Commission 2011, n.p.)

The logic, though, does more than simply associate risks with affluent whites. The passage deploys the National Historic Landmark District—and the ostensible absence of EJ populations—devoid of its specific historical geographic context, as the unproblematic and “natural” reality of Savannah’s urban space. The major consequence of locating the Garden City Terminal within this bounded political space was to redistribute risk: one, to spread it over the 34-mile length of the navigation channel, eliminating the possibility that air toxics be concentrated in low-income, communities of color. But second, it tapped into a colonial narrative of urban planning that did not include these communities. In short, Savannah’s downtown was a de facto “white” place; not only as a place where EJ communities are not located, but as one where EJ communities could not be located.

The redistribution of risk: consolidating spatial order in Savannah

The final *EIS* received only minor comments following its release. The Savannah District repeated its claim that the deepening project posed no risks to human health, refusing to conduct a detailed dispersion modeling assessment of potential emissions or a risk-based assessment of the health effects associated with the proposed project. According to the District, Chatham County’s designation as an attainment area was the reason that a Health Impact Assessment was not conducted. Additionally, the Corps argued that comparing emission assessments from the Port of Savannah and the Port of Los Angeles / Port of Long Beach was inappropriate, based on that port’s designation as “non-attainment.”⁵

⁵ U.S. Army Corps of Engineers responses to Andrea Hricko (Appendix A, p.1791-1801) and Citizens for Environmental Justice (Appendix A, p.1473-1487).

Despite continuing concerns with the Corps' *Air Emission Inventory* and the District's cargo and emission projections, EPA approved the project, and in October 2012, Jo Ellen Darcy, Assistant Secretary of the Army for Civil Works, signed the Record of Decision, officially completing the project's NEPA process. But the appeals by Citizens for Environmental Justice, EPA, and others were able to generate small victories in the months between the 2010 draft EIS and the Record of Decision. In response to lingering concerns over environmental injustice, the GPA, with assistance from the EPA, agreed to establish a community advisory group to meet periodically to identify and address community concerns or recommendations that may arise associated with ongoing port activities. In addition, the GPA—in consultation with EPA Region 4 and the Georgia Environmental Protection Division—announced its intent to conduct an air monitoring study to evaluate any potential impacts on surrounding communities once the project was complete and GPA was serving Post-Panamax ships in normal operations. In cooperation with this effort, the Corps included as a project cost funds to provide technical assistance to the community to help explain scientific data or findings related to ongoing port activities and studies (USACE 2012e, p.4).

Nonetheless, Citizens for Environmental Justice and EPA maintained that the Savannah District's final EIS still failed to accurately represent the risk—primarily air toxics—associated with port and its Goods Movement Corridor. In particular, environmental justice advocates claimed that the aggressive upgrades to the port and surrounding transportation network being made by the GPA and GDOT constituted an expansion of landside handling capacity, and argued that rather than factor into the analysis as mechanisms for reducing air-toxics through increased spatio-temporal

mobility, the upgrades demanded that emissions be recalculated to include additional cargo movements. Although Citizens for Environmental Justice and the EPA maintained that the emission estimates were still inadequate, GPA’s commitment to establish a community advisory group, conduct an air monitoring study in surrounding neighborhoods, and continue its new emphasis on sustainability and environmental stewardship, successfully consolidated the redistribution of risk – effectively eliminating the conditions for the legitimate expression of human health risk and environmental injustice (Figure 5).

Drawing from different conceptualizations of space—as relational, scalar, networked, and bounded—the Savannah District was able to rearrange the two primary elements necessary for “disproportionate impact” – risk and low-income communities of



(Figure 14. The redistribution of risk along the Savannah River. Image: Google Earth.)

color. These different ways of conceiving space operated and combined in ways that ultimately dismantled and delegitimized concerns over human health risk. Over the history of its assessments the Savannah District did not claim that the port's adjacent neighborhoods were not low-income communities of color. In fact, they acknowledge on several occasions that the neighborhoods surrounding the port have high concentrations of poverty and communities of color. Neither, though, has the Corps argued that these communities have not participated in the assessment process. Instead, the Corps has consistently argued that claims of environmental injustice simply do not make sense.

Drawing on a relational space, the Savannah District was able to argue that emissions would, at some point, stop growing. Drawing from a scalar construction of space, they were able to insist that emissions at the port were also coming down – based on a series of terminal upgrades and diesel reduction initiatives. Drawing from a networked construction of space, the District claimed that emissions were being reduced by increased efficiency and an intensified spatio-temporal mobility; transforming the Garden City Terminal from a site that emissions came from and into a corridor that emissions moved through. Lastly, drawing on a bounded construction of space allowed the Corps to spread emissions out through the county and along the entire length of the navigation channel, tapping into a colonial narrative that put affluent whites closest to the river and to risk.

Most importantly, it was the combination of these different conceptualizations of space that worked to dismantle and delegitimize concerns over human health risk. The Corps drew on multiple conceptualizations of space—at different points in time and with respect to different elements of the assessment. There were times when the Savannah

District emphasized one conceptualization of space over others, but it was ability to draw from multiple conceptions of space—to make them overlap, intersect, and combine in ways that produce effects—that the District was able to channel what started as a point of intensified controversy into a consensus.

For example, without positioning the Garden City Terminal within the wider relational space of port competition, the terminal upgrades and transportation infrastructure improvements could easily have been read as efforts to improve the port's competitive advantage—as efforts to bring additional cargo to Savannah. Indeed, that is exactly what environmental justice advocates argued. However, it was the ability of the Corps to “anchor” into that relational space—and to combine it with the diesel reduction initiatives and new highway projects—that provided them with the ability to justify their claims that emissions would continue declining. In short, one conceptualization of space reinforced the others, and made it possible to rearrange containers, emissions, air toxics, and low-income communities of color in such a way that human health risk was not a problem.

Discussion: rethinking the spatiality of environmental justice as distribution

So what does all of this mean for rethinking the spatiality of distribution? Rancière's work points to distribution not as a measure of proximity or distance, but as a logic of arrangement. In particular, Rancière's work suggests that distribution is not simply a measure of where things are, but a question of where things should be. It is an important difference; and it offers a way to separate distribution – as an object of analysis – from distributive justice. Distributional understandings of justice remain grounded in the notion of unequal distributions of impacts and responsibilities (Schlosberg 2007;

Walker 2009). The term “unequal,” here, is absolutely critical: it sets up “distribution” solely as a quantitative measure of amounts. This emphasis on inequality leads, by necessity to comparative analyses: whether some communities bear a disproportionate number of, proximity to, or responsibility for environmental risks compared to others. These comparative analyses, then, reduce the spatial dimensions of “distribution” to measures of quantity: proximity or distance from environmental hazards; unequal flows of waste or pollutants from one location to another; unequal exposures to pollutants or wastes produced in other places; unequal exposure thresholds between different bodies; unequal levels of political power; or differing levels of socio-spatial vulnerability. The salient point, then, is that the spatiality of environmental justice—grounded in distributional understandings of justice and focused on inequalities—becomes, by necessity, comparative.

Why might this be important? The necessity of comparative analysis limits the applicability of distributional approaches to case-by-case research. It cannot deliver powerful explanations of the forces driving environmental injustice because of the endless possibility of “things” that can be distributed unequally (e.g., political power, hazards, green space, etc.); thus the pivot by environmental justice scholars toward questions of procedural justice (i.e., recognition and participation). But this is not, or at least does not have to be, the only way of conceptualizing the spatiality of distribution. Rather than pursue distribution as a politics of amounts, Rancière’s work points to distribution as a mechanism for defining what is, and what can be, made common to the senses. It is about the construction of a particular world, and how the parts within it should be allocated. In practice, this means a renewed examination of place-making,

exploring how conceptualizations of space come to matter in how different characteristics—safety, sustainability, connectivity, and mobility, among others—become articulated with places. In Savannah, for example, the controversy over air toxics that has played out over the history of the District’s assessments has not, necessarily, been about how to better or more accurately calculate risk. It has been about whether the characterization of “risky” belongs at all.

Conclusion

Compliance with federal environmental justice policy in Savannah has been the result of things and people distributed in their proper places. The consensus over air toxics that was constructed in Savannah points to a necessity of rethinking what the spatiality of distribution can constitute. Previous conceptualizations rely on a relatively simplified, uncritical, and implicitly numeric understanding of “distribution.” Perhaps unwittingly, geographers have approached distribution as a purely quantitative phenomenon—in terms of proximity and distance. Doing so has resulted in a conceptualization of distribution as necessarily comparative. While these approaches were absolutely essential for generating the initial victories of early EJ activism, scholars have more recently emphasized other spatial dimensions of EJ – recognition and participation – in an effort to “move beyond” case study oriented approaches that focus on proximity and distance.

In contrast to these calls, I argue that EJ scholars need to revisit, and more fully theorize, the spatiality of distribution. Rancière's theorization of politics reveals a different spatial dimension of distribution, and provides EJ scholars with the conceptual tools (i.e., the police, the distribution of the sensible, sensible evidences) to examine the

“very space,” as he puts it, in which environmental injustice is given to sensory experience and made to make sense. But why is the consolidation of the police – as a system of organizing and arranging space “properly” – important, and how is it useful for analysis of environmental justice? In this chapter I have sought to argue that an expanded spatiality of distribution can help identify underlying causes and processes responsible for the patterns of racialized exposure that “first generation” EJ scholarship sought to identify and problematize.

But still, how is such an approach useful? Attending to the system of sensible evidences that arrange the givens of the risk assessment process point to how compliance with federal environmental justice policy is constructed and maintained through particular spatial orderings and arrangements that are made to make sense. In Savannah, these place-making practices have involved the articulation of different characteristics (e.g., safety, significance) with certain places. These characteristics, in turn, work to continually remake the material and discursive realities of Savannah’s urban space, and encourage a particular way of thinking about them (i.e., the Garden City Terminal as “sustainable,” the Historic District as “affluent,” and the city’s west-side neighborhoods as “poor and low-income”). Perhaps more importantly, these sensible evidences – policy documents, descriptive names, spatial designations, categorizations, definitions, mappings, and statistics – have enabled new institutional and bodily practices at the Port of Savannah and in its surrounding neighborhoods that reinforce these characterizations and sediment the possibilities of the relationship between them.

Using these statements, or sensible evidences, I argue that the origins of environmental injustice are found in different constitutions of space—as networked,

relational, or scalar—which operated and combined in ways that ultimately dismantled and delegitimized concerns over human health risk. In doing so, I argue that these sensible evidences, these ‘state’s statements,’ work to effectively rearrange—or redistribute—Savannah’s urban-ecological space in such a way that environmental injustice is simply unable to make sense. And this is the part that is crucial: the effort has not been to entirely erase low-income communities of color. Neither has it been to totally erase human health risk. Instead, the effort has been to separate them—to distribute them to different places—so that claims of environmental injustice simply don’t make sense.

The Savannah case also has some practical implications as well. Increased recognition and participation in environmental decision-making have not, necessarily, led to the realization of environmental justice. Instead, the participation of recognized environmental justice communities worked, somewhat counterintuitively to further justify the project’s compliance with federal environmental justice policy. As the EPA, the Georgia Ports Authority and Department of Transportation, and others continue terminal and infrastructure improvements, as well as ecological restoration and preservation efforts, in the areas bordering the Garden City Terminal, the capacity to reduce emissions (and, by extension, human health risk) has intensified. The result has been new highway projects like the Jimmy DeLoach Parkway Connector, used by the Ports Authority and the Department of Transportation to demonstrate: first, their own successes in reducing risks from air emissions at the port and along freight corridors; and second, the suitability of the Garden City Terminal and the Georgia Ports for further sustainability investments and infrastructure development – further securing its position as the leading port in the Southeast and legitimizing more growth.

In practice, the environmental impact assessment process has been about a full-scale remaking of the Port of Savannah, especially its Garden City Terminal. These efforts, however, have not necessarily translated into fewer exposures to less risks or to greater recognition and participation for environment justice communities, as much as, say, additional revenues, and the recent emphases on “sustainability” suggests profit incentives, rather than risk reduction, inform these new practices. As the port becomes more sustainable (at least on paper) the neighborhoods of Woodville, Hudson Hill and West Savannah become increasingly burdened by its growth and expansion. Not because of a regulatory failure to recognize them as low-income or minority, or institutionalized barriers that limit their participation in decision-making. Instead, these communities become more exposed to risk because of a much wider distribution of sensible evidences which stabilize the Garden City Terminal as a site of sustainability. The Garden City Terminal, then, becomes the logical – indeed, the best and, perhaps even the most just – site for continued cargo infrastructure expansion because of its increasing articulation with notions sustainability, mobility, connectivity, efficiency, corporate responsibility, and others.

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- Chapter 5 - Conclusions

My primary concern in this dissertation has been the remaking of a spectacular Southern landscape. Perhaps above all else, my aim has been to understand how the process of building consensus—of dismantling controversy and disagreement—has worked to reshape the landscape of capitalism, the state, and the lower Savannah River estuary. I have shown that the consensus that ultimately developed in Savannah took place after a series of efforts by the Corps and the Ports Authority to rearrange—and depoliticize—the spaces of non-human nature (e.g., fisheries habitat, dissolved oxygen, air toxics, wetlands) along the Savannah River in such a way that none of the project’s key stakeholders—the Ports Authority, the Corps, the wildlife refuge, waterfront industry and manufacturers, South Carolina, coastal environmental organizations, and “Nature” among others—experienced a significant loss. And this part has been central: all of the actors involved in the conflict in Savannah did, at least to some small degree, get what they wanted: a particular “nature of consensus” so-to-speak. These efforts, however, have not necessarily translated into less risks from fewer impacts or to greater protections for environmental and human health, as much as, say, potential revenues from the long term operation of the project *and* its subsequent ecological restoration efforts. This suggests that environmental impact assessment and mitigation planning are deeply intertwined with a desire to produce the river in such a way that reinforce the city of Savannah as a site of both modern industrial port operations and sleepy, moss-covered, bucolic Southern landscapes, in a tension-filled effort to remain articulated into both the tremendous flows of financial capital from global shipping *and* historic tourism that converge on the city.

Major findings, contributions, and broader implications

At the broadest level, my dissertation has demonstrated that the process of environmental impact assessment is, at its core, a practice of place-making. Environmental impact assessment does not merely act on a predefined space of the “lower Savannah River.” Rather, impact assessment is the very process that *creates* it – defining what is in the space; what is not; which things are related, and how; and, which things are not and why. Ways of constituting and arranging space, then, have different implications for the composition of problems—or, in this case, environmental impact—and their possible solutions. If we are to understand how the Savannah Harbor Expansion Project made the transition from controversy to consensus, we need to outright reject the notion that the “lower Savannah River” and its constituent parts have any predefined or static boundaries, relations, arrangements, values, meanings, “proper” or “natural” places, etc. Rather, we must see the space of “the lower Savannah River” as almost infinitely malleable; constantly transformed by new associations—supplemental oxygen injection, diesel engine emission standards, and adaptive management planning, for instance—and rearranged and reassembled in such a way that environmental impacts are slowly dismantled, controversy is delegitimized, and consensus and compliance are built and stabilized.

In Chapter two, I explore how, and with what consequences, oxygen injection has intersected with and transformed modes of water quality regulation in the Savannah Harbor. I find that the translation of dissolved oxygen from a biological concentration measured in milligrams per liter into a geographic object measured in acres of critical habitat gained or lost, allowed restoration efforts to be concentrated in *specific* places

(i.e., those areas identified as “essential fish habitat”) along the river, thereby enabling point-source pollution loads in *general* to remain (relatively) unchanged. I demonstrate how the predictability afforded by more accurate hydrodynamic modeling, combined with the injection of super-oxygenated river water and the identification of essential fish habitat, has allowed the states of Georgia and South Carolina—in conjunction with the EPA—to develop increasingly flexible implementation measures in order to meet future point-source pollution limits in the face of revised state water quality standards. This study contributes to a growing body of scholarship on the political ecology of water, showing how dissolved oxygen—and the ecological functions it performs—is remade into a form more suited to governance and markets. And while geographic scholarship has suggested that water has several unique values and entitlements attached to it which make it particularly resistant to commodification, its biophysical components (dissolved oxygen, chlorides, or salinity) or its ecological functions (fisheries habitat or the metabolization of oxygen-demanding wastes) may not present the same challenges. In particular, the case extends work on the political ecology of water by highlighting the intricate spatial arrangements necessary to resolve contradictions of capital accumulation associated with water quality crises and make “hydro-social fixes” (Swyngedouw 2013) work.

In Chapter three, I interrogate how the institutional resistance and inertia that undermine adaptive management implementation been overcome in Savannah. I find that the unintended consequences from past harbor deepening and engineering projects—particularly the fifteen year operation of a Tidegate across the Back River—lay at the center of knowledge conflicts in Savannah, with the Corps of Engineers’ proposed

mitigation strategies embedded in a politics of memory over how previous unintended impacts and the scientific claims about them are, or should be, remembered. I show how the activation of the Tidegate, and the unintended impacts from its operation, resulted in a subtle expansion of the project's mitigation plan—an extension of the monitoring period, funding guarantees, and performance criteria—and a significant reconfiguration of the river's governance arrangement. In doing so, I show how the landscape of the lower Savannah River estuary, especially the wildlife refuge and the Tidegate, were activated as specific “sites of counter-memory” (Legg 2005b) through which scientific knowledge claims were required to circulate in order to be seen as credible, legitimate, and bearing any scientific authority. I demonstrate that the presence of the Tidegate's impacts on the landscape made concerns over the management of scientific uncertainty inescapable, and provided the legitimate material and discursive history through which to challenge the Corps' narrow approach to adaptive management planning. This work contributes to geographic scholarship on adaptive management by revealing how it is implemented in practice, and how institutional resistance is overcome. Despite the numerous challenges that continue to frustrate efforts to implement adaptive management on a large scale, memory-work and the politics of remembering/forgetting provide important analytic and strategic tools for confronting institutional inertia and a techno-scientific culture of risk-aversion in order to secure a more open-ended, flexible, and experimental adaptive management plan. In particular, this work points to the ways in which memory and its material traces are mobilized as a political resource in disputes over resource management and environmental governance.

In Chapter four, I investigate how the Savannah District demonstrated that the deepening project posed no risk to public health and complied with federal environmental justice policy. I find that different conceptualizations of space—as relational, networked, and scalar—overlapped, intersected, and combined in ways that redistributed air emissions and remade the Garden City Terminal into a site of calculated risk reduction. Rather than locate environmental injustice in the exposure to more and greater human health risks or even the misrecognized and marginalized participation for environmental justice communities (although these are certainly its material manifestations), I show how the consolidation of a particular way of seeing and thinking about Savannah’s urban space redistributes risk, and (re)constructs and reifies the city as a space where environmental injustice is not only not present, but one in which it *cannot* be present. I draw from the political thinking of Jacques Rancière (1999, 2001, 2005) to argue for a fuller understanding of the spatiality of distribution, revealing the ways in which it serves as a mechanism for defining the boundaries of what becomes sensible, intelligible, and possible. In doing so, I argue that environmental justice scholars need to revisit, and more fully theorize, the spatiality of distribution.

Limitations and a few regrets...

Perhaps the most significant limitation to this research is that contains very limited input from stakeholders, scientists, policy-makers, and community members *actually* involved in the fifteen year risk assessment process. This limited input was the result of several interrelated factors, and the primary motivating force behind my decision to pursue a historical approach in each of the three papers. First, the meetings of the Stakeholder Evaluation Group had officially ended several months before my arrival in

Savannah. While the records kept by the Group did include the names, organizational affiliation, and contact information of the majority of its participants, court challenges throughout 2011 and 2012—with several members of the Group either represented as plaintiffs or called as witnesses—ultimately led many of my requests for interviews with non-profit organizations, Ports Authority consultants, and regulatory agencies to be denied. Most often, those interviews that I was granted were done with explicit recognition that they were to be “off the record.” While many of the people with whom I spoke were able to direct me to specific documents to help answer my questions, had they been able to or agreed to comment on them and provide additional or critical insights would have significantly enriched my reading and analyses of the documents.

A related limitation is presented by the rotating membership of the Stakeholder Evaluation Group. Many of the members who had participated during the early phases of the project were no longer involved by the project’s end. The reverse is also true: in the later years of the project, many of the Group’s most active members were also some of its more recent. This is particularly important in the case of scientific and technical consultants who were contracted to work on various components or phases of the project. While the majority of technical studies and final reports produced by these contractors are included in the Group’s records, their departure from the project ultimately meant that any number of potentially critical records containing important insights were no longer available. This is particularly relevant, for example, in the controversy over water quality modelling, where the vertical-mixing approach developed by the Ports Authority’s first contractor—Applied Technology and Management—was rejected by the federal agencies and resulted in their leaving the project, arguably leaving a biased and incomplete record

of what happened. A similar case existed early in the project, as the Group membership negotiated how, and to what extent, records should be kept. The Group's early meeting summaries, for example, indicated that meetings had been tape-recorded, used by Larry Keegan, a project manager from Lockwood-Greene Engineers, to help (re)produce the meetings summaries and the group's key decisions. But inconsistency and a lack of access ultimately led the Group to demand that Georgia Ports provide a court reporter to record and transcribe meeting proceedings. And while the transcriptions proved to be a tremendous improvement, missing the first several months of the Group's negotiations is an important limitation.

One of the biggest limitations to this research, and perhaps my greatest regret, has been the necessity of presenting several entangled controversies as discrete, different problems. The sheer size of the harbor deepening project meant that a number of interesting conflicts, developments, and influences on its trajectory were left out of the analysis. While the chapters are presented as a sequence of separate conflicts, the negotiations that I have discussed never unfolded so cleanly, and should not be read as a progression from one conflict to the next. Rather, the debates and conflicts I have discussed—as well as many others—occurred simultaneously and need to be thought together. For instance, many of the tensions with South Carolina were the result of tentative plans to build a bi-state port—the Jasper Ocean Terminal—closer to the mouth of the river on the South Carolina side of the river, and the deepening in Savannah was seen as a tremendous blow to its success. Similarly, my analysis neglects the ongoing transformation of several of Savannah's bedroom communities—Garden City and Pooler being perhaps the most important examples. The Port of Savannah—as well as its

surrounding and associated industries—is a tremendous economic driver in these communities, supporting a substantial portion of these cities’ jobs and their tax base. The economic development agenda and future land use plans of these places have undoubtedly played a significant, although unexplored, part in the harbor deepening project. My analysis also neglects several of the macro-level influences that have driven (and complicated) the project, particularly the paralysis induced by one of the more austere political climates in recent history. What I can be sure of, however, is that whatever challenges the future holds Savannah and its river will most certainly have to navigate them together.

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Education

Ph.D. Geography, University of Wisconsin-Milwaukee, Milwaukee, Wisconsin (*expected May 2015*)

Dissertation: *Estimating errors: the politics of environmental impact assessment on the Savannah River* (Chair: Ryan Holifield)

M.A. Geography, East Carolina University, Greenville, North Carolina (2009)

Master's Thesis: *So what do we do now? A critical analysis of ENGO climate campaigns*
 (Chair: Holly Hapke)

B.S. Geography, East Carolina University, Greenville, North Carolina, *Magna cum Laude* (2005)

Certificate in Geographic Information Science, Geography

Fellowships, Grants, and Awards

2012. Distinguished Graduate Student Fellowship, University of Wisconsin-Milwaukee.

2010-2014. Mary Jo Read Fellowship, Department of Geography, University of Wisconsin-Milwaukee.

2010-2014. Mary Jo Read Travel Grant, Department of Geography, University of Wisconsin-Milwaukee.

2008. Katie Ball Memorial Travel Grant, Department of Geography, East Carolina University.

Publications

Journal Articles:

Covington, Ryan, Jennifer Arrigo, Scott Curtis, Patrick Long, and Derek Alderman.
 2009-2010. Tourists' climate perceptions: A survey of preferences and

sensitivities in North Carolina's Outer Banks. *The North Carolina Geographer*, 17, 38-53.

Other Publications:

Curtis, Scott, Jennifer Arrigo, Patrick Long and **Ryan Covington**. 2009. *Climate, Weather and Tourism: Bridging Science and Practice*. For: Center for Sustainable Tourism, Division of Research and Graduate Studies, East Carolina University.

Academic Conferences

Presentations:

2014. "Rethinking the Oglethorpe Plan: historic preservation, environmental justice, and the reification of white space in Savannah, Georgia." Paper presented at the Association of American Geographers Annual Meeting, Tampa, Florida.
2013. "Seeing things: making environmental (in)justice make sense along the Savannah River." Paper presented at the Southeast Division of the Association of American Geographers Annual Meeting, Roanoke, Virginia.
2013. "Environmental governance across borders and boundaries: geographies of stakeholder participation." Co-author with Ryan Holifield and Katie Williams (presenter). Paper presented at the Association of American Geographers Annual Meeting, Los Angeles, California.
2013. "Estimating errors: borders, governance, and the politics of memory on the Savannah River." Paper presented at the Association of American Geographers Annual Meeting, Los Angeles, California.
2012. "Environmental governance across borders and boundaries: geographies of stakeholder participation." Co-author with Ryan Holifield (presenter) and Katie Williams. Paper presented at *Borderscapes III*, Trieste, Italy.
2012. "Visible and calculable: the politics of seeing and speaking on the Savannah River." Paper presented at the Southeast Division of the Association of American Geographers Annual Meeting, Asheville, North Carolina.
2012. "The production of regulatory science: the geography of human health risk on the Savannah River." Paper presented at the Association of American Geographers Annual Meeting, New York, New York.
2010. "The climate justice movement: Rethinking 'place' in environmental justice." Paper presented at the 17th Annual Critical Geography Mini-Conference, University of Wisconsin-Milwaukee, Milwaukee, Wisconsin.
2009. "So, what now? A Critical Analysis of ENGO Climate Campaign." Paper presented at the Southeast Division of the Association of American Geographers Annual Meeting, **Honors Paper Competition (Master's)**, Knoxville, Tennessee.
2009. "What do we do now: The Tangled Geographies of Global Climate Activism." Paper presented at the Association of American Geographers Annual Meeting, Las Vegas, Nevada.

2009. “It’s ‘just’ language: climate change discourse and NGOs.” Paper presented at the 6th Annual TESOL/Applied Linguistics Graduate Students (TALGS) Conference, Greenville, North Carolina.
2008. “Perceiving the Outer Banks: Climate and Tourism on the coast of North Carolina.” Paper presented at the Southeast Division of the Association of American Geographers Annual Meeting, Greensboro, North Carolina.
2008. “Tourism Climate Perceptions: Developing a Climate-Tourism Index for the Outer Banks.” Paper presented at the Climate, Weather and Tourism: Issues and Opportunities Research Symposium, Greenville, North Carolina.

Sessions Organized:

2013. Co-organizer and Session Chair - “Borders, natures, and environmental governance” Paper Session at the Association of American Geographers Annual Meeting, Los Angeles, California.
2010. Co-organizer and Session Chair - “Environmental Politics” Paper Session at the 17th Annual Critical Geography Mini-Conference, University of Wisconsin-Milwaukee, Milwaukee, Wisconsin.
2009. Organizer and Session Chair - “Spaces of Difference” Paper Session at the Association of American Geographers Annual Meeting, Las Vegas, Nevada.

Conference Organization:

2010. Planning Committee - “17th Annual Critical Geography Mini-Conference,” University of Wisconsin-Milwaukee, Milwaukee, Wisconsin.
2008. Co-organizer with Patrick Long, Ph.D. and Scott Curtis, Ph.D. - “Climate, Weather and Tourism: Issues and Opportunities,” Center for Sustainable Tourism, East Carolina University, Division of Research and Graduate Studies, Greenville, North Carolina.

Funding: North Carolina Sea Grant (\$2500); National Climatic Data Center (\$2500); Institute for Coastal Science and Policy (\$2500); East Carolina University College of Business (\$1500)

Professional Experience

University of Wisconsin-Milwaukee

August 2010—present (5 years) | Milwaukee, Wisconsin

Instructor, Department of Geography

- Geography 120: Our Physical Environment (Online)
- Geography 125: Introduction to Environmental Geography (**Service Learning**)
- Geography 140: Our Urban Environment: Introduction to the Urban Geography
- Geography 600: Perspectives in Geography (*Teaching Assistant*)

Invited Lectures:

Geography 430: Geography of Transportation, “Harboring risk: sustainability, environmental justice, and the politics of moving freight on the Georgia coast”

Research Assistant, Department of Geography

- Research Assistant to **Ryan Holilfield**, Co-PI with Timothy Ehlinger and Manu Sobti, “*Escaping Flatland: (Re) Writing the Histories, Geographies and Borderland Ecologies of Water.*”

East Carolina University

August 2007—August 2009 (2 years) | Greenville, North Carolina

Research Assistant, Center for Sustainable Tourism

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Professional Affiliations

2007 - present. Association of American Geographers

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