

MAPS AND CONTRADICTIONS: URBAN POLITICAL ECOLOGY AND CARTOGRAPHIC EXPERTISE IN EXURBAN SOUTHERN APPALACHIA

Seth Gustafson

s.gustafson@ucl.ac.uk

Geoforum 60, 143-152.

INTRODUCTION

The stormy remnants of Hurricanes Ivan and Frances passed over mountainous Macon County, North Carolina, only days apart from one another in September 2004, together dumping nearly 50 centimeters of rain across the County and much of the southern Appalachian mountains of the southeastern United States. In addition to significant flooding in the cities, towns, farms, and forests of the area, one result was a landslide in the Peeks Creek hamlet of Macon County, in which five people died, dozens were injured, and over thirty homes were damaged or destroyed. While this corner of southern Appalachia is famous for its generational landholding families, they were not the only group who suffered from the Peeks Creek tragedy. Among the victims and survivors were also exurban migrants from Florida, examples of a trend in which from the 1960s to present, retirees and second-home owners from across the southeastern US fuelled low-density, amenity-based urban growth in Macon County and southern Appalachia (see Gragson and Bolstad 2006, Gustafson et al. 2014). Though subsistence farming and forestry have been the economic basis for southern Appalachia for generations, the five-decade swell of exurban migrants has supplanted agriculture with tourism and residential construction. In terms of the spatial form of settlement patterns, exurban growth in southern Appalachia has expanded into higher elevations and onto historically uninhabited mountainsides (see Kirk et al. 2012 and Gragson and Bolstad 2006).

Prompted by the tragedies of Peeks Creek and exurban housing developments creeping up

mountainsides throughout the western portion of the state, the State of North Carolina sought to mitigate landslide vulnerability in the western counties in the early 2000s. In one of the first bills of the legislative session following the Peeks Creek landslide, the State legislature passed through a 47-0 vote The Hurricane Recovery Act of 2005. Part of the act commissioned the North Carolina Geological Survey (NCGS) to produce a series of landslide hazard maps for each of North Carolina's nineteen westernmost counties with the aim of delineating for the public downflow hazard zones and landslide initiation zones. Public support for the act and the maps was high, especially given the deaths at Peeks Creek as well as the region's hundreds of other landslides in the wake of Hurricane Ivan's and Frances' remnants during the previous autumn. Rick Wooten, a Senior Geologist at the NCGS, was charged with leading a team of six other geologists in this state mandated landslide hazard mapping program.

By 2011, though, the sentiments at the state and local levels and the popularity of the mapping program with the public were dramatically different. At the state level, the legislature entirely defunded the mapping program in its 2010 budget. At the local level, Macon County's politics became dominated by divergent opinions on the scientific merits of the maps and their regulatory implications for a controversially defeated county-wide steep slope development ordinance in 2011. Commissioned by the County Planning Board and comprised of a group of local geologists, hydrologists, surveyors, concerned citizens, lawyers, and planners, the Steep Slope Subcommittee drafted the ordinance, using the maps to help delineate the areas of the county subject to regulation.

Adding to the controversy, though the maps were produced for public information, Macon County officials removed them from the County's website, citing an unspecified fear of being held liable for their content. The maps also were designed to be used as local planning tools, a process inhibited in local planning board meetings by land rights activists who feared over-regulation of their land by the state. While the NCGS made hundreds of presentations in western North Carolina

about the maps, opponents regularly derided the merits and appropriateness of the maps in public meetings, newspapers, and other local media sources. These arguments regularly questioned the reliability of LiDAR data, the inability of the maps to predict the exact time and place of a landslide, and the arbitrary standards that the NCGS geologists used to delineate landslide prone areas. At both levels, then, the once popular maps went from a publicly valorized post-disaster relief strategy to a political lightning rod at the local and state levels. The shift in state and local politics raises the question: what happened from 2005-2011 to make such an improbable change in the public viability of the NCGS downslope hazard maps?

Drawing on recent theoretical and empirical scholarship at the intersection of urban political ecology (UPE) and science and technology studies (STS), I develop a narrative that details the political rise and fall of the NCGS downslope hazard maps from 2005-2011 in the context of longer term political ecological contradictions of exurban growth as mediated through the local epistemological politics of cartographic expertise. Following the growing literature at the intersection of UPE and STS, this paper first develops a theoretical framework linking cartographic expertise, practice, and products with the governance, management, calculation, and evaluation of exurban environments. Next, drawing on three years of fieldwork that included semi-structured interviews with southern Appalachian and Maconian scientists, homeowners, planners, officials, and other citizens; archival research; and participant observation at public meetings, the paper narrates the production, circulation, and deployment of the NCGS maps. It especially focuses on the public debates over the maps, highlighting epistemological rifts and disputes over their scientific merits. The paper concludes by offering both theoretical reflections upon and empirical consequences of the politics of exurban environmental knowledge.

This narrative combining insights from UPE and STS is important for two main reasons. First, without understanding exurban uneven development through the contradictions of exurban growth, we are left with an understanding of the politics of environmental knowledge devoid of

their relationship to the process of urbanization. Second, without understanding the scientific and technical means of urban environmental governance and management, especially through cartography, we miss the technoscientific outcomes and politics of urbanization in historically rural places. In short, it is because the maps spatially delineate and reveal the geomorphically shifting foundations of exurban developments that they were so hotly contested. Yet they also participate in a cartographic story of other shaky foundations of exurban development: the shifting role of the state, the social fault lines of expert and legitimate knowledge claims, and the fractured political economy of exurbanization. Though the landslides in Macon County represent perhaps the most obvious environmentally unstable foundations of the county's exurban growth, the controversy over the maps also exposes the contradictions of capital accumulation through residential construction and the fraught role of governance using cartographic and scientific expertise in exurbia.

THEORETICAL FRAMEWORK: URBAN POLITICAL ECOLOGY MEETS STS AND CRITICAL CARTOGRAPHY

Knowable Communities

In an often overlooked chapter in his otherwise widely celebrated and cited reflections on the modes of city life and country life as represented in the English novels of the 19th century, Raymond Williams in *The Country and the City* dissects novelists' strategy of creating 'knowable communities' in their work. These knowable communities, he notes, are not static, placeless, or timeless creations. Instead, as Williams shows, knowable communities as demonstrated by the interaction between characters, the diction describing the action and plot, and the familiarity of settings and relationships are often contingent upon the degree to which the novel's setting is urbanized. His observation is worth quoting at length. He writes (165):

There can be no doubt...that identity and community become more problematic, as a matter of perception and as a matter of valuation, as the scale and complexity of the characteristic social organization increase. Up to that point, the transition from country to city—from a

predominantly rural to a predominantly urban society—is transforming and significant. The growth of towns and especially of cities and a metropolis; the increasing division and complexity of labour; the altered and critical relations between and within social classes: in changes like these any assumption of a knowable community—a whole community, wholly knowable—become harder and harder to sustain. But this is not the whole story, and once again, in realising the new fact of the city, we must be careful not to idealize the old and new facts of the country. For what is knowable is not only a function of objects—of what there is to be known. It is also a function of subjects, of observers—of what is desired and what needs to be known.

Here, Williams initially recognizes the common observation of the increased complexity and density of social networks and relations in cities relative to the countryside, and that as historically rural areas undergo the processes of urbanization, the intimate and informal knowability of communities fractures. He then moves beyond the trope of 'simple country life' to note something more profound about the nature of urban life: that urbanization creates new objects and subjects of knowledge. In other words, transformations in the social categories of that which is worth and not worth knowing, who knows and who does not know, and what ought to be and ought not to be known are symptoms of urbanization. Implicit in Williams' chapter and in the novels he examines is the social upheaval and contestation that results from these transformations. Indeed, a central theme of these 19th century novels is the public and private struggle against the constraining yet dynamic categories of the age. Though Williams' aim is to critique Dickens', Bronte's, and other novelists' representations of knowable communities in the British countryside and cities, his argument has implications beyond literary criticism. In particular, Williams' insight into how urbanization changes the objects and subjects of knowledge and the concomitant contestation of these changes can contribute to scholarship at the intersection of UPE and STS by considering the role of cartographic expertise in urbanization.

As a field of inquiry, UPE is fundamentally concerned with the production of urban nature, meaning that urbanization is a historical-geographical process of creating dense, uneven, and unequal networked relationships between humans and non-humans, connecting and disconnecting

them by manipulating social and ecological processes (see Desfor and Keil 2004, Robbins 2007, Swyngedouw and Heynen 2003, Kaika 2005, Keil 2003, Loftus 2012). This creation and modification of relationships is often called ‘urban metabolism’ in UPE, and the term implies that the very definition of the urban condition is the “circulation of physical, chemical, and biological components” that “are never socially or ecologically neutral” (Heynen et al. 2006). As Williams notes, urbanization implies an increased complexity to the arrangements of social life in cities. This is not to say, of course, that rural social relations are somehow simple or unsophisticated, but only to note that a hallmark of the process of urbanization is the increasing density of the networked actors, objects, and subjects that constitute social relations.

Furthermore, and paralleling Williams' objects and subjects of knowledge, urban metabolism is not simply a new twist on old historical materialism, as it also considers the new patterned movements of humans and the changing knowledge they have of their environments: “While an understanding of the changes that have occurred within urban environments lies at the heart of [urban] political ecology research, they must be understood within the context of economic, political and social relations that have led to urban environmental change. ...The material production of environments is necessarily impregnated with the mobilization of particular discourses and understandings (if not ideologies) of and about nature and the environment” (Heynen et al. 2006, 7). Most holistically, then, the concept of urban metabolism attempts to account for the ever-changing “flows of people, objects, resources, and knowledge” that constitute urbanization (Gustafson et al. 2014).

STS, UPE, and Critical Cartography

These notions of urban metabolism from ‘first wave’ UPE are extended and challenged by at least two theoretical insights from an emerging ‘second wave’ (Heynen 2013) of UPE scholarship. First, one innovation of second wave UPE is an incorporation of STS. A significant portion of this work articulates the epistemological and ontological qualities of an actor-network (ANT) approach

to UPE (e.g., Holifield 2010). These ANT interventions into UPE are complemented by other non-ANT scholarship (e.g., Rice 2011, Furlong 2011, Gandy 2008), which demonstrate and theorize the ways in which scientific knowledge production, artifacts and devices, expert techniques of environmental management, and discourses invoking scientific and technical authority add necessary nuance and depth to UPE's notion of urban metabolism. For instance, UPE research is dominated by the urban metabolism of water (e.g., Swyngedouw 2004, Kaika 2004, Loftus 2012, Bakker 2003), a process creating hydrological objects (e.g., new sources of water drawn into the city) for hydrological subjects (e.g., individuals and institutions with management techniques, expertise, governance capacities, financial schemes, and consumption of urban water). Loftus, in his description of the fractured water regime of squatter settlements in South Africa, concretely describes these social and technical mediations and their importance for understanding UPE. He writes (Loftus 2012, 45-46):

...a profoundly gendered division of labor ensures a distribution of tasks that is generally favorable to men and, in turn, ensures that most men and most women in Amaoti interact with environments in profoundly different ways. [W]orld-changing perspectives emerge from consciousness of the coevolutionary processes out of which environments are constituted. ...Making the daily trek to a standpipe to fill a plastic bucket with water mediates a set of relationships with structures of local government; with distant shareholders and investment bankers; with gendered, raced, and classed subjects; and with the ground- or surface-water sources from which the supply is provided.

Here, Loftus argues that urban subjects and objects are not a set of preconfigured urban outcomes, but instead are rooted in and constitutive of the process of urbanization, drawn into networks of unequal and shifting socio-technical relations. In this example, urban water as an urban object becomes routed and rerouted, financialized and polluted, and piped and sanitized for particular subjects who come to know this water, its properties, its attendant sociotechnical systems, and modes of governance through their everyday experiences with it.

Because the growing intersection of UPE and STS has not yet addressed it, I propose here that the critical cartography literature can illuminate even further the ways in which artifacts like

maps and experts like cartographers are embroiled in processes of urban metabolism (though see Goldman, Nadasdy, and Turner 2010 for work at the intersection of political ecology and STS). Critical cartography is important for UPE because cartographic praxis is essential for the scientific management and administration of urban environments. It is cartography that often permits calculation of environmental risk, mapping of hazards, state legibility of non-human flows, and particular avenues of communication between scientists, managers, and various publics. This is especially relevant for exurban areas, where the office, personnel, and tools of local planners are often new and controversial additions to the role of the local state.

In this paper, I turn to Cidell's (2008) notion of 'lay critical cartography.' Most of the critical cartography literature, as Cidell (2008) notes, focuses on participatory GIS, countermapping, and other more inclusively democratic cartographic techniques (Crampton and Krygier 2006, Harley 1990, Monmonier 1995, Wood 1992). It does this mostly by critiquing practices of cartographic knowledge production. A more recent development in critical cartography, however, is "discovering how members of the public critique cartography as based on existing maps rather than through the production of new ones" (Cidell 2008, see also Crampton 2009, Wood 2010, and Kitchen, Dodge, and Perkins 2009). This 'lay critical cartography,' as Cidell calls it, is essential to understanding how maps function in cities and urbanizing areas because it draws attention to the social life of maps, the political responses they elicit, and the political possibilities they enable and disable. Thus, instead of focusing on the democratic production of cartographic knowledge, though, a lay critical cartography approach in UPE would methodically and methodologically track the maps through space and time, seeing how their already existing form and function provokes new political activities and environmental changes.

Beyond this paper, critical cartography and UPE have obvious connections. As a subdiscipline that incorporates critical theory, map making, and map meaning, critical cartography is an attempt to link processes and practices of cartographic knowledge with power (Crampton and

Krygier 2006, Harley 1989). Scholars of critical cartography often investigate the intersection of power, the technology of the map, knowledge, and space, critically examining the map as a form of knowledge that creates known and unknown landscapes, valorizes and demeans particular knowledge, and affirms the social positions of those who are able to produce, circulate, and apply the maps. Recent numerous authors have elucidated a deconstruction of maps and cartography, detailing the power relations, problems of representation, and assumptions of truth that are part and parcel of cartography (e.g., Elwood 2010, King 1996, Pickles 1995, Wood 1992, Black 1997). Other scholars working at the intersection of political ecology and critical cartography have created maps in conjunction with and using information from traditionally marginalized groups (Colchester 2005, Poole 2005, Rocheleau 2005, Rocheleau 1995, Topatimasang 2005). The practice of mapping is a practice of producing selective representations of the landscape, understanding the consequences of how these representations move in space and time, and interpreting the power relations of how maps are deployed for particular ends (see Winichakul 1997, Anderson 1991, Mitchell 2002). For scholars working in UPE, incorporating insights from critical cartography helps understand how the metabolic flows of exurban change are conceived and contested through maps. Tracing the use of maps thus further elucidates how local environmental managers, interest groups, and others understand, manipulate, control, regulate, and politicize the metabolic flows and disjunctures created by exurban change.

Exurban Political Ecology

A second theoretical innovation works to expand the purview of UPE beyond cities and into urbanizing areas. As Wachsmuth (2012) and Angelo and Wachsmuth (2013) note, most of first generation UPE's empirical focus is in locations commonly thought of as 'cities'. Wachsmuth (518) has termed this city-centrism "methodological cityism," in which

the city is taken to be the privileged analytical lens for studying contemporary processes of urban social transformation that are not necessarily limited to the city. So, while scholars working within the UPE tradition have produced insightful analyses of cities as products of global socio-natural processes, they have largely

failed to investigate noncity products of those same processes.

This mismatch is a missed opportunity for research and for contributing to how we understand urbanization in the countryside. Even more, it can also push scholars of political ecology to consider the consequences of urbanization, especially given the centrality of rural development research to political ecology's past and present. As Gustafson et al. (2014) demonstrate, the growing subfield of 'exurban studies' is a promising subfield with ways to avoid methodological cityism in UPE, offering nuance and insight into how urban metabolism is articulated in urbanizing contexts outside of cities.

In the exurban studies literature, critical political economic and political ecological perspectives can deepen the existing central topics of representations of the rural (Woods 2011), state interests in exurbanization (Scott et al. 2011), local conservation efforts in the face of non-local interests (Hurley and Halfacre 2011), expertise and democracy in land use conflict (Young 2011), and exurbia as a place and process (Gosnell and Adams 2011; Taylor 2011). Furthermore, though exurban growth in the US began in earnest in the mid-20th century, scholarship on the environmental implications of exurbanization began to substantially grow in the 1990s and 2000s (e.g., Abrams et al. 2012; Gragson et al. 2008; Lumpkin and Pearson 2013; Kirk et al. 2012; Scott 2006; Fleishman and MacNally 2007; Hansen et al. 2005; Bock and Bock 2009). While these studies focus primarily on ecological variables, physical environmental changes can serve as a robust complement to UPE analyses of urban metabolism. Indeed, much of this environmental scholarship focuses on the astounding urban growth patterns extending deep into historically rural areas (Kirk et al. 2012, Berube et al. 2006).

Focusing more intently on political economy in exurbia, I follow more closely Sayre's commentary (2011), which echoes Darling (2005), McCarthy (2007), and Robbins et al. (2011) as another recent contribution to urbanization and uneven development in exurbia. As Sayre (2011, 76) notes, "...the state [in exurbia]...must strike some balance between economic growth, local

legitimacy, and conformance to ... expectations of governance and investor confidence.” In particular, these scholars focus on the contradiction of exurban growth in which the accumulation of capital through residential construction undermines itself by degrading the environmental amenities that attracted the growth in the first place (O’Connor 1992). State and civil society are often situated in the fraught position of both responding to the environmental degradation via regulation or other measures while at the same time encouraging capitalist investment.

The state and civil society, then, find themselves in the middle of the contradiction, expected to promote economic growth as well as mitigate urban growth’s environmental consequences. The local state in particular often does this through planning, making even the mundane mechanisms of planning also subject to the balance of growth, legitimacy, and effective governance. In exurbia, this situation has often taken the form of local governments and interest groups incentivizing local residential construction while simultaneously developing zoning and municipal ordinances to mitigate the traffic, smog, water quality/quantity decreases, marring of viewsheds, and other externalities of exurban development that ultimately diminish the social and environmental amenities that attracted the urban growth in the first place.

State and civil society intervention into this contradiction is rarely as simple as writing a cookie-cutter ordinance or zoning policy, though. Instead, it is a highly contested process in which a range of knowledge and techniques—including scientific knowledge, expertise, local experience, and non-expert knowledge about the landscape, the appropriate role of the local state, the nature and existence of environmental externalities (e.g., Brint 2004, Fisher 2000, Christensen 2008, Gauchat 2012, Nowotny et al. 2001, Oreskes and Conway 2008)—are produced, circulated, and applied (Goldman, Nadasdy, and Turner 2012) in attempts to resolve the contradiction. The theoretical value added in bringing STS into conversation with UPE is that the particular expertise, tools, techniques, and strategies—including cartography and maps—of resolving this political ecological contradiction are instrumental in understanding the contradiction’s political and environmental

outcomes. Furthermore, the persistence of rural practices and the selective adoption of urban governance practices is a recent theme in some exurban-oriented scholarship (Walker and Hurley 2011, Cadieux and Taylor 2013, and Hurley 2013). These works show that whether or not communities adopt new forms of expertise and techniques of governance, the conflicted politics of managing the growth and degradation of exurban contradiction depends in large part on entrenched power relations.

FINDINGS: SOUTHERN APPALACHIAN CARTOGRAPHIC POLITICS IN AN EXURBAN ERA

Cartographic Origins

Receiving their mandate from the State legislature, from 2005 to 2010, state geologist Rick Wooten and his team of six other geologists mapped four western North Carolina counties using a variety of standard techniques ranging from LiDAR, GIS, soil maps, and on-the-ground sampling. Macon County, because of its rapid population increase and because of the deadly Peeks Creek landslide, was the first to be mapped. The NCGS geologists produced the maps, which are made freely available on the NCGS website, offering a chance for the public and for county officials to see a team of scientific experts' evaluation of landslide prone areas of their county. The maps themselves appear quite detailed: thin, squirming lines demarcate different geologically defined zones represented by a range of colors. Beyond this information, though, the maps contain almost no references to other variables, including property boundaries. Given the already high level of detailed information on the maps, any more information, like property boundaries, for instance, would make the map unreadable.

To be precise, the controversy in Macon County was over the one particular map used in the Steep Slope Subcommittee's ordinance, the Macon County Downslope Hazard Map. Two other maps, though, were created—the Slope Movements and Deposits Map and the Stability Index Map.

The three maps display slightly different but mutually contextual information: the Slope Movements and Deposits Map displays known locations of past landslides; the Stability Index Map displays places where landslides are likely to start in the future; and the Downslope Hazard Map shows where landslides are likely to move in the future. Together, they detail the areas of potentially risky construction in the mountains. Wooten's team used a variety of data sources to create the maps, including soil maps, geologic maps, aerial photography, satellite imagery, and field samples. LiDAR data created the digital elevation model (DEM), which was used in part to calculate the slope. The DEM calculated the slope at a 95% confidence interval for 1.6 feet of error in elevation. This is highly accurate data, but this kind of high accuracy is regularly achievable when LiDAR is done correctly. An interviewee (Personal interview, Interviewee A) familiar with the mapping project described this as a "state of the science" rather than "state of the art" endeavor. These comments both affirm the geologists' methods in the language of 'science' and also indicate that the NCGS geologists were relying on a well-established suite of data and their compilation and analysis rather than trying out new, untested, and potentially faulty methods.

Local Deployment and Resistance

North Carolina Governor Michael Easley unveiled Macon County's landslide hazard maps in October 2006 (Office of the Governor, Press Release, 3 October 2006). "These maps will show which areas are prone to landslides and that will help developers, county officials, and residents decide where to safely build homes, roads, and other structures," he said in a press release, noting that the maps will "enable communities to evaluate and reduce the risks of building homes and other structures in landslide-prone areas of the North Carolina mountains." Easley's statements implied an intended use of the NCGS's maps in local jurisdictions and communities. To this end, the NCGS made the maps available on their website and promised that four more western North Carolina counties would have maps by 2008. The maps were officially unveiled during the height of the pre-2008 crisis construction boom in western North Carolina. Given the central role of

residential construction and exurban real estate to the region's economy, Governor Easley had every interest in ensuring that the capital investment through exurban growth continued apace. Landslide hazard maps were one way to encourage local planning boards to assure developers and home buyers that their investments were located in safe places unlikely to be affected by landslides. Thus, the maps were intended to secure further capital investment through continued exurban growth.

Despite these aspirations, the further use of the maps faltered on two fronts. First, despite its initial popularity in 2005, the landslide mapping program turned controversial in 2010 at the state level. The state legislature that in 2005 enthusiastically and unanimously funded the program became Tea Party-led, and in 2010 it eliminated the mapping program in a suite of austerity measures gutting the state's budget. Secondly and paralleling the state level developments, the NCGS maps also encountered stiff political resistance in Macon County. Though some county politicians had expressed interest in the maps after their completion in 2008, by 2010, their support waned. The steep slope development ordinance's public meetings had drawn the interest of Macon County's well-organized and established conservative land rights activists, who began opposing the maps' inclusion in the steep slope development ordinance ordinance.

Amid this public controversy, rumors swirled that the county might be liable for the information on the maps if they remained posted on the website. Since their public release, the maps had appeared on the county's website and were available for download. In December 2010, though, a *Smoky Mountain News* reporter investigating landslides in the region noticed that the maps had been removed from the website (Ellison 2010). The county claimed to be concerned about being sued because the maps' presence on their website would imply an endorsement of their merits. The State of North Carolina and other legal experts, however, reassured Macon County officials that the county would not be liable for any information present on the maps, but the maps remained and continue to remain absent from the website. My interviewees noted that public

speculation remained rampant that the county was politically pressured to remove the maps from their website (Personal Interview, Interviewees B, D, G, H, I, N). Ultimately, public access to the maps was significantly hindered by the removal of the maps from the county website.

Maps as Junk Science

For their part in the local use of the maps, Wooten and the NCGS geologists working on the landslide hazard mapping projects presented their findings at nearly 200 community meetings in western North Carolina and roughly 20 times in Macon County alone (Personal Interview, Interviewee U). These invited presentations were at organizations like land trusts, subdivision groups, watershed councils, planning boards, county commissions, and other similar civic and volunteer organizations. At one of these presentations to the Macon County Planning Board, Wooten outlined the merits of the maps and their methodology. While many appreciated his presentation, some reported finding it inaccessibly technical and detailed, as Wooten presented mathematical equations and some of the nuances of GIS and LiDAR techniques. An anti-ordinance board member, at the conclusion of Wooten's presentation, abruptly said aloud to the audience that no one understood Wooten's complicated work and that now the planning board could return to its real business (personal interview, Interviewee D).

In addition to dismissing the maps as too complicated for the planning board's use, land rights activists deployed other arguments about the maps, aiming to show the maps' inaccuracies, inappropriateness for regulation, and unreliability. Land rights activist groups (e.g., the local and only chapter of Property Owners of America) sowed doubt about the quality, usefulness, and appropriateness of the maps. I draw primarily from Vic Drummond, a well-known county conservative activist, former county commission candidate, and operator of the blog Stop Steep Slope (stopsteepslope.wordpress.com), mostly because the blog and his frequent letters to the editor articulated most succinctly the range of anti-mapping arguments.

He (Drummond 2011) offers this take on the maps: "No one can predict when or where a

landslide will occur. Every inch of mountainside is susceptible to landslides. The Landslide Hazard Maps are pure speculation. They are based on scientific ‘theories’ not... ‘scientific methods.’” This avoids the point that the NCGS do not purport to predict the certainty of landslides, but more importantly, the polemical accusation that the maps cannot predict a landslide casts doubt on the credibility of the maps.

Drummond (2011) continues on the topic of accuracy:

“The statement that ‘No qualified professional has disputed the accuracy of the maps’ is absurd. It depends on what the meaning of ‘accuracy is.’ [sic] The geologist who developed the Macon County Landslide Hazard Map says they are simply a planning tool. Doesn’t that disprove their ‘accuracy?’ What is meant by ‘accuracy?’ That a landslide MIGHT occur on one of the predicted hazard zones? How can they be ‘accurate’ if they can’t tell us that a landslide WILL occur if there is a 5” rain?”

Here, the author misrepresents the meaning of the term ‘accuracy,’ but more importantly, he impedes the public’s use and understanding of the maps by again hinting at their lack of credibility.

Similarly, Drummond (2011) raises questions about LiDAR, GIS, and field techniques used to create the maps:

The NC geological Survey geologists...put [soil map information and a digital elevation model] into their computers and ran [SINMAP] while changing different input variables until the program generated a map that showed potential hazardous landslide origination points at points that included where their field survey’s [sic] show landslides occurred. This required the SINMAP program to be run many times. The people running the program decide when they have generated a ‘good’ map. Too few or too many high hazard points are ‘bad’. This is sort of like Goldilocks trying to pick which porridge temperature is just ‘right.’ The geologists then took their ‘good’ map of hazard zones and manually drew in areas that they felt represented landslide hazard zones shown on the Landslide Hazard Map.

Drummond notes that geologists make choices that influence the content and expression of scientific findings. He also implicitly references a detached objectivity that scientists often claim, observing that the geologists do not measure up to this scientific standard of objectivity.

Drummond (2012) has also referred to the maps as “bordering on ‘junk science’” in another letter to the editor. Wooten and his team of geologists were not detached, objective experts, of course, insofar as they were residents of the landslide prone region of the state. What is rhetorically

powerful about Drummond's statement, though, is the image of scientists creating maps they 'felt' like creating—an image of rigor-less irresponsibility and conflicted interest.

Finally, Drummond (2011) questioned the accuracy and appropriateness of LiDAR. In his modified FAQ's, he writes:

Is LiDAR accurate?

According to the Working Group [i.e., the steep slope ordinance subcommittee], “the data is accurate enough...” They admit it is least accurate in forests where the majority of steep slope property is located.

When the decision on whether or not a site falls into a 30% or 40% slope and falls under the ordinance, is the data “accurate enough?” I'm not sure it is.

The sentence Drummond refers to is from the Steep Slope Subcommittee's website, which reads “The data is accurate enough to use for determining the slope of a property in Macon County” after noting that the LiDAR-derived DEM is accurate to within 1.61 feet at a 95% confidence level. Aside from Drummond's deliberate selective quoting of his opponent, his answer to whether LiDAR is “accurate enough” is meant to sow doubt about its accuracy, suggesting that it is only marginally accurate.

Drummond's arguments pertain to the scientific merits of the maps, but another argument characterized by epistemological difference was more frequently articulated in public meetings than it was in print. Because the maps also relied on particular GIS and LiDAR methods of calculating the slope of the land, at public meetings both the spatialization of hazard zones and the LiDAR slope calculations troubled some landowners because the maps presented a radically different way of coming to know the landscape. These epistemological encounters happened frequently at public meetings and they revealed the divisions between how conservative land rights activists, especially those who were long term residents, understood the landscape differently than local planners, geologists, and GIS/LiDAR experts. An example of this encounter happened in the late summer of 2011 at a Steep Slope Subcommittee meeting in Cowee, a township in the northern reaches of the county. An older man whose family of generational landowners managed a large farm rose to speak

out against the maps. He said that the LiDAR-derived DEM had calculated the slope of his land, but that it was still safe for construction. He claimed to know this because he had taken a level out on his land, laid it down on a hill slope, and measured the angle between the level and a horizontal string. He (County Planning Board Meeting, 17 June 2010) also invited any map proponent to visit him on his land and he would show them the same demonstration.

In my case, I've got land that I've owned for 40, 50 years, 20 acres, that land, I've been paying based on an average of so much per acre. I know because I took my level out on the land and a goodly portion is around 30, 35, 40 percent grade. We have houses all over the county that have been built on that kind of a slope and it's never been a problem. But now, if you legislate my land out of usage and I've been paying based on a given price per acre on that land, are you going to then tell the county tax assessor on this land, this land, this land you've got to reduce their value because of the grade of the slope. I mean, how complicated is this going to get?

Other similar arguments complained that property lines and stream banks on the maps had been slightly misplaced and that the maps were, therefore, untrustworthy.

Though some land surveyors and geological experts would question the man's methods, to some degree, he was correct: he accurately measured the slope on a three-foot mini-transect of his land and found that it did not correspond to the DEM's assessment. Most cartographers would note, too, that this discrepancy is entirely possible and even likely, depending on the resolution of the LiDAR data. More important, though, is the difference between the experiential means by which this man knows his land and the technical means by which the DEM is calculated. The discrepancy reveals the kinds of difficult epistemological encounters at the collision of long-term firsthand experience with the land and the seemingly abstract and detached portrayals of landscape characteristics made possible by LiDAR and GIS.

To Apply or To Avoid the Maps?

From early 2010 until the defeat of the ordinance in late summer of 2011, public controversy about the NCGS maps raged in public meetings and newspaper editorials. Those who crafted the ordinance were aware of these arguments against the science of the maps. As one interviewee (Interviewee O) noted, "[The maps are] based on the best information that's available, using LiDAR

technology and a gazillion hours in the field verifying what the maps were showing. It's the best thing you could do. There's nothing out there better. Yet, because there is a lack of concrete '1+1=2' associated with the maps, there's some gray areas, sure, there's going to be some error associated with anything like that especially at the scale we're working. Because of that—because it wasn't definite—that created an opening for those who were opposed to the process.”

The impeded use of the maps still drew the ire of some pro-mapping and pro-ordinance Maconians and posed an important question: what exactly should be done with these maps? Two groups emerged who supported the use of the maps, yet for different reasons, neither group offered a winsome plan for the maps. The most organized group supporting the maps in public debate was the Steep Slope Subcommittee. Rather than a vociferous defense of the maps and their appropriateness for the project, the Subcommittee and Planning Board wrote (Macon County Steep Slope Subcommittee 2011) these notes in their FAQs about the ordinance and maps:

Q: Can the Landslide Hazard Maps predict landslides?

A: No techniques that are presently known can predict the time and place of future landslides with 100% accuracy. However, the maps are based on the best available scientific methods and data for making these predictions. The maps are planning and screening tools that show the general areas where landslides are likely to start, and where they will likely go should they occur. The maps are not a substitute for a site specific stability assessment by a qualified geologist or engineer. There are many examples of predictive maps being used to predict hazards. For example, the Flood Hazard maps are incorporated in a County ordinance, the State of NC Building Code uses maps to predict seismic risks, high wind risks, and even the risk of termite damage. All weathermen use maps to predict the weather. None of these are infallible, but all are useful. No qualified professional has disputed the accuracy of the maps.

This is a sample of the milquetoast but accurate language one might expect from a planning board patiently justifying their methodology, but it did not measure up in political effectiveness or fiery conviction to the subversive and polemical discourse of the county's land rights activists. The planning board, like many official bodies, had to first and foremost state their information plainly, clearly, and accurately so as to avoid public misinterpretation and to avoid misstating the legal ramifications of planning, mapping, and regulating steep slope development. While the board

justified the rigor of the maps, they did so in language that emphasizes that the maps help manage risk (see Boyd 2012), rather than give a ‘real’ representation of the terrain. Though their plain language is correct, it is uninspiring and it was magnified by the near absence of a politically organized effort to counter balance the county’s land rights activists.

The only other organization promoting the maps was an advocacy group calling themselves MaconSense. By the time of their formation in August 2011, though, the maps had already been divorced from the ordinance. MaconSense’s stance on the maps was essentially a strategy of non-engagement. While at their meetings they would talk occasionally about the maps, one of their members argued that the map controversy was a non-starter (personal interview, Interviewee D):

If you’re going to get into the components of it, which gets really quickly into a technical conversation that doesn’t seem to really motivate anybody. ... There seems to be this idea that if we could just get the facts out there then we would win the day. But that’s just not true. ... We don’t want to get into debates about the accuracy of LiDAR data. How do you form a message around that? It’s just a quagmire you get sucked into.

This lack of desire to engage political opponents on scientific issues is interesting because some members of MaconSense sensed that the local skepticism toward scientific expertise was driven by non-local political trends. As one (Interviewee G) said: “[the skepticism of the maps] goes back to the same thing, this mistrust of global warming or fear of thinking that...the data’s inaccurate or that there’s an agenda. It surprised me, but I don’t think it would have been as apparent 10 or 15 years ago. People in this community have had a pretty good respect for...Coweeta [Hydrologic Lab, a US Forest Service research station in Macon County] and places of scientific research. It seems like people question science now more than ever. They don’t really want to be confused by the facts.” Ultimately, debating over the fine details of the maps and fighting the battles of expertise proved to be uninviting for MaconSense. Not having crafted the technical arguments in favor of the maps or cooperated with Wooten’s team, they instead focused their energy on first, promoting the ordinance itself and, second, countering land rights activists on the benefits and burdens of ordinances. Though the well-organized land rights activists disputed the maps on a number of

points, their efforts were essentially ignored by MaconSense.

CONCLUSION

How exurban environments become known, measured, calculated, mapped, regulated, and protected, especially in the midst of the contradictions of exurban growth, is inextricably linked to the deployment of particular forms of expertise, knowledge, and techniques. In Macon County, these exurban environmental consequences as evinced by the NCGS maps' politics intersection with exurban contradictions perhaps come together no better—or worse—than in the precarious situation of Wayne and Cheryl Stacy. The Stacys moved to Macon County from Raleigh, North Carolina, upon their retirement and bought a house in the County in 2012, built in 1998 in the midst of the exurban boom years. The home is in a gated, suburban-style subdivision close to the top of a mountain in northeast Macon County. Crucially, part of their property also sits in a high risk zone on the NCGS Downslope Hazard Maps and their subdivision is criss-crossed by high risk and moderate risk zones on at least a portion of every street.

In the first two weeks January 2013, Macon County had received over 20 centimeters of rain. On the night of January 15 at 9:30, *The Franklin Press* reports that the Stacys were at home watching television when a landslide comprised of mud, water, rocks, trees, and other debris tumbled down the mountain, significantly damaging their garage and covering their driveway and part of their road. Had their house been situated slightly differently on their lot, the structure could have sustained much more damage. At the time of the reporting, there was no official cause of the landslide, but by all indications, the landslide had started on an upslope property owners' lot. The upslope property owners, though, had foreclosed on their lot in the 2008 financial crisis, meaning that the Stacys could not claim insurance money from them. Their own insurance company, according to their *Press* quotes, does not even sell landslide insurance. More distressingly, Cheryl Stacy laments that she and her husband had no idea that the NCGS maps even existed. She

(McCandless 2013) says:

If we had known there was a steep slope survey map, we could have looked at it. People coming here from outside don't know much about the mountains. I think we could have benefited from that kind of a survey, being able to check it out....This type of thing has happened over and over again (landslides), so you would think that either county or the state—somebody—would have some kind of program set up to help people that are in this kind of situation. We've maintained the property and upgraded the property and put in good drainage. We did everything right. And through no fault of our own, somebody's lot above us breaks loose and comes down and does irreparable damage to our property. And we have no recourse.

The Stacys frustration is obvious and understandable as the landslide exposed the precarity of life and property in the mountains. Not having adequate insurance, not knowing the risk of owning a home in a landslide prone area, not understanding the deferred maintenance on the foreclosed upslope property—all of these constitute the fractured social and environmental relationships that characterize exurban growth in the Macon County. They also illuminate the environmental knowledge and ignorance resulting from broken circuits of NCGS maps production, circulation, and application. Indeed, the Stacys circumstance is precisely the kind of symptomatic condition that broken circuits of environmental knowledge inevitably create: an unnecessarily risky landscape, resting on unstable foundations of financial uncertainty, conflicting claims of expertise, environmental degradation, and changing regulatory roles of the state.

As Williams notes in his chapter on “Knowable Communities,” urbanization implies a change in how communities become known. This is all the more pressing in urbanizing areas outside of the traditional boundaries of the city where rapid urban growth presents novel and politicized ways of seeing the landscape. In Macon County, the NCGS maps produced as objects of environmental knowledge the mountainous landscape itself, spatially defining its landslide proneness in a finely detailed manner and in a way most Maconians had not yet considered. Though the maps enabled the state to act in the interests of public safety and capital accumulation, then they also provoked a profound epistemological conflict with local residents who resisted seeing their familiar landscape according to the state's cartographic readings. Residents who

supported the maps found that even though their opponents questioned the cartographic and geological details of the maps, developing a compelling political message around defending the maps was impossible, meaning that currently, the NCGS maps still sit largely unused in Macon County. They are not part of any development ordinance, they do not appear on the County's website, and they are not circulated by any advocacy groups. Anecdotal evidence suggests that many realtors in the area avoid discussing the maps with exurban migrants. Furthermore, regional analysis of climate data trends suggest that extreme drought and extreme rainfall—two conditions known to increase incidents of landslides—will likely increase in southern Appalachia (Ford et al. 2011). Given this future climate scenario, coupled with public ignorance of the NCGS maps and the now recovering residential construction industry, Macon County seems bleakly headed for a hazardous but partially avoidable exurban future of deadly and damaging landslides, contradiction, and contentious politics.

The controversy over the NCGS maps also illuminate the value of further research at the intersection of STS and UPE in exurbia. Without seriously considering the political economy of exurban growth or without considering the expert and technical means of its negotiation, analyses of these commingled processes and elements will glaze over the theoretical significance and the empirical surprises found at the intersection of UPE and STS. These insights are made particularly clear when understood from the perspective of urban metabolism in exurbia. As the crisis worsened and as the epistemological difference between the cartographic expertise and the arguments against that expertise grew starker, it revealed a complicated politics of knowledge dependent on the state acting both in the public's interest and in the interest of exurban capital investment.

Additionally, these types of arguments also raise issues of what epistemological encounters over cartography and urbanization mean for urban futures, how a better exurban politics can negotiate these encounters, and how geographic technicians can better communicate their scientific portrayals of the landscape to those without their training and expertise. Some recent research on

the relationship between ecologists, locals, and cartography (see the Long-Term Ecological Research network's Maps and Locals project) shows that how 'locals' interface with cartographic expertise and experts is an interaction simultaneously fraught with tension and budding with promise. Other recent work on the intentional production of doubt and ignorance, however, shows that the political tactics deployed to discredit and hide the hazard maps are dispiritingly common (see Proctor and Schiebinger 2008 and Oreskes and Conway 2010). They also reveal the changing types of expertise in exurban landscapes, even in the face of Drummond's and other Macon County land rights activists' obscuring of these maps to overtly undermine public confidence in what is ultimately the best available information about the likelihood of dangerous landslides in particular places in Macon County.

The state and the embrace of its maps, then, are not some kind of panacea here. Instead, the NCGS maps are symptomatic of a contradiction of exurbanization: that natural amenities and attractive landscapes both attract and are subsequently degraded by exurban growth. Entangled in, complicating, and working out this contradiction in a highly unevenly developed geography are citizens, geological and cartographic experts, vulnerable land owners, and other political actors. This contradiction of exurban metabolic changes is generated and mediated by maps and experts, and represents a contest over what kind of knowledge will and ought to count in these historically rural areas' exurban future.

REFERENCES

- Abrams, Jesse B. Hannah Gosnell, Nicholas J. Gill, and Peter J. Klepeis. 2012. "Re-creating the Rural, Reconstructing Nature: An International Literature Review of the Environmental Implications of Amenity Migration." *Conservation and Society* 10 (3): 270-84.
- Anderson, Benedict. 1991. *Imagined Communities*. Verso: London.
- Angelo, Hillary and David Wachsmuth. 2014. "Urbanizing urban political ecology: A critique of methodological cityism." *International Journal of Urban and Regional Research*.
- Bakker, Karen J. 2003. *An uncooperative commodity: Privatising water in England and Wales*. Oxford: Oxford University Press.
- Berube, Alan. Audrey Singer, Jill. H. Wilson, and William H. Frey. 2006. "Finding Exurbia: Growing Communities at the Metropolitan Fringe." The Brookings Institute. Available at: <http://www.brookings.edu/research/reports/2006/10/metropolitanpolicy-berube>. Accessed 11 July 2013.
- Black, Jeremy. 1997. *Maps and Politics*. Chicago: The University of Chicago Press.
- Bock, Carl E. and Jane H. Bock. 2009. "Biodiversity and Residential Development beyond the urban fringe. In: *The Planner's Guide to Natural Resource Conservation*. Esparza, A. X., and G. McPherson, eds. Pp. 59-84. New York: Springer.
- Boyd, William. 2012. "Genealogies of Risk: Searching for Safety, 1930s-1970s." *Ecology Law Quarterly* 39: 895.
- Brint, Steven. 1994. *In an Age of Experts: The Changing Role of Professionals in Politics and Public Life*. Princeton: Princeton University Press.
- Cadieux, Kirsten Valentine. 2011. "Competing discourses of nature in exurbia." *GeoJournal* 76: 341-363.
- Cadieux, Kirsten Valentine, and Laura Taylor, eds. *Landscape and the Ideology of Nature in Exurbia: Green Sprawl*. Routledge, 2013.
- Cadieux, Kirsten Valentine and Patrick T. Hurley. 2011. "Amenity migration, exurbia, and emerging rural landscapes: global natural amenity as place and process." *GeoJournal* 76: 297-302.
- Christensen, Jon. 2008. "Smoking out Objectivity: Journalistic Gears in the Agnotology Machine." In *Agnotology: The Making and Unmaking of Ignorance*. Stanford: Stanford University Press.
- Crampton, Jeremy. 2010. *Mapping: A Critical Introduction to Cartography and GIS*. London: Wiley-Blackwell.
- Crampton, Jeremy and John Krygier. 2006. "An Introduction to Critical Cartography." *ACME: An International E-Journal for Critical Geographies* 4, 1, 11-33.

- Cidell, Julie. 2008. "Challenging the contours: critical cartography, local knowledge, and airport noise." *Environment and Planning A* 40 (5): 1202-1218.
- Colchester, Marcus. 2005. "Maps, Power, and the Defense of Territory: The Upper mazaruni Land Claim in Guyana." In *Communities and Conservation: Histories and Politics of Community-Based Natural Resource Management*. Eds., J. Peter Brosius, Anna Lowenhaupt Tsing, and Charles Zerner. Lanham: AltaMira Press.
- Darling, Eliza. 2005. The city in the country: Wilderness gentrification and the rent gap. *Environment and Planning A*, 37, 17.
- Desfor, Gene., & Keil, Roger. 2004. *Nature and the city: making environmental policy in Toronto and Los Angeles*. Tucson: University of Arizona Press.
- "Dennis." Personal Interview.
- Dodge, Martin, Rob Kitchin, and Chris Perkins, eds. 2011 *Rethinking maps: new frontiers in cartographic theory*. London: Routledge.
- Drummond, Vic. 2011. *Stop Steep Slope*. Stopsteepslope.wordpress.com. Accessed 11 July 2013.
- . 2012. "Explaining the pitfalls of geologic maps." *The Franklin Press*. Letter to the Editor. 29 February.
- Elwood, Sarah. (2010). Thinking outside the box: Engaging critical geographic information systems theory, practice and politics in human geography. *Geography Compass*, 4(1), 45-60.
- Ellison, Quintin and Barbara McRae. 2009. "End of the road? Foreclosures boom, bank files suits." *The Franklin Press*. 4 November.
- Ellison, Quintin. 2010. "Missing maps provoke discussion at Macon steep-slope meeting." *Smoky Mountain News*. 22 December.
- Fischer, Frank. 2000. *Citizens, Experts, and the Environment: The Politics of Local Knowledge*. Durham: Duke University Press.
- Fleishman, Erica and Mac Nally, Ralph. 2007. "Measuring the response of animals to contemporary drivers of fragmentation." *Canadian journal of zoology*, 85 (10): 1080-1090.
- Flint, Anthony. 2011. "How the Tea Party is Upending Urban Planning." In *The Atlantic Cities*. Available at <http://www.theatlanticcities.com/politics/2011/12/how-tea-party-upending-urban-planning/718/>. Accessed 3 February 2014.
- Ford, Chelcy R., Stephanie H. Laseter, Wayne T. Swank, and James M. Vose. 2011. "Can forest management be used to sustain water-based ecosystem services in the face of climate change?" *Ecological Applications* 21 (6), p. 2049-2067.
- Forsyth, Tim. 2013. *Critical political ecology: The politics of environmental science*. Routledge.

- Funtowicz, S. O., & Ravetz, J. R. (1993). Science for the post-normal age. *Futures*, 25(7), 739-755.
- Furlong, Kathryn. 2010. "Small technologies, big change: Rethinking infrastructure through STS and geography." *Progress in Human Geography* forthcoming.
- Gandy, Matthew. 2002. *Concrete and Clay: Reworking Nature in New York City*. Cambridge: The MIT Press
- Gauchat, Gordon. 2012. "Politicization of Science in the Public Sphere: A Study of Public Trust in the United States, 1974-2010." *American Sociological Review* 77 (2) 167-187.
- Gosnell, Hannah, and Jesse Abrams. 2011. "Amenity Migration: diverse conceptualizations of drivers, socioeconomic dimensions, and emerging challenges." *GeoJournal* 76: 303-322.
- Gragson, Ted L. and Paul V. Bolstad. 2006. "Land Use Legacies and the Future of Southern Appalachia." *Society and Natural Resources* 19, 175-190.
- Gragson et al. 2008. "Southern Appalachia on the Edge: Renewal proposal to the National Science Foundation." Available at coweeta.uga.edu. Accessed 15 December 2012.
- Gragson, Ted L., & Grove, Morgan. 2006. "Social science in the context of the Long Term Ecological Research Program." *Society and Natural Resources* 19 (2): 93-100.
- Gustafson, Seth, Nik Heynen, Jennifer L. Rice, Ted Gragson, J. Marshall. Shepherd, Christopher Strother. 2013. "Megapolitan Political Ecology and Urban Metabolism in Southern Appalachia" *Professional Geographer*. Forthcoming.
- Hansen, Andrew. J., et al. 2005. Effects of exurban development on biodiversity: patterns, mechanisms, and research needs. *Ecological Applications* 15 (6): 1893-1905.
- Harley, John B. 1990. "Cartography, ethics and social theory." *Cartographica* 27, 1-23.
- Heynen, Nik, Maria Kaika, and Erik Swyngedouw, eds. 2006. *In the Nature of Cities: Urban Political Ecology and the Politics of Urban Metabolism*. London: Routledge.
- Heynen, Nik. and Robbins, Paul., editors, 2005, The neoliberalization of nature: Governance, privatization, enclosure and valuation. *Capitalism, Nature, Socialism* 16 (1) 5–8.
- Heynen, Nik. 2013. "Urban Political Ecology I: The Urban Century." *Progress in Human Geography* 38: 598-604.
- Holifield, Ryan. 2009. "Actor-network theory as a critical approach to environmental justice: A case against synthesis with urban political ecology." *Antipode* 41 (4): 637-658.
- Hurley, Patrick T. "Whose Sense of Place? A Political Ecology of Amenity Development." *Place-Based Conservation*. Springer Netherlands, 2013. 165-180.
- Hurley, Patrick. T., & Walker, Peter. A. 2004. "Whose vision? Conspiracy theory and land-use planning in Nevada County, California." *Environment and Planning A* 36, 9: 1529.

- Kaika, Maria. 2005. *City of Flows: Modernity, Nature and the City*. New York: Routledge.
- Kasper, Andrew. 2013. "To map or not to map?" *Smoky Mountain News*. 6-12 March.
- King, Geoff. 1996. *Mapping Reality: An Exploration of Cultural Cartographies*. London: Macmillan Press.
- Kirk, R. W., Bolstad, P. V., & Manson, S. M. 2012. "Spatio-temporal trend analysis of long-term development patterns (1900–2030) in a Southern Appalachian County." *Landscape and Urban Planning*, 104, 1: 47-58.
- Interviewee A. Personal Interview.
- Interviewee B. Personal Interview.
- Interviewee D. Personal Interview.
- Interviewee G. Personal Interview.
- Interviewee H. Personal Interview.
- Interviewee I. Personal Interview.
- Interviewee N. Personal Interview.
- Interviewee O. Personal Interview.
- Interviewee U. Personal Interview.
- Kaika, Maria. 2006. *City of Flows*. Routledge: London.
- Loftus, Alex. 2012. *Everyday environmentalism: creating an urban political ecology*. U of Minnesota Press.
- Lumpkin, Heather A., Scott M. Pearson, and Monica G. Turner. 2012. "Effects of Climate and Exurban Development on Next Predation and Predator Presence in the southern Appalachian Mountains (U.S.A.)." *Conservation Biology*. DOI: 10.1111/j.1523-1739.2012.01851.x
- Macon County Steep Slope Subcommittee. 2011. "Frequently Asked Questions." Distributed at a public meeting in 2011.
- Macon County Planning Board Meeting. Recording. 17 June 2010.
- Macon County Planning Board Minutes. 18 February 2010.
- 20 May 2010. Archival Material, Coweeta Listening Project.
- 19 May 2011. Archival Material, Coweeta Listening Project.
- Macon County Department of Planning website. Accessed. 3 February 2014.

- Maracle, Melissa. 2005. "Landslide map in the works." *The Franklin Press*. 22 July.
- . 2009. "Wildflower: Impact on aquatic life." *The Franklin Press*. 27 November.
- McCandless, Colin. 2013. "Rain-drenched earth crashes down Watauga Vista hill, burying garage." *The Franklin Press*. 23 January.
- Mitchell, Timothy. 2002. *Rule of Experts: Egypt, Techno-Politics, Modernity*. Berkeley: University of California Press.
- McCarthy, James. 2008. Rural geography: globalizing the countryside. *Progress in Human Geography*, 32, 129-137.
- Monmonier, Mark. 1995. *Drawing the Line: Tales of Maps and Cartocontroversy*.
- Morrill, Richard L. 1987. "Redistricting, region, and representation." In *Political Geography Quarterly* 6, 3, 241-260.
- Nowotny, Helga, Peter Scott, and Michael Gibbons. 2001. *Rethinking Science: Knowledge and the Public in an Age of Uncertainty*. London: Polity.
- Office of the Governor, State of North Carolina. 2006. Press Release. "Gov. Easley announces new landslide hazard maps for Western N.C." Available at http://www.geology.enr.state.nc.us/Landslide_Info/DENR_landslide_release.pdf . Accessed 15 July 2013.
- Owen, Guillermo and Bernard Grofman. 1988. "Optimal Party Gerrymandering." In *Political Geography Quarterly* 7, 1, 5-22.
- Oreskes, Naomi and Erik Conway. 2008. *Challenging knowledge: How climate science became a victim of the Cold War*. Contingency and Dissent in Science Project, Centre for Philosophy of Natural and Social Science, London School of Economics and Political Science.
- . 2010. *Merchants of Doubt*. London: Bloomsbury.
- Pickles, John. 1995. *Ground Truth: The Social Implications of Geographic Information Systems*. New York: The Guilford Press.
- Property Owners of America. 2012. Website now not functional. Last accessed 2012.
- Prudham, Scott. 2004. "Poisoning the well: Neoliberalism and the contamination of municipal water in Walkerton, Ontario." *Geoforum* 35, 343–359.
- Poole, Peter. 2005. "Ye'kuana Mapping Project" In *Communities and Conservation: Histories and Politics of Community-Based Natural Resource Management*. Eds., J. Peter Brosius, Anna Lowenhaupt Tsing, and Charles Zerner. Lanham: AltaMira Press.
- Proctor, Robert N. and Londa Schiebinger. 2008. *Agnology: The Making and Unmaking of Ignorance*. Stanford: Stanford University Press.

Rice, Jennifer L. 2010. "Climate Carbon, and Territory: Greenhouse Gas Mitigation in Seattle, Washington." *Annals of the Association of American Geographers* 100 (4): 929-37.

Robbins, Paul, Stephen Martin, and Susan Gilbertz. 2011. "Developing the Commons: The Contradictions of Growth in Exurban Montana." *The Professional Geographer*
DOI:10.1080/00330124.2011.601193

Robbins, Paul. 2007. *Lawn people. How grasses, weeds and chemicals make us who we are.* Philadelphia: Temple University Press.

-----. 2000. "The Practical Politics of Knowing: State Environmental Knowledge and Local Political Economy." *Economic Geography*, 76 (2) 126-144.

Rocheleau, Dianne. 2005. "Maps as Power Tools: Locating Communities in Space or Situating People and Ecologies in Place?" In *Communities and Conservation: Histories and Politics of Community-Based Natural Resource Management*. Eds., J. Peter Brosius, Anna Lowenhaupt Tsing, and Charles Zerner. Lanham: AltaMira Press.

-----. 1995. "Maps, Numbers, Text and Context: Mixing Methods in Feminist Political Ecology." *Professional Geographer*. 47, 4, 458-467.

Sayre, Nathan F. 2011. "Commentary: scale, rent, and symbolic capital: political economy and emerging rural landscapes." *GeoJournal* 76: 437-439.

Scott, Mark C. 2006. "Winners and losers among stream fishes in relation to land use legacies and urban development in the southeastern US." *Biological Conservation*. DOI: 10.1016/j.biocon.2005.07.020.

Swyngedouw, Erik. 2004. *Social Power and the Urbanization of Water: Flows of Power*. Oxford: Oxford University Press.

-----. 1996. "The city as a hybrid: on nature, society and cyborg urbanization." *Capitalism Nature Socialism*, 7(2), 65-80.

-----. 1999. "Modernity and Hybridity: Nature, *Regeneracionismo*, and the Production of the Spanish Waterscape, 1890-1930." *Annals of the Association of American Geographers* 89, 3, 443-465

Taylor, Laura. 2011. "No Boundaries: Exurbia and the study of contemporary urban dispersion." *Geojournal* 76 (4) 323-339.

Topatimasang, Roem. 2005. "Mapping as a Tool for Community Organizing against Power: A Moluccas Experience." In *Communities and Conservation: Histories and Politics of Community-Based Natural Resource Management*. Eds., J. Peter Brosius, Anna Lowenhaupt Tsing, and Charles Zerner. Lanham: AltaMira Press.

Wachsmuth, David. 2012. "Three Ecologies: Urban Metabolism and the Society-Nature Opposition." *The Sociological Quarterly* 53: 506-523.

Walker, Peter, and Patrick T. Hurley. 2004. "Collaboration derailed: The politics of 'community-based' resource management in Nevada County." *Society and Natural Resources* 17, 735-751.

Walker, Peter A., and Louise P. Fortmann. 2003. "Whose landscape? A political ecology of the 'exurban' Sierra." *Cultural Geographies*. 10 (4) 469-491.

Walker, Peter. and Patrick. Hurley. 2011. *Planning paradise: Politics and visioning of landscapes in Oregon*. University of Arizona Press: Tucson, AZ.

Williams, Raymond. (1975). *The country and the city*. Oxford University Press.

Winichakul, Thongchai. 1997. *Siam Mapped: A History of the Geo-Body of a Nation*. Honolulu: University of Hawaii Press.

Wisner, Ben, Piers Blaikie, Terry Cannon, and Ian Davis. 2004. *At Risk*. New York: Routledge.

Wolman, H., Galster, G., Hanson, R., Ratcliffe, M., Furdell, K., & Sarzynski, A. (2005). The fundamental challenge in measuring sprawl: which land should be considered?. *The Professional Geographer*, 57(1), 94-105.

Wood, Denis. 1992. *The Power of Maps*. New York: The Guilford Press.

----- . 2010. *Rethinking the Power of Maps*. New York: The Guilford Press.

Wooten, Richard M., Rebecca S. Latham, Anne C. Witt, Stephen J. Fuemmeler, Kenneth A. Gillon, Thomas J. Douglas and Jennifer B. Bauer. 2006a. "Slope Movements and Slope Deposits Map of Macon County, North Carolina." *North Carolina Geological Survey*. Available at http://www.geology.enr.state.nc.us/Landslide_Info/MaconCounty.html. Accessed 12 July 2013.

----- . 2006b. "Stability Index Map of Macon County, North Carolina." *North Carolina Geological Survey*. Available at http://www.geology.enr.state.nc.us/Landslide_Info/MaconCounty.html. Accessed 12 July 2013.

----- . 2006c. "Downslope Hazard Map of Macon County, North Carolina." *North Carolina Geological Survey*. Available at http://www.geology.enr.state.nc.us/Landslide_Info/MaconCounty.html. Accessed 12 July 2013.

Yin, Robert K. 2003. *Case Study Research: Design and Methods*. Thousand Oaks: Sage Publications.

Young, Thomas H. N. 2011. "Democracy or expertise? Objectivity as an elusive ideal in the resolution of a Vermont land use dispute." *GeoJournal* 76: 401-415.