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Putting Policy in Its Place: Policy Enactment and Engagement through a Multiscalar Policy-shed Framework

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Putting Policy in Its Place: Policy Enactment and Engagement through a Multiscalar Policy-shed Framework

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Dissertation submitted
to the Eberly College of Arts and Sciences
at West Virginia University

Doctor of Philosophy in Geography

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2021

Keywords: GISc, Boundaries, Public Policy, Policy-sheds, Multiscalar Frameworks
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ABSTRACT

Putting Policy in Its Place: Policy Enactment and Engagement through a Multiscalar Policy-shed Framework

Barbara L. MacLennan

The objective of this research is to examine the spatial components integral to policy formation, implementation, and evaluation. The research uses solid waste as a case study to explore a multiscalar GIS policy-shed framework. To this end, the goal of this dissertation is to examine the spatial nature of public policy. The research applies spatial concepts and multiscalar methodological applications embedded within GIS and geovisualization to explore the complex spaces surrounding public policy implementation and evaluation.

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Dedication

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Chapter 1 Introduction

"When we try to pick out anything by itself, we find it hitched to everything else in the Universe" (Muir 1911, p.110).

Policy is inherently spatial. Policy is the product of a political world and is typically defined and implemented within specifically bounded areas. The linkages between policy and space are central to understanding contemporary government and society, yet the interrelationships between policy and its spatial extent are fraught with complexity.

Public policy would logically occur in a space that can be precisely defined. However, it is more often the case that policy space is ambiguous, fuzzy, uncertain, imprecise, and subject to other superimposed and intersecting spatial extents that are essentially multiscalar in nature.

Historically, the most frequent coping mechanisms employed to address the spatial expression of public policy has been to use legacy boundaries that often correspond to governmental units such as counties or states, or to create new boundaries such as watersheds or regional entities such as the Appalachian Regional Commission (ARC). Alternately, many policies are simply treated as being 'aspatial' and applicable to everywhere, usually within the nation state, if not beyond.

There is good reason to believe that these spatial coping mechanisms based on historical boundaries or precedence are problematic because of the resulting imprecise spatial context of public policy; the growing magnitude and extent of policy statutes and regulations; and the apparent overlap of multiple policies across space (Carlisle et al, 2019; Cash et al., 2006; Cundell and Fabricius, 2009; Gibson et al., 2000; Mitchell, 2003; Thrift, 2010).

The advent of precise mapping software such as GIS has brought the spatial manifestation of public policy to the foreground. As the case study of solid waste disposal in this dissertation will emphasize, public policy is awash with numerous spatial extents that overlap, conflict, or which are imprecise, undocumented, or unmapped. Such fuzziness can lead to public confusion, jurisdictional tensions, and ultimately inefficiencies in policy enactment, implementation, and evaluation.

The goal of this dissertation is to examine the spatial nature of public policy and to explore ways in which the often-complex spatial manifestations surrounding public policy implementation and evaluation can be identified and understood. The study develops policysheds based on the

spatial concepts and methodological applications embedded within GIS and Application Programming Interfaces (AAPIs).

Public Policy and the Spatial Dimension

Public policy impinges on many disciplines, stages of a policy life cycle system, and policy outcomes. Because of the complexity of public policy these stages of policy development and implementation are often viewed as opaque, enigmatic, and floating in the conceptual policy ‘black box’ that seems to continually stand on the verge of becoming unknowable. Arguably, all public policy must be spatially grounded in that it applies to some specific area such as a tract, region, or nation. In practice, however, there seems to be a disconnect between policy stages and spatial designation because policy, as it is enacted, is often spatially imprecise, misunderstood by stakeholders, or is held, stored, or perceived differently by varying groups and at different levels of the policy system.

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The Punctuated Equilibrium Theory (PET) in public policy, influenced as it is by biological theory, comes close to capturing this dichotomy whereby *ad hoc* policy sub-groups address specific parts of a policy area but fail to comprehend the overall holistic extent of the spatial, temporal, or the content of the entire policy enactment (Brummel et al., 2012; deLeon and Varda, 2009; Hall et al., 2004; True et al., 2019). Concepts of emergent scale in geography suggest that issues of scale could be a direct contributor to punctuated forms in that groups or agencies emerge with new powers and agency at differing levels and scales of the policy process to impact parts of that policy trajectory (Harris and Ferber, 2013). It is here that the praxis of policy

enactment, implementation, and evaluation plays a significant role in the varied understanding and spatialization of public policy.

Any discussion of how public policy issues are spatially delineated, in theory or in practice, must of course begin with some firm understanding of policy itself, not least because public policy is multifaceted and made up of administrative, legislative, judicial, and evaluative components. Furthermore, policy is also language, symbolism, intention, history, decisions and even non-decisions, or a combination thereof. These elements of policy can be offset or can run concurrent to each other and to other policies or policy arenas, often at varying spatial extents and scales. Although the interdisciplinary nature of policy means there is no overarching definition of the term policy, it is generally accepted that public policy is governance for the public good and is comprised of what is termed ‘Big P’ policy and ‘small p’ policy. For clarity hereafter, the term public policy is used to encompass all public policy combined unless otherwise indicated specifically as ‘Big P’ or ‘small p’ public policy. ‘Big P’ public policy occurs at the international, nation-state, and local-level and is typically enacted by formal laws, rules, or regulations that assume an implementation process that is fixed or embedded within a nested, aggregated, hierarchical or chronologically ordered scalar format with fixed spatial extents (Piettoni, 2009). In contrast ‘small p’ public policy is the articulation of standards of practice that are typically unregulated such as social norms, internal decisions, or best practices that are often held as part of personal, group, or institutional knowledge. The latter embodied knowledge can account for new experiences faster than traditional policy but is more easily lost because it is difficult to capture experiences or best practices due to their informal and often tacit nature, immersed as they are in shared history and experiences (Brownson et al., 2009; Cundell and Fabricium, 2009; Raymond et al., 2010). As Freeman and Sturdy (2014, p.51) suggest, “We note that knowledge is a local phenomenon, structured within a specific context and holding significance for social actors based on their purposes and objectives in that context.” Because of the differences between ‘Big P’ and ‘small p’ policy, the spatial delineation of ‘Big P’ public policy, such as policy regulation and evaluation, tends to have more rigidly defined spatial extents, while ‘small p’ public policy, such as policy implementation and development, tends to be more fluid or vaguely defined in their spatial extents and as a result are often open to interpretation.

The lack of integration between policy development, implementation, evaluation, and analysis is a major challenge to the policy environment and policy must be approached as an overarching process because a global view of policy can become meaningless due to overgeneralization (Castellani et al., 2015; Fischer, 1998; Grindle and Thomas, 1989). Overgeneralization is more likely to occur when the target audience for policy researchers are politicians or agencies because they tend to prefer quantitative methods that provide a standardized and universal view of policy. Ironically, focusing on situations or countries through case studies can equally overemphasize the idiosyncratic. The complexity and multiscale nature of politics is often seen in legal actions, media accounts, and case studies, which is why when the target audience for policy researchers is their peers, they tend to use narrative case studies or qualitative methods to capture the surprisingly imprecise nature of public policy (Abel et al., 2006; Cumming, and Redman, 2006; Kok and Veldkamp, 2011; Pede, 2019).

The ‘Big P’/‘small p’ quandary suggests that public policy must be studied within context and with due recognition of its dynamic nature, history, social and political culture, and location. Yet public policy itself strives to be parsimonious because of the mental constraints of processing a host of complex information involved in decision-making (Walt, 1994; Jones, 2001; Pollit, 2008). One of the more effective ways to link multiple policy areas and their spatial expression may be through mapping and geovisualization, which provides the ability to capture the spatial complexity of policy implementation and evaluation in the context of multiple policy arenas. However, this is no easy task. For example, the Canadian government took decades to determine who had the rights to manage or control its country’s ocean spaces and marine resources and this was largely because of the difficulty in defining what constituted ice, land, and water (Nichols and Monahan, 1999). Such spatial and semantic complexity created legal ramifications involving the mapping of the coastal region amid conflicting public and private rights, and jurisdictional uncertainty arising from decisions made by the Atlantic Provinces before the creation of Canada in 1867. The need for a spatio-political framework becomes apparent when policy is required to be specified in some geographical space with precise boundaries. Borders, therefore, are central to policy and policy mapping endeavors (Agnew, 2012; Cash et al., 2006; Castellani et al., 2015; Harris, 2006; Nichols and Monahan, 1999; Staeheli, 2010; True et al., 2006).

Boundaries, Space, and Scale

A border is often, but not always, considered to be the crisp meeting of two or more areal boundaries. A boundary can be based on physical features, such as an island, mountain range, river, ravine, ocean, or a cultural boundary. A political boundary can be a physical structure, such as Hadrian's Wall or the Great Wall of China, or politically or culturally defined such as for nation-states and their subregions. A border can be defined by the once seemingly unalterable borders of temporal zones or be socially constructed such as in the case of community neighborhoods. The classic boundary study question, "Where is my border? Draw me a line" is still vitally important in today's world because there are few simple lines of demarcation, and yet most policy decisions require some defined spatial unit.

Politics invariably demands hard boundaries. Yet, boundary concepts themselves have always been imbued with intertwined meaning and are complicated by a sense of place. As Rankin and Sofield (2004, p.3) suggest, boundary concepts are more than just the technicalities of boundary specification: "border, frontier, line, border line, bounds, front line, edge, limit, margin, periphery, rim, frame perimeter, circumference, fringe, lip, brim, enclosure, outskirt, belt..." imbue a multitude of cultural, economic, social, and political perspectives on border issues. Notions of space may also evoke more than the specification of a boundary and may include feelings and emotions about place rather than space. Addressing spatiality in political policy is among one of the most significant challenges facing the study of policy. Ignoring the challenges of spatiality potentially contributes to erroneous conclusions with significant real-world implications (Agnew, 1994; Fotheringham et al., 2003; Fotheringham et al., 2021; Elden, 2011). The spatial nature of policy is thus complicated. Agnew (1996, 2014), Johnston et al. (2004) and other political geographers have argued that politics are context-based and that recognizing the complexity of mapping space and place is one of the first steps in addressing the spatiality of policy. One clear issue concerning the spatio-political in practice is that of the modifiable areal unit problem (MAUP), an axiom expounded by Openshaw (1984). The MAUP in the context of policy mapping is inevitable. Openshaw (1996) proposed zonal systems to make the MAUP as neutral as possible. However, in the case of spatio-political boundaries, the MAUP is often used to describe the arbitrary, deliberate, or unintended ways in which political parties and institutions use geography to determine electoral voting districts, shape messaging, and mobilize their base. To political geographers, gerrymandering is clearly not a neutral process but the overt

manipulation of electoral constituency boundaries to favor one party or class over another and with the clear intent to influence electoral outcomes. The impact of the spatial manipulation of electoral boundaries is highlighted by the increased involvement of the U.S. federal court decisions concerning congressional election districts and gerrymandering (Forest, 2001). Agnew (1987) stresses the importance of place in the creation of personal political identities in that the same person or group can operate or have relations that overlap, even at multiple scales, and that has implications for spatio-political boundaries. The significance of boundary studies across disciplines has led to the growing call for the interdisciplinary conceptualization of boundaries and reflects the fuzzy, overlapping, porous, fluid, and ‘soft’ nature of boundaries arising from a multitude of causes, including transboundary regions and differing cultural perceptions of political borders (Agnew, 2012; Allmendinger and Haughton, 2009; Castellani et al., 2015; Elden, 2006; Harrison, 2006; Hess, 2004; Klitzner, 2002; Newman and Sheba, 2006). The nature of this fuzziness can be found in the classic boundary issue of a river, which is often used as a ‘hard’ political boundary because, by its physical nature, it can usually be found drawn as a line on a map. And yet a river is a place of water movement and changing water courses, and despite being politically or physically bounded, it represents the incorporation of history, events, relationships and personal boundaries specific to many groups that created the extent(s) of a river’s placial geography and because rivers are themselves scaled boundaries (Allmendinger and Haughton 2009; McKinney and Johnson 2009; Warner et al., 2014). Arrhenius (2015) encapsulates the very real problems involved in the conjoining of public policy and geography in the example of Northern Ireland:

The boundary problem is not only a conundrum of philosophical interest but also a pressing practical political problem. For example, what is the relevant constituency for a democratic solution to the conflict in Northern Ireland? Should a treaty be approved by the citizens (or their representatives) of Northern Ireland alone or should it also involve those of the United Kingdom and the Irish Republic as well?

The recent debacle of the United Kingdom’s exit from the European Community (EU) and the resulting need to enforce some form of trade boundary in the Irish Sea to separate the non-EU member Northern Ireland from a contiguous EU member, the Republic of Ireland, without reinstating a hard border and reigniting the ‘Troubles’ but as a result creating an internal UK

trade border demonstrates the complexities that creating borders entails. Many other examples exist as in the Middle East and northeast Africa.

Boundary scholarship is evolving such that ‘the boundary problem’ is now well recognized and not least because of the tensions that exist between areas defined by space and those defined by palatial associations. As Castellani et al. (2015) identified in *Place and Health as Complex Systems a Case Study and Empirical Test*, there is a need for a framework that uses theory and application to capture the *complexity of place* (COP) because despite the technological advances in social network analysis, agent-based modeling, topographical neural nets, and even initial forays into geospatial modeling, there is no rigorously-defined theory of place that can capture the multiscalar nature of typical problems. “In short, places need to be treated as complex systems” (Castellani et al. 2015, p.2; Cox, 2008; Hudson, 2012; Penrose, 2002; Reid-Henry, 2010).

It is perhaps the very nature of boundaries that causes policy studies to lack precision and consistency. Problems arise when varying definitions, understandings, terminology, scale, and spatial aggregation lead to mismatches and gaps in the delineation and recognition of boundaries, which in turn leads to multiple interpretations of policies and their spatial extents. While multi-disciplinary ambiguity is a serious challenge to boundary studies, it is not a problem that can be easily fixed or ignored. However, the political and public policy process does not become less valid because boundaries are imprecise or are being challenged. Instead, a new understanding of the spatial nature of public policy is required that encourages research toward a more effective framework that captures the spatiality of policy.

Research Goal and Objectives

Addressing these spatio-political issues is challenging. One possible way forward is to develop a framework, such as that of policy-sheds as proposed here, that can organize and represent complex public policy spatial manifestations of space and place, while retaining some practical sense of bounded rationality.

Nowhere are the issues of policy and space more evident than in the field of solid waste, traditionally paired with water and roads as one of the purest examples of a public good and

shared resource that predate the United States as a country (Anderies and Janssen, 2013; Bickford, 2013; Harden, 1968; Ostrom, 1990; World Bank, 2006).

Given the concern and issues raised about public policy and its spatial manifestation the objective of this research is to examine the spatial components integral to policy formation, implementation, and evaluation, and to use solid waste as a case study to explore a multiscalar GIS policy-shed framework.

To this end, the goal of this dissertation is to examine the spatial nature of public policy and to explore the complex spaces surrounding public policy implementation and evaluation. These spaces are identified and understood using spatial concepts and multiscalar methodological applications embedded within GIS and geovisualization representations.

To achieve this objective, the research is structured according to six objectives and related sub-questions:

1. Review how public policy is spatially delineated, in theory, and practice.
2. Evaluate the spatial tensions in public policy.
3. Explore the spatio-political complexities of solid waste policy.
4. Conceptualize a multiscalar spatial framework for policy based on 'policy-sheds'.
5. Develop a policy-shed framework for solid waste with a focus on Monongalia County, West Virginia
6. Examine, evaluate, and assess the design, implementation, and effectiveness of a multiscalar, policy-shed framework for specifying the spatiality of public policy.

The first two objectives are to review how public policy is spatially delineated and to then evaluate the resulting spatial tensions that arise in public policy. The third objective is to use this information to explore the spatio-political complexities of solid waste policy. The fourth and fifth objectives are to conceptualize a multiscalar framework for public policy based on a proposed concept of policy-sheds and to then develop a policy-shed framework for solid waste. The final objective will be to evaluate and assess the multiscalar, policy-shed framework and to summarize the results and make recommendations for future research.

A Brief Methodological Overview

This dissertation uses an integrated GIS approach to obtain an understanding of the spatial extent of solid waste policies by extracting and digitizing the spatial units embedded in the written regulations, laws, rules, and code, and to then codify these regulations and assign them to the applicable areal units to create a dynamic, interactive system that allows users to interrogate and operationalize solid waste policy. This methodological approach uses GIS, geovisualization, and geoprocessing to create a policy-shed framework that conjoins policy, space, and place based on a feature attribute table using a modified Tremper, Thomas and Wagenaar (2009) policy law template. The resulting policy-sheds are then used to display the spatial nature of waste policy and to identify instances of omission, commission, and spatial tensions and conflict associated with the cross-cutting policies related to solid waste disposal in Monongalia County, WV.

Chapter 2 The Geography of Public Policy

Public Policy and Spatial Tensions

Placing the spatial into public policy necessitates understanding why no agreed upon standard exists for what constitutes public policy other than the oft-repeated statement that public policy is governance for the public good. A review of public policy literature suggests that definitions of public policy are, seemingly, purposely subjective (Hill and Hupe, 2009). Commonly used characterizations of public policy are Lasswell's perspective: *Politics: Who Gets What, When, How* (Lasswell, 1936). Wildavsky (1979) describes public policy as simultaneously a process of decision-making and a product of the decision-making process while Dye (1992) describes public policy as the real-world action or inaction of government and the intentions behind those actions. Cumulatively, public policy can be regarded as the intersection of a series of inter-related sets of decisions that are continuously changing and are made by multiple people or organizations over time to achieve goals intended for the public good. This chapter undertakes an extensive review of public policy, the study of public policy, and the models, frameworks and concepts that underpin its study. As will be seen, applying a spatial perspective to public policy in later chapters is wrought with many challenges not least because of the inherent nature of public policy itself. Modern public policy has its roots in the U.S. Progressive Era (1890 – 1920s) when policy reformers believed that a more transparent and accountable government would improve U.S. society. To further that end, President Woodrow Wilson promoted the separation of politics and administration whereby legislative statesmen would make laws and regulations, but public law would be implemented by public administration personnel. According to Wilson (1887; p.201) "Where government once might follow the whims of a court, it must now follow the views of a nation. And those views are steadily widening to new conceptions of state duty; so that, at the same time that the functions of government are every day becoming more complex and difficult, they are also vastly multiplying in number." The complexities Wilson alluded to include the impact of telegraph and railway networks, utilities, corporate businesses, as well as town, city, country, state, and federal government. Areas recognized by geographers today as scalar and spatial.

Public administration personnel used thematic mapping as a powerful tool to examine and explain societal change during the Progressive Era. These maps often originated from public policy sub-disciplines such as sociology with projects such as those of pioneer investigative journalist William T. Stead, who incorporated maps into his articles and most notably his *If Christ Came to Chicago* that exposed inequalities in Chicago in 1893 (Figure 2.1). Florence Kelley and Agnes Sinclair Holbrook and Hull House used maps in humanitarian efforts to persuade politicians and the public to improve the health and welfare of Chicago immigrants and became the groundwork for social work in the United States. The Hull House maps (Figure 2.2), collected by the U.S Bureau of Labor as part of a study into the slums of Baltimore, Chicago, New York and Philadelphia, were commissioned by the United States Congress in 1892. Today, these studies, along with Bois's work in *The Philadelphia Negro*, are recognized as early efforts in community-based participatory research and public policy (Schastock, 2016; Stuart, 2018). The Chicago School of Sociology used maps in their sociological studies of urban patterns and in developing a sociological concept of space and home space. (Bulmer, 2019; Rezeanu, 2018). In other social reforms, maps were used to further the suffrage movement (Dando, 2010).

Figure 1: William T Stead's map from *If Christ Came to Chicago* (1895) Source: Boston Rare Maps and Prints website <https://bostonraremaps.com/inventory/if-christ-came-to-chicago-1894/>

Figure 2.2: Hull House Nationality Map. Source: *The Hull House Maps and Papers* Northwestern <https://florencekelley.northwestern.edu/historical/hullhouse/>

Other developments in public policy arising from the Progressive Era included the creation of new public agencies which were tasked with collecting, analyzing, and mapping data and included the U.S. Department of Labor's slums project (United States. Bureau of Labor, 1895), the National Conference on City Planning which focused on strengthening municipal administration and city planning (Fairfield, 1994; Peterson, 2009) and the Pure Food and Drug Act which dealt with the interstate commerce of adulterated goods, and which became the precursor to the FDA (Law and Libecap, 2007). Cartographic mapping then played a small part in the politics and laws of the Progressive Era as evidenced by the Ratification of the 16th Amendment or Income Tax Law (1913) that required property mapping (Schenk, 2012), and the Treaty of Versailles (1919) which created new territorial boundaries (Herb, 2017). However, government and public confidence in administrative expertise waned after the U.S. New Deal Era (Cocks et al., 2009; Frederickson et al., 2015; Robertson et al., 2015; Whittington et al., 2013)

Public policy failed to gain prominence again until the major political changes of the 1960s and the era of modern governance of the New Administrative Era (1960s – 1980s). During the New Administrative Era, the purpose of most policy was for prescriptive solution finding. Maps and statistical data were increasingly used to support public policy and especially so as computer technology became more efficient and cost-effective. Computing reinvigorating the former Progressive Era's shift towards data collection and analysis for policy decision-making. Lasswell (Farr et al. 2006) is credited with creating the discipline of policy science in the late 1950s to train policy experts drawn from economics, law, political science, anthropology, psychology, statistics, mathematics, and physical and natural sciences. Notably the discipline of geography was not included in this multi-disciplinary group though mapping was intertwined as a visual aid across different levels of government and academic disciplines (Farr et al. 2006; Lasswell, 1951; Lasswell, 1970; Turnbull, 2008). According to Friendly and Denis (2001), "In as much as their histories [probability, statistics, astronomy, cartography] are intertwined, so should be any telling of the development of data visualization. Another reason for interweaving these accounts is that practitioners in these fields today tend to be highly specialized and unaware of related developments in areas outside their domain, much less their history." Lasswell and policy scientists believed policy leaders could mediate between academia, government, and

citizenry to collectively solve society's problems. A major stage in the development of public policy science was President Johnson's *War on Poverty* (Bailey et al., 2014; Roucek, 1966) in which statistical models and demographic data were used to determine poverty levels and mathematical models used for the allocation and distribution of resources (Burkhauser et al. 2020; Haveman et al., 2015). Johnson believed in the ability of public policy to overcome societal problems and build a Great Society and eradicate poverty in the United States (DeLeon, 1988; Hill and Varone, 2014; Flusberg et al., 2018; Friendly and Denis, 2001; Rodriguez and Weingast, 2015).

However, both Wilson's and Lasswell's visions of using regulatory public policy to solve societal problems were difficult to achieve due to the subjective nature and complexity of public policy itself. Even the term poverty had no clear or agreed upon definition leading to the tendency for policy scientists to favor parsimonious, normative approaches to policy problem solving. According to Waldo (1968, p. 2), "...to argue that coherence can be found by stating that the problems, objectives, boundaries, and so on, all concern public administration is hardly helpful as it is unclear what public administration is". Later, Lasswell (1972) himself referred to public policy as being highly contextual, and increasingly complex and different from what he first envisioned as policy science. While a hierarchical, data-driven, problem-solving approach to policy problems was found to have questionable impact on the public good, it nonetheless remains one of the primary methods underpinning public policy. Shulock (1999), in *The Paradox of Policy Analysis: If it is not used, why do we produce so much of it?* found it paradoxical that the U.S. invested heavily in policy analysis even though political science research and theory had revealed that policymakers do not use policy analysis to make policy decisions. Shulock (1999) studied quantitative data on Congressional policy analysis for the years 1985-1994 and determined that despite its scientific origins, policy analysis may be a more effective instrument and indicator of the democratic process than of the problem-solving process. Shulock argued that as a problem-solving process, public policy rarely attained the desired outcomes (DeLeon, 1988; Fischer, 2003; Head and Alford, 2015; Learner and Lasswell, 1951; Jenkins, 1978; Lasswell, 1972; McCandless and Guy, 2013; Rittel and Webber, 1973; Rutgers, 2010; Schastok, 2015; Schulten, 2012).

Dye (1992) suggested that as the end of the twentieth century approached public policy had moved beyond a belief that government legislation was the only form of public policy that could influence real-world governmental action (or inaction). Prunty (1985) believed that taken in context, the process of pursuing public policy is used more to create an image of an ideal society than to achieve it. Fischer (2003) has argued that public policy is associated more with Big P policy elites, experts, and legislators, but that small p policy making was equally important. Fischer (2003) suggests that while public policy is often considered to be a process of agreement on a course of action or inaction that could then be evaluated, public policy was in fact a discursive construct or analytical category with substantive content that is subjective and interpretable. Lasswell's (1971, p.2) 20-year study of policy science considered the World Health Organization (WHO) work to eliminate smallpox, cholera, and other diseases to be a major policy science milestone which he attributed to the medical community and advances in epidemiology. In the modern era, the Obama administration focused on Open Government initiatives and interagency data sharing that included spatial data (Fenster, 2015; Fischer, 2003; Jaeger and Bertot, 2010; Lasswell, 1971; Leszczynski, 2015; Rutgers, 2010). However, while spatiality is a thread that runs implicitly throughout public policy the spatial metrics have to be interpreted or specifically sought out from the policy process.

The public good, is a term that is often invoked in public policy to justify political decision-making and as a core part of the mission of public policy. Public good is often interpreted as shared societal benefits obtained through governance. In the U.S., Thomas Jefferson (1776) believed that the promotion of the public good was indeed the purpose of government, while other early founders advocated for more individual rights, a discourse that continues in governance today (Stiglitz, 1999). As such the definition, intent, and scope of what is a public good within public policy varies depending upon who is defining the public good and for whom. Democracies tend to have high public good requirements linked to the apportionment of votes, while dictatorships tend to have low public good requirements (Deacon, 2009). According to Rutgers (2010), the recent use of the comprehensive term, "Governance" seems to suggest a social reality where the state-society bifurcation disappears although governance often lacks bounded meaning found in the specificity of terms such as "state and society" or "public administration."

The scope of public policy extends beyond regulation and legislation to include interactions that take place at multiple levels of government. Public policy is not one action or decision but the interaction of Big P policy and small p policy. Big P policy often takes the form of formal laws or regulations at all levels of government and takes many forms such as written legislation, statutes, executive orders, vetoes, appointments, zoning laws, and judicial decisions. Small p policy is characterized through the articulation of standards of practice, and these are typically unregulated, un-codified, non-legislated actions, best practices, non-governmental partnerships, and institutional knowledge. Small p policy includes administrative behaviors such as the enforcement of laws, decisions about which judicial cases to hear, and precedent based on the history of past policy decisions or actions. Small p policy can be expressed via symbology, language, text, forms, images, and maps, but as best practice it is often recorded or manifests only as oral narrative. Public policy is thus concurrently a political ideology; a political process; a type of governance; the outcome of governance decisions; a field of study; a professional discipline; and an analytic object of study. These diverse interpretations of public policy complicate any attempt to assign spatial representations to policy implementation or the assessment of policy outcomes.

The Study of Public Policy

Given the difficulty in defining public policy it is perhaps not surprising that a variety of approaches exist for the study of public policy. According to Goodin et al. (2006 p.5) both the practice of public policy making, and the study of public policy are more a form of persuasion, “It is mood more than a science, a loosely organized body of precepts and positions rather than a tightly integrated body of systematic knowledge, more art and craft than genuine science.” Even the scope of the disciplines that arguably fall within the study of public policy are contested. Rutgers (2010) critiqued Waldo’s (1968, p.1) attempt to clarify one aspect of public policy, that of Public Administration, due to its lack of internal consistency stating, “I have used upper case to refer to the self-conscious enterprise of study, and the like, and lower case to refer to the practices or processes which are the object of our attention”. Fan (2013) describes public policy, “As an interdisciplinary study, situated at the intersection of traditional academic disciplines combined with the needs of policy research in the governmental sphere”. While “At its core, the study of public policy can exist only through the intellectual constructs of other disciplines” (Shafritz et al., 2005, p. viii), nonetheless the lack of a single pedagogical

framework or approach to the study of public policy has contributed to the nebulous nature of public policy because different disciplines have used, and continue to use, their own doctrinal windows embedded in their disciplinary roots. This contributing sub-disciplinary design was intentionally developed by Lasswell (1956) to address public policy issues through a normative, multidisciplinary approach but the lack of a coherent framework for the study of public policy has been problematic. Some doctrines and disciplines can be distilled I would argue that anchor the study of public policy. Almost all the public policy books that Fan (2013) examined, for example, originated from political science, public administration, or economics. In many cases, public policy sub-fields are older than the discipline of public policy itself and except for countries such as Great Britain, the development of public policy studies has been largely an American phenomenon that was disseminated to other countries (Fisher, 2003). Peters and Pierre (2006) theorized that the shared physical proximity of scholars at American university campuses in the early 20th century contributed to a shared interdisciplinary approach to the study of public affairs and government (see also Fan, 2013; Fischer, 2003; Rutgers; 2010; Shafritz et al., 2005).

A review of schools of public policy by this researcher (Table 2.1) found that most offered accredited master's in public affairs or master's in public administration. In some countries, such as the U.K., these qualifications are vital to obtaining a state sector position. A greater number of schools offer master's programs with public policy specializations such as management, health, or planning, than offer doctoral degrees. Doctoral degrees tend to be in political science and economics departments. Lasswell's public policy subfields of economics, law, political science, public administration, anthropology, psychology, statistics, mathematics, and the physical and natural sciences remain at the disciplinary core of public policy study. Economics and law are the languages of the state (Lowi, 1992; Nathan; 2014). Political science and public administration also remain as dominant disciplines in the study of public policy. While Brooks and Cooper (2013) believe that science is central to the public good, some U.S. Government administrations have controversially criticized the academic relationship between public policy and the natural sciences in areas such as climate change for example.

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Table 2.1 Review of Schools of Public Policy Matrix

Significantly for this study, geography has historically not been a core component of public policy and its presence has been peripheral at best in the form of cartographic mapping and even this has often been through disciplines other than geography. Geography lacks a cohesive presence in public policy and even political geography is seen as a subgenre of political science or of international relations (DeLeon, 1999; Friendly and Denis; Lasswell, 1956; Lasswell, 1941; Lasswell et al., 1943; Nagel; 1994; Peters and Pierre, 2006; Sabatier, 1993). More recently, Geographic Information Systems (GIS) are making some inroads into public policy studies but again often through a discipline other than geography.

Public Policy Theory

While the study of public policy was envisioned as using a holistic approach, in reality political science, public administration, and economics have dominated theoretical contributions. David Easton (1965) provided a framework for understanding the political process from demand to policy formulation and implementation to societal feedback, and this has become the basis for the stages heuristic that moves from conception to policy. The stages heuristic policy process is often divided into the following stages:

- Identify the problem
- Set the agenda by focusing the media on the situation
- Formulate policy proposals
- Legitimize policies through governmental and political groups
- Implement policy through bureaucracies
- Evaluate policies through governmental agencies

Describe the policy process and implement public policy. Defining appropriate theories for the study of public policy is problematic because of its multidisciplinary background. Cairney (2013) found that in public policy studies “different definitions of theory are linked strongly to the different assumptions we make about the nature of the world and our ability to understand it.” Hill and Varone (2014) liken the study of policy to effective engineering, “While – at least in the past – many successful engineers have operated pragmatically, using trial and error methods and accumulating experience with only an intuitive understanding of physics, the latter can inform their activities. When things go wrong, moreover, for example when a bridge

collapses, questions will be asked about the extent to which practice was based upon the relevant body of scientific knowledge.” Mead (2013, p.390), suggests that the science of politics, or the science of policy, may at one time have been synonymous in the practice of statecraft, nonetheless:

“As they have developed, however, these programs seldom teach statecraft as officeholders experience it, with policy and politics in constant tension. Rather, research and teaching in the two subjects are largely separate. Policy analysis, or the study of what government should do about public problems, is done and taught mostly by economists; the subjects here include microeconomics and statistics. Studies about politics are done and taught largely by political scientists; the subjects here include the legislative process, implementation, and administration. The first group focuses largely on policy, the second mostly on politics, and neither says much about the other. Thus, ironically, economics tells government what to do while ignoring it, while political science does focus on government but will not tell it what to do. Neither achieves that union of policy and politics that Aristotle imagined.”

Sabatier’s (2007) proposed that a well-defined, parsimonious, scientific approach was required to determine if a public policy decision was based on sound theory, and this has become a commonly used metric especially for political scientists. Rosenbloom (2008) suggests that some contributing disciplines have moved away from a reliance on a hierarchical authority, even though elected officials and other government organizations continue to define themselves using hierarchical theory and rely on positivist and quantitative methods for policy analysis (DeLeon, 1999; Hill and Varone, 2014; Nagel; 1994; Sabatier, 2007). Lasswell envisioned policy science as the basis for training policy scientists, the forerunner to the policy analyst, with the skills necessary to work towards the public good:

“If, as political scientists, we were omniscient, we would have at our disposal descriptive and analytic tools enabling us to do the following: make a rapid survey of the predispositions found everywhere in the world, “predict” (retrospectively) the conditioning factors accounting for the direction and intensity of these predispositions; predict the way in which these predispositions would express themselves under the impact of any conceivable constellation of future conditional factors; predict the probable occurrence of future

constellations; outline the strategies by which the probability of future factor constellations can be modified (at stated cost in terms of values); and connect past and prospective sequences of events with specifications of goal (in our case, the goal of realizing the dignity of man—and other advanced forms of life—on the widest scale.” (Garson, 1980)

Policy analysts are immersed separately within the many sub-discipline that produced them and as such often perceive policy through dissimilar lenses (Sabatier, 2007 p. 5). Dunn (2015) suggests that these dissimilar lenses have produced bifurcated goals and evaluations. Furthermore, policy analysts tend to be rewarded for creating applied knowledge while academics tend to be rewarded for theory creation (Dunn, 2016, p31) and this has implications for policy analysis. The University of North Carolina Public Policy program, for example, pointedly notes that the academic mission of the program was not to produce what the founder of the Public Policy program in 1984 called ‘technocratic policy analysts’ but rather to embed the program in the application of the liberal arts and sciences to important civic issues (UNC, 2016). As a result of these differing perceptions to public policy and its study, many sub-disciplines have at some point questioned their own contributions and impact on real world public policy and theory. Such is the case in the relationship between Political Science and Public Administration, often called ‘The Great Dichotomy.’ The origins of The Great Dichotomy began with Woodrow Wilson’s separation of political administration from politics, which marginalized the role of public administration in politics, and which did not change until the 1960s, despite attempts by Lerner and Lasswell and the influence of Political Science on public policy. In the 1960s Political Science and Public Administration adapted their respective theories to deal with the rise of government pluralism and the increased number of actors involved in government. The Great Dichotomy debates included tense discussions about theory and practice, the appropriate role of public administration in political science (largely due to the latter emphasis on quantitative methods), and questions about the rise of public management within public administration. In the 1990s and early 2000s, some political science scholars feared that public policy had become hegemonic in their discipline (Guy, 2003). Similarly, sociologists questioned whether their contribution to public policy was the metaphorical equivalent of adding salt for flavor. Cairney (2013) questioned that though no one sub-field of public policy was to be greater than another, nonetheless some disciplinary-based theories have been adapted and hybridized to the detriment of a unifying public policy theory, which he claimed then failed to capture the complexities of contemporary public policy.

Theory wars in public policy

Until recently, the scientific method was considered superior to experience in public policy studies because of its emphasis on empirical study and ‘verifiable’ testability. Indeed, Dunn (2015, p. XVII) defines policy analysis as an applied social science and that “the methodology of policy analysis rests or should rest on epistemological foundations that differ from those of the disciplines of which policy analysis is comprised” and should not be stove-piped into the theories of economics or politics, or be “reduced to an academic spectator sport in which knowledge is prized for its own sake.”

Figure 2.3: Stages Heuristic Model of Decision Making

Lasswell’s Stages Heuristic (Figure 2.3) is often referred to as the “textbook approach” to policy because it is the most common heuristic technique used to describe the policy process. The Stages Heuristic was created to operationalize ideas about improving the quality of information provided to, and by, government. Urgent issues tend to gain more traction at the agenda setting stage and wane through subsequent stages. Lasswell termed the concept “knowledge of and in the policy process” (Torgenson, 1975 p.45) and proposed seven categories for a step-by-step, linear, hierarchical, top-down decision-making process: 1. intelligence or the aggregation and dissemination of information used by players in the decision process, 2. efforts to influence others to bring about the desired outcome through agenda setting, 3. prescription or the development and stabilization of norms including Big P (laws and regulations) and small p (codes of conduct), 4. Invocation or the original evaluative case of an implementation, prescription or approach, 5. application of the final implementation for a particular case, 6. appraisal, evaluation, or reflection on policies and to what extent policy goals were achieved, and finally 7. termination, cancelation or reformulation of a policy or approach (Aeur, 2017). The Stages Heuristic evolved into a policy process premised on a hierarchical set of stages involving

agenda setting, policy formulation and legislation, implementation, and evaluation and each stage is supported by respective concepts, theories, models, and processes. The heuristic is considered a useful and analytically powerful approach to public policy analysis but is criticized for being hierarchical and top-down and oversimplified in the context of multi-level government (Aeur, 2017; Aeur, 2018; Lasswell, 1956; Jones, 1970; Cobb, Ross, Ross, 1976; Hjern and Hull, 1982; Brewer and de Leon, 1983; Kingdom et al. 1984; Sabatier, 1986; Nakamura, 1987).

In similar fashion, the Institutional Rational Choice Framework (Figure 2.4) proposes policy

Figure 2.4: Institutional Rational Choice Framework

decision-making as a rational process that focuses on the specific instructional relationships between Congress and administrative agencies in the U.S. A key concept of the Rational Choice Intuitionism Framework is the principal agent theory taken from neo-classical economics that is integrated into the neo-institutionalism or resurgence in institutional theory.

Figure 2.5: Principal Agent Theory

The principal and agent theory (Figure 2.5) assumes a cooperative relationship between the President, Legislature (the principal), or agency which relies on bureaucrats (the agent) to provide expertise on complex problems and issues. Although, the principal is in charge, they cannot function without an agent or agents to carry out their needs. These agents of central or local government find how the goals of the political system or principal can be implemented. It is the nature of these institutions that drives political decisions, either through incentives or constraints that permit certain decisions to be implemented and which drives rational choice.

Agents in close proximity to their principal are considered more likely to share common values with the principal than if they were distanced in another agency with which they are more likely to share those organizational or cultural values (Miller 1992; Ostrom et al., 1994; Dowding 1995; Scharpf, 1997; Sokolowski; 2001, Worsham and Gatrell; 2005).

Figure 2.6: The Multiple Streams Framework

The Multiple Streams Framework (Figure 2.6) and as adapted by Zahariadis (2014, 2019), divides the public policy process into three streams of actors and processes: 1) a ‘problem stream’ consisting of problems and their proponents; 2) a ‘policy stream’ containing a variety of policy solutions and their proponents; and 3) a ‘politics stream’ consisting of public and elected officials. These streams often

operate independently except during “windows of opportunity” when some or all the streams may intersect and contribute to policy change. The Multiple Streams Framework has been criticized for its inability to handle fuzzy or ambiguous conditions; its inability to present multiple perspectives; and its seeming separation of complex themes into separate streams.

Figure 2.7: The Punctuated Equilibrium Framework

The Punctuated Equilibrium Framework (Figure 2.7) created by Baumgartner and Jones (1993) seeks to explain why policymaking in the U.S is characterized by long periods of incremental change punctuated by brief periods of major policy change. Baumgartner and Jones believed that

government institutions typically gravitate to maintaining the status quo and have a “monopoly” over defining the issues and decision making. As such ‘punctuated’ change occurs when opponents to the existing status quo manage to fashion new “policy images” or exploit multiple policy venues through the courts, legislatures, or local, state, and federal government. Significant change, therefore, might or might not occur when certain conditions exist. As to what creates the conditions for change will vary and might include the introduction of new actors, heightened media attention which increases issue salience, a narrative or narratives which mobilizes the public to demand change, and more rarely a fundamental reevaluation of a foundational truth (Baumgartner et al., 2014; Jones et al., 1998; Baumgartner and Jones, 1993).

The Advocacy Coalition Framework (ACF) (Sabatier et al., 2019) is one of the more influential public policy theories in use and emphasizes the role of external shocks to the political system and the role of technical knowledge and expert communities in influencing that system. The members of ACF communities are professional experts who closely follow and debate a shared policy problem. The ACF was created as a more sophisticated stages approach and incorporates the best features of the top-down and bottom-up approaches and incorporates technical information into the policy process. The ACF acknowledges the role played by technical information provided by the media, think tanks, and other outside experts; it takes long term view for this information to be disseminated, absorbed, and evaluated by the system; it emphasizes sub-domains as more useful units of policy analysis because they can account for when multiple groups might combine to advocate for a specific issue; and finally interest groups and journalists are acknowledged as policy actors. The ACF focuses on the interaction and lobbying of advocacy coalitions and actors from a variety of institutions who share a set of policy beliefs intent on overturning the status quo. These coalitions often explore multiple avenues to bring about change, which can lead to alignments between unlikely allies.

The policy diffusion framework developed by Berry and Berry (1992) seeks to explain variations in the adoption of specific policy innovations across states or localities. The policy diffusion framework posits that policy adoption is a function of the characteristics of specific political systems and of diffusion processes operating across boundaries. Mintrom and Vergari (1998) integrated the policy diffusion framework with a policy network structure. While the Policy Network Approach is not a theory, it draws upon hypotheses and models from other theories in which clusters of actors, and not governmental organizations, steer the policy process. Policy

networks are made up of micro-level relationships in policy-making, network structures, and individuals and groups. These networks form around an interest or have a stake in each policy and because these actors are treated as mutually interlinked, networks are self-organizing, autonomous, self-governing, and resistant to governmental influence. The success of a policy network depends on the type and quantity of actors involved; the complexity of the policy networks; the degree to which that network is self-referential; the cost-benefit analysis; and the absence of conflicts of interest. Adam and Kriesi (2007) criticized policy networks for their focus on national networks to the neglect of complex interactions at transnational and specific policy-domain levels (Kenis and Raab, 2003).

Complexity Theory is often considered a new scientific paradigm in public policy that shifts analysis from a focus on the individual components of the political system to a consideration of the political system as a whole network of interrelated elements that exhibit systemic behavior (Cairney and Geyer, 2017; Morçöl, 2012). Cairney (2013, p. 33) argues that “The best hope for complexity research, and public policy theory more generally, may be to develop such ‘toolkits’ in cooperation with policymakers, since that interaction can produce new ideas and ways of thinking.”

Figure 2.8: Garbage Can Model

But in contrast to these rational and unifying models, and perhaps revealing of the challenges faced in the spatialization of public policy, is the so-called 'Garbage Can' model of organizational decision-making developed by Cohen, March, and Olsen (1982) (Figure 2.8) who were dissatisfied with formal models of decision-making. In the studies by March and Olsen

(1976) and by Cohen and March (1982) the authors found that while ambiguity was a major feature in the decision-making of public organizations, this uncertainty was rarely acknowledged. The Garbage Can Model recognizes that problems, solutions, participants, and choice opportunities are unpredictable in any policy decision-making process. The model posits that few know the political motivation behind policy decisions because political minds are like

garbage cans collecting information from a diverse number of places and people all of which contribute to decision-making which is thus as much due to chance and the unknowable psyche of politicians as to any formalized analysis. According to Cohen, March, and Olsen (1982), a decision emerges based on ‘temporal proximity,’ as problems, solutions, and participants collide, and solutions get attached almost coincidentally in the proverbial garbage can. Public policy is thus, “a collection of choices looking for problems, issues, and feelings looking for decision situations in which they might be aired, solutions looking for issues to which they might be the answer, and decision-makers looking for work” (Cohen et al., 1972, p.1). In the context of this study, where the spatial representation of public policy based on some formal rules or logic might reasonably be assumed, the Garbage Can Model shifts the focus away from formalized geographic reasoning and spatial representation to more of a mental mapping exercise in which a seemingly random and unsystematic decision-making takes place in an environment of considerable uncertainty (Lomi et al., 2012; p. 3-18).

Chapter 3 Spatiality, geography, and public policy

For a number of reasons then, the discipline of geography, with the recent exception perhaps of GIS, has been peripheral to public policy science and has played only a minor role in the formation and application of public policy. While Gatrell and Worsham (2002) posited that some public policy theories such as the principal-agent relationship were implicitly geographical there have been few attempts to capture the spatiality and geographical complexity of public policy. In common with initiatives elsewhere some scholars have suggested that geography as a discipline inherently integrates theory from other disciplines into its own works, but less commonly experiences its own concepts being integrated into other disciplines (Bodman, 1991; Kaplan and Mapes, 2015; Ethington and McDaniel, 2007).

Public policy science and political geography

Ethington and McDaniel (2007) in reviewing the political science and political geography literature determined an apparent lack of collaboration between the two fields despite their seemingly shared interests. While the subject matter may be similar, they suggested, this lack of synergy was attributed to the differing analytical frameworks employed by the disciplines: “Geography is distinct from other disciplines for good reasons. It is founded on spatial or spatialized concepts: points, lines, polygons, distance, direction, place, area, network, path, context, scale, region, motion, boundary, borders, nodes, center, periphery, and so on” (Ethington and McDaniel, 2007; p. 129). Indeed, this analytical divergence may go deeper in that political geography in the early twentieth century was involved more in territorial decisions and world politics and environmental determinism, as propounded by the Nazis, which ultimately contributed to political geography retreating from political involvement. Later, political geography underwent further change through Marxist approaches (Harvey, 1973) which splintered the field further. Johnson (1984), for example, termed this “a political geography without politics” or it could be added spatial boundaries. The radicalization of the social sciences in the 1960s and 1970s prompted political geography to redefine itself in terms of Lasswell’s definition “who gets what and why” by adding the “where” component. (Dikshit, 2015).

Lasswell, who once viewed himself as an intellectual in exile, found his theories were held suspect because his work was largely in the service of government. Policy science had been viewed as being theory-driven but became increasingly viewed as being the government's handmaiden and a technocratic force (Straussman, 1978). The cultural turn in human geography in the 1990s challenged the seeming reification of scale and focus on economic structures and in political geography competing theoretical perspectives arose based tension between those critical of government policy on one hand and government administrators or politicians looking for geography to provide tools and analysis on the other. This was especially so involving topics such as the war on terror and the role of geography in foreign policy (Dictionary of Human Geography, 2011). Haynes, et al. (2004) contrast the public policy process typically pursued by policy analysts with the approaches of political geography which focused on scale, and the importance of geographic context in policymaking. Haynes et al. (2004) identified an apparent shift in public policy analysis that had the effect of diminishing the spatial dimension in policy debates and they argued for a geographic perspective to reinvigorate policy analysis. The term "geography of public policy" was used by House (1973) in his work *Geographers and Decision Makers* as he questioned the apparent separation of geography from the study of public policy. Dorling and Shaw (2002) and Martin (2001a) argued that geography's focus on the "cultural turn" and the post-modern/post-structural turn was to the detriment of a more applied geography in public policy. Martin posited that engagement in a geography of public policy would enable geography to be more relevant to the governmental arena and lamented that the lack of such engagement might ironically actually amplify social inequalities. Massey (2002) counters that human geography is still in the process of working out its own internal theories and should not be pressured by outside disciplines to chase political dollars or politicians, who often thought of geography as dull or irrelevant. Johnston (2008) suggested that the "geography of geographies" that emerged in the wake of World War II was a unified discipline focused on the study of regional differentiation or cartographic mapping, though Martin (2001) suggests that the dialogue with public policy science over the past two decades had been impacted by a fragmented discipline and that a wholesale rethinking of geography and public policy was required. Cutter (1988) in a pointedly titled work, *Geographers and Nuclear War: Why We Lack Influence on Public Policy* similarly identifies the lack of a comprehensive geographic approach to public policy as contributing to geography's lack of impact on specific policy areas. Imrie

(2004, p. 701) suggests that even advocates for a policy-turn tend to sidestep policy issues and conceptualization to focus on matters internal to geography and geographers. Johnston (2005) in *Geography: Coming Apart at the Seams?* questioned the increasing number of sub-disciplines in geography, which he argued weakened the discipline and contributed to a fragmented geography lacking presence in academia.

Warf (2010) suggested that public policy clearly intersected with political geography but he saw this cross cutting more narrowly as being largely pragmatic and technocratic in nature and based largely on remote sensing and GIS (Openshaw, 1989).

Indicative of the tensions being played out in political geography, geography, and public policy science, and despite the advent of GIS and the urging of some geographers such as Berry (1970) and Abler (1993a) for geography to be more involved in the public sphere in order to sustain the discipline's survival, by the early 2000s political geography took a significant turn toward structuralism, Marxist theory, and social theory. Such a change can be seen in the rise of new journals in political geography that focused on space and polity, geopolitics, and society and space such as *Geopolitics* (1998 – current) formally known as *Geopolitics and International Boundaries* (1996-1997), *Space and Polity* (1997-2020), *Territory, Politics and Governance* (Since 2013) (Flint, 2003; O'Loughlin and Sidaway, 2008). These approaches were in some contrast to the positivist and applied approaches embedded within public policy science.

Peters and Pierre (2006) argued that the lack of an applied positivist approach in the study of public policy would make public policy analysts' historians and journalists and they argued for the continued focus on applied contributions to public policy. Only in a few arenas does there appear to be some overlap between political geography and public policy and this is with regard to studies on the state, nationalism, and international politics – all part of the politics of representation and governance, or small 'p' politics (Flint, 2003a). An exception to this might be with studies on state and territory primarily undertaken by Agnew (1994), Taylor (1973), Martin (1989), Johnston and Pattie (2006), and Ethington (2007). These geographers are among the few to be cited in the policy science literature (Agnew, 1994; Jones and Clark, 2020).

Geography and Public Policy

It is argued here that geography and political geography especially, has largely been missing from the table about public policy discussion. Massey (2002) and Cairney (2013) suggested that communication was one roadblock to this peripheralization and argued that geographers needed to use an appropriate language for target audiences in public policy, “Yet, there is a major barrier to that conversation: both may have a different language (or jargon) to understand it and a meaningful conversation may require considerable translation” (Cairney, 2013, p. 22).

Contributing to this communication blockage, Cairney (2013) suggested was the need for compromise between the relatively pure theory of political geography and the practical application of public policy science for modern policy analysts to survive in the complex and messy real world.

Public policy then might be perceived as seemingly aspatial, but the inclusion of small p policy has forced a reevaluation within public policy science. Critiques of public policy science (Whitworth, 2019; Cairney, 2013; Termeer et al. 2010; Jones and Clark, 2020) highlight the missing spatial component and note that places are different and reflect local, regional, and national complexities and realities that are scalar in nature (Cairney, 2013; Martin, 2001; Ward, 2006). One area that might at first sight appear to be an exception to the peripheralization of geography from public policy is in Geographic Information Systems (GIS). GIS is a relatively new field in geography and has become an important component in many parts of social science such as public health, elections, social issues, and community development. The US is a leader in public policy theory and GIS respectively and government and private partnerships and a multitude of spatial databases and technology companies such as ESRI and Google, have reinforced these technological contributions. Government open mapping initiatives such as the National Spatial Data Infrastructure and Federal Geographic Data Committee, have created standards and protocols that apply to every government organization and participant in the US data infrastructure (Bevington, 2015). The Obama administration, for example, encouraged shared data platforms and e-government which are seen as critical for democratic procedures to operate in many Western countries (Bekkers and Moody, 2014; Bevington, 2015). These technological advances in geography certainly lend themselves to small p policy even though Box (2015) would assert that geography is needed to capture both Big P and small p policy.

As geospatial technologies and spatial data have become more accessible, one would have thought that the spatial has become more and more ingrained in public policy practice. The link between GIS and public policy, however, has been limited more to the use of GIS as a mapping tool, and the greater potential role of GIS as a media and analytical toolset to frame public policy has been diminished, ostensibly because of the heavy resource needs in expertise, hardware, and software. Significantly, Jerret et al. (2010) note the use of GIS in public policy but to the exclusion of geographers and geography. The role of GIS in contributing to the semantic web, wiki maps, and mashups, that are often the by-product of framing public policy, along with the use of location-based services, has been restricted. Lasswell (1971), in his review of 20 years of policy science, identified technology to advance the practice of public policy stating that:

“The trend toward a policy sciences viewpoint – contextual, problem-oriented, multi-method – is a move away from fragmentation. Too often a differentiated approach is permitted to degenerate into a fragmented “worm’s eye view” of policy matters. When properly linked with law and jurisprudence, political theory and philosophy, the new instruments of policy analysis and management provide tools of unprecedented versatility and effectiveness. Even an abbreviated list indicates the extraordinary richness of contemporary innovations: operations research, linear and dynamic programming, program budgeting, cost-benefit analysis, systems analysis, forecasting (Delphi and other techniques), computer simulation and gaming, sensitivity training, “brainstorming,” decision seminar techniques, social accounting, prototyping.”

Yet, despite the advent of GIS, a new spatially informed phase of public policy management and dissemination has been somewhat stifled. To this end the following chapters explore the use of GIS in public policy through the creation of policy-sheds based on statutory, administrative, and best practices and specifically in the waste industry.

Chapter 4 The Spatiality of Solid Waste Policy: The Solid Waste System and Policy Framework

Waste disposal is an everyday necessity and yet the field is rarely accorded the attention given to other essential infrastructures such as electricity, clean water, or transportation (Columbia, 2003; Higgs and Langford, 2009). Trash is intrinsically spatial. The methods used in dealing with solid waste have changed little since early times and involve burying it, burning it, storing it, or finding a way to reuse it (Bowler et al., 2009; Gifford-Gonzalez, 2014). Increasingly, however, as the mass of waste generated by modern society has increased, the ability to dispose of trash locally is now greatly diminished and often requires transportation to other jurisdictions or even export abroad. Due to the many demands on the national land stock, trash must compete with other land uses and, since space is finite, these spatial conflicts have become ever more evident, not least in the age of NIMBY-ism (Not in my backyard). Furthermore, solid waste disposal is interconnected with many other areas of everyday life including health, environment, transportation, homeland security, planning, economic development, water quality, and more recently, international relations -- all of which impinge on proper waste disposal (Fennell, 2011). Thus, solid waste disposal and its spatial delineation cannot be treated in isolation for it overlaps with many other policy areas with often differing spatial extents.

Solid waste can arise from many sources and contrary to popular thought household waste is not the dominant source of waste materials. Regulatory authorities may vary depending on the type and source of solid waste. Industrial waste is regulated because of concern for air, water, and land pollution which impacts public health and the environment. The regulation of industrial waste can be case specific as in the case of chemical waste which is controlled through the U.S. Clean Air Act (Kondo, 2014). Waste arising from natural and man-made disasters are less common and extend beyond everyday prescribed boundaries but events such as earthquakes and hurricanes even as exceptional events, can wreak havoc and overwhelm the solid waste disposal system. Brown et al. (2016), in a qualitative study of recycling disaster waste feasibility found that even when waste disposal and recycling are incorporated as part of a formal disaster waste

management system, its effectiveness depends on available and existing knowledge of the specific area and type of disaster event, resources and cooperative structures and groups (Holstrom, 2016; NFPA, 2009). Medical waste introduces further complications in the sourcing and handling of solid waste and not least with endocrine disrupters. West Virginia residents, for example, average over 18 prescriptions each year, while the national average is 11.6. The disposal of these pharmaceutical products causes problems with water bodies, commercial animal feed operations, surface applications of manure and biosolids, recycling operations, and wastewater treatment plants (Bhati, Dhawan, and Maheshwari, 2013). As a result, drug waste falls under several regulatory bodies including the Department of Highways, law enforcement, Environmental Protection Agency (EPA), and Department of Health and Human Resources (DHHR) in addition to other state authorities. In 2015 the U.S. EPA proposed *The Management Standards for Hazardous Waste Pharmaceuticals Rule* to regulate the management of hazardous waste pharmaceuticals by healthcare facilities to protect water quality from flushed medications (Vogler, 2014).

Similarly, interstate commerce associated with fracking waste is a growing problem in waste management worldwide that harks back to the Garbage Wars of the 1980s. Although well drilling is often performed by out-of-state companies the drilling waste is disposed in local landfills which are governed by Solid Waste Authorities (SWA) and are subject to the regulations and practices of the U.S. Centers for Disease Control, the U.S Groundwater Protection Council, and the U.S Department of Energy (Farah, Tremolda, 2013; Greenburg, 2018; Kotcon, 2014; Swickl, 2019). The case of scrap metal further reflects multiple levels of regulatory authority with the added complication arising from the intersection of municipal waste, volatile solid waste commodity markets, and transboundary issues arising from the global trade in waste. Solid waste has a cyclical nature and events can punctuate waste disposal policy based on a combination of global economics, world conflict, environmental and health concerns, and consumption patterns (Sabatier, 2007).

Thus, the Integrated Solid Waste approach adopted as standard industry and government practice has been criticized for using idealized waste scenarios and policy situations that focus on municipal waste, Big P regulations, and economics; all actions that take the crucial

understanding of place and space out of the waste equation. Each type of waste, depending on its location, has its own jurisdiction and spatial dimension. The U.S. government has created sets of laws related specifically to regulate federal waste practices, federal buildings, lands, and prisons. These laws are often stricter and preempt any local or state laws and are adhered to no matter the location of the federal agency. Airports, for example, operate as if they were a small federal town and are subject to different recycling, reuse, and waste rules than the jurisdiction within which they are located. The U.S. Department of Defense has its own policies concerning solid waste disposal and not least because of defunct armament (Abraham, Eick-Cost et al., 2014; Scavenger, 2011; Turner, 2002).

The disaggregated nature of the solid waste system further compounds the situation. While most people view waste disposal as a dyadic relationship between householder and the trash disposal company, there are multiple and varied actors and stakeholders involved in the process. Solid waste is often treated as a monolithic entity instead of an aggregation of many differing types of waste types and disposal systems, each incurring separate jurisdictional control and protocols. In addition, the respective agencies have their own procedures, policies, and practices. Attempts to stovepipe solid waste policy, therefore, is impossible. The extent of these interlocking forces is further compounded by a heightened public awareness of trash, from local issues of trash collection and recycling to climate change and the Great Pacific Garbage Patch. Popular movies such as WALL-E (2008), Gravity (2013), and The Story of Stuff (2012), and Sir David Attenborough's Blue Planet II (2019) have inspired zero-waste activist movements and raised the public awareness of trash, recycling, and waste disposal.

Correct waste disposal behavior often depends on community values and behaviors and the role of environmental groups, religious organizations, and individuals who perform stewardship through community involvement. Importantly, policy is often written that depends on the input and support of these organizations. Non-governmental groups often volunteer to perform community clean-ups of rivers, parks, and neighborhoods and take the initiative in recycling initiatives. Concerns to make volunteers aware of the risk of used heroin needles or

methamphetamine waste, for example, have necessitated the need for training resources for these groups (Hitzhusen, Tucker, 2013; Leary, Minton, Mittlestaedt, 2016).

Recent events have highlighted the transboundary nature of solid waste. Instances of transboundary waste disposal includes the waste deposited by hurricanes on distant shores, man-made waste generated by activities such as horizontal drilling and ‘fracking’ waste, and prescription drug disposal. The simplified, linear, and homogeneous portrayal of solid waste depicted in most public media, such as the *Story of Stuff* (2012), belies the complexities involved in the solid waste system and the related policies and jurisdictions that can range from natural resource extraction to product manufacturing and distribution, to public consumption and disposal. Despite appearing as a unified policy area, solid waste encompasses many political, technological, service, and environmental activities that transcend the local and garner the attention of multiple agencies. Added to which are the many constituents, actors, and stakeholders that make up waste policy disposal and best practices. Further, waste disposal is an everyday challenge punctuated by crisis events that can seriously disrupt the system and the procedures laid down for waste disposal (Achillas et al., 2013; Allmendinger and Haughton, 2009; Colin, 2007; Duany et al., 2010; Meadows, 1999; Li et al., 2014; United Nations Environmental Program, 2009; EPA, 2014; MacBride, 2012; MacLennan and Stiller, 2010). This chapter reviews three central themes to the solid waste disposal system as a prelude to discussing the potential role of policy-sheds to capture the spatiality of the solid waste system. First, the chapter reviews the solid waste industry itself and how the quantity and value of waste is determined and calculated. Second, the chapter reviews the nature of waste disposal in the context of a scaled geography, that at its simplest level extends from the local to the global, but in reality, exhibits other forms of scale that bypass hierarchical scale through worm-hole-like connections that connect the local directly to the global. Third, the chapter lays out the basis for the laws and regulations that surround solid waste disposal and especially so in the context of the regulatory system controlling the relations between waste, the environment, and people.

The solid waste industry

For the average home in the U.S., municipal trash comprises over 300,000 types of individual items used in everyday life and including furniture, electronics, clothes and textiles, cleaning

supplies, food, mementos, paperwork, and medications (human and pet) to name just a few. Each item has its own complex life cycle, and each is associated with its own set of policies and regulations that extend from source to manufacture to disposal. It is generally accepted that each person in the U.S. generates an average of 4.4 pounds of potential municipal solid waste (MSW) per day (Leahy, 2018). Yet, this figure only constitutes only 3% -7% of the waste generated within the U.S. (EPA, 2014). While a greater variety of items exist within municipal waste, other solid wastes, such as industrial waste, account for the bulk of solid waste worldwide (WorldBank, 2018). Taken in its entirety, waste items and the materials that subsequently become waste are constantly changing as new materials are developed, new trends followed, and conveniences desired. Alongside these new items, legacy items such as mercury, remain in the waste stream through either storage or continued use and these require specific handling for disposal. The material composition of an item determines the disposal method that might be available and the impact of that item on an individual, community health, or economy (Achillas et al., 2013a, 2013b; Gifford-Gonzalez, 2014; EPA, 2014; EPA, 2021; Gopalakrishnan et al., 2021; MacBride, 2012; MacLennan and Stiller, 2010).

Recent studies have revealed confusion concerning the appropriate disposal of waste materials. Waste materials that require specialized disposal such as medical, household hazardous waste, and electronic waste are a growing concern because they are more difficult to dispose of and usually need specialized knowledge, handling, and methods to keep harmful materials from impinging or adversely affecting human health or water quality. Advances in material science are often ahead of the methods available for disposing of new types of waste. This is made more complex since manufacturing is invariably disconnected from disposal, thereby leaving the responsibility for proper disposal to the buyer. In addition, waste companies often need to reverse engineer products to appropriately dispose of the material. Disposal practices struggle to keep pace with material changes. Reusable water bottles and plastic bottles, for example, replaced polyethylene-lined disposable paper cups, which were formerly lined with wax. These disposable cups had, in turn, replaced public water sources, such as water fountains with tin cups, and catalyzed the invention of processing methods for plastic materials. More recently, disposable products have gained traction as a marketing practice, and items such as disposable and biodegradable wipes, cups, or kitty litter require more specialized processing methods such

as composting because modern landfills were not designed for an increase in compostable material. In addition, now defunct materials that make up legacy items, many of which would now be banned, are often stockpiled to be disposed of later (Vining and Ebreo, 1990; ISRI, 2014). Waste materials are closely tied to economics because of their potential value as secondary materials which are items composed of materials which can be returned to near raw material state for further manufacture as new items which are highly desirable commodities.

Counting, under-counting solid waste

Current data used to estimate the amount of waste generated stems from multiple sources, such as the U.S. EPA Municipal Solid Waste Generation Chart and The Waste Atlas, that out of necessity have focused on readily generated data. Local waste generation is the foundation of aggregated waste data, analysis, and logistics, yet many publications refer broadly, “to the same cities for similar periods, different waste generation per capita rates, different overall waste generation, and internally different populations” (Waste Atlas, 2014 p. 17). Recent studies have found that this data contrasts with the fuzzy and complex real-life nature of waste, and consequently under-reports waste estimates which then go through an over-simplified waste analysis (U.S. EPA, 2015). One cause for under reporting waste data reporting is that waste estimates are based on a presumption that waste is homogenous, singular entity, which contributes to inaccurate normative estimations. Not least, waste sources use differing definitions of waste dependent on geography, economics, culture, history, and applicable law. The Waste Atlas (2016) postulates that the usual approaches used in waste analyses are based on data that assumes that waste generation has a steady relationship related to per capita population while ignoring economic growth/decline and other dynamic uncertainties. These assumptions hide the full scope of waste generation and disposal that comprises a multitude of specific items destined for sites that often compete such as landfills, recyclers, and non-profits. Waste can also be hoarded, dumped, or burned and may be generated by crisis events such as flooding or irregular events such as sporting events, concerts, and holidays. Another overlooked aspect in waste disposal is that the tracking and analysis of waste may occur outside of the data collected by governments or contracted companies. These overlooked waste sources include farms, restaurants, schools, businesses, small waste recycling operations, non-profits, the informal waste sector, and even community organizations. These waste sources intersect, partner, or work

alongside large municipal, private, and industrial waste disposal companies. Further complicating the under-reporting of solid waste is that the data is often recorded based on oral agreements, historical partnerships, or cash-in-hand deals that contribute to under-counting issues.

Calculating the full extent of waste generation is complicated by the time-consuming, expensive, and often infeasible means of undertaking these audits. Waste audits are often estimated for specific areas and are then extrapolated to other areas. The audits are invariably performed by collecting and recording items such as cigarette butts, litter, landfill waste, and industrial wastes and then extrapolating these figures for regions and countries. Pre-waste audits, waste estimation from receipts or inventory, can also serve as waste audits when factors such as safety or time constraints hinder traditional waste audit analysis (Pickles, 2008; Powell, 2014; Work and Hayward, 2011). Even when waste audits are conducted, the data may be proprietary and not widely distributed or not made available in an accessible format. In some instances, waste data for some items might not be available for all locations, as was found with scrap metal which does not appear in some accounting frameworks because industries are identified by their primary products, and scrap metal has no assigned industry (Jackson et al, 2008).

Self-reporting rules further complicate waste data due to the probability of unreported, inaccurate, or false data which generates waste profiles that are vague, misleading, or outright false. Self-reporting errors are often caused by the differing spatial units used for each waste item generated. When *New York Times* columnist John Tierney (2015), for example, questioned the need for recycling in his article *The Reign of Recycling*, he received negative responses by the independent waste industry. As the body representing the largest waste handlers, the industry argued that portraying recycling as one homogeneous municipal practice discouraged people from recycling altogether because most people cannot comprehend the scope of waste even within their own homes. Municipal waste, because it is the most visible aspect of the waste process, is the easiest to analyze compared to the real extent and complexity of the waste system. Other parts of the waste stream including businesses, industry, and infrastructure are not so well understood and yet generate by far the greater quantity of solid waste (ISRI, 2015).

The Fuzzy Value of Waste

Waste items are valued based on local to global commodity markets that trade alongside and intersect with four key commodity areas comprising energy, metals, food, and raw non-food agricultural materials. The secondary recycling commodity markets have grown along with the market for new technologies, such as electric cars, solar power units, and satellites. The secondary waste recycling market has also been impacted in part due to the recognition that there is a limited supply of raw materials and that the costs associated with material extraction can be volatile and influenced by economics, political events, and social contracts. The complexity of the waste system is difficult to appreciate and especially so when the secondary commodity markets, which tend not to track waste figures, is added to the solid waste system. Although a vast amount, about four billion tons of municipal, industrial, and hazardous waste by-products, are sold on the commodities market each year, the line between waste and valuable commodity is fuzzy and often determined by the seller, buyer, or market. Unlike ‘virgin’ or ‘raw’ material, secondary waste commodities are bought from the waste and recycling industry, usually comprising smaller companies, and then aggregated to create a viable source of raw material (Irwin et al. 2006; Cooper et al., 2008). The market for ‘virgin’ plastics material versus recycled commodity plastics material, for example, touches every manufacturing and product market from plastic drink bottles to car parts to medical devices, and vinyl siding. Raw plastic materials are manufactured from the by-products of the oil industry, and when oil prices are high the market for plastic made from raw materials decreases and the secondary or recycled materials market increases. In contrast, low market prices for raw plastic can create a crisis that can reverberate throughout the recycled plastic markets worldwide because secondary plastic commodities become more expensive than ‘virgin’ plastic. If oil prices slump, then the secondary market for plastics declines. Crashes in the secondary commodities market affects local recycling collection and private trash businesses because haulers and communities might stop collecting plastic items for recycling because the disposal cost is no longer offset by sales. Conversely, a 2015 series of earthquakes in Chile, a copper producing country, significantly reduced ‘virgin’ copper production thereby increasing copper prices for local scrap dealers in the U.S. and created a demand for recycled copper from any source including dilapidated houses.

While industrial and recycled building materials make up the largest bulk of traded waste commodity materials, electronic devices containing rare earth materials are particularly valuable. Recyclable items made from materials such as wastepaper, scrap metal, and plastics, among many others, have become a major part of global international trade. This trade often flows from waste generating developed countries to waste processing developing countries. Some items, such as glass, remain a locally traded commodity due to high transportation costs and a declining market for glass made products. Transportation for secondary commodities generally will only be cost effective over short travel distances, and while the market may be international in scope, the process itself is largely confined to local waste markets.

Decisions that impact the global exchange of waste commodities are not always directly related to the specific waste commodity involved. For example, industries in states and countries compete against each other for secondary commodities, which in turn, compete with ‘virgin’ commodities. Some waste items retain higher value in the secondary commodity market based on purity and proximity to the ‘virgin’ commodity. However, this is not always feasible or a desirable option that is open to municipalities or businesses that must weigh the cost of waste commodity collection with other priority needs. Waste is often a hand-to-mouth proposition that is highly subject to even small events, such as snow, that can delay waste pickup, to large global events such as market crashes. Underpinning all this is the potential impact of changing population growth and population density (Beukering, 2013; McKinsey Report, 2016; Swiss derivatives, 2015; Pew, 2015; Veryspatial, 2016; United Nations Comtrade Database).

Population and the waste system

Solid waste generation and disposal is often shaped by geographic region, population density, and economics. Even though population density is a defining factor in the waste material market owing to the complexity involved in providing services to different geographies and population densities, the ability to provide waste services tend to be treated as being homogeneous across the United States. Waste worldwide, from small haulers to multi-national conglomerates, is still based on the same basic principle of competition by haulers for territory, land, and cheap disposal options. Market share is often based on obtaining contracts, often decades-long in the making, to valuable population dense areas. These contract territories can be fuzzy because

multiple contracts can be differentiated between business and residential. Waste generated by events such as sporting occasions, outdoor concerts, and school graduations are often overlooked even though these can equal, or exceed, 'every day' trash collection quantities. Food waste generated, at home, by retailers, and during events, is homogenized with other types of waste which can obscure the figures (Jones 2006; Rathje 1992; Reynolds et al., 2014; USDA, 2015).

Many areas in the United States lack the population density and quantity of waste or transportation routes to support a trash pickup service, let alone a recycling service. Haulers often rely on informal negotiations that are dependent on local circumstance and knowledge. Information on these haulage routes is often worth large amounts of money, sometimes millions of dollars, and are rarely, if ever, shared. Once again, this can contribute to the under-counting of waste.

If waste is treated as a homogenous entity, then, so too are the waste behaviors that are shaped by local populations. Communities are often treated as though waste behavior has no impact on waste generation or disposal, even though waste behavior research has found that improper disposal by industry is heavily driven by the need to minimize costs and maximize profits. Improper waste disposal can be caused by prohibitive cost, lack of proper disposal outlets, or most often what educators term 'fossilized knowledge' or lags in training or best practices (MacLennan et al., 2014; Aksan et al., 2019; Dijkema, 2000; Scerri, 2009). Fossilized knowledge can be promulgated and passed down within a community in the guise of tradition (MacLennan et al., 2014; Scerri, 2009). Waste services are not standardized across the U.S. which complicates matters since each hauler, municipality, or neighborhood have their own rules about what constitutes 'proper' waste storage, handling, and disposal. The National Waste and Recycling Association President and CEO Sharon Kneiss believes that waste contamination occurs in part, due to 'aspirational recycling' or waste behavior "where people with the greatest intent believe you should be able to recycle this, so the logic is, (the processors will) figure it out. It just, unfortunately, doesn't work that way." (ISRI, 2014). Aspirational waste behavior happens when the public does not differentiate between the variations in waste disposal options applicable at their location relative to generalized waste education, consumer advice, or public outreach based on an often-homogeneous perception of waste disposal. For many residents,

knowledge about correct waste disposal has fossilized at a certain stage of learning, such as in elementary school when most people learn waste disposal practices, or from their parents, or later during career preparation. This is reflected in the former practice of ‘dilution is the solution to pollution’, a practice that led to low-level toxins and prescription drugs being present in the water supply. Many residents were told by home care attendants, for example, to flush prescription drugs down the toilet; some dump paint down sewer and storm water drains; and contractors empty buckets containing blacktop residue onto lawns. These actions are not questioned if they align with received knowledge of waste disposal often emanating from what an individual’s parents practiced, what they learned in school, or what a professional advocated, even if these conceptualizations are wrong.

Waste disposal behavior can also be shaped by different worldwide conceptualizations of solid waste and who is the responsible body for the collection and treatment of different types of waste. Municipalities have differing conceptualizations of waste which impacts everything from creating waste collection and disposal programs to metrics for measuring waste disposal success. Municipal jurisdictions vary and so too their responsibilities for the collection and treatment of different waste types. For example, many municipalities have ceased collecting waste as a public entity but rather issue licenses to private sector waste companies (Foggarty et al., 2008). Termeer et al. (2010, p.29) consider, “There is a trade-off involved here: while a small municipality will not have the capacity to deal with complex environmental permits, a big municipality could risk losing political trust among its citizens.” Widely publicized incidents involving loss of public trust have occurred in locations such as Beirut, Naples, and New York City. Love Canal remains one of the worst environmental disasters in U.S. history. Caused by a seemingly innocuous decision by the local government, and like many such municipal waste decisions, Love Canal was a cost saving measure to use the abandoned Love Canal near the Niagara River, Niagara Falls for waste disposal. Between 1942-1953 the local government gave the Love Canal site, a former free municipal waste dump adjacent to the working-class Love Canal neighborhood, to Hooker Chemicals and Plastics Corporation (now Occidental Chemical Corporation, or OXY) to use as a chemical waste dump. Hooker Chemicals and Plastics later sold the site back to a residential builder and the local school board with a codicil in the property deed absolving the company of any future liability. The buried chemical waste leached out via

previously unknown underground swales into the local sewer system and creeks which after hard rains flooded neighborhoods with contaminated water. Louis Gibbs and other parents suspected that the Niagara Falls elementary school playground built over the canal was making children sick and the Love Canal parents used local knowledge to link the swales to illness clusters and the chemical waste dump (Haraway, 1988; Temper et al., 2015). Complaints to New York State officials went unheeded until national media drew attention and caused President Carter to twice declare Love Canal as being in a state of emergency. The Love Canal disaster contributed to public pressure for legislation to make polluters financially responsible for the cleanup of toxic waste sites. The result was the creation of the U.S. environmental justice movement and creation of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (Superfund Law) of 1980 which identifies and remediates contaminated land (U.S. EPA, 2015). Waste disposal permeates almost all critical elements of a healthy modern-day society.

Solid waste disposal practices

This author suggests that there are three identifiable epochs in modern waste practices and beliefs: The Golden Age of Waste, The New Age of Waste, and the tentatively named, Third Industrial Era. These epochs encapsulate the experiences and practices of the solid waste profession since the 1940s when waste practices began to extend beyond the hyper-local community.

The Golden Age of Waste, which extends from about the 1940s to 1980s, shaped the current public and political perception of waste practices as local municipalities built and owned traditional landfills (now considered dumps) following the World War II manufacturing boom. These precursors to modern landfills proved to be profitable enterprises as American waste generation increased by a staggering 65% during the period, reflecting the symbiotic relationship between waste and consumption. Dubbed the ‘disposable age’ by *Time-Life*, companies marketed product packaging and disposable (single-use or one time use) products invented for the war effort to baby-boomers with large economic buying power. Disposable product consumption became a hallmark of modernity in the U.S. and according to the United Nations and World Bank, the biggest waste producer by volume in the world. Despite this increase in waste production, major changes in waste practices did not occur until the early 1980s with the

development of new landfill technologies, the privatization of many waste related industries, the rise of the global market in recyclables, and subsequent implementation of the U.S. solid waste legislation in the face of lax state requirements.

The end of the Golden Age of Waste and the beginning of The New Age is marked by the so-called Garbage Wars: a period of intense change in the solid waste disposal industry. The 1986 Khian Sea Waste Incident and the 1987 Mobro Garbage Barge Incident marked the start of the modern recycling movement. The 1986 Khian Sea waste incident involved a cargo ship, the Khian Sea, which was carrying incinerator ash from the city of Philadelphia (home of one of the U.S. largest incinerators) that was denied entry into Haiti and then several other countries for several months before dumping the hazardous ash cargo into the ocean. The Khian Sea waste incident raised public and official awareness about hazardous waste disposal and led to the adoption of stricter solid waste regulations in many countries, such as the U.S. Resource Conservation and Recovery Act (RCRA). The incident also increased the cost of hazardous waste disposal. In similar vein, Dan Rather called The Mobro 4000 Barge “The most watched load of garbage in the memory of man.” In this incident an Alabama businessman affiliated with Long Island mob boss, Salvatore Avellino, speculated that he could convince a landfill authority on the U.S. east coast or the Caribbean to convert municipal waste to methane without having a prior contract in place or permission from the target municipalities or ports. As with the Khian Sea, the Mobro wandered the Atlantic for months having been denied entrance by Mexico and Belize, before finally returning to New York City and having the waste buried in the same Islip landfill from which it originated. These two incidents, among many others, raised public awareness about the changing geography of solid waste and solid waste policy and the process transformed solid waste disposal from a local to an international and global issue (Brown, 2015; Cosgrove, 2014; EPA, 2003; MSW, 1999; Rogers, 2005; Taylor and Allen, 2006). In 1989, the international community drafted the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal treaty to reduce the flow of hazardous wastes from industrialized countries to developing countries. The convention's mission was to regulate the international transfer of hazardous wastes and to ensure that waste was managed and disposed of in an environmentally sound manner. However, these trade agreements have been problematic U.S. bilateral agreements overlap, contradict, or fail to address such waste issues.

From the New Age of waste onward, the fuzzy nature of waste has been most evident in the legal proceedings of the U.S. Supreme Court, where many solid waste lawsuits have occurred related to the Commerce Clause Article 1, Section 8, Clause 3, of the Constitution that empowers Congress "to regulate Commerce with foreign Nations, and among several States, and with the Indian Tribes." Lawyers consider solid waste cases, such as state disputes, hauler disagreements, renewable energy, pharmaceutical 'take-back' programs, 'bottle bill' recycling laws, brownfield reclamation and others, as being subject to the Commerce Clause. However, "virtually all dormant Commerce Clause challenges involve some difficult knots and hidden nuances" and these are often drawn from local knowledge (Adam, 2014; Gold, 1993).

The 1993 U.S. Municipal Solid Waste Landfill Criteria and the U.S. EPA Integrated Solid Waste (ISW) programs signified the beginning of The New Age of Waste. Although practices from The Golden Age of Waste co-exist alongside the New Age of Waste (1990s-2010s), the latter ushered in an era of globalization in the solid waste disposal industry and the creation of secondary commodity markets. In addition, environmental impact studies increasingly emphasize the need for solid waste regulation. U.S. EPA studies connected the contamination of local hydrological systems to traditional municipal landfills which threatened public health and water resources and led to an emphasis on waste regulation and proper solid waste disposal. Due to stricter and more complex international, federal, state, and local environmental regulations that originated in the 1980s, many municipalities transferred the task of waste disposal, along with the related environmental liability, to private companies. In response to these stricter regulations, small waste companies merged into larger multinational private waste corporations capable of handling all aspects of solid waste disposal including municipal waste hauling, recycling, landfilling, and toxic waste removal. This all-encompassing solution is often called a transboundary linear system of waste management (Cash, 2006; Duany, 2000; EPA, 2003; Goktug, 2014; Klinge, 2007; MSW, 1999; Northrop, 2010; Openshaw et al., 2012; Rogers, 2005; Strasser, 2005; Taylor and Allen, 2006). One unforeseen consequence of these regulations and mergers was the rise of criminal influences within the solid waste industry: "Beginning in the 1980s, globalization and the liberalization of international trade policies made it easier for legitimate entities to conduct business, but it also facilitated the growth of transnational organized crime—all manner of goods, including waste materials, could more easily cross

international borders. More strict environmental laws and regulations concurrently precipitated a steep rise in the costs of safe and legal disposal, and so it was that the perfect storm of conditions created the opportunity for the illicit (and cheaper) dumping of nonhazardous and toxic wastes” (Liddick, 2011, p 13-14).

In 2013, the waste commodities market experienced a worldwide crash which many professionals regard as the beginning of the Third Industrial Era of solid waste. The market share of many waste industries fell precipitously and caused fundamental change in the industry. The worldwide decline began as China, the largest importer of waste commodities, enforced its Green Fence Policy, the first of many subsequent waste import bans that banned the import of several types of waste. The bans were in response to internal Chinese policies to promote investment in domestic recycling facilities and innovation. This action caused many businesses around the world to reduce trash exports in response to the decline in the commodities market. Consequently, sustainable materials management (SMM) was conceived involving the use and reuse of materials in the most productive and sustainable ways across an entire waste product life cycle. SMM emphasized resource conservation, waste reduction, climate change mitigation, and minimizing environmental impact of waste materials (U.S. EPA, 2016).

Historically, solid waste was the responsibility of the individual, but this has over time assumed by local government. The basic waste problem, however, has remained constant throughout history, in that trash originates from a location, a home or business, and a decision is made to bury, burn, stockpile, reuse, incinerate, or illegally dump the trash. John Ehrlichman, President Nixon’s policy chief, expressed the unwritten U.S. policy that “the Federal Government has no business being in the garbage business” and that waste management policy is based on U.S. common law or common practice (Johnson, 2014). Even as trash policy has become more involved, there is a tendency to simplify an inherently complex trash disposal system. Disposal remains a personalized experience and is heavily dependent on local knowledge. The solid waste industry encompasses many political, technological, service, and environmental activities that transcend the local and involves multiple government agencies and policies, differing disposal needs, and the reality of varying spatial and trans-boundary issues. Added to these elements are the many constituents, actors, and actions that make up small ‘p’ policy. Many

private companies, associations, and organizations in the waste disposal system operate under a system of best practices rather than one of regulation. This is especially true concerning municipal solid waste. In 2015, The American Society of Civil Engineers (ASCE) wrote Policy Statement 516 Municipal Solid Waste Management, which was approved by the Federal Energy, Environment, and Water Policy Committee. The policy asserts that the ASCE supported federal and state legislation to promote, enhance, and facilitate development of resource recovery facilities, including those for recycling, composting, energy recovery, and waste reduction technologies. for the reduction of waste generation. The ASCE also indicated support for the US Environmental Protection Agency's Resource Conservation Challenge (RCC) strategic plan which sought to achieve a national recycling rate of 35% for municipal solid waste. The RCC promoted the beneficial use of secondary materials, and toxic chemical reduction, along with the reuse and recycling of electronic devices. However, the ACSE opposed federal legislation that would ban the interstate movement of municipal solid waste to regional solid waste facilities even though designed under state and federal regulations because many private waste services had invested in transboundary, linear waste systems that would be severely impacted.

Jurisdictions and autonomous waste disposal

For many municipalities, waste management implementation is often problematic because municipal waste practices and regulatory policies can conflict at the municipal, state, and federal levels. Berman (2015) found that such conflicts between local and state government often had historical roots in legal, political, and intergovernmental politics. Thrift (1983) suggested that political outcomes are usually place-specific because knowledge is interpreted through the varying contexts of institutional memory, local knowledge, and traditions. Some states create constitutional amendments giving specific municipalities home rule and the authority to pass their own laws and procedures for trash removal. In the U.S., two types of home rule give governmental groups, county commissions or board of supervisors, jurisdiction over unincorporated areas including important zoning issues. Dillon's Rule (1868) upholds a narrower interpretation of a local government's authority, whereby a local government may engage in an activity only if it is specifically sanctioned by the state government. Unlike home rule, which gives greater authority to substate municipalities, Dillon's Rule is sometimes used by states that want to give municipalities limited home rule to determine the bounds of its authority (Berman,

2015; Silva et al., 2015; Povich, 2021; Thrift, 1983). Approaches to the waste system certainly differ between urban and rural areas, but even within urban areas these policies vary markedly. Denmark, for example, “provides more frequent waste collections for more densely populated areas and provides customized infrastructure for those in flatted accommodation while in Seattle, targets for recycling and composting are lower for residents of flatted accommodation.” (Fogarty, H. et al., 2008).

Local Waste Disposal strategies

The most studied form of waste, although not the largest in quantity, is municipal solid waste (MSW), known as trash or garbage, which comprises everyday household items such as product packaging, grass clippings, furniture, clothing, bottles, food scraps, newspapers, appliances, paint, and batteries. Municipal solid waste originates from homes, schools, and local businesses. All municipal solid waste management comprises the same choices of either disposal through internal or external management systems. Handling solid waste internally gives municipalities greater control over what is collected and where the trash is disposed. In some instances, it can also reduce budget costs by using construction debris as clean fill on municipal projects, for example. Municipalities are then free from profit-making pressure or paying taxes on profits. However, internal waste management can be cost prohibitive in terms of personnel and equipment, as well as being logistically difficult to operationalize or sustain. A municipality can contract waste management control to external private service providers. This option is often chosen by densely populated municipalities because private contracts typically require less personnel and can be cost-effective. The waste, however, can only be managed in specific ways determined by the service provider such as by collecting, hauling, incinerating, recycling, or landfilling. When localities create bonds based on revenue from recycled materials, waste-to-energy (WTE) production, or other waste generated resources, it often requires a steady flow of revenue for the life of the bond (Gold, 1993). Municipalities, states, and interstate regions often try to increase correct disposal by creating economic incentives for recycling, establishing fines for not recycling or littering, or promoting public education on proper disposal. However, while financial motives may provide a strong incentive for recycling in many municipalities, when market prices fall, many local authorities stop recycling. Tucker (2011) posits that every locale

has jurisdictional problems with public services, which tend to have overlapping and often conflicting jurisdictions shaped by geography and local history.

In the past, many individuals have dealt with trash by throwing it over the hill into valleys, dumping it into or near flood plains where it could be carried away, dumping it into karst hollows or caves in the ground, or disposing of it in other hidden from sight areas. While no longer considered appropriate solid waste management, these are still common ways for residents and companies to dispose of unwanted trash. The U.S. EPA created a waste ranking of the most desirable management methods which include cleaner production, sustainable consumption, and prevention methods for reusing waste in its current form (reduction and reuse), processing waste to recover commercially valuable products (recycling/composting), and the least desirable method of safe disposal in a landfill (residuals). Of these options, landfilling remains one of the most feasible and commonly practiced methods of waste disposal for most areas in the U.S.

Solid waste professionals differentiate between a historic landfill or ‘dump’, usually a hole in the ground where waste had been essentially dumped, and a landfill, which is an engineered and correct means of waste disposal. The public, even those who live near landfills, often believe their waste goes to a ‘dump’. Confusion about dumps versus landfills occurs so often that landfills are often labeled ‘dumps’ for clarity in online and phone directories. However, dumps are banned by federal regulation because of the consequences that arise from the waste dumped, regardless of waste type. Legacy waste sites, especially of hazardous waste, are often unrecorded and as with brownfield sites require special handling to identify and mitigate potential dangers (Colten, 1990; DeSousa, 2005). In the case of above ground and underground tanks the U.S. EPA Solid Waste Management Act maintains regulatory power. The water contamination of the Elk River in West Virginia on January 9, 2014 is indicative of the need for special jurisdiction over such abandoned waste. The transition from dumps to current closed-system landfills was challenging for many because U.S. federal law regulates closed landfills as brownfield sites requiring cost-prohibitive remediation for subsequent uses. Landfills that have been closed have also become a growing problem because competition for land has led to construction on former dumps that are unmapped or forgotten. The U.S. EPA Hazardous and

Solid Waste Amendments of 1984 (HSWA) revised the criteria for landfills which receive hazardous household waste or small quantities of industrial hazardous waste. As new materials and waste by-products are created, the HSWA modifies its policies and disposal methods. To reduce landfill disposal and transportation costs, for example, municipalities now give away wastewater sewage sludge to farmers as cheap crop fertilizer. Until recently, this practice was considered to have an innocuous impact on areas and local waterways until the sludge was found to contain residue from medications and heavy metals (Kaufmann, 2014; Taylor and Allen, 2006; Thompson, 2009).

Incineration is often an alternative to landfills and is used to burn municipal waste. These plants have come under strict regulation, however, due to emissions containing carcinogens, heavy metals, and other particulates. Incinerators are typically located outside suburban areas but in low-income areas which place low-income households and minorities at risk (Melosi, 2005). Waste-to-Energy (WTE) uses waste incineration to create energy through heat. However, the large volume of trash needed for WTE requires a densely populated area to supply the necessary quantity of waste and this can often cross several municipalities or even states.

Recycling is a rapidly growing alternative to landfill disposal and is often the first environmental civic act that parents and children do together. Every municipal or private recycling service, whether curbside or drop-off, has its own rules about what can be recycled. In the Institute of Scrap Recycling Industries (ISRI) poll, 28% of recyclers said the recycling challenge was "understanding what types of plastic my municipality accepts in their curbside recycling program." (ISRI, 2018). Some recycling services take plastic bags, but many do not. A few take Styrofoam, but the majority do not. It is important for residents to know and practice the rules to avoid contaminating the recycling stream.

The link between energy extraction and recycling is often overlooked, even though the by-products of energy extraction are used to create materials like plastic and synthetic rubber that are recyclable. Plastic exemplifies this relationship. A 2013 *Nature* article summed up the characterization of plastics as solid waste with its title "Policy: Classify plastic waste as hazardous" to give environmental authorities greater power to counter its impact on people and the environment (Rochman et al., 2013).

The 'dormant' Commerce Clause has become a way for the waste industry to compete by challenging laws involving recycling, landfill, and incinerator waste reduction, or those that impact the importation of waste. Some states do not use federal regulation to deter the import of large volumes of waste from waste-exporting states such as New York. Rural states with lower disposal rates and low-cost land, such as those in Appalachia and the Midwest, are considered more attractive for landfills and incinerators than those areas with higher property costs such as Massachusetts. Pennsylvania is a top waste importer though in 2015, U.S. Senator Bob Casey (D-PA) introduced the Trash Reduction and Sensible Handling Act (TRASH) to restrict the flow of out-of-state waste into Pennsylvania and impose higher fees for disposal. In 2014, the state accepted waste from 21 states, the District of Columbia, and Puerto Rico. New Jersey sent the most, 3.5 million tons (Arosova et al., 2008; Breitenbucher, 1997; Kimmel, et al., 2014; Harper, 1991; Heinzerling, 1995; U.S. EPA, 2015; UN Basel. int, 2015).

The culmination of educational campaigns and outreach is that many municipalities, universities, and some countries such as Sweden, have adopted the goal of zero waste. However, unlike companies which have centralized control, the flow of waste in and out of an area is more difficult to regulate or implement, making the recycling or reuse of all items unachievable (Kurdve et al., 2015; Mann, 2015; Kondo et al., 2014).

Finally, there exist a growing number of alternative means for dealing with waste, especially non-municipal waste. These include tire collection events, non-profit runs, thrift stores, for-profit consignment shops, church rummage sales, and other non-profit collections such as textile or aluminium can drives. Informal waste sector activities even include dumpster diving and trash picking in the search for sellable or reusable items. The evolution of the Maker Movement and the emergence of online stores such as eBay and Etsy have shifted the informal waste sector into the mainstream with upcyclers and others competing with traditional pickers, often the homeless and poor (Peppler and Bender, 2013). Pre-cycling, is the preferred method for integrated solid waste management by the U.S. EPA because it addresses the creation of waste at source before it is purchased but involves implicit judgments over modes of consumption (MacLennan and Stiller, 2012).

The solid waste industry is thus complex and varied in the stakeholders involved. The spatial narratives associated with the case study of Monongalia County, WV reveal further complexities about the spatial nature of the solid waste system.

Chapter 5 The WV solid waste system and policy framework

Policy at the macro level, the Big P, provides the framework around which the regulatory system operates on a daily basis, small p policy. The solid waste challenges faced by West Virginia reflect many of the issues and evolving problems associated with trash and trash transportation. In seeking to create an exemplar geospatial policy-shed system for Monongalia County in West Virginia it is necessary to narrow the policy framework to the state and county level and from there develop and codify the hundreds of laws, regulations and best practices associated with solid waste disposal and that apply to what is a surprisingly large and varied number of spatial units. Subsequently, this codified regulatory structure is geospatially mapped as policy-sheds that display a spatially defined regulatory system for solid waste that illustrates not only the spatial complexity of the system but areas of omission and commission and conflicting regulatory protocols.

The West Virginia solid waste system

As a rural state, formal waste services in West Virginia came later than in many other states in the U.S. and many households and businesses used non-documentable disposal methods. In response to domestic pressure to establish correct waste disposal approaches in West Virginia and the need to satisfy the 1976 Resource Conservation and Recovery Act and associated regulations, the state created the first official solid waste management organization. The Resource Recovery-Solid Waste Disposal Authority was established in the Department of Health and later became the Solid Waste Management Board (SWMB). The SWMB later became part of the Department of Environmental Protection and sought to eliminate dumped car and appliance sites and instituted the daily covering of landfills with soil. Until 1992 no official statistics concerning solid waste in West Virginia are available but in that year the first waste study undertaken on the *Feasibility of Volume-based Collection Fees for Private Waste Hauler* (Ackennan, Breslow, Samuels, 1992). The study was conducted by the Boston-based Tellus Institute, an environmental resources strategy non-profit, in partnership with the West Virginia Public Service Commission (WVPSC), West Virginia Solid Waste Management Board

(WVSWMB), and the West Virginia Development Office (WVDO). With the intent to create an economically sound waste practice for the state, the study found that multiple definitions of waste were in use in the state which had contributed to significant variation in solid waste estimates. Even after implementing labor-intensive manual waste audits to fortify the study, the relative scarcity of state-specific information coupled with omissions due to exempted cities not subject to WVPSC regulation, impeded any actionable strategy being implemented for West Virginia solid waste. The report ultimately concluded that local communities were best able to determine how to meet local needs albeit such actions might impact adjacent areas. It was determined that the state Public Service Commission (PSC) would implement the checks and balances for the 'system' and resolve any such conflicts (Problems Associated with the Management of Solid Wastes: Is there a Solution in the Offing?, 83 W. VA. L. REV. 131, 137, 1980; WV Feasibility Study, 1992).

In 1995, a report made to the State of West Virginia examined the economic costs of Intermediate Resource Recovery Facilities (IRRF) based on an analysis of waste data garnered through landfill audits. The study found that waste in West Virginia consisted of a dozen major categories each linked to a specific end-use industry and waste cycle. These categories comprised paper (25%), plant material (vegetation) debris (25%), wood (10%), plastics (7%), glass (5%), metals (5%), reusable goods (5%), putrescible (food waste/compostable) (5%), ceramics (5%), textiles (3%), soil (3%), and chemicals (2%) (Gorell, Evans, Diener; 1995). These categories, however, did not specifically identify electronic waste (E-waste), specialized wastes such as household hazardous waste (HHW), low-level radioactive waste, prescription and medical waste, or industrial waste such as fracking waste.

In 1997, a comprehensive waste characterization study by the WVSWMB indicated that the average per capita waste generated in West Virginia was 4 pounds per person per day, noticeably less than the EPA national average (EPA, 2015). However, despite attempts to collect data according to EPA standards, the WVSWMB waste characterization report concluded that the lack of a reliable reporting system encompassing all waste including recyclables and non-MSW waste made it difficult to accurately determine waste data for the state. In 2015, some 1,189,021 tons of classified municipal waste was recorded as being deposited in 18 landfills, but a further

810,727 tons of ‘special’ waste, such as industrial sludge, petroleum contaminated soil, industrial waste, drilling waste, and construction and demolition waste was also deposited in landfills (WVSWMB, 1997; WVSWMB, 2015). In West Virginia specialized waste from coal and gas processing are unclassified because they are treated as a useable by-product even if most of the waste goes to landfills. Reliance on the self-reporting of waste further exasperates data collection and waste classification (WV Feasibility Study, 1992). In addition, the waste arising from small-business, home-businesses, and micro-businesses with less than five employees, which account for almost 90% of West Virginia businesses, are absent from almost all U.S. data analysis (MacLennan and Stiller, 2015).

Despite the lack of reliable waste data, it is suggested that West Virginia experienced the three epochs of solid waste management albeit shaped by its unique geography, history, industry, and land-uses. Until recently, what was considered waste in other regions was not typically considered as waste in West Virginia (Ackennan, Breslow, Samuels, 1992; Jackson et al., 2008). The state has many isolated communities where materials are repurposed and taken out of the waste stream. Thus, scrap metal, tires, and industrial waste are often repurposed and private recyclers and independent small waste haulers such as scrap metal merchants, self-provisioners, tinkers, and others play an important but often unnoticed role in ‘waste disposal’.

Many West Virginia solid waste practices stem from the state’s resource extraction and manufacturing past. Company towns, for example, acted as the de facto local government and established waste practices that were often based on ‘gentleman’s’ agreements and these continue today. In the 1920s some 80% of West Virginia miners lived in company owned houses though company towns were also based on glass, metal, and chemical industries. Over past decades, municipal and industrial waste dumpsites filled entire valleys and many are unmapped. In 1970, for example, Senator Robert C. Byrd wrote in his ‘Byrd’s-Eye View’ about his concern for the mountains of trash and the numerous trash dumps. Instances of such past dumpsites continue to cause problems such as when a former battery dumpsite caught fire when acres of tires dumped by haulers caught fire and caused an emergency situation as black smoke particulate settled in the D.C. area. Uncontrolled open dumps are a recognized problem in West Virginia and affect both public and private property values and land use. The decline of the extraction economy, however, has caused many of these company towns to decline leaving local government and waste agreements in a legacy limbo. Company town culture could be said to

remain engrained in municipal and state solid waste law. One example of this engrained company town culture are the community expectations that have grown out of past practices such as the landfill ‘Free Day’. Free days are a West Virginia tradition whereby residents, “not in the business of hauling or disposing of solid waste”, can dispose of solid waste for free at certain solid waste landfills though not at transfer stations (W. Va. Code § 22-15-7). Many municipalities and landfills have considered imposing limits on the ‘Free Day’ but have incurred significant resident opposition who consider it a ‘common good’. In 2016, the private Raleigh County Landfill counted upwards of 1,000 vehicles on such a free day.

Some counties now have transfer stations instead of landfills and independent haulers and family businesses, which West Virginia’s Small and Independent Hauler Association believe personify West Virginia’s can-do heritage, undertake the role of solid waste removal. Many independent haulers have updated their practices and equipment to stay competitive in the midst of clients unwilling to see fees increase from past historic low rates. One hauler family business created a makeshift transfer station in their barns and outbuildings before transferring the waste to a near landfill facility. However, the area became a dumpsite and it took a 15 year joint effort between state organizations including the EPA, the Department of Environmental Protection (DEP), the Pollution Prevention and Open Dump Program (PPOD), the Monongalia County Commission, and Monongalia County Public Health to remediate the property and the uncooperative elderly owner was fined and incarcerated. Ultimately, the agencies paid for what had become a brownfield site to be cleaned-up but despite the dump site’s impact on health, safety, and property values, some residents still felt the punishment was arbitrary and harsh for a family business that had provided consistent service over the decades. Modern waste disposal requires a paradigm shift in waste behavior, but local community viewpoints on waste disposal can vary and diverge from official norms and long-established practices such as trash burning linger on. Such cultural traits and behavior concerning trash is reflected in West Virginia which with Washington are the only states that regulate solid waste as a utility through a state Public Service Commission (PSC) with established hauling territories assigned to PSC-certified haulers. Residents do not have to use waste services by law but do need to provide proof of correct disposal. Part of this approach can be seen in the rural economics of solid waste disposal. Thompson (2015) reported that, “West Virginia did not have even the protection of landfills. Much of the state did not even have access to regular solid waste collection services. Because a

sustainable waste business relies on trash volume, high population density, and low travel costs, West Virginia, a low-density, mountainous state, was not profitable for many haulers who focused on population dense WV cities with calculable waste”. West Virginia became the only state with a comprehensive regulation of solid waste landfills to ensure public access. Aspects of the management of solid waste was divided among several state agencies including the Department of Environmental Protection, the Public Service Commission, and the Solid Waste Management Board. In many West Virginia counties, solid waste authorities, litter control officers, and landfills were also established. The WVDEP monitors industry and communal impacts, mine water run-off, illegal dump clean-ups, the Governor’s REAP (Rehabilitation Environmental Action Plan) program, and the State Recycling Coordinator’s office. The WWSWMB coordinates with county and regional solid waste authorities to provide planning help, solid waste management grants, and solid waste disposal revenue bonds. The WWSWMB is responsible for the *West Virginia Solid Waste Management Plan*.

Waste management in West Virginia is based on wastesheds as mandated under the Federal EPA Resource Conservation and Recovery Act of 1976 (RCRA) (Figure 5.1) and similar to the concept of watersheds (Figure 5.2). The RCRA wastesheds empower state and local authorities to qualify for federal aid. The West Virginia Resource Recovery - Solid Waste Disposal Authority, now the WWSWMB, defined wastesheds based on geographic regions with similar demographic characteristics in order to promote shared best practices and management practices (W. Va. Code § 22C-3-9). Since its inception, the WWSWMB has maintained monthly municipal solid waste tonnage estimations based on these wastesheds. This process has given them on-the-ground insight into the operation of waste management and its recording. In some states such as Oregon, wastesheds are defined based on county boundaries, whereas because accurate waste characterization depends on population density, states like West Virginia created wasteshed regions. These artificial regions are effectively static, irrespective of changing population characteristics. However, wastesheds rarely serve other administrative uses beyond waste management. The American Society for Testing and Materials (ASTM) D 5231-92 waste composition analysis protocol is used to measure municipal solid waste (Bobman and Culbertson, 2010). ASTM International is a for-profit company that establishes voluntary reporting standards. Wastesheds have become the de facto method for settling waste disputes and are used in legal disputes brought before the WV Public Service Commission. As

artificially defined units, watersheds can be problematic not least because they do not transcend state lines (McGowen, 2015).

Figure 5.1: West Virginia Watershed Map Source: 2016 WVSWMB Report

Figure 5.2: West Virginia Watershed Map Source: WV DEP

West Virginia solid waste disposal practices

The WVPSC has statutory authority over solid waste such as flow control and can direct where solid waste “generated in the surrounding geographical area of a solid waste facility be processed or disposed of at a designated solid waste facility or facilities” (W. Va. Code§24-2-1h). However, even this designation caused concern for the WWSWMB because solid waste management in the state requires the ability to predict the movement of solid waste into or out of the state, “This ruling has impacted the solid waste market in areas adjacent to West Virginia borders, resulting in greater exports of solid waste by out-of-state haulers, and a resulting loss of market-share by certified local haulers and disposal facilities. This trend has had a negative impact on the collection of solid waste assessment fees and on the revenue of local disposal facilities and has consequently generated interest in implementing flow control in some areas to require local waste be disposed of at local facilities” (WWSWMB, 2016). The WWSWMB promoted an integrated solid waste management plan though there are numerous instances where solid waste was and is treated in isolation with seeming exceptions to an integrated solid waste infrastructure. One local example would be the case of a large shopping center in

Morgantown, WV, for which waste collection was not planned or implemented until after the stores were in operation and when access roads had to be built retroactively for trash trucks to access the buildings (MacLennan and Bergeron, 2014).

For most local solid waste authorities in West Virginia the primary concern is acquiring and permitting sufficient land for a landfill or transfer station to be created. Disputes with surrounding neighborhoods are common. Supporting these landfills are a myriad hauler companies that collect and dispose of the municipal waste and whose routes are regulated as a public utility. The WVPSC uses established route tariffs to assign territories to solid waste haulers. These route tariffs, however, exist only in text form and no maps have been or are produced for these territories (MacLennan and Bergeron, 2012). Often, these tariffs can be confusing because territory in one tariff area will overlap with another hauler's territory particularly when one hauler might cover residential areas while another covers business waste for the same area. Competition for hauler territories is fierce and the most common formal complaint to the WVPSC involves territorial disputes and permits. Many lawsuits are between large mega-hauler companies, such as Republic Services of West Virginia, and other haulers or waste organizations. The relationship between the WVPSC defining hauler territories and transportation routes even when awarded by the WVPSC are problematic. MacLennan and Bergeron (2012) sought to translate the narrative-based tariffs into an accurate GIS data layer for a small town in north-central West Virginia but were confronted by a lack of detail in the older tariffs and the use of boundary conventions that had changed. In contrast, more recent tariffs issued to larger companies are more detailed and give more specific locational information on territory boundaries (Figures 5.3 and Figures 5.4). Further, while the WVPSC tariffs are a matter of public record, most solid waste haulers are reluctant to make customer lists available to solid waste authorities, even though this is an annual requirement of the WVPSC. Knowledge of hauler routes is integral to the value of a competitive waste company.

Figure 5.3: Preliminary hauler boundaries Source: (MacLennan and Bergeron, 2012)

Figure 5.4: Monongalia hauler route data Source: MacLennan and Bergeron, 2012

West Virginia and the Garbage Wars

While the focal point of this chapter is on the solid waste framework of West Virginia itself it would be remiss to treat the state as an isolated island immune from trends in the solid waste industry and the actions of its five surrounding states. Royte's (1992) article *Other People's Garbage*, published in *Harper's Magazine*, sparked national and international interest into West Virginia's central role in the so-called transboundary Garbage Wars. Royte wrote about following the route her own trash took from New York City to McDowell County, WV:

"At the end of Lower Shannon Branch, a dirt road that winds for six miles through West Virginia's hill country, there sits a vast, bowl-shaped hollow, its sides carpeted with 6,000 acres of second-growth hardwood trees. This particular piece of land holds little attraction for most people in rural McDowell County. It's not especially scenic—it looks like a thousand other wooded hollows in southern Appalachia that were first timbered and then mined. But the valley's ordinariness and resolute quiet belie a brewing national storm. Like many out-of-the-way sites in poor, rural communities across America, this hollow is considered by some an ideal place to dump the disposable diapers, orange rinds, Coca-Cola bottles, and chicken bones of several million people who live very far away. The scarred hillsides of this valley provide a good vantage point from which to view the nation's garbage wars," (Royte, 1992 p.42).

The importation of waste from outside the state, whether viewed as economic opportunity, industry competition, or exploitation (particularly of economically disadvantaged regions), is highly contentious and not only in West Virginia. Some West Virginia municipalities and landfills wrote flow control regulations to curb the importation of waste from other states, but in 1998, 2006, and again in 2009 a federal judge held that it was unconstitutional to discriminate against the importation and disposal of waste from other states under the U.S. Constitution's Dormant Commerce Clause. West Virginia statutes used flow control practice to impose a monthly limit on the amount of imported waste that could be handled at state solid waste facilities. A central legal outcome of the Dormant Clause was the Stamp Decision and the determination that the West Virginia solid waste statutes tonnage caps were unconstitutional because again they discriminated against out-of-state waste entities. In 1998, West Virginia amended the law (WV law S.B. 178) to keep tonnage caps in place and to maintain WVDEP

jurisdiction over tonnage limits for each solid waste facility. Class B waste facilities under the control of local solid waste authorities were redefined as Class A waste facilities under the jurisdiction of county commissions. Valero Terrestrial Corp and others contested sections of the West Virginia Landfill Closure Act enabling revenue to be collected in the “Closure Cost Assistance Fund” claiming it was unconstitutional because it violated the U.S. Commerce Clause and Valero’s due process rights. West Virginia’s Landfill Closure Assistance Program provides funds for landfills that do not meet environmental criteria set by the U.S. EPA to prevent groundwater contamination. The case lacked subject jurisdiction under the Tax Injunction Act because the West Virginia legislature imposed the landfill closure cost (and not an administrative agency), a charge imposed on anyone disposing of waste into a landfill and hence paid for by the service collection fee incurred by state citizens and businesses. Tensions escalated as West Virginia haulers and landfill owners met state standards for waste disposal that were not required for out-of-state haulers. In 2006 and again in 2011 entities such as the WV Solid Waste Hauling and Recycling Association went to court to demand out-of-state haulers be required to adhere to the same regulations. However, in 2009 WV Senate Bill 641 required the operator-driver of every solid waste motor carrier who deposited solid waste in a commercial landfill or transfer station to give written declaration, under oath, of the county and state of origin of the solid waste so disposed.

Yet not all are opposed to such import control. In 2011, Tucker County Solid Waste Authority (TCSWA) petitioned the state for municipal waste from Preston, Randolph, and Tucker counties to be disposed of at the TCSWA landfill because competition from out-of-state disposal facilities in nearby states had led to a 40% decline in the solid waste it received. The WVPSC dismissed the case as discriminatory, protectionist, and damaging to interstate commerce. In McDowell County, where the Garbage Wars captured the world’s attention, the garbage dump has become one of the few economic development opportunities in one of the poorest counties in the U.S. The Copper Ridge Landfill Class A facility managed by Enviro Solutions, Inc., is permitted to accept up to 50,000 tons of waste per month and still receives trash from New York City via double-decker trash cars on a high-speed rail line.. Indeed, out-of-state source waste generators paid to change the height of the rail infrastructure and rail tunnels along the route. In 2015 New York City implemented a zero-waste plan for the city that

requires internal disposal and treatment of trash by the year 2030. While the Garbage Wars have lost public attention, the controversy over transboundary garbage rights in West Virginia has never ceased and was recently reignited by plans to import low-radioactive medical waste, fracking waste, and nuclear waste (Arosova et al., 2008; Breitenbucher, 1997; Brglez, 2003, pp. 26; Kimmel et al., 2014).

While the garbage wars may have diminished, the secondary commodities market in which West Virginia had become a competitive force in the global waste market has created its own issues. During the boom years of the secondary waste commodity market, West Virginia was an aggressive participant in waste recycling and many small, independent waste haulers in relatively population dense areas sold their companies to larger waste companies, such as the sale of BFI-Waste to Republic in North Central West Virginia, and new haulers emerged. The secondary commodities market plummeted in 2013 largely because of China's Green Wall program and much of West Virginia's solid waste recycling program was thrown into turmoil. Not least these market losses were compounded because some municipalities and businesses had based their business model on cost savings achieved from not having to pay landfill fees (Pew, 2016). In Monongalia County WV, for example, the recycling center was closed and yet communities expected recycling collection to continue. Because incineration and waste-to-energy-plants are not permitted in West Virginia to limit competition with coal-fired power plants, much of this recycling, trash, and contaminated commodities is sent to a waste-to-energy plant in Pittsburgh (incidentally also a reason why cremation services must take place outside West Virginia). These events and the discontinuation of recycling services for many West Virginia counties points to the close link between local waste disposal and the national-global arena. Embedded, of course, within this solid waste scenario are the laws, statutes, regulations, and rules that determine what happens to differentiated solid waste materials in differing places throughout the state.

Chapter 6 Mapping public policy regulation

Solid waste policy and its regulatory framework is complicated by its multiscale nature and the need to grapple with macro-level national and international policy, the Big P, alongside the local, small p, and to do this for multiple organizations and agencies, if not individuals (De Man, 2007; Mellouli et al., 2009; Nelson and Brewer, 2015; SciDev. Net, 2017; Wang et al., 2016). These policy structures are not necessarily hierarchical but can intertwine multiple jurisdictions at a variety of scales (Kidd, 2007; Stead and Meijers, 2009; Zorica and Nedovic-Budic, 2016). Mapped representations of the solid waste industry are rare, and that even applies to the hauler routes which if mapped are proprietary or the routes are handed on by word-of-mouth. The regulatory rubric may define to which the regulation applies and even then this will be in text form buried in the ruling. At best, any mapping arising from monothetic studies have tended to focus on specific policies and their spatial representations (Nelson and Brewer, 2015). Despite the everyday grounded experiences of the many people involved in solid waste disposal, representing the spatial dimensions of related policies and regulations is highly problematic. Complexity arises not only from the need to derive the entirety of the regulatory and statutory components of the solid waste system embedded deep in statutes, legal documents, and agreements, but also determine and assign the underlying spatial dimensions of those regulations. Irregularities in the spatial disposition of a policy itself, gaps in the policy life cycle, and overlapping jurisdictions conspire to further complicate the spatiality of the solid waste system. Furthermore, some parts of the solid waste system are not recorded in formal regulatory code but are unwritten practices of everyday solid waste collection and disposal that have arisen over the course of generations. The spatial component of solid waste policy and the identification of the locations to which these rules apply is like the proverbial black hole and essentially leads to an aspatial solid waste unbeknownst to anyone except for those directly involved in that particular part of the system. A disconnect exists that often obscures public policy as understood and public policy as enacted. Certainly, as related to solid waste disposal this is exacerbated by spatial coping mechanisms that are used and which are often based on historical precedence and legacy boundaries. This is problematic and perhaps a surprise that such a scenario has not prompted earlier solutions not least because of the growing magnitude and extent of policy statutes and

regulations (Cash et al., 2006; Cundell and Fabricius, 2009; Gibson et al., 2000; Mitchell, 2003; Thrift, 2010).

A major challenge then to spatializing policy is how to capture and portray the spatial dimensions of a complex regulatory environment which operates at multiple scales. Currently no discernible spatial framework for use in public policy can be found (Cash et al., 2006; Martin, 2001; Nelson and Brewer, 2015; Wang et al., 2016). However, several researchers have attempted to capture some elements of the waste industry that include the Waste Atlas, the Hauler Map, and the Digital Star City. The following chapter discusses the conceptual basis for policy-sheds as proposed in this study.

The Waste Atlas: a crowd-sourced GIS

GIS has considerable power in spatializing information and its use in mapping the trash industry would seem to have considerable appeal to display the spatiality of the system, and its patterns, relationships, and governance. The *Waste Atlas*, is an interactive map that is based on nationally reported official data and on self-reported data collected worldwide. It is the only extensive source of waste data available worldwide and is used by professionals, government, scholars, and urban planners. As it also addresses solid waste in the context of public health, it is a primary source referenced by municipalities during the creation of their waste disposal plans. It has also been recently used as a source to create future scenarios of global waste generation and disposal (Lebreton and Andrady, 2019); to create an integrated approach to e-waste management for developing countries (Ikhlayel, 2018); to analyze the solid waste economy in Colombia and Latin America (Rua-Restrepo, Echeverri, and Colorado; 2019); and to demonstrate that the lack of data in decision making impacts the circular economy at the city scale (Owen and Liddell; 2016).

Yet, while the *Waste Atlas* provides a large and readily available worldwide map of waste generation it is nonetheless limited and flawed, and these limits are openly acknowledged by the *Waste Atlas*. There is considerable underreporting, and many gaps exist in the coverage of the Atlas, perhaps surprisingly including the generally data centric U.S. Further, its reliance on the aggregation of data into large areal units is unhelpful in examining the solid waste system (Waste Atlas, 2019; U.S. EPA, 2019).

Figure 6.1 is indicative of the map product achievable through *Waste Atlas* showing layers of country data (blue marker) and revealing the density of data available for regions of the world. The sparsity of data for the United States, Canada, and Eastern Europe, for example, is notable.

Figure 6.1: Waste Atlas Country and City Data

Figure 6.2 displays city dumpsites populated from federally mandated data reporting data for sanitary landfills (yellow markers). Further, the Atlas draws upon many national and international datasets of physical, demographic, social, economic, and environmental phenomenon to provide a context for solid waste reporting.

Figure 6.2: Waste Atlas Map of Sanitary Landfills

Hauler Maps

Hauler maps, when they can be found, root the solid waste industry to the locations from which municipal waste is collected and to the landfills or transfer stations to which the waste is subsequently disposed. The WVPSC is tasked with establishing hauler route tariffs that are assigned to business, residential, and municipal solid waste hauler territories (PSC § 150-9). The WVPSC requires no maps for tariff filing, nor are they provided by the PSC when the tariff is approved. These route tariffs exist only in narrative form with boundary information provided only in descriptive text terms. Figures 6.3 and 6.4 are copies of old hauler and tariff maps created for Monongalia County, WV by a hired contractor and consist of hauler routes denoted by color pencil with appended type written tariffs. The territories are explicitly stated as not being to scale or accurate but are for descriptive purposes only. While seemingly bounded, the interpretation of quadrants, radii, or even neighborhoods and businesses is largely left to the interpretation of the hauler. Hauler and tariff maps such as these are rarely found.

Figure 6.3: Pencil map of tariffs for Monongalia County (green)

Figure 6.4: Typewritten caption of a tariff

Mapping these tariff descriptions, as undertaken by this author, revealed more about the map analyst's interpretations of territory, fuzzy boundaries, overlapping areas, and conflicting territories than what the map in reality might appear to suggest (MacLennan and Bergeron,

2013). What the author's study indicated using participatory geography is that most hauler territory maps and the actual area covered by each waste hauler are based on local knowledge and exist more as mental maps maintained by the crews involved in the day-to-day process of solid waste collection. The retirement or death of long-time workers and deteriorating paper records can cause significant disruption to this operation. Capturing such spatial information for ingestion into a GIS requires extensive communication between the GIS operator and the hauler crews.

Turnkey GIS mapping initiatives

In some few instances turnkey GIS mapping has been undertaken and the topological and analytical power of GIS has been coupled to the mapping component. In the GIS study undertaken by this author a geodatabase schema was created capable of accommodating federal data comprising open dump sites, landfills (open and closed), EPA registered facilities, National Pollutant Discharge Elimination System (NPDES), along with state, and locally collected solid waste data for a community (Figure 6.5) (MacLennan and Bergeron, 2013). In addition, administrative units, hydrography, transportation networks, community demographics, recycling drop-offs, and environmental features are included to provide much needed contextualization for subsequent analysis. The study came across many of the issues previously noted about data pertaining to the solid waste system in the form of under-reporting, incomplete waste and dumping sites, duplication, and overlapping areas. Certain feature layers, such as recycling drop-off locations, changed often and in some instances were not recorded at all. Waste hauler routes and service addresses are not available in a usable spatial format.

Figure 6.5: Solid Waste Planning and Transportation: Challenges in implementing GIS in rural areas(Stiller, MacLennan, and Bergeron, Monongalia County Solid Waste Authority).

The importance of having transportation networks included in the GIS became very evident when waste hauler territories and tariffs taken from textual descriptions were digitized and ingested into the GIS. Even here the available 1:24,000 scale transportation network had to be expanded to determine streets and roads that were unrecorded but fell within hauler territories, along with a service address layer. Marrying WVPSC tariffs to hauler defined territories was a challenge, especially if service address owner names were to be protected for privacy purposes.

Figure 6.6 represents a waste hauler territory polygon produced through the turnkey system based on the WVPSC description which states, “those points and places in Marion County, east of I-79, that are located within a radius of five (5) miles of the intersection between I- 79 and W Va. Route 310.” This nebulous description is then followed by exemptions that state, “excluding

Figure 6.6: Initial Tariff Description

the following points and places: (a) those points and places that are located to the east of Little Creek; (b) those points and places that are located to the north of Marion County Route 76 ”.

The amended map is shown in Figure 6.7 and Figure 6.8. The actual hauler territory for the tariff as described is not a contiguous area as assumed but in the precise details reveals a history of spatial relationships that encompass Big P and small p policies in action (Figure 6.9). The challenges involved in pursuing such mapping for the state, region, or United States becomes very apparent.

Generating a waste hauler territory polygon - example

"excluding the following points and places: (a) those points and places that are located to the east of Little Creek; (b) those points and places that are located to the north of Marion County Route 76; "

Figure 6.7: Exemptions to hauler tariff Source: Sue Bergeron

Figure 6.8: Final polygon after all exclusions applied

After all exclusions enumerated in the textual description were applied, the remaining polygons represent the waste hauler territory as described in the tariff

Figure 6.9: Complete waste hauler territory GIS layer Source: Sue Bergeron

Figure 6.10: Waste Hauler Streets

Figure 6.11: Waste Hauler Geocoded

Not surprisingly the turnkey waste hauler map revealed considerable territorial overlap and omission and areas for which no information is available.

To demonstrate the power of GIS, its analytical capability, and its

visualization potential the author study created a 3D

geovisualization of the trash hauler routes in a pilot project for Star City, WV, using service address data and hauler route maps (Figures 6.9, 6.10, 6.11).

Significantly for Star City, it was found that all its institutional knowledge was retained by only

one trash collector who was approaching retirement and was already unable to lift heavy items. To build the GIS the hauler was asked to use different color crayon to capture his knowledge

on a paper map of the type of pickup and the day of week. This map was then transferred into digital form and ingested into the GIS (Figure 6.11, 6.12, 6.13). Notably, based on the 3D

representation, Star City municipal officials came to several realizations including that their trash routes were shrinking due to the slow creep into the area of other trash hauler companies hired by the adjacent City of Morgantown and the existence of new facilities within the city vicinity not covered by the current city hauler (Figure 6.12, 6.13).

Figure 6.13: Shows trash pickup on weekends (MacLennan and Bergeron, 2014)

The preceding chapter demonstrates the limited forms of mapping available for the solid waste system in general and Monongalia County in particular, which falls short of providing a robust system capable of handling the rules and regulations of multiple agencies across the spectrum of waste management. This gap provides the stimulus for conceptualizing a policy-shed approach.

Chapter 7 A GIS-policy-shed approach to solid waste policy

Given the challenges outlined above in mapping solid waste policy, alternative methods were examined before the novel idea of using a GIS-based ‘sheds’ or ‘scapes’ was pursued. A preliminary mind-mapping exercise was performed to identify the various policy, regulatory and spatial components of the proposed system and to examine the relationships between them. Mind maps are often used to define the boundaries and structure of a problem. Mind maps will vary between individuals but are a powerful means of capturing the entirety of a system and as an interactive tool for engaging complex geographical issues (Eppler, 2006; Lloyd et al., 2010). In this exercise I sought to capture in diagrammatic form the many components I was seeking to accommodate in my policy mapping – not dissimilar to a needs-analysis. Each radial line represents a type of solid waste, who was responsible for handling it, and how that waste was disposed (Figure 7.1). The radial lines could represent movement along hauler transportation routes and landfills but could also include policy interaction between agencies and the WVPSC, for example. The squares at the end of each radial line indicates termination of the dyad at a location or outcome.

Figure Figure 7.1: Mind-map of the local municipal waste process in Monongalia County, West Virginia

Figure 7.2 illustrates an initial schematic representation of the solid waste disposal trash disposal framework operating in Monongalia County, West Virginia. For household and business waste, various disposal options are identified including disposal at transfer stations, landfills, or recycling centers. Figure 7.3 is a more formal representation of a part of the initial sketched mind map and shows the types of trash, means of disposal, and geographic location of waste source and disposal destinations. Subsequently the U.S. EPA classification schema for solid waste was incorporated though it became apparent that this pushed the useful limits of mind mapping and the need for a formal database schema. Working with waste is like pulling a thread that as it unravels takes one to many other places not initially considered. For this reason the

mind map approach was extremely helpful in in the early stages in structuring the many elements of the solid waste system.

Figure 7.2: Diagram of waste flow

gradients to visualize data, whether numerical or textual. The color of each cell corresponds to the magnitude represented in the cell and this magnitude could be the strength or porosity of a policy relationship. Such visualizations can quickly summarize complex data sets and can be used to identify possible structures, relationships, gaps, and other areas for exploration such as identifying a grouping clusters of interest. The heat map matrix in Figure (7.4) was generated based on the 2016 WV legislative session and displays solid waste and solid waste policy. A matrix was also created for certain counties to capture basic policy areas that impact solid waste policy based on the multiple publications and information sources of the WWSWMB (Figure 7.4). The matrix is composed of red, blue, green, and orange tuples. Red shows the existence of policies that stand alone or have fixed boundaries such as Big P policies. When these policies are stand-alone or fixed, they tend to relate to both bounded policies and literally bounded locations such as prisons, military installations. Blue indicates policy areas that are fixed but have unintentional crossover relationships with other policies. These policy areas such as air quality, e-waste, and public health, ground water, tend to also be geographically porous. Green signifies loose couplings between policy areas such as those arising from small p policy or best practices while orange indicates policies and locations that are fuzzy or unclear. Some policies such as recycling are desired but how they are done is vaguely defined and often filled in with best practices. However, as can be seen most relationships between policy areas and their connection to stakeholders is fuzzy or unclear. Heat map matrices can be generated for differing waste types, places, or agency.

Figure 7.4: Solid Waste Policy Matrix

A heat chart can simplify complexity and highlight policies that overlap and those that appear as outliers. However, after extensive experimentation with heat matrices the difficulty of handling the spatial relationships and issues associated with scale, geography, or spatial relationships could not be overcome. In many ways, a heat chart matrix is a precursor to forming a geodatabase schema which requires deliberation as to the relationships between location, coverage, and attribution and generating heat matrices was a valuable exercise for that reason. Experimentation was also made with Venn diagrams to determine the interconnectivity in the solid waste regulatory system (Figure 7.5). A Venn diagram was generated to capture the medical waste system for Marion County, Monongalia County, and Harrison County in north central West Virginia. One outcome of this exercise was that the Venn diagram appeared to perform a reasonable job at visually capturing the various intersections and overlaps of waste policy areas. However, the aspatial representation made the exercise valuable only for identifying the primary policy components and their relationships.

Figure 7.5: Monongalia, Marion, and Harrison Counties Intersecting Policies related to Medication Disposal.

While useful, these exploratory exercises did indicate the challenges associated with developing a system capable of recording multiple regulations for multiple spatial units that was capable of being queried based on specific location and policy regulation. Ultimately, the concept of a GIS-based -shed was examined. Watersheds provide a powerful metaphor for developing what I have termed solid waste policy-sheds. As units of hydrologic classification, within defined

topographic areas, watersheds are critical in examining surface and shallow groundwater flow to common outfalls (Winter, 2001). Even though watersheds may cross multiple administrative areas, they are a primary organizing unit for water policy and water governance and are used by USGS and EPA for water quality assessment (Figures 7.6, 7.7, 7.8) (Loë and Patterson, 2018). Watershed boundaries can be fuzzy and multiple tiered watersheds are nested within each other which is somewhat contrary to the spatial way the regulatory framework for solid waste operates, nonetheless the analogy was intriguing.

Figure 7.6: Watershed

Figure 7.7: East Coast Watersheds Source: ArcGIS Online

Figure 7.8: HUC 12 Counties Source: ArcGIS Online

The concept of -sheds has been implemented beyond hydrological applications to include viewsheds, drivesheds, and wastesheds. Viewsheds capture the visible and non-visible features in a surrounding area and are used extensively in architecture and cultural and historical landscapes (Higuchi, 1988). Wastesheds, as previously discussed, were implemented by the U.S. EPA and conceived to emulate the role of watersheds but in waste management (Figure 7.9). Wastesheds tend to be static units much as watersheds and they fail to capture the dynamism or complexity of the solid waste environment.

Less well-known but thought-provoking are drive-sheds that measure the catchment areas of vehicles traveling to a specific destination based on networks of roadway routes. Using GIS such drive sheds can be based on Euclidian distance, travel time, cost, or other metrics. The

Figure 7.9: West Virginia Watersheds Map Source: WV SWMB 2019

2017 solar eclipse, for example, led to the construction of a fascinating series of drivesheds capturing the cumulative routes travelled by vehicles as people sought to locate to the closest zone of totality (Figure 7.10). Similar examples exist for identifying transportation corridors for mass evacuation in the event of natural or man-made disasters (Figure 7.11).

Figure 7.10: Drivesheds

Figure 7.11: FHWA Evacuation Driveshed through West Virginia: Barbour, Clarksburg, Grant, Greenbrier, Hampshire, Hardy, Jefferson, Marion, Monongalia, Pendleton, Pocahontas, Preston, Randolph, Tucker, Upshur, and Randolph.

Policy-sheds

Based on the idea of -sheds, preliminary thought was given as to how policy-sheds might be constructed in GIS for waste management. Although these musings were crude (Figure 7.12 and 7.13) they quickly evolved into a full-blown schema (Figure 7.14). As detailed later in this chapter the critical elements of this approach were to be able to extract and digitize the spatial units embedded in the written regulations, laws, rules, and code and to then codify these regulations and assign them to the applicable areal units. This turned out to be no small task. GIS lends itself well to this handling of spatial information. In contrast to the nested style of watersheds, however, waste policy-sheds can occur in multiple and overlaying administrative zones and the power of GIS to overlay these zones and to then drill through them provides a functional and robust technique for identifying codes that apply to specified locations. The designation of policy-sheds could thus cover the entire U.S., a state, or a county. But as will be seen, the regulations controlling solid waste can range from individual structures, such as a federal prison or a hospital, for which specific regulations apply, that may or may not reflect other regulatory environments. Similarly, cities or towns or communities may have solid waste code or practices that differ from others. West Virginia University, for example, has a different solid waste and recycling regimes that differ from those of the administrative city of Morgantown or the county of Monongalia in which the university is located. What will be seen from the application of policy-sheds is that not only are there a myriad solid waste regulations but that these regulations spatially overlap and on occasion contradict each other.

Figure 7.12: Multiscalar representation as a physical model

Figure 7.14: A Policy-shed Framework Schematic

Extracting regulatory code and related spatial information

As indicated, extracting the regulatory solid waste code and related spatial information from the varying official policy documents and legal documents such as treaties and case law and placing them into a standardized format was a formidable task. Invariably the spatial units or jurisdictions to which the code applied was not mapped and certainly not in a digital form that could be readily ingested into the GIS. Furthermore, the code had to be classified according to the type of waste involved. Some of the Code of Ordinances that apply to counties and cities, might be found in the American Legal Publishing Corporation which provides these documents for informational purposes only (Figures 7.15 and 7.16). Each code narrative had to be reviewed for relevant solid waste policy and for the location, and spatial extent of that policy. Waste characterization tends to be determined by its related industry or purpose but even this can be ambiguous. The code extraction process became a labyrinth of deep enquiry into the structure of the code that had many blind alleys and unhelpful paths. Interpreting code narrative requires an extensive knowledge of the policy area not least in recognizing the possible linkages to other policies or locations. Undertaking this necessary task and aggregating, classifying, and verifying the massive numbers of records and accounting for changing code over time was....time consuming. The multiplicity of differing words used to describe waste was problematic and often common terms were used to describe very different types of waste. Similarly, some code might refer to only one part or process in the waste system in contrast to other code. Furthermore, ultimately the regulatory code had to be spatially allocated to the respective place or places to which it applied, and this generated many issues associated with place names, administrative names, and spatial units. While the process provided a deep insight into the inner administrative workings and planning of municipalities the time and resources required to perform this work has to be considered when evaluating the efficacy of a policy-shed approach though in reality it also points to the absolute need to apply some standardized approach to the morass of regulations that represents the solid waste system.

Figure 7.15: Example Table of Contents Codified Ordinances of the Town of Star City, West Virginia (October 1, 2020)
https://codelibrary.amlegal.com/codes/starcity/latest/starcity_wv/0-0-0-12030

Figure 7.16: American Legal Publishing Online Google Map of Members

While not every state makes its codes available online, the West Virginia Code is so available. The WWSWMB annual bill tracker of solid waste regulation changes was particularly valuable in identifying bills related to solid waste. Nonetheless, almost a line-by-line search was necessary to extract waste policy and jurisdictions.

WV Code Analysis

The relationships and patterns observed in the initial waste heat map matrix were further developed into an analysis of WV code analysis. Identifying the spatial locations to which code applied could fall into several forms (Table 7.1).

Policy and Spatial Locations	
Stand-alone code or policy	Policy code that does not have any policy parts that are reliant or directly intersect with other policies.
Fixed boundary code	Regulations or policy that are tied to specific fixed hard boundaries.
Semi- Fixed boundary	A boundary intended to be fixed that has developed crossover relationships between policy areas or boundaries
Very Loose	Couplings between policy areas and policy locations such as those from small p policy or best practices.
Fuzzy or unclear	Policies and locations that are fuzzy or unclear because they are integrated into other policy regulations, originate from other policy arenas, or are held under the rubric of local knowledge or best practices.

Table 7.1: Policy and Spatial Locations

The linking of solid waste policy to location was an iterative process, requiring an almost a line-by-line search for international, federal, state, county, and local regulations through various agency data, sources, organizations, in order to extract waste policy and associated jurisdictions.

The regulatory code was assigned to named places, administrative areas, and jurisdictions identified in the code. Where possible spatial databases were used, as for example in the case of digital county boundary files. These spatial repositories included Data.gov, the databases housed by the WV State GIS Technical Center (Figure 7.17), and the Homeland Infrastructure Foundation Level-Data (HIFLD) Open Data Catalog (<https://hifld-geoplatform.opendata.arcgis.com/>). The latter HIFLD was surprisingly helpful because although established in 2002 it housed geospatial information that spanned multiple levels of

government community infrastructure. Issues of scale and spatial accuracy, as with any spatial data, pervade this work and a medley of best available scalar data was used.

In some instances, spatial conflicts arose largely based on the definitions used to define a jurisdictional extent. Thus HIFLD, for example, limited the geospatial extent of WVU to the downtown campus, while ignoring the other campuses and such are the problems of using legacy data originally provided to meet other purposes. In instances where no spatial dataset could be accessed then digital areal units and shapefiles had to be generated by the author.

Monongalia County, WV	
County Boundaries	
Selected County	UTM NAD27
County Boundaries	1:100,000 scale
Data Source	U.S. Census Bureau Data (Created 2000)
File Format	Compressed ESRI shapefile
Data Download	https://wvgis.wvu.edu/
Description	West Virginia County Boundaries from 1990 and 2000 Census geographic areas data 1990 shapefiles were derived by the WVGISTC from 1990 Census data. The 2000 shapefile was prepared by the Natural Resource Analysis Center (NRAC) at West Virginia University, NRAC downloaded and manipulated the file from ESRI. The 2000 County dataset was posted on the WVGISTC website in September 2003.
Attribute Information	1990 files include Federal Information Processing Standards (FIPS) codes and 1990 Census data. The 2000 dataset has over 35 population and household attributes and FIPS codes.

Coordinate System	Coordinate System Latitude/longitude with mapping units in decimal degrees, (2) UTM Zone 17 or (3) UTM Zone 18 in meters, (4) State Plane North (SPN) or (5) State Plane South (SPS) in feet. All coordinates referenced to NAD 83 datum.

HELD Access Point HELD Data is provided to individuals on HELD ID Open, HELD ID Secure, and HELD ID Locked. Please see the table below for more information. HELD ID Open: https://heldopen.held.gov HELD ID Secure: https://heldsecure.held.gov HELD ID Locked: https://heldlocked.held.gov This table is provided as a reference for HELD ID users.	Persistence - Open: Available on HELD ID Open - Secure: Available on HELD ID Secure (with restrictions) - Locked: Available on HELD ID Locked (with restrictions) (Data is not available on HELD ID Locked)	Category	User Name	Feature Type	Publication Date	Date Last Updated	Source	Access Constraints	User Comments	
HELD ID Open	Open	Boundaries	2018 USCB Housing Population	Area	Digitally updated	Apr 18	US Census Bureau, Geography Division	None (Public Domain Information)	None (Public Use)	
HELD ID Secure	Locked	Government	Administration of Environment & Quality Programs	Point	Sep 16	Oct 16	Data & Evidence (D&E)	Federal State, Local, Tribal, Territorial, Canadian Government and Partner Only	For Official Use Only (FOUO)	This data can only be used in accordance with the MAP
HELD ID Secure	Locked	Government	Administration of Human Resources Programs	Point	Sep 16	Oct 16	Data & Evidence (D&E)	Federal State, Local, Tribal, Territorial, Canadian Government and Partner Only	For Official Use Only (FOUO)	This data can only be used in accordance with the MAP
HELD ID Secure	Locked	Commercial	Administration and Support Services	Point	Jun 16	Oct 16	Data & Evidence (D&E)	Federal State, Local, Tribal, Territorial, Canadian Government and Partner Only	For Official Use Only (FOUO)	This data can only be used in accordance with the MAP
HELD ID Open	Open	Transportation/Veteran	Administration Areas (Area Vessel Map Analysis (VSMCA) EDC)	Area	Digitally updated	Aug 13	United States Army Corps of Engineers (USACE) Interdisciplinary Management Center (IDMC)	None (Public Domain Information)	None (Public Use)	
HELD ID Open	Open	Mining	Agency of Mineral Operations	Point	Dec 15	Sep 17	US Geological Survey (USGS)	None (Public Domain Information)	None (Public Use)	
HELD ID Secure	Secure	Emerging Services	At Medical Communication or Dispatch Centers (ACDMCS)	Point	Feb 13	Jun 20	At Medical Communication or Dispatch Centers (ACDMCS) Association of At Medical Services (AAMS)	Federal State, Local, Tribal, and Territorial Partner	Secure	Users are required to sign the USFQ Good Data Use Product Agreement before using the data
HELD ID Secure	Secure	Emerging Services	At Medical Service Provider (ACMSP)	Point	Feb 13	Jun 20	At Medical Service Provider (ACMSP) Association of At Medical Services (AAMS)	Federal State, Local, Tribal, and Territorial Partner	Secure	Users are required to sign the USFQ Good Data Use Product Agreement before using the data
HELD ID Secure	Locked	Transportation/Air	Air Transportation	Point	Sep 16	Oct 16	Data & Evidence (D&E)	Federal State, Local, Tribal, Territorial, Canadian Government and Partner Only	For Official Use Only (FOUO)	This data can only be used in accordance with the MAP
HELD ID Open	Open	Transportation/Air	Aircraft Landing Facilities	Point	Digitally updated	Apr 13	National Transportation Data Clearinghouse (NTDC)	None (Public Domain Information)	None (Public Use)	Authorized signers of the National Transportation
HELD ID Open	Open	Transportation/Veteran	Airport Name (EDCE EDC)	Area	Digitally updated	Aug 13	United States Army Corps of Engineers (USACE) Interdisciplinary Management Center (IDMC)	None (Public Domain Information)	None (Public Use)	
HELD ID Secure	Secure	Emerging Services	Airport Hospital and Ground Access Hospital Data Locations	Point	Feb 13	Jun 20	At Medical Communication or Dispatch Centers (ACDMCS) Association of At Medical Services (AAMS)	Federal State, Local, Tribal, and Territorial Partner	Secure	Users are required to sign the USFQ Good Data Use Product Agreement before using the data

Policy Narrative Audit

Location is an important part of the policy-shed concept but these spatial designations lie buried as textual descriptions in a mass of regulatory documents. Local knowledge of the case study area was critical to interpret and extract this information. A challenge is that policy is often not quantifiable into tabular data. For example, when analyzing WV State code, it took considerable geographic, waste, policy, and manufacturing knowledge to determine what in the WV State Code was solid waste and if so how to interpret the geographic scope of the code.

The terminology used was drawn out of the entirety of the code and fell into three types of regulatory geographic information comprising: 1. the physical manifestations of waste often portrayed as a geographic point, 2. spatial actions which implies the movement of solid waste across space, and finally 3. geographic location and land-use which often needed to be inferred from the nature of a solid waste item or material or land-use. As explored by Briassouli (2019) the human use of land resources gives rise to ‘land use’ which varies with the purposes it serves and is in a constant state of flux. Without an associated map there are limited ways to determine what these geographic forms and relationships imply and identifying specific boundaries, jurisdictions, and geographies is problematic. Table 7.2, drawn from the Content Analysis of WV State Code reveals the terms that relate to one of these three types of spatial interaction and it was these that populated the GIS attribute table.

West Virginia State Code Solid Waste Policy and Geography Attributes			
ITEM or MATERIAL	SPATIAL ACTION	LOCATION and LAND-USE	
<ul style="list-style-type: none"> • Accumulations • Alternative fuel vehicles (made from waste by-products) • Ashes • Biomass 	<ul style="list-style-type: none"> • Accumulation of Debris • Accumulation of refuse • Alteration • Decay • Decides to Destroy 	<ul style="list-style-type: none"> • Accumulations • Baler [Area] • Brownfield • Demolisher • In [doorway, etc. location making it] Unsanitary, 	<ul style="list-style-type: none"> •

<ul style="list-style-type: none"> • Commodities (items not yet determined if waste but probably are) • Debris • Disposal • Garbage • Incinerator Ash • Landfill Gas • Litter • Obsolete Vehicles, etc. (no longer serve their focus or are incompatible) • Recycling • Refuse • Residual components (unwanted parts from a cannibalized commodity) • Salvage (material) • Scrap (material) • Solid Waste to Fuel 	<ul style="list-style-type: none"> • Demolish • Demolished • Demolition • Destruction • Destruction • Disposal • Dispose of • Identify [items] that are not needed • Identify [items] that do not have value • Illegal dumping • Incinerate • Landfill • Litter • Orderly disposal of [item] no longer possessing sufficient administrative, legal, or fiscal value to warrant further keeping. • Plans destruction of • Recycling 	<p>dangerous, or detrimental to public safety or welfare</p> <ul style="list-style-type: none"> • Incinerator [Area] • Incinerator Plants • Landfill • Open Dumps • Recycling Facility • Salvage yard • Scrapyard • Voluntarily Remediated Site 	
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<ul style="list-style-type: none"> • Surplus property (unwanted property) • Toxic Seepage • Toxic Spillage • Trash • Unwanted materials • Waste Coal • Waste Disposal Companies • Wastes 	<ul style="list-style-type: none"> • Retirement of [equipment] • Salvage (action) • Scrap (action) • Surplus • Unlawful disposal • Waste Disposal 		
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Table 7.2: Table of West Virginia State Code Solid Waste Policy and Geography Attributes

Operationalizing Attributes and Characterization

Policy and legal data are dense, extensive, and difficult to use. Therefore, the Tremper, Thomas and Wagenaar (2009) guide and accompanying policy law template for interdisciplinary researchers was utilized extensively. The template acts as a categorization schema to measure and produce accurate indicators of the law. The author further adapted the template to categorize spatiality, geography, and policy information using spatial waste characterizations based on policy, including scale and jurisdiction characterizations table (Table 7.3) This narrowed the somewhat unwieldy list of attributes and aggregate categories into a manageable format. Each code narrative required review for embedded waste policy, location, and spatial extent and this was performed through multiple depth-centric organizational structures. Interpreting the code narrative and other sources requires a breadth of knowledge of the policy area and spatial concepts to recognize possible linkages to other scales or policies.

Aggregating large numbers of records and verifying their status was challenging and time-consuming because of the nature of place names, administrative names, the varying nature of municipal codes over time, and differing interpretations of waste typology.

Policy: Waste Scale and Jurisdiction Characterizations	
Policy ID	To be able to select individual policies and corresponding land use, a policy ID had to be used to give each type of policy location a unique value.
Attributes	Spatial attributes that specify features
Classification Agency	Official designated classifying agency
Policy Code	Official Agency or Government Code
Cross-Cutting	Cross-cutting between policies, waste types, agencies
Policy	Each policy needed to be identifiable by its official descriptor or a description that defined it in an easy to scan and read format. Many times policy codes had to exist in multiple selection lines with codes specific to the location type that drives waste type and subsequent policy, which was a time consuming challenge.
Text Description	Text narrative also provided a place to integrate digitized and non-cartographic records, news, practices, and spatialized often fuzzy small p policy, such as gentlemen's agreements, historic patterns, and best practices.
Economic Zone Description	Economic Zone information or data
Jurisdictional Authority	Authority over the jurisdiction (different from agency)
NAICS	The North American Industry Classification System (NAICS) standard used by Federal statistical agencies in classifying businesses
Name	Name the policy is commonly referred to as
Scale	The scale of policy was necessary to identify geographic scale and how that integration of policy scale and geographic scale would be represented through specifying jurisdictions and other types of policy areas.
Source	Source of policy information

Title	Official title for the policy (differs from name)
Type	A way to further correlate geography, policy, and waste typology is by type of policy or keyword related to policy, which is similar to how the initial waste matrix looked at waste policy by It is especially helpful with fuzzy boundaries or waste impacts such as air, but also indicates stove-piped and unusual attributes such as airports. Further, type allowed for a place to include historic references to type that equate to current terminology.
URL	Website URL if available
Further annotations	Any relevant information not contained above

Table 7.3: Waste Scale and Jurisdiction Characterizations

Creating an Overarching Proxy

Although vital to categorizing and characterizing policy, the resulting waste, scale, and jurisdictional characterizations were still too unwieldy for this project to employ and would have led the geodatabase and spatial relationships to grow exponentially. Accordingly, and to avoid using a representative selection of waste types, a proxy for types of waste in a jurisdiction was used to populate the attribute table. The usability of these categories was further addressed by creating an annotated baseline that nested typologies which could be combined into other categories (Table 7.4).

Overarching Generalized Typology	
General Waste	General Waste = (Municipal waste + universal waste)
Food Waste and Composting	Compost = (Compost waste + food waste)
Special Event Waste	Temporal event waste such as football games, festivals, and recreation
Specialized Wastes	(Specialized disposal and handling waste such as electronics, textiles)
Medical Waste	(Medical waste + sharps/needles + medications)
Recycling	Recycling = (Recycling and reuse)
Transportation	Transportation of waste
Water	Waste-related water issues
Land	Waste-related land area issues such as brownfields, ownership
Air	Waste related air issues such as emissions
Electronics	Electronic and e-waste
Industrial	Industrial and business waste
Agriculture	Agriculture and farm waste
Hazardous	All levels of classified hazardous waste including HHW
Enforcement	All levels of enforcement of waste-related issues
Recycling Commodities	Secondary market commodities
Energy	Waste related to energy and resource extraction

Table 7.4: Overarching Generalized Typology

Chapter 8 The case study, space, and solid waste policy

To undertake an achievable demonstration, the study area for this analysis was limited to Monongalia County, West Virginia which is the fourth most populated county in the state with a 2010 total population of 96,189 residents (Figure 8.1). Monongalia County has the usual mix of county and municipal government but also has additional authorities in the form of a federal prison, federal agencies, several hospital complexes, and West Virginia University among others. The largest urban area in the county is the city of Morgantown, yet within the greater Morgantown area there are several ‘cities’, regional authorities, and municipalities with their own jurisdictions and solid waste history and practices. It will be seen later in this chapter that there exist many fuzzy boundaries ‘defining’ these areas. The county thus provides a valuable case study with which to test the policy-shed system.

Figure 8.1: Monongalia County

Jurisdictions, authorities, and boundaries

To set the scene, in West Virginia, cities such as Morgantown, with a population of over 10,000 must meet higher federal and state waste and recycling standards than required from surrounding areas though they do have greater autonomy over their solid waste system (Figure 8.2).

Figure 8.2: The City of Morgantown

For communities with less than the 10,000 threshold there is no state mandate for implementing recycling programs so Morgantown is the only area in the county with a mandated recycling code. Morgantown, as a city, is under-bounded and though the city limits have expanded in recent years it is the Greater Morgantown area which prompted the US Census Bureau in 2000 to designate Morgantown as a metropolitan area based on the multiple adjoining jurisdictional areas which lifted the population size to over 50,000 people. A map of some of these adjoining jurisdictions such as Star City and Westover that make up the Morgantown metropolitan area, shows the proximity of these places to Morgantown such that there is almost no differentiation in urban sprawl (Figure 8.3).

Figure 8.3: Multiple Jurisdictions for Greater Morgantown

Anecdotally, while these jurisdictions are known to residents, most local people would think of the metropolitan Greater Morgantown as ‘Morgantown’ and as one continuous urban area. And yet while the City of Morgantown must follow federal and state solid waste disposal and recycling procedures, the immediately adjacent jurisdictions may follow their own code and establish separate and independent waste haulage procedures, many of which date back in history and are uncoded agreements that have been in operation for generations. Thus, multiple regulatory codes apply even within a seemingly common urban core.

Figure 8.4: Ward boundaries in Morgantown Source: City of Morgantown

Further, even within the City of Morgantown, there are disagreements over the boundary descriptions of several city wards (Figure 8.4). Nor are waste practices shared between wards. Part reason for these disagreements and differences can be traced back to historical unwritten agreements, the ‘gentlemen’s’ agreements, between waste haulers that often sought to overcome the barriers arising from old state tariff territories and that some wards have differing haulers depending on whether a structure is residential or commercial. In determining the latest ward boundaries, city officials used physical boundaries to ensure contiguity by preserving street connections across each ward using a form of territory analysis such that residents were not completely severed from their wards by another ward boundary. In addition, the ward boundaries were updated to rebalance the number of registered voters across the seven wards while seeking to preserve existing neighborhoods. However, local community perceptions as to what

constitutes a neighborhood conflict with these rational designations. According to the Morgantown GIS Ward Boundary Analysis Final Report (Davis, 2020) “Given the lack of reliable GIS data for neighborhoods and understanding what residents consider to be their neighborhood, this can only be evaluated through anecdotal information provided by public comments and the Commission's input”. In seeking to redefine these neighborhoods and wards, the legacy waste protocols and practices were placed in contention. Such legacy agreements have profound geographical implications for the regulation of solid waste disposal. Spatial anomalies in regulatory solid waste disposal can occur in other ways. Thus, in recent years a second Walmart Superstore was constructed on the southern periphery of the city of Morgantown. At the behest of the company, request was made for the complex to be incorporated within the city boundary leading to the southern peninsular-type boundary extension (Figure 8.5).

Figure 8.5: The southern Walmart extension

While Walmart is one of the largest generators of waste in the area it, along with other large box stores, have their own strict waste and recycling procedures, that often outstrip the municipal regulations in force.

While municipalities might have overall responsibility and authority over solid waste disposal there exist other authorities such as planning zones and economic zones that can prescribe their own applicable regulations over waste haulage (Figures 8.6).

Figure 8.6: City jurisdictions and zoning

The North American Industry Classification System (NAICS) is a classification of business establishments by type of economic activity. Economic zones, for example, tend to better

capture the types of waste and the related policies that apply to their disposal than do other areal units because they are smaller areal entities (Figure 8.7 and Figure 8.8). Yet even here, the zones may mask a variety of business practices, community practices, and small p policy activities for which differing procedures apply.

Figure 8.7: Greater Morgantown Area Economic Zones

Figure 8.8: NAICS

Thus, differing recycling requirements may exist in the same area depending on if a structure is residential or non-residential. Anomalies often become apparent when islands of residential structures exist in a sea of industrial units. Not least the rising trend of young business owners living above their businesses or industrial shops further complicates the situation. Similarly, multifamily unit housing (MFU) which are both a home and a business might be seen as residential and yet in a university town such as Morgantown with extensive student housing needs, they are officially considered a business. As non-residential entities, MFUs incur a greater number of waste collections than residential units, but since they are ineligible for curbside recycling it is left to the property owner to provide recycling services to the tenants, and many choose to offer no recycling at all. Thus, solid waste regulations, even for seemingly contiguous and homogenous areas, are peppered with omissions, overlaps, and gaps in regulatory

policy. Here, of course, the Modifiable Areal Unit Problems and the ecological fallacy runs riot through solid waste regulatory policy and spatial representation.

Other entities and authorities also complicate municipal waste regulations. Morgantown Municipal Airport, for example, is an unexpected mélange of overlapping jurisdictions and boundary designations. (Figure 8.9) Policy boundaries for the airport are fuzzy and difficult to categorize (Figure 8.10). There is co-ownership of the airport by the city, the airport, a leased restaurant, the county, WVU, the National Guard, the Civil Air Patrol, and the Transportation Security Administration (TSA). It is the federal TSA, for example, who determine the placement of trash cans to prevent possible tampering and other forms of waste disposal at the airport. The DOE (Figure 8.11) National Energy Technology Laboratory (NETL) is a federal facility and a large regional employer that has several sites in Monongalia County. As a federal facility NETL implements their own solid waste policies irrespective of being within the jurisdiction of the city of Morgantown. Similarly, with the federal low security prison located in Morgantown (Figure 8.12)

Figure 8.9 Example of how multiple authorities complicate municipal waste regulations

Figure 8.10: Morgantown Municipal Airport

Figure 8.11: DOE-NETL

Figure 8.12: Federal Prisons

West Virginia University, the state's only land grant university, is located on several campuses in Morgantown and in terms of solid waste disposal is almost a city within a city. WVU property extends across the Greater Morgantown area and thus impinges not only on the regulations of the city of Morgantown but surrounding jurisdictions as well (Figure 8.13). Indeed, WVU has outlying properties outside the county and state (Figure 8.14). As a research, teaching, and land grant university that includes several medical hospitals, WVU must handle hundreds of waste types, yet its procedures overlap with several surrounding jurisdictional units. The WVU Health System, for example, has very strict medical waste procedures, many of which are federal policies and transcend local or state policies and procedures.

Figure 8.13: WVU and surrounding city jurisdictions

Figure 8.14: WVU property within and outside Monongalia County

Even waterways can cause policy conflicts in that differing parts of the river have different jurisdictions. The Army Corp of Engineers (ACE), for example, has jurisdiction over the center of the Monongahela River and the Morgantown Lock and Dam. The dam has become a contentious issue of late for the debris released further up-river accumulates at the dam and yet the ACE are not permitted to open the dam gates to release it downstream. Despite pressure from townspeople and protests from the elected officials of City of Morgantown, the ACE cannot, or will not, clean up the sizeable flotilla of debris that has accumulated. What should be apparent by now is that once the spatial extent of solid waste policy is made explicit, the true complexity and nature of the numerous conflicting and overlapping policy regulations becomes abundantly clear.

Chapter 9 Operationalizing an interactive policy-shed platform

To be capable of examining and overcoming the constraints of a seemingly out of control regulatory behemoth and intricate morass of solid waste policy, and to be able to drill down through a location to discover all the policies that apply to a particular site, an interactive policy-shed platform was created. The problems associated with searching through the solid waste code to identify appropriate regulatory policies was, as outlined above, a herculean task and through necessity the tendency has been for many to default to legacy known practice, what has always been done, or to treat solid waste policy as aspatial. These default approaches are only functional until such times as conflict emerges. Having identified the spatial extents of each regulatory solid waste policy for Monongalia County, it is possible through GIS to create an operational policy-shed platform. Drilling down through even a few layers of solid waste policy at specific locations, as in chapter eight, reveals that the challenges to implementing solid waste policy and practices are posed not solely by the need to identify the spatial unit to which a policy might apply, or the actual policy or practice that applies, but how to handle the multiple overlapping or contradictory policies that apply based on the complicated nature of waste characterization.

To create a dynamic, interactive system that allows users to interrogate and operationalize solid waste policy several models were examined before a compelling solution that fused GIS, dashboard technology, and the interactive brushing and linking interrogation of the geodatabase. The ability to provide brushing and linking capability is a recent technical advance. This linking of solid waste geography and policy attribution enabled the generation of interactive maps that linked the thick textual narrative of policy to specific locations. This online GIS-based interactive mapping and policy interrogation dashboard is hereafter referred to as the policy-shed dashboard.

The architecture of the policy-shed platform and the integration of the databases to the spatial polygons was achieved using an innovative combination of ArcGIS Pro and Application Programming Interfaces (API). APIs are a relatively recent advance in spatial technologies and are intermediary software that allow applications to communicate and interact with each other. It

was Google's release of the Google Map API in 2005 that marked the beginning of many software companies providing the hooks and capability for multiple software platforms to be linked rather than be treated as in a silo. Web mapping APIs enable disparate programs and databases to be linked and combined to create hybrid systems – as here with the policy-shed platform. Libraries of programs, such as GOJS and JavaScript, are available that use HTML and JavaScript to enable systems to be linked in new and powerful ways (<https://gojs.net/latest/samples/index.html>). JavaScript was critical to creating the policy-shed system and provided the means to brush and link, and for diagrams, and even photographs of handwritten 'gentlemen's' agreements to be combined with ArcGIS Pro. Multiple APIs were used in this project.

Populating the geodatabase with applicable spatial units and policy attributes for particular waste characteristics has been discussed previously. One lesson learned from several experimentations with the system was the need to identify the spatial components early in the process rather than later, and this finding required considerable knowledge of the applicable solid waste policies up front. Identifying the available sources for creating the spatial units and digitizing analog maps before ingestion into the GIS was resource intensive. The resources required to develop a waste type classification and populate the attribute table was even more resource intensive. While the initial waste matrix developed for the dissertation proposal was extensive, it ultimately fell well short of what was required to capture the complexity of regulatory policy. The preferred approach was in the end to make the spatial geography dominant and to then assign the policy attributions to that geography. Based on the waste classification matrix a join was made to the appropriate spatial unit or, oftentimes, to multiple overlapping spatial units. Establishing a hierarchy of spatial units was unsuccessful. Because of the close connection between the types of waste generated by businesses or residences, the types of waste produced, and the availability of city zoning codes, the related NAICS economic zones were used as the basic building blocks to join spatial units to policy attributes based on waste types. Tax parcel data for West Virginia, available through the West Virginia GIS Clearinghouse, is rare to find for most states but was invaluable in this study. Based on these tax parcels, waste type polygons were merged to create the policy-shed. Some problems arose in the process of generating these policy-sheds that resulted in awkward looking sheds within the selected boundary hulls and which impacted the ability to pan and zoom across multiple policy scales and sheds. Overlapping policies and policy

gaps further complicated the outcome. GIS struggles to handle fuzzy, incomplete, and conflicting data and this may be one reason why such as an attempt as this policy-shed platform has not been attempted previously. For areas of overlapping, conflicting, or policies it was necessary to overcome the challenge of creating multiple polygon extents by a prismic interactive interrogation through dashboards, brushing and linking, APIs, and other extensions. The policy-shed prototype can be found at a permanent location forthcoming. In order to view these maps, it is necessary that Google Chrome or other extensions are up-to-date. The interrogative nature of the interactive dashboard allows either policies to be displayed for areas or for locations to be queried to disclose applicable policies. In the policy attribute table short, annotated versions of the applicable solid waste policies were provided and by using point and click and brushing maps of the associated policies and policy text itself are displayed in the window (Figures 9.1 and 9.2). In this way, the spatial extent of specific regulatory policies can also be displayed. Thus, query by location or locations and by specific policy or policies are possible. Performing a point-and-click search on a bank located on Chestnut Street in Morgantown for example, revealed that the bank is subject to federal law regarding waste disposal and recycling.

Figure 9.2: Brushing and linking between policies and location

Notably pursuing similar interrogations for the WVU Health Sciences Center and the WVU Ruby Memorial Hospital indicates similar solid waste disposal policies as would be expected for a medical school and a hospital, though there are differences in their solid waste disposal policies. The teaching hospital, for example, has additional animal lab waste disposal requirements that the hospital does not. Interestingly, the sliver of vacant residential property between the medical complexes has differing solid waste policies and in turn. What might be surprising is that the WVU medical complexes have solid waste policies that differ from those of the nearby community Monongalia General Hospital (Figures 9.2, 9.3, 9.4).

Figure 9.4: Sliver of residential vacant lot up against WV University- Health Sci and Ruby Memorial Hospital

Policies

- Summary**
- Physical Address**
- Buidling Map Description**
- Building Map**
- Policy Extent Map**
- Hospital**
- Parcels**

Data analysis tools such as box and whisker plots and graphs can be dynamically linked to the displays and policy attribute table and can be used to analyze an entire policy-shed or for selected policies. Through this means data exploration beyond mapping and policy recall can be utilized and policy structure and outliers can be identified and examined. Because the user can directly manipulate multiple perspectives of the data as dynamic graphics, the user experience and control over the platform is a major advance over what was possible before. The utility of brushing and linking is often overlooked due to its simplicity yet the ability to dynamically link windows and highlight and visualize spatial data is powerful and allows users to access related data and mapping. Most policy problems and analyses are not linear, and thus visualization is a valuable part of the platform toolbox.

<p>EPA 40 CFR 261.2-261.4 Resource Conservation and Recovery Act (RCRA) Exemptions that are not solid wastes https://www.epa.gov/hw/criteria-definition-solid-waste-and-solid-and-hazardous-waste-exclusions</p>	<p>Wastes Which Are Not Solid Wastes 40 CFR Citation for the Exclusion Domestic Sewage and Mixtures of Domestic Sewage §261.4(a)(1) Point Source Discharge §261.4(a)(2) Irrigation Return Flow §261.4(a)(3) Radioactive Waste §261.4(a)(4) In-Situ Mining §261.4(a)(5) Pulping Liquors §261.4(a)(6) Spent Sulfuric Acid §261.4(a)(7) Reclamation in Enclosed Tanks §261.4(a)(8) Spent Wood Preservatives §261.4(a)(9) Coke By-Product Wastes §261.4(a)(10) Splash Condenser Dross Residue §261.4(a)(11) Hazardous Secondary Materials From the Petroleum Refining Industry §261.4(a)(12) Excluded Scrap Metal §261.4(a)(13) Shredded Circuit Boards §261.4(a)(14) Pulping Condensates Derived from Kraft Mill Steam Strippers §261.4(a)(15) Spent materials generated within the primary mineral processing industry from which minerals, acids, cyanide, water, or other values are recovered by mineral processing or by beneficiation §261.4(a)(17) Petrochemical recovered oil from an associated organic chemical manufacturing facility §261.4(a)(18) Spent caustic solutions from petroleum refining liquid treating processes used as a feedstock to produce creosote or naphthenic acid §261.4(a)(19) Hazardous secondary materials used to make zinc fertilizers §261.4(a)(20) Zinc fertilizers made from hazardous wastes, or excluded hazardous secondary materials §261.4(a)(21) Used cathode ray tubes (CRTs) §261.4(a)(22) Hazardous secondary material generated and legitimately reclaimed within the United States or its territories and under the control of the generator §261.4(a)(23) Hazardous secondary material that is generated and then transferred for the purpose of reclamation is not a solid waste §261.4(a)(24) Solvent-contaminated wipes that are sent for cleaning and reuse are not solid wastes from the point of generation §261.4(a)(26) Hazardous secondary material that is generated and then transferred to another person for the purpose of remanufacturing is not a solid waste §261.4(a)(27)</p>	
<p>EPA 42 U.S.C. § 6992 Medical Waste Tracking Act</p>	<p>Federal</p>	<p>EPA 42 U.S.C. § 6992 Medical Waste Tracking Act A generator of medical (biological) waste it must track it from "cradle to grave" and make all records available to the Environmental Protection Agency upon request. Medical waste includes but is not limited to: cultures of infectious agents, discarded vaccines, tissues, organs, body parts, blood products, sharps, soiled dressings and surgical gloves, etc.</p>
<p>EPA Universal Waste Discarded Mercury-Containing Equipment Final Rule 40 CFR Parts 260, 261, 264, 265, 266, 270, and 273</p>	<p>Federal</p>	<p>This final rule adds mercury-containing equipment to the federal list of universal wastes regulated under the Resource Conservation and Recovery Act (RCRA) hazardous waste regulations. Hazardous universal wastes are subject to less stringent standards for storing, transporting, and collecting these wastes. EPA has concluded that regulating spent mercury-containing equipment as a universal waste will lead to better management of this equipment and will facilitate compliance with hazardous waste requirements."</p>

Citation of exclusion from

Final Rule Adds mercury-containing equipment

Figure 9.6 User Interface: Pan and Zoom shows jump Scale

Chapter 10 Discussion and conclusion

This study has drawn out the distinction between ‘Big P’ policy and ‘small p’ policy and it has contextualized the antecedence of policy science studies and the seeming aspatial nature of the policy record. Public policy, and especially small p policy, necessarily involves a spatial component and one would assume that the discipline of geography would have been heavily engaged in the policy process from the onset. This study has shown that this is not the case and that the geographical perspective in public policy has been shown to be deficient if not entirely absent. While GIS is recognized for its growing contribution and real potential in public policy initiatives and analysis, geography nonetheless struggles to be a full participant in public policy deliberations and is somewhat peripheralized from the field. Geography as a discipline comprises not just methods such as GIS but spatial and placial concepts and theories unique to the discipline and the study of terrestrial space. It is argued here that using geographical techniques devoid of geographical concepts that underpin them is problematic. Recent calls by the American Association for Geographers (AAG) for geographers to become involved with the upcoming and inherently geographic 2021 redistricting process in the United States is indicative of this peripheralization for “geographers are sorely lacking from the process at every level” (AAG, 2021).

Despite the lack of an extensive involvement of geography in public policy, there are many very real reasons why space is problematic in small p policy. Extracting the spatial implications and outcomes of the laws, rules, operating procedures, and regulations embedded in legal record is extremely challenging because of the dense textual and descriptive form in which small p policy is recorded. Even identifying the spatial components and structures contained within such documents is problematic. In the case study of solid waste disposal in Monongalia County, West Virginia, local knowledge of the geographical locations mentioned in the recorded regulatory texts was critical for tying the policy rulings to actual locations on the ground. The lack of maps as a foundation for recording the spatial outcomes of small p policy, or other graphical spatial representation as to the areas to which these policies apply, more than compounds the difficulty of the situation. Furthermore, the issue of scale and accuracy, as the trash case study undertaken here makes apparent, cannot be ignored. The increasing recognition and availability of GIS may influence the future ability to express policy spatially in the form of maps but there remains such

a legacy of unmapped policy that this issue may never be comprehensively handled. As this study has amply demonstrated, the resources required to even extract the spatial elements of solid waste policy for just one county is considerable and this fact alone may be a fundamental reason why no such spatial representation or spatial system exists to date. Harmonizing policy rulings with their spatial representation is demonstrably challenging.

While the case for spatially representing policy code may seem obvious, the experience of implementing such a course of action through the development of policysheds was enlightening. For many of the reasons discussed above extracting the spatial information associated with the regulation of the solid waste system for Monongalia County was a herculean effort. Initially a multitude of regulatory sources must be identified, and the regulatory code and agreements extracted in textual form. Subsequently these regulations had to be codified, attributed, and ingested into a database in readiness for inclusion in ArcGIS Pro. In addition, the spatial units to which the code is to be assigned must be generated. In reality, it was no easy task to even identify these spatial units, or the locations associated with the code and considerable effort was expended pursuing the locational information. Local knowledge of the geography of a place was highly valuable when performing this task. In the case of 'routine' spatial units, such as counties, census enumeration districts, or census tracts, many could be accessed through spatial data clearinghouses or state and federal agencies and were available in spatial digital format appropriate for incorporation within a GIS. But in many other instances, these spatial 'containers' had to be created and digitalized. Furthermore, as this study has demonstrated, not all small p policy is encoded or exists in written form and much of it is retained as oral narrative and best practice. Mapping this latter information revealed both the sheer complexity of the solid waste system even for a relatively small county, as well as the fragility of retaining such information for future generations. The process of undertaking the unravelling of the trash waste industry for one small county revealed a major disconnect between a vision of what should be and the reality of what is, or what is practically achievable, based on the resources available to undertake such a measure, however limited in scope.

For many of the reasons listed above it is easy to see why the somewhat logical step to map small p policy has had such limited success in public policy studies. And this is in the light on ongoing drives to assess the success or failure of policy initiatives which invariably requires that the 'where' question be addressed. Early exploratory forays into this field during the course of

this research study were problematic in many ways and a GIS-based policy-shed approach was pursued. The schematic detailed in Figure 10.1 portrays the policy-shed framework pursued in this study. Providing such a framework demarcates a generalized pathway that might be pursued by others though one would assume that due alteration and adaption would be necessary contingent on the domain policy being study. The framework is composed of several component parts dedicated to the regulatory code extraction with associated spatial and locational characteristics. Subsequently these rules were codified and the descriptive texts were ingested into a geodatabase along with the requisite spatial information. One important finding from this study was the realization that beginning the process with the geography had significant advantages in terms of efficiencies as opposed to the actual route taken which was to begin the process by characterizing policy and the policy attributes. This is a saving in both labor and time but also in the better encapsulation of how to proceed through the policy-shed process.

Figure 10.1: A Policy-shed Framework Flow Schematic

Subsequently, the geodatabase and GIS components were conjoined to several add-ons through APIs which enabled the mapping interface and brushing and linking capabilities along with an interactive dashboard. While this policy-shed conceptual model was successfully implemented as part of this doctoral study, the system has not undergone a real-world implementation and as a result the system has not been stress-tested to identify unknown deficiencies in the operation of the platform. While no end-user was specifically identified it would be valuable to explore the

solid waste trash platform capability further for multiple counties and for alternative small policy domains beyond solid waste. One could envisage the value of this system being to city planners, engineers, and the legal system grappling with the day-today operation of a seemingly chaotic and complex regime. Such extensions lie beyond the scope of this study but in addition to the findings of this study such reflexivity would be valuable in improving and strengthening the system. Given the ability of the system to combine and merge multiple jurisdictional and administrative it is also intriguing to consider using the policy-shed approach to identify meaningful and optimal administrative boundaries relevant to a whole slew of bureaucratic procedures ranging from electoral redistricting to planning zones to economic communities.

Ultimately, the policy-shed platform was designed to help explore, understand, and contribute to what is entailed in determining and assigning space to public policy. In doing so, the solid waste regulatory system was examined for Monongalia County, West Virginia, and ArcGIS Online and numerous APIs were linked to the database. Regulatory and best practice rules were extracted from text-based documents containing solid waste code and were codified and ingested into a database. An interactive dashboard was created that provided access to the GIS, regulatory database, and platform functions including map display and brushing and linking capability. The policy-shed platform enables user enabled queries of the database based on location or by regulatory code. Maps can be produced, analytics applied, and the brushing and linking capability provides a powerful exploratory environment for examining the solid waste regulatory system.

An examination of the solid waste industry for Morgantown using this platform raised interesting insights into the spatial nature of solid waste disposal. Mapping the various regulations identified the spatial patterning of the regulatory codes but also distinct anomalies. Thus, the mandated recycling for Morgantown can be clearly discerned because it surpassed the 10,000-population threshold, but despite the continuous urban sprawl into adjacent areas, alternative recycling programs were permissible to jurisdictions just outside of the Morgantown boundary. But even then, the differential between residential and business structures created differing recycling regimes within Morgantown and the idiosyncrasy of multiple occupancy residential structures which were also landlord owned businesses further complicated these rules. The effect of historical agreements concerning haulage routes permeates the rules. These agreements

are made more difficult to appreciate because many are based on verbal agreements and operate according to historical practice. Other spatial anomalies exist as with the peninsula type boundary extension to the south of Morgantown that incorporates the Super Walmart located there and which has differing waste disposal practices. Differing solid waste protocols can also be seen based on whether entities are federal complexes such as the National Energy Technology Laboratory or the Federal Correctional Institution. In the case of Morgantown Municipal Airport, multiple jurisdictions apply. Even medical facilities, such as hospitals, can reflect differing waste protocols as demonstrated by comparing the policies JW Ruby Memorial hospital, the WVU School of Medicine teaching hospital, and Monongalia Health Hospital. As a result, many entities have overlapping or multiple regulatory codes that differ based on the applicable jurisdiction or authority.

In conclusion, against the backdrop of international, national, state, and local public policy surrounding solid waste system, the very real complexity of the spatiality and geography of the regulatory code becomes very apparent. While public policy is under continued scrutiny to determine its effectiveness and value, the lack of a foundational spatial base significantly complicates the evaluation process. While the interrelationships between public policy and its spatial extent are fraught with complexity it is suggested here that a GIS-based policy-shed approach is one effective way to address the geographical shortcomings of small p policy regulatory code. The seeming diminution and lack of acknowledgement of the role of space in public policy is significant because the spatial manifestation of policy, and especially ‘small p’ policy, is either simplified to the point that it applies broadly to ‘everywhere’ and is ignored until legal spatial conflicts emerge.

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