Notational systems / Transforming infrastructures

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Abstract   Maps are inherently reductive, abstract representations of our environment. They create invisible boundaries, de-limiting zones for cultural action. This is also their power – maps reveal the hidden agendas of their authors, but they also seek to make legible and communicate a mentally abstract notion of the environment. Focusing specifically on cities, architects have a history of invading the geographer's turf, seeking to undermine (and capitalize on) the map with innovative representational and notational systems to characterize the city's complexities. These become the basis for future architectural action, effectively merging the translation process of site analysis with the design itself. This lineage of investigation into the city, breaking down and re-coding elements and spaces, extends from Debord's *Guide Psychogeographique de Paris* and Rowe and Koetter's *Collage City*, through Venturi, Scott-Brown and Izenour's *Learning from Las Vegas*, to Kuroda and Kaijima's *Made in Tokyo*. The project outlined in this paper seeks to build on this lineage by using systems of notational and analytical representation, examining infrastructure to reveal an invisible evolution of change, outlining the traces left by the mapmaker's hand and in the city itself.

Water, as a piece of infrastructure in the city, is almost always the spur of development. People are willing to live in swamps, drain land, control floods and pretty much risk their lives in order to have access to this resource. However, maps of water systems are fundamentally fragmented, illustrating pieces of what is essentially invisibly linked and sensitively dependent on our culturally embedded use at a local level.

Albuquerque, New Mexico, began as an agricultural community building on a hybrid of local and imported cultural traditions of irrigation from Moorish Spain to the local Pueblos, shaping the way land was distributed along the river. The city grew from Pueblo to Spanish fort town to outpost of the Wild West to tuberculosis retreat to POW camp and nuclear weapons development facility to the city it is today. Albuquerque is also a desert town: water is not a simple life-giving resource - flash flooding created dramatic shifts in the urban landscape, periodically eradicating whole sections of the city. By analyzing and remapping the historical shifts, growth, and remnants of the infrastructure of water as the city transformed through history, this paper explores alternate representational systems to suggest strategies that might capitalize on this infrastructure.

Fig. 1 City of Water
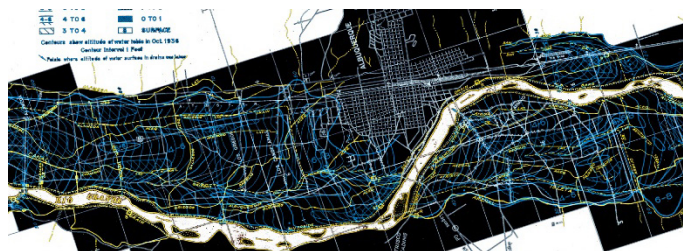
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Introduction

Robin Evans, discussing the translation from drawing to building, states: "Recognition of the drawing's power as a medium turns out, unexpectedly, to be the recognition of the drawing's distinctness from and unlikeness to the thing that is represented, rather than its likeness to it, which is neither paradoxical nor as dissociative as it may seem." (Evans, 1986, p. 154) A parallel example to this is musical composition as a translational system for the performance of music. The inherent understanding that a work intended to be listened to or played can be translated into a drawn system is already a leap in cognitive understanding. But that this system, because of the rules it contains, can then subdivide individual melodic strains so that, when played, these individual notations can coalesce into a whole work as intended by the composer is a feat in the notation's ability to provide coherence through communication. Any musician will tell you, however, that the act of "playing" a piece of music is not a translation in the precise definition of the word. Ambiguities are present in any composition, leaving gaps in understanding, or more importantly, potentialities in the ability of the performer to change the intentions of the music to suit their own purposes. This is similar to what Evans describes as, "…the locale for subterfuges and evasions that one way or another get round the enormous weight of convention that has always been architecture's greatest security and at the same time its greatest liability." (Evans, 1986, p. 186) Notation, as it relates to both musical composition and the architectural drawing, has power because of its authority to translate and at the same time to subvert that authority.

Stan Allen, attempting to unpack the definition of notation systems, describes them as, *"…'abstract machines' capable of producing new configurations out of given materials…. Each notational system articulates a specific interpretive community, a loosely bounded collective domain. The abstraction of notation is instrumental, and not an end in itself."* (Allen, 2000, p. 32) Notational systems, for the purposes of this paper, are broadly defined as any and all visual means of translation (as defined by Evans (1986, p. 154)) governed by systemic rules. This differs from Allen's definition by borrowing from the open-ended meaning of translation implied by Evans. The significance in beginning to contemplate any drawing as an act of notation is that these systems often capitalize on the ambiguities created by the system of abstraction and the freedom to act independently outside of the rules imposed. The following project could be called an exploration into the notational system and possibilities of a map, while also seeking to examine the architectonic potentialities revealed through this investigation.

Notational Interpretation - Mapping

Maps make visual what can be difficult to grasp on the ground. As Denis Cosgrove elaborates in the introduction to his book *Mappings*, "To map is in one way or another to take measure of a world, and more than merely take it, to figure the measure so taken in such a way that it may be communicated between people, places or times." (Cosgrove, 1999, p. 1-2) To map is to register, to inventory, to take stock of what is *there*, in some way to better understand the relationships between things. A map, like any system of representation, is also a reduction of the real world in an effort to promote communication, but more than that a map has the power to delineate difference or control its own ambiguity. Cosgrove goes on to discuss the power of maps:

"Acts of mapping are creative, sometimes anxious, moments in coming to knowledge of the world, and the map is both the spatial embodiment of knowledge and a stimulus to further cognitive engagements….Their apparent stability and their aesthetics of closure and finality dissolve with but a little reflection into recognition of their partiality and provisionally, their embodiment of intention, their imaginative and creative capacities, their mythical qualities, their appeal to reverie, their ability to record and stimulate anxiety, their silences and their powers of deception." (Cosgrove, 1999, p. 2)

This paper and the accompanying project do not seek to negate, critique or analyze the power or control inherent in a map, but rather to capitalize on the representational system itself to re-map, revealing objects left behind or hiding within the ambiguity of the notation.

From Giambattista Nolli's map of Rome on, architects and architectural thinkers might even be notorious when it comes to appropriating the notational systems of mapping to reveal an understanding of the city. Guy Debord's direct appropriation of the map to reconceive it as a spatial sequence in *The Naked City* (1957) is already undermining the map as a notational system meant to give proximities and information in a spatial relationship. The arrows connecting pieces of this map of Paris back together disassociate and recombine the fragments of the collage together in an attempt to convey the perceptual relationships these places have to one moving through the city, borrowing from the artifact of the map to force the viewer to still use the notations left to re-associate the place indicated. Colin Rowe and Fred Koetter's work in *Collage City* using figure grounds re-maps the city in black and white – topography is all but eliminated in service to generating an understanding of the texture of the city, the space of a city. This technique allows them to make what might seem like disparate associations comparing cities in an effort to promote what they term "urban *poché*." (Rowe & Koetter, 1978, pp. 50-85) Robert Venturi, Denise Scott Brown and Steven Izenour in *Learning from Las Vegas* map and re-map the Strip to both analyze and convey a new kind of space in the city that is directional and vast (Venturi et al, 1977, pp. 3-33). These drawings range from figure ground to serial photography (placing themselves in relationship to Ed Ruscha's work[1]) to the diagrammatic overlays of dots and dashes inserted on a map of streets delineated as a series of lines. More recently the work of Momoyo Kaijima, Junzo Kuroda and Yoshiharu Tsukamoto in *Made in Tokyo* fragment the system of the map one step further by appropriating the template of a guidebook. Seeking out specific odd combinations within the city that could not be understood through a traditional map, these are strung together in book form to imply a larger understanding of what Tokyo is, in essence remapping Tokyo. Each building is strictly catalogued by locating it within the city as a black mark within a small fragment of the city outlined in a kind of postage stamp frame, below which is a kind of bare-bones axonometric where constituent elements are labeled, and a black and white photograph serves to elaborate the notation on the facing page. Labels are restricted to the axonometric drawings: exact placement is understood only through the verbal descriptions provided. (Kaijima et al., 2001)

Water and the City

Recognizing this lineage of precedents borrowing from mapping to shift or reveal an understanding of the city, this project began with a rather basic objective of visualizing the role of water in the city. Water plays an essential part in shaping any city, but it lies in an ambiguous territory of a map's notation. (Fig. 1) Typically water is shown as a blue ribbon snaking through a city, or a blue expanse that a city runs up to. The innocent blue so often applied to this complex and dynamic system belies its two-fold role within the city as a provider and as a destroyer. This blue shape also quickly makes static and fixed the dynamic nature of the system of flow. Certain kinds of maps isolate this system to better understand its complexities, but this isolation disassociates it from the dynamics of the city and its impact on the architecture/urban fabric. The analysis that follows seeks to reveal the relationship of water to the city, its role as the shaper of urban form. The initial choice of Albuquerque, New Mexico, to examine and challenge the role of water within the city using notational systems was based on the inherent complexity of visualizing water in a desert town, but also its historically visual way of expressing its relationship to water.

Albuquerque's origins are distinct: it was a Spanish city for far longer than it has been an American city. Following the Spanish land grants, Albuquerque was formed around an integrated irrigation and water distribution system of *acequias*[2] and their resultant land right plats that gave

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[1] Specifically with reference to Ruscha's self-published photo books such as *Sunset Strip* or *Twentysix Gasoline Stations*.

[2] An *acequia* is a gravity-fed, community-operated water course used in Spain and in the Spanish colonies.

pressure to the formation of long rectangular lots to assure access to water. The agricultural community built on a hybrid of local and imported cultural traditions of irrigation from Moorish Spain to the local Pueblos, shaping the way land was distributed along the river. The city transformed at the hand of many cultures, growing from Pueblo to Spanish fort town to outpost of the Wild West to tuberculosis retreat to POW camp and nuclear weapons development facility to the city it is today. Albuquerque is also a desert town: water is not a simple life-giving resource. Periodic flooding in the river valley led quickly to large earthwork projects and later damming up the river to help control the flow of water through the city. When the population boomed during WWII, the city grew out of the river valley floodplains and onto the mesas leading towards the foothills. Floods came not from the river, but off the mountains: flash flooding created dramatic shifts in the urban landscape, periodically eradicating whole sections of the city, also leading to large public projects to control the flow of water off the foothills.

The water systems existing in the city today are the result of the continuous evolution in the city, highlighting the conversion of a developed agricultural landscape into an urban fabric, and the conversion of the natural landscape into built form. The water systems perform as a whole, but are now made up of several independent organizations at the national, state, regional, county, and city and neighborhood level. At the national, state, and regional level, the Corps of Engineers controls development projects and the maintenance of their systems in the city through the Albuquerque Metropolitan Arroyo [3] and Flood Control (AMAFCA). Flood control is also maintained through the city level in the Department of Municipal Development's Storm Sewer Division. Flood control of the river is performed by independently maintained Corps of Engineers projects at the national and state level, and additionally through the region's river valley by the Middle Rio Grande Conservancy District (MRGCD). The MRGCD also manages all of the regional irrigation systems that divert water off the Rio Grande. At the neighborhood level, Spanish land grant rights to the acequia systems are still use, typically tapping into the MRGCD lines and controlling the flow of water at the neighborhood level. These rights predate and may overrule any limits set in place at the city, regional, state, or national level. Drinking water no longer comes from the underground aquifer beneath the city, but is pulled off the surface water of the river through a diversion project called the San Juan-Chama Diversion Project channeling water from southern Colorado to bolster the flow needed to supply drinking water to the city off the river. This project is maintained by the county and inter-state alliances with Colorado, but the distribution of water and the systems within the city limits are maintained by the Albuquerque Bernalillo County Water Utility Authority (ABCWUA), who also maintains the separated sewage system, which treats wastewater that is eventually pumped back into the river.

The evolution of changes to these systems and the junctions between them is not always neat or clean, as these systems have grown in response to things, without a kind of master plan underwriting decisions. The number and kind of authorities in place has also evolved and changed over time, so that the institutional memory can be remarkably short. The result of all this is that there exists a kind of strange vocabulary within the city of solutions made, changed, forgotten, occasionally built over or butted up against. The series of maps in (Fig. 2) begin to reveal the evolution of change in the city. These maps were created by first seeking out all available historic maps of the city from relevant authorities – The American Soil Survey, the United States Geographic Survey (USGS), the MRGCD, the ABCWUA, the Army Corps of Engineers, AMAFCA, and the City of Albuquerque. Recognizing that the inherent bias and accuracy within the map was as relevant as the data it contained, these maps were overlaid using rough decade indicators to group maps together. All lines related to waterways (as arroyos, ditches, streams, storm sewers) or water bodies (as ponds, lakes, detention or retention ponds) were traced over and composited together for each decade. Attention was paid to whether the systems were indicated as

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[3] An arroyo is a dry creek or stream bed (like a gulch, wash, *wadi*, or *rambla*) that temporarily or seasonally fills and flows with rain.

dry or wet, and were notated as dashed lines if considered dry. If the line continued to exist in the following decade, the color shifted to grey. If the line had vanished this was indicated by an alternate dash and then erased in the following decade. The river was continuously retraced and colored blue – the visual anchor of these systems. Any water bodies were also indicated in blue. The result outlines the connected and designed network of flow through the city.
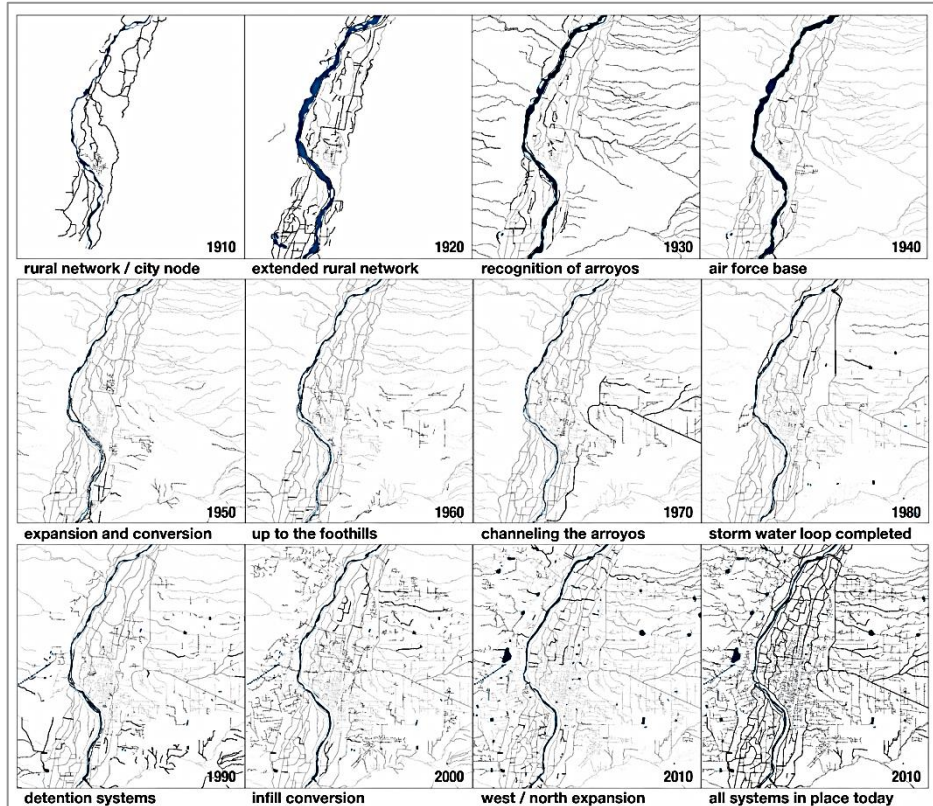

Fig. 2 Albuquerque – City of Water

This method of representation was intended to connect the various water systems in a single cohesive drawing. Tracking change was of primary significance to this analysis, and it revealed several interesting biases within the original historic maps. In (Fig. 2), in the decade of 1930, the surrounding arroyos in the city seem to appear dramatically over 10 years. These were in existence far before the map was drawn, but the relevance to the mapmaker/city was not apparent until the city began to expand onto the mesas beyond the river valley. The river also appears to wax and wane from 1910-1940 in this figure. This is due in large part to a given surveyor's take on what constituted "river." For example, the map that traced the outline provided for 1910 came from a Soil Survey map, which analyzed soil types and water tables in the valley. This map is careful to denote "bosque" or "sand bar" as distinct from the flow of water. The maps for 1920, 1930 and 1940 do not distinguish between these and paint them all as river, giving the sense that the river is much larger than it is. This method of demarcating dry creek beds and flood zones as equivalent notationally to waterways with active year-round flow is key to understanding many of the planning decisions made over the course of the city's history and its more complex relationship to water.

Changing Infrastructures / Notations

The next series of maps generated (Fig. 3, Fig. 4) begin to analyze the maps generated in (Fig. 2). The notational system created for the maps in (Fig. 2) is in response to the historic maps from which these drawings trace. However, the map of the city's water can be broken down by the nature of the lines represented. So, for instance, the systems can be read understanding that these are all an equivalent continuous system of lines of equal weight (Fig. 3), or can reveal what is seen above ground and below, or taking into consideration the relative dryness of each system (Fig. 4). Each of these drawings begins to reveal a radically different city: defined by networked infrastructures, revealing the displacement and erasure of natural arroyos, or highlighting a new landscape valued by its relationship to the prevalence of water.
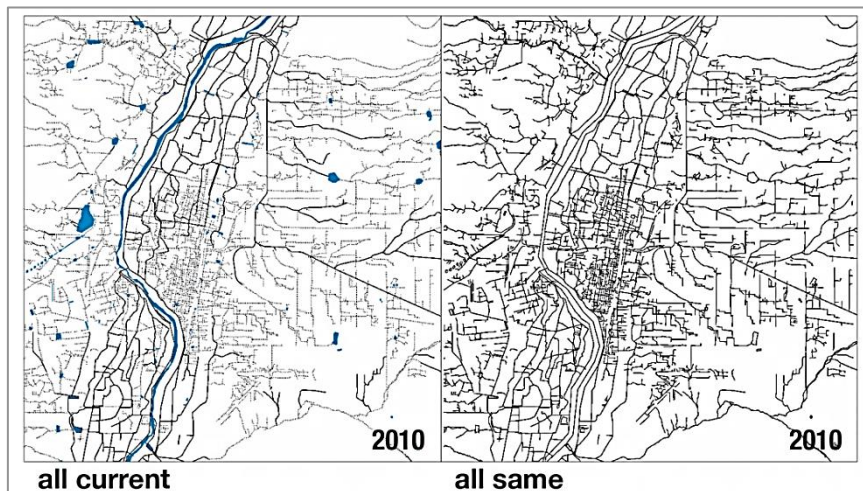

Fig. 3 Albuquerque – From Historic Amalgamation to Unified Network

The intentional or unintentional notation of various dry systems as wet systems permeates all of the historic maps taken into consideration. One could say this notational same-ness has become even more marked in recent years. In all maps from the last 10-15 years studied (especially those provided by the City), while the river has become a much narrower ribbon through the city, detention ponds, arroyos, and seasonal acequias are all boldly marked in an equivalent blue. It suggests a city teaming with streams and smaller bodies of water that belie the reality of vacant space and networks of dirt paths this blue has come to represent. The actuality of this strange infrastructurally networked space within the city is ripe with unnoticed potential.
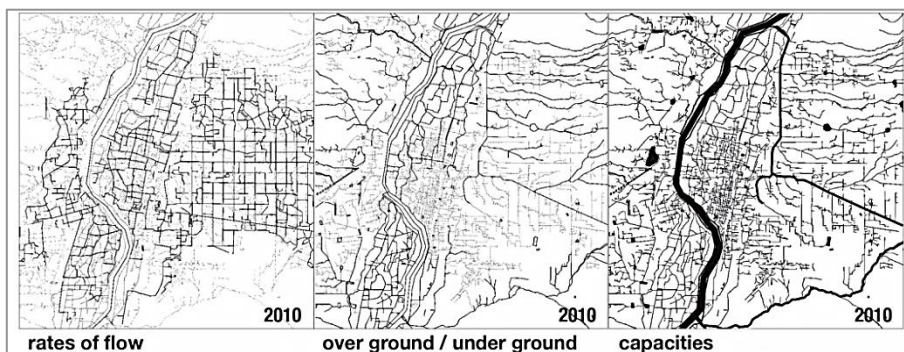

Fig. 4 Unpacking and Re-presenting the Infrastructural Network

While (Fig. 2) illustrates a synthesis of systems, and how they have grown over time, these maps fail to visualize the pieces of these systems that are left behind – that are absorbed or left as a kind of artifact within the city. Considering what has inevitably been forgotten, left behind, or erased in the landscape, (Fig. 5) illustrates the two most basic changes over the course of time in the city – the conversion of the natural arroyos, and the slow truncation and erasure of the acequia system. These systems all act as a kind of disaster mitigation or irrigation distribution, keeping in check the vagaries of the natural water systems coursing through the city, but their performance as protection or irrigation does little to enhance the urban fabric. These systems act as barriers, divides and vacancy, breeding a kind of fear or a polite look-the-other-way attitude to the infrastructure that makes the city unique and particular.
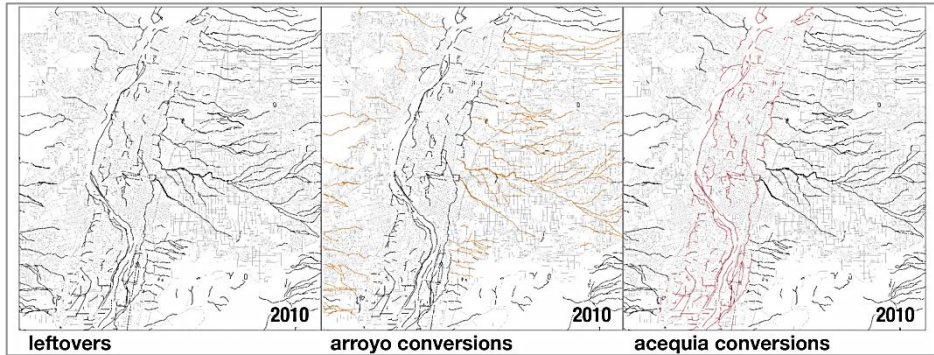

Fig. 5 An Evolution of Conversion and Change

(Fig. 6) illustrates examples of what can be found on today, the result of the evolution in the junctions between systems or their conversion. On the left side of (Fig. 6), the varied spaces/voids left in the city are shown, highlighting the conversion of arroyos and the remnants of the dormant acequias some of which now dead end into city. On the right are the various artifacts left in the urban landscape, highlighting the stopgap solutions often employed, along with still vital agricultural artifacts that thread their way through the city. The evolution of these infrastructures is ongoing, and this study is meant to underscore the idea that this vital piece of the city, what is fundamentally shaping the city, will continue its clunky progress primarily because of perception.

Fig. 6 Unpacking and Re-presenting the Infrastructural Network

Conclusions

The possibilities of these systems lie in part on their eventual transformation into a future infrastructure that may not depend on the existing systems in place. Another possibility lies in reimagining what these systems could be by taking radical advantage of what might be called the notational residue generated by these maps. Underlying all of this potential is the fact that the water systems in any city drive the way the city is shaped, so by building on these systems, instead of perhaps the street networks or land parcels overlaid, any city could best respond to future change by recognizing the armature these systems make.

While controversial, Paul Rudolph's vision for the Manhattan Expressway, Louis Kahn's vision for Midtown Philadelphia, or Cedric Price's vision for the Potteries area in Staffordshire all build on re-perceiving and re-presenting an existing (or proposed as in the case of Rudolph) infrastructural system as an advantageous new framework to spur design, program, and new life. While similar to Rowe and Koetter, Venturi, Scott Brown and Izenour, or Kaijima, Kuroda and Tsukamoto in that they all invested great effort to analyze and represent the systems at work in the city, these architects built directly from their understanding of the systems in place to construct their proposals – Rudolph's extrusion of the basic site section, Kahn's notational shifts of traffic distribution, and Price's tracing of aerial photographs to produce the master diagram. This lineage of architects rethinking infrastructure will serve as the foundation for the next step in this exploration. A leap in scale is required to begin to examine how the traces of the arroyos and acequias are still present in the urban landscape, to better comprehend how these traces could be capitalized on or revealed.

Borrowing from the analysis generated in these maps, radically new program can begin to fill, overlay, acknowledge, raise awareness, and build on what makes this city unique. Will these trace infrastructures take on the kind of preciousness seen in the Roman aqueducts left in the landscape across Europe? Can these traces be subsumed by a radically new housing prototype? Can these systems generate a radically different public space? What possibilities imagined by the systems in Albuquerque could translate to other cities? The analysis done on Albuquerque is, by its nature, notational. The methods used to create these maps, and the methodology behind the notation introduced also could easily apply to other cities, building a larger body of knowledge examining how individual cities deal with a system universal to human habitation.

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