Title

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Abstract: This paper analyzes how contemporary mapping technologies in urban planning reproduce colonial land logics and redlining, sustaining environmental injustice while masking structural inequality through technoscientific claims of neutrality.

INTRODUCTION

Urban planning technologies, particularly GIS-based mapping systems,[1] risk assessment models, and zoning algorithms, are often celebrated as neutral tools that enhance efficiency, promote sustainability, and enable evidence-based decision-making. These systems increasingly guide how cities interpret spatial data, assess environmental risk, allocate public resources, and determine where infrastructure is built, or redevelopment occurs. However, the appearance of technical neutrality obscures deeper historical continuities. Contemporary mapping technologies operate within spatial regimes structured by racialized property relations and settler colonial land logics. As a result, planning tools that appear purely technical may still reproduce longstanding patterns of spatial inequality.

This paper asks how contemporary urban mapping and planning technologies reproduce settler colonial spatial logics, particularly the "logic of elimination," and what environmental injustices do they sustain in historically redlined and Indigenous-displaced communities. Los Angeles provides an important case study because its spatial organization reflects both twentieth-century redlining and ongoing environmental inequalities. I argue that digital planning tools reproduce earlier forms of spatial governance by encoding land as property, risk as quantifiable threat to capital, and growth as a universal good. Through an environmental justice and settler colonial framework, this reveals how technoscientific systems preserve structural inequities while continuing to claim objectivity. This analysis highlights how seemingly neutral planning technologies can function as contemporary infrastructures of spatial inequality. This work is in partial fulfillment of the ENGR184 course using the blueprint curriculum in Ref[2,3] and captured in a collection [4].

HISTORICAL CONTEXT: REDLINING & SETTLER COLONICAL SPATIAL LOGIC

The racialized inequalities visible in Los Angeles today are not incidental, but the result of historical planning decisions and housing policies that shape urban development patterns. In the 1930s, the Home Owners' Loan Corporation[5] produced residential security maps that graded neighborhoods according to investment risk. These maps, reinforced by policies of the Federal Housing Administration, systemically devalued Black, immigrant, and working-class communities.[6] These historical planning practices established spatial patterns that continue to influence contemporary housing markets, infrastructure development, and environmental risk distribution. In Los Angeles neighborhoods such as Boyle Heights and South Central, redlining restricted access to investment and homeownership, shaping patterns of segregation and uneven infrastructure development that remain visible today. The risk was not simply financial, but it was racialized and spatialized, as land value became a proxy for social worth. As a result, entire neighborhoods were denied access to investment, homeownership opportunities, and public infrastructure.

Settler colonial theory deepens this analysis. As argued by Patrick Wolfe, settler colonialism is a structure rather than a singular historical event. Its organizing principle, the "logic of elimination,"[7] seeks the erasure or displacement of Indigenous presence to secure land as property. This transformation of land from relational territory into commodified property became a foundational principle of modern land governance. Thus, they view land as a shared

territory but ultimately treats it as property to buy and sell within market-based systems. Therefore, redlining not only discriminated against marginalized communities but also codified a property-centered ontology[8] that continues to shape technoscientific spatial governance and contemporary planning technologies.

TECHNOSCIENTIFIC SYSTEMS AND COLONIAL SPATIAL LOGIC

Contemporary urban planning relies heavily on Geographic Information Systems (GIS), predictive models, and algorithmic zoning tools. These technologies process large datasets to guide planning decisions about land use, infrastructure investment, and environmental risk management. In Los Angeles, climate vulnerability maps identify neighborhoods at high risk of heat exposure and pollution, while zoning models prioritize areas for redevelopment based on density metrics and projected property value growth. Infrastructure siting decisions often rely on cost benefit analyses tied to land valuation. Because these systems rely on historical datasets and property valuation of metrics, they often reproduce the same spatial hierarchies embedded in earlier planning practices.

Although these systems appear neutral, they embed on normative assumptions. Technoscientific planning frameworks frequently treat land primarily as an economic resource whose value is determined through market indicators such as property price, development potential, and investment return. For instance, the idea that land is primarily an economic asset; that risk is quantifiable in relation to capital exposure, and that growth equates to public good. The structural continuity of redlining is striking. Where redlining maps graded neighborhoods financially hazardous, contemporary risk models score areas by economic return and redevelopment potential. Where federal housing policies protect white property accumulation,[9] modern planning tools frequently protect investor confidence through predictive modeling.

As a result, algorithmic planning systems may unintentionally reinforce the same spatial inequalities they claim to address. When redevelopment priorities are determined through property value metrices or projected economic growth, historically marginalized communities, which are often shaped by earlier redlining policies, continue to be evaluated through frameworks that privilege investment potential over community wellbeing. Technoscientific efficiency therefore becomes a contemporary mechanism for reproducing spatial inequality. In this way, contemporary planning technologies do not simply reflect existing spatial inequalities but actively reproduce settler colonial land logics by encoding property value, investment risk, and growth-oriented development into the technical infrastructure of urban governance.

ENVIRONMENTAL JUSTICE IMPACTS

Environmental justice scholarship[10] demonstrates that the distribution of environmental harms is closely tied to historical patterns of urban planning and development. The pollution burdens, freeway siting, and industrial zoning disproportionately impact historically marginalized communities. In Los Angeles, neighborhoods shaped by redlining continue to experience elevated heat exposure, air pollution, and reduced green space. These neighborhoods also experience intensified urban heat island effects and higher exposure to freeway related air pollution, illustrating how historical planning decisions continue to shape present day environmental risks. As argued by Laura Pulido, environmental racism is not accidental but structurally produced through spatial governance.[11]

Planning technologies play a critical role in this reproduction. Infrastructure placement models often favor low-cost land, which frequently corresponds to neighborhoods that were historically devalued through racialized housing policies. Climate adaptation funding may prioritize areas with higher property value to protect economic investment, reinforcing development patterns that prioritize capital protection over environmental equity. Thus, environmental injustice is not merely a residue of past discrimination. Instead, it is actively sustained through contemporary technoscientific systems that continue to guide how resources, infrastructure, and environmental protections are distributed across urban space.

CRITICAL FRAMEWORK ANALYSIS

Beyond material harm, contemporary mapping technologies marginalize alternative epistemologies. Land-based knowledge systems rooted in reciprocity and stewardship are rarely legible within GIS frameworks, which prioritize quantifiable metrics such as property value, density, and projected revenue. When land is understood solely as a commodity, displacement becomes normalized as redevelopment. Indigenous futurity,[12] which is the possibility of enduring presence, conflicts with growth-oriented planning models. Justice, in this context, cannot be achieved

merely by adjusting datasets; instead, it requires questioning the ontological assumptions embedded in planning technologies themselves.

Standpoint theory further highlights how knowledge of production within technoscientific planning systems reflects the perspectives of dominant institutions rather than the communities most affected by environmental burdens. GIS datasets and predictive planning models are typically produced and interpreted by planners, engineers, and policy institutions, which means the lived experiences of historically marginalized residents are often absent from the data used to guide decision-making. Centering these community standpoints reveals forms of environmental harm, such as cumulative pollution exposure or displacement presses. These may remain invisible within technical metrics but are widely recognized within community knowledge.

The theory of change framework also suggests that addressing these inequities requires identifying leverage points within planning systems themselves. Rather than treating environmental injustice as the result of incomplete data, this perspective highlights the importance of transforming how planning technologies are designed and governed. Integrating participatory mapping practices and community generated data into GIS platforms could help shift technoscientific planning from reinforcing existing spatial inequalities toward supporting more equitable urban development.

COMMUNITY ENGAGEMENT AND STRUCTURAL INTERVENTION

Addressing these dynamics demands more than policy reform. It requires restructuring technoscientific governance. One intervention would be the establishment of participatory GIS governance boards composed on community members, Indigenous representatives, and environmental justice advocates. Such bodies could review zoning algorithms, climate models, and infrastructure proposals before implementation. By involving residents directly in the evaluation of planning technologies, these governance structures could help ensure that local knowledge and lived experience inform urban decision-making.

Additionally, municipalities could mandate historical redlining overlays in all redevelopment proposals,[13] requiring planners to demonstrate how projects disrupt rather than reproduce spatial inequality. Universities like the University of California, Los Angeles could partner with the community and local advocacy groups to develop publicly accessible environmental burden mapping platforms that center resident knowledge alongside quantitative data. These collaborative mapping projects could allow communities to document pollution exposure, heat vulnerability, and displacement pressures that may not be captured within conventional planning datasets.

Importantly, community engagement must move beyond consultation toward a co-governance model in which communities share decision-making authority over planning technologies and redevelopment priorities. Justice-oriented epistemologies cannot be appended as policy add-ons; they must shape the design and authority of planning technologies. These participatory approaches could also inform municipal planning policies and environmental justice initiatives by providing decision makers with community-centered data. Through participatory governance and community centered data practices, urban planning systems could begin to address historical spatial inequalities rather than inadvertently reproducing them.

CONCLUSION

Contemporary urban planning technologies present themselves as rational, data driven, and future oriented. Yet they are embedded within historical structures of settler colonial land dispossession and racialized property governance. By reproducing property-centered logic under the guise of neutrality, GIS systems and planning algorithms sustain environmental injustice in historically marginalized communities.

If settler colonialism is an enduring structure, then technoscientific spatial governance is one of its modern infrastructures. Taken together, these dynamics demonstrate how planning technologies, historical land governance, and environmental risk distribution are deeply interconnected rather than separate systems. Environmental justice requires not only redistributive reform but epistemological transformation. Recognizing these dynamics is a necessary step forward towards developing planning systems that prioritize environmental justice and

community wellbeing rather than purely economic optimization. This includes rethinking how land, value, and community permanence are encoded into the technologies that shape urban futures.

REFERENCES

1. *What is GIS? | Geographic Information System Mapping Technology*. https://www.esri.com/en-us/what-is-gis/overview (accessed 2026-02-25).

2. Lee, Ethan, et al. "Education for a Future in Crisis: Developing a Humanities-Informed STEM Curriculum." arXiv preprint arXiv:2311.06674 (2023).

3. Sergio Carbajo, Nurturing Deeper Ways of Knowing in Science, Issues in Science & Technology, 2025, v. 41, n. 2, p. 71, doi. 10.58875/jkrw4525

4. Carbajo, S. (2026). Queered Science & Technology Center: Volume 4. Queered Science & Technology Center, 4. Retrieved from https://escholarship.org/uc/item/0zb930m0

5. *Jewish Histories in Multiethnic Boyle Heights: The Home Owners Loan Corporation and the Redlining of Boyle Heights*. Jewish Histories in Multiethnic Boyle Heights. https://scalar.usc.edu/hc/jewish-histories-boyle-heights/the-home-owners-loan-corporation-and-the-redlining-of-boyle-heights (accessed 2026-02-25).

6. PhD, B. M.; Analyst, S. R.; Franco, J.; Specialist, S. G.; NCRC. *HOLC "redlining" maps: The persistent structure of segregation and economic inequality » NCRC*. https://ncrc.org/holc/ (accessed 2026-02-25).

7. Kauanui, J. K. "A Structure, Not an Event": Settler Colonialism and Enduring Indigeneity. *Lateral* **2016**, *5* (1). https://doi.org/10.25158/L5.1.7.

8. Guarino, N.; Welty, C. A Formal Ontology of Properties.

9. *Racial Differences in Economic Security: Housing*. U.S. Department of the Treasury. https://home.treasury.gov/news/featured-stories/racial-differences-in-economic-security-housing (accessed 2026-02-25).

10. *Home | Yardi Scholars for Environmental Justice Program*. https://yardischolarsej.ucsb.edu/ (accessed 2026-02-25).

11. *Environmental Justice*. laurapulido_2022. https://www.laurapulido.org/blank-4 (accessed 2026-02-25).

12. *Unfolding Futures: Indigenous Ways of Knowing for the Twenty-First Century | American Academy of Arts and Sciences*.https://www.amacad.org/daedalus/unfolding-futures-indigenous-ways-knowing-twenty-first-century (accessed 2026-02-25).

13. Xu, W.; Markley, S.; Bronin, S. C.; Drogaris, D. A National Zoning Atlas to Inform Housing Research, Policy, and Public Participation.

14. Tijerina, J. Finding a Path Forward in 2019 and Beyond.