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The Polygon and the Perimeter: Algorithmic Failure and the 2025 Eaton Fire

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Abstract: The 2025 Eaton Fire's alert algorithm failed West Altadena, a historically Black, redlined neighborhood on Tongva ancestral land, leading to 19 deaths. This paper argues the failure was epistemological, not technical.

INTRODUCTION

On the night of January 7, 2025, a fire began in Eaton Canyon in the San Gabriel Mountains and exploded west into Altadena, California. The fire tragically killed at least 19 people and destroyed more than 9,000 buildings, and is now the fifth deadliest and second most destructive wildfire in California history (Wikipedia, 2026). Its death toll was not distributed evenly. 18 of the 19 victims lived west of Lake Avenue, the historically Black, working-class half of Altadena. For these people, evacuation alerts arrived more than eight hours after the fire's ignition, and in some cases, they never arrived at all. The notification system is powered by Genasys, a multichannel public safety warning system. (Blood & Freking, 2025). In February 2026, the California Attorney General opened a civil rights investigation into whether race, age, or disability discrimination shaped the disproportionate response (NBC Los Angeles, 2026).

Growing up in the Los Angeles area, I watched the fires spread with a helplessness that felt personal. As a child of immigrants and a person of color studying the systems built to "protect" us, I felt implicated as a future engineer. The question driving this paper is one I could not stop asking: not whether the algorithm failed, but exactly what it was built to know and whose lives it was designed to protect.

It is important to note that climate change and global warming is intensifying fire behavior at unprecedented levels. As extreme wildfires grow more frequent and more damaging, the government has increasing accountability to build robust solutions to protect their citizens from harm. The rise of automated emergency responses at scale improves efficiency, yet it is vital to emphasize equal protection. There must be public accountability for the failure of the Eaton Fire's alerts, as situations like these may only become more common in the future.

This work is in partial fulfillment of the ENGR184 course using the blueprint curriculum in Lee et al. (2023) and Carbajo (2025), and is captured in a collection (Carbajo, 2026).

METHODS

This paper is a critical case study of the Genasys Protect alert polygon algorithm as deployed by Los Angeles County during the January 2025 Eaton fire, applying the following frameworks.

Harding's (1992) concept of standpoint epistemology and "strong objectivity" provides the primary

lens for examining what standpoint to evaluate automated alert systems. Noble's (2018) account of how algorithmic systems reproduce structural inequality under the appearance of technical neutrality explains Genasys's default user assumptions. Collins's (1990) theorization of the "outsider within" illuminates the forms of relational knowledge that polygon-based systems are incapable of encoding. Finally, Arvin, Tuck, and Morrill's (2013) analysis of settler colonialism as ongoing epistemic dispossession, extended through TallBear's (2013) critique of technoscientific governance, grounds the argument that wildfire risk models inherit a definition of fire-prone landscape shaped by colonial land management rather than ecological fact.

The analysis draws on Genasys's publicly documented system architecture (Genasys, 2025; CBS News, 2025), the independent McChrystal Group after-action report commissioned by the LA County Board of Supervisors (McChrystal Group, 2025), the UCLA Bunch Center data brief layering 2020 Census data, 1939 HOCL redlining maps, and Cal Fire perimeter shapefiles (Frasure et al., 2025), the California Attorney General's civil rights investigation filings (NBC Los Angeles, 2026), and documentation of Tongva, Chumash, and Fernandeano Tataviam cultural burning practices and their colonial suppression (Environmental Policy Innovation Center, 2025; Jack4thePlanet, 2025; PBS NewsHour, 2021).

RESULTS AND INTERPRETATION

1. Algorithmic Exclusion

The Genasys Protect system generates geographic alert polygons by drawing automated boundaries around projected fire hazard zones. It takes into account population density data, modeled fire behavior, and zone templates established in advance by county planners (Genasys, 2025). "There isn't a person sitting at a desk sending the alert," as a Genasys spokesperson said during the Eaton Fire response (CBS News, 2025). Because the alert system becomes automated, this changes the nature of responsibility. Harm can be framed as an unfortunate system failure while still making life-or-death decisions. When the cell towers failed and residents became unreachable, this shows that the system is built on a fragile model of communication that assumes stable infrastructure during disasters that could easily destroy it. Furthermore, the efficacy of the system is contingent on its data accurately representing who is present in a given area. In West Altadena, it did not.

What standpoint theory reveals, when applied to this failure, is the cluster of assumptions the system treats as universal. Harding's (1992) critique of "weak objectivity" describes how knowledge that is produced from dominant social positions is presented as neutral, but has hidden biases. We see this with the Genasys architecture, which assumes that residents have a fixed home address, are registered with county emergency systems, and are digitally reachable. This likely describes those who designed the system: someone who is housed, English-speaking, and legible with the government. But what about the elderly residents without a mobile phone, or undocumented and unhoused people that have no way of getting in the system, or renters that have no reason to register with the county? Or, what about someone visiting the city to see family, or someone that commutes there for work? In a sense, the system equates protection with legibility to the state. Noble (2018) observes that these assumptions are not the product of malicious intent but of structural invisibility. Those that are not the default user are unseen by the system. Oppression comes not in the form of explicit exclusion, but in the normalization of one specific social position

as the norm.

Collins (1990) provides an alternative perspective by introducing the idea of the "outsider within," in which Black West Altadena residents are structurally marginalized in America but possess knowledge that the algorithm does not. According to Collins, marginalized communities can produce better knowledge about survival conditions because they are forced to navigate systems that do not serve them. The residents are aware of the unofficial social networks in their neighborhood, such as which elderly neighbors lack smartphones and which households are undocumented and unable to register with government systems. Furthermore, geographic proximity and social vulnerability are not the same. Two households in the same region might have completely different abilities to evacuate. A polygon-based automated system is unable to encode this kind of distributed, relational, and living geography-based knowledge. The algorithm didn't fail because it lacked intelligence, but because it only recognized one kind of intelligence as valid.

2. Historical Exclusion

We can observe a deeper problem based on UCLA Bunche Center's spatial analysis. When overlaying 1939 HOLC Residential Security Maps that classify West Altadena as "Definitely Declining" against the 2025 Eaton Fire perimeter and the distribution of notification delays, there is a near-perfect correspondence (Frasure et al., 2025). The same neighborhoods that are receiving alerts last are the ones that have been systematically denied mortgage access, infrastructure investment, and property insurance for decades. This overlap is not coincidental, it reflects how past policy decisions have shaped present day exposure. Insurance withdrawal and underinsurance in historically redlined areas might have discouraged fire-hardening improvement, which creates a self-enforcing feedback loop of vulnerability. 61% of Black households in Altadena were located within the Eaton Fire perimeter, in comparison to 50% of non-Black households. Furthermore, nearly half of Black households were destroyed or majorly damaged. 18 out of 19 deaths occurred in West Altadena and the average age of victims was 77 (NBC Los Angeles, 2026).

Harding (1992) argues that the dominant standpoint produces knowledge that is framed as universal but is truly partial, a form of "weak objectivity." The Genasys polygon does exactly this, where everyone is grouped into a geographic boundary with equal efficiency while silently, they inherit the unequal geographies that colonial housing policy has produced. Applying the HEADS UP framework's category of ahistorical thinking (Machado de Oliveira, as cited in ENGR184 course materials, 2024), the system formulates the problem of who is at risk without accounting for historical processes that determined the risk distribution. The McChrystal Group's after-action review identified "outdated policies, inconsistent practices and communications vulnerabilities" as a systemic pattern across the alert failures, not solely an isolated glitch that can be easily fixed (McChrystal Group, 2025).

3. Colonial Exclusion

Beyond the missed alerts, the wildfire risk models that decide where to draw these polygons use information about the environment that is shaped by colonial land management. The fuel loads that caused the 2025 fire to be so catastrophic, like thick chaparral and invasive species, are not natural features of the Southern California landscape. They are the product of prohibiting Indigenous burning practiced by the Tongva, Chumash, and Fernández Tataviam for thousands of years. This ban started with Spanish Governor Arrillaga's 1793 proclamation and lasted through the U.S. federal total-suppression policy (Environmental Policy Innovation Center, 2025; PBS

NewsHouse, 2021). Before colonization, these nations would use controlled burns to keep coastal grasslands healthy, suppress dense chaparral, and create fire-resilient ecosystems (Jack4thePlanet, 2025).

Arvin, Tuck, and Morrill (2013) argue that settler colonialism is not just land dispossession, but also the simultaneous suppression of Indigenous knowledge systems. A good example is the prohibition of Indigenous burning. It removed Indigenous people from the land while also voiding their knowledge practices through which the land was maintained. When wildfire risk models exclude Tongva, Chumash, and Fernandeano Tataviam land knowledge, then they inherit a definition of “fire-prone” that treats colonial landscapes as natural.

TallBear (2013) extends this critique to technoscience governance, which is the institutional structures that determine which knowledge systems get incorporated into scientific and computational models. She argues that this leads to a reproduction of settler logic, where Indigenous knowledge is not treated as scientific. There is a clear consequence of this during the fires, where a Tongva-managed acre near Eaton Canyon, maintained through traditional vegetation practices, sustained significantly less fire damage when the 2025 fires occurred than surrounding unmanaged land (Jack4thePlanet, 2025). This outcome is proof that Tongva land stewardship produces fire-resilient landscapes. When the algorithm ignores proven knowledge by institutional choice and not scientific judgement, it is not being objective. It is actively choosing one knowledge system over another by modeling a landscape that has been shaped by 230 years of colonial suppression.

CONCLUSIONS

The HEADS UP framework (Machado de Oliveira, as cited in ENGR184 course materials, 2024) offers a diagnostic for the failures discussed in this paper. The Genasys system exhibits *hegemonic practices* by treating notifications sent to registered addresses as the universal standard. It *projects ethnocentrically* by assuming a propertied, smart-phone carrying resident as the default user. It *thinks ahistorically* by modeling fire risk on a redlined, colonially managed landscape without taking into account how that landscape was produced. It is *depoliticized* by presenting as a technical solution instead of a political decision of whose safety is urgent. Reform proposals that focus on adding cell towers and fixing software bugs offer *uncomplicated solutions* that do not address the root cause.

This paper proposes the following Theory of Change. There should be a redesign from the standpoint of the least legible residents. There should be mandatory non-digital backup policies, like door-to-door protocols or acoustic systems. Indigenous knowledge should be integrated into fire risk models. A wildfire notification system built from the standpoint of West Altadena would be a more rigorous and equitable system. Those marginalized should never be an edge case, but the center of what matters most.

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