Wildfire Resilient Landscapes Institute

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Urban Tree Renewal for Resilience (UTRR)
Closing the Urban Canopy Regeneration Gap

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Executive Summary

Urban tree canopy is increasingly recognized as critical infrastructure for climate resilience. Trees help moderate urban heat, improve air quality, regulate stormwater, and support ecosystem stability. In response to rising temperatures and environmental stress, many cities across California and the United States have expanded investments in urban forestry programs.

Despite these efforts, long term canopy recovery remains uneven. Many cities continue to experience declining canopy coverage or limited growth of replacement trees even after large scale planting initiatives.

One contributing factor may lie in the transition between tree removal and tree planting. Urban forestry programs typically treat hazard mitigation and canopy expansion as separate activities. Hazardous trees are removed to address safety risks, and replacement trees are planted to restore canopy coverage. However, the physical condition of the site between these phases often receives limited attention.

When a tree is removed, the stump, residual root system, and surrounding soil conditions frequently remain in place. These conditions can restrict rooting space and limit the ability of replacement trees to establish healthy root systems.

This policy brief introduces the **Urban Tree Renewal for Resilience (UTRR)** framework, which identifies stump removal and site restoration as the structural transition between hazard mitigation and canopy regeneration. By recognizing canopy renewal as a continuous lifecycle rather than a sequence of isolated actions, the UTRR framework highlights an overlooked management gap that may influence canopy recovery and the effectiveness of urban forestry investments.

Key Takeaways

• Urban tree removal programs often end after hazard mitigation, leaving sites structurally unprepared for canopy regeneration.

• Soil compaction, residual root systems, and limited rooting volume frequently limit the success of replacement plantings.

• The Urban Tree Renewal for Resilience (UTRR) framework identifies stump removal and site preparation as the transition phase between tree removal and canopy regeneration.

• Treating urban canopy management as a lifecycle system can improve tree survival, canopy stability, and long-term climate resilience.

The Urban Canopy Regeneration Challenge

Urban tree canopy is increasingly incorporated into climate adaptation and public health strategies because trees can reduce heat exposure and improve environmental conditions in densely developed areas (Hardaway et al., 2025; Jerrett et al., 2024; Chen et al., 2022). In response, cities have expanded tree planting investments.

Despite these investments, canopy recovery remains uneven and some areas continue to experience canopy decline or limited performance of replacement trees (Nowak & Greenfield, 2018; Hilbert et al., 2019). Evidence from planting initiatives and survival reviews shows that outcomes vary substantially across neighborhoods and cities and are strongly influenced by local site conditions (Breger et al., 2019; Hilbert et al., 2019).

Urban planting sites often exist within constrained built environments where sidewalks, paved surfaces, and infrastructure corridors restrict rooting space and create persistent subsurface constraints that shape tree performance over time (Wojnowska Heciak et al., 2025; Mailloux et al., 2024). These constraints do not disappear when a tree is removed. In many cases, the stump and residual root system remain in place and continue to occupy space within an already constrained planting zone.

The Canopy Regeneration Gap

Urban forestry programs often follow a simplified sequence. Hazardous trees are identified and removed to reduce safety risks, and replacement trees are planted to restore canopy coverage. This approach treats removal and planting as separate interventions.

However, a critical transition occurs between removal and regeneration. When the canopy is removed, the stump and subsurface root system frequently remain. In constrained streetscapes and residential planting strips, this legacy structure can persist within compacted or space limited planting zones and contribute to ongoing site limitations that influence establishment and long-term performance (Hilbert et al., 2019; Wojnowska Heciak et al., 2025).

This transition can be described as a canopy regeneration gap. Hazard mitigation may be completed successfully, but the conditions necessary for canopy renewal may not be restored. This gap helps explain why planting activity does not consistently translate into durable canopy recovery (Hilbert et al., 2019; Breger et al., 2019).

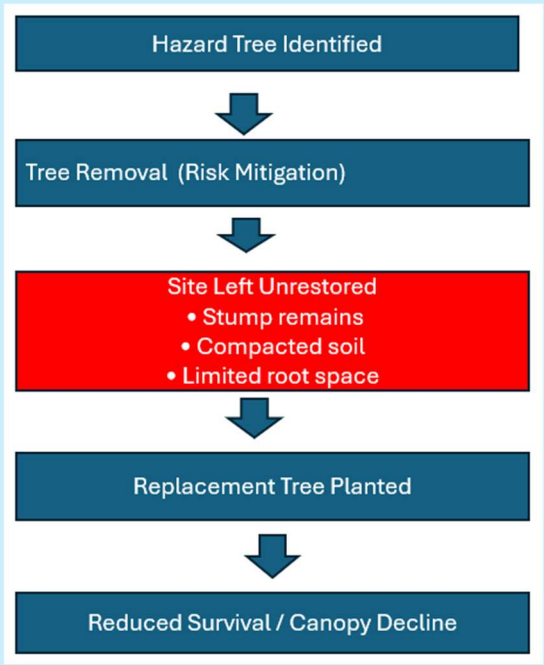

Figure 1. Current Urban Forestry Practice and the Canopy Regeneration Gap

This figure illustrates the typical sequence used in many urban forestry programs. Hazardous trees are removed to reduce public safety risks, and replacement planting often follows. However, the stump and surrounding soil conditions may remain unchanged.

Urban Tree Renewal for Resilience (UTRR)

The Urban Tree Renewal for Resilience (UTRR) framework proposes a lifecycle approach to canopy management that treats hazard mitigation, site reset, and regeneration as connected phases within one renewal process.

In this model, stump removal and regeneration site preparation function as the transition phase between removal and planting. The purpose is to restore planting site readiness before replanting occurs, especially in constrained urban locations where rooting volume and subsurface conditions shape long term performance (Hilbert et al., 2019; Mailloux et al., 2024; Wojnowska Heciak et al., 2025).

UTRR does not replace planting programs. It strengthens them by adding an operational step that is frequently missing from the renewal sequence.

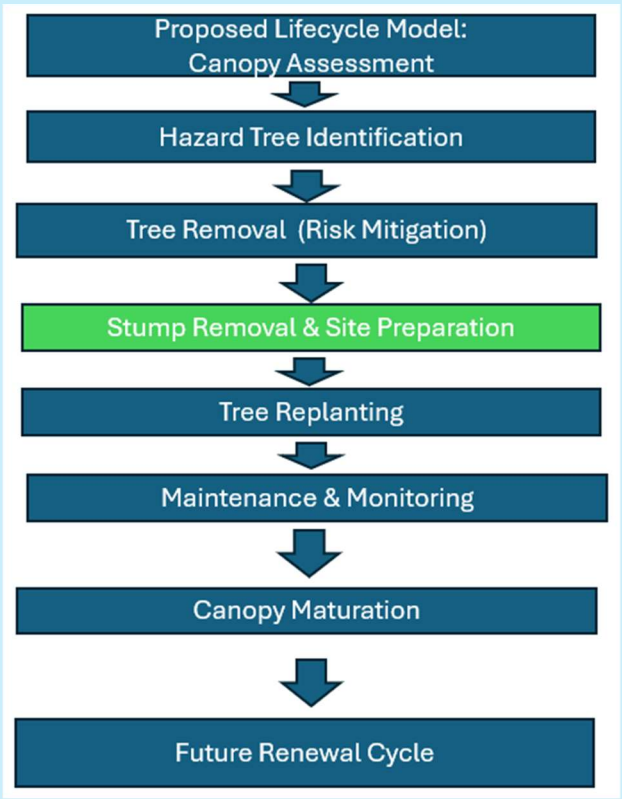

Figure 2. Urban Tree Renewal for Resilience (UTRR) Lifecycle Model

The UTRR lifecycle model illustrates how stump removal and soil restoration connect hazard mitigation to canopy regeneration. By restoring the site system before planting occurs, cities may improve tree survival rates and strengthen the long-term effectiveness of urban forestry investments.

Why Site Restoration Matters

Successful urban tree establishment depends on the physical conditions of the planting site. Rooting space, soil structure, and subsurface constraints strongly influence whether newly planted trees can develop stable root systems and achieve long term growth (Hilbert et al., 2019; Mailloux et al., 2024).

When a mature tree is removed, the stump and portions of the root system often remain within the planting site. In constrained urban environments such as sidewalks, planting strips, and compacted streetscapes, these remaining structures can continue to occupy space within the root zone. This legacy condition may limit the ability of replacement trees to expand roots and access water and nutrients.

Urban soil conditions further complicate this process. Compaction from construction, paving, and repeated foot traffic can reduce soil pore space and restrict root development. Research examining urban tree performance shows that limited rooting volume and constrained planting environments are important drivers of variation in tree growth and survival across cities (Wojnowska-Heciak et al., 2025; Hilbert et al., 2019).

Site restoration practices help reset these conditions before new trees are planted. Removing the stump, addressing compaction, and restoring sufficient rooting space can improve planting site readiness and support more durable canopy regeneration. By restoring the physical environment prior to planting, cities may improve survival outcomes and strengthen the long-term performance of urban forestry investments (Breger et al., 2019).

Restoring planting site conditions can improve canopy renewal outcomes, yet these practices are not consistently integrated into urban forestry programs. In many cities, tree removal, stump removal, and replacement planting are administered through separate departments, funding streams, or regulatory frameworks. As a result, the transition between hazard mitigation and canopy regeneration may receive limited attention even though it plays an important role in determining long term canopy performance

Structural Drivers of the Regeneration Gap

The regeneration gap is not only ecological. It is also structural. In many jurisdictions, hazardous tree removal is funded and managed through public works or risk functions, while tree planting is funded through climate, sustainability, or greening initiatives. Urban forest managers commonly report governance and coordination challenges that affect implementation and long-term outcomes (Ordóñez et al., 2020).

Where responsibilities are fragmented, stump removal and regeneration site reset can fall outside the scope of either program. This is especially common on private land or in shared right of way contexts where requirements, incentives, and enforcement mechanisms vary (Holzman Gazit & Kaplinsky, 2026).

Policy Opportunities

Cities can improve canopy renewal outcomes by formally recognizing stump removal and regeneration site reset as a standard phase of canopy renewal.

Policy options include integrating stump removal into renewal project specifications, aligning removal and planting funding streams, coordinating timelines across departments, and establishing clear requirements or incentives for stump removal when trees are removed on private land in ways that affect future canopy replacement (Ordóñez et al., 2020; Holzman Gazit & Kaplinsky, 2026; Grigg, 2025).

Prioritizing renewal investments in heat vulnerable and historically under canopied neighborhoods can also strengthen equity outcomes and climate resilience benefits (Hardaway et al., 2025; Locke et al., 2021; Shi, 2020).

Implications for Climate Resilience

Urban heat risk is rising, and climate adaptation strategies increasingly rely on effective nature-based solutions, including tree canopy, to reduce exposure and support public health (Jerrett et al., 2024; Chen et al., 2022). These benefits depend on long term survival and growth, not planting counts. Improving renewal site readiness by closing the stump transition gap can increase the durability of canopy investments and reduce inefficiencies associated with repeated replacement cycles (Hilbert et al., 2019; Breger et al., 2019).

Conclusion

Urban forestry programs play an important role in climate adaptation, but canopy renewal outcomes remain inconsistent. The UTRR framework identifies stump removal and regeneration site reset as the missing transition between hazard mitigation and canopy regeneration. Treating canopy renewal as a lifecycle system, rather than isolated actions, can improve tree survival, strengthen long term canopy stability, and increase the effectiveness of public investment in urban greening (Hilbert et al., 2019; Ordóñez et al., 2020).

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About the Wildfire Resilient Landscapes Institute

The Wildfire Resilient Landscapes Institute is an independent research initiative focused on climate resilience, ecological restoration, and landscape systems in wildfire-affected regions. The institute develops analytical frameworks that connect environmental science, infrastructure planning, and public policy to support long-term landscape resilience.

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