

## Concerning Dwellings Per Acre

I am a licensed professional engineer in the State of Tennessee with over 29 years of fire protection experience. Based on my training and experience, the placement of homes with side yard setbacks less than allowed under general residential (RB) zoning represents a distinct fire hazard.

The number of dwellings per acre is a significant consideration when planning subdivisions. Generally, higher density planning allows for more houses within a defined area, which can be desirable in areas where a housing shortage exists. However, there are safety concerns associated with fire in any dwelling, which can be exacerbated in higher density subdivisions without mitigative design features. For the purposes of this paper, the concern of fire propagation between houses and potential conflagration within a subdivision is addressed.

In Knox County, TN, homes with vinyl siding make up a significant percentage of existing home construction, and represent the majority of new home construction due to the ease of construction and cost. In older and/or more affluent neighborhoods, brick veneer can be found in higher percentages. Some houses also utilize cement fiber siding (e.g. Hardie board). The type of siding can dramatically impact the potential for a fire to spread from one house to adjacent houses, as was seen during the 2016 Gatlinburg fire.

House fires are devastating events for their occupants. Unfortunately, if subdivision planning does not anticipate the potential for fire to spread from house to house, then a devastating event for one family can become a devastating event for the entire community.

Under existing Knox County Codes, general residential zoning (RB) requires a lot size for each house of at least 10,000 square feet, with setbacks on the front, sides, and rear. Since one acre is 43,560 square feet, general residential zoning allows for slightly more than four dwelling units per acre. Typically, the side yard is of highest concern for controlling fire spread, and RB zoning requires single-story dwellings to have side yards at least eight feet in width and two and three-story dwellings to have side yards not less than 12 feet. This requirement ensures a separation for single story dwellings of at least 16 feet and a separation of two and three-story dwellings of at least 24 feet.

However, planned residential zoning (PR) allows for a significant reduction in spacing, including allowing lot sizes to be as little as 3,000 square feet as long as the average lot size is 4,000 square feet. Planned Residential zoning also allows buildings to be located within 15 feet of adjacent residential developments. Additionally, and of more general concern from a fire standpoint, side yards have a default minimum setback of only five feet, but can be reduced to zero feet. Thus, in a PR zone, regardless of whether single-story or two or three-story dwellings are located, a separation of only 10 feet is expected, but this is dependent upon the number of dwelling units per acre allowed for the development. For reference, Creek Bend Farms is a recent development off of Karns Valley Road, which was zoned PR with less than 5 dwelling units per acre. The separation distance between 8 houses on both sides of Lazy River Drive averages 16.2 feet, with a median distance of 15 feet (of note: the underground utilities for the subdivision run between two houses where a 26 foot separation distance is provided, with all other houses being separated by a distance of 12 – 16 feet).

As noted above in the discussion of the allowances provided between RB and PR zoning, the minimum separation distance is 10 feet for PR zoning and 24 feet for RB zoning. While the difference between 10 feet and 24 feet of separation may not sound like a lot, it is significant from a fire standpoint. To help demonstrate why the difference between 10 and 24 feet of separation is significant, Chapter 86 in the

Society of Fire Protection Engineer's (SFPE) Handbook of Fire Protection Engineering describes how the amount of radiative heat transfer is dependent upon the amount of separation between the fire and the adjacent house. The example provided in Chapter 86 of the SFPE Handbook describes a house wall that is 12 feet high and 25 feet wide separated from a two-story house by 20 feet. The SFPE Handbook indicates the 20 feet of separation, which is consistent with the RB zoning requirements would melt vinyl siding, but may not ignite the underlying wood frame. However, additional testing in both the US\* and Canada\*\* has shown that separation distances allowed by PR zoning, without mitigative features, will result in a single fire to spread rapidly to multiple dwellings.

Based on the above information from the SFPE Handbook and the referenced research papers, it is readily apparent that a 20' separation from a single-story house to a two-story house and a 24' separation between two and three-story houses is a minimum amount to help ensure a fire in one house does not spread to an adjacent house – as is provided by the RB zoning requirements. If closer spacing of dwelling units is desired versus what is allowed in RB zoning, then additional fire protection features should be required in order to help ensure occupant safety and minimize the potential for a single house fire from igniting adjacent houses and potentially leading to a conflagration where multiple houses within a subdivision catch on fire. Possible options include:

- (1) requiring residential sprinklers within each dwelling unit in order to minimize the potential for a fire to breach the perimeter walls, or
- (2) requiring all houses within the PR zone where the RB separation requirements are not being met to be constructed with 4-sided brick veneer.

The use of sprinkler systems and/or clay brick veneer is extremely effective in retarding the spread of fire and represents a means to help ensure both occupant safety and the safety of the surrounding dwelling units.

Therefore, my opinion as a licensed professional engineer in the State of Tennessee with over 29 years of fire protection experience is that additional provisions should be required if more dwelling units per acre than is provided within the framework of RB zoning is desired, which should include either the provision of sprinkler systems in each dwelling unit or the use of brick siding for each side of a unit that does not meet the spacing requirements provided by RB zoning.



Scott A. Frazer, PE, ARM



\* *Ignitability Analysis of Siding Materials Using Modified Protocol for Lift Apparatus*, Dientenberger for the USDA Forest Service Forest Products Laboratory

\*\* *Performance Evaluation of Siding Materials Subjected to Radiant Heat Loads*, FP Innovations for FireSmart Canada