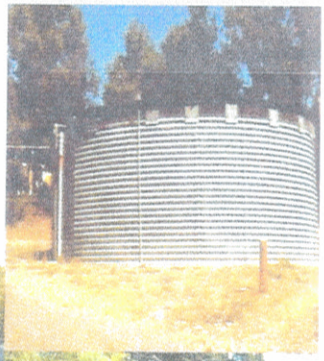
A STRATEGIC GUIDE—with Tools for Local Government

- Planners
- Developers
- Property Owners
- Fire Authorities

MANAGING FIRE IN THE URBAN WILDLAND INTERFACE



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In this chapter . . .

After reviewing chapter 12, the reader will understand:

- *Worst-case scenario related to new residential developments and what lessons can be learned*
- *Goals and objectives for design solutions related to layouts of new residential development*
- *When best practices are most helpful*
- *Alternative practices*
- *Why best practices are sometimes not adopted, and issues related to sustainability*

To meet future demand the State of California predicts that "California homebuilders would have to construct an average of 220,000 additional housing units each and every year through 2020. Since 1987, new single- and multi-family home production has averaged just 141,000 units per year."[1] Increasing population raises the value of land and places pressure on local jurisdictions and builders to increase the density of new subdivisions and build in marginal locations.

Developing a new residential community also offers unique opportunities to incorporate fire-safe design. At an early stage critical components are set in place that influence future fire behavior, effectiveness of suppression, and the potential damage. The overall relationship of a new development to adjacent wildlands, structure density, open space, road networks, and other infrastructure factors, once established, become building blocks (or obstacles) for the more focused community design solutions covered in subsequent chapters.

CHAPTER 12

Community Design Solutions—New Residential Development Layout

Implications of a Worst-Case Scenario

Whispering Pines is a fictional neighborhood of one hundred homes developed on 150 acres in the foothills near Lincoln, California. The retirement community has been designed with the latest amenities buyers desire. Access to this exclusive neighborhood is gated with a two-mile road that winds through a scenic canyon. Each home site is 1.5 acres, most with separate driveways screened by vegetation to provide plenty of privacy. The building sites have been dramatically located at the edge of hillsides to take advantage of scenic views of each parcel's own private pieces of nature and the adjacent park lands. The self-sufficient community provides it own water from their private water tank. Approximately 55 of the homes have been constructed and it appears that sales of lots have slowed. The current residents are concerned about wildland fire safety. The homeowner association has been working with the regional park system to see if they can deed the lower slopes of their community to the adjacent parks.

What Can Be Learned from This Scenario?

From a fire-safety perspective some new developments are classic examples of worst-case scenarios. These subdivisions are built today with features like Whispering Pines, that appeal to the homebuyer, but are not fire safe in practice. The scattered development pattern makes suppression difficult as the firefighting forces must chose between structure protection and wildland fire containment. The single access with winding roads increases the conflict between arriving emergency personnel and evacuating

From a fire-safety perspective some new developments are classic examples of worst-case scenarios.

residents. This access could be blocked by the fire or by burning roadside vegetation, limiting fire suppression options. The siting of homes on the edge of open space above steep slopes decreases their survivability in the event of a fire. The private water tank may fall short of meeting the needs of the community for structure protection and fire suppression. It is difficult to reduce fuel buildup on interspersed undeveloped lots. The adjacent parklands may not have the funds to adequately reduce fuel loads at the interface with the residential development. This community, like many throughout the western United States, has good reason to be concerned with wildland fire safety.

Goals and Objectives of Best Practices

The best practices community design solutions for new development need to increase the odds of survival from fire, as well as allow for effective fire response. These practices must recognize that both structures and landscape contribute to protection and design to optimize their impact from all three stages of threat (advance firebrands, fire front, and post-fire). These practices must share the responsibility of protection with adjacent wildlands to effectively reduce structure ignitions.

When Are the Best Practices Most Helpful?

New residential development layout recommendations are most effective before a community is built or expanded.

New residential development layout recommendations are most effective before a community is built or expanded. They target the relationship of a new residential development to topography, overall density and building sites, road network, and the community's relationship to adjacent open space lands. These practices are best used as a first step in implementing more fire safe communities.

Best Practices

The review and approval of the initial platting or site master plan provides a powerful tool for fire safety in the UWI.

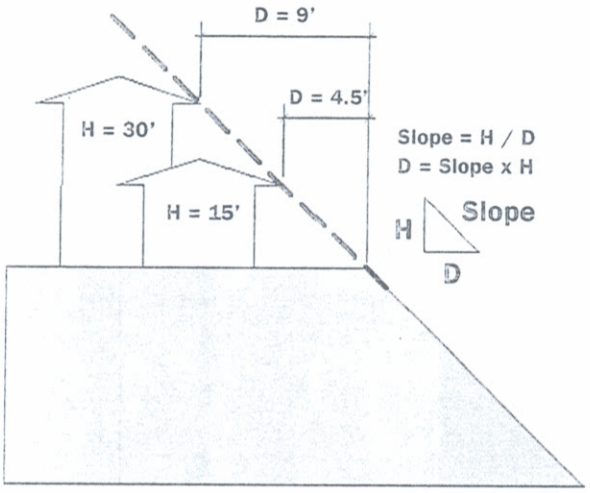
The review and approval of the initial platting or site master plan provides a powerful tool for fire safety in the UWI. It is only at this early stage of a new housing development that a planner or fire department can actually influence one of the key factors of fire behavior—topography. This is the stage of development when the relationship of overall density, building sites, and roads to each other and to natural vegetation can also be influenced. Other suppression-related factors such as utilities (water, electrical, and gas) and access are also established at this early stage before anything is constructed. Once built, all these elements either limit or enhance UWI fire protection strategies.

Best Development Layouts

The best development layouts incorporate the following:

- Design parcels and roads that respond to the existing topography and potential fire behavior
- Designate building sites that locate structures away from the edge of steep slopes; this distance, which varies depending upon the structure's height and steepness of slope, is not a scientifically-supported, definitive distance; structure survivability analysis from past fires indicates that the farther back from the slope edge, the greater the protection from both convective and radiant heat, as well as direct flame impingement; additionally, this setback allows space for a homeowner to reduce the fuel adjacent to the structure, creating defensible space; if an imaginary line is extended from the top of the slope, the structure should be set far enough back to fall beneath that slope extension; for a 15-foot tall, single-story house on a 30 percent slope, the setback would be 4.5 feet; for a 30-foot tall, two-story house, the setback would need to be twice that or 9 feet; in general, the greater the setback the better
- Avoid siting a road or structure at the top of a steep ravine that can act as a chimney or saddle that intensifies a fire's heat; again, setbacks from these edges are most effective
- Locate structures midslope or below; from a fire-safety perspective, the best building sites are at the bottom of a slope; when ridgetops are free from development, strategic fuel breaks can be developed, with the additional advantage that regional views are preserved
- Design road networks to facilitate simultaneous evacuation and emergency response; *see* chapter 15 for more detail on access and evacuation
- Plan for the phasing of construction and how to enhance community fire safety before all lots are built out and occupied
- Define ultimate maximum building envelope (square footage, structure height, and floor area ratio) and assess impacts on surrounding building parcels, water supply, and access routes

Figure 12-1
Determining Structure Setback from Slope



Structures should be set back far enough from the edge of a slope to fall beneath an imaginary line extended from the slope. For a house 15 feet tall (H = 15 feet) with a slope of 30 percent (slope = 0.3), the setback distance equals 4.5 feet. D = H x Slope or 4.5 = 15 x 0.3.

A Broader Perspective in Community-Scale Planning for Fire

Fire has no jurisdictional boundaries. In its strategic approach to mitigating fire hazards, a new community must have regional continuity. A narrow viewpoint may increase vulnerability to UWI fire, often by overlooking surrounding fuel loads that increase the size of a fire and its intensity.

A single home or small groups of homes can benefit from defensible space. However, community-scale planning should also have a broad approach that incorporates strategically placed fuel breaks and fuel-reduction zones. Regional and community utilities should include underground electric lines and adequate water supply. The community design should not overlook connectivity of regional roads that is critical to safe evacuation and mutual aid.

- Require that property owners comply with landscape fuel management requirement in adjacent structures' threat zones; *see* chapters 17 and 18 for more information on domestic and wildland fuels treatment and structure threat zones

Cluster Building Sites

Increase defensibility by clustering building sites. While the construction of these grouped homes needs to recognize potential ignitions from house to house radiation, the advantages of grouping homes are many and include the following:[2]

- Clustered development decreases the amount of area that must be defended in the event of a fire, when compared to a traditional dispersed development pattern.
- Clustered structures are often easier to protect. The edge between structures/private yards and wildland areas is the most difficult from the perspective of suppression. By reducing the extent of this edge, the cluster of structures is relatively easier to protect compared to areas where the structures are widely separated.
- Clustered structures are easier to maintain at low fuel levels due to less space between buildings.
- The desire for privacy can help make a community more fire-safe. Privacy for homeowners can be obtained by sensitive siting of both the structures themselves, windows, and private open space. Reduce house-to-house fire transmission by not aligning windows or other openings that are vulnerable to radiant heat.
- Clustered development has a positive side effect as it reduces the incremental un-reviewed lot splits over longer periods of time. This may make it easier to identify the future demand for water, road access, and other community infrastructure.

Designing Clustered Building Sites

Issues to consider in designing clustered building sites include:

- Create defensible clusters with breaks between clusters approximately every 1000 feet, especially if clusters back onto wildlands. These breaks provide safe access for fire personnel to reach adjacent wildland areas. If the breaks are a minimum of 130 to 200 feet wide and maintained as a low fuel zone they can also provide a means to contain a house-to-house conflagration caused by radiant heat transfer.

- Design the community to enhance protection of structures and wildland fire-suppression. Site structures at some distance from natural areas to allow for the creation of easily maintained low fuel zones and defensible space. Locate common green space that can be managed to protect structures by breaking up the continuity of flammable vegetation and reducing the fuel load. Ideally, a homeowner association should maintain the common area, since it is more likely to manage the open space to acceptable fuel requirements than 150 homeowners with individual back yards. One unmanaged yard can threaten an entire community.

Ideally, a homeowner association should maintain the common area, since it is more likely to manage the open space to acceptable fuel requirements than 150 homeowners with individual back yards.

- Provide vehicle access to the common space or other areas adjacent to slopes to enable the defense of structures during fire suppression. Locate roads on outer edges of structure clusters to provide additional low fuel zones. Roads should be strategically interconnected to provide multiple exits from the community that can be used tactically for both suppression and evacuation. If the slopes are benched for geologic stability, the width of the bench should be at least 12 feet. Benches should be maintained to accommodate vehicles for ease of fuel reduction. Treat vegetative fuels along roads and on benches above and below roads (*see* roadside treatment discussed in chapter 18, Wildland Fuels).

Alternative Practices—"Making Do"

New communities are often faced with limited area for defensible space. The best community-scale defensible space is created from common areas within a development at the time the neighborhood is designed and constructed. The most effective are managed uniformly to create zones of reduced fuels. If it is not created at the development's outset, concerned homeowners can treat adjoining areas on private property as common space. In spite of its many strengths, common defensible space also has shortcomings. Ironically, the challenges are almost exactly reversed when the community has only private land.

The best community-scale defensible space is created from common areas within a development at the time that the neighborhood is designed and constructed.

- Steep slopes often limit options for layout and development; in this situation consider identifying areas of extreme fire behavior and modifying development patterns to avoid siting structures at the most vulnerable locations (saddles, chimneys, and top or midway of long slopes)

Steep slopes often limit options for layout and development; consider identifying areas of extreme fire behavior to avoid siting structures at the most vulnerable locations.

- Incorporate fire-resistant materials in adjacent landscaping such as stone patios, rock mulch, pools, irrigated lawns, and low-fuel plantings
- Install solid barriers of fire-resistive construction (earth berms, rock, or concrete walls) on steep slopes to deflect heat before it reaches the structures

STRENGTHS OF COMMON DEFENSIBLE SPACE

- Easy to inspect
- Regular treatment schedule (the treatment is done all at once)
- Treatment more likely to be uniform, meet a single standard and costs less
- Less chance of weak links that make the neighborhood more vulnerable if managed well

SHORTCOMINGS OF COMMON DEFENSIBLE SPACE

- When not regularly treated the whole neighborhood is at risk
- Funding for the needed maintenance may be difficult to secure
- Homeowners don't have to actively participate so they may not be informed of fire issues
- Homeowners may become complacent about the defensibility of their individual homes; the attitude that "the common area will protect our home so I don't need to do anything" may threaten the community

STRENGTHS OF PRIVATE DEFENSIBLE SPACE

- Privately funded with each owner realizing individual benefit
- Active involvement of homeowners increases awareness of UWI fire issues

SHORTCOMINGS OF PRIVATE DEFENSIBLE SPACE

- Inspection requires more time and funds to ensure all properties meet standard
- Treatment schedule dependent upon individual homeowner
- More difficult to reach uniform treatment and more costly
- Single untreated parcel can endanger entire neighborhood

The classic example of a single house with a generous amount of defensible space is only applicable where the density of development is low.

The classic example of a single house with a generous amount of defensible space protecting it from wildland fire is only applicable where density of development is low. In many areas multiple privately-owned lands must be treated to create effective defensible space. Small parcel size results in an inability to achieve the recommended 30- to 100-foot clearances due to the density and resulting narrow setbacks between structures. Where structures are tightly clustered, or environmental situations restrict fuel modification of adjacent wildlands, the following alternatives should be considered:

- More stringent building codes to harden the structures and increase survivability; *see* chapter 16 for more detail on structure-related issues
- Technological fixes such as fire barriers or foam that can be sprayed on the structures as a fire approaches, or fire sprinklers (interior/exterior)

If the development cannot achieve all of the best practices, incorporate as many of the following to improve the community's fire safety:

- Locate road networks on outer edge of community instead of using traditional development pattern on both sides of road
- Provide an open space buffer that can be managed by the community; do not locate privately owned back yards directly adjacent to areas of native vegetation or adjacent slopes

- Enhance fuel management of native vegetation with larger treatment zones on steeper slopes
- Setback structures as far as possible from downhill slopes, and choose exterior construction materials to create survivable structures
- Incorporate less-flammable hardscape such as pools, stone patios, walls between vulnerable areas, and structures
- Avoid overhanging decks or parking structures; where decks cannot be avoided, upgrade materials and design to improve structure survivability; this can be done through heavy timber construction or enclosing the undersides to avoid trapping the heat of a fire below the structure
- Setback buildings from each other to allow for defensible space and to reduce house-to-house ignitions
- Require that all parcels develop onsite parking if road widths cannot accommodate parking and two-way traffic (for emergency ingress and egress)

Typical Reasons Best Practices Are Not Used

New residential development layouts do not incorporate recommended best practices for many reasons, including:

- Extra cost to implement
- Increase in grading resulting in environmental consequences such as impact to rare and endangered species or erosive soils
- High real estate values or existing development patterns result in development in areas that are highly prone to, and difficult to defend against, fire
- Aesthetics and real estate market expectations
- Homeowner outcry and resulting political pressure related to restriction of parking

Issues Related to Sustainability

Most design features related to subdivision layout—density, building location, or road network—once established, are viable for perpetuity. However, new communities should develop a realistic plan for private lands adjoining public open space for long-term management. Prior to development, determine how both private and public lands will be managed and who will pay for required treatments. Determine ownership (local, regional, state, federal, or tribal) and how to communicate with the owners of adjacent lands to develop long-term agreements for fuel reduction treatments. In addition, establish funding mechanisms that include the ability to address escalating costs.

Prior to development, determine how both private and public lands will be managed and who will pay for required treatments.

In this chapter...

After reviewing chapter 15, the reader will understand:

- *Worst-case scenario related to roads for access and evacuation and what lessons can be learned*
- *Goals and objectives for design solutions related to road networks*
- *When the best practices are most helpful*
- *Alternative practices*
- *Why best practices are sometimes not adopted and issues related to sustainability*

In many communities a local road serves the simultaneous role of emergency vehicle access and homeowner escape route. Success not only depends upon road location and design, but also on the absence of obstacles. A downed power pole can eliminate the effective use of an entire road. Even a seemingly minor detail, such as a street sign and address, is critical, particularly for a large fire where personnel from outside the community must assist. Once established, a network may be difficult to modify, so it's important to establish a proper road network early in the planning process. Additionally, many things that may not qualify as best practices can be done to help improve the effectiveness of existing roads.

CHAPTER 15

Community Design Solutions—Road Networks for Access and Evacuation

Implications of a Worst-Case Scenario

Orange County has been a desirable place to live for many decades. The fictitious community "Hidden Ranch" was platted in the late 1940s with generously sized parcels across the steep chaparral slopes. Throughout this rugged terrain are locations with spectacular views to the Pacific Ocean, with fewer than 30 homes having been built on the 500-acre ranch over the ensuing years. However, the topography means each home has a long, narrow driveway (some a half-mile long) that connects to the eight-mile 16-foot wide private access road. Developed following the original ranch road alignments, the dirt access road and driveways up and down the ridges have poor sightlines and few places to pass. A beautiful wooden bridge with stone supports was built in 1920 to serve the original ranch. Many of the home sites have been fenced in the past 20-years for security and privacy, with gates at each driveway. Most of the residents have lived here many years. The ranch house at the end of the road has been a family treasure passed through the generations.

Recently the residents have been active in developing a habitat conservation plan (HCP) for the surrounding wildland; protecting critical habitat for several endangered species endemic to this specific mix of chaparral species. A current debate among the residents is the repair of the continuation of the ranch road on the north side of the community. Three winters ago the seasonal rains and ensuing landslides made it impassable. The six property owners at the north end of the community want it repaired as it provides a closer access route to the county road to the north. Other residents object to the amount of grading and habitat destruction that would be required to repair the road and stabilize the landslide.

HCP = Habitat conservation plan

What Can Be Learned from This Scenario?

In an emergency, the narrow dirt roads of Hidden Ranch cannot accommodate simultaneously incoming suppression forces and evacuation of residents. A key choke point is likely to be the beautiful bridge that will not support any of the heavier vehicles such as the large water tenders from the neighboring county. None of the community driveways that are typically 8 to 10 feet wide meet practical standards of width, length, grade, surface, or alignment; they represent potential fire traps for emergency personnel and equipment. The secondary access to the north has been rendered impassable because of winter rains and landslides.

This scenario highlights the need to meet road and driveway design minimums for simultaneous access and evacuation. Considerations include road grade, width, alignment, and surface. It is preferable to have two distinct and remote ingress and egress routes. It is also critical to minimize obstructions such as parked vehicles, gates, bridges, and vegetation. The importance of adequate signage and addresses should not be overlooked.

Goals and Objectives of Best Practices

Road networks need to accommodate unimpeded evacuation simultaneously with emergency response.

Road networks need to accommodate unimpeded evacuation simultaneously with emergency response. Signage and addresses must facilitate locating a fire and avoid delays in response. An effective road network primarily supports firefighter access to the fire front and prefire evacuation. The roads network's strategic effectiveness as fuel-free zones that fire personnel can use to contain a fire front will depend upon specific fire behavior. This role should be considered in developing a road network to support tactical response plans.[1] However, roads serve only limited roles related to the other two stages of a fire—the advanced firebrands and post-fire front.

When Are the Best Practices Most Helpful?

Access must be addressed early in the planning stage of a community. Once a community is built the layout of roads cannot be effectively changed.

Access must be addressed early in the planning stage of a community. Once a community is built the layout of roads cannot be effectively changed. Retrofit is extremely difficult, costly, and often infeasible due to ownership or environmental impacts. For instance, narrow roads contributed to many deaths in the 1991 Tunnel Fire. However, few of these roads were widened during the reconstruction because it would require the condemnation of small building lots and major environmental impacts to the adjacent steep hillsides. Some roads still await the development of

adjacent lots that will be required to address the additional footage necessary to meet road width standards.

Best Practices

The road network should be strategically interconnected to provide numerous exits from a community, so that it can be used tactically for both suppression and evacuation. Best practices include:

- Providing two distinctly separate routes of ingress and egress located as remotely from each other as possible
- Including no dead-end roads
- Locating roads on the outer edges of structure clusters for the added advantage of providing additional low fuel zones for the community
- Pre-designating strategic access and evacuation routes

Road networks need to accommodate unimpeded evacuation simultaneously with emergency response.

Road design standards for UWI fire safety focus on the physical features of the road—its width, alignment, surfacing, and location. The route should be part of the community transportation network, so that it is regularly maintained to sustain the recommended standards. Without regular use, maintenance on access routes is often deferred until it is too late. The best practices road design standards include:

- Minimum 20-foot hard, all-season surface for a two-way road (12 feet preferred minimum per lane, excluding shoulder and parking)
- One-way roads designed to driveway standards
- Grade less than 10 percent
- Inside radius curvature of 50 feet (length of vertical curve minimum 100 feet)
- Vertical clearance of 13.5 feet
- Minimum turning radius of 40 feet for turnarounds; hammerhead Ts should have a minimum length of 60 feet
- Regular maintenance of road surfacing and clearances

Driveway design standards extend the usable road network to provide the necessary ingress and egress to buildings throughout the community. Driveways should be designed to the following standards:

Driveway design standards extend the usable road network to provide the necessary ingress and egress to buildings throughout the community.

- Provide driveways for all buildings
- Provide means for turning fire apparatus around for all roads and private drives longer than 150 feet; minimum of 36 feet unobstructed, paved radius width for cul-de-sac in residential areas
- Minimum improved width driveway of 12 feet (serving no more than two single-family dwellings)

Other key elements of the road network should include:

- A turnout every 400 feet to allow for passing on access roads and driveways where unobstructed road width is less than 24 feet
- Parking allowed only where paved road has an additional 9 foot width
- No gates
- Post load limits on bridges (must accommodate load of the largest fire apparatus typically used in the jurisdiction); road surfaces typically carry at least 50,000 lbs; AASHTO HS 15–44 is one of the nationally recognized standards for bridges

Vehicle access must also be provided to the common space or other areas adjacent to slopes to enable the defense of structures during fire suppression.

Vehicle access must also be provided to the common space or other areas adjacent to slopes to enable the defense of structures during fire suppression. The following issues need to be considered:

- The road network should be designed to provide all-weather vehicular access to adjacent wildlands every 1000 feet between homes; the access points do not need to be paved, but should be connected to the paved road network
- If slopes are benched for geologic stability, the bench width should have a minimum 12-foot drivable surface (excluding v-ditches); these benches should be maintained before the start of fire season as access roads to facilitate fuel-reduction activity
- Treat vegetative fuels along roads and on benches above and below roads (*see* chapter 18 for more detail on wildland fuels roadside treatment)

Street signs and addresses are critical details that are often forgotten.

Street signs and addresses are critical details that are often forgotten. Provide signs for roads, fire service access, dwellings, and commercial structures with a consistent identification system of sequenced numbers and non-duplicated street names. Consult with local fire departments to ensure local practices meet any regional or state standards, particularly where mutual aid agreements may be in place. Design and install street signs and addresses to meet the following standards:

- Lettering on signs should be four inches in height, with a one-inch stroke width on reflectorized surfaces contrasting with the sign's background color
- Locate signs that are visible from the road and mounted between four and eight feet above road surface
- Use non-combustible supporting structures (*e.g.*, steel poles)
- Locate address signs where property intersects with a named roadway
- All addresses should be plainly visible and legible from the street or roadway from either direction; address numbers should be four inches in height, with a .375 inch stroke width that contrasts with sign's background color
- Maintain a minimum of 10-foot vegetation clearance from signs

Alternative Practices–"Making Do"

The best practices for road networks present an insurmountable challenge to many communities. Alternative practices may provide more practical benefits.

The best practices for road networks present an insurmountable challenge to many communities. Engineering solutions, such as periodic turnouts if the road width is not sufficient, or parking restrictions, may meet the needs of some communities. Developing one-way couplets may be another solution. However, these couplets can create problems with getting fire apparatus in and residents out. The following alternative practices may provide practical improvements:

- **Install turnouts and turnarounds for dead-end roads**—dead-end roads longer than 300 feet can be improved by providing turnouts and a turnaround at their terminus; turnouts should be a minimum of 10 feet wide, 30 feet long, with 25-foot tapers at each end; the total length of dead-end road should be no more than one mile long
- **Explore surfacing options**—surfacing options that vary in effectiveness, initial cost, maintenance requirements, and community acceptance include graded and compacted earth, deep base rock/gravel, grass blocks, pavement (asphaltic concrete or concrete), and the addition of grooved pavements on steeper slopes
- **Accept steeper road grades**—minimize the length of continuous, steep grades (a 10 to 15 percent grade requires mitigation); to enhance traction for steeper portions, use portland cement concrete with a heavy broom finish perpendicular to the direction of travel (if the angle of departure and angle of approach exceed 7 degrees or 12 percent, most fire equipment will not be able to use the road)
- **Accept narrower road widths**—consider a road width of 18 feet with a 10-foot minimum driveway

The use of EVAs should be viewed as a provisonal solution when two access points are not possible.

An emergency vehicle access (EVA) is a roadway developed for use only by emergency vehicles, primarily for medical emergencies rather than fire. However, EVAs should be viewed as provisional when two access points are not possible. A minimum acceptable design should include:

- A maximum roadway grade of 16 percent
- Access width same as a driveway or one-way street (12-foot minimum)
- An all-weather surface
- Control can be gated, but must accommodate multiple owner access

EVA = Emergency vehicle access

Maintenance of access routes is critical; a history of poor maintenance is the reason this type of access is not accepted as a best practice.

Gated roads that limit access are another common challenge in the network. A "no gates" policy is the best practice. If gates are installed, consider the following:

- Gates that open inward should be two feet wider than travel lanes and be located 30 feet from the public right of way; if achievable, a 50-foot setback is preferred, as the additional setback allows access to the gates without obstructing traffic on the road
- Emergency responders must have ready access to any locks in the gates; a possible alternative is a Knox key/box or the ability to accommodate multiple owner locks
- Gates should be a minimum of 16 feet wide to accommodate fire equipment

Parking is often a difficult community issue.

Parking is often a difficult community issue. If parking on narrow roads cannot be eliminated by requiring onsite parking or communal off-street parking areas, consider the following:

- Enforce parking restrictions for narrow roads (less than 29 feet for an improved road that accommodates single-side parking or a 38-foot road for parking on both sides)
- Limit parking to one side of road
- Enact seasonal parking restrictions during fire season

Typical Reasons Best Practices Are Not Used

In new developments typical reasons best practices related to roads are not implemented include:

- Increased cost of road development, especially if the change departs from an accepted design standard for a narrow- or single-access route
- Environmental impact of an additional or wide road
- Topographic limitations on grading and the resulting economic and/or environmental constraints
- Economic considerations leading to a reduction in the number of buildable sites and/or a developer's profit

Incremental growth often makes it difficult to plan a comprehensive circulation pattern of interlinked access between multiple neighborhoods.

Incremental growth often makes it difficult to plan a comprehensive circulation pattern of interlinked access between multiple neighborhoods. Where new development has an interface with an existing neighborhood, some additional reasons best practices are difficult to implement include:

- Opposition to new roads from neighboring residents, especially where there are existing dead-end streets and residents are concerned about access into their neighborhood
- Traffic impacts; new access can become shortcuts or have detrimental traffic impacts by increasing traffic volumes

It is difficult to mitigate road network deficiencies if they are not developed properly as a community is first established.

It is difficult to mitigate road network deficiencies if they are not developed properly when the community is first established. Typical reasons best practices are not used in existing communities include:

- Additional land for right-of-way to accommodate width, grades, and alignment often means acquiring land from numerous private landowners or condemnation of lands
- If adjacent lot sizes are small, expansion of road width (and grading requirements) can create substandard lots (too small for legal development); this can be viewed as a "taking"
- Undesirable aesthetics of wider roads, less vegetation adjacent to roads

Issues Related to Sustainability

Issues of sustainability for effective road networks are primarily related to maintenance and the life cycle of roads.

Issues of sustainability for effective road networks are primarily related to maintenance and the life cycle of roads. Roadside clearance is a necessary annual task, as is repair of damage after winter storms. Especially challenging is the maintenance of EVAs that are often forgotten if not used regularly. The ongoing funding of this maintenance, as well as anticipating the types of minor repair and life-cycle major rebuilding/repaving, are critical issues that need to be addressed.