Greener Streets:
Enhancing Livability and Neighborhood Values through Greener Engineering Practices

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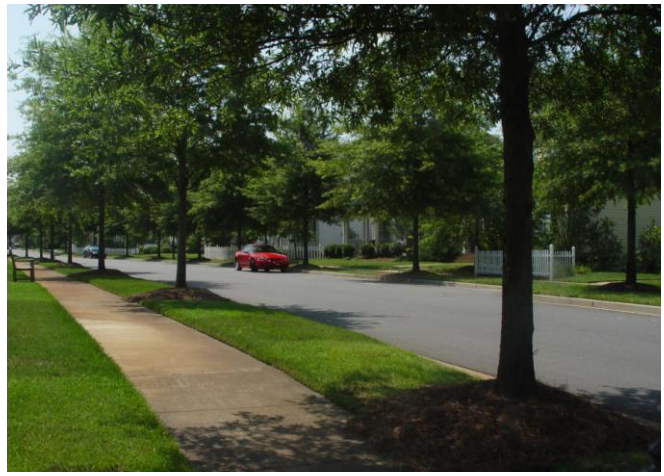
This article describes several ways in which standards Township Engineers and consulting engineers can help the communities they work for by "greening up" a number of that regularly appear in local subdivision ordinances.

The Right Book: Old Rules No Longer Apply

Many of the standard engineering requirements in local codes today originated in regulations adopted decades ago, when municipal officials reached for the most readily-available source books of the time, which were then produced by state highway departments. As noted in *Residential Streets* (co-published by the American Society of Civil Engineers. the Institute of Transportation Engineers, the Urban Land Institute, and the National Association of Homebuilders), many public officials "focused on guidelines that are most reasonable for major thoroughfares, but are excessive for local residential streets". The above-cited volume is a godsend for communities wondering why their municipal streets must be so wide and characterless. However, excessive street paving width is only one of several aspects where civil engineers can help their townships and boroughs achieve safer more attractive streets that are *also less costly to maintain*.

Figures 1, compared with 2 and 3, illustrate contrasting approaches to residential street design. One features wide pavements without either sidewalks or shade trees, while the other is more appropriately scaled and provides appropriate places for residents to walk, in addition to being 100% more attractive.

Fig. 1 *What's wrong with this picture, taken in Lancaster County, but typical across the Commonwealth? (Clue: Typical subdivision street standards that specify excessive cartway width, which leads to increased vehicular travel speed, while not even requiring sidewalks for pedestrian safety or shade trees for neighborhood beauty.)*

Figures 2 and 3 *What's right with these two pictures? (Clue: Everything was done in exactly the opposite manner to typical current ordinance standards, with an appropriately-scaled cartway, and sidewalks buffered from the street by a line of shade trees planted in a proper tree lawn, as was traditionally done before the 1960s.)*

Improving Safety with Less-wide Streets

I follow the principle that cartway width should be related to the number of lanes needed. That number is a function of two factors: traffic volume (rarely very great in most residential subdivision situations), and the need for on-street parking (seldom much of a factor when homes have two-car garages and two driveway parking spaces in front of each garage). In most subdivisions with lots larger than 15,000 or 20,000 sq. ft., the need for on-street parking provision is minimal. The standards I generally recommend are those in *Residential Streets*: 18 feet for low-volume local streets (with occasional parking on one side only) and 22-26 feet for higher volume local streets (with parking on one side or staggered parking on both sides).

Quoting from *Residential Streets*, "Designers should select the minimum width that will reasonably satisfy all realistic needs... The tendency of many communities to equate wider streets with better streets and to design traffic and parking lanes for free-flow traffic is a highly questionable practice. Certainly providing for two 11- or 12-foot traffic lanes that are never occupied by parking can encourage traffic to speed. Encouraging slower traffic speeds through narrower streets can improve the safety of streets for residents. Some studies indicate that as a street becomes wider, accidents per mile increase exponentially; and that the safest residential street may be a narrow street."

However, when smaller lots are involved, such as 50-80 feet wide, local streets should probably be sized to accommodate one or two lanes of on-street parking. This would lead to a pavement width of 26 feet (for one parking lane) and 32 feet (for two such lanes), but as these parking lanes would frequently be occupied by parked vehicles, narrowing the street to the two travel lanes does not present a micro-freeway situation.

- wider streets are actually more dangerous than narrower ones. The traffic accident rate on 36-foot wide subdivision streets is 400 percent greater than the risk on 24-foot streets, according to studies from Longmont. CO.

- wider streets are also more dangerous when all risks are considered (because of the higher travel speeds they generate). The risks from being injured in traffic accidents on wide subdivision streets is 37 times greater than the risks of being injured in a burning house located on a narrower street, due to the fact that house fires are exceedingly rare, while traffic accidents are not.

- wider streets are 33-100% more costly for Township taxpayers to repave every 7-10 years

• wider streets shed more stormwater, leading to ever-larger stormwater facilities, and further impairing water quality.

“Yield Streets” to Calm Speed

Some streets are **so wide that cars can be parked sideways in the middle, and still allow room for vehicles to pass on either side** (see Fig. 4). These streets are inherently dangerous because they encourage faster travel speeds, and they add unnecessarily to Township repaving budgets. Fortunately, a new generation of engineers has begun to recognize the virtues of the not-so-wide street, where a car parked on one side essentially blocks one travel lane, as illustrated in Fig. 5. Whereas old-school thinking was that this constituted a hazard when two moving vehicles approached each other with the parked car in between, an increasing number of planners and engineers now realize that such situations force the occasional on-coming vehicle to *slow down* and allow the other one to pass through. In the counter-example, my station wagon is parked along one side of First Street in Malvern, providing room for the oncoming car to pass me, while a third car behind me waits a moment for that lane to clear. Obviously, this approach works well on local access streets, but not on collectors.

Figures 4 and 5

Sidewalks for Exercise and Safety

Regarding sidewalks, the typical requirement that they be provided “when density is greater than three dwellings per acre, or when the subdivision is located near schools, shops, and churches” should be replaced with more realistic criteria.

Because most subdivisions in unserviced areas are built at one-acre densities (or lower), and because they are typically not located near schools, shops, or churches, sidewalks are rarely provided any more.

Clearly, schoolchildren, shoppers, and worshippers are not the only residents possessing working legs. Such criteria just don’t make any sense in this day and age, when virtually no one walks to schools, churches, or shops. However, this does not mean that sidewalks are therefore not an essential part of every residential neighborhood.

Such ordinance language misses the most important point about sidewalks, and fails to recognize the benefits that such amenities contribute. Numerous surveys have revealed that the No. 1 recreational pastime of Americans is walking.

Sidewalks provide basic separation between motor vehicles and pedestrians (children walking to/from the school bus, kids on tricycles or scooters, parents pushing baby carriages, couples out for an evening stroll around the neighborhood, etc.), not to mention joggers.

The results of careless decisions to waive subdivision sidewalk requirements have long-term implications for the families and seniors living in those new neighborhoods, both now and for generations to come. Local officials can either cause safe off-street paths to be provided for children on foot or tricycle, parents pushing prams or pulling wagons, and empty-nesters or retired folks looking for safe places to get moderate exercise by walking -- or they can effectively force all these folks onto travel lanes where they must be ever-vigilant in dodging cars, SUVs, pick-ups, and large trucks.


Figures 6 and 7 *Imagine where these children would necessarily be walking without the sidewalks that this community required the developer to install. In the street, of course, just like the couple pictured in the next photo, pulling their child in a wagon, the dad keeping his eyes focused on the rear flank, while the mom looks out for vehicles coming from the other direction.*

Street Trees: Beautifying and Purifying the Environment

Based on much experience, I have concluded that canopy street trees are one of the most important improvements any community can require of developers. They should be deciduous varieties of hardy species capable of attaining a mature height of at least 60 feet (not flowering ornamentals, which are more suited to courtyard situations and areas of lawn decoration), they should be planted with a minimum dbh of 2-1/2", at intervals of 40 feet or less on both sides of each street, in "tree-lawns" at least six feet wide located between the sidewalk and the curb or edge of pavement. Those who maintain that trees are "fixed deadly objects", but who also permit utility poles to be placed close to the street pavement, argue an inconsistent and extreme position.

The perceived threat that tree roots might possibly crack and lift sidewalks or rupture footpaths after decades of growth can be greatly diminished -- if not altogether eliminated -- by new techniques devised by urban foresters. One approach involves the developer installing vertical barriers 12 inches deep along the inside edge of sidewalks, to deflect root growth down deep under the sidewalk. The second approach requires that developers install a special "structural soil mix" developed at Cornell University, consisting of large stones with sizable gaps or spaces between them, through which the roots would grow. For further details, please download the publication "Using Porous Asphalt and CU-Structural Soil" at http://hort.cals,cornell.edu/cals/hort/extension/publications.cfm.

Allowing existing trees along subdivision streets to substitute for new shade tree planting (as is often permitted) is a poor policy, in my view. The presence of many trees on a thickly wooded site should never be taken as demonstrating no need for proper shade tree planting along new streets. When swaths are cleared through existing woodlands in preparation for street grading and construction, the trees remaining along the edges tend to be tall and spindly, having grown up in a forested situation with sunlight coming only from above. For that reason, such trees are not round and full in shape, and will not become so for many years (if ever) after being exposed to daylight as a result of the road clearing. These existing trees along the roadside edges are therefore no substitute for new canopy shade tree plantings.

Fig. 8 *Imagine this street in Phoenixville (left) without its canopy shade trees, sometimes referred to as "fixed deadly objects", even though the design speed is 25 mph. Such engineering prohibitions might be relevant along highways with 55 mph speed limits, but certainly not along residential streets. And, if trees are so dangerous, since when did dead trees become safe to install along streets (in the form of utility poles)? Clearly the ban on tree planting near street curbs is hugely misguided.*

Fig. 9 *Street trees can utterly transform the appearance of even modestly-priced developments. Pictured here is a typical street in Levittown, in Bristol Township, Bucks County (right).*

Fig. 10 *Even in low-density rural subdivisions, shade trees are just as important, if the character is the street is not to be defined entirely by asphalt and concrete, as shown here in this example from Doylestown Township.*

Controlling Stormwater Naturally

Conservation planners generally favor open drainage swales rather than curb-and-gutter, except in situations where lots are in the village/hamlet size range (6,000-12,000 sq. ft.). Curbs channel all stormwater into pipes and detention basins, rather than allowing part of the stormwater to infiltrate into the ground as it flows along grassy swales. Such infiltration could be increased through the construction of so-called "rain gardens" at various points along the street (say for every 4-6 lots), which are designed to serve as infiltration areas landscaped with moisture-tolerant trees and flowers. Another effective stormwater management technique is to require that downspouts be connected to "French drains" located in yards. The design flexibility in the *Growing Greener* system (endorsed by the PA DCNR and DEP, and administered by the Natural Lands Trust in Media) permits extensive areas to be utilized for on-site infiltration, such as in conservation meadows or through infiltration trenches carefully located to snake between the larger trees in a woodland setting (as has been done behind the West Bradford Township office building in Chester County).

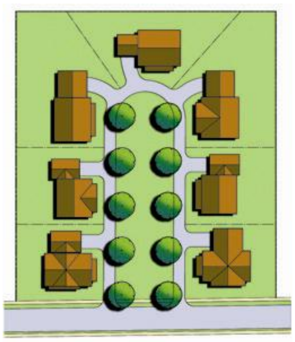
Stormwater management standards in many codes are a bit antiquated, based on the "detention basin" (impact crater/bath-tub) approach, and focusing only on the rate of runoff rather than on the total volume of runoff, after development. I recommend that townships consider adopting a goal of zero increase in runoff volume after development, through various infiltration techniques. A good source of information on this approach can be found at www.cwp.org, the website of the Center for Watershed Protection, a nonprofit in Ellicott City, MD, which helps municipalities update their stormwater practices. Conservation design (with more compact lot and significant open space) offers many opportunities to disperse stormwater over much broader areas, so that deep engineered structures with steep sides and spillways are not needed in most situations. Even more important than the aesthetic advantage is the aquifer recharge benefit that such infiltration-focused stormwater design brings.

Fig. 11 *Swales can easily serve in place of curbs, even when density is more than two or three dwellings per acre.*

Figures 12 and 13 *Infiltration meadows, promoting aquifer recharge, are a less expensive, more attractive, and environmentally superior alternative to deep "bomb-crater" basin design, and are very easy to create when lot sizes are reduced to provide common open space. In this example from Doylestown Twp., the side slopes are so gentle that the entire "facility" can be mowed with large equipment just once a year, a cost saving that also allows the area to function as wildlife habitat throughout the summer, attracting birds, bats, insects, small mammals, and raptors. Small seasonal ponds can also enhance roadside open space, such as shown here in a modest neighborhood green encircled by a residential street.*

Greener Alternatives to Cul-de-Sacs

An alternative to standard short cul-de-sacs is the "court" or "close" (Figures 14 and 15). Instead of there being a 50-foot wide right-of-way leading up to a turnaround with a 130' outer-edge diameter, the street would be designed as two parallel one-way travel lanes 16 feet wide within a 130-foot wide right-of-way separated by a central bio-retention area or planting strip perhaps 60 feet wide. Such streets could be limited in length to 750 feet, if desired. The turning radius at the end would be identical to that which is currently required for cul-de-sac" bulbs", for ease in maneuvering long vehicles. This street form is essentially a "boulevarded cul-de-sac" and, as such, probably does not require any special waivers from existing ordinances to be created. They can also be constructed so their surfaces pitch inward to the center, without curbs on the inside edge, to irrigate a central planting area that is not elevated but instead a foot or so lower (in the middle) compared with the street. This kind of "bio-retention" area is represents an innovative improvement over current practice, adding grace and beauty as well as utility. The median should be planted with canopy shade trees that do well in both wet and dry conditions, such as red maple and sycamore.



Figures 14, 15, and 16 *The "court" or "close", pictured in the above sketch, is essentially a short cul-de-sac with a central boulevard median, greatly expanded in width to serve various functions, from aesthetic enhancement to stormwater management. The central open space is bounded by a one-way circulatory street, and provides a green oasis with much scope for shade tree planting and stormwater management – plus a safe place for young residents to recreate informally.*


Figures 17 and 18 When the above concept is not feasible, cul-de-sacs should at least be terminated with an island planted with canopy shade trees to properly fill the "celestial space" above this wide bulbous street form. Or existing trees can be left in place. Plowing snow is much easier because plow operators can make one efficient sweep around the central island.

Safer Curves

With respect to horizontal curves, having grown up on a local street with a curve designed to a 72-foot radius (and until recently living in a neighborhood in Malvern with a right-angle curve even tighter than that), I feel that radii longer than 100 feet for curves along local access streets are generally unnecessary and encourage higher travel speeds. Many codes specify a 150-foot minimum for local streets and 350 feet for collector streets. This is way too much for design speeds of 20 mph (appropriate for local access streets) and 25-30 mph for collectors, as recommended by the ASCE -- which suggests 90-foot radii for local streets and 165-260 feet for collectors.

350-foot radii unwittingly promote travel speeds of nearly 35 mph around such curves, which means that drivers can travel at 40 mph on the straight stretches and then slow down only a little as they round the bends. I would ask if driving at such speeds through residential areas is really what the Supervisors wish to encourage. In recent years the advantage of shorter curve radii have become more appreciated for the traffic-calming effects they have in slowing down the speed of vehicles traveling through residential neighborhoods filled with children, pets, and pedestrians.

Fig. 19 *This curve, along which my childhood home sits, in Cranford NJ, measures only 72 feet in radius. Such radii are far more effective than any speed sign or bump in terms of calming traffic moving through the neighborhood.*

Conclusion: Promoting Dialogue

In conclusion, the existing situation in many townships and boroughs could be measurably improved if staff and consulting engineers serving those communities were to recommend any of the ideas discussed in this article to their Supervisors and Planning Commissioners, who generally hold their engineering professionals in very high esteem.

More than any other player in local government, engineers are uniquely positioned to influence the street design policies in their communities, either for the better or for the worse. Hopefully the concepts raised and illustrated here will be further discussed, perhaps with the benefit of up-to-date engineering publications, which reflect current thinking by leaders in the profession, and which are often at variance with older standards contained in existing, outdated codes.

About the Author: Randall Arendt is a town planner with 35 years experience working with civil engineers in assisting local governments. He serves as Senior Conservation Advisor to the Natural Lands Trust (NLT) in Media, has designed subdivisions in more than 20 states and several Canadian provinces, and is the author of six books. An elected Fellow of the Royal Town Planning Institute, his website is www.greenerprospects.com. NLT's website is www.natlands.org.