Town of Nolensville Road Infrastructure:
Sprawl and Fiscal Solvency

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The purpose of this report is to investigate the fiscal solvency of the development patterns in the town of Nolensville, TN. Five representative residential blocks are evaluated against the 2020-2021 budget totals to determine whether the amortized replacement value of the infrastructure required by each lot exceeds the annual per household tax contribution to road infrastructure. One block face each from Stonebrook Boulevard, Delaware Drive, Clemente Avenue, Pulley Place, and Greenbrook North Way are evaluated. The report concludes that, at the current rate of household tax contributions toward road infrastructure, only the townhomes of Greenbrook North Way represent a fiscally solvent investment for the city. Mitigating factors such as differing home values and their effect on tax contributions are taken into consideration. A possible way forward is explored in the conclusion.

Household Contribution to Roadway Infrastructure

In the town of Nolensville, local roads are maintained by items within the Public Works budget, funded by the General Fund, and State Street Aid, revenue funded by the gasoline tax disbursed by the state on a per capita basis to municipalities. In the case of Nolensville, State Street Aid for 2020-21 totaled $393,395.[1]

Determining which portions of the Public Works budget directly fund road maintenance is more difficult. For example, personnel expenditures touch all aspects of Public Works' mission, yet parsing out how much of this line item to allocate to road maintenance specifically would be almost impossible. To that end, I've only included items in the Public Works budget that directly fund road upkeep. Those items are listed below:

Repair and Maintenance Services	$1,600
Repair and Maintenance Roads	$2,513
Repair and Maintenance Sidewalks	$25,000
Traffic and Street Lighting	$35,100
Repair and Maintenance Traffic Lights	$8,000
Drainage Improvement	$37,000
Total	$109,213[2]

With Public Works expenditures and State Street Aid together, Nolensville spent $502,608 in the 20-21 fiscal year on road maintenance. This includes patching potholes; milling, repaving, and reconstructing roads; fixing and replacing sidewalks and curbs and gutters; and maintaining and replacing stormwater infrastructure (inlets, pipes, and headwalls).

Using the 2019 population estimate for Nolensville of 10,062[3] gives a per capita spending on road maintenance of $49.95. Average household size is estimated at 3.49 persons per household,[4] which results in per household spending on roads of $174.33. A few caveats: this number equalizes spending across all the households in the town and therefore makes no allowance for different levels of contribution based on household value and wealth. Adjustments are made later in the report to account for these differences, but the per household rate is useful nonetheless, and its use could be argued on the basis that the greatest share of road maintenance funding comes from State Street Aid, which is disbursed by the state on a per capita basis, irrespective of household wealth.

The value of $174.33 is the bar for infrastructure costs, then. Annual infrastructure costs below that amount represent a solvent investment for the city and those above it represent a net loss. Of course, how solvent a municipality is is based on a whole host of factors. Under the current tax structure, it would be inadvisable to require every parcel to generate enough tax revenue to pay for the road infrastructure it fronts. For example, there is broad political agreement that the fringes of urban areas should remain in a low-density, rural state. This requires long road frontages serving comparatively few households. The problem is that for any given city, low-density suburban development patterns (which will be shown to be similarly insolvent below) make up the vast majority of the urban fabric. Dense areas of high revenue productivity can carry low-density areas fiscally—as long as they outnumber them. Each community needs to make the political decision about how many net-negative neighborhoods should be allowed within the municipal bounds. The alternative is to begin charging road maintenance utility fees based on frontage length or distance from the city center (both of which are measurements of "urban sprawl").

Infrastructure Costs

First, a breakdown of how much the various pieces of road infrastructure cost. I received local market road repair estimates from Dewayne "Buck" Rogers, PE, formerly of the Gallatin Engineering Division. These estimates are from his extensive experience in local road construction management. They are in Table 1.

Table 1. Roadway Reconstruction per Mile

	Activity		
	Milling/Roadway Repair[a]	Paving[b]	Total
Local Road[c]	$15,000 (roadway repair)	$92,960 (1,162 tons)	$107,960

[a]Milling estimated at $3.75 per square yard

[b]Paving estimated at $80.00 per ton. Assume the spread rate for 1.5" of pavement to be 165 lbs/square yard

[c]Local estimated as 2-lane, 24', no shoulders = 24' wide

Source: Gallatin Engineering Division (2020)[5]

These numbers cover routine maintenance and milling and repaving, which I'll estimate as occurring every 20 years (local residential roads usually have the longest lifespans of all roads because they receive very little tractor trailer traffic).[6] This results in a yearly cost of $5,398 per mile. The per foot cost is $1.02 per year. This number must be reduced again because I'm only allocating half of a road's cost to each parcel (presumably there will be two houses on either side of the road sharing it). That leaves $0.51 per foot per year for routine maintenance and milling/repaving.

To these costs must be added the cost of total reconstruction, which I'll estimate as occurring once every 60 years.[7] Strong Towns has estimated this cost to be about $840,000 per lane mile.[8] This number broken down for half of a two-lane road on a per-foot basis results in an annual cost of $2.65. If we multiply this by the market multiplier for the Nashville construction industry (0.869), we get $2.31.[9]

Adding routine maintenance and repaving ($0.51) to reconstruction ($2.31) leaves us with $2.82 per foot annually for a 12-foot-wide asphalt road.

For sidewalks, each foot of construction costs $37.50.[10] If we estimate sidewalk life as being 50 years (it's usually less, but sidewalks are rarely replaced when they need to be), that gives a cost of $0.75 per year per foot.[11] For curb and gutter, a cost of $25.20 per foot[12] becomes $0.84 annually if it's replaced every 30 years.[13] For extruded curb with no gutter, a cost of 12.86 per linear foot is estimated.[14] Over 30 years that becomes $0.43 annually.

For stormwater infrastructure, the following construction and installation estimates are from *Site Work & Landscape Costs with RSMeans Data*.[15] Inlets are estimated at 2,845.98 with a lifespan of 100 years,[16] so $28.46 annually. Headwalls are estimated at $3,032.81[17] over 50 years[18] or $60.66 annually.

15-inch high-density polyethylene (HDPE) pipe is valued at $28.45 per foot[19] over 50 years[20] ($0.57 per foot annually) and 15-inch reinforced concrete pipe (RCP) at 54.69 per foot[21] over 50 years[22] ($1.09 annually).[*]

Estimates for the following two items are based on figures from Missouri: 18-inch Corrugated Metal Pipe (12-guage) at $34.82[23] over a 50-year lifespan is $0.70 per foot annually and 36-inch CMP is $52.74[24] per foot and $1.05 per foot annually.

All of these items are paid for out of State Street Aid and the General Fund (utilities like water, sewer, and electric are handled by their respective public utility providers). Below I break down the total yearly maintenance bill for each type of development pattern based on the costs cited above.

The Roads

The five roads chosen for analysis exhibit different levels of density and infrastructure. They are Stonebrook Boulevard, Delaware Drive, Clemente Avenue, Pulley Place, and Greenbrook North Way. Greenbrook North Way is a private road but is included because it services townhomes. Its dense development pattern will serve as a contrast to the other four roads.

First Stonebrook Boulevard. I'm using the 830-852 block, including 111 Oak Creek Drive as a representative sample of this neighborhood.

Image via Google.

[*] In cases where the exact size of storm sewer infrastructure is not known, all pipes under car-traveled surfaces are estimated to be 15" reinforced concrete pipe and all pipes outside of travel lanes are estimated to be 15" high density polyethylene pipe. In many cases the actual pipes may be larger or of more expensive materials, but these assumptions give a good low-cost baseline so that costs are not overestimated.

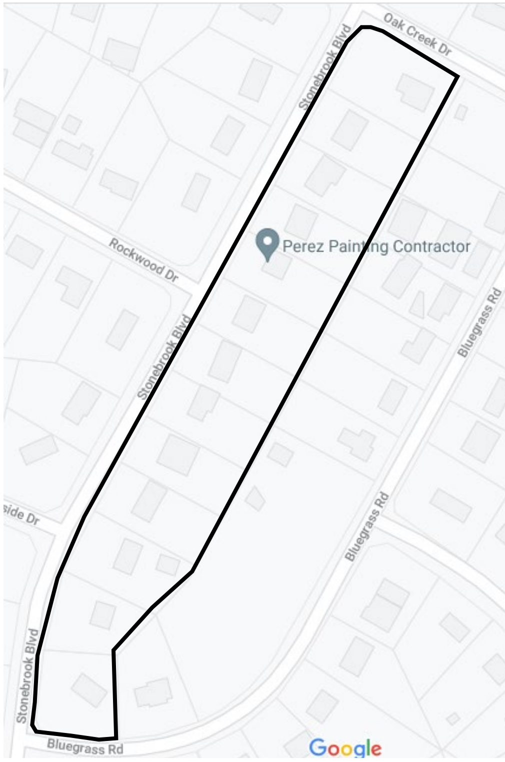

Image via Google.

Stonebrook Boulevard (platted 1978-88)		
Average Lot Width: 114 feet		
Item	Quantity	Cost (per year per household)
Asphalt	114 feet x 12 feet (half of road)	$321.48
Sidewalk	None	$0.00
Storm Sewer	7 inlets, 149' of 18" CMP, 39' of 36" CMP, 4 headwalls	$22.58 (half of total divided among 13 lots)
Curb & Gutter	114 feet of extruded curb, no gutter	$49.02
	Total	**$393.08**

Stonebrook Boulevard exhibits what might be considered the purest suburban development pattern. “Suburbs” as we conceive of them began to be built after the Second World War. The period from 1945 to 1985 saw gradually larger and wider lots become more and more widespread. Stonebrook’s peak suburbanism consists of very large lots (average of 114 feet wide) coupled with no sidewalks and no gutters for drainage. This development pattern reflects a cultural mood that rejected the notion of walking to destinations for practical purposes.

While being uniquely suited for the suburban lifestyle and therefore what many might consider the poster child for “sprawl,” Stonebrook Boulevard’s lack of sidewalks and gutters allows its wider lot widths to come with lower price tags. The storm infrastructure handles runoff from higher up to the west and only includes pipes running perpendicular under the road rather than parallel lengthwise, further reducing costs. Though Stonebrook Boulevard was laid out and platted through the 80s, many homes were not built until the early 90s. The architectural styles thus reflect a later period than the wide lots would suggest.

The total infrastructure cost per lot frontage (household) is $393.08. This far exceeds the $174.33 limit cited above, resulting in an annual deficit of $218.75.

The second road is Pulley Place; specifically, the 2001-2033 block.

Image via Google.

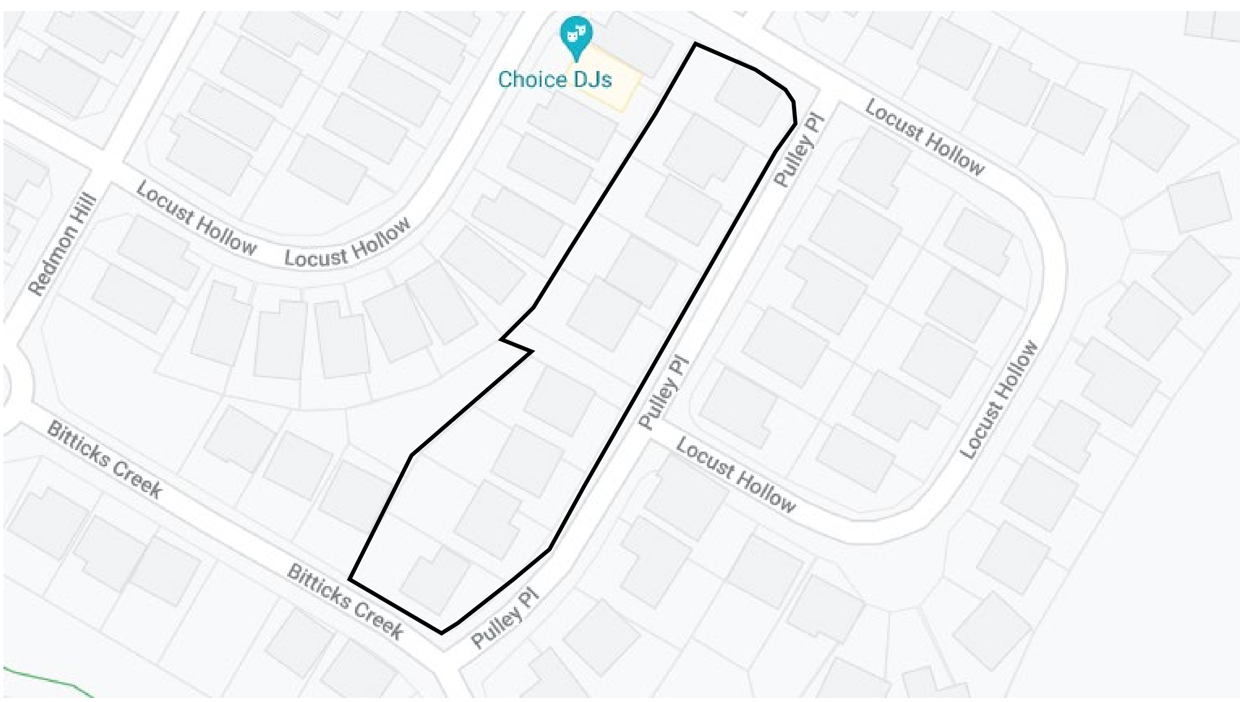

Image via Google.

Pulley Place (platted 2004-05)		
Average Lot Width: 69 feet		
Item	Quantity	Cost (per year per household)
Asphalt	69 feet x 12 feet (half of road)	$194.58
Sidewalk	69 feet	$51.75
Storm Sewer	5 inlets, 806' of 15" HDPE, 25' of 15" RCP, 1 headwall	$38.32 (half of total divided among 9 lots)
Curb & Gutter	69 feet	$57.96
	Total	**$342.61**

Average lot sizes began to shrink in the 80s and 90s, and by the early 2000s, subdivisions like Pulley Place were becoming commonplace: the size of the homes has remained the same (or increased) while the lots have become narrower. The total infrastructure price tag is not significantly less than Stonebrook Boulevard's, however, because by this time standard road infrastructure invariably included sidewalks and curbs and gutters. These elements, when coupled with stormwater improvements, give even medium-sized lots hefty price tags. The deficit for Pulley Place comes in at $168.28.

The third road considered is Delaware Drive. This is the 2012-2082 block.

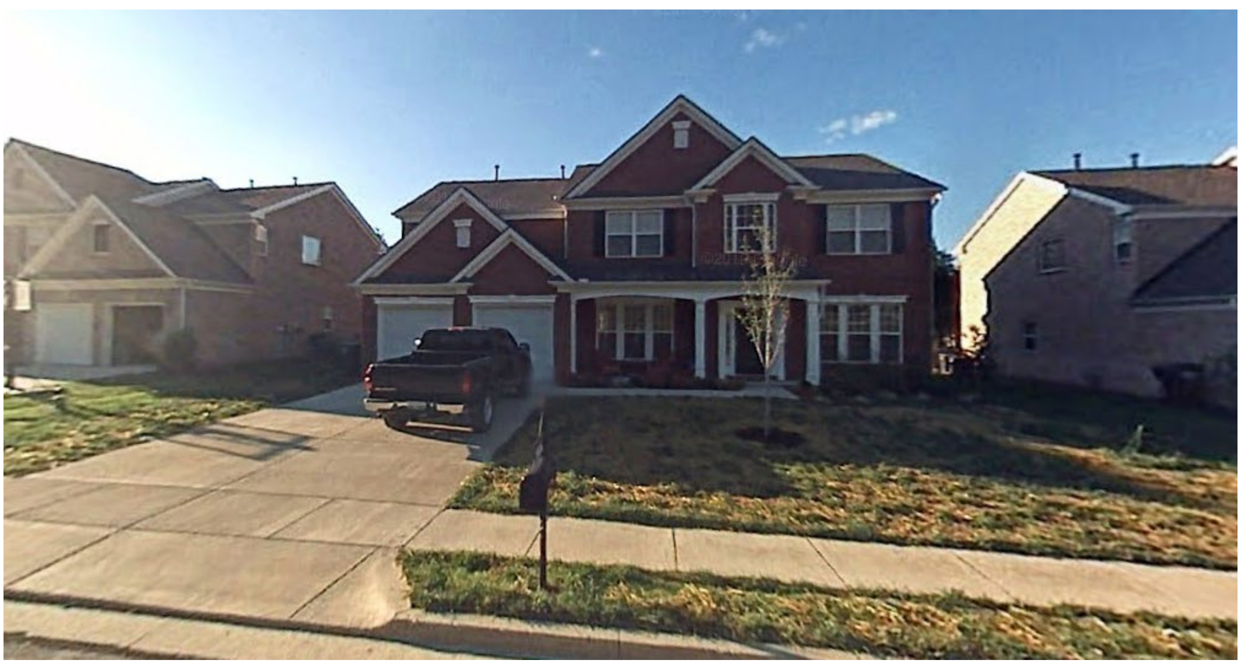

Image via Google.

Image via Google.

Delaware Drive (platted 2006)		
Average Lot Width: 82 feet		
Item	Quantity	Cost (per year per household)
Asphalt	82 feet x 12 feet (half of road)	$231.24
Sidewalk	Half of 82 feet (sidewalk shared with other side)	$30.75
Storm Sewer	8 inlets, 533' of 15" HDPE, 169' of 15" RCP, 5 headwalls	$26.82 (half of total divided among 19 lots)
Curb & Gutter	82 feet	$68.88
	Total	**$357.69**

Delaware Drive features the classic suburban lot width of roughly 80 feet. Many of the ranch subdivisions of earlier decades featured lots of this width; the difference being that the homes did not dominate the lots as much as these do. Though narrower lots were becoming more acceptable, more upscale subdivisions with bigger lots were still commonplace. Delaware Drive interestingly has a sidewalk only on one side of the road, which reduces costs somewhat. However, the full complement of stormwater and curb and gutter infrastructure still saddle this street with many expensive liabilities. The deficit here is $186.36.

The fourth road is Clemente Avenue. Considered below is the 500-536 block.

Image via Google.

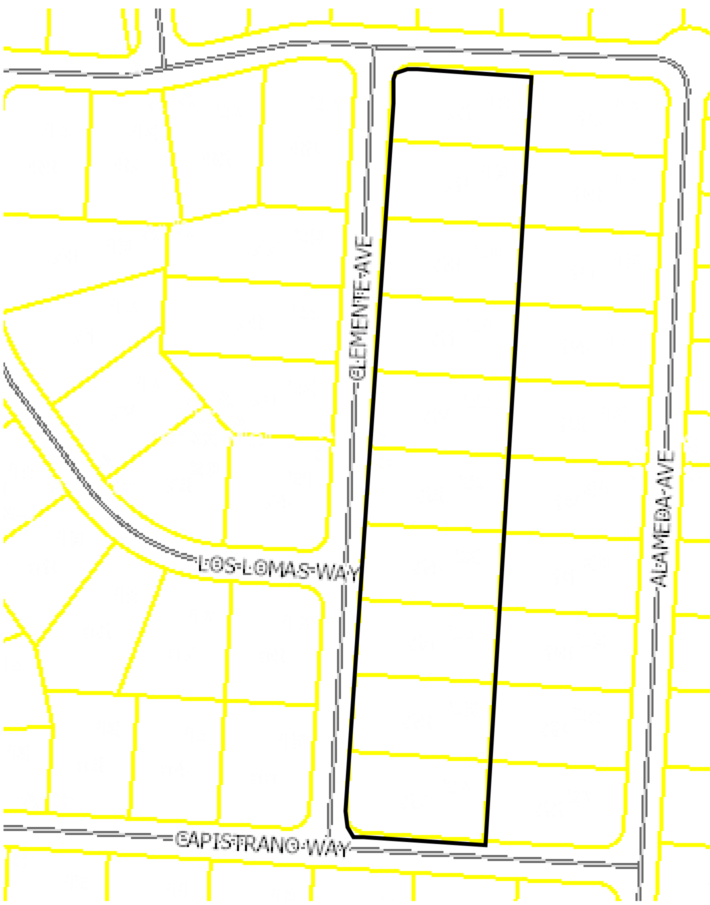

Image via Google.

Clemente Avenue (platted 2013-16)		
Average Lot Width: 103 feet		
Item	Quantity	Cost (per year per household)
Asphalt	103 feet x 12 feet (half of road)	$290.46
Sidewalk	103 feet	$77.25
Storm Sewer	17 inlets, 539' of 15" HDPE, 125' of 15" RCP	$46.37 (half of total divided among 10 lots)
Curb & Gutter	103 feet	$86.52
	Total	**$500.60**

This subdivision combines all of the most expensive aspects of the suburban development pattern: an abnormally wide lot (only the upper segment of the market has routinely featured widths of this size in recent years) combined with the full complement of road infrastructure: sidewalks, storm sewers, and curb and gutter. The deficit is $326.27.

The final road is Greenbrook North Way, which is a private road. We will take the 158-182 block as representative.

Image via greenbrooknorth.com

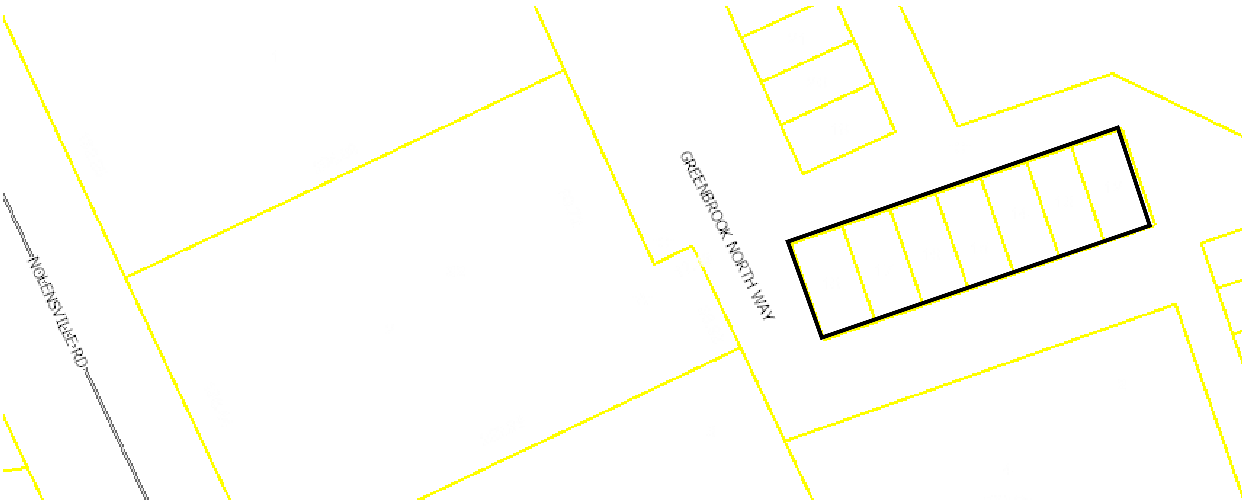

Image via Williamson County GIS.

Greenbrook North Way (platted 2019)		
Average Lot Width: 24 feet		
Item	Quantity	Cost (per year per household)
Asphalt	24 feet x 12 feet (half of road)	$67.68
Sidewalk	24 feet	$18.00
Storm Sewer	2 inlets, 165' of 15" HDPE, 25' of 15" RCP, 1 headwall	$17.06 (half of total divided among 7 lots)
Curb & Gutter	24 feet	$20.16
	Total	**$122.90**

For this road, I have changed a few things for the purposes of comparison. First, this is a private road, and so the city does not pay for the infrastructure. Second, the actual storm sewer system is configured in a way atypical for residential streets because it is handling runoff from the nearby commercial uses, which are within walking distance. For that reason I'm figuring in a more typical storm sewer configuration that is actually more expensive than what exists there now. This is a level of infrastructure more typical for a short residential street considered in isolation (HDPE pipe running parallel to the road with some RCP crossing the travel lanes and connecting the inlets, with a headwall for outfall). Even with this added infrastructure, however, the total cost for everything still comes in at only $122.90, leaving a budget surplus for lots in this subdivision of $51.43 per lot—the only type of lot so far that doesn't result in a loss to the city.

Effect of Home Value

A rejoinder to this line of argument might be that a per capita-based estimation of average household tax contributions doesn't take into account differences in home value, and thus actual tax contributions. Don't the large homes on the wide lots sell for more, therefore generating higher assessments and larger property tax bills?

In an effort to incorporate this factor into my research, I gathered the average home value for each of the blocks analyzed above:

Stonebrook Boulevard average home price: $456,000
Pulley Place average home price: $632,000
Delaware Drive average home price: $655,000
Clemente Avenue average home price: $929,000
Greenbrook North Way average home price: $404,000
Home value data via Zillow.com.

Using these values, we can estimate the property tax bills in each of these neighborhoods. The property tax rate for the Town of Nolensville is 0.29 per every $100 assessed (the county property tax bill is not included and is not necessary for this analysis).

That means that the annual municipal property tax bills for each block are on average as shown below (residential properties are assessed at 25% of their appraised value):

Stonebrook Boulevard average property tax: $330.60
Pulley Place average property tax: $458.20
Delaware Drive average property tax: $474.88
Clemente Avenue average property tax: $673.53
Greenbrook North Way average property tax: $292.90

In the original analysis above, per capita-based household spending on roads was estimated at $174.33. That means that when differences in household wealth are not taken into account, each household is estimated as contributing $174.33 per year towards road maintenance. Obviously, however, as the above property tax bills show, households pay differing amounts of property tax based on how valuable the home is. It makes sense then to try to account for these differences in home value. For example, if a home is truly valuable enough, it might generate such a massive amount of tax revenue that it could justify the level of infrastructure it requires. But is this the case with the roads here considered?

If Greenbrook North is taken as a baseline, the other neighborhood averages can be weighted based on how many percentage points larger they are than the baseline. Consider these adjustments:

Greenbrook North Way property tax adjusted value: 100%
Stonebrook Boulevard property tax adjusted value: 113%
Pulley Place property tax adjusted value: 156%
Delaware Drive property tax adjusted value: 162%
Clemente Avenue property tax adjusted value: 230%

These percentages can be used as adjustment factors when evaluating what these neighborhoods are paying towards road maintenance. Note that this is not an exact science: property taxes make up only a portion of the funds used to repair roads. The other fund is the State Street Aid, which actually is per capita-based. Regardless, this exercise will help better record the effect on the road maintenance budget that higher home values have.

Again, let $174.33 represent the baseline of 100% for comparison purposes. Using the percentages above, we can multiply that baseline by how far above and beyond the baseline the more expensive homes are contributing.

Greenbrook North Way:	$174.33 x 1.00 = $174.33
Stonebrook Boulevard:	$174.33 x 1.13 = $196.99
Pulley Place:	$174.33 x 1.56 = $271.95
Delaware Drive:	$174.33 x 1.62 = $282.41
Clemente Avenue:	$174.33 x 2.30 = $400.96

The numbers above are in reality generous; as stated, only a portion of the roadway maintenance fund is paid for by property tax revenues that vary based on home value.

Do the new adjusted tax contributions based on relative home value withstand the infrastructure-generated maintenance bills?

Greenbrook North Way:	\$174.33 - \$122.90 = +\$51.43
Stonebrook Boulevard:	\$196.99 - \$393.08 = –\$196.09
Pulley Place:	\$271.95 - \$342.61 = –\$70.66
Delaware Drive:	\$282.41 - \$357.69 = –\$75.28
Clemente Avenue:	\$400.96 - \$500.60 = –\$99.64

Once again, even with the relative home value adjustment, which significantly reduces the shortfall in several cases, none of the suburban roads break even. All produce budgetary shortfalls in the long run. Consider this: a home with the infrastructure level of Clemente Avenue would need to be valued at \$1,159,475.86 to generate enough property tax revenue to become solvent. Except for the upper end of the market, only townhome-level densities are fiscally solvent under the current rate of taxation.

Results Discussion

The results above demonstrate just how critical density is to municipal solvency. The fact is that every extra foot of asphalt and concrete bakes in that much bigger of a ticking time bomb of maintenance obligations. A few observations are in order.

The critical problem that many municipal leaders and concerned citizens will note is that not everyone wants to live in a townhome or condominium. The preliminary results of this study seem to indicate that a city would be wise to not only permit, but mandate townhomes and other attached products going forward, which, as anyone who is involved in planning and development knows, is politically untenable. Of course, there is a growing demographic shift toward a preference for such developments, but it is by no means a majority, especially in smaller towns. Leaders face the problem then of being fiscally constrained to encourage a development pattern that the public they are responsible to largely rejects. This is what is called in planning a “wicked” problem, and there are no easy answers.

The other seeming solution would be to charge what amounts to a road user fee, or “sprawl utility,” which would raise tax bills in proportion to the amount of road infrastructure that people actually use. This too, like congestion pricing in central cities, is politically unfeasible. No one wants raised taxes, least of all those who bought into their current living arrangements budgeting for one level of taxation. They would scarcely see much tangible personal benefit to the increased levee, at least in the short term.

Is there a way forward?

The results of this study hit at a deeper problem in our society at this late stage of the continent-wide suburban experiment. Perhaps the most poignant illustration of what I’m talking about is the collapse of the Champlain Towers in Surfside, Florida, on June 24th of this year.[25] All indications point to their being no malfeasance involved in the tragedy: there was no damning report ignored by the people in charge warning of widespread structural failures and imminent collapse. There was simply the familiar story of deferred maintenance: a homeowners’ association that budgeted enough money to keep things running smoothly on the surface, but probably not at the deeper level required for proactive, sustained care. HOAs have a financial incentive to only do the bare minimum—nobody wants dues increased unless it’s absolutely necessary.[26]

A tax base is a lot like an HOA. There is a strong incentive, from the elected officials, to the civil servants, down to the voters themselves, to discount future pain in favor of present enjoyment. This tendency results in the patterns of road maintenance funding that this study has partially uncovered. The Town of Nolensville is by no means unique in this respect—cities across the country have not adequately prepared for the financial reckoning that is sure to come when their overstretched infrastructure runs up against its useful lifespan, and the tax revenues simply aren't there to cover the cost of replacement. Look to the older communities of the Northeast for a warning sign: once the growth stops, the system can no longer expand itself. This is what Strong Towns founder Chuck Marohn calls the "Growth Ponzi Scheme."[27] One day, growth will stop in Middle Tennessee as well.

But there is a bright side. There are a growing number of young politicians and concerned citizens that are not wedded psychologically to "the way we've always done things" (which, in reality, is only the way we've done things for the past 80 years—prior to that, things were done in a way that bears a striking resemblance to what Strong Towns advocates). With patience and perseverance, these lovers of their communities are doing the hard work of explaining to their fellow citizens the predicament in which we all find ourselves. How strong and prepared our communities are for the challenges ahead depends in large part upon their resolve.

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[14] Hale, p. 379.
[15] Ibid., p. 708.
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[18] National Cooperative Highway Research Program.
[19] Hale, pp. 505, 699.
[20] National Cooperative Highway Research Program.
[21] Hale, pp. 506, 699.
[22] National Cooperative Highway Research Program.
[23] Memorandum – Request for Council Action – Metal Culverts, Inc. Contech Engineered Solutions, RE: 16-031 Corrugated Metal Pipe. (2016). Retrieved from https://www.sccmo.org/AgendaCenter/ViewFile/Item/1602?fileID=6396. Installation costs calculated from Hale, p. 699.
[24] Ibid.
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