Planning for Opportunities
SMART GROWTH
St. Albert

BULLETIN 5
Aug. 13, 2009

STREET SYSTEMS

Street systems create the framework for the design and interaction of buildings, public spaces and neighbourhoods; provide places for people to meet; and move pedestrians, cyclists, transit and vehicles. Streets appear to be permanent fixtures, however “streets are also dynamic, and their character and uses can change as the city continually evolves and reinvents itself” (Hawkes and Sheridan, 2009). Over time, three basic street systems have evolved:

- *Grid system* is a series of uniform blocks first used by Greek and Roman towns. Traffic is uniformly dispersed by providing multiple options for pedestrians and vehicles.
- *Modified grid system* is a modification of the grid system. It maintains the high level of connectivity, but creates more variety in the pattern. Modified grids emerged in the 1950s; and
- *Hierarchical system* became popular in the 1960’s, and involves smaller roads leading to larger collector and arterials roads. Traffic is concentrated on fewer roads, with few alternative routes (Hall and Porterfield, 2001).

Street design impacts the efficiency and safety of travel for multiple users (vehicles, pedestrians, cyclists and transit), and development potential. Some of the elements considered in street design are:

- *Connectivity*- number and directness of routes. Places with good connectivity have numerous intersections, short block lengths and minimal dead ends such as cul-de-sacs.
- *Safety and security*-vehicle speed, number of accidents, and access times for emergency vehicles.
- *Land consumption*-amount of land required for streets, and its impact on type and intensity of developments.
- *Traffic movement*-travel time and route options.

In St. Albert, most street patterns follow the hierarchical system, with curvilinear loops, cul-de-sacs and long blocks. New development will be based on the modified grid (Municipal Development Plan Policy 4.11). Opportunities associated with this street system include:

- improved emergency response times with connectivity;
- slower vehicle speeds due to shorter block lengths;
- reduced congestion due to dispersion of traffic; and
- shorter and more direct walking and cycling distances; and
- opportunities for higher density development and housing choices.

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Hall, K. and Porterfield, G. *Community by Design: new urbanism for suburbs and small communities*, 2001.

Hawkes and Sheridan. *Rethinking the street space: why street design matters,* 2009 from www.planetizen.com/node/39815VTPI.

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TO READ:

Rethinking the Street Space: Why Street Design Matters- read about how street design impacts our economy, health and environment.

Find it at:
http://www.planetizen.com/node/39815

TO WATCH:

National Geographic’s *The New Suburb is* an interactive tool to learn about elements that contribute to active streets. Click on different elements to find out more and you scroll along the streetscape.

Find it at:
http://www.nationalgeographic.com/features/00/earthpulse/sprawl/index_flash-feature.html

TO DISCUSS:

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PLACES TO SEE:

Charlotte, NC has banned cul-de-sacs in new developments, unless geographic barriers prevent street connections. The rule was implemented to address increasing traffic congestion. “Frequently, subdivisions of cul-de-sacs have only one or two connections to an adjacent road. When cul-de-sac communities are lined up along that road, it clogs with drivers who have no alternative route (VTPI, 2007).” Hundreds of other local governments across the U.S have also banned or limited cul-de-sacs.

The articles and videos referenced in the Bulletins do not necessarily reflect the position of the City of St. Albert and are meant to encourage debate and discussion.

THE CITY OF
St. Albert
Planning & Development

SMART GROWTH BRIEF

STREET SYSTEMS

STREET SYSTEMS

Street systems create the framework for the design of, and movement and activity within, cities. Street systems link neighbourhoods and the public and private domains. Street systems can do more than move traffic from point A to B; they can fulfill a variety of functions for a diverse group of users. Streets can also provide places for people to meet, with sidewalk cafes and window shopping, and move pedestrians, cyclists, and transit. "Street design contributes significantly to the quality and character of a community since appropriately designed street create safe, quiet and healthy environments" (Grammenos and Tasker-Brown, ND).

Street systems make up a significant portion of our land base offering significant potential for a city's quality of life.

> *"On average, streets, sidewalks and alleys occupy between 25-30% of our urban land. As the largest chunk of undeveloped space in cities, streets present an incredible opportunity to address a wide range of urban problems. And since they are publicly-owned, cities do not need to negotiate ownership, maintenance, and regulatory control. Our street spaces are the ultimate untapped urban resource, a public land bank that is waiting to be cashed in (Hawkes and Sheridan, 2009)."*

This brief will provide an overview of the significance of streets in building communities, elements of street design, comparison of conventional and traditional/modified grid street design, and how Smart Growth St. Albert will address street design.

STREET SYSTEM PATTERNS

There are three basic street patterns. Many neighbourhoods are a combination of two or more of these types.

Grid system

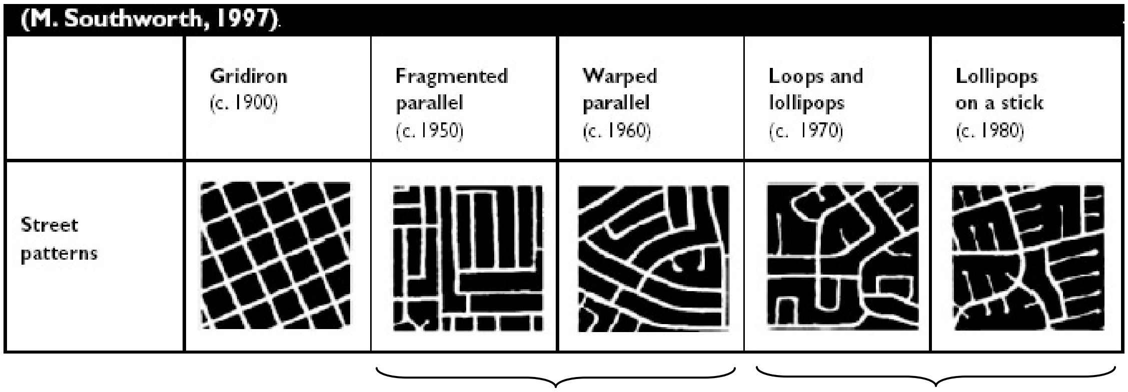
The grid system (see Figure 1 and Table 1) is series of uniform blocks. It disperses traffic uniformly by providing multiple options for pedestrians and vehicles. Greek and Roman militia towns first adopted this form to rapidly move around towns for defence purposes. "The success of the grid system lies is its predictability of intersections, which gives the traveler clues and reference points in wayfinding (Hall and Porterfield, 2001)." Repeating block patterns can consume more land for streets than some other systems. A local example of the grid system is Braeside Neighbourhood (see Appendix 1).

Figure 1

Source: C. Bergum

A traditional grid street system in Boston

Table 1 – evolution of street patterns since 1900



(M. Southworth, 1997).

	Gridiron (c. 1900)	Fragmented parallel (c. 1950)	Warped parallel (c. 1960)	Loops and lollipops (c. 1970)	Lollipops on a stick (c. 1980)
Street patterns					

Modified grid patterns

Hierarchical patterns

Source: Canada Mortgage and Housing Corporation, 2002

Modified grid system

Modifications to the true gridiron system maintain the high level of connectivity, but create more variety in the pattern. Three types of modified grids emerged in the 1950s: fragmented parallel, warped parallel and radial system (see Table 1, and Figures 2 and 3).

Fragmented and warped parallel street patterns incorporate longer blocks than the grid system, offset streets, and warped parallel streets integrate curves. In St. Albert, portions of Mission, Akinsdale and Sturgeon follow these street patterns (see Appendix 1).

The radial system involves a series of streets focussed on a central point, and works best with circumferential roads that create concentric circles around the centre. (Hall and Porterfield, 2001). The radial pattern is a common street pattern used in transit-oriented development areas (see Figure 3).

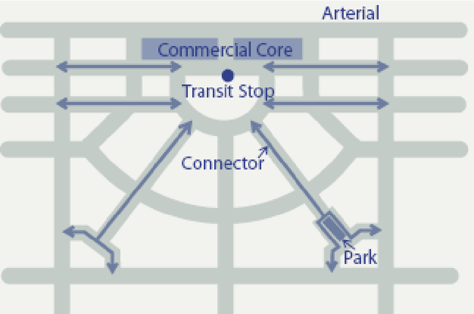
Figure 2

Modified grid from Camden NJ

Hierarchical system

The hierarchical system emerged in the 1960's with the looping and lollipop street patterns (see Table 1 and Figure 4). It involves smaller roads leading to larger collector and arterials roads. These patterns tend to have restricted access points via arterials roads. Traffic is concentrated on fewer roads, with few alternative routes. As a result, there tends to be more congestion and isolated communities. These street patterns rely heavily on cul-de-sacs. Wayfinding is more difficult, as loops and curves in the system may not lead to the desired point of destinations. Hierarchical systems tend to be more economical as they have fewer streets and intersections, have little through traffic on local streets and maximize land available for development (Hall and Porterfield, 2001). They can be characterized by the following:

Figure 3



Source:http://www.calgarytransit.com/pdf/transit_oriented_development_guidelines.pdf

- cul-de-sacs and dead ends;
- wider pavement width;

- longer blocks;
- rolled curbs;
- long radius at corners; and
- infrequent sidewalks (Local Government Commission, ND).

Hierarchical street patterns exist throughout St. Albert's newer neighbourhoods, including Erin Ridge, North Ridge and Lacombe (see Appendix 1).

COMPARING STREET DESIGN SYSTEMS

Land consumption

The grid plan generally consumes more land (31.7 per cent) for streets than the loop & cul-de-sac (28.8 per cent) (CMHC, 2002). Developers tend to favour the hierarchical system, as it reduces costs due to fewer cross streets, greenways and sidewalks (Walters & Brown, 2002). While this form of street system reduces land consumption, it compromises connectivity and the quality of design by removing cross streets and intersections, and lengthening blocks.

Figure 4

Source: City of St. Albert

Conventional street layout in St. Albert

The grid and modified grid systems facilitate a greater variety and higher density development since additional traffic can be dispersed with less noticeable impact, and provides suitable lot patterns for apartments, townhouses and small-lot housing. This can compensate for the additional costs of road development.

Traffic movement

In some studies, the hierarchical system has been found to increase vehicle speed and efficiency due to longer blocks and fewer intersections. However an American Society of Civil Engineers study (Taylor, 2001) found that while both systems had similar capacity, the grid and modified grid systems dispersed traffic more, travel demand was 43% lower, and had lower speeds but comparable travel times to the hierarchical systems due to more direct connections. With intersections every 200-500 feet, or every 6 to 8 seconds for cars, cars are forced to slow down more frequently, reducing their speed (CMHC, 2002).

Hierarchical systems provide less direct routes and fewer travel options if streets are congested or closed, impacting not only drivers but also pedestrians and cyclists. Cul-de sacs and loops also focus traffic onto collectors and arterials, so there is inequitable distribution of traffic within the neighbourhood.

> *A problem with conventional subdivision loop and curl street patterns is that they inhibit walking and are disorienting and confusing to pedestrians as well as to drivers. They provide tranquility, safety and security at the expense of connectivity. They control traffic well but often create bottlenecks at peak times in predictable spots (CMHC).*

Safety and Security

Research on the traffic safety of grid and modified grid systems versus hierarchical systems is inconsistent. Some studies suggest hierarchical systems can reduce accidents with the incorporation of cul-de sacs and T-intersections (CMHC, ND). However, according to William Lucy, author of *Tomorrow's Cities, Tomorrow's Suburbs*, "cul-de-sac communities turn out to have some of the highest rates of traffic accidents involving young children (Nielsen, 2006)." Lucy also points out that "the absence of empirical and theoretical justification for [the safety of] cul-de-sac based networks continues to the present."

Grid and modified grid street systems calms traffic by having narrower travel lanes, on-street parking, and more intersections that require motorists to stop. Pedestrians hit by a vehicle traveling at 20 mph has a 15% chance of death versus 45% at 35 mph and 85% at 40 mph (Hawkes and Sheridan, 2009). Response times are also reduced for emergency vehicles, due to improved connectivity.

There has been little substantial research on crime rates and streets systems until more recently. A good study by Hillier and Sahbaz (2005) found that smaller cul-de-sacs with few houses have a higher risk of crime. They further found a reduced risk of crime with:

- A mix of uses where there is more residential than non-residential
- Active streets
- More dwelling units on a street segment
- The grid system, even with alleys, with a higher number dwelling units in each block
- Cul-de-sacs that are longer and linear, with more dwelling units, and if they are less frequent and embedded within a street system

Connectivity

A measurement of street design is connectivity, which refers to “the directness of links and the density of connections in path or road network” (VTPI, 2007). Places with good connectivity have numerous intersections, short block lengths and minimal dead ends such as cul-de-sacs. As a result, travel times are shorter, and there are more route options. A traffic modeling exercise predicted a connected road network could reduce vehicle miles travelled (VMT) by up to 57% within a neighbourhood (VTPI, 2007). It also improves emergency response times, reduces pollution and congestion, and creates more travel options when one part of the roadway is inaccessible (VTPI, 2007).

A *Connectivity Index* can be used to measure road connectivity, and can be used for motorized and non-motorized travel (VTPI, 2007). Several methods can be used, which involve counting the number and spacing of intersections, or examining the actual travel distance between destinations.

Cul-de-sacs and loops, longer blocks and fewer intersections associated with hierarchical systems compromise connectivity. With fewer direct routes, vehicles, pedestrians and cyclists have longer and less direct trips.

Grid and modified grid systems support connectivity, both within a neighbourhood and between neighbourhoods. With clear and direct routes, connectivity is provided for multiple uses and users, including cyclists and pedestrians and commercial and residential.

> *A connected road network emphasizes accessibility by accommodating more direct travel with traffic dispersed over more roads, while a hierarchical road network emphasizes mobility by accommodating higher traffic volumes and speeds on fewer roads (VTPI, 2007).*

STREET PATTERNS IN ST. ALBERT

In St. Albert, the majority of neighbourhood street patterns follow the hierarchical system, with curvilinear loops, cul-de-sacs and long blocks, although the other forms have been used in older neighbourhoods. Uses in St. Albert are clearly separated, with the majority of retail focussed on St. Albert Trail with few homes within walking distance of stores and services.

Blocks are long, based on a distance suitable for driving rather than walking, and the many cul-de-sacs result in extra long distances. The map in Appendix 2 shows the direct distance and the actual distance between different locations within a St. Albert neighbourhood that has the hierarchical road system. The actual distances range from two to eighteen times longer than the direct distance between points.

Other challenges St. Albert faces as a result of its predominant street system include:

- Congestion which leads to driver frustration, health issues and environmental issues;

- Poor connectivity, which discourages walking or cycling; and
- Cost and efficiency of transit that must follow circuitous routes to come within 400 m of each home, rather than following more direct routes.

Regardless of the implementation of Smart Growth Regulations, the Municipal Development Plan (Policy 4.11, subsection 9) already requires all new neighbourhoods to use a modified grid street system as its framework.

SMART GROWTH ST. ALBERT AND STREET SYSTEMS

Smart Growth St. Albert would be based on the modified grid system, as specified in the Municipal Development Plan. However, it would also include many of the design elements[1] that work with the basic street system framework to create a successful community with increased density. Opportunities created by the modified grid street system within the Smart Growth context would include:

- Increased emergency response times with improved connectivity;
- Opportunities for more direct, and therefore more efficient, transit routes;
- Slower vehicle speeds due to shorter block lengths and more on-street parking;
- Reduced congestion due to dispersion of traffic on more route alternatives;
- Shorter and more direct walking and cycling distances, increasing use of these alternative forms of transportation;
- Opportunities for higher density development and more housing choices;
- Tree canopies along local streets; and
- Increased street-oriented and mixed use development opportunities.

CONCLUSION

Street systems should be designed as complete streets for all users and uses. Safety and convenience for cyclists, transit and pedestrians should be similar to vehicles, and streets should draw in people and activities. The modified grid system, along with the other elements of Smart Growth St. Albert, will provide streets that not only efficiently and safely move traffic and people through, but also create places for people in a cohesive public realm.

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[1] *To be elaborated on in subsequent Smart Growth briefs*

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APPENDIX 1: ST. ALBERT STREET SYSTEMS

The Grid System can be found in Braeside.

The Modified Grid System can be found in Mission.

The Hierarchical System can be found in Erin Ridge.

Appendix 2 : Road connectivity in Deer Ridge