Evaluating Sustainable Urban Form: Comparing Two Neighbourhood Development Patterns in Adelaide

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ABSTRACT
Advocates of *New Urbanism* and *Smart Growth* concepts emphasize on neighbourhood form and design to achieve sustainability. Generally, three aspects of neighbourhood form are thought to be influencing travel patterns: density; diversity and design. Higher density and diversity provide more services and facilities available for those who are not using motor vehicles. Grid street networks compared with other patterns have better connectivity and provide shorter distances between destinations. The aggregate effects encourage walking; bicycling and using public transport thus decreasing the share of motorized travel. This paper compares two case suburban areas with two different development patterns in terms of design attributes and travel trends: *Norwood* and *Golden Grove*. The older suburb of *Norwood* (1953) promotes a sense of community through its scale; mixed-use development pattern; and walkable environments. The more recent (1980s — 90s) suburb *Golden Grove* has high-quality movement networks and landscaped recreational spaces, but it is less successful in properly addressing the creation of a pedestrian-oriented environment. The comparative study of the two suburbs enables us to evaluate sustainable urban form and realize the causal relationship between the neighbourhood form and travel patterns.

TOWARDS NEW URBANISM

New Urbanism and *Smart Growth* emphasise on making a human scale, walkable community with moderate to high residential densities and a mixed use core. *New Urbanism* is a reaction against urban segregation, which is believed, is unsustainable, in terms of different aspects. The environment is damaged by compulsory daily commutes, and new developing projects. From a social viewpoint, sprawl segregates people, and decreases social-cultural communications. The dependence on the automobile threatens society health, and from an economic aspect, urban management system need to spend more on establishing infrastructure and public services required for them such as sewer, water, police, fire, streets and roadways (Barton 2000). *New Urbanism* solutions include increasing the population density within built areas, increasing reliance on public transit and other environment-friendly modes such as walking and biking instead of dependence on automobile (Katz 1994).

There is an on-going trend to apply *New Urbanism* in Australian new and exist developments. *Australian New Urbanism* is focused towards urban structuring

principles at all scales-from regions to neighbourhood to street and house. In Western Australia, new building code as 'Liveable Neighbourhoods' which experienced on the centre of the Perth satellite town of *Joondalup* and the new residential suburb of *Ellen brook* are examples of planning reforms in Australia. A similar effort made in the Melbourne inner brownfield development of *Kensington Banks* (Jones 2002). The recent revaluation of inner urban areas has re-emphasised the specific qualities of urban environments where residences, employment, shops and services are integrated in a walkable context (Scheurer 2004). One of the challenges with *New Urbanism* in Australia is to achieve a good neighbourhood form where all the privileges and necessities of daily life within a comfortable walking distance are available. New Greenfield suburbs in Australian cities are now nearly consistently based on a traditional grid pattern of streets encouraging walking activities, they integrate at least some shopping, education and recreational facilities in mixed-use, pedestrian-friendly precincts, and in some cases (notably in Perth) they are configured around rail extensions (Scheurer 2004).

CASE STUDY AREAS FROM METROPOLITAN ADELAIDE

In metropolitan Adelaide, a mixture of different suburban forms can be found which are combining from different land use patterns with distinct historical background: first, relatively high density inner suburbs which are more walk-oriented. This type of development is mostly traditionally designed based on Garden City movement (i.e. *Norwood*). Second, development of medium density, mixed use areas as middle suburbs which are both walk oriented and car oriented (i.e. *Burnside*); third, development of medium and low density areas around transport corridors which are partly transit-oriented (i.e. *Camdon Park*); and finally, new development of low density urban villages which are car-oriented (i.e. *Golden Grove*).

In this study, two cases are selected as representatives of different suburban patterns: *Norwood* and *Golden Grove*. The older suburb of *Norwood* (1853) promotes a sense of community through its scale; mixed-use development pattern; and pedestrian-friendly environments. The more recent (1980s—90s) suburb *Golden Grove* has high-quality networks and landscaped recreational spaces but the community design favours automobiles. And for those who would like to make active choices, neighbourhood design limits their options. The locations of these two areas in metropolitan Adelaide context are illustrated on Figure 1.

Norwood is an old neighbourhood located approximately 3 km east of the Adelaide CBD. In the early years of Adelaide development, the villages of *Norwood* were closely associated with the original settlement and development. It was relatively self-contained and development occurred around the main street: *Parade*. Local government was granted in 1853 when the existing villages combined to become the first Municipal Town in South Australia with a combined population of 2,553 (including *Kent Town* and *Kensington* villages). Currently, more than 5,000 households live in this suburb.

Golden Grove, located in the north east of metropolitan Adelaide, approximately 18 km from Adelaide CBD. The *Delfin Land Lease* and the *SAULT (*now the *Land Management Corporation)* developed *Golden Grove* jointly it in the mid 1980s. The aim was to develop a planned suburb with the purpose of creating a safe, pleasant and

convenient living environment with a full range of affordable accommodation in harmony with the environmental features of the area while supporting local community development. The development project was awarded 'Best urban development in the world' by the *International Real State Federati*on in 1998, and 'Best master-planned residential development' by the *Urban Development Institute of Australia* in 2002 (SA) and 2003 (national). The study area is around 508 hectares (the development plan targeting for 1240 hectares). Currently, around 30,000 people live there.

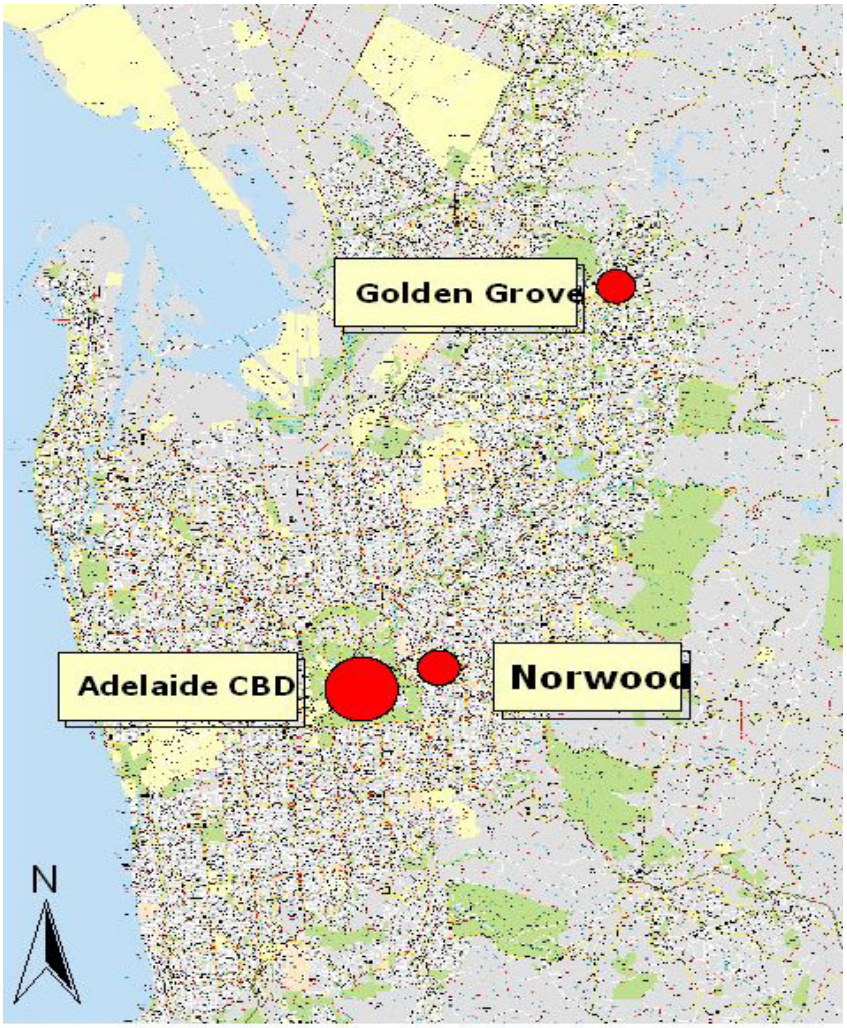

Figure 1: Metropolitan Adelaide and the locations of two study areas.

DIFFERENCES BETWEEN TWO NEIGHBORHOODS

Two case study areas are compared in terms of socio-demographics and urban form features. Then the potential impacts of individual factors on sustainable travel are discussed.

Differences in Socio-economics

A brief comparison between the socio-economics of the two suburbs is detailed (Table 1). Only the characteristics are included which might be important in influencing travel patterns: Car ownership; income; employment status; age groups; education; household type and size and home rent.

The figures show that residents on Golden Grove are more dependent on cars. While 29% of Norwood people have no cars, only 10% of Golden Grove residents are without a car.

Table 1: Comparison of socio-economics for two case study areas.

Factor		Norwood	Golden Grove
Car Ownership	households without car (percent)	29	10
	households with one car (percent)	44	36
	households with two cars (percent)	22	42
	households with three cars and more (percent)	5	12
Income level	households with weekly income higher than $1500 (percent)	8	4
	households with weekly income less than $500 (percent)	50	54
	households with weekly income higher than $500 and less than $1000 (percent)	32	33
	households with weekly income higher than $1000 and less than $1500 (percent)	11	9
Employment	Workers employed Full Time (percent)	50	47
	workers with management & administration jobs (percent)	11	8
	supply workers (percent)	36	54
	labourer workers (percent)	3	6
Age groups	people aged between 15 and 35 (percent)	38	28
	people elder than 65 (percent)	17	7
	people aged between 35 and 65 (percent)	38	41
Education	high educated people (percent)	45	27
Family type	family with dependent kids or students (percent)	12	18
Household size	Median household Size	1.85	2.80
Home rent	Median weekly rent ($)	171	143

(Source: ABS 2001)

On the other hand, while 27% of *Norwood* residents have two or more cars available, 54% of *Golden Grove* residents possess two or more cars. The average vehicle ownership rate for *Golden Grove* is 1.6 but for *Norwood* residents is 1.2. These statistics Cleary explain the more reliance on cars for *Golden Grove* people than *Norwood* people. Comparing income level for households of two suburbs shows the higher level of income for the residents of *Norwood*. The *Norwood* has elder people than *Golden Grove* area (17% rather than 7%). *Norwood* accommodates a higher number of high-educated people. Household size of *Norwood* people is smaller than those of *Golden Grove* people. Consequently, families with kids or students have higher rate in *Golden Grove* than in *Norwood*. Weekly home rent in *Norwood* is higher than in *Golden Grove*, showing that housing market has better situation there.

Differences in Travel Patterns

Table 2 details the differences in travel pattern for both work and non-work travel in the two suburbs. The items are included: mode of travel; travel distance; the proportions of local and short trips and trip frequency rate. In both suburbs, the car is the dominant mode for both work and non-work trips. Walking/cycling is more

preferred than public transport (metro-ticket bus) in *Norwood* for work and non-work trips.

Table 2: Travel pattern for work and non-work trips.

	Mode of travel	Norwood	Golden Grove
Journey to work	public transport	9	8
	car	74	85
	walking/cycling	12	2
Non-work trips	public transport	7	3
	car	70	88
	walking/cycling	20	6
Average travel distance (km)	Work trips	6.7	19.5
	Non-work trips	5.1	16.3
Percentage of local trips within suburb		25	16
Percentage of short trips (less than 2km)		28	7
Trip frequency (number of trips per adult per day)		3.7	3.3

(Source: Metropolitan Adelaide Household Travel Survey 1999)

About 20% of non-work trips were taken by walk/bicycle probably within neighbourhood area. The number of workers in *Golden Grove* who chose public transport (bus) service for journey to work was only 5%. The figures for walking/bicycling journeys were also low nearly 2%. *Golden Grove* also has longer travel distance, higher share of local and short trips but lower trip frequency.

3-3- Differences in Urban features

The differences in the some urban form indicators between *Norwood* and *Golden Grove* are highlighted in Table 3.

As the table shows there are significant differences between the urban form characteristics of *Norwood* and *Golden Grove*. The differences included difference in block area; land use diversity; density; proximity; and dwelling structures.

TRAVEL EFFECTS OF NEIGHBORHOOD DESIGN

The built environment factors in addition to socio-demographics influence in market share for non-motorized mobility. Several studies (Cervero & Kocklman 1998; Frank & Pivo 1994) have examined the effects of built environments on daily travel, however far less attention has been given to the impacts of micro-scale urban form attributes on non-motorized travel. In this study, the effects of micro-design attributes of built environment are investigated through a comparative methodology for two typical suburbs.

Density

The density allowed for an area by zoning codes represents its size and scale. In *Norwood*, residential densities, lot sizes and housing types have been varied, thus the average dwelling density of the suburb is about 13 units per hectare, which is four times more than *Golden Grove*. Population net density for *Norwood* is also bigger than *Golden Grove* despite a higher household size there. There is similar significant difference for employment density. The higher density in *Norwood* has been commonly reached by establishing and developing business units in mixed

Table 3: Urban form features

Variable	Description	Norwood	Golden Grove
MBA	Median block area (ha)	1.9	7.2
LUM	Land use mix entropy	0.63	0.38
Residential Net Density	People per developed residential area (pp/ha)	53.8	47.2
Jobs/housing Balance	Proportion of jobs per dwelling units	2.1	.3
Proximity to Schools	Average distance from home to local schools (km)	1.0	1.8
Proximity to Shopping Centre	Average distance from home to local shopping centre (km)	0.9	1.6
Employment Density	Number of jobs per developed area	13.3	8.0
Percentage of cul-de-sacs or dead-ends		35	62
Percentage of Single-family houses		40	86
Percentage of semi-detached, terrace or townhouse		32	14
Percentage of flat, apartment or unit		28	0

(Source: Soltani and Allan 2005)

buildings where face directly onto the street. As Mackay (2005) suggested Australian traditionally designed older suburbs general attract uses (such as offices) that need a credible business address (that is a degree of prestige) that provides better exposure to customers and business partners and offers more amenity for employees. In other words, *Norwood* could provide job opportunities for residents within its borders, as a self-sufficient community. This advantage resulted from the scale of the settlement and its fine grain. This was explained by Lynch (1986) as:

> *"A fine-grain neighbourhood is made up of small buildings which can be more closely fitted to the varying activities of occupants, than are the larger features of a coarser grain."*

As the number of jobs greater than the number of households in an area self-sufficiency is higher. Jobs-housing balance can be defined as number of jobs per housing units. Within the two case areas, *Norwood* is more favourable because of higher job-housing figure - about 2.1- which is seven times bigger than *Golden Grove*. Frank and Pivo (1994) defined job-hosing value of more than 1.5 as favourable case. Such area has enough attraction to support its residents in terms of finding a job nearby. Since some job positions can be shared with neighbouring communities, but still there is more likely to attract local people.

Housing Stock Diversity

Diverse dwelling types especially the presence of units make it more favourable for different types of families.

> *"Within neighbourhoods, a broad range of housing types and price levels can bring people of diverse ages, races, and incomes into daily interactions, strengthening the personal and civic bonds essential to an authentic community" (Charter of the Congress of New Urbanism: Katz 1994).*

A wider diversity of housing types is more likely to have mixed neighbourhoods where households with different socio-economics can be accommodated. The comparison shows that the majority of dwelling structures in *Golden Grove* are as single-family houses while *Norwood* has more variation.

Land Use Diversity
Mixed land use refers to the act of putting differing land uses (residential and commercial, residential and business, etc) in close proximity to one another. Such development pattern, provides a more diverse and sizable population and commercial base for supporting viable public transit, and enhances the vitality and perceived security of an area by increasing the number of people on the street (Appleyard 1981). Mixing land uses helps streets; public spaces and pedestrian-oriented retail again become places where people meet, attracting pedestrians back onto the street and helping to revitalize community life.

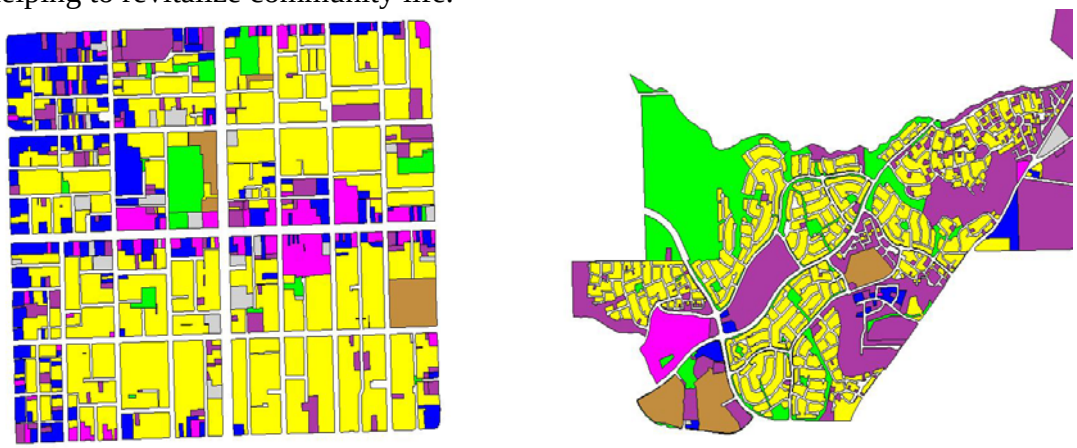

Figure 2: Land use mix and street network in Norwood and Golden Grove.

In this study, an indicator of land use mix (**LUM**) has been applied to determine the variety of land uses within an area. This index ranges between 0 and 1 as non-mixed and completely mixed area respectively. A perfect land use mix means the full range of human activities: living, learning, working, playing, creating, and worshiping within neighbourhood area. A non-mixed area only covers single use.

The composition of *Golden Grove* (Figure 2) shows that it lacks a good mixture of residential and non-residential land uses, with only 27% of the developed area consisting of non-residential uses. Exist non-residential uses are located out of access for most residents. On the other hand, in *Norwood*, public structures, such as schools, shops and civic buildings, and public open spaces - 36% residential and non-residential 64%- have been integrated into the neighbourhood pattern (SA Digital Cadastral Data Base 2000). *Norwood***,** in fact, has a mix of land uses, residential, office, shopping, civic uses, and entertainment, within easy walking distance of home. Proving mixed uses increase proximity to key amenities such as schools and shopping centre. The homogenous zoning of *Golden Grove* that puts workplaces, commercial and recreational centres at a far distance from home discourages people to make short trips which can be by walking.

New Urbanism idea suggests that all residents within neighbourhood area are benefited from public facilities and services which located in central or lateral nodes

of the neighbourhood (Burton 2000). In such a centre, a mix of compatible uses is provided with good access to activities thus making public transport more reliable. It also makes single trips with multi-purposes which consequently lead to decline in length and frequency of travel. In *Golden Grove* there is no community-supporting central area for supporting such activities, while in *Norwood* there is a commercial corridor containing different business units established, which is called *the Parade*. Such agglomeration meets the requirement of the economy and also provides different choices for people's movement. *Golden Grove* design has been little successful to providing facilities within walking distances. In fact, current business centre at the North West part of *Golden Grove* is not supportive for residences to have walking access to it. But in *Norwood,* the *Parade* plays a role of central axis where different uses (i.e. cinema, library, shopping centre, retailing, and bus stops) have been located along the street (Figure 3).

Figure 3: Norwood parade.

Street Design: Connectivity; Safety; Convenience and Street Furniture

The dispersed development and segregation of uses in *Golden Grove* do little support walkable communities. In contrast, traditional street design of *Norwood Parade* emphasizes pedestrian friendly features including sidewalks, a mix of uses, on-street parking, pathways, short blocks and green medians. The overall function of the *Parade* can be considered as a multi-purpose or shared street which is not only for vehicular efficiency alone. Block length should be short to increase the degree of interconnectivity. This lead to ability to permit multiple routes and shorten walking distances. As Table 3 shows median block area (MBA) of *Golden Grove* is approximately four times larger than *Norwood.* This leads definitely to less permeability and connectivity.

Local street networks servicing a residential area should have good interconnectivity with each other as well as appropriate connection with arterial roads. *Golden Grove* design has often applied circuitous roads and many cul-de-sacs. This can not be reconnected to the surrounding street network without great cost. Although cul-de-sac idea targets the safety and privacy of property and people (especially children), but these values can be achieved via other measures (Southworth & Ben-Joseph 2004). On the other hand, a gridiron network which provides multiple pedestrian and cycle routes with proper connections to adjacent streets, open spaces, bus stops and local business units is more efficient. The street pattern of *Golden Grove* also lacks from legibility that can not be easily understood. The higher proportion of cul-de-sacs and dead ends – 60% for *Golden Grove*-, evolves walking long and boring because of insufficient connections to nearby destinations. Developing on large lots makes the routes less permeable compared with shorter blocks and smaller lot sizes. In fact,

flexibility of grid network in *Norwood,* allow for more choice of movement options within the neighbourhood area.

Convenience for pedestrian and bicyclists is provided through building proper footpaths. The bicycle routes should have clear lines of sight, smooth and free of obstacles. Also they have to be well connected to the network to maximize the directness of travel. Street furniture, landscaping, and architecture may encourage walking, provided that they do not obstruct footpaths. In *Norwood,* most of local streets have paved sidewalks on both sides, but in a few cases, they are obstructed by trees. Sidewalks are mostly separated from the street by a planting verge as buffer. Shade trees are regularly spaced in the edge to help define the street edge and moderate summer temperatures. But there are also a few blind spots and areas with inappropriate width. Separate bicycle lanes are provided in *Norwood,* in a few streets. On-street parking helps to slow traffic and thus improve safety for pedestrians and cyclists. In *Golden Grove* in some streets sidewalks have been shared with the motorised traffic where it is considered unsafe. The design of *Golden Grove* streets, also considered pavement only on one side. The hilly topography of *Golden Grove* discourages pedestrian/bicyclists uses.

Streets should provide a sense of security for pedestrians. This can be assisted by building and activity centres such as cafés, restaurants and grocery shops being oriented to the street. The proper lighting and signage support the feeling of personal security. Unfortunately both *Norwood* and *Golden Grove* suffer from poor lighting. In *Golden Grove* shorter height lights make streets much brightness, and a specific design in some areas is attractive. In *Norwood,* poor lighting is of main challenges for walking/cycling after dark. Safety measures need to be reducing the potential danger of conflicting with car traffic. High speed designed street discourage people to walk through. In both *Golden Grove* and *Norwood,* local streets lack from adequate traffic calming means. It needs to do a study of speed for vehicles passing through theses areas.

Street furniture found to be related in encouraging sustainable travel. Attractive and coordinated street furniture, signage, lighting, increase pedestrian and cyclists' amenity. Buildings and their pedestrian entrances should be oriented to the street. Buildings should be aligned and made close to the street. In this way, buildings can form the space of the street. In contrast, buildings which are far from the street are little contributed in shaping street space. The closeness of building to the street helps to protect open space (yard, garden or courtyard) and keep it as private secure place. Building setbacks can provide natural surveillance of footpaths. Making front porches or balconies increase the sense of security for walking around (Chapman 1996). With the garage taking over the front of the house, only the rear and sides are available for light and views. Since residents are cut off from the street and the neighbourhood, the pedestrians have no sense of security. Furthermore the houses that faces the street benefit the residence to participate in street life through front porches as vantage points (Chapman 1996). Therefore, the usable space of a house with a front of rooms and a porch is much greater than a house with a garage door. What has already built in *Golden Grove* can be criticized in terms of being far from the street. Because the street side—usually considered the "face" of the house—is left with only the garage door and other utility rooms. Landscaping is then applied to soften its looks. Also landscaping has been used to shape the property border. In contrast, in *Norwood*

property lines have been physically defined by fences, hedges or garden walls to give a sense of privacy.

CONCLUSION

Norwood development pattern is different from the development of *Golden Grove* in three aspects which have significant impact on sustainable travel: density; land use pattern, and street design. These three elements define the context of the neighbourhood. While in *Norwood* key elements of the neighbourhood blended into a cohesive pattern, which called by planners the "fabric" of the neighbourhood (Chapman 1996), *Golden Grove* pattern occupying large lots of land has filled them with open spaces and connected them with arterial/collector roads. In *Norwood*, different dwelling structures accommodate the varied households, while in *Golden Grove* single family houses are the dominant housing pattern with less flexibility**.**

Street design of *Norwood parade* has been accompanied with more amenity, accessibility and attractions. Local streets need to make safer from motorised traffic through separating them from car lanes, and providing better lighting and more brightness. Also building the homes on the edge provides a feeling of safety for pedestrians. The gridiron street network allows car traffic to distribute in different ways, instead of clogging up an arterial road. While in *Golden Grove*, cul-de-sacs and "loop streets" which circle back on themselves reduce legibility and identity of area.

The older suburb of *Norwood*, presents higher values of a sustainable community. A sustainable neighbourhood is characterized by mixed land uses, and compact buildings, thus creating pedestrian corridors, and a streetscape that better serves a range of non automobile users - pedestrians, bicyclists, and public transport riders. Such neighbourhoods allow residents to replace car trips with walking, bicycling or other non-auto modes for short trips, thus contributing to reduced congestion and better air quality.

In contrast, the planned new suburb, *Golden Grove* design can be criticized in terms of sustainability criteria. The comparative study showed that although *Golden Grove* design has high-quality movement networks, an attractive landscape, and architecture it is less successful in addressing the creation of a pedestrian-friendly community. Also it does not achieve the density required for viable public transport catchment areas or easy accessibility of facilities by non-motorized transport modes. For those who would like to make active choices, community design limits their options. Key functions and activities are often located far from people’s homes. In other words, although walking and cycling facilities are relatively good in *Golden Grove*, do residents have anywhere to walk/bicycle to?

In conclusion, current car-oriented development of *Golden Grove* should be modified. Any changes can be done through strategic policy and planning, land use planning, development codes and guides, and project design and assessment. There are a limitations with multiple, safe and connected options- public transport, bicycling, walking - to get from one place to the other. Doing this effectively requires adopting development practices- mix land use, compact building design, etc- that support multiple travel choices, or modes. Providing choice finally enables the community to move toward a less congested transportation system and cleaner air. *Travel Smart* programs which have been successful in established communities in Unite States may

be approached in *Golden Grove* with considering design, infrastructure, and service initiatives.

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