Triple Bottom Line for systems analyses on integrated transport and land use planning in urban renewal

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Abstract: Regional economic restructuring is a critical issue currently faced in the Northern Adelaide region. Urban development that promotes a transport-oriented environment has the potential to be an efficient strategy that can be the catalyst for social and economic renewal. Achieving optimised outcomes is challenging in suburban areas with low population density where dispersed suburban settings and behavioural patterns are reinforced by planning trends based on private vehicle usage. Similar transformational pressures, especially in relation to the land use around transit nodes, are shared across Australian suburban centres that were originally designed with private vehicle travel as the main transport mode.

This study applies a Triple Bottom Line assessment tool to critically analyse detailed mixed-use community centre development plans for the Salisbury City Centre (SCC) located within the Adelaide Northern Rail Corridor (ANRC) catchment area. Utilising travel and residential choice behavioural models, the paper analyses current issues facing the SCC and provides suggestions on new developments for community facilities, land use, parking standards, transport and water development.

The proposed SCC development attempts to overcome some of the dilemmas associated with the supply of high density housing with adequate car parking, providing greater accessibility to activities and services and sustainable behaviour transformation. This study provides estimates of social, economic and environmental benefits for the region, and provides useful references for place making with transit orient development (TOD) and integrated transport and land use (LUTI) planning standards.

Key Words: Urban renewal, transit-oriented development, residents' preference, social and economic impacts, Triple Bottom Line assessment

1 Introduction

Sustainable living has been intensely advocated with different approaches contributing to desired outcomes such as creating low carbon living laboratories, providing more 'park and ride; facilities to reduce private car travel and generating green energy, with varying degrees of success. Some urban areas in Australia were developed in low density forms with the private car as the dominant means of transport. Population and economic growth has resulted in many of these urban systems being unsustainable with the functions of these areas deteriorating over time. Households face the pressure of high costs of living along with economic downturns, making the quality of social wellbeing an important concern. In recent years, transit-oriented development (TOD) and integrated transport and land use (LUTI) planning concepts have focused on sustainability with shared common characteristics and have been gradually introduced urban development and renewal.

Urban renewal has proceeded slowly in recent decades, the implementation of which has become more complex over time. Issues such as considering integrating economic analysis into the planning process at an early stage (Thompson 1965), efficiency planning with community equity (Hanley & Spash 1993), the ignorance of professional networks, political insiders, and cultural elites (Woolcock 1998), the disconnect of welfare, political forces, physical, social and economic structures in the planning of urban areas (Kleinhans 2004) and the conflicts between adaptation and mitigation of climate change (Hamin & Gurran 2009) are frequently discussed and highlighted as key contemporary urban planning concerns. KPMG and Clayton UTz (2014) highlighted that the urban renewal of centres are about 'building on the strengths of each place, transforming under-used or dilapidated areas, boosting local economies and providing a mix of uses and activities which meet the needs of a community'. The planning of urban form, land use, transport and other infrastructure would be improved with an assessment tool that considers all factors in one integrated package.

In Australian cities, city and town centre renewal has been argued as necessary to achieve sustainability through creating a clear vision of mixed land uses and activities, more affordable housing, increasing accessibility through transit-oriented development, and allowing people to live close to work and convenient public transport (ACT Government 2015; KPMG & Clayton UTz 2014; Meng 2013). In achieving transformation to sustainable land use, urban renewal needs to consider population and economic growth as per the 30 Year Plan for Greater Adelaide (Government of South Australia 2010) that is supported by a transport system as detailed within the Integrated Transport Land Use Plan (Government of South Australia 2015) and adopts suitable planning themes that require extensive rezoning and redevelopment of established urban areas. Such redevelopments within or near town centres are important to revitalize local environments, encourage investment and economic growth, and improve social wellbeing.

The primary aim of this study is to assess what type of town centre renewal plan can have a sustainable and positive impact on the social and environmental aspects and economic growth. This research uses a suburban town centre, Salisbury City Centre, in the northern part of Adelaide's metropolitan area, as a case study to explore the Triple Bottom Line (TBL) assessment method and demonstrate how government policy and stakeholders can play an interactive and efficient role in supporting the achievement of sustainable outcomes and maximising community benefit in relation to economic, social and environmental development.

The structure of this paper is set as follows: Section 2 discusses the methodology of cost benefit analysis; Section 3 uses SCC as an example to implement TBL analysis to assess renewal options; the paper then provides a list of specific indicators for transport and land use renewal that associated with TBL criteria in Section 4 and it then concludes with Section 5.

2 Triple Bottom Line assessment and urban renewal

In urban renewal plans, governments play an important role in initiating an assessment for sustainable development. Conventional methods of evaluating urban renewal options adopt cost benefit analysis (CBA) and are complemented by other tools, such as those issued by the Commonwealth of Australia (2006) in providing National Guidelines for transport decision making. The methodologies consist of:

- Strategic Merit Test (SMT) to assess how well the initiatives fit with the government's objectives;
- BCA which focuses on monetised impacts;
- An optional adjusted BCA (an extension of BCA) uses a set of weight of different objectives;
- Appraisal summary Table (AST) evaluates overall net benefit with both monetised and non-monetised benefits and costs.

These assessment tools were commented on by Professionals Australia (2014) in an overview that whilst they serve as key methodologies in transport system management appraisals, as appraisal tools, they lack an analysis of demand forecasts and the likely impact on the community. Given that traditional CBAs are very much financially based, they provide little consideration of social and environmental benefits as this can be difficult to quantify due to their often subjective and qualitative nature (Camagni, Gibelli & Rigamonti 2002; Prest & Turvey 1965; Woolcock 1998). In recent times, governments have carried out a Triple Bottom Line (TBL) assessment framework which aims to reduce any negative consequences of actions and maximise positive impacts in policy change (Commonwealth of Australia 2012). TBL was initially developed for corporate sectors to assess sustainable investment in relation to social and environmental impacts (Elkington 1997). This tool has subsequently been introduced by government and agencies in the South Australian context, for example, by the Department of Planning, Transport and Infrastructure (DPTI) of South Australia, and the City of Salisbury (South Australia). TBL is a sub-set of the indicators assessment method and helps identify positive and negative impacts for decision makers. Blair et al. (2004) applied TBL indicators to help determine effective sustainability policy for affordable housing and reduced environmental impact. The ACT Government (2009) proposed using TBL for sustainable policy assessment, and the Commonwealth of Australia (2014) recently reviewed the TBL appraisal system so that it could be broadened to apply to an integrated transport and land use plan.

In regard to social and community impacts, Lichfield, Kettle and Whitbread (2013) had suggested that planning assessment should involve the segregation of the community into several homogeneous

groups based on willingness to pay for the cost and benefit associated with an option estimated for each group. Some discrete choice modelling studies focused on analysing individual preference of individuals for testing policy indicators by applying discrete choice models (Ben-Akiva & Lerman 1985; Meng 2013; Olaru, Smith & Taplin 2011; Primerano & Taylor 2005). Primerano and Taylor (2005) created a policy assessment framework that measures the effectiveness of a policy in improving accessibility in relation to transport and urban from for all socio-economic groups.

This study applies a TBL assessment tool to analyse urban renewal planning. Some individual preferences derived from previous research of transit-oriented development (Meng 2013) were applied in this method as sustainable planning policy indicators which were then analysed against each TBL assessment criterion. The framework suggested in this study is shown in Figure 1.

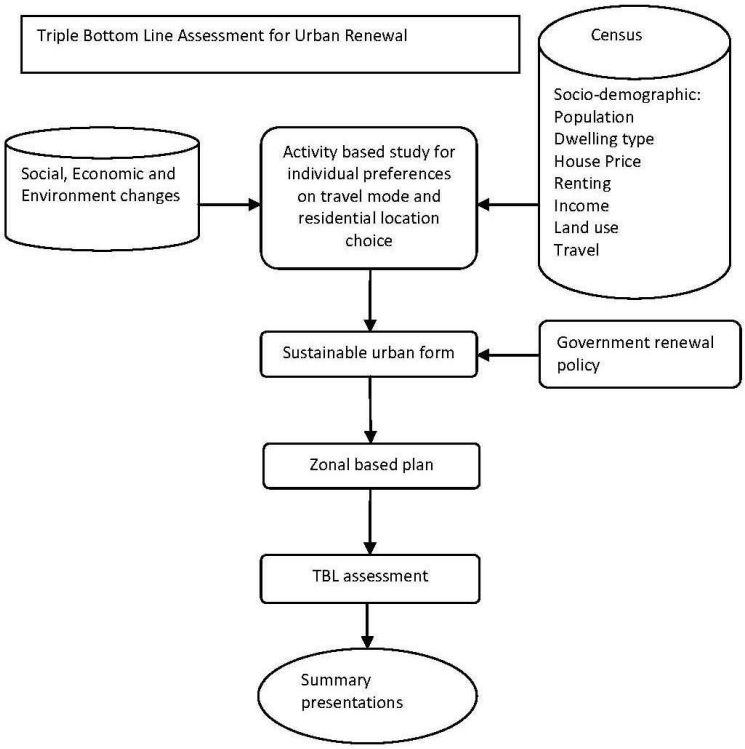

Figure 1. Framework for TBL analysis

3 TBL assessment in a suburban case study

3.1 *Salisbury City Centre and renewal plan*

Salisbury City Centre (SCC) is located in the heart of the Northern Adelaide region. The economy currently depends on the car and manufacturing industries, which will dramatically change over coming years due to the shutdown of GM Holden plant in 2017. Daily living, travel, energy use and social life in the region will be radically altered. Reduced incomes could mean that people may not be able to afford the goods and services that they were previously accustomed to (Pieters 2013). Population, economic and environmental growth may stop and economic decline is a distinct risk. Without a renewal plan to reshape land use and service and infrastructure provision, the community is likely to suffer high rates of unemployment, deteriorating infrastructure and congested traffic systems. Government needs to take some initiatives to regenerate the economy to ensure a stable social environment and at the same time protect and enhance the environment to achieve sustainability.

Sustainability is the focus of urban renewal. The ACT Government (2009) has defined its components in 'People, Place, Prosperity' as:

- recognition of the interdependence of social, economic and environmental wellbeing;
- a focus on equity and fairness, taking account of the effect of our actions on others in an interdependent world; and

- recognition that meeting the needs of today must not be at the expense of future generations being able to meet their own needs.

This policy also translates sustainability into 7 themes of action: quality health care; a fair and safe community; excellent education; quality teaching and skills development; a strong, dynamic economy; a vibrant city and great neighbourhoods; a sustainable future; and high quality services.

In South Australia, the Strategic Plan (2011) presents a vision that 'creates a future shaped by choice, not chance. Keeping our communities strong and vibrant, protecting our rich environment and pursuing shared economic prosperity will provide a better future for South Australians. By investing together in our health, education and innovative ideas we can secure our top priority: the wellbeing of all South Australians. Our plan expresses our values; its targets reflect our priorities.'

At the local government level, each council has developed its own strategies to cope with urban renewal. The City of Salisbury released a Renewal Strategy which was developed to revitalise and invigorate the SCC based on the following desired renewal outcomes:

1. Population—provide a substantive population increase which underpins activation within the SCC and provides the basis for all other desired outcomes to flourish;
2. Business & Employment—Establish SCC as the pre-eminent business hub of the mid Northern metropolitan area by stimulating new business and employment opportunities;
3. Retail—Increase retail offerings and establish the SCC as an active and thriving retail hub;
4. Community—Enhance access to community facilities and services to inform, support, and celebrate community diversity and promote community wellbeing;
5. Place—Provide a sense of place which reflects Salisbury's heart and identity and connects all elements of the wider urban realm - linking pedestrian, residential, economic, civic, community and recreation networks (City of Salisbury 2012).

The City of Salisbury has considered the Renewal Plan and initiated a Development Plan, Salisbury Council (Government of South Australia 2014a). In the plan, the potential improvement areas include advertisement, animal keeping, community facilities, crime prevention, design and appearance, energy efficiency, hazard prevention, infrastructure, land uses, open space and recreation, renewable energy facilities, tourism and transport and access. The plan highlights the centres and retail development, including its city centre. For SCC, the objectives of development are to increase retail, administrative, community, educational, recreational and cultural activities. These policies are technically feasible and align with the ACT Government's strategic priorities. SCC's development reinforces historic buildings and features in the area and seeks to retain the following historic buildings and sites within the SCC, including Salisbury Primary School, churches, Police Station, hotels, and the Salisbury Institute. The envisaged land uses include expanded services and shops, offices and dwellings in conjunction with non-residential development (Government of South Australia 2014a).

Figure 2 demonstrates the study area of the SCC, with around 200k m^2 of land, separated into 23 zones whose boundaries were defined by the Mesh Blocks used in the 2011 Census. This study emphasizes that the land owned by the council and the South Australian state government facilitates an easier process for decision making, as land ownership is the main obstruction to urban renewal plans, and includes zones 1, 5, 15 and 23 around the railway station interchange, and zones 2, 3, 6 and 22 being the civic square, council office, car park and library.

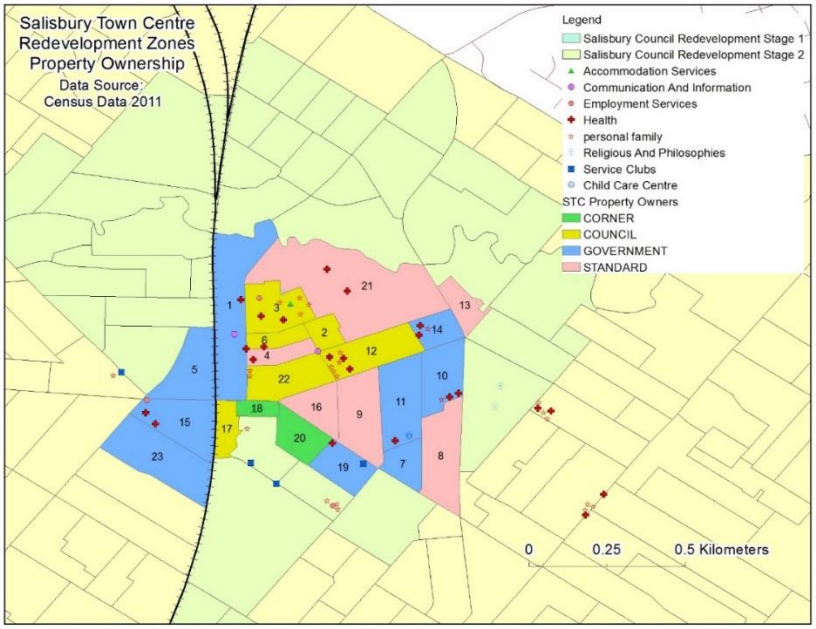

Figure 2. Salisbury City Centre zones and their ownership

3.2 *Sustainable uran renewal indicators*

This section includes five initiatives for integrated transport and land use sustainable designs: 1—community sub-group and preferences; 2—land use planning; 3—car parking and management; 4—transport and 5—water use planning. The analyses are mostly based on the transit-oriented study which was conducted for bigger area of rail corridor and drew Salisbury City Centre local characteristics. Some important factors identified in the study via a stated preference survey and the development of discrete choice modelling (Meng 2013).

3.2.1 **Community planning**

Local residents are important drivers in urban design, and studies have found that residential attitudes and lifestyle variables have the greatest impact on travel behaviour whilst the type of neighbourhood only has a small impact (Bagley & Mokhtarian 2002; Mees 2009a). Often people who live near transit nodes use more public transport and own fewer cars (Cao, Xu & Fan 2010; Cervero 2007; TRB 2004). Sustainable planning of TOD developments can influence behaviour towards more public transit usage and contribute towards a more environmentally sustainable lifestyle (Cao, Xu & Fan 2010). However, residents' preferences can also create barriers to TOD implementation as residents may be opposed to some TOD approaches. Uncertainty and changes to the local environment may not be welcomed at first. 'Not-in-my-back-yard' (NIMBY) is a typical reaction as some people resist the use of public transport and are opposed to higher density apartments (TRB 2004). Such situations are not unusual in TOD implementation. One way to minimise NIMBY is to reconcile local community's preferences, create mutual understandings and gain support from residents (Curtis 2006). Local TOD planning needs to reflect local residents' vision of what kind of area they want to live in and what transport they want to use in the future (Department of Environment Transport and the Regions [DETR] 2000). Residents' behaviours and attitudes are also impacted by a number of other factors, such as local economic forces, the effects of political traditions and cultural ideologies (Hall 1989). It is useful to identify what services the community lacks and what specific development characteristics are required. Attention to socio-demographic change has led to some successful TOD developments, such as in Southern California (TRB 2004).

Residents' preferences of travel and house location choice were estimated in discrete choice models in a previous study of Adelaide's Northern Rail Corridor (which included the Salisbury area) (Meng 2013). By analysing latent classes outputs, the population can potentially be subdivided into groups by age (34 and under, between 35-54, and 55 and over); by personal income with a higher income groups (over A$67,600 p.a.), a middle income group (between A$41,600~A$67,599) and a lower

income group (under A$41,599)[1]; or by occupation, (e.g. a labourer group (labourers or machinery operators), administrator group (sales and administrations), and a professional group (including mangers, professionals and technicians)). The proportion of each group in the Salisbury area derived from ABS data can be found in Appendix 1 (ABS 2011). Some estimated results of travel preferences are consistent with ABS survey results (ABS 2013): Those aged 55-64 years old were more likely to drive to work or full time study (78 per cent), while young people aged 18-24 years old were less likely to use a car (63 per cent), and more likely to take public transport (28 per cent). Meng's findings also suggested that higher income residents tend to seek a house close to a preferred school and also close to their work place, and are more likely to choose a location with convenient services. The lower income levels show the opposite trend in that they are most likely to choose a place that is transit convenient if the service is available. As the younger population group is dominant in the corridor (around half), a focus on the needs of the younger group (aged 34 years and under) with low and middle levels of income is required to encourage more frequent use of public transport, through better access to train stations, including sufficient 'park and ride', reliable bus services, good walking access, and good services provided at shift change times. These results would help planners to provide efficient policies to benefit the community.

3.2.2 **Land use planning**

Mixed land use with shops, schools and services and higher density residential housing can encourage walking or cycling (TRB 2004) and also create more job opportunities for local residents travelling by non-motorised modes (Cervero 2006; TRB 2008). Land for commercial use is often specifically selected, such as the shops at ground-floor facing a street with busy pedestrian or car access. In a vertical design, a restaurant may not be ideal for upper level residents who seek peace and privacy in the evening. Offices above shops have been shown to be an acceptable way of achieving mixed uses in contrast to development with shops under residential uses in a building. Land for commercial use should also consider what else is or will be developed in the area (Howe, Glass & Curtis 2009). Mixed land use can be considered not only for different levels of services and employment but also at a residential level to accommodate diverse population communities for different socio-economic backgrounds (Dittmar, Zelzer & Autler 2004; Mees 2009b). Studies have suggested that open space, such as greenery, playgrounds and parks, tend to increase the price of a house (Irwin 2002), encourage physical activities and contribute to a healthy environment and lifestyle (Giles-Corti et al. 2005). There is a need to pay attention to amenities and environmental design of the open space (Smith, Poulos & Kim 2002). In addition, the local walking environment is affected by streetscape design (Moudon et al. 2006). Detailed street design should include a defined street width, footpaths, cycle lanes and even the location and appearance of trees, flowers or art sculptures (Campbell Reid 2009).

Station precinct area design influences people's choice of whether to travel by car or public transport or walk (Givoni & Rietveld 2007; Zemp et al. 2011). Housing density around the railway station may be the most influential factor among all of the built-environment factors (TRB 2004). A lack of vacant land near stations or the availability of small plots owned by different agencies, such as state government, local government and private enterprise makes redevelopment complex. The TRB report suggested a need to bring owners together and find the maximum value for land development, e.g., in the south of Los Angeles, negotiations between the city and local councils resulted in a compromised solution to relax parking standards along Long Beach's Blue Line stations. Often, the area around the station is perceived as cheap land and can be used for car parks. A station redesign can act as an anchor to foster economic revitalization while simultaneously transforming the local urban fabric (Renne 2009). While, there are challenges in a station precinct land use plan, such as local zoning codes and surrounding uses can provide challenges (TRB 2004, p.420), 'Park and ride' lots and feeder bus stops at the train station can be significant physical barriers for pedestrians, as well as wide and busy roads and incomplete footpath networks, and the creation of safe walking zones (TRB 2004).

The present land use of SCC is predominantly single storey commercial and retail. The redevelopment of SCC presents a great opportunity to develop affordable housing and to conserve transit usage and energy consumption. Some detailed suggestions can be found in Appendix 1 with regard to house style, size and number of bedrooms. The revitalised areas such as John Street could accommodate medium-high buildings in Zone 22. However, a two-way street with curb parking would

[1] These income brackets are based on 2006 census data information

not provide a place that is conducive for pedestrians and cyclists to move around. Instead, more traffic may be generated as people seek parking closer to the retail core by driving around continuously until one is found. Under this circumstance, it is recommended that some businesses to provide the necessary car access from the rear to improve the development's attraction to tenants and customers. In Adelaide's Unley Road, a retail high street along a busy suburban arterial road, this strategy has been applied successfully.

The land use around the station (Zone 1 and 15) includes a hotel, liquor land and gaming which are all closely located around the station area. It is possible that patrons from these establishments could make rail passengers and pedestrians feel uncomfortable. Some partitioning between hotels and pedestrian routes is necessary. For all defined zones in the SCC, pedestrian, cycling paths and disabled access are essential. There is a plan to increase pedestrian paths and provide visual and physical amenity and safety surveillance (Aurecon 2012). The other remaining issues are that some traffic conditions can cause feelings of uncertainty for some people, thereby implying difficulty in walking within, into and out of the Centre, due to busy traffic, street parking, Salisbury Highway and the at grade rail tracks with its level crossing. In addition, as the habit of walking for short distances has not been well developed, it might be better to provide sheltered walkways or walkways under tree canopies to encourage walking. It is also important to provide enough lighting for walking at night. Walking paths should be available at the side of every road in the town centre. John Street could be turned into a walking street with street shops, seating, alfresco dining and entertainment (around area of Zone 22).

In considering bicycle lanes, which link the town centre to major roads, there is a lack of 'bike direct' initiatives such as reducing traffic volumes and lowering speeds on local roads and to provide enough bike lockers. The extension of a road north of Parabanks to form a ring road for vehicles around the SCC is suggested to support traffic flow. However, it may deter pedestrians and cyclists entering the SCC and reduce any motivation to walk even for short distances. As a result people may drive a car to travel to another destination within the town for around 400-500m rather than walking.

3.2.3 **Car parking planning**

In a culture with an automotive dependent history, TOD implementation with low parking supply is difficult, unless a project plan includes undercover garages. Past experience has shown that the need for parking has been a perceived requirement of the investment community so mixed use is difficult to sell, e.g., in Los Angeles (TRB 2004). Ample parking would also put huge stress on non-profit developers in a mixed plan, and expensive parking puts mixed-use out of a reach of TOD. In the Bay Area Rapid Transit (BART) parking limitations in a TOD development in San Francisco were ignored and created high costs for the development (TRB 2004). TOD planning has to improve alternative accessibilities such as public transport, walking and cycling as a priority that makes it easier to develop a suitable car parking plan. The provision of car access to a station may promote ridership (TRB 2009), however it may also encourage car use to access the station rather than other sustainable modes, such as taking a bus or walking. Rationalizing parking policies related to TOD is essential in influencing station accessibility and setting a parking standard. Parking can deteriorate the walking environment of pedestrians and disturb neighbourhood communities especially when the residents complain about cars being parked in their local street during daytime. Car parking structures, in the form of underground or multi-storey parking can replace surface parks, thereby freeing up land for other development in future, such as walkways and community spaces (TRB 2004). The ability to reduce parking outlays can further attract developer interest in a TOD. Some car parks need to be well planned as a renewable provision and slowly transformed into TODs.

Reduced or flexible residential parking standards or shared parking zones can help meet residents' requirements and development costs. It is important to first design an appropriate cycleable and walkable landscape strategy, and build enough flexibility into the future development process to change if and when circumstances allow it. The parking standard has to be carefully considered and weighted in line with the overall goals for TOD and tempered by the financial realities that transit agencies face (TRB 2004). In the Subi Centro development, car parks have been designed with the provision of pedestrian routes, with the majority of parks being underground, under buildings and under roads, while some of them are above ground at the central square as provisional access until stronger pedestrian activity is established (Howe, Glass & Curtis 2009). Car parking around railway stations has resulted in a changed focus by the South Australian government. In a strategy designed to encourage more public transit commuting, substantial investments have been made in providing

long term commuting parking at transit interchanges. An example is the recently completed multi-level car park adjacent to the Tea Tree Plaza O-Bahn Interchange at Modbury to promote park and ride, which can accommodate 700 cars (Government of South Australia 2014b).

Car parks in the SCC show low occupation rates, for example, the northern car park is only 20 per cent utilised and the private parks located for businesses between John and Wiltshire Streets are usually only 70 per cent utilised. A QED staff survey indicated a strong unwillingness to walk further than 2 minutes from a car park to destinations (Aurecon 2012). This report has discussed the parking strategy; however, it seems there is still a lack of a clear guide for a TOD parking provision standard which should be further defined within a detailed landscape plan.

In Australian suburban settings, especially in a local town centre like Salisbury, car parks act as an important tool for attracting customers to local businesses, as residents are used to travelling everywhere by car. The introduction of a short term parking limit of 30 min or a parking levy is likely to play a negative role in promoting the economic viability of SCC, as would restricting staff parking availability. The provision of parking should be adequately or at least temporarily supplied until the public transport network achieves a satisfactory service level in terms of frequency and connection. An interim medium term car parking strategy would be to concentrate parking on the edge of the retail/commercial core within a multi-deck parking station, thereby allowing parking traffic to be eliminated from sensitive pedestrian and cycling oriented thoroughfares. For a transformation to occur, in the short term it would be feasible to provide an equivalent but flexible car parking provision, with shared car parking (reserved car parking for different people to use at different time period) being utilised optimally. Specialised car park management can be provided to support businesses trading or renting out car parks. The registration of a car park service can provide opportunities to help residents to lease or share their car park for long or short term periods within the town centre. Both business tenants' and residents' car parking can be supplied in the under croft of buildings, where they abut through traffic streets. In addition, residential parking may be better supplied as one permanent park and one shared (or temporary) park. For public use, multi-storey parking can be considered as a short term solution, where usage could be planned as a visitor's facility in the day and for residents at night. However it should be planned to be ultimately converted to other land uses in 5 to 10 years, as public transit services improve and development in the town centre is transformed into a TOD.

For Salisbury City Centre's development, the Car parking plans can follow some standard guides, such as the guide of Parking and Vehicular Access General Code (ACT Parliamentary Counsel 2012). It provides parking provision rates for residential zones (p 21-23). One of the other characteristics of parking is distance from the parking lot to the next destination. Parking locations are preferable when designed to be located 100-300 metres away from the destination which helps to promote non-car travel but walking paths have to be designed with shelter, minimised or no conflict with traffic and sufficient loading zones segregated from pedestrian/cycling routes but near each building and service. According to the Parking and Vehicular Access General Code and stated preference study results (Meng 2013), a proposed parking standard was developed and is shown in Appendix 1, where the average parking for each residential building is set as 1.4 which is under current Australian TOD plans as 1.7. During the period of conversion to a less car dependent future, this number can be dropped further.

3.2.4 **Transport planning**

Before designing land use arrangements, it is important to ensure that the transit system and other infrastructure is adequately designed to serve the anticipated population target. Convenient public transport provision gives tenants and customers a chance to avoid traffic congestion. In the redevelopment of Subiaco, the underground railway station provided significant environmental remediation and the substantial benefit of linking Rokeby Road to the residential area (Howe, Glass & Curtis 2009). Transit agencies can coordinate and integrate the timetables, fares and routes to match the demands of TOD. Local traffic management standards sometimes need to be altered, such as speed limits.

A well-designed transport network promotes sustainable urban growth and shortens transfer distances and times which will promote non-motorised travel and reduce energy consumption and carbon emissions (Breheny 1995; Dittmar, Zelzer & Autler 2004). Rail, light rail (LRT) or a rapid bus transport corridor is usually the focus of network linkage studies, especially with regards to the topic of transport and land planning (Curtis 2006; Mees 2009a). Networks consist of and are linked by

different routes such as roads, walking paths, bicycle routes and public transit routes, between two different spatial locations which can be residential, business, service or other facilities. Fast public transport services that provide easily accessible connections in higher density residential and employment areas are the goal of TOD corridor development. A Feeder bus interchange at the railway station is also an important element of station area development. As rail is only easily accessed by a minimal amount of passengers who live near the station, other passengers require convenient access which could be in the form of feeder buses which may be achieved at a minimised cost for both providers and users (Chien & Schonfeld 1998). Supporting policies may be required to encourage the use of a public transport corridor, such as flexible tickets, bus feeders or 'park and ride' provisions.

Figure 3 shows the SCC's preferred infrastructure plan at an early stage. In the SCC's infrastructure plan, the suggested development is focussed around John Street and an extended Church Street with higher density developments. The Aurecon report suggested that if the road hierarchy is modified, John and Church Streets can become main streets, however, these new changes may cause too much car traffic and not fit well with street level shopping and the convenience of walking to John Street and Civic Park.

Figure 3: Preferred structure plan for SCC

Source: (Aurecon 2012)

The internal road network extension of Church Street has been reconsidered and modified compared to an earlier project review (General Accounting Office 2001). To reduce the number of cars roaming for parking within the centre inner streets, there should be some careful design scenarios that consider John Street as a pedestrian only street, supported with extensive side walkways linking the Street to car parks behind its commercial buildings. Some areas need to be restricted to access only by car to promote parking a considerably acceptable distance away (e.g. 300 m) and accompanied by walk through friendly pedestrian paths. Therefore, the core of the precinct remains pedestrian and cycling are the focus of the local plan.

On the southern side access point near the train station, the SCC has discussed construction of a level crossing to ease congestion and to create a friendly walking path, but there is still a need to communicate with DPTI (General Accounting Office 2001):

> '…such as driveway crossovers, street tree planting, footpath design, shelters, street furniture are council works and not a development control issue because they are under Council ownership and control. Many aspects of urban design will be adequately described by the new zone modules developed by DPTI.'

The plan needs to carefully set out to consider the issues such as morning and afternoon peak travel flow within the area on Park Terrace and Commercial Road (work trip to the town centre and the school based trips) that cause traffic delays. The number of parking spaces should be supplied based on a car park management for shared occupants according to the specific land use zone and streetscape design.

Transit agencies will have different tasks and guides in coordinating and integrating timetables, fares and routes with the demands of a TOD. Survey results from local residents showed that 20 per cent of participants use the interchange and 8 per cent are working in the SCC (Fischer 2011, p.7). A third of the participants (n=200) used the interchange to arrive at the Centre, while 43 per cent used a car. One fifth of respondents mentioned safety issues, while the report also mentioned that 'safety is not an issue in mind but was raised when pushed'. More than a third of the respondents would consider moving to a house near the SCC. After affordability, a convenient location and good design were considerations for those who tentatively indicated they would consider living near the SCC.

Timely and connected public transport services provide tenants and customers with a chance to avoid traffic congestion. Designs with the ability to reduce parking outlays further attract developer interest in TODs. Currently, bus routes serve the SCC and feed into the interchange, however, the routes loop around in the town centre deteriorating the walkability and cyclability of the local area and contribute to traffic congestion to some extent. This can be seen from some of the bus routes in Figure . There is another method to improve the situation is the bus routes can be redesigned so that the bus does not cross the railway from Park TCE, as a consequence of the 2002 tragedy when a train struck collide a car which rammed into a nearby school bus killing four people (Debelle 2002).

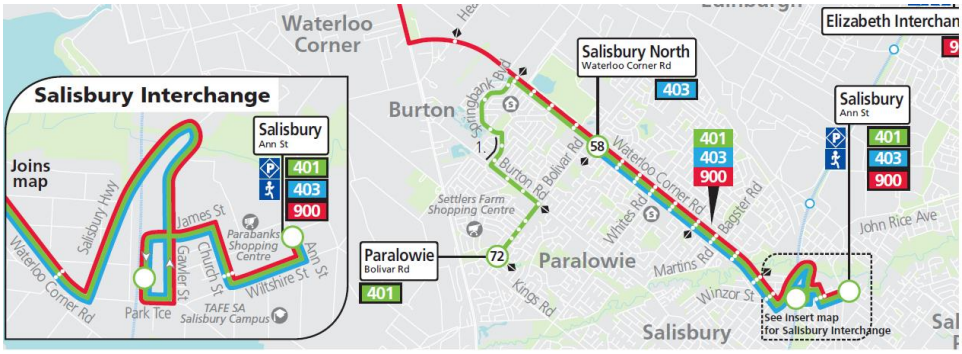

Figure 4: Bus routes to around Salisbury Interchange

Source: (Adelaide Metro 2013)

In the town centre itself, buses should not loop uncessarily around in the centre. They should directly come in and out near the railways stations which would encourage more people to walk a maximum of 300 metres, help local traffic flow and improve the friendliness of the environment. In Figure 5, bus interchanges and routes in the SCC are proposed. An improvement option has been discussed in recent years which proposes building an overpass to the railway line, which would improve safety and traffic flow for cycling, walking and motor vehicles. However this plan has to be modelled and assessed to determine its efficacy and impacts. John Street is proposed as a walking street which would help build an entertaining, vibrant and social connected environment.

For the population in Salisbury, the younger generation with middle to low incomes could be encouraged to drive their cars less by providing good feeder buses to train stations, improved walkability, car parking, higher train frequency, disabled assess, and by developing affordable housing around the train station supplied with schools, shops and open parks. The selected areas which have a higher number of younger people with low to middle incomes should be targeted for improved bus services. By doing so, older generations may also be influenced to use public transport more. The feeder bus routes have been preliminarily proposed by Meng (2014) but it noted that

further modelling work is required to validate the routes. It is possible to provide some subsidies for shopping when people arrive by public transport which technically could be managed such as by linking Metro ticketing with a shopping centre loyalty customer card. Based on the estimated mode choice for Adelaide Northern Rail Corridor (Meng 2013), if the transit network is well designed, the mode share indicated for private cars could be reduced to 30 per cent, and increased to 40 per cent for transit (train or bus) and 30% for non-motorised travel (walk, cycling or others) (see Appendix 1).

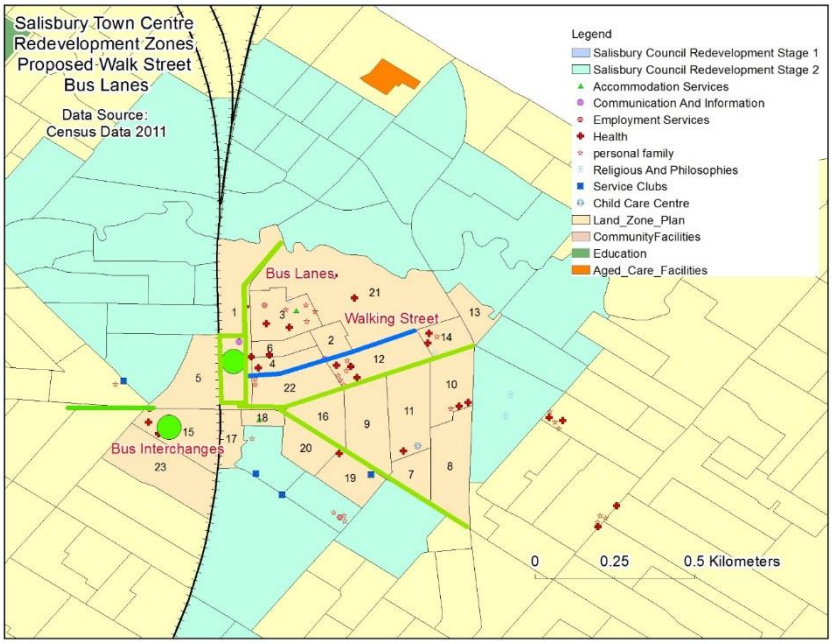

Figure 5: Proposed bus interchanges and routes in the Salisbury City Centre

3.2.5 **Water planning**

For a sustainable urban design, it is also important to consider natural resources conservation in landscape planning (de Groot 2006), which includes drainage and natural irrigation and the provision of water for consumptive use. Green Roofs might be necessary to introduce to the City Centre's new buildings which would reduce the stress of the urban water cycle and urban heat island defects (Razzaghmanesh, Beecham & Kazemi 2014). Well managed water use will also reduce the harmful impacts of urbanisation while providing an additional amenity for communities and the environment (Beecham, SC 2003). The choice of pavements will affect water sensitive urban design systems. Detailed suggestions can be found in Beecham and Chowdhury (2012).

For SCC, the Little Para River (northern side of Zone 21) is a useful and natural catchment to be utilised for sustainable water management. The river can be transformed into a water feature which captures and re-uses stormwater and at the same time supporting natural water flow. Linear park walking and cycle ways could be developed in the area, which also can link to walking and cycle networks serving the wider region. In addition, if coffee shops and restaurants were built around the area with water as the main theme, potentially more customers would be attracted, although feasibility studies would be required to determine the best approach and design strategy.

The land use plans that are related to the aforementioned 5 indicators of Salisbury City Centre renewal were further assessed according to the three TBL criteria, the impacts of which are presented in Appendix 2. Some of the detailed planning scenarios have been interpreted according to relative scales, a methodology recommended by Saaty (1990) and it demonstrates the potential to be for incorporation into a mathematical transport and land use model. Some of the important factors with levels and suggested planning proportion were included in Appendix 1.

4 Specific indicators associated with TBL for urban renewal

The sustainable indicators for the TBL consisted of 33 social, economic and environmental impact criteria that were identified in the '*Triple bottom line assessment for the ACT Government, framework and templates'* (Commonwealth of Australia 2012) (see the column headers in Table 1). For transport and land use integrated urban renewal analysis, these defined criteria are too far ranging to be adequately considered in detail. Thus, based on the Salisbury Town Centre renewal planning analysis, some specific indicators were selected that were deemed to be directly associated with TBL indicators for a sustainable urban renewal scheme that can be applied as a design benchmark for urban and transport planners.

The items listed in the Table 1 are not limited as presented and can be potentially contradictory, such as S31 'higher density' land development would conflicts with En44 'car park design' under the low density neighbourhood characteristics. This occurs in Salisbury City Centre development, where if a lower number of car parks were provided, then visitors may experience difficulty in driving to the Centre and retail expenditure would "escape" to a rival shopping centre with better parking facilities. Therefore, a subsequent and further stage to this research is to define, apply, and investigate the compatibility of these indicators and their implications for sustainable transport and integrated land use development.

5 Conclusions

This paper has presented an approach for an urban town centre renewal development with detailed sustainability initiatives of community preferences, land use, parking and transport goals driving as identified as being necessary at local, state and federal levels. The framework presented in this paper for Salisbury City Centre has the capacity to accommodate a wide range of TBL assessing indicators in relation to social, economic and environmental impacts in a defined district zone. Thus, the use and application of this framework will lead to more coherent and detailed sustainable urban renewal planning initiatives within an integrated system. This approach using TBL criteria has the potential to be applied to other suburbs in metropolitan Adelaide and elsewhere in Australia. The dilemma as to whether the plan created critical conflicts between TBL indicators need to resolved with further analyses according local characteristics.

A central advantage of this approach to an urban renewal planning framework developed according to TBL principles, is that it does take into consideration community preferences, and whilst success is ultimately subject to economic conditions, the benefits include more affordable housing, optimised car parking, better public transport and improved civic service provisions. Policy guidelines for sustainable transport and land use development will require a long lead time, however, the benefit would be to create an urban environment that is genuinely compliant with TBL principles that would encourage sustainable planning for the Salisbury City Centre, and in the long term to help nourish sustainable travel behaviour. One particularly important finding of this study was that the higher density housing proposed could supply sufficient housing units and car parks to satisfy present policy standards whilst meeting sustainability criteria and yet remain competitive with other nearby shopping centres.

One area of concern is that TBL assessment indicators tend to be too large for urban planning so additional care needs to be put into the process. A key uncertainty of an urban renewal plan is in securing finance, particularly in an area such as Salisbury where investment is normally funded by the tax payer. However, during an economic downturn, revitalising the economy should become the first priority.

6 Further study

A future study is to implement TBL assessment tools into metropolitan renewal plans through the utilization of software such as Citilabs Voyager and Land, which include Transport and Land Use integrated model. The specific criteria proposed in this study can be explored further by using quantitative scales to assess the potential upgrading of Metropolitan Adelaide Strategic Transport Evaluation Model (MASTEM)--an integrated transport and land use model, to assess the overall sustainability of the plan.

Table 1 Specific indicators associated with TBL criteria for sustainable urban renewal

TBL Criteria		Sustainable urban renewal indicator		TBL Criteria		Sustainable urban renewal indicator		TBL Criteria		Sustainable urban renewal indicator	
No.	**Social**	No.	Indicators associated with Social	**No.`**	**Economic**	No.	Indicators associated with Economic	**No.**	**Environmental**	No.	Indicators associated with Environment
S1	**Community and individual health**	S11	preferences and choices	**Ec1**	**ACT Government Budget**	Ec11	affordable development	**En1**	**Biodiversity**	En11	mixed land use
		S12	amenity			Ec12	mortgage repayment			En12	diverse food supply
		S13	outdoor activity								
		S14	pleasant environment								
S2	**Access to services**	S21	walk and cycling connections and public transport service	**Ec2**	**Productivity and Innovation**	Ec21	shortest travel time	**En2**	**Landscape changes**	En21	land size
		S22	disabled accessibility			Ec22	sustainable innovative designs			En22	real estate type
										En23	mixed land use
S3	**Housing and affordable housing**	S31	high density	**Ec3**	**Income levels and distribution**	Ec31	income group	**En3**	**Heritage**	En31	heritage sites
		S32	real estate type			Ec32	real estate type				
		S33	land size			Ec33	affordability				
S4	**Access to social networks and community activities**	S41	open entertainment	**Ec4**	**Employment**	Ec41	mixed employment	**En4**	**Natural resources**	En41	real estate type
		S42	community facility							En42	travel modes
										En43	mixed land use
										En44	car park design
S5	**Human rights**	S51	disabled accessibility	**Ec5**	**Small Business Impact**	Ec51	infrastructure service	**En5**	**Environmental quality**	En51	greenery design
										En52	car park design
S6	**Gender**	S61	gender group	**Ec6**	**Skills and Education**	Ec61	education and training centre	**En6**	**Greenhouse gas emissions**	En61	reduce private car driving
S7	**Indigenous and multicultural**	S71	occupation group	**Ec7**	**Investment and Economic Growth**	Ec71	vibrate business	**En7**	**Water**	En71	water supply
		S72	multicultural centre			Ec72	future industry			En72	outdoor irrigation
		S73	church and temple								
S8	**Impacts on different age groups**	S81	retirement village	**Ec8**	**Consumption**	Ec81	vibrate shopping centre	**En8**	**Air**	En81	open plans
		S82	children plan ground			Ec82	variety of services			En82	reduced emissions
S9	**Disability**	S91	disable accessibility	**Ec9**	**Competition**	Ec91	competitive land designs	**En9**	**Microclimate**	En91	trees and greenery
S10	**Disadvantage and vulnerable**	S101	multi community centre and activities	**Ec10**	**Cost of living**	Ec101	reduced travel and car ownership	**En10**	**Visual quality**	En101	amenity and leafy designs
S11	**Justice and crime**	S111	safety	**Ec11**	**Procurement**	Ec111	freight connection	**En11**	**Waste**	En111	real estate type
		S112	street lighting			Ec112	mixed land sue			En112	land size
										En113	use of recycled material

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Appendix 1. Planning scenarios by residents' preferences

No.	Planning initiatives	Planning detail in levels	Percentage	Sub-percentage
1	Community sub group			
1.1	Income group	1=High ($15,000/week, $78,000/year)	15%	
		2=Middle (between $800-$14,999/week, $41,600-$77,999/year)	35%	
		3=Low (lower than $799/ week,$41,599/year)	50%	
1.2	Age group	1= Old (55 and over)	23%	
		2= Middle (between 35-54)	37%	
		3=Young (34 and under)	50%	
1.3	Occupation group	1=labourer group (machinery operators, labourers and none-stated occupations)	28%	
		2=administrator group (personal services, administrative and sales)	36%	
		3=professional group (mangers, professionals and technicians)	36%	
2	Land use			
2.1	Real estate type	2=Separate House	5%	
		4=Semi-Detached/Townhouse	10%	
		6=Apartment/Flat	85%	
2.2	House Cost/Affordability	4=40%	10%	
		8=30%	55%	
		12=20%	25%	
		16=10%	10%	
2.3	House ownership	1=Fully owned	25%	
		2=Being purchased	45%	
		3=Being rented	27%	
		4=Other	3%	
2.4	Family relationship	1=Person living alone	20%	
		2=Couple with no children	35%	
		3=Family (including extended) with children	43%	
		4=Other	2%	
2.5	Average land lot size	370 square meters		
2.6	Average land lot price	$170,000		
2.7	Average people per dwelling	2.6		
2.8	Average motor vehicle per dwelling	1.7		
2.9	Median weekly household income	$1021		
2.10	Median monthly mortgage repayments	$1410		
2.11	Median weekly rent	$240		
2.12	Occupied rate	1=Occupied	95%	
No.	Planning initiatives	Planning detail in levels	Percentage	Sub-percentage
3	Car park			
3.1	Commercial building and car parks	1=Bulky goods retailing (2 per 100 sqm)		
		2=Business agency (4 per 100 sqm)		
		3=drink establishment, night club (5 per 100 sqm)		
		4=Education establishment (0.1 per person)		
		5=hotel (0.3 per employee, 1 per guest room)		
		6=Indoor entertainment facility (0.25 per employee)		
		7=Outdoor recreation area (5 per 100 sqm)		
		8=Personal service (4 per 100 sqm)		
3.2	Community facility	1=Child care centre (0.13 per person)		
		2=Schools (0.08 parking per person, 0.02 pick up bay per person)		
		3=Secondary college (0.18 parking per person, 0.02 pick up bay per person)		
		4=Community activity centre (3 per 100 sqm)		
		5=Health service (0.25 per person)		
3.3	Residential and car park	1=4 bedrooms 2 car parks+ 1 shared car park	10%	20%

		2=4 bedrooms 2 car parks		60%
		3=4 bedrooms 1 car park+ 1 shared car park		20%
		4=3 bedrooms 2 car parks	40%	30%
		5=3 bedrooms 1 car parks+ 1 shared car park		40%
		6=3 bedrooms 1 car park		20%
		7=3 bedrooms 1 shared car park		10%
		8=2 bedrooms 2 car parks	30%	30%
		9=2 bedrooms 1 car parks+ 1 shared car park		40%
		10=2 bedrooms 1 car park		20%
		11=2 bedrooms 1 shared car park		10%
		12=1 bedrooms 1 car park	20%	50%
		13=1 bedrooms 1 shared car park		50%
4	Transport			
4.1	Travel by mode	1=Private car	30%	
		2=Train or bus	40%	
		3=Promotable transit (bicycle, walk and others)	30%	
5	Water			
5.1	Indoor water usage	1=Fresh water		
		2=Rain water		
5.2	Outdoor irrigation	1=Fresh water		
		2=Grey water		

Appendix 2. Assessing Salisbury Town Centre renewal in relation to TBL three criteria

Zone _num	Area size (sqm)	Area type	Existing building type and condition	Existing car park number	Proposed plan (from researcher's point of view)	Sustainable planning initiatives	Social impacts	Economic impacts	Environ-mental impacts
1	53373	Interchange, Car park, toilet	Car park	230	Medium rise residential (town house) and offices and shops (2-3storeys)	1; 2; 3; 4	√	√	√
2	8185	Developed reserve	Open space	70	Civic Park and Coffee shop	1; 2	√		√
3	23583	Salisbury council office	Two story office	100	High rise building for residential and shops (6-8storeys)	1; 2; 3; 4	√	√	√
4	9559	Shops and services	One storey shops		Medium rise building for childcare and services (2-4storeys)	1; 2; 3; 4	√	√	√
5	26740	Interchange Open space	Open space	195	Multi level car park and street front shops (6-8storeys)	1; 2; 3; 4	√	√	√
6	8309	Car park	Car park	150	High rise building for residential and shops (6-8storeys)	1; 2; 3; 4	√	√	√
7	12438	child care service	Single storey house		Medium rise building for childcare and services (2-4storeys)	1; 2; 3; 4	√	√	√
8	32348	Offices and shops	Single storey house		Medium rise building for childcare and services (2-4storeys)	1; 2; 3; 4	√	√	√
9	30353	Church, Housing SA	1-2storeys building		Historical building (Renovation)	1; 2	√		√
10	22210	Kindergarten	Single storey house		Historical building (Renovation)	2	√		√
11	30034	Police station	Single storey house	300	Historical building (Renovation)	2	√		√
12	25757	Salisbury Institute	Single storey house	79	Historical building (Renovation)	2	√		√
13	11490	Offices and shops	1-2storeys building		Medium rise building for childcare and services (2-4storeys)	1; 2; 3; 4; 5	√	√	√
14	11776	Child and youth health	Single storey house		Medium rise building for youth and services (2-4storeys)	1; 2; 3; 4	√	√	√
15	28511	Interchange Car park	Car park	420	Multi level car park and street front shops (4-6storeys)	1; 2; 3; 4	√	√	√
16	15962	Offices and shops	Single storey house		High rise building for offices, services and shops (6-8storeys)	1; 2; 3; 4	√	√	
17	10369	Young centre	Single storey House		Medium rise building (2-4storeys)	1; 2; 3; 4	√	√	√
18	5585	Offices and shops	Single storey house		Medium rise building for entertainment, education, shops (2-4storeys)	1; 2; 3; 4	√	√	√
19	16925	Offices	Single storey house		Medium rise building for offices, disabled services an shops (2-4storeys)	1; 2; 3; 4	√	√	√
20	16206	Offices, vacant land	Single storey house		Medium rise building for childcare and services (2-4storeys)	1; 2; 3; 4	√	√	√
21	95096	Parabanks	One storey shopping centre and car parks	1100	Medium rise building for shopping mall and residential (4-6storeys)	1; 2; 3; 4; 5	√	√	√
22	23907	Street car park, library	Open space and one storey	144	High rise building for offices, library and communities (6-8storeys)	1; 2; 3; 4	√	√	√
23	39912	Interchange Median strips	Open space		Medium rise building for car parking, shops and services (4-6storeys)	1; 2; 3; 4	√	√	√