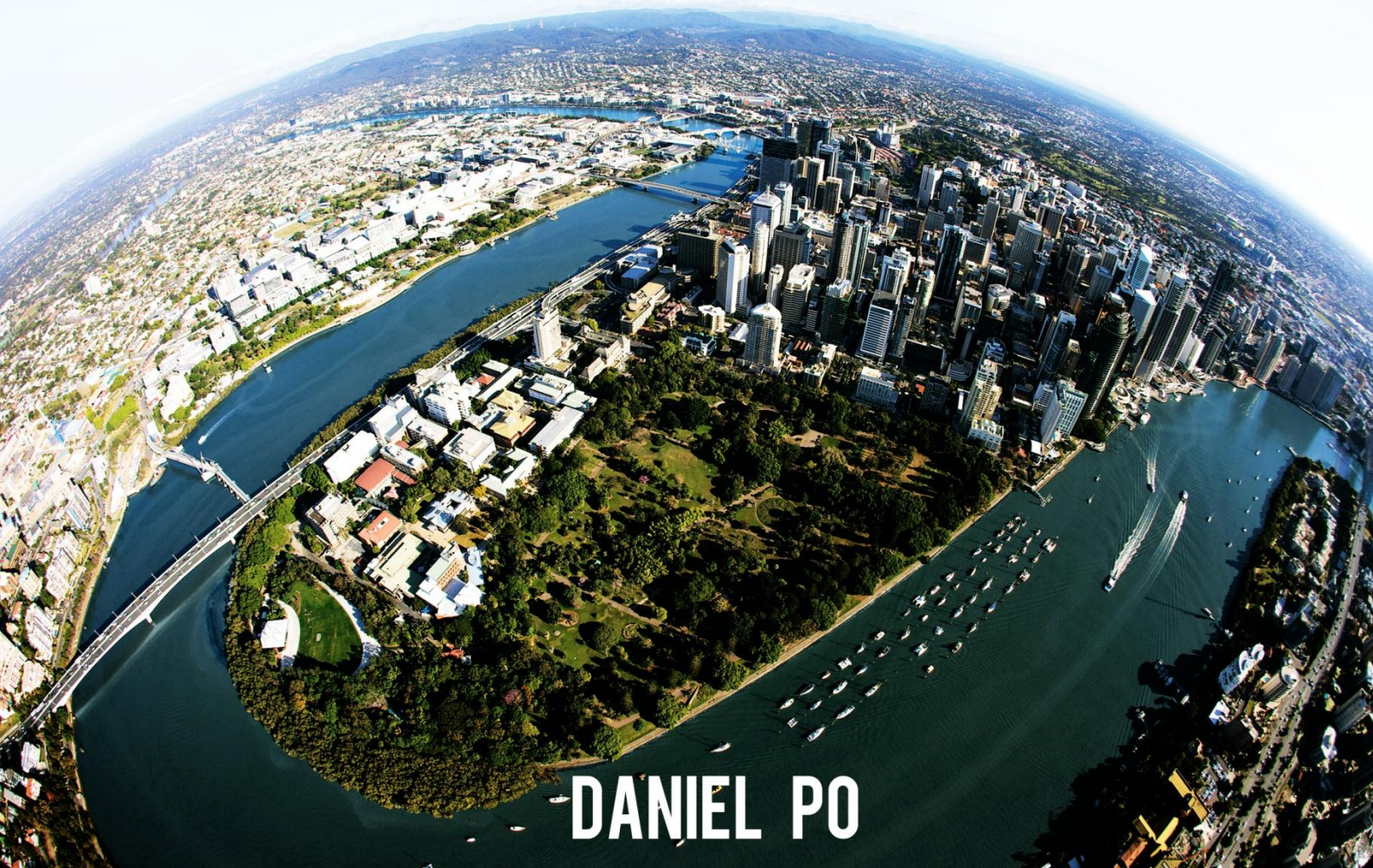
SUSTAINABLE URBAN FORM THROUGH CLUSTER DEVELOPMENT

A BRISBANE CASE STUDY OF BIODIVERSITY AND WATER LIFE CYCLES RESPONDING TO SOCIO-ECONOMIC NEEDS



DANIEL PO

ARCI 591 – Architecture Research Thesis

Sustainable Urban Form Through Cluster Development: A Brisbane case study of biodiversity and water life cycles responding to socio-economic needs

Daniel Po

301016257

Supervisor: Chris McDonald

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Abstract

Brisbane is increasingly experiencing problems relating to ecological and water sustainability within the urban fabric. This is caused by developments that are overly focused on keeping itself sustainable but neglecting the overall scheme of the urban layout. As individual developments make up the larger part of the cities, an investigation on the benefits of having them clustered together is explored in this research.

Through analyses of current urban practices in Brisbane, it was found that the city aspires to attain better standards in ecological sustainability, and has progressively supported sustainable practices in government and local groups alike. However, little has been done in terms of the larger urban fabric working cohesively in achieving sustainable goals. Investigation into the sustainable realms of ecology reveals other themes that must also be addressed, primarily subjects relating to social liveability, and the viability of increasing biodiversity in an already dense city. The results indicate that current practices and policies need a broader scope in application to the urban fabric, and are followed with proposals utilising clustered development in addressing the shortcomings of these on-going practices.

The feasibilities of the proposals are addressed in regards to sustainability, liveability, and viability. The urban renewal proposal of Newstead Park also accepts the current urban form without making drastic changes to Brisbane's character and culture. Overall, the findings of this research encourages a broader framework of thinking to address ecological concerns only solvable at a larger cluster scale, and ties together the many facets of ecological preservation and its relationship with socio-economic demands to solve Brisbane's growing sustainable problems in their urban environment.

Chapter 1: Introduction

As a country and also the driest continent on earth, Australian cities have faced some of the most inhospitable human habitation conditions, with water shortages and long term droughts being their biggest problem. In this modern age, Australian cities and their citizens have also become increasingly reliant on fossil fuels for daily affairs, with a carbon footprint[1] of 4.5 times the global average (CSIRO Research, 2007). The loss of native bushland has also caused extinction of many local species in the interest of expanding the urban framework.

With the Kyoto Protocol[2] finally signed in 2007, sustainability has spring boarded to the forefront of development projects within Australia. The Copenhagen Accord introduced in 2009 also included the direction to immediately enforce a 'technology mechanism' to drive innovation and diffusion of clean technology, with specific emphasis placed on reducing emissions from deforestation and forest degradation (United Nations, 2010). As the Copenhagen Accord and Kyoto Protocol are strongly backed by the Australian Government, this has spurred local governments and agencies to adopt environmentally friendly solutions during the development of new buildings and urban centres. Many of these efforts are aimed at managing resources, guiding urban growth and stimulating innovative thinking and action to reduce ecological impact. In Brisbane, Queensland, the city council has established the vision of forming a "city of walks" with connected, walkable centres flanked by protected green land and habitat with "ecological corridors" between them (Brisbane City Council, 2005a). The city council also has goals of creating a "canopy of shade" across the city through means of new planting and building design.

As stated earlier, water conservation represents a challenge that requires attention in delivering cost-effective water provision and wastewater services. The current focus in shifting to a more sustainable system necessitates a complete rethinking of water lifecycles from a domestic scale to urban scale. Therefore, producing an economically viable and sustainable water management system in turn necessitates much innovation in areas of industry policy, design, planning and management. Queensland Urban Utilities introduced late 2009 is the newest approach in dealing with water delivery, treatment, and infrastructure within Brisbane and other South East Queensland (SEQ) states.

[1] Carbon footprint is a unit of measurement of the amount of energy consumed by an entity.

[2] The Kyoto Protocol is an international environmental treaty with the goal of achieving stabilisation of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.

From an urban development perspective, 90% of Australian residents currently live within the urban environment (United Nations, 2007). Brisbane itself is currently growing more than twice as fast than the average for Australian capital cities and the national rate of growth (Barker, 2004). The Queensland government has put forth a target goal of infilling 40% of this growth within the urban footprint to 2031 (Queensland Government, 2009a). Consequently, a Local Growth Management Strategy (LGMS) called "CityShape" has been detailed for infill and redevelopment areas around regional activity centres and growth corridors (Brisbane City Council, 2007b). The projected outcome of this new regional plan affects urban growth in three areas:

- Delineation of where urban growth occurs
- Designation of protected areas
- Dedication of a network of regional activity centres connected by public transit

Urban social sustainability is often a neglected factor, encompassing aspects of community and urban quality. Likewise, social sustainable challenges are extensions beyond the imperatives of environmental and economic factors and thus cannot be excluded in urban planning and its policies. As one of the SEQ Regional Plan's goals is to "concentrate urban development in the urban footprint and redirect an increased proportion of new growth to existing communities" (Brisbane City Council, 2007b), the long term effects of inner city urban renewals should be inclusive of the social performance and long-term viability in sustaining its community and environment.

This research paper seeks to explore current and projected sustainable and physical environment issues within Brisbane, and methods/proposals being employed to deal with these issues. In particular, the research carried out will examine local councils and groups, strategies they have employed and development guidelines in formulating solutions for sustainable urban design within the city by adopting clustered development[3]. This study of urban development will encompass the three areas of ecology, management of energy, and movement within the urban fabric with respect to the social and economic function of the city.

Therefore, this research aims to find solutions pertaining to ecology, energy, and movement by adopting sustainable urban infrastructure through clustered development within Brisbane city.

For the purposes of this research, the scale of a development cluster – which refers to clusters formed through clearly defined unity of multiple developments from both public and private sectors – is outlined by Brisbane's urban renewal plan and segmented into the main components of its CBD (Figure 1). The strategies and research involved is therefore done where they

[3] Refer to Chapter 2.0.3 for more detailed definition

are applicable within central city living areas and does not cover suburb sections and rural area issues. A clustered development adverts to individual projects that have broader appeal to its surroundings that may include one or more buildings, public areas, or a combination of both. A clustered development also refers to developments that integrate a variety of built elements from architecture and landscaping during planning. The two are synonymous in trait, both focusing on issues that are typically larger than the average development and policy scale.

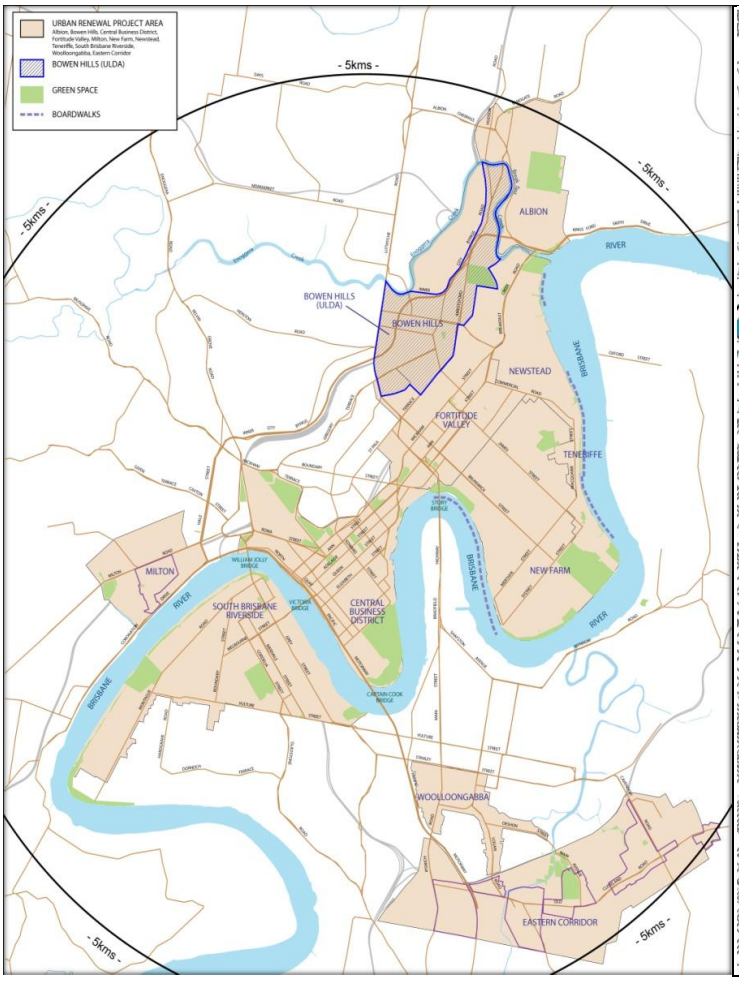


Figure 1: Urban Renewal Brisbane master plan

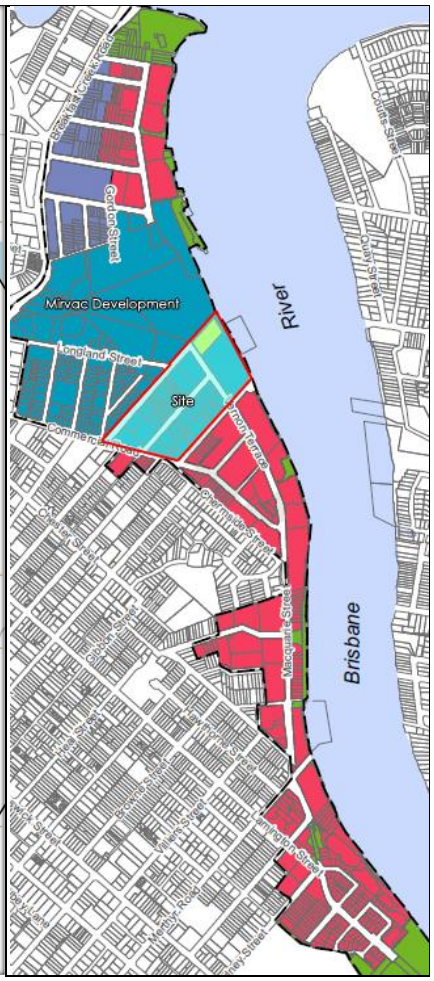


Figure 2: Newstead Masterplan

A design case study will also be performed as part of this research to demonstrate clustered development methodology and its benefits in Brisbane. As shown in Figure 2 above, the Newstead Riverpark development and its surrounding areas are suitable sites at the right 'clustered development' scale to which these methods can be applied. The site itself has a lengthy history of economic function, formerly a gas works site that only closed in 1996. It currently stands as part of Brisbane's urban renewal plan and is the largest of its kind currently in Australia. The design will be presented alongside the proposals as an illustration throughout the research.

Redevelopment in this urban area also earmarks contemporary change in its urban structure in terms of scale, area of influence, and its built components. Consequently, the LGMS plays a large role in detailing urban function and socio-economic effects from these urban renewals. Governments and political elites are currently beginning to acknowledge the link between urban design and broader economic policies (Hubbard, 1999). For this reason, government policies and legislation that can be classified as impediments to promoting sustainable clustered development are also investigated, along with practice changes that can contribute to better sustainable developments without hindering economic progress.

Following this introductory chapter, this research contains three more substantive chapters containing literature review respective to each of the key sections of ecology within urban environments, urban liveability aspects, and the viability of such themes. Chapter 2 provides a background of the current urban planning processes in place in Queensland, and also presents case studies of other cities in foreign countries that use sustainable practices and laws that are applicable within Queensland. Chapter 3 contains research and solutions more specific to the Newstead site based on the findings from the former chapter in their respective fields. These chapters discuss the viability of clustered development imposed from Brisbane's perspective. Chapter 4 focuses on the combined themes in each field and analyses the extents of their area of influence.

Chapter 2 begins with looking at bushland in Queensland and describes the effects of recent laws and urban planning guidelines on Brisbane city. This chapter also examines the current use of the city's recreational parks and investigates programs and initiatives the city council has put forth to improve the function of these parks and additional steps that can be taken to increase its use and sustainability factor. This includes issues of increased biodiversity within the city, and using green spaces in clustered developments as a tool for connecting spaces together. This section then presents a broad study on water use within Queensland, particularly on water conservation and current water infrastructure operations. This looks into current sustainable technologies developed to function within a single building development, drawing from principles applied in foreign precedent. These ideas are then presented and projected onto an urban scale with more opportunity to further increase carbon sequestration in clustered developments.

Following this, Chapter 2 discusses liveability, looking at the conflicting relationship between ecology and human habitation. This encompasses topics of community relevance in ecosystems, examining human requirements for green elements within urban environments, and landscape management strategies for human utility & access. This chapter goes on to examine these topics

and suggests methods of organising clustered developments around new landscape design strategies, as well as improving the current existing green and open spaces.

The final section of Chapter 2 examines policy frameworks and its various influences on urban development. The overarching concerns of planning requirements versus sustainable benchmarks are also studied in this section, and are scrutinised to develop a more holistic approach to generating policy frameworks. Urbanisation and sustainability are also discussed to inform the creation of these new policy frameworks while still sustaining socio-economic growth. This is then reflected in new ways of managing urban morphology aided through clustered development. The changes in urban planning provided by these policy frameworks are then presented to promote symbiotic growth between clustered developments.

Chapter 3 introduces the site and sets up the project brief for the Newstead Riverpark's master plan proposal. The current Newstead Neighbourhood Framework Plan is referenced in the new proposal to fit within Brisbane's greater vision, but is re-examined to better achieve them through clustered development. The remainder of the chapter presents ideas through reworked plans and supporting text.

Following this, Chapter 3 demonstrates sustainable ecological aspects on the Newstead site cluster development. The effect of the application in biodiversity and current social views of landscape roles is examined within the Australian context. The idea of 'ecological aesthetics' is modelled into the site to combine contemporary urban design and managing and protecting ecology. Furthermore, context specific planning and effects of current environmentally friendly cluster-type planning models are adapted into Newstead's higher density urban form.

Chapter 3 also focuses on developing strategies for a less centralised water infrastructure. Full life cycle models of water infrastructure are explored and then presented in a built form on the Newstead Riverpark site. An integrative approach of managing Brisbane River and catchment areas within the site for a multifunctional landscape is also modelled into the site's urban function. The catalyst single development for this site is also described to work cohesively with the closed loop urban infrastructure.

The last section on Chapter 3 highlights future growth opportunities and demographic makeup of the Newstead district. The core ideas of ecology, liveability and viability are made present within the plan through new guided yet flexible development policies. This is implemented at the architectural scale with focus being on the smaller scale aspects of building, edges and open space design. The architectural design ensures that the core ideas are executable in urban

development practice, but also demonstrates how the development's programme can enhance the cluster's ecological and social character.

Chapter 4 concludes the overall study, and extracts overall impressions of the design case study performed and its implications on Brisbane. The feasibility of the proposal is drawn back to the strategies as set by the Brisbane City Council and Queensland Government, ensuring that these ideas are not only practical, but also proven and applicable solutions within Queensland's environmental context today and the near future.

Chapter 2: Literature Review

2.0.1 Bushland laws and integration into the urban environment

The geographical context of Brisbane city is shaped around Brisbane River, following a snake-like pattern that has contributed much to the city's character and growth. Brisbane is also known as being the most biologically diverse capital city in Australia, with large amounts of ecosystems, supporting over 1500 flora species, and more than 500 vertebrate fauna species and innumerable invertebrates (Brisbane City Council, 2007a). Several examples that are within the city's perimeter include the Koala Bushlands[4], Toohey Forest[5] and Mt. Cootha[6]. Studies have shown that bushland is a multifaceted asset in which its social and natural values are entwined and mutually constituted (Gill, Waitt, & Head, 2009). It is to no surprise then that for many residents of Brisbane conservation of these natural bushland is considered to be the main factor in keeping the city's character and liveability. The biggest challenges facing Brisbane is therefore how urban development and growth can occur while encouraging the preservation and integration of ecosystems within its city boundaries.

In 1991, Brisbane City Council formed "Urban Renewal Brisbane", with the objective of targeting areas with redevelopment potential (Brisbane City Council, 2008). A subset of this initiative is Brisbane's bushland preservation levy, which is funded by ratepayers to purchase bushland areas and convert them to protected reserves, prioritising those with high biodiversity within and nearby the city. In the same year, a new legislation[7] was introduced to protect endangered and threatened types of bushland on leasehold land. In 1999, the Vegetation Management Act (VMA)[8] was imposed, with standards reflecting the changes applied into a regional code for local areas (Queensland Government, 2004). The founding of these laws effectively halted large scale clearing of mature remnant bushland, the single biggest threat to species survival in Australia. In a complete turnaround, the Queensland Government now has targets of restoring 40% of its mainland to natural habitat (Brisbane City Council, 2005a). Greenhouse gas emissions have also been drastically reduced as a by-product of these laws, mainly by the reduced loss of carbon offset in bushland (Beatley & Newman, 2008).

[4] An 800 hectare reserve 15km south of Brisbane supporting up to 5000 koalas and other flora and fauna.
[5] A 260 hectare woodland 10km south of Brisbane and refuge to over 400 plants and animals.
[6] A 1500 hectare forest frequented regularly by visitors and residents just 5km west of Brisbane.
[7] Legislation states that a permit is required for leasehold land owners for land clearing (World Wildlife Fund, n.d.).
[8] The VMA was targeted to protect remnant native vegetation, prevent land degradation, protect biodiversity and ecological processes, and reduce greenhouse gas emissions.

2.0.2 Objectives and goals of the SEQ Regional Plan

The greatest contribution to the livelihood and sustainable objectives within Brisbane's densely populated areas is the introduction of the Southeast Queensland (SEQ) Regional Plan in 2006[9]. In recent and immediate years, Queensland faces the challenges of accommodating population infill and development growth while maintaining its sustainable theme. Prior to the formation of the SEQ regional plan, it was foreseen that to accommodate the then rate of population growth over 20 years within the city, it would require more than just voluntary frameworks to manage effective and sustainable growth in all areas of economic, social and environmental context (Gillen, 2006). This is evidenced by the protection measures it has taken in restricting 85% of large scale and inappropriate urban development outside the designated urban footprint for future urban growth (Queensland Government, 2010). Notably, the plan emphasises the need to look for better ways to occupy underutilised land in existing urban areas, with aims of instating half of the additional dwellings required through infill and development.

The regional plan also recognises the regressing standard of environmental management as seen in the degradation of treatment of native bushland and sensitive ecosystems found within Brisbane and its immediate outlying areas (Peterson, Mcalpine, Ward, & Rayner, 2007). In addition to informing state planning policy and priorities as is case with previously mentioned legislation and initiatives mentioned in the previous section, the regional plan also informs other non-statutory processes. One of the initiatives most relevant to this research is the planning of urban renewal and new growth areas at the district and neighbourhood levels (Queensland Government, 2009a). This is addressed in the plan by developing urban areas that integrate Brisbane's subtropical character while ensuring ecological and culturally significant landscapes are valued, celebrated, protected, and enhanced.

Like all other cities, Brisbane strives to promote cultural identity through its urban form. Within the regional plan there are strides to ensure aspects of sustainability become part of this identity, with efforts to reduce carbon emissions, travel times and their distances taking precedence in this city characterisation. The plan also seeks to improve Brisbane's urban character through the heightening of living standards and personal character development of Queenslanders. Of interest to this research is the focus on creating local communities that are inclusive, with community access to open space and provision of recreational opportunities in urban areas. This goal suggests lifestyle

[9] The SEQ Regional Plan was later revised in 2009 to respond to important growth management issues that have emerged since its release. These issues include continued high population growth, housing affordability pressures, transport congestion, koala protection and climate change.

changes and explores the relatively untouched area of the relationship between environmental sustainability and human needs.

The final factor within the regional plan makes note of economic function and outlines the drivers for stimulating a sustainable economy in a rapidly growing population. One such high priority driver is in supplying diverse employment opportunities by providing quality infrastructure and services. Likewise, increasing Brisbane's presence in the international economy scene is also affected by the availability of education services, which is reflected in development strategies based around generating a 'smart city' – an upcoming and important trend in supporting local economic development of cities in creating a knowledge-based economy (Smart State Council, 2007).

Taking all these factors into consideration, the realisation of the SEQ regional plan's goals would create an inner city urban form with characteristics of having a more compact, self contained, and interconnected urban pattern of activity centres. Indirectly or inadvertently, the reformation of these activity centres also allow for opportunities to utilise planning practices of developing a new form of managing "grouped" developments.

2.0.3 Defining clustered development and development clusters

As generally observed of governmental bodies in managing urbanisation, developments that fall under the same activity centre have favoured comprehensive developments – whereby developments rely on each other's utility in the urban environment to complete an urban scheme. Evidently however, there are many more aspects of consideration in urban planning that are not fulfilled through comprehensive developments; issues such as urban green spaces and biodiversity are left to planning authorities and not private developers to resolve. Hence, clustered developments are a means to fill the crucial missing components of comprehensive developments.

To better comprehend the term 'clustered development', the definition of urbanisation must also be understood. Residential areas are often identified as 'urban' when settlements attain a certain population density, which is often outgrowth from a rural area experiencing urbanisation. Urbanisation itself takes place when a manner of hierarchical administration is established, often in the form of a governmental body or administrative jurisdiction that leads to direct changes in the growing character of that settlement. The social, economic, and technological aspects in turn becomes more complex and causes significant changes in the way people live. This is particularly true as people begin to value time as money and this then dictates how people carry out day to day

activities. It is through this idea that travel time and actual time spent on an activity[10] become proportional to each other. It is this time, distance, and duration relationship that is generally accepted as an 'urban cluster' (Choe & Laquian, 2008) – with multiple urban clusters making up city districts and its central business district (CBD).

This time versus activity relationship can influence the size of an urban cluster, which is represented within the urban environment in the form of the number of services, range of accommodation, and variety of work available. Aside from the more obvious architectural elements, the configuration of urban clusters is also largely determined by local factors such as ecological environment, transportation infrastructure, and living preferences of locals. From the conglomeration of these factors emerge central areas – often areas of economic function – as a result of the mixed elements present in each cluster. Matters of public and private interests then become more intertwined within each urban cluster, and again fall back to a governmental body to ascertain how each cluster operates.

Despite the recognition of urban clusters within cities, planning them has merely constituted the drawing up of a master plan specifying urban function in most jurisdictional authorities. Brisbane city falls under such a system and so does the SEQ Regional Plan. This initiative however is lacking in promoting integrative development between stakeholders in that urban area. This void in urban design management in the government sector and between private developers is able to be filled by clustered development initiatives. An example of the benefits of clustered development in urban planning can be seen in the abundance of options in achieving environmentally sustainable design (ESD). The result of using clustered development mimics that of growth outcomes of urbanisation. Such can be seen when areas of development experience positive change inclusively while maintaining socio-economic growth, but at a cluster scale. Much like the founding of a settlement, these developments are still guided by a governmental body. In the long run, this form of sustainable urban development also affects the life and character of the city as much as it does the environment.

The shift towards clustered developments has intensified, at the very least in its themes and motives, ever since sustainability has become a growing issue on the SEQ urban planning scene. At present, ecological principles applicable only to larger developments like industrial parks have been used in demonstrating the potential for eco-industrial development (Roberts, 2004). The emergence of city nodes is becoming ever more obvious as higher density inner city developments seemingly

[10] Activity represents a range of daily achievable objectives such as available services, working areas, recreation, and home.

have become more coherent with the characterisation of city districts (Figure 3). With the steps currently being taken in achieving the city's vision, Brisbane itself would consist of several polycentric nodes of concentrated activity shaped around economic growth and its sustainable developments. In reference to the land use planning framework for Queensland, the scale of clustered developments will operate in the realms of a neighbourhood. This respects the zoning codes already delineated within the framework but provides a more successful way in developing better activity centres.

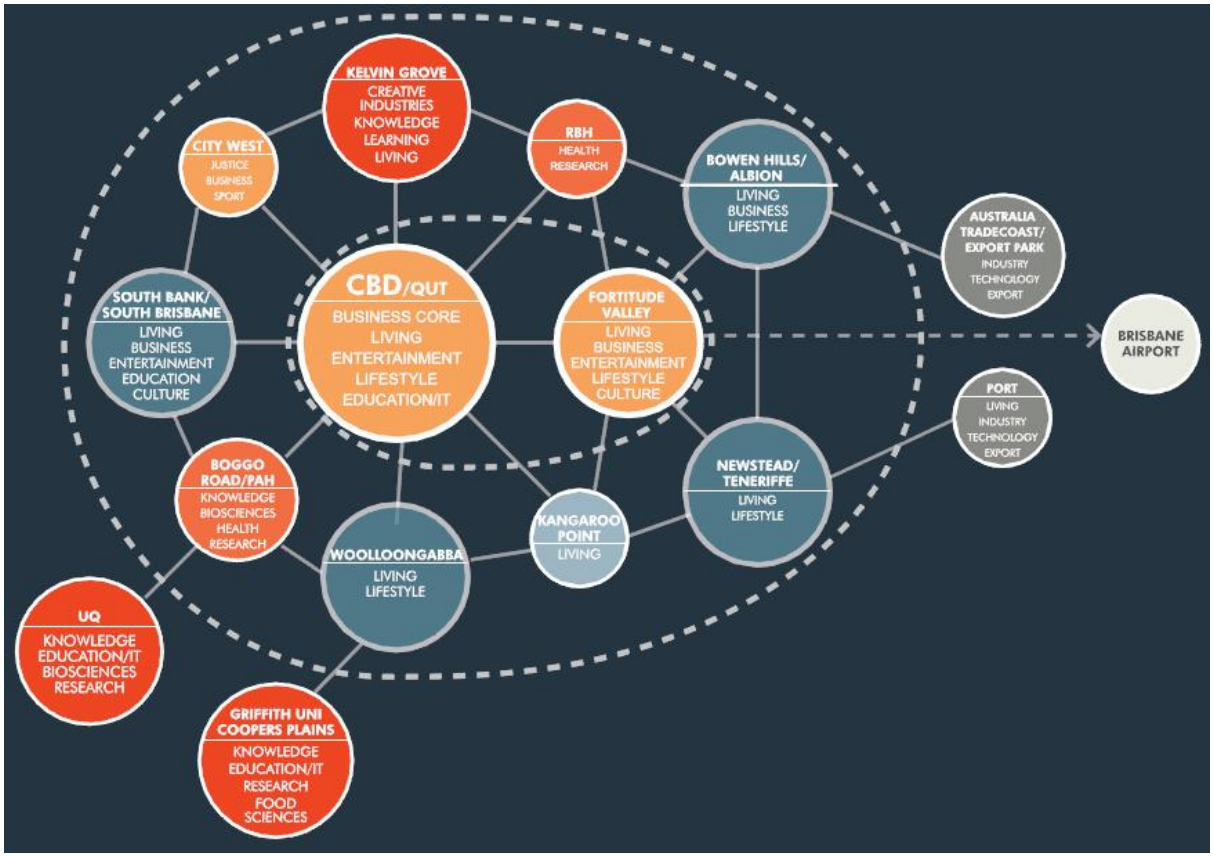


Figure 3: Characterisation of Brisbane City activity nodes

Source: (Smart State Council, 2007)

In developing a starting point for a viable proposal for clustered development planning and execution, the key strategies in the SEQ regional plan as covered in this chapter are used as 'triple bottom line' grounds around the subjects of:

- Sustainability – in development being sensitive to "ecosystem generation", and meeting other ecologically sustainable benchmarks
- Liveability – in cultural place making to draw people into the area, entitlement to a healthy and productive life with their immediate environment
- Viability – in the trending changes of urban form, ensuring its ability to create an economic base for employment opportunity. On this note, defining the management strategies/policies that will reduce environmental impact of human land use while having the social and economic benefits simultaneously

2.1 Sustainability concerns within the city

2.1.1 Ecology within the city

As metropolitan areas move towards becoming living areas for the general populace, green spaces have grown in demand within the urban fabric. With the population density increasing within the city area, more people will find their direct experiences with nature takes place mainly within the urban environment. This makes the interdependence of people and nature in urban spaces a key development issue when planning cities (Miller J. R., 2008). In turn, this makes green spaces within the city a vital component to the wellbeing of humans and biota alike. Additionally, there have been significant relationships of dependencies and post contamination effects between water lifecycles and the ecological environment (McAlister, 1998). In many ways this increases the importance of having greater synergy between ecosystems and the urban setting, the ideal situation being that where both people and nature benefit from creating this new green infrastructure. As these concerns normally appear at a district scale, clustered development can unite these ecological concerns through examination of their dependencies.

To that effect, ecology within Brisbane's urban environment can be explored with reference to the following three fields:

- The importance of maximising biodiversity within the urban environment and how it impacts its environment and adjacent ecosystems
- The organisation of green spaces and remnant forest patches in meeting sustainable standards
- Water sensitive urban design and its role in ecological matters and water lifecycle performance within the built environment

2.1.2 Nurturing biodiversity within the urban environment

One of the issues with the lack of biodiversity within the city fabric is the problem of uniformity, where a small handful of biota are segregated and only seen within a small area. Flora is often specified and planted merely for their aesthetic quality while requiring significant amounts of maintenance effort. This alludes to the fact that the segregation between man and nature is not due to the lack of contact with nature, but the lack of exposure to a variety of native species (Miller J. R., 2005). Additionally, another drawback to uniformity is that biodiversity levels are greatly reduced

without enough variation for an active ecological cycle to occur within the environment (Savard, Clergeau, & Mennechez, 2000).

2.1.3 The importance of ecological planning and configuration

Another reason for the decrease of biodiversity is the existence of 'ecological thresholds', which are areas where relatively rapid change occurs from one ecological condition to another (Radford & Bennett, 2004). This threshold can be described as a zone where there is a dramatic change in the state of matter or system which creates a tipping point causing the decline of species richness within an area. This knowledge is particularly applicable to natural resource managers and policy makers because of their potential to set a limit on the magnitude of change an urban environment can sustain before its critical threshold is breached.

Brisbane faces a high degree of ecological fragmentation as these thresholds change. This is mainly caused by climate change and the division of ecological systems within the city (Low, 2007). Brisbane has, and continues to, experience the norm of a decrease in urban ecology as the result of adverse structural changes by the clearing of bushland. The fragmentation of these landscapes causes the splitting of ecosystems and creates habitat patches with biota left to sustain itself within the constrained borders. The incremental loss of habitat has an immediate effect in dispersed landscapes with low connectivity as the threshold at which patch size is compromised is reached sooner, leading to depletion of species richness (Radford, Bennett, & Cheers, 2005).

Understanding how these ecosystems work can be extremely difficult, as little empirical data has been provided to ascertain the threshold limits in fragmented landscapes. These thresholds differ according to species which are determined by habitat requirements, tolerances and mobility. However in development practice, there are several consistent points which can be drawn from studies that have been done:

- Fragmented habitats are unable to support self-sustaining populations of biota
- Some species require access to different landscape elements for resources
- Landscape context can influence ecological processes within habitat patches

The placement of habitat patches within developments also influences the abundance of species, necessitating consideration of habitat configuration. One such example would be the squirrel glider, which has the innate behaviour of gliding between trees. Research done in Brisbane forest remnants found that roads were acting as barriers to the gliders' movements, as they would

not travel across roads if they could not glide over safely (Brisbane City Council, 2007a). These roads intersect wildlife corridors, causing the glider population to gradually decline in areas where they have been cut off and hunted by other animals. At this scale, studies indicate that the coverage of habitat remnants within its environmental context is the most important factor in the design of conservation networks (Collinge, 1998). It is therefore imperative that clustered developments include sizeable habitat patches to support fragmented habitats without surpassing its thresholds. Moreover, a network of green corridors should be considered to connect these patches, placing softer threshold limits where movement and migration of biota is encouraged should their limits be exceeded.

A management system to protect these remnant habitats thus becomes a priority in development areas. Drinnan (2005) notes that the identification of ecological thresholds and relationships are crucial for the design of fragmented urban environments aimed at protecting biodiversity. Prescribing empirical data for individual habitats would be required to determine the thresholds for the local species, as it has been proven that thresholds can differ greatly from one area to another (Huggett, 2005). While this is the ideal situation, in reality it becomes unwieldy as it is impossible to determine specific species threshold patterns due to the effects brought about by the change of development. Regardless, using threshold figures is a concept that serves as a tool to conserve biodiversity and the handling of natural resource which cannot be ignored.

2.1.4 Dynamics of water sensitive urban design

A more pressing on going issue since colonisation is Australia's water problems. Australia is a country frequented by devastating droughts, and conserving water on a daily basis has become a nationwide affair. With climate change already making matters worse, Australian cities face a future with increasingly severe and prolonged water shortages. The history of water management in Australian cities has shifted from decentralised beginnings to a centralised management system in order to meet stringent water quality control. The currently adopted centralised system is considered to be unsustainable as it works using a conveyance approach. To elaborate, water is sourced water from one location, nutrients are added during transportation, and this waste is then disposed at an exit point after a single use (Livingston et al., 2004). Furthermore, it is estimated that 85% of capital investment made principally by government agencies goes towards the provision of pipes for these services and less than 15 to 20% is actually spent on water treatment (Thomas & McLeod, 1992). Thus, avoiding pipe-centric solutions could equate to more funds being made available for advancing treatment in meeting the goals of sustainability (Newman, 2007).

Currently, Queensland has followed the Australian trend of building large desalination[11] plants connected to the main grid as a means of producing potable water in urban centres. Granted, while desalination is an improvement over existing water infrastructure, it is arguably not as efficient as decentralised systems as it follows the age-old mentality of 'once-through' systems that limit sustainable options amongst concerns of anticipated and unforeseen environmental effects (Dickie, 2007).

Due to these aforementioned circumstances, Australia has in recent years has poured much effort into water conservation research and development. One of these by-products is Water Sensitive Urban Design (WSUD). WSUD is a storm water management philosophy which aims to mitigate the environmental impacts on water quantity, quality and receiving waterways conventionally associated with urbanisation (McAlister, 1998). WSUD addresses ways to utilise water cycles completely in a 'closed loop', beginning at the stage of collection of rain and local water sources. This collected water is fed into the water distribution grid, where grey water is recycled locally with black water being discharged regionally, resulting in significant reductions in water consumption (Figure 4). The utilisation of WSUD has particular bearing on local infrastructure management, as water recycling can be incorporated into ecological wetlands and runoff swales that represent important habitats in the urban environment (Figure 5). As a prerequisite, WSUD requires the detailed knowledge of local natural processes[12] and aspects of nature[13] in a clustered development site (Chanan, Kandasamy, Vigneswaran, & Sharma, 2009).

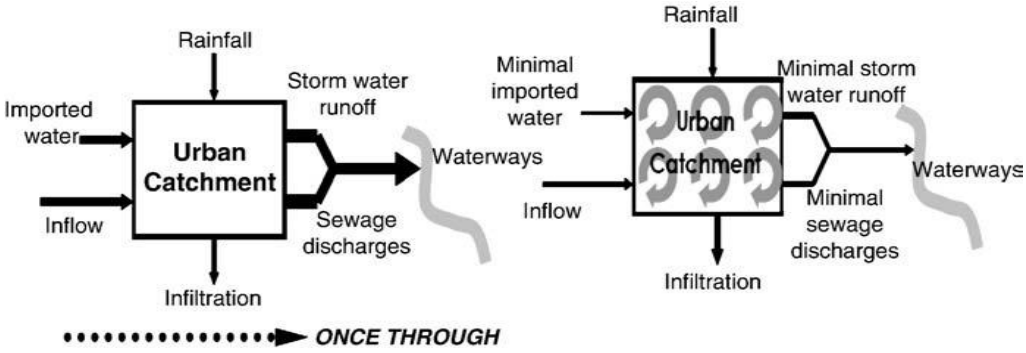


Figure 4: Traditional versus sustainable urban water cycle management

Source: (Stenekes, Livingston, Colebatch, Waite, & Ashbolt, 2004)

[11] Desalination refers to processes that remove excess salt and other minerals from water.
[12] Local knowledge of topography, wetlands, soils etc.
[13] Local knowledge of open spaces, community gardens, species of trees etc.

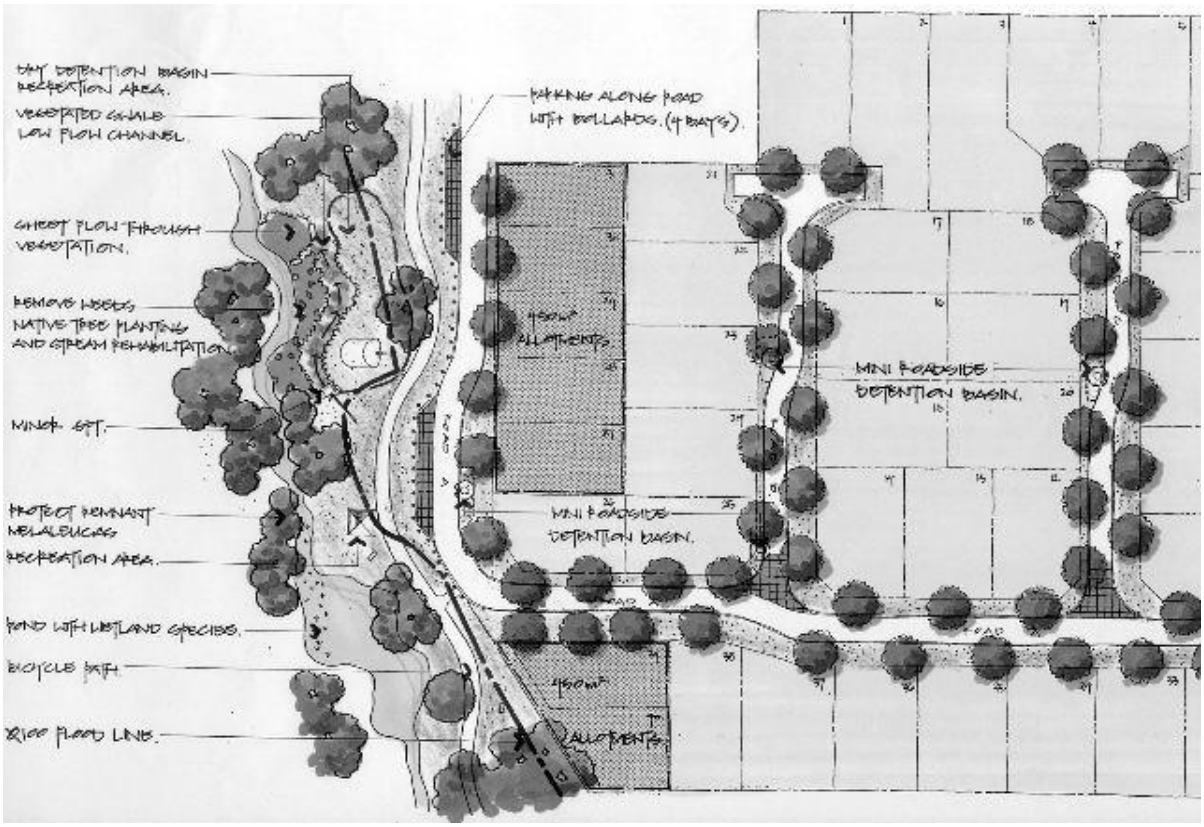


Figure 5: Case study of a WSUD site illustrating bio-swales from urban environment to wetlands

Source: (McAlister, 1998)

However, once WSUD is implemented on a cluster-wide scale, other issues such as total water cycle performance, reformation of regulatory guidelines to encourage reliable decentralised recycled water systems and broadening of criteria for the sustainability of water recycling need to be instigated to account for social and environmental objectives. For example, stormwater harvesting in catchment areas within the development could cause ecological damage to dependant downstream environments (Naji & Lustig, 2006). Present WSUD guidelines only impose standards for lot and industrial/commercial scales, with runoff water managed only on a per standalone development basis (Brisbane City Council, 2005b). An opportunity exists here for clustered developments to formulate WSUD guidelines that extend to multi development water infrastructure planning. Hence, a framework outlining the catchment scales between differing developments and ecological areas needs to be addressed on a wider district scale.

2.2 Determining factors that affect liveability

2.2.1 Social engagement with ecology

The city is no longer just a place of work and commerce, but also a place for living and relaxation. Despite the emphasis placed on ecological importance made in the previous section, increasing the quality of urban life is justly viewed as the priority in developing cities. Therefore, urban planners often do not include the possibilities of local communities adding to the management of ecology. This not only leads to the neglect of vital social aspects of community engagement within the role of urban planning, but also the urban environments relation with the values of ecology. One of the main driving factors to the lack of ecologically sensitive developments is the fact that not much effort have been made in harmonising urban lifestyle and ecology. With Brisbane's LGMS, infilling aims to be more optimised in land-use by giving control over clustered developments to key stakeholders. However, no mention is made on how these stakeholders plan to coalesce social with ecological interests. Clustered development planning acknowledges the fact that these stakeholders are only part and parcel of the renewal process and must include local community engagement. Hence, the issues pertaining to the human effect on urban landscapes that need scrutiny are:

- Community relevance and engagement to better planning for urban liveability
- Landscape utility and access within and between development clusters

2.2.2 Known human dimension matters of urban landscapes

Gobster (2007) states that it is equally important to pay attention to human values in ecological urban design as it is to biodiversity for it to be successful within cities. It is also a fair claim to say that different individuals derive and experience green spaces differently, each seeking qualities like naturalness, access, and aesthetics. These factors are difficult to ascertain during the planning phases of urban developments, and is nearly always a result of what architects and planners feel is the best method of creating and managing these landscapes. Once these plans are set into motion, community involvement is severely limited as they are restricted to modifying small components of the environment created and policies that are in place.

Ideally, it would be left to the localised community to determine how green spaces are developed, but these grassroots movements usually only occur after the spaces have been developed. This presents one of the unmet challenges associated with including people as a part of

urban development ecosystems, as people are often categorised as a disturbance variable in a fragile ecosystem (Williams & Stewart, 1998). Similarly, iconic elements that people are familiar with, such as structures or landmarks, are difficult to alter as people are generally resistant to this change. These people find place identity in such places and rely on these iconic elements when developing a sense of place. It follows than that the notion of creating a sense of place also extends to landscape utility for recreation and work needs, and access to these services. Creating an environment that first relates strongly with the desires of people ultimately affects quality of life and appreciation of the environment and are integral to the success of any urban environment.

In the UK, planners have taken up trends of developing garden cities circa early 1900s as a response to cultural and living comfort loss caused by rapid urbanisation during its industrial years. In some ways, the objective was to mirror the quality of life found beyond city boundaries in the urban environment and to act as a catalyst for stimulating an integrated service-based economy (Short, Benton, Luce, & Walton, 1993). In addition to being an expression of environmental qualities in country areas, these new urban landscapes also play the role of promoting liveability in cities. Similar trains of thought were also reinterpreted by Jane Jacobs (1961), who strongly advocated liveability within city areas through the creation of vibrant environments, as opposed to the separation of areas by function. While much of the underlying concerns of Jacobs are overcome in modern planning, her argument also subtly implies that biodiversity meshed into urban spaces can achieve this vibrancy.

The problem commonly regarded today is in fact not an issue of unaccredited importance of landscape aesthetics and ecosystems, but rather the way urban planning is divorced from ecosystem restoration work, of which siting and scale are two crucial design elements (Gobster, 2004). Within city boundaries, there is little way to dictate where natural patches occur, and planners tend to leave such sites alone for preservation work. However, as made clear from the previous paragraph, ecosystem regeneration should be more closely tied to aesthetics and activity characteristics already present. Unfortunately, by separating natural patches from built environments, it has become the norm for planners to prescriptively use trees and planting solely to fulfil the need for pedestrian amenity. As a result, city dwellers are lost to the natural qualities associated with urban green spaces and elements. To restate a point in nurturing biodiversity, the designs for many of Brisbane's green spaces is for their aesthetics to be corrected so that it is based on diversity not uniformity, and by doing so the dynamics of natural processes as a method for environmental sustenance is acknowledged, negating the need for arbitrary human planting (Hough, 2002). An approach which follows a more sustainable planning strategy is to create conditions for biodiversity to thrive while

simultaneously designing spaces for human physical conditions, and recognising the need for native bushland and foreign species alike to create an ecosystem that is inclusive of human habitation.

2.2.3 Learning from garden city communities

Returning to the case in the UK, civic participation is now recognised as a key part in shaping their urban environments. In a publication by the Urban Green Spaces Task Force (2002), change is mentioned as often being led by voluntary and community groups who contribute greatly in articulating local needs, creating or renovating community green spaces, and getting involved in managing traditional parks. Such activity is vital to the creation of highly liveable spaces that include participation by inhabitants and the authenticity of cultural place making. Here we begin to see a snippet of how human interjection and our need for aesthetics to not necessarily interfere with ecological landscapes, as this form of community participation increases the role of guardianship over the locals own surroundings. The way in which we plan for urban ecology in clustered developments will stem from this dependency and reliance on societal interaction to sustain them.

2.2.4 Landscape management, utility and access

As mentioned above, extending the function of what urban green space is would involve rethinking its constituents, and importantly, would involve the transformation of these constituents from standalone leisure parks to clustering them together. At this scale, the concern over the character of open space and wildlife corridors becomes pertinent in the design of green spaces. This inevitably affects the scale at which these ecosystems work together with their areas of overlap, otherwise termed as green corridors. These green corridors help in determining the desired function of several green spaces and how wildlife will exist between them. Habitat patches will once again become part of a larger system, while larger parklands will be more sensitive in relation to its neighbouring green spaces.

Similarly, the utility of how landscapes are used by individuals needs to be considered broadly over a series of spaces, while bearing in mind the condition for aesthetical preferences. Coming to terms with ways to control their operation scale therefore involves reconsideration of planning methods where the design of clustered development is concerned.

In dense areas, a desegregation of ecology and urban environments has the potential to accommodate native biota and concurrently improve social well-being (Miller J. R., Biodiversity

Conservation and the Extinction of Experience, 2005). To accomplish this in clustered developments, the different local groups, architects, planners, and government agencies need to engage in more dialogue to create more collaborative opportunities in defining land-management strategies. In this scenario, one such avenue is to combine the ecological values like biodiversity with social values like voluntary restoration works (Miller & Hobbs, 2002). Assessing the needs of biodiversity and society in finding that middle ground would support such management strategies.

In Brisbane's case, the integration of the Terrestrial Invertebrate Status Review[14] (TISR) with urban planning would allow for the detailed analysis and observation of greenways with the built environment. The results of the TISR carried out in forest reserves within the city indicate that these biota are a good indication of bushland and ecological health. The city would therefore benefit from using this as a bio indication in areas which require conservation within development areas. Having this broader view of development and conservation brings about the advantage of planning more logical ways to preserve protected bushland while benefiting the wellbeing of city dwellers (Arendt, 1996). City dwellers in Brisbane will begin to appreciate larger more continuous greenways, as much of the current urban fabric is occupied by seamless blankets of wall-to-wall subdivisions with little to no open space for recreation. The creation of green corridors between ecological features will naturally occur and will expand the depth which native species can reach within the city. The effects of conservation development will not simply create a single, linear corridor that extends its reach (Angold, et al., 2006). Rather, it will link pre-existing habitats of different types and qualities within the city in a chain-like fashion. This would produce areas with a symbiotic relationship between city living and its biodiversity – the new 'city park'.

[14] The TISR is Queensland's first attempt at documenting ecological traits and distribution within Brisbane City. The objectives of this database include ecological sustainability, bushland management, and improving community appreciation of the city's biodiversity (Stanisic, Burwell, Raven, Monteith, & Baehr, 2005).

2.3 Viability of clustered developments

2.3.1 Urbanisation and sustainability

Urban sustainability can be seen as the intersection of the two intricate problems of rapid urbanisation and sustainability. Inevitably, there are bound to be conflicts where the two issues collide as where an action that benefits one, it will inescapably be cause for concern for the other. Over time, the variance between these two opposing elements has been reduced with the advancements of new technologies and evolution of urban morphology. However, poor decisions made in the past have created pre-existing conditions that are difficult to reverse. Often, changes in urban development revolve around these past mistakes, with the urban pattern resilient to any change for better infrastructure development to occur.

Notwithstanding the benefit of hindsight, both problems need to fulfil the requirements of current city dwellers without compromising those of future generations (World Commission on Environment and Development, 1987). As in the same case for liveability, Yiftachel and Hedgcock (1993) reaffirm this notion by questioning whether social sustainability addresses the question of whether planning intervention in the social development of cities will be regarded as a social benefit or social cost by future generations. For example, inner city developments today largely respond to the growing economy by demanding more office blocks and additional car parking spaces, which leads to the decline of other central city activities. Hence, it is essential that proper policies and frameworks are devised to ensure the success of clustered development planning.

With that forming the fundamental scope of core issues, this section will discuss the viability of urban planning regulation and economic provision with reference to the following areas:

- Utilisation of sustainability assessments in policy frameworks
- Acknowledgement of sustainability education as a means in planning policies and
- Structuring of activity centres responding to these policies

2.3.2 Towards planning for urban environment policy frameworks

As expressed above, the role of environment and urban life requires a form of policy framework in order for both goals to be reasoned with. In Australia's growing commitment to sustainable development by the political elite, the emergence of sustainability assessment tools are becoming more common as an aid to them in policy decision making (Gibson, 2006). Such frameworks have been tested using tools consisting of sustainable indicators, measuring factors

pertaining to complex ecological footprint dynamics (Wei, Xu, & Yang, 2009). The research results from these indicators then become part of the process that directs policy making towards sustainability. Even so, the increased availability of such information alongside the increased awareness of sustainability assessment tools has made little appearance in policy making (Pope, Annandale, & Morrison-Saunders, 2004; Cashmore, 2004). Bond and Morrison-Saunders (2010) comments that the credibility of sustainability assessment results contradict each other and frustrates decision making, as they either tend towards reductionism – where complicated systems are broken down into smaller units of analysis for ease of evaluation, or holism – where systems are better considered as wholes rather than broken down.

Nonetheless, there are two ways of managing this policy framework. In the case of Australia, the first option is for policy makers to adopt broad and integrative sustainability themes into their urban planning. Specifically on the Newstead Redevelopment Plan, the city council has presented 25 performance criteria encompassing the categories of acceptable sustainable, social, and economical solutions (Brisbane City Council, 2010). However, attempting to achieve performance criteria in one policy area may very well hinder progress over a longer period which would create unsustainable long term trends. Furthermore, without a coherent long-term perspective, there is too much emphasis on short-term costs and goals, which then leads to future policies repeating the cycle of working around existing conditions as mentioned earlier.

In the second more direct approach, as adopted by Europe, it is observed economic growth merely supports social progress and is respectful to the environment, social policy underpins economic performance, and environmental policy is cost-effective (European Commission, 2001). This approach in theory offers more checks and balances beyond the short term “cause and effect” module of policy making. However, these approaches too are not without caution, as these sustainable indicators can lead to proscriptive regulation, focusing on the achievable social and ecological targets rather than its desirable outcomes (Abley & Heartfield, 2001). Again, trying to prescribe a set of ecological targets is one of the main facets in the struggle to find balance between sustainability and socio-economic needs and will ostensibly be part of the problem as long as this practice continues.

2.3.3 An alternative view on reconstituting sustainability and socio-economic needs

Perhaps the best way to address the issue of sustainability and its effects on urban development is to rethink how sustainable development is approached. In its conventional and

current outlook, sustainability has been thought of as providing a prescribed set of benefits over its consequences in the urban development. One such method of measuring urban impact on the urban environment is by analysing the flows of natural resources that support urban metabolism, amongst which the common measure used is ecological footprints. For every sustainable or green feature present in a development that reduces its ecological footprint, the value placed in it increases. The programmatic planning of urban environments has therefore been based on the act of responding to assessment tools, as can be seen in the case of green rating systems on individual developments.

Conversely, Holden (2006) states that practicing sustainability as a means "to learn more, to learn better, and to learn in a more contextualised fashion within the communities of our experience, reprioritises the first principles of sustainability to include adaptability, negotiability and flexibility." As it is nigh impossible to challenge why we choose to learn, this attitude fostered through education has potential to be more effective than policy frameworks dictating how urban planning – which is complicated by nature – should occur for our benefit. Should we begin treating sustainability as a means to learning more contextually through our living experiences, policy frameworks will then give way to the core principles of sustainability as the urban environment changes. By doing so, the decisions we make will be based on long term achievements, with changes to policies and urban environments being very feasible as sustainable performance will be based originally on a learning process. It is through enabling these changes to occur seamlessly that we are encouraged to pursue and achieve our highest standards of liveability and innovation.

Entailing these thoughts, clustered developments that downplay assessment tool ratings in favour of cohesive sustainable planning will likely add up to tighter integration of landscapes and urban function (Arup Sustainability; Brisbane City Council, 2004). Policy frameworks that are not forceful and particular about developments achieving sustainable targets, but which instead adopt a "greater in numbers" stance will arguably yield better, or be it later results. Assuming this stance will create greater awareness of longer lasting impacts of our choices on urban environments. Furthermore, the adaptability of these environments that are open to community input and participation also gradually metes out the desired lifestyles of city inhabitants which evolve over time (Bond & Morrison-Saunders, 2010). Hence, policy making that treats sustainability as a process will likely be more balanced in outcome and more comprehensive compared to traditional policy frameworks.

Granted, there will always be a need for sustainability assessment measures, be it for generating commercial interest or a method of regulation control as its importance in urban planning cannot ever be discounted for. Even so, these processes too can be made to be more

adaptable, negotiable, and flexible to the learning experience and the context of urban setting; with the means to alternate between reductionist and holist approaches depending on effectiveness of each strategy. Such an example would be policy making in water life cycles in developments that are to be expanded to clustered and regional scales. As water cycles are no longer contained within one development and its runoff areas, it should ideally be made part of a larger network of catchment areas, swales, and effected ecological areas. Furthermore, the issue of balance between sustainability and liveability would then migrate to the balance between subjectivity of learning (and experimentation) and the more founded principles of policy frameworks.

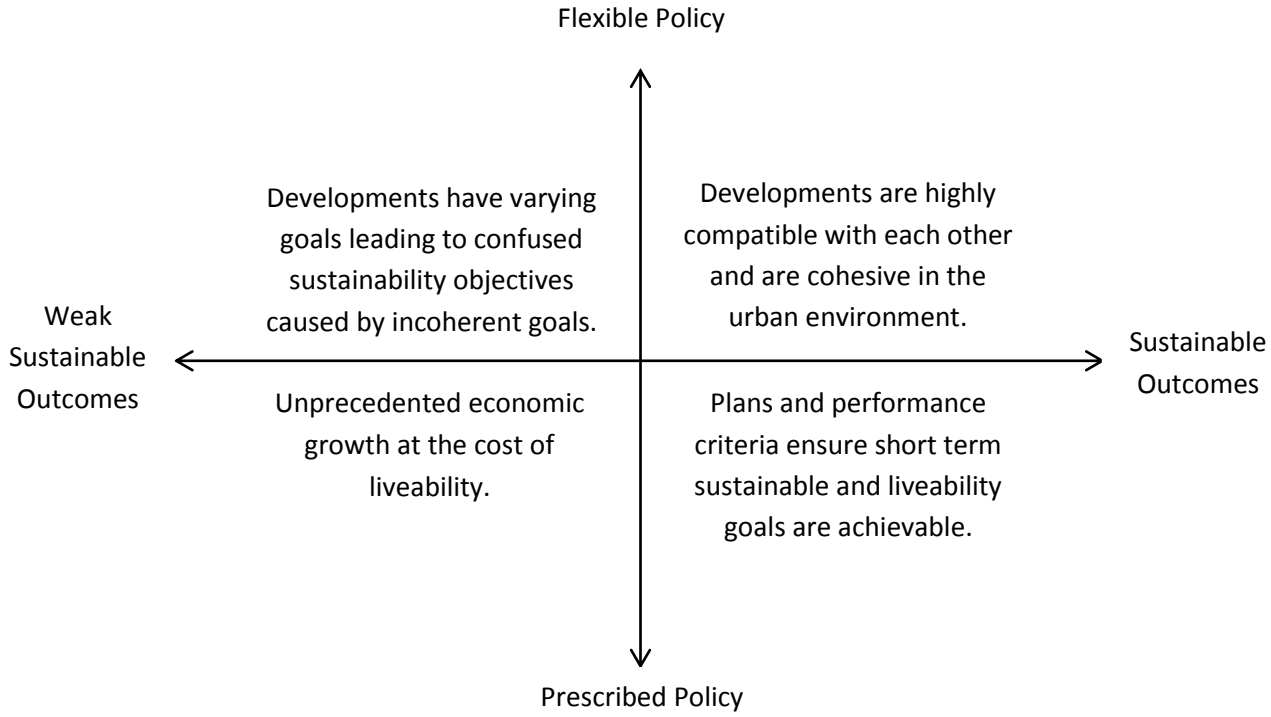


Figure 6: Relationships between targeted policy and sustainability outcomes

Of course, the difficulty in having such a versatile policy/urban framework is having to depend on developers and the community to reason and resolve the desired long term effects of their decisions. As can be seen in Figure 6 above, we already know and have experienced how prescribed policy can accurately determine the outcome of urban environments. On the other hand, creating flexible policy to adopt learning principles would necessitate relying on anticipatory results as much as it does on exploratory results. As the diagram demonstrates, the anticipated long term outcome of an urban environment can drastically change as a result of shifting sustainability goals and standards. Developments are also required to be highly aggregated for a cohesive and decided outcome in a cluster. This would be difficult to achieve without an overarching plan which requires

them to meet certain sustainability criteria. The challenge will therefore lie in balancing the degree of flexibility in specific policy areas, and not on reductionist or holistic approaches.

2.3.4 Knowledge based urban development

The final act in implementing a successful framework strategy is economy in the urban environment. Following on from the previous section, it is clear that policy frameworks and sustainability education come as a package in developing socially and ecologically sensitive urban environments. Brisbane currently uses knowledge based urban development (KBUD) in planning. KBUD in essence assigns the city into nodes and characterises them based on local living trends and knowledge precincts (Smart State Council, 2007). The principle behind the motivation for creating nodes is the theory that once conditions of a creative urban environment are met, external investments and talent will be attracted to the city. Thus, this new urban structure must be symbolic of the revitalisation of the economy and enterprising policies being pursued, as this strategy would not be treated just as a stimulant for the economy, but also has implications to service infrastructure for the urban environment (Hubbard, 1999).

The biggest entailment of using KBUD is how these nodes become marketed as service centres as opposed to merely meeting ecological and liveability standards. The rebranding[15] and selling of the city requires not only an aesthetically pleasing city be created for new corporate space, but also the creation of more residential space to cater for inhabitants. As the majority of land within Brisbane is privately owned and valuations are dependent on the property market, local policies that attempt to make housing more affordable for residents becomes increasingly unlikely to be promoted. This is seen as a huge problem within Brisbane, as there is a serious shortage of affordable housing and this is viewed as a roadblock in attracting the targeted creative and intellectual workforce (Yigitcanlar & Velibeyoglu, 2008). Therefore, in the process of creating a denser city, open space and leisure environments need to be increased and improved for working requirements, and the cost of living spectrum also needs to be taken into account and distributed in a feasible matter within single or many clusters. At the very least, convenient access should be provided from areas further away into these activity centres (Bertolini, 2005).

[15] Queensland was previously branded as the Sunshine state, consistent with its former competencies with agriculture, mining, and tourism. The Queensland Government are now taking initiatives in rebranding themselves as the Smart State.

2.4 Discussion

The purpose of this chapter has been twofold. First, we have come to better understand the dynamics and tensions between ecological interests, human habitation, and economic processes within urban environments; or more simply put sustainability, liveability and viability. Through this literature review, a number of observations are made in current day situations and alternative solutions that potentially reduce this conflict are presented. Second, we have come some way in developing a framework to be set as a precedent for clustered developments to occur within Brisbane while understanding its goals for the future. The following sections summarise each of the key points as presented in this chapter.

2.4.1 On urban landscapes, biodiversity, and water sensitive urban design

The problem with green spaces and forest patches located in Brisbane is that they have not improved much from their original functions. The findings found in this section show an increasing trend between the connectivity of urban living conditions and biodiversity importance which demands a new perspective of local land use and purposefulness in these spaces. There is also much evidence showing that the appreciation of ecosystems is only possible through unrestricted interaction. As the urban form begins to evolve and city living culture shifts, it is no longer appropriate for planning authorities to exercise their disposition in using laws determining acceptable behaviour in human interaction with natural elements. Furthermore, empathising with the many aspects of green space dynamics found in clustered developments will have an enormous bearing on how successful the integration of biodiversity into Brisbane will be.

The same goes for the existing infrastructure of water life cycle in developments to be expanded to a clustered scale. Water cycles are no longer contained within one development and its runoff areas, and ideally should be part of a larger network of catchment areas, swales, and effected ecological areas. Additionally, the relationship between water and ecology needs to be closely linked and with growing understanding on WSUD, this relationship should be incorporated in sustaining urban and ecological requirements within a clustered urban environment.

2.4.2 On liveability and landscape management, utility & access

With everyone's nature experiences currently divorced from everyday living, ecological regeneration work and lifestyle can be resolved by bridging them through the revitalisation of urban

green elements and by increasing our daily interactions with them. In Section 2.2, we ascertained that Brisbanites have to participate and be made more knowledgeable in the shaping, management, and upkeep of urban landscapes & ecosystems in achieving greater comfort and also in diversifying activity in the urban environment. As a whole, the greatest way to rehabilitate biodiversity into urban areas is through the design of Brisbane's city spaces, and this will only occur if urban planners treat ecological awareness and urban design as one. Clustered developments can prove to be a valuable asset in putting ecological preservation work into urban planning.

Section 2.2 also shows that the management of landscapes today is ineffective for ensuring the on-going existence of habitat patches as green spaces within the urban environment. As habitat patches are gradually declining, action must be taken to ensure they are reconnected through green corridors. Bio indicators must also be well understood, and the reviewing of ecological data should be included in the management and surveillance of ecological performance in the urban environment. For clustered developments, the crucial step is to ensure these corridors have thresholds that are not discontinuous with neighbouring clusters. All the more, the overlapping areas are most significant in ensuring green corridors are successfully ingrained in the greater city plan.

2.4.3 On policy, socio-economic needs & knowledge based urban development

Policy frameworks of the past and present are beginning to show its weaknesses when it comes to managing sustainability issues. As cities broadly speaking are becoming more representative in its role in the growing global economy, so should policy frameworks reflect actions that adapt to new world knowledge and desires. While using learning based approach to policy making is a relatively new area which challenges both government and society to work closely, the foreseen outcomes of having more seamless urban environments of work and recreational balance are far too rewarding to be overlooked. Acknowledging that, clustered development plays an important part in ensuring that these policies work to promote Brisbane in growing a knowledge based economy.

With that mind-set, the emergence of a learned population is required for innovation in sustainable urban design and economic progress to occur. Because of this, it is argued in Section 2.3 that the formulation of new policies must have a wider focus on innovation, and must also include societal involvement when dealing with the broad knowledge economy. Therefore, in the pursuit of increasing economy and the quality of the urban environment, the urban environment should also

be made more accessible to attract larger groups of people and stakeholders. However, these policies are still reflective of a work in progress, and there are yet more problems to be teased out between the interests of government and private sector.

Chapter 3: Newstead Riverpark Urban Proposal

3.1 Newstead Riverpark and its potential as a cluster development

The Newstead Riverpark district represents an important keystone development due to its central location and given its size and unoccupied land, flexibility for planning and integration on a metropolitan scale. The challenge for the government is not only to create a new urban centre to support the existing CBD, but also to introduce innovative urban solutions that will improve environmental sustainability beyond current standards.

With Brisbane's desire to reach an additional 40% of population infill growth, along with the characteristics of the site, the cluster has greater opportunity to house more residents in better places to live and work, and to increase access to parks, water, and transportation around the city. It is imperative that the masterplan strategy put in place not only addresses these issues but also those regarding sustainability and its consolidation within the clusters activity. The proposal in this chapter examines how this can be achieved with a long term vision for Brisbane's growing economy and how this urban centre will assume a critical role as a catalyst for sustainable urban design within the city.

3.1.1 Current masterplan objectives and areas of shortcomings

Brisbane employs a three tier City Plan in developing the character and growth of the city. At the top level, the strategic plan provides the overall vision which enhances liveability and addresses ecological concerns. This is then divided into districts or clustered areas, which are grouped areas of residential, industrial, green space, centres, emerging communities, community use and roads. These clusters are classified to meet described environmental outcomes (Brisbane City Council, 2010). The *Newstead and Teneriffe Waterfront Neighbourhood Plan* is a local plan under the City Plan, which details strategies and principles during the transitioning of the district from a former industrial zone to a compatible mix of residential, commercial, industrial and recreational activities areas. As such, detailed land use outcomes are specific to its locality and are given rule of exception should they differ from the City Plan. Codes and related provisions are entailed in the neighbourhood plan for achieving these criteria.

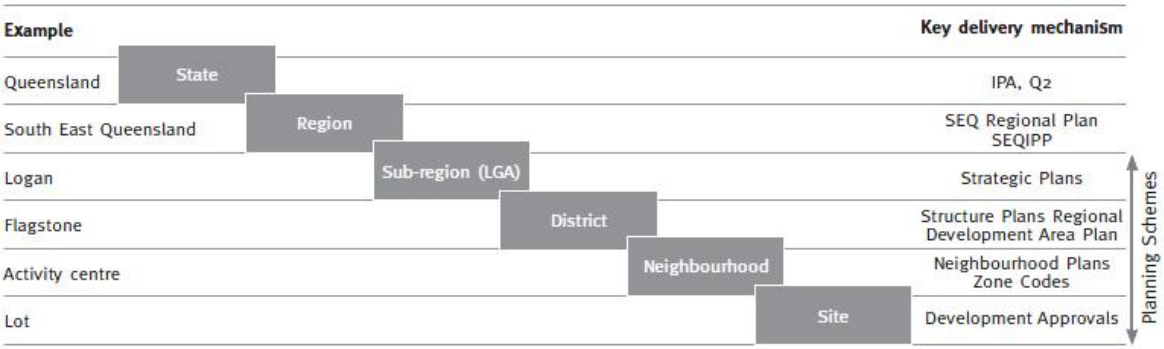


Figure 7: Land use planning framework for Queensland

Source: (Queensland Government, 2009a)

This multi-tiered strategy methodically addresses the key issues as elaborated on in the earlier section; Newstead is zoned into a well-defined cluster that fills residential needs while activating a new urban centre. However, ideas passed down from the City Plan to the local plan has resulted in the alteration or loss of some core objectives, primarily on the ecological front which is completely unaddressed within the local plan (Brisbane City Council, 2010). Such objectives are noted in Brisbane's LGMS, where it states "the purpose of the Urban Open Space Strategy is to identify and protect Brisbane's preferred future open space network; establish how this network is to function and interact with urban areas and the wider region. It must ensure adequate open space is provided in accordance with this network, and that environmental, scenic and recreational values are protected" (Brisbane City Council, 2007b, p. 34). In addition to this lack of response in the neighbourhood plan, sustainability issues are also under emphasised with only passing comments on appropriate street planting and vegetated recreation areas along pedestrian amenities.

Figure 8: Precinct Zoning Map

Source: (Brisbane City Council, 2010)

The zoning plan in Figure 8 details the key precincts that the neighbourhood plan addresses within the scope of the Newstead site. Taking this into consideration, the urban proposal tabled will abide by these criteria and are summarised as follows:

- The waterfront precinct (3) is primarily zoned as an integrated community of residential, shopping, business and employment activities located around a large parkland area. The precinct will have a varied built form that includes low, mid and high rise buildings that are designed to minimise the appearance of building bulk and provide visual interest.
- Commercial Road precinct (2) is foreseen to transform into a medium-high density community, with plans for future public transport to run along this key route due to the projected increase of small scale retail shops. Development in sub-precinct 2A is to form a transition zone between the character of the Waterfront precinct and residential area to the south, while developments in sub-precinct 2B are intended to activate and survey Skyring Terrace while addressing the River Walk[16].

3.1.2 Site Introduction

Figure 9: Entities developing Newstead

[16] Refer appendices pg. 5 for road information.

The Newstead site was chosen for a myriad of reasons, but primarily because it best represents the scale and potential reformation opportunities with respect to Queensland's urban framework plan. The Newstead Riverpark is a site with historical relevance to Brisbane's roots as an economic hub, it being a former gasworks industry which was founded in 1863 and decommissioned in 1996. Since then, the site remained unoccupied from 1996 to 2008 while work took place to remediate the polluted grounds. The site is also ideal in setting a management scheme on a cluster scale as Brisbane City Council holds jurisdiction over the direction of the district. Thus far, the council has awarded Mirvac the rights to the development of a large portion of the cluster as a residential area, and similarly FKP group has been commissioned to develop the Gasworks site (Figure 9).

Figure 10: Artist impression of Riverpark & Gasworks site with commercial blocks on right

Source: (FKP Limited, 2010)

Currently, only the living criteria are fulfilled by Mirvac's development of luxury apartments scattered along the waterfront. Certain conditions have been enforced, such as, continuing the growing river walk and retaining the gasometer as a historical icon. However, many issues had not been resolved gracefully within the neighbourhood masterplan, and this can be attributed to the division of Newstead redevelopment into two entities. Roads leading from the inner city abruptly end where the cluster begins, breaking the structured urban form. Furthermore, the masterplan disregards the existing road pattern southwards and does not attempt to rectify it beyond the district's borders. Figure 10 above clearly shows a hard edge created by proposed developments and

how both these entities have treated Newstead as a closed community with disregard to the surrounding urban pattern. Additionally, the commercial blocks where the irregular road patterns occur are largely quiet and are only occupied by smaller businesses and warehouses following Newstead's previous industrial character (Figure 11). Finally, located on the edge of Mirvac's development is a CitiCat[17] terminal. However, this stop experiences less activity due to the lack of, and inconveniently placed, pedestrian access and with no zones of interest nearby.

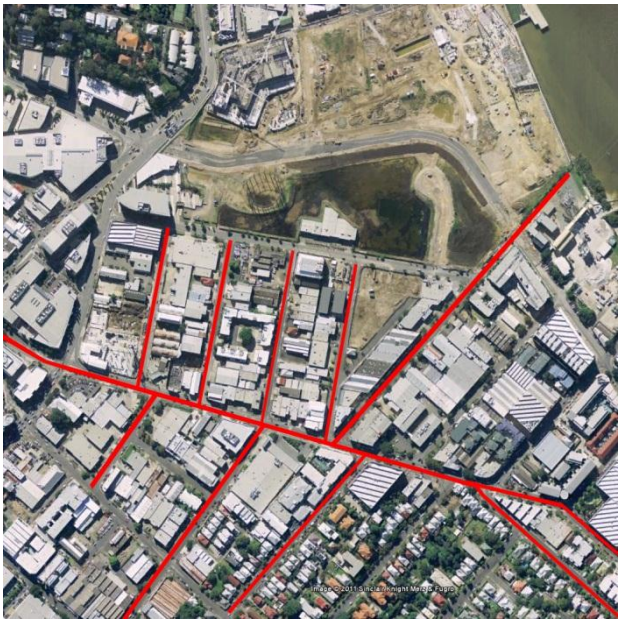


Figure 11: Irregular road pattern, segmentation of cluster defined by Commercial Road

3.1.3 Overview

The design undertaken applies the concepts as discussed in the former chapter on the site surrounding Mirvac's residential development and sets precedent changes on FKP's gasworks site. As identified in Section 2.0.4, the purposefulness of creating clustered developments requires the cooperation of these entities for the district to be accepted into the greater city. These include a landscape that encourages biodiversity and increased daily interaction, and a more comprehensive sustainable water system achievable through clustered development. Other notable design considerations include better transportation and pedestrian links not only within the cluster, but also between it and the CBD to encourage accessibility and urban renewal along these routes.

[17] CityCat is Brisbane's multiple stop ferry service along the Brisbane River.

3.2 Design process

3.2.1 Bridging two city districts

Brisbane in its vision by the year 2031 has planned for two city extensions to occur – first, the Newstead district and second, Bowen Hills to its North-west (Figure 12). As the Newstead site sits strategically in between the waterfront and city, both vehicular and pedestrian access into the site needs to be made more active. The proposed masterplan should also ensure ecological development and movement access merges well with Bowen Hills in the foreseeable future.

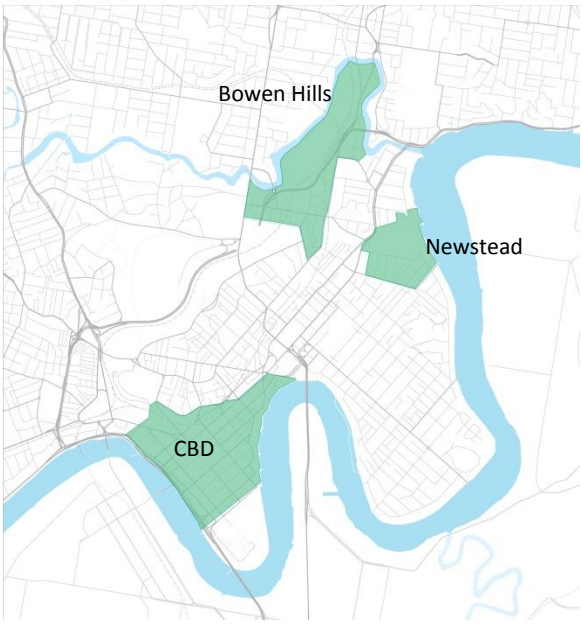


Figure 12: CBD and city extension districts highlighted

3.2.2 Existing conditions

Figure 13 shows habitat patches that exist closer to the edge of the city boundaries and many more isolated patches that are too small to sustain an acceptable level of ecology. Most of Brisbane's urban green elements come from street planting and do not serve any function apart from pedestrian amenity and aesthetics. In general as habitats thrive along waterways, the logical action is to introduce a new ecological spine deeper into the city via riparian and forest habitats. This follows the trail of existing habitats as indicated roughly on plan, making the site the first step in introducing increased biodiversity in Brisbane city. This has opportunity to work hand in hand with enhancing the commercial strip as well as the movement routes between the Bowen Hills district and CBD.

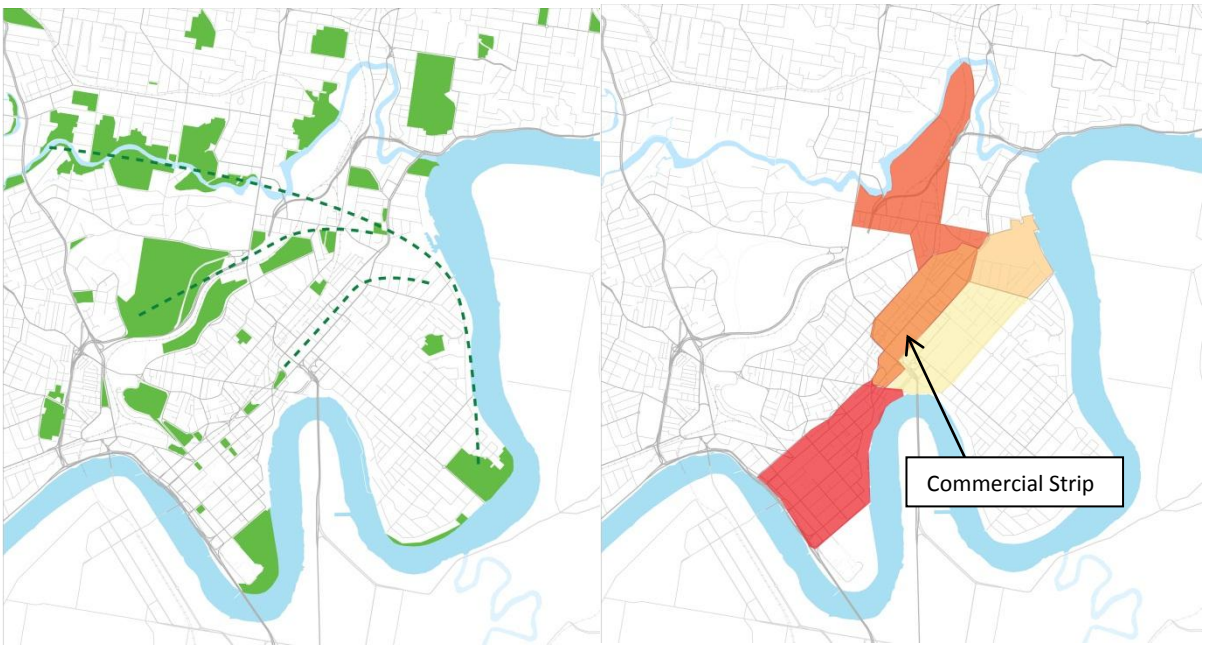


Figure 13: Green spaces surrounding Brisbane city (left), proposed clusters urban renewal (right)

3.2.3 Managing ecology within the urban plan

From chapter 2, we have identified that in order for ecology and biodiversity to thrive within the city, there must be amendments made to the way we approach ecology and urban planning. Specifically, the goal for clustered developments is to fulfil both environmental sustainability and liveability concerns. In this proposal, the plan will therefore:

- Introduce green ways to link up and introduce new ecosystems
- Rethink green elements and their function within urban environments
- Utilise water beyond what is allowed with current infrastructure

The fragmentation of environmental sustainability and liveability issues is caused by conflicting interests and usually results in each of these interests being fulfilled in separate parts of the urban environment. The split is evident when looking at environmental preservation, where it is more easily done in areas with less development occurring. Therefore, formulating an urban plan that appeals to a wide number of people groups first requires their common interests to be identified in order for environmental sustainability and liveability interests to be united. These factors can then form the basis of utilising greenways as a tool to resolve these issues. The diagram 14 below summarises how each group has utilised green spaces for their own interests.

Group archetype	Utility of green spaces
Environmental Activists	Supportive of preserving natural habitats, native plant communities and wildlife corridors.
Urban Planners	As an important feature in building inner-city neighbourhoods.
Community Activists	Attracted by the egalitarian aspects of equalising open-space access for the greatest number of people.
Governmental Bodies	Attracted to new developments or investments, hence the creation of jobs and tax base.

Figure 14: Summary of green space utility based on interest groups

Source: (Walmsley, 1995).

As most green ecosystems flourish outside of the city, environmental interest has always garnered more attention in those areas. This is a strong contrast to inner city green spaces which are only seen as a means of creating pleasant open spaces and as providing some structure in pedestrian movement. Given this information, the most accessible public free spaces within the city become the best element to merge these two factors together. Firstly, the principal streets of the city can be transformed as tree-lined routes – appropriately sized and scaled – with a branching reticulated system of ways that will reach habitat patches and larger parks, braiding into the broader masses of habitats and at the urban outskirts to more or less continuous greenbelts beyond.

As illustrated earlier in Figure 13, Brisbane follows this same pattern with greenways connected at the city border. The cluster development proposal on the Newstead Site capitalises on extending this network gradually into the city hub. This also touches on the idea of having “green streets”, which have dual functions of improved pedestrian amenity and the creation of deeper reach of habitats.

3.2.4 Giving shape to the proposals vision

The remarkable diversity of these greenways requires any planning for its future to be shaped and structured to recognise and enhance the best of these values and distinctions. Consequently, four core ideas based around movement will guide future planning, design and policy making for management of greenways within the cluster, with each responding to the context of existing and proposed urban development. The four core ideas are:

- Dedicated vehicular traffic routes leading into and out of the cluster
- Park spaces responding to ecological thresholds
- Street hierarchy shaped around amenity and biodiversity
- Cross-blocks as sites for habitat generation

The sections that follow will realise the overall vision through drawings along with supporting written text. The drawings will also address the proposal strategies in accordance to scale (larger to smaller). The drawings and writing will also inform the site on a number of considerations when attempting to plan a catalyst development. The masterplan below is indicative of the Newstead cluster proposal and includes some alterations to the Mirvac and FKP group sites. The overall cluster follows several design concepts in its pursuit of increasing ecological biodiversity and through it describes and suggests positive changes to current policies.

Figure 15: Masterplan proposal for a new Newstead cluster

3.2.4.1 Connections and destinations

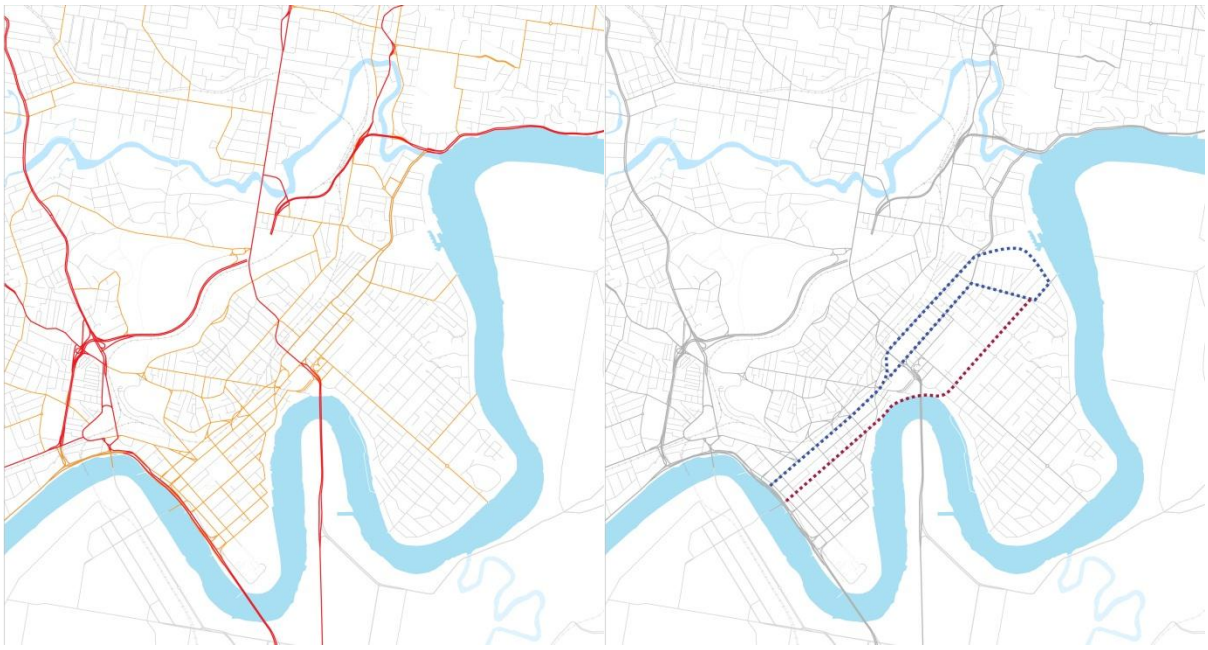


Figure 16: Traffic flow on motorways and main roads (left), shortest accessible routes (right)

The site acts as a gateway for traffic coming from northern Brisbane into the CBD. As shown, this main road is distinctively separate from the shortest pedestrian route into the site. Brisbane's target of further developing Bowen Hills as well as Newstead will greatly increase the amount of traffic along this transport corridor. Another noteworthy fact is that the shortest accessible route leading from Queen Street[18] into Newstead bypasses the main traffic corridor due to topographical constraints around the river edge. This informs us not only of the increased redevelopment potential along the red and blue lines in Figure 16 above, but also the prioritised entry routes into the cluster.

As highlighted earlier in Figure 15, the altered street orientation shown above not only includes Newstead more in the greater urban fabric, but also corrects the east-west roads to continuously bridge Newstead and the inner city for better flow. This opens up an avenue for infrastructural improvements as will be discussed in the following sections. Also, with the projected increase of traffic, High Street and Skyring Terrace would serve as the main thoroughfare into the cluster, and would loop traffic back into the CBD via Commercial Road.

[18] Queen Street Mall is Brisbane's vehicle free, main shopping street.

3.2.4.2 Determining park space and green corridor conditions

The issue of manicured landscapes lies with developments supporting diverse green elements that are not well merged with sizeable green spaces. The absence of consistent and coordinated management throughout the full extent of district and site developments of the many parties and shareholders has precluded the sense of a tightly integrated landscape. Hence, the first step in ensuring that green spaces are integrated well with each other is implementing and maturing a green corridor accessible by all developments within the cluster. Green spaces that are managed by private or public use, with the administration of new policy, are able to extend the greenways into their own developments. This however requires the main green corridor to be linked to Brisbane's outer greenbelts and also to be of a decent size for native species to gradually meld into the cluster. The proposal below demonstrates how such a corridor can be integrated and how development green spaces can exist within the Newstead cluster.

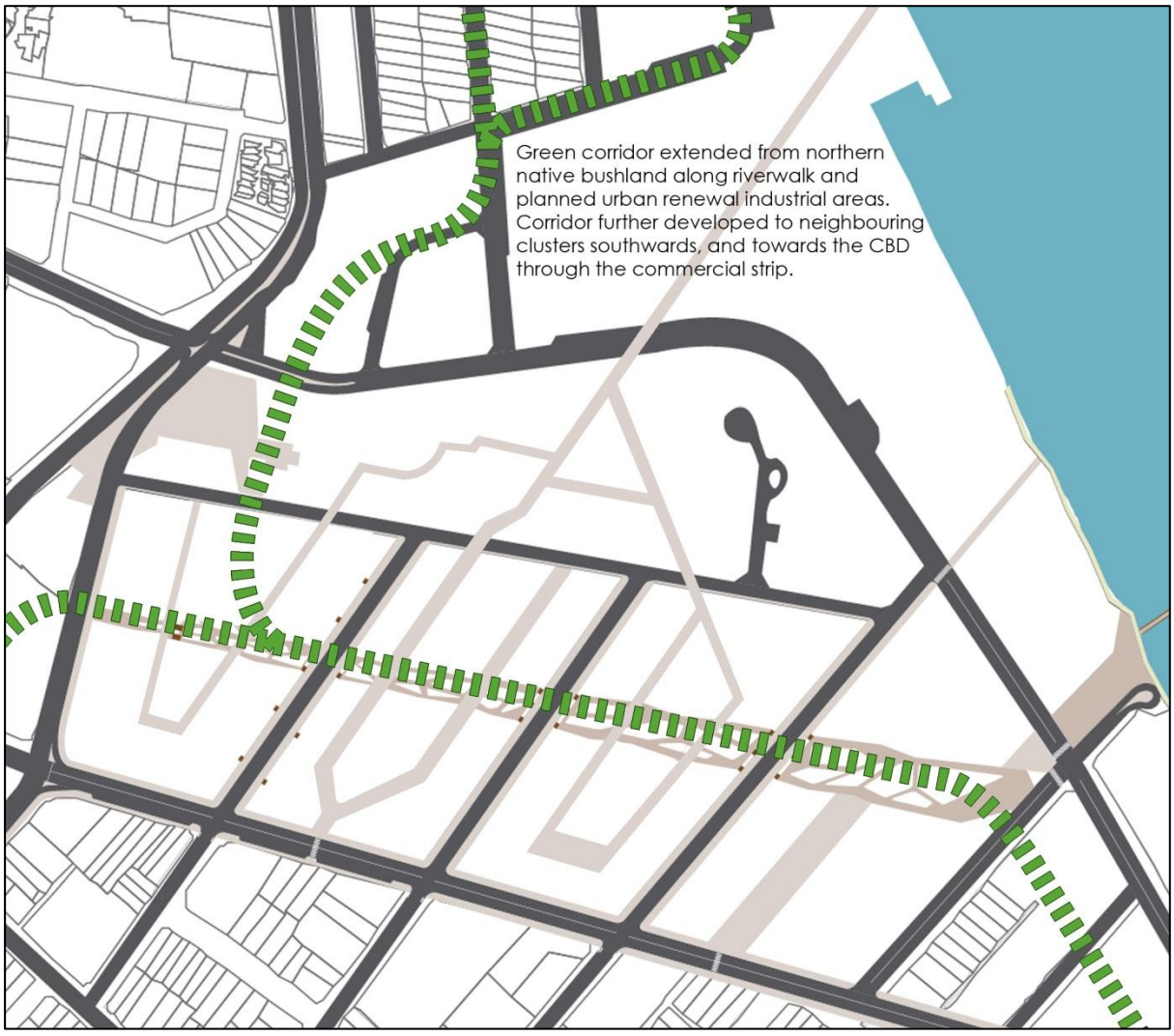


Figure 17: Green corridor in the cluster and future expansion routes

As the purpose of the green corridor is to extend the greenbelts reach, initial management would be required before it can sustain its own ecosystem. In accordance with Davidson et al.'s (2007) research findings, a ground covering of approximately 2 hectares is required to maintain a stable ecological threshold. Of this makeup, the planting of native bushland would include various species of Eucalyptus trees, lowland vegetation, and riparian communities (TISR). A cross section through the corridor shows the likely makeup of corridor configuration during its introduction period (Figure 18). Though difficult to determine during the initial years, site surveys and management will better inform heterogeneous landscape conditions specific to the cluster as both urban and green presence increases. Following this period, amendments to policy frameworks and spatial analyses can be made based on this newfound knowledge to best suit the demands of locals, authorities, and green advocates alike.

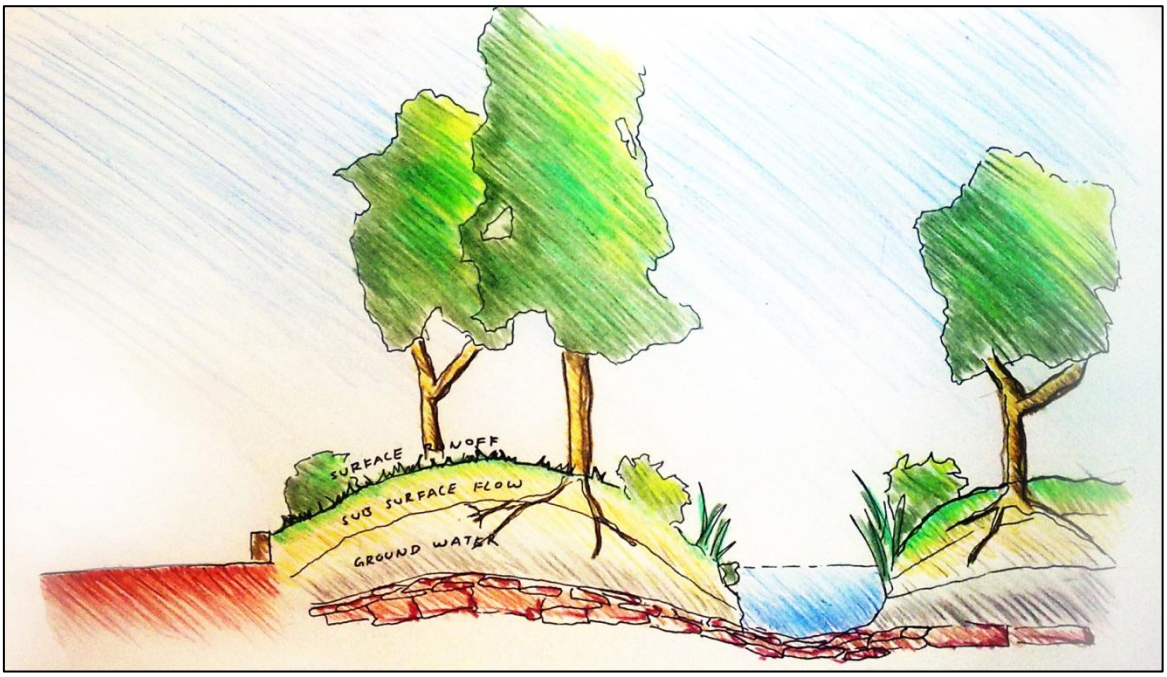


Figure 18: General green corridor configuration for self sustenance

3.2.4.3 Street hierarchy and character

Currently, the Newstead site lacks any separation between vehicular and pedestrian realms; therefore the new proposal establishes a hierarchy of street patterns for movement that goes hand in hand with linking green spaces. The plan below highlights the overall movement pattern within and outside of the cluster. The street elevations and plans that follow represent the indicative profile of each street type.

Figure 19: Newstead Riverpark urban proposal street map

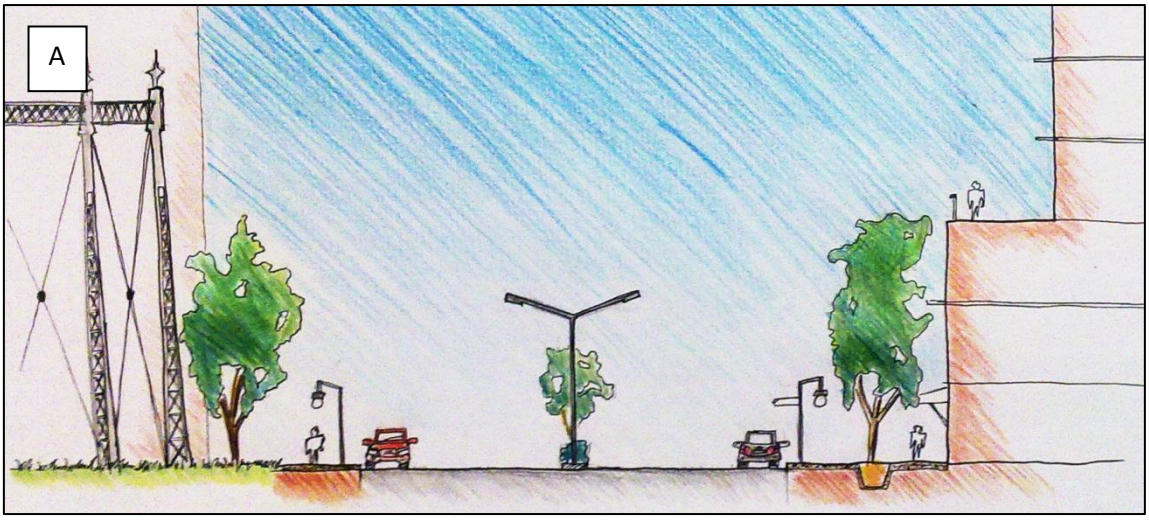


Figure 20: Section through High Street

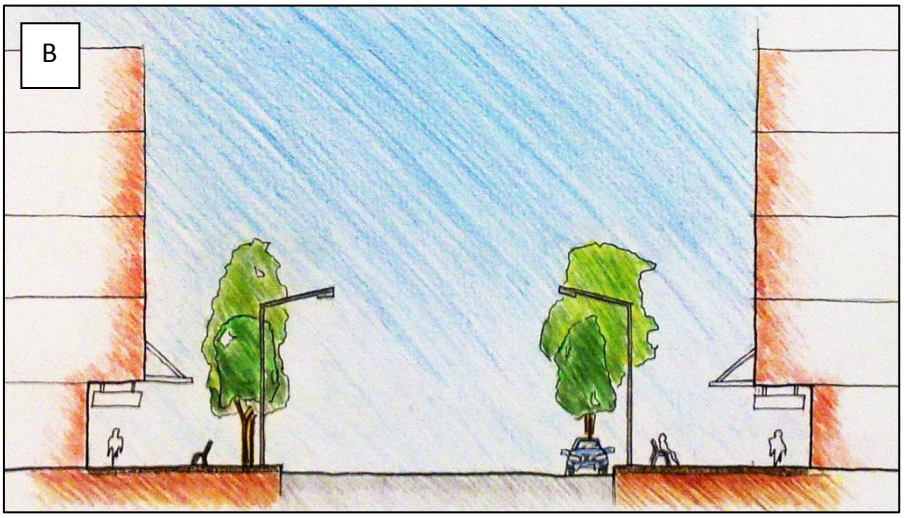


Figure 21: Section through Commercial Road

At the cluster scale, vehicular traffic is targeted around the perimeter of the more public domains via the main roads around High Street, Skyring Terrace and Commercial Road. As these streets are more exposed, commercial developments along either side will be met by large numbers of traffic and pedestrians. Hence, the main/perimeter streets are derived as a gateway to provide

the general sense of Newstead as an activity centre[19]. Parking requirements will also mostly be met on these streets to reduce vehicular presence on other streets within the cluster[20].

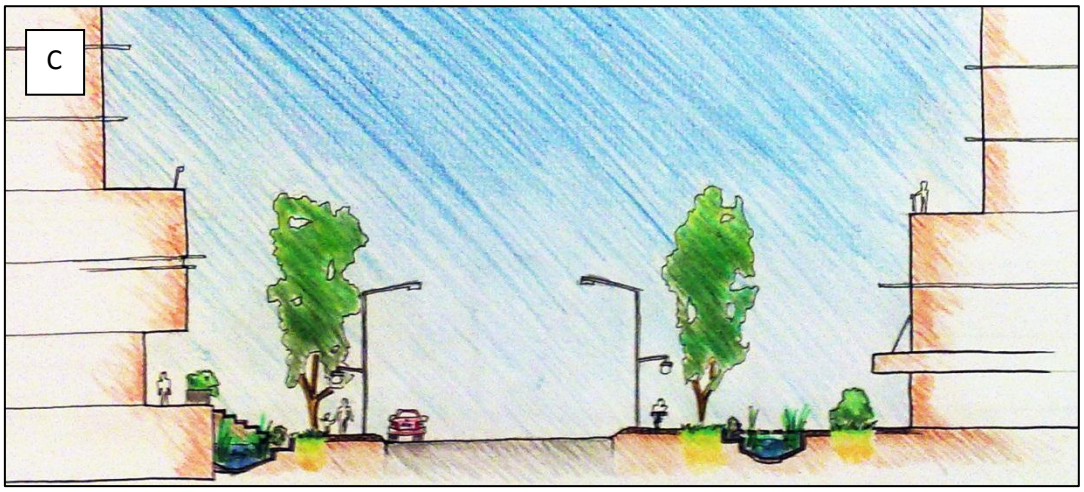


Figure 22: Section through green streets

The smaller secondary green streets are designed for pedestrian amenity while permitting lighter and slower traffic to occur. Entryways to developments occur on either side of these streets. Therefore, the character of these streets is centred on utilising biodiversity as an aesthetical element in urbanised areas. As figure 22 indicates, the special arrangement of the street edge with planting alongside bio swales, which are part of a cluster wide water reclamation infrastructure, provides greater traffic buffer. Simultaneously, these streets also present itself an opportunity to be extended towards neighbouring sites beyond the cluster, from both northern ends following the greenbelt and by directing them towards the CBD.

Figure 23: Section through Longland Street

[19] Traffic and pedestrians must first pass these streets to get into quieter local, green and pedestrian streets (Refer plan)
[20] Other parking will be hosted by developments themselves off-street away from street view.

Local streets are those caught in between areas of development on a different block. Longland Street, as depicted above, bridges the heavier edge developments on streets on the south side and the more open spaced park to its north. Functioning primarily as vehicular thoroughfare, it has minimal emphasis on pedestrian movement facing south. Instead, a wider bio swale is required to channel larger water flows from the southern developments into the main water body. Developments occurring on the south side of Longland Street will provide a façade suitable for faster traffic movement, which shares the benefit of open green views across the street. Meanwhile, developments facing the north side will be given a much larger setback for a better pedestrian experience away from street traffic.

Figure 24: Section through green corridor and pedestrian pathways

One of the common shortcomings of greenways is that it might not be evident as a continuous environmental system, in part due to thresholds and interruptions caused by roads and developments (Collinge, 1998). To avert this, the green corridor as proposed runs through the stretch of developments and functions as the ecological “heart” of the cluster. In addition to the objectives stated in section 3.2.4, this corridor promotes ecological awareness by encouraging movement and access to the surrounding developments, and also provides visual amenity through clear lines of sight from these developments. Doing so includes human activity as part of its ecosystem. Pedestrian pathways intersecting the corridor and park areas into development courtyards will carry similar atmospheres from these open green spaces and integrate with it more urban elements thereby blurring and smoothing the transition between them. These routes also explore linkages by foot and cycle paths for recreational and community use, building upon the established Mirvac pathways as planned and identifying local cluster destinations for inhabitants of the cluster.

3.2.4.4 Cross blocks

The previous section describes the overarching strategy for movement and ecological sustainability. At the architectural scale, developments are often persuaded by practical design to include movement and open spaces within their property boundaries. One of the ways in which the Newstead Neighbourhood Plan addresses this is through retaining movement between development blocks within the district (Figure 25 below). However, specifications regarding the fittings and treatment in these areas are non-existent.

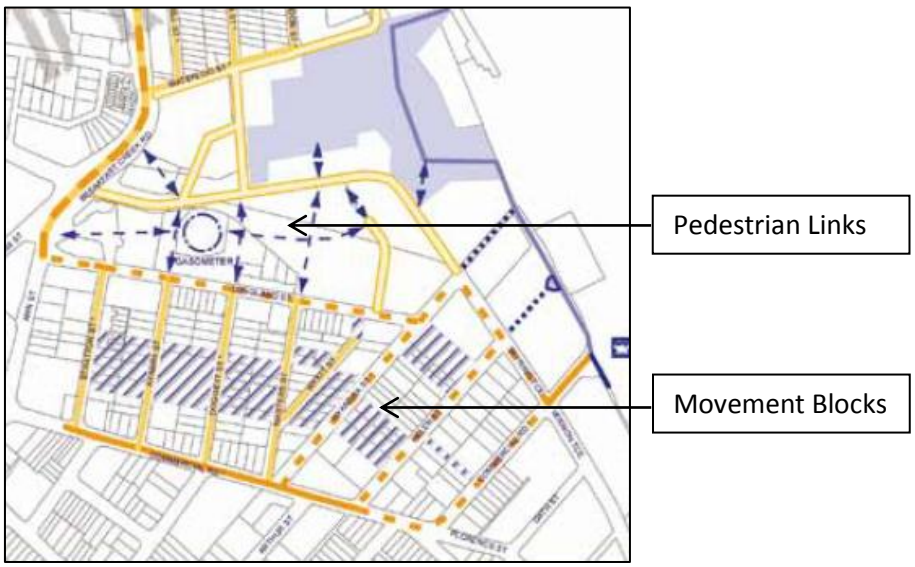


Figure 25: Movement blocks and pedestrian links planned by council

Source: (Brisbane City Council, 2010)

As part of the policy proposal, introducing cross blocks as a validated feature to include urban and environmental elements into the development of open spaces is an avenue to assist in collaborating private and governmental interests. Cross block movement can prove to be an effective method in creating pocket spaces as they divert pedestrians off public streets into dedicated pedestrian realm space where passers-by are encouraged to linger. Developments in turn can benefit from obtaining more attractive and utilised open spaces, while the environmental management of ecological elements have the option of being entrusted to building managers, local authorities, or the resident community. Each pocket space can be treated as niche areas and can be tailored into smaller controlled habitat spaces (Morris, Alonso, Jefferson, & Kirby, 2006).

3.2.5 Water within the urban plan

In many areas, rising levels of water consumption are unsustainable and adaptive management of water will be required to sustain economic growth (Thomas et al., 1999). In general, a waste water treatment plant consists of collection, treatment and disposal of effluent water. The 85% cost figure stated in Chapter 2.1.4 is largely accounted for during the collection stage as treatment plants are usually located outside the city. In Australia where water resources are tightly constrained and distances between communities and treatment plants are large, recycling is amongst one of the most cost effective ways of improving water use efficiency. In 2008 the state of Queensland logged 400 GL of effluent water pushed through its water treatment plants annually, of which 118 GL was able to be reused (29.5%) (Dillon, 2000). This figure is set to rise with urban water use projected to increase by up to 49% by the year 2026 (Water Services Association of Australia, 2010).

As also mentioned in Chapter 2, changes to WSUD guidelines need to implicate catchment areas beyond individual lot developments to a much larger scale and ensure water flows into runoff areas are appropriately addressed. Therefore, in order to achieve an ecologically sustainable management of water resources, it is pivotal that water is used optimally across all sectors from its capture to its disposal. This is not to say conservation efforts along river ways are any less important as ecological resource management and restoration efforts will always prioritise waterways, largely because of their greater potential ecological and economic value (Lake & Bond, 2007). Instead, the challenge is in allowing urban developments to actively take interest and to be responsible for their own water consumption.

This research proposal approaches water management from two factors touched on in the previous section. Firstly, the amount of water collected and recycled is foremost in providing the means to develop an urban framework of water harvesting. This is derived from a total collection sum approach, where developments which in the past have had their own water storage are now contributing to a local reservoir for use. Secondly, examining the full life cycle of water flows becomes crucial in creating infrastructure for use in the clusters' urban developments' recreational and building use and ecology in creating riparian habitats.

3.2.5.1 Reorganising urban water infrastructure in the proposal

The proposal in this research aims to provide all developments within the cluster equal access to a decentralised water infrastructure. Furthermore, this water infrastructure is designed to

meet the government's vision of increasing locals' knowledge and awareness of sustainability themes. Therefore, the infrastructure in place goes beyond pipe centric solutions and integrates itself with environmental objectives on the visible level. Figure 26 below highlights how bio swales are tightly woven into the urban pattern as part of a clustered water network. Figure 27 demonstrates the programmatic management for this decentralised system to operate within the cluster.

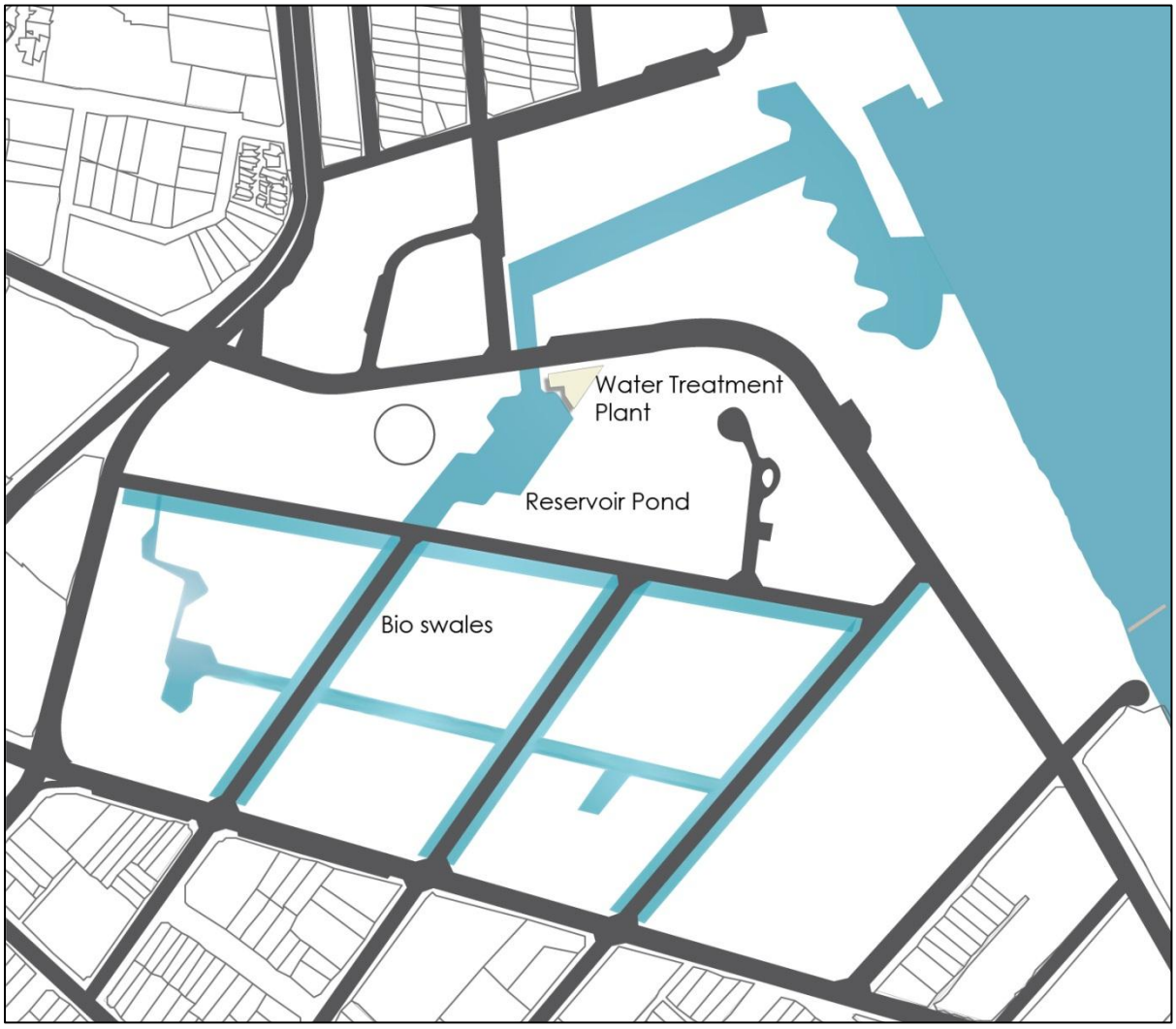


Figure 26: Proposed water infrastructure on masterplan

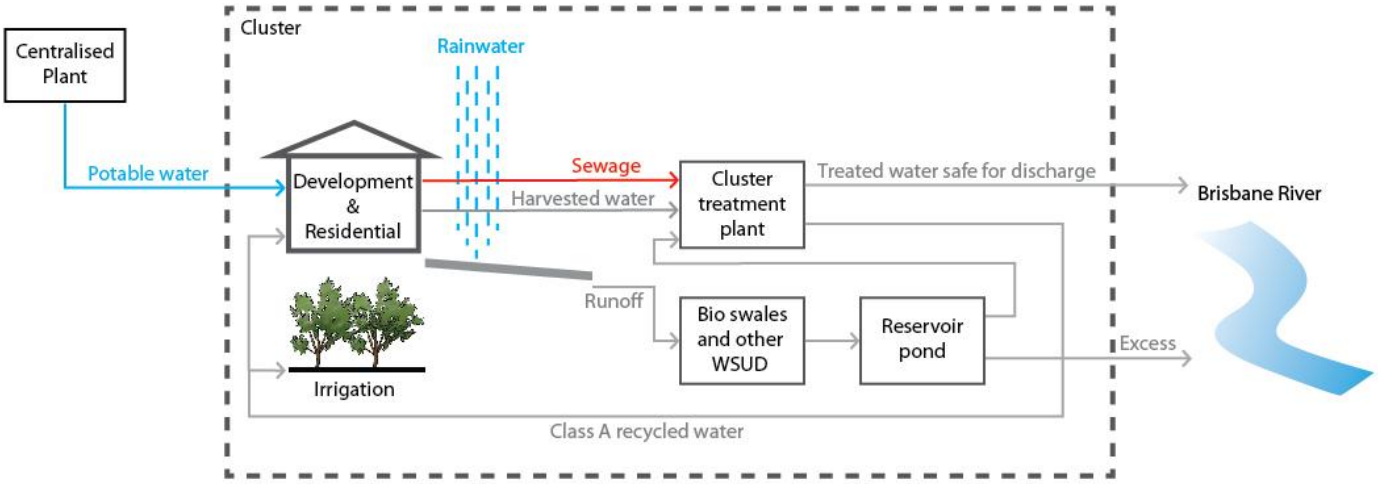


Figure 27: Decentralised cluster water infrastructure flow diagram

3.2.5.2 Design implications

From a design standpoint, the contribution of these bio swales to the local ecology is crucial in driving an active ecosystem. In addition to introducing riparian plantation to an otherwise standardised streetscape, these swales collect rainwater commonly lost from road and sidewalk runoffs and naturally filter grey water discharged by local developments. This adds up to a vast amount of off-site water stored in a common reservoir, which can be recycled and redistributed easily and cheaply with the installation of a local treatment plant as proven in a number of case studies[21] [22]. Another benefit from locally managed water is the accessibility of irrigation. Although irrigation is traditionally viewed as unsustainable (Smith, 1998), the availability of water for local green spaces means the broadening of urban vegetation options beyond water saving strategies of drought tolerant natives. The relationship between stormwater runoff and bio swales is particularly important in the water's lifecycle, as Sharma et al (2008) has proven that these swales significantly decrease the nutrient count from stormwater runoff for later reuse. In another case study done in NSW, bio swales had positive impacts on urban biodiversity compared to the green spaces they replaced (Kazemi, Beecham, & Gibbs, 2009), strengthening the argument for the proposals' green street profiles.

Inevitably, the technical consequence of decentralised infrastructure on developments calls for its integration with standard centralised water delivery infrastructure for potable water needs. The decentralised building scale system as commonly found across Australian case studies involve a

[21] Lloyd Crossing, Portland, Oregon (Portland Development Commission, 2004)
[22] Aurora housing development, Epping North, Melbourne (Othman & Jayasuriya, 2010)

dual pipe system for effluent water recycling within developments themselves, where access effluent water is also discharged into sewer mains as localised plants are likely to be inadequate for greater levels of treatment (Cook, Tjandraatmadja, Ho, & Sharma, 2009). This leads to a greater cost burden on developments, and is only feasible for large scale developments where it is worthwhile on a 'fit for purpose' basis. The inclusion of a local treatment plant in the proposal negates the need for less capable development scale filters. Furthermore, smaller developments such as housing and commercial lots can tap into the shared local resource by linking up with this local infrastructure. According to recent research surveys, this decentralised system could potentially reduce up to 44% of potable water intake where grey water is deemed sufficient for the task (Sharma, Gray, Diaper, Liston, & Howe, 2008). The diagram below demonstrates the differences between the schemes as discussed.

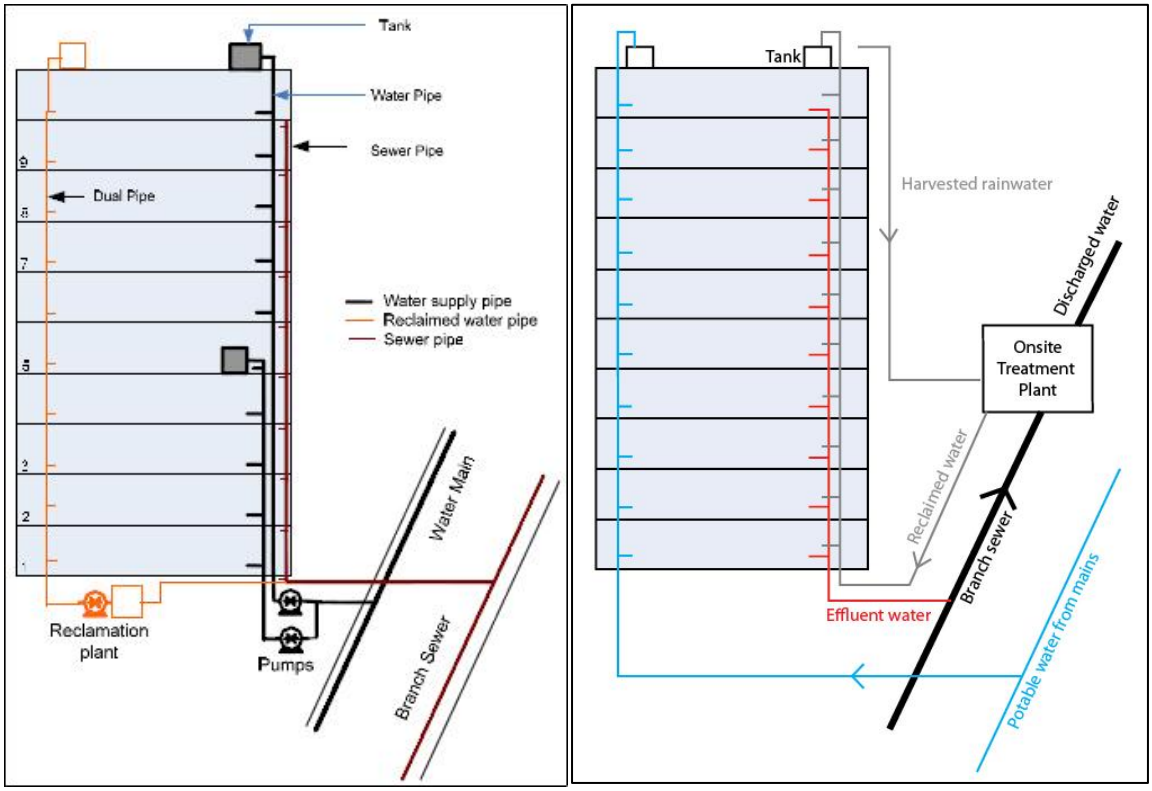


Figure 28: Development based water recycling (left), cluster based water recycling (right)

3.2.5.3 Management and policy implications

With the current centralised water infrastructure system, increased demand for water within city districts will gradually increase the price of water. This is in lieu of escalating costs for expanding infrastructure, ecological impacts, water curfews during shortages, and effluent water

treatment. Therefore, switching from centralised beginnings to a decentralised infrastructure requires the change from regional to local management. With the proposal of an exposed cluster wide water infrastructure, already foreseen problems in water reuse are raised and demand for recycled water, including public health concerns, social acceptance, environmental effects, treatment reliability and quality, and availability of expertise for monitoring and management are increased. To alleviate these fears, the neighbourhood plan must translate the implications of regional scale concerns appropriately to the cluster scale. For example, a water resource plan needs to be introduced to identify water flow supply and conditions from surface water, streams, and other sources into the cluster's catchment area. From there, how the catchment will provide a specified probability of supply through secure water entitlements to developments for environmental needs as well as building uses.

From an ecological management point of view, this closed loop water cycle approach differs greatly from present segregated and sectionalised management scheme where certain authorities only are responsible for certain parts of the water lifecycle. This segregation of responsibilities results in poor use of water in the later stages of its cycle. Therefore, coordinated management across all developments and other public or private uses must be made necessary if ecologically sustainable management of water resources is to be made possible. This management plan demands detailed examination of the capture of water from its source to its ultimate disposal. Hence, the authority that manages the cluster's water distribution and its delivery to the cluster's users would be the same authority responsible for its environmental impacts and achievement of ecological sustainability (Lake & Bond, 2007). This drives home the idea of water infrastructure first prioritising ecological interests over the current situation where water utility companies are driven by market forces, and such change can be reflected through new policies. With that said substantial investment into research to guide the restoration and management of catchments, rivers and wetlands become more feasible as the area of study is significantly reduced from the regional scale.

3.3 Architectural design

With the previous section highlighting design implication for a masterplan and new policy frameworks, this research resolves the final implementation step through a bio-science work & research campus design scheme for Queensland University of Technology (QUT). The campus development reinforces the theme of sustainability and is ideal for monitoring site conditions and steering future changes to the masterplan as the cluster's condition changes.

The block is divided into several sections as shows below.

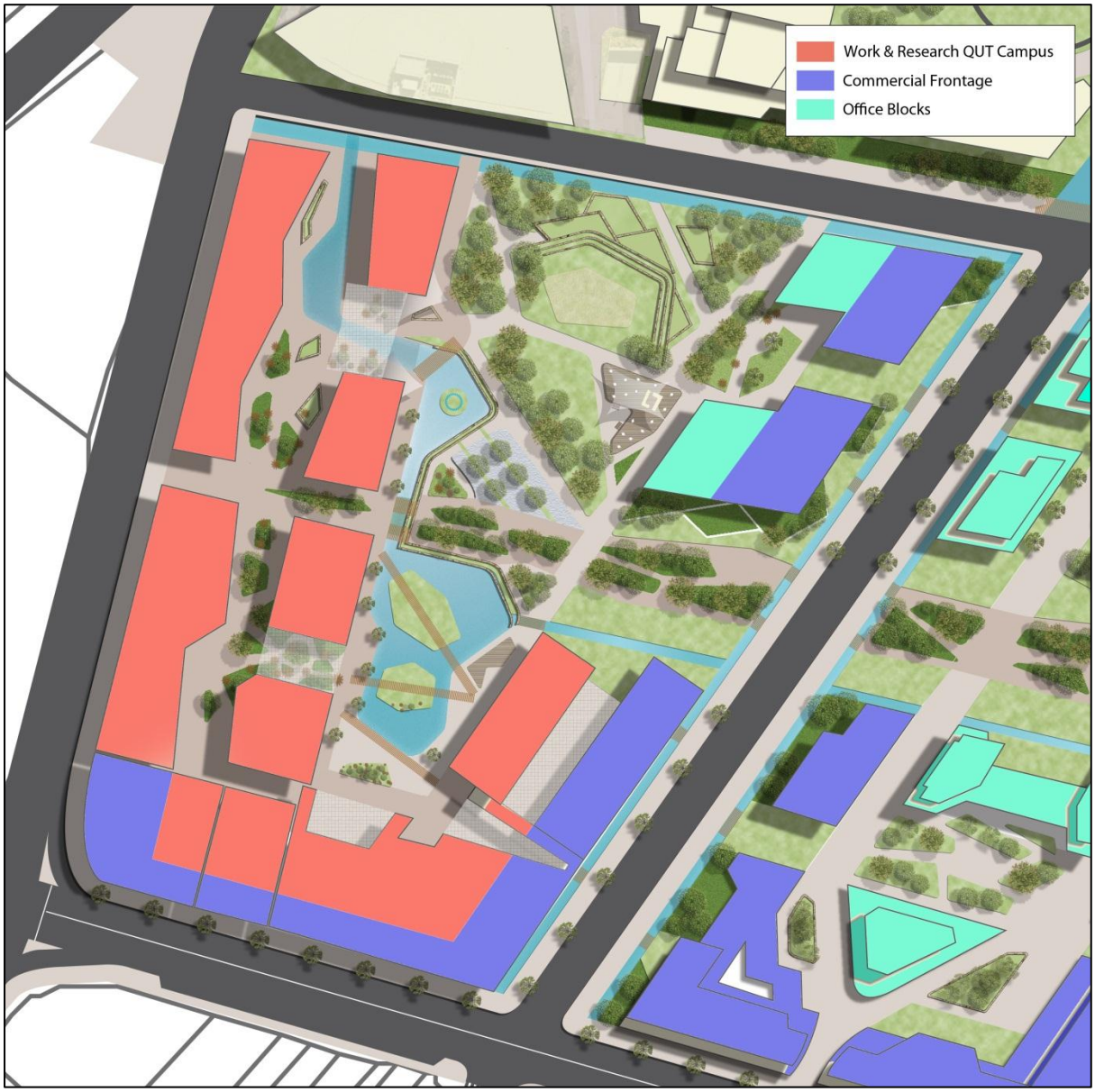


Figure 29: Site map highlighting development typology

The campus serves three main purposes:

- it serves as actual campus grounds for students and academic staff
- it provides an on-going research facility for non-academic use, sharing facilities as required between students and workforce
- it serves to showcase environmental sustainability through its architecture and programme

The sections that follow describe how the campus is designed conceptually around policies that are described alongside the design process.

3.3.1 Creating a building concept through movement

The importance of the campus as a catalyst site to develop closer ties between developments and the natural environment is the driving factor for its design in fulfilling the masterplan and policies proposed. As such, the concept of park space blurring into indoor environments is best displayed with movement between indoor and outdoor areas through different parts of the campus and other developments in the cluster. This concept is bolstered by creating spaces that expose the users of space to a variety of experiences when moving between areas. In this design, this is achieved by separating campus spaces into blocks according to use; study rooms, laboratories, library, etc. are all spaced out in different areas to ensure users have to move out into atriums or other open areas to reach a destination[23].

The intermediary spaces thus become a key element in the composition of the progression of spaces, as the motion from smaller rooms, laboratories and corridors into large open areas define spatial change in this instance. This is particularly true in this instance since the campus indoor environment must meet stringent sterile conditions for operation. The traditional module to maintaining a laboratory environment between indoor atriums and controlled laboratory is through managed partitioning of spaces. To circumvent the problem of introducing wilder green elements which create disturbance in sterile spaces, the design adds a transitional phase, via cross blocks, in between outdoor and atrium spaces thus bringing more architecture components of the building into the external environment. This concept of movement therefore treats the cross block spaces as both architecture and environment, as well as recreational atrium spaces as discussed in the following sections.

[23] Refer floor plans in appendices pg. 9 - 13

3.3.2 Designing cross block spaces and engineering habitats

The cross block spaces show that despite stringent requirements for closed environments, natural green elements can still coexist in atrium spaces and reinforce the architecture. The need for cross blocks arises from the demand for public pedestrian movement between the cluster's development blocks. Following the proposal, developments must keep cross blocks transparent and open for public use while continuing the green network of the cluster as part of new land use and environmental policy. The campus design furthers this idea by allowing movement to occur over the ground level public realm, achieving both private access for campus users and exposure to green space below (Figure 30).

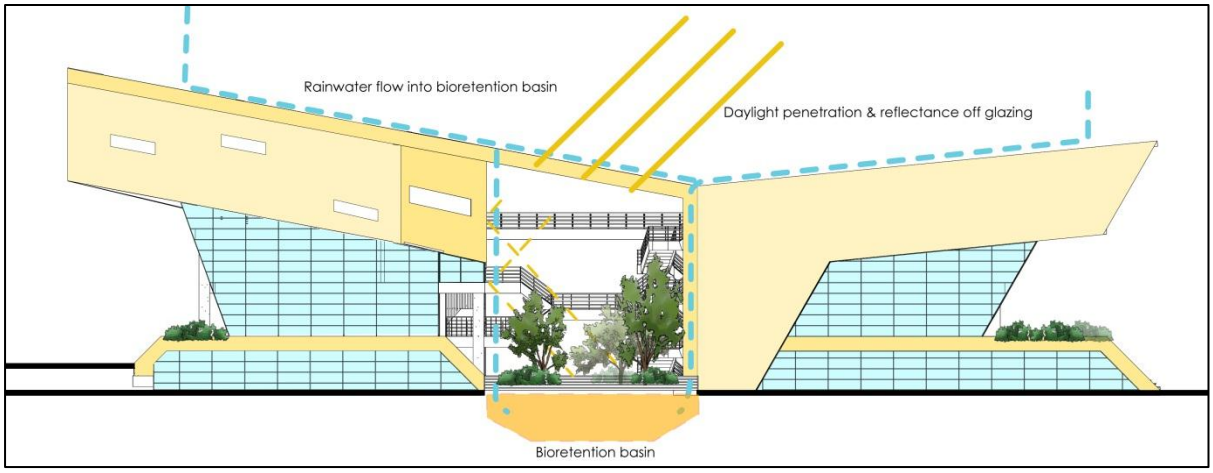


Figure 30: Campus cross block elevation

Another avenue of exploration is to use these cross blocks as micro habitats within the urban environment. This in part is done as many non-native species will either be invasive or will not survive in the wider green network of the cluster, such as in the case of floristically rich environments which are a rarity in Australian bushland. However, these habitats still have a place in urban settings to increase both aesthetical options and exposure to more fragile species. As new development projects emerge, these cross blocks are opportune to introduce or foster smaller habitats independent from the cluster's greenways. The cross blocks themselves are tailored to sustain these habitats and replace traditional approaches of cosmetic green elements. A typical example of a micro habitat that could exist in this scenario is the creation of a pond, of which some plants and animals will colonise relatively quickly (Morris, Alonso, Jefferson, & Kirby, 2006). The culmination of a series of cross blocks in succession has the potential to contribute to positive action for increasing biodiversity levels, particularly when carried out in the proximity of existing habitats.

3.3.3 Creating outdoor spaces

Most relevant to the users of the campus is how functional the spaces are within the building while maintaining the theme of openly exposing ecological sustainability. Furthermore, with seamless open space environments prioritised as a key concept, there is cause for concern that these spaces would feel overtly public. Several key spaces occur where this idea is best interpreted; the library, atriums & foyers, and outdoor corridors. Each of these spaces is designed to take advantage of wide views of the external environment. For example, the library space imitates the open space approach and is achieved through the stacking of library holdings levels to overlook the library's foyer. Study desks and pods are installed on the perimeter of the stacked levels, granting panoramic views of the outdoor environments.

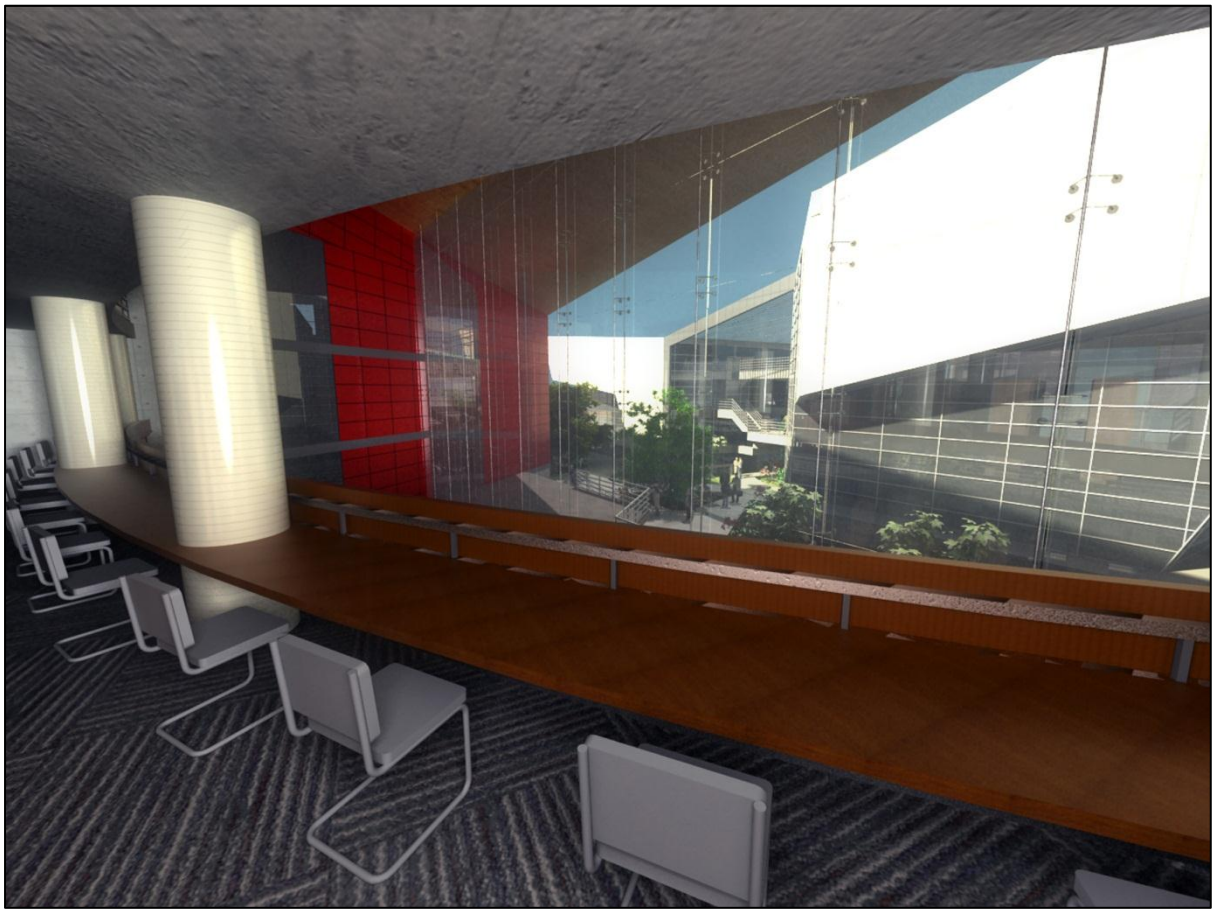


Figure 31: View of campus corridor from library through curtain wall

Equally important to the campus lifestyle are recreational areas between user schedules. In addition to being the campus' core movement space, the corridor that splits the campus into two wings is an ideal location for such activities to take place. Hence, the corridor's lengthy stretch must accommodate a degree of vibrancy through the pushing of ecological agendas and provision of

green views for campus blocks that face inwards. As a side objective, creating a culture of a highly utilised and trafficked space by campus users helps develop a sense of space that associates the corridor with campus activities, thus diverting public users to the public park spaces instead. The creation of a sense of space heralds back to current lacklustre policies of the development of Newstead as an example part of the city showcasing business, knowledge and social interdependency. By introducing policies that instigate landscapes as a tool to create unique character spaces, future developments that shape their courtyard or plaza spaces in similar fashion increase the probability of spaces that will be well utilised by city inhabitants.

3.4 Discussion

The concepts presented in this chapter focus on responses to the issues of ecology through the creation of green corridors and bio swales, liveability concerns by integrating green elements as a daily occurrence, and viability in creating an active cluster through clear movement patterns into and within the cluster. The Newstead cluster proposal is also based on responses to the analyses made of Brisbane's urban makeup which ranges from predicted traffic patterns and spatial characteristics of other districts, precincts, and strategic key location around the cluster.

However upon working through this design process, certain limitations have been identified. This research does not aim to produce a definitive method of creating policies and green urban design, such as describing specific requirements for spatial planning. Defining a set of policies would in fact be counterproductive as evolving practices require constant change in dealing with ecologically sensitive urban design. Instead, the proposal developed illuminates how the intrinsic complexity of the concept of biological diversity can be aided through clustered planning and appropriate management processes.

The portioning of development lots in the masterplan maintains targets of low ground coverage and reaching high population density. Furthermore, the proposal put forth goes beyond the cluster's borders which Mirvac and FKP have failed to properly address. Moreover, the design choices made in the proposal are justified by long term objectives revolving around Brisbane city's urban plan. This is achieved through increased connectivity with surrounding districts and better characterisation of spaces through clustering. Features such as the green streets and bio swales proposed offers insight into allowing flexibility for future expansion beyond the cluster as a solution for linking Newstead with the greater city. Shifting to a decentralised water infrastructure will also undoubtedly incur a higher upfront cost for the government due to the initial groundwork, as in the case of introducing riparian habitats that are safe and usable by developments. However, on the flip side, there will be considerable cost savings from pumping water across for regional treating and piping infrastructure, and developments will also experience savings through lowered levels of water consumption across the board.

Crucially, it is important to realise that communities do not accept change easily, especially when new infrastructure technologies raise concerns of public health and safety. Gaining community support for sustainable development is important, and requires the government and developers to educate and encourage communities to learn more about sustainability issues and lend support to local developments that uphold sustainable development principles. In this instance, the proposal of developing a campus fits well into supporting the cluster's redevelopment and also attracts a

younger, learned populace in developing Newstead as a knowledgeable community. Furthermore, economic objectives can also be met by building up professional skills and capacity for implementation of sustainable management in the cluster.

Lastly, the campus design proposed teases out the finer details of policy actions that ensure developments adhere to the overall vision of the cluster. The design demonstrates how developments are able to integrate its surroundings to enliven the character of the spaces both inside and outside the campus grounds. Areas such as cross blocks inform us that policies regarding its use for council and development purposes can benefit both parties in creating seamless transitional spaces following the developments architecture. Such policies should detail rights of way for development influences over the space and supported biota, and responsibilities of each party in the on-going management of the space. It also goes without saying that the campus also incorporates other obvious sustainable technologies such as photovoltaic cells, day-lit interior spaces, and computer controlled energy saving opportunities in other building services[24]. More critically, the design of campus spaces displays how vital the environment is in supporting and influencing its architectural ideas, and how this applies for other developments in the cluster.

[24] Refer to appendices for full design scheme and documentation.

Chapter 4: Conclusion

4.1 Summary

The purpose of this research is to develop new methods in setting broader sustainable policies and urban framework planning for future urban renewals in Brisbane. The investigation in Chapter 2 of current accepted practices and policy making leading to the achievement of sustainable design reveals that urban environments do not benefit significantly from an aggregation of highly rated green developments. The effect of uncoordinated management of green spaces also shows that green spaces within cities only exist as habitat patches. These spaces are also declining in levels of biodiversity due to disconnection and urban growth. Another element in ecology is its association with water. This precious Australian commodity has in the past decade experienced new innovations in its management through WSUD, but still merely remains loosely tied to ecological objectives. As was shown in this research, clustered developments are shown to enable greater planning coordination in ecological conservation and water management matters by converging sustainable efforts of aggregated developments.

As sustainability in Brisbane is a growing issue amongst its residents, local groups and government alike, stakeholders search for new ways to improve conditions with creative and collaborative urban design. Improvement of policy also assists in achieving Brisbane's Urban Renewal Plan objectives. These ideas exist in the form of clustered developments, and challenge the acceptable standards of sustainability and starts viewing sustainable targets on a broader development scale. As evident in the literature review, clustered planning forces more attention on to the fostering of meaningful connections with ecological systems and urban activity by observing their interactions and spatial scales relative to the human experience. This observation of scale also includes complex processes in Brisbane's ecology and water cycles and is extensively explained in Chapter 2. This chapter also addresses and challenges common views of green space, parks, remnant forest patches, their supported wildlife, and our daily interactions with them. Through this literature review, it is clear that these larger scale issues cannot be solved practically on a standalone development basis. The importance of sustainability and its role in future economic growth is also well understood as can be seen with knowledge based urban planning gaining favour in Brisbane.

Having presented these shortcomings and their desired outcomes, it becomes clear that the characterisation of each space needs to be emphasised in clustered developments. At its basic level, character of space is shared by all private and public developments and park areas, which in turn extrapolates the policies and design framework required to achieve this vision. The desire to bind ecology and social needs, alongside the importance of creating a sense of space, leads to the design

proposal priming itself on characterising the Newstead cluster as a 'catalyst urban activity centre for ecological sustainability within Brisbane'.

4.2 Making sense of the proposal

Through the urban design proposal presented in Chapter 3, more ecologically and economically sustainable cities are shown to be viable in concurrence with Brisbane's CityShape strategy. In this thesis, this is accomplished through:

- networking and increased bio-diversification of green spaces
- identification of underperforming policies
- formulation of new ecologically and socially focused standards
- upholding of economic viability aided through linking movement and new infrastructure with existing urban surroundings.

Where possible, in realms sharing ecological and human habitation, the masterplan takes the opportunity to integrate new urban infrastructure into the cluster for raising social awareness and interactivity.

The following conclusions were found following this design methodology.

First, the realisation of an urban catalyst, in this instance the Newstead development, is important in developing a cluster. During the preliminary stages of design, the conceptual characterisation of the cluster is foremost in bringing together key stakeholders. Stakeholders benefit from this synergy. Green spaces cannot be successful without sufficient ground coverage, and neither can biota sustain themselves without proper greenway connections. This can only be accomplished through early planning and incorporation green corridors and greenways. Rehabilitation of existing urban habitat patches has proven difficult to maintain and is largely ineffective as urban growth encroaches on these remaining spaces over time. Therefore, it is crucial that city fringe habitats have deeper reach into the city through the cooperation of stakeholders in creating these greenways.

Second, open spaces of developments need planning that provides flexibility for multiple uses. This is the crucial step in realising tighter interaction between ecology and human needs. The cause for lack of interactivity with ecology is the scripting by modern urban planners for human behaviour but not for ecosystems. The proposal remedies this situation by modifying primary

movement streets and pathways to accommodate both these factors. The success of these dual function streets relies on established knowledge about ecological thresholds. This implies that urban planners and ecologists have to work closely when establishing urban links from habitats into greenways. At a basic level, identification of urban elements – such as vehicular streets, cross blocks, and bio swales – that will fracture or encourage areas where ecosystems and urban movement overlap dictates how a clustered development would take form.

Third, it is necessary for key stakeholders, government, and the residential community to engage closely with each other on the management and aesthetic treatment of green spaces. It was identified that this process often comes too late in the development process, which leads to green spaces that are underappreciated and underutilised as a result of a lack of sense of responsibility and guardianship. The proposal applies two groups of management processes for these environments to alleviate the need for an overarching scheme to achieve local community and development targets. Greenways and green corridors provide the backbone to a self-sustaining ecosystem, while cross blocks create the platform for them to provide flexibility in landscape aesthetic treatment and maintenance for micro habitats. This concept can also be applied to other relevant areas, notably courtyards, backstreets, and urban garden farms which may exist in other clustered developments. Clearly, urban frameworks would benefit from applying this hierarchical relationship of landscape management.

Lastly, with regards to policy making, urban planners must also realise that they constantly have to deal with rapid and occasionally large-scale urban structure changes that may not fit traditional framework requirements. This is evident in the proposal for shifting from a centralised to decentralised water infrastructure. The systems already found in buildings today indicate that there is a capacity for them to be used on a wider scale, beginning first with clustered developments then expanding out on a regional scale. The conversion from centralised water sources to local decentralised systems has greatly affected sustainability outcomes in water conservation. As a result, new policies must first determine if they adhere to the regional sustainable themes before adjusting for environmentally determined changes within the cluster. Again, the Newstead proposal balances the holistic vs. reductionist policy making processes through learning by enforcing the decentralised system throughout the cluster before detailing broadly how other developments and future clusters may potentially utilise the system. As there is no absolute way to predict reality and resolve questions pertaining to specific ways of writing policies, on-going studies and surveys of the principles and rules of this system are needed to make this policy model more detailed over time but this work should never be regarded as complete.

4.3 Limitations of research

While the research has referenced many ecological studies relating to ecosystems and habitat generation in urban environments, there is limited information on how well certain groups of species, especially vertebrate species, will perform around human activity. As a starting point, this research based the proposal's ecology performance mostly on results from fringe habitats around Australian cities. However, the unpredictable shifts of ecological thresholds will require monitoring of urban habitats before the size, scale, positioning, and migration patterns assumed in the proposal are accepted as canon. This lack of empirical data also fails to show how effective and successful these ecosystems are in mimicking city fringe habitats and whether ecosystem conditions will change during the introduction period of native greenways.

This research also does not address flooding issues as observed during the Queensland floods in the year 2011. The water infrastructure proposed is limited to performance during normal rainfall and drought periods. However, it is logical to assume that severe flooding would cause water supply to be disrupted for long periods of time. This is due to the location of localised treatment plants lying within the affected areas proximity. Given Newstead's proximity to Brisbane River, bio swales will also first be more prone to damage during flooding.

Another limitation of this research lies within the concepts of management and policy that are based on the current CityShape strategy and Newstead Neighbourhood Plan. Beyond the scope of this LGMS and neighbourhood plan, not many references could be made to other planned district clusters around Brisbane as their frameworks and policies have yet to be written. Certain results discovered through this research, such as defined land use management by Mirvac and FKP Limited, may not apply to other clusters and will need to be revised according to the concepts in the proposal.

The design proposal also revealed planning outcomes that are difficult to predict. The continuous green belt from city fringe habitats into inner city areas faces barriers at key intersections and nodes. Highways that run parallel to the corridor's crossing create an impenetrable threshold for ecosystems to migrate smoothly into the cluster. This also affects pedestrian movement to a lesser degree. The design circumvents this by leading secondary corridor paths that reach around these barriers where it is more permeable. However, these permeable sections are located outside Newstead's cluster borders and require wider regional planning to ensure continuity of the green corridor.

4.4 Future research areas

The limitations detailed above reveal future areas of research. For example, the research could be expanded by referencing results of flooding across areas of Brisbane. As Brisbane receives excessive rainfall during occasional periods, it may be useful to investigate how excess water can be managed or discharged offsite as well as to identify preventative measures to overfilling of reservoirs.

A further avenue of investigation in urban planning is to expand sustainability issues of electricity at the cluster scale. The added dynamic of sharing solar generated power over a decentralised power grid deserves much attention. Furthermore, designing the cluster to incorporate positional benefits such as channelling prevailing winds, and introducing a multi-development thermal loop to minimise dependencies of temperature conditioning via electricity increases sustainable benefits derived from clustered developments.

Finally, new urban planning tools such as Geographic Information Systems (GIS) are becoming more popular in aiding urban planners in taking recommended courses of action. The use and awareness of GIS in recent planning initiatives internationally makes it easy to identify overlapping areas between all assets of environmental properties and attributes. Design informed by GIS can also ascertain the rippling effect of influences clustered developments will have in the greater urban fabric. Conclusions found through these analyses are much harder to dispute during planning when multiple stakeholders are involved, resulting in smoother delivery of sustainable practices within the city. GIS at a regional scale can also identify best pathways for green corridors to take in each cluster by identifying areas of least threshold resistance.

In summary, these areas for further investigation together with the outcomes of this research will be able to create a more inclusive urban planning environment that can be attributed to clustered development planning. With the government and more local groups stepping up to tackle growing sustainability concerns across matters of ecology and socio-economic wellbeing, Brisbane will certainly be successful in attaining its vision of a well-planned, accessible, clean and green, vibrant, creative, and prosperous sub-tropical city.

Bibliography

Abley, I., & Heartfield, J. (2001). *Sustaining Architecture in the Anti-Machine Age.* London: Wiley-Academy.

Angold, P. G., Sadler, J. P., Hill, M. O., Pullin, A., Rushton, S., Austin, K., et al. (2006). Biodiversity in Urban Habitat Patches. *Science of the Total Environment, 360*(1 - 3), 196 - 204.

Arendt, R. G. (1996). *Conservation Design for Subdivisions: A Practical Guide to Creating Open Space Networks.* Washington D.C.: Island Press.

Arup Sustainability; Brisbane City Council. (2004). Assessing Sustainable Urban Developments. *Australian Planner, 41*(4), 33-36.

Barker, R. (2004). South East Queensland: Australia's Population Powerhouse! *Queensland Planner, 44*(3), 50-62.

Beatley, T., & Newman, P. (2008). *Green Urbanism Down Under.* Washington D.C.: Island Press.

Bertolini, L. (2005). The Multi-modal Urban Region: A Concept to Combine Environmental and Economic Goals. In M. Jenks, & N. Dempsey, *Future Forms and Design for Sustainable Cities* (pp. 73 - 93). Burlington: Architectural Press.

Bond, A. J., & Morrison-Saunders, A. (2010). Re-evaluating Sustainability Assessment: Aligning the Vision and the Practice. In Press.

Brisbane City Council. (2005a). *Our shared vision - Living in Brisbane 2026.* Retrieved August 15, 2009, from http://www.brisbane.qld.gov.au/bccwr/about_council/documents/vision_2026.pdf

Brisbane City Council. (2005b). *Planning and Building: Water Sensitive Urban Design.* Retrieved October 15, 2009, from Brisbane City Council: http://www.brisbane.qld.gov.au

Brisbane City Council. (2007a). *Biodiversity Research Partnerships Program Newsletter.* Retrieved August 15, 2009, from http://www.brisbane.qld.gov.au/bccwr/environment/documents/biodiversity_research_partnerships_program_newsletter.pdf

Brisbane City Council. (2007b). *Local Growth Management Strategy for Brisbane: CityShape Implementation Strategy.* Brisbane: Brisbane City Council.

Brisbane City Council. (2008). *Neighbourhood Planning in Urban Renewal Areas.* Retrieved August 16, 2009, from http://www.brisbane.qld.gov.au/bccwr/lib502/neighbourhood_planning_in_urban_renewal_areas.pdf

Brisbane City Council. (2010). *Draft Newstead and Teneriffe Waterfront Neighbourhood Plans - Proposed City Plan Amendments.* Brisbane: Brisbane City Council.

Cashmore, M. (2004). The Role of Science in Evironmental Impact Assessment: Process and Procedure versus Purpose in the Development of Theory. *Environmental Impact Assessment Review, 24*, 403 - 426.

Chanan, A., Kandasamy, J., Vigneswaran, S., & Sharma, D. (2009). A gradualist approach to address Australia's urban water challenge. *Desalination, In press*.

Choe, K., & Laquian, A. (2008). *City Cluster Development: Toward an Urban-Led Development Strategy for Asia.* Mandaluyong: Asian Development Bank.

Collinge, S. K. (1998). Spatial Arrangement of Habitat Patches and Corridors:Clues From Ecological Field Experiments. *Landscape and Urban Planning, 42*(2 - 4), 157 - 168.

Cook, S., Tjandraatmadja, G., Ho, A., & Sharma, A. (2009). *Definition of Decentralised Systems in the South East Queensland Context.* Queensland: Urban Water Security Research Alliance.

CSIRO Research. (2007). *CO2 Emissions Increasing Faster Than Expected*. Retrieved July 31, 2009, from Commonwealth Scientific and Industrial Research Organisation: http://www.csiro.au/news/GlobalCarbonProject-PNAS.html#1

Davidson, N. J., Close, D. C., Battaglia, M., Churchhill, K., Ottenschlaegera, M., Watson, T., et al. (2007). Eucalypt health and agricultural land management within bushland remnants in the Midlands of Tasmania, Australia. *Biological Conservation, 139*(3-4), 439-446.

Dickie, P. (2007). *Making Water: Desalination: Option or Distraction for a Thirsty World?* Avenue du Mont-Blanc, Switzerland: WWF.

Dillon, P. J. (2000). Water Reuse in Australia: Current Status, Projections and Research. *Water Recycling Australia*, 99-104.

Drinnan, I. N. (2005). The Search for Fragmentation Thresholds in a Southern Sydney Suburb. *Biological Conservation, 124*(3), 229 - 349.

European Commission. (2001). *A Sustainable Europe for a Better World: A European Union Strategy for Sustainable Development.* Brussels: Commission of the European Communities.

FKP Limited. (2010). *The Gasworks*. Retrieved 1 6, 2011, from The Gasworks: http://www.thegasworks.com.au/

Gibson, R. B. (2006). Sustainability Assessment: Basic Components of a Practical Approach. *Impact Assessment and Project Appraisal, 24*, 170 - 182.

Gill, N., Waitt, G., & Head, L. (2009). Local Engagements with Urban Bushland: Moving Beyond Bounded Practice for Urban Biodiversity Management. *Landscape and Urban Planning*, In press.

Gillen, M. (2006). The Challenge of Attaining a Sustainable Urban Morphology for South East Queensland. *Planning Practice and Research, 21*(3), 291 - 308.

Gobster, P. H. (2004). The Urban Restoration Experience. *San Francisco Natural History Lecture Series*. San Francisco, CA.

Gobster, P. H. (2007). Urban Park Restoration and the "Museumification" of Nature. *Nature and Culture, 2*(2), 95 - 114.

Holden, M. (2006). Urban Indicators and the Integrative Ideals of Cities. *Cities, 23*(3), 170 - 183.

Hough, M. (2002). Looking Beneath the Surface: Teaching a Landscape Ethic. In B. R. Johnson, & K. Hill (Eds.), *Ecology and Design: Frameworks for Learning* (pp. 245 - 268). Washington D.C.: Island Press.

Hubbard, P. (1999). Urban Design and Local Economic Development: A Case Study in Birmingham. *Cities, 12*(4), 243-251.

Huggett, A. J. (2005). The Concept and Utility of Ecological Thresholds in Biodiversity Conservation. *Biological Conservation, 124*(3), 301 - 310.

Jacobs, J. (1961). *The Death and Life of Great American Cities.* New York: Random House.

Kazemi, F., Beecham, S., & Gibbs, J. (2009). Streetscale bioretention basins in Melbourne and their effect on local biodiversity. *Ecological Engineering, 35*(10), 1454 - 1465.

Lake, P. S., & Bond, N. R. (2007). Australian futures: Freshwater ecosystems and human water usage. *Future, 39*(2-3), 288-305.

Low, T. (2007). *Climate Change and Brisbane Biodiversity: A Critique of the Climate Change & Energy Taskforce Final Report with Recommendations for Biodiversity added.* Brisbane: Brisbane City Council.

McAlister, T. (1998). *Brisbane City Council Water Sensitive Urban Design Case Study.* Adelaide: HydraStorm.

Miller, J. R. (2005). Biodiversity Conservation and the Extinction of Experience. *TRENDS in Ecology and Evolution, 20*(8), 430 - 434.

Miller, J. R. (2008). Conserving Biodiversity in Metropolitan Landscapes: A Matter of Scale (But Which Scale?). *Landscape Journal, 27*(1-08), 114-126.

Miller, J. R., & Hobbs, R. J. (2002). Conservation Where People Live and Work. *Conservation Biology, 16*, 330 - 337.

Morris, R. K., Alonso, I., Jefferson, R. G., & Kirby, K. J. (2006). he creation of compensatory habitat — Can it secure sustainable development? *Journal for Nature Conservation, 14*(2), 106-116.

Naji, F., & Lustig, T. (2006). On-site Water Recycling – A Total Water Cycle Management Approach. *Desalination, 188*(1 - 3), 195 - 202.

Newman, P. (2007). *Sustainability and the Urban Water System.* Institute for Sustainability and Technology Policy. Murdoch University.

Othman, M., & Jayasuriya, N. (2010). Retrieved 1 5, 2011, from City of Melbourne Website: http://www.melbourne.vic.gov.au/Environment/CH2/DesignDelivery/Documents/Study7TechnicalPaper_updated.DOC

Peterson, A., Mcalpine, C. A., Ward, D., & Rayner, S. (2007). New regionalism and nature conservation: Lessons from South East Queensland, Australia. *Landscape and Urban Planning, 82*(3), 132 - 144.

Pope, J., Annandale, D., & Morrison-Saunders, A. (2004). Conceptualizing Sustainability Assessment. *Environmental Impact Assessment Review, 24*(6), 595 - 616.

Portland Development Commission. (2004). *Lloyd Crossing: Sustainable Urban Design Plan & Catalyst Project.* Retrieved October 27, 2009, from Portland Development Commission: http://www.pdc.us/pdf/ura/convention_center/lloyd_crossing_sustainable.pdf

Queensland Government. (2004). *Vegetation Management Act and Other Legislation Amendment Bill 2004.* Retrieved August 15, 2009, from Queensland Legislation: http://www.legislation.qld.gov.au

Queensland Government. (2009a). *SEQ Regional Plan: 2009 - 2031.* Retrieved October 1, 2009, from Department of Infrastructure and Planning: http://www.dip.qld.gov.au/regional-planning/regional-plan.html

Queensland Government. (2010). *Department of Infrastructure and Planning*. Retrieved 5 12, 2010, from Queensland Government: http://www.dip.qld.gov.au/seq

Radford, J. Q., & Bennett, A. F. (2004). Thresholds in Landscape Parameters: Occurrence of the White-browed Treecreeper Climacteris Affinis in Victoria, Australia. *Biological Conservation, 117*(4), 375 - 391.

Radford, J. Q., Bennett, A. F., & Cheers, G. J. (2005). Landscape-level Thresholds of Habitat Cover for Woodland-dependant Birds. *Biological Conservation, 124*(3), 317 - 337.

Roberts, B. H. (2004). The Application of Industrial Ecology principles and Planning Guidelines for the Development of Eco-industrial Parks: An Australian Case Study. *Journal of Cleaner Production, 12*(8 - 10), 997 - 1010.

Savard, J.-P. L., Clergeau, P., & Mennechez, G. (2000). Biodiversity Concepts and Urban Ecosystems. *Landscape and Urban Planning, 48*(3 - 4), 131 - 142.

Sharma, A. K., Gray, S., Diaper, C., Liston, P., & Howe, C. (2008). Assessing integrated water management options for urban developments - Canberra case study. *Urban Water Journal, 5*(2), 147-159.

Short, J. R., Benton, L. M., Luce, W. B., & Walton, J. (1993). Reconstructing the Image of an Industrial City. *Annals of the Association ofAmerican Geographers*, 207 - 224.

Smart State Council. (2007). *Smart Cities: Rethinking the City Centre.* Brisbane: Smart State Council.

Smith, D. I. (1998). *Water in Australia: Resource and management.* Victoria, Australia: Oxford University Press.

Stanisic, J., Burwell, C., Raven, R., Monteith, G., & Baehr, B. (2005). *Terrestrial Invertebrate Status Review.* Retrieved September 1, 2009, from http://www.qm.qld.gov.au/organisation/2005/terrestrialinvertebratesstatusreview_brisbane.pdf

Stenekes, N., Livingston, D., Colebatch, H. K., Waite, T. D., & Ashbolt, N. J. (2004). Sustainable water management in Australia: An Institutional Analysis. *Good Water Governance for People and Nature: Water Roles for Law, Institutions & Finance Conference.* Dundee, Scotland.

Thomas, J. F., & McLeod, P. B. (1992). *Australian Research Priorities in the Urban Water Services and Utilities Area, no. 7.* Canberra: CSIRO Division of Water Resources.

United Nations. (2007). *World Urbanization Prospects: The 2007 Revision Population Database*. Retrieved July 31, 2007, from http://esa.un.org/unup/

United Nations. (2010). Part Two: Action taken by the Conference of the Parties. *United Nations Framework Convention On Climate Change.* Copenhagen: United Nations.

Urban Green Spaces Task Force. (2002). *Green Spaces, Better Places.* London: The Stationery Office.

Walmsley, A. (1995). Greenways and the making of urban form. *33*(1-3), 81-127.

Water Services Association of Australia. (2010). *Implications of popular urban growth in Australia on urban water resources.* Melbourne: Water Services Association of Australia.

Wei, J., Xu, L., & Yang, Z. (2009). Modeling a policy making framework for urban sustainability: Incorporating system dynamics into the Ecological Footprint. *Ecological Economics, 68*(12), 2938–2949.

Williams, D. R., & Stewart, S. I. (1998). Sense of Place: An Elusive Concept that is Finding a Home in Ecosystem Management. *Journal of Forestry*, 18 - 23.

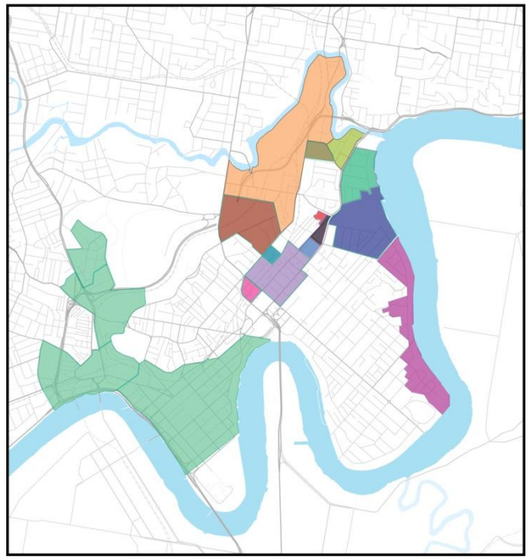
World Commission on Environment and Development. (1987). *Our Common Future.* Oxford: Oxford University Press.

World Wildlife Fund. (n.d.). *Timeline - Land Clearing in Queensland*. Retrieved October 12, 2009, from World Wildlife Fund: http://wwf.org.au/act/takeaction/queenslandelection/landclearing

Yiftachel, O., & Hedgcock, D. (1993). Urban Social Sustainability: The Planning of an Australian City. *Cities, 10*(2), 139 - 157.

Yigitcanlar, T., & Velibeyoglu, K. (2008). Knowledge-Based Urban Development: The Local Economic Development Path of Brisbane, Australia. *Local Economy, 23*(3), 195 - 207.

Appendices



URBAN RENEWAL DISTRICTS

Current identified urban renewal clusters at varying stages of (re)development.

Scale of each renewal is inconsistent, and renewal plans have little to no consideration of neighbouring developments.

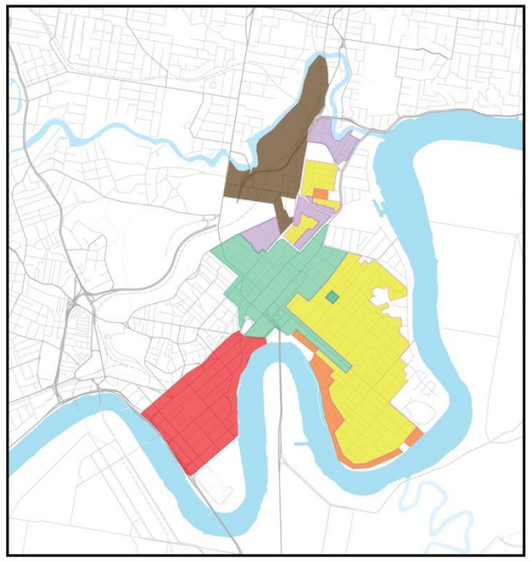
Only the CBD and its neighbouring areas are consistent in urban form and movement.

GREEN SPACES & CORRIDOR ROUTES

Analysis diagram of all green spaces in and around Brisbane City.

Water bodies are consistent with healthy ecosystems, while inner city habitat patches are dwindling and disconnected.

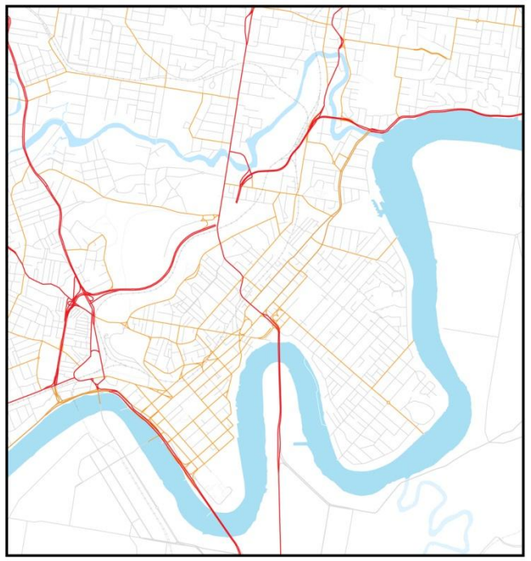
The green line indicates the most logical extension for existing ecosystems into inner city areas. This converges all major green spaces into Newstead, and from there be expanded through the two neighbouring clusters.



BRISBANE CITY COMPOSITION

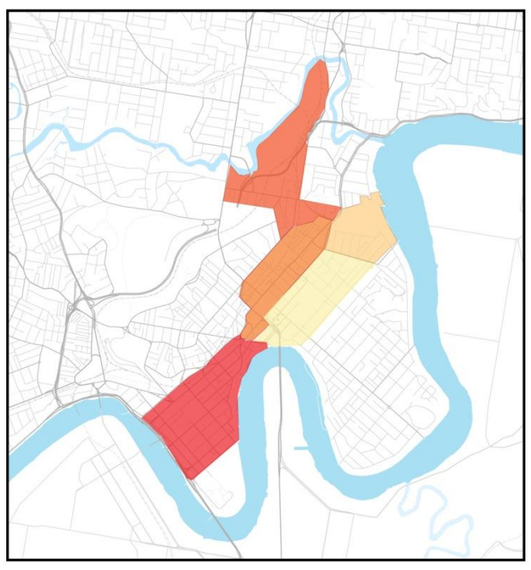
Analysis diagram of current makeup of Brisbane City.

- CBD
- COMMERCIAL
- LIGHT INDUSTRIAL
- HIGH DENSITY RESIDENTIAL
- LOW DENSITY RESIDENTiAL
- UNDEVELOPED LAND



VEHICULAR TRAFFIC PATTERNS

This analysis diagram highlights majority of vehicular traffic in the North - South direction, with sporadic routes heading towards Eastern Brisbane via secondarly roads.

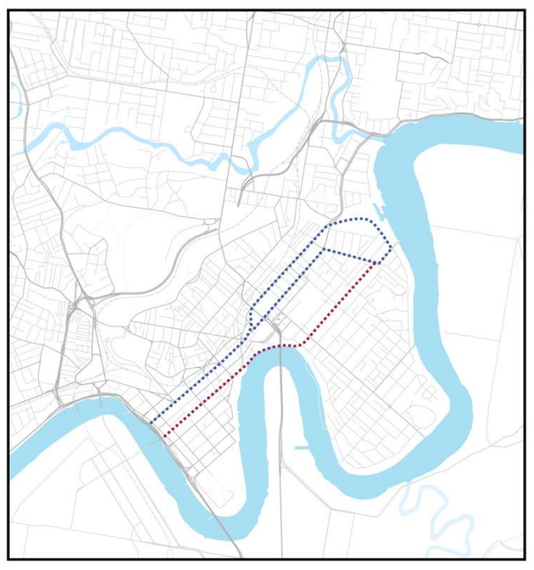


DEFINED CLUSTERS

Through the analysis above, clearly defined clusters can be formed.

Clusters edges adjoining to its neighbouring clusters are uniform, allowing for smoother transition planning between them.

Other movement issues such as movement pace, continuous routes for transportation and pedestrian, linking habitat patches are more easily planned with larger scale clusters with uniform borders.



SHORTEST DIRECT ROUTES FROM CBD

This diagram highlights the most direct routes to connect the CBD and Newstead cluster.

The blue vehicular route creates a loop around the cluster. This is inline with the proposed cluster in the diagram to the left.

The red pedestrian line connects to Queen Street, and follows quieter street edges along more commercial and residential streets (refer city composition diagram).

URBAN ANALYSIS DIAGRAMS

NEWSTEAD RIVERPARK URBAN CLUSTER MASTERPLAN

SCALE 1 : 2500

The main green corridor extends its reach from northern native bushland areas. passing through the planned Bowen Hills cluster and riverfront.

The cluster internally creates its own ecosystem and series of green spaces. This is accomplished through cross blocks, and open parks located along these designated green belts. Each belt connects to the main green corridor for migration and other ecosystem dependencies.

Developments maintain courtyard, cross block, and general green open spaces for continuity of greenways. All developments linked into this network potentially benefit from symbiotic relationships with other micro habitats.

The green corridor will continue to reach deeper into the CBD and southwards along the riverfront to connect remaining habitat patches.

NEWSTEAD RIVERPARK GREENWAYS DIAGRAM

SCALE 1 : 2500

Excess water passes is controlled through the dam and is treated using micro-filtration along this stretch.

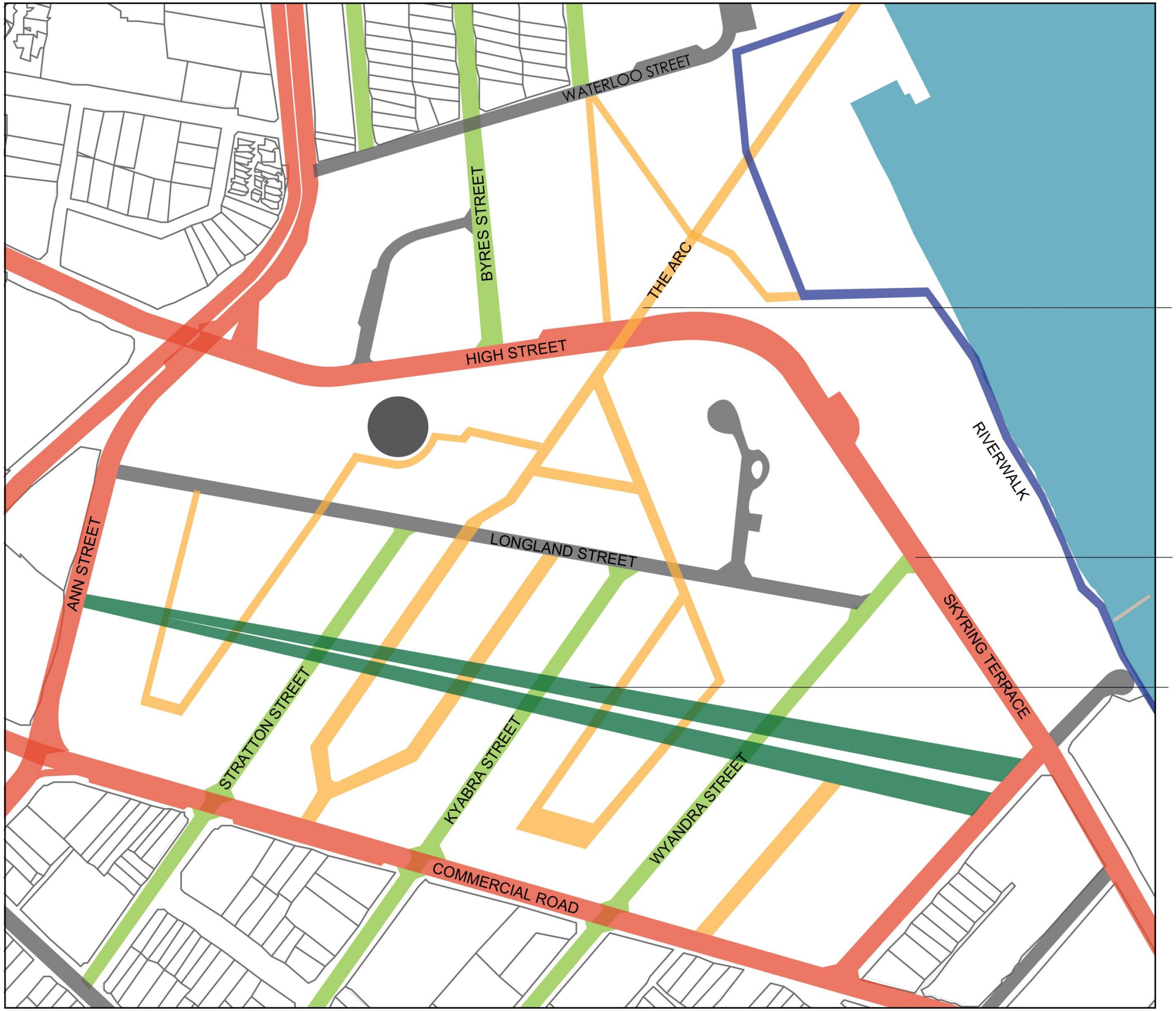
Local treatment plant has capacity to service cluster use only. Any excess water is either directed to Brisbane River or discharged offsite for other irrigation use.

Local reservoir pond stores water and is processed by the local treatment plant for distribution within the cluster.

Bio swales are integral to all developments within the cluster. The swales collect all runoff and is processed at the local treatment plant before being delivered to buildings for appllicable grey water reuse. These swales also have opportunity for future expansion in extending riparian habitats.

NEWSTEAD RIVERPARK URBAN CLUSTER WATERWAYS DIAGRAM

SCALE 1 : 2500



Main / Perimeter Streets
Green Corridor
Green Streets
Local Streets
Pedestrian Ways
Riverwalk

Pedestrian ways are bridged to the water front and converge at "The Arc". Pedestrian movement also links directly into CBD through green streets.

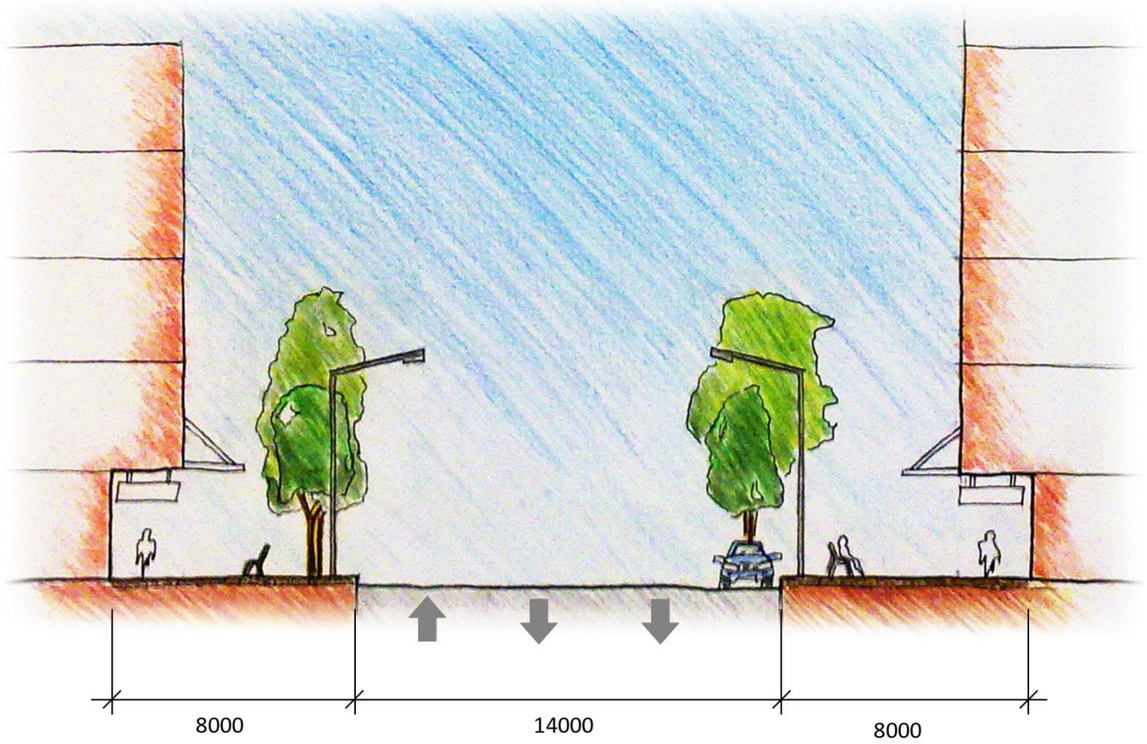
Green Streets are pedestrian friendly with commercial frontages and 5 meter wide walkways detailed with planting and 2-3 meter wide bio swales.

The main & perimeter streets act as gateways and directs traffic in and out of the cluster.

The green corridor functions as the heart of the cluster's ecosystem, and merely exists as part of a greater network. Native planting is introduced in this corridor with sufficient ground covering for self sustenance. Pedestrian interaction is highly encouraged with no vehicular interference.

NEWSTEAD RIVERPARK URBAN ROAD MAP

SCALE 1 : 2500

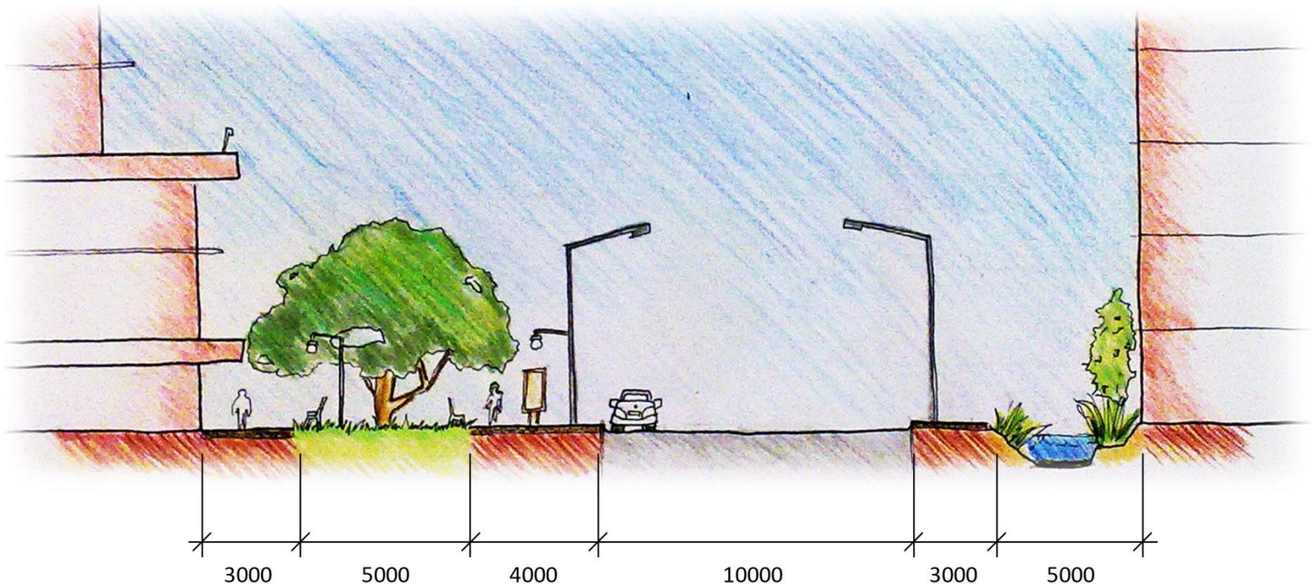


COMMERCIAL ROAD

Building heights step down towards the cluster (right to left).

Traffic is two ways, three lanes, with parking on one side.

Pedestrian traffic is heavy, with commercial frontages and directs movement into the cluster through green streets.



LONGLAND STREET

Buildings on south side (pictured right) create a hard edge overlooking the green street across the road.

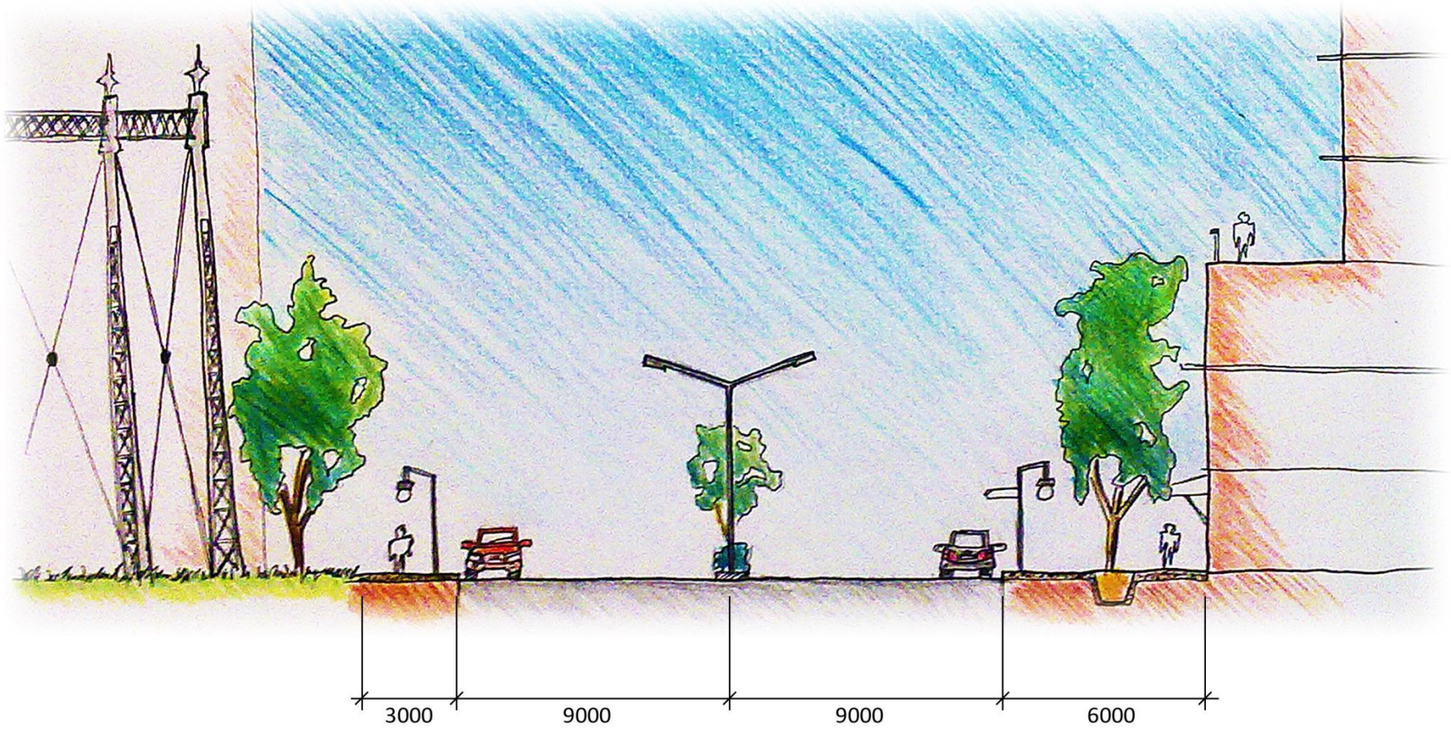
Traffic is moderate, two way, two lane traffic with parking.

Pedestrian movement is focused on the north side (left) Developments are placed far back to provide additional green space and movement space parellel to the green streets.

Bio swale section is wider as smaller swales link up from parellel streets. Required for increased water flow into the reservoir pond.

STREET PROFILES

SCALE 1 : 200

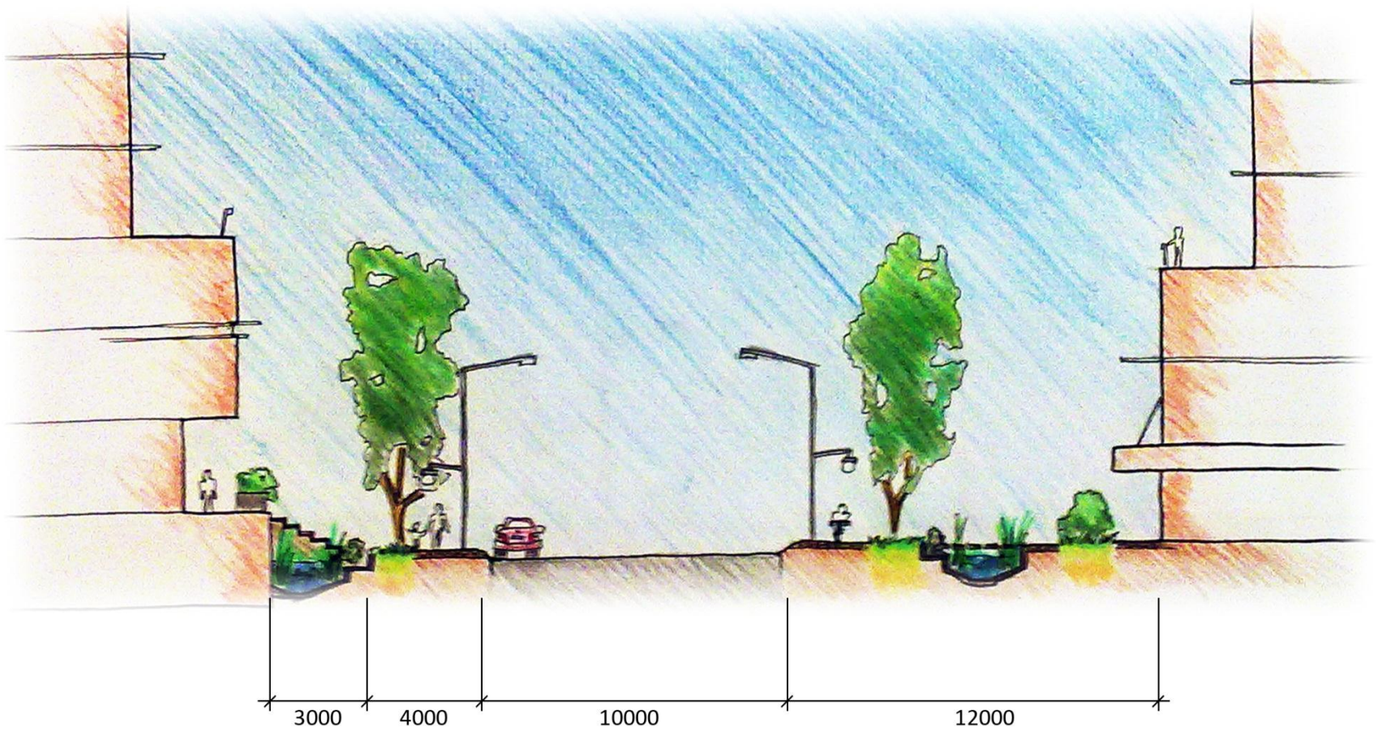


HIGH STREET + SKYRING TERRACE

Traffic is heavy, being the main entrance into the cluster.

Buildings have setbacks to provide more open airspace and creating a softer street edge.

Pedestrian traffic is directed away from these streets into inner cluster streets or adjacent park spaces.



GREEN STREETS

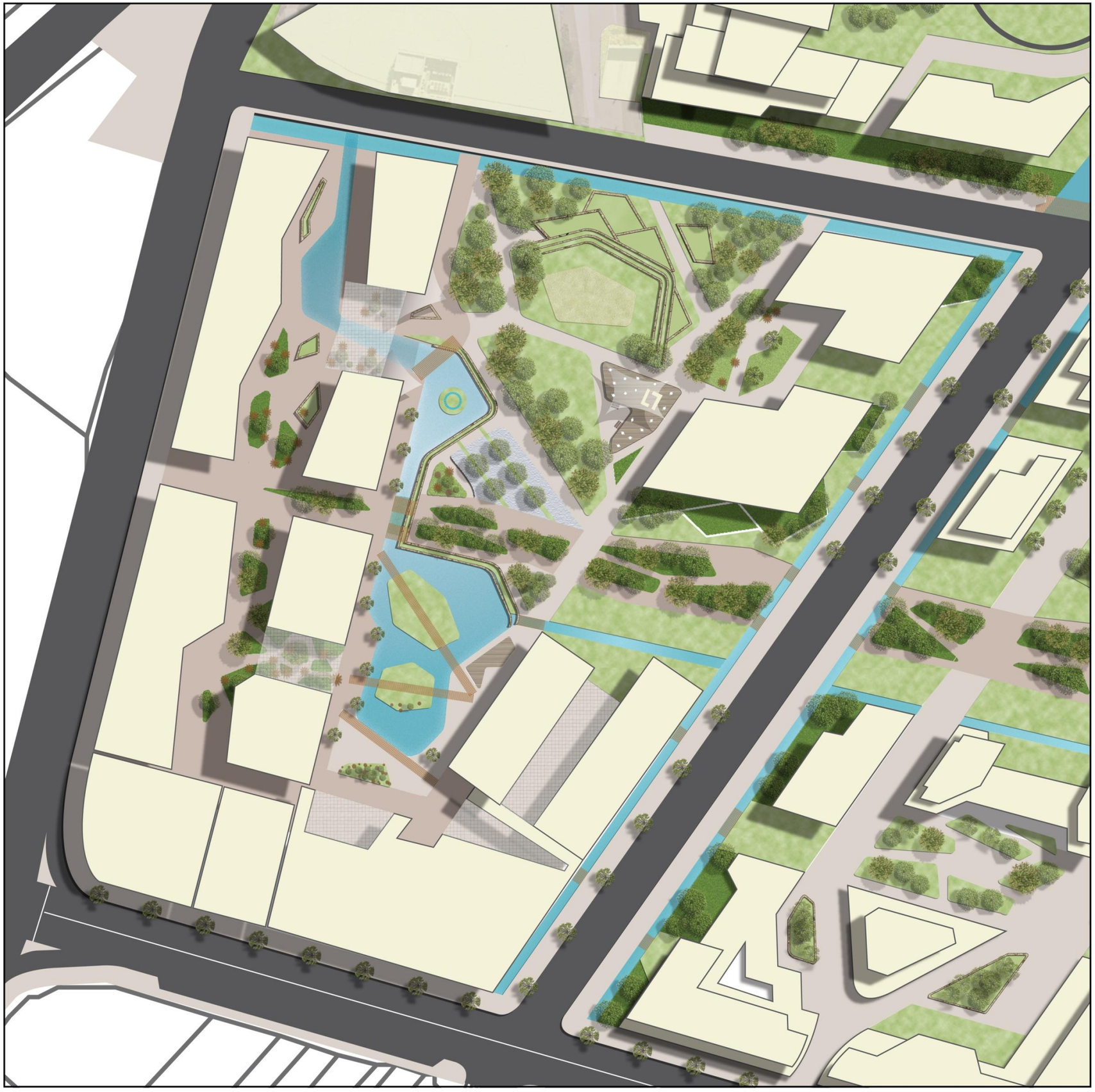
Light traffic, giving way to pedestrian movement parellel to the street via green corridor.

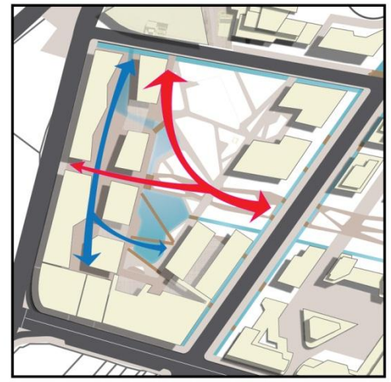
Bio swales on either side of the street collect runoff water and also provide riparian habitat space.

Buildings on one side are raised for more private developments (eg. offices). Developments on other side is commercial focused, and have wider footpaths segmented into two for slow and fast walking.

STREET PROFILES

SCALE 1 : 200





Campus corridor is orientated for more private use. Private park space is made more accessible with no thoroughfare through campus grounds.

Pedestrian pathways generated by movement between key nodes, determined by entrance and rest areas.

Public park area extends green corridor northwards to form linkages towards other native bushlands. Tree line route also follows way of pedestrian movement.

SITE PLAN

SCALE 1 : 1000

LEVEL 1

SCALE 1:200

LEVEL 2

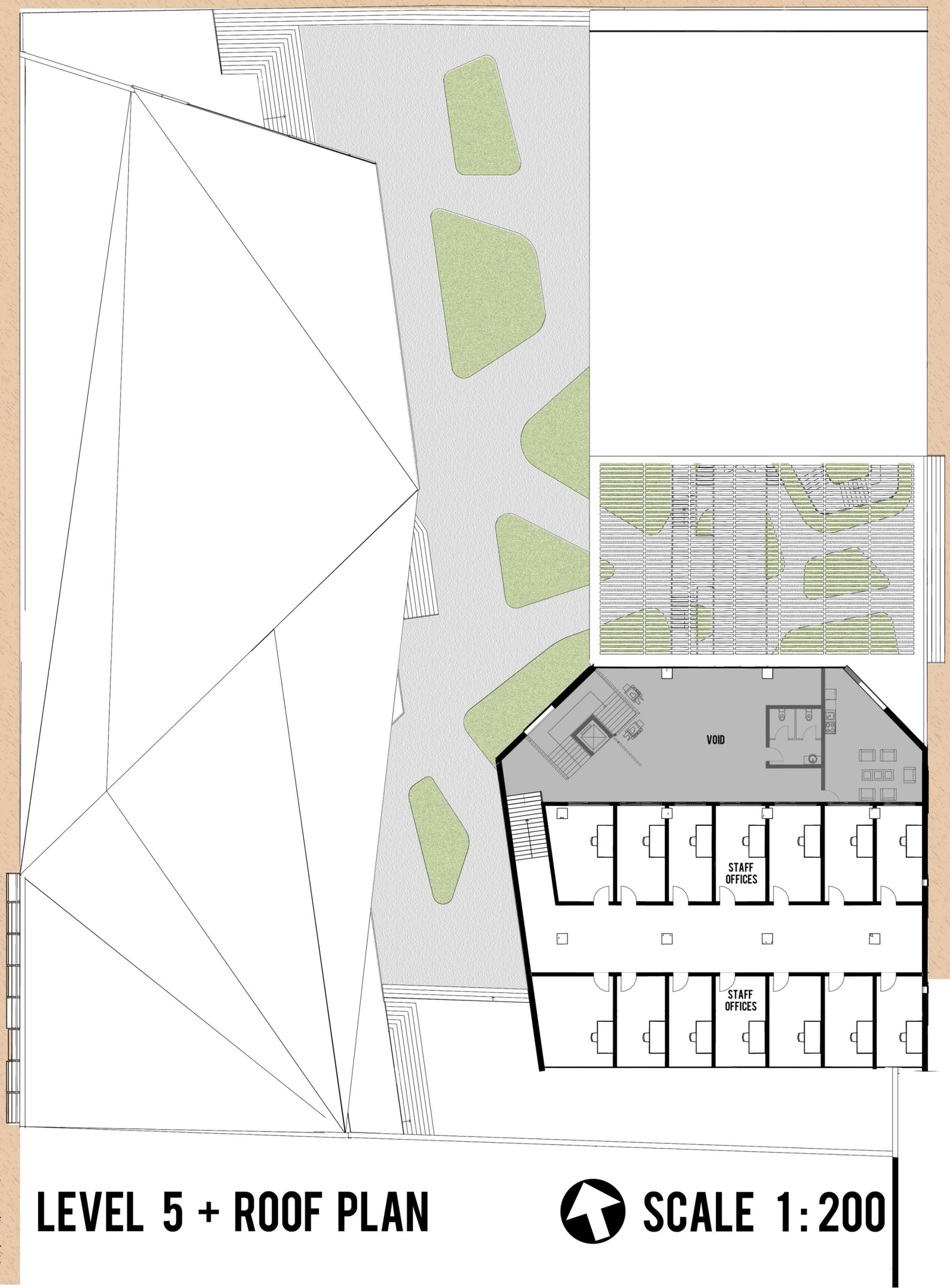
SCALE 1:200

LEVEL 3

SCALE 1:200

LEVEL 4

SCALE 1:200



LEVEL 5 + ROOF PLAN

SCALE 1:200

Winged roof form directs rain water into cross block into the bio-retention basin below. Excess water is channeled to local treatment plant.

SECTION PERSPECTIVE

- CIRCULATION SPACE
- OFFICE & STAFF ROOMS
- CLASSROOMS
- COMPUTER LAB
- LECTURE HALL

Movement is directed on either side of the campus blocks, or in the centre open spaced cross block “atrium”. Moving between any two campus sections requires traversing through either the cross block or campus corridor to encourage environmental awareness.

Library levels are concaved for study desks to overlook green movement corridor between campus blocks.

Polygonal roof form utlises similar water harvesting strategy as the other campus block.

Laboratories are arranged in a "single corridor" layout, research space are on the outer perimeter for natural daylight, while inventory and writeup rooms are centrally located (shown here).

SECTION PERSPECTIVE

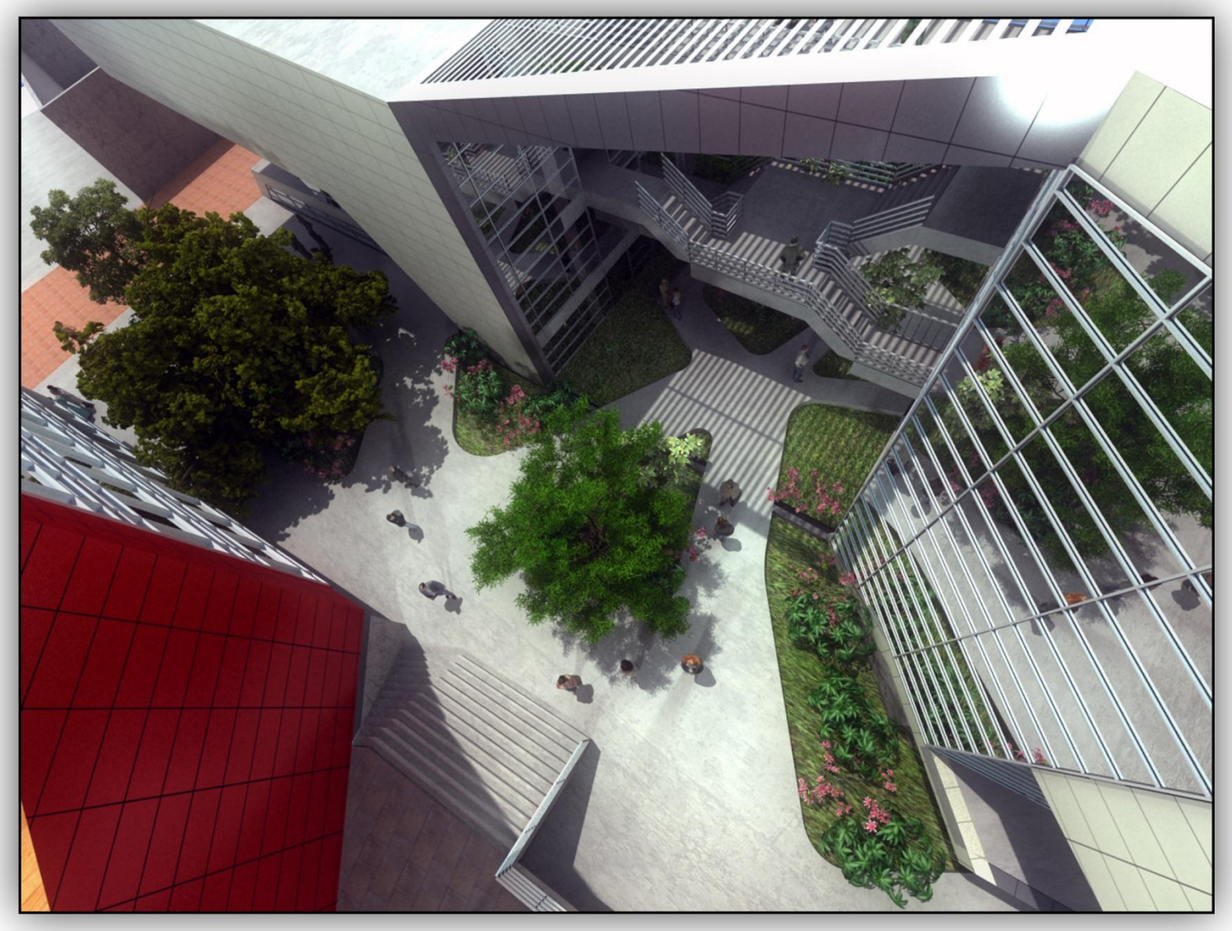
LIBRARY
CIRCULATION SPACE
LABORATORIES

VIEW FROM EAST ELEVATION (PARK SIDE)

VIEW FROM WEST ELEVATION, ANN ST. (ROAD SIDE)

RENDERS

CAMPUS CORRIDOR - VIEW FROM NORTH END



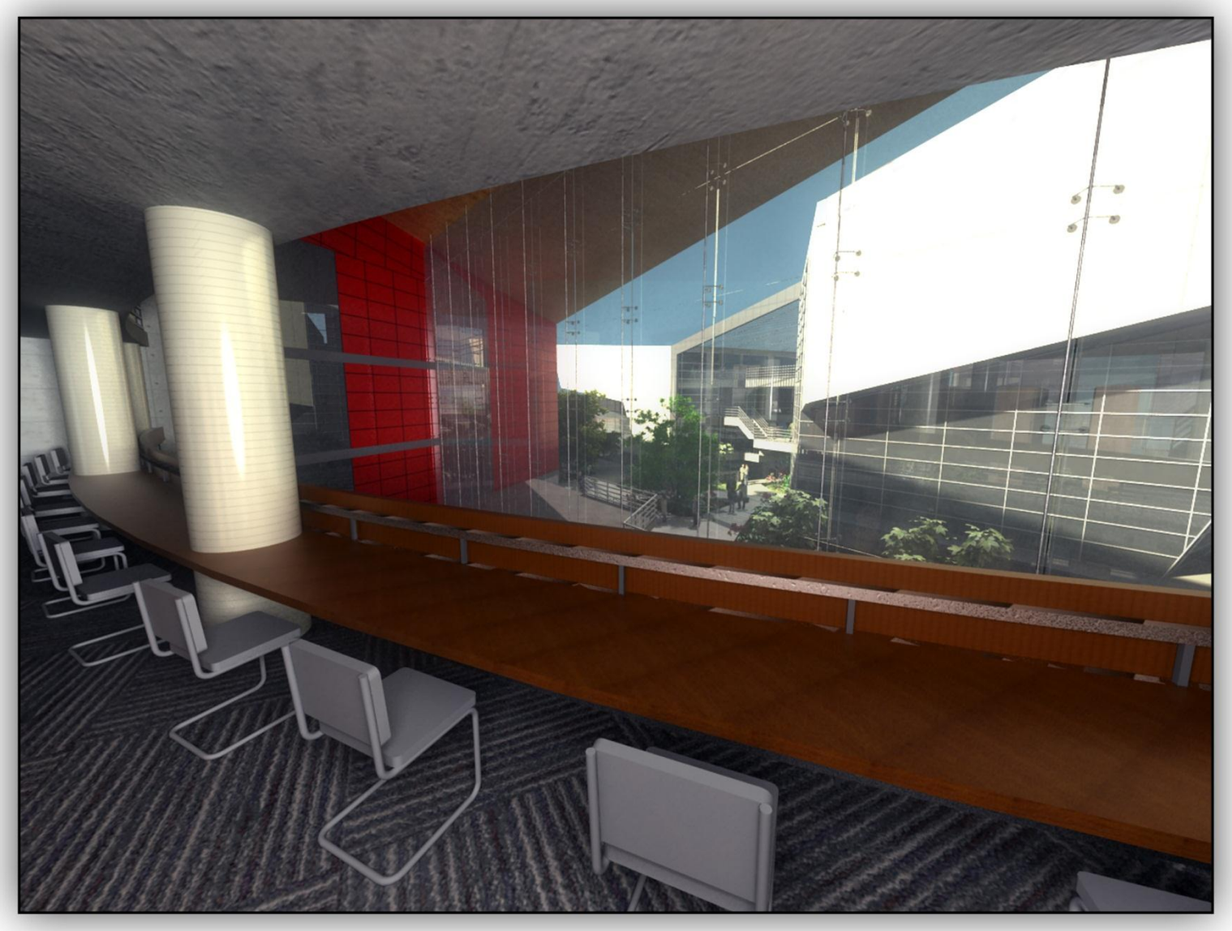
CAMPUS CORRIDOR - BIRD'S EYE VIEW

RENDERS

CROSS BLOCK - WEST SIDE VIEW

CROSS BLOCK - EAST SIDE VIEW

RENDERS



VIEW OF LIBRARY OVERLOOKING CAMPUS CORRIDOR

VIEW OF LIBRARY CONCAVE LEVELS

RENDERS


WATER SENSITIVE URBAN DESIGN
DECENTRALISED
SUSTAINABILITY
INFRASTRUCTURE
WATER MANAGEMENT
COMMUNITY
RAINWATER HARVESTING
CULTURE
ECOSYSTEM
URBANISATION
CLUSTER DEVELOPMENT
BIODIVERSITY
KNOWLEDGE BASED URBAN DEVELOPMENT
ECONOMY
NATIVE
BIOSWALE
CHARACTER
BUSHLAND
HABITAT
ECOLOGY
LIVEABILITY
CROSS
GREEN
RENEWAL
BLOCK
CORRIDOR
VIABILITY
LANDSCAPE
MOVEMENT
ARCHITECTURE
POLICY FRAMEWORK