

SUSTAINING SHENZHEN:

Residential Development for Livable Futures



PLANNING STUDIO > Spring 2008
Massachusetts Institute of Technology
Department of Urban Studies and Planning

Acknowledgments

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STUDIO TIMELINE

[01.12–21]	Stage Zero: Field trip to Hong Kong and Shenzhen
[02.05–12]	Stage One: Reaction from the Field Trip
[02.14–03.04]	Stage Two: Individual Topics
[03.06–03.18]	Stage Three: Site Planning
[03.20]	Midterm Review
[04.01–05.06]	Stage Four: Site Planning and Topics
[05.08–05.15]	Final Review/Exhibition

Introduction

Tunney Lee and Liang Zhao

Sustainable Residential Development in Shenzhen

Starting in the fall of 2005, MIT's Department of Urban Studies and Planning has offered a series of studios and research seminars on sustainable residential development with sponsorship from the Vanke Co. This report contains the work of the Spring 2008 Shenzhen Planning Studio. The studio's goal has been to address sustainable neighborhood and related environmental, social, and economic issues expected to emerge over the next twenty years. The students undertook extensive research on selected topics and tested them through hypothetical re-planning of an existing project, Vanke Town. This report records that process and outlines a series of ideas and guidelines for developing a sustainable community in Shenzhen – and other parts of China – in the future. The report has two parts: the first comprises the re-planning of Vanke Town and the Bantian District by four student teams; the second includes each student's individual research work on related topics.

Scenarios

"Scenarios are not predictions, forecasts or projections. Rather they are stories about the future with a logical plan and narrative....Scenarios usually include images of the future – snapshots of the major features of interest at various points in time...." —Gallopín

In the next twenty years, Shenzhen, the former Special Economic Zone which has played an important role in China's development, is expected to transform into a "normalized" city with a more stable population and less rapid economic growth. Urban housing is a physical reaction to the future social, economical, and environmental context. Although no one can predict the future, we still can ask: what will be a likely socioeconomic environment in the next twenty years when the next generation of housing and community is formed? The MIT project starts by describing reasonable scenarios of the future by looking at a series of meta-trends in urbanization, economic development, demography, and lifestyle. From these assumptions, we begin to lay a base for the studio to rethink urban planning and design. The assumptions include the following:

Economy

- > The Pearl River Delta's economy will continue to grow, but less aggressively, e.g. 10% instead of 25% up to now.
- > The economy will grow in a more balanced pattern between high-tech manufacturing, services, logistics, etc.
- > Household income will continue to grow steadily.
- > Income and municipal benefits will be dis-

tributed more equally – housing, schools, health care, etc.

- > Integration with Hong Kong will increase.

Population

- > Transition from an immigration city to a more stable and "normal" population profile.
- > Fewer single workers, more families and children.
- > Less disparity in educational/socio-economic level.
- > More active elderly population.

Energy and Resource Use

- > More national and local regulations on energy efficiency, water conservation, materials, recycling and waste disposal. Restrictions will be placed on polluting sources.
- > Higher energy costs will make alternative sources more economical.

Lifestyle

- > Increased demand for mobility for commuting, recreation, entertainment, etc.
- > Higher automobile ownership.
- > Extended families will still be important but the elderly will become more inde-

pendent from their children.

Transportation Planning

- > Increased auto ownership and use along with increased truck and cargo volumes will create bigger problems of congestion and air quality.
- > Public transit system continues development.
- > The government will control automobile use through congestion pricing, auto-sharing, etc.
- > Incentives for transit use through more convenient and comfortable transit options and easier access to stations.

Land Planning

- > Integration of land use and transportation planning.
- > District planning to accommodate mixed income groups with access to transit, open space networks.
- > Land disposition procedures will be more regulated and based on district plans.
- > Need for redevelopment of areas/structures reaching obsolescence.

Technology

- > Cell phone usage for multi-purposes.
- > More widespread internet access.

Research framework

These scenarios, if they materialize, will affect people's lifestyles and provide challenges and opportunities to housing and community development in the future. The next generation of neighborhood should be smarter and more considerate of people and the environment – more sustainable. Here sustainability is characterized by the “three E’s”: environment, economy, and equity. Sustainable residential development covers a wide range of topics related to the three E’s, some of which are listed in the table to the right. We start to organize the topics under four categories: resource efficiency, demographic inclusiveness, community facilities, and mobility. Each category has different implications at different scales and each of the topics may be addressed by different parties including national and local government, developers, and local organizations. It should be noted that the framework is by no means complete and only a starting point as a guide for future research and studios. It is

also clear that one studio can not cover every topic. Research on sustainable residential development should be a continuous, multi-year effort.

Research Framework

		[District]	[Site]	[Building/Courtyard]
Resource Efficiency	<i>Energy</i>	Conservation Local Generation Education Pricing Peak-time usage	Site usage Generation and distribution Education District cooling/heating Metering	Building usage Building ventilation Insulation Life-cycle energy consumption
	<i>Water Nature Land</i>	Conservation Natural systems Open space network Density Farmland preservation	Ecosystem Landscape Water usage Grey water Stormwater management	Water usage Grey water Black water Adaptive reuse of buildings
	<i>Waste</i>	Citywide collection/sorting Industry Education Recycling/reuse Sewage	Collection/sorting Recycling Education	Construction waste Household waste
Demographic Inclusiveness		Affordable and village housing Mixing incomes Elderly housing	Openness vs. security (gated community) Family within same project boundary	Unit size Unit layout Shared units
Community		Retail facilities Public facilities Mixed uses Open space network Natural systems Digital connection	Resident mix Open space Management Community center Access to facilities	Mailbox Security
Mobility		Transit/TOD Auto usage Walkability and bikeability Live-work balance Telecommunication	Circulation and parking Local transit/TOD Walkability and bikeability	Elevator

Individual tools

The framework above establishes a structure for the planning studio. Each year, students focus on group and individual research topics from the list. In this studio, twelve students from different academic and professional backgrounds selected their topics. Each looked at existing research and cases from other places in the world and developed a series of “tools” for Shenzhen and China. The research can be found in the second part of the report. There is always the risk of mis-applying planning ideas from another place. In order to avoid superficial or improper adaptation, the students carefully examined their “tools” by asking the following questions:

- > What is the tool?
- > What is the goal of using this tool?
- > On what scale does the tool apply (e.g. district, site, building)?
- > Who will use the tool (e.g. developer, government, residents)?
- > How do you measure the cost effectiveness?
- > What is required to make the tool work?
- > What are the best practices?
- > What research already exists and what further research is needed?

Topical site planning exercises

Located in the Bantian district, 5 km north of Shenzhen’s government center, Vanke Town is a 50 hectare housing project developed by Vanke within the last five years. The district was traditionally out of the Special Economic Zone and composed of a mosaic of local and international manufacture factories, urban villages¹, and residential and office development. The studio takes the site and the district as a reference to discuss what could be improved within the sustainable development framework. The class does not attempt to make a comprehensive site plan for Vanke Town. Instead, it takes the idea of “research through design,” testing ideas through the hypothetical re-planning of different aspects of the project and its context. Four teams organized to address the following issues:

- > **Natural Systems**
Restore natural systems, including preservation of the watershed and construction of a continuous park system.
- > **Community Facilities**
Provide appropriate retail, health care, educational, and recreational facilities in the neighborhood.
- > **Mobility**
Improve mobility through site planning

and facilitation of multiple transportation options.

- > **Affordability & Density**

Create an inclusive community by integrating urban villages and providing housing units for a diverse income mix.

A range of diagrams and maps have been created to analyze the site and propose ideas. Cases, including those from Hong Kong and Singapore, are cited for comparison. Like the individual topics, each group articulated its goals, assumptions, and major concepts, and also specified its planning “role.” For example, some groups assumed the role of the district planning agency. Others took the perspective of planning consultants to a private developer. Although there is still an opportunity to redevelop the district in the future, the main purpose of this study is to provide suggestions for other Chinese cities and regions which are not yet urbanized, with the hope that mistakes made in Shenzhen may be avoided in the future.

¹ Villages surrounded by urbanized areas. The land is usually collectively owned by the village council instead of local government. In the Bantian District, most of the villages already have been filled by dense informal development which provides low-rent apartments for migrant workers.

GEOGRAPHIC CONTEXT > Regional Scale



- Special Administrative Region (SAR) boundary
- Special Economic Zone (SEZ) boundary
- City-level administrative boundary
- Expressway
- Railroad
- Vanke Town
- Urban center

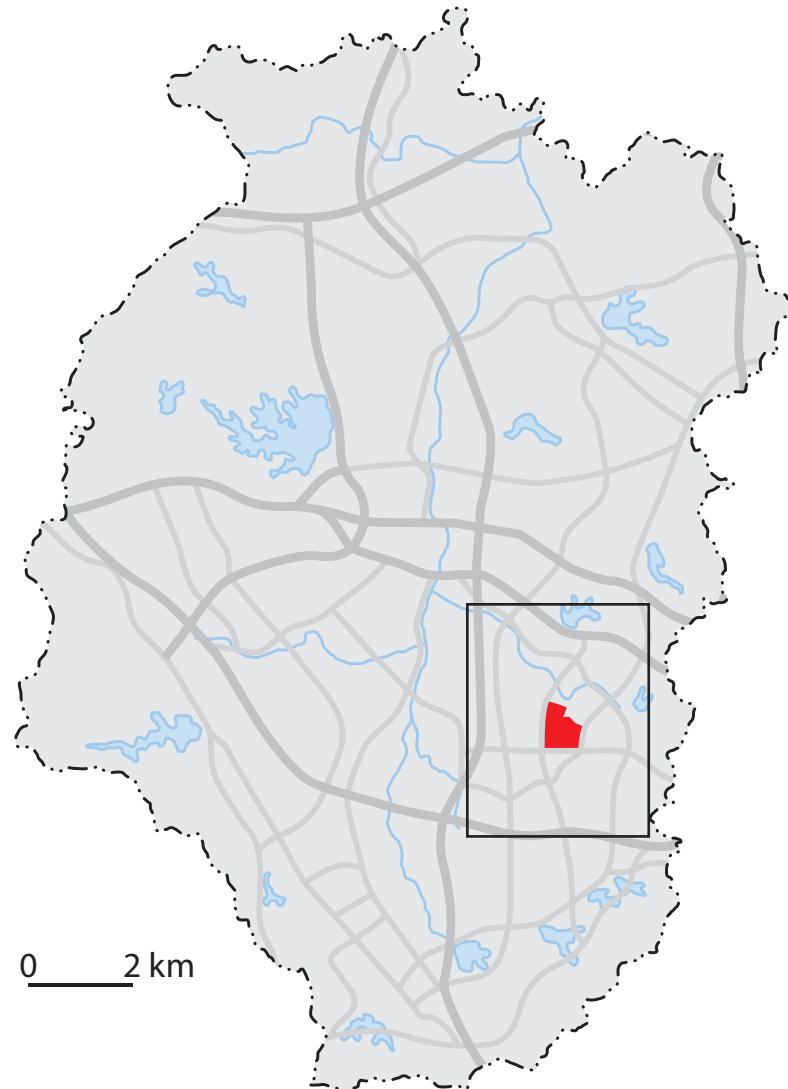
The Vanke Town site is located within the city of Shenzhen in the greater Pearl River Delta region. The site is located north of the city center, near a major north-south expressway and adjacent to a regional rail line. Shenzhen is closely connected geographically to the Hong Kong Special Administrative Region (SAR), and regional infrastructure permits increasingly easy access between the two metropolitan areas.

GEOGRAPHIC CONTEXT > District Scale

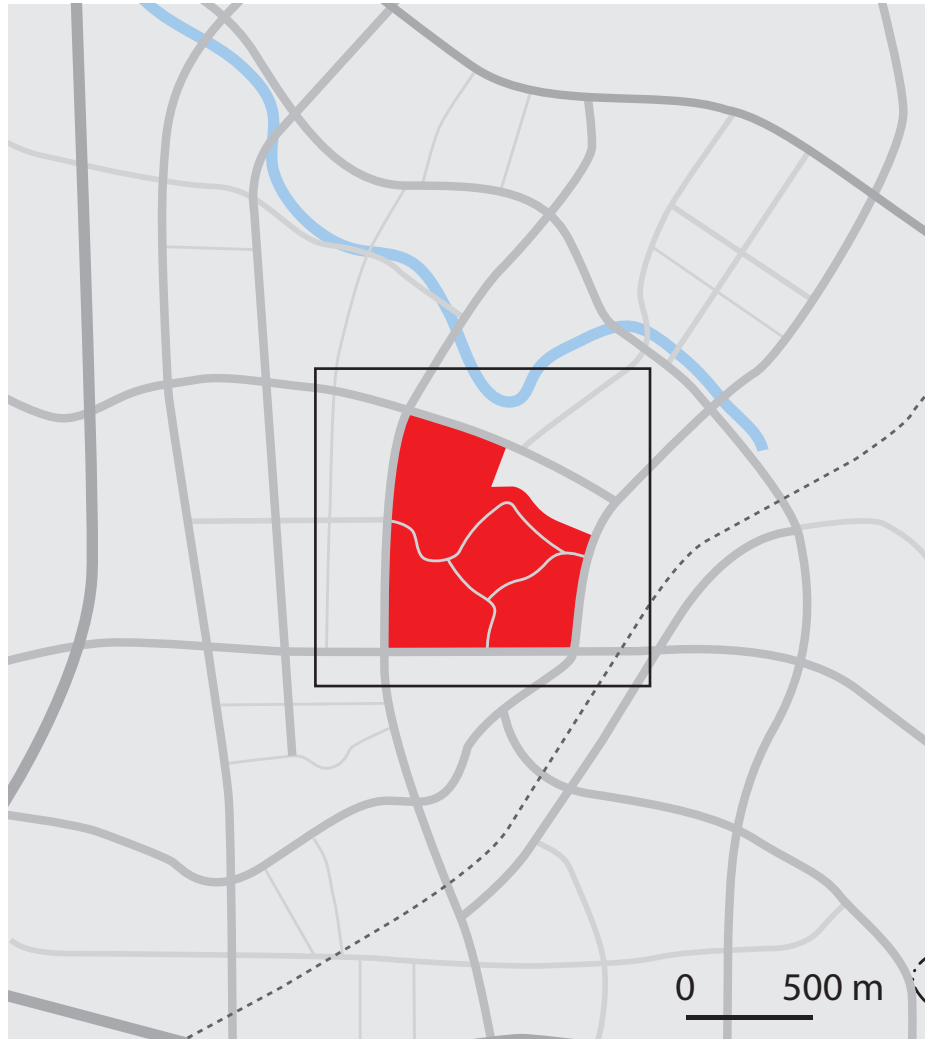
Vanke Town is located within the Bantian district (which is part of the larger Longhua district), north of the Shenzhen Special Economic Zone boundary. The natural systems of the district are generally characterized by mountains at the district boundaries and a major river flowing south with tributaries branching out in easterly and westerly directions. Additionally there are several man-made reservoirs on the outer edges of the district.

The main access to the district from the south is via a highway at the former SEZ border crossing. This road continues north to Dongguan. Other east-west connector highways transport people and goods to other districts, including the Shenzhen port area. There also is a major railroad that connects the district to the port; it passes within several hundred meters of the Vanke Town site.

- District boundary
- Highway
- Major road
- Railroad
- Vanke Town



GEOGRAPHIC CONTEXT > Site Scale



- District boundary
- Highway
- Major road
- Local road
- Railroad
- River
- Vanke Town



Vanke Town is located adjacent to several major artery roadways and a regional rail line. The site is also immediately south of a district waterway.

The internal road network within Vanke Town has three principal connections to the existing road network. A hierarchy of smaller roads aids mobility within the site.

PART 1 > Topics

Natural Systems

Jeff Beam, Haley Peckett, Mimi Zhang



Source: Andrew Trueblood

INTRODUCTION > Scenario Assumptions

Introduction

The natural topography and hydrology of the Longhua district has shaped the current land use patterns. Two decades of increasing development pressures has resulted in a degradation of natural systems amid the expanding built environment. Highly sensitive areas such as steep slopes and watersheds are the sites of intensive development, which can have dangerous repercussions for the health and safety of residents as well as the environmental sustainability.

Altering regional development patterns to consider the health of natural systems will revitalize the ecosystem. In addition to environmental and health benefits, planning for natural systems leads to social and economic benefits such as recreational amenities and increased property values. The goal of this analysis is to envision the Longhua district with a greater sensitivity to natural systems in order to realize an array of benefits to developers, residents, and the environment.

Built Environment Assumptions

- > **High density development.** The Longhua district is currently in the process of rapid urbanization. We assume this growth will

continue in coming decades as Shenzhen spreads outward. While high-density development would seem to be incompatible with ecologically-sensitive development, we target strategies that blend low-impact development techniques with high density growth.

- > **Little or no greenfield sites.** Most of the region has been built out, which means developers will build on infill sites. The focus, therefore, will be on restoring the natural hydrological functions of developed land, in combination with preservation.
- > **Higher land values and redevelopment.** The increasing density and development pressures in the region will raise land values. Consequently, there will be more redevelopment of under utilized sites to recover higher land costs.

Regulatory Assumptions

- > **Restoration of riparian corridor.** While the natural hydrological system cannot be restored to predevelopment conditions, the regional government will prioritize the restoration of critical riparian corridors to create a connected network.
- > **Restrictions on development of wetlands**

and on steep slopes. Greater concern for protecting natural systems and for managing regional land use patterns will result in development restrictions.

- > **Stormwater Management.** To control the expense of stormwater infrastructure and restore the health of the watershed, development will be required to comply with strict, on-site controls on stormwater quantity and quality.
- > **Emphasis on Infiltration.** Regulations will emphasize infiltration techniques, which result in cleaner wastewater treatment and outflow than traditional, pipe-based drainage methods. The wastewater output treatment will be an important component of a restored watershed.
- > **Parks and Open Space.** A regional emphasis on a parks and open space network will emerge as development pressures increase. This includes government-level design and enforcement of greenways and open space regulations.

Goals

- > **Preserve natural systems by reevaluating regional land use patterns.** Development sites in the region can be classified accord-

INTRODUCTION > Goals

ing to their sensitivity to natural features, such as steep slopes, hydrology, vegetation, habitat, and soils. Sites appropriate for intensive development should be selected based on their natural features as well as proximity to transportation routes and urbanized corridors. Sites with high sensitivity should be prioritized for regional preservation or low-intensity development.

- > ***Envision site-scale regulation guidelines that protect natural system features while allowing development intensities appropriate to Shenzhen's rapid expansion.*** Develop a scale of stormwater management techniques that can serve a range from intensive, high density developments to sensitive sites adjacent to waterways. The goal is to allow each site to minimize its impact on natural systems relative to the intensity of its use.
- > ***Create a district network of open space providing ecological and pedestrian connections.*** Contiguous open space is vital to restore environmental health and maintain plant and animal habitats. The presence of open space networks should also increase recreational opportunities and pedestrian mobility.



Functional, Attractive Stormwater Management > Site amenities, such as this canal from Vanke Town in Shenzhen, will increasingly serve a dual function in the treatment and infiltration of on-site storm and wastewater. Source: Connie Chung.

HISTORIC CONDITIONS > The Urbanizing Context

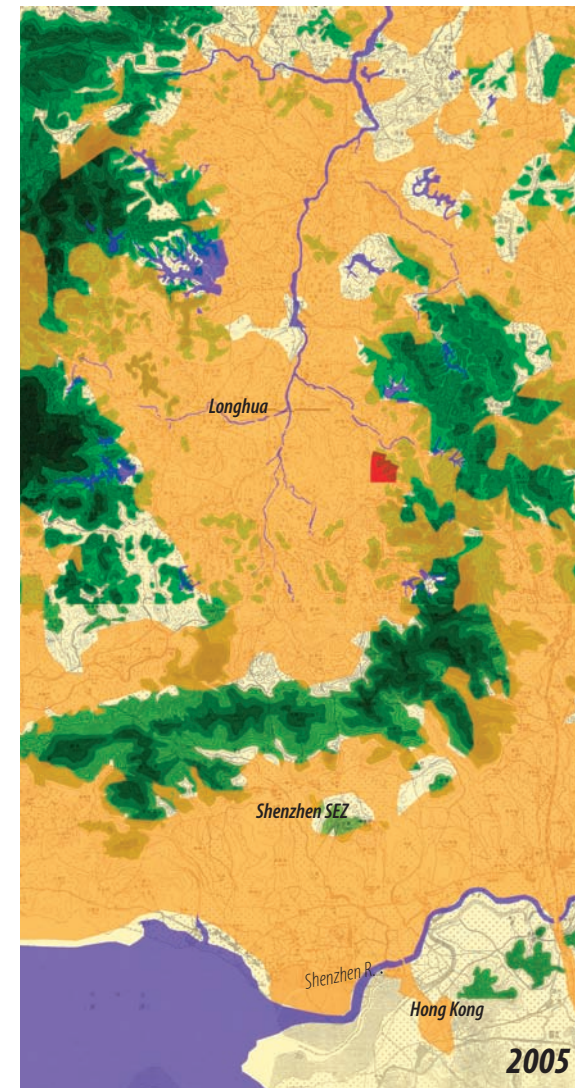
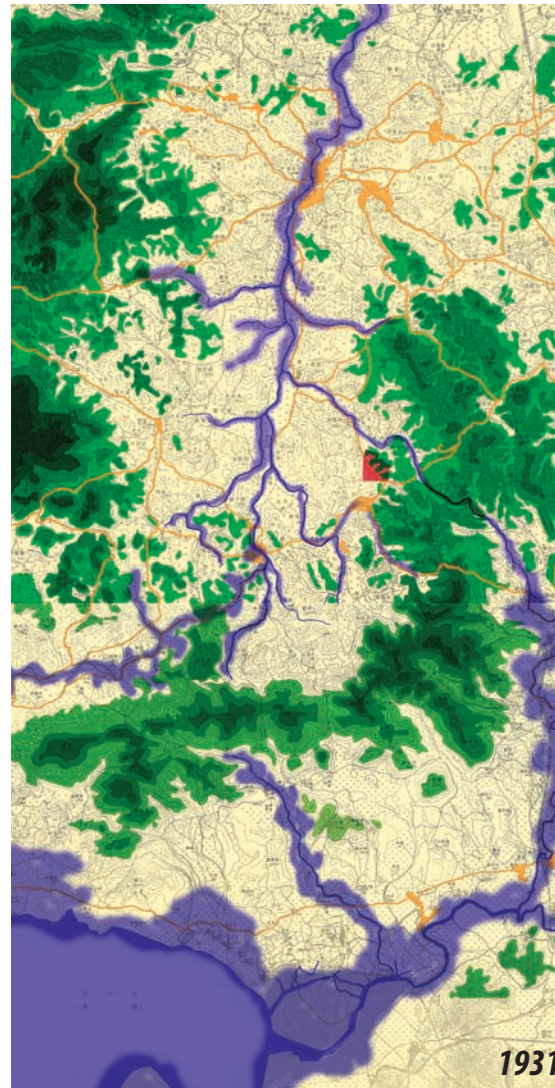
Historical Context

To understand the environmental consequences of the Longhua district's rapid urbanization, the region's predevelopment conditions must first be understood. For millennia, the hydrology of the site functioned normally through cycles of rain, flooding, and natural drainage. It is only in the past forty years that human development has impacted those cycles through rapid urbanization.

Today, though, the rapid economic development of the Pearl Delta marches on, and there is no reverting to the natural, undeveloped state of the past. Future development regulations will focus on restoring the *function* of the natural systems, forcing projects to manage stormwater, prevent erosion, and provide habitat as the project site did historically.

The maps on these pages illustrate the rapid changes to the area. The 1931 map shows the area stretching from Longhua down to the Shenzhen River and the northern edge of Hong Kong, as the land existed in 1931. Small villages and trails had little impact on the natural environment.

Rapid Urbanization > In the process of rapid growth, the development footprint has expanded to cover most of Shenzhen's buildable land, degrading the natural hydrological system.



HISTORIC CONDITIONS > The Urbanizing Context

The region was divided into two main watersheds by a crescent-shaped ridge that runs along the northern border of the current SEZ. To the north, water drains into a tributary of the Dong Jiang (Eastern Branch) before making its way back southward to the Pearl River. Land south of the ridge drains southward into the Shenzhen River. Before development, the watershed handled fluctuations in stormwater through the periodic flooding of adjacent flatlands. This tributary system and the periodic flooding regularly replenished underground aquifers - essential to the region's ecology and agriculture (and later, to its drinking supply).

Present Conditions

The 2005 map shows the current condition, where the footprint of urban development has spread over the entire Longhua valley, covering streams and mud flats with impervious surfaces. At the valley edges, development carves away the natural ridges, disturbing drainage patterns and causing erosion and sedimentation problems. For the most part, stormwater is drained and piped to reservoirs. Parts of the crescent-shaped ridge that runs along the northern border of the current SEZ have been flattened, reducing the ridge's ability to divert water.



The result is a mostly impervious land area, incapable of absorbing stormwater and recharging underground aquifers. To control flooding, streambeds are replaced by canals with steep concrete embankments, which cannot support the same habitat and ecological functions as natural streambeds. Trash and sediment clog the waterways and damage the regional watershed. Seasonal rainfall, deprived of natural flood plain, will overwhelm existing stormwater infrastructure while groundwater (and the region's drinking supply) rapidly disappears.



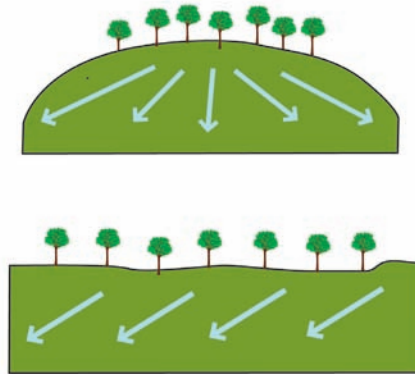
Existing River Conditions > The current state of the waterway running through the Longhua District is polluted and unattractive. The river is lined with concrete and appears littered with trash and other debris. Source: Andrew Trueblood.

HISTORIC CONDITIONS > Geographic Features

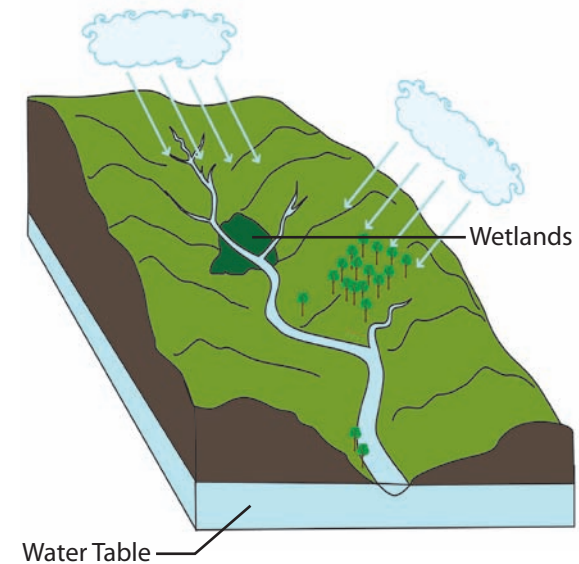
Historic Watershed System

The Longhua district used to have varied topography with steep slopes that have more or less been flattened for development. While grading slopes is necessary for some development, it is important to remember the importance of natural topography. Slopes can be composed of pervious sediment that serve as aquifers during times of rain and help replenish the water table. Flattening a slope can damage a hydrological system.

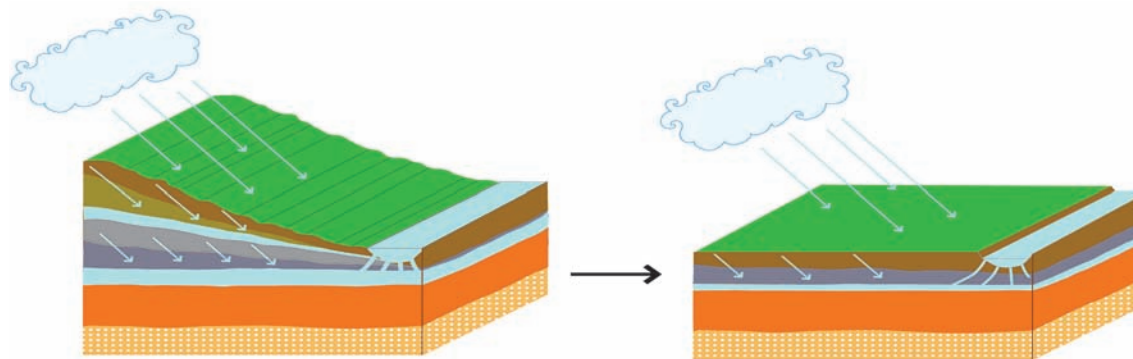
In the Longhua district, natural rivers have been turned into small streams, constricted by dams and reservoirs. Reintroducing the natural river along with some natural slopes to feed the river is a key component of a district-scale green network.



Slope shape > Slope shape affects the direction in which water flows below ground. Changing a convex slope, as shown in this picture, diverts all precipitation in one direction instead of dispersing it.



Watershed and Slope > It is important to view a watershed as just that--one watershed, rather than small, isolated parcels of land that do not interact with a larger system. Natural watersheds are regions where all precipitation flow into a river or stream. Changing slopes in areas of the watershed should be done with concern as to how the change would affect the overall hydrology of the entire watershed. A watershed supports numerous types of vegetation, habitats, and effectively absorbs and supplies water.



EXISTING SITE CONDITIONS > Open Space



Contiguous Open Spaces > The areas that have been preserved as significant open and/or natural spaces in the existing site. The total built square meters on site is 530,100, giving the site an FAR of 1.1-1.3.

Open Space in Vanke Town

Thirty percent of the site area in Vanke Town is devoted to open space. The large ratio of green space in the development contributes to a park-like living environment and is highly praised by Vanke Town residents. Much of the green space is composed of landscaping features, individual courtyards of townhouses, and other small-scale greenery, mostly separated in residual pockets. These features contribute to the stormwater filtration and management on site, which is important to the hydrologic system.

Vanke has produced a skillful integration of water and natural features as an aesthetic benefit. While these do have important stormwater benefits, they are primarily amenity features that contribute to a sense of serenity and nature. They do not serve functional hydrological purposes on a larger scale.

Large, contiguous sections of open space serve a valuable purpose: preservation of vegetative habitat and natural systems. Large parcels of green space also have a greater ability to absorb and manage runoff. An approximate analysis of existing large parcels of green space reveals 77,975 square meters of green space, representing approximately 15% of Vanke Town.

EXISTING SITE CONDITIONS > Open Space



In addition to the open spaces provided on site, Vanke incorporates Low Impact Development (LID) techniques into infrastructure design. LID techniques manage stormwater with low-tech quantity and quality controls to mitigate the effect of runoff caused by the addition of impervious surfaces. LID techniques on the site include:

- > Pervious pavement in parking areas.
- > Landscaped roadways and commercial areas
- > Grass swales on one side of creek
- > Soft-bottomed drainage ditch to capture seasonal runoff



Open Space in Vanke Town > Counterclockwise from top left: A lake provides views and a gathering spot. Source: Jeff Beam. Roadside landscaping adds greenery. Source: Jeff Beam. A playground offers a small patch of grass. Source: Yew Chin Leow. Pervious pavement aids drainage in parking areas. Source: Haley Peckett.



PROJECTED CONDITIONS > Regional Priorities

Land Use Vision

As Shenzhen matures, the city's goals for land use policies will evolve beyond economic development to incorporate social, public health, and environmental issues. In response to this changing context, development within the Longhua District will likely become more strategic and coordinated with larger district and citywide goals.

Priorities for Development

The first land use priority will be to identify the undeveloped areas that must be preserved as open space to protect the health of the watershed. These areas are indicated in the map to the right in green. The green areas should have the greatest restrictions on future development.

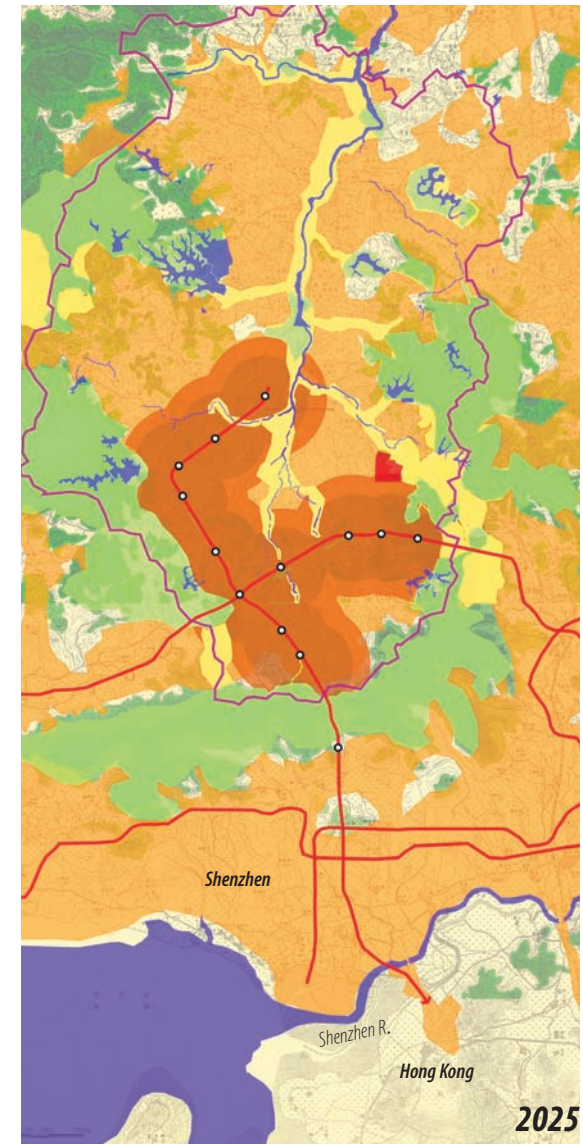
Next, planners should identify areas that may already be developed, but because of their critical location or natural function, will be restored to predevelopment hydrology. Severe restrictions on redevelopment will be put in place, with some parcels even partially restored to an open space use. Indicated in yellow, these places are strategic "links" in the chain of interconnected park and waterways that will allow the system to function as a whole. They will allow for the daylighting of streambeds

and the protection of steep slopes, plant and animal habitats, and wetlands.

In these areas, new construction will be constrained by these new protections. In response, development will prioritize areas that are integrated with the transportation system, especially the fully built-out subway system. Transit Oriented Development (TOD), indicated in red, will focus high densities of residential, office, and other uses into areas one kilometer or less from a transit stop, while still respecting the protected natural zones. The orange areas will be permitted to develop according to market demand.

In the future, the official distinctions between Hong Kong, the Shenzhen Special Economic Zone, and the Longhua District will continue to dissolve. These TOD locations will take on even greater importance, as the district is the northern anchor of the extended #4 Line reaching through downtown to the Huang-gang connection with the Hong Kong MTR.

Focused Growth > A projected map in 2025, where natural systems have been restored and growth is focused in high density areas near transit.



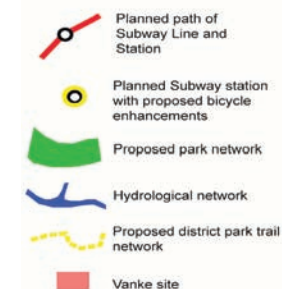
PROJECTED CONDITIONS > Jade Necklace



A “Jade Necklace”

Combining the green (preserved) and yellow (restored) areas from the previous map would yield an interconnected network of open space throughout the Longhua District. This coordinated system would unify the district around a common, natural amenity: a “Jade Necklace” of parks, streams and trails.

More than a series of disconnected, leftover green spaces, a planned network would rehabilitate the ecological health of the watershed by restoring drainage patterns, natural recharge of underground aquifers, and functional hydrology. Overlaid on this natural system would be an integrated network of paths and trails that work as a parallel, non-vehicular circulation system for the district. These networks would be carefully coordinated with appropriate land uses and intensities and with transit locations.



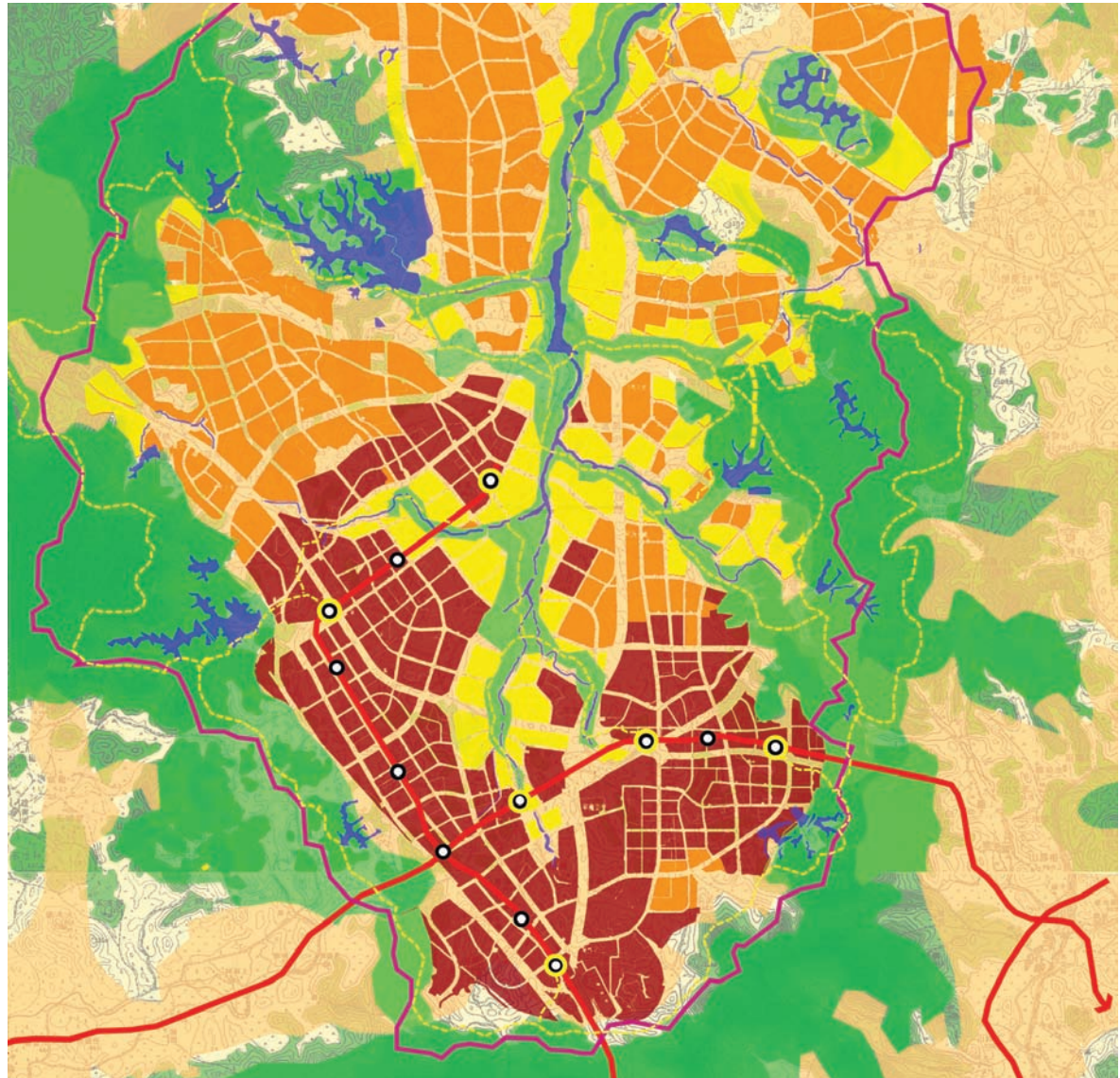
Longhua's Jade Necklace >
An interconnected system of restored riparian corridors, integrated with trail networks, transit, and focused land use regulations

PROJECTED CONDITIONS > District Land Use

The map to the right shows this integrated system and how it could be fully integrated with (and reinforced by) land use planning. Development parcels throughout the district would have specific land use regulation guidelines, depending on location within the district and relationship to the park and waterway system. In Longhua, this system could work retroactively, adjusting existing private parcels through incremental redevelopment. In other areas yet to be developed, it could guide the initial planning framework.

This system is roughly modeled on Boston's famous "Emerald Necklace", a 19th century landscape intervention that tied together existing and new open spaces and greenways to achieve multiple ends: creating urban parks, managing drainage issues, and creating pedestrian and carriage paths off the busy city streets (See Case Study, next page).

Both the historic Emerald and proposed Jade Necklace park systems rely on coordination with regional transit systems and trail networks to allow many users to enter. Both also provide access to significant open space at the urban periphery through river trails. Lastly, both are "engineered nature" - places where interventions into existing development restores natural functions and reestablishes a connection between people and nature.



CASE STUDY > Boston's Emerald Necklace

The Emerald Necklace in Boston, Massachusetts, is a 1,100 acre (445 ha) chain of parks connecting the Boston Common downtown with the large suburban Franklin Park. The total "Necklace" is a string of green spaces composing an urban park network over seven miles (11.25 km) long.

Designed by Frederick Law Olmsted in the late 19th century, it consists of parkways, waterways, and other landscape elements that tied existing and new parks together into a coherent system, uniting disconnected neighborhoods and creating a network of non-vehicular paths through the city.

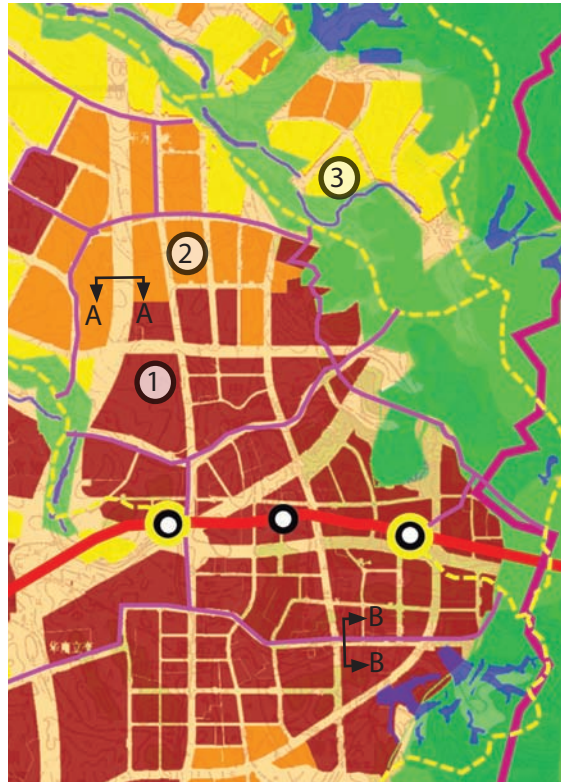
Far from mere preserved open space, the Emerald Necklace represents careful engineering and urban planning. The naturalistic topography was actually dramatically reshaped by Olmsted to solve major drainage and sewer problems created by increasing urbanization and by tidal flows in the Back Bay. Landscape elements and trees were selected to support filtration and hydrology goals.

Other cities throughout the U.S.A. followed this model, building park *systems*, as opposed to separate, independent open spaces. (City of Boston Dept. of Parks and Recreation 2008).



Beautiful and Functional > A tidal management system devised as an amenity in the heart of the city. Source: Emerald Necklace Conservancy, including the 1978 Frederick Law Olmsted plan.

PROJECTED CONDITIONS > District Scale



Development Zones > Future Development will be shaped by its potential impact on natural systems and greenway corridors.

- ① INTENSIVE
- ② MODERATE
- ③ SENSITIVE

— Greenway Corridor
- - - Regional Trail Network

Development Guidelines

Intensive (Red)

Parcels located within a kilometer of a planned subway station will accommodate most of the anticipated growth in housing and commercial development in the district, in support of the city's goals for compact, transit-oriented development. These parcels are considered the most appropriate for intensive, high-density, mixed used development, which will be reflected in zoning and building regulations. Certain stormwater and water quality regulations will apply to these sites, as they will to all sites in the district.

Moderate (Orange)

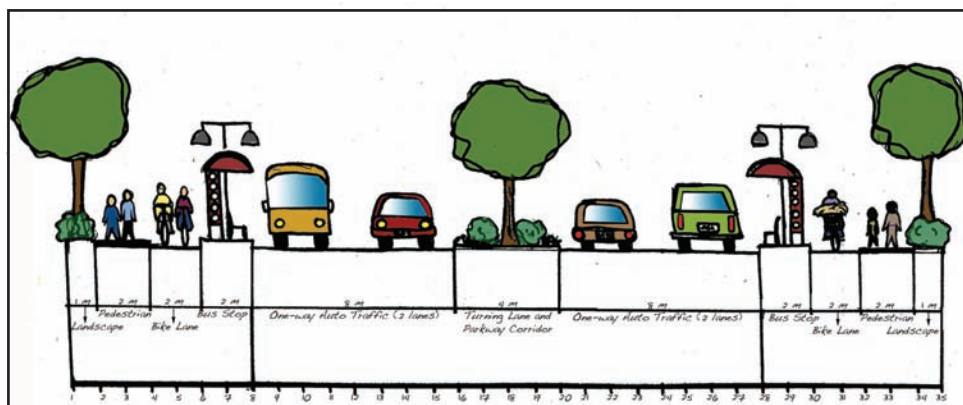
At the periphery of the district, there are properties that are already within the development footprint but not in close proximity to currently planned transit stations. Despite not being immediately adjacent to the natural open space network, these parcels have an important impact on the health and restoration of the watershed. They are appropriate for moderately scaled development, shaped to maximize walkability.

Sensitive (Yellow)

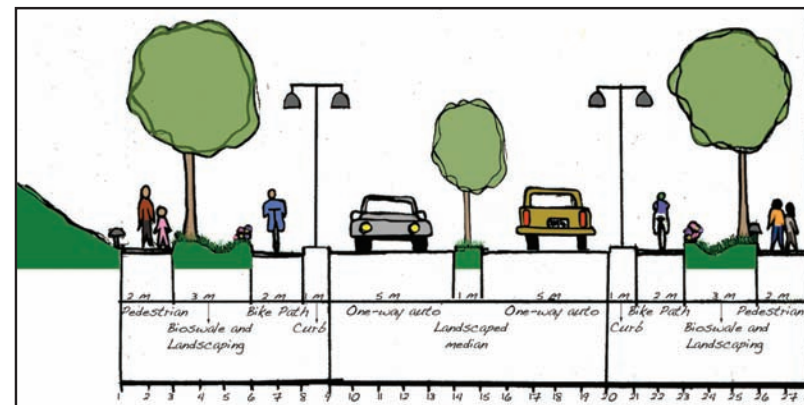
Once the coordinated open space network is established, the adjacent parcels will take on additional importance in its health and maintenance. New development in these areas (and even existing buildings) will need to follow specific regulations regarding development footprint, stormwater management, and landscape design to meet strict water quantity and quality standards. Important natural features, such as steep slopes and existing tree stands, will be protected and preserved.

The following pages describe how development parcel and public space design will be regulated in support of these goals.

TOOLS > Street Sections



Arterial (A-A)



Minor Parkway (B-B)

Street Sections

The street sections shown above illustrate proposed greenway corridors. These corridors serve as connections to link the riparian corridors, open space/park systems, and places of home and employment. The goal of these corridors is to provide a park-like connector between resident activities, transit nodes, and natural systems.

The corridors are differentiated by the scale of roadway. Arterial roads are intended to serve higher traffic areas, including transit routes. Minor Parkways are intended to serve lower-

volume streets with enhanced stormwater protection features. Both road corridors contain ample room for pedestrians, bicyclists, and landscaping.

Arterial

The Arterial street section has a 35 meter public right-of-way, which is typical of a major arterial street. Within this right-of-way, there are four lanes of vehicle travel and one landscaped median that can double as a turning lane for busy intersections. The Arterial street features a total of eight meters of width of landscaped bike and pedestrian lanes as well

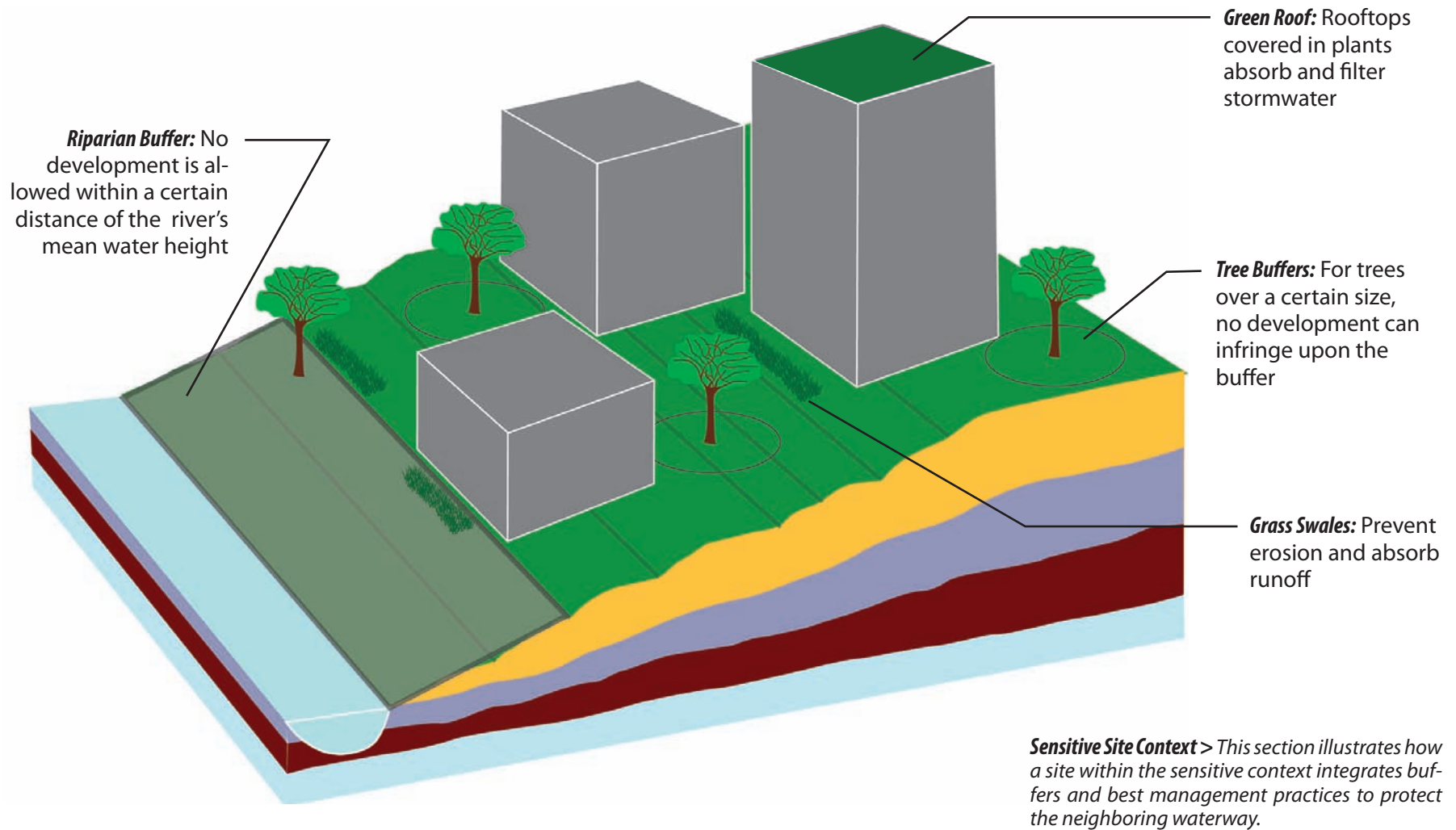
as designated pedestrianized bus stops.

Minor Parkway

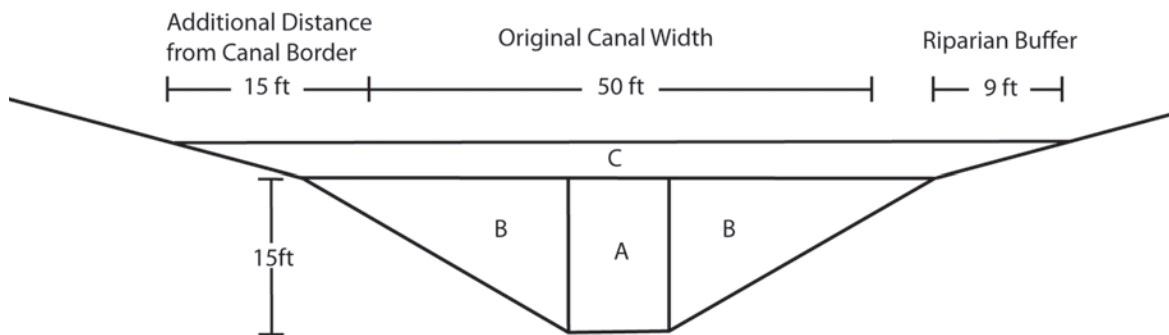
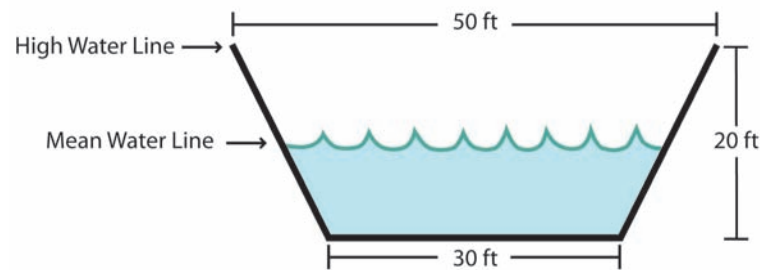
The Minor Parkway street section has a 28 meter public right-of-way, seven meters of which are dedicated to landscaping and swales for runoff filtration. There are also extensive bike and pedestrian lanes separated from two lanes of vehicle traffic.

Properties adjacent to both corridors will be part of a greenway overlay that includes extra provision for buffers depending on the intensity and context of site development.

TOOLS > Example in Context



TOOLS > Streambed Capacity



River Cross Section > The new river cross section is broken up in several shapes. A real river cross-section would not be completely symmetric or made of straight lines. This is an approximation of the minimum riparian buffer.

Reintroducing the River

The area of the new river cross-section should equal the area of the original canal cross-section so that the river and canal have the same water capacity.

Calculations and Justification

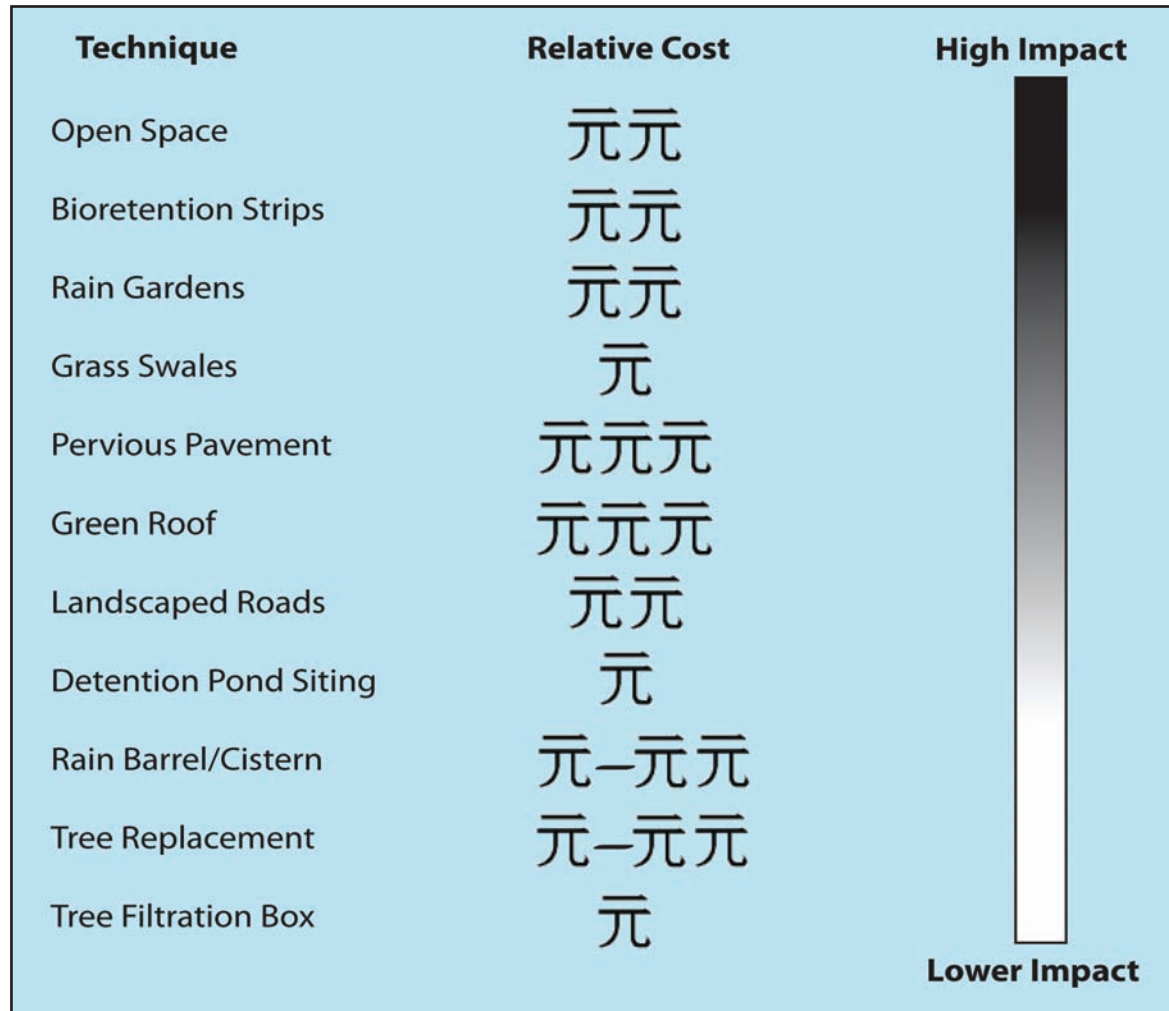
Section A Area: 150 sq. ft.

Section B Area: 195 sq. ft.

Based on the calculated areas of Sections A and B, the approximated cross-sectional area of the river is 540 square feet. The area of the original canal cross-section is 800 square feet. Therefore the area of Section C must equal 160 square feet.

Based on slopes of 15 degrees on the river bank, the height of Section C should be 2.43 feet, resulting in a riparian buffer of 9.07 feet, or 2.76 meters (on each side of the river). Compared to the original width of the canal, the river would require an additional 15ft. on either side of the banks, an increase of 60%. More detailed calculations can be found in the appendix.

TOOLS > Low Impact Development Techniques



LID Relative Costs and Impacts

LID techniques are one way to mitigate the effect of dense developments on the surrounding natural systems. Even high intensity developments can incorporate LID techniques such as green roofs, tree replacement, pervious pavement, and landscaping. LID measures can also be scaled relative to development intensity (see Case Studies). Regulations that make basic LID techniques standard in all developments can significantly reduce hydrologic damage to the region.

Developers will prefer to integrate LID techniques that are compatible with their development type, site design, and budgetary restrictions. Flexible requirements for LID can help developers maximize their stormwater management contributions. The LID Chart at left begins to consider trade-offs between impact and cost of various techniques.

***LID Chart** > Low Impact Development techniques range in level of impact and relative cost. This chart shows how potential LID measures compare to each other in terms of cost and effectiveness.*

TOOLS > Low Impact Development Techniques



LID Examples > From left: Tree filtration box at Vanke Holiday Town in Shanghai. Source: Haley Peckett. Vegetated swales in Fifth Garden, Shenzhen. Source: Yew Chin Leow. Retention pond in Sha Tin, Hong Kong. Source: Jeff Beam.

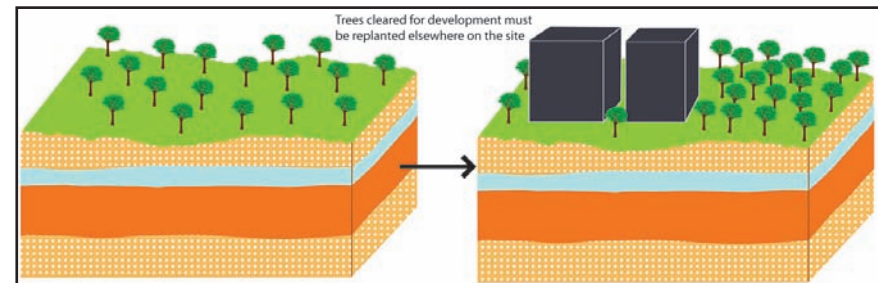


Other factors that should be considered when devising LID guidelines include:

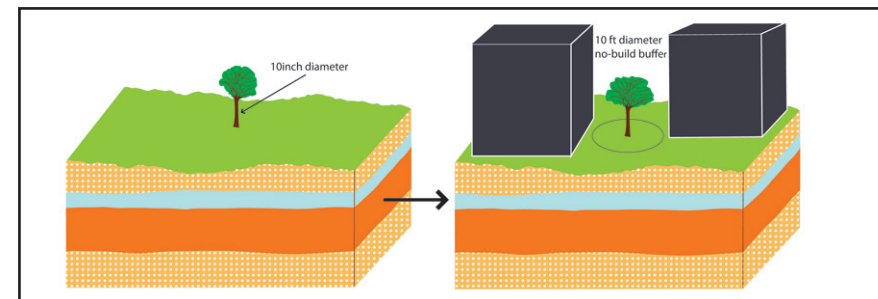
- > Hydrologic conditions on site
- > Slopes and topography
- > Intensity of development
- > Ratio of pervious to impervious surfaces
- > Other site design features

The key idea is that LID techniques are flexible enough to be incorporated into any site design in a way that is cost-effective.

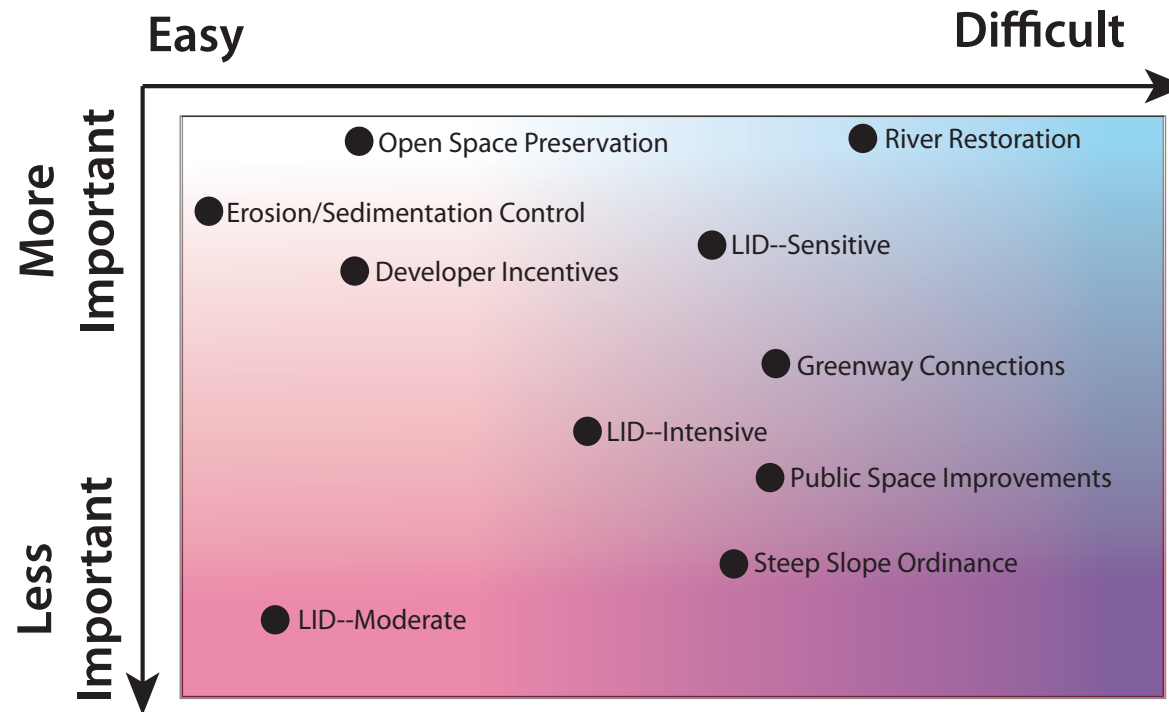
Tree Replacement > Trees removed during the development process are replaced with trees of a comparable size and species.



Tree Preservation > Trees of significant size or importance are buffered and preserved during the design process.



IMPLEMENTATION > Priority Matrix



Intervention Priorities

In the course of restoring the natural systems of the Longhua district, a series of interventions can be undertaken. While all measures to preserve the integrity of the natural systems are important, the government will prioritize its actions based on a range of goals and feasibility measurements.













The Priority Matrix shows the relative importance and ease of implementation of the mitigation measures described in the remainder of this analysis. This Matrix should be used in conjunction with planning objectives to prioritize actions.

River restoration, or the creation of a soft-bottomed riparian corridor with a green space buffer, is a key component of natural system preservation. Likewise, LID regulations for sensitive sites abutting the river are an integral protection measure. Both of these should be implemented despite their relative difficulty.

Other important and easy-to-implement actions include generalized open space preservation, erosion and sedimentation control ordinances, and developer incentives to incorporate better LID techniques into their developments.

IMPLEMENTATION > Interventions by Context

Regulatory Guidelines and Site Contexts

Context	Best Management Practices	Open Space	Greenway Contribution	Buffers
Intensive				
Moderate				
Sensitive				

Regulatory Guidelines

Sites should have different guidelines for intervention strategies based on the context. Best management practices, minimum open space requirements, and financial contributions to a greenway fund should be required of all sites. Buffers are only applicable to sensitive sites abutting water bodies and greenways.

The chart illustrates the relative needs of each site context in terms of natural systems interventions. For example, sensitive sites require greater open space dedication than intensive or moderate site contexts. However, greenway contributions should be required (through a defined formula) for all site contexts.

IMPLEMENTATION > Urbanized Context

The centerpiece of a natural systems restoration is a re-establishment of the riparian corridor with a permanent, flowing stream buffered by a public greenway. Such a restoration is a complex process that must be carefully planned to maximize public and environmental health benefits.

1. **Natural Systems Restoration and Management Plan:** The District government must study the individual characteristics of the watershed, slopes and hydrology, anticipated development patterns, and potential impacts of restoration to the District. The Plan must also include a thorough cost/benefit analysis considering both monetary and non-monetary costs and benefits of a restoration.
2. **Restoration Design and Phasing:** Based on details gathered in the Plan, as well as public input, the government should create specific design standards for the restoration. These standards will include a phasing element that identifies river sections to target for initial development and primary connectors without the greenway system. The phasing should be based upon timeline targets for full system completion.
3. **Participation:** The most cost-effective



River Restored > Seoul's Cheonggyecheon restoration project removes a major downtown expressway and uncovers a long-buried riverbed, restoring both the natural hydrology and a beautiful amenity. Source: flickr user PJ and Dorian.

and politically viable restoration will occur with a mix of regulatory and voluntary measures. Sites undergoing development, redevelopment, or renegotiation of land leases will be required to comply with minimum natural systems regulations as outlined in the following section. These will provide, at minimum, dedication of right-of-way for greenways and basic protection features for the watershed. Developers can undertake additional voluntary measures in return for density bonuses and other incentives.

4. **Funding:** Financing for the restoration will depend on the extent of restoration measures implemented. Possible funding sources include developer impact fees, funds dedicated for district and regional open space and recreation, national environmental program funds, and grants for nongovernmental organizations. A functioning network of greenways will likely raise property values in the District, and residents and landowners may be expected to finance the maintenance of such a system.

IMPLEMENTATION > Greenfield Sites

While the focus of this analysis is the restoration of Longhua's degraded natural systems, the same principles can be applied to the protection of the topography, hydrology, and natural habitat in new development sites. The preservation of natural systems on greenfield sites is substantially easier and more cost-effective than retroactive management. It is important that future development be guided by the lessons learned from the previous development.

The following guiding steps should commence at the beginning of the development process:

1. *Natural Systems Study and Management Plan:* A thorough assessment of the natural systems must guide the creation of a management plan. Data to collect would include detailed topography, seasonal hydrologic conditions, native plant and animal species, and potential impacts of development. Areas with the most sensitive natural features should be prioritized for preservation or less-intensive development. In nearly all cases, sensitive areas would be ideal anchoring points for a green network that would also provide a desirable public amenity.

2. *Development Context Selection:* Infrastructure should ideally be planned to circumvent preservation areas and create corridors that can safely accommodate intensive development. A Development Zone map, similar to the one created for the Longhua District, can designate parcels for intensive, moderate, and sensitive development. Roadways and amenities can be planned accordingly. Additionally, land selected for preservation can be transferred to a managing entity to maintain the land for habitat and recreation.

3. *Regulatory Implementation:* The Management Plan and Context Selection would both occur prior to land lease auctions. Therefore, regulations should be established for each development context to create a built environment compatible with natural system protection. The financial costs of such regulations to the developers can be included in their bids. The regulatory guidelines in the following section can inform the creation of context-specific regulations.

4. *Funding:* The primary monetary burden of natural system restoration is the legal and technical costs of acquiring land and physically restoring a water system. Ab-



Undeveloped Landscape > The natural systems of undeveloped areas should be protected prior to land sales and construction. Source: Jeff Beam

sent those costs, new development sites will primarily need funding to maintain greenways. Additional government expenditures may be required to tailor infrastructure in ways that protects natural systems. Greenway contribution funds can still be required from landowners to help cover these cost. Landowners would see a rise in the value of property that is connected to a green network.

REGULATIONS > Justification

Riparian Corridor Regulations

The Longhua District Riparian Corridor (LDRC) is visibly suffering from poor ecological health and requires significant efforts for restoration. A restored, vibrant riparian corridor has benefits for the entire community, including health and recreational benefits, increased land values, and improved environmental measures.

However, the LDRC is located in an area of emerging, intensive building patterns with density that is only likely to increase over the next few decades. The land use patterns in the Longhua District are not conducive to riparian corridor health. Studies show that impervious surfaces covering more than ten to fifteen percent of a river's watershed results in various means of stream decline (Moglen and Kim 2007), but this scenario would be unrealistic in the Longhua District. Therefore, a set of protective regulations to guide restoration is particularly important to mitigate the inevitable impacts of intense development.

Protective Techniques for High-Density Development

Studies show that dense, mixed-use development is highly beneficial to riparian corridors

compared with conventional development patterns given the land area that is preserved from development using low-density land use patterns (Berke et al 2003). However, this finding is lessened when the dense developments take place in infill sites. There are two primary reasons: first, streams in infill areas may be too degraded to merit much attention or investment, and second, new urbanist development guidelines tend to be focused on greenfields (Berke et al 2003; Plater-Zyberk & Company 2001). The LDRC restoration should be implemented with particular attention to infill-based regulations for high-density developments to enhance restoration efforts.

Low-impact design techniques are compatible both with a high-density, mixed-use development characteristic of Vanke Town and surrounding developments as well as with riparian corridor preservation and restoration. These techniques fall into three categories:

- > Protection of hydrologically sensitive areas (steep slopes, porous soils, forested lands)
- > Reduction of impervious surfaces of the built environment
- > Best management practices to detain and filter stormwater (Moglen and Kim 2007; Berke et al 2003)

Proposed Regulatory Structure:

The restoration of the riparian corridor is the keystone to natural system preservation in the Longhua District, and the proposed regulations assume that such a restoration will take place over the next few decades. The restoration and preservation of a healthy regional watershed will be implemented through two sets of regulations:

- > Requirements for developers and landowners.
- > Incentives for developers and landowners

The types of natural systems standards to be included are:

- > Best Management Practices
- > Open space/impervious surface requirements
- > Contribution to a greenway fund
- > Buffer requirements from river or greenway (for applicable properties)

Development standards should be based on careful, localized analysis as well as a natural systems restoration and management plan. The plan should be conducted by the district government to determine the costs and benefits of natural systems restoration, district priorities, and responsibilities of individual

REGULATIONS > Types of Standards



Shenzhen Open Space (Above) > Landscaping and playing fields provide space for active and passive recreation in the Longhua District. Photo by Yew-chin Leow.



landowners. The following regulations guidelines provide illustrative examples that can inform further efforts in this arena.

Best Management Practices

The following guidelines are based on the analysis of LID techniques employed in three contexts (Intensive, Moderate, and Sensitive) as well as the relative cost and impacts of various techniques. The LID guidelines can be employed for any of the three site contexts, but they are of the highest priority to implement at the Sensitive sites, where stormwater runoff can have the greatest direct detriment.

The Case Studies for Intensive, Moderate, and Sensitive contexts best show how LID techniques can be employed on sites of varying densities. In determining stormwater management regulations, Sensitive sites should have the strictest requirements. Requirements for Moderate and Intensive areas will be less strict, but developers may be given strong incentives to implement optional LID techniques to further improve the management practices in those areas.

Hong Kong River (Left) > Restored river with enhanced pedestrian features in a dense residential development in Hong Kong. Source: Yew-chin Leow.

Open Space

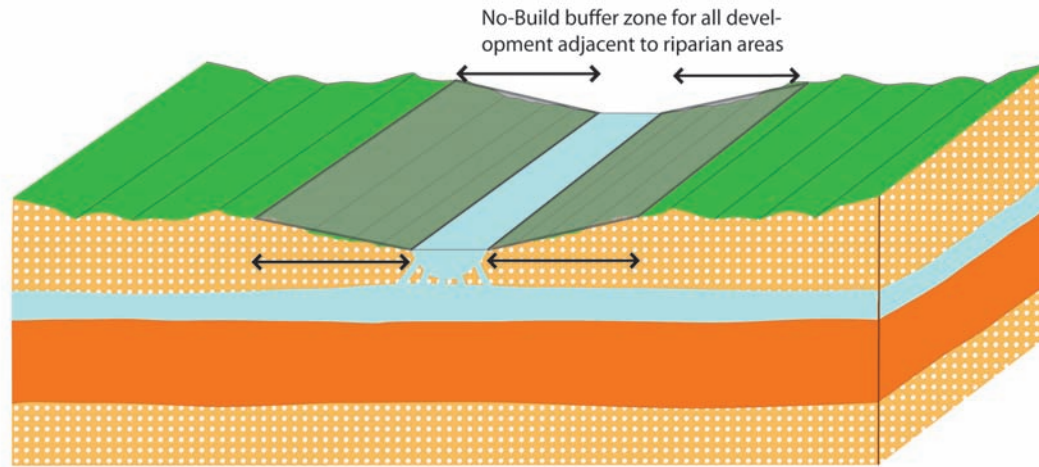
Hong Kong requires the dedication of 2 square meters of open space per person in most public and private residential developments. Half of the open space is dedicated as “local” open space, primarily for passive uses. The other half is “district” open space, subject to a 3:2 ratio of active to passive open space. Active uses include sports and fields whereas passive uses include children’s playgrounds and sitting areas.

Hong Kong additionally has greening standards under which residential developments must include landscaping and ornamental plantings of foliage and flowers in their “local” open space. The purpose of such greening is to “provide a serene and comfortable setting in human scale to minimize the unpleasant impacts of high-density development” (Hong Kong Special Administrative Region 2007).

Greenway Contribution

The financing of greenways and river restoration can be costly. However, greenways and urban rivers have a host of benefits to nearby property owners, including higher property values, aesthetic enjoyment, and health and recreation opportunities for tenants (Wenger

REGULATIONS > Types of Standards



Riparian Buffer and Water Table > A riparian buffer should be wide enough to prevent development below the high water mark, which would be flooded during heavy rains. The steepness of the river banks is also an important factor.

and Fowler 2000). The use of a greenway fee can help to align costs and benefits.

Due to varying intensities of development, the fee should be assessed per square meter of built area or per unit (varying by unit type). Seattle, Washington proposed a one-time fee of \$1-2 per built square foot (\$11-22 per square meter) (Young 2005). Hillsborough County, Florida charges one-time open space impact fees ranging from \$175 for a one-bedroom unit

to \$430 for a three-bedroom unit (Hillsborough County 2008). Other jurisdictions charge annual maintenance fees based on property size (Roberts 2006). When calculating a fee for the Longhua District, the government should consider the lifecycle costs of restoration and the differing benefits to property owners based on proximity to greenways.

Buffers

Buffer strips in particular can be useful in protecting the newly restored river and greenway. Buffer strips serve as a physical barrier for sediments, increase the retention time of sediment-bound contaminants, and capture nitrates in the vegetated swales. The effectiveness of the buffer is positively correlated with buffer width and negatively correlated with buffer slope (Zhaoning et al 2005). However, buffer width is dependent upon water flow and quality, the width of the floodplain, steepness of slopes, and other individualized measures. Guidelines for a buffer in the Longhua District can only be made after studying these factors.

A few examples of buffers can illustrate the determination of width. A study of the Guanting Watershed northwest of Beijing recommended a buffer width of 18 meters in an area with some urban development but less dense than the Longhua district. The same study noted that a minimum of 9 meters should be required for a riparian buffer (Zhaoning et al 2005).

A study of U.S. and Canadian riparian buffers found a movement away from a "one-size-fits-all" buffer. This survey found buffer widths ranging from 20 meters to 43.8 meters for per-

REGULATIONS > Types of Standards

manent streams (Lee et al 2004).

Minneapolis, Minnesota is a highly urbanized city on the banks of the Mississippi River. Their development regulations require a 50 foot (17 m) setback from the river and restrictions for building on steep slopes. The City also restricts building height within the first 30 meters of the riverbank with exceptions for specified high density areas (City of Minneapolis 2008).

Guidelines and Case Studies

These regulatory guidelines can be compared with the case studies described on the following pages. These case studies document best practices for natural systems management in three different development contexts. They offer examples of how various combinations of regulations and implementation tools have been used to integrate natural systems considerations with open space amenities and urban development.



Residential Waterway> Soft-edged river abutting lower-density residential development in Vanke's Holiday Town Shanghai. Source: Haley Peckett.

CASE STUDIES > Intensive and Moderate

Intensive: Battery Park

Solaire is a high-rise luxury residential tower in Manhattan, New York. The site area is 18,000 square feet (0.41 acres) with a FAR of 21.3. The building consists of 293 multi-family units.

Solaire's best management practices for low income development include:

- > Building uses 50 percent less water than other buildings of its size
- > Rainwater collection and storage for use in irrigation (also supplies water for an adjacent park)
- > On-site water treatment facility
- > Two rooftop gardens with special water retention layers
- > Water efficient appliances

Solaire Roof Garden > The Solaire condominium building in Battery Park, New York City, features green roofs for stormwater filtration. Source: Solaire

Naval Yard Landscaping > The Washington Naval Yard includes significant amounts of landscaping along roadways, along with many other LID techniques. Source: flickr user Mr. T in DC



Moderate: Naval Yard

The Washington Naval Yard is located in Washington, D.C. The naval base includes military, office, and residential uses on approximately 16,000 hectares with approximately 60 acres of impervious surfaces.

Best management practices include:

- > Runoff collection from parking lots, roads, rooftops, and landscaped areas
- > Bioretention retrofits to intercept stormwater and treat at least the first one-half inch of rain
- > Bioretention strips, sand filter gutter strips, and permeable pavers between parking rows and bordering parking areas. The pavers utilize a water storage area that can slowly release stormwater to avoid peak discharge
- > Rain barrels that collect and store roof runoff for irrigation
- > Tree box filters utilized (mini bioretention areas installed beneath trees to help irrigate the trees)

CASE STUDIES > Sensitive

Sensitive: Jinji Lake

The Suzhou Industrial Park (SIP) is an industrial development zone established through a partnership between China and Singapore. The primary area for residences and amenities is Jinji Lake, which is located on 515.2 hectares.

Jinji Lake's best management practices for low income development include:

- > Continuous walkway along the 14.5 km lake perimeter with hard and soft edges
- > Created and natural wetlands and green-spaces
- > Filtration of agricultural/stormwater runoff
- > 45% open space ratio
- > Runoff collected and used for irrigation and toilet flushing
- > Water-saving techniques integrated into industrial processes (in private companies) (SIPAC 2008).

Jinji Lake Waterfront (Top) > The lake waterfront is a vibrant mixed-use community with a mix of hard and soft water edges. Source: SIPAC.

Industrial Park Greenspace (Bottom) > On land privately held by Goldhua within Suzhou Industrial Park, best management practices combine with passive recreation space. Source: SIPAC.



Conclusions

A comprehensive natural systems restoration in the Longhua District is a complex process. Success requires thorough planning, intensive geographic and financial analysis, and careful phasing. Stakeholders such as government officials, land use planners, scientists, developers, and residents must contribute to the process.

The potential benefits to the district are great; a restored waterway with preserved open spaces will contribute to residents' health and well-being, raise property values, and prevent future environmental damage. Based on successful precedents elsewhere, such a restoration is an attainable goal.

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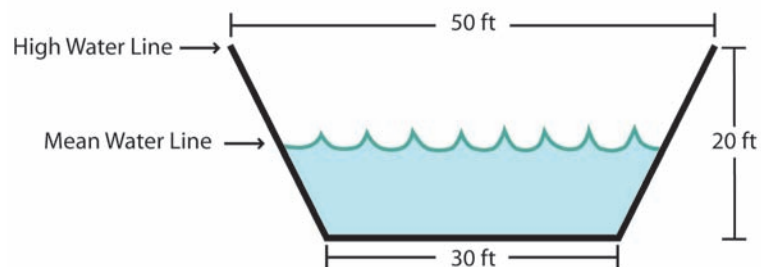
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APPENDIX > Streambed Calculations



Canal

base₁ = 50 ft

base₂ = 40 ft

height = 20 ft

$$\text{Area}_{\text{Canal}} = \frac{1}{2}(\text{base}_1 + \text{base}_2) \cdot \text{height}$$

$$\text{Area}_{\text{Canal}} = \frac{1}{2}(50 \text{ ft} + 40 \text{ ft}) \cdot 20 \text{ ft} = 800 \text{ ft}^2$$

Section A

base = 10 ft

height = 15 ft

$$\text{Area}_A = \text{base} \cdot \text{height}$$

$$\text{Area}_A = 10 \text{ ft} \cdot 15 \text{ ft} = 150 \text{ ft}^2$$

Section B

Triangle : 30 – 60 – 90

height = 15 ft

$$\text{base} = \text{height} \cdot \sqrt{3}$$

$$\text{base} = 15 \text{ ft} \cdot \sqrt{3} = 25.98 \text{ ft}$$

$$\text{Area}_B = \frac{1}{2} \cdot \text{base} \cdot \text{height}$$

$$\text{Area}_B = \frac{1}{2} \cdot 26 \text{ ft} \cdot 15 \text{ ft} = 195 \text{ ft}^2$$

$$\text{Area}_{\text{Canal}} = 800 \text{ ft}^2$$

$$\text{Area}_{A+2B} = 150 \text{ ft}^2 + 2(194.9 \text{ ft}^2) = 540 \text{ ft}^2$$

$$\text{Area}_C = 800 \text{ ft}^2 - 540 \text{ ft}^2 = 160 \text{ ft}^2$$

$$\text{Slope}_C = 15 \text{ degrees}$$

$$\text{base}_1 = \text{base}_A + 2(\text{base}_B) = 10 \text{ ft} + 2(26 \text{ ft}) = 62 \text{ ft}$$

$$\text{Area}_C = \text{base}_1 \cdot \text{height} + (\text{base}_2 - \text{base}_1) \cdot \text{height}$$

$$\text{base}_2 - \text{base}_1 = \frac{\text{height}}{\tan 15}$$

$$\text{Area}_C = \text{base}_1 \cdot \text{height} + \frac{\text{height}}{\tan 15} \cdot \text{height}$$

$$160 = 62 \text{ ft} \cdot \text{height} + \frac{\text{height}}{\tan 15} \cdot \text{height}$$

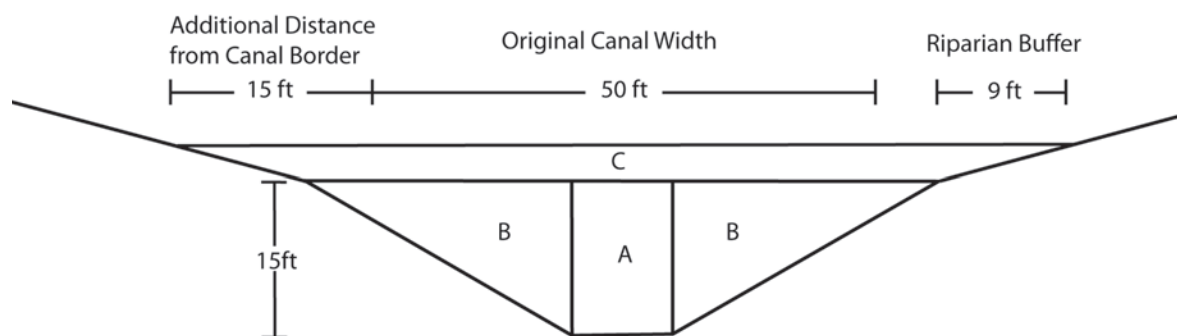
$$\text{height} = 2.43 \text{ ft}$$

$$\text{base}_2 = 2\left(\frac{\text{height}}{\tan 15}\right) + \text{base}_1$$

$$\text{base}_2 = 2\left(\frac{2.43 \text{ ft}}{\tan 15}\right) + 62 \text{ ft} = 80.14 \text{ ft}$$

$$\text{Riparian Buffer} = \frac{\text{base}_2 - \text{base}_1}{2} = 9.07 \text{ ft}$$

$$9.07 \text{ ft} = 2.76 \text{ m}$$



Community Facilities

Jie Bai, Yew Chin Leow, Kanda Song



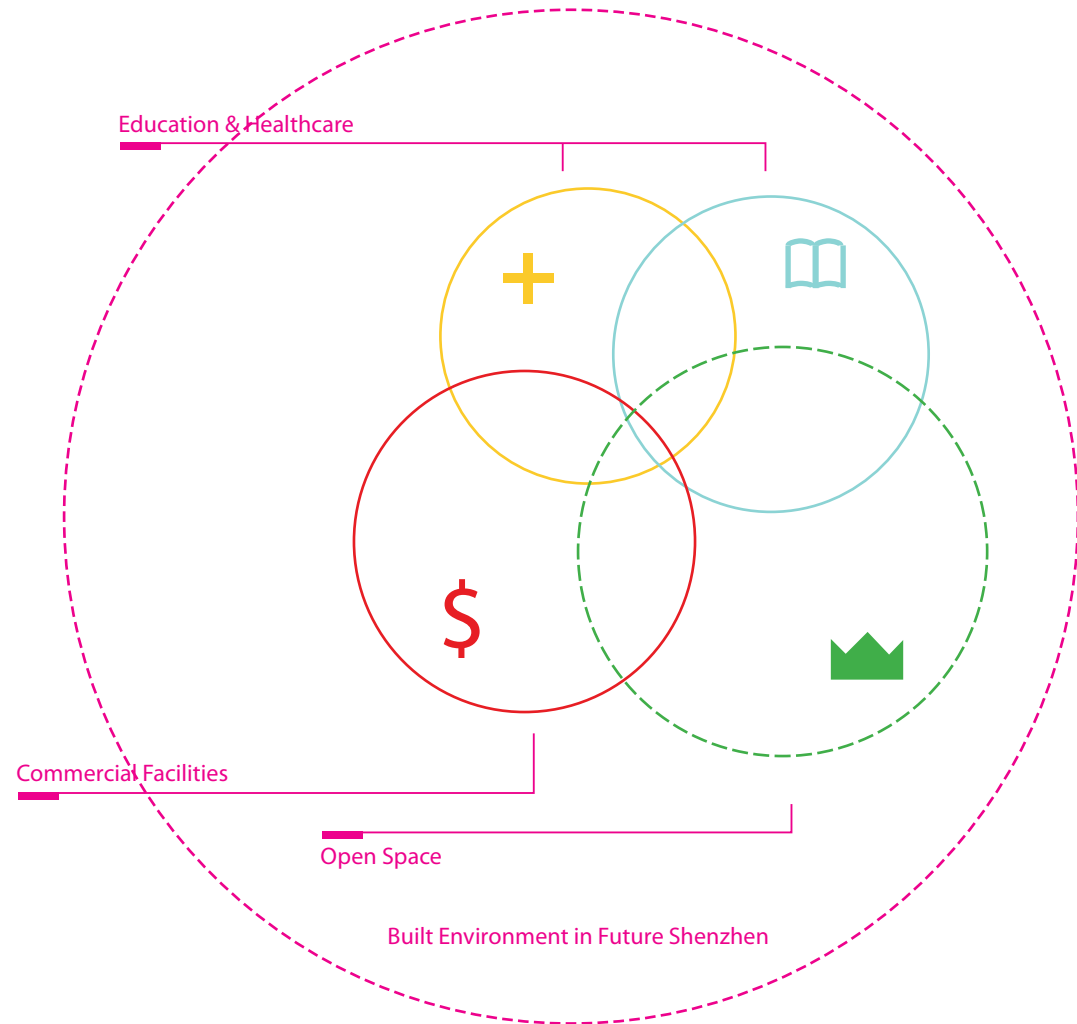
GOALS

The goals of the team's work is to:

- > Fulfill the residents' demand for health care, education, retail, services and recreation.
- > Increase the accessibility of communal facilities.
- > Enhance space equality in the distribution of communal facilities
- > Strengthen connections among communities and create vital public spaces.

The area of focus is Bantian, which is the immediate district that Vanke Town is in. Attaining these goals will allow for a better quality of life for the future Bantian neighborhood.

In order to achieve these goals, appropriate planning guidelines were developed through the analysis of three case studies, namely Cambridge, Hong Kong, and Singapore. Afterwards, the planning guidelines were applied to design the community facilities for Bantian.



The Interconnected Relationships of the Four Categories of Community Facilities

EXISTING CONDITIONS > Retail & Services



Shenzhen Commercial Plan(2006-2010)

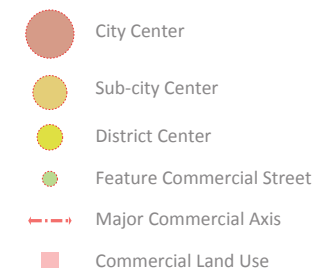
City Level

The current retail floor area in the city of Shenzhen is 16,000,000 sqm, which is equal to be a per capita floor area of 1.23 sqm. (Shenzhen Business Bureau 2006)

According to (Shenzhen Business Bureau 2006), the current retail network in the city is composed of:

- > 2 axes: along subway line 1 and line 4
- > 2 bands: along the highways
- > 2 city centers
- > 4 sub-city centers
- > 8 district centers
- > A number of featured shopping streets

Very few shopping centers are located around the Vanke Town site. In the absence of public transit, people who live there have to drive to the downtown area for durable goods, luxury commodities and entertainment.



District Level

Retail Structure

Although there is little reliable data on the retail in Bantian, a study on the retail development of Longhua was recently undertaken by Shenzhen City Development Research Institution. Since Bantian is one of the town centers of Longhua district, it is reasonable to assume that it shares similar retail characteristics with Longhua. Compared to the city level, the retail in Longhua is characterized by:

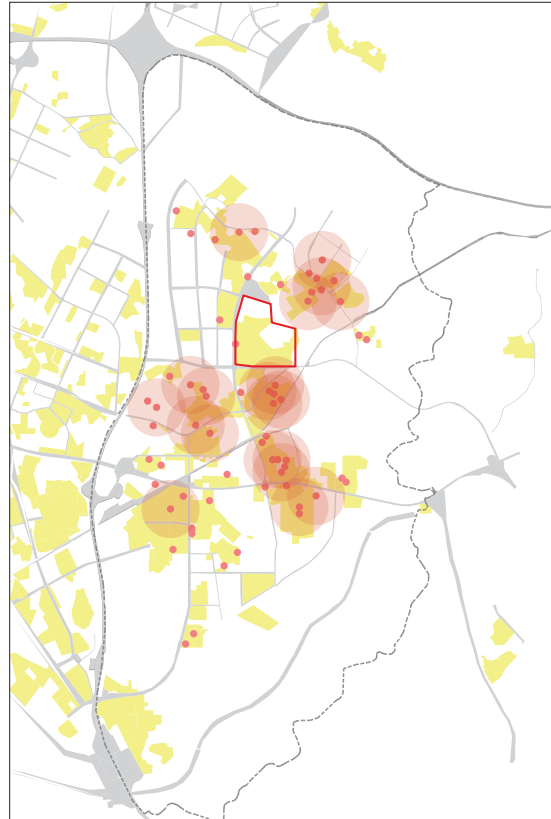
- > Slightly higher total floor area,
- > Lower proportion of catering, recreation and service industry
- > High proportion of smaller scale retail over a lack of large scale retail facilities.

Distribution

The distribution of the retail and services in Bantian is greatly driven by short-term market demands. As a result, the supply of retail and services covers only the high demand areas and is unable to adjust to the rapid market transitions promptly.

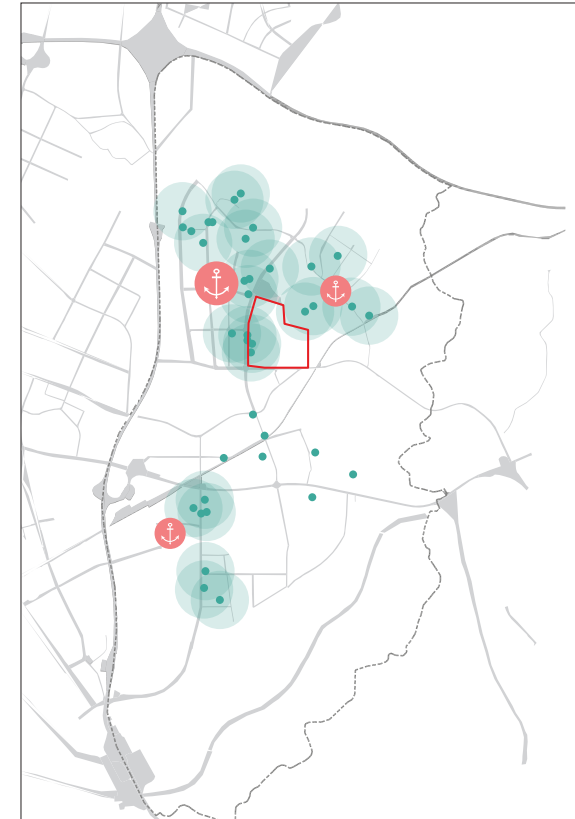
Daily Supplies Stores

The stores catering to daily needs are now concentrated at the Bantian town center and

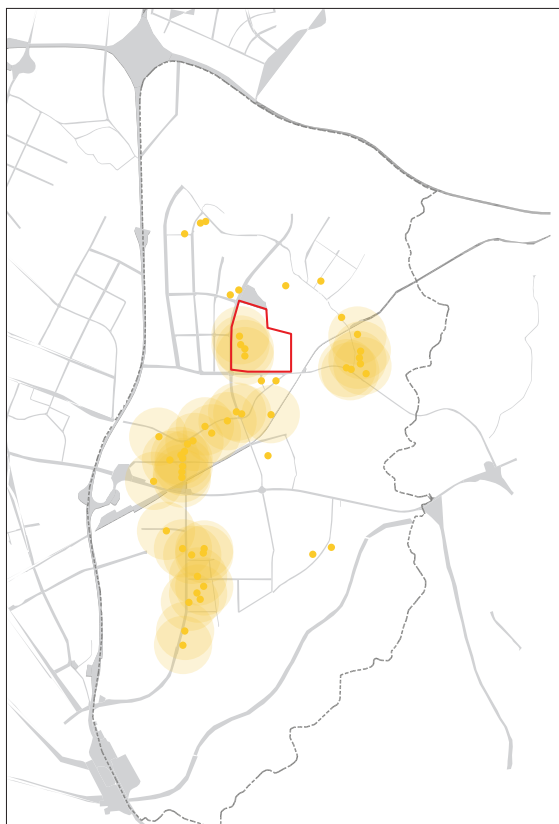


Distribution of Daily Supplies Stores

Source: adapted from 51ditu.com

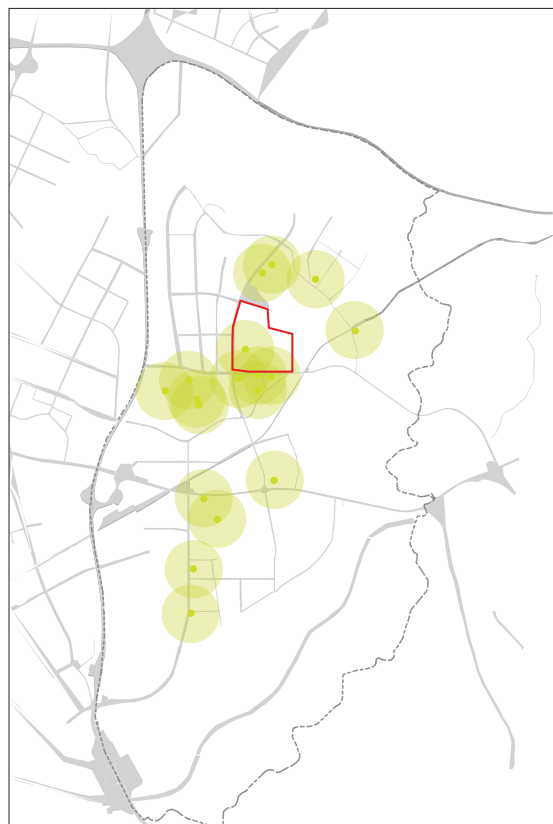


Distribution of Food & Beverage Outlets and Entertainment Facilities



Distribution of Specialist Stores

the Xuegang urban village to the northeast of the site. The high density in the two centers has significantly revitalized the retail activities around them. Due to the concentration of these relatively basic retail stores, the commodities are sold at very affordable prices. In the newly developed housing compounds, although adequate daily supplies are also pro-



Distribution of Service Facilities

vided, they cannot compete with the retail in the original village centers because of a lack of variety. Through the interviews with the Vanke Town residents, people said that they prefer to do daily shopping in Bantian Center rather than at the on-site supermarket, even though Bantian Center is further in distance.

Food & Beverage (F&B)

The F&B industry in Bantian district is anchored by several larger entities. The biggest cluster is around Huawei, which generates the highest demand. In the urban village to the north of Vanke Town, there are also many restaurants to meet the demand of the migrant workers living there. Wonderland, which has gradually grown into a mature neighborhood, also attracts a sizeable amount of F&B business along the major street to its east.

Specialist Stores

Furniture stores, houseware stores, and construction material markets take up a significant proportion of the specialist stores in Bantian, due to high demand generated by the numerous new housing compounds in the area. However, there are only a limited number of specialist stores that cater for everyday life, such as fashion boutiques, book stores, etc.

Services

Bantian district is currently short of services like banks and post offices. due to its industrial past. However, in the past few years, a small number of service facilities have sprouted around the newly developed housing projects to capture the growing demand from the new residents.

EXISTING CONDITIONS > Healthcare & Education

City Level

Healthcare

Shenzhen has a good, structured healthcare system. The city currently has various classification of healthcare facilities as follows:

- > Comprehensive hospitals, provided at the city, district and neighborhood levels. All scales supply primary to tertiary healthcare services, distinguished by the facility size and sophistication.
- > Community hospitals which are more of a neighborhood-level asset, while they are not funded by the government, they provide affordable healthcare.
- > Other hospitals like traditional Chinese medicine hospitals, specialist hospitals, rehabilitation hospitals, and women's and children's hospitals.
- > Clinics and medical stations are the lowest category of healthcare provision.

The study will focus on the planning of comprehensive hospitals at the various levels, which is the basic foundation of healthcare provision.

At the city scale, currently there are only 3 city-level hospitals, all concentrated in Lohu District. While this has sufficed for Shenzhen's initial development up till today, as the city expands

into the districts outside of the Shenzhen Economic Zone, it is foreseen that city-level hospitals would need to be decentralized. Existing district hospitals can be upgraded to fill this gap (Shenzhen Health Bureau 2008).



Shenzhen People's Hospital > The biggest healthcare facility with 1,000 beds on 9ha of land. Source: Shenzhen People's Hospital

Education

Currently Shenzhen's development in higher education is lacking in contrast to its social and economic progress.

Traditionally, from China's socialist history, Shenzhen has good provision of basic education up to secondary level. Due to the manufacturing focus, vocational post-secondary education in Shenzhen, like Shenzhen Polytechnic is also satisfactory.

However, at the city level, university education is key but inadequate. Currently Shenzhen only has one full-time university which is government-owned - Shenzhen University (SZU). University Town, which is a collection of graduate schools and jointly set up by the

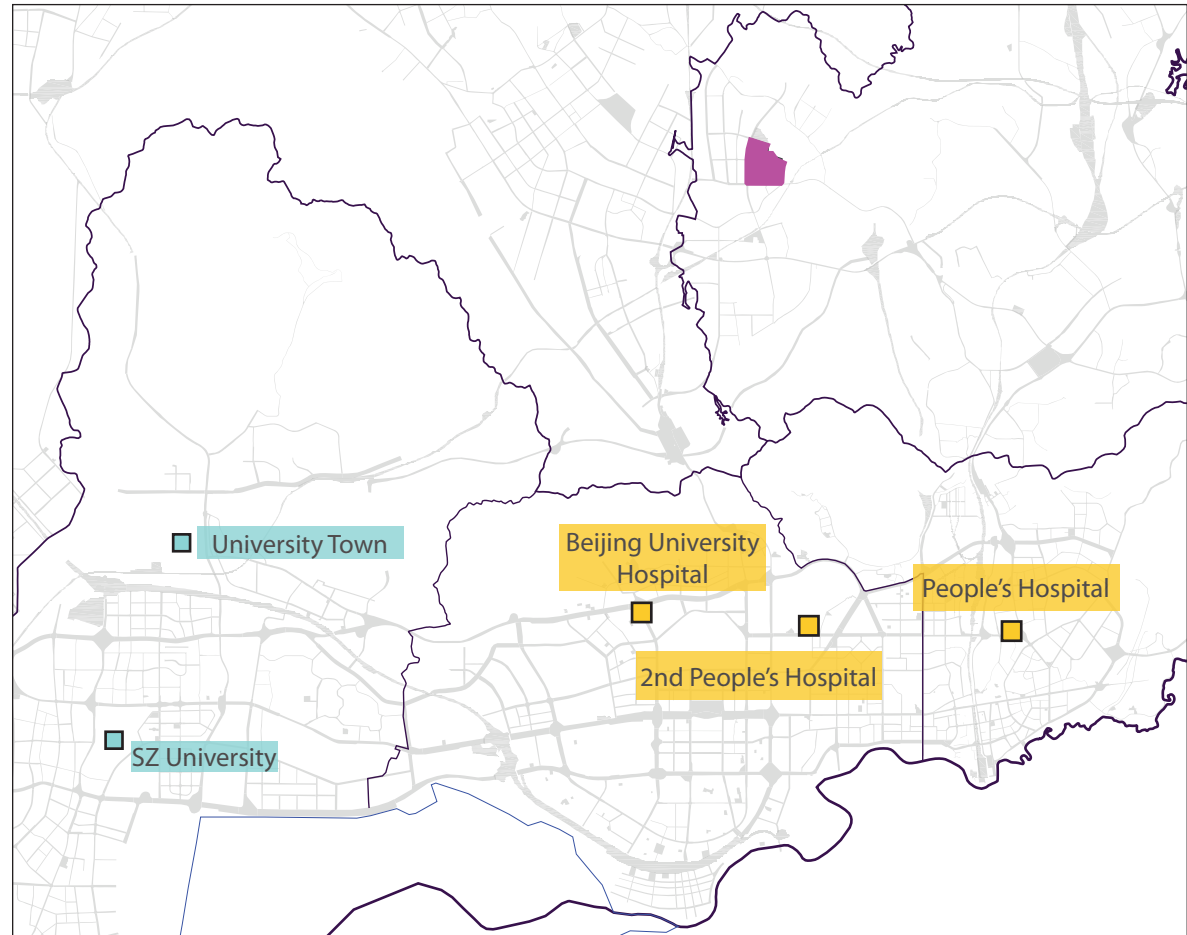
Shenzhen University > Source: Shenzhen University



government, can be considered as the second one. However, private/part-time institutes are excluded from the definition of public universities even though there are a few of them. Both SZU and University Town are located in Shenzhen's southwest district of Nanshan, and a third one in the same area is under construction. (Shenzhen Government 2008) Shenzhen definitely has more population density to support a greater supply of tertiary education. Like healthcare, there could be greater deconcentration of quality tertiary education to other parts of the city as well to reduce the propensity to travel and to further catalyze the growth of the district centers. (Shenzhen Education Bureau 2008)



Rendering of University Town > Source: University Town of Shenzhen



Existing Spatial Distribution of City-Level Hospitals and Universities in Shenzhen > Source: adapted from 51ditu.com

EXISTING CONDITIONS > Healthcare & Education

District Level

Healthcare

Bantian district is part of the bigger Longhua district. A district-level public comprehensive hospital exists in Longhua, which is Longhua People's Hospital. Bantian has 3 community hospitals: Bantian Hospital, Huaxia Hospital and Xuexiang Hospital. As their names suggests, the three hospitals are relatively small-scale, e.g. Bantian Hospital is only covering 0.4 ha of land area. While the three may provide adequate healthcare services today (Bantian Hospital 2008 and Xuexiang Hospital 2008), it would be ideal to plan for a more comprehensive one in Bantian as its population grows.

Besides this new hospital(s), intermediate healthcare is demanded at the Bantian level. Intermediate care as its name suggests, is between primary care and tertiary care, i.e. healthcare that is beyond the scope of a primary care provider but not as serious as to demand hospitalization. The team see elderly medical care facilities, hospices and rehabilitation centers fitting within this category. In the Bantian area, the team did not manage to locate any intermediate care facilities. The nearest ones are two elderly homes located at Longhua and Buji - the township to the east of Bantian.



Bantian Community Hospital > Source: Shenzhen Bantian Hospital

Education

At the Bantian level, education is demanded across three classifications, namely primary, secondary and high schools. Upper post-secondary education is rightfully more of a bigger asset under Longhua, but the spatial distribution of Longhua's post-secondary education institutions may result in institutions like vocational institutes or even tertiary institutions being located in Bantian.

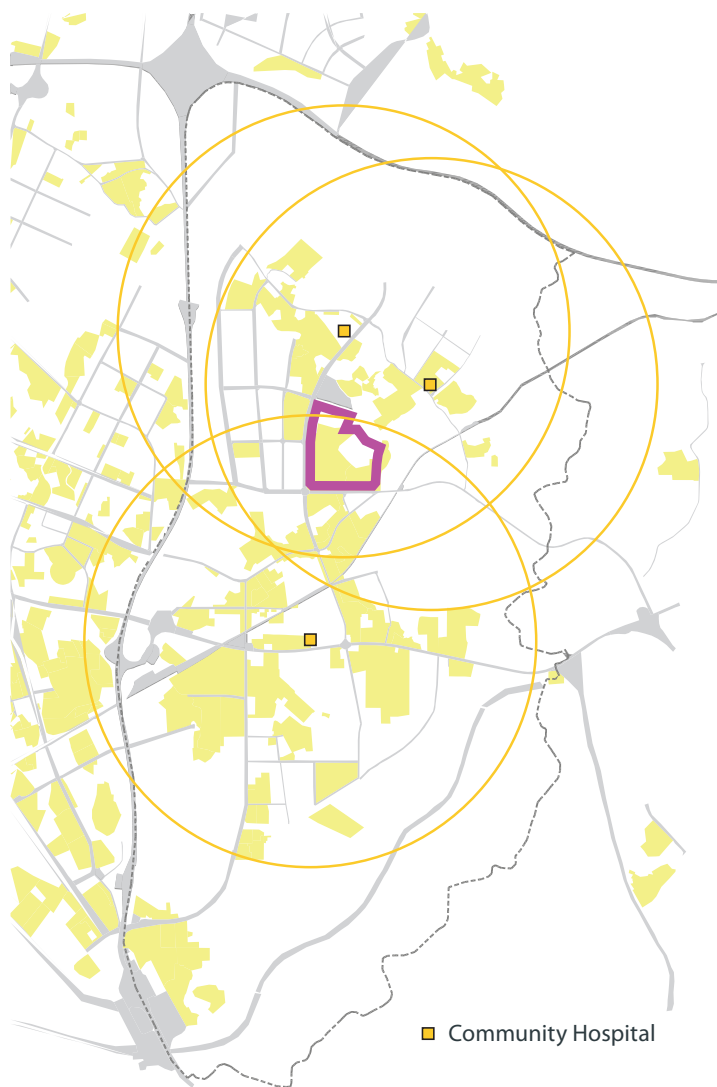
Currently, Bantian only has primary and secondary schools which are shown in the district map on the facing pages, and there are also schools with combined 9-year primary and secondary levels. A typical school is reasonably sized - based on 10 schools in Bantian, they averaged 0.14ha of land area for every 100 students.

From the district map on the facing page, it appears that there is adequate coverage of the primary schools. However, even at 800m walking range, now all neighborhoods are covered, implying students have to walk extended distances or they have to take the school bus or be dropped off by parents in their vehicles.

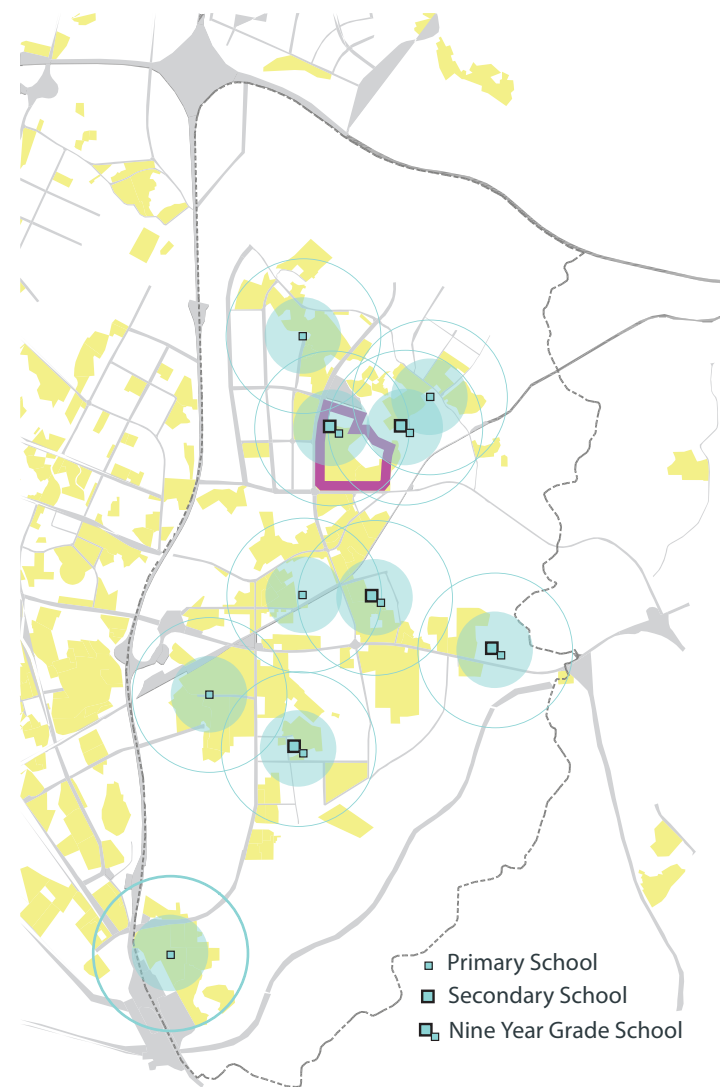
In essence, the provision of basic education in Shenzhen is still reasonably satisfactory, but there had been issues of demand outstripping supply recently in 2007, which is partially linked to the millennium baby boom. (Shenzhen Government 2007) However, it is identified clearly that more needs to be done for higher levels of education beyond secondary schools, besides needing more of the basic fundamental education schools and improving their spatial distribution for greater accessibility on foot. (Electronic Map of Shenzhen City Schools 2008)



School bus in Bantian > Source: Yew Chin Leow

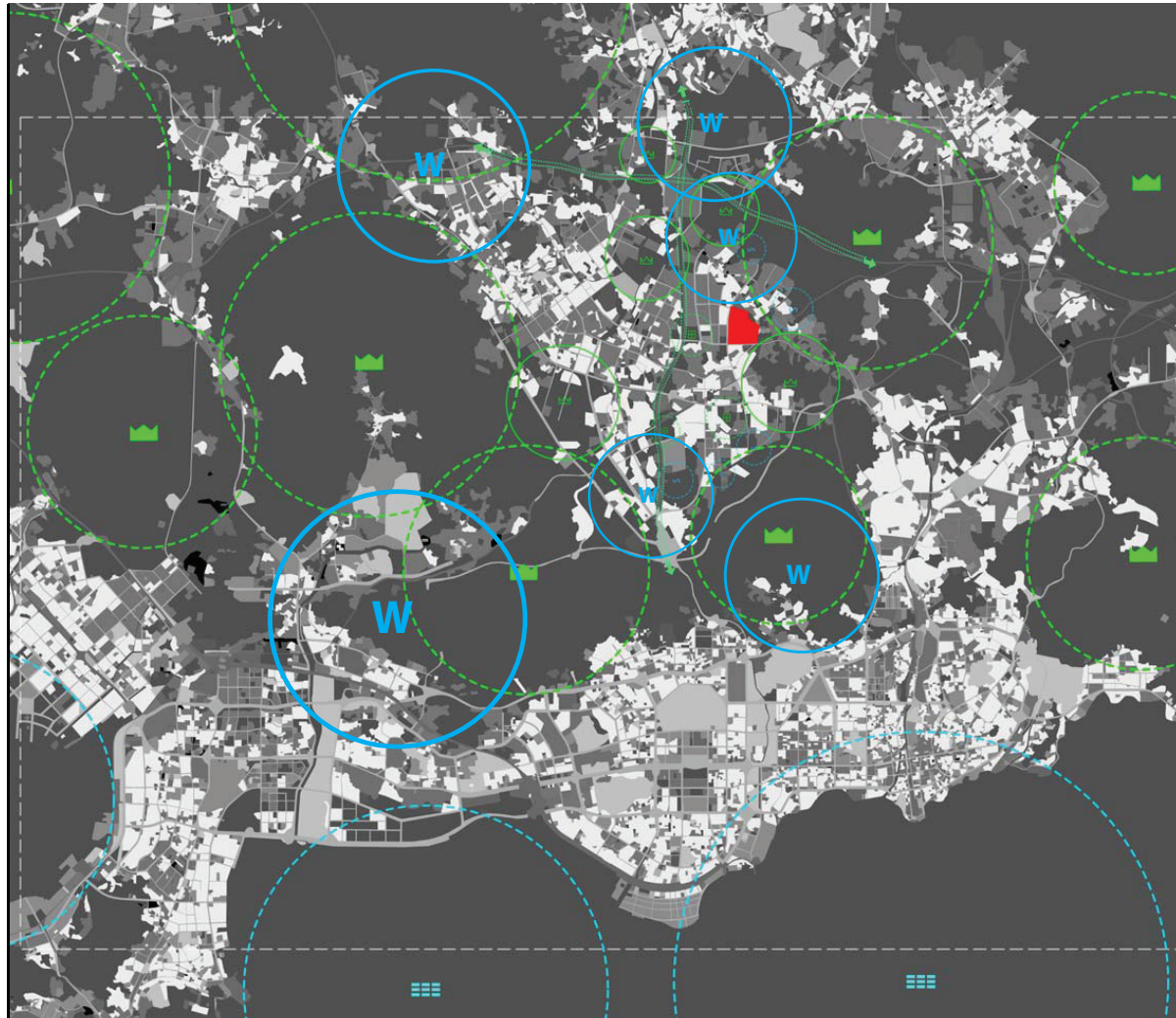


Existing Spatial Distribution of Hospitals in Bantian > Shown with a service radius of 2km which barely covers the entire district. No intermediate healthcare provider is located in the district currently. Source: Adapted from 51ditu.com



Existing Spatial Distribution of Schools in Bantian > Shown with 400m and 800m catchment radii. Even at 800m walking range, not all residential neighborhoods are covered. Source: Adapted from 51ditu.com

EXISTING CONDITIONS > Open Space



City Level

Shenzhen is surrounded by numerous mountains, which constitute a unique natural topography. The mountainous landscape is interwoven by a number of water bodies of different scales and shapes, connected by flows from inland to the South China Sea.

From this, one of the team's inspiration to develop the future plan for Bantian is to utilize the existing water system in the Longhua and Bantian areas.



Existing Spatial Distribution of Open Spaces in Shenzhen > Source: Shenzhen Planning Bureau 1996

	Open space /Regional	District	Neighborhood	Total Area	Area(m2/per capita)
Bantian present	1400ha	215ha	95ha	1710ha	9.7m2
Bantian future	1500ha	380 ha	120 ha	2000ha	12m2
Growth rate	7%	76.7%	26.3%		



= 500 ha Bantian open space in 2028

Existing Spatial Distribution of Open Spaces in Bantian >
Source: Shenzhen Planning Bureau 1996

District Level

Looking next at the district level of Bantian, the various categories of open space are illustrated in the diagram to the left. Based on the existing open space and using the projections from Shenzhen Planning Bureau and from the analysis of case studies of Hong Kong's and Cambridge's open space systems, the team estimated the area for the three categories of open space in Bantian in 2028, which is summarized in the table.

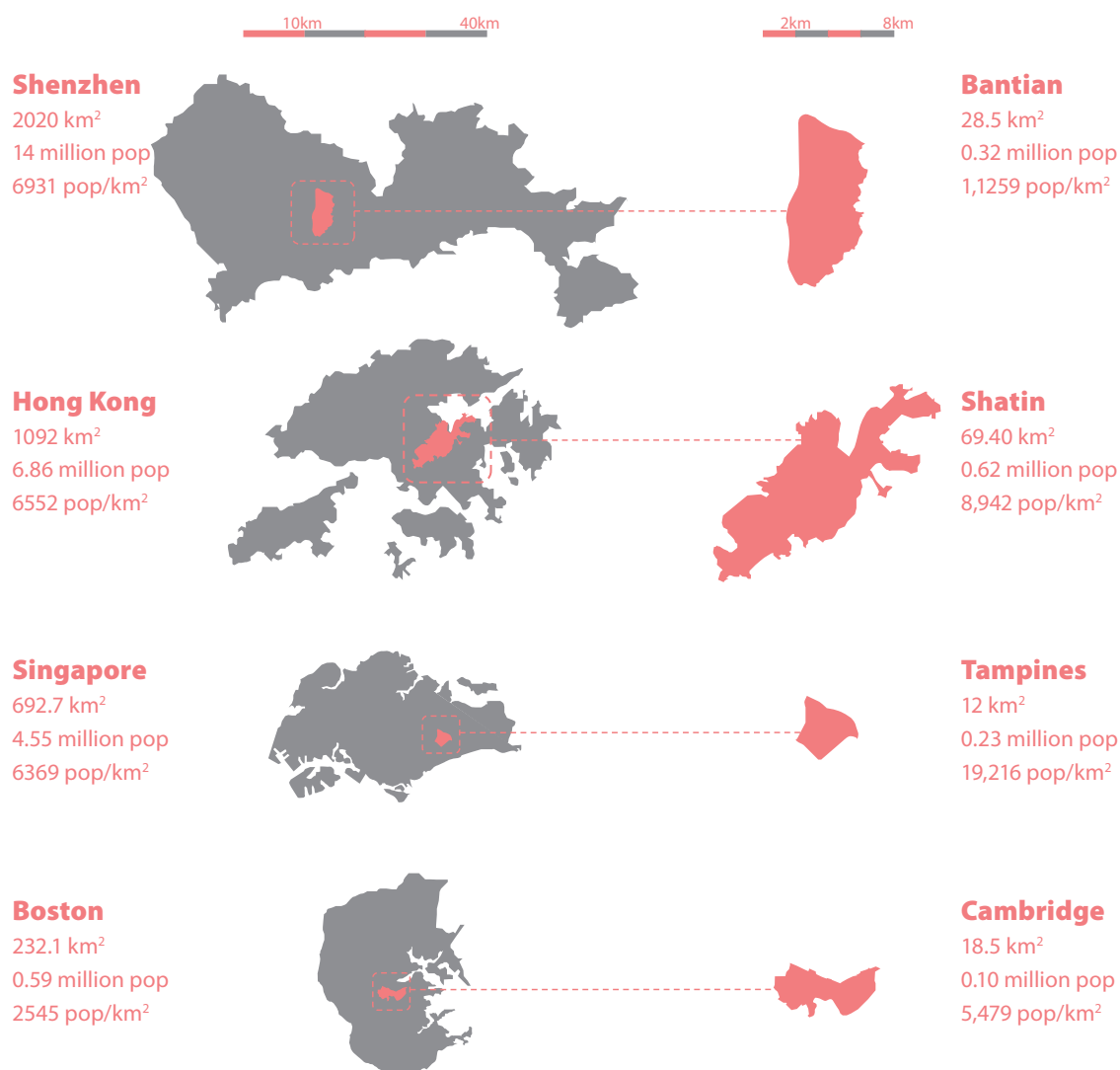
Specifically, the focus of planning the open spaces in the future Bantian is at the district and neighborhood levels, which will undergo more extensive development based on its current growth rate. The open space provision would therefore have closer relationships with other community facilities and people's everyday lives.

ASSUMPTIONS

By reviewing three cases of similar size and context with Bantian and Shenzhen, the team made assumptions of Shenzhen's future in terms of population density, demographic structure, income level, car ownership, land use, healthcare and education level. This future scenario will serve as the base in which the analysis and planning of community facilities in Bantian district are developed.

The selected cases are: Shatin in Hong Kong, Tampines in Singapore, and Cambridge in Boston. The reason for selecting Hong Kong and Singapore is that they have gone through the industrial transition which Shenzhen is currently experiencing. In addition, these two cities share a common social and cultural context with Shenzhen. Boston also went through a similar history of industrialization, and it represents a more developed Western perspective to bring balance to the analyses.

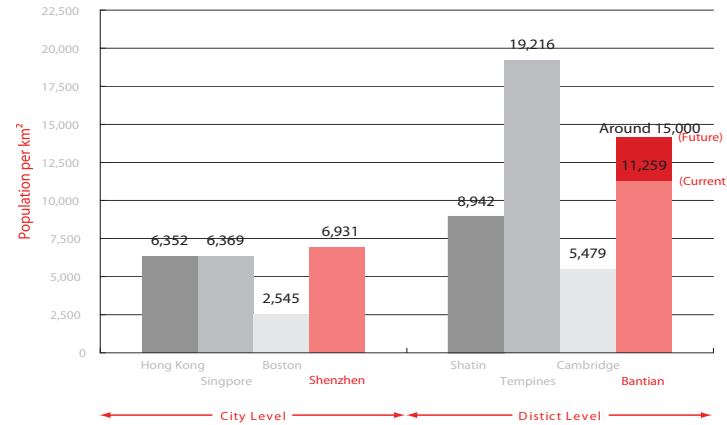
The planning of the community facilities in Bantian will be done based on the assumption of retaining the existing conditions as far as possible. The aim is to guide the future urban redevelopment rather than to assume that Bantian is being planned from scratch.



Size and Population of Reference Cities and Towns > Source: Bantian Street Branch Office 2008; Hong Kong Planning Department 2008; Foo 2001; Cambridge Community Development Department 2006; Hong Kong Census and Statistics Department 2008; Boston Metropolitan Area Planning Council 2008

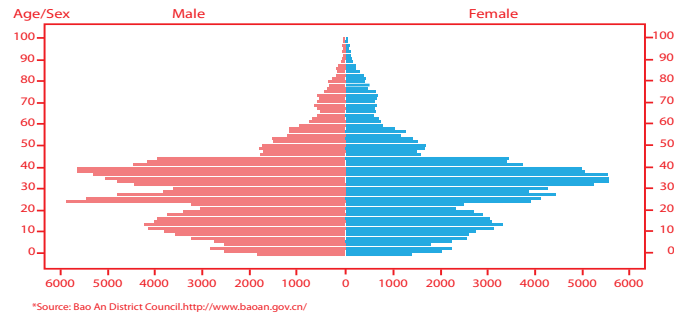
Population Density Comparison >

Source: Shenzhen Statistics Year Book 2006; Bantian Street Branch Office 2008; Hong Kong Census and Statistics Department 2008; Hong Kong Planning Department 2002; Singapore Department of Statistics 2008; Foo 2001; Boston Metropolitan Area Planning Council 2008; Cambridge Community Development Department 2006

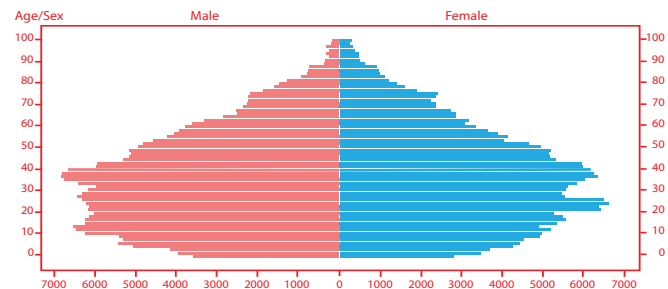


Current Bao An Demographic Structure and Projected Structure > Source: Bao An District Council 2008

Demographic structure in 2006/Bao An District



Demographic structure in 2028/Bao An District



Population and Density

Bantian now has a population of 320,000, which corresponds to a population density of 11,259/km². (Bantian Street Branch Office 2008) Longhua's long term planning predicts a growth of 1.71 times the current population between 2025 and 2005. (Shenzhen Central Sub-District Planning (2005-2020) 2005) Considering Bantian is more developed than Longhua currently, the team assumed that its growth capacity would be lower than the entire Longhua District. Therefore, 1.33 times is adopted as the growth for Bantian and the future population of Bantian works out to be approximately 420,000 in 2028. In this assumption, the population density will be around 15,000 per km². This density is similar to that of other reference cities.

Demographic Structure

In 20 years, there will be more families with two or three generations, and there will be an increase in the elderly population too. The distribution of the various age groups in 20 years' time will be more gradual than what it was like in 2006. Therefore, there will be more demands on almost all types of community facilities, especially on health care (elderly) and education (the young).

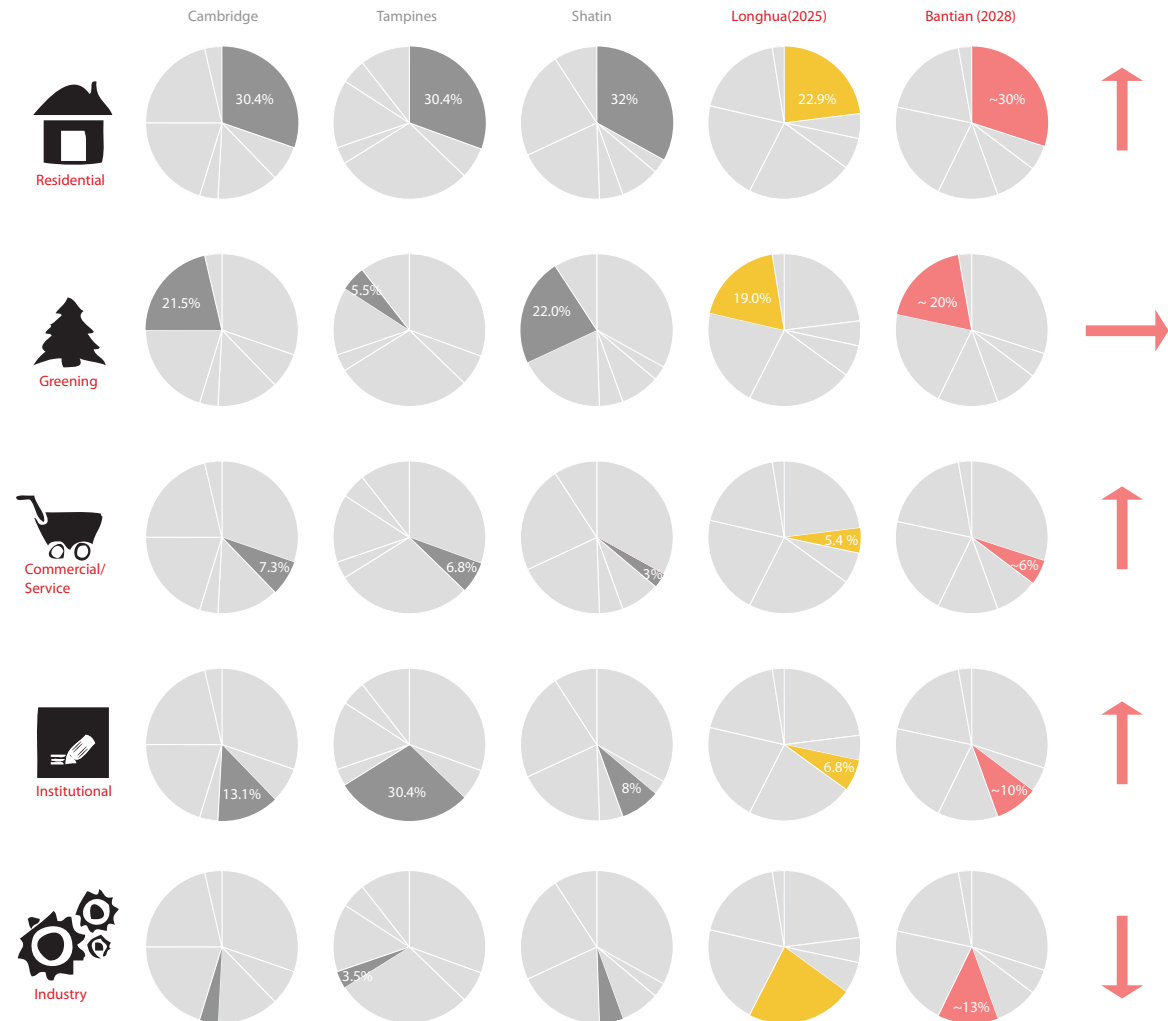
ASSUMPTIONS

Land Use

The land use structure in Bantian will dramatically alter as the industry upgrading and city sprawl continues. In this section, the land use composition of Shatin, Tampines and Cambridge are reviewed in order to project the structure for future Bantian. The land use planning in Shenzhen's Long Range Planning (2005-2025) is also referred to estimate the residential, greening space, institutional, commercial, and industrial land use proportion for Bantian in 2028.

Residential

In Tampines, Shatin and Cambridge, although the sizes of the town and the land use compositions vary, residential land takes up approximately 30% of the total area for all three. This suggests a proper residential proportion that a developed district should have. The Longhua District (2005-2020) Plan projected 22% of land area devoted to residential use for 2025. (Shenzhen Central Sub-District Planning (2005-2020) 2005) As a town center, Bantian's residential land should take up a higher proportion of nearly 30%, which is around 8.5 km². The community facilities will primarily serve these residential areas.



Land Use Composition Analysis > Source: Cambridge Community Development Department 2006, Urban Redevelopment Authority 1993, Hong Kong Planning Department 2002, Shenzhen Planning Bureau 2005

Open Space

In terms of natural land and open spaces, the proportions in Cambridge and Hong Kong are fairly close to each other, at around 20%. The denser and more built-up Tampines has fewer natural spaces; hence it only has about 5.5% of its land as open space. Bantian is bordered by continuous hills on its east and north, which gives it the potential of a relatively high open space proportion. The future plan of 19.8% already matches the Cambridge and Hong Kong level, so it is reasonable to apply this assumption to Bantian.

Institutional

In spite of limited land, the proportion of institutional use in Tampines is remarkably higher than the other cases. Cambridge, which is reputed for education and health care, also presents high standards of institutional facilities. It will take more than 20 years for Bantian to

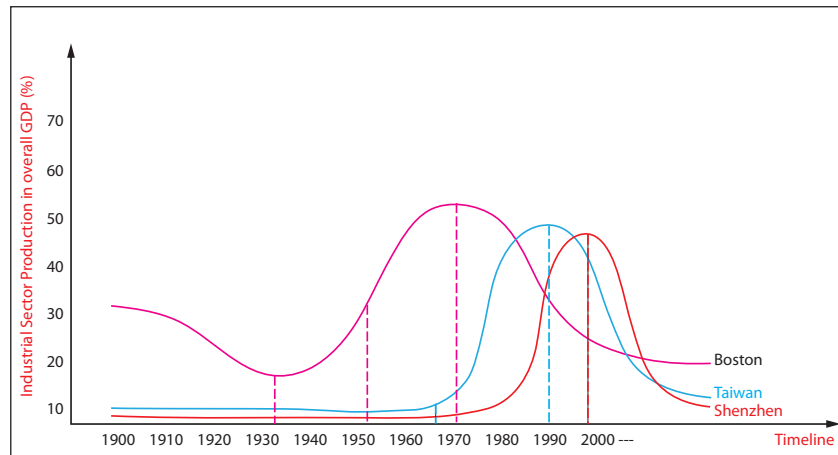
catch up. Therefore, it is assumed in 20 years, the proportion of institutional land use will be closer to the Hong Kong level, at around 8%.

Commercial

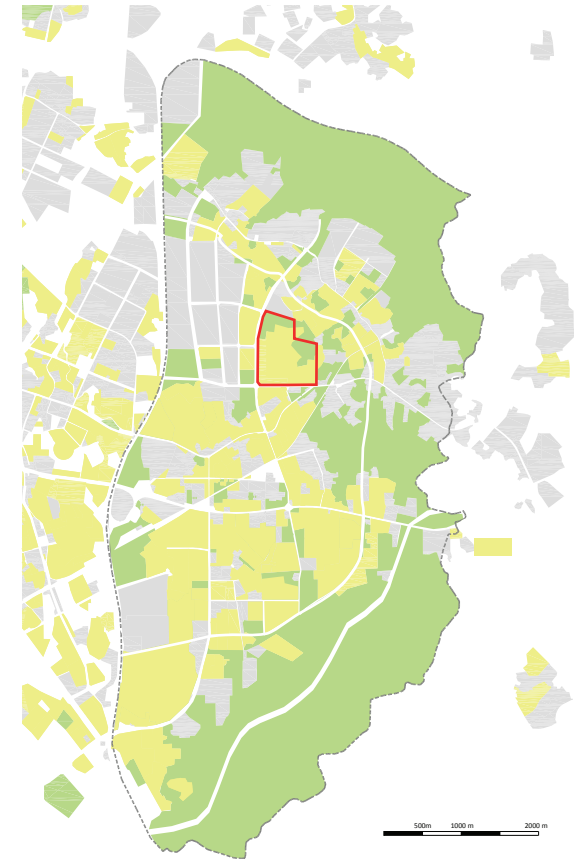
The 5.4% commercial land use for Longhua Plan is slightly behind other cases. Considering that Bantian has more prosperous commercial activities, the proportion of commercial land could be further increased up to approximately 6%, closer to the reference cases.

Industry

The diagram below shows three cities' industrial components in their overall economic structure. Compared with Boston and Taiwan, Shenzhen's industry has a sharper curve, which indicates a faster transition. Therefore, the current industrial area will potentially be transformed into other types of land uses in 20 years' time.



Industrial structure/Comparison of Boston, Taiwan and Shenzhen > The diagram shows the 3 cities' constituency of industrial sectors in overall economic structure. Source: Boston Indicators Project 2008; Amsden and Chu 2003; Shenzhen Statistics 2008



Proposed Bantian Land Use Assumption 2028

> The map summarizes the land use analysis, which adds 8% more residential area to the current base, taking the place of certain industrial land. The distribution and programming of retail, greening space, health care and education will be further developed and mapped on this base future scenario.

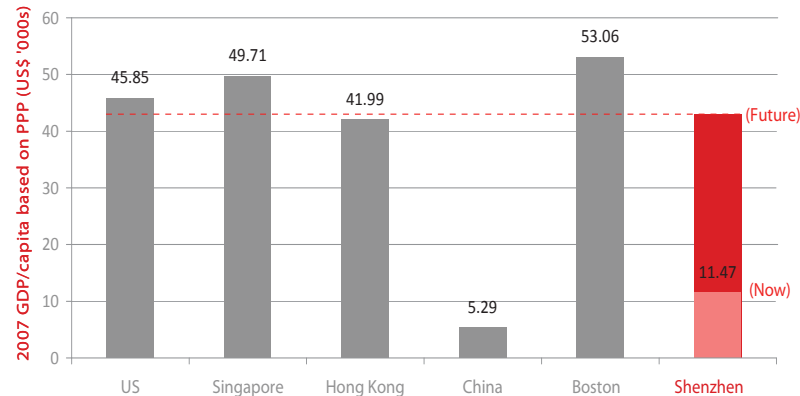
ASSUMPTIONS

Income

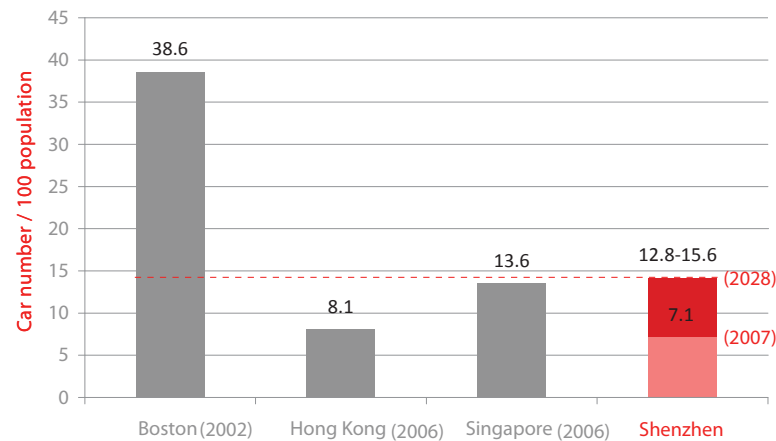
Shenzhen is the top Chinese city (NewsGD.com 2008) in terms of GDP/capita and it has passed the US\$10,000 threshold which gives it a developed economy status by the World Bank's definition. However, the disparity with Shenzhen and other advanced economies of Singapore, Hong Kong and US is still very big, but the gap will be narrowed eventually. According to projections, Shenzhen's GDP per capita is expected to grow to US\$20,000 by the year 2020 (Peopledaily.com.cn 2003). Given Shenzhen's astronomical growth for the past decades, it is assumed as an upper bound that Shenzhen's income level will be on par with the three advanced cities.

Car Ownership

The automobile development in Shenzhen has undergone three stages: initial boom (1986-1995), steady growth (1996-2000) and second boom (2001-present). According to the forecast, the growth will continue through 2010 and will slow down due to the Shenzhen reaching its road capacity thereafter. The growth rate will gradually fall from 20% to around 5%. The number in 2020 is estimated to be 2 million -2.4 million. In 2028, the car number will be between 2.3 to 2.8 million. That is 12.8-15.6 cars per 100 people. (Liu 2006)



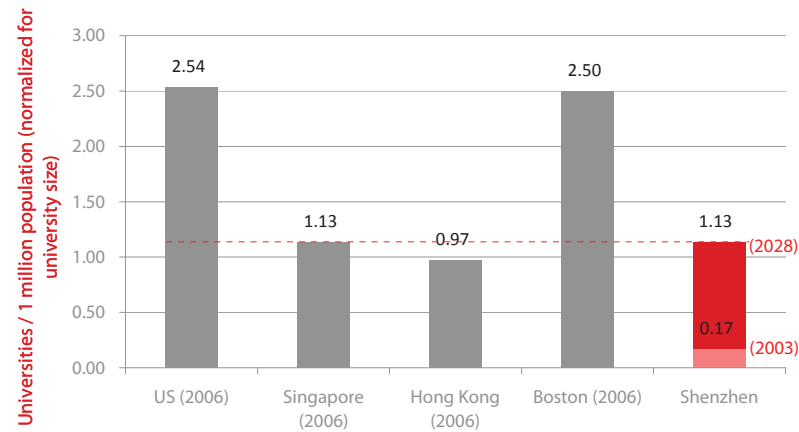
GDP/capita Comparison > Source: IMF World Economic Outlook Database 2008; American Factfinder 2008; China Statistical Data 2005



Car ownership per 100 population > Source: Liu 2002; Boston Indicators Project 2002; Singapore Department of Statistics 2007; Hong Kong Census and Statistics Department 2008

Universities per 1 million population>

Source: Digest of Education statistics 2008; Statistics Singapore 2007; Wikipedia 2008; Massachusetts Department of Higher Education 2008; Shenzhen Education Bureau 2001; Shenzhen Government 2004

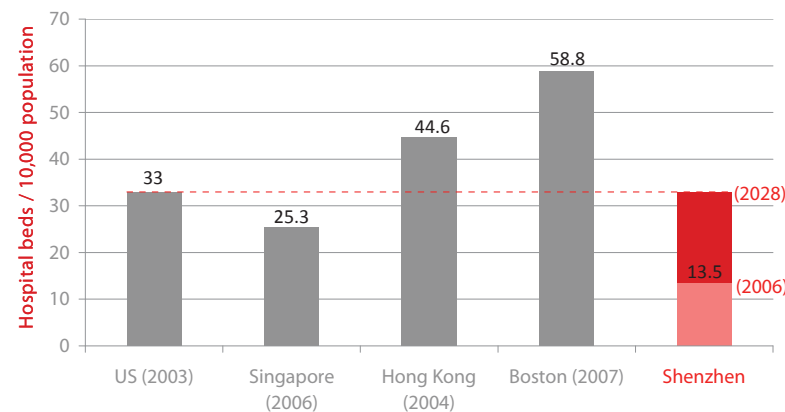


Education

Shenzhen's higher education supply falls short of the other developed cities. Even though its demographic profile and literacy levels may not demand a great level of higher education today, as Shenzhen's economy grows, naturally towards more service and tertiary industries, there will be a greater demand for university education. The team assumed that Shenzhen will be at least up to Singapore's levels of education.

Hospital beds per 10,000 population >

Source: WHO online database 2008; Singapore Department of Statistics 2008; Hong Kong Department of Health 2005. MassHealth 2008; Shenzhen Statistics 2008



Healthcare

Similarly for healthcare, Shenzhen is expected to improve its provision of services. (Gauld 1998) For this case, Boston is famous for being a healthcare and medical research hub which could explain the much higher supply of hospital beds. For Hong Kong, there could be an duplication/oversupply of hospital services, even though the number of beds is 10,000 pop. (World Health Organization 2008)

METHODOLOGY > Concept & Planning Tools

Concept

Now that the team has examined the existing conditions of Shenzhen and Bantian and made broad assumptions of where they will be heading in 20 years later, the planning tools will be established next to enable the planning of the community facilities.

The planning focus is on the district level of Bantian because of its close relevance to Vanke Town. However, where applicable, considerations for the larger Longhua district may govern certain planning provisions for Bantian which will be addressed accordingly.

For each type of community facility, the team evaluated case studies of Hong Kong, Cambridge and/or Singapore to assist in deriving the planning tools. They will be elaborated in the relevant proposal sections later.

The idea is to first apply the planning tools for each of the community facilities individually on Bantian. At the end of the planning exercise, all four types of community facilities will be synthesized onto a single plan in the most complementary and integrated way.

Planning Tools

As each type of community facility has its own unique planning requirements, the team will elaborate how to derive their planning tools

in greater detail in the respective Proposal and Case Studies sections. The purpose of this sub-section is to briefly introduce them and highlight their general commonalities in the planning of community facilities.

Classification

Different types of community facilities are desired under different context. For example, one would not expect a mega-shopping mall, a regional park system or a university to be located at their home's doorstep. Instead, one would expect a convenience store, a pocket park and a clinic to be within that range. This is essentially the team's idea in classifying these facilities.

When it comes to planning for these facilities at the district level, it is not practical to be planning for the more micro-level neighborhood assets, so the relevant district-level assets will be identified. The different classifications of facilities usually depict different quality of services, e.g. a city-level retail shop can sell luxury goods while a store with the same retail space would more likely be selling vegetables at the neighborhood level.

Quantity

Quantity essentially describes the amount of

a facility that needs to be provided, both in terms of physical number and floor area space. For retail, it is typically quantified as floor area. While each individual shop space may have the same floor area, higher category of retail would have more clustering, e.g. big shopping malls would have a bigger combined floor area compared to a neighborhood shopping center.

For hospitals and schools, it is necessary to know the number of facilities to provide for a known population of an area, which can be derived from the expected size of each facility (e.g. a 300-bed hospital, a 1,500-student school).

Aside from the physical number or floor area, it is also necessary to establish how much land area each facility would take. Retail floor area can be derived from an assumed FAR, and for hospitals and schools, planning guidelines can be established for how much land area to plan for each patient or student. Again this would be through the analyses of the case studies.

For open spaces, its quantity tool would simply be the land area required given a certain population size.

Accessibility

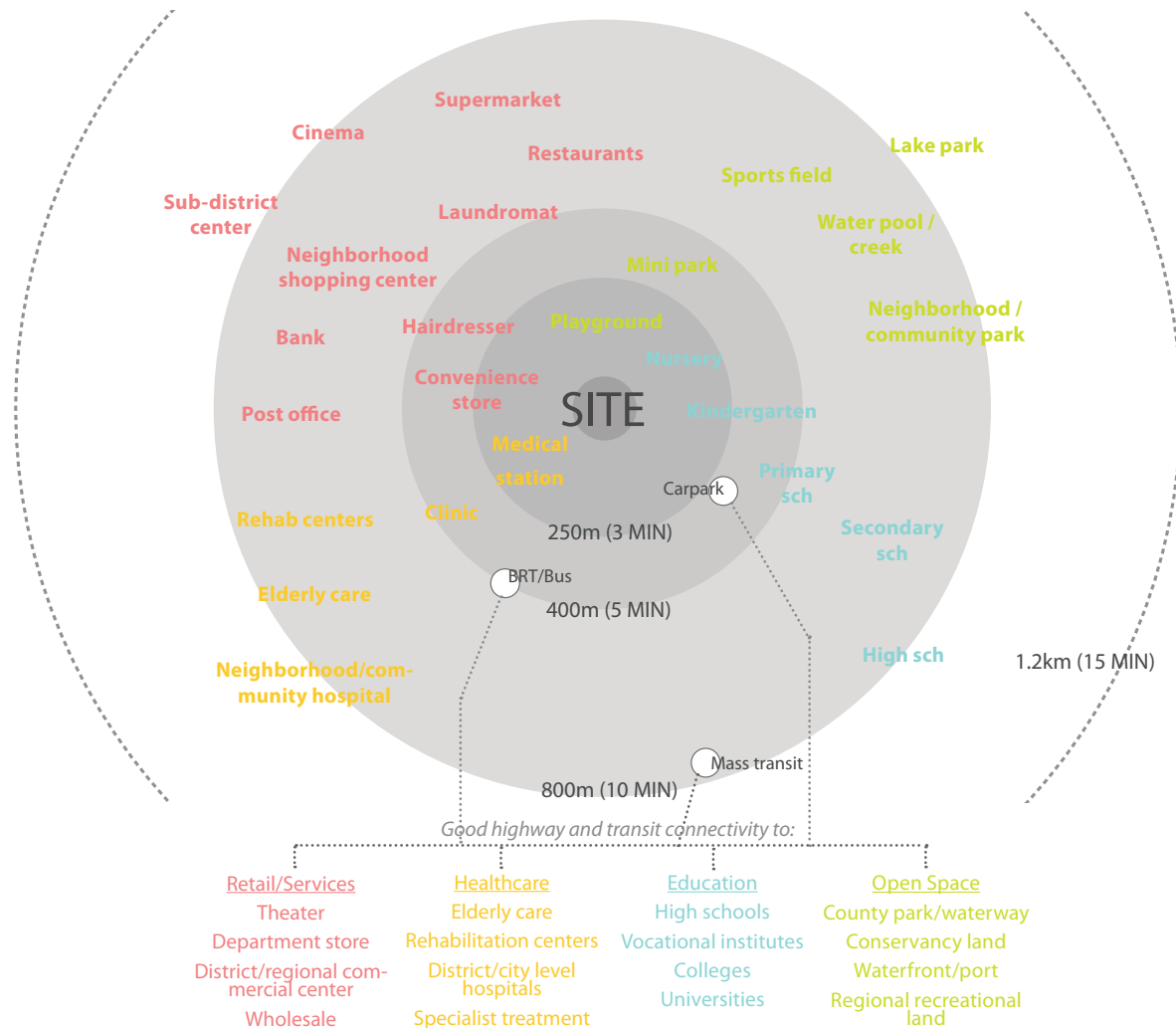
With the tools of knowing what classification and how much of each community facility to

plan for, this accessibility measures will next spatially distribute them.

In general, there are certain community facilities that are desired to be within walking distance - typically within 400m (5 min) and 800m (10 min) radii which are the criteria used in most planning literature.

However, there are community facilities that fall outside of walking range, either by necessity (takes up too much land), or they are only occasionally used so it is acceptable to travel further for such type of facilities. Generally, the higher classification of community facilities like big box retail, specialist care and regional parks fall under this category.

Even though such facilities need not be within walking range, it is still necessary to ensure that their spatial planning allows good transportation accessibility, i.e. near transit or main roads. The diagram on the right combines the analyses of each community facility that were derived from the case studies.



Ideal accessibility diagram of community facilities > This diagram shows the spatial distribution of facilities according to walking distances and times under an ideal situation. The information is derived from the case studies and research of community facilities literature.

PROPOSAL > Retail & Services

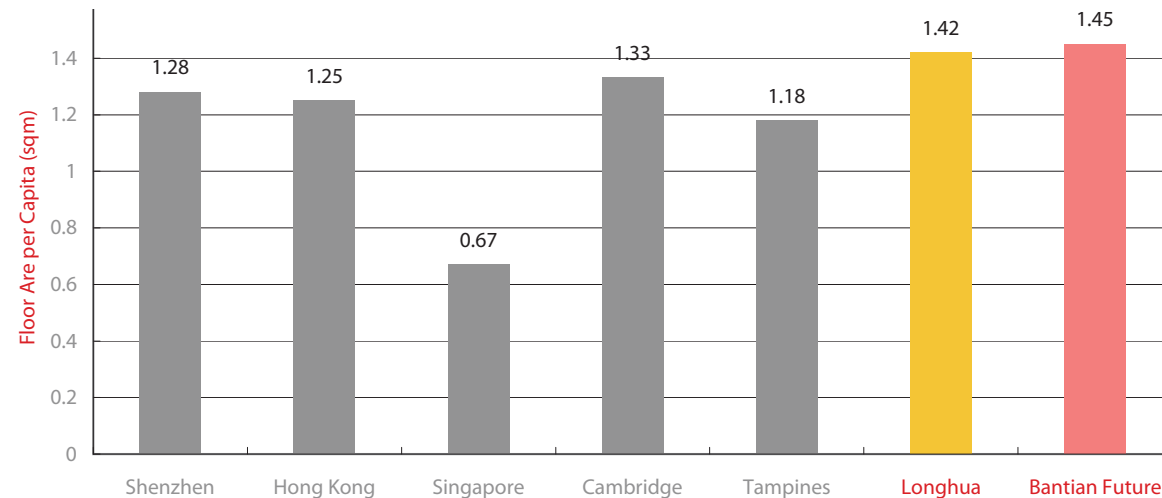
Quantity

Retail Floor Space per Capita

In order to project the future retail demand in Bantian, the team reviewed the retail floor space per capita in the reference cases to derive the planning parameter. At the city level, Shenzhen currently has 1.28 sqm retail floor space per capita, compared to 1.25-1.3 sqm in Hong Kong (ISCS Asia Expo 2006) and 0.67sqm in Singapore (Chung 2005). At the district level, information is only available for Tampines and not Shatin. The figure of 1.33 sqm per capita in Cambridge represents the level for a more developed city. The retail floor area per capita in Bantian should be higher than Longhua district, hence it is projected that it will go up to 1.45 sqm per capita.

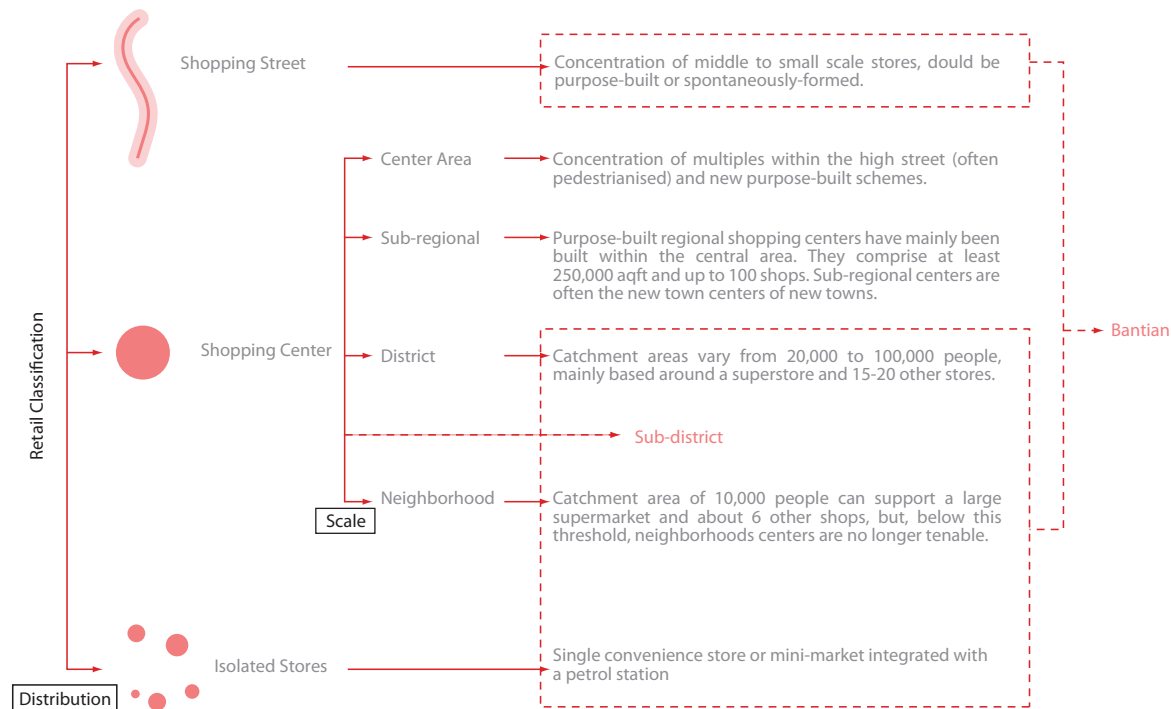
Total Retail Floor Space

Referring back to the population projection in the assumption section, the total retail floor area provided in the future Bantian would be around 609,000 sqm.



Retail Floor Area per Capita Comparison

Source: Shenzhen Business Bureau 2006; Foo, 2001; Li 2006; Cambridge Community Development Department 2006; Lushhome 2008; Chung 2005



Retail Classification > Source: Davies 1984.

Classification

Retail can be classified by the way it is distributed.

- > Linear: Shopping Street
- > Cluster: Shopping Center
- > Dispersed: Isolated Stores

The shopping centers can be further classified by scale. The figure on the left provides a conventional description about each type of shopping center. Given Bantian's administrative hierarchy, size and population, the team believes the retail facilities should compose a couple of district centers, some neighborhood centers, some shopping streets and a number of isolated stores. In addition, considering Bantian's long north-south dimension and its population density, another level of shopping is introduced between the town center and neighborhood center in order to bridge the two centers at a more intermediate level - the sub-town center.

PROPOSAL > Retail & Services

Scale and Catchment

With reference to the retail planning guidelines of Hong Kong and Singapore, the following standards for scale and catchment in Bantian were developed. By multiplying the catchment population by the retail floor area per capita, the total retail floor space in each shopping center/street is derived. From there, the team assumed an FAR of each type of retail to derive the approximate site area. The assumed FARs are 3.0 for district centers, 2.5 for sub-centers, 1.5 for neighborhood centers shopping centers, 1.5 for shopping streets and 0.8 for isolated stores.

Scale and Catchment Population of Different Retail Nodes> The catchment population of each retail prototype is derived from Hong Kong and Singapore case studies.

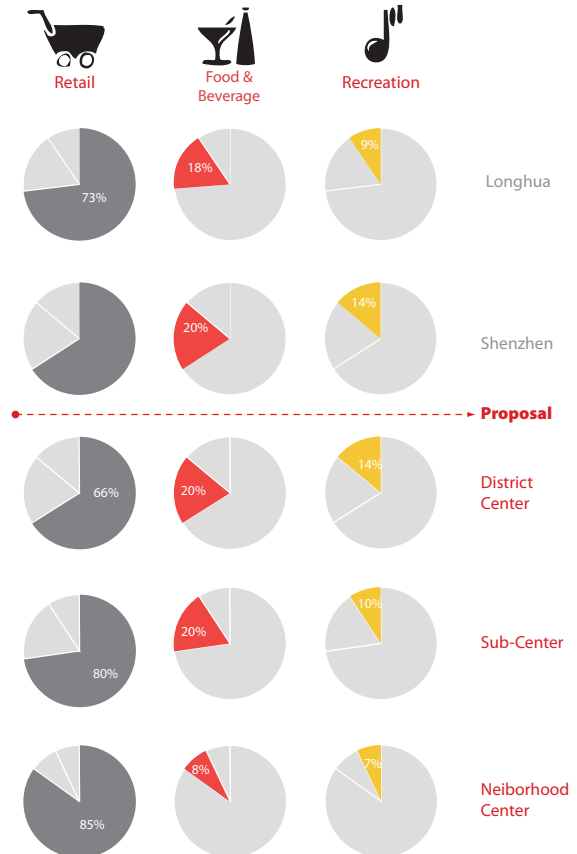
Hierarchy	Catchment Population	Floor Area	Foot Print Area
District-Center	70,000	99,400	19,880
District Sub-center	40,000	56,800	14,200
Neighborhood Center	10,000	14,200	5,680
Shopping Street	15,000-20,000	21,300-28,400	10,750-14,200
Isolated Stores	<200	<284	<2,84

Business Scope

Different level of centers and streets will target different business areas:

- > Town center: Significant concentrations of retail facilities, restaurants, entertainment and social facilities.
- > Sub-town center: Significant concentrations of retail facilities and restaurants, but limited entertainment and social facilities
- > Neighborhood center: Small-scale concentrations of shops, support town center retail services and restaurant establishment
- > Shopping Street: Serve as substitute to the neighborhood center in terms of grocery shopping and daily supplies. Concentration of small to middle scale retail, with the major type of specialist stores, certain amount of entertainment and F&B facilities.

The proportion between retail, F&B and recreational business will also vary because of the different business scopes. The Longhua retail development report indicates that Longhua currently has an overly high proportion of retail and lacks F&B and entertainment. The planning for Bantian should correct this inadequate composition, especially when the future demand for F&B and entertainment will



Distribution between retail, F&B and recreation in different level of shopping centers>Source: Li 2006

grow further as the income increase. Therefore, the business composition in the district centers in 20 years should be on par with the current Shenzhen city level. The proportion of catering and entertainment decreases as the shopping nodes get smaller in scale.

Store scales

The retail floor space should be properly distributed between the various scales of retail. Compared to the city level, small stores (under 200 sqm) take up a heavy proportion of the

Store Size (m²)	Percentage	Total Area (m²)	Number
<50	18%	107,352	2500-2700
51-100	17%	101,388	1200-1400
100-200	7%	41,748	260-280
201-500	10%	59,640	160-180
501-2000	10%	59,640	40-60
2001-5000	13%	77,532	20-25
>5000	25%	149,100	15-18

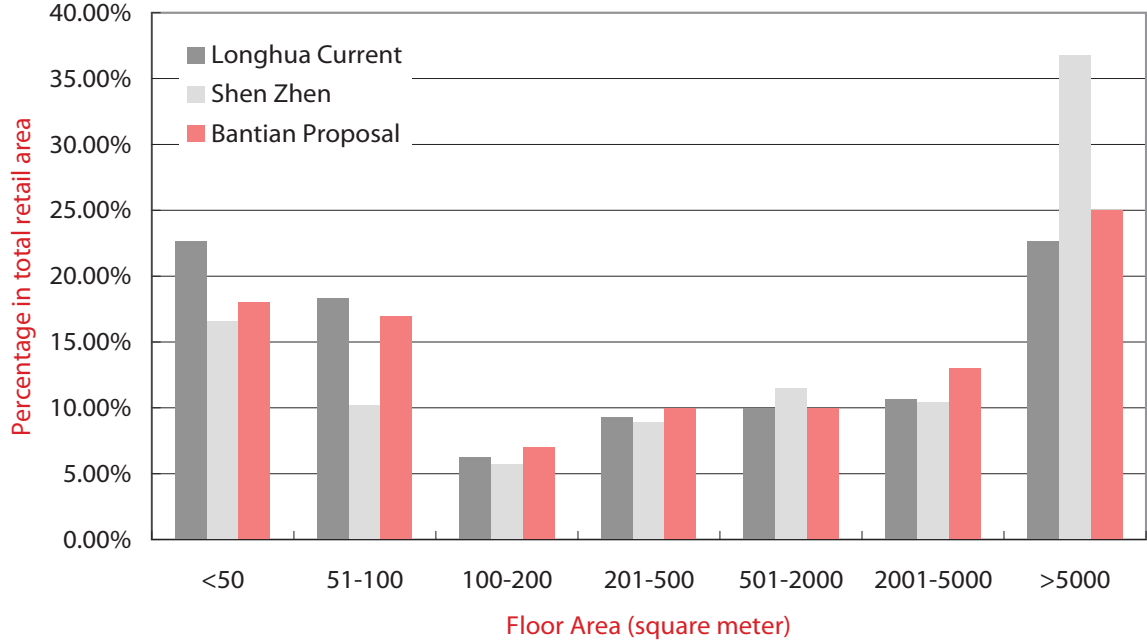
Retail Scale Distribution > This table shows the proposed scale tiers of the retail nodes in Bantian based on the analysis of Longhua District.

total retail floor area of Longhua because of the spontaneous growth of retail. (Li 2006) The district is in great need of larger retail complexity to improve both the quality and diversity of commodities. This current deficiency is taken into consideration in the retail

planning of the future Bantian. The proportion of large scale retail should be increase but still be lower than the city level in the absence of central areas and sub-regional centers.

Retail Scale Distribution

> The percentage shows the proportion of the area of each category out of the total retail floor area. The pink columns are proposed for Bantian. Source: Li 2006



PROPOSAL > Retail & Services

Accessibility

Walkability

Neighborhood centers, which are used for daily needs by residents, should be accessible within a 5-minute walk. In order to cover most of the residential area in Bantian, 18 neighborhood centers are needed.

The shopping streets aim to complement the neighborhood centers to provide daily supplies; therefore their catchment area is within 400 meters on both sides of the streets. The three commercial streets, generating from the existing retail clusters, help to cover the rest of residential areas and ensure all the residents can shop for their daily supplies within a 5-minute walk.

As the frequency of travelling to the district centers and sub-centers would not be as high as that to the neighborhood centers, longer walking distance is acceptable. Based on the case studies, the team propose 1,200 m and 800 m as the walking radii of district centers and sub-centers, respectively.

Public Transit

The town centers and sub-town centers are intended to serve a larger population, some of which would be essentially out of walking range. Therefore, the location of these centers requires good public transit accessibility.

In Bantian's future plan, the two town centers are located within close proximity to the subway stations. Two subway stations are planned along line 5 within Bantian district. One is close to the Bantian center; the other will be located to the southeast of the Vanke Town.

District sub-centers will be located close to BRT stops. The BRT will run through the north-south arterial road in Bantian with four stops within the district. The two sub-centers will be placed near the stops at the Vanke Town and Wonderland stops, respectively. These subcenters will provide daily supplies, F&B and entertainment facilities for the northern and southern sections of the district.

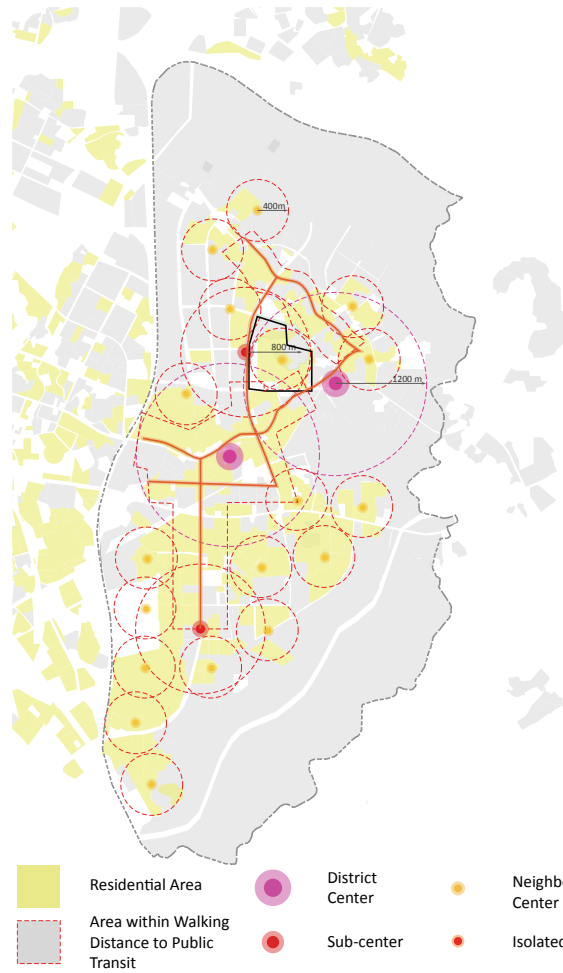
In addition, a shuttle route circling within the district is proposed to link the neighborhoods

at the southeast part of the district, which are out of walking distance to both the BRT and the subway, i.e. to the larger retail nodes. The route planning of the shopping shuttle can also be integrated with the neighborhood centers. This proposed shuttle could be part of the public bus network to enhance the connections between the inner and outer district areas.

Pedestrian Connection Pathways

Pedestrian and bicycle-oriented connections will be created to link the neighborhood to the larger scale retail nodes. A good pedestrian environment will encourage residents to circulate between different retail nodes and allow fuller use of all retail facilities. This concentration of pedestrian traffic along the connection pathways will further catalyze the increase in retail activity along them. It will be attractive for isolated stores to be distributed along these pedestrian pathways due to the high human traffic.

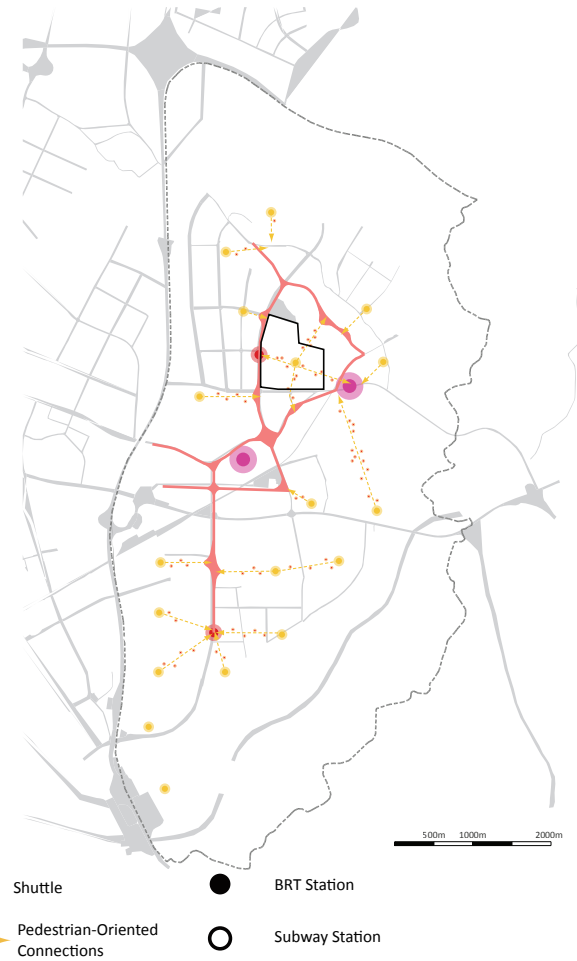
Walkability of the Shopping Centers and Streets



Public Transit Connection Between the Centers



Pedestrian Connections and Distribution of Isolated Stores



PROPOSAL > Healthcare

From the conceptual methodology introduced in the previous section, this section will now develop the healthcare proposal for Bantian. The team chose to study Cambridge, Massachusetts, USA and Tampines, Singapore because they are in relatively same scale as Bantian. Through their case studies, the finer details of the planning tools, i.e. classification, quantity and accessibility, are determined.

Classification

Both Cambridge and Tampines have hospitals serving them, which is similar to what Bantian has now for its healthcare services. Tampines hospital care has fewer beds for its population, but that is because Singapore has a different healthcare concept. In Singapore, hospitals are really the tertiary level of care that people go to for major ailments, unlike those community ones in the US and Shenzhen, where they serve a primary care function, too. Nevertheless, the healthcare services in Singapore is still expanding and it is expected that Shenzhen will continue in its current trend and be closer to the US for its level of provision. Going back to the earlier analysis of the existing conditions healthcare in Bantian, it is also expected that the existing community hospitals would need to be upgraded to bigger and more comprehensive hospitals to cater to a higher

population density.

Another healthcare asset that was identified in Cambridge and Tampines is intermediate care services like nursing homes, hospices and rehabilitation centers. By this, the team is referring specifically to facilities that provide medical care for non-urgent cases but which require regular attention. This ranges from elderly homes that provide medical attention, to hospices for the terminally ill to day rehab centers for those which are still physically mobile. Social elderly homes and assisted living facilities are excluded from the definition.

Currently Bantian seems to be lacking in such intermediate care facilities and it is foreseen that as its population ages and when retirees join their children or relocate on their own accord to Shenzhen, there will be a demand and need for this intermediate care sector.

Quantity

Regarding quantity, the planning tool that was adopted is beds per 10,000 people. While it is acknowledged that healthcare provision is a complex issue involving quality of care, hospital staffing, healthcare affordability, etc. but the use of hospital beds 10,000 population is a good proxy to plan for the spatial distribution of healthcare. Regarding the size of the healthcare facilities the team uses, the

tool of land area per 100 hospital beds that was derived from the case studies is used. The details from the case studies and the rationale for deriving the guidelines for Bantian's use can be found in the case studies section. The summary is reproduced in the table below.

Recommended healthcare planning guidelines for Bantian

Healthcare classification	Beds / 10,000 pop	Land area / 100 beds (ha)
Hospitals	33	0.72
Intermediate care	20	0.31

Based on Bantian's assumed future population of 420,000, the future healthcare services that need to be planned can be projected. Another assumption is that the facilities to be planned for are 400-bed hospitals and 200-bed intermediate care facilities. At the broad planning level for the entire district, these basic assumptions are sufficient, but when planning progresses to the more detailed planning at the neighborhood level, land area will need to be adjusted based on the demographics and density in the immediate area. The table below summarizes the healthcare requirements that need to be planned for Bantian.

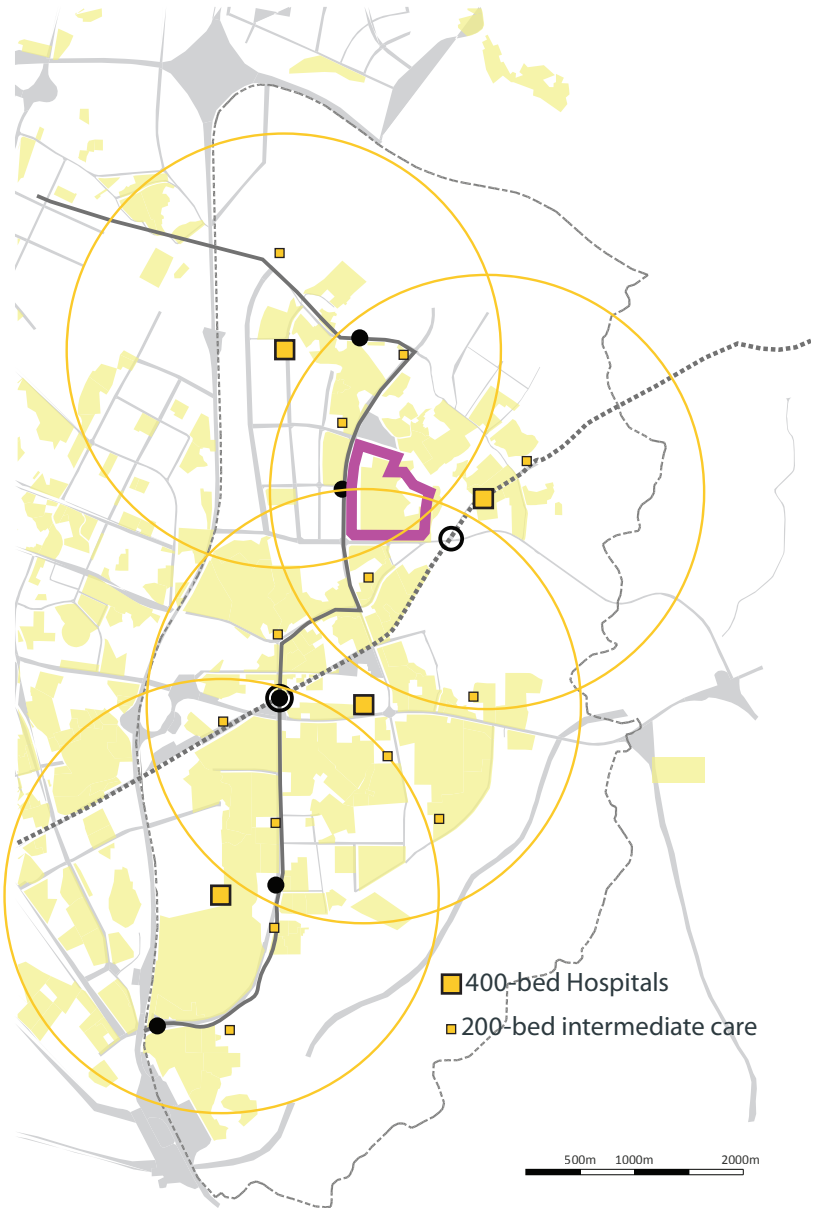
Facilities to Be Planned Bantian > Derived from planning guidelines in previous table and assumed Bantian population projections.

Healthcare classification	Facility capacity	Land area (ha)	Qty
Hospitals	400-bed	2.9	4
Intermediate care	200-bed	0.6	13

Accessibility

Between the spatial planning of healthcare in Cambridge and Tampines, the team's inclination is to go for the Tampines model because of its higher density and Shenzhen's likely lesser reliance on automobiles (as compared to the US), therefore the facilities are required to be sited conveniently. Hospitals do not need to be within walking distance because they are occasional visits, but it is important that they have good highway and transit access for ambulances and patients. For intermediate care, while it is desirable for them to be of a convenient distance, it may not be realistic for intermediate care patients to walk excessively. Hence they should have good transportation connectivity too.

Proposed Plan of Healthcare Provision in Bantian > The hospitals are shown with an equivalent service radius of 2 km which easily covers the entire district. The 13 intermediate healthcare facilities are equally distributed throughout the area to maximize their service coverage.



PROPOSAL > Education

For the planning of education in Bantian, the team's approach is similar to that for healthcare. By examining the same case studies of Cambridge and Tampines, the planning tools in classification, quantity and accessibility for school planning in Bantian will be derived.

Classification

From the case studies and the earlier analysis of the existing education provision in Bantian, the team proposed that four classifications of educational facilities are needed for the future Bantian district level: tertiary vocational institute, high school, secondary school and primary school. The two new classifications of high school and tertiary institution are in expectations that Shenzhen's population will demand more higher education in 20 years' time, not unlike what Singapore is providing now in Tampines housing estate.

Quantity

For quantity, the team based the planning guidelines on the number of enrollment spaces per 10,000 population - this determines the number of schools to be planned. Another guideline of land area per 100 students is also used to size the facilities. The derivation of the planning figures are described in more detail

in the case studies, and the summary table is reproduced below.

Recommended Education Planning Guidelines for Bantian

Educational category	Enrollment space / 10,000 pop	Land area / 100 students (ha)
Tertiary (Vocational)	230	0.2
High sch	100	0.3
Secondary sch	550	0.2
Primary sch	800	0.1

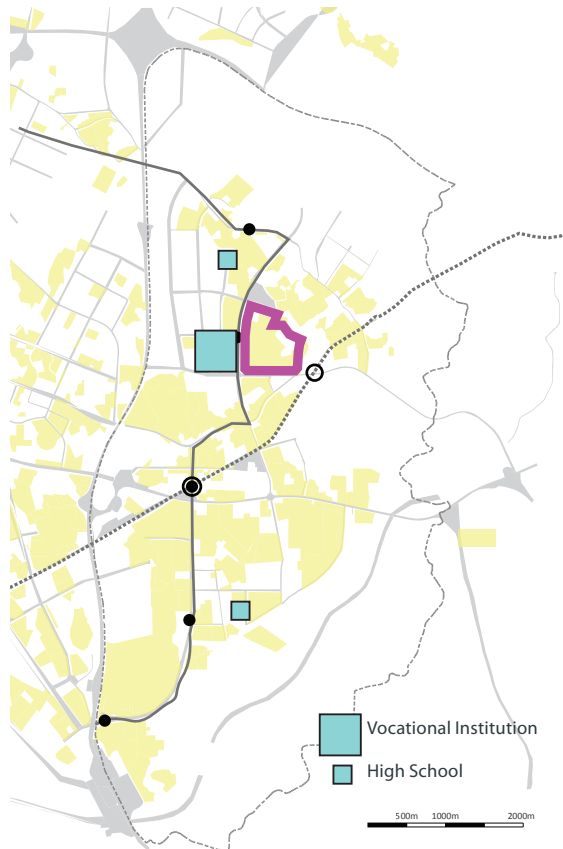
From these parameters and the future population projection of Bantian, the quantity of facilities to be planned is derived. Like the healthcare considerations, assumptions were made for the capacity of the facility that are being planned, like each secondary school has 1,500 students, etc. Similarly this can be fine-tuned at the detailed planning stage.

Facilities to be planned for in Bantian > Derived from planning guidelines in previous table and assumed Bantian population projections

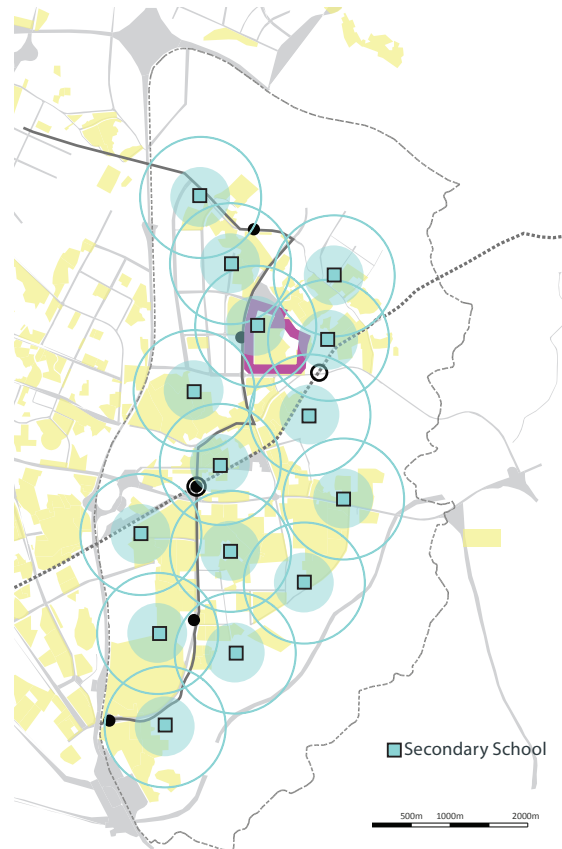
Educational category	Facility capacity	Land area (ha)	Qty
Tertiary (vocational)	15,000	30	1
High sch	1,800	5.4	2
Secondary sch	1,500	3	15
Primary sch	1,500	1.5	22

Accessibility

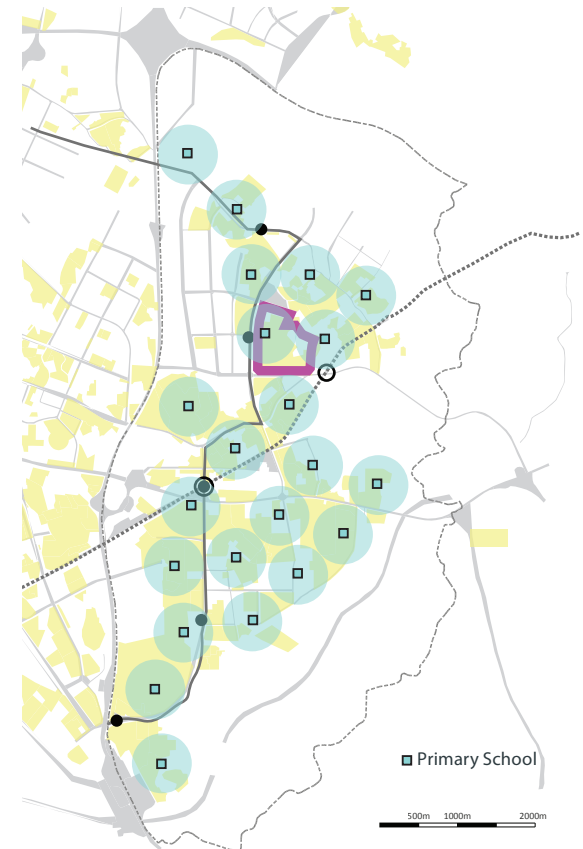
The consideration for the spatial planning of the educational facilities are explained in the case studies. The Singapore model is more relevant for Shenzhen or Bantian in this instance. For institutions at the high school level and above, students are more independent and physically mobile. Additionally, the school comes from a larger catchment; hence they need not be within walking range, but it is crucial for them to be near transit since that is the only possible means of transportation for most students. Primary and secondary schools are proposed to be within walking distance: the former within a 400m walking range, and the latter within an 800m range.



Proposed Tertiary Institution and High Schools in Bantian
 > The planning consideration is for the schools to be near to a transit node, which in this case is the future BRT system.



Proposed Secondary Schools in Bantian > The planning consideration is for the schools to be within an 800m walk from a residential neighborhood.



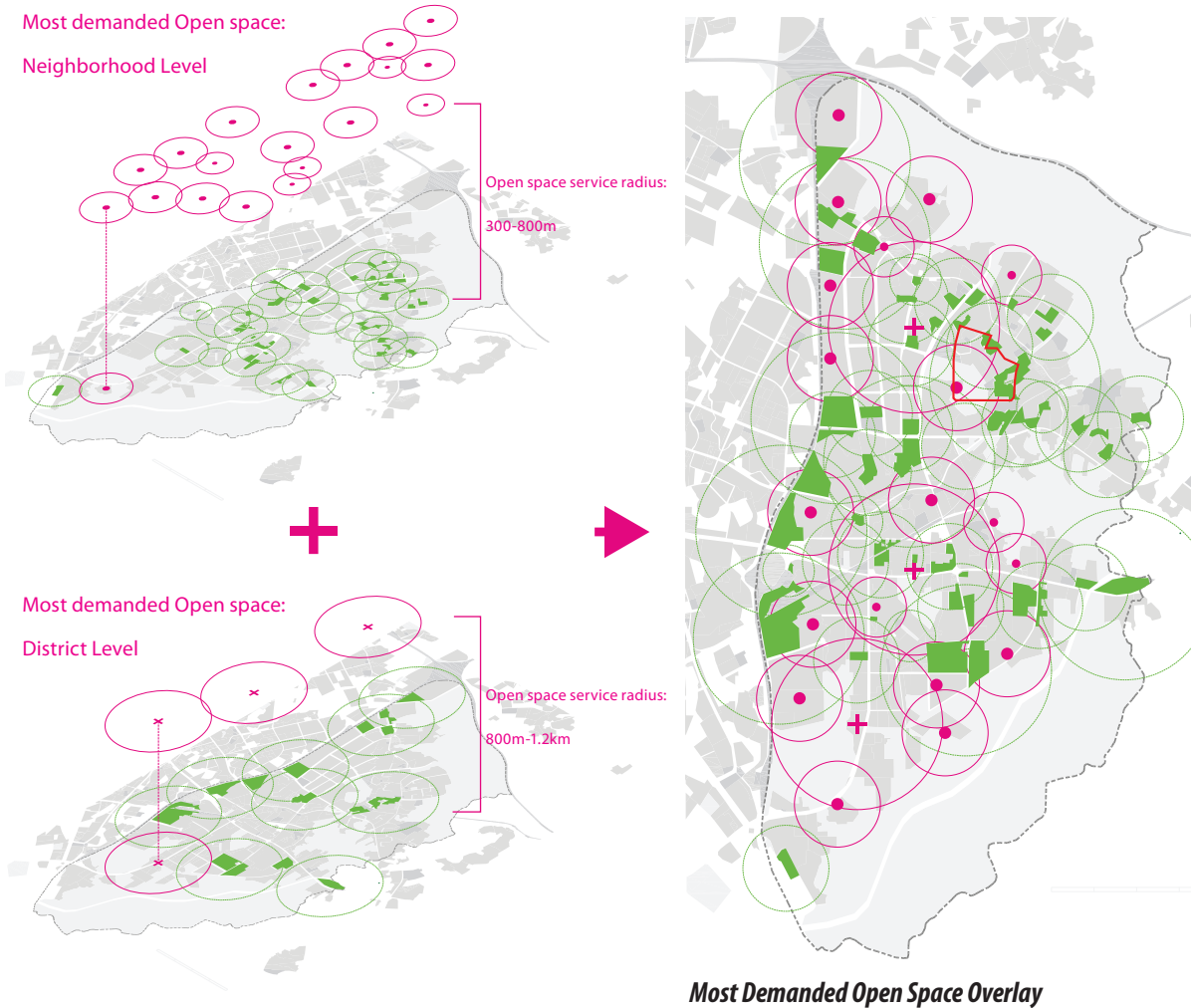
Proposed Primary Schools in Bantian > The planning consideration is for the schools to be within a 400m walk from a residential neighborhood.

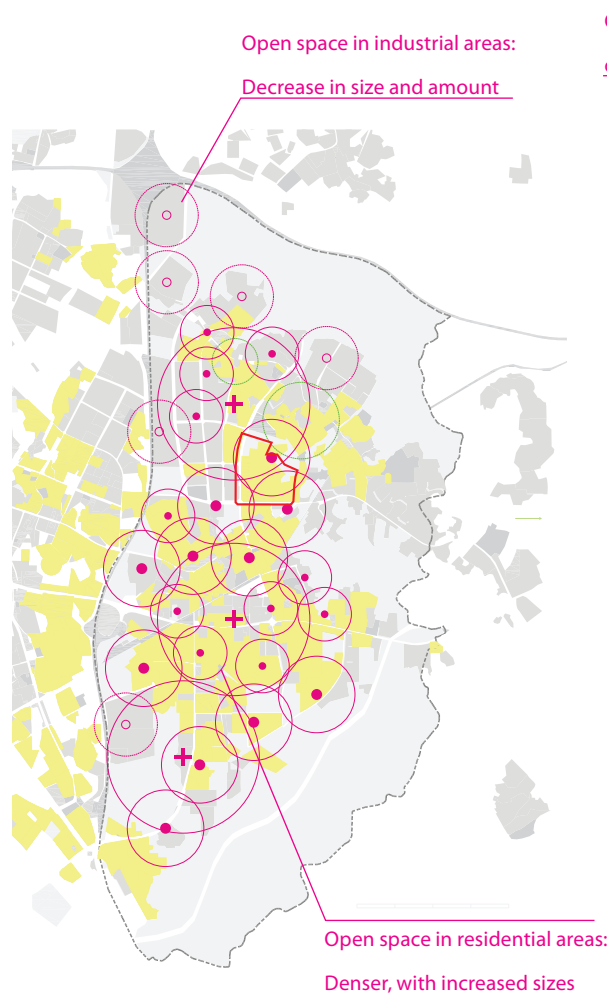
PROPOSAL > Open Space

Will the Existing Open Space Satisfy Future Needs?

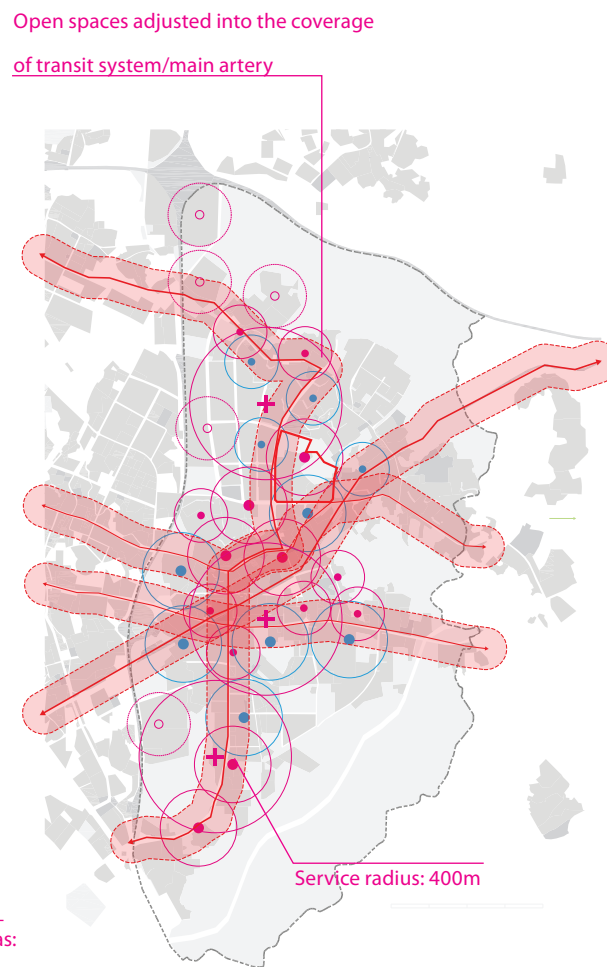
The future scenario of the Bantian area is established on the basis of a good network of pedestrian and public transit system. Therefore, it is important to examine whether the current open space can cover the whole Bantian area. If not, it is necessary to identify the distribution of the most demanded open space, according to the methodology used in planning Cambridge's open space system. (Cambridge Community Development Department 2000)

The diagrams on the right identify the most demanded open space at the neighborhood level and district level separately, as these spaces have different programs at different levels. The two layers of distribution are then overlapped to show the juxtaposition of existing open spaces and most demanded spaces on both levels.





Open Space Re-distribution >
Residential/Industrial Area



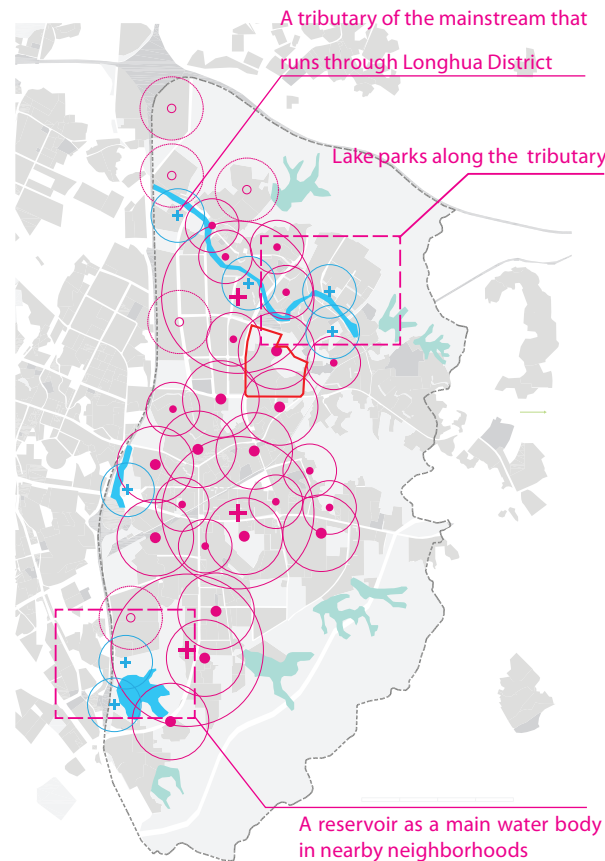
Open Space Re-distribution >
BRT/Subway/Main artery

Factors Affecting Spatial Distribution

This distribution is proposed on the basis of an ideal situation: a uniform urban fabric. However, there are several important factors that would affect the distribution of the open spaces: different land uses that require different physical sizes of the open spaces, and traffic systems that would provide accessibility to these amenities and to water bodies. These factors combined together shape the spatial patterns of the open spaces.

Factors Affecting Spatial Distribution

Water bodies are another factor shaping the spatial distribution of the district and neighborhood open spaces; a tributary runs from the northwest through Bantian and a reservoir on the southwest. Therefore, a number of lake parks are proposed along the water bodies, which will establish the future “lake park nodes”.

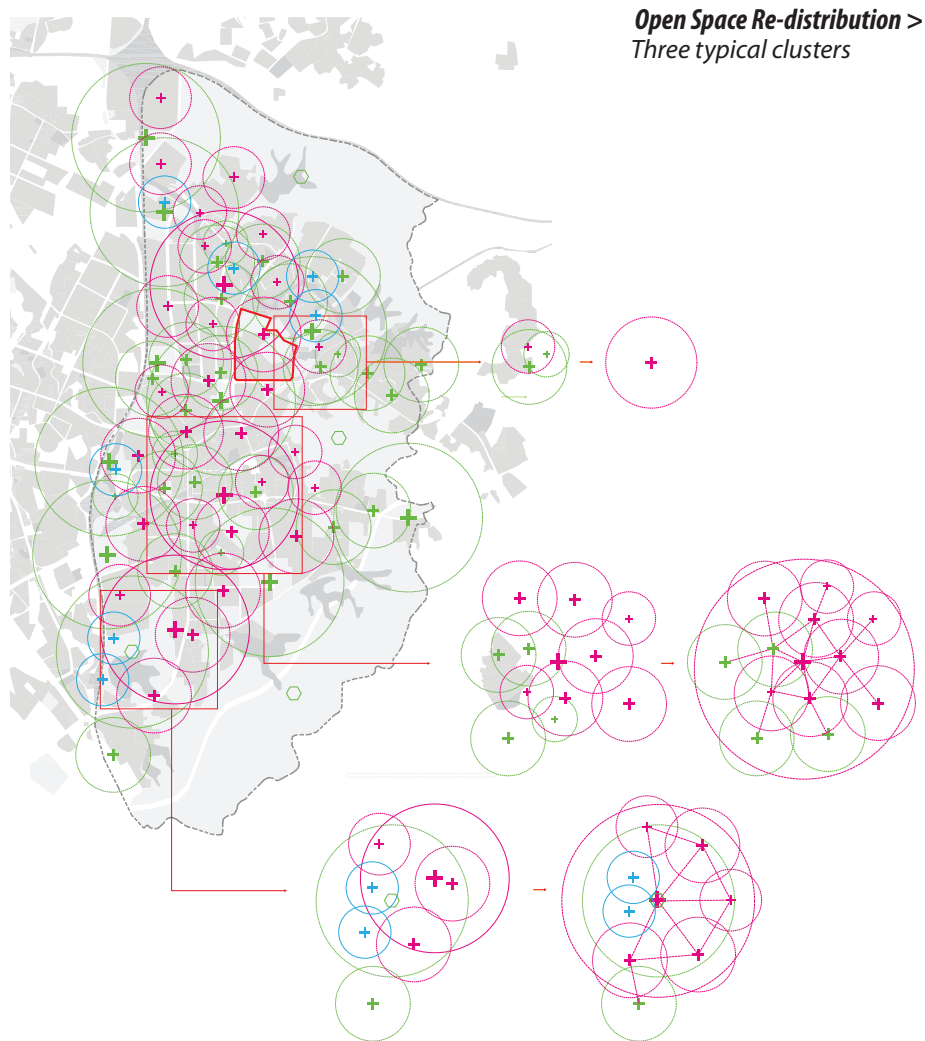


Lake Ontario Park, Canada > Source: Field Operations 2008



Lake Park at Fresh Kills, NY > Source: Field Operations 2008

Open Space Re-distribution >
Water bodies in different scales/contexts



Study of Pattern: Clusters of Open Spaces

The relationships between open space elements are complicated when they are overlapped, for example, the existing open spaces, proposed open spaces on neighborhood level/district level, and the lake parks. Therefore, the team used three types of clusters to comprise different types of open spaces:

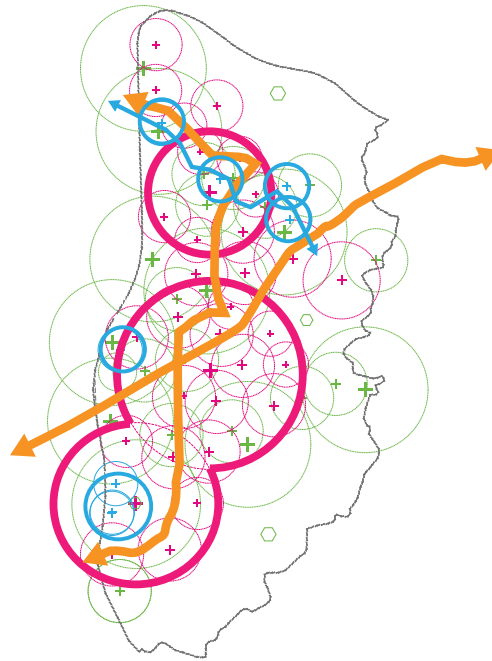
- > Evenly distributed open spaces
- > District open space as a "core"
- > Natural green space as a "core"

According to their physical sizes and service radius, the team re-structured the layouts to maximize the service coverage and at the same time maintain a certain degree of function overlay.

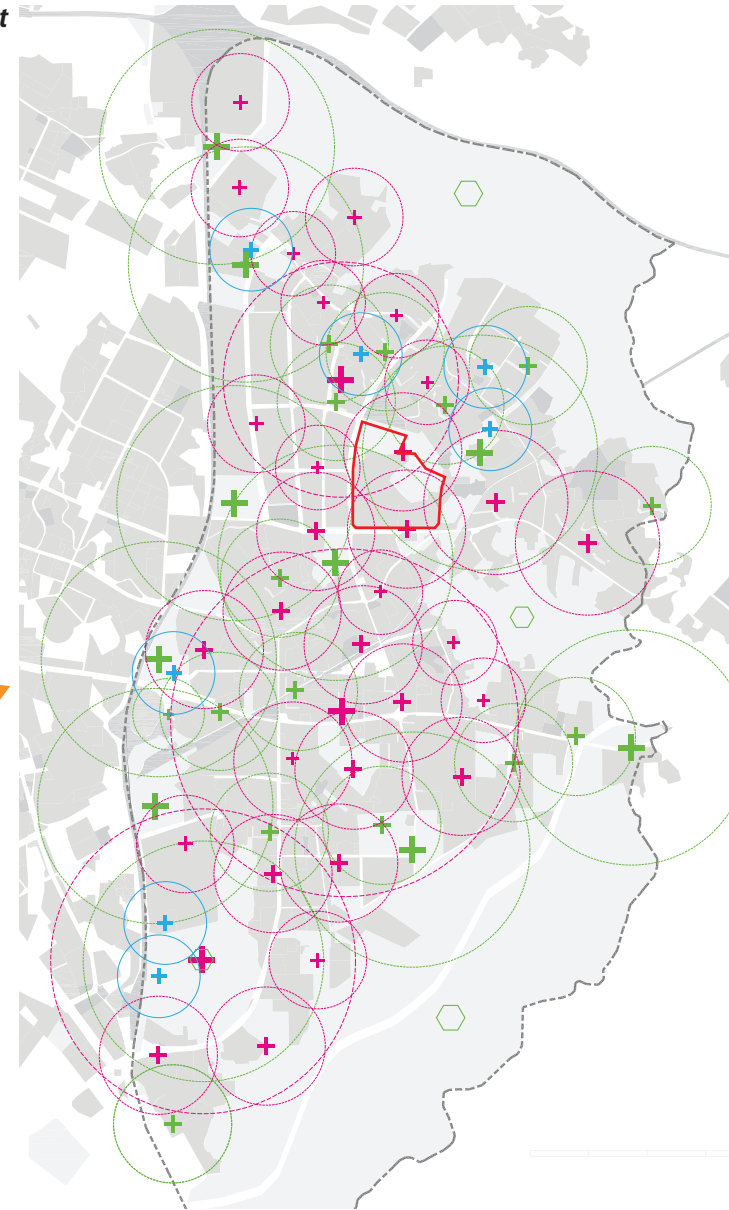
Final Layout of Open Space

The final layout clearly illustrates its characteristics: three clusters centered with district open spaces. Moreover, each of the clusters comprises different types of open spaces ranging from neighborhood open space to lake park. The main spine of the layout follows the BRT and allows for greater accessibility from the main arteries. In addition, a secondary open space corridor is formed along the water bodies that run along the northern edge of the Bantian area.

Open Space Spatial Pattern



Open Space Final Layout



INTERPLAY OF COMMUNITY FACILITIES > Best Practices

Alexandra Hospital, Singapore > With 12 ha of publicly accessible green that has 500 species of trees and a butterfly trail that boasts 100 species (Chang 2007), this is a hospital which befits the term “healing gardens” coined by Clare Cooper Marcus. (Puget Sound Public Radio 2008) Source: Chun See Lam and Memories of Singapore



University Square at University of Wisconsin, USA > These before and after images show the redevelopment of the eastern gateway to the campus into a retail, residential cum university student services hub. This project is a partnership between the university and the developer. (Lackey 2007 and Chaptman 2004) Source: Executive Management, Inc. Developments

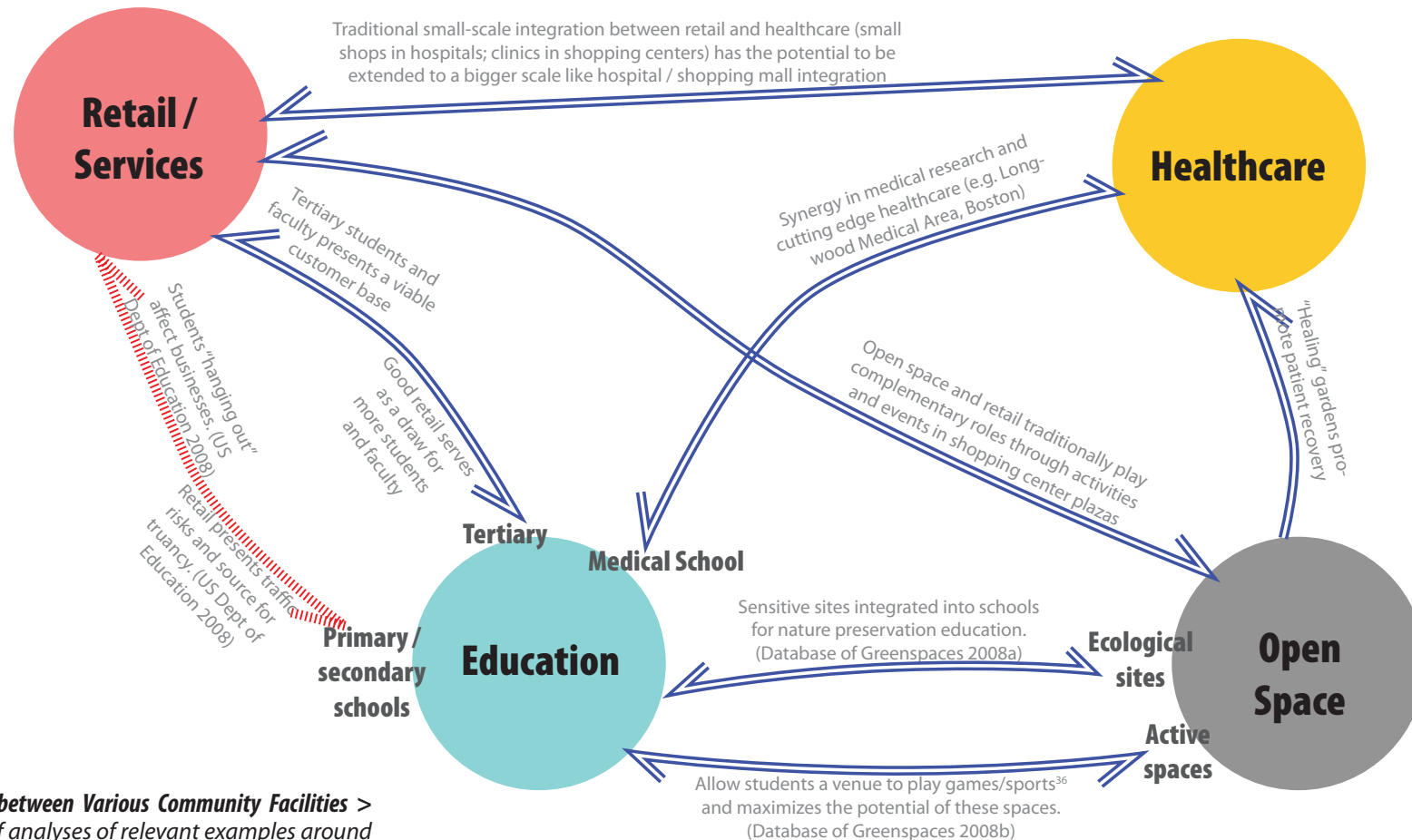
Integration of retail > Retail malls typically feature green spaces as part of their draw. Small medical facilities are common too. The reverse is also true, big hospitals and parks typically have retail clusters to provide convenience for visitors/park-goers. (Associated Press 2006) Source: Associated Press



Comprehensive mixed-facilities project > The expansion of both the shopping center and the University Medical Center at Stanford, US will create an integrated area with retail, education and healthcare. (City of Palo Alto 2008) Source: All About Stanford University

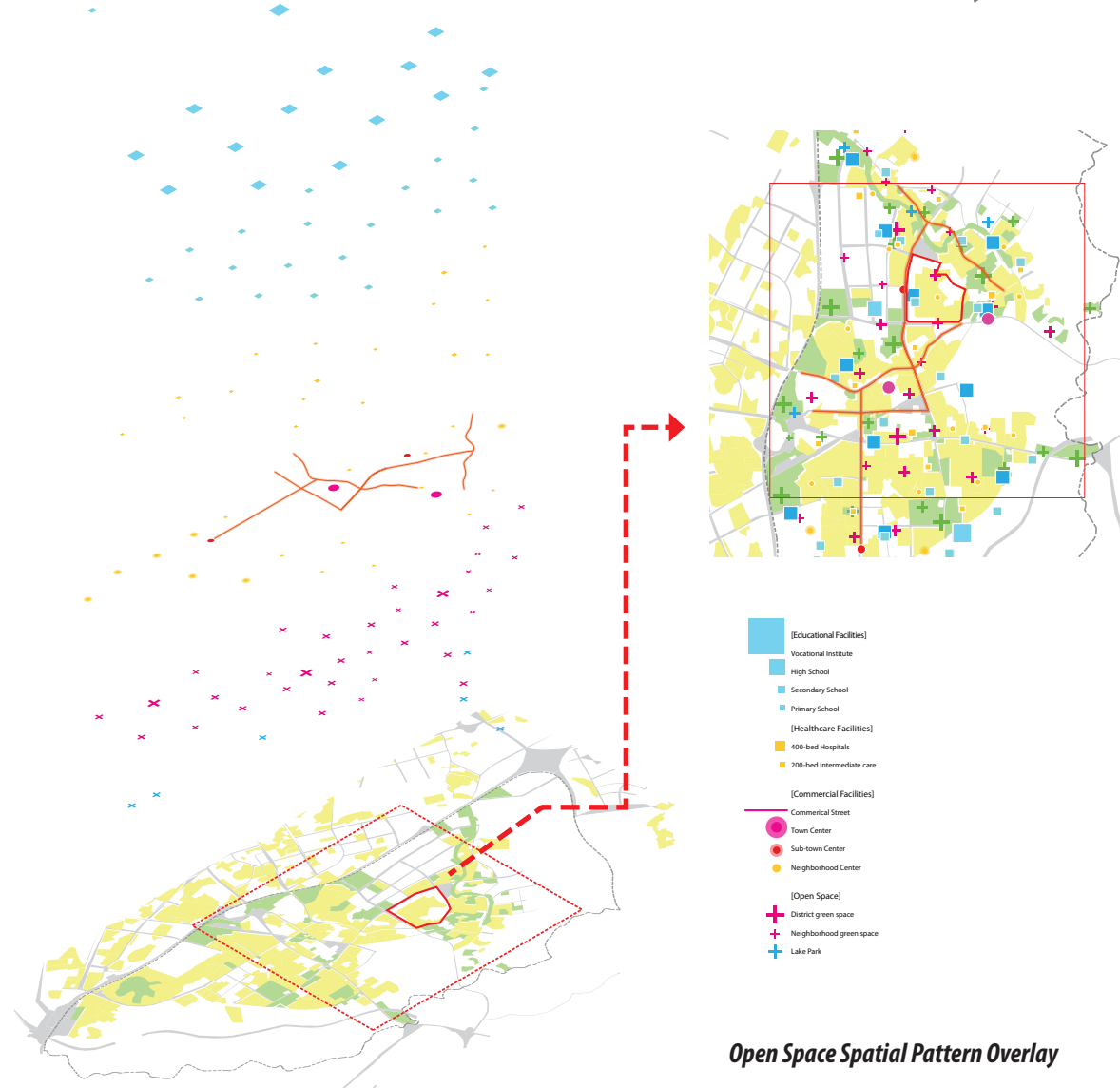


INTERPLAY OF COMMUNITY FACILITIES > Relationships



Relationships between Various Community Facilities >
Based on brief analyses of relevant examples around the world.

INTERPLAY OF COMMUNITY FACILITIES > Analysis



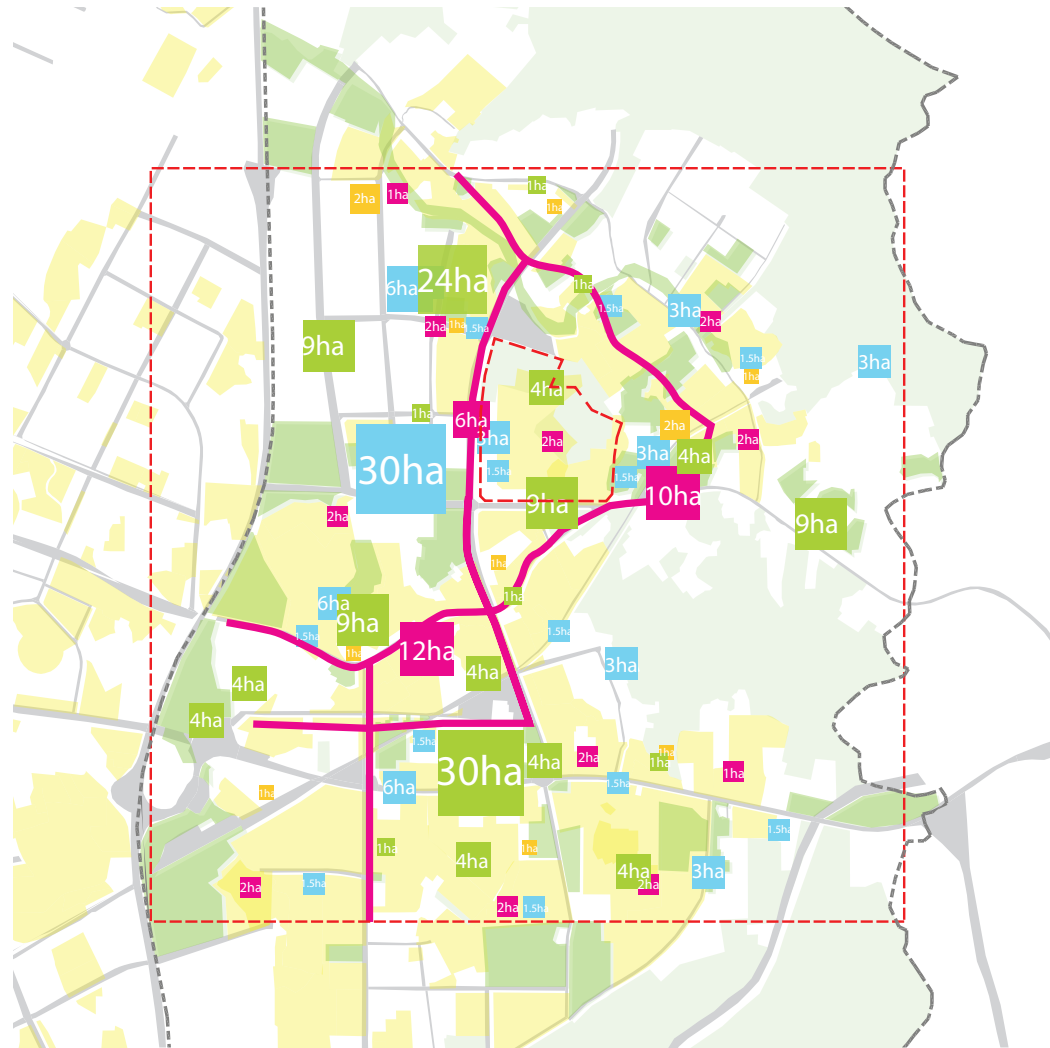
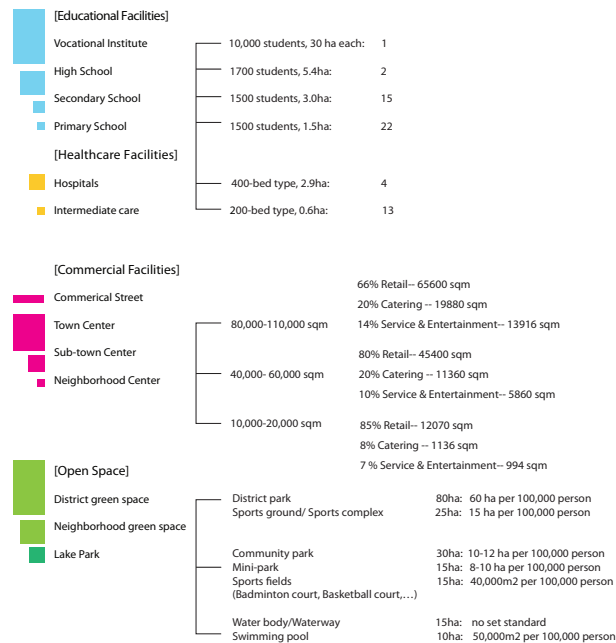
Testing the Proposal: Overlaying All Four Categories of Facilities

Based on the relationships that were established from the study of the best practices in the previous page to integrate the four community facilities of education, healthcare, retail and services, and open space, this last section of the study will now focus on deriving an integrated plan for the Bantian area.

From the previous individual proposals that were done for each category of community facility, they are now overlaid together in the map on the left and zoomed in closer to the immediate area around Vanke Town in order for the integrated plan to be derived with Vanke Town at the center.

Distribution of Area on Combined Facilities Map

This diagram illustrates the detailed assignments of the areas of each type of community facility according to the projected land use plan. The size of the rectangles are to scale.



Distribution of Areas of the Various Community Facilities

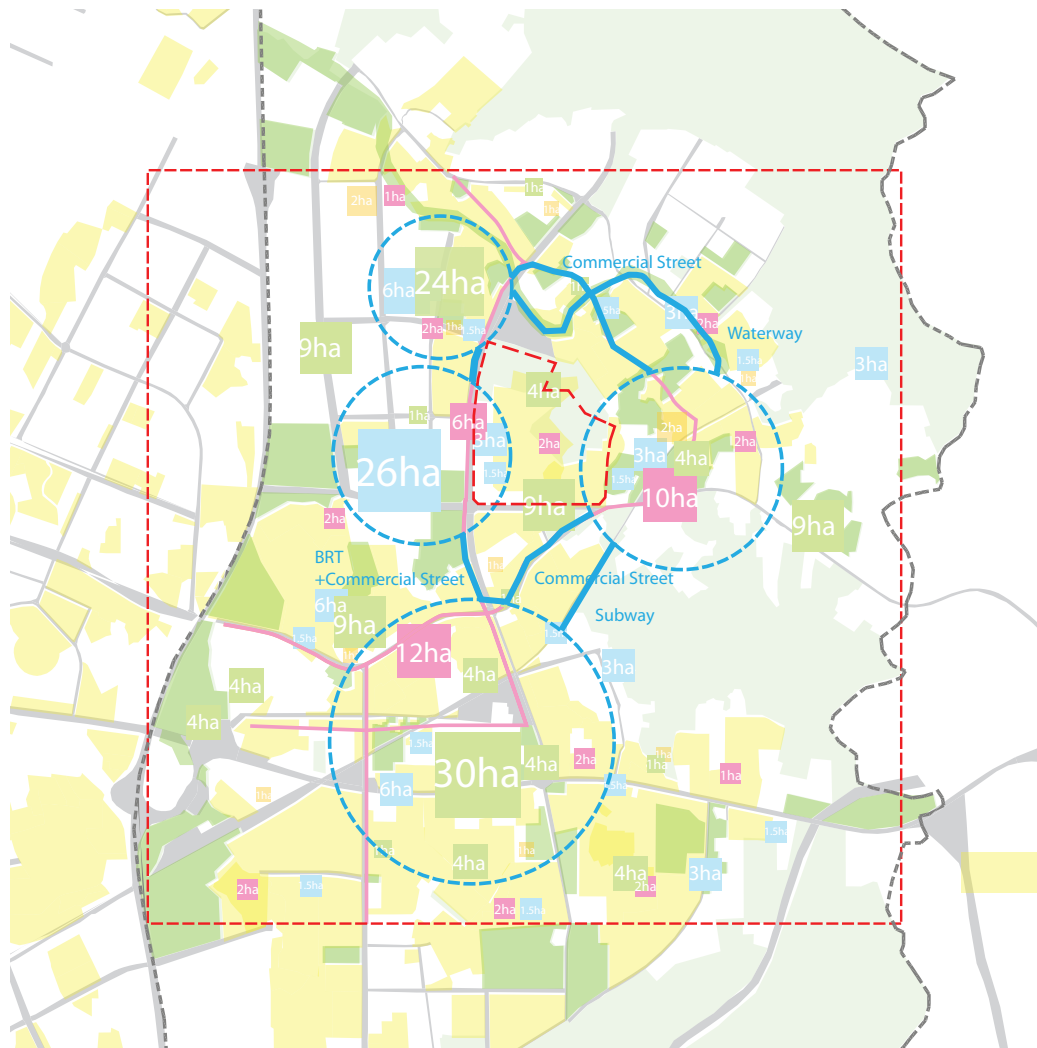


Diagram to Show Spatial Pattern of Four Clusters> These clusters are identified based on the area distribution in former diagram.

Focal Points: Four Clusters Linked with Public Transit/Waterway

From the area distribution of the facilities, four main clusters are identified in the diagram, and they are interconnected by the commercial streets, BRT/subway system, and the waterway on the north. These four clusters could be categorized as (from north to south):

- > District park
- > Educational cluster
- > District commercial center
- > Mixed-use Cluster: District park and commercial center

The following proposal will focus on these four clusters and try to delineate their specific spatial pattern.

FINAL PROPOSAL & CONCLUSION

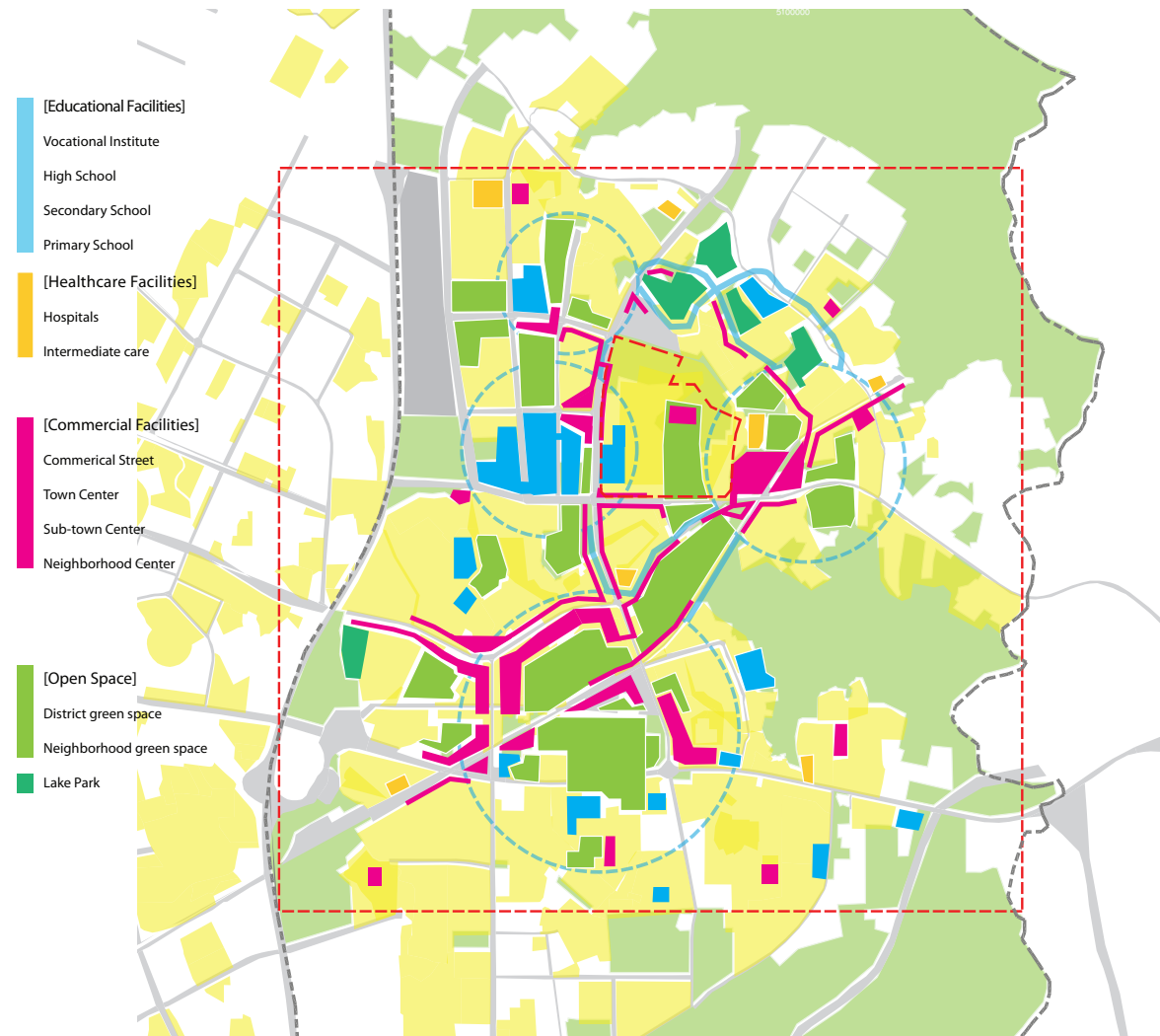
The team integrated the four categories of community facilities into the existing land use and arrived at this possible solution for the future land use of this Bantian sub-area. This proposal reflects the earlier assumptions as well as the planning guidelines that were derived from the case studies of Cambridge, Hong Kong, and Singapore.

At the detailed planning level which is beyond the scope of this study, more follow-up analyses will need to deal with the detailed programming of this proposed plan, and physical forms could be addressed then.

Takeaway for Vanke Corporation

This study of district level planning may not be directly relevant to Vanke Corp, but if Vanke Corp. is to do large scale residential master planning in future, then there would be a need for them to consider the integrated planning of community facilities to derive the maximum utility for their residents.

This study can also allow Vanke to better appreciate the planning of community facilities to enable discussion with Shenzhen's planning authorities to influence the development of community facilities around their development. As Shenzhen grows, Vanke's client base will grow as well.



Final Layout of Community Facilities

Illustrations of the Four Clusters



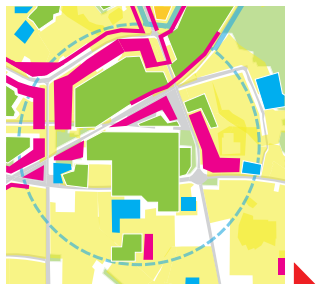
Scene: Cluster 1 > This cluster is characterized by district park surrounded by education and commercial facilities.
Source: Field Operations 2008



Scene: Cluster 2 > This cluster is characterized by a vocational institute that is established on the former industrial area. Besides, a number of high schools/middle schools adjacent to the institute constitute an educational cluster. Source: Field Operations 2008



Scene: Cluster 3 > This cluster sites adjacent to the intersection of a subway and a main artery, characterized by a large scale district commercial area.
Source: Field Operations 2008



Scene: Cluster 4 > This cluster combines a district commercial center and a 30-hectare park to establish a mix of land uses providing both services and recreational space. Source: Field Operations 2008

CASE STUDIES> Retail & Services

Retail Design Guidelines of Hong Kong

Specific Objectives of Guidelines

- > Establish broad planning guidelines to facilitate the development of functional and attractive shopping facilities through forward planning.
- > Establish criteria and methodologies which will permit choice, allow for market competition and provide sufficient flexibility to accommodate possible economic and social changes to which retailing is likely to be subject.

Shopping Center Hierarchy and Catchment

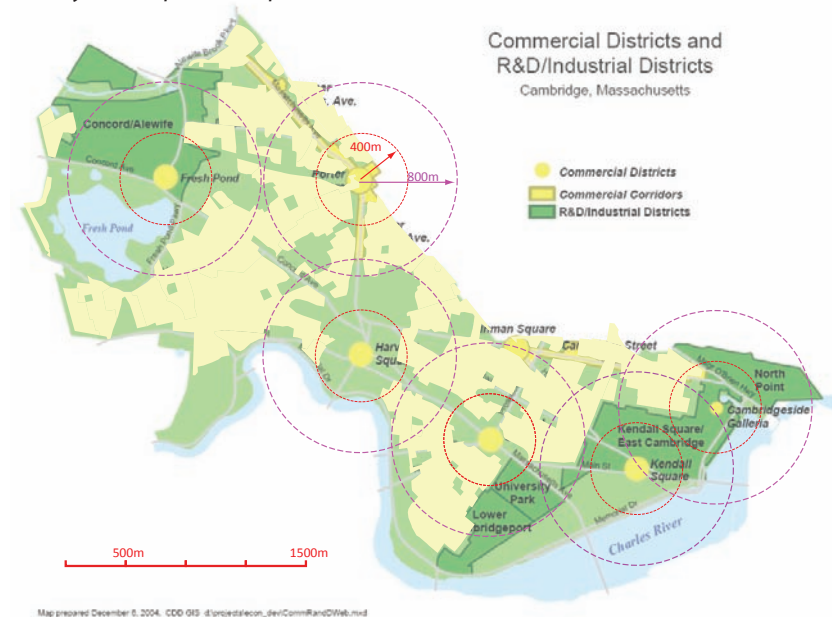
Hierarchy	Catchment Population	Floor Area	Business Scope
Metropolitan Centres	Hong Kong Residents and Tourists	No standard	durable goods, a wide range of banks and commercial services, a large number of cinemas, theatres and restaurants
Regional Centres	250,000 to 1,000,000	50,000 to 250,000 sqm	modern department stores/ supermarkets and a wide range of ancillary services
District Centres	50,000 to 250,000	10,000 to 50,000 sqm	significant concentrations of retail facilities and restaurants, but limited entertainment and social facilities
Local Centres	less than 50,000	less than 10,000 sqm	small-scale concentrations of shops, support local retail services and restaurant establishments

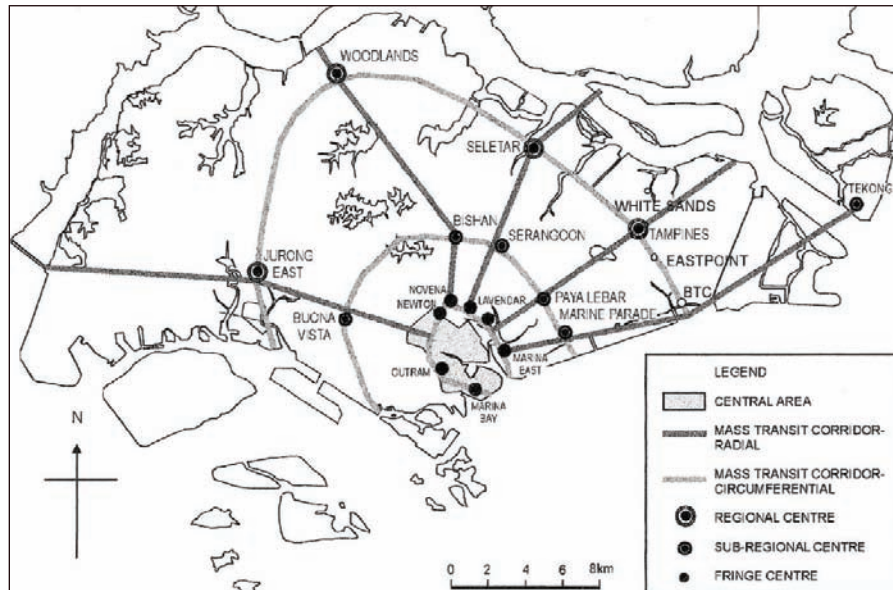
Commodity Categories:

- > Convenience goods : daily needs including foodstuffs; newspapers and books; cosmetics; medicines; and drinks.

- > Comparison good: goods (usually durable) which customers compare for quality, variety and price including shoes, clothing, furnishings, jewelry, personal goods, electrical and household goods.
- > Restaurants, bars and cafes: food and drink consumed away from home.
- > Retail services: services associated with retail centres, i.e. banks , barbers, dry-cleaners.

Distribution of Commercial District in Cambridge > Source: Cambridge Community Development Department 2008



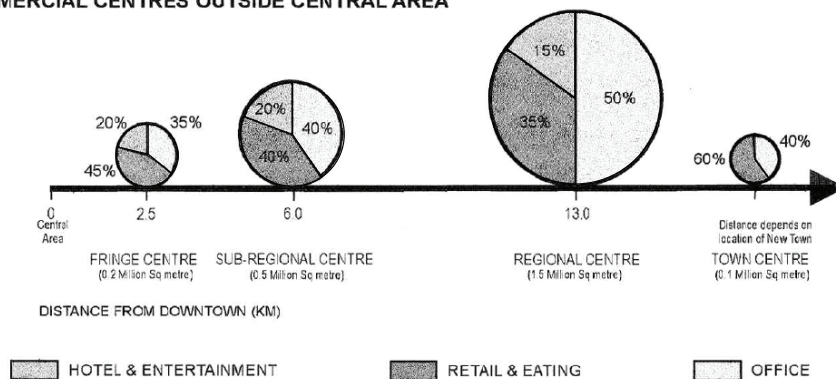


Distribution of Shopping Centers in Singapore > Source: Sim, Yu and Malone-Lee 2002

Hierarchy	Commodity	Attractions	Amenities
Downtown/ Orchard Road	Convenience goods, shopping goods and luxury goods	Theaters, cinemas, art galleries and others	Very good amenities
Regional Center	Convenience goods, shopping goods and luxury goods	Cinemas, sports complexes	Good amenities
Town Center	Convenience goods and shop- ping goods	Cinemas, sports complexes	Some amenities
Neighborhood Center	Convenience goods	No attractions	Poor amenities
Private Suburban Shopping Center	Shopping goods and some luxury goods	Some attractions	Some amenities

Retail Hierarchy in Singapore > Source: Source: Sim, Yu and Malone-Lee 2002

IMERCIAL CENTRES OUTSIDE CENTRAL AREA



Commercial Centers outside the Central Area > Source: Sim, Yu and Malone-Lee 2002



Shopping Centers in Tampines > Source: Housing Development Board 2007

CASE STUDIES > Healthcare

One case study each was chosen from US and Singapore, which is Cambridge and Tampines respectively, and the rationale for choosing them is that they have different city planning characteristics even though both countries are known for having good healthcare and education systems.

The team examined each case study in the three areas specified in the methodology section, namely classification, quantity and accessibility. Classification is to assess the appropriate healthcare facilities that need to be provided for a city/estate of a certain population/density. For quantity, hospital beds per capita and land area per 100 beds as proxies for the level of healthcare supply are used. And lastly for accessibility, the facilities should be within certain spatial catchment.

While there are many other aspects of healthcare provision like hospital staffing, quality of care, affordability, mortality rate, etc. which can inform if the healthcare is good or bad, the team's choice to adopt hospital beds per population is to allow for the spatial planning of the healthcare services for Bantian.

Cambridge, Massachusetts, USA

In Cambridge, there are two classifications of healthcare that are district-level assets, namely community hospitals and intermediate care

for elderly/rehabilitation. By analyzing the number of hospital beds and the land area, the level of healthcare provision for Cambridge, quantity-wise, for both healthcare classifications can be obtained. (MassHealth 2008)

Hospitals	Beds	Land area (ha)
Mt Auburn Hospital	189	3.5
Cambridge Hospital Community Health	304	1.6
Youville Hospital and Rehab Center	180	2.6

Beds/10,000 pop = 66

Land area / 100 beds = 1.14 ha

Intermediate care	Beds	Land area (ha)
Cambridge Hospital (as above)	45	-
Youville Hospital (as above)	95	-
Neville Center at Fresh Pond for Nursing & Rehab	112	2.4
Sancta Maria Nursing Facility	141	2.1

Beds/10,000 pop = 39

Land area / 100 beds = 1.78 ha

From the map of Cambridge, the service areas of the hospitals are approximately 2 km. For intermediate care, their service radii are within 2 km as well but not within walking range.

Tampines Estate, Singapore

While Tampines does not have hospitals within its estate, there is one outside its periphery which serves the East Region of Singapore with a population of around 650,000. (HDB 2007 and Sim 2001)

Hospital	Beds	Land area (ha)
Changi General Hosp (Changi Hospital 2008)	790	5.2

Beds/10,000 pop = 12

Land area / 100 beds = 0.658 ha

Intermediate care	Beds	Land area (ha)
All Saints Home	179	0.5
Metta Home Hospice & Day Rehab for Elderly	Nil	NA
New Horizon Centre Day Rehab	Nil	NA

Beds/10,000 pop = 8

Land area / 100 beds = 0.28 ha

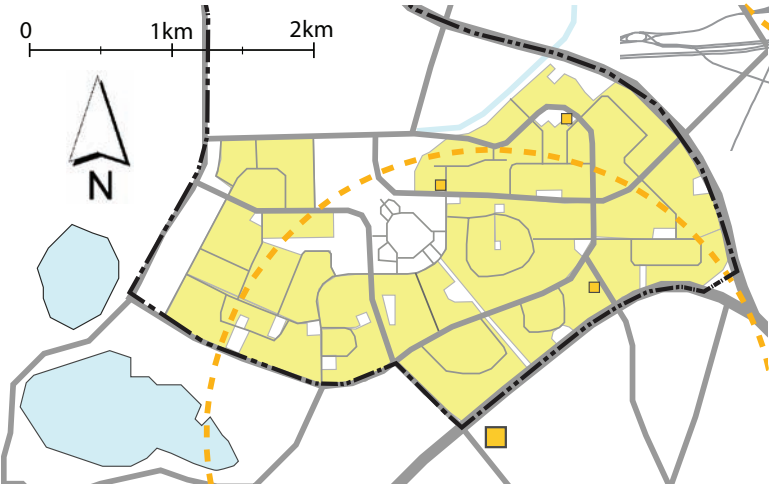
In terms of accessibility, Tampines is similar to Cambridge, but it is more compact.

Analysis

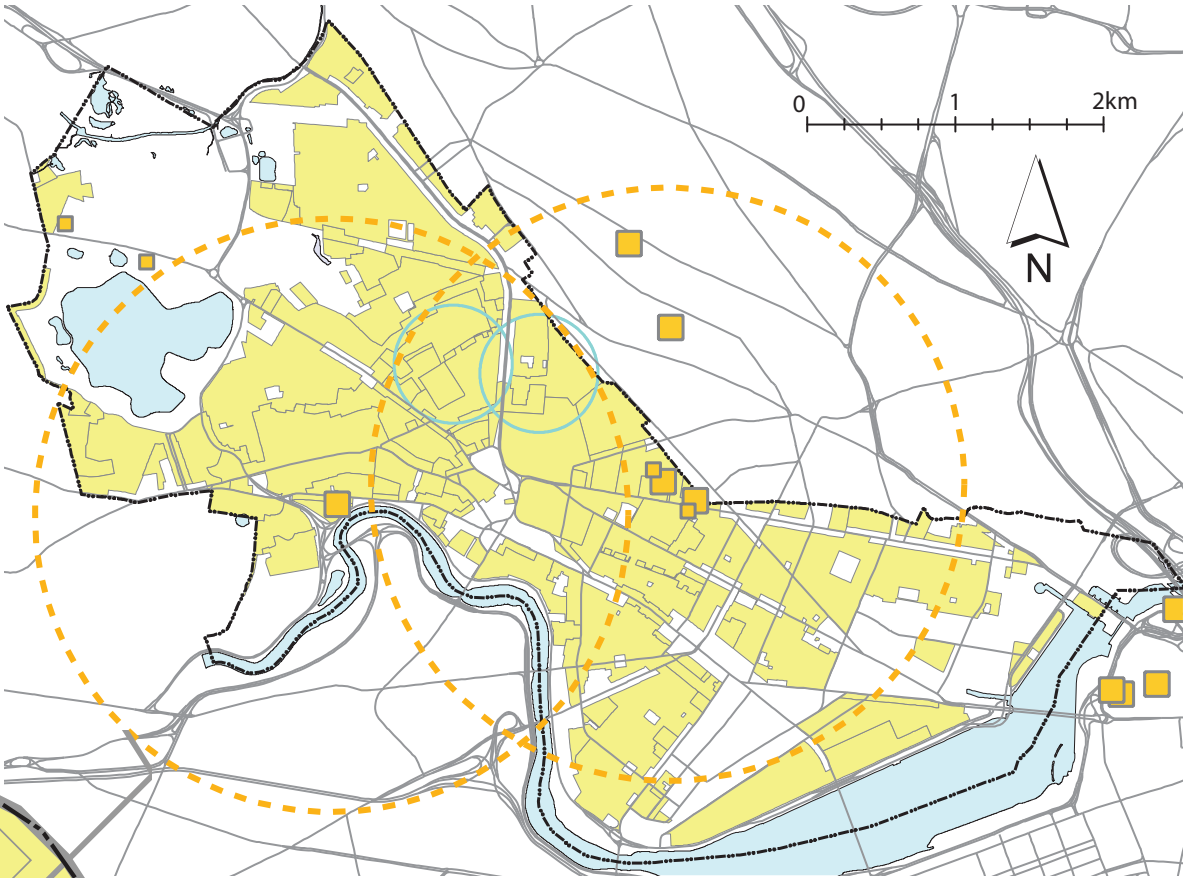
From the case studies, Cambridge is clearly better in healthcare provision than Tamp-

ines, but it is on the higher side, hence the team used the 33bed/10,000 pop that is average across the US or somewhere in between Tampines and Cambridge. Regarding land area, Bantian should follow Singapore's model more closely due to similar density considerations. For accessibility, the facilities need be within walking range, but they should have an ideal service coverage of 2 km and have good transportation access. The following planning guidelines are proposed for Bantian.

Healthcare category	Beds / 10,000 pop	Land area / 100 beds (ha)
Hospital.	33	0.72
Intermediate care	20	0.31



Existing Healthcare in Tampines > The hospital is shown with 2km service radius; intermediate care facilities are indicated too.



Existing Healthcare Supply in Cambridge > Community hospitals are shown with 2km service radii; intermediate care facilities are indicated too.

CASE STUDIES > Education

The two case studies are approached similarly to that of healthcare to assess the level of education provision. For the quantity tool, it is proposed that the number of enrollment spaces for 10,000 people is used as a gauge for educational supply, and land area per 100 students is to serve as a guide for sizing the educational facilities.

Cambridge, Massachusetts, USA

In Cambridge, if public education is considered, there are only two levels of education, namely elementary schools and high schools. Their relevant figures are extracted below. (Cambridge Public Schools Report 2006)

High School	Enrollment	Land area (ha)
Cambridge Rindge and Latin High School	1625	4.8

Enrollment space/10,000 pop = 160

Land area / 100 students = 0.3 ha

There are 11 elementary schools, so only their average figures are stated.

Average enrollment = 337

Enrollment space /10,000 pop = 399

Land area / 100 students = 0.28 ha

Tampines Estate, Singapore

Within Tampines, there are three categories of schools, namely primary, secondary and junior colleges. The first two are equivalent to elementary schools, and the last one is at the high school level. There is also a polytechnic which is outside the periphery of Tampines that serves the 650,000 people in the East Region of Singapore. As there are 12 primary schools, nine secondary schools, along with one high school and one polytechnic, again only the average figures are listed here. (Ministry of Education 2008)

School type	Avg enrollment	Avg enrollment / 10,000 pop	Avg land area (ha) / 100 students
Polytechnic (tertiary)	15000	231	0.2
Junior college	1800	78	0.28
Secondary sch	1901	575	0.18
Primary sch	1473	814	0.09

Analysis

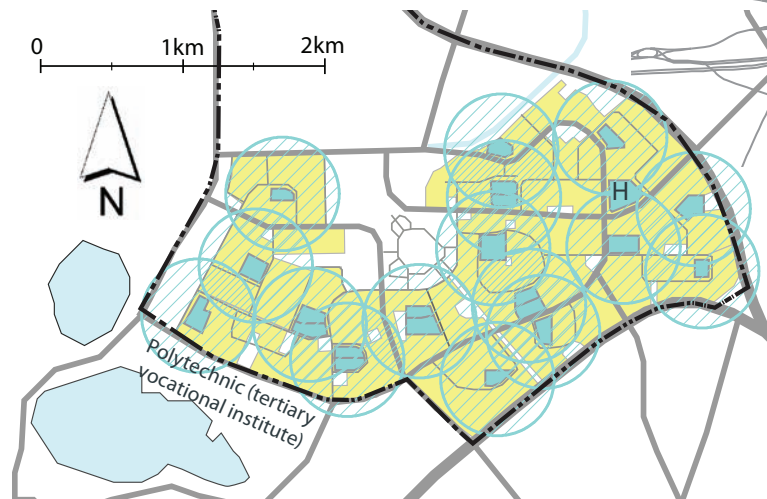
From the case studies, the level of public education provision is clearly higher in Singapore, and this is the model that Shenzhen/Bantian is

expected to take. The only exception between Singapore and Cambridge is in the high school provision, but that is because in Singapore, after secondary school, students can opt to go for the junior colleges-universities path or go straight to a polytechnic which is considered a tertiary institute of the vocational type. Therefore the provision of post-secondary education is even richer for Singapore in this sense. These planning guidelines are proposed for Bantian. Aside for adopting more of Tampines' figures, the high school provision is improved to somewhere in between Cambridge and Tampines.

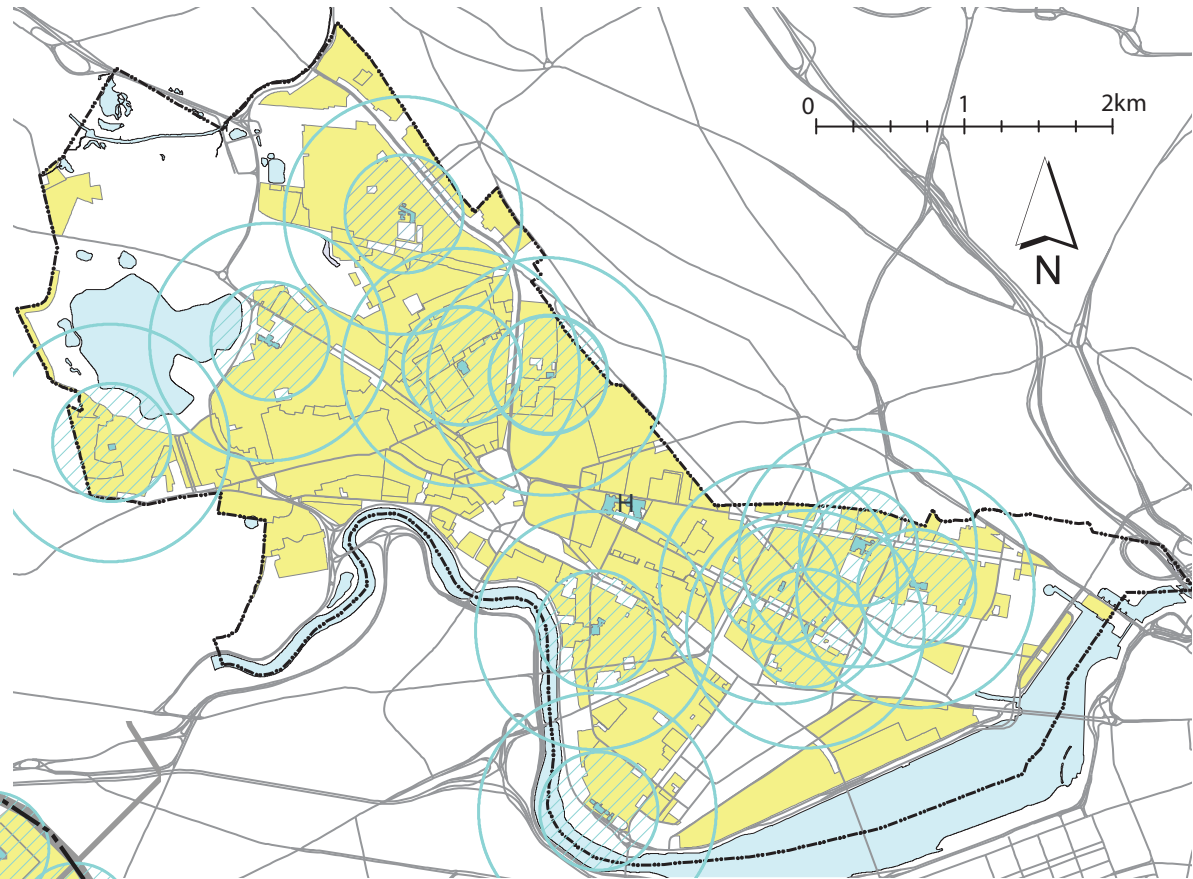
Educational category	Enrollment space / 10,000 pop	Land area / 100 students (ha)
Tertiary (Vocational)	230	0.2
High sch	100	0.3
Secondary sch	550	0.2
Primary sch	800	0.1

In terms of accessibility, it is not surprising to see that Cambridge's schools are not all within walking distance, even at 800 m. In fact, Boston categorizes "walk zones" of 1 mile (1.6km)

and 1.5 miles for elementary and middle schools respectively. (Boston Redevelopment Authority 2008) However, at the density level of Tampines, it can allow for schools mostly within 400 m walking range. A more walkable school is more ideal because of safety, reduced child obesity, etc. and since Shenzhen will have high density levels not unlike Singapore, the team thinks that the schools' accessibility patterns should be similar too.



Existing Schools in Tampines > Both primary and secondary schools are shown with a 400m catchment. The high school has a service radius up to 3km.



Existing Schools in Cambridge > The elementary schools are shown with 400m/800m catchment. The only high school in Cambridge is right in the middle of the city, and its service area is up to 3.7km away.

CASE STUDIES > Open Space

Design Guidelines of Open Space: Hong Kong

Scope of the guidelines:

- > The planning standards and guidelines aim to provide an equitable basis for the reservation and better use of land for open space and recreation facilities; and to guide the planning, distribution and, where appropriate, design of these facilities.
- > These guidelines/standards may not be achieved at one time. Areas of new development should be planned to meet the standards, whereas developed areas should be planned to pursue incremental improvements following the standards through means TO urban renewal.

Implementation of the Guideline:

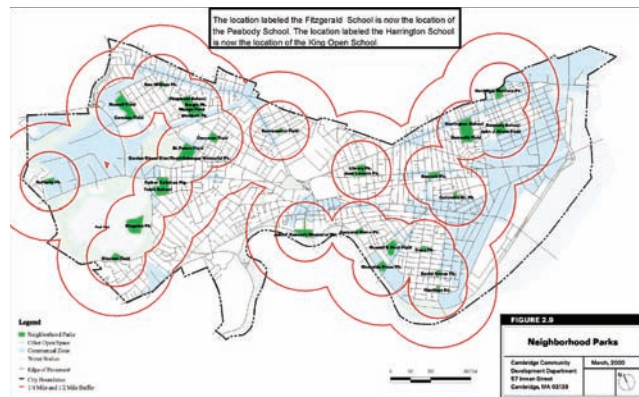
- > Many different bodies are involved in the organization and provision of open space and recreation facilities: the Sports Commission, the Leisure and Cultural Services Department, and the Agriculture, Fisheries and Conservation Department, just to name a few.

Open Space Category	Standard	Remarks
Regional Open Space (at least 5 ha in size and a maximum building site coverage of 20%)	no set standard	- 50% counts as District Open Space in the Metro Area
District Open Space (at least 1 ha in size and a maximum building site coverage of 10%)	10 ha per 100,000 persons (i.e. 1m ² per person)	- Subject to slope correction factor* - Active to passive ratio of 3:2 is applied - Not applicable to industrial, industrial-office, business and commercial areas, rural villages and small residential developments in the rural areas - Subject to slope correction factor *
Local Open Space	10 ha per 100,000 (i.e. 1m ² per person)	

Facility	Standard	Remarks
Indoor		
Badminton Court ²	1 per 8,000)	- Provided in sports centres, leisure centres or purpose-built facilities in composite developments - To be accommodated in the multi-purpose arenas in sports centres
Squash Court	on a district need basis)	
Table Tennis Table ²	2 per 15,000 or 1 per 7,500)	
Fitness/Dance Hall	1 per sports centre	
Gymnastic	1 per district	
Swimming - swimming pool complex leisure pool	1 per 287,000 or 1 m ² water per 85 1 per district	
Outdoor		
Tennis Court ¹	2 per 30,000	- Minimum 2 courts - Football pitches within sports grounds do not count towards standard due to their inaccessibility to the general public
Basketball Court ^{1&2}	1 per 10,000	
Volleyball court ¹	1 per 20,000	
Football pitch	1 per 100,000	- Provision for both facilities - To be accommodated in multi-purpose grass pitches
Mini-Soccer Pitch		
5-a-side ³	1 per 30,000)	
7-a-side ³	1 per 30,000)	- To be accommodated in sports ground/sports complex - May be provided in district open space or as part of pedestrian circulation system
Rugby/Baseball/Cricket pitch	1 per district	
Athletics	1 per 200,000-250,000	
Roller Skating Rink	300 m ² per 30,000	
Jogging Track	500m-1,000m per 30,000	
Children's Playground ²	400 m ² per 5,000	

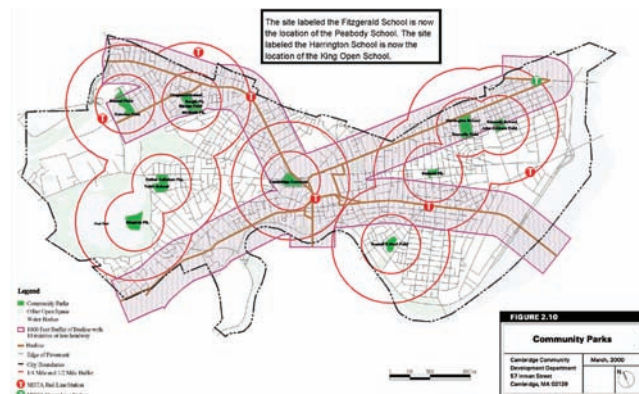
Facility	Standard	Site Area ²
Sports Centre	1 per 50,000-65,000	0.6 ha (i.e. 100m x 60m)
Leisure Centre	1 per 50,000	0.6 ha
Sports Ground/ Sports Complex	1 per 200,000-250,000	3.0 ha
Swimming Pool Complex		
- standard	1 standard complex per 287,000 or 1 m ² water per 85	2.0 ha for a standard complex
Swimming Pool		
- leisure	1 per district (Min. per 900 m ² pool size)	0.6 ha - 2 ha subject to advice from LCSD
Indoor Stadium	Territorial facility based on need	To be determined at detailed design stage subject to advice from LCSD
-multi-purpose		
Indoor Stadium - sports	Territorial facility based on need	To be determined at detailed design stage
Outdoor Stadium	Territorial facility based on need	4.5 ha - 6.0 ha
Water Sports Centre	No set standard	To be determined at detailed design stage subject to advice from LCSD/Arch SD

Diagram to Show Design Guidelines of Open Spaces/ Recreation Facilities in HK> These standards are comparatively low due to the high population density with limited amount of open spaces. However, the classification and set standards are useful reference for the research of open space in Shenzhen. Source: Hong Kong Planning Department. 2008



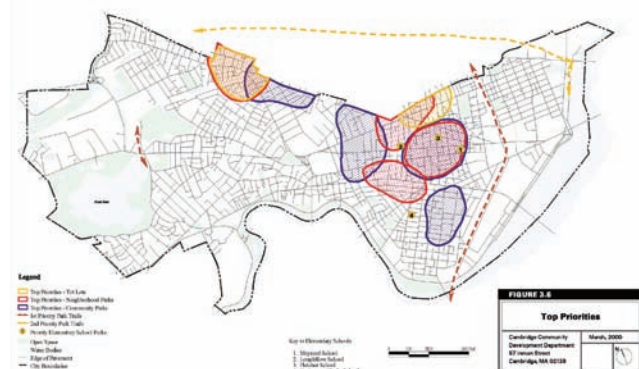
Service coverage of Neighborhood Parks

> According to NRPA's suggestion that neighborhood parks primarily serve people within a 1/4 mile to 1/2 mile walking radius. Source: Community Development 2000



Service Coverage of Community Parks

> The community park category includes parks that serve more than one neighborhood and have facilities for programmed activities, e.g., soccer league games and little league baseball games. Besides, the transit system plays an important role in accessibility of the parks. (Source: Ibid.)



Most Needed Open Spaces Following the analysis of the existing open spaces, the most needed open spaces on different levels are identified on the map. (Source: Ibid.)

Design Guidelines of Open Space: Cambridge

The Community Development Department (CDD) of Cambridge seeks a systematic approach to find open space spatial distribution. They try to identify existing land uses and distribution of open spaces in Cambridge from different perspectives. This kind of systematic method examples a practical way to map the spatial patterns of the open space in the studied area.

- > Service radius of different scales of open spaces.
- > Demographic information, including maps showing the city's population.
- > Density, income distribution, age structure, and distribution of children from elementary through high school-age.
- > Current open space and park use according to park and school programs.

Finally Areas of Need for each park type and Top Priorities among those areas are identified with their respective scale, as the bottom diagram on the right illustrates.

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Density and Affordability

Victor Eskinazi, Andrew Trueblood, Torrey Wolff



Sources: Omari Davis, Connie Chung.

INTRODUCTION > Goals and Assumptions

Housing is an important issue on two levels. At its most basic level, adequate provision of decent shelter for all residents, regardless of their income, serves a basic human need. At a macroeconomic level, affordable housing is necessary for ensuring that an economy can continue to grow, and that low-income families now have an opportunity to establish themselves and improve their livelihoods in the future.

This topic will examine how government actors can leverage undeveloped land and increase density in and around the current Vanke Town site to ensure private redevelopment of village housing and provision of housing for middle income residents.

Outline

This section will explore three topics integral to accomplishing our goals. These are Development, Income Mixing and building for a greater density. The format in which we layout this information involves:

- > Context
- > Existing Conditions
- > Development Concepts
 - > Development Scenarios
- > Income Mixing Concepts
 - > Income Mixing Scenario
- > Density and Typologies Concepts
 - > Density and Typologies Scenario

Goals

- > Improve the living quality of and decrease code violations related to urban villages
- > Ensure the same number of overall low-income units
- > Provide housing for moderate income residents
- > Ensure that a modest overall profit can be made while providing housing at and below market rate

Subgoals

- > Respect topography and preserve some area as unbuilt
- > Plan the physical site to encourage comfortable interaction between income groups
- > Create connections between the Vanke Town site and the area to the north

Assumptions

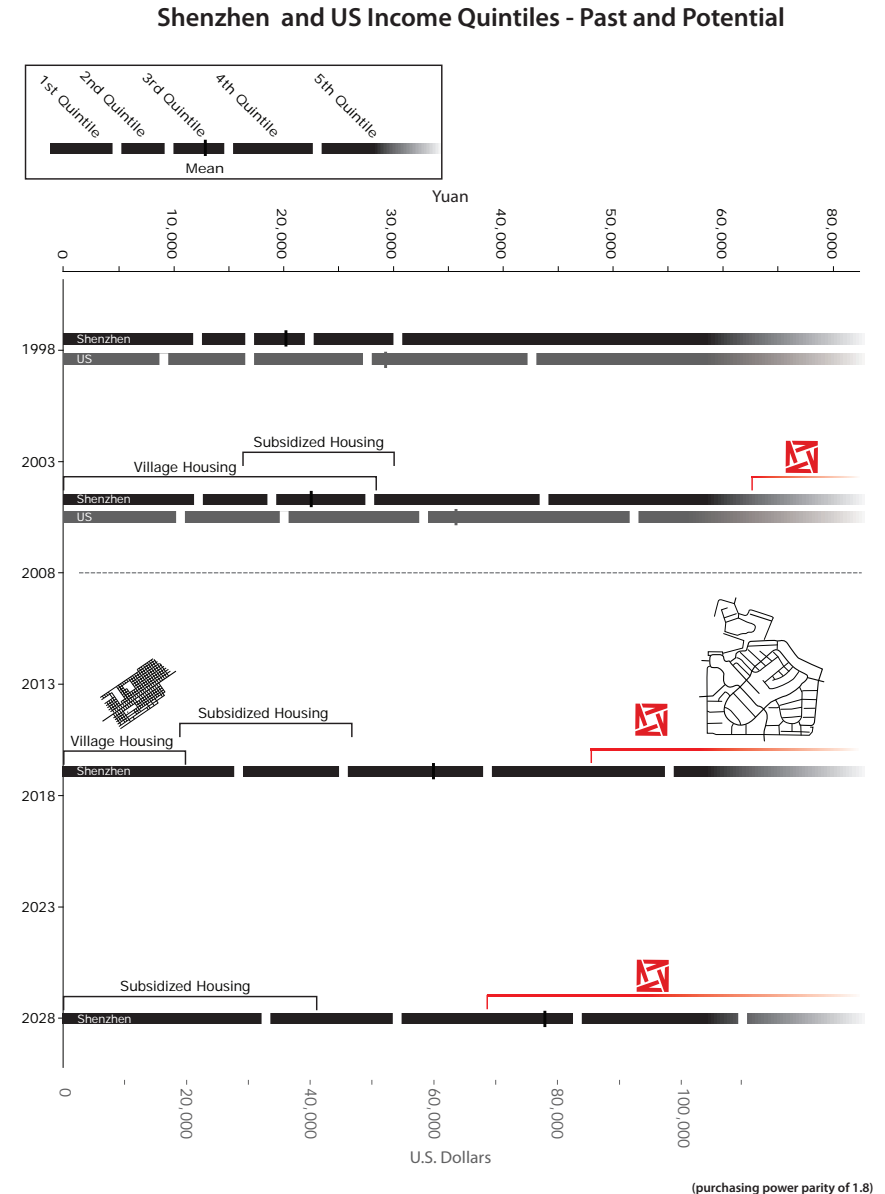
In order to illustrate the processes of low-income housing development and density we have made a number of assumptions about the conditions that will prevail in 2028.

Overall Assumptions

- > Increasing incomes and growing middle to upper-middle income households (see chart next page)
- > Market and political pressure to redevelop village housing
- > Government incentives, subsidies and mandates for developers to provide affordable housing
- > A housing crunch and higher land costs that encourage developers to increase residential density

Site Assumptions

- > Low-tech factories to the north of the current Vanke Town site will move out of the area
- > Current owners and tenants will be appropriately compensated
- > The developer will be able to create the same number of market rate units across the joint site as they otherwise would developing only market rate on the current Vanke Town site at an FAR of 2.5
- > The portion of units that can be sold at market rate will increase while the portion of non-market rate households provided by private developers will also increase



CONTEXT > Current Low-Income Housing Policies

There have been a variety of housing policies since the market reforms of the late 1970s. The first affordable housing policy was this very privatization or work unit housing, which was often sold to workers for very large discounts. In 1998, the government began selling all state-owned housing at market prices, ending any subsidies. As this work housing was privatized, there became a greater shortage of affordable housing (Brown and Orr 2006). To date, most policies intended to address affordable housing have suffered from too little coverage given the demand. In addition, they are targeted to urban residents, which misses the huge population of rural migrants in cities such as Shenzhen.

With the privatization of state-owned housing, the government set up a Provident Fund, which was a compulsory housing savings account. This program assists only those whose employer participates in the program (primarily state-owned enterprises), limiting its ability to help those with low-income. In addition, it has been shown to assist only a small number of those who participate in it (4% in a survey in Shanghai) (Wang 2000).

The Affordable Housing Estates or economical housing programs (such as *anju*) sought to address housing for middle-income workers. Through loans by the government and the

free allocation of land, the cost of housing was reduced. These programs suffered from both a small scale, as well as the creation of housing that was ultimately unaffordable to many middle-income workers (Brown and Orr 2006, Wang 2000).

In order to serve those who could not afford to buy housing, low-rent social housing was implemented in many cities in 2001 and supported by the central government in 2002. This policy was targeted to the lowest-income workers, as well as those who had been laid off from state-owned enterprises. It was believed that over time, as China developed and layoffs passed through the system, the need for this housing would decline (Wang 2000). However, developed countries such as the United States show that there is often an acute need for heavily subsidized housing, even when the economy is strong.

In China, a lack of finance for low-rent housing has led to minimal supply for those who could use it, but cities such as Guangzhou provide insight into how such a low-rent program can operate. It has set up criteria, based on household income and composition, including consideration of disabilities. After identifying 1940 eligible households, the government sought to build an adequate number of units. Yearly re-certifications ensured that the fami-



Formerly State-Owned Worker Units >

Source: Andrew Trueblood.

lies still met the income criteria. If their financial situation had improved, then they had to move out. Guangzhou has subsequently seen the number of households in need of housing decline (Wang, 2000).

All of these policies assisted residents whose registration was urban. Yet in cities such as Shenzhen, a majority of the low-income workers are rural migrants who do not have access to the subsidized affordable housing. These workers have been served primarily by urban villages as well as company-provided housing (Song et al. 2008, Duda and Li 2008). To date,



Guangzhou Affordable Housing > Source: Omari Davis.

these seem to have met the demand for low-income housing, even if the conditions have often been substandard. Because of this, these housing options are slowly being phased out, which could lead to an acute shortage of affordable housing for the lowest-income workers, who are the hardest to serve.

We seek to create housing for all workers, regardless of registration, without requiring costly ongoing government subsidies. Through the leveraging of public land, the development proposal seeks to maintain the same number of low-income units as current-

ly provided by the villages, but in a safer and healthier environment. It will also produce middle-income and higher-income housing. It is hoped that the proposal can provide a model for developing affordable housing policies that address the needs of workers and that create a sufficient number of units to address aggregate demand.

*For further information on affordable housing policies and a U.S. case study, please see: **Developing Affordable Housing** (p. 175)*

CONTEXT > Shenzhen's Urban Villages

Currently, Shenzhen's supply of affordable housing is largely provided in urban villages (see map), but these often exist in an environment that is unsafe, unsanitary, and insalubrious. When faced with such conditions, authorities have often opted for what they call comprehensive transformation, or complete demolition and redevelopment (Shenzhen Government 2005). This was the case with slum clearance and urban renewal in the United States. In the United States, the government would purchase slums, assemble



Typical Village "Handshake" Building > Source: Andrew Trueblood.



significant parcels of land, then either sell it to a developer or contract to build public housing.

Shenzhen's urban villages are redeveloping in a slightly different matter, but with the same result. As in the Yunong Village, villagers worked with developers to demolish the village building and construct luxury high-rise apartments in their place. The low-income housing is lost and residents, primarily migrant workers, must find a new place to live.

While in the short run this type of redevelopment may serve to improve the image of the city, it is insidious at both the human and

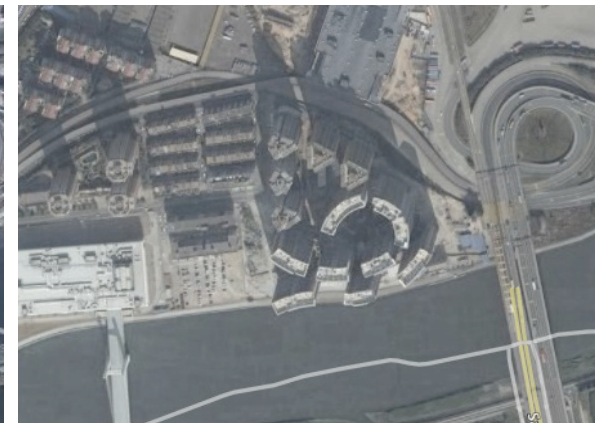
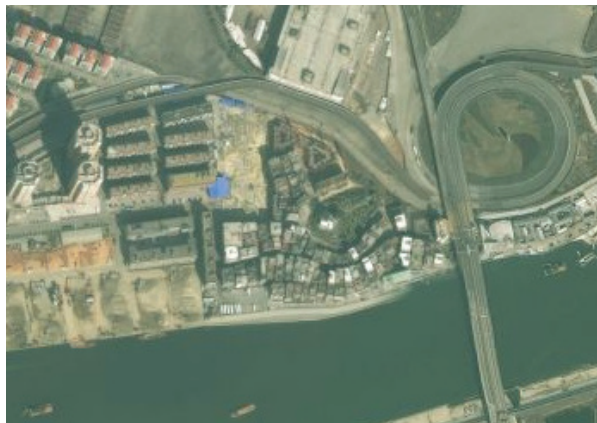
economic levels (Song et al., 2008). Given that one of the government's goals is to improve housing conditions, it does not assist low-income residents to demolish their apartments and replace them with luxury apartments, even if though the conditions at the new apartments are certainly better. But this type of redevelopment can do real harm to a local economy. As the overall supply of affordable housing dwindles, either wages must go up to ensure that workers can afford the more expensive housing, migrants will no longer move to the area, thereby cutting the number of workers (and limiting growth),

or new village housing will be built in other areas, thereby simply shifting the low income housing and not solving the overall problem of poor housing conditions.

Inaction will not solve the problem, but neither will the type of redevelopment that is current occurring. Through a sophisticated financial approach, combined with a practical physical plan, redevelopment can be achieved with reasonable costs, vastly improved conditions for all, and the maintenance of all low-income housing units. It will require adjustments to current laws and regulations, especially as they relate to ownership and density.

Yunong Village Redevelopment > Before, During, and After Construction

Sources: Microsoft Local Live, Google Maps, Google Earth.



EXISTING CONDITIONS > Vanke Town Site

The site under consideration is the current 51 ha Vanke Town Site (in salmon) plus the 60 hectare village residential and industrial area to the north. This total site is bound on 3 edges by major arteries with a proposed road to the east and another running through the site from east to west.

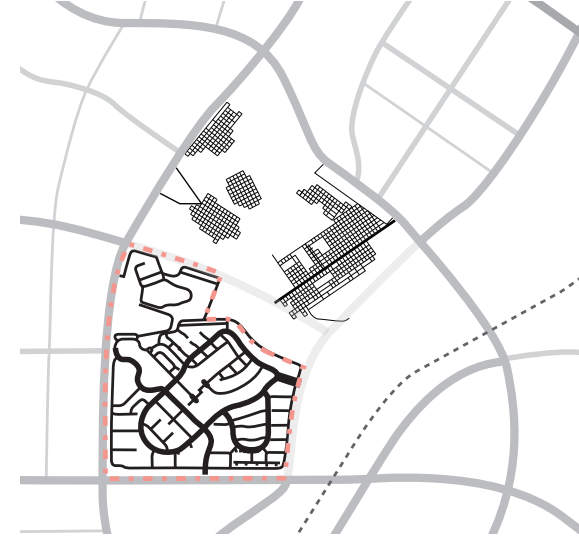
As it has been developed, the southern portion of the site is a fenced in high income development. The northern portion includes 20.5 ha of 4.1 FAR congested village development laid out in a grid of 10 story 10x10 meter building blocks. The industry that fills the rest of the northern portion of the site is low-tech compared to other industry in the surrounding area and of the kind likely to be phased out in Shenzhen over the next 20 years.

Assuming no current development on the southern portion of the site, there is a notable opportunity to incorporate the whole site into a single development for a variety of income ranges.

Overhead Photos (center) > Vanke Town is dashed, the villages are outlined and factories exist in the area in between. Source: Google Earth

Village and Vanke Town Street Patterns (top right)

Village to the north of Vanke Town (bottom right) > Source: Andrew Trueblood



CONCEPT > Development

Development Process

The proposed redevelopment utilizes land leveraging and a public-private development model to construct new low- and middle-income housing.

*For further information on creating and financing affordable housing, please see: **Developing Affordable Housing** (p. 175)*

The process by which the redevelopment occurs should be inclusive, but must be spearheaded by the government, which ultimately has the power to ensure that it occurs and achieves the desired goals. The following is an example of how officials and developers can begin to think through the financial, procedural, and physical aspects of village redevelopment. As it is merely an example with various assumptions, its value lies largely in its process, which is based on the inclusive HOPE VI model in the United States, which has evolved over the past decade.

Stage I – Organize and Plan

Organize steering committee

A steering committee comprising of residents, villagers, government officials is vital for guiding the process. Such a committee allows for the views of various stakeholders to be ex-

pressed. It is especially important that current residents are heard, as in many cases they are easily overlooked. This committee will guide the redevelopment process, and help ensure the creation and realization of the plan.

Establish property rights

In order for land leveraging and a redevelopment scheme to function, clear property rights must be established. This represents a point of leverage for the government, as it can issue clear lease or title under certain conditions. For example, the government should condition the provision of clear title on the preservation of low-income units. This would be done through the official redevelopment plan for buildings that are demolished. For those that are not, the owners would be expected to replace the units in any future development. Establishment of property rights (and responsibilities) should be done before the plan is developed to allow for an equitable distribution that is not unduly influenced by plans.

Develop plan and overlay

Once the steering committee and property rights are established, the redevelopment plan can be developed. By bringing in consultants, the steering committee can begin determining what is realistic. One or multiple charettes should be held for various groups, such as ten-

ants, children, villagers and nearby residents. This process should develop a master plan comprising the following:

1. Plan for demolition of selected village housing
2. Plan for vacant or vacated land
3. Overlay plan for remaining village housing

These plans include the programming, tenure, and density for the sites as well as phasing, timelines, and design standards. In addition, they include the provision of public and open space. While detailed finances will be developed later, initial finances should be constructed that illustrate the feasibility of the plan.

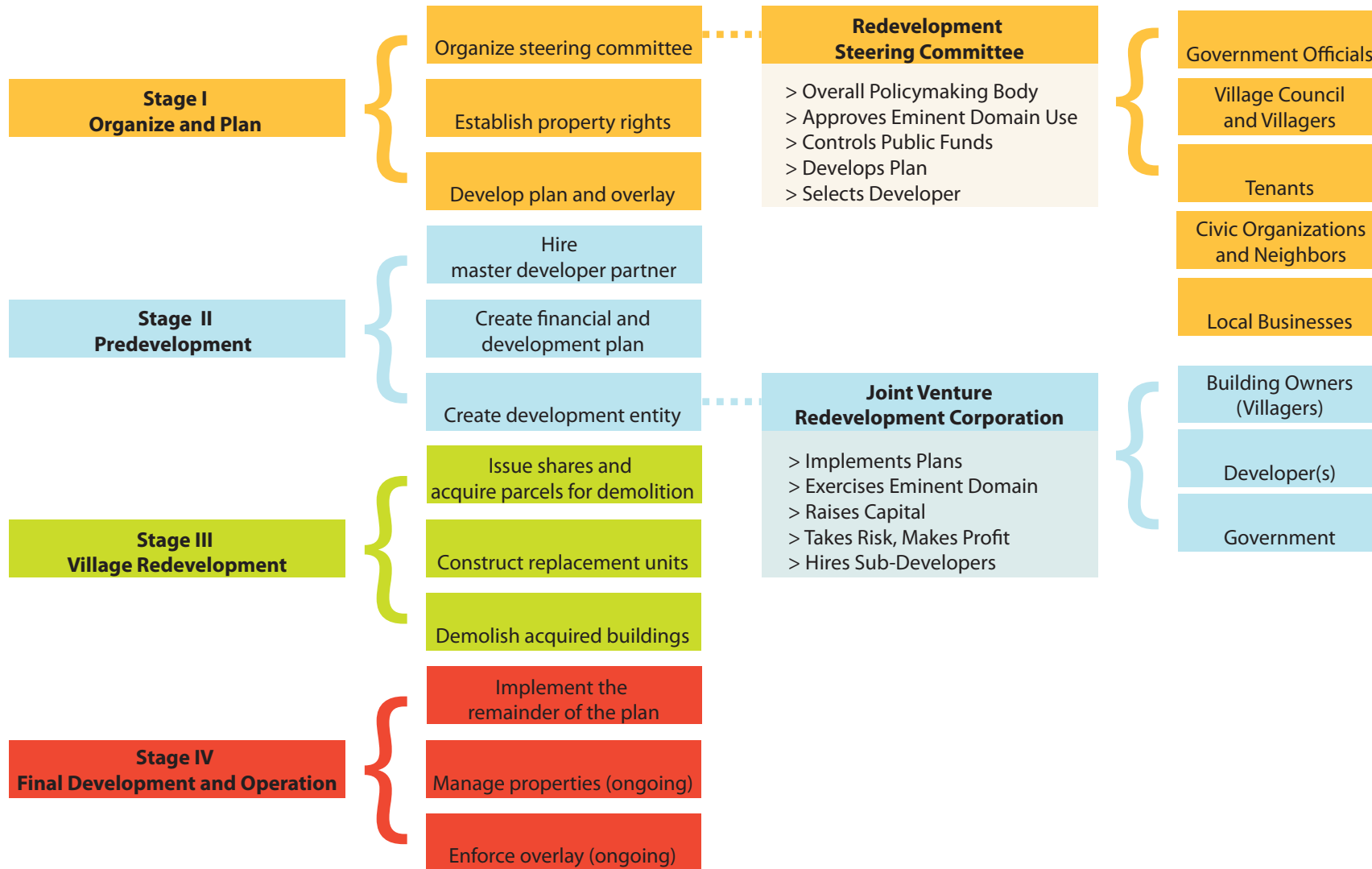
Stage II – Predevelopment

Hire master developer partner

With a plan in place, the steering committee can seek a master developer who would be suited for such a major undertaking. While the developer may not develop every parcel, it would be in charge of overseeing the overall plan and finances. Because of the size and variety of residential, commercial, and retail development within the project, the developer would likely partner with other developers for some phases.

Development Process

Organization Structure



Create financial and development plan

With the master developer hired, a detailed budget and pro forma should be prepared. This may require slight changes to the overall plan, which will require close coordination with the steering committee. The budget outlines sources and uses for the development program. The gap for non-market rate units must be filled with various subsidies. It also includes pro formas for rental units, retail, and office space in order to ensure their long-term financial viability.

Create development entity

A joint venture corporation is necessary to acquire the urban village parcels. This entity will be owned, in part, by landowners who contribute their land to the development. The value of their contribution will be equal to the shares issued in the entity. The developer partners will also be a part of the ownership structure, as they will likely outlay upfront financing for predevelopment and some land acquisition.

Stage III – Village Redevelopment

Issue shares and acquire parcels for demolition

Villagers whose buildings are acquired will be issued shares in the development entity equal to the value of their parcels. This will allow

them to take part in the upside of the development, or if they are interested in cash, to sell their ownership shares for the full market value. This process lowers the upfront acquisition costs, which could be prohibitively high and allows current owners an opportunity to share in the upside of the development.

Construct replacement units

To limit relocation out of the neighborhood, replacement units can be constructed first on vacant or nonresidential land. This “build first” strategy helps to keep the neighborhood in tact while allowing the buildings and public spaces to be improved. It also ensures that the developers address the difficult goals of village redevelopment before undertaking the more appealing and profitable market-rate development.

Demolish acquired buildings

Once the replacement housing is built and occupied by residents whose buildings will be demolished, these units can be demolished to make room for wider streets and public space.

Stage IV – Final Development and Operations

Implement remainder of plan

The redevelopment of the low-income village housing will make the remaining area more appealing, thereby raising the value of nearby land and allow for more leveraging of funds. After the initial phase of village redevelopment is completed, the developers should phase in the rest of the plan as they see fit. This should be staged based on the developer’s best estimates of market saturation.

Manage properties (ongoing)

For those properties that are not sold, the developers will need to maintain and manage the properties to prevent them from falling into disrepair and to ensure the continued vitality of the overall neighborhood.

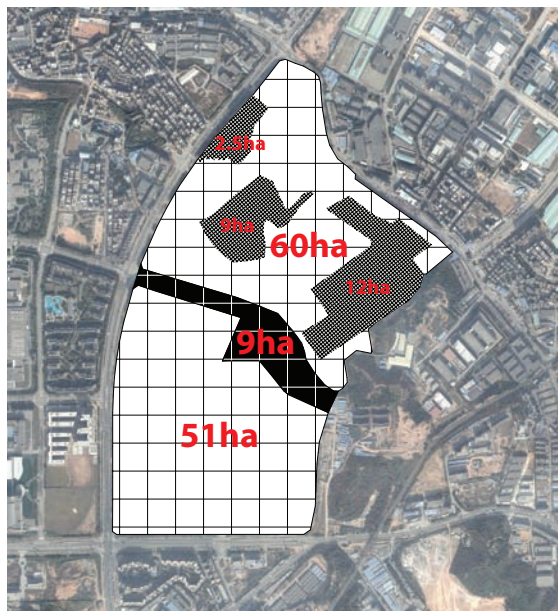
Enforce overlay (ongoing)

Once the master developer has completed the official plan, the neighborhood will continue to evolve over time. Especially likely to change will be the remaining urban village buildings. Ensuring that these are redeveloped according to the standards set forth by the government and in the overlay district is vital for ensuring the continued improvement of the area.

CONCEPT > Scenario Building

Scenario building is about making a few assumptions and then running a range of scenarios to determine the implications of each option. Often, this is helpful at community charrettes to show implications to decision-makers.

First we defined our target: the current Vanke Town site and the village sites to the north. We classified the land into three categories: buildable (all vacant land, including the current



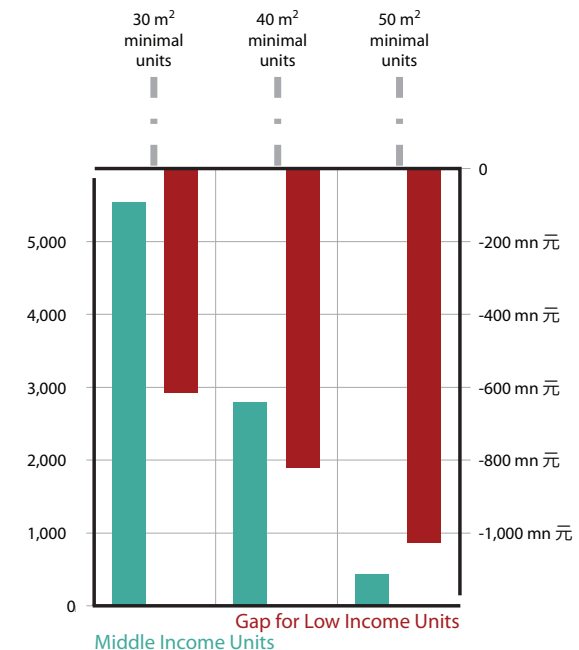
Define Site > Buildable Land (white), Villages (Gray), and Nonbuildable Land (Black). Source: Google Earth.

Vanke Town site as well as current low-level factories to the north), villages, and nonbuildable (roads, public facilities, etc.) We then set up a spreadsheet with a number of assumptions, such as unit size, values, and construction costs (see next section, “Development Scenario” for a complete spreadsheet).

The total buildable square footage is determined by an overall 2.5 FAR on the site. Since the goal is to maximize the value of the Vanke Town site (maximizing land leveraging), we assumed that it would be entirely upper-income housing. Whether some of that gets spread to the north site could be determined at a later iteration of the exercise. With the total number of upper-income units fixed, the amount of low-income and middle-income space was constrained.

Given the assumption that tastes will change and larger units will be demanded, we first tested the implications of making the new low-income units larger. As the chart to the right shows, larger units create a larger gap and fewer middle-income units. This can create a “barbell” effect wherein the site contains almost all high and low income residents.

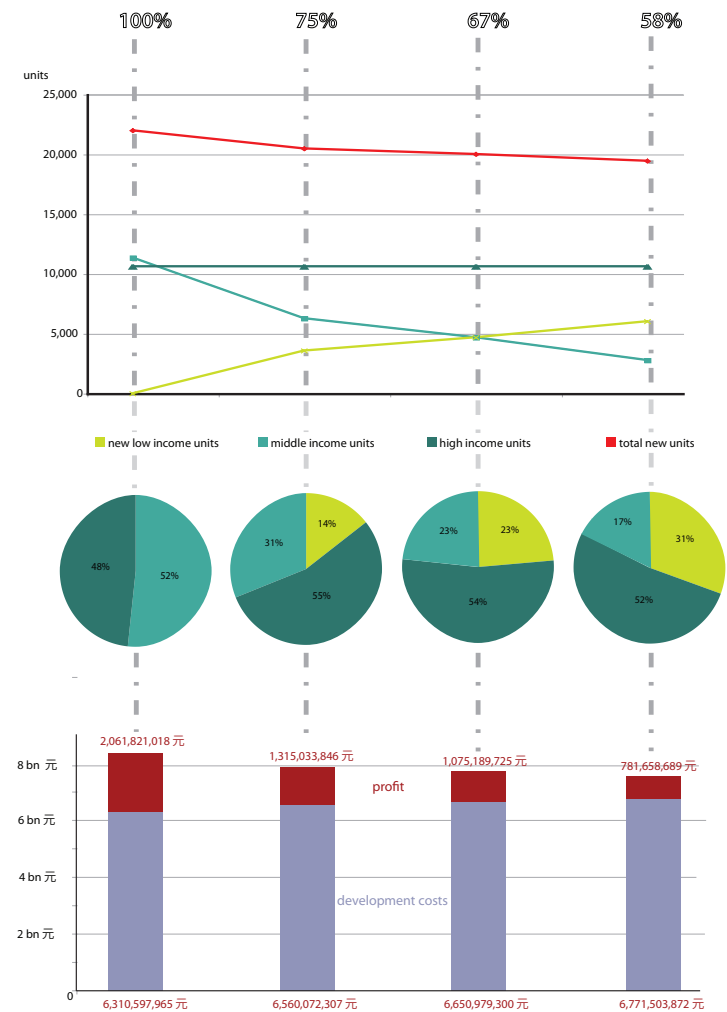
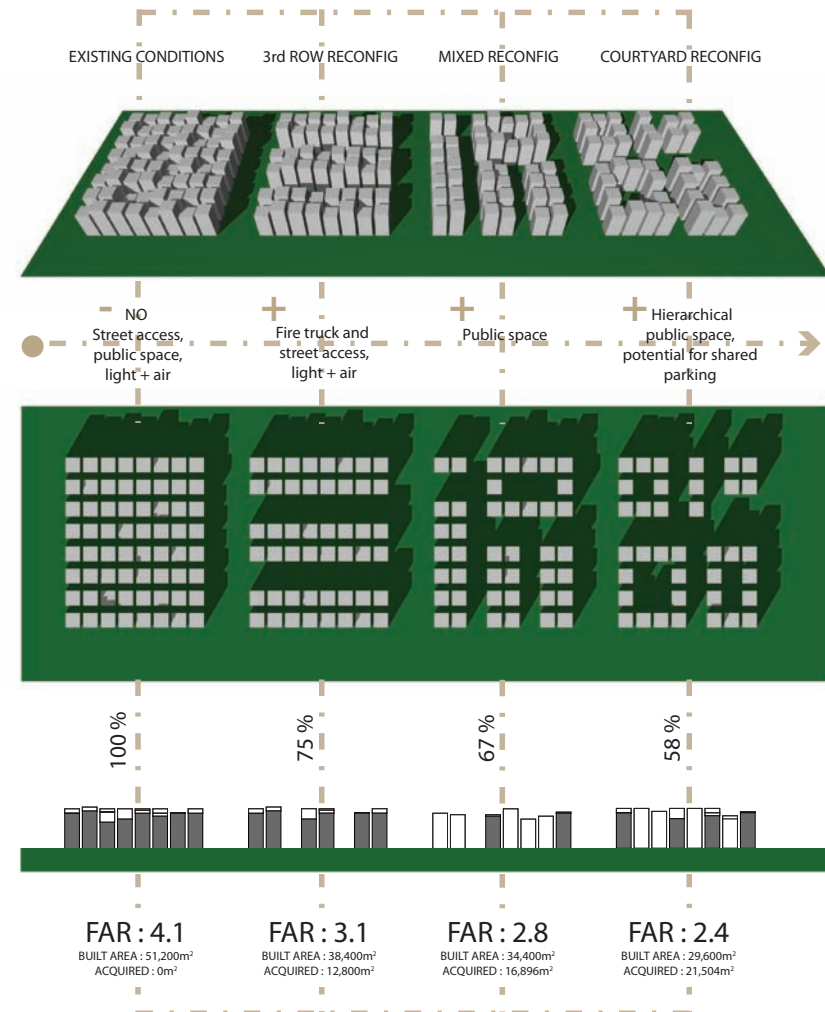
Another set of scenarios dealt with how much village area should be acquired and demolished. The diagrams on the following page show the physical and financial implications of four different scenarios, from minimal



Implications of Unit Size > How larger low-income units affect the overall development gap and number of middle income units on site

demolition to more intense acquisition that allows for a hierarchy of open space. We did not examine complete demolition, for reasons discussed in the previous section on urban villages. As more village buildings are demolished, profits and costs go down, as de-densification will result in fewer new units.

CONCEPT > Scenario Building: Acquisition and Demolition



DEVELOPMENT SCENARIO

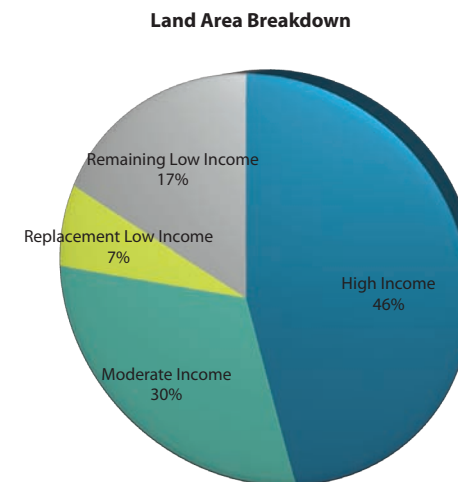
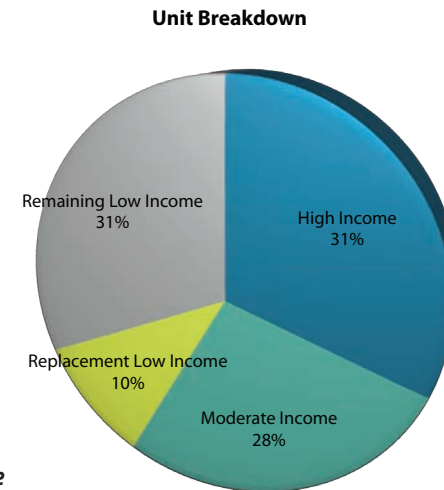
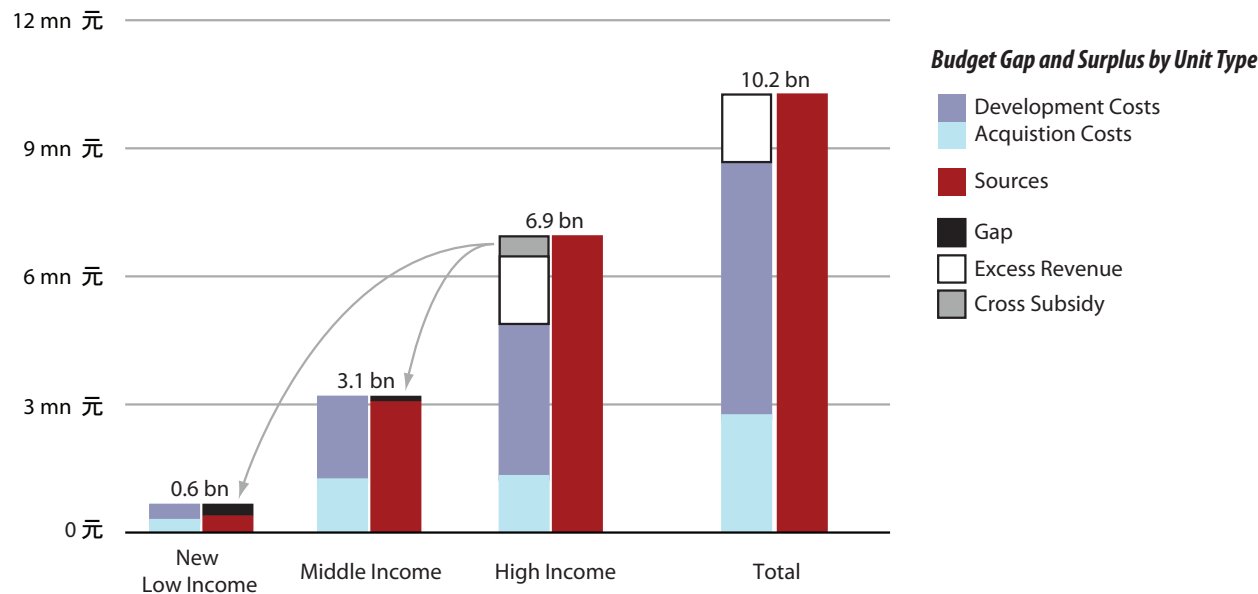
Given the various options, we chose to proceed with a scenario that had the moderately-sized 40 sqm low-income units and that acquired and demolished the minimal amount (3rd row reconfig.) This would provide for a reasonable gap as well as achieve the goals of health and safety within the villages.

Given our scenario, the chart below shows that the low and middle income development gaps can be filled with cross subsidy from the high income units, while still allowing for a reasonable profit for the developers.

The following charts illustrate the unit mix and amount of area each takes up. It is clear that high income units take up far more land (and FAR) than low income units, which affects the amount of income mixing possible.

The final tables illustrate our assumptions for the overall development scenario. The assumptions are highlighted in blue.

*For further information on gap financing and cross-subsidies please see: **Developing Affordable Housing** (p. 177)*



Development Scenario Calculations

Village Calculations		
Buildings		
Footprint	100	m2
Total Floors	8	
Residential Floors	7.5	
Unit Size	20	m2
Units/Floor	3.1	m2
Units/Buildings	25	
GBA	800	m2
Residential Area	750	m2
Retail Area	50	m2
Rent	20	RMB/m2/month
Gross Rent per Building	16,000	RMB/year
Vacancies and Expenses	35%	
Total Income Per Building	10,400	RMB/year
Industrial Building Size	1,000	m2
Site		
Housing Buildings	572	
Total Residential Land	57,200	m2
Nuber of Victor Hectares	9	
Total Residential Area	429,000	m2
Average Unit Size	30	m2
Total Units	14,300	
Industrial Buildings	48	
Stories	4	
Industrial Building Land	48,000	
Total Industrial Area	192,000	
Buildable Land	70%	
Nonbuildable Land	180,000	
Total Vacant Land	346,360	
Total Retail Area	28,600	m2
Yearly Income per Building	124,800	
Capitalization Rate	10%	
Value per Building	1,248,000	RMB
Housing Construction Cost	1,250	RMB/m2
	1,000,000	RMB/Building
Industry Construction Cost	1,500	RMB/m2

assumptions

key figures

Unit Calculations/Program	Vanketown Site	Total Village	Village Site
			Acquired/Developed
Site area	510,000 m2	600,000 m2	408,660 m2
FAR	2.5	2.5	2.5
GBA	1,275,000 m2	1,500,000 m2	1,021,650 m2
Nonresidential Building Area	25%	25%	25%
Gross Residential Area	956,250 m2	1,125,000 m2	766,238 m2

Valuation		
Value of Housing Parcel	12,480	RMB/m2
Value of Industrial Parcel	8,480	RMB/m2
Value of Vacant Village Parcel	2,480	RMB/m2
Total Housing Value	713,856,000	RMB
Total Industrial Value	407,040,000	RMB
Total Vacant Land Value	858,972,800	RMB
Total Value	1,979,868,800	RMB
Vanketown		
Price Paid in 2003	960,000,000	RMB
Cost per m2	1,882	RMB/m2

Program	Residential	Industrial	Vacant	Total
Buildings Acquired	143			143
Area Acquired	14,300	48,000	346,360	408,660
Acquisition Cost	178,464,000	407,040,000	858,972,800	1,444,476,800
				3535
Land Acquired	408,660	m2		
Units Acquired	3,575			
Res. Area Remaining	321,750	m2		
Units Remaining	10,725			
Residential Area Developed	766,238			
Land Area Developed	408,660			

	High Income	Replacement Low Income	Moderate Income	Remaining Low Income
Future Avg. Unit Size	90 m2	40 m2	65 m2	30 m2
Total Units	10,625 units 31%	3,575 units 10%	9,588 units 28%	10,725 units 31%
Future Res. Area	-	143,000 m2	623,238 m2	321,750 m2
Percentage of Area	-	13%	57%	30%
Future Land Area	1,275,000 m2	76,267 m2	332,393 m2	191,340 m2
Rents	60 RMB/m2	20 RMB/m2	40 RMB/m2	
Future Value	6,885,000,000 RMB	343,200,000 RMB	2,991,540,000 RMB	
Total Future Value	10,219,740,000 RMB			
Construction Cost	3,000 RMB/m2	2000 RMB/m2	2500 RMB/m2	
Other Cost Factor	25%			
Development Cost	3,750 RMB/m2	2,500 RMB/m2	3,125 RMB/m2	
Development Cost (- land)	3,585,937,500 RMB	357,500,000 RMB	1,947,617,188 RMB	
Total Development Cost (- land)	5,891,054,688 RMB			
Premium for Existing Buildings	0 RMB	269,577,230 RMB	1,174,899,570 RMB	
Future Land Cost	1,264,800,000 RMB	0 RMB	0 RMB	
Total Land Cost	2,709,276,800 RMB			
Development Cost (w/ land)	4,850,737,500 RMB	627,077,230 RMB	3,122,516,758 RMB	
Total Development Cost (w/land)	8,600,331,488 RMB			
Return	2,034,262,500 RMB	-283,877,230 RMB	-130,976,758 RMB	
Total Return	1,619,408,513 RMB			

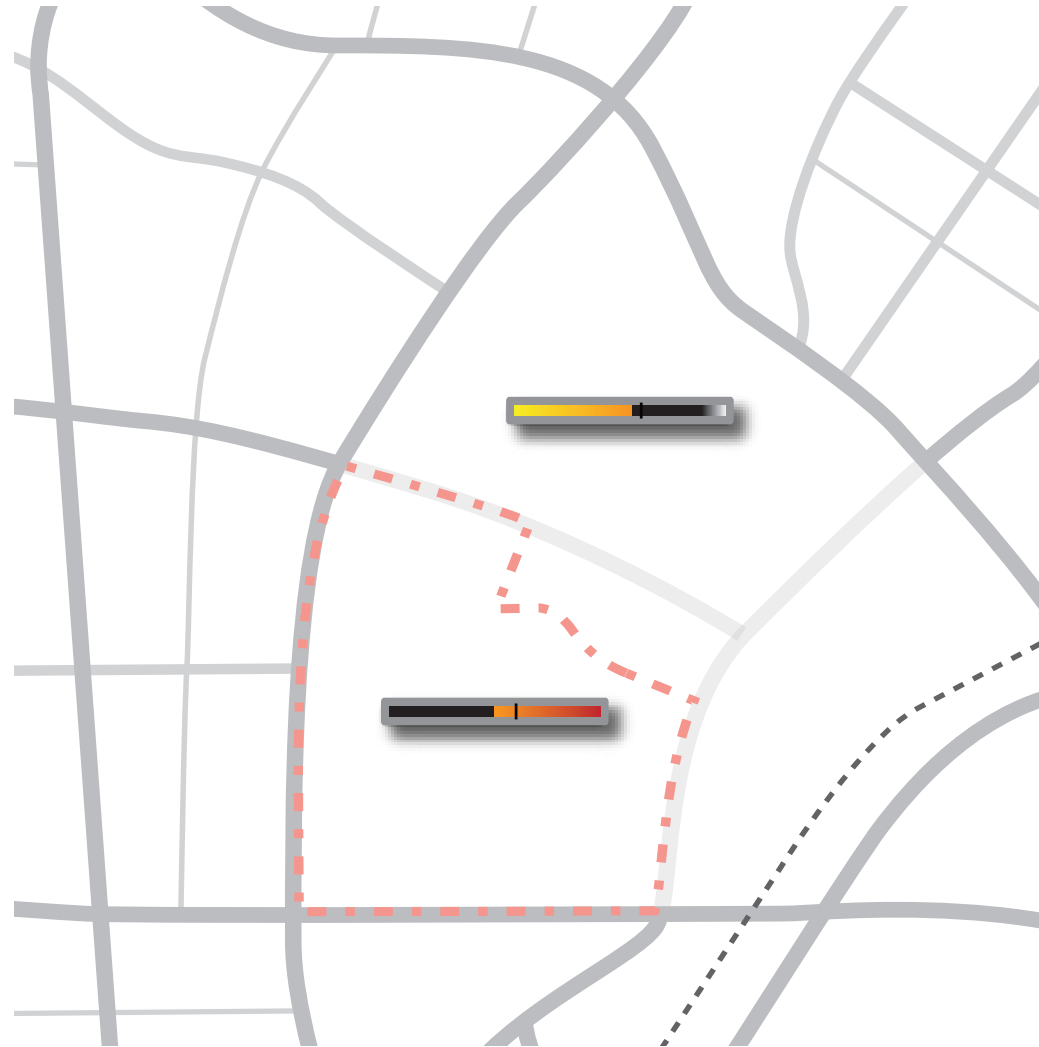
CONCEPT > Income Mixing

Responding to Existing Conditions

The northern portion of the site currently provides very low income housing while the southern portion, as shown by Vanke's current development there, could offer high profit through production of housing for the high income bracket. Thus, assuming that we keep some of the existing village housing, the northern portion of the site will have a lower average income than the southern portion.

As noted before, however, the upper and lower income brackets in Shenzhen will begin to become less disparate and there will be overlap in the income ranges served by each portion of the site.

Income Ranges > The median income across the site will continue to vary, but the ranges will overlap.



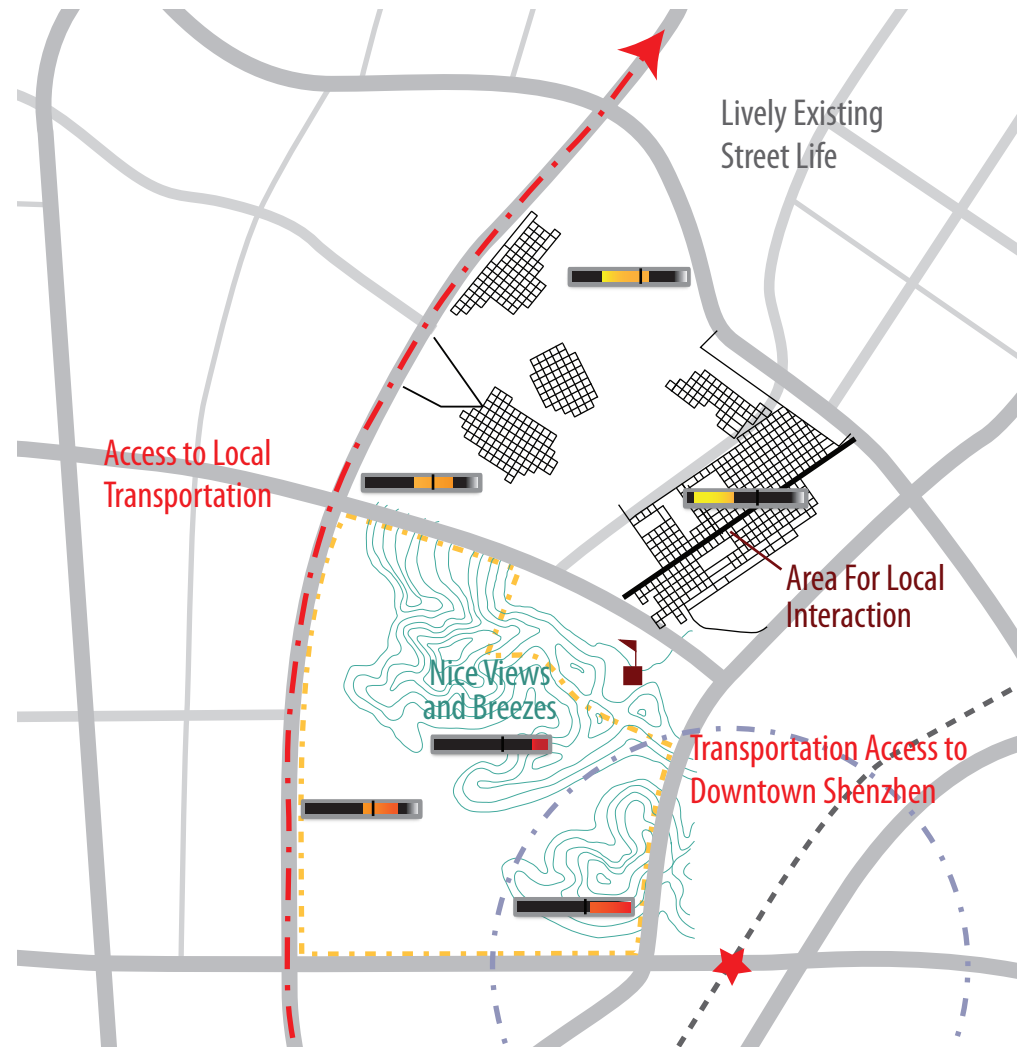
INCOME SCENARIO

Degree of Mix

Mixed income developments tend to work best and allow for comfortable public interaction between income groups when there is a smooth range of incomes rather than only households at opposite extremes. Thus moderately low income households may directly abut the urban villages while high to moderately high income households occupy the most valuable land. Sufficient supply of moderate income housing is key to making a broad mix of incomes viable.

For further information on strategies for income mixing, please see: Mixed Income Housing (p.157)

Layout of Income Ranges > Each bar represents the range of incomes in Shenzhen in 2028. The black vertical bars represent the median. The red bars suggest the income range that will be accommodated on that portion of the site



CONCEPT > Density

Density and Character

In studying Vanke Town, we assume a future site FAR of 2.5, notably higher than the existing FAR of 1.1. However, a prescribed site density still allows for a variety of character. The following two images overlay block scale sites approaching an FAR of two on the Vanke Town site.

Tent City; Boston, MA

This mixed-income development in a prominent central area serves as a transition between higher density development to the north and the four story row houses to the south. Despite being much newer than surrounding developments, it blends in nicely

Block FAR: 1.8

Height: 4-12 stories



Tent City Overlay (right) > The tent city site is overlayed on the Vanke Town site to scale
Source: Google Earth.

Tent City (left) > left: a photograph of the interior circulation space. Source: Goody Clancy



Sea Park; Coney Island, NY

This affordable housing development creatively merges heights with step-downs and connects forms to define open public space. Its presence is more monumental than comfortable and its form calls attention to itself. Over the past quarter century, US developers have tended to avoid the stigma of associated with monumental housing blocks.

Block FAR: 1.8 (approx)

Height: 6-23 stories



*Sea Park Overlay (right) > The Sea Park site is overlayed on the Vanke Town site to scale
Source: Google Earth.*

*Sea Park (left) > A photograph of the Sea Park site
Source: Urban Development Corporation.*



Typologies and their Densities

The next several pages show examples of site layouts and building typologies (all incorporating some low-income units) that may be appropriate for the density and character of a mixed-income development on the site at hand.

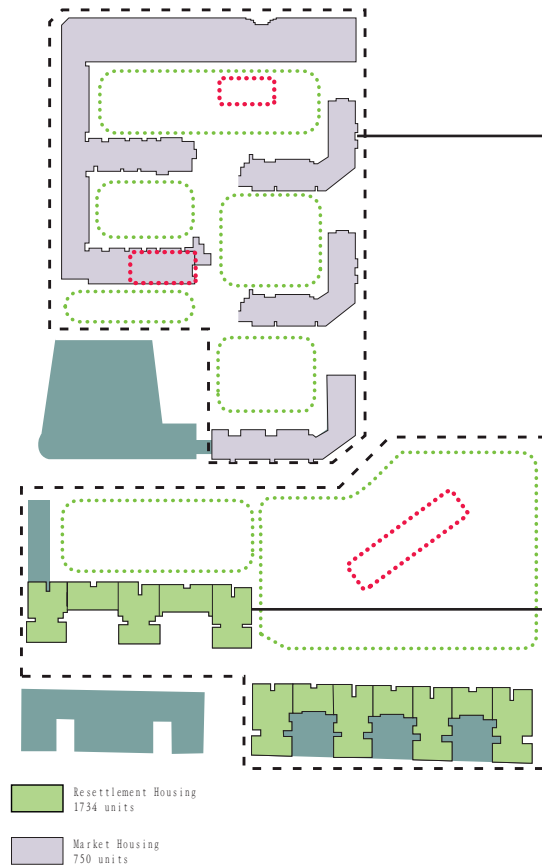
Benjia Estates

Benjia Estates is a recent development near the second ring road in Beijing. It uses a variety of connected midrise slabs and towers. The market rate housing offers more courtyard oriented spaces.

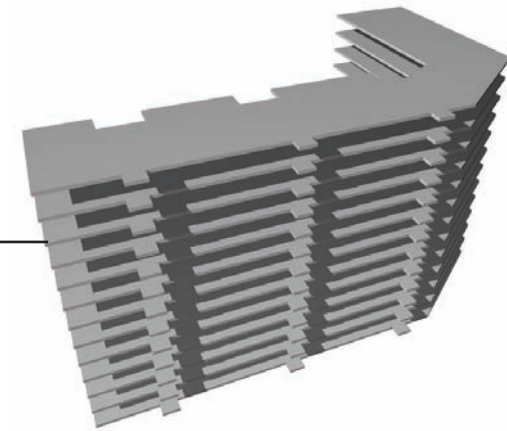
Block FAR 2.9



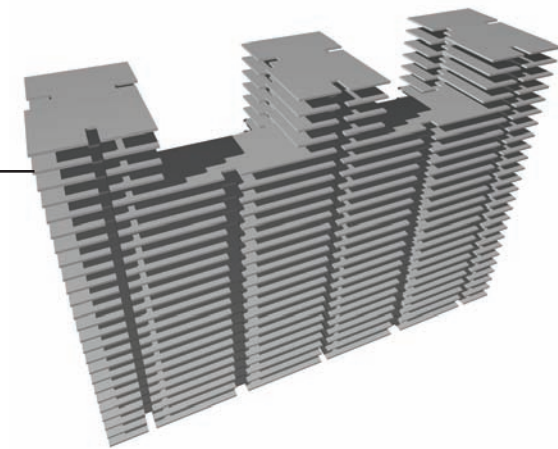
Benjia Estate > Photograph from interior
Source: Jie Bai.



Benjia Estate > Site plan
Source: Jie Bai.



Benjia A > GBA=16,200 Height = 12 stories



Benjia B > GBA=40,800 Height = 16-20 stories

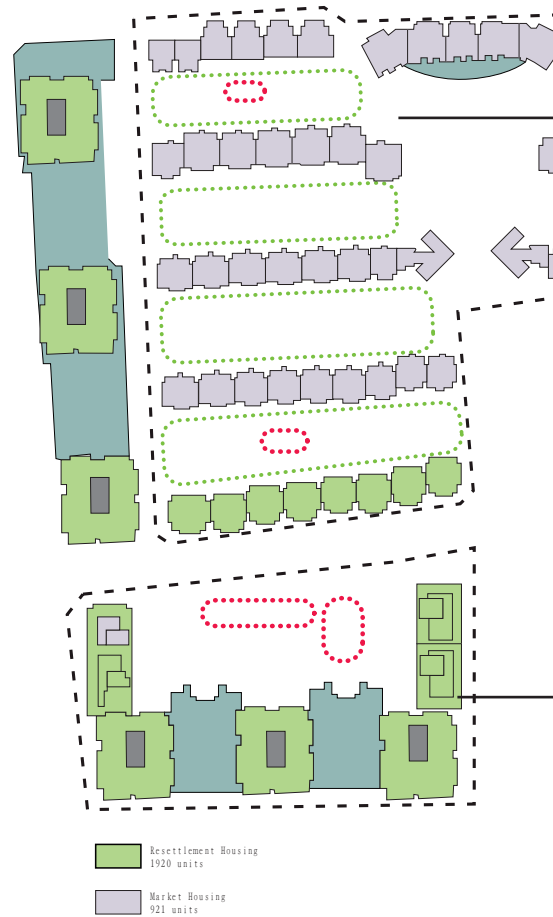
Fuguiyuan

Fuguiyuan is a recent development near the second ring road in Beijing. It uses a combination of thick midrise towers and articulated midrise flats. There is a notable distinction in terms of site location and typology between the market rate and replacement units.

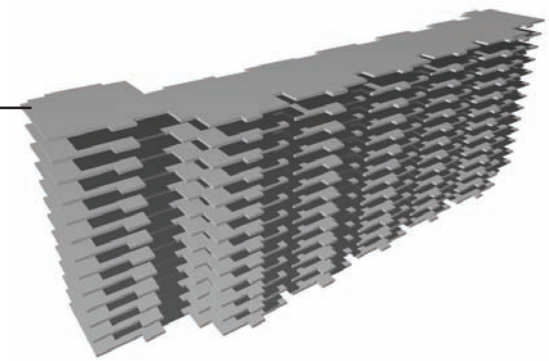
Block FAR 3



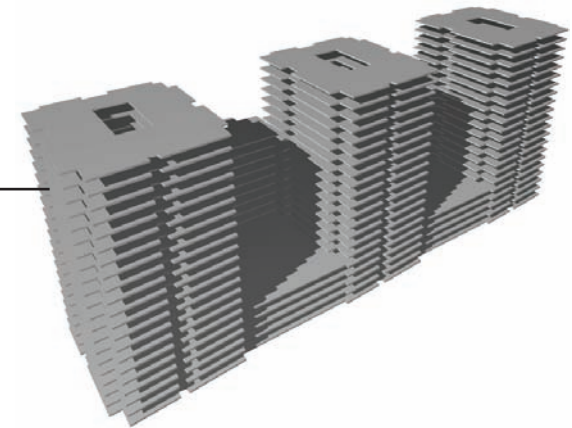
Fuguiyuan > Photograph of towers and flats
Source Jie Bai.



Fuguiyuan > Site plan
Source: Jie Bai.



Fuguiyuan A > GBA=23,850 Height = 12 stories



Fuguiyuan B > GBA=100,504 Height = 4-19 stories

Glory City

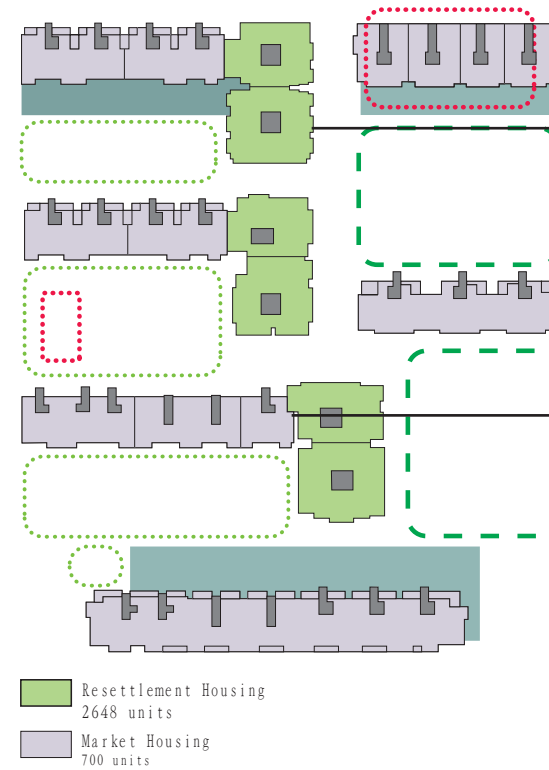
Benjia Estates is a recent development near the second ring road in Beijing. It uses midrise flats and connected towers. Buildings with typologies serving different incomes are connected to form joint courtyards.

Block FAR 2.7

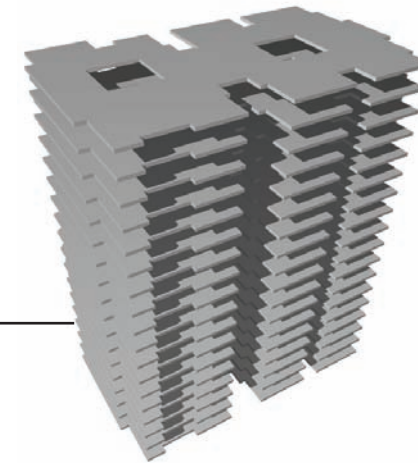
For further information on income mixing in Glory City, please see: **Mixed Income Housing** (p. 157)



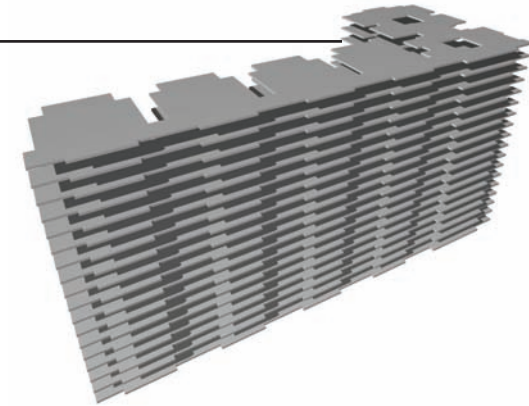
Glory City > Photograph from interior street
Source: Jie Bai.



Glory City > Site plan
Source: Jie Bai.



Glory City A > GBA=20,400 Height = 17 stories



Glory City B > GBA=43,000 Height = 17 stories

Tao Payoh

Tao Payoh is an award winning redevelopment scheme in Singapore. These tall towers fit the largest amount of building area on a slender footprint. They are also highly standardized for maximum use of precast components that reduce costs. The space between the towers are filled with a combination of green space and low level non-residential space such as parking.

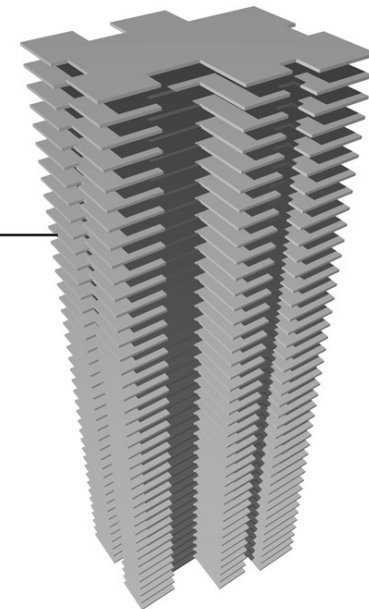
Block FAR 4.5



Tao Payoh > Project rendering. Source: Singapore Building and Construction Authority.



Tao Payoh > Overhead image
Source: Google Earth.



Tao Payoh > GBA=34,300 Height = 35 stories

111 Jones and 201 Turk

This affordable housing development in the center of San Francisco succeeds despite American misgivings about high density affordable housing. The courtyard offers respite from the hectic street life and a comfortable place for children to play.

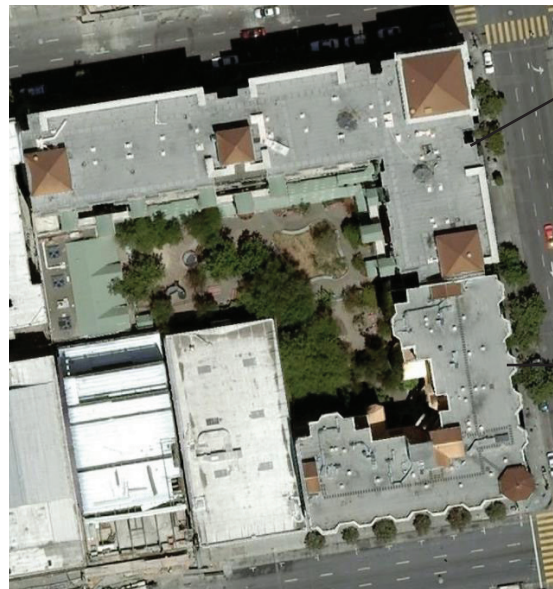
Block FAR 4



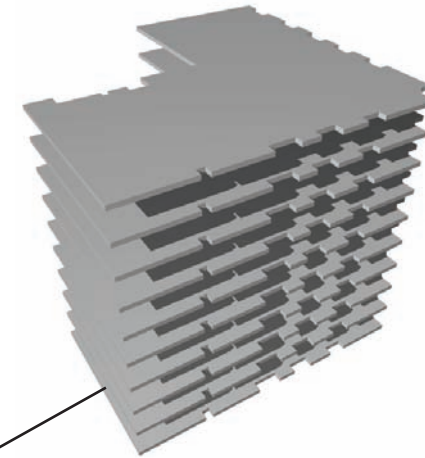
Jones and Turk > Courtyard View
Source: Affordable Housing Design Advisor.



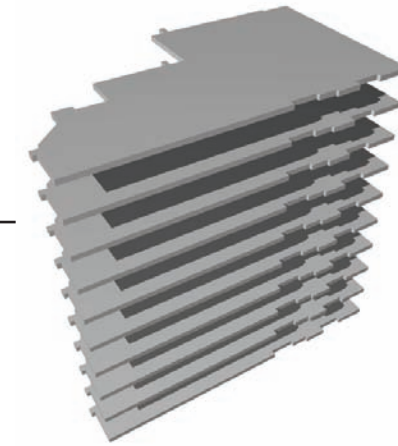
Jones and Turk > Street View
Source: Affordable Housing Design Advisor.



Jones and Turk > Overhead image
Source: Google Earth.



Jones + Turk A > GBA=8,200 Height = 9 stories



Jones + Turk B > GBA=3,800 Height = 9 stories

Tent City

This mixed-income housing development in the center of Boston responds to a neighborhood of row houses to the southeast and a more dense commercial area to the northwest. It does this in part through a subtle transition from 5 story row houses to a 12 story elevator building. Articulation of the street facade helps to break down the scale of the long mass.

Block FAR 1.8



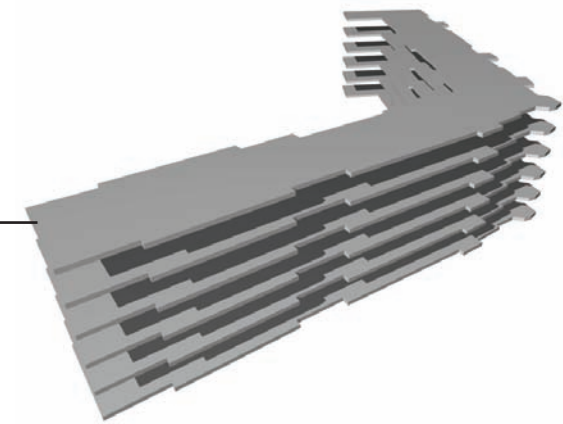
Tent City > Street View
Source: Goody Clancy



Tent City > Left: street entrance. Right: interior court
Source: Goody Clancy



Tent City > Overhead image
Source: Google Earth



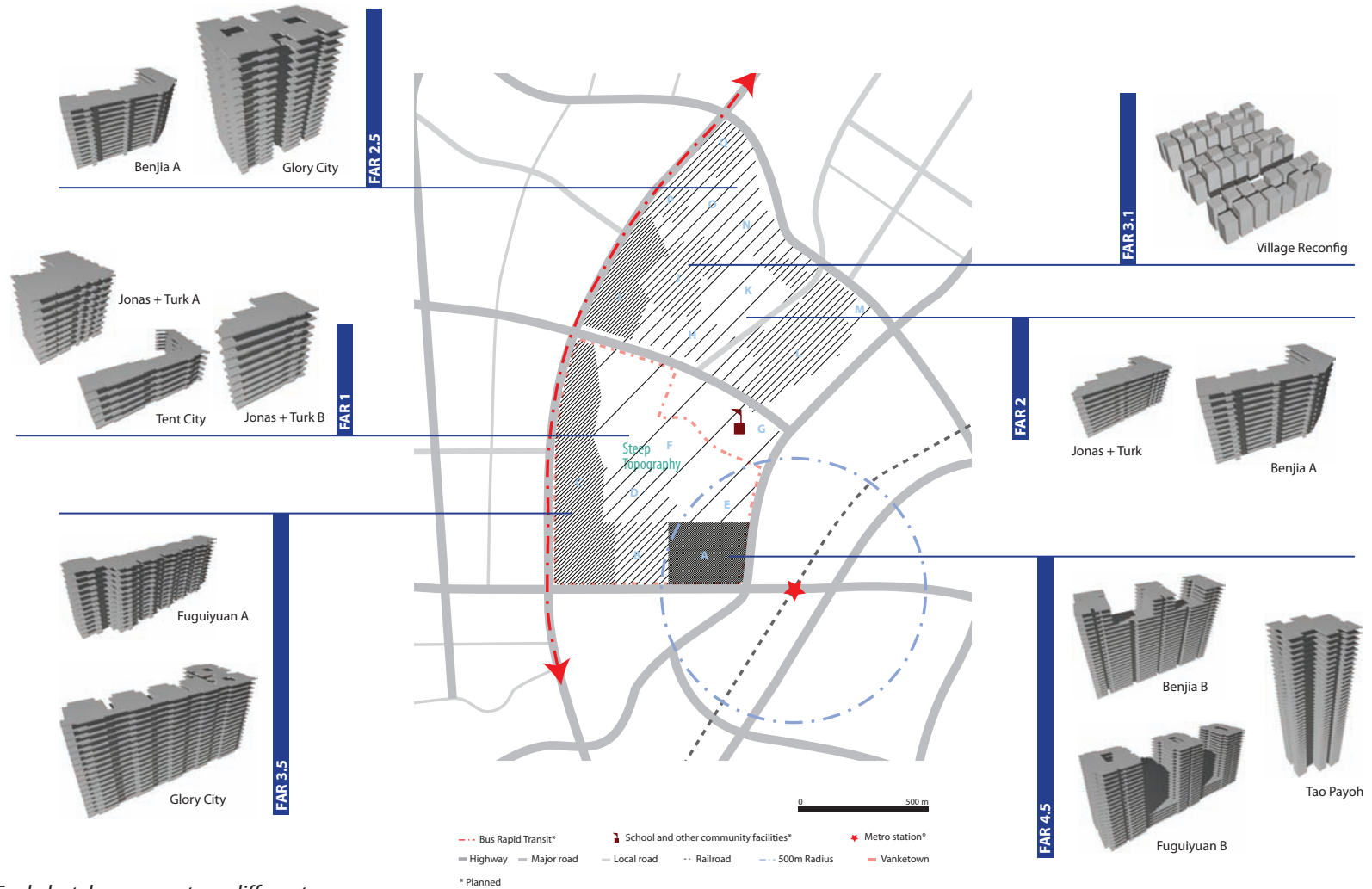
Tent City A > GBA=6,200 Height = 5 stories

DENSITY DISTRIBUTION SCENARIO

Building Type	Floor plate	Stories	GBA	A	C	F	K	O
Benjia A	1,353	12	16,236				4 64,944	3 48,708
Benjia B	2,551	16	40,816	3 122,448				
Fuguiyuan A	1,988	12	23,856		9 214,704			
Fuguiyuan B		4-19	100,504	1 100,504				
Glory City	2,532	17	43,046		7 301,322			
Glory City Part	1,198	17	20,366					4 81,464
Tent	1,238	5	6,190			6 37,140		
JT B	421	9	3,789			12 45,468	7 26,523	
JT A	908	9	8,172			12 98,064	7 57,204	
Tao Payoh	981	35	34,335	2 68,670				
Total				6 291,622	16 516,026	30 180,672	18 148,671	7 130,172
FAR				4.5	3.5	1.0	2.0	2.5
Size				66,800	146,800	180,300	71,500	54,100
GBA needed				300,600	513,800	180,300	143,000	135,250

Using typologies to distribute density > The chart above shows a methodology of incorporating different typologies to meet the overall FAR 2.5 for the site.

DENSITY AND TYPOLOGY SCENARIO



Layout of Density > Each hatch represents a different density between 1 and 4.5 FAR. Darker hatches are used for higher densities.

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Mobility

Connie Chung, Omari Davis, Hope Stege



INTRODUCTION > Goals and Assumptions

Mobility is at once (i) the freedom to move about whenever one wishes, (ii) the availability of choice among multiple modes of transportation, and (iii) the existence of connections between destinations.

Rapid economic growth in recent years has led to equally rapid transitions in city structures, urban form and, consequently, mobility patterns within urban centers. For example, Yang and Gakenheimer (2007) point to the fact that the increasing spatial separation between home and work has increased commuting times by 30% on average.

The rapid pace of economic development also necessitates the building of more roads and highways. However, such road-building activities tend to threaten or eliminate non-motorized transportation amenities such as bicycle lanes and sidewalks. This not only denigrates the pedestrian experience and attractiveness of transit options but also endangers non-motorists, as evidenced by a recent rise in pedestrian fatalities (Yang and Gakenheimer 2007). Thus, it is clear that improving the quality of connections between various modes, particularly non-motorized modes of transportation, will become a priority in the future both in Shenzhen and China at large, in order to improve mobility and the security of all transportation users.

There are also economic arguments for improving mobility. Neglecting pedestrians and walkability has negative economic implications for cities. The level of physical mobility affects economic and social mobility. For example, workers without access to private cars who are forced to risk walking or bicycling on auto-oriented roadways not only risk safety but spend more time and energy commuting to and from work opportunities. The social effect is evident, as well, in that the same lack of accessibility negatively impacts family and social life (Krambeck and Shah 2006).

Yet in spite of these facts, and spurred by rapid transformation of land uses surrounding city centers, the observed pattern has been hasty construction of road networks that correspond poorly with actual travel behaviors. In addition, such historical lack of planning is

Goals

- > Provide equitable access to transportation systems
- > Reduce environmental impacts of transportation
- > Increase multi-modal transportation usage
- > Reduce auto use

likely to result in a Western-style pattern of extreme sprawl and congestion if left unchecked (Yang and Gakenheimer 2007). Planning for increased accessibility and improved mobility becomes crucial to sustainable futures in China.

Assumptions

In addition to the the site-wide assumptions described in the introduction, the following assumptions are made about mobility patterns in China, Shenzhen, and the Vanke Town site:

- > National transit policy has been further developed, mandating development of interconnected public transportation networks
- > National and local policy call for reduced emissions and energy use in transportation
- > Shenzhen's citywide transit network has been expanded to include bus rapid transit (BRT), a comprehensive subway network, and regional rail station that serves the new high-speed link between Hong Kong and Beijing
- > Economic prosperity in the neighborhoods surrounding Vanke Town has resulted in a reduced need for stringent security measures, increased volume of office jobs translating to more stable jobs, and a more stable (less transient) local resident population

FRAMEWORK > Concept, strategy, users

Concept and Strategy

The primary concept behind our investigations is the idea of developing a sustainable mobility system that incorporates both physical and non-physical strategies for maximizing the mobility of all Vanke Town residents. Specifically:

- > Connect various transportation systems for more efficient and flexible movement of people
- > Decrease total vehicle miles traveled by reducing the number of car trips
- > Encourage use of non-motorized and public transportation as an alternative to driving

The frequency-distance chart to the right plots the various destinations future Vanke Town residents are expected to visit, and groups them by appropriate mode of transit. (Destinations are stated and associated with users more explicitly in the future user scenario later in the section.)



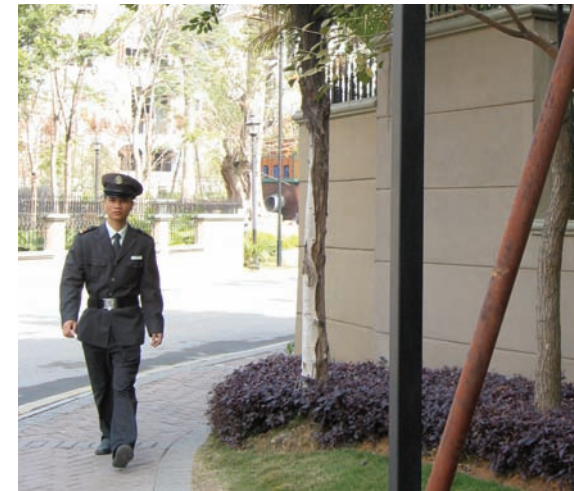
Shenzhen street > Policy and design interventions should work to enhance the vibrant street life of Shenzhen. Source: Omari Davis.

EXISTING CONDITIONS > District and Site

Although the analysis later in this chapter focuses on a scenario twenty years in the future, it is helpful to understand the current conditions of the Vanke Town site. The following series of maps and images depicts existing conditions at both the district and the site scales. Some particularly important existing trends, as well as some that do not show up graphically, include:

- > Low site permeability
- > High level of security (guards, driving barriers, wall)
- > One parking spot per unit (at or very near unit)
- > Average of one car per family
- > Lack of internal transportation system (shuttle bus)
- > Main streets are pedestrian friendly

Existing conditions for mobility > (clockwise from upper left) Two-lane retail street in Vanke Town with wide sidewalks, pedestrian furniture, and shade trees; security guard and gate at entrance to site; security guard walking perimeter wall of site; two car attached garage at high-end home. Source: Hope Stege.



Longhua District

One of seven districts making up the city of Shenzhen, Longhua is north of the Special Economic Zone and connects to the center city via a limited-access highway.

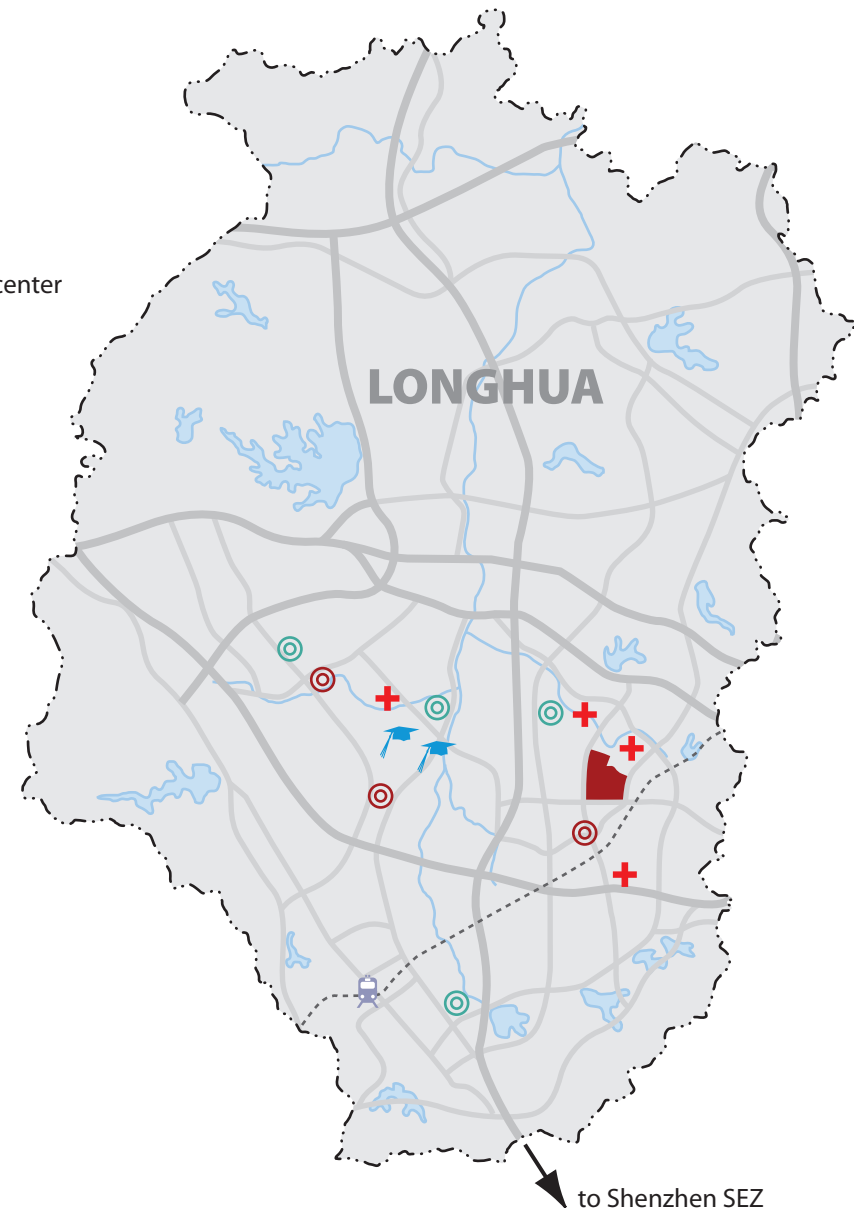
Major streets in Longhua are often six lanes wide, with fast-moving traffic in both directions. Many corners have traffic signals and crosswalks, but the blocks are at an automobile scale rather than a pedestrian scale, so intersections can be up to a kilometer apart.

Most streets have sidewalks, often separated from driving lanes by metal fencing or a change in paving material. Retail areas often have wide sidewalk zones that are used for displaying goods, temporary parking, street vending, and pedestrian traffic.



- Commercial/retail
- Community/recreation center
- Hospital
- School
- Train station
- Railroad
- Vanketown

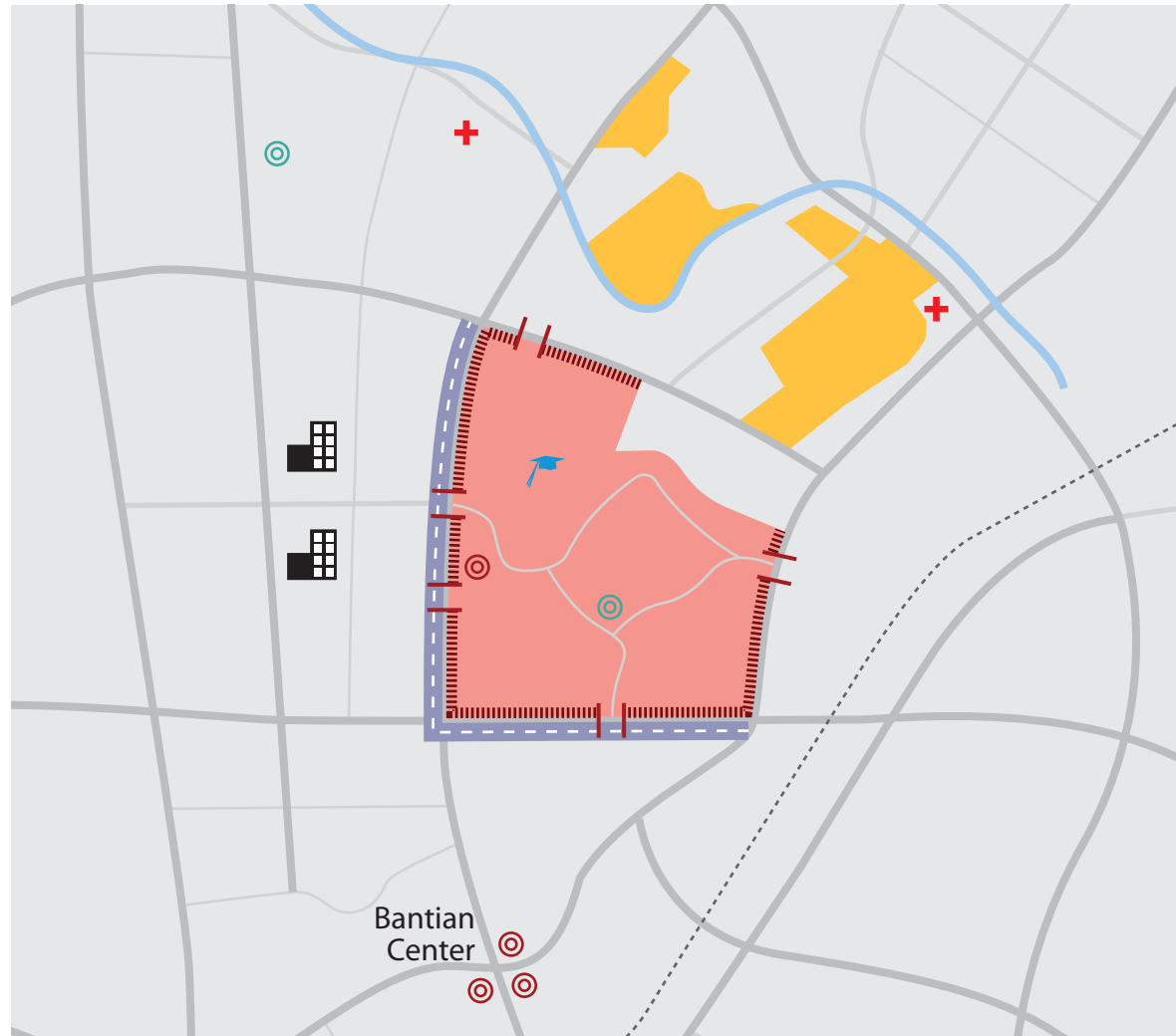
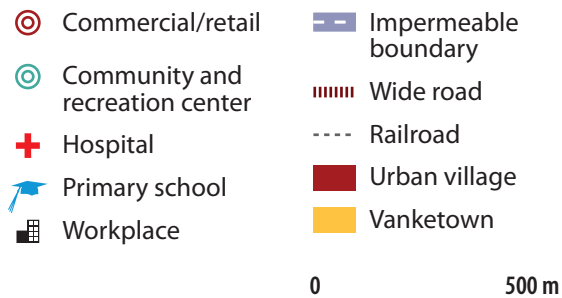
0 2 km



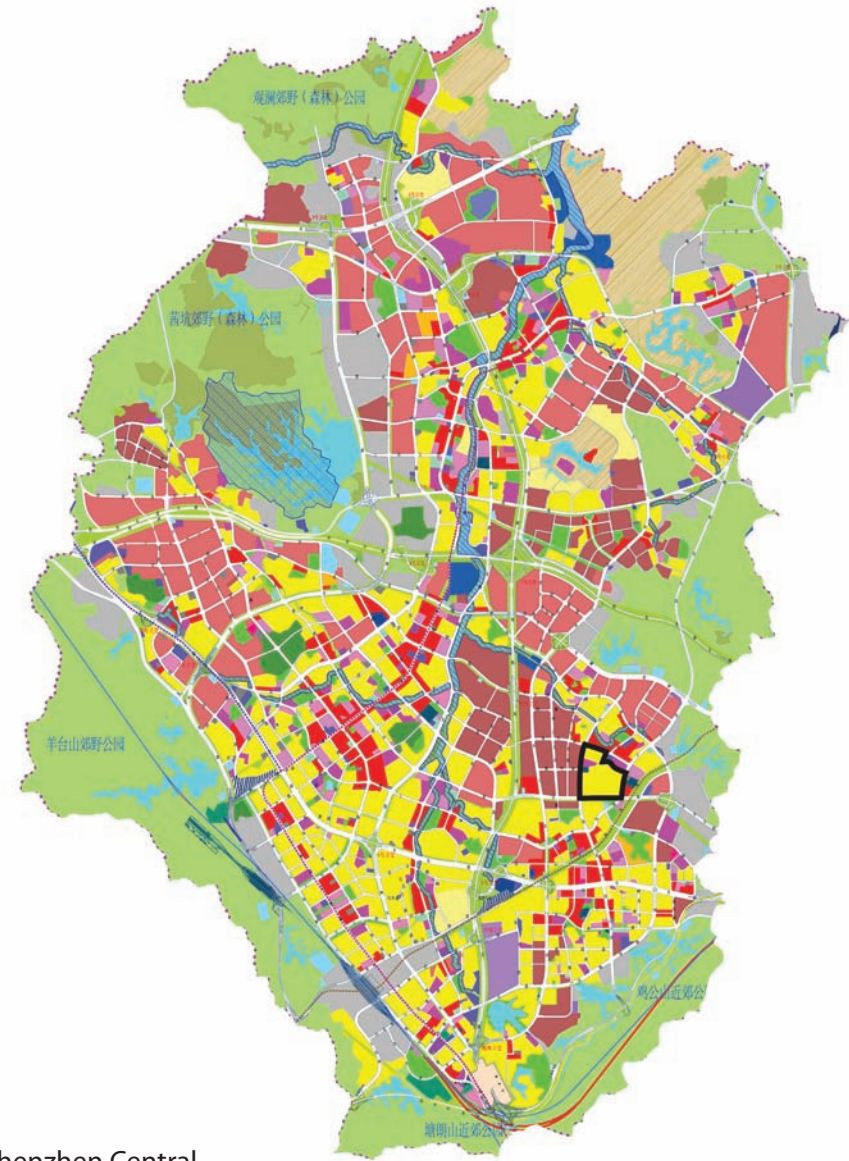
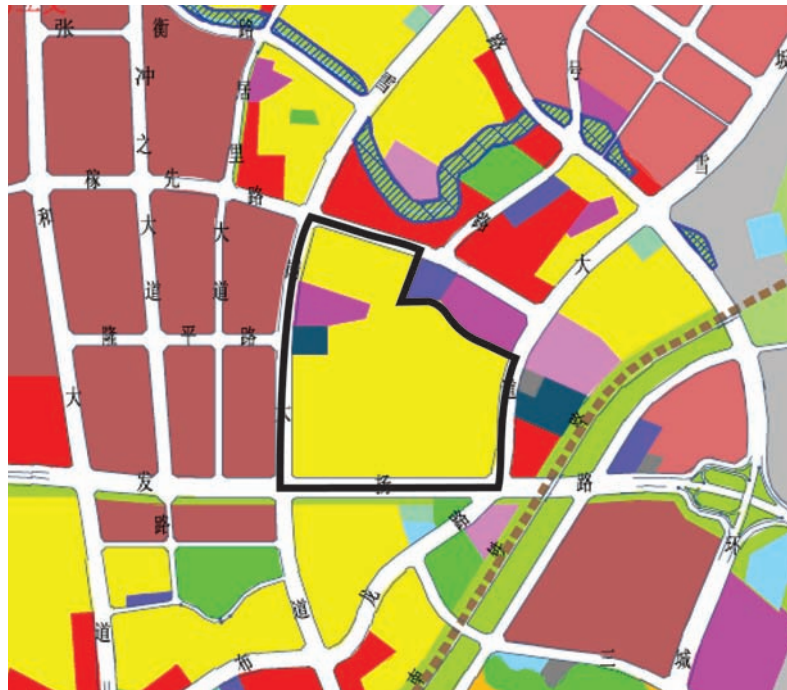
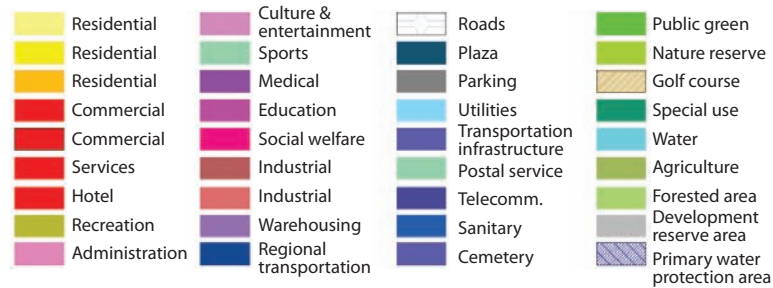
Immediate Surroundings

Interviews with current Vanke Town residents revealed that most basic services and amenities can be found within about a kilometer of the development. Many people report walking or bicycling to do their daily grocery shopping at the grocery store in Bantian Center or the wet market in the village north of Vanke Town. There is a primary and secondary school within the development, and Huawei—a major employer—is headquartered just a few hundred meters to the west of Vanke Town.

Nearly all of Vanke Town's perimeter is lined by a combination of heavy plantings and a 3-meter, solid plaster wall. Additionally, the southern and western edges of Vanke Town are bounded by six-lane arterial streets with fast-moving traffic. These visual and physical barriers create an impermeable edge to the site, broken by only five points of access.



Land Use



Source: Shenzhen Central
Sub-District Planning 2005.

ANALYSIS > Policy

Current Policy Scenario

Current policy is effectively geared towards increasing auto mode share. See *Historical automobile demand* and *Projected urban car ownership* at right for more details. Despite Premier Wen Jiabao's 2004 declaration that "giving priority to urban public transport development is a correct line of strategic thinking that suits the reality of China's urban and transport development," road expansion has outpaced public transport expansion, and cities are building more roads and simultaneously dismantling bicycle and pedestrian rights-of-way (World Bank 2006). This has serious implications for the equitable accessibility of transportation networks, and for mobility as a whole. Such actions also have implications on the public health of Chinese citizens.

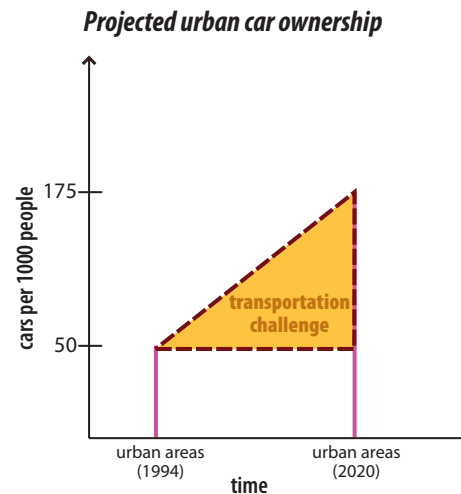
For further information on transportation and public health, please see: [Auto Use Reduction for Healthy Cities](#) (p. 213)

The Premier's statement is in line with progressive policy goals, but transportation policy at the national level is not strong (Yang and Gakenheimer 2007). It would seem that a shift in focus, not goals, is needed at the national level.

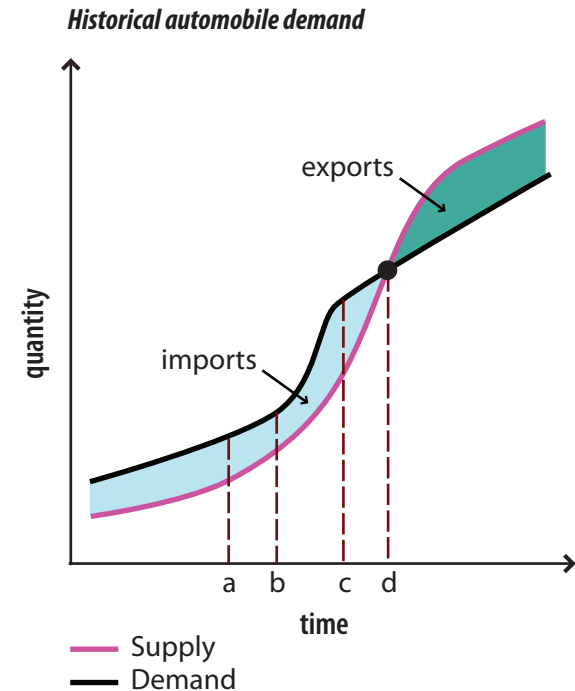
Conversely, local-level land use policy has been driven by the need to succeed economi-

cally at the expense of sustainable transportation (World Bank 2006). At the local level a paradigm shift needs to occur. One need only review Wen's declaration for inspiration—public transport is the priority.

Similarly, developers too have a role to play. They have the opportunity to manage on-site transit in a sustainable manner, and they can be at the forefront of sustainable practices. For all three levels to develop a progressive and holistic system, public transit is considered first, then implementation of policy and form interventions. Such policy and form interventions are discussed on the following page.



Source: World Bank 2006.



- a 8th Five Year Plan (1991–1995): auto industry designated a "pillar industry"
- b World Trade Organization membership (2001); tariffs lowered on imports
- c New policy promotes domestic and international auto industry expansion
- d Continued government support of auto industry expansion until 2010

Source: World Bank 2006.

Policy Assumptions:

- > The densities of urban China will rise.
- > The standard of living will rise.
- > Auto ownership will rise relative to the standard of living

Auto use, or auto mode share, is defined as the percentage of auto trips made relative to the other mode types. It is negatively related to increasing densities and positively related to rising incomes.

In Shenzhen it is difficult to tell what specific effect density and income will have on auto mode share. However, the increase in population will effectively offset any marginal increases or declines. As such, policy should be geared towards a negative effect on auto mode share.

The equation below mathematically depicts the goal of policy intervention, where auto mode share is equal to the sum of: a constant (alpha), income, density, and some policy intervention. Policy is meant to have a negative effect on auto mode share.

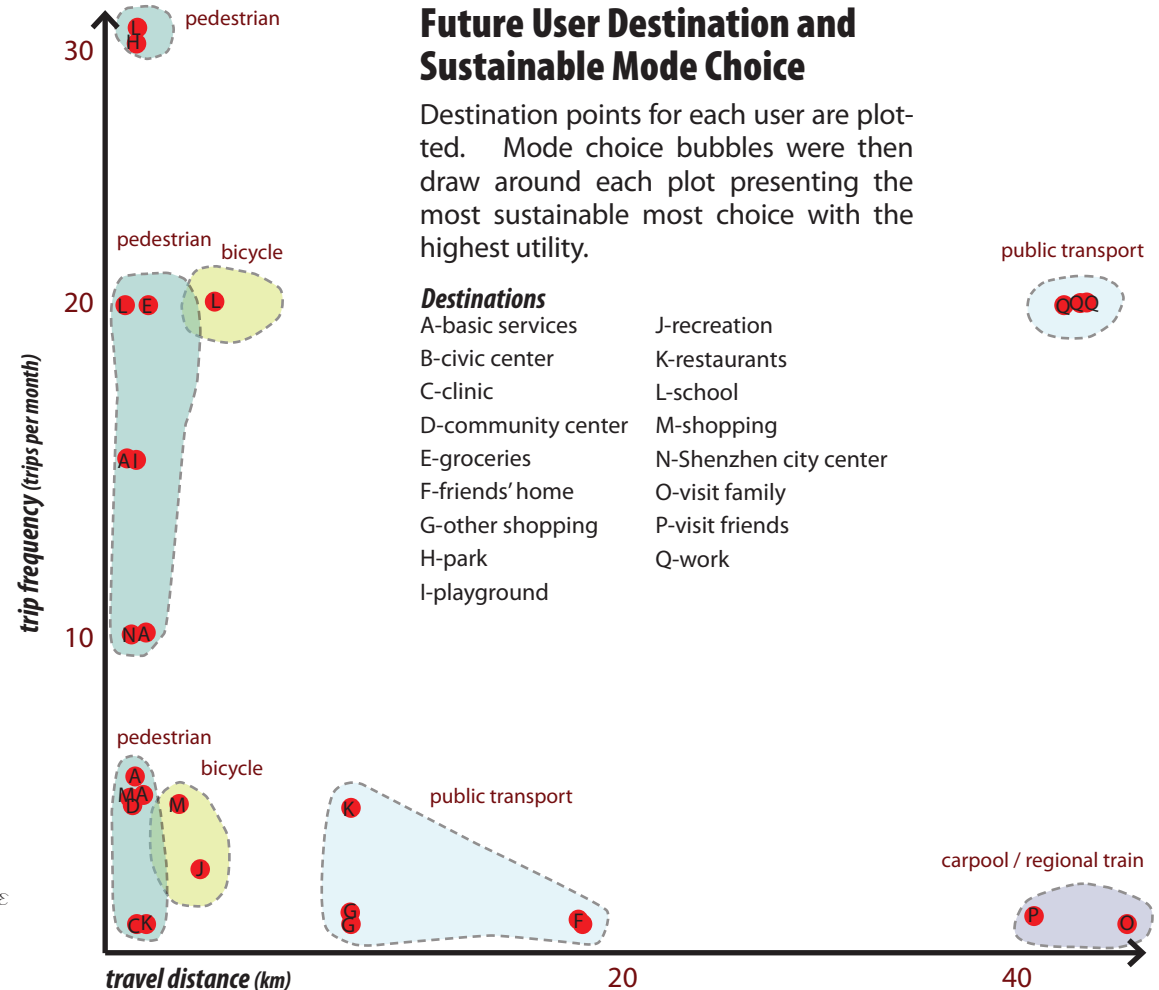
↓ **auto mode share** = $\alpha + \beta_1 \text{income} + \beta_2 \text{density} + \beta_3 \text{policy} + \varepsilon$

Future User Destination and Sustainable Mode Choice

Destination points for each user are plotted. Mode choice bubbles were then drawn around each plot presenting the most sustainable most choice with the highest utility.


















Destinations

A-basic services	J-recreation
B-civic center	K-restaurants
C-clinic	L-school
D-community center	M-shopping
E-groceries	N-Shenzhen city center
F-friends' home	O-visit family
G-other shopping	P-visit friends
H-park	Q-work
I-playground	



Future User Groups

When looking at mobility, one must always remember that not all users are alike. People of different ages have very different mobility patterns and needs, as described in the table below, which projects the potential future needs of various Vanke Town residents. The table also emphasizes that certain destinations will be much more frequently visited than others. Paying attention to this can help to identify destinations that are most critical to consider when developing a mobility system.

User	Destination	Frequency (trips per month)	Maximum distance (km)	Mode	Notes
Child	playground	15	0.3	 	younger children go more frequently, often with an adult
	community center	5	0.5	 	
	school	40	0.5	 	two round-trips per day to come home for lunch
	clinic	1	1	  	
Teenager	school	20	3.5–4	  	
	shopping	4	1.5	 	probably with friends
	Shenzhen city center	1	12	  	probably with friends



walking



car



subway



bicycle











































bus
























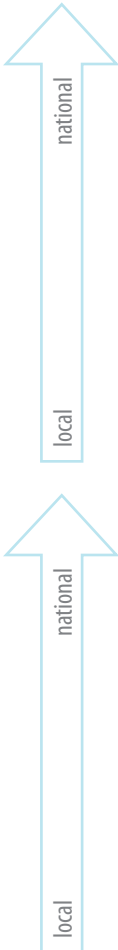
train



primary transit mode(s)
used to reach destination
(correlates to points on
frequency-distance graph)

<i>User</i>	<i>Destination</i>	<i>Frequency (trips per month)</i>	<i>Maximum distance (km)</i>	<i>Mode</i>	<i>Notes</i>
Young couple (no children)	work	20	42	    	
	basic services dry cleaning groceries	4 10	0.7 1.5	 	
	other shopping	2	12	  	
	restaurants	4	12	   	
	friends' homes	2	20	    	
Couple (with children)	work	20	42	    	
	basic services dry cleaning groceries	4 15	0.7 1.5	 	
	other shopping	2	12	  	
	restaurants	1	1	 	
	visit family	1	50	   	could be any distance away; usually travel with multiple people
	recreation	2	3	    	

<i>User</i>	<i>Destination</i>	<i>Frequency (trips per month)</i>	<i>Maximum distance (km)</i>	<i>Mode</i>	<i>Notes</i>
Retirees/grand- parents	park	30	0.5	 	
	pick up grandchild at school	20	0.5		
	groceries	20	1.5	 	
	shopping	4	2	   	
	visit friends	2	42	   	
Vanke Town employees	work (in Vanke Town)	20	42	   	
Visitors	Vanke Town			   	



	<i>Incentives (Carrots)</i>	<i>Disincentives (Sticks)</i>
<i>Policy</i>	<ul style="list-style-type: none"> • National government promotion of urban transportation planning • Education of transportation and land use planners • Tiered (demographic-based) fare pricing • Transit-oriented property tax capitalization funding • Location efficient mortgages (LEMs) • Provision of employee housing 	<ul style="list-style-type: none"> • Dynamic fuel pricing • Maximum age driving limits • Impact fees • Congestion pricing • Odd/even driving days • Congestion pricing for parking
<i>Form</i>	<ul style="list-style-type: none"> • Maintenance subsidy for non-motorized transit paths • Design guidelines for non-motorized transit paths 	<ul style="list-style-type: none"> • Minimum FAR requirements • Minimum connectivity index score • Pedestrian overlay district (POD) • Minimum diversity index score • Maximum parking allowances • Satellite parking network

Policy Intervention Matrix

Influencing the mobility habits of individuals is a complex endeavor. However, it can be approached from four salient angles. One can intervene in policy and regulation and hope to have an influence. Similarly one can intervene in the physical environment and hope for some modicum of environmental determinism. Additionally there are two ways of influencing individuals to take action—encourage a behavior or discourage a behavior. The matrix to the left is a means of exploring these different options.

TOTAL: 10.6% auto mode share reduction

Incentives ("carrots")

SCALE	POLICY	DESCRIPTION	DECREASE in AUTO MODE SHARE
Policy National	National Government Promotion of Urban Transportation Planning ^a	Provides institutional support around transit planning for local governments, as well as a provision of macro-level checks and balances for transportation systems nationwide	0.25%
Policy National	Education of Transportation and Land Use Planners ^a	Provides a decentralized coalition of individuals concerned with transportation planning	0.25%
Policy National	Location Efficient Mortgages (LEM)s	Lower rate mortgages which account for lower transit costs of the borrower	0.5%
Policy Local	Tiered Fare Pricing	Sets fair based on demographic composition accounting for price sensitivities amongst different groups	1.25%
Policy Local	Property Tax Capitalization	Transit infrastructure related tax revenue increases are appropriated for further infrastructure improvements	0.25%
Policy Local	Parking Market Segmentation	Provides enhanced automobile storage services based on user preference. Adds value to satellite parking schemes thereby increasing their supply in the market. (See "Satellite Parking Network" below for further details regarding auto mode share reduction.)	0.05%
Policy Local	Employee Housing Set-Aside	Provides housing for employees close to work which will encourage NMT commute.	0.5%
Form Local	Woonerf Maintenance Subsidy	Local government assistance in maintaining private woonerven as a "quasi-public" good	0.5%
Form Local	Design Guidelines for NMT Paths	Ensure an ascetically pleasing experience for pedestrians and bikers	0.05%

^a Source: Yang and Gakenheimer 2007.

Disincentives (“sticks”)

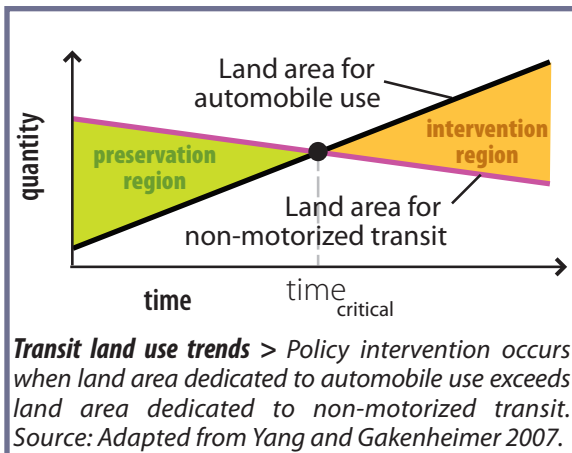
SCALE	POLICY	DESCRIPTION	DECREASE in AUTO MODE SHARE
Policy National	Dynamic Fuel Pricing	Price of fuel directly tied to daily oil price. Raises marginal costs, thereby lowering demand/use	2.0%
Policy National	Maximum Driving Age Limit	Lessens road demand, possibly increases traffic safety	0.25%
Policy National	Impact Fees	Developers are charged for the impact development places on transportation infrastructure	0.25%
Policy Local/National	Odd/Even Driving Days	Effectively halves road demand restricted driving allowances based on license plate numbers	1.0%
Policy Local	Congestion Pricing	Users are charged for externalities of peak hour road consumption	1.25%
Policy Local	Congestion Pricing for Parking	Users are charged for externalities of peak hour access to parking	0.5%
Form Local	Minimum Floor Area Ratio (FAR)	Ensures a minimum density, thereby providing opportunity to limit auto-mode share and increase diversity	0.5%
Form Local	Minimum Connectivity Index Score	Ensures higher access, provides greater mobility. Should not be applied uniformly to all modes	0.25%
Form Local	Pedestrian Overlay District	A district in which built form is geared toward optimizing the pedestrian experience	0.25%
Form Local	Minimum Diversity Index Score	Ensures the integration of land uses, ideally eliminating the need for multiple trip are chaining of trips	0.5%
Form Local	Maximum Parking Amounts	Limits the supply of parking which effectively raises the demand threshold for parking, acts as a disincentive for destination auto use.	0.5%
Form Site	Satellite Parking Network	Concentrating parking will allow more dynamic land use resulting in increased efficiency	0.25% (75% reduction in on-site travel)

Diametric Land Use Scenarios

Transportation policy can follow one of two extreme trends, described in two scenarios below:

The **Status Quo Scenario** assumes that transportation develops along current unsustainable trajectories. The ramifications of such regulatory inaction are potentially devastating, in all aspects—ecological, financial, and political.

The **Composite Scenario** assumes that all sustainable transportation policy and form-based interventions described in the preceding pages are adopted—both incentives and disincentives; local and national. While it may not be necessary to adopt all policies it is important to realize that they all work with one another in a holistic manner. For instance, without national government coordination it will be difficult to enforce dynamic fuel pricing.

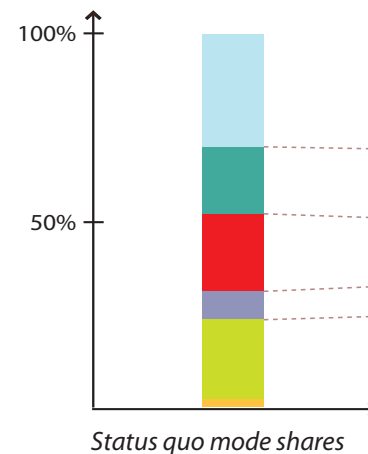


Status Quo Scenario

AUTO MODE SHARE IS INCREASED

Some of the more dire outcomes are as follows:

- > Increased energy use
- > Decreased energy security
- > Increased road densities
- > Decreased open space
- > Increased pollution
- > Increased public health costs
- > Inequitable accessibility

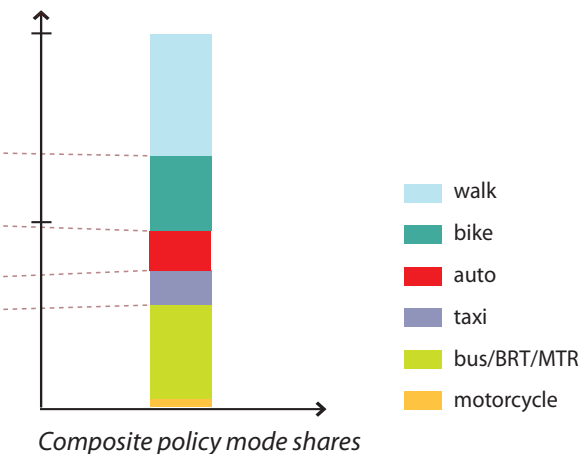


Composite Policy Scenario

AUTO MODE SHARE IS DECREASED

The following are potential outcomes if the progressive policies are enacted and Chinese transport systems change trajectory:

- > Measured energy use
- > Energy-related technological innovation
- > Increased/constant amounts of open space
- > Increased levels of public health
- > Increased pollution
- > Equitable accessibility
- > Increased leisure time (less travel time)



Best Practices

BRT Station

Curitiba, Brazil



Curitiba > Curitiba showed the world the possibilities of BRT. Mode share in the city rose 2.3% per year from 1974 to 1994 (Wright and Fulton 2005). Source: [cerdsp@flickr.com](#).

Pedestrian-Friendly Zone

Washington, DC, USA



All principal buildings shall be located on the front lot line

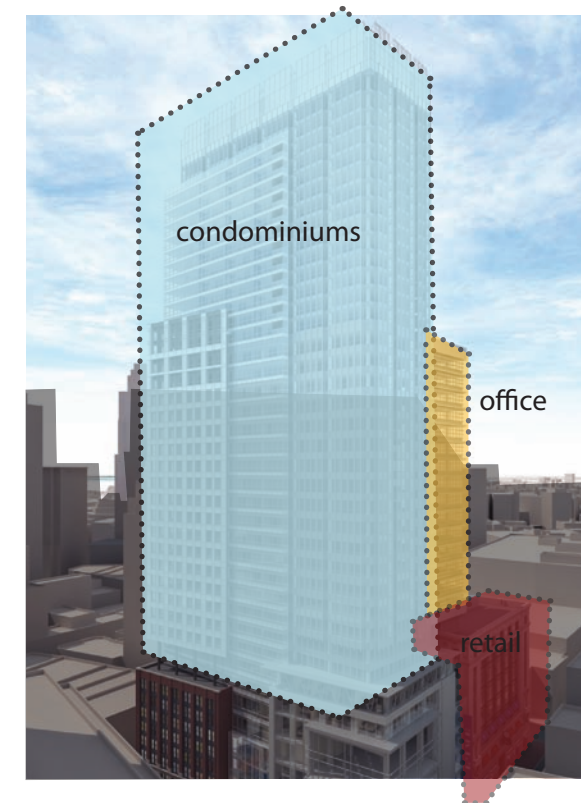
At least 50% of ground level wall area shall be devoted to interesting features

All public and commercial buildings shall have an awning or canopy over any building entrance that abuts the public right-of-way

Pedestrian Overlay District (POD) > The street above exemplifies many of the characteristics of the POD. Source: Omari Davis.

Diversity Index at Work

Boston, Massachusetts, USA



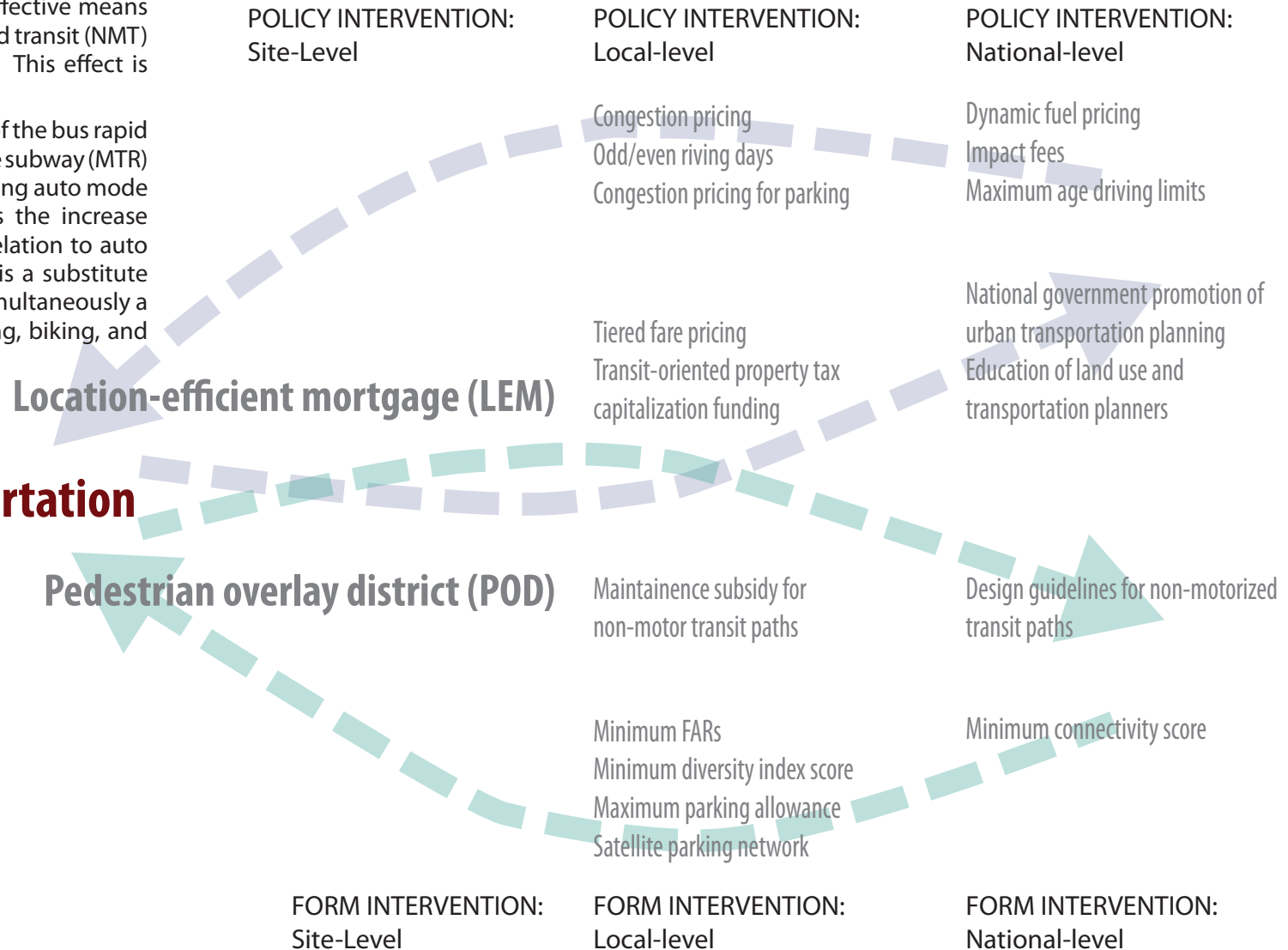
Minimum Diversity Index > Mixed use high-rise building in downtown Boston. Source: Adapted from The Boston Globe online edition.

Transit-Oriented Policy Intervention

Studies have shown that improvements to public transport is an effective means of increasing non-motorized transit (NMT) (Wright and Fulton 2005). This effect is diagrammed at the right.

Effective implementation of the bus rapid transit system (BRT) and the subway (MTR) will be key factors in reducing auto mode share. The BRT facilitates the increase of other mode shares in relation to auto mode share because BRT is a substitute for the automobile, and simultaneously a complement of the walking, biking, and other NMT modes.

Public Transportation





Shenzhen Street > Policy and design interventions should facilitate a pedestrian-friendly environment in Shenzhen. Source: Omari Davis.

ANALYSIS > Connectivity

Establishing a solid network of connections to encourage non-motorized transportation is at the heart of developing a sustainable mobility system. Connections need to be considered at multiple scales, and for various modes of travel.

Site-scale Connectivity

Existing access to Vanke Town is quite limited, in part because of security concerns and being surrounded by light industrial facilities. However, in a future scenario within which the area surrounding Vanke Town will be vibrant and safe with many retail, commercial, and recreational destinations in the Longhua District and beyond—it will be critical to encourage Vanke Town residents to utilize off-site amenities. Conversely, public amenities within Vanke Town need to be accessible to the local community.

Factors contributing to the degree of connectivity between a site and its surroundings revolve around the manner in which the site is accessed. Important considerations include:

- > Number of access points to the site
- > Location/spacing of access points
- > Degree of security at access points
- > Visibility from street to site
- > Proximity of destinations and amenities



- Existing vehicular access point
- Existing pedestrian access point

0 500 m

Existing Access to Vanke Town > (top) A main automobile entrance to Vanke Town, with security station, pedestrian crossing, walls, and plantings; (bottom) Pedestrian entrance to Vanke Town along the southern edge of the site—note uneven sidewalk and steps. See *Existing Conditions* for surrounding land uses and amenities. Source: Hope Stege.



Case Study

Regent Park, Toronto: Restoring the Grid

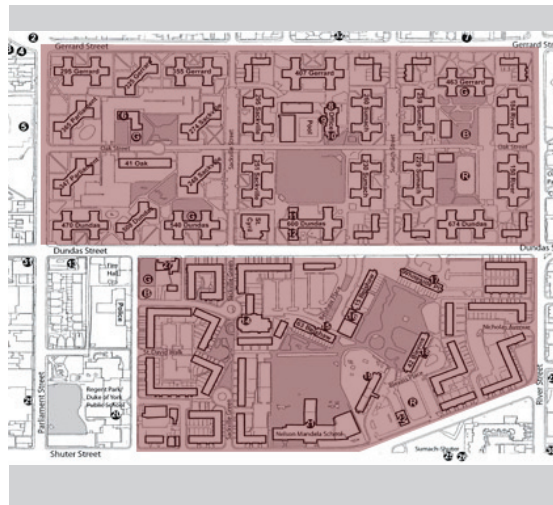
Built in the 1940s and 1950s during the height of slum clearance, Regent Park in Toronto is a classic example of “towers in the park” social housing. However, the lack of through streets as well as homogenous architecture and insufficient public facilities have caused Regent Park residents to feel isolated from the rest of the city. A revitalization effort is underway to update the development and reintegrate it with its surroundings.

A key element of the revitalization plan’s urban design is to reestablish the street grid that was lost when slums were replaced with superblocks over a half-century ago. All of the original streets are restored, and new street segments are added to create an even finer-grained block pattern. The new plan provides much greater site permeability while still allowing for some flexibility in development. Importantly, the smaller residential blocks (measuring no more than 130x90m) improve walkability within the site, and create a sense of continuity and connection with the surrounding neighborhood. (Toronto Community Housing 2006)

For more information:
<http://www.regentparkplan.ca>



Context > Regent Park, shown in red, is surrounded by a fine-grained street grid. Source: Google Earth.



Before > Site plan of Regent Park in Toronto, Canada before revitalization. Source: Toronto Community Housing.



After > Site plan of Regent Park in Toronto, Canada after revitalization with restored street grid. Source: Toronto Community Housing.

Addressing connectivity

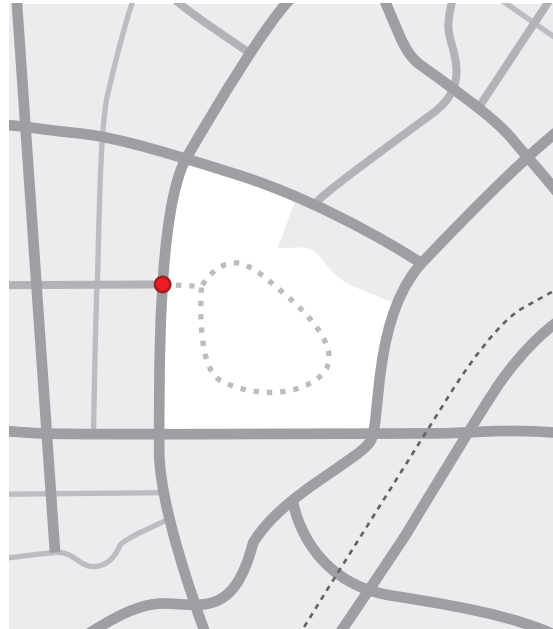
The following scenarios consider potential ways to address the connections between Vanke Town and the surrounding area. These scenarios follow the same assumptions as mentioned earlier, namely that the area around Vanke Town is vibrant, safe and includes desirable destinations.

The range of options brings out both the advantages and disadvantages of connectivity, cautioning planners from moving too far towards either extreme. The two sets of diagrams illustrate a progression of connectivity, first only considering motorized vehicles, and then adding in pedestrian connections as well.

Vehicular access

● Vehicular access point

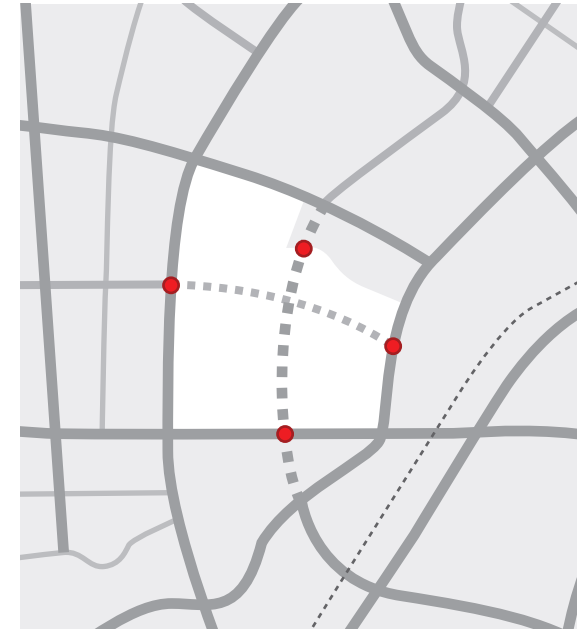
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Scenario A

Limited access

In this scenario, little is done to connect Vanke Town with the external street system. Site access is limited to a single entrance, located at the only mid-block intersection along the site's perimeter and internal circulation follows a single looped street. This option allows for high security (access can be controlled at the entrance) but very low connectivity with the surroundings.



Scenario B

Street extensions

As in the Regent Park case study on the prior page, another option is to extend existing streets across the site. This scenario offers entries on each edge of the site, providing access to the street and surroundings in every direction. The extensions may bring significant traffic through the site (good for retail/commercial), though would also divide the site into four discrete quadrants.



Scenario C

Grid replication

Building on Scenario B, this option mimics the size and shape of roads to the west of the site. Though several more entrances to the site are introduced, the larger north-south and east-west streets from Scenario B are still likely to bear the heaviest traffic burden as they connect to existing roads. However, further extending the new minor roads could help distribute traffic and activity.



Scenario D

Neighborhood grid

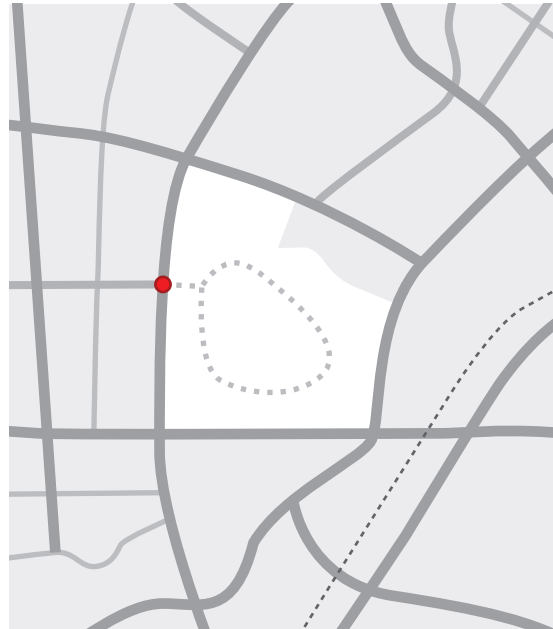
Scenario D takes the neighborhood streets from the Regent Park case study and applies them to the Vanke Town site. It is painfully obvious that such a fine-grained street pattern does not fit into the surrounding context, and that the numerous points of access it creates are superfluous and redundant. However, the small blocks are much more pedestrian friendly than any in other scenarios.

This set of scenarios layers pedestrian connectivity on top of the vehicular connectivity examined on the prior pages. Each diagram takes into account the scenarios defined for vehicles, and projects forth a pedestrian access system in keeping with similar principles

Pedestrian access

- Vehicular and pedestrian access point
- Pedestrian access point

0 500 m



Scenario A

Limited access

Like the vehicular version of this scenario, pedestrian access is limited to the single point of entry on the western edge of the site. Presumably, this entrance is kept secure and the perimeter of the site is walled in keeping with the desire for heavy security. Pedestrians have very little access to their surroundings, and when they do leave the site, must share the same entry point with cars.



Scenario B

Street extensions

With only four entrances, pedestrians could be stuck walking up to 500 m just to exit the site, then retracing their steps once they are on the external street. Adding pedestrian access between the main vehicular entries will greatly cut down on travel distance in addition to providing more windows into Vanke Town from the outside, encouraging people from the outside to come in, as well.



Scenario C

Grid replication

This situation sets up a pedestrian access pattern similar to Scenario B, but with more access points shared by motorized and non-motorized modes of transit. Though the mid-block access points do not create connections to any additional streets, they do allow both cars and people to take more direct routes in and out of the site, shortening overall distance traveled.



Scenario D

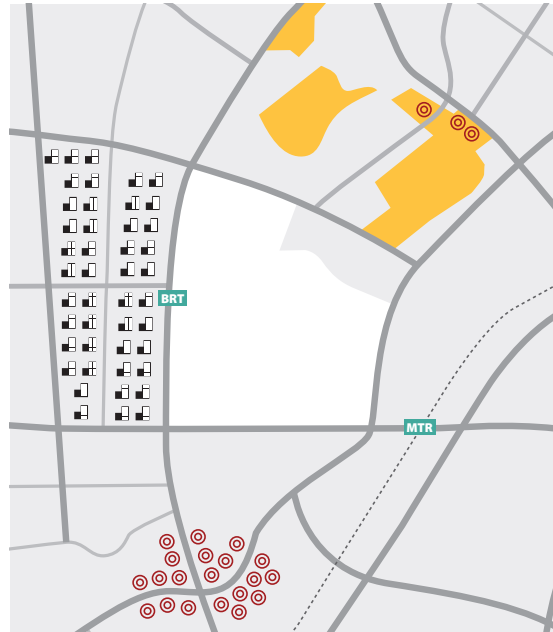
Neighborhood grid

In this scenario, access points off of neighborhood connector streets are used for vehicular traffic, while access from smaller residential streets is restricted to pedestrians only. This many pedestrian access points might be useful if the residential grid continued on the outsides of the site, but is unnecessary with the present large block sizes.

Potential connections

As the areas adjacent to Vanke Town continue to develop and densify, it will be important to create appropriate connections between the site and its surroundings. The diagram to the right suggests patterns of connectivity based on the following situation:

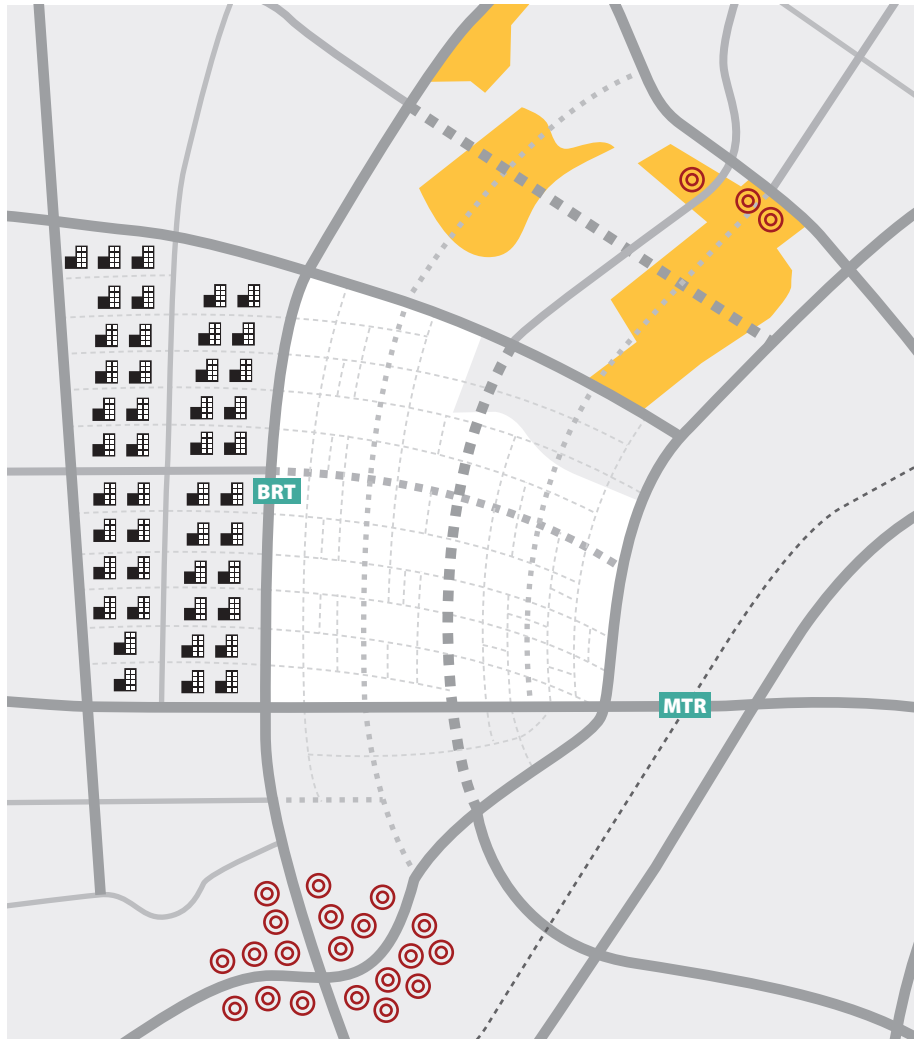
- > The Bantian commercial center has continued to grow, and now includes specialty retail stores as well as restaurants, a movie theater, and a large supermarket.
- > Industrial areas to the west of Vanke Town are still owned by Huawei, but employment there has changed from manufacturing to office jobs. Many of the salaried employees live in Vanke Town.
- > The village to the north of Vanke Town consists of low- to moderate-income residents, with improved safety and security. The village offers retail and commercial alternatives to Bantian.
- > Shenzhen's public transportation system has expanded to include a bus rapid transit line with a stop on Vanke Town's western edge, and new subway line with a stop less than 200 meters from the southeast corner of Vanke Town.



Future Situation > This graphic documents the potential future uses of the areas surrounding Vanke Town: office work to the west, heavy commercial/retail in Bantian center to the south, village with amenities to north, and both bus rapid transit (BRT) and subway (MTR) stops in the vicinity.

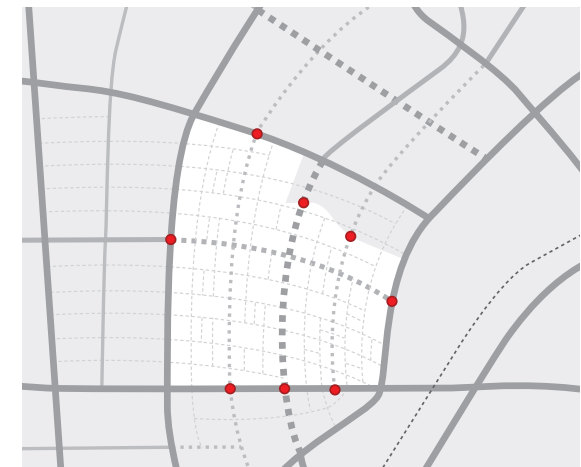


Key Connections > Each of these new uses will intensify the need for connectivity. Given the short distances under consideration (all featured destinations are within 1 km of the edge of Vanke Town), there is a valuable opportunity to encourage non-motorized transportation in the neighborhood by establishing strong connectivity and pleasant travel environments.



This schematic plan for connecting Vanke Town with adjacent areas is based on several modes of thought:

- > Apply a neighborhood-scale grid such as that in the Regent Park example in order to encourage non-motorized transportation and provide a generally more pleasant living environment.
- > Focus connectivity on key destinations, such as retail corridors, workplaces, or transit stops.
- > Connect streets within the site with those outside the site, and similarly, have internal street density relate to external street density



ANALYSIS > Parking and Access

With car ownership levels rising annually across China and in Shenzhen, it is crucial to consider the impact of car ownership on the built environment. From 2000 to 2004, private cars owned per one hundred households in the Shenzhen metropolitan area tripled from an average of 7.0 to 21.5; this average shifts dramatically upward when analyzing the middle- to high-income groups (Shenzhen Statistical Yearbook 2006). Developers and planners must contend with the reality that in the future, each household on average will own one car. Designing and siting parking for the storage of cars at the Vanke Town site presents many opportunities for bolstering a broader, sustainable mobility network.

Parking Placement and Site Mobility

The placement of parking lots on the Vanke Town site affects the mobility patterns of auto, bicycle, and pedestrian traffic on the site. Existing conditions dictate that parking be localized by unit, meaning that each resident's car is stored immediately within, or adjacent to, the housing unit. However, the placement of parking spaces need not be localized; the following three parking placement scenarios explore different possible arrangements of parking on the site, and the site-level consequences on mobility patterns which result.

Parking access and multi-modal demand

Location of parking structures across the site can be used, much like policy interventions, as a way to moderate demand for auto usage, while stimulating demand for public modes of transportation. For example, the Centralized Parking Scenario limits residents' direct access to their cars, and thus encourages non-daily use. In addition, the relative absence of auto-oriented thoroughfares on the site augments the pedestrian environment and allows for the creation of an extensive pedestrian and bicycle network. Meanwhile, the Localized Scenario necessitates auto access to every block of the site, which may degrade the pedestrian experience.

Automated car storage

Many technologically advanced solutions exist today for the high-capacity storage of autos. One solution is the automated parking garage, in use today in Europe. Adapted from technology used in warehouses, these parking structures utilize a more efficient internal layout because ramps and circulation are eliminated. They are able to store twice as many cars as a traditional garage (Patton 2007).



Automated Parking Garage by Stolzer Parkhaus > This high-efficiency garage allows for increased security, simplicity, and efficiency for both the parking customer and developer, despite the fact that the structure is underground. A customer can retrieve his car within three minutes. Source: New York Times.



Volkswagen Autostadt, Germany > New cars are delivered to their owners via a 60-meter tall auto elevator at this Volkswagen factory in Germany. The elevator transports the cars at a speed of 1.5m per second. Source: New York Times.

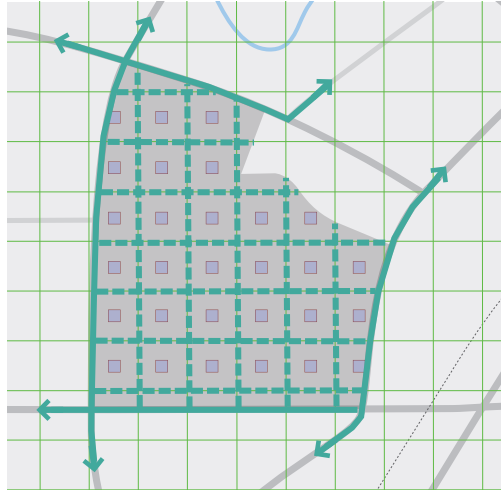
Parking Location Scenarios

To explore outcomes of parking location on the Vanke Town site, three scenarios help to illustrate placement of lots and the resulting mobility flows. To simplify conceptualization of the scenarios, a conceptual grid is applied to the site's residential street layout. Based upon this grid concept, and assuming 10,000 parked cars on the site, the three scenarios describe *Localized*, *Corridor*, and *Centralized* placement of parking lots on the site. In the following diagrams, parking lots are indicated by purple squares, car paths for entry/exit are indicated by solid lines, and auto patterns within the site are indicated by dashed lines.

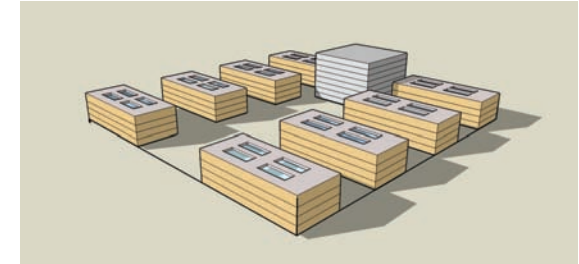
Parking Scenario: Localized

In this scenario, car users travel a minimum distance to pick up and drop off their cars, not leaving the bounds of their residential blocks to do so. The negative urban design impacts of a block's parking lot(s) are also minimized due to the relatively small size of the lots. If parking is localized by unit (see bottom right), it can be sunk underground in one level of below-grade structured parking.

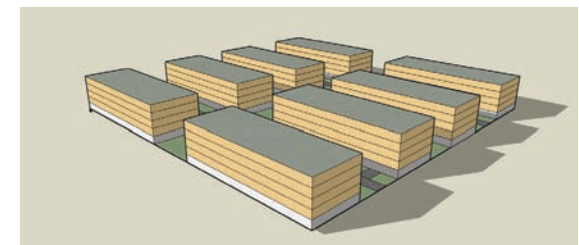
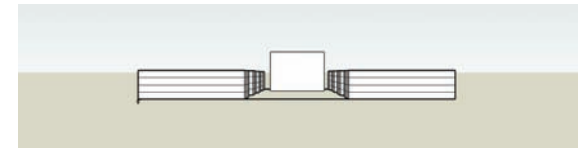
However, locating parking on each block requires that car access be extended across all residential blocks, which may denigrate the pedestrian experience or, at the least, limit the opportunities to create a site-wide pedestrian network.



Parking Scenario: Localized > Residential parking is located on each block, pursuant to the respective density of housing located on each block, making parking easily accessible to car users. However, opportunities for the creation of a site-wide pedestrian network are limited in this scenario, as all streets must be auto-oriented by design. In addition, the ease of access to private cars reduces the demand for public transit and thus perpetuates auto dependency.



Localized by Block > One parking garage with 380 spaces on each block is located separate from residential buildings



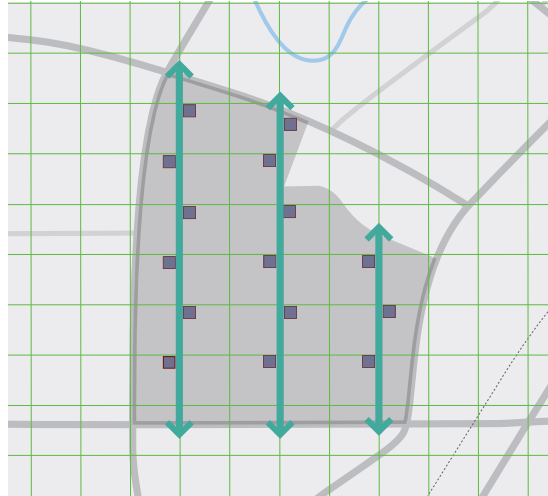
Localized by Unit > 48 parking spaces are located on the first floor of residential buildings (or sunk underground to basement level)



Parking Scenario: Corridor

In this scenario, parking lots are located along three major corridors of auto traffic on the site, connecting the major roads to the north and south of Vanke Town. Car users would walk two blocks at most to retrieve their cars and return home. Opportunities for the creation of pedestrian and bicycle networks are plentiful, particularly in connecting the nodes on the western edge and southeast corner of the site of the Bus Rapid Transit and subway stops, respectively.

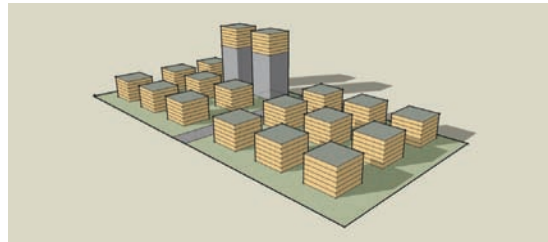
However, the scale of such parking structures must be very large (16 stories) in order to provide the required amount of parking. The cost related to the large scale of these structures may render them infeasible.



Parking Scenario: Corridor > Fourteen 16-story parking structures are located along three auto corridors on the site, with each structure housing 762 parking spaces.



Marina City Towers, Chicago > 19 floors of exposed spiral parking ramp, housing nearly 900 parking spaces form the base of each of these 179-meter tall buildings. Source: supernova9@flickr.com.



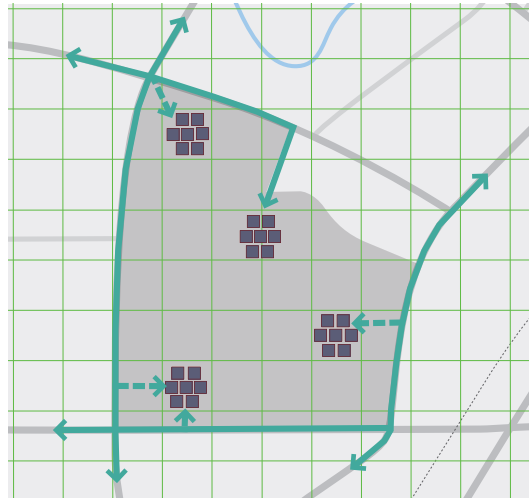
Parking Scenario: Corridor > The scale of this parking scenario may be too unwieldy to be considered feasible.



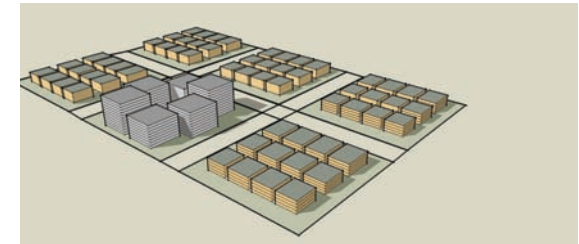
Parking Scenario: Centralized

The Centralized parking location scenario clusters all site parking into four main parking clusters, each of which takes up approximately one block in diameter and is located as close to the perimeter of the site as possible. Frequent car traffic into the center of the site is reduced, allowing for the greatest extent of pedestrian and bicycle network connectivity, and reserving the interior of the site for human-scale activity. In addition, the proximity of the garages to the high-speed roads and highway connections is convenient for commuters.

However, some drivers may consider it inconvenient to walk several blocks (or take a shuttle) to access their personal cars. In addition, the block of parking garages will, without careful design consideration, produce an unpleasant pedestrian environment, even if dismissed to the edges of the site. The image at top right is an aerial perspective diagram of a possible configuration for a “neighborhood” of six blocks, the scale of which is dominated by the parking garages.



Parking Scenario: Centralized > Parking is located in four central facilities, each consisting of approximately seven 8-story buildings that each house 381 parking spaces. Car access into the center of the site is limited to loading and unloading, while car owners travel up to 300 meters in order to access their vehicles.



Parking Scenario: Centralized > The scale of centralized “parking blocs” described in the Centralized scenario may be counterproductive to the creation of a pedestrian- and bicycle-friendly mobility environment.

SYNTHESIS > Hypothetical Scheme for Mobility

Some of the basic concepts of connectivity and accessibility discussed earlier can be combined with specific tools in order to come up with a future, site-wide sustainable mobility scheme for Vanke Town. The scheme takes on the many assumptions discussed earlier; some critical ones to keep in mind are that the areas adjacent to Vanke Town are safe, and that there are numerous external destinations frequented by Vanke Town residents.

Connectivity

The site diagram builds on the neighborhood grid connectivity scenario, chosen because it best reaches the goal of stimulating non-motorized transport. The frequent intersections and small block sizes encourage walkability by defining scale and allowing direct routes of travel.

Good connectivity also involves reaching from the site to the adjacent community. The neighborhood grid scheme introduces numerous access point to the site, and the additional streets are extended to the west and south of the site to create a continuous urban fabric.

Parking and accessibility

While each of the parking scenarios presented earlier has its own merits and shortcomings, the following mobility scheme incorporates

the distributed scheme of 14 parking structures spaced approximately evenly throughout the site, each with a capacity of 762 cars. This scenario is layered on top of the neighborhood grid system.

Street hierarchy

Merging the neighborhood grid with the distributed parking clearly points to a scheme with three major north-south streets and one major east-west street. The main entrances to Vanke Town are located where these streets intersect with the local connector streets surrounding the site.

In order to encourage pedestrian and bicycle mobility, several innovative street types are included in the scheme. The woonerf and bicycle boulevard both function to prioritize non-motorized movement, while the tree boulevard is intended to improve the pedestrian experience by providing shade and a walkway protected from traffic.

For further information on street types, please see:
Street types for pedestrians and cyclists (p. 219)

Additional interventions

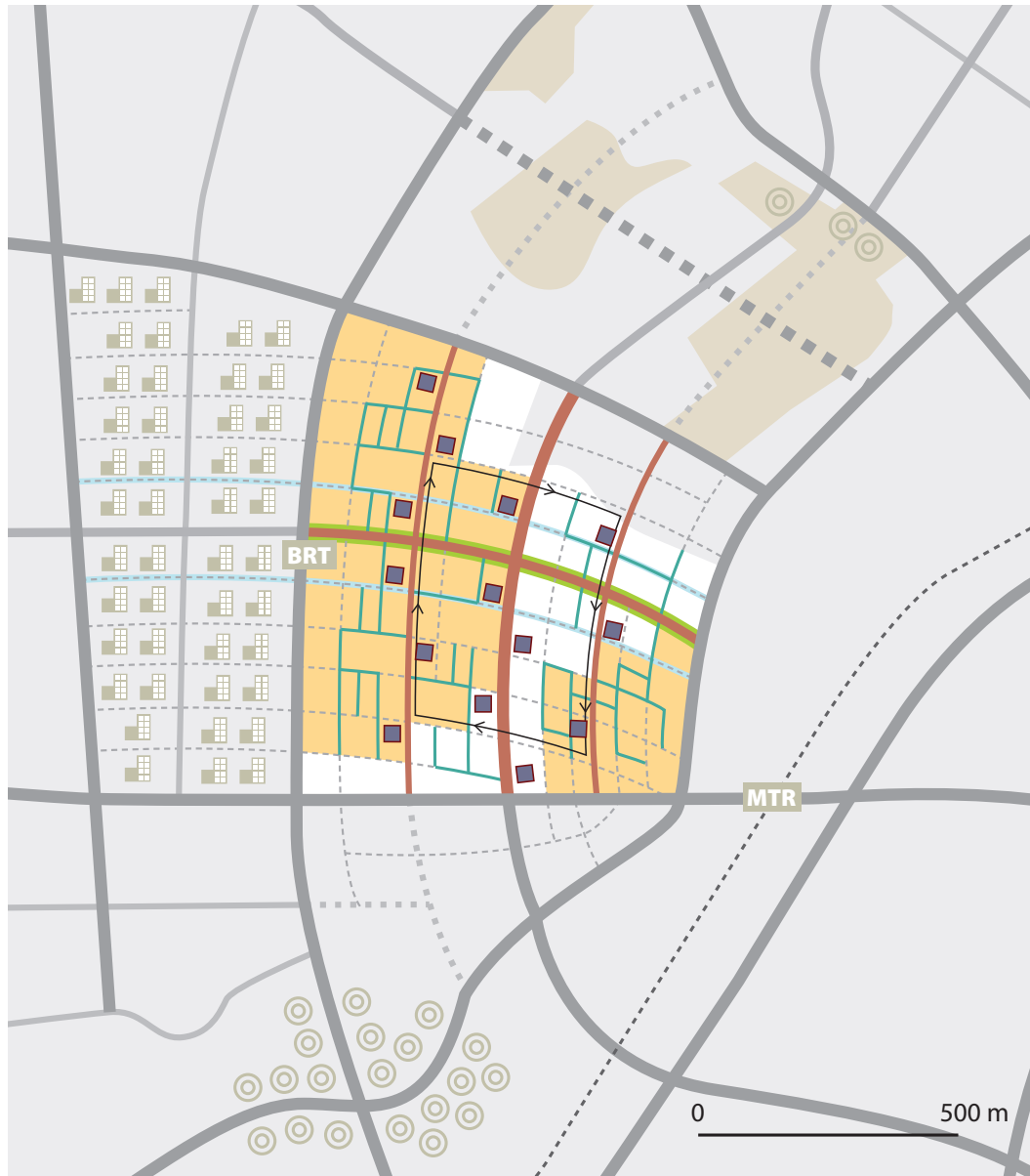
To round out the mobility scheme, both an on-site shuttle and high-density transit oriented

development sectors have been applied. The on-site shuttle provides a simple way to get around the site, and is within no more than 300 meters of any point in Vanke Town, making the whole site reachable even for children or elderly residents with limited mobility.

Policy

Under current governance trends, local governments provide transportation infrastructure as a means of spurring foreign direct investment and growth (World Bank 2006). Housing developers must now ask localities for the same preferential treatment in the form of public transit access for their projects. Developers also can mollify mobility issues by increasing the job/housing balance with the provision of on site housing for employees.

Though this is just a hypothetical situation, and only one of infinite ways to address the scenario, it is aimed to provide an example of what a comprehensive mobility system might involve. In order for Vanke Town to maintain its viability as a residential community, it is critical to proactively address issues of mobility, especially as the site grows more dense and as resources become more scarce.



Elements of Mobility Scheme

- **Distributed parking structures**
14 garages spread throughout site, each with capacity of 762 cars
- ⋯ **Residential-scale street grid**
Small block sizes to increase connectivity; street hierarchy
- **Woonerf**
Pedestrian-priority residential street with multi-modal travel area
- **Bicycle boulevard**
Street shared by bicycles and cars with numerous interventions prioritizing bicycle travel
- **Tree-lined boulevard**
Heavily-traveled street with pedestrian-friendly green strip
- **On-site shuttle**
Energy-efficient shuttle on continuous route that includes most parking structures
- **Transit Oriented Development (TOD)**
High-density development areas within walking distance of major transit nodes

Assumed Conditions

- Huawei office complex
- ⊙ Vibrant commercial/retail areas
- BRT Bus rapid transit (BRT) stop
- MTR Subway (MTR) stop
- Urban village

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PART 2 > Tools

Mass Customization

Omari Davis

Mass customization is the customization and personalization of products and services for individual customers at a mass production price, as conceived by Stan Davis (www.managingchange.com 2008).

Like many other housing providers who came before, Vanke seeks to meet the ever-present housing demand with mass production in the form of prefabrication. Modern notions of mass production were inspired by the research of F.W. Taylor and successfully implemented by Henry Ford. The success and proclivity of his Model T was a superlative example of modern production possibilities (Finnimore 1989). Architects, builders, technocrats, and utopists all embraced the idea of technology, "If the standardization and the assembly line had made the motor car a commodity for mass consumption then...it could do the same for housing" (1989). Vanke's prefabrication project is a modern day extension of this technological trajectory.

However, today's state of the art is not mass production but mass customization. Current technological tools and processes are efficient, and they have the added benefit of being dynamic as well. Dynamism is the added value that makes mass customization possible. Everyone wants their dream house, and the latent demand for mass customization can be derived from its pres-



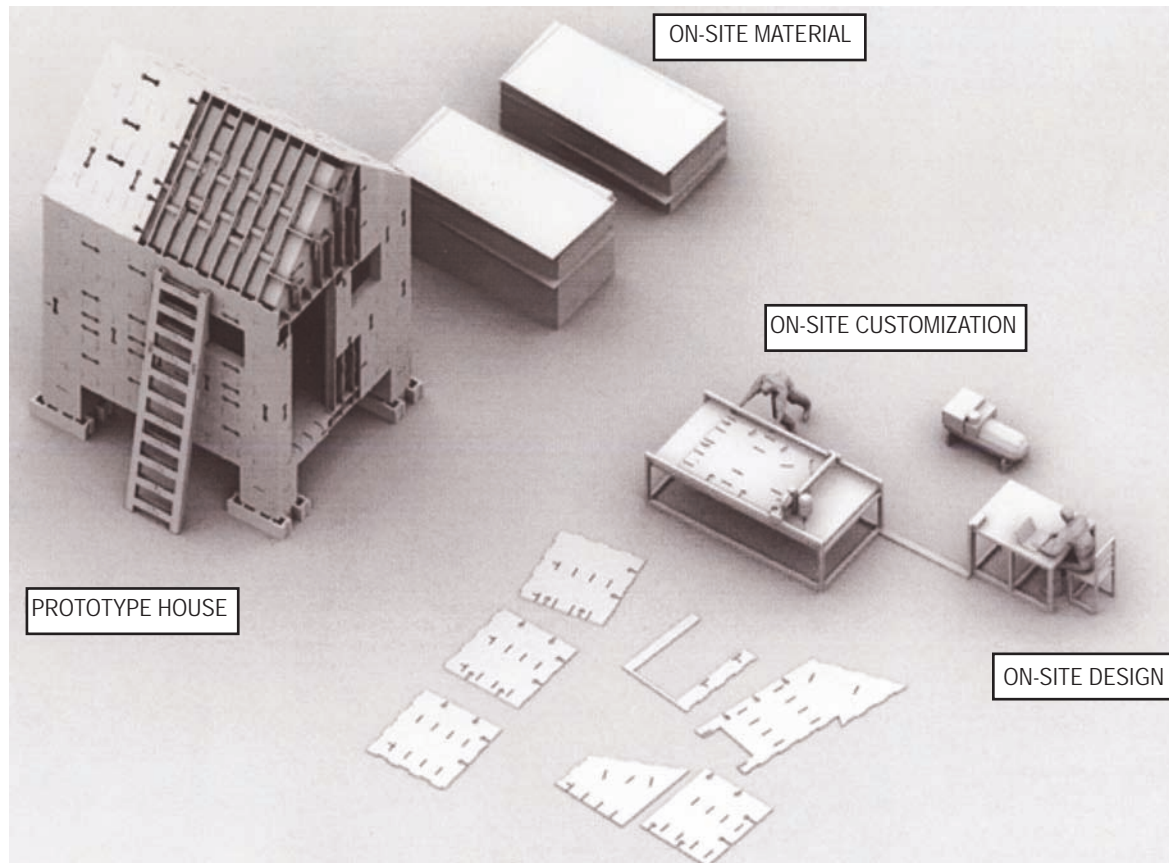
ence in various consumer goods from clothes, to computers; to auto insurance. There has always been some degree of customization in architecture and the home in particular. Ideally, in practice architecture is a collaborative effort between the client and the architect (Davies 2005). An architect's work on the home, the most intimate of collaborations, would no doubt involve some level of customization. In practice however few get to work directly with an architect on a home. Houses are instead a consumer good to be bought and sold in the marketplace. That is why the idea of mass customization is so powerful. The idea of giving a heightened sense of authorship to the user is simultaneously powerful and profitable.



Differing Approaches > Vanke's efforts (left) provide prefabricated dwelling units considering the needs of use, whilst Nike allows the **user** to address her own needs in the making of the object. Source: Author and austin.pheiffer@flickr.com

The following is a case study of the Digital Design Fabrication Group (DDFG) at MIT and their method of mass customization. Specifically this paper focuses on their work with the "[Y]our House" project.

Mass customization is made possible with two tools: computer aided drafting (CAD) software and computer numerically controlled (CNC) machinery. These two tools make mass customiza-



On-Site Mass Customization > The image depicts the relative simplicity of a mass customization job site. There are no dumpsters, no sheds of power tools, just the designer, builder, and fabrication device--an efficient process (Adapted from: <http://mit.edu/your-house/project3.html> 2008)

tion possible. The designers' role is as follows:

- > Builds a computer model in 3D
- > Subdivides the object into components then flattens the objects to a horizontal position in CAD
- > Sends each component to a computer controlled router in order to cut custom pieces from raw material (<http://ddf.mit.edu/projects/CABIN/index.html> 2008).

An infinite number of amalgamations are possible from this rather simple process. Furthermore, the simplicity of the process eliminates the huge gap between design and fabrication, thereby saving time and money. These saving will quickly account for the minor capitalization of adopting such an advanced system. The cost of the CNC machine is approximately \$12,000 (US) and the computer to run the software is an additional \$2,000 (US), a fraction of the cost of a comparable amount of labor. Moreover the system does not necessitate the possession of a CNC machine. All the drawings are digital, so one can simply post drawings to the web and different milling contractors bid the work. This competition ensures that the work is done for the lowest price.

Comparatively little skilled labor is required in order to produce a mass customized product. The designer, who translates the idea into CAD,

needs to have a high skill set as the component connections are all drawn by hand. However, there is currently work being done to automate this process as well. The fabrication of components requires little skill. The components can be assembled simply using hand labor and a rubber mallet, no glue or nails are necessary. This is solely a product of computer fabrication, where the precision is of such a high tolerance that an entire house can be built using only friction connections.

The mobility of the product is also noteworthy in addition to the ease of assembly and fabrication. The process requires hardly any space as compared to a conventional construction site. One has a work station, an automated routing device, and a place for material, as seen in the diagram. The work site can occur in almost any location—even indoors. Additionally, waste is greatly reduced as the designer can preview how things are to be cut efficiently make use of the raw materials (Sass 2008).

Drawback: Issues of Scale

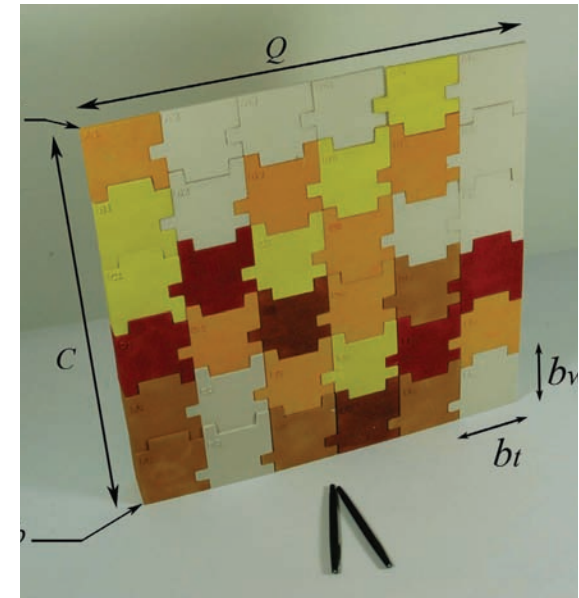
The current state of mass customization does not allow for fabrication at a large physical scale. The work of Professor Larry Sass and others at MIT has gone as large as a house. The current limitations imply two things for a large housing developer. First there is great opportunity in utilizing this tool in its current stage of develop-



Similar Languages

> The DDFG's work (right) with grammar language and the traditional Shikumen house (left) share the language of multiplication as a means of form-making. Source: Rowe and <http://mit.edu/yorhouse/index1a.html>

ment. If it can be used to build houses, then it can surely be used to build-out apartment units in a large building. One would simply build the structure of the building with conventional means and then use the mass customization process to provide tenant fit-out. The developer could also use mass customization as a means of expansion into the furniture market. The low marginal costs of fabrication make such unusual market transition feasible. Both the interiors and furniture products will add value and cache to the Vanke brand.



Second, it means that Vanke should invest in further research. Mass customization is only at the beginning of its technological evolution: the possibilities are infinite.

In fact it is the concept of the infinite that will make it possible for the current small scale of fabrication to multiply and morph into a larger product that Vanke typically markets. Infinity is the concept that the DDFG works with in their study of physical grammars.

[Physical grammars] address a need to generate functionally large geometries/

Objects for layered manufacturing machines. Novelty is found in the translation from an initial shape in CAD to subdivision as interlocking objects that are further subdivided into slicing layers using traditional layered manufacturing software. Translation from an initial shape to individual component geometry is guided by shape rules as a set grammar that generates a 2D drawing of interlocking shapes (<http://ddf.mit.edu> 2008)

Similar logic was used in the evolution of traditional Chinese courtyard houses south of the Yangtze River in which, “Rooms make a unit and units, together with gates, corridors and walls, make a courtyard. A big house, which consists of a few courtyards, contains a group of buildings” (Rowe 2001). Thus in both cases the concept of unit hierarchy, incrementalism, and composition are inherent. All the ingredients are available to create a uniquely contextual mass customized apartment block.

- > Unit fabrication knowledge is well established and in practice.
- > Physical grammar needs more research but operates from the proper logic for future expansion.
- > The opportunity to connect this new form to the existing context without pandering

to historicism makes the formation of the apartment block all the more intriguing.

Vanke is on a valid path toward generating profitable prefabricated housing. Others have tried in the past and failed for various reasons. There is no reason why Vanke should not succeed in producing a profitable prefabricated product with the proper management. However, mass customization is another research tract that is less certain, but well worth while. The reality is that we know little of the concept. It is practical, at least at a small scale, the DDFG has been working on the project for years. It is economical, especially in terms of labor savings. Most of all it is appealing in terms of desire, something one cannot discount regarding the home—everyone wants his dream house.

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Vertical Mixed Use

Victor Eskinazi

Why Mixed Use and Density?

Increasing density is primary theme of the Shenzhen Studio 2008 in promoting a more sustainable city. The recent development patterns in Shenzhen show that growth has been pushed to suburban areas, away from the developed city core. Meanwhile, large-scale developments such as Vanke Town are not integrated to the transportation matrix and do not incorporate a substantial mix of uses.

When conducting interviews in Vanke Town, residents stated that the level of community facilities at the site were insufficient to meet their needs. As a result, the development sharply increased the number of travels outside the site for work, shopping and entertainment. Furthermore, given the disconnection with public transit, Vanke Town residents rely heavily on individual transportation, putting pressure on the existing road infrastructure that is already working at capacity.

Fortunately, government authorities are implementing public transportation projects in newly developed areas, such as the Bantian district where Vanke Town is located. Although these initiatives are being implemented *a posteriori* (a common characteristic of fast growing metropolis), they will help alleviate congestion in post-suburban Shenzhen. However, in order to maximize the overall benefits



of such an investment, the new infrastructure must be coupled with changes in land use regulation to promote a denser urban fabric around transit stations and stops.

The Shenzhen Studio worked under the assumption that the municipality will introduce new regulations to better integrate land use to

AOL Time Warner Center > A mixed-use, award winning project designed by Skidmore, Owings and Merrill. Source: Flickr, user carlpalmerhull

infrastructure as well as requiring a minimum FAR of 2.5 to guide the city's suburban expansion. In addition, Shenzhen would have to limit, or even prohibit, single-use large-scale developments to minimize trips in the city and strengthen district and local centralities. As a result, Shenzhen would have a efficient use of its infrastructure leading to a more sustainable urban development.

This research investigates existing strategies for mixing uses in high-density projects. Moreover, it will focus on access and circulation in successful case studies in the United States and Hong Kong that mixed uses vertically. The research builds on the work conducted by Benjamin Solomon-Schwartz (Master in City Planning 2008) for the 2007 Shenzhen studio that focused on Wonderland.

Goals of Stacking Uses

- > Maximize the public benefit in infrastructure projects
- > Provide a wider array of services within a specific site
- > Minimize trips outside the site for work, shopping and entertainment

- > Maximize profit for the developer by diversifying sources of revenue within a development

Benefits for the Developer

Stacking uses in vertical projects is a tool that should be used by developers such as Vanke. The Vanke projects in Shenzhen all have limited retail and services incorporated in the site. The goal of introducing these components to the projects is to cater almost exclusively to the their residents (a sort of private amenity). Also, the neighborhood density might not be able to support these uses.

However, if we assume that the city will introduce new regulations to increase the density in Shenzhen, providing a wider array of services to cater to adjacent areas of a development begin making sense. Especially in the case of Vanke Town that is in a very privileged location, close to bus rapid transit lines and metro stations.

It is a common practice for city officials to provide incentives for mixed-use development in key urban areas. In many major cities around the world, introducing a mix of components to a project can yield greater FAR and even generous support from the municipality to the development.



Time Warner Center > Access and circulation schemes in mixed-use developments have drawn great attention from developers. Source: <http://upload.wikimedia.org/wikipedia/commons/d/d6/Time-Warner-Center.JPG>

In the United States, developers have found that a diversified stream of revenue is not only is more lucrative, but safer. Spreading the risk across several fronts is becoming more common. Developers that do not have a specific expertise are partnering with other firms that have accumulated experience in building and/or managing what they are not confident in doing themselves.

Best Practices

Two case studies illustrate the vertical mixed use in a higher density context. The Time Warner Center in New York and the Filenes renovation (One Franklin) in downtown Boston. Both projects are similar in terms of the use of vertical mixing, yet they are located in different contexts and have distinct approaches to form and program.

Common themes between the two projects are the importance of retail as a tool to draw people to the site, luxury residential and office space, yet with separate street entrances. This allows every use to have its own address in the complex.

AOL Time Warner Center - New York

Overview:

- > Retail: 70,000 m²
- > Hotel: 251 rooms
- > Residential: 182 units
- > Office Space: 101,000 m²
- > Performing Arts Space: 1856 seats
- > Site Area: 13,875 m²
- > Gross Built Area: 260,128 m²
- > Project FAR: 18.8

Directly facing Central Park in New York, the complex is the highest-listed market value property in the city (New York Times, 2006). Given it's privileged location, the project caters to high-end residents, companies and shops.

The program is distributed in a podium and two slender towers. The changes in volumes are a formal adaptation of the different programmatic typologies. Retail activities are concentrated in the lower levels, adopting a mall-like circulation scheme. Stores are lo-

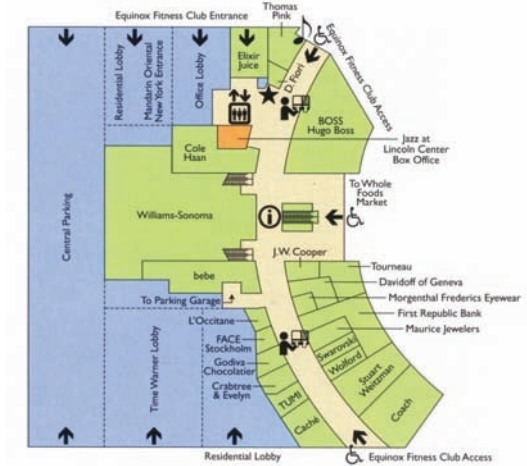
***AOL Time Warner Center** > Changes in volume reflect different programs in the project. Source: Flickr, user wallyg*





Time Warner Center > Above, performance center and retail mall share access and amenities. On the left, access and circulation of the ground and second floors. Source: SOM Architects

First Floor



Second Floor



cated on the ground floor and upper levels. Retail shares the same main entrance with the performance space.

Other uses are stacked over the podium and have separate entrances adjacent to each other. The lower levels of the towers have a deeper volume and accommodate the office program. As the towers become more slender they accommodate the residential and hotel uses, respectively.

One Franklin - Boston

Overview:

- > Retail: 27,871 m²
- > Hotel: 250 rooms
- > Residential: 140 units
- > Office: 46,450 m²
- > Site Area: 8,274 m²
- > Gross Built Area: 112,000 m²
- > Project FAR: 13.5

One Franklin uses the same tool as AOL Time Warner Center. It also stacks different uses in a very compact site, yet it incorporates affordable housing units and a strong historic preservation component to the development.

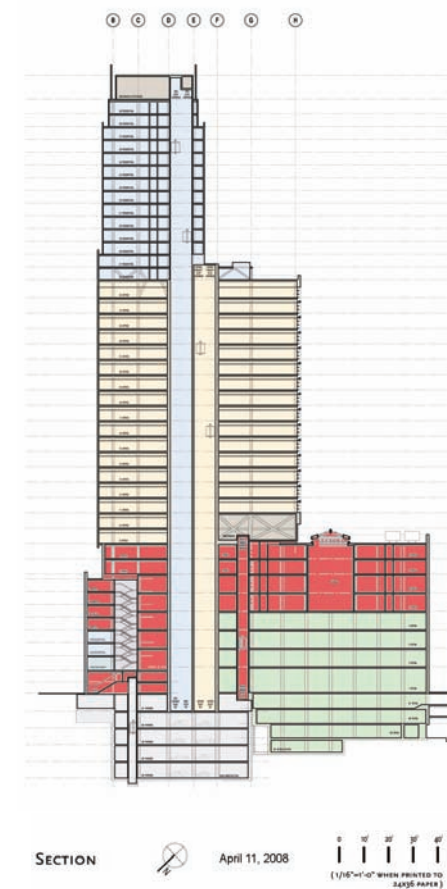


Currently under construction, the tower is located above the old Filene's department store, one of the most significant historic buildings in downtown Boston.

The project developed by Elkis/Manfredi Archi-



One Franklin > Renderings show how project managed to introduce a large program in a small and wrinkled site. On the top left, office entrance is separated from housing and located on busiest corner of the block (Source: Elkis/Manfredi Architects)



One Franklin > Floorplans and section show different uses distributed vertically within the project. Source: Elkis/Manfredi Architects

jects is ingenious in accommodating the existing structure to the new program. It preserves the character of downtown by providing a continuous retail frontage on the street level and various accesses to the building. Each use has its own entrance and street address and the affordable units are segregated from the luxury condos. The project's main entrance is located on the corner of Summer and Washington Streets (a bustling downtown subway integration station) as a way of maximizing the development's visibility.

In the same way as AOL Time Warner, the volume of the building is directly related to the program typology. The top floors are set back given that housing slabs are substantially narrower than those dedicated to office use. To reach these upper floors, the project solution was to have separate circulation cores (elevators and stairs) for each program. The housing core vertically crosses the office volume without making any stops. On the other hand, the office core is interrupted once it reaches the housing level.

Evaluating Vertical Mixed Use

A set of criteria may be useful to indicate the level of success of vertical mixed use development. Mixed use buildings introduced in dense area always are bound to generate some level of tension between public and private spaces, access and privacy.

- > Does the development properly equate public space appropriation in contrast to the need of privacy of some of its users?
- > Does the stacking of uses generate value to the property?
- > Does it create value among its surroundings?
- > How successful does the mixing integrate the development with outside communities?
- > Does the development cater to a broader array of users?



One Franklin > Mixed use projects in dense areas must be successful in catering to a wide array of users
.Source: Elkis/Manfredi Architects

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Mixed Income Housing

Torrey Wolff

Over the last quarter century, cities around the world, particularly those in the US, have relied on mixed income housing as a tool for responding to:

- > Increasing demand for decent affordable housing,
- > Concern about blight and inequity in low income areas, and
- > Concern about tension related to social segregation.

Mixed-income developments provide housing for people with a range of incomes within a single development and they generally include units that are partially subsidized for low to moderate income residents. The form that these developments take on, however, varies widely. While mixed income development can be a very useful tool, its full potential can only be realized through appropriate design and implementation.

Tool

This section will explore the physical dimensions of how to provide mixed income developments that encourage comfortable interaction between income groups. Specifically it will explore building typologies and site layout that provide for a variety of different unit types and a modest grain of mix between income groups.

Assumptions

Density

Given the rapid growth of cities like Shenzhen, the intrinsic value of land will increase along with the need to develop land at densities higher than current ones. For these reasons this section will focus on mixed income typologies and solutions that would be appropriate for an FAR greater than 1.5 and a unit density of greater than 150 units per hectare.

Why Use this Tool?

Address the need for affordable housing

Much of China has been experiencing and will continue to experience rapid urbanization in combination with economic growth. To date, factory workers and other lower income residents in cities like Shenzhen have been able to find housing through employee dorms or urban village rentals. However, these solutions will not continue to serve the population. Employee-sponsored housing is becoming scarce and the government is concerned with the condition of urban villages which are unsafe, sometimes unsanitary, and generally lacking in air and light.

As cities clean up urban villages and provide for an increase in the low income urban population due to migration, they will need to provide more decent affordable housing. However, the government is rapidly minimizing its role in the housing market and other developers recognize that high income development is much more profitable. With appropriate regulations and incentives, private developers can be asked to produce a certain amount of low and moderate income housing for each unit of high income housing produced. This rate would be set such that developers could continue to make a profit.

Avoid income segregation

In its own past, China has struggled with the costs of income disparities and the accompanying social segregation. As we have learned from other places around the world, such as the US and Paris, France, physical segregation between incomes only deepens the divide between groups and can create general unrest. Some degree of shared space and regular interaction that results from effective income mixing can diffuse the tension of segregation.

Improve the quality of low income housing and neighborhoods

When areas of low income housing are highly concentrated and separated from the rest of

the population, these neighborhoods and developments often suffer from decayed structures and a minimal share of municipal resources. Because there is less money in such developments there are fewer resources to deal with neglected and decaying structures and landscapes. At the same time, low income residents tend to be less connected to the government and have less leverage to demand municipal resources. Thus when the budget is tight, the needs of low income residents are only partially met. For these and other reasons, uniquely low income areas tend to suffer more blight than others which has a negative effect on both the local residents and surrounding areas. In mixed income communities sharing spaces and public amenities with and living proximate to market-rate tenants will ensure a minimum quality for all.

Who Will Use This Tool?

Successful mixed income housing requires a joint effort between government, developers and residents. As housing provision is dominated by the private market, private developers will ultimately be responsible for the creation of these developments. Thus it is essential that developers understand not only

the need for mixed-income developments but also the methods for designing that will provide for and even encourage comfortable interaction between residents.

Developers, however, can not be expected to simply chose to provide a product which is less profitable than high income development. Thus it is essential that the government understand the nuances of mixed income developments so as to provide appropriate regulations and incentives to developers.

Ultimately, residents will determine the success of each individual development. Interaction within mixed income developments will prove challenging if residents actively choose not to associate with their neighbors of other incomes. In the US, this has been a challenge since income-mixing is often tied to a troubled history of racial segregation. However, as China has not had to deal with such related tensions, it is likely that any resistance to income group mixing will be more easily overcome. While the distinction between residents and migrant workers, which is highly correlated to income, has provided some tension in the recent past, relations are likely to become more cordial as itinerant workers settle down and become permanent members of the community.

On What Scale Does the Tool Apply?

Mixing of incomes can and does happen at a variety of scales from the district scale to the unit scale. At the district scale, people of different income groups share the same tax base and rules, and some of the same central amenities, but overall, there is usually very little interaction when the scale is this coarse. Mixing can also occur at the large development scale and this may be preferable for Shenzhen. The grain and character of mixing here, however, can range from two separated sections of a development with physical or non-physical barriers between them to buildings placed next to each other without regard for income.

At the building level, income groups may share the same building but use different entrances, or they may be separated by floor. In the most fine grained situation, units are mixed with absolutely no regard for income. While some feel that this last option is the most equitable, others wonder why low-income residents end up paying less for virtually the same product, are concerned that this will add unnecessary cost to the development, and feel this approach is too prescriptive.

What is Required to Make the Tool Work?

Well developed financing mechanisms

As mentioned before, this is part of the governmental role. These mechanisms might include mortgage guarantees, requirements, or financial incentives, such as targeted availability of low interest rates.

A moderate grain of mixing

As noted above, mixing can happen from the district level to the individual unit level. In Shenzhen, there appears to be no demand or need to mix at the unit level, and this could add cost, but layouts that encourage regular informal interaction and shared public spaces will lead people to become more comfortable with each other.

People are often most comfortable with those who they are familiar with and with whom they share common lifestyles. If people are a little different from them and have slightly different expectations, that tends to add to the color of things without causing gross misunderstandings or agreement on principles. For this reason, it would be difficult to successfully

integrate two income extremes. Thus middle income residents can be an important part of mixed income development. People on both ends of the spectrum tend to be comfortable with middle income residents. The smoother the gradient of the incomes, the more seamless will be the interaction between residents.

Typologies and site plans that encourage interaction

Given the temperate climate of Shenzhen, people can and do easily enjoy the amenities provided outside of their residential buildings. These include use of programmed or unprogrammed outdoor space and street level commercial space. Community centers with space for planned community events also serve as excellent opportunities for interaction between residents. Given this, there appears to be little need to provide mixed-income interaction space within residential buildings. At the same time, to encourage chance or planned interaction between people of different income groups, the layout should direct people to cross paths. This may include shared courtyards and centrally located amenities.

Examples of Mixed Income Developments

Wo Che

Wo Che is an all affordable public development in the new town of Shatin in Hong Kong. It consists of clusters of three figure-eight towers and H-block slabs. Recreational space and other community amenities are distributed throughout the site to provide space for the residence of the site to come together.

Because the development is all affordable public housing, mixing with other income groups must happen at the district level. However, because Hong Kong enjoys very high density and very high public transportation use, there is still some interaction between residence from different income groups. Developments adjacent to Wo Che are private market rate developments. Residence from both private and public developments may cross paths daily as they share the same metro

stop and some of the retail spaces at the central Shatin New Town Plaza.

While someone who knows Hong Kong housing can easily distinguish the public housing typologies from the private housing typologies, the condition of both types of development are pleasant, and the distinction is not blatantly apparent to an outsider. The strong state of the economy in recent years has likely contributed to good upkeep among public estates. Because of this and the fact that a large percentage of Hong Kong citizens live in public housing, there appears to be relatively little stigma associated with low-income public housing and relatively little class tension.

While this grain of development appears to work well in the somewhat unique context of Hong Kong, such developments in Shenzhen would likely feel more segregated, as evidenced by the contemporary use of fences and high level security to separate high income developments from low income developments.



Wo Che > View of shared space. Source: Yew Chin Leow



Wo Che > Site Plan. Source: The Chinese University of Hong Kong



Wo Che> Overhead image. Source: Google Earth

Glory City

Glory City is a mixed-income development near the second ring road of Beijing. It houses two somewhat distinct residence groups: market rate tenants and resettlement tenants, who lived in the area before and who generally have lower incomes. Of several such developments in the region that mix at the project level, this is the most integrated. Whereas other developments have a section of resettlement housing behind a section of market rate housing with few shared spaces or amenities, the market rate and resettlement buildings in Glory City are connected and form shared courtyards. Residents also have equal access to many of the shared facilities. At the same time, the typologies vary so that the market rate housing, with narrower floor plates for better ventilation and more south orientation, are more valued while the resettlement housing towers with bulkier footprints are likely cheaper to construct.

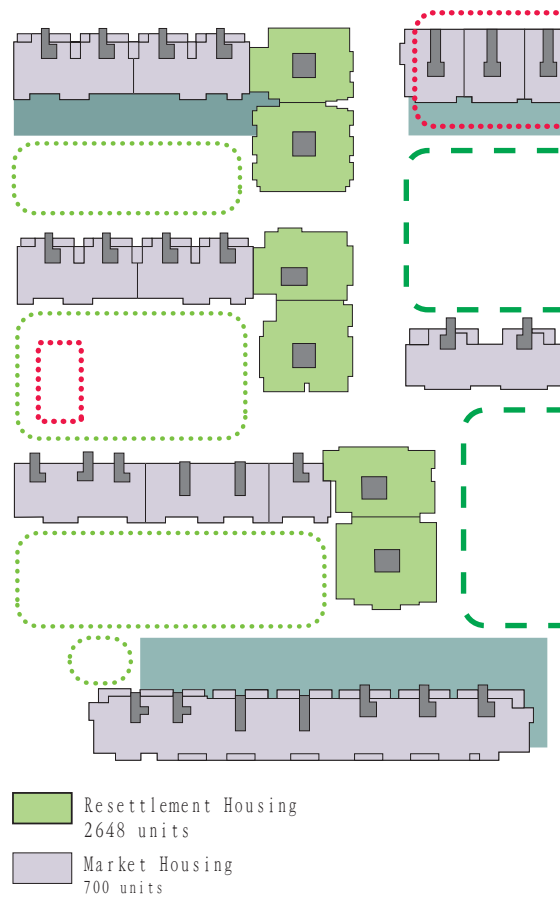
Because both residents groups share several amenities and because their residences are

so close to one another, both resident groups enjoy very decent services and maintenance whereas resettlement residents in other similar developments tend to receive less from the developer and management staff.

Unfortunately, the market rate tenants in this development have expressed a preference to have their own spaces and amenities, particularly since they are paying more in maintenance fees for the same facilities. This situation has caused as much tension between tenant groups as it has brought them together. The cause of the tension, however, is likely as much an issue of fairness as an issue of integration. Such an approach to mixing may prove more successful if fees for shared spaces are handled such that market rate residents do not feel that they are paying more to directly subsidize their lower income neighbors. Additionally, this is a relatively new model and residents will likely adjust to the more integrated approach as time passes.



Glory City > Street View. Source: Jie Bai



Glory City > Site Plan. Source: Jie Bai



Glory City > Overhead image. Source: Google Earth

Tent City

Tent City is a mixed-income development in a central, high land value area of Boston. The project is part of a trend in Boston to develop mixed income developments in which, at least from the exterior, market rate units are indistinguishable and grain of income-mixing is at the unit level. In this situation, residents often don't even know which of their neighbors are receiving housing subsidies and which are paying full market rates. Because much of the subsidy money comes from government resources rather than cross subsidy, market rate residents do not feel that they are directly carrying the burden of providing for lower income residents. For these reasons, relatively little tension builds between market rate and subsidized tenants.

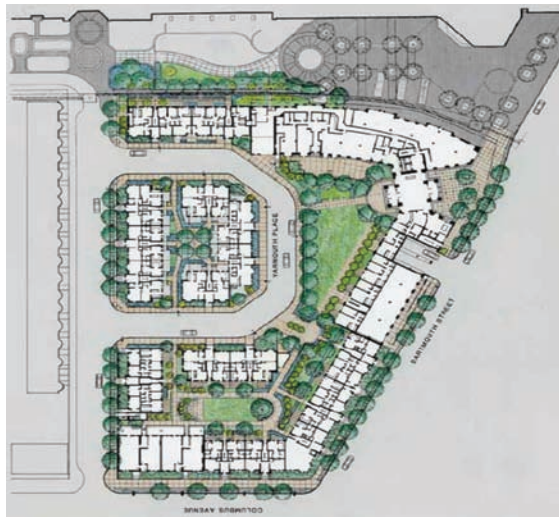
By mixing the units indiscriminately, interactions between tenant groups are more comfortable and low-income tenants are assured decent housing, but there is a cost. A developer is often unable to develop an inexpensive but decent building type that would serve the needs of low-income residents because the same building could not fetch top market dollar.

In Boston's not so distant past, racial tensions have met with class and income tensions to deteriorate the quality of society. Thus it has been important that the government play an active role in encouraging real interaction and ensuring that no group is stigmatized. This reality may justify the need for affordable developments to appear just as high quality as market rate developments. Shenzhen does not have the same legacy of institutionalized segregation, and so paying the extra cost to accomplish that goal would be unnecessary and, consequently, unwise.

Another element that contributes to the success of Tent City, from which China can learn, is its carefully chosen range of income groups. Tent City serves 25% low income households, 50% moderate-income households, and 25% market rate households. As opposed to a development with two notably distinct income groups, Tent City houses a more continuous income range. Both low income tenants and high income tenants are likely to relate to moderate income tenants more readily than they relate to each other. Thus the continuum of incomes helps to break down the barriers between two distinct income groups.



Tent City > Street View. Source: Goody Clancy



Tent City > Site Plan. Source: UMASS architecture presentation



Tent City > Overhead image. Source: Google Earth

Existing Research and Needed Research

The US has championed mixed-income development for over a decade at both the national and local level. Thus there are several good sources for understanding the American model of financing, designing, and developing mixed-income housing. (including some of those listed in the reference section) However, it is less apparent that other parts of the world, particularly China, have had the opportunity to both build and assess many mixed-income developments in a thorough way.

It would be very useful to gather more information, on how recent mixed income developments in China have worked, and what the concerns or complements of the residents there are. Such research will contribute enormously to the success of mixed income housing in China's future.



Vanke Town > A juxtaposition of market rate and worker housing. Source: Omari Davis

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Financing Housing Aspirations

Yew Chin Leow

Defining housing aspirations

Housing preferences or choices are two different ways of describing where people choose to dwell. While housing aspirations are very similar to both, it is of a slightly higher consideration. People's housing choices are in a way shaped by circumstances, but their aspirations for a certain kind of housing will always be what they hope to get eventually if they cast aside their constraints. For example, an individual may choose (or have no choice but) to stay in public housing given his financial status though he aspires to stay in private housing as an eventual dream. The nature of this tool therefore constitutes government policies, or more specifically, financing schemes that can help to meet housing aspirations.

What is the goal of using this tool?

The underlying goal of designing financing schemes to meet people's housing aspirations is, to put it plainly, to make the people happy. This has the effect of fostering their loyalty to the city, particularly for a transient population at the early stage of city building. A stable population will then have other secondary advantages of a stable economy, workforce, defence, society, etc. With Shenzhen's young age and almost entirely immigrant population, this tool will be very applicable.

Note that this tool needs to go beyond simply providing housing financing policies to put people under some form of shelter. A worker cramped with 7 other people in a worker housing can hardly be considered happy, hence this tool delves deeper to attempt to realize what the worker aspires for.

Understanding what people want

So what are the factors that influence where people choose or aspire to stay? Five very general factors are put forth.

- > Tenure: Perhaps the most basic decision that individuals have to make is between ownership and rental of their dwellings.
- > Housing stock quality: This covers a broad range of factors like floor area, age, number of rooms, design/finishings, etc.
- > Living environment: This is whatever that is outside of the house, i.e. neighbors, adjacent amenities, green spaces, security, etc.
- > Affordability: This covers both the down-payment as well as the monthly mortgage financing.
- > Location: Not to be confused with living environment above, this locational decision is based on the compromise of where the workplaces or schools of the family

members are at, i.e. how much to commute.

All the factors above result in the complex decision process of where people aspire to stay but may ultimately choose otherwise. For example, an ideal living environment is perfect for an individual, but its high costs do not allow him to own it. However, if he is only able to rent, he may want to just rent a place that is fuss-free and closer to his workplace, since that is ultimately just a temporary home. From the analyses of case studies in US, Hong Kong and Singapore, people generally aspire for the following:

Home ownership

This is particularly true in the Chinese context of "growing roots" to a place. (Lu and Chen 2006) This is the fundamental aspiration which drives this tool. Only with ownership desire would this tool be useful in achieving its goal of encouraging a more stable economy. If people fundamentally opt to rent instead, it probably means they intend to relocate eventually and do not treat the city as a permanent home. With regards to this, there is a very relevant statement by Singapore's first Prime Minister Lee Kuan Yew about his vision in Singapore's early years of nation building:

"My primary preoccupation was to give every citizen a stake in the country and its future. I want

a home-owning society. I have seen the contrast between blocks of low cost rental apartments, badly misused and poorly maintained, those of house-proud owners, and was convinced that if every family owned its home, the country would be more stable.” (Vasoo and Lee 2001)

Private or more quality housing

Private housing is usually associated with home quality and social status, particularly for Hong Kong and Singapore, which rely heavily on public housing. In the US where public housing has a social stigma and private housing may be the minimum expectations of any individual, their aspirations would then be for higher quality housing to distinguish their social status, e.g. more bedrooms, better kitchen/bathrooms, etc.

Good living environment

People generally value good living environment with reputable schools, good neighbors and/or plenty of open spaces, as important locational factors. E.g. in the US, staying in the suburbs is the American dream even though it typically means longer commutes.

Location location location

In Singapore and Hong Kong, real estate prices are sky high in the downtown area, and this applies too for public housing. In the US, due to heavy automobile use, location is

not that critical because people are mobile, in fact downtown is usually depressed due to relatively poorer housing stock. However with recent rising fuel prices and decreasing real estate values in the US, only properties that are closer to transit have resisted the downward trend of home prices. (Boyer 2008)

What forms do this tool take?

There is a broad gamut of financing policies for housing but in this instance, the tool needs to be designed to meet home aspirations. Given limited resources, it is not possible or equitable to fulfill everybody's aspirations. What the schemes should allow is a form of hierarchical priority. For example, home ownership is the most fundamental and should take top priority in allocation of government funds. The priority would also be for public housing only since it is the most equitable way of allocating public funds. However, the financing schemes cannot stop at just giving people public housing because those who aspire to better housing may leave the city for more affordable quality housing in other cities. Therefore, secondary financing schemes would need to be in place to allow home owners to upgrade from public housing and/or to meet other housing aspirations like quality housing, location, etc. A table summarizing financing schemes in Singapore

is shown as an example in the facing page.

On what scale does this tool apply?

Financing schemes are higher level policies that need to be applied at the city level. This tool will also generally apply to new cities, which are growing more rapidly than mature cities.

Who will use this tool?

On the consumer end, naturally it would be the residents who would use the home financing tools to enable their housing aspirations. Though it is probably unlikely for an average income level worker to fulfill his housing dreams immediately, he can achieve that progressively by first getting public housing and being proud of his home, and then upgrading to private housing or a better public home as his income grows, aided with the profit he makes from the sale of his first public home.

On the supply side, private developers can also make use of this tool indirectly. With government financing schemes that allow the people to fulfill their housing aspirations, it means there will be a steady stream of middle-income earners who would be able to afford private homes. For a young economy like Shenzhen, the primary market that private developers

Tools that Singapore uses to fulfill housing aspirations (Hong 2007)

Home ownership

Financing Tool	Description
Central Provident Fund	<ul style="list-style-type: none"> - Compulsory savings from income which can be used to finance homes, and which the government pay higher interest rates for - More importantly, the provident funds pool can be used to give out low interest mortgages (described below) which would otherwise overly stretch the government budget - Minimalist approach, encourages self-sufficiency
Subsidize the cost of building public housing and provide it at low prices	<ul style="list-style-type: none"> - Low interest loans or grants given to developers to build low-cost housing - Government owned land sold at a low price to further bring home prices down - Peg selling prices to income to enable affordability

are targeting right now is the upper class. With financing tools like these, developers will be able to gradually open up their market to the middle class which is a very sizable proportion of any economy.

Measuring Cost Effectiveness

The cost of this tool is essentially borne by the government, although the budget ultimately comes from taxpayers' money. It would be very complicated to attempt to quantify the cost effectiveness of this tool, but the reason why cities like Singapore and Hong Kong adopt extensive housing policies is to improve the

stability of their economies given the limited land that they have. Judging by the success of their economic growth, it would be hard pressed to say that the housing financing tools are not cost-effective, though of course their economic successes are also attributable to a whole host of other factors like economic investment, industrialization, etc.

What is required to make this tool work?

Complementary government policies

Financing tools are only one, albeit critical, part of necessary government intervention to meet housing aspirations. Other relevant poli-

Direct subsidies to individuals to purchase homes	- Grants to subsidize the cost of public housing
Low interest mortgages to individuals	- provide affordable monthly financing means

Higher housing aspirations

Tool	Description
Encourage parents/ children to stay close	- grants for parents who buy a home near to their children or vice versa to encourage close knit relations
Upgrade public housing	- subsidize the upgrading to renew public housing with good quality features, design and amenities
Enable private housing quality type homes	- these quasi-public private homes are developed by private developers and sold at a relatively higher price but enjoys the financing perks of public housing
Enable people to own private housing	- allow the Central Provident Fund to be used for financing the private housing purchase

cies would include:

- > Supply an affordable but reasonable quality housing stock.
- > Integrated land use planning for good siting of community facilities, employment and accessible transportation infrastructure with residential districts.
- > Societal enhancement--to fulfill the basic housing aspirations of safety, security, hygiene, cleanliness, etc.
- > Other secondary policies would be job creation, maintaining the cost of living, prices, etc., to improve living standards.

All these policies need to work hand in hand. Even if financing schemes make homes so cheap, the home is hardly a dream home if transportation accessibility is poor, if the city is crime-ridden or if the overall living expenses offset all income. However facilitating affordability through financing schemes is a big first step.

Delicate private/public balance

Despite the supposed benefit to private developers that was mentioned above, the government's involvement in the housing market would undoubtedly affect housing prices. Therefore, the financing tool needs to maintain a delicate harmony in both public and private housing prices in order for stability in the real estate market.

Moreover, by facilitating housing aspirations, the government should not be channelling public funds into private developers' coffers, so the financing schemes should be tailored to minimize this. As mentioned earlier, priority should be for public homes ownership.

Eliminate speculation

While it is important to fulfill housing aspirations, real estate transactions usually have an investment or speculative element in them. It is important then for the financing tools to be able to isolate these speculative elements to

prevent abuse of the financing tools. The financing tools should only allow serious home buyers to acquire property to meet their housing aspirations and eliminate repeat buyers who are just trying to diversify their investment portfolio.

Address equity issues

An economy is hardly a good or a stable one if there are issues of excessive income disparity. The financing tools should not only allow the middle-income to fulfill their housing aspirations and leave the lower-income level stuck in the rut of renting homes or buying the poorest quality of public housing. Financing tools need to be tailored to this segment of the population to achieve equity and social stability. Examples would be redistribution of public funds to retrofit old public housing stock but with the government absorbing the costs for the lower income.

What are the best practices?

Singapore, with her high home ownership rates and successful economy, probably has some of the best practices in the world when it comes to home financing tools. In fact the table in the previous page is largely derived from Singapore's system. However, Singapore's financing tools have their own imperfections, such as issues of housing prices stability, hom-

owners being asset rich but cash poor, equity, etc. (Hong 2007)

Other case studies of economies with high home ownership and a stable economy with sound financing tools include Hong Kong, Taiwan and the European Union.

Research opportunities

The issues of housing policies, which include financing tools, are one of the most widely researched and discussed topics of any economy. Much existing research is available from books and online journals. However, despite the extensive research that is available, housing policies are hardly portable across different cities due to varying concerns like political context, different culture and social considerations, etc.

Therefore, for a new economy like Shenzhen, the wealth of research that is available would serve as a good reference for the city government to devise its own financing tools. However, the end result should be one that needs more specific research into the requirements of the city (and possibly the national government), but it could definitely draw upon different best practices from various cities to arrive at the final basket of financing tools to meet people's housing aspirations.

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Developing Affordable Housing

Andrew Trueblood

Affordable Housing in China

China is finding that as it develops, its rules, regulations, and standards are becoming more stringent. This results in housing development costs that increase faster than incomes. The affordable housing shortage occurs when a family's income is not sufficient to pay rents that meet or exceed these rising development costs.

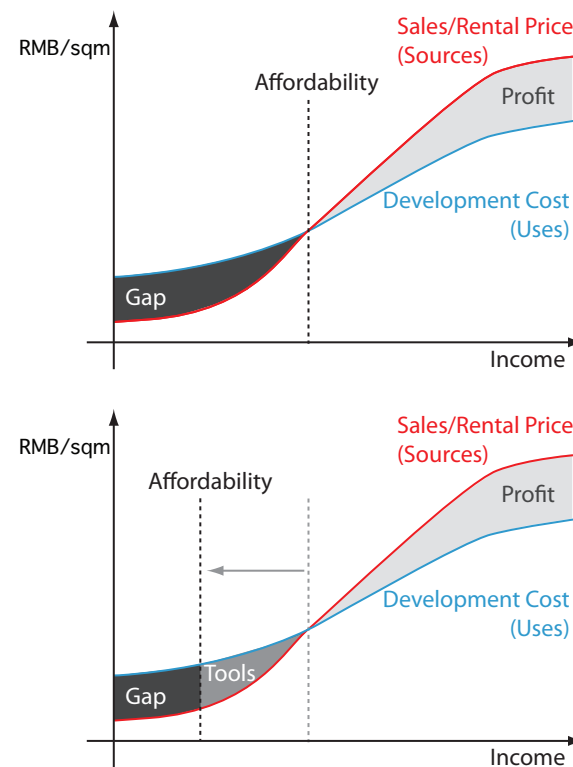
In the United States, housing is considered affordable if it costs less than 30% of a family's income. In some more expensive cities, such as Boston, affordability is considered to be closer to 40% of a family's income. In order to fill this growing gap (see chart) market interventions are required (Song et al. 1996).

At the macroeconomic level, the adequate provision of low-income housing ensures that the economy can continue to prosper without overburdening low-income workers with unhealthy, unsafe or unaffordable conditions. Without the right tools in place, affordable housing is unlikely to be created.

Tools

The affordable housing development gap can be filled by lowering costs or raising more sources (see chart). The tools in this section are primarily government policies that can fill that gap. But for many to work, they need the support of developers, nongovernmental

organizations, and residents. The tools are general and apply to all areas of China and Shenzhen.



Development Gap > Housing becomes uneconomical due to costs that exceed the prices that households can afford. By filling the gap, housing for lower-income households can be built.

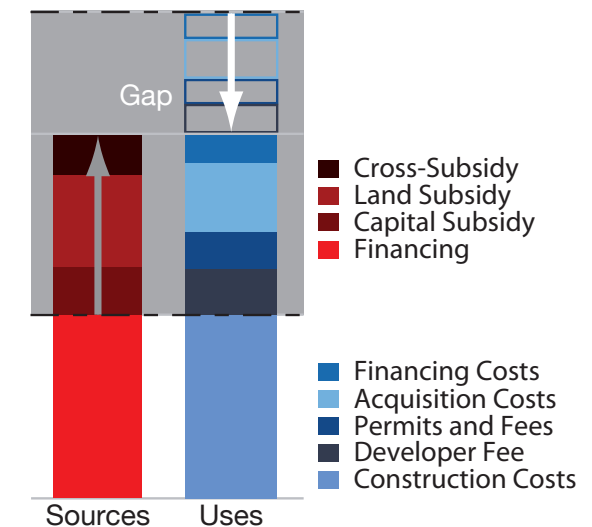
The following tools are a simplification of the Enterprise Foundation's (2002) discussion of means of filling the affordable housing gap:

Subsidies

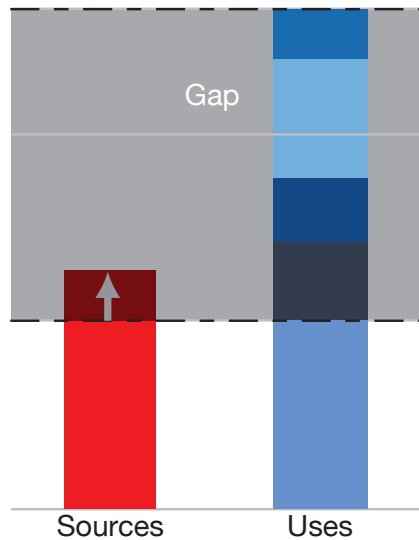
- > Operating/capital subsidy
- > Financial write-downs
- > Land subsidy
- > Cross subsidy (mixed-income housing)

Regulatory incentives

Ownership structuring

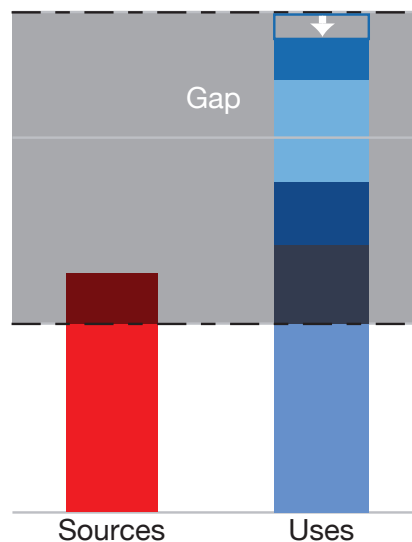


Tools Used to Cover the Development Budget Gap



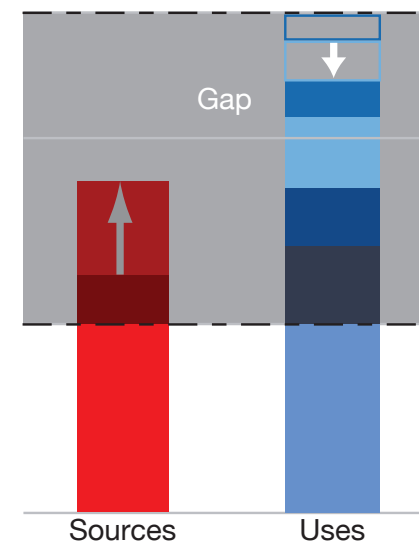
Operating/capital subsidy

Direct subsidies exist primarily in two forms: capital and operating subsidies. In the first, the government provides up-front funding to assist in defraying development costs. This is especially helpful in affordable housing, where a major hurdle is covering the initial development gap. With operating subsidies, such as Housing Choice Vouchers in the United States, the developer is able to ensure a future cash flow, which increases the amount it can borrow. These subsidies require direct outlays by the government, which often limits their availability.



Financial write-down

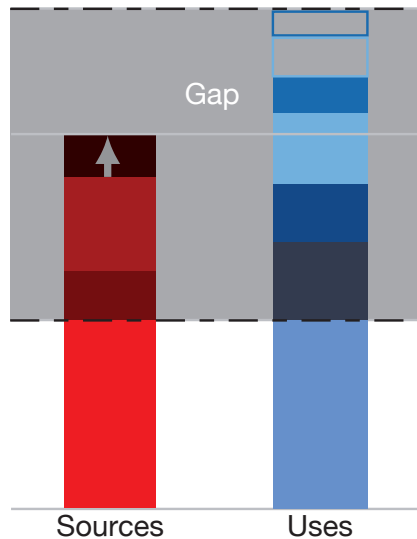
Through subsidized rates, financing is cheaper, making overall development less costly. Guarantees involve the government assuming some risk, which allows lenders to offer more financing than would otherwise be available. Both methods involve indirect costs to the government, which may be easier to provide than direct subsidies. These subsidies are limited in their ability to make a project viable, as the cost of financing is often a small part of overall costs. They are almost always used in conjunction with other tools.



Land subsidy

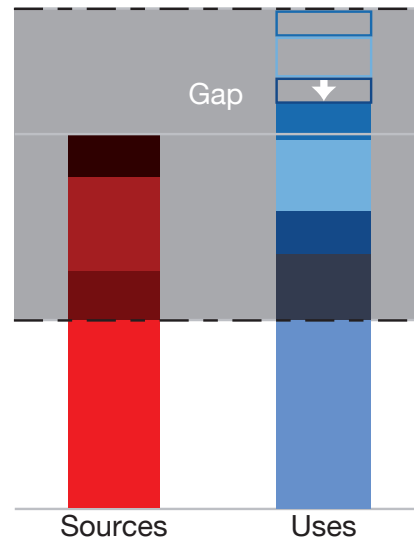
Land subsidies can work on both sides of the ledger. The government can contribute public land, thereby decreasing acquisition costs. Also, it can sell public land and use the proceeds as a development source. When developing mixed-income housing, these two can be combined to have an even greater effect.

A land subsidy would be especially valuable at an empty site near villages. The land could be leveraged to fund the redevelopment of the low-income housing (see case study for a U.S. example).



Cross subsidy (mixed-income)

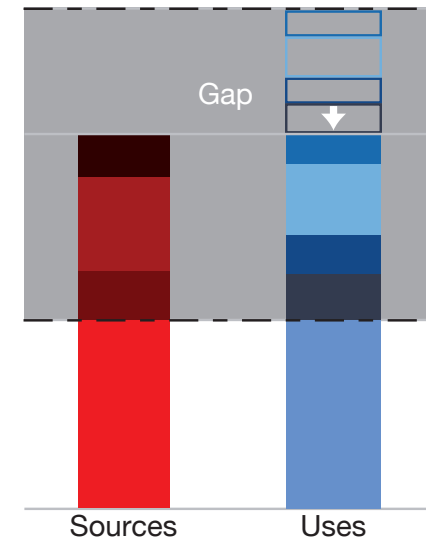
Cross subsidization is really a derivative tool of others, such as regulatory or land leveraging. It works through utilizing some value of market-rate housing (or commercial development) to subsidize the costs of affordable housing. It can work for both development and operating costs, and is often used as a way to provide ongoing operational subsidies for low-income development. Because it involves decreased profits for the private sector, there must be some incentive for the developer such as regulations or government partnerships.



Regulatory incentives

Regulatory relief is a way of reducing some of the costs of development and encourage affordable housing. Relief can include upzoning, property tax relief, or expedited permitting.

Shenzhen does not have the historic and height regulations that cities such as Beijing have. Yet it does have regulations that limit each 100 sqm parcel to 480 sqm of floor area, which could be lifted in order to achieve the goal of improved low-income dwellings. In addition, as more regulations and zoning are enacted, they offer an opportunity to incentivize affordable housing through regulatory relief.



Ownership structuring

Public private partnerships are an important ownership tool that utilize the expertise and financial borrowing power of the private sector with the powers of the public sector to achieve goals that would otherwise not be achievable in the market (Brown and Orr 2006).

In addition, the opportunity to include current owners in a joint venture can help decrease upfront acquisition costs and share in the risks and rewards of development.

In both cases, if the government is an owner, it can share in the profits and use that to help cover the development gap.

Case Study: Arthur Capper/Carrollsbury HOPE VI

This project is the redevelopment of a public housing property in Washington, DC by the District of Columbia Housing Authority (DCHA), in partnership with private developers and other public agencies. A \$35 million grant from the federal government will be leveraged to replace all of the public housing units in a mixed-income, mixed-use development.

The case is particularly applicable to Shenzhen's urban villages, development where the replacement of low-income units is a priority. In this case, a number of subsidies were used to create a mixed-income plan in a neighborhood that is rapidly gentrifying. Because of the appreciating land values, it was possible to increase density and leverage the greater land values to pay for the replacement of the public housing units.

The 1,597 unit housing plan includes:

- > 707 replacement public housing units
- > 480 market rate rental units
- > 118 workforce ownership units
- > 50 Housing Choice homeownership Vouchers
- > 140 market rate ownership units
- > 90 market rate condominium units



Capper/Carrollsbury Townhomes > This development is in an increasingly appealing neighborhood, allowing for a great deal of land leveraging to fund the low-income replacement public housing units. Source: District of Columbia Housing Authority.

Public housing in the United States represents a valuable case study because it can carry no debt: rents can cover only operating costs. Without financing, the effective gap is the entire development cost, so producing the units requires major financial subsidies.

Because of the complexity of the project, the townhomes phase, which is one of a number of phases, will be used to illustrate the way in which the development gap was filled for the public housing units. This phase, which is currently under construction, will construct a total 277 units broken down as follows:

- > 39 replacement public housing units
- > 91 workforce ownership units
- > 25 Housing Choice homeownership Vouchers
- > 122 market rate ownership units

Financing

While the overall project won a capital grant from the federal government, this subsidy was exhausted in earlier phases. As such, the project depends upon other forms of financing. Overall, cross-subsidy from the extremely appealing townhomes was used to fund the affordable non-public housing units. More daunting was the public housing, which had an effective gap of over \$11 million. The following section will explain how it was filled.

Public Housing Townhomes

The townhomes phase of the Capper/Carrollsborg redevelopment includes 39 units which can carry no debt, and utilized the following tools.

Cross Subsidy

A portion of the gap was filled through a contribution by the developer, who will make a profit from the non-public housing units.

Land Sales (Land Subsidy)

Most of the development costs were covered by selling the land of the non-public housing units to the developer. In the map on the previous page, the land under units that are not orange was sold, while the public housing units will remain publicly-owned.

Tax Credit Equity (Capital Subsidy)

As the budget shows, a major portion of funding comes from the Low-Income Housing Tax Credit program. This program provides corporations with federal tax deductions for funding affordable housing. From the development point of view, it is treated as an up-front capital grant (Enterprise Foundation 2002).

Financing Costs

Because of the public good served by affordable housing, the developer was able to issue tax-exempt bonds, which carry a lower interest rate.

This is an indirect subsidy by the federal government, which forgoes taxes on the interest.

Acquisition Costs

As the redevelopment was of public land, there were no acquisition costs for the public housing units. The developer had to purchase land for the market and moderate units, which was used as the land subsidy mentioned above.

Permits and Fees (Regulatory Relief)

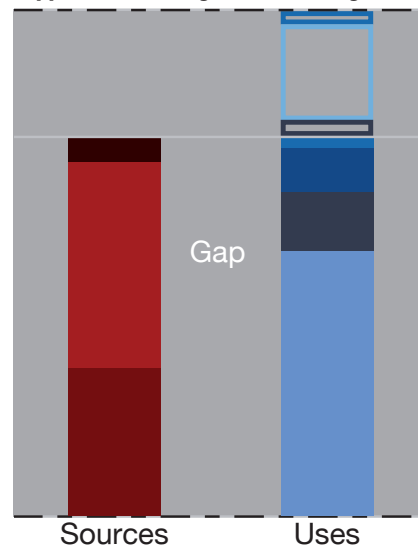
As a public agency, DCHA was able to expedite certain permitting and reduce various fees.

Not shown on the chart is the District of Columbia's contribution, through a special taxing district, that will fund the public infrastructure, which would normally be paid for by the developer.

Developer Fee

The public private partnership allowed DCHA to reduce some of the development risk, thereby reducing the developer's fee. In addition, it agreed to share in the risk in return for a portion of the developer's fee, which will be used for a portion of the low-income housing.

Capper/Carrollsborg Public Housing Townhomes Development Budget



Source	Per Unit	Total	Percentage
Cross Subsidy	\$20,443	\$797,274	7%
Land Sales (Land Subsidy)	\$149,743	\$5,840,000	53%
Tax Credit Equity (Capital Subsidy)	\$110,837	\$4,322,628	39%
Total Sources	\$281,023	\$10,959,902	100%

Use	Per Unit	Total	Percentage
Financing Costs	\$7,307	\$285,000	3%
Acquisition Cost	\$0	\$0	0%
Permits and Fees	\$42,052	\$1,640,039	15%
Developer Fee	\$36,205	\$1,412,000	13%
Construction Costs and Professional Fees	\$195,458	\$7,622,863	70%
Total Uses	\$281,023	\$10,959,902	100%

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Community Facility Management

Jie Bai

Estate Level Community Facilities for Mixed-income Housing

This section will mainly discuss the estate level communal facilities and amenities, which are provided on-site with the housing construction by developers. These facilities are used and managed at estate level, usually composed of:

- > Recreational/Sport Facilities
- > Open Space & Greenery
- > Interior Common Areas
- > Utilities

The management of these facilities involves fund-raising, maintenance, and accessibility control.

One of the major objectives of mixed-

income housing projects is to promote social connections between different social classes. Some research shows that it is necessary that interactions occur in situations of equal status, as some writing about mixed income situations suggests (Kleit, 2001a; Rosenbaum et al, 1998). Equitably managing the proper distribution of the benefits and the maintenance costs between residents of different income pools becomes a key issue in sharing community facilities.

In China, as the spatial segregation in housing market intensifies, the government has started to encourage income mixing in some of the old housing redevelopment projects. The current policy of sharing the on-site community facilities with differentiated maintenance fees, without operating subsidies from government, has resulted in great tension

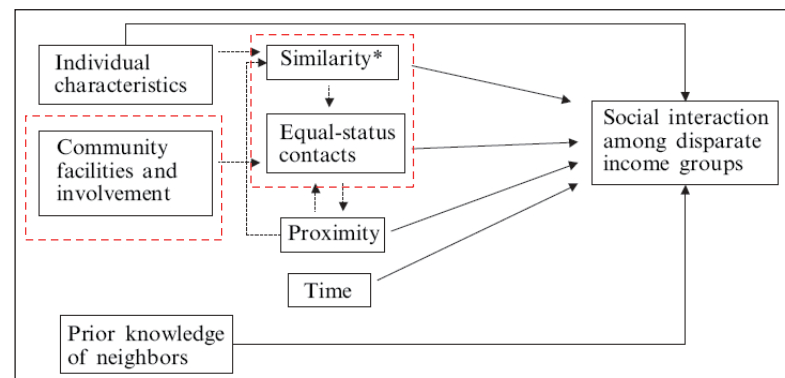
between market-rate and subsidized residents. As a new serving field, commercialized property management still lacks experience in dealing with mixed-income projects. The subsidy system and policies need to be further polished to promote better social networks in mixed-income neighborhoods.

Tools

Financing tools

Financing tools target at bridging the gap in operating fees (sometimes called maintenance fees or common fees) between market-rate and subsidized residents.

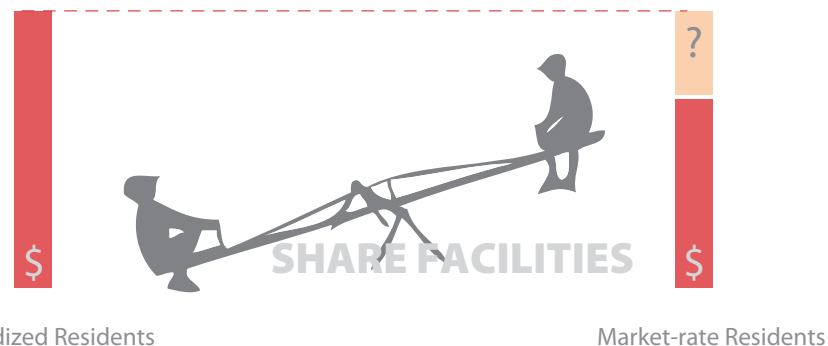
- > Public subsidies: public subsidies not only play an important role in launching affordable housing projects by means of tax credits, subsidized loans, funds, grants, and etc., but also subsidize the low-income group in the provision and maintenance of community facilities catering for daily life. Operating subsidies can come from either governmental financial sources or charity.
- > Commercial Leasing Subsidy: Commercial development owned by the community can also serve as an important source to cover certain amount of the operating costs of the facilities and amenities, as it is



Role of community facilities in promoting social interactions among disparate income groups > Source: Sim et al. 2002

applied in Roosevelt Island.

- > Inter-neighborhood Cross-subsidy: It is also possible to make the high-income residents subsidize the low-income tenants in facility maintenance expenses. In return, the high-income residents should be endowed with higher priorities in using facilities that are less related to daily life, or with higher positions in neighborhood management. How to differentiate the fees and priority should be delicately designed to avoid debates on fairness.



Financing tools: how the bridge the gap? > Source: Jie Bai 2008

Tools	For whom	Best practice	To make these tools work
<div>\$</div> Public Subsidy <div>\$</div>	Government	Harbor Point, MA Rollin Square, MA	>Higher proportion of market rate housing) <div>\$ \$ \$</div> <div>👤 👤</div>
Commercial Leasing Income <div>\$</div>	Developers & Property Mangement Company	Roosevelt Island, NYC	>Influential non-profit organizations coordinating the stakeholders <div>\$</div> <div>👤 👤</div>
Inter neighborhood Cross-subsidy <div>\$</div>	Property mangement company & Residents' committee	Rollin Square, MA	>Constitution of affordable housing subsidy policies <div>\$</div>
<div>👤 👤</div> Self-management <div>👤 👤</div>	Property owners/residents	Alexandra Park, Ontario, Canada	>Competent property owner association /board <div>\$ \$</div> <div>👤 👤</div>
Non-profit management <div>👤 👤</div>	Property owners & Non-profit Organizationsz	Rollin Square, MA	>Considerable amount of commercial program <div>\$</div>
			> Enforcement of the management rules <div>\$</div> <div>👤 👤</div>

Facility Management Tools > Source: Jie Bai

Management Structure

Innovative management structures will help improve facility management, as well as the interaction between property owners and managers.

- > Self-management: self-management is widely applied in housing cooperatives. A housing cooperative is a cooperative where member-residents jointly own their building. Ideally, member-residents democratically control the cooperative and receive the social and economic benefits from living in and owning the cooperative (Sazama 2000). Collective ownership contributes to consolidating various demands from different groups of residents, for the common aspiration to increase the property value.
- > Nonprofit management can be carried out in the forms of self-management by nonprofit owner, management by subsidiaries from nonprofit organizations, or direct management by nonprofit organizations (Diaz 2004).

Goals

The goals for applying these financing tools and management tools are:

- > Ensure proper usage and maintenance of

communal facilities/amenities

- > Fairly distribute the benefit of using communal facilities/amenities and expenses of maintenance between residents belonging to different income tiers.
- > Relieve the tension between different income tenants and promote healthy neighborhood relationship.

Scale

These tools attempt to guide facility management on the estate scale.

Cost Effectiveness

Cost

- > Effort to produce affordable housing subsidy policies
- > Governmental subsidy fund-raising
- > Construction of non-profit organizations

Benefits

- > Establish well maintained mix-income neighborhood
- > Increase property value
- > Enhance social equity and stability

It is clear that the benefits of these tools can outweigh the costs. As economy grows, social equity and stability will be more and more highly valued.

Users of Tools

The users of these tools are supposed to be:

- > Public Subsidies: Government
- > Commercial Leasing Income: Developers & property management Company
- > Inter-neighborhood Cross-subsidy: Property Management Company & Residents' Committee
- > Self-management: Property Owners & Residents
- > Non-profit Management: Non-profit Owners & Non-profit Organizations

Implementing the Tools

- > Higher proportion of market-rate housing: more market-rate housing will improve the financial capability of facility management and help to form good neighborhood habits to limit negative behaviors.
- > Influential non-profit organizations coordinating the stakeholders. Non-profit organizations can act as property owners

of the property, managers or coordinators between stakeholders.

- > Constitution of affordable housing subsidy policies and systems.
- > Competent property owner association / board
- > Considerable amount of commercial uses

Best Practices

Successful management in mixed-income housing usually involves synthesis application of different tools. Three cases are briefly introduced to illustrate how these tools work in different ownerships and income mixes.

Rollins Square

Rollins Square is an award-winning mixed-income and mixed-tenure housing project located in Boston's South End. The estate is consist of 184 units, of which 40% are market rate condominiums, 40% are price-controlled condominiums for moderate-income households, and 20% are affordable rental apartments for households with very low incomes (Eddins 2007). One hundred and forty-seven of the units are condominiums owned by individuals; and the rest of thirty-seven are owned by Rollins Square Limited Partnership (Ibid).This property is managed by Maloney Properties, a for-profit firm

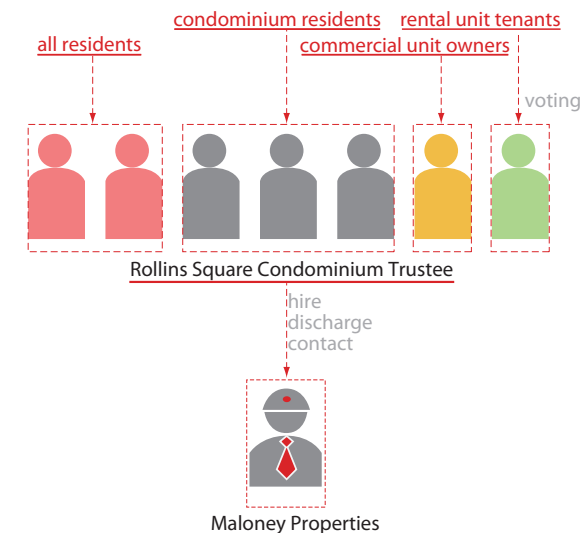
specializing in affordable housing. It takes care of both the condominiums and the affordable rental units, but with separate management budgets for each.

Rollins Square has a condominium trust composed of 7 trustees, whom are elected by all the members to hire and contact with the property manager.

The developer of this project is the Planning Office for Urban Affairs (POUA), a non-profit organization. They devoted significant effort towards establishing the governance structure, property management standards, and later towards balancing the governance duties and power between the equity partner and different groups of residents.

Beneficial interest is invented to determine the common expenses each household should pay and to weight effectiveness of each household's vote in the trustee election. It is simply the percentage of the individual property value in the total development value(Ibid). In this way, the market-rate residents subsidize the low-income tenants in common expenses in return of priority in community governance. Although the process and standard of valuing individual property is complicated, the beneficial interest is considered to be reasonable differentiation indicator and accepted by most residents.

The rental units are additionally subsidized by project-based Section 8 Housing Assistance (Chen 2007), which helps to cover the gap of common expenses between the condominium owners and the rental housing tenants further more.



Management Structure in Rollins Square > Source: Jie Bai 2008, information from: Eddins 2007

Harbor Point

Harbor Point is a 1,283-unit mixed-income rental development, successfully converted from the public housing of Columbia point. Among the units, 883 are market-rate, and the other 400 are subsidized (Schubert 1996). Its amenities package contains a clubhouse, a fitness center, a pool, a water front park, and several child play areas.

It is developed and managed by Corcoran, Mullins and Jenison (CMJ), "acting as agent for the Boston Housing Authority with full power to enforce the lease." (Roseener 2000).

The developer and Columbia Task Enforcement, elected out of the old Columbia Point tenants, split the ownership and decision-making duties. The community strictly enforces rules and follows up on those who are not in compliance with the rules and regulations.

The management of Harbor Point relies heavily on the various public operating subsidy sources:

- > Section 8 project-based units
- > Chapter 707 funds (a state program similar to section 8)
- > SHARP funds (another state rental subsidy program) (Schubert 1996)

Harbor Point Site Plan > Source: University of Buffalo Library 1993



Tennis Court and Commonwealth Avenue Mall in Harbor Point > Source: Roseener 2000

Atkinson Housing

Atkinson housing, located in downtown Toronto, was converted from the previous public housing of Alexandra Park. "The belief was that by increased tenant control in the management of community, the residents felt safer and a healthier community would emerge." (Quarter 2004) In 1992, a non-profit cooperative was established in the neighborhood. 80 percent of households were members of the co-op. The residents were consequently empowered with controls over: maintenance, tenant selection, security procedures, and the maximum rent charged to residents.

The cooperative's board of directors of the cooperative is its legal authority and is responsible for developing and approving any by-laws or legal agreements. There are nine directors of the board, democratically elected by all co-op members. In order to overcome the residents' lack of knowledge and experience, the board appoints two non-resident advisors to facilitate the decision making process. The government also held comprehensive community development programs to train in the skills and knowledge necessary for maintaining the property.

Past Research

- > Public subsidies on affordable housing
- > Financing tools of property management
- > Case studies of property management in mixed-income housing
- > Property self-management
- > Cooperative housing

Future Research

- > Rule enforcement tools
- > Mixed-income housing cooperatives
- > Non-profit property management



Community Center of Atkinson Housing > Source: Atkinson Housing Cooperative 2008

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Financing Green Development

Haley Peckett

Introduction to Financing Tools

Tools for financing energy-efficient buildings provide standardized methods to pay for energy-saving measures in new construction. Current technology offers numerous measures to reduce building energy use, and these measures are easiest to implement at the time of construction. Such measures include:

- > Building insulation
- > Tight construction and ducts
- > Double-paned windows
- > Energy-efficient lights and appliances
- > Energy-efficient heating and cooling systems (Energy Star 2008)

Technological advances have already improved the availability, reliability, and affordability of these measures, yet developers use them sparingly, if at all. Energy-efficient construction generally costs between one and five percent more than conventional construction, and these costs are easily recouped through energy savings over the first few years of the building's occupancy. However, the developer pays for the initial building costs, and the resident pays electricity bills. Therefore, incentives to invest in energy efficiency are misaligned, and financing tools can help to correct this problem.

Energy savings may not be a high priority for Chinese home buyers because energy is currently cheap and plentiful. Home buyers may be unaware of the environmental and financial benefits associated with energy-efficient homes. However, greater availability of information about efficient homes can increase awareness and popularity, especially as energy prices rise in the next few decades. Other home buyers may be deterred by the additional hassle of researching an energy-efficient home within a sea of conventional buildings.

Two financing tools are examined in this analysis. Energy-efficient mortgages (EEM) pass the costs of construction to home buyers, and these costs are paid over time as energy savings accrue, thereby relieving the burden on both the developer and the home buyer. EEM allows borrowers to take out more debt to finance up-front energy-efficiency costs, but mortgage payments remain constant or are reduced through energy savings.

Third-party financing relieves the developer of the additional costs of efficiency improvements. An Energy Service Company (ESCO) or a private company invests their capital in energy-efficiency and receives a return on their investment through the resulting energy savings over a specified time period.

Vanke has already positioned itself to become a pioneer in China's residential green building movement. The Zero House in Vanke Town and associated research into energy-efficient homes show that Vanke can make a natural transition to implementing these technologies on a nation-wide scale.

Goals and Assumptions

The goal of the financing tools is to create funding opportunities to pay for any additional costs associated with energy efficiency. In the long term, the costs for green building and conventional building may be identical, but this will most likely not happen until green buildings are more widespread. EEM and third-party efficiency can correct misaligned incentives and facilitate the spread of energy-efficient buildings.

The analysis of financing tools is based upon the following assumptions:

1. Demand for energy will increase as China's economic growth continues
2. Energy prices will rise
3. China will be more proactive about energy conservation

China's Climate for Energy Efficiency

Up to 95% of new construction does not meet existing building codes for energy efficiency (Kahn and Yardley 2007). This demonstrates tremendous potential for Chinese developers to increase energy efficiency, particularly in the face of the catastrophic consequences of current environmental habits.

The Green GDP Index, which China launched in 2004 to measure the environmental effects of the country's economic growth, showed that in 2004, China lost the equivalent of 511.8 billion yuan to pollution, accounting for three percent of the gross domestic product (Liu 2006). In some towns, the GDP was close to zero when environmental factors were included. The government effectively inactivated the Green GDP project in 2007 (Kahn and Yardley 2007).

If anything, the findings from the Green GDP prove a greater need for China to amplify its environmental efforts. The following signals indicate that China is moving towards more stringent measures for building energy use:

- > Energy Conservation Law took effect April 2008; first significant energy legislation in ten years, which upgrades energy conservation from an economic strategy to a basic national policy (Jianhua 2007)

"Difficulties in promoting energy conservation in China lie mostly in a lack of initiative. Despite continuous efforts on the part of the government, energy consumers have been unwilling or unable to take practical action due to the cost of energy conservation." --Feng Jianhua, 2007

- > Creation of an Energy Conservation Administrative Department under the State Council (Devine 2008)
- > New requirement for developers to inform buyers of the building's energy saving measures (Jianhua 2007)
- > New requirement for individual metering in residential buildings and charges based on energy use rather than floor area (Devine 2008)
- > Preferential loan policies for environmental protection (Guo and Yu 2004, 3-4)

Chinese citizens are gaining awareness of environmental and energy problems from media and education, the personal health effects of pollution, and higher expectations of living conditions resulting from increased wealth. However, awareness only translates into action when the cost of the energy-efficient option is equal to the cost of the conventional

choice (Guo and Yu 2004). Consumers have been reluctant to invest in energy efficiency; they view efficiency as a high risk investment. The greatest risks associated with efficiency improvements are stagnation in technology and a drop in energy prices, both of which are highly unlikely in the near future (Frank 2007). Greater exposure to and education about financing energy efficiency can combat these behavioral challenges.

Scale and Actors

The energy efficiency financing tools are dependent upon efficiency measures instituted during construction on the site scale. Vanke has the potential to lead China in employing energy efficient mortgages and third-party financing in new developments and retrofits.

Energy efficiency mortgages can be used at the site level. As a developer, Vanke can form partnerships with lending institutions that facilitate energy efficient mortgages in the home buying process across all Vanke developments in China. Vanke can streamline the mortgage process such that home buyers clearly see the savings resulting from their green home and such that EEM can be obtained as part of the general financing package. Ultimately, the home buyer provides the capital for the ener-

Table 1: Investment Return for EEM

Investment	Time Period	IRR
EEM	2 years	50%
REIT	30 years	16%
Stocks	30 years	10%

gy-efficient buildings, but they do so as part of the standard Vanke purchasing procedures.

Third-party efficiency companies must be hired by Vanke early in the development process (see Figure 1: Timeline of Development). The tool will be implemented through a strong partnership between the developer and a third-party company that holds expertise in maximizing energy efficiency in new and retrofitted construction. In this case, the home buyer does not pay any cost differential for an energy efficient building.

Cost-Effectiveness Measures

One barrier to investment in energy efficient buildings is the perception of higher risk from

efficiency improvements and an unwillingness to invest in efficiency over the long term. Table 1 demonstrates the estimated internal rate of return (IRR) from several investments, including Real Estate Investment Trusts (REIT) and stocks. It demonstrates that EEM are very safe investments with paybacks that will increase as energy prices continue to rise (Frank 2007). Therefore, an educational component is critical to implement these financing tools to demonstrate the risk and reward split.

EEM is immediately effective in aligning the costs and benefits of energy-efficient building, provided that a developer requires these for all home buyers. The costs no longer rest with the developer, who has little incentive to lower energy bills. However, the mandatory EEM process for home buyers must be easy and attractive; otherwise, it puts the developer at a competitive disadvantage. This tool requires an initial investment in establishing the connections with lenders. Residents with EEM will have net cost savings over conventional developments, giving developers with EEM an advantage in attracting customers.

For third-party efficiency, the company must be able to install energy efficient infrastructure at costs where they will retrieve energy savings within the defined time period. Thanks to rapidly improving technologies, many companies

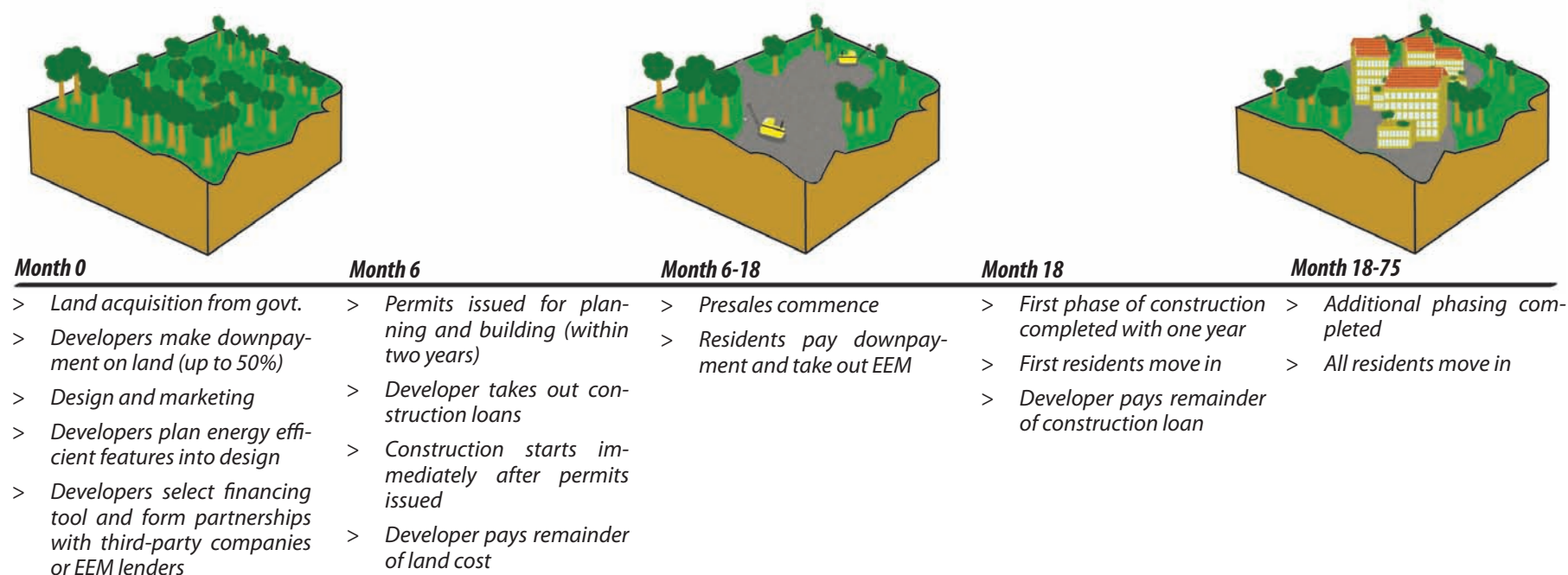
have already accomplished this with little difficulty (see Best Practices). After the contract period expires, the developer (or residents) stand to enjoy significant energy bill savings for the life of the project (or until the time of the next energy-efficiency upgrade).

Requirements for Tools to Work

The newly-enacted Energy Conservation Law will establish a regulatory framework to cut energy use for all new construction. Enforcement of this energy use reduction will require a large trained workforce of building inspectors to ensure compliance. The government should also provide further incentives for developers who go beyond the “minimum” energy savings measures in the code to encourage innovation in energy efficiency.

Once an energy-efficient building code is enacted and enforced, the developer must be committed to partnering with mortgage lenders and third-party efficiency companies to create streamlined processes for financing. EEM also requires that mortgage lenders in China have the ability to provide specialized energy-saving mortgages. In the United States, banks are still learning how to underwrite these loans, and Chinese and international banks should study these institutions to

Figure 1: Timeline of Development Process



gain proficiency. EEM further requires that the culture of borrowing among Chinese home buyers will increase in coming decades, which may be expected based on current trends and lending patterns (Stuchell 2008).

Third-party efficiency is contingent upon a new industry of efficiency agents who are specialized in installing and maintaining energy efficient systems. Third-party efficiency also requires an investment community that recognizes the opportunities from energy-savings investments. Finally, the financing of efficiency improvements is contingent upon accurate measurements of energy and cost

savings accrued. These calculations and forecasts are currently imperfect, at best (Frank 2008). Improvements in calculating savings are an important security measure for private companies to enter the market.

Timeline

Planning for these financing tools must be implemented early in the development process. Energy efficient mortgages should be available to the home buyer at the time of sale. For this to be feasible, the developer should have established connections to EEM

lenders, and the lenders can therefore have a streamlined process in place to combine EEM with a mortgage typical for Vanke residents. Similarly, Vanke should form a relationship with a third-party company early in the design phases in order to incorporate and finance energy-efficient features. Figure 1 shows a timeline of Vanke's development process and the points at which each financing tool should be considered and utilized.

Best Practices: EEM

Energy efficient mortgages are provided by a

lending institution and, in most cases, participation is elective and instigated by the home buyer. Furthermore, most existing EEM programs are through the public sector's lending institutions, with private sector expansion driven by perceived demand (Roberts et al 2005). The following are examples of EEM.

Citigroup

Citigroup, a global banker and investment corporation, has formed a partnership with Sharp Electronics Corporation to offer energy-efficient mortgages through its CitiMortgage division. The EEM apply specifically to solar electric systems produced by Sharp's Solar Energy Solutions Group through home equity loans and credit lines. Citi's commercial finance and leasing division is also working with campus and municipal partners to underwrite energy efficient upgrades, which allows the partners to amortize the energy savings over a 15 to 20 year period (Citigroup Inc. 2007).

A homeowner applying for a Citi EEM must first hire a third-party to verify the energy efficiency of the property. Then a loan is calculated based on energy savings or tax credits from energy efficiency. The borrower's contribution towards the downpayment and closing costs may be funded through energy efficiency rebates from government, utilities, or private sector. Finally, the Citi EEM is available for construction loans as well as property purchase (CitiMortgage 2007). Construction loan EEM allows Vanke to take out a greater loan during early project phases and then pass the

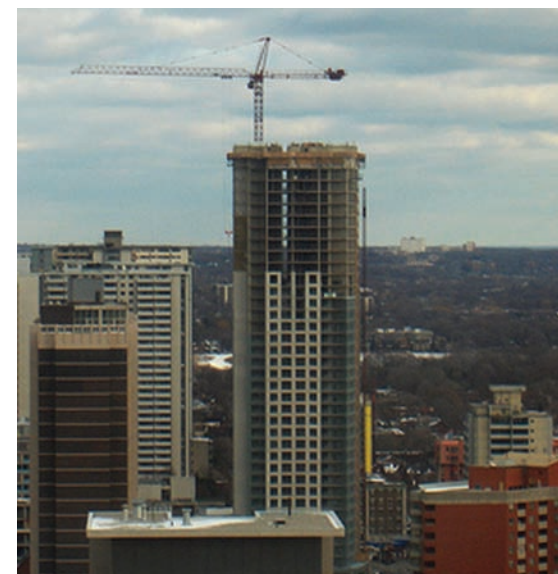
costs to home buyers, who can capitalize on energy savings through time-of-sale EEM.

Toronto Atmospheric Fund Condominium Energy Efficiency Loans

The Toronto Atmospheric Fund (TAF), a quasi-public organization dedicated to the reduction of greenhouse gases, offers loans to developers for energy efficiency measures in the design or construction process. The liability for these loans is transferred to the condominium association, which is then transferred to residents in the form of monthly condominium fees (comparable to Vanke's maintenance fees). The method has been piloted with Tridel, Toronto's largest condo developer. In 2005 the TAF provided a seven-year loan to Verve condominium building, a 344-unit tower in Toronto. The funded efficiency improvements will outperform energy code requirements by 25 percent and result in annual greenhouse gas emissions of 944 tons. The condominium loan tool is expanding across Canada with potential migration to the United States (Frank 2007; "Tridel's Verve" 2005).

The TAF uses the following criteria to assess loan applicants:

- > Quantifiable energy savings and revenue stream
- > Measurable risk
- > Quantified emissions reductions
- > Potential to attract other financing and investment
- > Security arrangement (TAF 2008)



The Verve, Toronto, Ontario > Energy efficiency infrastructure for the condominium tower financed by a loan from the Toronto Atmospheric Fund. Source: seekdes@flickr.com.

Best Practices: Third-Party Financing

Third-party energy efficiency companies are becoming more profitable in private-sector industry as energy costs rise. The following best practices demonstrate business models in which a third-party provides client benefits while also making profits for the company.

Transcend Equity Development Corporation

Transcend Equity was founded in Dallas, Texas in 2001 to improve financial performance of

multi-tenant commercial office buildings by investing in energy efficiency. Real Estate Investment Trusts (REIT) are Transcend Equity's primary clientele. Transcend Equity invests its own capital in building improvements, focusing on HVAC equipment and lighting, through a proprietary transaction structure called MESA. MESA then becomes an operating cost that replaces traditional utility expenditures and is set equal to historical energy costs. MESA is set for a specific time period, and after that the energy savings will be transferred to building owners and occupants.

Unlike other public-sector efficiency programs, Transcend Equity serves REIT and other large-scale real estate investors with the promise of improved building performance and upgrades with no cost to investors or increase in debt service. Traditionally capital expenses, including the improvement of outdated building systems, decrease funds available for distribution to REIT partners, representing decreased gains on investments. Transcend also advertises an increased Net Operating Income resulting from the efficiency investment, which is another tool to increase real estate investment returns.

While the efficiency improvements do result in environmental benefits, these are advertised as secondary to the financial benefits.

Transcend Equity markets their product with the assumption that more customers are attracted to the financial returns associated with efficiency rather than the social environmental benefits, which may allow them to capture a wider market share (Transcend Equity 2008).

Ameresco

Ameresco is an Energy Service Company (ESCO) founded in 2000, and it serves as an example of Clinton Climate Initiative's new ESCO models to realize the large-scale energy efficiency improvement potential. Ameresco has grown by 400% in the past year by purchasing failed ESCOs, and they are the only major ESCO not owned by a technology-based parent company (Frank 2008).

Ameresco features Energy Savings Performance Contracting (ESPC) under which Ameresco pays all costs for installing and/or upgrading energy-efficient equipment. The customer pays for these upgrades through a share of the cost savings over a set term, and the customer retains all savings for the life of the project at the end of the contract (see graphic). Ameresco used ESPC for several large-scale public housing projects in the United States, including the multi-site project run by Fall River Housing Authority in Massachusetts. In Fall River, Ameresco converted a

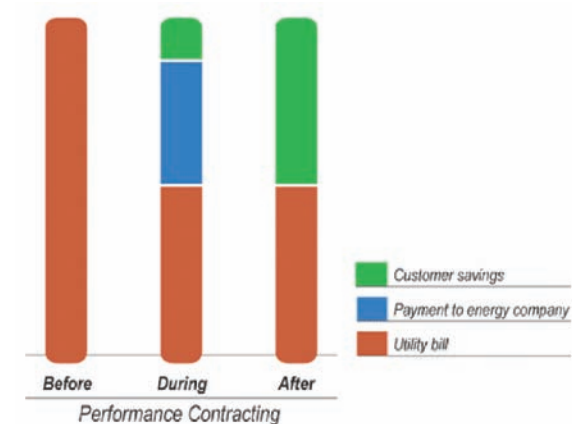


Figure 2: Ameresco Performance Contracting >The graphic shows the utility bill effects from Performance Contracting, a form of third-party financing. Source: Ameresco 2008.

high-cost, inefficient steam heating system to site-based gas equipment and replaced space heat and hot water systems. The project is currently in Year 6 of an eight year performance contract with cost savings of over 40% annually. The Housing Authority has been able to retain additional savings net of debt, allowing it to apply to other capital projects (Ameresco 2008).

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District Heating and Cooling

Mimi Zhang

Introduction

District heating and cooling systems are networks of underground pipes connected to one or more power generators. The piping system delivers waste heat and steam from the power generator to a network of customers. The most common district heating/cooling systems are fueled by waste heat or steam produced from a gas turbine that is fueled by natural gas or municipal solid waste.

Combustion processes to produce energy have efficiencies of around 30%-40%, so 60%-70% of all thermal energy stored in fuel is emitted as waste heat (Benonysson et al 1995). In many cases, the power generators that fuel district heating and cooling networks are Combined Heat and Power (CHP) generators, which produce both electricity and high quality heat, oftentimes in the form of steam (Harvey et al 2000). CHP plants are more efficient than normal power plants because some initial waste heat from the combustion process is cycled back into the system. CHP generators are ideal for delivery systems that provide steam instead of just hot water to customers. Steam delivery systems are ideal for industrial or commercial areas, or regions with large government buildings. District heating and cooling systems can be connected to



District Heating/Cooling Network Installation > Piping is installed for a district heating and cooling network in Sweden. Pipes must be heavily insulated and buried underground. Source: SP Technical Research Institute of Sweden 2008.

small-scale power generators or large power plants.

District heating/cooling systems are ideal for densely populated areas that do not require heat to be transported over long distances before delivery. They can also be used as energy storage devices where steam/hot water is produced during off-peak hours and



Solar Power > Solar hot water panels can be installed on building rooftops to heat water that can be used by residents. Excess hot water can be “sold” to the district heating/cooling network. Source: [nenorufus.at flickr.com](https://www.flickr.com/photos/nenorufus/)

pumped underground to be used during peak hours. Many district heating/cooling systems include an underground storage tank for this purpose (Lindenberger et al 2000). Additionally, the heat pumped into these systems can also be used for cooling.

Goals

The main goal of implementing a district heating and cooling system is to reduce emissions from energy production. This is achieved by reducing net energy demand from power plants through using waste heat from power generation. Using waste heat for heating and cooling reduces the amount of electricity that must be burned for heating and cooling homes, which, in some locations, can amount to more than half of all energy use. Such a reduction in electricity demand not only reduces CO₂ emissions, but also reduces emissions of NO_x, SO_x, particulates, and heavy metals. A district heating and cooling network also lends itself to integrating cleaner power sources such as biomass, solar, or geothermal. Waste to energy plants are also an ideal size for connecting to a district heating/cooling network, and burning waste for energy with proper containment of byproducts can reduce emissions and significantly reduce landfill requirements.

Scale

District heating and cooling can apply on multiple scales.



- > **Site scale:** A 1-2 MW generator could be linked with a pipe network sized to provide heating and cooling for Vanke Town and its surrounding areas.
- > **District scale:** Multiple generators could be plugged into a larger piping network to supply heating and cooling for an entire district. If there are any large power plants in the district, they can also feed waste heat into the system via a longer, better insulated heat transmission pipe.
- > **Regional Scale:** The system would be too large to manage efficiently on a regional level. However, it is important that the city or regional government encourage the development of district heating/cooling through implementing policy tools that provide incentives for utilities and developers to collaborate in planning and developing district heating/cooling networks.

Users

- > **Customers:** End-users would notice very little difference in their heat delivery or air conditioning. They would have access to



District Heating/Cooling Network in Context > A 1 MW turbine would be able to service an area of 2 square km, more than twice the size of Vanke Town. Source: Google Earth

 District Heating/Cooling Network Area
 Vanke Town

the same amount of heat and cooling that they are used to, but much of that heating and cooling would be fueled by waste heat instead of electricity. Customers may see more stable energy bills if the district heating and cooling system is partially powered with biomass or municipal solid waste, which would not be subject to fluctuations in gas prices. Ultimately, customers would not buy as much electricity and would have the added benefit of knowing that their energy use has a lower impact on the environment.



Potential Customer > Residential developments such as Vanke Town could be heated and cooled with a district heating/cooling network. Source: Yew Chin Leow.

- > **Developer:** Since all customers must be connected to a district heating and cooling system through piping infrastructure, developers must be involved in building the system and integrating new housing and infrastructure into a district heating and cooling pipeline system. The cost of the network is generally borne by the energy provider, but a developer striving to maintain higher sustainability standards could approach energy providers prior to site development

Developments as large as Vanke Town could have their own district heating and cooling network, which a developer can facilitate through working with energy providers to create the necessary infrastructure during the development's construction phase.

- > **Energy Provider:** The energy provider is generally responsible for building and maintaining both the power generator and the heating/cooling distribution network. The energy company has an incentive to collaborate with developers because timing is important. Laying down a distribution network during or prior to a site's construction is significantly more cost-effective than installing a piping sys-

tem on a developed site and retrofitting all buildings on the site to connect with the network.

- > **Government:** District heating and cooling networks require large up-front capital investment, and may not be viewed as initially cost-effective by an energy provider. It may take government incentives to encourage energy providers to invest in building such infrastructure. The gov-



Energy Provider > District heating/cooling networks are fueled by waste heat from power plants, which are often sited near urban development in China. Source: Brett Arnett at flickr.com.

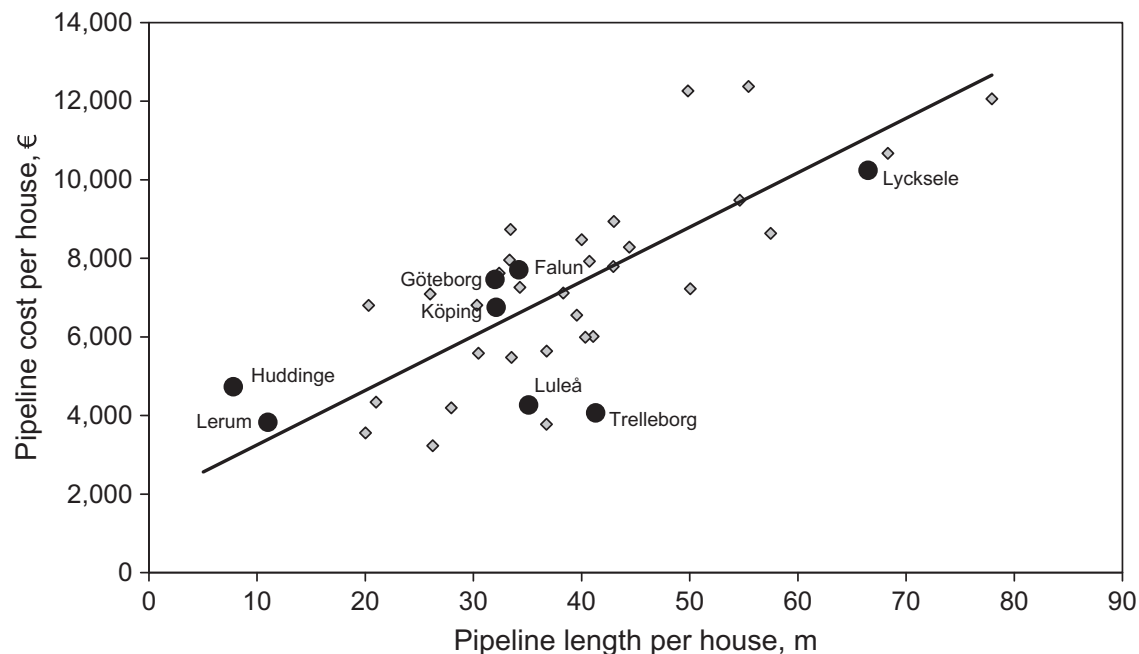
ernment should implement policy tools to encourage the building of more systems, as well as tools that would encourage the integration of renewable energy with district heating/cooling systems.

Cost-Effectiveness

A successful district heating and cooling system should pay for itself. The heat in a district heating system is produced from waste heat during the electricity generation process, so that heat is being produced at no cost. The cost for the energy provider lies in the piping system, which—if coordinated to happen during the construction of a site—would primarily consist of material and some labor costs. Retrofitting would cost more due to the need to tear down and rebuild existing infrastructure to install piping. The MIT Cogen Project, a retrofit project, is expected to pay for itself in just six years from fuel savings (MIT Cogen Plant 2008).

Implementation

To implement this tool on a district level would require government support and policies that encourage energy providers to invest in district heating/cooling networks. Installing the system would require permits and collaboration with developers and landowners as well



Piping Cost > The cost effectiveness of a network is related to density of customers. Pipeline costs increase as a function of distance between customers. District heating/cooling is ideal for urbanized areas such as Shenzhen, though studies are being conducted to determine its cost effectiveness for rural areas. Source: Nilsson et al 2008

as customer acceptance. Questions that need to be dealt with include where the piping system should be laid, which existing generators will be plugged in, where new generators should be built, what size the new generator should be, what kind of fuel it should use, etc. If possible, the development of a district heating/cooling network should be timed to coincide with new construction.

On a site level, this tool requires a pipeline framework that allows all residences and commercial areas to be serviced. Each connection requires a metering system to control and monitor delivery. Each customer would need to keep their standard hot water heater and electric-powered air conditioners in case the network cannot provide enough heating/cooling during times of peak demand.

The energy provider would set prices for heating and cooling that are comparable to historic costs of heating and cooling fueled by natural gas or electricity. In order for the customer to also benefit, the contracts can be designed such that prices for heating and cooling are locked in after a certain point, i.e. when the provider has recovered all investment costs. A developer may also be entitled to some of the profits through its role in providing customers by facilitating the district heating/cooling network.

Case Studies

- > **Southampton, UK** has installed a district heating and cooling system fueled by a high efficiency generator. This system has 11 km of insulated piping and serves a 2 km radius around the generator. It delivers 30,000 MWh of heat and 4000 MWh of electricity each year, resulting in a yearly reduction of 10,000 tonnes of CO₂ emissions (Southampton City Council 2006).
- > **Kotka, Finland** saves 180,000 tons of CO₂ emissions a year by using CHP and district heating. District heating makes up 55% of the municipal power company's heating supply (Clinton Foundation 2008).
- > **Reykjavik, Iceland** has a geothermal district heating system using hot water as a heat source. The water distribution system generates 60 million cubic meters of hot water while 750 MW of thermal power are converted to electricity. Geothermal energy has reduced the city's CO₂ emissions by 4 million tons of CO₂/year (Clinton Foundation 2008).
- > **Charlottetown, Prince Edward Island** has three solid waste and biofuel plant built



MIT Cogen Plant > Steam escaping from the MIT Cogen Plant, which serves all of MIT through a network of piping integrated into tunnels or building infrastructure. Source: Frank Hebbert.

during the 1980's. In 1995, Trigen Energy Canada bought all three systems and converted to a distributed energy system. The project consists of 15 km of piping, services 84 buildings, and is powered by a 1.2 MW turbine. It began operations in 1998 (IEA Bioenergy 2008).

- > **Massachusetts Institute of Technology** has a cogeneration plan on campus that provides district heating to the entire campus including dormitories, classrooms, and research facilities. The project cost \$40 million, will be repaid in 6 years, and is fueled by a 20 MW gas turbine. The MIT campus is 2 square km (MIT Cogen Plant 2008).

Further Research

Future research should be conducted regarding the optimal size and scale of district heating systems in temperate climates. Additionally, finding more examples of the effectiveness of integrating solar or geothermal resources into a district heating/cooling system would be necessary to develop a framework for constructing solar and geothermal projects in Shenzhen.

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Innovative Wastewater Management

Jeff Beam

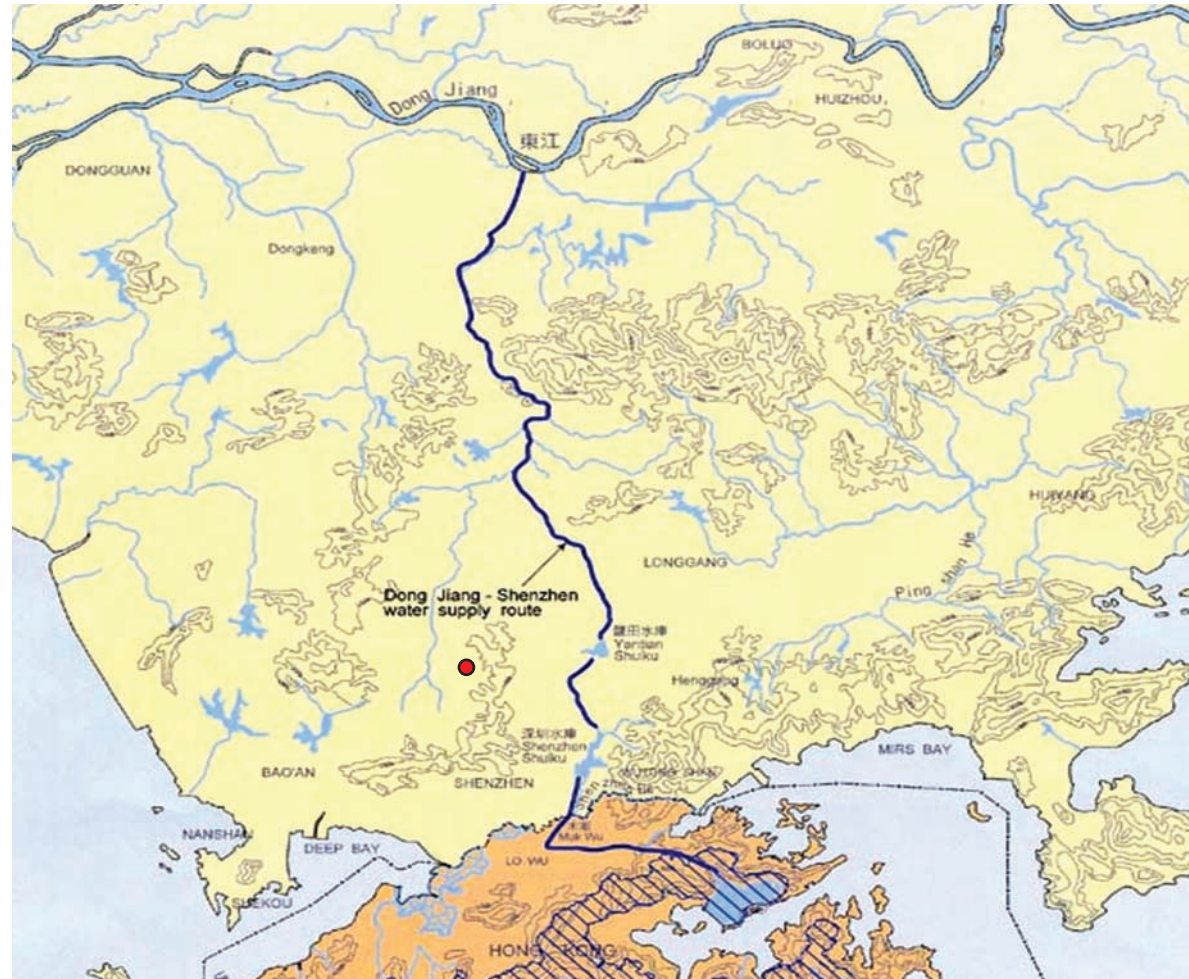
Treating Wastewater Sustainably

Facing a looming national water crisis and ever-increasing urbanization, water management is an increasingly important factor in development. National and municipal standards will grow more and more strict in coming years to respond to this threat. The primary goal of these standards will be to reduce the required amount of water purification to preserve dwindling national water resources, which will manifest in four parallel strategies:

- > Reduce potable water use through greater fixture efficiencies
- > Reduce need for potable water by incorporating greywater and collected rainwater where appropriate
- > Recharge groundwater and freshwater streams through Low Impact Development techniques and reduced reliance on conventional stormwater infrastructure

And, finally, the tool that is the focus of this section:

- > Treat wastewater at the site or neighborhood scale, especially through the use of sustainable, restorative natural systems



The Dong Jiang (Eastern Branch) Watershed > Water use, treatment, and pollution issues affect a vast land area of streams and tributaries. The Vanke Town site is indicated by the red dot. Source: Shenzhen Planning Agency

Current Conditions

A national water shortage for urban areas has become one of the top problems confronting China's rapid economic development and urbanization, with about two-thirds of Chinese cities challenged by this issue. The crisis more directly affects the more arid cities in the north

and west, but its effects are felt nationally, and government standards imposed to address the issue will likely affect development in all cities, regardless of location.

National statistics on water supply and population indicate a dire situation (China Business Services 2005):

- > Per capita water supply is 2200 cubic meters, one quarter of the world average; Usable per capita water supply is just 900 cubic meters
- > 110 cities face "serious" water shortages, lacking adequate supply for residential or industrial use
- > 300 million people do not have safe drinking water

Even in areas that have ready access to adequate freshwater, such as Shenzhen and the Pearl River Delta, wastewater pollution due to urbanization threatens the water quality. Again, national statistics show a looming crisis (China Daily 2005):

- > More than 70 billion tons of wastewater were released in 2004, with 45 billion tons pumped into lakes and rivers without any treatment
- > 90 percent of surface runoff in the country is polluted, and 70 percent of China's rivers are polluted

Currently, the infrastructure required to address wastewater management needs is sorely lacking. As of the end of 2005, more than 40 percent of Chinese cities had no stormwater



Deadly effluent > Pollution contributes to an epidemic of fish deaths in Hebei Province. Source: Wuhan/AP

treatment plants. Chinese factories are particularly wasteful, using five to ten times more water than the average in developed countries for an equivalent amount of industrial output. Despite having less water resources to begin with, cities are wasteful with what they have.

Government Response

The national government's initial responses to these issues are promising, but will take many years to reverse the negative effects of these problems (China Daily 2006).

- > More than 330 billion yuan will have been dedicated toward sewage treatment infrastructure from 2006 to 2010.
- > Currently, publicly-supplied water is underpriced, by international standards. To curb excessive water use encouraged by the low prices, the government is reforming the water market through the regulation of steadily increasing water prices.
- > The national ministry is increasingly avoiding the development of high water-consumption industries
- > Government planning agencies increasingly frown on wasteful, large-scale artificial water landscapes.

In this context, Chinese cities will rely on new development that handles wastewater treat-

ment on-site and does not increase the municipal burdens to provide potable water and to treat wastewater. Strategies and systems that reduce these burdens will be encouraged through infrastructure impact fees, through regulations, or through other means, requiring some degree of treatment on-site. Given the expense of distributed wastewater treatment facilities, other solutions must be considered. Sustainable techniques and systems, such as those described on the following pages, are cost effective, relative to conventional development.

Real estate developers that understand these issues and are practiced in incorporating these systems and strategies into projects today will have a competitive advantage in the awarding of new work. These leading developers will be better positioned to build new neighborhoods and districts of tomorrow.



Polluted waterways > More than 25,000 towns have no sewage treatment facilities. Source: AFP-Stephen Shaver)

What is this Tool?

Sustainable, on-site wastewater treatment can take several forms. Often, they are integrated into the project design as an amenity – especially in many eastern projects, where water is a powerful symbol and design element. These treatment systems include:

- > Constructed Wetlands
- > Restorers
- > Sand Filters
- > Mini Treatment Systems

Constructed Wetlands

Created to treat discharge such as wastewater, stormwater, or sewage, a constructed wetland is an artificial marsh or swamp. These engineered natural systems act as biofilters, removing sediments and pollutants such as heavy metals from the water, mimicking the function of natural wetlands. Nutrient rich, it also acts as habitat for wildlife, or for land reclamation after a site has been disturbed by pollution or excavation. (Lienard, et al 2005)

Though similar in productive biological function, constructed wetlands differ from natural wetlands. They are engineered to accommodate more sediment and to rapidly develop a diversity of plant life. Also, they are contained,



which maintains their shape and separates them from groundwater.

Developed in Germany, the U.S., the United Kingdom and Denmark, constructed wetlands are an evolution of a filtration and purification technique using aquatic plants that has only evolved in the last four decades.

Functional amenities > Examples of constructed wetlands in Shanghai (above) and the UK countryside (right); Source: Janisch & Schulz and Environment Probe's constructedwetlands.org.



Restorers

A proprietary technology developed by a U.S. researcher, John Todd, and Ocean Arks International, restorers are “an assembly of engineered ecologies incorporated into floating rafts.” They can treat wastewater and sewage in constructed lagoons or canals, or be used to maintain or restore the health of lakes, ponds, and canals.

The restorer “rafts” are essentially five components:

- > floating structure made of wood or welded composite plastic (HDPE) pipes
- > a high surface area media for support of diverse biological communities
- > an air distribution system for aeration and circulation
- > an energy system to provide electrical power to air distribution blowers and compressors
- > the restorative ecology: native wetland plants, fish, bacteria, fungi, algae, protozoa and other diverse life

Described by Todd, the restorers “work in much the same way that a marsh or a forest works,... [substituting] nature's wisdom for heavy duty engineering, chemicals and massive amounts of energy.” (Rawlinson 2007)



Floating rafts of 'engineered ecologies' > A rendering and a built example of Ocean Ark International's natural water quality system, the Restorer. Source: Ocean Arks International



See the Case Study in this section for how a Chinese city is already using this technology to combat municipal water quality issues..

Sand Filters

In many locations, especially in developed urban contexts, there are site-specific constraints on the use of infiltration devices to soak up and filter wastewater. Infiltration may not be possible due to clayish soil conditions or high ground water tables. In rural areas, the filtration site may be too close to drinking water wells. At such sites, other treatment options must be used, such as a compact, underground, biological sand filter. (Brix & Arias 2005)

While not providing a site amenity like a constructed wetlands, sand filters are a well known passive technology, used worldwide to filter water without the use of additive chemical treatment.

Mini-Treatment Systems

Small, distributed water treatment systems can vary in size from one house to a small district. While there is nothing inherently more sustainable in the size of the treatment facility, substantial infrastructure and energy savings can result from decentralizing treatment facilities. Providing a neighborhood-scale treatment plant eliminates:

- > many kilometers of piping infrastructure needed for a municipal distribution of

clean water and collection of wastewater

- > energy required for pumping millions of cubic meters of water to and from a building site
- > wasteful leakage from municipal water piping (it is estimated that leakage from about 21.5% of urban supply networks wastes 10 billion cubic meters a year) (Beijing SHI BO HONG YE 2007)

Rising Demand

Through a combination of these strategies, as well as efforts to reduce potable water use through efficiency and reuse systems, new development could begin to mitigate the dramatic increase in potable water demand projected in Shenzhen, nearly doubling from 2005 levels in the next 25 years.

Water Demand	billion m ³
2005	1.6
2010	2.1
2020	2.6
2030	2.8

Rising Projections> Projected potable water demand will nearly double in Shenzhen in the next 20 years. Source: Shenzhen Planning Agency.



Case Study

Fuzhou, a city of nearly 3 million along the Min River in Fujian Province, suffers consequences for its rapid growth. The city's historic canals, which date back to the Jin Dynasty, are filled with garbage, raw sewage, and sediment, filling surrounding streets with an overwhelming stench. Faced with this threat to public health and economic development, Fuzhou officials have taken a nonconventional approach to a solution: low tech but high science devices known as "living machines," invented across the world in Vermont, U.S.A.

Ocean Arks International, developer of the "Restorer" living machine, worked with the city



Canal "Restored" > Baima Canal before and after the installation of Restorers. Source: Ocean Arks International

in 2004 to install the system along 600 meters of canal in an intensely developed area. The stretch of polluted waterway receives waste from over 12,000 people at 40 inflow points.

The results? "After just one year of operation, the water beside the Restorer is clear, no longer stinks, and contains abundant fish. Neighbors report seeing butterflies and birds there for the first time in their lifetimes." (Charman 2004) Levels of harmful biochemical oxygen demand and ammonia are way down,

while dissolved oxygen (which supports life) is increased.

The installed system runs down the middle of the canal along access walks, with racks housing 100,000 plants and small pumps and pipes to invigorate bacteria. 10,000 koi contribute to the filtration process and produce oxygen. The combined effect is a beautiful amenity, and a working system that is one-eighth the cost of conventional sewage treatment.

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Auto Use Reduction for Healthy Cities

Connie Chung

Public Health, Air Pollution and Transportation

Shenzhen and much of China has in recent decades witnessed rapid economic growth that provides for improved standards of living, a broader array of available technology, and greater purchasing power. However, with such advancements come exponential increases in energy needs which place a strain on national resources, and also pollute the air with harmful nitrogen oxide (NOx), sulfur oxides (SOx), and particulates. Studies have shown that prolonged exposure to NOx, SOx, and particulates may result in respiratory illnesses or asthma. Much of the increases in pollutants that come from personal activities are the result of increased auto dependency.

For example, a recent study showed that motorized transport emissions make up 45-60% of NOx emissions. In addition, it should be noted that because automobiles emit pollutants at ground level (as opposed to factories which emit pollutants through smokestacks into the atmosphere), their emissions are more noxious to humans than is indicated by the absolute amount of emissions. It has been found that automobiles on urban roadways contribute 2 to 10 times as much pollution as other sources of emissions. (Energy Futures 2007).

Both (i) national, regional, and local policy regulation and incentives, and (ii) site-level urban design interventions can be used to curb such NOx, SOx, and particulates emissions, wean future generations from auto dependency, and improve overall health of the population.

Goals and Assumptions

Reducing auto dependency is a tool for achieving the following goals:

- > **Encourage transportation mode shift.** Increasing demand for public transit naturally reduces use of private autos and reduces congestion, improving overall mobility.
- > **Improve air quality.** Keeping emissions levels down translates into improved air quality, and as a result, better public health.
- > **Increase individual physical activity.** The creation of walkable urban environments provides a venue in which the public can participate in physical activities.

Underlying these goals are certain assumptions about the future of transportation in Shenzhen and China. First, car ownership will only continue to rise. From 2000 to 2004, average car ownership per 100 households in Shenzhen tripled from 7.0 to 21.5. A



Shenzhen Air Pollution > Air quality will worsen as car ownership levels rise, without intervention from government or developers. Source: Connie Chung



Encouraging Other Transport Modes > Inciting demand for alternative modes is effective, but air quality remains an issue. Source: Connie Chung

closer look at the car ownership levels for the middle- to high-income groups reveals even more dramatic shifts towards car ownership during that time period (Shenzhen Statistical Yearbook 2006).

Second, to support such increased car ownership, and to appease local interests, municipal governments will bolster auto dependency by building more highways in already-congested areas (EASTR 2006; Yang and Gakenheimer 2007). However, this reactionary response to congestion problems cannot be sustained over the long term.

Tools

Policy tools

A comprehensive transportation policy that incorporates both land use and public health considerations entails several policy tools:

- > **Demand-pricing.** Congestion pricing of roadways, tunnels and bridges, and market-based pricing of parking structures and fuel can reduce the use of and demand for auto-centric facilities and improve mode share.
- > **Transit-focused spending.** The other side of improving mode share is to augment demand for public transit. However,

poor facilities quickly disincentivize users of public transit, and so policy should be focused on transferring spending from highway networks to improving the quality of public transit, as well as facilitating connections between modes.

- > **Emissions caps.** The National Air Quality Standard of China dictates a baseline standard for ambient air quality, with oversight performed by local environmental protection offices (Energy Futures 2007). However, stringently-regulated emissions caps, including smog-reduction requirements, are needed in order to ensure that both businesses and individuals comply with the national standard.

Design tools

Design interventions on a local level pair with policy guidelines to apply public health principles on the street level:

- > **Traffic calming.** Residential zones need streets that are safe and pleasant for walking, cycling, and playing. Streets that are actually usable by people - not by cars - encourage outdoor physical activity and exercise, while also discouraging overuse of cars.
- > **Bicycling and walking networks.** Similar

to the concept of improving transit facilities, bicycle and pedestrian facilities must also be kept pristine in order to encourage use. This includes raised paths, sufficient resting spots, helpful signage, safety barriers, and thoughtful consideration of connections at intersections or at over- or underpasses

- > **Green street network.** Trees not only provide a canopy of needed shade and pleasant walking environment, but they also trap airborne pollutants, absorbing carbon dioxide and other harmful effects of auto emissions. Thus both air quality and mode share are improved.

Implementation

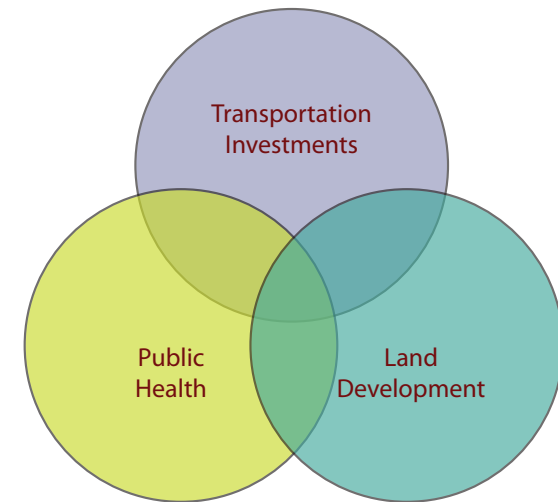
The chart on the following page summarizes the Policy and Design tools, the scale of intervention appropriate to each, responsible parties for implementing the policies, current best practices for each tool, and measures of effectiveness.

Tool	Scale of Intervention	Responsible Party	Current Best Practices	Measures of Effectiveness
<i>Policy Tools:</i>				
Demand-pricing	Regional/District, Local	Provincial and Municipal legislative bodies	London: Congestion Charge Zone requires payment of £8 for vehicles entering the Zone between 7am and 6pm, with fines imposed for non-payment (Transport for London website)	Air quality indices; transit demand; reduction in auto congestion
Transit spending	National	National legislative body	Hong Kong: rail-based transport strategy; diverse mode types (underground subway, heavy rail, light rail, tram, bus, minibus, ferry, escalator/walkway system, taxi) (Cullinane 2003)	Transit demand
Emissions Caps	National, Regional/District, Local	National, Provincial, and Municipal legislative bodies	European Union: E.U. Emission Trading Scheme, a cap-and-trade scheme that limits carbon dioxide emissions (Ellerman and Buchner 2007)	Net reduction in carbon dioxide
<i>Design Tools:</i>				
Traffic Calming	Local	Municipal planning agency	Delft: pedestrian-centric Woonerf streets which prioritize pedestrian/cyclist mobility over that of autos (Tolley 1990)	Pedestrian injuries; incidence of asthma/respiratory illness
Cycling/Walking Networks	Regional/District	Provincial and Municipal planning agencies	Portland, Oregon: increasing its bikeway network from 83 miles to 260 miles between 1992 and 2005, bicycle commute trips doubled citywide (Birk and Geller 2006)	Increase in bicycle use; reduction in auto traffic
Green Street Network	Local	Municipal parks agency	Melbourne: Plane Tree canopy along Swanston Street and St. Kilda Road complete a green tree network of streets that contribute to both daytime and nighttime pedestrian quality of life (City of Melbourne and Gehl Architects 2004)	Air quality indices; incidence of asthma/respiratory illness;

Policy and design interactions

In implementing any of these tools to design street networks for a healthier Shenzhen, it is important to take a wholistic approach to transportation planning, public health. The diagram at right illustrates this point: while each realm of policy-making can be considered individually, each sector has concerns that coincide with the others. Land use decisions depend greatly upon location of transporta-

tion investments; public health relies upon network connectivity of the public transport system; and locational decisions about land use and development affects air pollution levels and thus public health. But considering policy decisions from the nexus of the three sectors ensures that sustainable transportation networks are built which uphold public health.



Policy and design interactions > Taking a holistic approach to decision-making. Source: Frank et al. 2003

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Street Types for Pedestrians and Cyclists

Hope Stege

It is generally known that walking and bicycling for transport both improve health and reduce non-renewable resource consumption. Yet despite these benefits, people are often reluctant to give up their cars for non-motorized forms of transportation. Reasons for choosing not to walk or bike fall into three categories: physical conditions (safety, pleurability), personal motivation, and lack of institutional support (National Bike and Walking Study 1992, Barton and Tsourou 2000). A form-based approach to improving the quality of pedestrian and bicycle environments can go a long way towards addressing the first of these rationales, particularly if it is part of a multi-pronged, city- or regional-scale mobility plan.

What is the goal of using this tool?

The sample street sections on the following pages depict several innovative street typologies that create effective conditions for walking or bicycling. While these are just a small sample, they help explain the many urban design concepts behind creating human-scale streets for non-motorized transportation. They are intended to encourage the deliberate incorporation of such streets in future developments. The goal of actually building this sort of streetscape is to increase walking and bicycling while creating a pleasant outdoor space that fosters a sense of community (Barton and

Tsourou 2000). Careful street design has many indirect benefits as well:

- > Improved traffic safety
 - > Healthier lifestyles
 - > Increased property values
 - > Increased accessibility
 - > Improved stormwater management
 - > Improved community image
- (RDG Planning and Design 2007)

On what scale does this tool apply?

These street types can be incorporated within a single development site, and they can also be applied at an expanded scale in order to create human-scale connections between neighborhoods and to build a district-wide non-motorized transportation network.

Cost Effectiveness

Though building new streets is always an expensive undertaking, it is much more cost-effective to do so during initial construction rather than as a retrofit later in time.

Who will use this tool?

This tool will be applied by site planners and developers as a new project is designed, but the streets themselves will be used by all resi-

dents. Even if a street is focused on pedestrian or bicyclist movement, cars and other motor vehicles will be able to travel the same paths.

What is required to make this tool work?

The application of pedestrian or bicyclist-focused street typologies is most effective when done in conjunction with an overall mobility scheme. These streets should serve as just one of many tools for increasing non-motorized transportation.

Creating attractive pedestrian spaces requires careful consideration of both context and scale. Important elements to consider include:

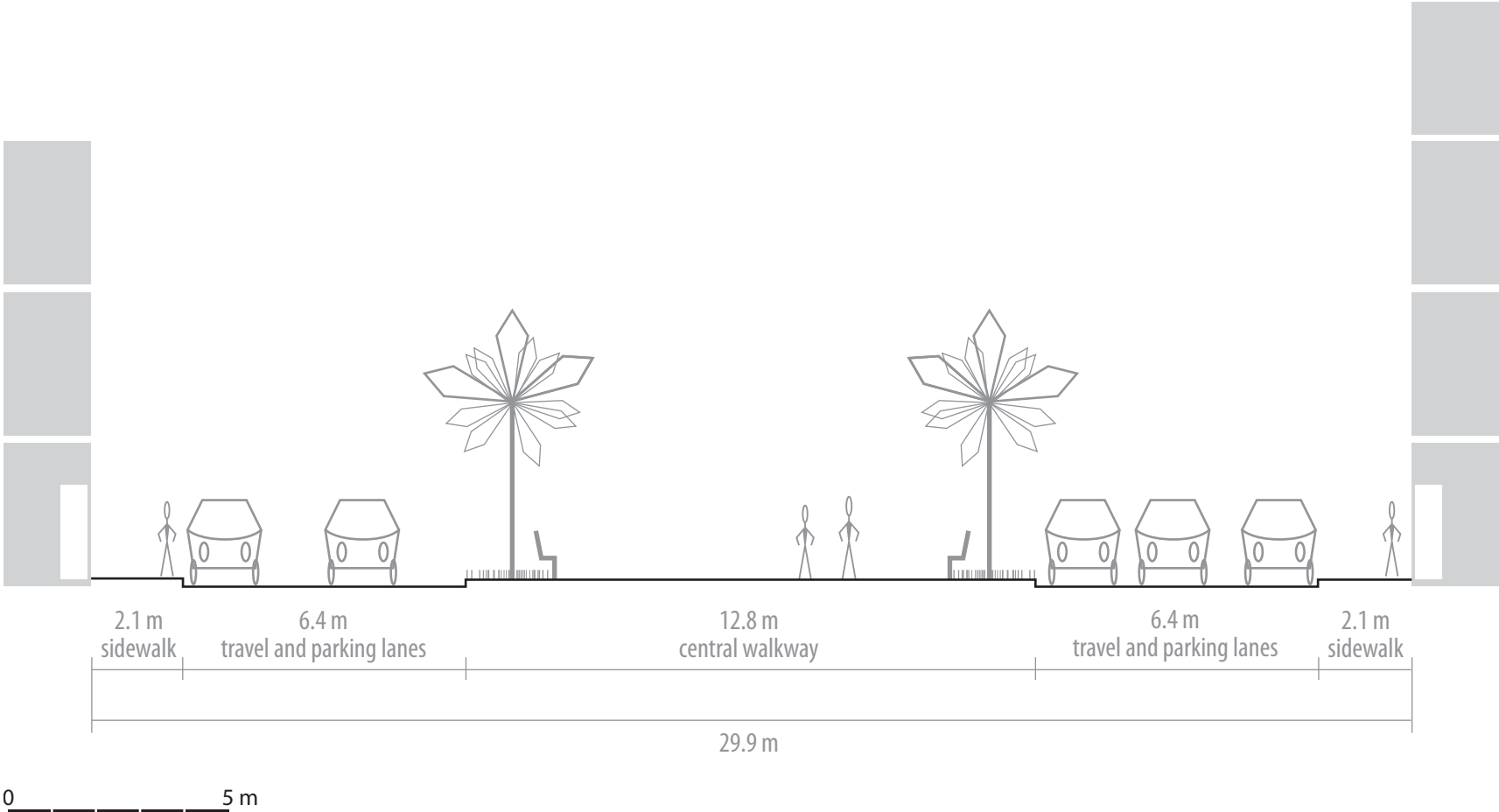
- > Location
- > Land use, building use, and amenities
- > Degree and type of non-motorized movement
- > Speed and degree of motorized vehicle movement
- > Parking configuration

(Steiner and Butler 2007, Schmitz and Scully 2006)

The following pages depict examples of several forms of people-focused streets.

Tree-lined Boulevard

High-traffic street at the pedestrian scale



1:150

Source: Adapted from Jacobs 1993.

Despite being flanked by multiple lanes of traffic and a wide right-of-way, the tree-lined center of this boulevard creates an intimate passage for pedestrians. The tree canopy provides pleasant shade in the summer, and pedestrian furniture is spaced along the walkway. Five- to seven-story buildings help to define the street and provide a backdrop for the activity and movement along the central walkway. The grassy strips along the walkway leave plenty of room for special exhibitions, temporary cafes or vendors, and space to spread out and enjoy the lush surroundings.

Best practices



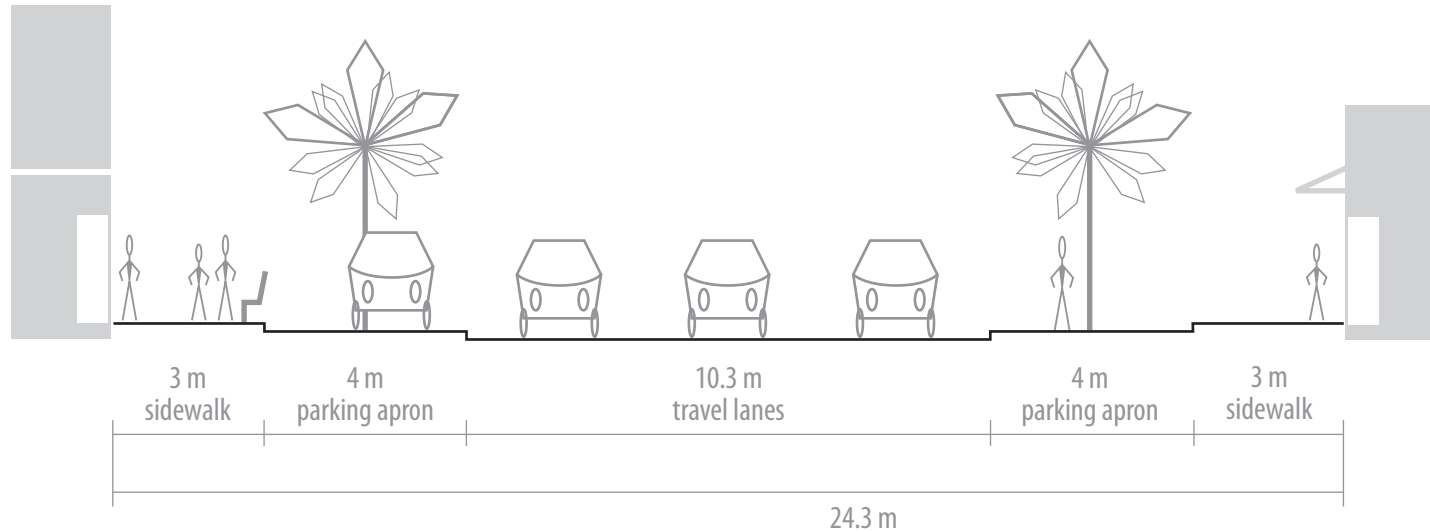
Commonwealth Avenue, Boston > Running parallel to several other major thoroughfares in Boston, Commonwealth Avenue provides a pleasant options for pedestrians in the Back Bay neighborhood. The streets are lined with beautiful brick townhouses, giving it a very established feel. Automobile traffic can be heavy at times, so there are stop signs or traffic lights at many of the cross-streets. Source: mcqua-by_lake@flickr.com.



Rambla de Catalunya, Barcelona > The Rambla is a busy pedestrian passageway. In contrast to Commonwealth Avenue, it is primarily paved, with a one-meter-wide planting strip on either edge of the pavement. Source: Gary@picasa.com.

Flexible Main Street

Pedestrian-friendly downtown

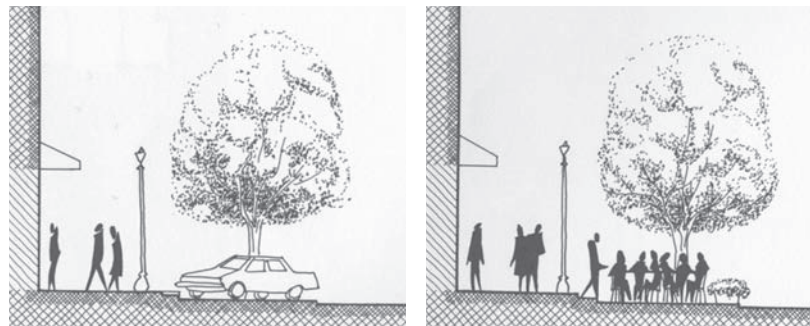


0 5 m

1:150

Source: Adapted from Jacobs 1993

The diagram above is based on the main street of Mountain View, California, a town of about 70,000. The recently-implemented streetscape creatively separates cars from pedestrians while maintaining an open feel and staying at the pedestrian scale. The critical element of this scheme is the parking apron, which can accommodate on-street car parking or be reserved for additional pedestrian spaces such as sidewalk cafes or exhibitions.



Flexible street-space > The parking apron can be used for street parking, or cleared and converted to cafe seating or exhibition space. Source: Jacobs 1993.

Bicycle Boulevard

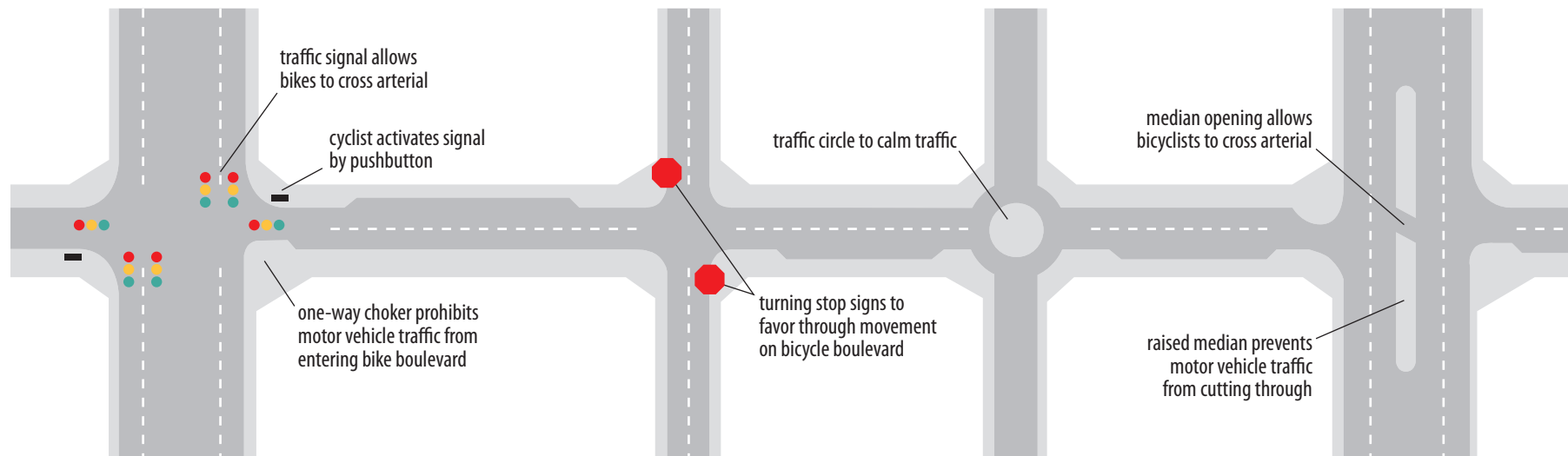
Prioritizing bicyclists

The bicycle boulevard is an emerging street type in which bicycles and cars share the street, but bicycle movement is prioritized over that of motor vehicles. While every bike boulevard is designed to address location-specific issues, the following are some of the basic elements typically pieced together to create a safe, bicycle-friendly environment:

- > Traffic calming devices (traffic circles, bulbouts)
- > Traffic signals and signage
- > Limitations to motorized vehicle travel
- > Curbs and medians moderating motor vehicle access
- > Unique pavement and pavement legends

- > High-visibility crosswalks

Bicycle boulevards are best established on local or collector roadways with fairly low traffic volumes (Steiner and Butler 2007, Wilbur Smith Associates 2000).



Source: Steiner and Butler 2007.

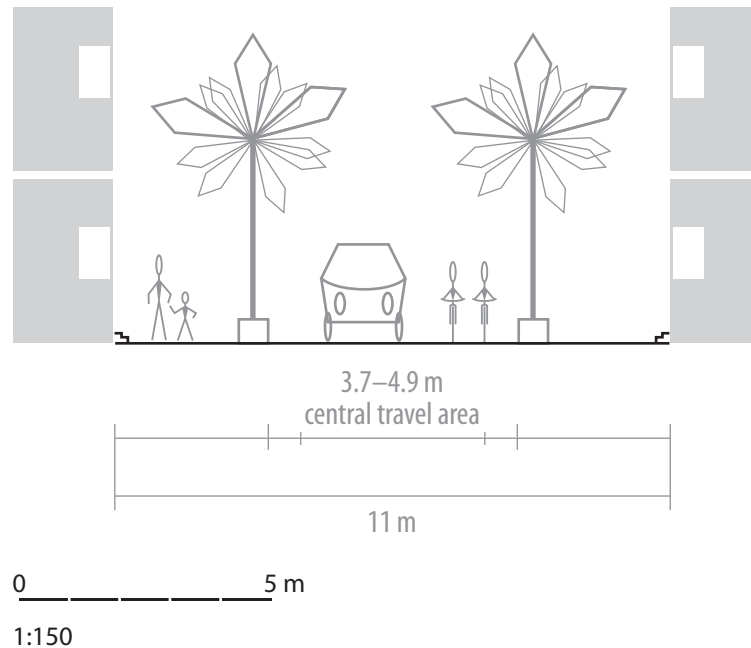
Woonerf

Prioritizing pedestrians

The woonerf, or “living street,” originated in the Netherlands and is a residential or small-scale retail street that prioritizes pedestrians over motorized vehicles. A number of cues are used to accomplish this:

- > Travel area at the same height as the sidewalk, creating a level surface
- > Special paving demarcating the main travel area
- > Stop signs, traffic lights, crosswalks, or other traffic-moderating devices
- > Street furniture such as planters, benches, and bike racks
- > Plentiful plantings and trees

These elements combine to create a people-scaled environment which encourages social interaction and provides a safe street environment, as the lack of signage and stoplights actually causes drivers to be more cautious than usual (Byles 2008, Steiner and Butler 2007).



Source: Adapted from Steiner and Butler 2007

Conclusion

The palette of pedestrian- and bicyclist-prioritized street goes much beyond the four examples shown here, but in every case, this type of street focuses on the human scale. Though cars are becoming more and more ubiquitous as incomes rise, driving them regularly puts an ever-increasing amount of pressure on limited resources. Stronger utilization of non-motorized transportation is one way to help relieve some of this pressure, but the first step in moving toward less driving is to create an abundance of routes and destinations that are comfortable and pleasant for people outside of the protection of a car.

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Shrinking Cities

Kanda Song

Background

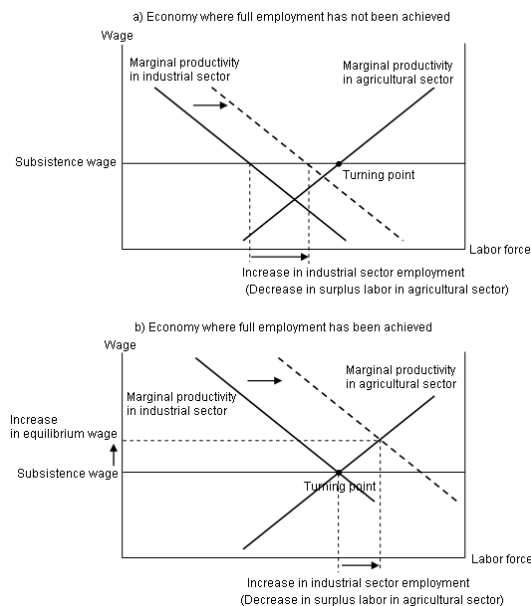
Nowadays one out of six cities worldwide could be defined as a “shrinking city” (Definition from Shrinking Cities Group). This phenomenon mostly refers to the cities such as Detroit, Pittsburgh and Manchester, which suffer dramatic losses in both economic and demographic bases in developed countries. However, cities undergoing sharp industrial transitions which result in either temporary or long term shrinkage in industrial bases can be considered “shrinking” in a specific sense. The industrial transitions always take place in Asian cities: Seoul, Taipei, Hong Kong and Shenzhen (Shrinking Cities Group), just name a few.

As Arthur Lewis’ Dual Sector Theory states, the relation of wages and labor changes between two sectors -- a traditional agricultural sector and a modern industrial sector -- will eventually reach a turning point, indicating that no further manufacturing sector development will take place as workers no longer have a financial incentive to move. Furthermore, there might be a back flow from modern industrial sector, because of some other factors related to living expenses, resource provision and policy making (Fang, Cai, 2007).

Shenzhen is not currently a “shrinking city” in terms of economic development. It has kept



Cities with the Highest Shrinking Rates within the Last 50 Years (highlighted in red) > Source: <http://www.pingmag.jp/2007/01/26/shrinking-cities/>



an amazingly fast pace development rate averaging 22% since 1978. However, its industrial base, though constituting 52.4% of the overall GDP in 2005, is exhibiting a gradual decrease in the increment rate (Shenzhen Statistics). Comparing with other domestic large-scale cities, the industrial development rate of Shenzhen is among the lowest ones. Furthermore, the labor force sharply declined from 8 million in 2005 to 6.5 million in 2007, and a number of both domestic and foreign enterprises have decided to move their manufacturing base out of Shenzhen. Besides, the decreases in foreign direct investment (FDI) also indicate a industrial transition in Shenzhen (Shenzhen Statistics).

Therefore, the paper will try to identify the tools that will improve the economic condition so as to avoid a real “Shrinkage” when facing the inevitable industrial transition in Shenzhen, which is a challenge, while a precious opportunity to upgrade the city’s economic structure.

Illustration of “Turning Point” > Source: Chi Hung KWAN. *China in Transition*. <http://www.rieti.go.jp/en/china/07091101.html>

Tools

The paper will try to identify the factors that result in the industrial transition and accordingly, put forward the tools on different levels including government policies and development strategies. The aim of proposing these tools is in accord with the final “goal” of the paper: to maintain a comparatively high speed of local industries development, while at the same time achieving a successful upgrade in industrial sector.

Tool I. Establish Institutional network

1. On what scale does the tool apply (district, site, and building)?

District level

2. Who will use the tool (developer, government, residents)?

Government, research institutes and enterprises

3. Implementing techniques:

i. improve the level of local advanced education as well as expertise education

ii. strengthen connections between institutes/ research labs and enterprises

iii. establish linkages between local R&D sectors and overseas institutes

4. Best practice examples:

Taiwan: Hsinchu Park

Boston: Bio-tech industry

The IT manufacturing industry in Shenzhen is a “latercomer”(Amsden and Chu, 2003) comparing with that in Silicon Valley and Hsinchu Park, which though contribute a considerable proportion in the overall GDP of Shenzhen. Moreover, the fast-paced development of the manufacturing industry can be largely ascribed to the industrial transition twenty years ago in Taiwan: most of the manufacturing sectors of the Taiwan enterprises have settled in Shenzhen, and in the whole Delta area (Amsden and Chu, 2003)

From the best practice examples, one of the most important issues is the investment in local education. Promoting the local advanced education will serve the needs of R&D sectors, and meet the needs from the manufacturing sectors that require workers with specialized skills.

Furthermore, the communication between companies and research institutes is crucial to both of them: the scientific outcomes will be commercialized more smoothly, which will ensure the continual fiscal support from enterprises; the companies will receive considerable profit based on the first-hand

research achievements: as the biotechnology industry in Boston exemplifies, there are broad inter-relationships between enterprises and research institutes. Besides, these dense social networks have greatly contributed to the cultivation of high-tech regions.

The array of university-industry linkages in the life sciences spans both formal connections and informal flows. A partial list includes (Porter, Kelly, et al. 2005):

> The movement of university graduates into commercial firms.

> Consulting relations between faculty and companies.

> Licensing of university technologies.

> Industry gifts supporting university research and student training.

> Faculty entrepreneurship leading to the founding of new companies.

> Faculty involvement on scientific advisory boards.

> Co-patenting between university and industry scientists

> Formal contractual partnerships to pursue joint R&D, product or prototype development, and clinical trials.

The social/institutional connection of a technical community at local level is essential to

industrial production. Moreover, the local enterprises in Shenzhen should extend their connection, both formal and informal, to a broader range. Fred Chang, who runs Winbond North America, claims that: "the best way to start a technology company today is to take the best from each region, combining Taiwanese financial and manufacturing strength with Silicon Valley's engineering and technical skill." (Amsden and Chu. 2003)

The firm was once considered as the sole organizational form for the creation and internal transfer of knowledge, especially for the technological methods that are difficult to codify. This notion now has been challenged. In regions like Boston, the bio-tech industrial park and in the Silicon Valley, the technical communities always transcend firm boundaries. Furthermore, an international technological community provides an alternative and potentially more flexible/responsive mechanism for long-distance transfers of skills and know-how. The case studies will exemplify how the transnational community linking Hsinchu and Silicon Valley was formed and strengthened, which then result in the subsequent process of industrial upgrading.

Tool II. Promote Creative industries

1. On what scale does the tool apply (district, site, and building)?

District level

2. Who will use the tool (developer, government, residents)?

Government and enterprises

3. Implement techniques:

i. Integrate HK's management system of CCI (Cultural & Creative Industries) with Shenzhen's local creative industry.

ii. Using Hong Kong's international environment to link the CCI in Hong Kong to Shenzhen and the international market

4. Best practice examples:

Hong Kong: Cultural & Creative Industries

London: Creative Industries

The DCMS (Department of Culture, Media and Sport, UK) defines creative industries as "the industries which have their origin in individual creativity, skill and talent and which have a potential for wealth and job creation through the generation and exploitation of intellectual property"(DCMS).

The main problem of development for creative industries in Shenzhen is the incompleteness of the system: the municipality of Shenzhen

since 1978 has made over 200 ordinances and laws, but less than 5 are about the creative industries (Centre for Cultural Policy Research, 2006). There is a huge grey area in terms of openness of information, monitoring of finance, quality checking, protection of intellectual property rights, classification of video and film, and entry to the market. The collaboration with Hong Kong will gradually introduce its legal experience to promote the linkage of creative industries of the two cities and to nurture a flourishing market for Shenzhen.

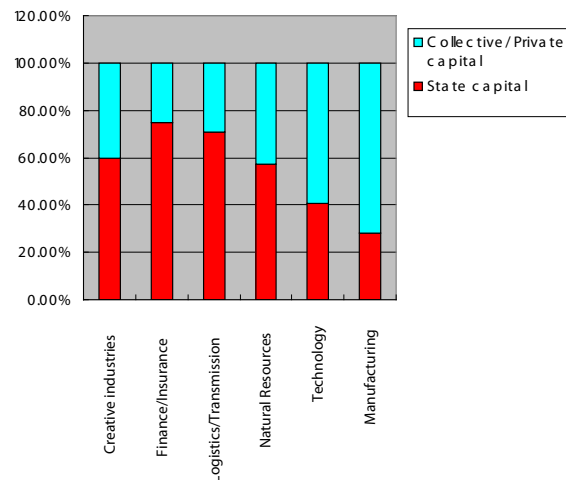
Furthermore, the Shenzhen's creative industries seriously lack funding because the legal system for finance and investment is not developed. The previous cultural investment was structured mainly under the planned economy with the following characteristics:

> The power of the officials in charge of the projects is highly concentrated, which affects the areas such as the consultancy, project assessment, project decision, financial operation, investment information.

> Decisions are made according to wills of the officials and not market information, leading to a high degree of monopoly in the creative fields. According to information from the National Bureau of Statistics, by the end of 2001, state capital still dominates the related indus-

tries: 59.93% in education, culture, art, radio, film and television, which is lower than finance and insurance (74.85%) and transport, storage and electronic communication (70.91%), while higher than electricity, gas and water (57.08%), scientific research, integrated technical services (40.85%) and manufacturing (28.29%) (Centre for Cultural Policy Research, 2006).

> For those industries with higher state investment such as press, radio and television, the



Capital and Collective/Private Proportion in Related Industries > Source: Centre for Cultural Policy Research, 2006)

input and output obviously is not as efficient as those with higher private capital such as printing and entertainment. And yet the main body of the printing sector in the Mainland consists of a large number of private and joint-venture enterprises (Centre for Cultural Policy Research, 2006). The investment management of CCI in Shenzhen therefore is urgently in need of reform.

On the other hand, Hong Kong as a free port with a high degree of globalized economics and finance, convenience of import and export trade, is naturally the best place to facilitate development of the creative industries in Shenzhen through interrelated services.

For instance, Hong Kong is now an important centre for international exhibitions since the 1980s and holds annually 70 large, regular and professional international exhibitions, 14 of which have been recognized by the UFI, the largest number in Asia, attracting over 30,000 exhibitors and buyers from all over the world. Among these, seven exhibitions held by the Hong Kong Trade Development Council are already the largest international exhibitions in Asia. Moreover, Hong Kong exhibition industry announced its revenue of HK\$1.88 billion and indirect consumption profit of HK\$5.4 billion in 2002, which means for every dollar the exhibition industry earns, other industries

will earn HK\$2.8 (Centre for Cultural Policy Research, 2006). The integrated advantages of Hong Kong cannot be matched by Shenzhen at present. Therefore, Hong Kong can act as an accelerator for the import and export of Creative Industries to regulate the flow of cultural products and services between Shenzhen and the international market.



AsiaWorld-Expo . Hong Kong's Newest Exhibition Center > Source: <http://www.asiaworld-expo.com>

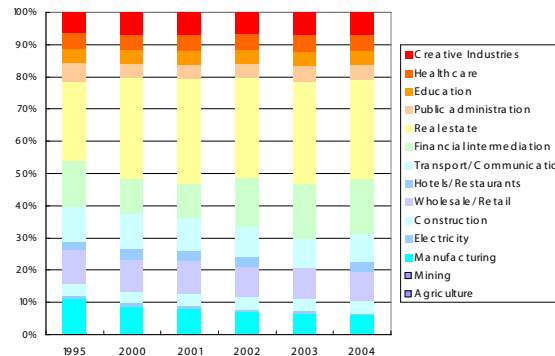
Measurement of effectiveness

The goal of the tools is to achieve a “smooth” transition of the industrial sectors in Shenzhen. Therefore, a most important indicator is the Shenzhen’s revenue growth in industrial sectors: a positive growth rate indicates a promising industrial transition, and vice versa.

Furthermore, it is important to examine industrial structural change, which is illustrated by the proportion of main local industries. Take the industrial structure of London as an example: as the service sector maintains a considerably high proportion in the overall annual gross value added, the manufacturing sector decreases steadily. Another key observation is the percentage of the creative industries always maintains a high level in the overall gross value added, as the government promoted this industry early in 1990s (Greater London Authority, 2004).

What is required to make the tools work?

- > Government regulations and policies as economic leverage and incentives.
- > Governmental/public funding to provide financial assurance to research institutes.



Industrial Structure Change of London > Source: Greater London Authority, 2004.

> Improve legal systems to provide a healthy environment to promote information openness, fair competition and protection of property rights.

> Promote formal/informal connections between institutes/research labs and enterprises through conferences, exhibitions and other cultural activities.

> Strengthen the cultural and economic connections between Hong Kong and Shenzhen.

The best practices

1. The institutional connections of Boston's Bio-tech industry

The development of biotechnology in Boston is not a smooth process. Unlike the industry in California, there is much more contention concerning whether biotechnology is science or just another “alchemy” like the pharmaceutical industry in the mid-20th century in Boston.

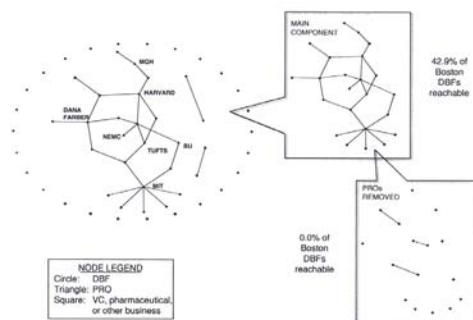
In 1980 the US Congress approved the Bayh-Dole Act, which allowed US universities to keep intellectual patents applying to commercial practices (Wikipedia, May 5th, 2008). However, the relations between US universities and enterprises have a deep and long-lasting history. Particularly, the university-industry relations in biotechnology may be more extensive than any other science sector.

I. Boston contractual network:

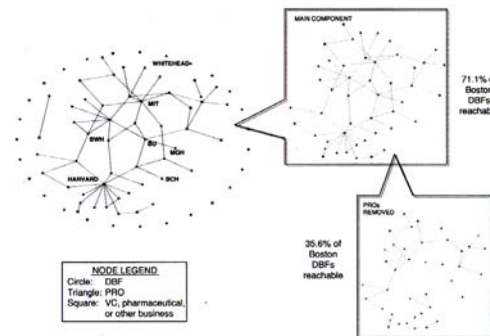
Kelly Porter in his work, “the Institutional Embeddedness of High-tech Regions: Relational Foundations of the Boston Biotechnology Community” delineates the networks between institutions and enterprises from 1988, when the network was relatively sparse with organizations isolated from the network of formal relationships. More interestingly, the Public Research Organizations (PROs)

played a crucial role in connecting the main elements of the network: Six PROs (MIT, BU, Tufts, Harvard, the Dana Farber Cancer Center, MGH, and the NEMC) were centrally positioned in the network. Only a small number of the Bio-tech firms were well connected, such as Biogen, Genetics Institute, Genzyme and etc. The following diagram suggests that, the Boston Bio-tech cluster in its early development is weakly linked; the coherence of this network is maintained by the participation of local public research organizations.

As a comparison of the Boston network in 1998, more than 71 percent of the Dedicated Biochemistry Firms (DBFs) were connected to the



Bio-tech Industries in Boston: Contractual Network, 1988
 > Source: Owen-Smith, J. and Powell, W.W. Knowledge networks as channels and conduits: the effects of spillovers in the Boston biotechnology community. 2004.



Bio-tech Industries in Boston: Contractual Network, 1998
 > Source: Ibid.

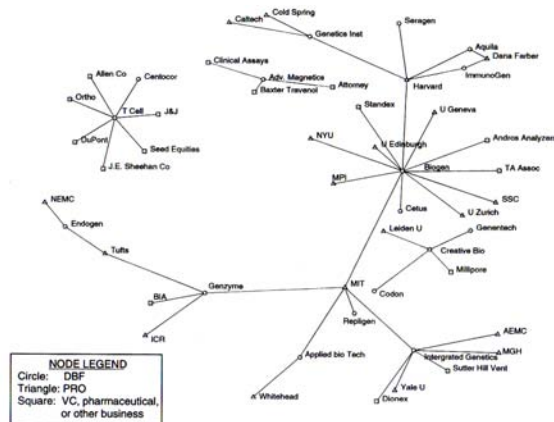
main component. More importantly, the network itself is undergoing a structural change: the local biotech firms begin working directly with each other, rather than forming indirect "chains" through shared ties to PROs. Local VC(Venture Capital) firms also play an active role as they gradually form relations with MIT, which is evident from the diagram. The former prominent PROs still play an important role at that time, but their position is declining, as analyzed in the diagram when removing them from the main component, there is still 35.6 percent of DBFs reachable (Porter, et al, 2005).

II. The structure of founding teams

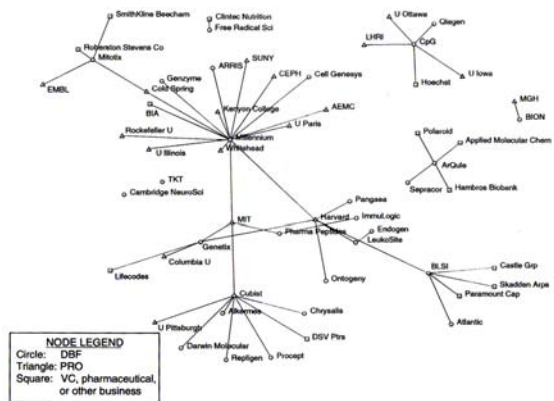
Tracing the biographies of the founder teams allow to construct a network of founders. Kelly

links the newly founded companies with the organizations that the founders belong to. The establishment of a bio-tech company always requires some combination of scientific research in life sciences, business experience in pharmaceutical industry or high-tech fields, and venture capital.

The following diagrams present a picture of the founder network in 1983, showing that six hubs representing founding teams of Biogen, Advanced Magnetics, Integrated Genetics, Creative Biomolecules, Genzyme, and T Cell Science. If it was not because of the Nobel Laureate, Phillip Sharp who co-founded of the Integrated Genetics, Genzyme, and Biogen, these groups would be unconnected. Furthermore, these 3 firms all have one or more MIT faculty in their founding teams. Then in 1997, we could see Millennium, the genomics company, Cubist, Argule and CPG as key new elements to the network. MIT is at this time still serving as an important bridge linking these companies. Moreover, Harvard plays as another important linkage connecting Millennium, Genetix, Boston Life Sciences Inc. (Porter, et al, 2005)



Bio-tech Industries in Boston: Founder Affiliation Network, 1983 > Source: *Porte, et al. 2005*



Bio-tech Industries in Boston: Founder Affiliation Network, 1997 > Source: *Ibid.*

III. Implications from Boston bio-tech industry

The above sections have shown how dependent the Boston biotech clusters is on formal/informal relations of researchers and scientists, strong linkages among research institutes, enterprises and venture capitals. Simple duplication of this connectivity would be irrational and may be fruitless; however, it is useful to consider which institutional features are important to the growth of the enterprises and the whole industry's success.

I. Uniqueness of Biochemistry

Gordon Moore, the founder of Intel, argues that early semiconductor companies in Silicon Valley were not greatly influenced by researchers at Stanford, and most of the development could be ascribed to a sufficient supply of labor forces¹⁹. However, the Bio-tech industry is an unusual science-motivated industry as the internal competition is less intense, while the cycle of product is extremely long (commonly 5-10 years to produce a new type of medicine). Besides, these produced bio-medicines seldom have competitors in traditional types.

II. Unique features of Boston

Boston has several valuable and unique characteristics: it is home to numerous universities and colleges, and is one of the most educated areas in the US. Therefore, there is an abundant

supply of highly educated labor force, and rich resources provided by these leading universities.

However, Boston is not always an example of success: the city has been struggling from a maritime center in early nineteenth century, a industrialized town in late nineteenth century to a IT center in the late twentieth century (Rosenberg, 2007). It is famous for its cold weather, heavy taxes, and high living costs which are the reasons that many enterprises refuse to move in. The attractiveness for Boston is its provision of large amount of educated work force, and the supply of ideas and creativity.



Large Textile Mills along the Merrimack River, Lowell. 1900

> Source: *Rosenberg, Chaim M. Good for sale. University of Massachusetts Press. 2007.*

III. Diversity of organizations

Another important feature is the diverse types of organizations participated in the Bio-tech industry. Universities, research institutes, hospitals and small firms established the industry at the beginning of the 1970s; local venture capital joined in the 1990s; and large pharmaceutical factories stepped in at the beginning of 2000s (Porter, et al, 2005). This organized network provides interrelated ways to facilitate knowledge and capital flows.

IV. Open Science

In Boston, competition in the Bio-tech industry promotes a cycle, which allows researchers, entrepreneurs and investors to make progress based on the former success. The key reason of this phenomenon is the dominant role of the research organizations that claim “open science”: research is published, discussed in seminars, and related applications are protected by laws. Papers and patents are easily acquired through related institutions and organizations. The Boston area has been an expansive cluster including Bio-tech industry and healthcare services because of its openness of technique and information.

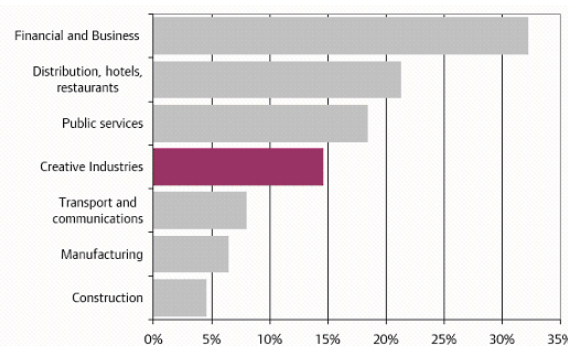
2. London's Cultural & Creative Industries

London has developed a series of culture strategies to establish the city's role as a centre of creativity and culture. The culture strategies have been developed on the basis of three factors:

i. London is the focal point of the UK's culture and creativity.

The capital's creative sector generates an average revenue of £25 to 29 billion per year, employing more than 650,000 people, more than manufacturing and construction sectors combined in 2002 (Greater London Authority, 2004).

ii. London is a most culturally diverse city in the world.



Labor Employment in Industries in 2002 (in percentage) >

Source: Greater London Authority, 2004

The capital's reputation as a multicultural city has been maintained for a long time. The mixture of diverse cultures is a major factor resulting in the success of London's creative industry. But there is inequity that needs to be adjusted as many talents of diverse cultural organizations have been neglected.

iii. London's population will grow significantly by 2016.

It is considered that the population may rise to 8.1 million by 2016 due to natural population growth. A significantly enhanced and sustainable cultural infrastructure is required to support the needs of the growing population (Greater London Authority, 2004).

The culture strategies focus on how to enhance London as a world-class city of culture based on the above three aspects of London's context:

Policy 1: London needs to maintain its cultural institutions and events on a high quality, world class status.

The major cultural infrastructure requires further investment if the city intends to develop its world-class reputation. There is significant gap between the provision in London, and inadequate facilities that some major institutions struggling to maintain for their world-class programs. Improving the service quality

for visitors is crucial to maintain many older facilities that are in lower standards.

There are many benefits for London to hold international, large scale events. They raise the city's global profile while giving the world a positive story about life in the capital. Cul-



A £215 Million Iconic Extension to the Tate Modern on the South Bank of the River Thames > Source: www.archidose.org.

tural activities are revitalized by events that go beyond the area in which they are held. Importantly, such activities would greatly stimulate London's economy.

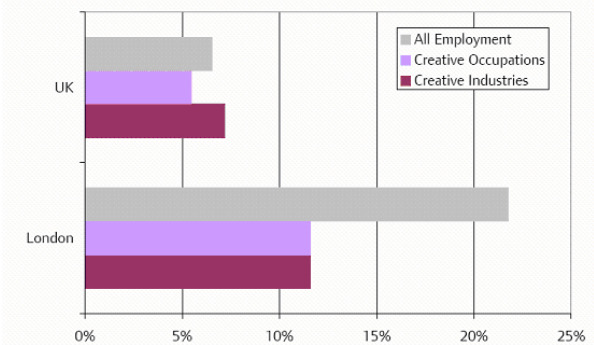
Policy 2: Improvements in infrastructure and support are necessary to obtain the creative potential of London's cultural diversity

The mix of fashion, ideas, music and arts in London is what draws many people to the city. There is a huge diversity of culture and people in London, but it should be reflected in its cultural industries. London needs to make full use of cultural resources in the city, and explore how people engage with culture. As the following diagram illustrates, the proportion of workers of black or ethnic minority (BME) in London's creative industries is 11.6 per cent, only around half the proportion in London's workforce as a whole, which is 22.8 per cent²⁴.

Policy 3: London should nurture the city's brand so as to develop itself as a world cultural city and a destination of tourism

The "evening and late economy" makes a significant contribution to London's creative economy and to its reputation as an exciting and vibrant city. However, there is a need to manage this activity balancing the benefits with some of the possible negative aspects. More types of late-night entertainment needs to be encouraged.

While creative industries may be a substantial source the city's annual income, it needs to be operated in a way considering more about sustainability. For example, the benefits of creative industries need to be spread across London. More areas are developing their



Labor Employment of BME in different Industrial Sectors
> Source: Greater London Authority, 2004

own tourist attractions and infrastructure for creative industries, which would benefit from London's fame for tourists. However, London still maintains the most important advantage: the cultural sector is the most crucial factor in attracting global venture capital. The city flourishes because of the mixture of people already living here and the continual flow of people, ideas and products from other cities and places in the world.

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